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Proposed Special Review Decision PSRD2018-01

Special Review of Clothianidin Risk to Aquatic Invertebrates: Proposed Decision for Consultation

Consultation Document

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Publications
Pest Management Regulatory Agency
Health Canada
2720 Riverside Drive
A.L. 6607 D
Ottawa, Ontario K1A 0K9

Internet: canada.ca/pesticides
hc.pmra.publications-arla.sc@canada.ca
Facsimile: 613-736-3758
Information Service:
1-800-267-6315 or 613-736-3799
hc.pmra.info-arla.sc@canada.ca

Canada

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1.0 Introduction

The Pest Management Regulatory Agency (PMRA) initiated a special review of clothianidin under subsection 17(1) of the *Pest Control Products Act* based on a preliminary analysis of available information on the concentrations and frequency of detection of clothianidin in aquatic environments.

As required by subsection 18(4) of the *Pest Control Products Act*, the PMRA has evaluated the aspects of concern that prompted the special review of pest control products containing clothianidin. The aspect of concern for this review is to assess potential risk to aquatic invertebrates exposed to clothianidin applied as a seed, foliar or soil treatment.

2.0 Uses of Clothianidin in Canada

Appendix I lists all clothianidin products with uses that are registered under the authority of the *Pest Control Products Act* as of May 2018 that were subject to this special review. Clothianidin is currently found in 14 end-use products to which aquatic invertebrates may be exposed. These products may be used as a seed dressing (on canola, mustard, rapeseed, corn, wheat, various vegetable crops and potato as a seed piece treatment), foliar spray application (on turf, potato, pome fruit, stone fruit, grape, strawberry, and cucurbit vegetable crops), in-furrow (for potato) or pre-plant incorporated (for sweet potato). Foliar spray applications can be made by ground boom, airblast or aerial sprayers, depending on crop. Appendix II lists all registered uses of Commercial Class end-use products containing clothianidin that were subject to this special review.

3.0 Aspects of Concern that Prompted the Special Review

This special review was initiated on 23 November 2016, at the same time the PMRA's proposed cyclical re-evaluation decision was published for imidacloprid (PRVD2016-20). The aquatic risk assessment for imidacloprid identified risks of concern to aquatic invertebrates. Clothianidin shares the same mode of action with a similar toxicity profile. Available monitoring data indicated that clothianidin was being detected at concentrations and frequencies in aquatic environments that may pose a risk to aquatic invertebrates. A preliminary assessment was conducted to determine if a special review was required. Based on the available fate, toxicity and water monitoring information for clothianidin, there were reasonable grounds to believe that the potential risk to aquatic invertebrates from the use of clothianidin may exceed the PMRA's level of concern under the current conditions of use.

The initiation of the special review was announced in REV2016-17, Initiation of Special Reviews: Potential Environmental Risk to Aquatic Invertebrates Related to the Use of Clothianidin and Thiamethoxam. The aspect of concern for this special review is to assess potential risk to aquatic invertebrates exposed to clothianidin applied as a seed, foliar or soil treatment.

4.0 PMRA Evaluation of the Aspects of Concern

The PMRA required the registrant to submit all available data that are relevant to the environmental fate of clothianidin, including Canadian surface water monitoring data, and to its toxicity to aquatic invertebrates. In addition, the PMRA requested the same information from provinces and other relevant federal departments and agencies, in accordance with subsection 18(2) of the *Pest Control Products Act*. In response to the PMRA's requests, information was received related to the aspect of concern.

Additional data supplied by the registrant included information on the environmental fate of clothianidin in soil and water as well as the ecotoxicity of clothianidin and its major transformation products to aquatic invertebrates. Data on clothianidin's toxicity to aquatic invertebrates generated by Environment and Climate Change Canada (ECCC) and by academic researchers were included for this special review. A comprehensive literature review of current data relevant to the special review provided additional ecotoxicity data for clothianidin. In total, the PMRA considered acute ecotoxicity data for 39 species of aquatic invertebrates and chronic data for 7 species, as well as higher-tier community-based endpoints from three studies. Environmental incidents of concern for aquatic invertebrates were not identified in North America.

Published and unpublished Canadian freshwater monitoring data were received from federal and provincial governments and academic researchers, registrant companies, and members of Agriculture and Agri-Food Canada's Multi-stakeholder Environmental Monitoring Working Group. Freshwater monitoring data consisted of several robust datasets often with large numbers of samples taken at high frequencies from agricultural areas from 2010 to 2017.

Key Findings
The environmental assessment showed that, in aquatic environments in Canada, clothianidin is being measured at concentrations that are harmful to aquatic insects. These insects are an important part of the ecosystem, including as a food source for fish, birds and other animals. Based on currently available information, most outdoor uses in Canada are not sustainable. For more information on Health Canada's proposed decision for this special review of clothianidin, refer to Section 5.0.

Risk Assessment Conclusions
In conducting environmental risk assessments, it is the PMRA's policy to always consider both monitoring data (when available) and estimated environmental concentrations (EECs) generated using water models as part of its overall risk assessment. Although valid monitoring data are considered preferable to modelled EECs, the weight given to these data varies depending on the circumstances.

When determining the most appropriate toxicity endpoints for consideration in the risk assessment, the PMRA considers both registrant submitted studies and publically available studies. The ecotoxicity data is considered in a tiered approach which consists of the following:

- the endpoint of the most sensitive species,
- a species sensitivity distribution when enough data points are available, and
- mesocosm studies which considers effects at the community level.

For clothianidin, Species Sensitivity Distributions (SSDs) for both acute and chronic exposure in freshwater environments were determined. In addition, two acceptable mesocosm studies were available to assess the concentrations at which community level effects would be observed. For the chronic assessment, the endpoints from the most sensitive species, the SSD and the most sensitive mesocosm study were considered in a weight-of-evidence approach in the risk assessment.

The risk assessment based on the modelling results indicates that exposure to clothianidin may pose both an acute and chronic risk to freshwater invertebrates and a chronic risk to marine/estuarine invertebrates. Typically, modelling inputs and assumptions are conservative and the EECs generated are likely to be higher than actual concentrations present in waterbodies. For clothianidin, however, the range of surface water EECs predicted from modelling overlaps with the range of concentrations measured in surface freshwater bodies.

Acute and chronic risks to freshwater invertebrates were identified based on robust Canadian monitoring data sets. Clothianidin concentrations occasionally exceeded the level of concern for acute risk in waterbodies associated with areas growing mixed vegetables and potatoes. Clothianidin concentrations also exceeded the acute toxicity endpoint in three wetlands located in agricultural areas of the Prairies. However, due to a lack of site information the PMRA is unable to state with certainty that these wetlands are relevant for an aquatic invertebrate risk assessment. Monitoring data likely provided an underestimate of acute exposure, as sampling typically does not capture peak concentrations.

Clothianidin concentrations detected in the following areas frequently exceeded the chronic level of concern for freshwater invertebrates (the registered methods of application of clothianidin are listed in parentheses):

- Corn and soybean growing regions (seed treatment),
- Potatoes (seed treatment, soil application or foliar spray),
- Vegetables (seed treatment or foliar spray, depending on the type), and
- Orchards and vineyards (foliar spray).

The chronic level of concern in standing and flowing waterbodies primarily associated with seed treatment uses in the Prairies was exceeded, however, there was uncertainty surrounding the duration of exposure.

Concentrations detected in some waterbodies located in regions growing potatoes and mixed vegetables exceeded the mesocosm endpoint for periods of weeks to months. This chronic exposure may result in effects at the community level, including changes in insect species abundance and taxa richness. Concentrations of clothianidin exceeding the community-level endpoint were also detected in other crop-growing regions, however, they were sporadic and of short duration. The occurrence of clothianidin concentrations at or above the community-level endpoint may have significant impacts on community invertebrate structure, which is a primary protection goal of the PMRA. It is also possible that effects at the community level may be observed at lower concentrations given the uncertainties identified with the most sensitive mesocosm endpoint (as discussed later in this document).

No Canadian monitoring data for clothianidin in estuarine or marine water were available to exclude the identified risks to marine/estuarine invertebrates.

4.1 Fate and Behaviour in the Environment

A summary of all available information pertaining to the fate and behaviour of clothianidin in the environment is provided in Appendix III. The environmental fate and behaviour of clothianidin are summarized as follows:

- Clothianidin will come in contact with soil when it is applied directly on the ground, sprayed on foliage, or when clothianidin contained in the seed coating moves away from the seed into the surrounding soil. The length of time that clothianidin will persist in soil depends on various factors including soil type. In certain fields, clothianidin may persist long enough to carryover from one growing season to the next. When clothianidin is used for many years, concentrations in soil have been shown to initially increase, then stabilize after approximately 3-5 years.

- Major products formed from the microbial degradation of clothianidin in soil are *N*-(2-Chlorothiazol-5-ylmethyl)-*N'*-methylurea (TZMU), *N*-Methyl-*N'*-nitroguanidine (MNG) and *N*-(2-Chlorothiazol-5-ylmethyl)-*N'*-nitroguanidine (TZNG). These compounds can persist in soil. MNG and TZNG have been found in rotational crops.

- Clothianidin can leach through the soil profile and has been detected in groundwater. Some of the soil transformation products of clothianidin may also be mobile.

- Clothianidin may enter the aquatic environment through spray drift or runoff. Clothianidin readily dissolves in water and is not expected to enter the air or break down by chemical reactions with water molecules of environmentally relevant pH.

- In water, clothianidin is expected to dissipate relatively quickly if exposed to sunlight. In the absence of sunlight, clothianidin will be broken down more slowly by microbes. In the laboratory, clothianidin is moderately persistent to persistent in water systems containing sediment. Under more realistic conditions in outdoor studies, clothianidin is moderately persistent.

- Clothianidin is frequently found in surface waters located in Canadian agricultural areas.

- Under laboratory conditions, major products formed from the transformation of clothianidin in water, in the presence of light, include formamide (FA), 4-Hydroxy-2-methylamino-2-imidazolin-5-one (HMIO), 7-Methylamino-4*H*-imidazo[5,1-*b*][1,2,5]thiadiazin-4-one (MIT), methylguanidine (MG), methylurea (MU) and TZMU. Without sunlight, *N*-(2-chlorothiazol-5-ylmethyl)-*N'*-methylguanidine (TMG) was the only major product and it was primarily found in the sediment.

- Residues relevant to the aquatic environment include clothianidin, MG and MU in surface waters. MG and MU are transformation products formed from exposure to sunlight that do not readily break down in water in the presence of microbes. Residues relevant in the sediment include clothianidin and TMG.

4.2 Mode of Action

Clothianidin is a second-generation neonicotinoid insecticide. Clothianidin is classified by the Insecticide Resistance Action Committee (IRAC) as a Group 4A mode of action insecticide. It acts via contact exposure or ingestion by binding to the nicotinic acetylcholine receptor sites in the central nervous system of insect pests. While the enzyme acetylcholinesterase normally breaks down acetylcholine to terminate signals from these receptors, it does not readily break down neonicotinoid insecticides. The prolonged stimulation of the cholinergic nerves leads to paralysis and eventually death. Neonicotinoids are known to have greater affinity for the insect nicotinic acetylcholine receptors than those of birds or mammals. The reason for this is that nicotinic acetylcholine receptors are different in insects and vertebrates thus affecting the ability to bind nicotinoids (described in detail in Tomizawa and Casida, 2003 and 2005).

4.3 Toxicity to Aquatic Invertebrates

A summary of clothianidin toxicity data available for aquatic invertebrates is presented in Table A.3-8 for the technical grade active ingredient and end-use products formulated with clothianidin alone, and in Table A.3-9 for transformation products of clothianidin. Toxicity information was assessed from registrant-generated studies, government and academia-generated studies and published studies in the open literature. Endpoints for acute toxicity studies with aquatic invertebrates were reported as either EC_{50} or LC_{50} values. Sub-lethal EC_{50} endpoints were generally characterized by immobilization of the animal. As immobilization often occurred, followed by mortality in test subjects, several of the reported EC_{50} values included both immobilization and mortality effects, which are identified in Table A.3-8 and Table A.3-9. In the cases where the observed effect was due to mortality alone, the LC_{50} is provided. As immobility can significantly impact the survival of an aquatic invertebrate in the natural environment, EC_{50} and LC_{50} values are considered as an equivalent measure of mortality for this group of animals.

4.3.1 Clothianidin and Its End-use Products

Freshwater invertebrates

Clothianidin toxicity to freshwater invertebrates differs according to taxonomic group. Crustaceans belonging to the Cladocera order are generally less sensitive, with clothianidin ranging from moderately toxic (*Ceriodaphnia dubia*, 48-h EC_{50}=1690 µg a.i./L) to practically non-toxic (*Daphnia magna,* 48-h EC_{50}>119 000 µg a.i./L) to a variety of daphnid species. Exposure to formulated products containing clothianidin as the sole active ingredient generally resulted in more sensitive endpoints for cladocerans than exposure to the technical grade active ingredient. This suggests that components of the formulations may be contributing to the toxicity.

Clothianidin is, however, highly to very highly toxic to crustaceans belonging to amphipod, isopod and decapod groups. Acute endpoints based on observed immobilization and mortality resulted in EC_{50} values ranging from 4.8 µg a.i./L (*Hyalella azteca*, 96-h EC_{50}) to 599 µg a.i./L (*Procambarus clarkii*, 96-h EC_{50}). Endpoints based on mortality alone ranged from 1.65 µg a.i./L (*Hyalella azteca*, 7-d sub-chronic LC_{50}) to 16 086 µg a.i./L (*Caecidotea* sp., 96-h LC_{50}).

Clothianidin is moderately toxic to adult snails based on a sub-chronic exposure (7-d LC_{50}=4000 µg a.i./L, *Planorbella pilsbryi*) and was not toxic to larval veligers of *Lampsilis fasciola* up to the highest concentration tested (NOEC=478 µg a.i./L, highest concentration tested). Clothianidin is very highly toxic to oligochaetes based on immobilization (96-h EC_{50}=41.7 µg a.i./L).

Clothianidin is highly toxic to very highly toxic to at least one representative species from all available insect groups tested, based on either immobilization or mortality. EC_{50} values based on immobilization and mortality ranged from 1.85 µg a.i./L (*Chironomus dilutus*, 96-h EC_{50}) to <5919 µg a.i./L (*Coenagrion* sp. 96-h EC_{50}, where 100% immobilization plus mortality occurred at 5 919 µg a.i./L). Acute endpoints based on mortality alone ranged from 2 µg a.i./L (*Graphoderus fascicollis*, 48-h LC_{50}) to 14 556 µg a.i./L (*Coenagrion* sp., 96 h LC_{50}).

Freshwater invertebrates are highly sensitive to chronic (long-term or repeated) exposure of clothianidin. Sub-lethal effects, including reductions in reproduction capacity, growth, emergence and sex ratios of insects, were observed at concentrations far below acute median effect concentrations for immobilization and/or lethality. Chronic aquatic exposure data were available for cladocerans, amphipods, molluscs and dipteran insects. The most sensitive endpoints seen among these species ranged from 0.020 µg a.i./L (*Chironomus dilutus*, 40-d EC_{20} emergence) to 120 µg a.i./L (*Daphnia magna*, 21-d NOEC reproduction).

Three studies with sediment exposure to dipteran insects (chironomid sp.) were available, of which two were found to be acceptable for use in the risk assessment. Endpoints from these studies were expressed relative to concentrations in the sediments, overlying water and/or interstitial pore water. For the risk assessment, the most sensitive endpoint based on pore water concentrations was 1.1 µg a.i./L (*Chironomus riparius*, 10-d NOEC dry weight).

Marine invertebrates

Acute toxicity data for marine invertebrates were only available for two species. Clothianidin is very highly toxic to the mysid shrimp, *Mysidopsis bahia* (96-h LC_{50}=51 µg a.i./L), but practically non-toxic to the clam, *Crassostrea virginica* (96-h EC_{50}>129 100 µg a.i./L).

Chronic toxicity data for marine invertebrates were also only available for two species. Chronic exposure to clothianidin resulted in significant reductions in reproduction for *M. bahia* (39-d NOEC reproduction=5.1 µg a.i./L). In a treated-sediment study survival of the marine amphipod, *Leptocheirus plumulosus*, was significantly reduced (10-d NOEC mortality=11.6 µg a.i./L pore water).

Mesocosm studies

Registrant-submitted studies

Two registrant-submitted studies examining the chronic exposure of clothianidin to natural aquatic invertebrate communities in controlled outdoor artificial ponds (mesocosms) were reviewed. In both studies, a wettable granule (50 WG) formulation (guarantee: 49.3% clothianidin) was applied once as a surface spray at nominal concentrations up to 10 µg a.i./L and effects on pond communities were observed for 98 and 56 days, respectively. In both studies, concentrations in the water phase of the test ponds decreased with time and therefore, effects were characterized by the PMRA according to time weighted average (TWA) concentrations. In the first study, freshwater emergent insects (predominantly chironomid species) were significantly affected, with reductions in emergence rates for several insect species, as well as larval densities of the chironomids in the sediment, and toxic effects on community parameters including taxa abundance, diversity, evenness and similarity (PMRA #1636641). Based on these results, the NOEC was determined to be 0.54 µg a.i./L TWA. Toxic effects on emergent insects were observed within the first three weeks after test substance application. Population densities of sediment-dwelling chironomids recovered to control levels by 28 days post-treatment and densities of all affected emergent insects as well as all community parameters recovered to control levels by 77 days post-treatment.

In the second study (PMRA #2713555), exposure to clothianidin resulted in the following significant changes to community structure at 0.573 µg a.i./L TWA (1.0 µg a.i./L nominal):

- increases in *Chaoborus* sp. larvae,
- reductions in *Plea* sp. (Hemiptera) abundance,
- reductions in total Hemipteran abundance, and
- reductions in emergent insect taxa richness.

A statistically significant increase in *Tanypodinae* sp. (Diptera) larvae was also noted, but was not deemed ecologically relevant due to variability between treatment replicates. The resulting NOEC for individual species or for community or taxa richness was 0.281 µg a.i./L TWA (0.5 µg a.i./L nominal). These effects were transient at this level as recovery was noted by the end of the 56-day study. At 5.76 µg a.i./L TWA (10 µg a.i./L nominal), significant effects were observed at either the community or individual species level where no recovery was observed by the end of the study: decreases in abundance of *Asellus aquaticus* immatures and juveniles, total abundance of Crustacea and species richness of emerging insects. The reported NOAEC based on a lack of recovery was 0.573 µg a.i./L TWA (1.0 µg a.i./L nominal).

The recovery observed for emergent insects in both of the registrant-submitted mesocosm studies may have been partially due to additional recruitment from the environment, as the test systems were not closed. Conclusions, based on the result of these mesocosm studies, regarding the potential for recovery in the field cannot be made as neither of the mesocosms examined effects after repeated dosing. For waterbodies receiving clothianidin inputs after repeated applications in the same growing season, or continuous runoff inputs from treated fields, recovery could be delayed. According to the current registered label, repeated foliar applications of clothianidin are allowed on certain crops within 7–14 days, which is much sooner than the time required for some communities to fully recover in the mesocosm studies (i.e., up to 77 days). In addition, due to low abundance in the study ponds, in both studies, it was not possible to determine the effects on Ephemeroptera, which are known to be sensitive to clothianidin. The lack of repeated dosing and the lack of these sensitive species may indicate that the NOAEC of 0.573 µg a.i./L, which is based on no observed recovery, is an overestimate and may not be protective of the insect communities in the aquatic environment. Observed NOECs from the mesocosm studies based on the lowest observed effect levels, regardless of recovery, are consistent with the range of endpoints reported for larval insect species in laboratory toxicity studies. Therefore, the PMRA considers the 56-d NOEC of 0.281 µg a.i./L TWA to be a reasonable estimate for no effects occurring at the community-level following a single application.

Published literature micro- or mesocosm studies

Two recently published outdoor micro- or mesocosm studies were reviewed. In the first study, Miles et al. 2017 (PMRA #2832753) conducted an outdoor mesocosm study with Arena (0.25% clothianidin). Mesocosms with or without the presence of field-collected predatory invertebrate species (for example, adult diving beetles, backswimmers, dragonfly larvae, crayfish) were exposed to clothianidin concentrations of 0.6 (control), 5 and 352 µg a.i./L (initial mean measured concentration). Mesocosm tanks were covered with shade cloth to exclude colonization from flying insects. Well water from the agricultural region was used which accounted for the presence of clothianidin in control water. Due to significant loss of test material (i.e, 55–78% of initial measured values) by Day 21, the PMRA determined time-weighted average concentrations of 0.54, 2.8, and 139 µg a.i./L. High invertebrate predator mortality occurred with increases in clothianidin concentration, which in turn increased prey survival by an average of 32% at the highest clothianidin concentration (as determined based on raw data). Clothianidin significantly reduced overall predator abundance at the highest treatment level; however, a definitive NOEC could not be established as there was no difference between either the 0.54 and 2.8 µg a.i./L treatments or the 2.8 and 139 µg a.i./L treatments. Although clothianidin had a significant effect on predator mortality at the highest treatment rate for water bugs (*Belostoma flumineum)* and crayfish (*Orconectes propinquus*), the NOEC of 2.8 µg a.i./L TWA [5 µg a.i./L initial measured concentration] as reported by the study author was not considered quantitatively in the risk assessment. The study design, with limited treatment levels, results in a large gap between the NOEC and LOEC (i.e., a factor of approximately 50) which adds uncertainty as to where the NOEC lies. However, exposure to clothianidin was shown to result in top-down trophic changes to aquatic invertebrate communities in a semi-natural mesocosm setting.

In the second study, Basley and Goulson 2018 (PMRA #2861918) examined the ability of aquatic invertebrates to colonize aquatic habitats at environmentally relevant concentrations of either clothianidin or thiamethoxam in small-scale outdoor microcosm treatments. Microcosm containers (14 L) were filled with loamy soil with no history of neonicotinoid use and 10 L of fresh tap water and exposed to nominal concentrations of 0 (control), 0.1, 1, 3, 7, 10 and 15 µg a.i./L of analytical grade pesticide. Microcosms were housed outdoors with no cover to allow for colonization of flying insects and left in-situ for 33–38 days, beginning in late August.

Invertebrate populations quantified included Ostracoda (likely to have come from the soils) and Chironomidae and Culicidae dipterans.

There was a significant relationship in invertebrate abundance across clothianidin exposure concentrations, with a general pattern of reduced numbers at higher concentrations for Chironomidae larvae, Culex pupae and Ostracoda. The strongest trend in decreasing abundance with concentration was with ostracods; however, variability in abundance was very high, with peak numbers occurring at the second-lowest treatment level, making it difficult to establish a true NOEC. Chironomidae larvae were the only taxa to show significant reductions relative to controls, occurring at the two highest clothianidin concentrations. The NOEC determined for this species was 7 µg a.i./L. However, variability in abundance in controls was very high, and as treatment concentrations were not verified analytically and test conditions were not monitored throughout the study, the PMRA will consider these results in a qualitative manner only. The results however, were consistent with laboratory studies which show that Chironomidae are among the most sensitive invertebrates to clothianidin exposure, with acute EC_{50}/LC_{50}s ranging from 1.85–29 µg a.i./L and chronic NOEC or EC_{20}s ranging from 0.02–0.89 µg a.i./L (Table A.3-8).

4.3.2 Clothianidin Transformation Products

For a complete listing of clothianidin transformation products, including common identifier codes and chemical names, along with a summary of where they are formed, see Table A.3-7. Based on available acute toxicity data for cladoceran crustaceans (*Daphnia magna*) and dipteran insects (*Chironomus riparius*), major transformation products of clothianidin are generally not as toxic to freshwater invertebrates as the parent (Table A.3-9). For *D. magna* the transformation products TMG and MNG were practically non-toxic (48-h EC_{50}>100 000 µg/L), while TZNG was not toxic up to the highest concentration tested (48-h EC_{50}>64 000 µg/L). For *C. riparius*, MAI, HMIO, CTCA, MG, NTG and TZFA were not toxic up to the highest nominal concentration tested (48-h EC_{50}>10 000 µg/L). Similary, MU was not toxic up the highest concentration tested (48-h LC_{50}>82 000 µg/L) and TZMU and MNG were practically non-toxic (48-h LC_{50}s>101 000 µg/L). Only TZNG was highly toxic to *C. riparius*, with a 48-h LC_{50} of 386 µg/L.

The chronic toxicity of TMG, the only major transformation product found in laboratory aerobic aquatic systems and primarily associated with the sediments, was assessed for two chironomid species. In a treated water study, chronic exposure to TMG did not adversely affect emergence of *C. riparius* at concentrations up to 47 µg/L (28-d NOEC emergence=47 µg/L, highest concentration tested; Table A.3-9). In a 61-day life-cycle study with treated sediment, TMG significantly reduced *C. dilutus* emergence at the lowest treatment concentration of 450 µg/kg sediment (or 31 µg/L in pore water). As a NOEC could not be established in this study, the LOEC was considered in assessing the risk of TMG exposure from sediments. Based on a comparison with the LOEC for the most sensitive clothianidin pore water endpoint for *C. riparius* (10-d LOEC dry weight=3.4 µg a.i./L; PMRA #1636640, Table A.3-8), TMG does not appear to be more toxic to benthic invertebrates than the parent clothianidin.

4.4 Risks to Aquatic Invertebrates

The environmental risk assessment integrates the environmental exposure and ecotoxicology information to estimate the potential for adverse effects on non-target species. This integration is achieved by comparing exposure concentrations with concentrations at which adverse effects occur. EECs are concentrations of pesticide in various environmental media, such as food, water, soil and air. The EECs are estimated using standard models which take into consideration the application rate(s), chemical properties and environmental fate properties, including the dissipation of the pesticide between applications. For this special review, ecotoxicology information includes acute and chronic toxicity data for various aquatic invertebrates. Toxicity endpoints used in risk assessments may be adjusted to account for potential differences in species sensitivity as well as varying protection goals (i.e., protection at the community, population, or individual level).

Initially, a screening level risk assessment is performed to identify pesticides and/or specific uses that do not pose a risk to non-target organisms, and to identify those groups of organisms for which there may be a potential risk. The screening level risk assessment uses simple methods, conservative exposure scenarios (for example, direct application at a maximum cumulative application rate) and sensitive toxicity endpoints. A risk quotient (RQ) is calculated by dividing the exposure estimate by an appropriate toxicity value (RQ=exposure/toxicity), and the risk quotient is then compared to the level of concern (LOC). For aquatic invertebrates, the PMRA's LOC is equal to a RQ = 1. If the screening level risk quotient is below the level of concern, the risk is considered negligible and no further risk characterization is necessary. If the screening level risk quotient is equal to or greater than the level of concern, then a refined risk assessment is performed to further characterize the risk. A refined assessment takes into consideration more realistic exposure scenarios (such as drift to non-target habitats) and might consider different toxicity endpoints. Refinements may include further characterization of risk based on exposure modelling, monitoring data, results from field or mesocosm studies, and probabilistic risk assessment methods. Refinements to the risk assessment may continue until the risk is adequately characterized or no further refinements are possible.

4.4.1 Clothianidin Endpoints

For the assessment of risk, toxicity endpoints for the available aquatic invertebrate species tested were used as surrogates for the wider range of species that can be exposed following treatment with clothianidin. The PMRA takes a tiered approach in determining risk based on the availability of data. When limited data are available and a SSD cannot be derived, the most sensitive endpoint identified for a single species is used. When sufficient laboratory data are available to determine an SSD, the HC_5 value (the 5^{th} percentile of the SSD) is used to identify the concentration which is expected to be protective of 95% of the species in the community. When outdoor semi-field or field studies conducted under relevant exposure and environmental conditions are available, the endpoints from these studies may be used preferentially, as they can more closely approximate community-level effects in the natural environment. Table 1 outlines the different clothianidin endpoints considered in the current risk assessment.

For freshwater invertebrates, the most sensitive acute endpoint was a 7-day sub-chronic LC_{50} value for the amphipod *Hyalella azteca* (1.65 µg a.i./L). For assessing risk, acute single-species endpoints are divided by a factor of two (2) to account for potential differences in species sensitivity as well as protection at the community or population level. The most sensitive chronic endpoint was a 40-day EC_{20} based on reduced emergence for the dipteran larvae *Chironomus dilutus* (0.020 µg a.i./L). The PMRA is aware of another study reporting a 28-day EC_{20} of 0.34 µg a.i./L for the same species (*C. dilutus*). The known mode of action for neonicotinoids is such that clothianidin results in increased sensitivity with prolonged exposure due to cumulative binding to neuronal receptors that do not regenerate (Sanchez-Bayo et al. 2016; PMRA #2723759). With this knowledge, the PMRA considers the 40-d EC_{20} as the most sensitive endpoint.

Sufficient laboratory toxicity data were available for freshwater invertebrates to determine acute and chronic HC_5 values for either the acute EC_{50}/LC_{50} endpoints or the chronic NOEC or EC_{10}/EC_{20} endpoints). For acute studies reporting both EC_{50} and LC_{50} values, large differences were observed between the EC_{50} (immobility) and LC_{50} (mortality) values (i.e., EC_{50}s<LC_{50}s) for several species (Table A.3-8), a result that is likely characteristic of the time dependent nature of clothianidin toxicity. For neurotoxic substances, such as neonicotinoids, paralysis may result in altered behaviour and increased susceptibility to drift in flowing waters, which may ultimately affect survival in the environment (Raby et al. 2018). In cases where both an EC_{50} and LC_{50} were reported, the more sensitive endpoint was chosen for the SSD. A total of 37 acute and 5 chronic toxicity endpoints were available for freshwater invertebrate species. Corresponding acute and chronic HC_5 values (with 90% confidence intervals) were 1.5 (0.38–4.4) µg a.i./L for acute exposure and 0.0015 (5.1×10^{-7}–0.035) µg a.i./L for chronic exposure. Further details regarding the calculation of HC_5 values are provided in Appendix IV.

The most sensitive community-level endpoint available from a freshwater mesocosm study was a 56-d NOEC of 0.281 µg a.i./L based on reductions in individual species populations and in community or taxa richness. There were limitations with this study that prevented its use as the highest-tier endpoint in the risk assessment. This is further discussed in Section 4.5.

For marine invertebrates there were an insufficient number of species to determine HC_5 values for acute or chronic endpoints. Risks were assessed for the most sensitive endpoints for individual species as shown in Table 1.

Table 1 The different endpoints considered in the clothianidin risk assessment for aquatic invertebrates.

Endpoint	Value (µg a.i./L) with confidence interval, where available	Comments
Freshwater		
Acute most sensitive	0.825	Calculated as 1.65 µg a.i./L divided by 2[1] based

Endpoint	Value (µg a.i./L) with confidence interval, where available	Comments
sp.		on 7-d sub-chronic LC_{50} *H. azteca.*
Acute HC_5	1.5 (0.38–4.4)	Calculated by PMRA (n = 37).
Chronic most sensitive sp.	0.020	40-d EC_{20} *C. dilutus*
Chronic HC_5	0.0015 (5.1×10^{-7}–0.035)	Calculated by PMRA (n=5). Uncertainty was identified for this endpoint based on number of available species.
Mesocosm	0.281	56-d NOEC. Uncertainty was identified for this endpoint based on exposure duration and inconclusive results for sensitive taxa.
Marine		
Acute most sensitive sp.	25.5	Calculated as 51 µg a.i./L divided by 2[1] based on 96-h LC_{50} *M. bahia.*
Chronic most sensitive sp.	5.1	39-d NOEC *M. bahia*

1 For assessing risk, acute single-species endpoints are divided by a factor of two (2) to account for potential differences in species sensitivity as well as protection at the community or population level.

Comparison to other reference values

The PMRA's reference values used for assessing risk are compared with reference values available from the public literature in Table 2. In their preliminary aquatic risk assessment, the USEPA (2017) determined risk to aquatic invertebrates based on the most sensitive acceptable endpoints for acute and chronic invertebrate species. These same species were considered in the PMRA risk assessment, but in the case of freshwater invertebrates, the PMRA considered additional acceptable endpoints for derivation of SSDs.

The PMRA-calculated acute HC_5 of 1.5 µg a.i./L for combined immobilization and mortality effects (EC_{50}/LC_{50} endpoints) for all taxa is similar to recently published acute HC_5 values of Raby et al. (2018) (Table 2). Raby et al. (2018) report acute HC_5 values of 0.14 µg a.i./L for immobilization and 4.13 µg a.i./L for mortality based on EC_{50} and LC_{50} endpoints respectively, using toxicity data for invertebrates as well as fish, plant/algae and amphibian species. Hayasaka et al. (2013) report an HC_5 of 0.34 µg a.i./L for invertebrates and fish based on combined EC_{50}/LC_{50} endpoints. Acute clothianidin HC_5 values for crustaceans alone from Whiteside et al. (2008) and Hayasaka et al. (2013) were 1–3 orders of magnitude higher (less sensitive) than for the PMRA's acute HC_5 of 1.5 µg a.i./L for all invertebrates.

The PMRA's acute HC_5 estimate based on sub-lethal and lethal effects is nearly an order of magnitude higher (less sensitive) than the lower confidence limit of the lethality-based HC_5 for neonicotinoids (0.2 µg/L) recommended for the protection of aquatic invertebrates by Morrissey et al. (2015). This value was derived using 24–96-h LC_{50} values available for six neonicotinoid active ingredients, which were standardized and weighted by molecular mass to imidacloprid. The HC_5 estimate of Morrissey et al. (2015) is however, largely weighted by the influence of imidacloprid, which makes up 66% of the 178 acute endpoints considered.

The PMRA chronic reference value for clothianidin of 0.0015 µg a.i./L based on the HC_5 is more than an order of magnitude lower (more sensitive) than the USEPA's unbound reference value of < 0.05 µg a.i./L based on significant effects occurring at the lowest test concentration for the most sensitive species endpoint (*Chironomus dilutus* NOEC emergence < 0.05 µg a.i./L; Cavallaro et al. 2017, PMRA #2712687). The PMRA SSD takes into account the 40-d EC_{20} of 0.020 µg a.i./L from this same study. There are no chronic SSD reference values for clothianidin alone to compare against, but the PMRA HC_5 is an order of magnitude lower than the lower confidence limit of the HC_5 for neonicotinoids (0.035 µg a.i./L) recommended for the protection of aquatic invertebrates, derived using chronic EC_{50}/LC_{50} endpoints for clothianidin, imidacloprid and thiacloprid (Morrissey et al. 2015).

Table 2 Comparison of PMRA's clothianidin reference values with those from the open literature.

Source (PMRA#)	Reference Value (µg a.i./L)	Comments
Clothianidin		
PMRA	Freshwater: 1.5 (acute HC5) 0.0015 (chronic HC5) 1.65 (acute single species) 0.020 (chronic single species) Marine: 51 (acute) 5.1 (chronic)	Freshwater HC5 values based on EC_{50}/LC_{50} values for 37 species (acute) and on NOEC, EC_{10}/EC_{20} values for 5 species (chronic). Freshwater single species values: Acute 7-d sub-chronic LC_{50} (*H. azteca*); chronic 40-d EC_{20} emergence (*C. dilutus*). Marine endpoints based on lowest single species values. Acute: 96-h LC_{50} (*A. bahia*); chronic: 39-d NOEC (*A. bahia*).
USEPA (2017) (PMRA #2862808)	Freshwater: 22 (acute) <0.05 (chronic) Marine: 53 (acute) 5.1 (chronic)	Reference values for risk assessment are based on the lowest acceptable single-species endpoints for each. Acute: 48–96-h EC_{50}/LC_{50}; Chronic: NOEC.
Raby et al. (2018) (PMRA #2842540)	0.14 (acute immobilization) 4.1 (acute mortality)	Combined freshwater and marine HC_5. Data include acute 48–96-h EC_{50} or LC_{50} values for invertebrates from authors' study plus additional taxa from the literature including fish (LC_{50} values) and plants/algae (EC/IC_{50} values).
Hayasaka et al. (2013) (PMRA #2712667)	1929.7 (acute; 5 cladocerans only) 0.34 (acute; all invertebrates except cladocerans + fish)	Freshwater HC_5 values. Acute EC_{50} or LC_{50} values. HC_5 with 5 cladoceran species from that study only. Combined HC_5 based on literature survey.

Source (PMRA#)	Reference Value (µg a.i./L)	Comments
Clothianidin		
Whiteside et al. (2008) (PMRA #2862805)	38.9 (acute)	Freshwater HC5 for crustaceans only (24–96-h EC/LC_{50} values)
Combined neonicotinoids		
Morrissey et al. 2015 (PMRA #2538669)	0.2 (acute) 0.035 (chronic)	Lower confidence intervals of HC_5 values from SSDs generated from 42 species (acute 24–96-h LC_{50} values) and 18 species (chronic 7–39-d EC_{50}/LC_{50} values). SSDs included six neonicotinoid compounds (acute) or clothianidin, imidacloprid and thiacloprid (chronic) standardized and weighted by molecular mass to imidacloprid.

4.4.2 Screening Level Assessment

Estimated environmental concentrations

Screening level EECs for clothianidin and its transformation products in water were calculated assuming a reasonable conservative scenario of direct application into waterbodies of 80 cm depth. The pesticide is assumed to be instantaneously and completely mixed within the waterbody. EECs for transformation products assume a 100% transformation from parent. The 80-cm waterbody was chosen to represent a permanent body of water to assess the risk to aquatic invertebrates that depend on a permanent waterbody. The screening level calculation is intended to be a simple, conservative estimate of clothianidin and transformation products concentrations in a surface waterbody.

For the initial conservative screening level assessment, EECs were calculated based on the highest maximum annual application rates among all use types and crops. Details on derivation of the cumulative annual application rates for determining EECs can be found in Appendix V, Table A.5-1. The screening level assessment considered the highest foliar application rate of 350 g a.i./ha to turf by ground sprayer and the highest seed treatment rate of 420 g a.i./ha for a variety of vegetables. In addition, the screening level assessment also considered a representative low rate among all crops of 17.5 g a.i./ha for seed treatment to wheat (Table A.5-1). Screening level EECs for clothianidin transformation products assumed that 100% of the clothianidin EEC in 80 cm of water is converted to the transformation product in question, adjusted for the molecular weight ratios of the two molecules. Screening level EECs for clothianidin and its major transformation products in surface waters of 80-cm depth are provided in Table A.5-2.

Assessment of Risk

Clothianidin

The screening level risk assessment for aquatic invertebrates is presented in Table A.3-10. Freshwater invertebrates are highly sensitive to clothianidin exposure based on HC_5 values derived from laboratory toxicity studies, particularly under chronic exposure. Screening level risk was further characterized using the most sensitive single acute and chronic endpoints for freshwater species. For marine invertebrates there were an insufficient number of species to determine HC_5 values for acute or chronic endpoints. Screening level risks were therefore assessed for the most sensitive endpoints for individual species.

For freshwater invertebrates, screening level risk quotients based on either the HC_5 values or on the most sensitive single species endpoints exceeded the PMRA's level of concern (LOC) of 1 ($RQ \geq 1$) for the entire range of EECs under both acute and chronic exposures. For estuarine/marine invertebrates, risk quotients exceeded the LOC for the maximum foliar and seed treatment rates only ($RQs \leq 2.1$ for acute and ≤ 10 for chronic exposure); however, application of clothianidin at a representative low seed treatment rate of 17.5 g a.i./ha is not expected to pose a risk to marine invertebrates.

Transformation products
A screening level risk assessment was performed for water exposures of major transformation products identified from laboratory transformation studies with clothianidin (Table A.3-11). Based on acute toxicity studies conducted with *Daphnia magna* and *Chironomus riparius* and conservative EEC estimates, exposure to TMG, MNG, TZNG, TZMU, MU, MAI, HMIO, CTCA, MG, NTG and TZFA is not expected to pose a risk to aquatic invertebrates ($RQs < 1$). Chronic exposure of the major sediment transformation product TMG from overlying water is not expected to pose a concern to sediment-dwelling invertebrates ($RQ < 1$).

4.4.3 Refined Risk Assessment

Aquatic organisms can be exposed to clothianidin as a result of spray drift into an aquatic environment during application and through runoff from the application site. To further characterize potential aquatic risk, inputs from spray drift and runoff are assessed separately.

Spray drift risk assessment
The risk to aquatic invertebrates was further characterized by taking into consideration the concentrations of clothianidin that could be deposited through spray drift in aquatic habitats that are 1 m downwind from the treatment area. End-use products containing clothianidin are applied by a variety of foliar spray methods that may result in spray drift, including field sprayer, airblast and aerial sprayer applications. The maximum amount of spray that is expected to deposit 1 m downwind from the application site during application by field and aerial sprayers with an ASAE (American Society of Agricultural and Biological Engineers) S572.1 fine spray droplet size is 11% and 26% respectively. For early and late airblast applications, 74% and 59% of spray is expected to deposit 1 m downwind from the application site, respectively. Given the variation in percent drift off site for each of the application methods, the assessment of potential risk from drift was assessed for the maximum cumulative application rate for each method: for field sprayers, a single application of 350 g a.i./ha for turf; for airblast spray a single application of 210 g a.i./ha for pome fruit; and for aerial spray, a cumulative application rate of 152.2 g a.i./ha (3 × 52.5 g a.i./ha with a 7-day interval) for potatoes. Details on derivation of maximum cumulative rates are provided in Table A.5-1. Estimated environmental concentrations from spray drift are provided in Table A.3-12.

For marine environments, exposure from cumulative applications is not expected due to high water replacement rates from daily tidal flushing events. Risk from spray drift exposure from aerial application to potatoes in marine environments is therefore based on a single application only.

The risk to aquatic invertebrates resulting from spray drift is summarized in Table A.3-12. The risk quotients indicate that the LOC is exceeded for freshwater invertebrates exposed to drift at the highest application rates from all application methods on an acute and chronic basis, regardless of whether the HC_5 or most sensitive laboratory-derived endpoint is considered. Estuarine/marine invertebrates may be at risk from chronic exposure to spray drift from airblast applications as the LOC was exceeded for *M. bahia* (RQ=3.8). It is noted that the semi-diurnal replacement of water in tidal estuarine/marine environments may minimize the potential for chronic exposure; however, due to the persistence of clothianidin in aquatic environments (80^{th} percentile of laboratory half-lives=141 days), the potential for chronic exposure in marine environments cannot be ruled out.

Mitigation in the form of spray buffer zones for both freshwater and estuarine/marine habitats may be required during the phase-out period and is presented in Appendix VIII.

Runoff risk assessment

Aquatic organisms can also be exposed to clothianidin as a result of runoff into a body of water. The Pesticide in Water Calculator (PWC) model was used to predict EECs resulting from runoff of clothianidin following application. Details on modelling inputs and assumptions are provided in Appendix VI. The models were run for a variety of scenarios to ensure that runoff potential was assessed for a) representative application rates for each of the major application methods, and b) major crop uses across the country (Table 3).

Table 3 Clothianidin use scenarios selected for surface water modelling

Application Method	Crops selected
Seed treatment	• canola (32.5 g a.i./ha) • potato (381 g a.i./ha) • vegetable crops (as represented by lettuce, at high rate of 420 g a.i./ha and low rate of 4.7 g a.i./ha)[1] • corn (118 g a.i./ha)
In-furrow	• potato (224 g a.i./ha)
Foliar spray[2]	• potato (3 × 52.5 g a.i./ha) • squash/pumpkin (2 × 105 g a.i./ha) • strawberry (1 × 224 g a.i./ha)

1 There were a variety of seed treatment rates for the vegetable crops, as such the maximum rate along with the lowest rates were modelled based on a lettuce scenario.

2 The highest foliar spray rate is for turf (1 × 350 g a.i./ha); however, this rate was not modelled, as runoff from turf is not as great as for leafy field crops and does not represent the most conservative scenario

The Level 1 clothianidin EECs in a 1-ha receiving waterbody (80 cm deep) predicted by PWC for these crops are presented in Appendix VI. The pore water EECs in a 0.8 m wetland were also generated. Table A.6-3 provides EECs for all selected crops using runoff extraction parameters recommended in Young and Fry (2017) and using a modelling scenario for seed treaments that assumes that, at the time of application, the pesticide is present in soil only at the depth the seed is planted. Table A.6-3 also provides alternate EECs for corn seed treatments generated using a modelling scenario that assumes the pesticide concentration in soil at the time of application linearly increases with depth from the soil surface to the seeding depth. This latter approach takes into consideration the potential impact of dust generated during planting using pneumatic sowing equipment on water EECs. The values reported by PWC are 90th percentile concentrations of the concentrations determined at a number of time-frames including the peak (or daily maximum), 96-h, 21-d, 60-d and 90-d averages.

Acute and chronic RQ values were calculated using the EEC for the appropriate time frame which most closely matched the exposure time used to generate the endpoint. For comparison against acute invertebrate endpoints based on data with 48–96-h and 7-d sub-chronic studies, peak EECs were used to derive RQs. Peak EECs were chosen over 96-h EECs as the duration for many of the acute studies considered was < 96-h. There are minimal differences between the peak EECs and the 96-h EECs due to clothianidin's persistence in the environment (Table A.6-3), and therefore this choice does not affect risk conclusions. For comparison against chronic invertebrate endpoints based on data with 21–40-d NOEC or EC_{10}/EC_{20} endpoints, 21-day EECs were used to derive RQs. For comparison against chronic invertebrate endpoints based on pore water exposures, 21-day pore water EECs were used to derive the RQs. The acute and chronic RQ values for all runoff scenarios are reported in Table A.3-13 (Appendix III). In cases where EECs were modelled for different geographic regions, risk quotients were calculated for each region.

Acute risk

Risk quotients for freshwater invertebrates based on EECs from acute exposure to clothianidin in runoff and the acute HC_5 of 1.5 µg a.i./L exceeded the LOC for at least one of the modelled regions for all foliar uses (RQs up to 7.3). Of the seed treatment uses modelled, the LOC was exceeded for vegetables at the highest application rate (RQs up to 14) and for canola in eastern Canada (RQs up to 2.2). Runoff from seed treatment or in-furrow application to potatoes did not exceed the LOC (RQs≤0.1), nor did runoff from corn seed treatments (RQs≤0.5) (Table A.3-13). Comparison of acute exposure with the most sensitive acute freshwater invertebrate endpoint, a 7-d sub-chronic LC_{50} = 1.65 for the amphipod *Hyalella azteca* multiplied by a safety factor of 0.5, also resulted in exceedance of the LOC for all foliar uses (RQs up to 13) and seed treatment uses for vegetables at the highest application rate (RQs up to 26) and canola (RQs up to 4.1), but not for seed treatment or in-furrow application to potatoes (RQs≤0.1), or for corn seed treatments (RQs≤0.9).

Clothianidin runoff from treated agricultural fields may therefore pose an acute risk to freshwater invertebrates for all modelled foliar uses, for seed treatment uses for canola, and for vegetables at the maximum labelled application rate. Acute risk from clothianidin runoff is not expected for seed treatment or in-furrow applications to potatoes or for corn seed treatments.

Clothianidin runoff from treated agricultural fields is not expected to pose an acute risk to estuarine/marine invertebrates (RQs≤0.8).

Chronic risk

Freshwater aquatic invertebrates are highly sensitive to chronic clothianidin exposure. Risk quotients greatly exceed the LOC based on the chronic 21-d average EECs and the chronic HC_5 of 0.0015 µg a.i./L for all modelled use patterns in all regions (RQs=1.3–11 200) (Table A.3-13). Chronic risk was also assessed with the most sensitive single-species endpoint available (40-d EC_{20} emergence=0.020 µg a.i./L for *C. dilutus*).Using this single-species endpoint, risk quotients exceed the LOC for all use patterns and regions (RQs=1.2–840), with the exception of potato in-furrow and seed treatment uses in the Prairies (RQs=0.1–0.2) (Table A.3-13).

Chronic risk from pore water exposure was also assessed for clothianidin and the sediment transformation product TMG based on pore water NOECs from treated sediment studies using *C. riparius* and *C. dilutus*, respectively.

Risk from chronic clothianidin exposure via sediment pore water is expected to be minimal based on a 10-d NOEC dry weight of 1.1 µg a.i./L pore water for *C. riparius* (Table A.3-13). Foliar applications of clothianidin marginally exceed the LOC for strawberry (RQs up to 2.1) and squash and pumpkin crops (RQs up to 1.4). Seed treatments of canola present a minimal risk (RQs up to 1.0), whereas risks are slightly higher for vegetable crops (RQs up to 4.3).

The risk to benthic invertebrates from chronic pore water exposure to TMG was determined by comparing the highest modelled clothianidin pore water EEC for vegetable crops in Atlantic Canada (4.72 µg a.i./L), adjusted for the molecular weight ratio of TMG/clothianidin (204.68 g/mol TMG/ 249.68 g/mol clothianidin) against the 20-d LOEC emergence of 31 µg/L TMG for *C. dilutus*. A definitive NOEC could not be established in the study (PMRA #2615169) as statistically significant reductions in emergence rate were seen at the lowest treatment level compared to controls. Based on the LOEC, the resulting RQ is 0.12. In this study, the effect of TMG on emergence rate was small and did not follow a dose-response relationship; reductions compared to controls ranged from 4 to 17% for males and from 11 to 24% for females, for concentrations ranging from 31 to 340 µg/L TMG. Comparatively, pore water exposure of parent clothianidin at a lower concentration of 3.4 µg a.i./L resulted in significant reductions in dry weight of *C. riparius* (LOEC, PMRA #1636640). Given that the magnitude of effects of the transformation product TMG on emergence rate of *C. dilutus* was small, that the RQ calculated using the LOEC was well below the level of concern, and that the parent clothianidin is more toxic than TMG, this transformation product is not expected to impact the risk assessment. Clothianidin is expected to represent a greater risk to benthic invertebrates than the transformation product TMG.

In the marine environment, chronic exposure to clothianidin from runoff may present a risk in overlying water for foliar applications to strawberry in the Atlantic region (RQ=1.6) and vegetable seed treatments at the highest application rate of 420 g a.i./ha in the Quebec and Atlantic regions (RQs 1.7–3.3; Table A.3-13). Chronic risk from clothianidin pore water exposure to marine invertebrates was determined from a treated sediment study using the marine amphipod *Leptocheirus plumulosus*. Based on a 10-day NOEC mortality of 11.6 µg a.i./L pore water, risk to aquatic invertebrates from chronic clothianidin exposure in marine sediments is not expected for all modelled uses (RQs≤0.4; Table A.3-13).

Further risk characterization: Mesocosms

Two acceptable outdoor mesocosm studies were considered for further characterizing the expected level of risk from clothianidin inputs to freshwater systems from both spray drift and surface runoff. Both registrant-supplied studies represent potential community-level effects following a single exposure of clothianidin to outdoor artificial ponds. The lowest available NOEC of 0.281 µg a.i./L from both studies was used to determine potential risk (TableA.3-8). At this level of effect, there was recovery of emergent insect populations in the mesocosms by the end of the 56-day study, presumably due to recruitment of new individuals from the environment. However, it is noted that comparing the potential effects from clothianidin exposure in these studies to real-world exposures was limited by the fact that the studies were a) based on a single exposure event, whereas up to three applications are permitted for foliar use and monitoring data shows consistent presence in Canadian surface waters, which could limit the potential for longer-term recovery in the environment and b) effects on ephemeropterans, an order of insects known to be sensitive to neonicotinoids including clothianidin, could not be determined.

Based on the mesocosm NOEC of 0.281 µg a.i./L risk from clothianidin, spray drift alone to aquatic habitats exceeds the LOC, with RQs for the highest labelled spray application rates ranging from 17–69 (Table A.3-12). Risk from runoff sources to aquatic habitats exceeds the LOC for all modelled foliar applications (RQs=2.0–29), but not for modelled in-furrow uses on potatoes (RQs≤0.2; Table A.3-13). Seed treatment uses may pose a risk to aquatic invertebrate communities from clothianidin runoff for vegetables at the high rate of 420 g a.i./ha in all regions of Canada (RQs up to 60), but not at the low rate of 4.7 g a.i./ha (RQ≤0.7). Risk to aquatic invertebrate communities is also identified for most modelled regions of canola (RQs=0.8–10) and for corn when clothianidin was modelled using the “increasing with depth” scenario (RQs=1.9–2.2). A runoff risk was not identified for corn seed treatments when clothianidin was modelled using the “at depth” scenario or for potato seed pieces (RQs≤0.2; Table A.3-13).

Further risk characterization: Chronic exposure level

The chronic runoff EECs used in the refined risk assessment above represent the 90th percentile of the maximum 21-day average EECs over a 50-year period (see Appendix VI for a full description of EEC derivation). The distributions of annual maximum 21-day average EECs for the 50 model years were further characterized to examine the proportion of years where the maximum 21-day average EECs exceeded the LOC. The distribution of the 50 annual maximum 21-day averages for each of the modelled crops and regions are provided in violin plots presented in Figure 1 and Figure 2. The annual maximum 21-day average concentration is plotted along the vertical axis on a logarithmic scale and the width of the plot is proportional to the number of years with similar annual maximum 21-day average concentrations. Three different endpoints are presented on the plots: the chronic HC_5, the lowest single species endpoint and the mesocosm NOEC.

For foliar applications, all of the annual maximum 21-d EECs for 50 years exceeded the chronic HC_5 of 0.0015 µg a.i./L by a factor ranging from approximately 10 to more than 10 000

(Figure 1). The most sensitive chronic EC_{20} of 0.020 µg a.i./L was exceeded in all but a few years for foliar use on squash and strawberry in British Columbia. Foliar use on potato, squash and strawberry can be expected to result in annual maximum 21-d EECs that exceed the most sensitive mesocosm endpoint of 0.281 µg a.i./L for the majority of the 50-year period, with the exception of squash and strawberry use in British Columbia. For these two cases, chronic EECs may exceed the mesocosm LOC approximately 20% of the time.

In-furrow applications to potato result in smaller annual maximum 21-d EECs than for foliar use (Figure 1). In Manitoba, the HC_5 was exceeded approximately 30% of the time, but nearly all of the time in the other Canadian regions. In-furrow use on potatoes did not exceed the mesocosm NOEC in any region, but did exceed the most sensitive species EC_{20} approximately 10–40% of the time. Annual maximum 21-d EECs exceeded the chronic HC_5 for the majority of modelled seed treatment uses by a factor ranging from approximately 10 to more than 10 000. The 50-year distributions of annual maximum 21-day average EECs are shown in Figure 2. Only potato and vegetable seed treatments at the low rate in certain regions did not exceed the HC_5 for a significant portion of years. The annual 21-day average EECs exceeded the EC_{20} for the most sensitive species for either all, or for the majority of years in canola, vegetables at the highest rate and corn assuming increasing clothianidin concentrations with depth. For corn modelled using the "at depth" scenario, and for potato and vegetables at the lowest rate (in three of the four regions), annual maximum 21-d EECs from clothianidin runoff exceeded the EC_{20} in approximately 20–60% of the years. The most sensitive NOEC from a mesocosm study was exceeded for a significant portion of the 50-year span for canola, vegetable seed treatment at the highest rate and for the more conservative corn scenario ("increasing with depth" modelling scenario). Uses that did not exceed the mesocosm NOEC included potato, vegetables at the lowest rate and the less conservative corn seed treatment scenario assuming pesticide distribution at planting depth. It is noted however, that the highest EECs from these distributions are within a factor of 10 of the mesocosm NOEC.

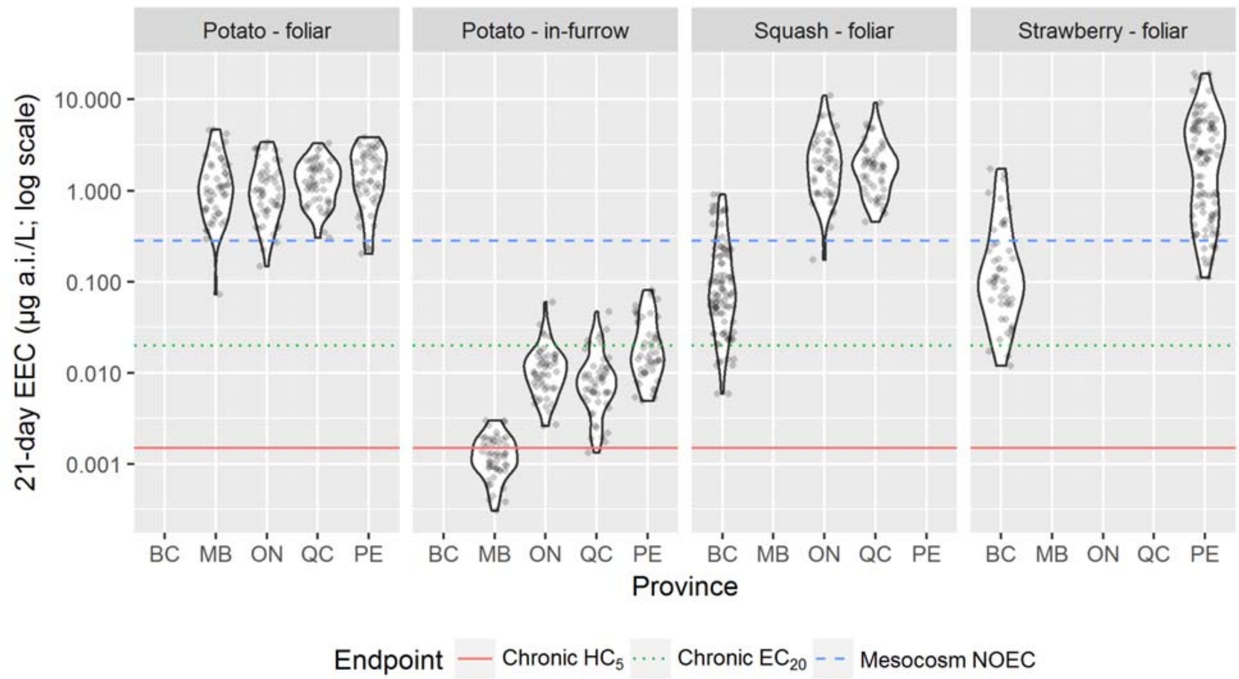


Figure 1 **Yearly average 21-day clothianidin surface water EECs for modelled foliar and in-furrow crop uses over a 50-year period compared to chronic endpoints.**

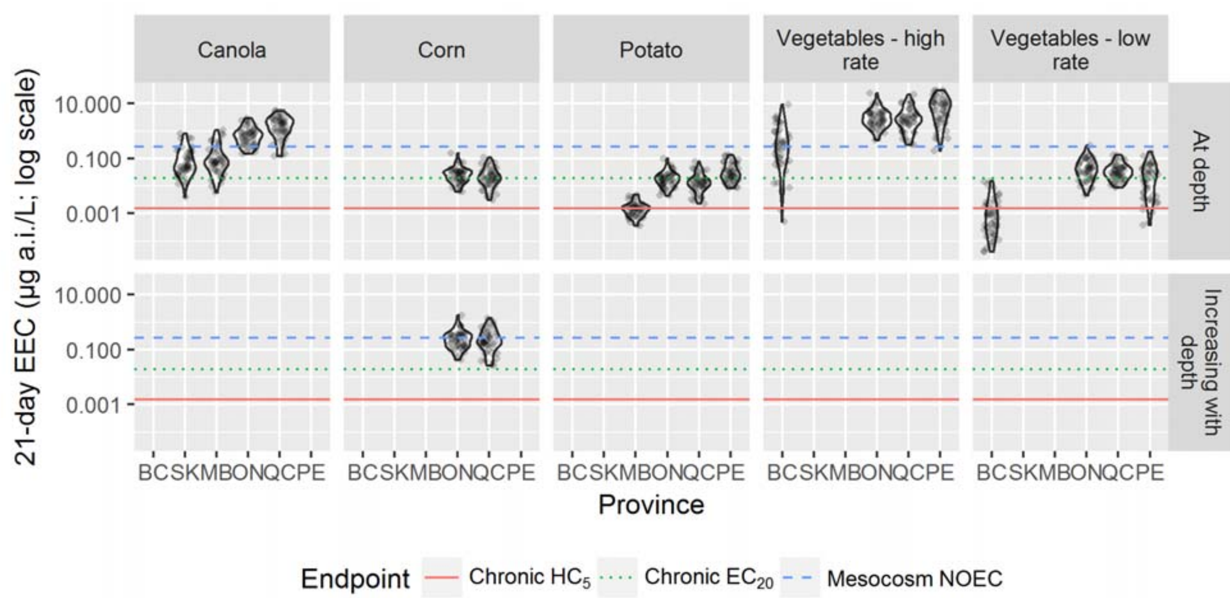


Figure 2 **Yearly average 21-day clothianidin surface water EECs for modelled seed treatment crop uses over a 50-year period compared to chronic endpoints.**

Water monitoring risk assessment

There were sufficient clothianidin surface water monitoring data available to consider in the risk assessment for freshwater aquatic invertebrates. No monitoring data for clothianidin in estuarine or marine water from Canada were available. This section summarizes available Canadian monitoring data for clothianidin in freshwater bodies the PMRA considers to be relevant for use in the risk assessment.

Canadian freshwater monitoring data were available from Prince Edward Island, Nova Scotia, New Brunswick, Ontario, Quebec, Manitoba, Saskatchewan, Alberta and British Columbia. Most sites were located in agricultural areas, but data were also available in urban areas as well as less developed, more pristine sites. The available data for clothianidin spanned from 2010 to 2017. Some sites in Quebec and Ontario were sampled over six or seven years; most sites in other locations were sampled over one to three years.

Average concentrations of clothianidin can provide an estimate of its presence in water over time. Because the average can be affected by a single value being too high or too low compared to the rest of the values in a data set, median concentrations were also calculated to provide another measure of a middle concentration. The duration of time that concentrations of clothianidin approached or exceeded toxicity endpoints was also considered in the assessment, but exposure estimates for these shorter time periods were not generated. In calculations, the PMRA assigned a value equal to half the limit of detection for samples that showed no detection.

A summary of monitoring data on clothianidin in Canadian surface waterbodies is provided in Appendix VII. Table A.7-1 presents data from Prince Edward Island, Nova Scotia and New Brunswick. Table A.7-3 and Table A.7-5 present data from Quebec and Ontario, respectively.

Table A.7-7 summarizes data from from Manitoba, Saskatchewan and Alberta and Table A.7-9 presents data from British Columbia. These tables present the number of samples collected at each site, the frequency of detection, the average, median and maximum concentrations as well as how many samples exceed the PMRA's various acute and chronic toxicity endpoints. Risk quotients[1] calculated using measured concentrations and acute and chronic toxicity endpoints are presented in Table A.7-2 for Prince Edward Island, Nova Scotia and New Brunswick, Table A.7-4 for Quebec, Table A.7-6 for Ontario, Table A.7-8 for Manitoba, Saskatchewan and Alberta and Table Table A.7-10 for British Columbia. Shaded areas in these tables indicate instances where the level of concern is exceeded, meaning that risk quotients equal or exceed a value of 1.

Concentrations of clothianidin measured in Canadian waterbodies frequently exceed chronic toxicity endpoints for freshwater invertebrates throughout the growing season in some agricultural areas, including areas where potatoes, vegetables, corn, soybeans, orchards and vineyards occupy large portions of the watershed. There is also evidence that concentrations in Prairie wetlands surrounding fields seeded to a variety of crops frequently exceed chronic toxicity endpoints at least during some parts of the growing season. Concentrations of

[1] Risk quotient = exposure concentration ÷ toxicity endpoint

clothianidin measured in water were higher than the acute toxicity endpoint for freshwater invertebrates in a few creeks and rivers located in vegetable- and potato-growing regions of Canada, as well as a few wetlands in the Prairies. More details on clothianidin concentrations detected in these areas follows.

Potatoes

Clothianidin can be used on potatoes as a seed treatment, a soil application or a foliar spray. Clothianidin concentrations in three waterbodies located in potato-growing areas of Quebec frequently exceeded chronic toxicity endpoints for aquatic invertebrates. Potatoes represented 21–47% of the cultivated area of the watershed for the Point-du-Jour Creek, the Chartier Creek and the Blanche River, based on information presented in Giroux 2014 (PMRA #2544468). Corn, soybeans and cereals are also grown in the watersheds. Corn represents between 21% and 30% of the cultivated area of the three watersheds and cereals represent from 9 to 20%, while soybeans represent 18% of cultivated area in the Point-du-Jour Creek only.

As can be seen in Table A.7-3, maximum, average and median concentrations of clothianidin in these three waterbodies appear to have increased between 2010 and 2017. In every year sampled (2010, 2012 and 2017), clothianidin concentrations in the three waterbodies exceeded the chronic HC_5 of 0.0015 µg/L between 74% and 100% percent of the time. Average and median concentrations exceeded the chronic HC_5 of 0.0015 µg/L for every year sampled except in 2010 in Point-du-Jour Creek. The yearly average and yearly median concentrations both ranged from 0.005 µg/L in Point-du-Jour Creek in 2010 to 0.24 µg/L in 2017 in the Blanche River. Risk quotients ranged from 3.6 to 161 for average concentrations of clothianidin and from 3.3 and 157 for median concentrations (Table A.7-4).

Between 2010 and 2017, concentrations of clothianidin in a given year exceeded the chronic endpoint of concern for the most sensitive species, an EC_{20} of 0.02 µg/L, for periods of weeks to months in the three rivers. The chronic EC_{20} was exceeded in 100% of the samples from the Blanche River, in 44–100% of the samples from the Chartier Creek and in 4–93% of the samples from the Point-du-Jour Creek. Risk quotients for the chronic EC_{20} and the average concentrations ranged from 3.5 to 12 in the Blanche River, from 1.5 to 9.4 in the Chartier Creek and from 0.3 to 3.1 in the Point-du-Jour Creek (Table A.7-4). Corresponding risk quotients calculated using the median concentrations ranged from 3.6 to 12, 0.9 to 9.3 and 0.3 to 23.1, respectively.

The mesocosm NOEC of 0.281 µg/L for community-level effects was exceeded in 33% of the 30 samples analyzed in the Blanche River in 2017 (Table A.7-3). Concentrations were close to or exceeded the mesocosm NOEC from late-May to mid-June, as well as from mid-July to late-August. Risk quotients calculated using average and median concentrations in 2017 in the Blanche River approached the level of concern, at 0.9 and 0.8, respectively (Table A.7-4). In Chartier Creek, the mesocosm NOEC was exceeded in 13% of the 30 samples analyzed in 2017 (Table A.7-3). In this waterbody, clothianidin concentrations were close to or exceeded the mesocosm NOEC of 0.281 µg/L from late-May to mid-July. Risk quotients calculated using average and median concentrations in 2017 in the Chartier Creek were 0.7 (Table A.7-4).

Clothianidin concentrations consistently higher than the chronic HC_5, chronic EC_{20}, and mesocosm NOEC were also observed in other potato-growing areas of Canada. Six rivers in

Prince Edward Island sampled in 2017 (the Dunk, Huntley, Mill, Montague, Wilmot and Winter Rivers) had 100% of monthly samples exceeding the chronic HC_5 of 0.0015 µg/L from the months of June to October (Table A.7-1). A seventh river, Clyde, had three of five samples exceeding the chronic HC_5. Of these rivers, the Huntley, Mill, Montague and Wilmot Rivers also had concentrations exceeding the chronic HC_5 in previous sampling years. In 2017, the average concentration of clothianidin in these seven rivers ranged from 0.01 µg/L to 0.31 µg/L, while the median concentration ranged from 0.01 µg/L to 0.26 µg/L.

It is noted that other rivers were also sampled in Prince Edward Island between the years 2010 and 2017. For many of the waterbodies sampled, the limit of detection for the analyses was 0.01 µg/L, which is higher than the chronic HC_5 of 0.0015 µg/L. There is uncertainty in the interpretation of non-detects in these waterbodies and whether concentrations exceed the chronic toxicity endpoint of 0.0015/L. Using half the limit of detection as an estimate of exposure when clothianidin was not detected in any sample results in risk quotients of 3.3 (Table A.7-2).

From June to October 2017, 100% of the five monthly samples exceeded the chronic EC_{20} of 0.02 µg/L in the Huntley, Mill, Montague, and Wilmot Rivers, while 40% exceeded the endpoint in the Winter and Dunk Rivers. In years prior to 2017, clothianidin concentrations exceeded the chronic EC_{20} in the Huntley and Wilmot Rivers.

In the Huntley River, concentrations were at or approaching the mesocosm NOEC of 0.281 µg/L for community-level effects between the months of July and October (values ranging from 0.24 µg/L to 0.28 µg/L). The risk quotient calculated using measured concentrations and the mesocosm NOEC approached the level of concern (RQ=0.9 for both average and median concentrations; Table A.7-2). Concentrations of clothianidin measured in these waterbodies were in the same range as those observed in waterbodies in potato-growing areas of Quebec (Table A.7-3).

Samples were collected in watersheds from British Columbia where potatoes and vegetable crops represented approximately 26% of the cultivated area of the watershed (PMRA #2842169, 2842180). Berries occupied a significant portion (16–44%) of the cultivated area as well. There were a few detections of clothianidin in the Nicomekl River and the Sumas Lake Canal in June and July 2017 (Table A.7-9). Clothianidin concentrations were as high as 0.16 µg/L in these waterbodies. The limit of detection for monitoring data collected in the year 2017 in British Columbia (PMRA #2842180) was 0.005 µg/L, more than two times higher than the chronic HC_5 of 0.0015 µg/L. Thus, all samples collected in 2017, including non-detects at half the limit of detection, exceeded the level of concern. There is uncertainty in the interpretation of non-detects in the year 2017 and whether concentrations exceed the chronic toxicity endpoint of 0.0015 µg/L. In waterbodies where clothianidin was not detected in any sample collected in 2017, using half the limit of detection as an estimate of exposure, the resulting risk quotients are 1.7 (Table A.7-10). Clothianidin concentrations in the Nicomekl River exceeded the chronic EC_{20} of 0.02 µg/L in two out of eight samples (25%) collected in 2017.

Mixed vegetables and potatoes

As stated previously, all three methods of application can be used on potatoes (seed treatment, foliar spray, or soil application). Depending on the type of vegetable, clothianidin can be used as a seed treatment or as a foliar spray. Waterbodies sampled in vegetable-growing areas of Quebec (Gibeault-Delisle Creek and Norton Creek) had concentrations of clothianidin frequently exceeding chronic toxicity endpoints and occasionally the acute toxicity endpoint. These waterbodies were sampled two to three times per week from May to August 2013 and 2014. A total of 68% of the watershed upstream of the Gibeault-Delisle Creek sampling site was cultivated, while 46% of the area was cultivated upstream of the Norton Creek site based on information in Giroux 2017 (PMRA #2821394). In the Gibeault-Delisle Creek watershed, vegetables (mainly carrots, onions, green onions and lettuce) represented 25% of the cultivated area upstream of the sampling site, potatoes represented 21%, and corn and soybeans represented 19% of the area. In Norton Creek, vegetable crops (mainly onions, lettuce, beans, carrots and cucurbits) represented 18% of the cultivated area upstream of the sampling site, potatoes represented approximately 9% of the cultivated area, while corn and soybeans represented approximately 24%.

Clothianidin concentrations in the two creeks exceeded the chronic HC_5 of 0.0015 µg/L in 100% of the samples analyzed in 2013 and 2014 (Table A.7-3). Yearly average and yearly median concentrations in the two waterbodies were well above the chronic HC_5 in both years sampled. Concentrations were higher in Gibeault-Delisle Creek compared to Norton Creek. In Gibeault-Delisle Creek, the yearly average concentrations ranged from 0.55 µg/L to 0.88 µg/L, and the yearly median concentrations ranged from 0.25 µg/L to 0.32 µg/L. The associated risk quotients ranged from 367 to 590 using the average concentration and from 167 to 213 using the median concentration (Table A.7-4). In Norton Creek, the yearly average concentration ranged from 0.047 µg/L to 0.057 µg/L, while the yearly median concentration was 0.038 µg/L for both years (Table A.7-3). Associated risk quotients for Norton Creek ranged from 32 to 38 for the average concentration and were 25 for both years using the median concentration (Table A.7-4).

Concentrations of clothianidin in these two waterbodies also exceeded the chronic EC_{20} throughout the sampling periods of 2013 and 2014; a total of 78–100% of samples analyzed exceeded the endpoint from May to August of both years (Table A.7-3). Risk quotients for Gibeault-Delisle Creek ranged from 28 to 44 for the average concentration and from 13 to 16 using the median concentration (Table A.7-4). For Norton Creek, risk quotients ranged from 2.4 to 2.9 for the average concentration and were 1.9 for both years using the median concentration.

In Gibeault-Delisle Creek, the average and median concentrations of clothianidin measured in 2013 and 2014 slightly exceeded the mesocosm NOEC of 0.281 µg/L (Table A.7-3). The mesocosm NOEC for potential community-level effects was exceeded in 43 to 54% of the samples analyzed from May to August 2013 and 2014 (Table A.7-3). The risk quotients for Gibeault-Delisle Creek ranged from 2 to 3.1 and from 0.9 to 1.1 for average and median concentrations, respectively (Table A.7-4).

Clothianidin concentrations in Gibeault-Delisle Creek exceeded the acute HC_5 of 1.5 µg/L on four occasions: three samples (11%) in 2013 and one sample (3%) in 2014 (Table A.7-3). The maximum concentration of clothianidin measured in Gibeault-Delisle Creek was 11 µg/L, in 2013. The highest risk quotient for acute exposure was 7.3 for this waterbody, calculated using the single highest detection (Table A.7-4).

Due to the mixed uses within the watershed, it is not possible, based on the existing monitoring data, to identify which crops are leading to the elevated concentrations of clothianidin in these waterbodies.

Corn and soybeans

Neonicotinoids are used a seed treatment on corn, soybean and other cereal crops. Concentrations of clothianidin exceeded the chronic HC_5 of 0.0015 µg/L in several waterbodies located in corn and soybean areas of Ontario and Quebec. It is recognized that clothianidin is not registered for use on soybeans; however, clothianidin is a transformation product of thiamethoxam, which is registered on soybeans. Also, clothianidin is persistent in soil, and corn and soybean crops are regularly rotated.

Four rivers located in major corn and soybean areas of Quebec were sampled between 2012 and 2017. Corn and soybeans crops represented between 64% and 83% of the cultivated area of the watersheds, based on information presented in Giroux 2015 (PMRA #2561884). Other crops in the watershed included cereal crops, which occupied approximately 5% of the cultivated area, and vegetables which represented 0.6–11% of the cultivated area.

In each of the four rivers sampled between 2012 and 2017, clothianidin concentrations exceeded the chronic HC_5 between 79 and 100% of the time (Table A.7-3). In 2017, the limit of detection was 0.005 µg/L, which is more than two times higher than the chronic HC_5. Thus, all samples, including those non-detects assigned a value of half the limit of detection exceeded the chronic HC_5. Every year from 2012 to 2017, the average and median concentrations of clothianidin measured between May and August in the four rivers exceeded the chronic HC_5 of 0.0015 µg/L. Risk quotients calculated using average and median concentrations ranged from 11 to 44 and from 5.3 to 34, respectively (Table A.7-4).

In the four rivers, clothianidin concentrations exceeded the chronic EC_{20} in 10–97% of the samples collected, the frequency varying depending on the year of sampling (Table A.7-3). In some years, the chronic EC_{20} was exceeded for several weeks to months, particularly in the Saint-Zéphirin, des Hurons and Chibouet Rivers. Risk quotients for sampling years 2012 to 2017 ranged from 0.9 to 3.3 based on average concentrations, and from 0.4 to 2.6 based on median concentrations (Table A.7-4).

There were multiple other waterbodies in the province of Quebec where the major land uses in the watersheds are mixed crops, as well as corn and soybeans, and where the chronic HC_5 and the chronic EC_{20} are exceeded in large portions of samples collected (Table A.7-3).

Similar to Quebec, several waterbodies located in watersheds in Ontario where row crops such as corn, soybeans and wheat are major components of the watershed showed clothianidin concentrations exceeding the chronic HC_5. Between 2012 and 2017 in Ontario, concentrations of clothianidin in Twenty Mile Creek, Innisfil Creek, Lebo Drain, Nissouri Creek, Nottawagasa River, Sturgeon Creek, Sydenham River, and Thames River exceeded the chronic HC_5 in 50–100% of samples (Table A.7-5). Every year from 2012 to 2017, the average and median concentrations of clothianidin measured over the growing season in the eight waterbodies exceeded the chronic HC_5 of 0.0015 µg/L. Risk quotients calculated using average and median concentrations ranged from 2.9 to 122 and from 3.1 to 88, respectively (Table A.7-6).

In Ontario, clothianidin concentrations were higher than the chronic EC_{20} in more than 50% of the samples collected in a given year in the Twenty Mile Creek, Lebo Drain, Sturgeon Creek, Sydenham River and Thames River (Table A.7-3). In some years, concentrations in these rivers exceeded the chronic EC_{20} for several weeks to months. Risk quotients for sampling years 2012 to 2017 ranged from 0.1 to 9.1 based on the average concentrations, and from 0.1 to 6.6 based on the median concentrations, depending on the year (Table A.7-4).

These waterbodies are located in southwestern Ontario, and samples were collected approximately every two weeks from April to November. Several other waterbodies located in corn and soybean areas in the Ottawa region also showed exceedances of the chronic HC_5 and chronic EC_{20} in 2015 and 2016 (Table A.7-5). However, the waterbodies in this dataset (PMRA #2785041), were sampled only once or twice per year, making the dataset less robust compared to the data from southwestern Ontario.

Clothianidin concentrations higher than the mesocosm NOEC of 0.281 µg/L were rare in waterbodies from corn and soybean areas of Quebec and Ontario, and occurred on only one occasion in four rivers from Quebec and one creek from Ontario (Table A.7-3 and Table A.7-5). The maximum concentration of clothianidin measured in waterbodies from corn and soybean areas was 0.52 µg/L, from a sample collected in the Chibouet River in 2015. Researchers have analyzed monitoring data and land use data in watersheds in southwestern Ontario for correlations between surface water monitoring detections and agricultural land uses in the watersheds. Concentrations of clothianidin measured in waterbodies from southwestern Ontario have been associated with the presence of corn, soybean and cereal grain crops in the areas surrounding the waterways (PMRA #2703534 and #2818731).

Orchards and vineyards

Clothianidin is used as a foliar spray on orchard and vineyard crops. Concentrations of clothianidin exceeded the chronic HC_5 of 0.0015 µg/L in several waterbodies located in areas where orchards and vineyards occupy large portions of the cultivated area of a watersheds in Ontario and Quebec.

Rousse Creek and Déversant-du-Lac Creek are located in Quebec and were sampled in 2010, 2011, 2015 and 2016. Based on crop information presented in Giroux 2017 (PMRA #2821394), orchards represented approximately 27% and 12.5% of the cultivated area of the watershed upstream of the sampling sites for Rousse Creek and Déversant-du-Lac Creek, respectively. Other crops also represented large portions of watersheds upstream of the sampling sites. In the Rousse Creek watershed, corn and soybeans represented a total of 16% of the cultivated area upstream of the sampling site, while vegetables represented 10%. In the Déversant-du-Lac Creek watersheds, corn and soybeans represented a total of about 65% of the cultivated area upstream of the sampling site, and cereal crops represented approximately 5%.

Clothianidin concentrations in water exceeded the chronic HC_5 less frequently over time in Déversant-du-Lac Creek. Clothianidin concentrations exceeded the chronic HC_5 a total of 60%, 84%, 25% and 7% of the time in 2010, 2011, 2015 and 2016, respectively (Table A.7-3). The yearly average concentration exceeded the chronic HC_5 in each of the four years sampled. Associated risk quotients ranged from 3.1 to 6.3 (Table A.7-4). The yearly median concentration was below the chronic HC_5 in two of the four years sampled. The associated risk quotients ranged from 0.3 to 3.3. In Rousse Creek, clothianidin concentrations exceeded the chronic HC_5 between 0% and 15% of the time during the four years sampled (Table A.7-3). The yearly average concentration in Rousse Creek exceeded the chronic HC_5 during one of the four years sampled. The associated risk quotients ranged from 0.3 to 1.1 (Table A.7-4).

The chronic EC_{20} was only sporadically exceeded in Déversant-du-Lac Creek and was not exceeded in Rouse Creek. Risk quotients did not exceed the level of concern when comparing clothianidin concentrations with the chronic EC_{20} (Table A.7-4).

In Ontario, three waterbodies in areas where orchards or vineyards occupy large portions of the watersheds showed frequent exceedances of the chronic HC_5 of 0.0015 µg/L between 2012 and 2016 (Table A.7-5). In Two Mile Creek, Four Mile Creek, and Prudhomme Creek, clothianidin concentrations exceeded the chronic HC_5 between 20% and 100%, 62% and 93% and 93–100% of the time, respectively, during the five seasons of sampling. Associated risk quotients calculated using the average concentrations ranged from 0.9 to 24, 2.6 to 16 and 8.1 to 33 for Two Mile Creek, Four Mile Creek, and Prudhomme Creek, respectively (Table A.7-6). Risk quotients calculated using the median concentrations also routinely exceeded the level of concern of 1, ranging from 0.6 to 2.9, 1.6 to 3.5 and 4.2 to 7.6, Two Mile Creek, Four Mile Creek, and Prudhomme Creek, respectively.

Up to 8%, 17% and 50% of samples exceeded the chronic EC_{20} in Two Mile Creek, Four Mile Creek, and Prudhomme Creek, respectively (Table A.3-5). Clothianidin concentrations were near or exceeded the chronic EC_{20} for a few days to weeks between late-May and September in these waterbodies. Risk quotients were as high as 2.5 in Prudhomme Creek, when using average concentrations, and as high as 1.2 when using median concentrations (Table A.3-6).

Due to the mixed uses within the watersheds sampled in Ontario and Quebec, it is not possible, based on the existing monitoring data, to identify which crops are leading to the elevated concentrations of clothianidin in these waterbodies.

While sampling was also conducted in 2017 in areas of British Columbia where orchards and vineyards crops are present in watersheds, clothianidin was not detected in any samples collected between June and September 2017 (Table A.7-9; PMRA #2842180). The limit of detection for monitoring data collected in the year 2017 in British Columbia was 0.005 µg/L, more than two times higher than the chronic HC_5 of 0.0015 µg/L. Thus, all samples collected in 2017, including non-detects at half the limit of detection, exceeded the level of concern. As such, there is uncertainty in the interpretation of non-detects in the year 2017 and whether concentrations exceed the chronic toxicity endpoint of 0.0015 µg/L. In addition, neonicotinoid use information for some watersheds in British Columbia (PMRA #2842180) indicates that growers used a neonicotinoid other than clothianidin to treat fruit trees in 2017. Therefore, the lack of detections of clothianidin in waterbodies where orchards are a major component of watersheds in British Columbia could also be due to the absence of use.

Seed treatments in Prairie Provinces

The primary use of neonicotinoids in the Prairies is as a seed treatment. There is evidence that concentrations measured in Prairie wetlands, rivers and creeks can exceed acute and chronic toxicity endpoints at different times throughout the season, particularly in the spring and summer.

The Prairie wetlands sampled were located in agricultural areas, near fields seeded to crops such as canola, barley, oats, wheat, field peas, lentils, soybeans, corn and grasslands; however, site information was not available for all sampled wetlands. In addition, there is uncertainty as to whether some of the temporary wetlands sampled are relevant for an aquatic invertebrate risk assessment.

Most wetlands in the available datasets were sampled only once per sampling period, which consisted of spring/pre-seed, summer, or fall. As such, the PMRA did not generate chronic exposure estimates for these waterbodies. The percentage of wetlands with clothianidin concentrations exceeding the toxicity endpoints was determined for each sampling period. Risk quotients calculated using the range of measured concentrations in all wetlands sampled provide a broad estimate of the potential risks, assuming concentrations measured remained constant over time. There is uncertainty associated with longer-term exposure concentrations in the Prairie wetlands sampled.

Clothianidin concentrations in wetlands sampled in the spring prior to seeding exceeded the chronic HC_5 in 36% of the 138 wetlands sampled in 2012, 87% of the 90 wetlands sampled in 2013, and 100% of the 16 wetlands sampled in 2014 (Table A.7-7). The chronic EC_{20} was exceeded in 11%, 62% and 69% of the wetlands sampled in the spring of 2012, 2013 and 2014, respectively. Concentrations measured in the spring ranged from below detection limits up to 0.17 µg/L. Risk quotients calculated using the range of concentrations spanned from 0.3 to 116 for the chronic HC_5, and from less than 0.1 to 8.7 for the chronic EC_{20} (Table A.7-8). Main et al. 2016 (PMRA #2572395) reported that the presence of clothianidin in wetlands prior to seeding may be a result of the persistence of clothianidin residues in the soil and transport to wetlands via snowmelt and particulate matter during spring runoff.

Wetlands sampled in the summer had clothianidin concentrations exceeding the chronic HC_5 in 51% of the 134 wetlands sampled in 2012, 76% of the 144 wetlands sampled in 2013, 44% of the 115 wetlands sampled in 2014 (Table A.7-7). The chronic EC_{20} was exceeded in 39%, 56% and 23% of the wetlands sampled in the summer of 2012, 2013 and 2014, respectively. Clothianidin concentrations ranged from below detection limits up to 3.1 µg/L. Risk quotients calculated using the range of concentrations range from 0.4 to 2072 for the chronic HC_5, and from less than 0.1 to 103 for the chronic EC_{20} (Table A.7-8). In the summer of 2017, clothianidin was detected in 10 of the 60 wetlands (17%) sampled in the three Prairie Provinces, at concentrations exceeding the HC_5 (two in Manitoba, five in Saskatchewan, and three in Alberta; Table A.7-7). It was detected in nine of the 60 wetlands (15%) sampled (two in Manitoba, four in Saskatchewan and three in Alberta). Clothianidin concentrations measured in the summer of 2017 ranged from below detection limits up to 0.51 µg/L. Risk quotients calculated using the range of concentrations measured in the summer of 2017 ranged from 3.3 to 342 for the chronic HC_5, and from 0.3 to 26 for the chronic EC_{20} (Table A.7-8). The limit of detection for the data collected in 2017 was 0.01 µg/L, more than two times higher than the chronic HC_5 of 0.0015 µg/L. Thus, all samples in the 2017 dataset, including non-detects at half the limit of detection, exceeded the level of concern. There is uncertainty in the interpretation of non-detects for the year 2017 and whether concentrations exceed the chronic toxicity endpoint of 0.0015 µg/L. In waterbodies where clothianidin was not detected in any sample collected in 2017, using half the limit of detection as an estimate of exposure, the resulting risk quotients are 1.8 (Table A.7-8). The mesocosm NOEC of 0.281 µg/L for possible community-level effects was exceeded in 7% of the 134 wetlands sampled in the summer of 2012, 5% of the 144 wetlands sampled in the summer of 2013, 3% of the 115 wetlands sampled in the summer of 2014 and 2% of the 60 wetlands sampled in the summer of 2017 (Table A.7-7). Risk quotients calculated using the mesocosm NOEC ranged from < 0.1 to 11 (Table A.7-8). Three wetlands had clothianidin concentrations exceeding the acute toxicity endpoint of 1.5 µg/L: one in the summer of 2012 and two in the summer of 2014 (Table A.7-7). The risk quotients associated with the acute HC_5 ranged from < 0.1 to 2.1 (Table A.7-8).

Clothianidin concentrations and detection frequencies in Prairie wetlands were generally lower in the fall compared to spring or summer (Table A.7-7). Some wetlands dried up during the season and thus sampling in the fall could not occur. Clothianidin concentrations exceeded the toxicity endpoint of 0.0015 µg/L in four out of the 80 wetlands sampled in the fall of 2012; the chronic EC_{20} of 0.281 µg/L was exceeded in only one of the wetlands. Clothianidin was not detected in any of the 23 wetlands sampled in the fall of 2017. It should be noted that there was widespread drought in the Canadian Prairies in 2017. Also, as stated previously, the limit of detection for the samples collected in 2017 was more than two times higher than the chronic HC_5 of 0.0015 µg/L. As such, there is uncertainty in the interpretation of non-detects in this 2017 dataset and whether concentrations exceed the chronic toxicity endpoint of 0.0015 µg/L. The highest concentration of clothianidin measured in the fall was 0.031 µg/L in 2012. The risk quotient for wetlands sampled in the fall ranged from 0.4 to 21, when comparing concentrations with the chronic HC_5 (Table A.3-8).

In their research, Main et al. 2014 (PMRA #2526133) reported that wetlands near canola fields typically had higher maximum neonicotinoid concentrations and higher detection frequencies than wetlands surrounded by grasslands. However, average neonicotinoid concentrations were not statistically different between wetlands near canola fields and those seeded to other crops such as barley, oats, peas, wheat and grassland. Similarly, Main et al. 2016 (PMRA #2572395) found that wetlands located in oat fields not previously treated with neonicotinoids the previous year had similar clothianidin concentrations to wetlands found in previously treated canola fields. The authors report that this result may be due to persistence and carry-over of neonicotinoid residues between seasons, where neonicotinoid treated crops such as canola are frequently rotated with untreated crops, such as oats, in alternating years.

Ducks Unlimited Canada (PMRA #2847073) reported that neonicotinoids were detected more often and at higher concentrations in Prairie wetlands where canola and wheat were the dominant crop types within a 250-metre area surrounding the wetlands. Neonicotinoid concentrations were also reported to vary between wetlands situated in the same field and surrounded by the same crop, possibly due to differences in preferential flow paths of the runoff and the size of contributing areas between the basins.

Based on the available monitoring data for clothianidin in Prairie wetlands, there is uncertainty associated with clothianidin concentrations over the growing season, as most wetlands were sampled only once per sampling period, and concentrations of clothianidin varied between the different sampling periods. However, in the study by Main et al. 2014 (PMRA #2526133 and #2612760), the same wetlands in Saskatchewan were generally sampled more than once, and up to four times, between the spring of 2012 and the spring of 2013. A total of 125 wetlands were sampled in the spring of 2012 (between 25 April and 1 May) and in the summer of 2012 (between 23 June and 5 July). Of these wetlands, 34 (27%) had concentrations exceeding the chronic HC_5 on both occasions. A total of 55 wetlands were sampled during all four sample periods between the spring of 2012 and the spring of 2013. Of these, three wetlands (5%) had concentrations of clothianidin exceeding the chronic HC_5 for all four sampling periods. These results suggest that concentrations in some Prairie wetlands may exceed toxicity endpoints for several weeks to months. In addition, the 2017 season was a particularly dry year in the Canadian Prairies, and there is uncertainty as to whether concentrations measured represent those that would be present in a more typical season. There is also uncertainty with the data from the 2017 season because the limit of detection for reported samples was more than two times higher than the chronic HC_5.

Monitoring data for clothianidin in flowing waterbodies such as rivers and streams were available in Manitoba, Saskatchewan and Alberta. Clothianidin concentrations were generally lower in rivers and streams compared to those measured in Prairie wetlands. Nonetheless, there is evidence that clothianidin concentrations can exceed chronic toxicity endpoints in some rivers. For example, clothianidin concentrations exceeded the chronic HC_5 of 0.0015 µg/L in 67–100% of the three samples collected between June and October 2017 in each of the Red, Boyne, Morris and Rat Rivers in Manitoba. Concentrations also exceeded the chronic HC_5 in all of the six samples collected in the Assiniboine River in Saskatchewan between May and September 2014 (Table A.7-7). The maximum concentration measured in a flowing waterbody was 0.055 µg/L in the Red River in Manitoba. Risk quotients at these sites ranged from 4 to 22 when using the average concentrations in a given year and ranged from 2.8 to 28 when using the median concentrations (Table A.7-8). Major crops grown in the watersheds of these sites include soybeans, wheat, canola, oats, and corn. Several other sites sampled in the Prairie Provinces showed isolated detections of clothianidin above the chronic toxicity endpoint of 0.0015 µg/L. Clothianidin concentrations were higher than the chronic EC_{20} in two consecutive samples out of the total of three samples collected in each of the Red, Boyne, Morris and Rat Rivers in Manitoba in 2017 (Table A.7-7). Samples were collected in June, July and October 2017. There is uncertainty as to the duration of time concentrations exceeded the chronic EC_{20} (and the chronic HC_5), because samples were collected weeks to months apart. Concentrations could potentially have been above the chronic EC_{20} (and the chronic HC_5) for several months in these rivers. Most of the monitoring data were from the year 2017, which was a particularly dry in the Canadian Prairies. There is uncertainty as to whether concentrations of clothianidin in rivers and streams would exceed toxicity endpoints for aquatic invertebrates when precipitation concentrations are more typical.

Incident reports

Since 26 April 2007, registrants have been required by law to report pesticide incidents to the PMRA that are related to their products. In addition, the general public, medical community, government and non-governmental organizations are able to report pesticide incidents directly to the PMRA. The USEPA's Ecological Incident Information System (EIIS) was also queried for environmental incidents related to clothianidin that were available in that database up to February 2018. No incidents involving aquatic invertebrates have been reported in Canada or the United States related to clothianidin use.

4.5 Uncertainties Identified in the Risk Assessment

The PMRA has identified the following uncertainties in assessing clothianidin risk to aquatic invertebrates. These may be addressed in the future with the submission of additional data. However, the PMRA has determined that the risk conclusions presented are sound on the basis of the weight-of-evidence available with the chronic toxicity data, extensive surface water modelling that was conducted, and recent Canadian environmental monitoring data that were available.

4.5.1 Endpoints

The chronic SSD for clothianidin was based on a limited dataset of only five species, which is the minimum sample size for the construction of a species distribution as identified by Belanger et al. (2017) for use in regulatory risk assessment frameworks by global regulatory agencies. The PMRA distribution was statistically sound, meeting the criteria for normality of data. However, a wide confidence interval (CI) of approximately five orders of magnitude in the HC_5 value indicates that the actual 5% effect level may lie over a wide range of values. The PMRA's HC_5 value of 0.0015 µg a.i./L is conservative compared to a chronic endpoint for the protection of aquatic invertebrates from neonicotinoids of 0.035 µg/L that was recommended by Morrissey et al. (2015). It is acknowledged that the PMRA's HC_5 is at or below the limit of detection in several surface water monitoring programs.

The most sensitive community-level NOEC of 0.281 µg a.i./L from the available outdoor mesocosm studies was not relied on exclusively for making a regulatory decision. At this level of effects, recovery was seen by the end of the study; however, there is uncertainty as to whether recovery would be expected in the environment as a) the study was based on a single application, while monitoring data has shown the presence of clothianidin in Canadian surface waters throughout the growing season, and b) because it was not possible to make a statistical determination on the effects of sensitive ephemeropteran species in the study.

4.5.2 Exposure

Similarly to the endpoint selection, the PMRA uses a tiered approach to estimating exposure during a risk assessment which moves from a highly conservative screening level estimation to modelling estimation and finally to real-world monitoring data. Runoff is the primary route of exposure of clothianidin to aquatic invertebrates due to its solubility, high potential for movement into surface waters and persistence in waters with limited levels of sunlight penetration. At each step there are some uncertainties that are outlined below.

4.5.3 Modelling

Higher-tiered surface water runoff modelling was conducted for approximately half of the registered outdoor uses of clothianidin. Uses were chosen to ensure that runoff potential was assessed for a) representative application rates for each of the major application methods, and b) major crop uses across the country. For the uses of clothianidin that were not modelled, the acceptability of continued use cannot be demonstrated given that similar application rates and methods were modelled for other crops and risks were identified.

4.5.4 Monitoring

While monitoring data provide a real-life picture of the expected exposure concentrations, there were some areas where questions remain.

When considering the water monitoring data, the risk to aquatic invertebrates was assessed for clothianidin alone. Neonicotinoids share a common mode of action and have been shown to co-occur in many Canadian waterbodies [Main et al. 2014 (PMRA #2526133); Main et al. 2015 (PMRA #2608629); Main et al. 2016 (PMRA #2572395); Struger et al. 2017 (PMRA #2703534); Giroux 2014 (PMRA #2544468); Giroux 2015 (PMRA #2561884); Giroux 2017 (PMRA #2821394)]. As such, the potential risk from the combined residue is unknown but, the potential risk will be higher in waterbodies containing two or more neonicotinoids than that when the individual neonicotinoids are considered alone.

Given that clothianidin is a transformation product of thiamethoxam, another registered neonicotinoid insecticide, the use of thiamethoxam may contribute to the presence of clothianidin in waterbodies. The potential contribution from thiamethoxam transformation to clothianidin is not possible to estimate at this time.

Regarding acute exposure, monitoring data likely underestimate short-term exposure to clothianidin, as most sampling regimes are unlikely to capture peak concentrations.

Not all regions across Canada are represented equally in a variety of ways. Sampling regimes differ between datasets in different regions; some waterbodies were only sampled a few times during the season resulting in some uncertainty as to the duration of exposure in these areas and some areas of Canada lack water monitoring. In areas where clothianidin is used but monitoring data are lacking, there is no reason to believe that detection patterns would differ compared to those observed in areas where monitoring data are available.

Relating clothianidin concentrations in water to use on a specific crop is difficult in watersheds where multiple clothianidin-treated crops are common. Similarly, it is difficult to relate clothianidin concentrations in water to a specific application method in watersheds where the crops grown can be treated using multiple methods (for example, potatoes can be treated using foliar spray, soil application or seed treatment, and certain vegetables can be treated using a seed treatment or a foliar spray).

In some cases there is limited site information, such as some temporary wetlands, therefore, the relevancy for an aquatic invertebrates risk assessment was difficult to determine. In the absence of additional information, these were considered relevant water bodies in this assessment.

The weather patterns across Canada in 2017 were unusually dry in some areas, especially in the Prairies. This dry year may have affected the concentrations detected in these areas.

Samples showing no detections can be difficult to interpret, particularly when the limit of detection is high, and when use information in the vicinity of sampling areas is not available. The non-detects could be due to factors such as the non-transport of the chemical from the site of application, the lack of use of the chemical in the area studied, or the lack of sensitivity of the analytical method.

4.6 Risk Assessment Conclusions

Surface water modelling of clothianidin uses showed widespread exceedances of the level of concern for chronic effects to aquatic invertebrates. The modelling was region-specific, and it encompassed a wide range of crops and application methods across Canada. Recent water monitoring data show that clothianidin is being detected in Canadian surface waters at concentrations that frequently exceed the level of concern for chronic adverse effects on aquatic invertebrates. Concentrations that may impact individual species and invertebrate communities occurred from weeks to months in some waterbodies associated with many outdoor uses of clothianidin. This assessment is based on the exposure of clothianidin alone to aquatic invertebrates, whereas neonicotinoids have been shown to co-occur in the environment and share a common mode of action. Thus, the impact of exposure to multiple neonicotinoids will be higher than for exposure to clothianidin alone.

Therefore, based on the available information the PMRA is unable to conclude that the risks to aquatic invertebrates are acceptable from outdoor agricultural and turf uses of clothianidin. The PMRA acknowledges that research on neonicotinoids is ongoing and scientific studies are published regularly. Relevant information that became available after the initiation of the PMRA's publication process and any information submitted during the consultation period will be considered by the PMRA before making a final decision.

4.7 Risk Mitigation for Aquatic Invertebrates

4.7.1 Use Restrictions

Given the risks that have been identified and considering the available information, effective risk mitigation through a use-reduction strategy would be difficult to achieve for several reasons. In mixed-use areas of agriculture, it would be difficult to identify inputs from specific crops or application methods causing the elevated concentrations seen in water. In addition, it is not possible to accurately predict how much use reduction would be necessary to achieve acceptable concentrations of clothianidin in the environment and, therefore, any use-reduction strategy would require extensive and comprehensive water monitoring information to confirm that risk reduction targets are being achieved. It is also not possible to estimate how long a reduction in environmental concentrations would take. In addition, in sectors where clothianidin is approved for use but not currently used extensively, intensification of uses in the future may lead to additional risks of concern. Given the above, cancellation of all outdoor agricultural and turf uses for clothianidin is being proposed.

4.7.2 Spray Buffer Zones

During the phase out period, updated spray buffer zones based on the risks identified in this assessment will be required for the protection of freshwater and marine habitats. Spray buffer zones for terrestrial habitats are also required as per existing conditions of use. Spray buffer zones were determined based on existing directions for use on product labels, including a spray quality of ASAE Fine for field and aerial sprayers. The complete proposed spray buffer zone table and drift mitigation instructions for clothianidin products are provided in Appendix VIII.

Agriculture and Agri-Food Canada's Multi-stakeholder Mitigation Working Group submitted information on recommended drift mitigation strategies which included:

- promoting the use of best management practices for minimizing spray drift,
- promoting the adoption of the PMRA's on-line spray buffer zone calculator tool, and
- increasing label restrictions for foliar spray applications to minimize spray drift.

As for all pest control products, during the phase-out period for clothianidin, the PMRA will continue to encourage the adoption of best management practices for spray drift management. Required drift mitigation measures for specific application methods will be identified on product labels. At this time, additional application restrictions to minimize spray drift are not required. With the exception of identified buffer zones of 120 m for field sprayer use on turf and 800 m for aerial use on potatoes, the on-line spray buffer zone calculator can be used to further mitigate the potential for spray drift based on the use of coarser spray qualities and by accounting for meteorological conditions at the time of application.

4.7.3 Runoff Mitigation

Precautionary label statements are currently on all product labels to reduce the potential for runoff to adjacent aquatic habitats. Despite the current label statement, concentrations of clothianidin posing a risk to aquatic invertebrates have been found in Canadian surface waters where clothianidin is used for pest management in agriculture.

Agriculture and Agri-Food Canada's Multi-stakeholder Mitigation Working Group submitted information on the potential use of vegetative filter strips to reduce runoff into adjacent waterbodies. While studies exist on the effectiveness of vegetative filter strips at reducing runoff of pesticides, most of the research has been conducted using pesticides that are much less water soluble than neonicotinoids. Only two studies were conducted using neonicotinoids, namely those by Denning et al. 2004 (PMRA #2518467) and Hladik et al. 2017 (PMRA #2866915) and the results of both studies as to the potential effectiveness of vegetative filter strips to reduce surface water runoff of neonicotinoids were inconclusive. In both studies, neonicotinoid concentrations in surface water runoff were variable and they were not significantly different or were higher at sites with vegetative filter strips compared to sites without them. Field dynamics and/or input from nearby neonicotinoid-treated fields that were not a part of the study confounded the results. No quantifiable measure to reduce the runoff of neonicotinoids into waterbodies using vegetative filter strips could be derived from the two studies. Notwithstanding the lack of quantifiable risk reduction, the PMRA will continue to include the standard recommended label statement for the use of vegetative filter strips on clothianidin product labels as part of a runoff mitigation strategy.

5.0 Proposed Special Review Decision for Clothianidin

The evaluation of available scientific information related to the aspects of concern indicated that the registered products containing clothianidin that are subject to this special review pose environmental risks that have not been shown to be acceptable. Therefore, under the authority of the *Pest Control Products Act* and based on the evaluation of currently available scientific information, Health Canada is proposing to cancel all outdoor uses of clothianidin on food and feed crops (use site categories 13 and 14), including seed treatments (use site category 10), and on turf (use site category 30), over three to five years, taking into account Regulatory Directive DIR2018-01, *Policy on Cancellations and Amendments Following Re-evaluation and Special Review*. The PMRA will consider alternate risk management proposals, provided that they can achieve acceptable levels in the environment within the same timeframe.

Additional mitigation measures may be required during the phase-out period (Appendix VIII).

The proposed special review decision is open for public consultation for 90 days from the date of this publication. The PMRA is inviting the public to submit comments on the proposed special review decision for clothianidin including proposals that may refine the risk assessment and risk management. Once the PMRA considers the comments and any information that are received during the public consultation period, the Agency will publish a final decision.

6.0 Next Steps

Before making a special review decision on clothianidin, the PMRA will consider all comments received from the public in response to this consultation document. A science-based approach will be applied in making a final decision on clothianidin. The PMRA will then publish a special review decision document, which will include the decision, the reasons for it, a summary of the comments received on the proposed decision and the PMRA's response to these comments.

List of Abbreviations

<	less than
>	greater than
≤	less than or equal to
≥	greater than or equal to
µg	microgram(s)
1/n	exponent for the Freundlich isotherm
a.i.	technical active ingredient
ASAE	American Society of Agricultural and Biological Engineers
atm	atmosphere(s)
CAS	chemical abstracts service
CI	confidence interval
cm	centimetre(s)
d	day(s)
DFOP	double first order in parallel
DT_{50}	dissipation time 50% (the time required to observe a 50% decline in concentration)
DT_{90}	dissipation time 90% (the time required to observe a 90% decline in concentration)
dw	dry weight
EC_{10}	effective concentration on 10% of the population
EC_{20}	effective concentration on 20% of the population
ECCC	Environment and Climate Change Canada
EEC	estimated environmental concentration
EP	end-use product
FA	fraction of species affected
g	gram(s)
h	hour(s)
ha	hectare(s)
HC_5	hazardous concentration estimate that is assumed to be protective of 95% of species in a species sensitivity distribution
Hg	mercury
HPLC	high performance liquid chromatography
IORE	Indeterminate Order Rate Equation Model
IUPAC	International Union of Pure and Applied Chemistry
K_d	soil-water partition coefficient
K_F	Freundlich adsorption coefficient
kg	kilogram(s)
K_{oc}	organic-carbon partition coefficient
K_{ow}	octanol-water partition coefficient
L	litre(s)
LC_{10}	lethal concentration on 10% of the population
LC_{50}	median lethal concentration
LOEC	lowest observed effect concentration
LOD	limit of detection
LOQ	limit of quantification

m	metre(s)
mg	milligram(s)
min	minute(s)
mL	millilitre(s)
mm	millimitre(s)
MS	mass spectrometry
N	sample size
NA	not applicable
NC	not calculated
ND	not detected
ng	nanogram(s)
NOAEC	no observed adverse effect concentration
NOAEL	no observed adverse effect level
NOEC	no observed effect concentration
NOEL	no observed effect level
NR	not reported
N/R	not required
OC	organic carbon content
OM	organic matter content
PCP	Pest Control Product number
pKa	dissociation constant
PMRA	Pest Management Regulatory Agency
ppb	parts per billion
ppm	parts per million
RQ	risk quotient
SFO	single first order
sp.	species (singular)
spp.	species (plural)
SSD	Species Sensitivity Distribution
Stdev	standard deviation
$t_{1/2}$	half-life
TGAI	technical grade active ingredient
t_R	representative half-life
TWA	time weighted average
USEPA	United States Environmental Protection Agency
UV	ultraviolet
wt(s)	weight(s)
WWTP	waste water treatment plant

Appendix I Registered Clothianidin Products as of May 2018 that are subject to this Special Review, Excluding Discontinued Products or Products with a Submission for Discontinuation

Registration Number	Marketing Class	Registrant	Product Name	Formulation Type	Guarantee
27445	Technical Grade Active Ingredient	Sumitomo Chemical Company Inc.	Clothianidin Technical Insecticide	Solid	Clothianidin 97.5%
27449	Commercial	Bayer CropScience Inc.	Titan Insecticide	Suspension	Clothianidin 600 g/L
27453		Bayer CropScience Inc.	Poncho 600 FS Seed Treatment Insecticide	Suspension	Clothianidin 600 g/L
27564		Bayer CropScience Inc.	Prosper FL Flowable Insecticide And Fungicide Seed Treatment	Suspension	Clothianidin 120 g/L; carbathiin 56 g/L; thiram 120 g/L; metalaxyl 4g/L
28975		Valent Canada Inc.	Nipsit Inside 600 Insecticide	Suspension	Clothianidin 600g/L
29158		Bayer CropScience Inc.	Prosper T 200 Flowable Insecticide And Fungicide Seed Treatment	Suspension	Clothianidin 142.8g/L; carbathiin 50g/L; trifloxystrobin 7.14g/L; metalaxyl 5.36g/L
29159		Bayer CropScience Inc.	Prosper FX Flowable Insecticide And Fungicide Seed Treatment	Suspension	Clothinidin 285.7 g/L; carbathiin 50 g/L; trifloxystrobin 7.14g/L; metalaxyl 5.36 g/L
29382		Valent Canada Inc.	Clutch 50 WDG Insecticide	Water dispersible granules	Clothianidin 50%
29383		Valent Canada Inc.	Arena 50 WDG Insecticide	Water dispersible granules	Clothianidin 50%
29384		Valent Canada Inc.	Clothianidin Insecticide	Water dispersible granules	Clothianidin 50%
30362		Bayer CropScience Inc.	Emesto Quantum	Suspension	Clothianidin 207g/L; penflufen 66.5 g/L
30363		Bayer CropScience Inc.	Prosper Evergol	Suspension	Clothianidin 290 g/L; trifloxystrobin 7.15g/L; penflufen 10.7g/L; metalaxyl 7.15g/L
30972		Bayer CropScience Inc.	Sepresto 75 WS	Wettable powder	Clothianidin 56.25%; imidacloprid 18.75%
31355		Valent Canada Inc.	Nipsit Suite Canola Seed Protectant	Suspension	Clothianidin 279 g/L; metalaxyl 5.23 g/L; metconazole 1.04 g/L

Registration Number	Marketing Class	Registrant	Product Name	Formulation Type	Guarantee
31357		Valent Canada Inc.	Nipsit Suite Cereals Of Seed Protectant	Suspension	Clothianidin 30.7 g/L; metalaxyl 9.24 g/L; metconazole 4.62 g/L

Appendix II Registered Commercial Class Uses of clothianidin in Canada as of May 2018 that are subject to this Special Review

Use Site Category[1]	Site(s)[2,3]	Pest(s)[3]	Formulation Type	Application Methods and Equipment	Single Application Rate or Rate Range[3]	Maximum Number of Applications per Year[3]	Minimum Interval Between Applications (Days)[3]
10	Canola, rapeseed, Carinata, mustard	Flea beetle	Suspension	Commercial seed treatment facility: seed treatment equipment	150–406 g a.i./100 kg seed (canola 16–32.5 g a.i./ha), (mustard 18.3–45.5 g a.i./ha), (carinata 18–44.7 g a.i./ha)	1	Not applicable
10	Carrot	Carrot rust fly	Wettable powder	Seed not treated in Canada	0.035–0.068 g a.i. /1000 seed (31.5–275.4 g a.i./ha)	1	Not applicable
	Leek, Onion (bulb)	Onion maggot, seedcorn maggot, thrips			0.12 g a.i./1000 seed (leek 46.2–92.4 g a.i./ha), (bulb onion 57.1–117.6 g a.i./ha)		
	Onion (bunching)				0.09 g a.i./1000 seed (176.4 g a.i./ha)		
	Lettuce	Aphids, leafminer			0.6 g a.i./1000 seed (420 g a.i./ha)		
	Broccoli, cabbage	Aphids, flea beetle			0.9 g a.i./1000 seed (75.6–110.3 g a.i./ha)		
	Pepper	Aphids, leafminer, thrips			0.25 g a.i./1000 seed (7.5 g a.i./ha)		
	Tomato	Aphids, leafminer, thrips			0.038 g a.i./1000 seed (0.6 -14.6 g a.i./ha)		

Use Site Category[1]	Site(s)[2,3]	Pest(s)[3]	Formulation Type	Application Methods and Equipment	Single Application Rate or Rate Range[3]	Maximum Number of Applications per Year[3]	Minimum Interval Between Applications (Days)[3]
	Cucumber, melon, squash	Aphids, thrips			0.75 g a.i./1000 seed (cucumber 13.8–150 g a.i./ha), (melon 2.5–4.7 g a.i./ha), (squash 1.7–18.5 g a.i./ha)		
10	Corn (field, sweet, pop)	Corn rootworm	Suspension	Commercial seed treatment facility: seed treatment equipment	1.25 mg a.i./kernel (field 78.8–118.3 g a.i./ha), (sweet 52.5–75.6 g a.i./ha)	1	Not applicable
10	Corn (field, sweet, pop)	Corn flea beetle, black cutworm, seedcorn maggot, wireworm		Commercial seed treatment facility: seed treatment equipment	0.25–0.5 mg a.i./kernel (field 15.8–47.3 g a.i./ha), (sweet 10.5–30.3 g a.i./ha)		
		White grub (larvae of European chafer, May/June beetle, Japanese beetle)			0.25 mg a.i./kernel (field 15.8–23.7 g a.i./ha), (sweet 10.5–15.1 g a.i./ha)		
10	Wheat	Wireworm	Suspension	On farm and/or commercial seed treatment facility: seed treatment equipment	10 g a.i./100 kg seed (6.73–17.5 g a.i./ha)	1	Not applicable
10	Potato	Aphids, Colorado potato beetle, leafhoppers, potato flea beetle	Suspension	Ground application: Seed piece treatment equipment	6.2–12.48 g a.i./100 kg seed (119–190 g a.i./ha)	1	Not applicable

Use Site Category[1]	Site(s)[2,3]	Pest(s)[3]	Formulation Type	Application Methods and Equipment	Single Application Rate or Rate Range[3]	Maximum Number of Applications per Year[3]	Minimum Interval Between Applications (Days)[3]
		Wireworm		Ground application: Seed piece treatment – shielded spray system	12.48 g a.i./100 kg seed (239–381 g a.i./ha)		
13, 14	Potato	Colorado potato beetle, leafhoppers	Suspension	Ground application: In furrow – boom sprayer	1.2–2 g a.i./100 m of row (132.6–223.8 g a.i./h) based upon 90 cm row spacing		
		Colorado potato beetle	Water dispersible granule				
		Aphids, Colorado potato beetle, leafhoppers		Ground application: Foliar spray – boom sprayer Aerial application: Rotary or fixed wing	35–52.5 g a.i./ha	3	7
14	Crop Group 11: Pome fruit	Oriental fruit moth, codling moth, Brown marmorated stink bug		Ground application: Foliar spray – airblast sprayer	105–210 g a.i./ha	2	14
							10
		Aphids, leafhoppers, leafminer			70–105 g a.i./ha		
		Pear psylla			140–210 g a.i./ha		
		Plum curculio			105 g a.i./ha		
14	Grape	Leafhoppers		Ground application: Foliar spray – over the row sprayer (boom), airblast sprayer	50–70 g a.i./ha	1	Not applicable
		Grape phyloxera, meallybug			70–105 g a.i./ha		
		Thrips			70 g a.i./ha		
		Brown marmorated stink bug			105 g a.i./ha		

Use Site Category[1]	Site(s)[2,3]	Pest(s)[3]	Formulation Type	Application Methods and Equipment	Single Application Rate or Rate Range[3]	Maximum Number of Applications per Year[3]	Minimum Interval Between Applications (Days)[3]
14	Strawberry	Lygus bug	Water dispersible granule	Ground application: foliar spray	224 g a.i./ha	1	Not applicable
14	Crop Group 1209: Stone Fruit	Oriental fruit moth	Water dispersible granule	Ground application: Foliar spray – airblast sprayer	105–210 g a.i./ha	2	14
		Brown marmorated stink bug (Suppression)					10
		Plum curculio			105 g a.i./ha		
		Aphids, leafhoppers			70–105 g a.i./ha		
14	Sweet potato	Larvae of: European Chafer, Japanese Beetle, Masked Chafers, Asiatic Garden Beetle, Oriental Beetle	Water dispersible granule	Ground application: soil spray/drench – incorporated	224 g a.i./ha	1	Not applicable
14	Crop Group 9: Cucurbit vegetables	Cucumber beetle, Squash bug, Tarnished plant bug	Water dispersible granule	Ground application: Foliar spray – boom sprayer	70 g a.i./ha	2	7
		Brown marmorated stink bug			105 g a.i./ha		
30	Turf	European Chafer, Japanese Beetle, Masked Chafers, Asiatic Garden Beetle, Oriental Beetle	Water dispersible granule	Ground application: Foliar spray – boom sprayer	1.25–2.5 g a.i./100 m^2 125–250 g a.i./ha	1	Not applicable
		Hairy chinch bug			1.75–2.5 g a.i./100 m^2 175–250 g a.i./ha		
		Annual bluegrass weevil			2.75 –3.5 g a.i./100m^2 275 - 350 g a.i./ha		
		Bluegrass billbug			2.25 g a.i./100 m^2 225 g a.i./ha		

Use Site Category[1]	Site(s)[2,3]	Pest(s)[3]	Formulation Type	Application Methods and Equipment	Single Application Rate or Rate Range[3]	Maximum Number of Applications per Year[3]	Minimum Interval Between Applications (Days)[3]
		European crane fly			2.75 g a.i./100 m^2 275 g a.i./ha		

[1] Use Site Category (USC): 10 – Seed and Plant Propagation Materials Food and Feed, 13 - Terrestrial Feed Crops, 14 - Terrestrial Food Crops, 30 – Turf

[2] Crop groups are identified as listed on the end use product labels and may not be identical to the crop groups listed on the Health Canada Residue Chemistry Crop Groups website: http://hc-sc.gc.ca/cps-spc/pest/part/protect-proteger/food-nourriture/rccg-gcpcr-eng.php

[3] All information is from the registered labels.

Appendix III Fate, Toxicity, and Risks to the Aquatic Invertebrates

Table A.3-1 Identity of active substance clothianidin

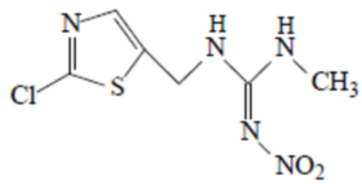
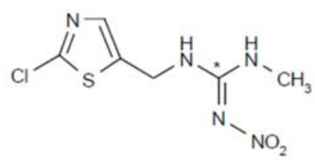
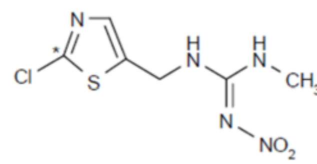
Active Substance	**Clothianidin (Development Code: TI-435)**
Function	Insecticide
Chemical name	Clothianidin
1. International Union of Pure and Applied Chemistry (IUPAC)	(*E*)-1-(2-chloro-1,3-thiazol-5-ylmethyl)-3-methyl-2- nitroguanidine
2. Chemical Abstract Services (CAS)	[*C*(*E*)]-*N*-[(2-chloro-5-thiazolyl)methyl]-*N*'-methyl-*N*''- nitroguanidine
CAS Number	210880-92-5
Molecular Formula	$C_6H_8ClN_5O_2S$
Molecular Weight	249.68 g/mol
Structural Formula	
Position of Radiolabels in EnvironmentalStudies	 [Nitroimino-^{14}C] Clothianidin
	 [Thiazolyl-2-^{14}C] Clothianidin

Table A.3-2 Physical and chemical properties of clothianidin relevant to the environment

Property	Value	Comments[1]
Solubility in water at 20°C	327 mg/L	Very soluble in water.
Vapour pressure	1.3×10^{-10} Pa at 25°C 3.8×10^{-11} Pa at 20°C (extrapolated)	Non-volatile under field conditions.
Henry's law constant	9.8×10^{-16} atm·m^3/mole at 25°C 2.9×10^{-16} atm·m^3/mole at 20°C	Non-volatile from water and moist soil surface.
Ultraviolet (UV) / visible spectrum	Maximum of 265.5 nm in acidic and neutral solution, maximum of 246.0 nm in basic solution	Minimal phototransformation expected in the natural environment.
Octanol/water partition coefficient (K_{ow}) at 25°C	log K_{ow} = 0.7	Low potential for bioaccumulation.
Dissociation constant (pK_a) at 20°C	11.09	Under acidic and neutral conditions, clothianidin will be in the undissociated form.
[1] Source: ERC2011-01 and REG2004-06		

Table A.3-3 Estimated octanol-water partition coefficients for clothianidin transformation products at pH7

Transformation Product	Value	Comments[1]
MNG	log K_{ow} = - 0.8	Low potential for bioaccumulation.
TMG	log K_{ow} = - 1.8	
TZNG	log K_{ow} = 0.9	
TZMU	log K_{ow} = 0.8	

1 Source: Tier III Summaries prepared by the registrant; PMRA #1039673

Table A.3-4 Summary of fate and behaviour of clothianidin in the terrestrial environment

Type of study	Test substance	Value	Comments	Study
Abiotic transformation				
Hydrolysis	Clothianidin	At 25°C: Stable at pH 5 and pH 7. Minimal hydrolysis at pH 9.	No major or minor transformation products identified at pH 5 and pH 7. Minor transformation products identified at pH 9 were CTNU and TZMU.	PMRA #1194690
Long-term hydrolysis	Clothianidin	At 25°C: Negligible hydrolysis at pH 7 up to 180 days.	No major transformation products were formed. Two unidentified minor transformation products were observed.	PMRA #1464605, #1636689
Phototransforma tion on soil	Clothianidin	$t_{½}$ = 8.2 days (continuous irradiation)	No major transformation products were identified. Minor transformation products were MNG, TZNG, TZMU and TZU.	PMRA # 1194678
Phototransforma tion in air	Clothianidin	Not required – clothianidin is not volatile		
Biotransformation[1]				
Biotransformati on in aerobic soil	Clothianidin	DT_{50}: 144–1646 days Representative half-life: 144–16100 days	Moderately persistent to persistent. All values were extrapolated beyond the test duration. Four soils were tested (silt loam, silt, loamy	PMRA #1194671

Type of study	Test substance	Value	Comments	Study
			sand and sandy loam). - Silt loam: MNG was a major transformation product. Minor transformation products were NTG, TZNG and TZMU. - Silt: MNG and TZNG were considered as probable major transformation products (close to 10% of the applied amount and still increasing). Probable minor transformation products were NTG and TZMU. - Sandy loam and loamy sand: No major transformation products were formed other than CO_2 due to slower degradation. Minor transformation products were MNG, NTG, TZNG and TZMU.	
	Clothianidin	DT_{50}: 542–5357 days. Representative half-life: 542–5357 days	Persistent. All values were extrapolated beyond the test duration. Six soils were tested (loam, sand, 2 silt loam soils and 2 loamy sand soils). - No major transformation products were formed in any of the test soils. Minor transformation products were TZNG and TZMU.	PMRA #1194675
	Clothianidin	DT_{50}: 235 days. Representative half-life: 1490 days	Persistent. All values were extrapolated beyond the test duration. Sandy loam soil. - No major transformation products except CO_2 were formed. The only minor transformation product identified was TZNG.	PMRA #2741626
	Clothianidin	DT_{50}: 258 days. Representative half-life: 317 days	Persistent. All values were extrapolated beyond the test duration. Loamy sand soil. - No major transformation products except CO_2 were formed. No minor transformation products were identified.	PMRA# 2741629
	Clothianidin	DT_{50}: 1910 days. Representative half-life: 2.2×10^7 days	Persistent. All values were extrapolated beyond the test duration. Loamy sand soil. - No major transformation products were formed. Minor transformation products included CO_2 and TZNG.	PMRA #2741625
	Clothianidin	DT_{50}: 11–204 days Representative half-life: 139–263 days	Non-persistent to persistent. Study was a combined time-dependent soil adsorption, aerobic soil degradation study conducted for 120 days. Four soils were tested (silt loam, 2 sandy loam soils, clay loam). - Silt loam: TZMU was a major transformation product, plus CO_2. Minor	PMRA #2739670

Type of study	Test substance	Value	Comments	Study
			transformation products were TZNG, MNG, TMG, NTG, and TZFA. - Sandy loam #1 and #2 and clay loam: No major transformation products except CO_2 were formed. Minor transformation products were TZNG, MNG, TZMU, TMG, NTG, and TZFA.	
	MNG	DT_{50}: 71–113 days Representative half-life: 82–220 days	Moderately persistent. Three soils (sandy loam, silt loam, loam).	PMRA #1194679
	TZNG	DT_{50}: 53 - 133 days Representative half-life: 91–355 days	Moderately persistent. Three soils (sandy loam, silt loam, loam).	PMRA #1194681
Biotransformation in anaerobic soil	Clothianidin	See biotransformation in anaerobic water/sediment system.		
Mobility[2]				
Adsorption/desorption in soil	Clothianidin	Adsorption K_d = 0.52–4.14 Adsorption K_{oc} = 84–345	Moderate to high mobility. Five soils. A leaching assessment was previously carried out for clothianidin (ERC2001-01) and included the following information: - GUS[3]of 3.75–6.52 (probable leacher) - Most of the Cohen criteria[4] are met	PMRA #1194682
	Clothianidin	Adsorption K_d = 1.51–15.8 Adsorption K_{oc} = 68–80	High mobility. Three soils, with two replicates each (loam, silt loam and humic soil).	PMRA #2741630
	Clothianidin	Adsorption K_d = 0.87–7.43 Adsorption K_{oc} = 60–293	Moderate to high mobility. Six soils (sandy loam, clay, sand, sandy loam, loam and silt loam).	PMRA #2741627
	Clothianidin	Adsorption K_d = 0.57 Adsorption K_{oc} = 63.5	Highly mobile. One loamy sand soil	PMRA #2757917
	Clothianidin	Time dependant sorption (incubation time up to 99 days): Over the course of the study, the K_{oc} increased by a factor of 2.1–3.5.	Sorption of clothianidin increases with residence time in soil.	PMRA #1194683
		Time dependant sorption (incubation time up to 120 days): Over the course of the study, the K_{oc} increased by a factor of 2.6–3.7.	Sorption of clothianidin increases with residence time in soil. Four soils were tested (silt loam, 2 sandy loam soils, clay loam).	PMRA #2739670
	MNG	Adsorption K_d = 0.02 - 0.31 Adsorption K_{oc} = 5.2 - 28	Very high mobility. Five soils.	PMRA #1194684
	TZNG	Adsorption K_d = 0.5–	Moderate mobility.	PMRA #1194685

Type of study	Test substance	Value	Comments	Study
		4.7 Adsorption K_{oc} = 205–432	Five soils.	
	TZMU	Adsorption K_d = 0.12–1.0 Adsorption K_{oc} = 46–96	High to very high mobility. Five soils.	PMRA #1194686
	TMG	Adsorption K_d = 2.4–39 Adsorption K_{oc} = 525–6159	Low mobility to immobile. Five soils.	PMRA #1194687
Column leaching with treated seed	Clothianidin	Treated corn seed planted in soil column: As radioactivity decreased in the treated seed over the course of the 16-week study period, radioactivity increased in the soil (maximum in soil: 76.2% of the applied after 8 weeks) and in plant material (maximum in roots + plant: 6.58% of the applied after 16 weeks and still increasing). Soil DT_{50} was estimated at 165 days. The highest amount of applied radioactivity observed in the leachate was 0.05%. A cumulative 0.17% of the applied radioactivity was leached. Clothianidin was the primary residue in the leachate, accounting for a maximum of 0.055% of the applied radioactivity. TZMU and an unidentified polar product accounted for 0.014% and 0.016% of the applied radioactivity, respectively.		PMRA #1464604, #1636690
Movement from treated seed	Clothianidin	This study was originally intended to refine the bird and mammal risk assessment, but was thought to provide some information on the fate of clothianidin on treated seeds. Corn seeds were treated at 2.0 mg a.i./seed and were sown according to normal agricultural practices: At the 2–3 leaf stage, 3–45 ppm had moved from the seed to the foliage and 106–630 ppm remained in the seed. In another experiment, it was determined that 5471–6640 ppm of clothianidin is on seeds immediately after treatment when these are treated at 2.0 mg a.i./seed. Considering the difference between the latter concentration and that recovered in seedlings, it can be assumed that a large proportion of the clothianidin moved from the seed to the soil in the first experiment (interpretation is proposed by the reviewer; not verified in study).		PMRA #1194863
Field studies				
Field dissipation in site relevant to Canadian conditions: Ontario	TI-435 FS 600 (595 g a.i./L)	One spray application at 600 g a.i./ha on bare ground, incorporated. Based on residues in the total soil profile: DT_{50} = 351 days DT_{90} = 1166 days Representative half-life: 351 days	Persistent. No major transformation products were observed. Minor transformation products were MNG, TZNG, TZMU and TMG (noted that the latter transformation product was not observed in laboratory studies; this is not discussed in the study report or in the original review). Residues of clothianidin are expected to carry-over to the next growing season, as approximately 80% and 31% of residues remained in the soil after 9 months (no measurements at 4 months, which would be the end of one growing season for crops such as canola and corn) and two years, respectively.	PMRA #1194854

Type of study	Test substance	Value	Comments	Study
			Residues of clothianidin were not detected below a depth of 30 cm. Transformation products were not detected below 15 cm.	
Field dissipation in site relevant to Canadian conditions: Saskatchewan	TI-435 FS 600 (595 g a.i./L)	One spray application at 243 g a.i./ha on bare ground, incorporated. The DT_{50} and DT_{90} could not be calculated due to limited dissipation.	Persistent. No major transformation products were observed. Minor transformation products were MNG, TZNG and TMG (noted that the latter transformation product was not observed in laboratory studies; this is not discussed in the study report or in the original review). Residues of clothianidin are expected to carry-over to the next growing season, as 91% and 80% of clothianidin residues remained in soil after four months and two years, respectively. Residues of clothianidin were not detected below a depth of 45 cm*. Transformation products were not detected below 15 cm. *While info in REG2004-06 states that clothianidin did not leach below 30 cm, study results indicate that clothianidin was found in the 30–45 cm layer at one sampling event, albeit at low concentrations.	PMRA #1194855
Field dissipation in site relevant to Canadian conditions: North Dakota	TI-435 FS 600 (595 g a.i./L)	One spray application at 243 g a.i./ha on bare ground, not incorporated.[6] Based on residues in the total soil profile: DT_{50} = 2033 days DT_{90} = 6754 days Representative half-life: 2033 days	Persistent. No major transformation products were observed. Minor transformation products were MNG, TZNG and TZMU. Residues of clothianidin are expected to carry-over to the next growing season, as >100% and 47% of clothianidin residues remained in soil after our months and two years, respectively. Residues of clothianidin were not detected below a depth of 45 cm. Transformation products were not detected below 15 cm.	PMRA #1194853
Field dissipation in site relevant to Canadian conditions: Washington	TI-435 50 WDG (50% a.i.)	One spray application at 225 g a.i./ha on bare ground, not incorporated: DT_{50} = 379 days (slow half-life from a bisphasic dissipation curve; the first-phase half-life was less than a day) DT_{90} = 824 days Representative half-life: 379 days	Persistent. No major transformation products were observed. TZMU was the only minor transformation product. Residues of clothianidin are expected to carry-over to the next growing season, as approximately 39%* and 10% of clothianidin residues remained in soil at the end of the growing season after four months and two years, respectively. No residues of clothianidin were detected below a depth of 45 cm. TZMU was not detected below 15 cm.	PMRA #1544535
Field dissipation in other sites: Wisconsin	TI-435 FS 600 (595 g a.i./L)	One spray application at 600 g a.i./ha on bare ground, incorporated. Based on residues in the	Persistent. No major transformation products were observed. Minor transformation products were MNG, TZNG and TZMU. Residues of clothianidin are expected to	PMRA #1194898

Type of study	Test substance	Value	Comments	Study
		total soil profile: DT_{50} = 408 days DT_{90} = 1355 days Representative half-life: 408 days	carry-over to the next growing season, as 89% and 13% of clothianidin residues remained in soil at the end of the growing season (four months) and after two years, respectively. Residues of clothianidin were not detected below a depth of 60 cm. Transformation products were not detected below 45 cm (for TZNG) and 15 cm (for MNG and TZMU).	
Field dissipation in other sites: Ohio	TI-435 FS 600 (595 g a.i./L)	One spray application at 600 g a.i./ha on bare ground, not incorporated.[5] Based on residues in the total soil profile: DT_{50} = 447 days (slow half-life from a bisphasic dissipation curve; the first phase half-life was approximately 13 days) DT_{90} = 1209 days Representative half-life: 447 days	Persistent. No major transformation products were observed. Minor transformation products were MNG, TZNG and TZMU. Residues of clothianidin are expected to carry-over to the next growing season, as 52% and 14% of clothianidin residues remained in soil after four months and two years, respectively. Residues of clothianidin were not detected below a depth of 30 cm. Transformation products were not detected below 15 cm.	PMRA #1194899
Multi-year accumulation study: North America	Not applicable (monitoring study)	50 corn fields in the mid-western United States and 27 canola fields in western Canada were sampled (for soil, pollen and nectar); fields had various years of clothianidin use: Maximum clothianidin residues measured in soil replicates from corn and canola fields were 25.5 and 24.1 ng/g (ppb, dry weight), respectively. Maximum clothianidin residues measured in corn and canola pollen replicates were 11.4 and 17.3 ng/g (ppb, wet weight), respectively; canola pollen samples were however deemed of low quality as they contained fragments of flowers. Clothianidin residues measured in canola nectar replicates reached 2.8 ng/g. The TZNG and TZMU transformation products were detected in corn pollen replicates up to concentrations of 1.0 and 1.3 ng/g, respectively. These transformation products were not detected in canola pollen or nectar. In corn, clothianidin initially built up in soil and did not seem to further accumulate after approximately 4–5 years of previous use. Residues were correlated with the number of years of use; this parameter explained up to 25% of the variability of clothianidin residues in soil when all sites were considered in the analysis and up to 40% when only sites with 5 years of use or less were considered. There was a weak but statistically significant correlation of soil residues with the soil organic matter content; this parameter explained about 16% of the variability. There was no correlation with other soil properties. Clothianidin residues in corn pollen did not appear to be related to the number of years of treatment or to soil concentrations. In canola, residues of clothianidin in soil appeared to increase with more years of treatment, although the relationship was not statistically significant. The canola dataset had a limited range of		PMRA #2465502, #2555839

Type of study	Test substance	Value	Comments	Study
		years of clothianidin use, and interpretation was complicated by the various rotations of clothianidin and thiamethoxam treated seeds. There was no correlation with soil properties or other site specific conditions. Also, clothianidin residues in canola nectar showed no correlation with the number of years of treatment or to soil concentrations.		
Multi-year accumulation study: Europe	TI-435 600 FS (600 g a.i./L)	Field trials were conducted in Germany, in France and in Great Britain (sites relevant to Canadian conditions). Wheat seeds coated with clothianidin were sown in the fall of each year for 7 consecutive years and soil residues were measured: Clothianidin residues in the 0–30 cm soil layer initially increased to then appear to reach a plateau concentration after about 4–5 years. Maximum clothianidin residues measured in the spring during the crop's vegetative stage were 30.2 µg/kg (ppb, dry weight; Germany, crop cycle 4), 40.0 µg/kg (France, crop cycle 5) and 35.1 µg/kg (Great Britain, crop cycle 6). While clothianidin dissipated each year, residues were still remaining in the in the 0–30 cm soil layer at the end of each crop cycle and accumulated over time. Maximum residues measured immediately sowing in the fall were 13.0 µg/kg (Germany, before sowing for crop cycle 7), 20.7 µg/kg (France, before sowing for crop cycle 6), 20.0 µg/kg (Great Britain, before sowing for crop cycle 6). Clothianidin leached to deeper soil layers at some sites. The maximum clothianidin concentration measured in the 30–40 cm soil layer was 17.5 µg/kg. While clothianidin was detected at some sites in the 40–50 cm soil layers, levels were not quantifiable (between 2 and 5 µg/kg). Residues of TZNG were generally not detected in the 0–30 cm soil layer and were below the level of detection in all samples taken from deeper soil layers. MNG was below the level of detection in all soil samples.		PMRA #2465501
Field lysimeter	TI-435 200 SC (20% a.i.)	Sprayed on grass from a pome fruit orchard once a year for two years at approx. 160 g a.i./ha; lysimeter placed at depth of 1.3 metres: In the third year of the study, the amount of total radioactive residues in soil and in leachate represented 43–46% and 1.1–1.3% of the applied radioactivity, respectively. Plants were not analyzed. Approximately 55% of the applied radioactivity was attributed to losses due to mineralization. The majority of the total radioactive residues in soil was in the top layers (mainly the 0–10 cm layer); approximately 2% of the applied was found below 30 cm. Residues attributed to clothianidin in the 0–10 cm layer represented 30% of the applied radioactivity and 70% of the radioactivity in soil. MNG and TZNG were the main transformation products found in soil and these were mostly found in the 0–10 cm layer. Clothianidin was not detected in leachate at any of the sampling times. MNG and NTG were detected in the leachate.		PMRA #1194689
	TI-435 70 WS (70% a.i.)	Applied as a seed treatment at a rate of 100 g a.i./ha the first year (winter barley) and 137.5 g a.i./ha the second year (wheat), lysimeter placed at depth of 1.3 metres: In the third year of the study, the amount of total radioactive residues in soil, leachate and crop represented 59.3%, less than 0.3% and 3.2% of the applied radioactivity, respectively. Approximately 37% of the applied radioactivity was attributed to losses due to		PMRA #1194688

Type of study	Test substance	Value	Comments	Study
		mineralization. The majority of the total radioactive residues in soil was in the top layers (mainly in the 0–20 cm layer); less than 2% of the applied was found below 30 cm. Residues attributed to clothianidin in the 0–20 cm layers represented 52% of the applied radioactivity and 87% of the radioactivity in soil. TZNG was the main transformation product found in soil. Clothianidin or TZNG were not detected in leachate over the course of the study.		
Small scale prospective groundwater study (preliminary results)	Arena 50 WDG (50% a.i.)	One broadcast spray application on turf at 450 g a.i./ha (potassium bromide tracer applied at 100 kg/ha), sampled monthly in lysimeters placed at 3, 6, 9 and 12 feet below ground surface and in monitoring wells; to date, sampling was performed up to 15 MMA (months after application): Clothianidin residues in soil-pore water were first observed at 1 MMA (3.21 ppb in a 3-foot lysimeter). Over the course of the 15–month sampling period, clothianidin has been observed sporadically in the 3-, 6-, and 9-foot lysimeters (maximum residue of 7.51 ppb in a 3-foot lysimeter). To date, no quantifiable residues of clothianidin (LOQ of 1.0 ppb) have been observed in the 12-foot lysimeters and no detectable residues have been determined in groundwater. The first widespread appearance (breakthrough) of the bromide ion tracer in the 3-, 6-, 9-, and 12-foot lysimeters was observed at 3 MAA.		PMRA #2617174

1 Classification of the relative persistence of pesticide in soils is based on Goring et al. (1975). The DT_{50} is from the curve that better fits the data; can be from a single first-order exponential function (SFO), double first-order in parallel (DFOP) or indeterminate order rate equation (IORE). The representative half-life is used for modelling and is different from the DT_{50} when the decline is not exponential (i.e. when the decline follows DFOP or IORE), in which case it is a conservative approximation of the first order decline.

2 Classification of soil mobility potential is based on McCall et al. (1981)

3 GUS = Groundwater Ubiquity Score, based on Gustafson (1989)

4 Described in Cohen et al. (1984)

5 Tier II summaries for clothianidin prepared by the registrant state that, at all sites, “the test substance was incorporated to a depth of 5–10 cm to minimize exposure to light, as would be typical for the seed treatment uses” (PMRA #1039671, p. 373). There is however no evidence of incorporation in the study report for the North Dakota and Ohio sites.

Table A.3-5 Summary of fate and behaviour of clothianidin in the aquatic environment

Type of study	Test substance	Value	Comments	Study
Abiotic transformation				
Hydrolysis	Clothianidin	Stable at pH 5 and pH 7. Minimal hydrolysis at pH 9.	No major or minor transformation products identified at pH 5 and pH 7. Minor transformation products identified at pH 9 were CTNU and TZMU.	PMRA #1194690
Phototransformation in water (sterile buffer)	Clothianidin	$t_{½}$ = 3.1–3.4 hours (sterile buffer, continuous irradiation)	Nitroimino radiolabel: Major transformation products were HMIO, MG, MU and TZMU. Minor transformation products were MAI, MIO, MIT, TMG and other unidentified minor products. Thiazolyl radiolabel: Major transformation products were FA, MIT, TZMU and CO_2. Minor transformation products were MAI, TMG and other unidentified minor products.	PMRA #1194126, #1194152, #1194206
	TZMU	$t_{½}$ = 24–27 days (continuous irradiation)	Calculated based on results from definitive study with clothianidin. No half-life calculations were carried out for MG and MU, as these are expected to be photostable based on the UV absorption spectra and also because that no decline of these compounds was observed in irradiated samples.	PMRA #1194126, #1194152
	HMIO	$t_{½}$ = 9.5 days (continuous irradiation)		
	MIT	$t_{½}$ = 6 days (continuous irradiation)		
	FA	$t_{½}$ = 10 days (continuous irradiation)		
Phototransformation in water (natural water)	Clothianidin	$t_{½}$ = 25–28 hours (natural sunlight cycle of 9h light:15h dark)	Was considered to provide supplemental information (not a typical data requirement). Minimal transformation in the dark controls suggests that phototransformation is the predominant route of transformation in non-sterile water. Nitroimino radiolabel: Major transformation products were HMIO, MG and MU. Minor transformation products were MAI, MIO, MIT, TMG, TZMU, CO_2 and other unidentified minor products. Thiazolyl radiolabel: Major transformation products were FA, CTCA, MAI, TMG, urea and CO_2. Minor transformation products were MIT, TZMU and other unidentified minor products. Most transformation products were declining at study termination. MG however continued to increase and other products such as	PMRA #1194139, #1194195

Type of study	Test substance	Value	Comments	Study
			MU and TZMU did not show a clear decrease by the end of the study.	
Biotransformation[1]				
Biotransformation in aerobic water	Clothianidin	Pond water, no sediment: DT_{50} > 181 days, extrapolated to 2085 days	Persistent. More than 85% of the parent was remaining at the end of the study. No major transformation products were observed. One unidentified minor transformation product was observed.	PMRA #1194208
Biotransformation in aerobic water-sediment system	Clothianidin	Pond water-loam sediment system: DT_{50} = 21–42 days (water), 486 day (sediment), 61–230 days (whole system) Representative half-life: 158 days (water) and 97 days (whole system)	Moderately persistent to persistent in the whole system. TMG was the only major transformation product; found almost entirely in the sediment. TZMU was the only minor transformation product. Whole system half-lives were extrapolated beyond the duration of the study; 60–72% of the parent was remaining at the end of the study (120 days).	PMRA #2491176
	Clothianidin	Pond water-loam sediment system: DT_{50} = 9 days (water), 36 days (sediment), 25 days (whole system) Representative half-life: 25 days (water) and 57 days (whole system) Lake water-sandy loam sediment system: DT_{50} = 19 days (water), 98 days (sediment), 52 days (whole system) Representative half-life: 56 days (water) and 131 days (whole system)	Slightly to moderately persistent in the whole system. TMG was the only major transformation product; found in sediment.	PMRA #1194209
	Clothianidin	River water- coarse textured sediment system: DT_{50} = 23.1 days (water), 59.6 days (sediment), 45.2 days (whole system) Representative half-life: 34.4 days (water), 79.7 days	Slightly persistent in the whole system. TMG was the only major transformation product; found in sediment.	PMRA #2744380

Type of study	Test substance	Value	Comments	Study
		(sediment) and 45.2 days (whole system) Pond water- fine textured sediment system: DT_{50} = 10.9 days (water), 18.5 days (sediment), 25.1 days (whole system) Representative half-life: 16.5 days (water), 18.5 days (sediment) and 25.1 days (whole system)		
Biotransformation in anaerobic water-sediment system	Clothianidin	Pond water-silt loam sediment system under nitrogen: DT_{50} = 5.0 days (water), 25 days (sediment), 19 days (whole system) Representative half-life: 10 days (water) and 19 days (whole system)	Slightly persistent in the whole system. No major transformation products were observed.	PMRA #1194210
Field studies				
Outdoor freshwater mesocosm study	TI-435 50 WG (49.3% a.i.)	Only the fate component of the study was reviewed at this time. Artificial ponds with 3500–4200 litres of water (1.1 m depth) and a 10 cm layer of natural silt loam/loam sediment were sprayed once at 0.10, 0.32, 1.0, 3.2, and 10 µg a.i./L (nominal; note that the highest test rate would be equivalent to an EEC in 80 cm of water from a direct spray at approximately 80 g a.i./ha, which is much lower than the seasonal rates for clothianidin and also lower than most single application rates): The concentration in the pond water continuously decreased in all test ponds. DT_{50} = 8.9–24 days (average of 16.4 days). DT_{90} = 70–98 days. At the highest test level, concentrations in the sediment increased until day 28–42 and then decreased. DT_{50} = 46 days. DT_{90} = 153 days. Dissipation rates could not be determined at other test levels. At the highest test level, the whole system DT_{50} = 54 days. DT_{90} = 179 days.		PMRA #1636641

[1] Classification of the relative persistence of pesticides in water is based on McEwen and Stephenson, 1979. The DT_{50} is from the curve that better fits the data; can be from a single first-order exponential function (SFO), double first-order in parallel (DFOP) or indeterminate order rate equation (IORE). The representative half-life is used for modelling and is different from the DT_{50} when the decline is not exponential (i.e. when the decline follows DFOP or IORE), in which case it is a conservative approximation of the first order decline.

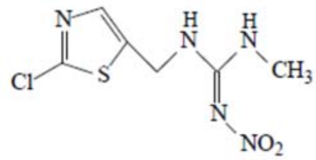
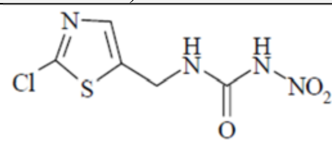
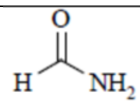
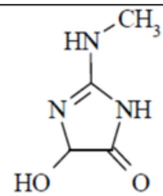
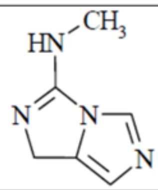
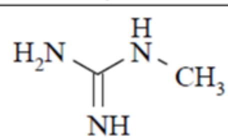
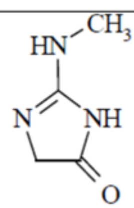
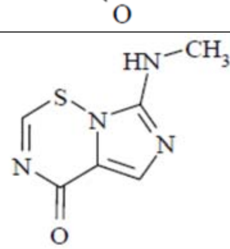
Table A.3-6 Information on the fate of clothianidin from the scientific literature

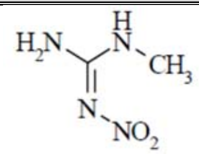
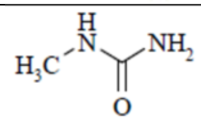
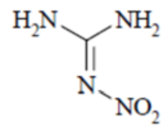
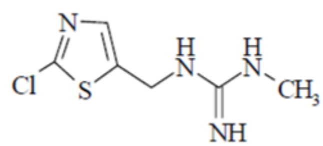
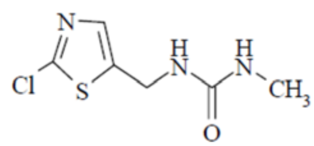
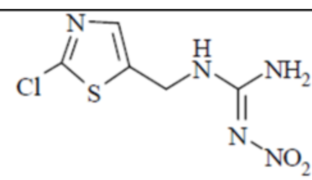
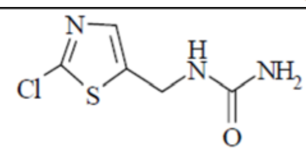
Type of information	Value	Comments	Reference
Physical and chemical properties			
Water solubility	340 mg/L	Original source: pesticide properties database (http://sitem.herts.ac.uk/aeru/ppdb/en/index.htm)	As cited in Bonmatin et al. (2014) (PMRA #2545407)
Log K_{oc}	0.905		
pK_a	11.1		
Abiotic transformation			
Aqueous photolysis	DT_{50} = 0.1 days to stable	Original source: pesticide properties database (http://sitem.herts.ac.uk/aeru/ppdb/en/index.htm) for the 0.1 day value. Stable is reportedly from a USEPA report (2010): Environmental fate and ecological risk assessment for the registration of clothianidin for use as a seed treatment on mustard seed (oilseed and condiment) and cotton. The current reviewer believes that the 'stable' statement in Bonmatin et al. is a misinterpretation of the information provided in the USEPA report. In its report, the USEPA indicates that the aqueous photolysis half-life was < 1 day in lab studies, but also states that the very slow rate of dissipation that was observed in field studies suggests that photolysis probably is not significant under most actual-use conditions. It is possible that the latter lead Bonmatin et al. to believe that clothianidin in aqueous systems was stable to photolysis.	As cited in Bonmatin et al. (2014) (PMRA #2545407)
	Stable	Original source: Peña et al. 2011. Persistence of two neonicotinoid insecticides in wastewater, and in aqueous solutions of surfactants and dissolved organic matter. Chemosphere, 84(4), 464-470 [picked up by our literature search] A cursory examination of the above article indicated that clothianidin was in fact not tested in this study (only thiacloprid and thiamethoxam).	
Biotransformation			
Biotransformation in aerobic soil	DT_{50} = 148–7000 days	Original source: 2010 USEPA review for Prosper T400 and Poncho/Votivo [believed to be document EPA-HQ-OPP-2011-0865-0010]. Cited values are drawn from studies that were also reviewed by the PMRA (PMRA# 1194671 and 1194675). The USEPA has reported a range of 148–1115 days for these studies; the 7000 day value reported by Bonmatin et al. was rounded from 6931 days (Fugay soil series; this result is typically not included by the USEPA since too little degradation occurred to accurately calculate a half-life). For the current re-evaluation, PMRA has recalculated DT_{50} values based on updated methodology and has obtained a range of 144–5357 days. Bonmatin also cites Goulson 2013 [An overview of the environmental risks posed by neonicotinoid insecticides. J Appl Ecol 50(4):977-987] as a source of half-life information. Values in Goulson are drawn from a variety of sources, including the above USEPA report. For clothianidin, a range of 148 - 6931 days is reported.	As cited in Bonmatin et al. (2014) (PMRA #2545407)

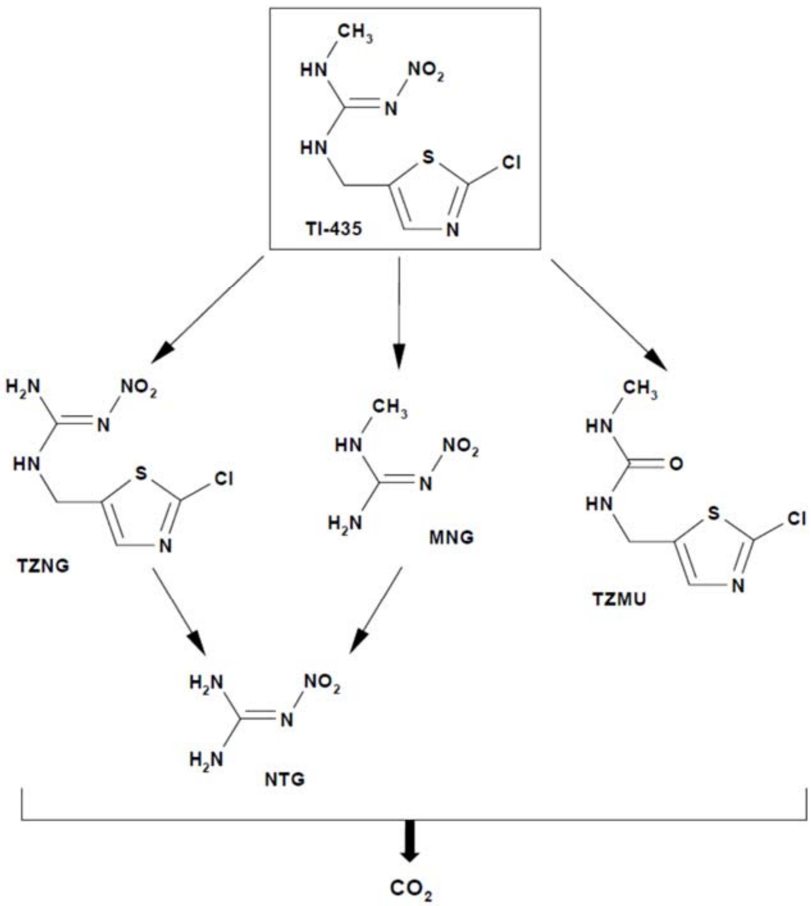
Type of information	Value	Comments	Reference
Biotransformation in water-sediment	DT_{50} = 56.4 days	Original source: pesticide properties database (http://sitem.herts.ac.uk/aeru/ppdb/en/index.htm)	As cited in Bonmatin et al. (2014) (PMRA #2545407)
Mobility			
Groundwater ubiquity score	4.91	Original source: pesticide properties database (http://sitem.herts.ac.uk/aeru/ppdb/en/index.htm)	As cited in Bonmatin et al. (2014) (PMRA #2545407)
Field studies			
Multi-year study: Illinois	Corn seeds treated with clothianidin at 0.25 or 0.50 mg a.i./seed were planted every other year over the course of three growing seasons (corn-soybean-corn rotation, various tillage practices): During the first corn-soybean rotation (first two years of the study), soil concentrations (top 2 cm) reached a maximum of approximately 3 ng/g (ppb, dry weight; value approximated from a graph) about two months after sowing to then decline to approximately 2 ppb, which is similar to background levels measured prior to study initiation (clothianidin was likely applied to the field previously; use history was not known). The author calculated a DT_{50} of 164 days and a DT_{90} of 543 days using data from high treatment rate. At the low treatment rate, concentrations were lower and fairly constant, which resulted in a DT_{50} of 955 days and a DT_{90} of 3174 days. Note that rates were not recalculated by evaluator. After the second corn planting (third and last year of the study), soil concentrations reached a maximum of 6.4 ppb in early fall and 5 ppb by the end of the study in late fall. Residues in the last year were on average 2x higher than in previous years. The dissipation was much slower than in the first two years of the study; rate calculations were not possible. Surface runoff was collected three to four times each year and within 24 hours after a rain event. Maximum concentrations of approximately 400 ng/L (low rate; value approximated from a graph) and 850 ng/L (high rate) were observed shortly after planting in the third year of the study. Maximum concentrations in water from lysimeters installed at a depth of 1 metre were approximately 100 ng/L (low rate; value approximated from a graph) and 203 ng/L (high rate) and were observed in the third year of the study. At a depth of approximately 2 metres, concentrations in water were lower (maximum of approximately 60 ng/L; value approximated from a graph). Concentrations in the high and low treatments were similar. Tillage practice had little or no effect on clothianidin concentrations. Test sites were in Macon County Illinois (Ecoregion 8.2 or 8.3, Central and Southeastern USA planes). Even though these ecoregions are not relevant to Canada, it is noted that fields were frozen and snow covered during the winter months. The study also includes a bioassay component which was not reviewed at this time.		De Perre et al. 2015 (PMRA #2712666)
Multi-year study: Illinois	Corn seeds treated with clothianidin at 0.25 mg a.i./seed were planted for three consecutive years in the same field in Central Illinois using a continuous corn, no-till agricultural system. Sampled soil (top 3 cm), runoff water and sediment (collected after rainfall events using overland samplers), soil pore water (lysimeter, 1 m depth), and groundwater (4 m deep wells, purged prior to sampling): In soil, the mean soil concentration (calculated using data for all three years) was 24 ng a.i./L at corn		Whiting et al. 2014 (PMRA #2722304)

Type of information	Value	Comments	Reference
	emergence, 11 ng a.i./L during the corn vegetative stage, 9 ng/L at tassel development/first reproductive stages and 8 ng a.i./L at the end of the growing season. The author calculated a DT50 of 20–28 days in soil (not recalculated by evaluator). However, clothianidin did not dissipate completely, as residual concentrations were found in soil before the start of each growing season. In runoff water, clothianidin mean concentrations were 232 ng a.i./ha at corn emergence, 164 ng a.i./L during the corn vegetative stage, 143 ng/L at tassel development/first reproductive stages and 87 ng/L at the end of the growing season. In runoff sediment, clothianidin mean concentrations were 9 ng a.i./ha at corn emergence, 22 ng a.i./L during the corn vegetative stage, 3 ng/L at tassel development/first reproductive stages and 4 ng/L at the end of the growing season. In soil pore water, clothianidin mean concentrations were 200 ng a.i./ha at corn emergence, 217 ng a.i./L during the corn vegetative stage, 166 ng/L at tassel development / first reproductive stages and 182 ng/L at the end of the growing season.. In groundwater, clothianidin mean concentrations were 49 ng a.i./ha at corn emergence, 67 ng a.i./L during the corn vegetative stage, 60 ng/L at tassel development/first reproductive stages and 67 ng/L at the end of the growing season.		

Table A.3-7 Transformation products of clothianidin observed in environmental fate studies

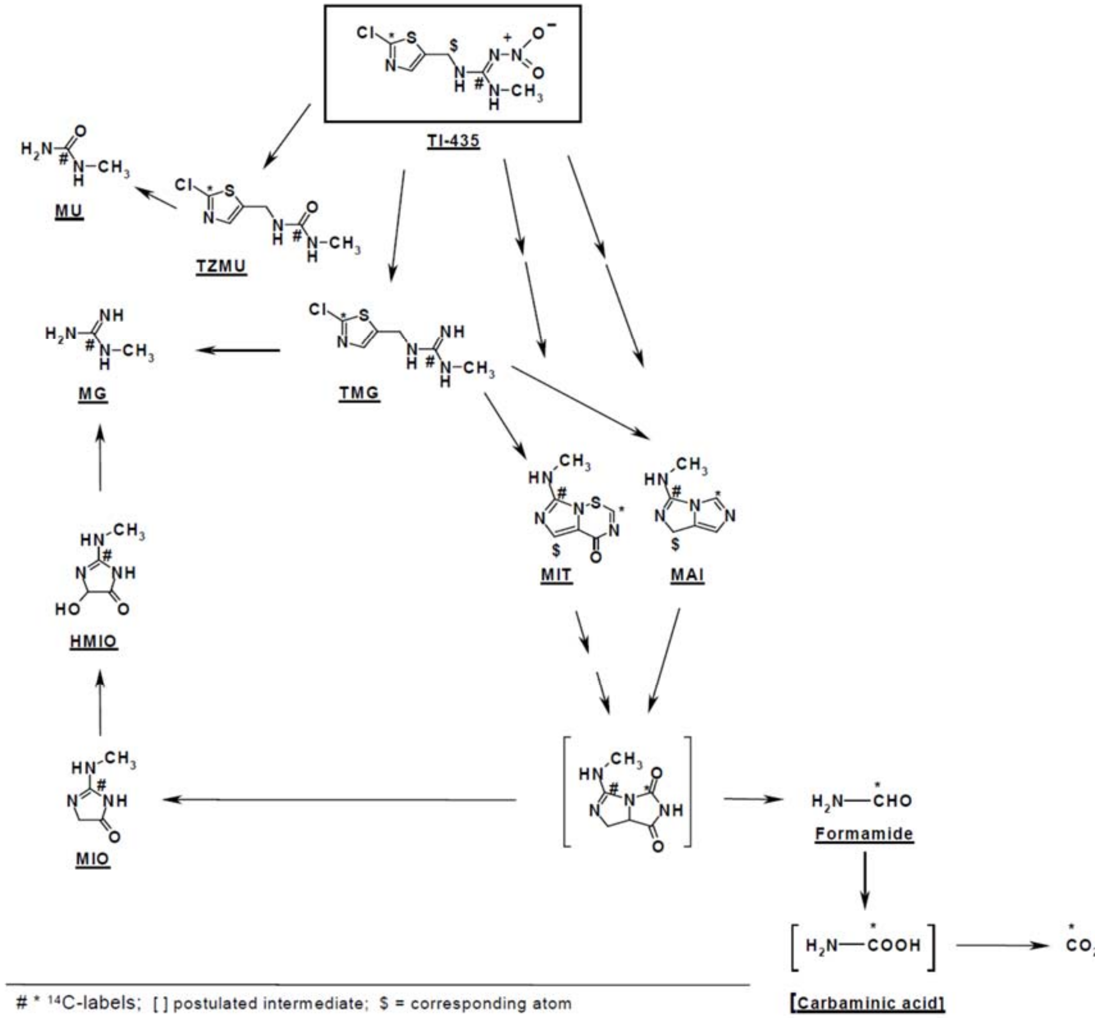
Name	Structure	Matrix: Process (details)
Parent molecule:		
Clothianidin		NA
Transformation products (in alphabetical order):		
CTNU (*N*-(2- Chlorothiazol-5-ylmethyl)-*N'*-nitrourea)		Soil/Water: Hydrolysis (minor at pH 9) Plant: NA
FA (Formamide)		Soil: NA Water: Phototransformation in buffer (major, thiazolyl label) Plant: NA
HMIO (4-Hydroxy-2-methylamino-2-imidazolin-5-one)		Soil: NA Water: Phototransformation (major, nitroimino radiolabel) Plant: NA
MAI (3-Methylamino-1*H*imidazo[1,5-*c*]imidazole)		Soil: NA Water: Phototransformation (minor, nitroimino and thiazolyl radiolabels) Plant: NA
MG (Methylguanidine)		Soil: NA Water: Phototransformation (major, nitroimino radiolabel) Plant: Metabolism (major)
MIO (2-Methylamino-2-imidazolin-5-one)		Soil: NA Water: Phototransformation (minor, nitroimino label) Plant: NA
MIT (7-Methylamino-4*H*-imidazo[5,1-*b*][1,2,5]thiadiazin-4-one)		Soil: NA Water: Phototransformation (major, thiazolyl radiolabel; minor, nitroimino radiolabel) Plant: NA

Name	Structure	Matrix: Process (details)
MNG (*N*-Methyl-*N'*-nitroguanidine)		Soil: Phototransformation (minor) Aerobic (minor, probable major) Field (minor) Water: NA Plant: Metabolism (major)
MU (Methylurea)		Soil: NA Water: Phototransformation (major, nitroimino radiolabel) Plant: NA
NTG (Nitroguanidine)		Soil: Aerobic (minor) Water: NA Plant: Metabolism (minor)
TMG (*N*-(2-chlorothiazol-5-ylmethyl)-*N'*-methylguanidine)		Soil: Field (minor) Water: Phototransformation (minor, nitroimino and thiazolyl radiolabels) Aerobic water/sediment (major, in sediment) Plant: Metabolism (major)
TZMU (*N*-(2-Chlorothiazol-5-ylmethyl)-*N'*-methylurea)		Soil/Water: Hydrolysis (minor at pH 9) Soil: Phototransformation (minor) Aerobic (minor) Field (minor) Water: Phototransformation (major, nitroimino and thiazolyl radiolabels) Aerobic water/sediment (minor) Plant: Metabolism (major)
TZNG (*N*-(2-Chlorothiazol-5-ylmethyl)-*N'*-nitroguanidine)		Soil: Phototransformation (minor) Aerobic (minor, probable major) Field (minor) Water: NA Plant: Metabolism (minor)
TZU (2-Chlorothiazol-5-ylmethylurea)		Soil: Phototransformation (minor) Water: NA Plant: Metabolism (minor)



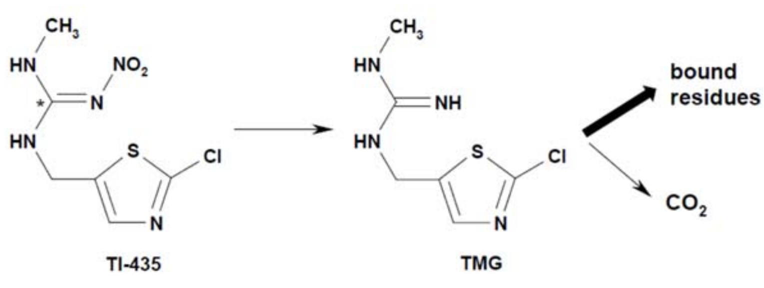
Source: Tier III Summaries prepared by the registrant (PMRA #1039673)

Figure A.3-1 Proposed transformation pathway for clothianidin in aerobic soil



Source: Tier III Summaries prepared by the registrant (PMRA #1039673)

Figure A.3-2 Proposed phototransformation pathway of clothianidin in sterile buffer



Source: Tier III Summaries prepared by the registrant (PMRA #1039673)

Figure A.3-3 Proposed transformation pathway of clothianidin in aerobic water/sediment

Table A.3-8 Effects of clothianidin and formulated products containing clothianidin alone on aquatic invertebrates

Organism	Exposure	Test Substance	Endpoint value (µg a.i./L)	Degree of toxicity	Data used in SSDs	Comments	Reference PMRA # (Publication)
Acute							
Freshwater invertebrates							
Crustaceans - Cladocera							
Daphnia magna	Acute 48-h	Clothianidin (97.6% purity)	48-h EC_{50} > 119 000 (0% mortality/ immobilization)	Practically non-toxic	No[1]		1194141
	Acute 48-h	Clothianidin (purity not reported)	48-h EC_{50} = 109 523	Practically non-toxic	Yes		2538669 (Morrissey et al. 2015)
	Acute 48-h	Clothianidin (96% purity)	48-h EC_{50} = 25 100 (17 000–37 100) (mortality/ immobilization)	Slightly toxic	Yes		2713565
	Acute 48-h	Clothianidin (99.9% purity)	48-h EC_{50} > 500 (0% mortality/ immobilization)	Not toxic up to highest concentration tested.	No[1]		2712666 (de Perre et al. 2015)
	Acute 48-h	Clothianidin (99.8% purity)	48-h EC_{50} > 100 000 (0% mortality/ immobilization)	Practically non-toxic	No[1]		2712674
	Acute 48-h	Clothianidin (Dantotsu Flowable; 20% v/v)	48-h EC_{50} = 67 564 (48 762–98 441) (mortality/ immobilization)	Slightly toxic	Yes		2712667 (Hayasaka et al. 2013)
	Acute 48-h	Clothianidin (FS 600 G; 47.0% purity)	48-h EC_{50} = 91 650 (64 860–129 720) (mortality/ immobilization)	Slightly toxic	Yes		2713529
	Acute 48-h	Clothianidin (600 g/L)	48-h EC_{50} = 2140 (912–5040)	Moderately toxic	Yes		2712665 (Li et al. 2013)

Organism	Exposure	Test Substance	Endpoint value (µg a.i./L)	Degree of toxicity	Data used in SSDs	Comments	Reference PMRA # (Publication)
			(mortality/ immobilization)				
	Acute 48-h	Clothianidin (50 WDG G; 50.3% purity)	48-h EC_{50} = 14 100 (14 000–15 000) (mortality/ immobilization)	Slightly toxic	Yes		2713564
Daphnia pulex	Acute 48-h	Clothianidin (Dantotsu Flowable; 20% v/v)	48-h EC_{50} = 31 448 (20 881–46 463) (mortality/ immobilization)	Slightly toxic	Yes		2712667 (Hayasaka et al. 2013)
Daphnia similis	Acute 48-h	Clothianidin (Poncho SC; guarantee not reported)	48-h EC_{50} = 1740 (1310–2320) (mortality/ immobilization)	Moderately toxic	Yes		2713531
Ceriodaphnia dubia	Acute 48-h	Clothianidin (Dantotsu Flowable; 20% v/v)	48-h EC_{50} = 1691 (1077–19 844) (mortality/ immobilization)	Moderately toxic	Yes		2712667 (Hayasaka et al. 2013)
	Acute 48-h	Clothianidin (≥ 98.6% purity)	48-h LC_{50} > 100 000 (0% mortality)	Practically non-toxic	No[1]	EC_{50} Not available (immobilization not recorded)	2842540 (Raby et al. 2018)
Ceriodaphnia reticulata	Acute 48-h	Clothianidin (Dantotsu Flowable; 20% v/v)	48-h EC_{50} = 29 474 (21 076–49 968) (mortality/ immobilization)	Slightly toxic	Yes		2712667 (Hayasaka et al. 2013)
Moina macrocopa	Acute 48-h	Clothianidin (Dantotsu Flowable; 20% v/v)	48-h EC_{50} = 61 106 (42 582–106 290) (mortality/ immobilization)	Slightly toxic	Yes		2712667 (Hayasaka et al. 2013)
Crustaceans – Amphipoda							
Hyalella azteca	Acute 96-h	Clothianidin (99.9% purity)	96-h EC_{50} = 6.67 (3.88–8.97) (mobility:	Very highly toxic	Yes		2712666 (de Perre et al. 2015)

Organism	Exposure	Test Substance	Endpoint value (µg a.i./L)	Degree of toxicity	Data used in SSDs	Comments	Reference PMRA # (Publication)
			difficulty of swimming, lack of or erratic movements)				
			96-h LC_{50} = 12.5 (9.01–15.8)	Very highly toxic	No[2]		
	Acute 96-h	Clothianidin (analytical grade; purity not reported)	96-h LC_{50} = 9.68 (7.64–11.8)	Very highly toxic	Yes		2712690 (Whiting and Lydy 2015)
	Sub-chronic 7-d	Clothianidin (≥ 95% purity)	7-d LC_{50} = 1.65 (1.55–1.75)	Very highly toxic	Yes		2753706 (ECCC 2017)
	Acute 96-h	Clothianidin (≥ 98.6% purity)	96-h EC_{50} = 4.8 (4.1–5.6) (immobilization)	Very highly toxic	Yes		2842540 (Raby et al. 2018)
			96-h LC_{50} = 5.2 (4.4–5.9)	Very highly toxic	No[2]		
Crustaceans –Isopoda							
Asellus aquaticus	Acute 48-h	Clothianidin (99% purity)	48-h EC_{50} = 67 (43–105) (mortality/ immobilization)	Very highly toxic	Yes		2712685
Caecidotea sp.	Acute 96-h	Clothianidin (≥ 98.6% purity)	96-h EC_{50} = 537.2 (248.0–826.3) (immobilization)	Highly toxic	Yes		2842540 (Raby et al. 2018)
			96-h LC_{50} = 16 085.8 (2636.6 – 29 534.9)	Slightly toxic	No[2]		
Crustaceans –Decopoda							
Procambarus clarkii	Acute 96-h	Clothianidin (99% purity)	96-h EC_{50} = 59 (6–137) (mortality/ immobilization)	Very highly toxic	Yes	Reported LC_{50} includes mortality + immobilization (can therefore be considered as EC_{50}).	2712686 (Barbee and Stout 2009)
	Acute 96-h	Clothianidin (97.7% purity)	96-h EC_{50} = 599 (339–1048) (mortality and	Highly toxic	Yes		2713537

Organism	Exposure	Test Substance	Endpoint value (µg a.i./L)	Degree of toxicity	Data used in SSDs	Comments	Reference PMRA # (Publication)
			immobilization, including slow movement, difficulty walking, lying on bottom, and lack of reaction upon gentle prodding)				
Orconectes propinquus	Acute 48-h	Clothianidin (Arena; 0.25% purity)	48-h LC_{50} = 805 (509 –1462)	Highly toxic	Yes		2832753 (Miles et al. 2017)
Molluscs							
Lampsilis fasciola	Acute 48-h	Clothianidin (≥ 95% purity)	48-h LC_{50} > 478 (5.6% mortality)	Not toxic up to highest concentration tested.	Yes[3]		2712688 (Prosser et al. 2016)
Planorbella pilsbryi	Sub-chronic 7-d	Clothianidin (≥ 95% purity)	7-d LC_{50} = 4000 (247–552)	Moderately toxic	Yes	7-d LC_{10} = 431 (179 - 682)	2712688 (Prosser et al. 2016)
Insects – Diptera							
Chironomus riparius	Acute 48-h	Clothianidin (97.6% purity)	48-h EC_{50} = 21 (mortality/ immobilization)	Very highly toxic	Yes		1194168
	Acute 48-h	Clothianidin (99% purity)	48-h EC_{50} = 14 (4–29) (mortality/ immobilization)	Very highly toxic	Yes		2712685
	Acute 48-h	Clothianidin (purity not reported)	48-h EC_{50} = 29	Very highly toxic	Yes		EC 2005
	Acute 48-h	Clothianidin (FS 600 G)	48-h EC_{50} = 26.7 (17.1–41.8) (immobilization)	Very highly toxic	Yes		2713530
Chironomus dilutus	Acute 96-h	Clothianidin (99.9% purity)	96-h EC_{50} = 1.85 (1.49–2.29) (immobilization)	Very highly toxic	Yes	Effects on mobility included difficulty of swimming, lack of or erratic movements.	2712666 (de Perre et al. 2015)
			96-h LC_{50} = 2.32 (1.97–2.75)	Very highly toxic	No[2]		

Organism	Exposure	Test Substance	Endpoint value (µg a.i./L)	Degree of toxicity	Data used in SSDs	Comments	Reference PMRA # (Publication)
	Acute 96-h	Clothianidin (≥ 98.6% purity)	96-h EC_{50} = 3.4 (2.7–5.5) (immobilization)	Very highly toxic	Yes		2842540 (Raby et al. 2018)
			96-h LC_{50} = 11.6 (6.5–16.8)	Very highly toxic	No[2]		
	Acute 96-h	Clothianidin (99.6% purity)	96-h LC_{50} = 5.93 (5.29–6.63)	Very highly toxic	Yes		2818524 (Maloney et al. 2017)
Chrionomus tepperi	Acute 24-h	Clothianidin (TI 435, 200 g a.i./L SC)	24-h LC_{50} = 5.19 (3.95–6.83)	Very highly toxic	No	Qualitative endpoint. Cannot be used quantitatively in a risk assessment.	2712705 (Stevens et al. 2005)
Aedes aegypti	Acute 72-h	Clothianidin (98% purity)	72-h LC_{50} = 98 (28–114)	Very highly toxic	No	Qualitative endpoint. Cannot be used quantitatively in a risk assessment.	2841145 (Ahmed and Matsumura 2012)
Insects – Trichoptera							
Cheumatopsyche brevilineata	Acute 48-h	Clothianidin (≥ 98.0% purity)	48-h EC_{50} = 4.44 (4.07–4.87) (mortality/ immobilization)	Very highly toxic	Yes		2722291 (Yokoyama et al. 2009)
Cheumatopsyche sp.	Acute 96-h	Clothianidin (≥ 98.6% purity)	96-h LC_{50} = 1281.0 (423.1–2138.8)	Moderately toxic	No[2]		2842540 (Raby et al. 2018)
			96-h EC_{50} < 108.8 (100% immobilization + mortality at 108.8 µg a.i./L)	Very highly toxic	No [1]		
Insects - Ephemeroptera							
Cloeon dipterum	Acute 48-h	Clothianidin (99% purity)	48-h EC_{50} = 12 (8–16) (mortality/ immobilization)	Very highly toxic	Yes		2712685
Cloeon sp.	Acute 96-h	Clothianidin (≥ 98.6% purity)	96-h LC_{50} = 3932.0 (1044.9–6833.5)	Moderately toxic	No[2]		2842540 (Raby et al. 2018)
			96-h EC_{50} < 16.4 (100%	Very highly toxic	No[1]		

Organism	Exposure	Test Substance	Endpoint value (µg a.i./L)	Degree of toxicity	Data used in SSDs	Comments	Reference PMRA # (Publication)
			immobilization + mortality at 16.4 µg a.i./L)				
Ephemerella sp.	Acute 96-h	Clothianidin (≥ 98.6% purity)	96-h EC_{50} = 18.5 (13.3–25.7) (immobilization)	Very highly toxic	Yes		2842540 (Raby et al. 2018)
			96-h LC_{50} = 586.9 (415.0–830.0)	Highly toxic	No[2]		
Hexagenia sp.	Acute 96-h	Clothianidin (≥ 95% purity)	96-h EC_{50} = 24 (13–46) (behaviour: number of surviving animals after 96 h found inside artificial burrows)	Very highly toxic	Yes		2861091 (Bartlett et al. 2018)
			96-h LC_{50} = 2000 (150–26 000)	Moderately toxic	No[2]		
	Acute 96-h	Clothianidin (≥ 98.6% purity)	96-h EC_{50} = 5.5 (3.9–7.0) (immobilization)	Very highly toxic	Yes		2842540 (Raby et al. 2018)
			96-h LC_{50} > 17 400	Slightly toxic	No[2]		
Isonychia bicolor	Acute 96-h	Clothianidin (≥ 98.6% purity)	96-h LC_{50} > 1740	Moderately toxic	No[1]		2842540 (Raby et al. 2018)
			96-h EC_{50} < 108.8 (100% immobilization + mortality at 108.8 µg a.i./L)	Very highly toxic	Yes[3]		
McCaffertium sp.	Acute 96-h	Clothianidin (≥ 98.6% purity)	96-h LC_{50} = 1328.3 (653.9–2002.7)	Moderately toxic	No[2]		2842540 (Raby et al. 2018)
			96-h EC_{50} < 108.8 (100% immobilization + mortality at 108.8	Very highly toxic	Yes[3]		

Organism	Exposure	Test Substance	Endpoint value (µg a.i./L)	Degree of toxicity	Data used in SSDs	Comments	Reference PMRA # (Publication)
			µg a.i./L)				
Neocloeon triangulifer	Acute 96-h	Clothianidin (≥ 98.6% purity)	96-h EC_{50} / LC_{50} = 3.5 (2.5–5.0) (mortality/ immobilization)	Very highly toxic	Yes		2842540 (Raby et al. 2018)
Insects – Odonata							
Coenagrion sp.	Acute 96-h	Clothianidin (≥ 98.6% purity)	96-h LC_{50} = 14 556.3 (7632.8–21 479.9)	Slightly toxic	No[2]		2842540 (Raby et al. 2018)
			96-h EC_{50} < 5918.8 (100% immobilization + mortality at 5918.8 µg a.i./L)	Moderately toxic	Yes[3]		
Lestes unguiculatus	Acute 48-h	Clothianidin (Arena; 0.25% purity)	48-h LC_{50} = 1245 (572 – 2110)	Moderately toxic	Yes		2832753 (Miles et al. 2017)
Anax junius	Acute 48-h	Clothianidin (Arena; 0.25% purity)	48-h LC_{50} = 1000 (NA)	Highly toxic	Yes		2832753 (Miles et al. 2017)
Plathemis lydia	Acute 48-h	Clothianidin (Arena; 0.25% purity)	48-h LC_{50} = 865 (306–2133)	Highly toxic	Yes		2832753 (Miles et al. 2017)
Insects – Plecoptera							
Agnetina, Paragnetina sp.	Acute 96-h	Clothianidin (≥ 98.6% purity)	96-h LC_{50} = 1714.8 (1105.3–2324.2)	Moderately toxic	No[2]		2842540 (Raby et al. 2018)
			96-h EC_{50} < 300.5 (100% immobilization + mortality at 300.5 µg a.i./L)	Highly toxic	Yes[3]		
Insects – Hemiptera							
Trichocorixa sp.	Acute 48-h	Clothianidin (≥ 98.6% purity)	48-h EC_{50} = 21.3 (11.7–30.9) (immobilization)	Very highly toxic	Yes		2842540 (Raby et al. 2018)

Organism	Exposure	Test Substance	Endpoint value (µg a.i./L)	Degree of toxicity	Data used in SSDs	Comments	Reference PMRA # (Publication)
			48-h LC_{50} = 34.8 (17.1–52.5)	Very highly toxic	No[2]		
Belostoma flumineum	Acute 48-h	Clothianidin (Arena; 0.25% purity)	48-h LC_{50} = 79 (52–107)	Very highly toxic	Yes		2832753 (Miles et al. 2017)
Notonecta undulata	Acute 48-h	Clothianidin (Arena; 0.25% purity)	48-h LC_{50} = 59 (35–107)	Very highly toxic	Yes		2832753 (Miles et al. 2017)
Hesperocorixa atopodonta	Acute 48-h	Clothianidin (Arena; 0.25% purity)	48-h LC_{50} = 56 (39–82)	Very highly toxic	Yes		2832753 (Miles et al. 2017)
Insects - Coleoptera							
Ancyronyx sp. (larvae)	Sub-chronic 7-d	Clothianidin (purity not reported)	7-d LC_{50} = 50.9 (26.6–97.3)	Very highly toxic	Yes		2712690 (Whiting and Lydy 2015)
Dytiscidae sp. (adults)	Acute 48-h	Clothianidin (99% purity)	48-h EC_{50} = 7 (2–14) (mortality/ immobilization)	Very highly toxic	Yes		2712685
Gyrinus sp.	Acute 96-h	Clothianidin (≥ 98.6% purity)	96-h EC_{50} = 41.2 (30.2–52.1) (immobilization)	Very highly toxic	Yes		2842540 (Raby et al. 2018)
			96-h LC_{50} = 62.6 (45.4–79.8)	Very highly toxic	No[2]		
Stenelmis sp.	Acute 96-h	Clothianidin (≥ 98.6% purity)	96-h EC_{50} = 84.9 (60.0–120.0) (immobilization)	Very highly toxic	Yes		2842540 (Raby et al. 2018)
			96-h LC_{50} = 208.0 (136.5–279.4)	Highly toxic	No[2]		
Graphoderus fascicollis	Acute 48-h	Clothianidin (Arena; 0.25% purity)	48-h LC_{50} = 2 (1–5)	Very highly toxic	Yes		2832753 (Miles et al. 2017)
Oligochaetes							
Lumbriculus variegatus	Acute 96-h	Clothianidin (≥ 98.6% purity)	96-h EC_{50} = 41.7 (34.9–49.8) (immobilization)	Very highly toxic	Yes		2842540 (Raby et al. 2018)
			96-h LC_{50} = 177.1	Highly toxic	No[2]		

Organism	Exposure	Test Substance	Endpoint value (µg a.i./L)	Degree of toxicity	Data used in SSDs	Comments	Reference PMRA # (Publication)
			(145.3–207.5)				
Marine invertebrates							
Crustaceans – Decapoda							
Mysidopsis bahia	Acute 96-h	Clothianidin (97.6% purity)	96-h LC_{50} = 51	Very highly toxic	NA		1194202
Molluscs							
Crassostrea virginica	Acute 96-h	Clothianidin (97.6% purity)	96-h EC_{50} / LC_{50} > 129 100 (0% reduction in shell growth and survival)	Practically non-toxic	NA		1194203
Chronic							
Freshwater invertebrates							
Crustaceans - Cladocera							
Daphnia magna	21-d Chronic	Clothianidin (96% purity)	21-d NOEC reproduction / mortality = 120		Yes	21-d EC_{50} reproduction = 7400 (4480 – 11 000) µg a.i./L; 21-d LC_{50} = 17 300 (5800 – 228 700) µg a.i./L. PMRA assessment of NOEC reproduction differs from USEPA; EFED (2011) NOEC reproduction = 42 µg a.i./L.	1194147
Crustaceans - Amphipoda							
Hyalella azteca	28-d Chronic	Clothianidin (≥ 95% purity)	28-d NOEC growth = 0.31		Yes	28-d EC_{10} growth = 2.2 (1.8–2.8) µg a.i./L; 28-d EC_{50} growth = 3.5 (3.1–3.9) µg a.i./L. PMRA assessment of NOEC growth differs from study authors.	2753706 (ECCC 2017)
			28-d NOEC mortality = 1.3		No[2]	28-d LC_{10} = 2.0 (1.7–2.5) µg a.i./L; 28-d LC_{50} = 3.4 (3.0–3.8) µg a.i./L.	
Molluscs							
Planorbella pilsbryi	28-d Chronic	Clothianidin (≥ 95% purity)	28-d EC_{10} growth = 0.1 (-0.8–1.1)		Yes	28-d EC_{50} growth = 122 (-181–425) µg a.i./L	2712688 (Prosser et al. 2016)
			28-d EC_{10} biomass = 0.9 (-1.1–3.0)		No[2]	28-d EC_{50} biomass = 33.2 (3.8–62.6) µg a.i./L	
			28-d LC_{10} mortality = 19.8 (6.5–33)		No[2]	28-d LC_{50} mortality = 183 (118–248) µg a.i./L	
Insects - Diptera							

Organism	Exposure	Test Substance	Endpoint value (µg a.i./L)	Degree of toxicity	Data used in SSDs	Comments	Reference PMRA # (Publication)
Chironomus riparius	28-d Chronic	Clothianidin 50 WDG (50.3% purity)	28-d NOEC emergence rate = 0.38		Yes	Previously reported as EC_{15} = 0.72 µg a.i./L based on nominal treatment concentrations (ERC2011-01). Nominal NOEC of 0.56 µg a.i./L re-assessed based on mean measured concentrations from Day 0 and 7.	2713553 (also 1194187)
	28-d Chronic	Clothianidin (98 ± 2% purity)	28-d NOEC emergence/sex ratio = 0.55		Yes	NOEC determined by PMRA based on mean measured concentrations from Day 0 and 7 at 0.67 µg a.i./L nominal treatment. 28-d EC_{50} emergence = 1.2 µg a.i./L nominal.	2712700
Chironomus dilutus	40-d Life-cycle bioassay	Clothianidin (99.6% purity)	14-d LC_{50} = 2.41 (1.73–2.83)		No[2]		2712687 (Cavallero et al. 2017)
			40-d EC_{20} emergence = 0.02 (0.019– 0.036)		Yes	40-d EC_{50} emergence = 0.28 (0.20–0.33) µg a.i./L	
			14-d EC_{20} biomass = 0.89 (0.74–0.98)		No[2]	14-d EC_{50} biomass = 1.83 (1.74–2.08) µg a.i./L	
			40-d EC_{20} sex ratio = 0.15 (NA)		No[2]	40-d EC_{50} sex ratio = 0.46 (0.29–1.17) µg a.i./L	
	28-d Chronic	Clothianidin (99.6% purity)	28-d EC_{20} emergence = 0.34 (0.19–0.45)		No[4]	28-d EC_{50} emergence = 0.71 (0.50–0.85) µg a.i./L	2873503 (Maloney et al. 2018)
Studies using treated sediments:							
Endpoints based on overlying water concentrations:							
Chironomus riparius	10-d Chronic	Clothianidin (>99% purity)	10-d NOEC mortality = 0.45		NA	10-d LC_{50} = 0.99 (0.88–1.1) µg a.i./L	1636640
			10-d NOEC dry weight = 0.12			10-d EC_{50} dry weight = 1.0 (0.89–1.2) µg a.i./L	
Endpoints based on pore water concentrations:							
Chironomus riparius	10-d Chronic	Clothianidin (>99% purity)	10-d NOEC mortality = 3.4		NA	10-d LC_{50} = 11 (9.2–13) µg a.i./L	1636640
			10-d NOEC dry weight = 1.1			10-d EC_{50} dry weight = 12 (9.4–15) µg a.i./L	
Chironomus dilutus	63-d life-cycle bioassay	Clothianidin (98.6% purity)	20-d NOEC survival, growth = 3.2		NA	20-d EC/LC_{50} > 7.6 µg a.i./L. Endpoints based on overlying water not reported due to very low recoveries in overlying water.	2615168
	63-d life-cycle bioassay	Clothianidin (98.6% purity)	63-d NOEC emergence = 1.6			63-d EC_{50} emergence = 4.8 (3.9–5.8)	

Organism	Exposure	Test Substance	Endpoint value (µg a.i./L)	Degree of toxicity	Data used in SSDs	Comments	Reference PMRA # (Publication)
Endpoints based on sediment concentrations:							
Chironomus riparius	10-d Chronic	Clothianidin (>99% purity)	10-d LC_{50} = 400 (340–460) µg a.i./kg dw		NA		1636640
			10-d NOEC mortality = 140 µg a.i./kg dw				
			10-d EC_{50} dry weight = 430 (350–520) µg a.i./kg dw				
			10-d NOEC dry weight = 51 µg a.i./kg dw				
	28-d Chronic	Clothianidin (99% purity)	28-d EC_{50} emergence = 25 µg a.i./kg dw		NA	Recoveries were low and endpoints were based on nominal exposure concentrations. The endpoints cannot be used quantitatively in a risk assessment, but may be used as qualitative evidence only.	2712695
			28-d NOEC emergence = 15 µg a.i./kg dw				
Chironomus dilutus	63-d life-cycle bioassay	Clothianidin (98.6% purity)	20-d NOEC survival, growth = 30 µg a.i./kg dw		NA	20-d EC/LC_{50} > 60 µg a.i./kg dw	2615168
			63-d NOEC emergence = 16 µg a.i./kg dw			63-d EC_{50} emergence = 42 (35–50) µg a.i./kg dw	
Microcosm or mesocosm tests							
Multiple invertebrate species	98-d Chronic	Clothianidin 50 WG (49.3% purity)	98-d NOEC = 0.54 (emergent insect populations)		NA	Significant reductions in emergence rates of several insect species (Chironominae, Chaoboridae, Orthocladiinae, total emergence), as well as the larval densities of the chironomids in the sediment. Significant toxic effects on community parameters included taxa abundance, diversity, evenness and similarity. Toxic effects on emergent insects were observed within the first three weeks after test substance application. Sediment-dwelling chironomids recovered to control levels by 28 days post treatment and densities of all affected emergent insects as well as all community parameters recovered to control levels by 77 days post treatment. There was an insufficient abundance of Ephemeropterans to assess effects on this sensitive group of insects. NOEC determined by PMRA as TWA concentration due to loss of test material over time in mesocosms.	1636641

Organism	Exposure	Test Substance	Endpoint value (µg a.i./L)	Degree of toxicity	Data used in SSDs	Comments	Reference PMRA # (Publication)
	56-d Chronic	Clothianidin 50 WG (49.2% purity)	56-d NOEC = 0.281 (reductions in individual species populations and in community or taxa richness)		NA	NOEC is based on significant increases in *Chaoborus* sp. larvae, reductions in *Plea* sp. (Hemiptera) abundance and reduction in total Hemiptera abundance and a reduction in emergent insect taxa richness. Effects were transient and recovery was observed by end of the study. A NOAEC of 1.0 µg a.i./L (PMRA TWA concentration = 0.573 µg a.i./L) was reported by the study author based on the following significant effects that were observed at either the community or individual species level where no recovery was observed by the end of the study: decreases in abundance of *Asellus aquaticus* immatures and juveniles, total abundance of Crustacea and species richness of emerging insects. The reported NOAEC was 1.0 µg a.i./L nominal (0.573 µg a.i./L TWA). There was an insufficient abundance of Ephemeropterans to assess effects on this sensitive group of insects. NOEC determined by PMRA as TWA concentration due to loss of test material over time in mesocosms.	2713555
Marine invertebrates							
Crustaceans - Decapoda							
Mysidopsis bahia	39-d Chronic	Clothianidin (97.6% purity)	39-d NOEC reproduction = 5.1		NA	EC_{50} reproduction = 7.6 µg a.i./L	1194204
Crustaceans - Amphipoda							
Studies using treated sediments:							
Endpoints based on overlying water concentrations:							
Leptocheirus plumulosus	10-d Chronic	Clothianidin (99.4% purity)	10-d NOEC mortality = 2.03		NA	10-d LC_{50} mortality = 3.23 (2.11–4.47) µg a.i./L	2713580

Organism	Exposure	Test Substance	Endpoint value (µg a.i./L)	Degree of toxicity	Data used in SSDs	Comments	Reference PMRA # (Publication)
Endpoints based on pore water concentrations:							
Leptocheirus plumulosus	10-d Chronic	Clothianidin (99.4% purity)	10-d NOEC mortality = 11.6		NA	10-d LC_{50} mortality = 20.4 (18.3–22.6) µg a.i./L	2713580
Endpoints based on sediment concentrations:							
Leptocheirus plumulosus	10-d Chronic	Clothianidin (99.4% purity)	10-d NOEC mortality = 5.5 µg a.i./kg dw		NA	10-d LC_{50} mortality = 8.5 (8.0–9.0) µg a.i./kg dw	2713580

NA: Not applicable, an SSD was not constructed for these taxa;
[1] Unbound endpoint was not included as a more sensitive endpoint is available for this species or a similar taxa from another study (as per EFSA 2013 guidance);
[2] A more sensitive endpoint is available from the same study;
[3] Unbound endpoint was included as it represents the most sensitive endpoint for this unique species (as per EFSA 2013 guidance);
[4] 28-d EC_{20} for *Chironomus dilutus* was not included in a geomean with the 40-d EC_{20} for this same species as the difference in toxicity is thought to be due tothe longer exposure period in the latter study. The studies by Cavallaro et al. (2017) and Maloney et al. (2018) were conducted in the same laboratory using the same protocols.

Table A.3-9 Effects of major transformation products of clothianidin on aquatic invertebrates

Organism	Exposure	Test Substance	Endpoint value (µg/L)	Degree of toxicity	Comments	Reference PMRA#, (Publication)
Acute						
Freshwater invertebrates						
Crustaceans - Cladocera						
Daphnia magna	Acute 48-h	TMG (95.1% purity)	48-h EC_{50} > 115 200 (50% immobilization)	Practically non-toxic		1194142

Organism	Exposure	Test Substance	Endpoint value (µg/L)	Degree of toxicity	Comments	Reference PMRA#, (Publication)
	Acute 48-h	MNG (99.0% purity)	48-h EC_{50} > 100 800 (0% immobilization)	Practically non-toxic		1194144
	Acute 48-h	TZNG (99.0% purity)	48-h EC_{50} = 64 000 (immobilization)	Not toxic up to highest concentration tested.		1194145
Insects - Diptera						
Chironomus riparius	Acute 48-h	TZMU (98.8% purity)	48-h EC_{50} > 101 000 (25% immobilization)	Practically non-toxic		1194168
	Acute 48-h	MU (98.1% purity)	48-h EC_{50} > 82 000 (20% immobilization)	Not toxic up to highest concentration tested.		1194168
	Acute 48-h	TZNG (98.6% purity)	48-h EC_{50} = 386 (immobilization)	Highly toxic		1194168
	Acute 48-h	MNG (99.2% purity)	48-h EC_{50} > 101 000 (35% immobilization)	Practically non-toxic		1194168
	Acute 48-h	MAI (90.0% purity)	48-h EC_{50} > 10 000 (0% immobilization)	Not toxic up to highest concentration tested.		2713558
	Acute 48-h	HMIO (98.9% purity)	48-h EC_{50} > 10 000 (0% immobilization)	Not toxic up to highest concentration tested.		2713557
	Acute 48-h	CTCA (98.4% purity)	48-h EC_{50} > 10 000 (0% immobilization)	Not toxic up to highest concentration tested.		2713556

Organism	Exposure	Test Substance	Endpoint value (µg/L)	Degree of toxicity	Comments	Reference PMRA#, (Publication)
	Acute 48-h	MG (99.5% purity)	48-h EC_{50} > 10 000 (0% immobilization)	Not toxic up to highest concentration tested.		2713559
	Acute 48-h	NTG (99.0% purity)	48-h EC_{50} > 10 000 (0% immobilization)	Not toxic up to highest concentration tested.		2713560
	Acute 48-h	TZFA (97.2% purity)	48-h EC_{50} > 8760 (3% immobilization)	Not toxic up to highest concentration tested.		2713561
Chronic						
Freshwater invertebrates						
Insects - Diptera						
Chironomus riparius	28-d Chronic	TMG (98.2% purity)	28-d NOEC emergence = 47 (highest TWA concentration tested)		Limit test at 100 µg/L. Previously reported as NOEC emergence < 100 µg/L (ERC2011-01). However, original PMRA review states "The results indicate that TMG does not impact on the emergence of *Chironomus riparius* at nominal concentrations below 0.1 mg/L". The PMRA has re-assessed the exposure based on time-weighted average concentrations due to loss of test material over time. The revised TWA NOEC = 47 µg/L (highest concentration tested).	1194188
Studies using treated sediments:						
Endpoints based on pore water concentrations:						
Chironomus dilutus	61-d life-cycle bioassay	TMG (79.9% purity)	20-d NOEC survival = 31			2615169
			20-d NOEC growth = 820 (highest concentration tested) (35% reduction in dry weight)		NOEC = 820 µg/L (highest concentration tested)	

Organism	Exposure	Test Substance	Endpoint value (µg/L)	Degree of toxicity	Comments	Reference PMRA#, (Publication)
			61-d LOEC emergence rate = 31		NOEC < lowest treatment rate. Reductions in emergence rate at lowest treatment rate = 12.4 and 19.7% for males and females, respectively.	
Endpoints based on sediment concentrations:						
Chironomus dilutus	61-d life-cycle bioassay	TMG (79.9% purity)	20-d NOEC survival = 450 µg/kg dw			2615169
			20-d NOEC growth = 7300 µg/kg dw (highest concentration tested) (35% reduction in dry weight)		NOEC = 7300 µg/kg dw (highest concentration tested)	
			61-d LOEC emergence rate = 450 µg/kg dw		NOEC < lowest treatment rate. Reductions in emergence rate at lowest treatment rate = 12.4 and 19.7% for males and females, respectively.	

Table A.3-10 Summary of screening level risk of clothianidin to aquatic invertebrates exposed at a range of seasonal application rates

Organism	Exposure	Species	Endpoint eported (µg a.i./L)	Endpoint for RA[1] (µg a.i./L)	EEC[2] (µg a.i./L)	RQ	LOC Exceeded
Freshwater organisms							
Invertebrates	Acute	25 invertebrate species	HC_5 = 1.5	1.1	2.19 (low seed treatment rate)	**1.5**	**Yes**
					43.8 (maximum foliar treatment rate)	**29**	**Yes**
					52.6 (maximum seed treatment rate)	**35**	**Yes**
	Chronic	5 invertebrate	HC_5 = 0.0015	0.0015	2.19 (low seed	**1460**	**Yes**

Organism	Exposure	Species	Endpoint eported (µg a.i./L)	Endpoint for RA[1] (µg a.i./L)	EEC[2] (µg a.i./L)	RQ	LOC Exceeded
		species			treatment rate)		
					43.8 (maximum foliar treatment rate)	**29200**	**Yes**
					52.6 (maximum seed treatment rate)	**35067**	**Yes**
Most sensitive single invertebrate species (for comparison against SSD HC_5 values).	Acute	Amphipod *Hyalella azteca*	7-d sub-chronic LC_{50} = 1.65	0.83	2.19 (low seed treatment rate)	**2.7**	**Yes**
					43.8 (maximum foliar treatment rate)	**53**	**Yes**
					52.6 (maximum seed treatment rate)	**64**	**Yes**
	Chronic	Chironomid *Chironomus dilutus*	40-d EC_{20} emergence = 0.020	0.020	2.19 (low seed treatment rate)	**110**	**Yes**
					43.8 (maximum foliar treatment rate)	**2190**	**Yes**
					52.6 (maximum seed treatment rate)	**2630**	**Yes**
Marine/Estuarine organisms							
Mysid shrimp	Acute	*Mysidopsis bahia*	96-h LC_{50} = 51.0	25.5	2.19 (low seed treatment rate)	0.09	No
					43.8 (maximum foliar treatment rate)	**1.7**	**Yes**
					52.6 (maximum	**2.1**	**Yes**

Organism	Exposure	Species	Endpoint eported (µg a.i./L)	Endpoint for RA[1] (µg a.i./L)	EEC[2] (µg a.i./L)	RQ	LOC Exceeded
					seed treatment rate)		
	Chronic		39-d NOEC reproduction = 5.1	5.1	2.19 (low seed treatment rate)	0.43	No
					43.8 (maximum foliar treatment rate)	**8.6**	**Yes**
					52.6 (maximum seed treatment rate)	**10**	**Yes**

1 Endpoints used in the acute exposure risk assessment (RA) are derived by dividing the EC_{50} or LC_{50} from the appropriate laboratory study by a factor of two (2) for aquatic invertebrates. The HC_5 is the 5th percentile of the species sensitivity distribution for 48–96-h and 7-d sub-chronic LC_{50} or EC_{50} endpoints (acute exposures), or for 14–40-d NOEC or EC_{10}/EC_{20} endpoints (chronic exposures).

2 EEC based on an 80 cm water depth.

Bolded values indicates an exceedence of the level of concern (RQ = 1).

Table A.3-11 Summary of screening level risk of major clothianidin transformation products to aquatic invertebrates exposed at the highest seasonal application rate for all crops (seed treatment rate of 420 g a.i./ha)

Organism	Exposure	Test Substance	Endpoint value (µg a.i./L)	Endpoint for RA[1] (µg a.i./L)	EEC[2] (µg a.i./L)	RQ	LOC Exceeded
Acute							
Freshwater invertebrates							
Crustaceans - Cladocera							
Daphnia magna	Acute 48-h	TMG (95.1% purity)	48-h EC_{50} > 115 200	57 600	43.1	< 0.01	No
	Acute 48-h	MNG (99.0% purity)	48-h EC_{50} > 100 800	50 400	24.9	< 0.01	No
	Acute 48-h	TZNG (99.0% purity)	48-h EC_{50} > 64 000	32 000	49.6	< 0.01	No
Insects - Diptera							

Organism	Exposure	Test Substance	Endpoint value (µg a.i./L)	Endpoint for RA[1] (µg a.i./L)	EEC[2] (µg a.i./L)	RQ	LOC Exceeded
Chironomus riparius	Acute 48-h	TZMU (98.8% purity)	48-h LC_{50} > 101 000	50 500	43.3	< 0.01	No
	Acute 48-h	MU (98.1% purity)	48-h LC_{50} > 82 000	41 000	15.6	< 0.01	No
	Acute 48-h	TZNG (98.6% purity)	48-h LC_{50} = 386	193	49.6	0.26	No
	Acute 48-h	MNG (99.2% purity)	48-h LC_{50} > 101 000	50 500	24.9	< 0.01	No
	Acute 48-h	MAI (90.0% purity)	48-h EC_{50} > 10 000	5000	36.3	< 0.01	No
	Acute 48-h	HMIO (98.9% purity)	48-h EC_{50} > 10 000	5000	27.2	< 0.01	No
	Acute 48-h	CTCA (98.4% purity)	48-h EC_{50} > 10 000	5000	34.4	< 0.01	No
	Acute 48-h	MG (99.5% purity)	48-h EC_{50} > 10 000	5000	15.4	< 0.01	No
	Acute 48-h	NTG (99.0% purity)	48-h EC_{50} > 10 000	5000	21.9	< 0.01	No
	Acute 48-h	TZFA (97.2% purity)	48-h EC_{50} > 8760	4380	47.6	0.011	No
Chronic							
Freshwater invertebrates							
Insects - Diptera							
Chironomus riparius	28-d Chronic	TMG (98.2% purity)	28-d NOEC emergence ≥ 47	47	43.1	≤ 0.92	No

[1] Endpoints used in the acute exposure risk assessment (RA) are derived by dividing the EC_{50} or LC_{50} from the appropriate laboratory study by a factor of two (2) for aquatic invertebrates.

[2] EEC based on an 80 cm water depth. EECs for transformation products based on highest clothianidin screening-level EEC for vegetable seed treatment rate of 420 g a.i./ha = 52.6 µg a.i./L clothianidin. EECs for individual transformation products adjusted for the molecular-weight ratio relative to clothianidin. For example, EEC in 80 cm for TMG = 52.6 µg a.i./L clothianidin × (204.7 g/mol TMG/249.7 g/mol clothianidin) = 43.1 µg/L TMG

Table A.3-12 Refined risk assessment of clothianidin for aquatic invertebrates from predicted levels of spray drift

Organism	Exposure	Species	Endpoint reported (µg a.i./L)	Endpoint for RA[1] (µg a.i./L)	EEC[2] (µg a.i./L)	RQ	LOC Exceeded
Freshwater organisms							
Invertebrates	Acute	37 invertebrate species	HC_5 = 1.5	1.5	4.9 (field sprayer)	**3.2**	**Yes**
					19.5 (airblast sprayer)	**13**	**Yes**
					4.8 (aerial sprayer)	**3.3**	**Yes**
	Chronic	5 invertebrate species	HC_5 = 0.0015	0.0015	4.9 (field sprayer)	**3212**	**Yes**
					19.5 (airblast sprayer)	**12975**	**Yes**
					4.8 (aerial sprayer)	**3293**	**Yes**
Most sensitive single invertebrate species (for comparison against SSD HC_5 values).	Acute	Amphipod *Hyalella azteca*	7-d sub-chronic LC_{50} = 1.65	0.83	4.9 (field sprayer)	**5.8**	**Yes**
					19.5 (airblast sprayer)	**24**	**Yes**
					4.8 (aerial sprayer)	**6.0**	**Yes**
	Chronic	Chironomid *Chironomus dilutus*	40-d EC_{20} emergence = 0.020	0.020	4.9 (field sprayer)	**241**	**Yes**
					19.5 (airblast sprayer)	**973**	**Yes**
					4.8 (aerial sprayer)	**247**	**Yes**
Microcosm or mesocosm tests							
Invertebrates	Chronic	Emergent insects and crustaceans	56-d NOEC = 0.281 (reductions in individual	0.281	4.9 (field sprayer)	**17**	**Yes**

Organism	Exposure	Species	Endpoint reported (µg a.i./L)	Endpoint for RA[1] (µg a.i./L)	EEC[2] (µg a.i./L)	RQ	LOC Exceeded
			species populations and in community or taxa richness)		19.5 (airblast sprayer)	**69**	**Yes**
					4.8 (aerial sprayer)	**18**	**Yes**
Marine/Estuarine organisms							
Mysid shrimp	Acute	*Mysidopsis bahia*	96-h LC_{50} = 51.0	25.5	4.9 (field sprayer)	0.19	No
					19.5 (airblast sprayer)	0.76	No
					1.7 (aerial sprayer)[3]	0.07	No
	Chronic		39-d NOEC reproduction = 5.1	5.1	4.9 (field sprayer)	0.94	No
					19.5 (airblast sprayer)	**3.8**	**Yes**
					1.7 (aerial sprayer)[3]	0.33	No

[1] Endpoints used in the acute exposure risk assessment (RA) are derived by dividing the EC_{50} or LC_{50} from the appropriate laboratory study by a factor of two (2) for aquatic invertebrates. The HC_5 is the 5[th] percentile of the species sensitivity distribution for 48 – 96-h and 7-d sub-chronic LC_{50} or EC_{50} endpoints (acute exposures), or for 21–40-d NOEC or EC10 endpoints (chronic exposures).
[2] EECs based on an 80 cm water depth and on the maximum cumulative use rates for each application method: Aerial sprayer = 3 × 52.5 g a.i./ha (potatoes) with 7-d application interval and 80[th] percentile $t_{1/2}$ = 141 d, EEC = 19.0 µg a.i./L; airblast = 1 × 210 g a.i./ha (e.g. pome fruit), EEC = 26.3 µg a.i./L; field sprayer = 1 × 350 g a.i./ha (turf), EEC = 43.8 µg a.i./L. EECs were then adjusted for expected spray drift deposit 1 m downwind: Field sprayer = 11% (ASAE Fine spray quality); aerial sprayer = 26% (ASAE Fine spray quality); airblast = 74% (early season).
Bolded values indicates an exceedence of the level of concern (RQ = 1).
[3] Marine EECs for aerial application to potatoes based on a single application only. Cumulative deposit from multiple applications is not expected given the high rates of water replacement due to tidal flushing.

Table A.3-13 Refined risk assessment of clothianidin for aquatic invertebrates from predicted levels of pesticide runoff

Organism	Exposure	Representative species	Endpoint reported (µg a.i./L)	Endpoint for RA[1] (µg a.i./L)	Use Scenario	Crop	Use rate[2]	Region	EEC[3] (µg a.i./L)	RQ	LOC exceeded
Freshwater organisms											
Invertebrates	Acute	37 invertebrate species	HC_5 = 1.5	1.5	Foliar	Strawberry	1 × 224 g a.i./ha	BC	1.1	0.7	No
								Atlantic	11	**7.3**	**Yes**
						Squash, pumpkin	2 × 105 g a.i./ha at a 7-d interval	BC	0.78	0.5	No
								ON	6.5	**4.3**	**Yes**
								QC	5.9	**3.9**	**Yes**
						Potato	3 × 52.5 g a.i./ha at a 10-d interval	Prairie-MB	4.5	**3.0**	**Yes**
								ON	3.9	**2.6**	**Yes**
								QC	3.1	**2.1**	**Yes**
								Atlantic	4.1	**2.7**	**Yes**
					In-furrow	Potato	1 × 223.8 g a.i./ha	Prairie-MB	0.003	0.0	No
								ON	0.031	0.0	No
								QC	0.028	0.0	No
								Atlantic	0.068	0.0	No
					Seed treatment	Vegetables	1 × 419.6 g a.i./ha (high rate)	BC	2.56	**1.7**	**Yes**
								ON	8	**5.3**	**Yes**
								QC	10.4	**6.9**	**Yes**
								Atlantic	21.6	**14.4**	**Yes**
							1 × 4.7 g a.i./ha (low rate)	BC	0.028	0.0	No
								ON	0.152	0.1	No
								QC	0.2	0.1	No
								Atlantic	0.408	0.2	No
						Canola	1 × 32.5 g a.i./ha	Prairie - SK	0.288	0.2	No
								Prairie - MB	0.44	0.3	No
								ON	2.24	**1.5**	**Yes**
								QC	3.36	**2.2**	**Yes**
						Potato	1 × 381 g a.i./ha	Prairie - MB	0.004	0.0	No
								ON	0.0424	0.0	No
								QC	0.0384	0.0	No
								Atlantic	0.096	0.1	No
						Corn[4]	1 × 118.3	ON	0.0656	0.0	No

Organism	Exposure	Representative species	Endpoint reported (µg a.i./L)	Endpoint for RA[1] (µg a.i./L)	Use Scenario	Crop	Use rate[2]	Region	EEC[3] (µg a.i./L)	RQ	LOC exceeded
							g a.i./ha	QC	0.0672	0.0	No
						Corn[5]	1 × 118.3 g a.i./ha	ON	0.608	0.4	No
								QC	0.776	0.5	No
	Chronic	5 invertebrate species	HC_5 = 0.0015	0.0015	Foliar	Strawberry	1 × 224 g a.i./ha	BC	0.8	**533.3**	**Yes**
								Atlantic	8.2	**5466.7**	**Yes**
						Squash and pumpkin	2 × 105 g a.i./ha at a 7-d interval	BC	0.57	**380.0**	**Yes**
								ON	5	**3333.3**	**Yes**
								QC	4.7	**3133.3**	**Yes**
						Potato	3 × 52.5 g a.i./ha at a 10-d interval	Prairie-MB	3.2	**2133.3**	**Yes**
								ON	2.9	**1933.3**	**Yes**
								QC	2.3	**1533.3**	**Yes**
								Atlantic	3.1	**2066.7**	**Yes**
					In-furrow	Potato	1 × 223.8 g a.i./ha	Prairie-MB	0.002	**1.3**	**Yes**
								ON	0.024	**16.0**	**Yes**
								QC	0.023	**15.3**	**Yes**
								Atlantic	0.054	**36.0**	**Yes**
					Seed treatment	Vegetables	1 × 419.6 g a.i./ha (high rate)	BC	1.84	**1226.7**	**Yes**
								ON	6.88	**4586.7**	**Yes**
								QC	8.8	**5866.7**	**Yes**
								Atlantic	16.8	**11200.0**	**Yes**
							1 × 4.7 g a.i./ha (low rate)	BC	0.0208	**13.9**	**Yes**
								ON	0.128	**51.2**	**Yes**
								QC	0.16	**64.0**	**Yes**
								Atlantic	0.32	**122.7**	**Yes**
						Canola	1 × 32.5 g a.i./ha	Prairie - SK	0.216	**144.0**	**Yes**
								Prairie - MB	0.368	**245.3**	**Yes**
								ON	1.68	**1120.0**	**Yes**
								QC	2.88	**1920.0**	**Yes**
						Potato	1 × 381 g a.i./ha	Prairie - MB	0.0032	**2.1**	**Yes**
								ON	0.0328	**21.9**	**Yes**
								QC	0.0304	**20.3**	**Yes**
								Atlantic	0.0736	**49.1**	**Yes**
						Corn[4]	1 × 118.3 g a.i./ha	ON	0.0512	**34.1**	**Yes**
								QC	0.0528	**35.2**	**Yes**

Organism	Exposure	Representative species	Endpoint reported (µg a.i./L)	Endpoint for RA[1] (µg a.i./L)	Use Scenario	Crop	Use rate[2]	Region	EEC[3] (µg a.i./L)	RQ	LOC exceeded
						Corn[5]	1 × 118.3 g a.i./ha	ON	0.52	**346.7**	**Yes**
								QC	0.632	**421.3**	**Yes**
Most sensitive single invertebrate species (for comparison against SSD HC_5 values).	Acute	Amphipod *Hyalella azteca*	7-d sub-chronic LC_{50} = 1.65	0.83	Foliar	Strawberry	1 × 224 g a.i./ha	BC	1.1	**1.3**	**Yes**
								Atlantic	11	**13.3**	**Yes**
						Squash and pumpkin	2 × 105 g a.i./ha at a 7-d interval	BC	0.78	0.9	No
								ON	6.5	**7.9**	**Yes**
								QC	5.9	**7.2**	**Yes**
						Potato	3 × 52.5 g a.i./ha at a 10-d interval	Prairie-MB	4.5	**5.5**	**Yes**
								ON	3.9	**4.7**	**Yes**
								QC	3.1	**3.8**	**Yes**
								Atlantic	4.1	**5.0**	**Yes**
					In-furrow	Potato	1 × 223.8 g a.i./ha	Prairie-MB	0.003	0.0	No
								ON	0.031	0.0	No
								QC	0.028	0.0	No
								Atlantic	0.068	0.1	No
					Seed treatment	Vegetables	1 × 419.6 g a.i./ha (high rate)	BC	2.56	**3.1**	**Yes**
								ON	8	**9.7**	**Yes**
								QC	10.4	**12.6**	**Yes**
								Atlantic	21.6	**26.2**	**Yes**
							1 × 4.7 g a.i./ha (low rate)	BC	0.028	0.0	No
								ON	0.152	0.1	No
								QC	0.2	0.1	No
								Atlantic	0.408	0.3	No
						Canola	1 × 32.5 g a.i./ha	Prairie - SK	0.288	0.3	No
								Prairie - MB	0.44	0.5	No
								ON	2.24	**2.7**	**Yes**
								QC	3.36	**4.1**	**Yes**
						Potato	1 × 381 g a.i./ha	Prairie - MB	0.004	0.0	No
								ON	0.0424	0.1	No
								QC	0.0384	0.0	No
								Atlantic	0.096	0.1	No
						Corn[4]	1 × 118.3 g a.i./ha	ON	0.0656	0.1	No
								QC	0.0672	0.1	No

Organism	Exposure	Representative species	Endpoint reported (µg a.i./L)	Endpoint for RA[1] (µg a.i./L)	Use Scenario	Crop	Use rate[2]	Region	EEC[3] (µg a.i./L)	RQ	LOC exceeded
						Corn[5]	1 × 118.3 g a.i./ha	ON	0.608	0.7	No
								QC	0.776	0.9	No
	Chronic		40-d EC_{20} emergence = 0.020	0.020	Foliar	Strawberry	1 × 224 g a.i./ha	BC	0.8	**40.0**	**Yes**
								Atlantic	8.2	**410.0**	**Yes**
						Squash and pumpkin	2 × 105 g a.i./ha at a 7-d interval	BC	0.57	**28.5**	**Yes**
								ON	5	**250.0**	**Yes**
								QC	4.7	**235.0**	**Yes**
						Potato	3 × 52.5 g a.i./ha at a 10-d interval	Prairie-MB	3.2	**160.0**	**Yes**
								ON	2.9	**145.0**	**Yes**
								QC	2.3	**115.0**	**Yes**
								Atlantic	3.1	**155.0**	**Yes**
					In-furrow	Potato	1 × 223.8 g a.i./ha	Prairie-MB	0.002	0.1	No
								ON	0.024	**1.2**	**Yes**
								QC	0.023	**1.2**	**Yes**
								Atlantic	0.054	**2.7**	**Yes**
					Seed treatment	Vegetables	1 × 419.6 g a.i./ha (high rate)	BC	1.84	**92.0**	**Yes**
								ON	6.88	**344.0**	**Yes**
								QC	8.8	**440.0**	**Yes**
								Atlantic	16.8	**840.0**	**Yes**
							1 × 4.7 g a.i./ha (low rate)	BC	0.0208	**1.0**	**Yes**
								ON	0.128	**3.8**	**Yes**
								QC	0.16	**4.8**	**Yes**
								Atlantic	0.32	**9.2**	**Yes**
						Canola	1 × 32.5 g a.i./ha	Prairie - SK	0.216	**10.8**	**Yes**
								Prairie - MB	0.368	**18.4**	**Yes**
								ON	1.68	**84.0**	**Yes**
								QC	2.88	**144.0**	**Yes**
						Potato	1 × 381 g a.i./ha	Prairie - MB	0.0032	0.2	No
								ON	0.0328	**1.6**	**Yes**
								QC	0.0304	**1.5**	**Yes**
								Atlantic	0.0736	**3.7**	**Yes**
						Corn[4]	1 × 118.3 g a.i./ha	ON	0.0512	**2.6**	**Yes**
								QC	0.0528	**2.6**	**Yes**
						Corn[5]	1 × 118.3 g a.i./ha	ON	0.52	**26.0**	**Yes**
								QC	0.632	**31.6**	**Yes**

Organism	Exposure	Representative species	Endpoint reported (µg a.i./L)	Endpoint for RA[1] (µg a.i./L)	Use Scenario	Crop	Use rate[2]	Region	EEC[3] (µg a.i./L)	RQ	LOC exceeded
Studies using treated sediments											
Chironomid	Chronic	*Chironomus riparius*	10-d NOEC dry weight = 1.1 (pore water)	1.1	Foliar	Strawberry	1 × 224 g a.i./ha	BC	0.24	0.2	No
								Atlantic	2.3	**2.1**	**Yes**
						Squash, pumpkin	2 × 105 g a.i./ha at a 7-d interval	BC	0.15	0.1	No
								ON	1.5	**1.4**	**Yes**
								QC	1.5	**1.4**	**Yes**
						Potato	3 × 52.5 g a.i./ha at a 10-d interval	Prairie-MB	0.72	0.7	No
								ON	0.57	0.5	No
								QC	0.62	0.6	No
								Atlantic	0.87	0.8	No
					In-furrow	Potato	1 × 223.8 g a.i./ha	Prairie-MB	0.0007	0.0	No
								ON	0.0063	0.0	No
								QC	0.0065	0.0	No
								Atlantic	0.015	0.0	No
					Seed treatment	Vegetables	1 × 419.6 g a.i./ha (high rate)	BC	0.512	0.5	No
								ON	1.92	**1.7**	**Yes**
								QC	2.4	**2.2**	**Yes**
								Atlantic	4.72	**4.3**	**Yes**
							1 × 4.7 g a.i./ha (low rate)	BC	0.0056	0.0	No
								ON	0.0344	0.0	No
								QC	0.0448	0.0	No
								Atlantic	0.088	0.0	No
						Canola	1 × 32.5 g a.i./ha	Prairie - SK	0.0616	0.1	No
								Prairie - MB	0.104	0.1	No
								ON	0.48	0.4	No
								QC	1.12	**1.0**	**Yes**
						Potato	1 × 381 g a.i./ha	Prairie - MB	0.0008	0.0	No
								ON	0.0088	0.0	No
								QC	0.0088	0.0	No
								Atlantic	0.02	0.0	No
						Corn[4]	1 × 118.3 g a.i./ha	ON	0.0136	0.0	No
								QC	0.0152	0.0	No
						Corn[5]	1 × 118.3 g a.i./ha	ON	0.144	0.1	No
								QC	0.176	0.2	No
Microcosm or mesocosm tests											

Organism	Exposure	Representative species	Endpoint reported (µg a.i./L)	Endpoint for RA[1] (µg a.i./L)	Use Scenario	Crop	Use rate[2]	Region	EEC[3] (µg a.i./L)	RQ	LOC exceeded
Invertebrates	Chronic	Emergent insects and crustaceans	56-d NOEC = 0.281 (reductions in individual species populations and in community or taxa richness)	0.281	Foliar	Strawberry	1 × 224 g a.i./ha	BC	0.8	**2.8**	**Yes**
								Atlantic	8.2	**29.2**	**Yes**
						Squash and pumpkin	2 × 105 g a.i./ha at a 7-d interval	BC	0.57	**2.0**	**Yes**
								ON	5	**17.8**	**Yes**
								QC	4.7	**16.7**	**Yes**
						Potato	3 × 52.5 g a.i./ha at a 10-d interval	Prairie-MB	3.2	**11.4**	**Yes**
								ON	2.9	**10.3**	**Yes**
								QC	2.3	**8.2**	**Yes**
								Atlantic	3.1	**11.0**	**Yes**
					In-furrow	Potato	1 × 223.8 g a.i./ha	Prairie-MB	0.002	0.0	No
								ON	0.024	0.1	No
								QC	0.023	0.1	No
								Atlantic	0.054	0.2	No
					Seed treatment	Vegetables	1 × 419.6 g a.i./ha (high rate)	BC	1.84	**6.5**	**Yes**
								ON	6.88	**24.5**	**Yes**
								QC	8.8	**31.3**	**Yes**
								Atlantic	16.8	**59.8**	**Yes**
							1 × 4.7 g a.i./ha (low rate)	BC	0.0208	0.1	No
								ON	0.128	0.3	No
								QC	0.16	0.3	No
								Atlantic	0.32	0.7	No
						Canola	1 × 32.5 g a.i./ha	Prairie - SK	0.216	0.8	No
								Prairie - MB	0.368	**1.3**	**Yes**
								ON	1.68	**6.0**	**Yes**
								QC	2.88	**10.2**	**Yes**
						Potato	1 × 381 g a.i./ha	Prairie - MB	0.0032	0.0	No
								ON	0.0328	0.1	No
								QC	0.0304	0.1	No
								Atlantic	0.0736	0.3	No
						Corn[4]	1 × 118.3 g a.i./ha	ON	0.0512	0.2	No
								QC	0.0528	0.2	No
						Corn[5]	1 × 118.3 g a.i./ha	ON	0.52	**1.9**	**Yes**
								QC	0.632	**2.2**	**Yes**
Marine/Estuarine organisms											
Mysid shrimp	Acute	*Mysidopsis bahia*	96-h LC_{50} =	25.5	Foliar	Strawberry	1 × 224 g	BC	1.1	0.0	No

Organism	Exposure	Representative species	Endpoint reported (µg a.i./L)	Endpoint for RA[1] (µg a.i./L)	Use Scenario	Crop	Use rate[2]	Region	EEC[3] (µg a.i./L)	RQ	LOC exceeded
			51.0				a.i./ha	Atlantic	11	0.4	No
						Squash and pumpkin	2 × 105 g a.i./ha at a 7-d interval	BC	0.78	0.0	No
								QC	5.9	0.2	No
						Potato	3 × 52.5 g a.i./ha at a 10-d interval	QC	3.1	0.1	No
								Atlantic	4.1	0.2	No
					In-furrow	Potato	1 × 223.8 g a.i./ha	QC	0.028	0.0	No
								Atlantic	0.068	0.0	No
					Seed treatment	Vegetables	1 × 419.6 g a.i./ha (high rate)	BC	2.56	0.1	No
								QC	10.4	0.4	No
								Atlantic	21.6	0.8	No
							1 × 4.7 g a.i./ha (low rate)	BC	0.028	0.0	No
								QC	0.2	0.0	No
								Atlantic	0.408	0.0	No
						Canola	1 × 32.5 g a.i./ha	QC	3.36	0.1	No
						Potato	1 × 381 g a.i./ha	QC	0.0384	0.0	No
								Atlantic	0.096	0.0	No
						Corn[4]	1 × 118.3 g a.i./ha	QC	0.0672	0.0	No
						Corn[5]	1 × 118.3 g a.i./ha	QC	0.776	0.0	No
	Chronic	*Mysidopsis bahia*	39-d NOEC reproduction = 5.1	5.1	Foliar	Strawberry	1 × 224 g a.i./ha	BC	0.8	0.2	No
								Atlantic	8.2	**1.6**	**Yes**
						Squash and pumpkin	2 × 105 g a.i./ha at a 7-d interval	BC	0.57	0.1	No
								QC	4.7	0.9	No
						Potato	3 × 52.5 g a.i./ha at a 10-d interval	QC	2.3	0.5	No
								Atlantic	3.1	0.6	No
					In-furrow	Potato	1 × 223.8 g a.i./ha	QC	0.023	0.0	No
								Atlantic	0.054	0.0	No
					Seed treatment	Vegetables	1 × 419.6 g a.i./ha	BC	1.84	0.4	No
								QC	8.8	**1.7**	**Yes**

Organism	Exposure	Representative species	Endpoint reported (µg a.i./L)	Endpoint for RA[1] (µg a.i./L)	Use Scenario	Crop	Use rate[2]	Region	EEC[3] (µg a.i./L)	RQ	LOC exceeded
							(high rate)	Atlantic	16.8	**3.3**	**Yes**
							1 × 4.7 g a.i./ha (low rate)	BC	0.0208	0.0	No
								QC	0.16	0.0	No
								Atlantic	0.32	0.0	No
						Canola	1 × 32.5 g a.i./ha	QC	2.88	0.6	No
						Potato	1 × 381 g a.i./ha	QC	0.0304	0.0	No
								Atlantic	0.0736	0.0	No
						Corn[4]	1 × 118.3 g a.i./ha	QC	0.0528	0.0	No
						Corn[5]	1 × 118.3 g a.i./ha	QC	0.632	0.1	No
Studies using treated sediments											
Amphipod	Chronic	*Leptocheirus plumulosus*	10-d NOEC mortality = 11.6 (pore water)	11.6	Foliar	Strawberry	1 × 224 g a.i./ha	BC	0.24	0.0	No
								Atlantic	2.3	0.2	No
						Squash and pumpkin	2 × 105 g a.i./ha at a 7-d interval	BC	0.15	0.0	No
								QC	1.5	0.1	No
						Potato	3 × 52.5 g a.i./ha at a 10-d interval	QC	0.62	0.1	No
								Atlantic	0.87	0.1	No
					In-furrow	Potato	1 × 223.8 g a.i./ha	QC	0.0065	0.0	No
								Atlantic	0.015	0.0	No
					Seed treatment	Vegetables	1 × 419.6 g a.i./ha (high rate)	BC	0.512	0.0	No
								QC	2.4	0.2	No
								Atlantic	4.72	0.4	No
							1 × 4.7 g a.i./ha (low rate)	BC	0.0056	0.0	No
								QC	0.0448	0.0	No
								Atlantic	0.088	0.0	No
						Canola	1 × 32.5 g a.i./ha	QC	1.12	0.1	No
						Potato	1 × 381 g	QC	0.0088	0.0	No

Organism	Exposure	Representative species	Endpoint reported (µg a.i./L)	Endpoint for RA[1] (µg a.i./L)	Use Scenario	Crop	Use rate[2]	Region	EEC[3] (µg a.i./L)	RQ	LOC exceeded
							a.i./ha	Atlantic	0.02	0.0	No
						Corn[4]	1 × 118.3 g a.i./ha	QC	0.0152	0.0	No
						Corn[5]	1 × 118.3 g a.i./ha	QC	0.176	0.0	No

[1] The HC_5 is the 5th percentile of the species sensitivity distribution for the LC_{50} or EC_{50} at 50% confidence intervals (acute exposures) or NOEC or EC_{10} (chronic exposures).
[2] Use rate represents the maximum number of applications and rate (g a.i./ha) for a crop.
[3] EECs based on an 80 cm water depth. For comparison against acute invertebrate endpoints based on data with 48–96-h and 7-d sub-chronic studies, peak EECs were used to derive RQs. For comparison against chronic invertebrate endpoints based on data with 21 – 40-d NOEC or EC_{10}/EC_{20} endpoints, 21-day EECs were used to derive RQs. For comparison against chronic invertebrate endpoints based on pore water exposures, 21-day pore water EECs were used to derive RQs. EECs for seed treatments were adjusted for 20% removal by uptake from plants.
Bolded values indicates an exceedence of the level of concern (RQ = 1).
[4] Use on corn modelled using the “at depth” scenario.
[5] Use on corn modelled using the “increasing with depth” scenario.

Appendix IV Species Sensitivity Distribution (SSD)

Background information

The median HC_5 and confidence values were reported for the SSDs. The hazardous concentration to 5% of species (HC_5) is theoretically protective of 95% of all species at the effect level used in the analysis (e.g., LC_{50}, NOEC, etc). An SSD is conducted for taxonomic groups of interest where sufficient data are available. The software program ETX 2.1 is used to generate SSDs which was developed by RIVM (Rijksinstituut voor Volksgezondheid en Milieu, The Netherlands.).

SSD Toxicity Data Analysis for clothianadin

Data submitted by the registrant and published literature studies were consulted in the risk assessment process. Only those studies with acceptable quantitative effects endpoints were considered for the SSDs. Additional sorting was done to separate data into taxonomic sub groups while also accounting for appropriate test methods, exposure durations, matrices and other variables. Studies from the published literature were deemed acceptable if they reported the appropriate biologically relevant endpoints and generally followed recognized methods such as the Organisation for Economic Co-operation and Development (OECD) or similar.

Results of SSD analysis for clothianadin insecticide

Distributions were determined for the taxonomic groups below. Results are reported in summary Table A.4-1 to Table A.4-3:

- Aquatic species: Freshwater invertebrates. Acute and chronic data sets.

The acute HC_5 is 1.5 µg a.i./L, and the chronic HC_5 is 0.0015 µg a.i./L. Based on the available data, the results indicate that the HC_5 for chronic effects (NOEC/EC_{10}/EC_{20}) is approximately three orders of magnitude more sensitive than the HC_5 for acute effects (EC/LC_{50s}) for freshwater invertebrate populations.

Table A.4-1 Summary of SSDs toxicity data analysis for clothianadin insecticide.

Study Type/Exposure	SSD results Freshwater invertebrates
Acute toxicity	HC_5: 1.5 µg a.i./L
	CI: 0.38-4.35 FA: 1.9–9.2%
	Number of species used: 37 (48–96-h, 7-d subchronic EC_{50}/LC_{50}s)
	Most sensitive species: *Graphoderus fascicollis;* 48-h LC_{50} = 2.0 µg a.i./L
Chronic toxicity	HC_5: 0.0015 µg a.i./L
	CI: 5×10^{-7}-0.034 FA: 0.15–31.5%
	Number of species used: 5 (NOEC/$EC_{10/20}$s)
	Most sensitive species: *Chironomus dilutus*; 40-d EC_{20} = 0.02 µg a.i./L

HC_5 = Hazardous concentration to 5% of species.
CI = lower and upper 90% confidence level of HC_5
FA = fraction of species affected. This value reflects the lower and upper 90% confidence level of the proportion of species expected to be affected at the HC_5 value.

Table A.4-2 Toxicity data used in the SSD for acute effects of clothianadin on freshwater invertebrates.

Species count	Species name	EC_{50}/LC_{50} (µg a.i./L)
1	*Moina macrocopa*	61 106.0
2	*Daphnia pulex*	31 448.0
3	*Ceriodaphnia reticulata*	29 474.0
4	*Daphnia magna*[1]	28 299.4
5	*Coenagrion* sp.	5918.8
6	*Planorbella pilsbryi*	4000.0
7	*Daphnia similis*	1740.0
8	*Ceriodaphnia dubia*	1691.3
9	*Lestes unguiculatus*	1245.0
10	*Anax junius*	1000.0
11	*Plathemis lydia*	865.0
12	*Orchonectes propinquus*	805.0
13	*Caecidotea* sp.	537.2
14	*Lampsilis fasciola*	478.0
15	*Agnetina, Paragnetina* sp.	300.5
16	*Procambarus clarkii*[1]	188.0
17	*Isonychia bicolor*	108.8
18	*McCaffertium* sp.	108.8
19	*Stenelmis* sp.	84.9
20	*Belostoma flumineum*	79.0
21	*Asellus aquaticus*	67.0
22	*Notonecta undulata*	59.0
23	*Hesperocorixa atopodonta*	56.0
24	*Ancyronyx* spp.	50.9
25	*Lumbriculus variegatus*	41.7
26	*Gyrinus* sp.	41.2
27	*Chironomus riparius*[1]	21.8
28	*Trichocorixa* sp.	21.3
29	*Ephemerella* sp.	18.5
30	*Cloeon dipterum*	12.0
31	*Hexagenia* spp.[1]	11.5
32	*Dytiscidae*	7.0
33	*Hyalella azteca*[1]	4.8
34	*Cheumatopsyche brevilineata*	4.4
35	*Neocloeon triangulifer*	3.5
36	*Chironomus dilutus*[1]	3.3
37	*Graphoderus fascicollis*	2.0

[1] Toxicity value based on geometric mean

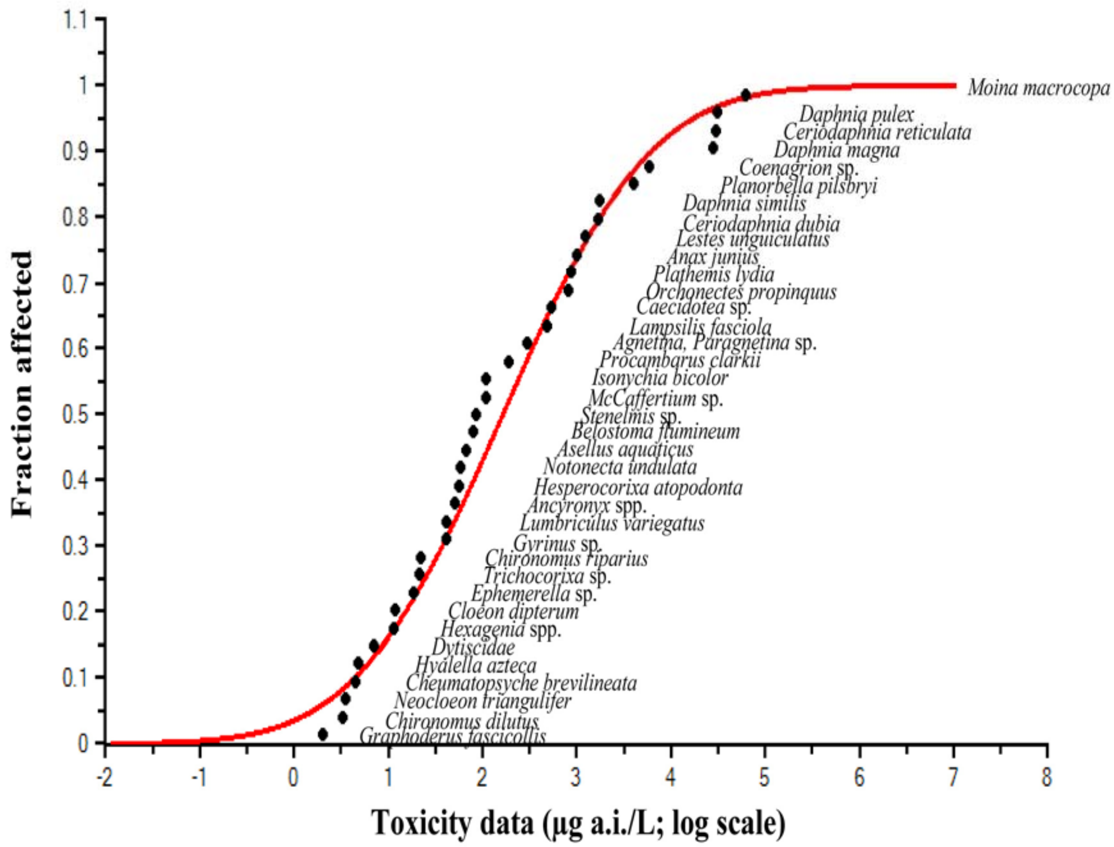


Figure A.4-1 SSD for acute toxicity of clothianidin to freshwater aquatic invertebrates.

Table A.4-3 Toxicity data used in the SSD for chronic effects of clothianadin on freshwater invertebrates.

Species count	Species name	NOEC/EC$_{10/20}$ (µg a.i./L)
1	*Daphnia magna*	120.0
2	*Chironomus riparius*[1]	0.46
3	*Hyalella azteca*	0.31
4	*Planorbella pilsbryi*	0.10
5	*Chironomus dilutus*	0.02

[1] Toxicity value based on geometric mean

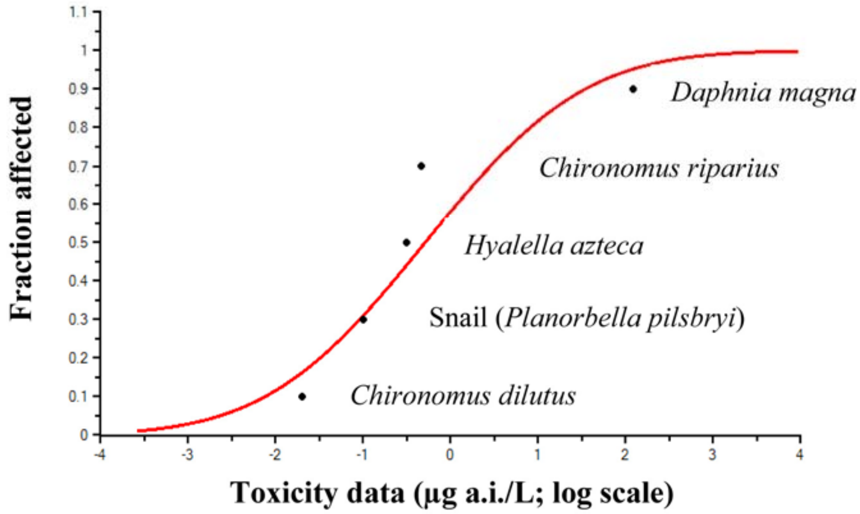


Figure A.4-2 SSD for chronic toxicity of clothianidin to freshwater aquatic invertebrates.

Comments on data handling for SSDs

Data sorting for use in the SSDs:

- The measurement endpoints used within data subsets are similar (exposure units, toxicity units) and appropriate to the duration category.
- The endpoints included in all data sets are those assumed to ultimately affect survival of the test organisms or populations.
- All short term exposure data are grouped together as “acute” (i.e., 24 hours, 48 hours, 96 hours, etc.) for individual taxonomic groups.
- All data which are considered to be “chronic” are grouped together for individual taxonomic groups (i.e., studies examining the survival or sub-lethal effects from long exposure periods).
- Geometric means of toxicity values are calculated for multiple endpoints for the same species.
- Where more than one measurement endpoint was available for a given study (e.g., both an EC_{50} and an LC_{50} are provided, or endpoints from multiple time periods), the more sensitive endpoint is used and not a geometric mean.
- Study results which are insufficient or not compatible for inclusion in either the acute or chronic distribution groups established for the current assessment were not used. This includes for example incompatible effects levels such as EC_{25}, different or unique exposure matrix studies and units, different exposure time/method, etc.

Additional notes on data handling specific to the current active:

- Toxicity data having no effects at the highest test concentration were excluded (e.g., EC_{50}>X) if there were other results to represent the species (consistent with EFSA (2013) guidance).
- In cases where only one study was available for a species and the resulting endpoint was unbound, i.e., a greater than or less than (</>) toxicity value, the endpoint was used to represent that species (consistent with EFSA (2013) guidance).
- Where both LC_{50} and EC_{50} values were available, the more sensitive value was used.
- For chronic effects, NOECs and EC_{10}/EC_{20} values were considered from studies with a water phase exposure.

Appendix V Estimated Environmental Concentrations from Spray Drift

Table A.5-1 Summary of highest cumulative clothianidin use rates according to application method

Ground and aerial Use Data							
Crop	**Formulation Type**	**Min single application rate (g a.i./ha)**	**Max single application rate (g a.i./ha)**	**Number of applications**	**Application interval (days)**	**Max seasonal rate (g a.i./ha)**	**Max cumulative seasonal rate (g a.i./ha)[1]**
Ground boom foliar spray							
Turf	Water dispersible granule	125	350	1	NA	350	350
Airblast foliar spray							
Stone fruits, Fruiting vegetables	Water dispersible granule	35	210	2 (only 1 at the maximum single rate)	7	210	210
Aerial application							
Potato	Water dispersible granule	35	52.5	3	7	157.5	152.2
In-furrow/soil drench application							
Sweet potato	Water dispersible granule	224	224	1	NA	224	224
Seed treatment							
Vegetables: Carrot, leek, onion, lettuce, broccoli, cabbage, pepper, tomato, Cucumber, melon, squash (summer, winter)	Wettable powder	419.6	419.6	1	NA	419.6	419.6
Wheat	Suspension	6.73	17.5	1	NA	17.5	17.5

[1] Maximum cumulative seasonal rate = maximum single application rate × number of applications, adjusted for degredation between applications using the 80th percentile of aerobic aquatic half-lives = 141 d and the application interval.

Table A.5-2 Screening level EECs of clothianidin and its transformation products in bodies of water 80 cm deep after direct application rates of 17.5 g a.i./ha (minimum seed treatment rate), 350 g a.i./ha (maximum foliar treatment rate) and 420 g a.i./ha (maximum seed treatment rate)

Compound	Alternate registrant code from thiamethoxam evaluation	Molecular weight (g/mol)	Ratio	17.5 g a.i./ha	350 g a.i./ha	420 g a.i./ha
				80 cm depth (µg a.i./L)		
Clothianidin	CGA 322704	249.68	1	2.19	43.8	52.6
TMG (N-(2-Chloro-5-thiazolylmethyl)-*N*=-methyguanidine)*	NOA 421275	204.68	0.820	1.80	35.9	43.1
MNG (N-Methyl-*N*=-nitroguanidine)	NOA 405217	118.09	0.473	1.04	20.7	24.9
TZNG (N-(2-chlorothiazol-5-ylmethyl)-*N*=-nitroguanidine)	CGA 265307	235.65	0.944	2.07	41.3	49.6
TZMU (N-(2-Chloro-5-thiazolylmethyl)-*N*=-methyurea)	CGA 353968	205.66	0.824	1.80	36.0	43.3
MU (Methylurea)		74.08	0.297	0.65	13.0	15.6
MAI (3-Methylamino-1H-imidazo [1,5-c]imidazole)		172.62	0.691	1.51	30.2	36.3
HMIO (4-Hydroxy-2-methylamino-2-imidazilin-5-one)		129.12	0.517	1.13	22.6	27.2
CTCA (2-Chlorothiazol-5-carboxylic acid)	CGA 359683	163.58	0.655	1.43	28.7	34.4
MG (Methylguanidine)	CGA 382191	73.097	0.293	0.64	12.8	15.4
NTG (Nitroguanidine)	NOA 424255	104.07	0.417	0.91	18.2	21.9
TZFA (Thiazolylformamidine)		226.13	0.906	1.98	39.6	47.6

*: major transformation product found in both clothianidin and thiamethoxam

Appendix VI Estimated Environmental Concentrations from Water Modelling

1.0 Introduction

The following sections summarize the EECs of clothianidin resulting from water modelling for aquatic ecoscenarios.

2.0 Modelling Estimates

2.1 Application Information and Model Inputs

Crops, application rates and timing for various regions were used for modelling ground and aerial foliar applications, ground in-furrow and seed treatments. Regional information on planting and seeding depths for seed treatments was considered. The shallowest depth in the range for seed treatment was assumed for "in-furrow" application for the corresponding crop. All application information is summarized in Table A.6-1.

Table A.6-1 Application rates, timing and other relevant information

Region	Crop	Use Pattern	Application method	Seed depth (cm)	Timing
BC	Vegetables (high rate)	1 × 419.6 g a.i./ha	Seed treatment	0.6–2.5	Early-March to late-June
	Vegetables (low rate)	1 × 4.7 g a.i./ha			
	Strawberry	1 × 224 g a.i./ha	Ground foliar	NA	Assumed same as for squash
	Squash/pumpkin	2 × 105 g a.i./ha at a 7-d interval	Ground foliar	NA	Early-May to late-September
Prairie	Canola	1 × 32.5 g a.i./ha	Seed treatment	1.2–5	17 April to 28 June
	Potato	1 × 381 g a.i./ha	Seed piece treatment	7–15	Early April to 15 June
	Potato	1 × 223.8 g a.i./ha	In-furrow	7 assumed	Early-April to 15 June
	Potato	3 × 52.5 g a.i./ha at a 10-d interval	Ground and aerial foliar	NA	Early-May to early-September
ON/QC	Canola	1 × 32.5 g a.i./ha	Seed treatment	0–3	1 April to 10 June
	Vegetables (high rate)	1 × 419.6 g a.i./ha	Seed treatment	1–2	15 April to 25 June
	Vegetables (low rate)	1 × 4.7 g a.i./ha			
	Potato	1 × 381 g a.i./ha	Seed piece treatment	5–12	15 April to 25 June
	Potato	1 × 223.8 g a.i./ha	In-furrow	5	15 April to 25 June
	Potato	3 × 52.5 g a.i./ha at a 10-d interval	Ground and aerial foliar	NA	Mid-May to mid-August
	Corn	1 × 118.3 g a.i./ha	Seed treatment	3.8–6.5	14 April to 30 June
	Squash/pumpkin	2 × 105 g a.i./ha at a 7-d interval	Ground foliar	NA	Early-May to early-October
Atlantic	Vegetables (high	1 × 419.6 g a.i./ha	Seed treatment	1.0	15 April to 20 June

Region	Crop	Use Pattern	Application method	Seed depth (cm)	Timing
	rate)				
	Vegetables (low rate)	1 × 4.7 g a.i./ha			
	Potato	1 × 381 g a.i./ha	Seed piece treatment	5–15	20 March to 15 June
	Potato	1 × 223.8 g a.i./ha	In-furrow	5	20 March to 15 June
	Potato	3 × 52.5 g a.i./ha at a 10-d interval	Ground and aerial foliar	NA	Late-June to mid-September
	Strawberry	1 × 224 g a.i./ha	Ground foliar	NA	Early-May to mid-August

The main environmental fate parameters used in the models are summarized in Table A.6-2.

Table A.6-2 Major groundwater and surface water model inputs for the ecoscenario assessment of clothianidin

Parameter	Value	Comment
Molecular weight (g/mol)	249.68	
Vapour pressure (mm Hg) at 25°C	9.75E-13	
Solubility (mg/L) in water	327	
Henry's law constant (unitless)	4.0E-14	
Photolysis half-life (day) at 33.45° latitude	0.6	Phoenix, Arizona
Hydrolysis at pH 7	stable	
K_{oc} (L/kg)	72.0	20th centile of 15 values
Soil half-life (day) at 20°C	1353	90th centile confidence on the mean of 17 values
Aerobic aquatic half-life at 20°C (day)	141	80th centile of 5 values
Anaerobic aquatic half-life at 20°C (day)	18.5	One value
Application efficiency	0.99, 1.0	ground foliar, in-furrow and seed treatment
Diffusion coefficient in air (cm^2/day)	4320	
Heat of Henry (J/mole)	59000	default in PWC

2.2 Aquatic Ecoscenario Assessment

The EECs of clothianidin from runoff into a receiving waterbody were simulated using the Pesticide in Water Calculator model (PWC version 1.52). The PWC model simulates pesticide runoff from a treated field into an adjacent body of water and the fate of a pesticide within it. Spray drift is not considered for this modelling. The waterbody used in the modelling is a 1-ha wetland with an average depth of 0.8 m and a drainage area of 10 ha. Pore water EECs in a 0.8-m wetland were also generated.

Various initial application dates were modelled (5 to 24 depending on the use patterns and application windows) with eight standard scenarios to cover all use patterns listed in Table A.6-1. For seed treatments where a range of seeding depths was available, the shallowest was selected for the modelling. Models were run for 50 years for all scenarios.

For each year of the simulation, PWC reports peak (or daily maximum) and time-averaged concentrations calculated by averaging the daily concentrations over five time periods (96-hour, 21-day, 60-day and 90-day). The 90th percentiles over each averaging period are reported as the EECs for that period.

The EECs were generated for all selected crops using runoff extraction parameters recommended inYoung and Fry (2017). These parameters include a runoff interaction fraction of 0.19, a maximum runoff interaction depth of 8 cm and an exponential decline coefficient of 1.4 cm^{-1}.

Specifically for seed treatments, PWC allows for different modelling approaches to determine pesticide concentrations in water. For the current modelling, two of these scenarios were selected: “at depth” and “increasing with depth”. The “at depth” scenario assumes that, at the time of application, the pesticide is present in soil only at the depth the seed is planted. This scenario was used for all the seed treatments selected for modelling. The “increasing with depth” scenario assumes that the pesticide concentration in soil at the time of application linearly increases with depth from the soil surface to the seeding depth. This scenario was used for corn, as these are larger seeds which are typically sown using pneumatic equipment. With this type of seeding method, as the seed penetrates the soil, there is deposition of seeding dust close to the surface and up to the final depth of the seed.

Modelled EECs are presented in Table A.6-3.

Table A.6-3 Modelled EECs (µg a.i./L) for clothianidin in a waterbody 0.8 m deep, excluding spray drift

Crop	Use rate	Region	EEC (µg a.i./L) in overlying water					EEC (µg a.i./L) in pore water	
			Peak	96-hour	21-day	60-day	90-day	Peak	21-day
Foliar uses									
Strawberry	1 × 224 g a.i./ha	BC	1.1	1.1	0.8	0.58	0.61	0.24	0.24
		Atlantic	11	10	8.2	5.2	3.9	2.3	2.3
Squash, pumpkin	2 × 105 g a.i./ha at a 7-d interval	BC	0.78	0.73	0.57	0.37	0.28	0.15	0.15
		ON	6.5	6.1	5	3.4	3.2	1.6	1.5
		QC	5.9	5.5	4.7	3.2	2.7	1.5	1.5
Potato	3 × 52.5 g a.i./ha at a 10-d interval	Prairie–MB	4.5	4.2	3.2	1.9	0.15	0.73	0.72
		ON	3.9	3.7	2.9	1.8	1.3	0.58	0.57
		QC	3.1	2.9	2.3	1.7	1.3	0.63	0.62
		Atlantic	4.1	3.9	3.1	2.2	1.7	0.88	0.87
In-furrow uses									
Potato	1 × 223.8 g a.i./ha	Prairie-MB	0.003	0.003	0.002	0.002	0.001	0.0007	0.0007
		ON	0.031	0.03	0.024	0.016	0.012	0.0065	0.0063
		QC	0.028	0.028	0.023	0.015	0.011	0.0066	0.0065
		Atlantic	0.068	0.066	0.054	0.034	0.025	0.015	0.015

Crop	Use rate	Region	EEC (µg a.i./L) in overlying water					EEC (µg a.i./L) in pore water	
			Peak	96-hour	21-day	60-day	90-day	Peak	21-day
Seed treatment uses modelled using "at depth" scenario									
Vegetables	1 × 419.6 g a.i./ha (high rate)	BC	3.2	3	2.3	1.5	1.1	0.65	0.64
		ON	10	9.5	8.6	5.9	4.4	2.5	2.4
		QC	13	13	11	6.8	5.1	3.1	3
		Atlantic	27	26	21	13	9.7	6	5.9
	1 × 4.7 g a.i./ha (low rate)	BC	0.035	0.033	0.026	0.016	0.012	0.007	0.007
		ON	0.11	0.11	0.096	0.066	0.050	0.028	0.027
		QC	0.15	0.14	0.12	0.076	0.057	0.034	0.033
		Atlantic	0.30	0.29	0.23	0.15	0.11	0.067	0.066
Canola	1 × 32.5 g a.i./ha	Prairie–SK	0.36	0.34	0.27	0.18	0.14	0.079	0.077
		Prairie–MB	0.55	0.55	0.46	0.3	0.23	0.14	0.13
		ON	2.8	2.6	2.1	1.4	1.1	0.62	0.6
		QC	4.2	4.1	3.6	2.5	1.9	1.5	1.4
Potato	1 × 381 g a.i./ha	Prairie–MB	0.005	0.004	0.004	0.003	0.002	0.001	0.001
		ON	0.053	0.05	0.041	0.027	0.02	0.011	0.011
		QC	0.048	0.047	0.038	0.025	0.019	0.011	0.011
		Atlantic	0.12	0.11	0.092	0.057	0.042	0.026	0.025
Corn	1 × 118.3 g a.i./ha	ON	0.082	0.078	0.064	0.041	0.031	0.018	0.017
		QC	0.084	0.081	0.066	0.043	0.032	0.02	0.019
Seed treatment uses modelled using "increasing with depth" scenario									
Corn	1 × 118.3 g a.i./ha	ON	0.76	0.71	0.65	0.45	0.34	0.19	0.18

Appendix VII Summary of Water Monitoring Analysis

Table A.7-1 Summary statistics for clothianidin measured in waterbodies from Prince Edward Island, Nova Scotia and New Brunswick.

NOTES:

-In calculations, the PMRA assigned a value equal to half the limit of detection to samples that showed no detection.
-The frequency of sampling and the length of the sampling period varied between data sets. Sampling generally occurred once or twice per month between May and October. Sampling at some sites occurred only a few times over a short time period, and values measured may not represent concentrations throughout the growing season.

Waterbody (Data source)	Major land use	Year	LOD (µg/L)	N	N detects	% Detection	Average (µg/L)	Stdev	Median (µg/L)	Max (µg/L)	N (% of samples) exceeding the toxicity endpoints			
											Chronic HC_5 of 0.0015 µg/L	Chronic EC_{20} of 0.02 µg/L	Mesocosm NOEC of 0.281 µg/L	Acute HC_5 of 1.5 µg/L
Prince Edward Island														
Clyde River (PMRA #2745506, 2468268)	Pasture, forest, potatoes, soybeans, other crops	2012	0.01	4	0	0	0.005	0	0.005	0.005	0 detects, 4 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
		2015	0.01	4	2	50	0.01	0.007	0.008	0.02	2 detects, 4 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Clyde River (PMRA #2845169)	Pasture, forest, potatoes, soybeans, other crops	2017	0.01	5	3	60	0.01	0.006	0.01	0.02	3 detects, 5 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Dunk River (PMRA #2745506, 2468268)	Pasture, forest, potatoes, other crops	2010	0.01	4	0	0	0.005	0	0.005	0.005	0 detects, 4 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
		2013	0.01	4	0	0	0.005	0	0.005	0.005	0 detects, 4 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Dunk River (PMRA #2845169)	Pasture, forest, potatoes, other crops	2017	0.01	5	5	100	0.022	0.008	0.02	0.03	5 (100%)	2 (40%)	0 (0%)	0 (0%)
Huntley River (PMRA #2745506, 2468268)	Pasture, potatoes, soybeans, other crops	2012	0.01	4	3	75	0.019	0.01	0.02	0.03	3 detects, 4 samples (100%)[1]	1 (25%)	0 (0%)	0 (0%)
		2015	0.01	4	4	100	0.12	0.082	0.09	0.24	4 (100%)	4 (100%)	0 (0%)	0 (0%)
Huntley River (PMRA #2845169)	Pasture, potatoes, soybeans, other crops	2017	0.01	5	5	100	0.24	0.044	0.26	0.28	5 (100%)	5 (100%)	0 (0%)	0 (0%)
Mill River (PMRA #2745506, 2468268)	Forest, potatoes, soybeans, other crops	2011	0.01	4	0	0	0.005	0	0.005	0.005	0 detects, 4 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
		2014	0.01	4	4	100	0.015	0.006	0.015	0.02	4 (100%)	0 (0%)	0 (0%)	0 (0%)

Waterbody (Data source)	**Major land use**	**Year**	**LOD (µg/L)**	**N**	**N detects**	**% Detection**	**Average (µg/L)**	**Stdev**	**Median (µg/L)**	**Max (µg/L)**	**N (% of samples) exceeding the toxicity endpoints**			
											Chronic HC_5 of 0.0015 µg/L	**Chronic EC_{20} of 0.02 µg/L**	**Mesocosm NOEC of 0.281 µg/L**	**Acute HC_5 of 1.5 µg/L**
Mill River (PMRA #2845169)	Forest, potatoes, soybeans, other crops	2017	0.01	5	5	100	0.086	0.03	0.09	0.12	5 (100%)	5 (100%)	0 (0%)	0 (0%)
Montague River (PMRA #2745506, 2468268)	Forest, potatoes, soybeans, wheat, other crops	2011	0.01	4	0	0	0.005	0	0.005	0.005	0 detects, 4 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
		2014	0.01	4	4	100	0.015	0.006	0.015	0.02	4 (100%)	0 (0%)	0 (0%)	0 (0%)
Montague River (PMRA #2845169)	Forest, potatoes, soybeans, wheat, other crops	2017	0.01	5	5	100	0.038	0.008	0.04	0.05	5 (100%)	5 (100%)	0 (0%)	0 (0%)
Morell River (PMRA #2745506, 2468268)	Mainly not cultivated (forest, shrubland, pasture)	2010	0.01	4	0	0	0.005	0	0.005	0.005	0 detects, 4 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
		2013	0.01	4	0	0	0.005	0	0.005	0.005	0 detects, 4 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Morell River (PMRA #2845169)	Mainly not cultivated (forest, shrubland, pasture)	2017	0.01	5	0	0	0.005	0	0.005	0.005	0 detects, 5 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
West River (PMRA #2745506, 2468268)	Mainly not cultivated (forest, shrubland, pasture)	2010	0.01	4	0	0	0.005	0	0.005	0.005	0 detects, 4 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
		2013	0.01	4	0	0	0.005	0	0.005	0.005	0 detects, 4 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
West River (PMRA #2845169)	Mainly not cultivated (forest, shrubland, pasture)	2017	0.01	5	0	0	0.005	0	0.005	0.005	0 detects, 5 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Wilmot River (PMRA #2745506, 2468268)	Potatoes, soybeans, other crops, pasture	2012	0.01	4	3	75	0.014	0.008	0.015	0.02	3 detects, 4 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
		2015	0.01	4	4	100	0.02	0.008	0.02	0.03	4 (100%)	1 (25%)	0 (0%)	0 (0%)
Wilmot River (PMRA #2834289, 2745820)	Potatoes, soybeans, other crops, pasture	2015	0.00176	6	4	67	0.017	0.015	0.018	0.039	4 (67%)	2 (33%)	0 (0%)	0 (0%)
		2016	0.00176	3	3	100	0.047	0.009	0.043	0.057	3 (100%)	3 (100%)	0 (0%)	0 (0%)
Wilmot River (PMRA #2845169)	Potatoes, soybeans, other crops, pasture	2017	0.01	5	5	100	0.31	0.56	0.06	1.3	5 (100%)	5 (100%)	1 (20%)	0 (0%)
Winter River (PMRA #2745506, 2468268)	Corn, soybeans, cereals, fruit, vegetables	2011	0.01	4	0	0	0.005	0	0.005	0.005	0 detects, 4 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
		2014	0.01	4	0	0	0.005	0	0.005	0.005	0 detects, 4 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Winter River (PMRA #2845169)	Potatoes, barley, wheat, corn	2017	0.01	5	5	100	0.022	0.008	0.02	0.03	5 (100%)	2 (40%)	0 (0%)	0 (0%)

Waterbody (Data source)	Major land use	Year	LOD (µg/L)	N	N detects	% Detection	Average (µg/L)	Stdev	Median (µg/L)	Max (µg/L)	N (% of samples) exceeding the toxicity endpoints			
											Chronic HC_5 of 0.0015 µg/L	Chronic EC_{20} of 0.02 µg/L	Mesocosm NOEC of 0.281 µg/L	Acute HC_5 of 1.5 µg/L
New Brunswick														
Big Presqu'île CMP station (PMRA #2834289, 2745820)	Potatoes, corn, other crops	2015	0.00176	7	1	14	0.003	0.004	0.0009	0.013	1 (14%)	0 (0%)	0 (0%)	0 (0%)
Nova Scotia														
Cornwallis River (PMRA #2834289, 2745820)	Urban, potatoes, corn, other crops	2015	0.00176	6	6	100	0.009	0.003	0.008	0.013	6 (100%)	0 (0%)	0 (0%)	0 (0%)
		2016	0.00176	1	1	100	0.003	NA	0.003	0.003	1 (100%)	0 (0%)	0 (0%)	0 (0%)
Coleman Brook (PMRA #2834289, 2745820)	Forest, shrubland, wheat, corn, other crops	2016	0.00176	1	1	100	0.017	NA	0.017	0.017	1 (100%)	1 (100%)	0 (0%)	0 (0%)
Rand Brook (PMRA #2834289, 2745820)	Corn, pasture, other crops, wheat	2016	0.00176	1	1	100	0.008	NA	0.008	0.008	1 (100%)	0 (0%)	0 (0%)	0 (0%)
Skinner Brook (PMRA #2834289, 2745820)	Cranberries, corn, urban, potatoes, other crops	2016	0.00176	1	1	100	0.013	NA	0.013	0.013	1 (100%)	1 (100%)	0 (0%)	0 (0%)
Watton Brook (PMRA #2834289, 2745820)	Urban, shrubland, pasture and forages	2016	0.00176	1	0	0	0.0009	NA	0.0009	0.0009	0 (0%)	0 (0%)	0 (0%)	0 (0%)

LOD = limit of detection;
N = sample size;
Stdev = standard deviation;
Chronic HC_5 = the 5th percentile of the species sensitivity distribution for the NOEC at 50% confidence intervals;
EC_{20} = effective concentration on 20% of the population (it is the most sensitive single species chronic endpoint for clothianidin);
NOEC = no observable effect concentration;
Acute HC_5 = the 5th percentile of the species sensitivity distribution for the LC_{50} (the median lethal concentration) at 50% confidence intervals;
NA = not applicable
[1]The LOD is more than two times higher than the chronic HC_5 of 0.0015 µg/L. Assigning half the limit of detection to non-detected samples still results in a concentration exceeding the toxicity endpoint. Thus, all samples, including non-detects at half the limit of detection, exceed the toxicity endpoint.

Table A.7-2 Risk quotients for clothianidin measured in waterbodies located in Prince Edward Island, Nova Scotia and New Brunswick.

NOTES:

-Shaded cells indicate the level of concern is exceeded, meaning that the risk quotient is equal to or greater than a value of 1.
-The frequency of sampling and the length of the sampling period varied between data sets. Sampling generally occurred once or twice per month between May and October. Sampling at some sites occurred only a few times over a short time period, and values measured may not represent concentrations throughout the growing season.

Waterbody (Data source)	Major land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Acute HC_5 (1.5 µg/L)
Prince Edward Island										
Clyde River (PMRA #2745506, 2468268)	Pasture, forest, potatoes, soybeans, other crops	2012	4	3.3[4]	0.3	< 0.1	3.3[4]	0.3	< 0.1	< 0.1
		2015	4	6.7	0.5	< 0.1	5	0.4	< 0.1	< 0.1
Clyde River (PMRA #2845169)	Pasture, forest, potatoes, soybeans, other crops	2017	5	6.7	0.5	< 0.1	6.7	0.5	< 0.1	< 0.1
Dunk River (PMRA #2745506, 2468268)	Pasture, forest, potatoes, other crops	2010	4	3.3[4]	0.3	< 0.1	3.3[4]	0.3	< 0.1	< 0.1
		2013	4	3.3[4]	0.3	< 0.1	3.3[4]	0.3	< 0.1	< 0.1
Dunk River (PMRA #2845169)	Pasture, forest, potatoes, other crops	2017	5	15	1.1	0.1	13	1	0.1	< 0.1
Huntley River (PMRA #2745506, 2468268)	Pasture, potatoes, soybeans, other crops	2012	4	13	0.9	0.1	13	1	0.4	< 0.1
		2015	4	80	6	0.4	60	4.5	0.3	0.2
Huntley River (PMRA #2845169)	Pasture, potatoes, soybeans, other crops	2017	5	163	12	0.9	173	13	0.9	0.2
Mill River (PMRA #2745506, 2468268)	Forest, potatoes, soybeans, other crops	2011	4	3.3[4]	0.3	< 0.1	3.3[4]	0.3	< 0.1	< 0.1
		2014	4	10	0.8	0.1	10	0.8	0.1	< 0.1

Waterbody (Data source)	Major land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Acute HC_5 (1.5 µg/L)
Mill River (PMRA #2845169)	Forest, potatoes, soybeans, other crops	2017	5	57	4.3	0.3	60	4.5	0.3	0.1
Montague River (PMRA #2745506, 2468268)	Forest, potatoes, soybeans, wheat, other crops	2011	4	3.3[4]	0.3	< 0.1	3.3[4]	0.3	< 0.1	< 0.1
		2014	4	10	0.8	< 0.1	10	0.8	< 0.1	< 0.1
Montague River (PMRA #2845169)	Forest, potatoes, soybeans, wheat, other crops	2017	5	25	1.9	0.1	27	2	0.1	< 0.1
Morell River (PMRA #2745506, 2468268)	Mainly not cultivated (forest, shrubland, pasture)	2010	4	3.3[4]	0.3	< 0.1	3.3[4]	0.3	< 0.1	< 0.1
		2013	4	3.3[4]	0.3	< 0.1	3.3[4]	0.3	< 0.1	< 0.1
Morell River (PMRA #2845169)	Mainly not cultivated (forest, shrubland, pasture)	2017	5	3.3[4]	0.3	< 0.1	3.3[4]	0.3	< 0.1	< 0.1
West River (PMRA #2745506, 2468268)	Mainly not cultivated (forest, shrubland, pasture)	2010	4	3.3[4]	0.3	< 0.1	3.3[4]	0.3	< 0.1	< 0.1
		2013	4	3.3[4]	0.3	< 0.1	3.3[4]	0.3	< 0.1	< 0.1
West River (PMRA #2845169)	Mainly not cultivated (forest, shrubland, pasture)	2017	5	3.3[4]	0.3	< 0.1	3.3[4]	0.3	< 0.1	< 0.1
Wilmot River (PMRA #2745506, 2468268)	Potatoes, soybeans, other crops, pasture	2012	4	9.2	0.7	< 0.1	10	0.8	< 0.1	< 0.1
		2015	4	13	1	0.1	13	1	0.1	< 0.1
Wilmot River (PMRA #2834289, 2745820)	Potatoes, soybeans, other crops, pasture	2015	6	12	0.9	0.1	12	0.9	0.1	< 0.1
		2016	3	31	2.4	0.2	29	2.2	0.2	< 0.1
Wilmot River (PMRA #2845169)	Potatoes, soybeans, other crops, pasture	2017	5	203	15	1.1	40	3	0.2	0.9
Winter River (PMRA #2745506, 2468268)	Corn, soybeans, cereals, fruit, vegetables	2011	4	3.3[4]	0.3	< 0.1	3.3[4]	0.3	< 0.1	< 0.1
		2014	4	3.3[4]	0.3	< 0.1	3.3[4]	0.3	< 0.1	< 0.1

Waterbody (Data source)	Major land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Acute HC_5 (1.5 µg/L)
Winter River (PMRA#2845169)	Potatoes, barley, wheat, corn	2017	5	15	1.1	0.1	13	1	0.1	< 0.1
New Brunswick										
Big Presqu'île CMP station (PMRA #2834289, #2745820)	Urban, potatoes, corn, other crops	2015	7	1.7	0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
Nova Scotia										
Cornwallis River (PMRA #2834289, #2745820)	Urban, potatoes, corn, other crops	2015	6	6	0.5	< 0.1	5.2	0.4	< 0.1	< 0.1
		2016	1	1.7	0.1	< 0.1	1.7	0.1	< 0.1	< 0.1
Coleman Brook (PMRA #2834289, #2745820)	Forest, shrubland, wheat, corn, other crops	2016	1	11	0.8	0.1	11	0.8	0.1	< 0.1
Rand Brook (PMRA #2834289, #2745820)	Corn, pasture, other crops, wheat	2016	1	5.3	0.4	< 0.1	5.3	0.4	< 0.1	< 0.1
Skinner Brook (PMRA #2834289, #2745820)	Cranberries, corn, urban, potatoes, other crops	2016	1	8.3	0.6	< 0.1	8.3	0.6	< 0.1	< 0.1
Watton Brook (PMRA #2834289, #2745820)	Urban, shrubland, pasture and forages	2016	1	0.6	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1

N = sample size;
Chronic HC_5 = the 5th percentile of the species sensitivity distribution for the NOEC at 50% confidence intervals;
EC_{20} = effective concentration on 20% of the population (it is the most sensitive single species chronic endpoint for clothianidin);
NOEC = no observable effect concentration;
Acute HC_5 = the 5th percentile of the species sensitivity distribution for the LC_{50} (the median lethal concentration) at 50% confidence intervals
[1]Risk Quotient = concentration ÷ toxicity endpoint
[2]Average, median and maximum concentrations measured over the sampling period are reported in Table A.7-1.
[3]Because monitoring may not capture peak concentrations, maximum concentrations may be underestimated.
[4]The limit of detection for these samples was more than two times higher than the chronic endpoint. Even though clothianidin was not detected in any samples, assigning half the limit of detection to non-detected samples still results in average and median concentrations which exceed the chronic toxicity endpoint. Thus, calculated risk quotients exceed the level of concern.

Table A.7-3 Summary statistics for clothianidin measured in waterbodies from Quebec.

NOTES:

-In calculations, the PMRA assigned a value equal to half the limit of detection to samples that showed no detection.

-The frequency of sampling and the length of the sampling period varied between data sets. Sampling generally occurred one to three times per week between May and August. Sampling at two sites occurred only once, and values measured at these sites may not represent concentrations throughout the growing season.

Waterbody (Data source)	**Major land use**	**Year**	**LOD (µg/L)**	**N**	**N detects**	**% Detection**	**Average (µg/L)**	**Stdev**	**Median (µg/L)**	**Max (µg/L)**	**N (% of samples) exceeding the toxicity endpoints**			
											Chronic HC_5 of 0.0015 µg/L	**Chronic EC_{20} of 0.02 µg/L**	**Mesocosm NOEC of 0.281 µg/L**	**Acute HC_5 of 1.5 µg/L**
Chibouet River (PMRA #2523837, #2561884, #2709791, #2821395)	Corn, soybeans	2012	0.002	30	30	100	0.026	0.038	0.017	0.21	30 (100%)	11 (37%)	0 (0%)	0 (0%)
		2013	0.002	30	29	97	0.031	0.034	0.018	0.15	29 (97%)	13 (43%)	0 (0%)	0 (0%)
		2014	0.002	29	29	100	0.027	0.028	0.018	0.14	29 (100%)	11 (38%)	0 (0%)	0 (0%)
		2015	0.002	29	29	100	0.064	0.1	0.034	0.52	29 (100%)	25 (86%)	1 (3%)	0 (0%)
		2016	0.002	30	26	87	0.05	0.05	0.037	0.26	26 (87%)	25 (83%)	0 (0%)	0 (0%)
		2017	0.005	22	15	68	0.023	0.022	0.024	0.099	15 detects, 22 samples (100%)[1]	12 (55%)	0 (0%)	0 (0%)
Des Hurons River (PMRA #2523837, #2561884, #2709791, #2821395)	Corn, soybeans	2012	0.002	29	26	90	0.041	0.052	0.019	0.23	26 (90%)	13 (43%)	0 (0%)	0 (0%)
		2013	0.002	29	23	79	0.017	0.028	0.01	0.13	23 (79%)	3 (10%)	0 (0%)	0 (0%)
		2014	0.002	30	28	93	0.04	0.078	0.016	0.42	28 (93%)	11 (37%)	1 (3%)	0 (0%)
		2015	0.002	30	30	100	0.051	0.031	0.044	0.14	30 (100%)	27 (90%)	0 (0%)	0 (0%)
		2016	0.002	29	28	97	0.058	0.072	0.028	0.34	28 (97%)	18 (62%)	1 (3%)	0 (0%)
		2017	0.005	23	18	78	0.031	0.032	0.025	0.14	18 detects, 23 samples (100%)[1]	12 (52%)	0 (0%)	0 (0%)
Saint-Régis River (PMRA #2523837, #2561884, #2709791, #2821395)	Corn, soybeans	2012	0.002	30	29	97	0.028	0.071	0.008	0.37	29 (97%)	6 (20%)	1 (3%)	0 (0%)
		2013	0.002	30	29	97	0.033	0.056	0.009	0.2	29 (97%)	7 (23%)	0 (0%)	0 (0%)
		2014	0.002	29	28	97	0.033	0.044	0.009	0.17	28 (97%)	12 (41%)	0 (0%)	0 (0%)
		2015	0.002	30	30	100	0.023	0.02	0.015	0.076	30 (100%)	10 (33%)	0 (0%)	0 (0%)
		2016	0.002	30	27	90	0.032	0.044	0.015	0.22	27 (90%)	15 (50%)	0 (0%)	0 (0%)
		2017	0.005	24	15	63	0.018	0.019	0.015	0.083	15 detects, 24 samples (100%)[1]	8 (33%)	0 (0%)	0 (0%)
Saint-Zéphirin River (PMRA #2523837, #2561884, #2709791, #2821395)	Corn, soybeans	2012	0.002	30	30	100	0.039	0.037	0.023	0.17	30 (100%)	20 (67%)	0 (0%)	0 (0%)
		2013	0.002	30	30	100	0.029	0.033	0.019	0.15	30 (100%)	13 (43%)	0 (0%)	0 (0%)
		2014	0.002	29	29	100	0.024	0.026	0.017	0.13	29 (100%)	9 (31%)	0 (0%)	0 (0%)
		2015	0.002	30	30	100	0.052	0.045	0.038	0.20	30 (100%)	29 (97%)	0 (0%)	0 (0%)
		2016	0.002	30	30	100	0.066	0.053	0.051	0.31	30 (100%)	29 (97%)	1 (3%)	0 (0%)
		2017	0.005	23	23	100	0.041	0.02	0.035	0.08	23 (100%)	22 (96%)	0 (0%)	0 (0%)
Blanche River (PMRA #2544468, #2821395)	Potatoes, corn, cereals	2012	0.002	24	24	100	0.07	0.023	0.072	0.11	24 (100%)	24 (100%)	0 (0%)	0 (0%)
		2017	0.005	30	30	100	0.24	0.066	0.24	0.35	30 (100%)	30 (100%)	10 (33%)	0 (0%)

Waterbody (Data source)	Major land use	Year	LOD (µg/L)	N	N detects	% Detection	Average (µg/L)	Stdev	Median (µg/L)	Max (µg/L)	N (% of samples) exceeding the toxicity endpoints			
											Chronic HC_5 of 0.0015 µg/L	Chronic EC_{20} of 0.02 µg/L	Mesocosm NOEC of 0.281 µg/L	Acute HC_5 of 1.5 µg/L
Chartier Creek (PMRA #2523837, #2544468, #2821395)	Potatoes, corn, cereals	2010	0.001	27	27	100	0.031	0.034	0.017	0.15	27 (100%)	12 (44%)	0 (0%)	0 (0%)
		2012	0.002	28	28	100	0.1	0.086	0.067	0.26	28 (100%)	25 (89%)	0 (0%)	0 (0%)
		2017	0.005	30	30	100	0.19	0.091	0.19	0.38	30 (100%)	30 (100%)	4 (13%)	0 (0%)
Point-du-Jour Creek (PMRA #2523837, #2544468, #2821395)	Potatoes, corn, soybeans, cereals	2010	0.001	27	27	100	0.005	0.005	0.005	0.023	20 (74%)	1 (4%)	0 (0%)	0 (0%)
		2012	0.002	28	28	100	0.022	0.014	0.016	0.075	28 (100%)	10 (36%)	0 (0%)	0 (0%)
		2017	0.005	29	28	97	0.061	0.12	0.042	0.68	28 detects, 29 samples (100%)[1]	27 (93%)	1 (3%)	0 (0%)
Déversant-du-Lac Creek (PMRA #2523837, #2544468, #2821394, #2821395)	Orchards, corn, soybeans, cereals	2010	0.001	30	23	77	0.005	0.006	0.003	0.023	18 (60%)	1 (3%)	0 (0%)	0 (0%)
		2011	0.001	31	28	90	0.007	0.009	0.005	0.047	26 (84%)	2 (6%)	0 (0%)	0 (0%)
		2015	0.001	28	7	25	0.009	0.021	0.0005	0.089	7 (25%)	4 (14%)	0 (0%)	0 (0%)
		2016	0.001	30	2	7	0.005	0.016	0.0005	0.068	2 (7%)	2 (7%)	0 (0%)	0 (0%)
Rousse Creek (PMRA #2523837, #2544468, #2821394, #2821395)	Orchards, corn, soybeans, vegetables	2010	0.001	29	2	7	0.001	0.001	0.0005	0.004	2 (7%)	0 (0%)	0 (0%)	0 (0%)
		2011	0.001	27	6	22	0.002	0.004	0.0005	0.019	4 (15%)	0 (0%)	0 (0%)	0 (0%)
		2015	0.001	29	0	0	0.0005	0	0.0005	0.0005	0 (0%)	0 (0%)	0 (0%)	0 (0%)
		2016	0.001	30	1	3	0.001	0.001	0.0005	0.005	1 (3%)	0 (0%)	0 (0%)	0 (0%)
Gibeault-Delisle Creek (PMRA #2709793, #2821394)	Vegetables, potatoes, corn, soybeans	2013	0.001	28	28	100	0.88	2.1	0.32	11	28 (100%)	27 (96%)	15 (54%)	3 (11%)
		2014	0.001	30	30	100	0.55	1.2	0.25	6.9	30 (100%)	30 (100%)	13 (43%)	1 (3%)
Norton Creek (PMRA #2709793, #2821394)	Vegetables, potatoes, corn, soybeans	2013	0.001	27	27	100	0.057	0.078	0.038	0.43	27 (100%)	21 (78%)	1 (4%)	0 (0%)
		2014	0.001	30	30	100	0.047	0.039	0.038	0.18	30 (100%)	24 (80%)	0 (0%)	0 (0%)
Yamaska River (PMRA# 2561884, 2821395)	Mixed crops, corn, soybeans	2014	0.002	10	10	100	0.028	0.035	0.016	0.11	10 (100%)	2 (20%)	0 (0%)	0 (0%)
		2016	0.002	9	9	100	0.046	0.07	0.02	0.23	9 (100%)	3 (33%)	0 (0%)	0 (0%)
		2017	0.005	9	6	67	0.026	0.031	0.018	0.1	6 detects, 9 samples (100%)[1]	4 (44%)	0 (0%)	0 (0%)
À la Barbue River (PMRA #2561884)	Mixed crops, corn, soybeans	2013	0.001	10	10	100	0.038	0.041	0.028	0.14	10 (100%)	6 (60%)	0 (0%)	0 (0%)
À la Tortue River (PMRA #2523837, #2561884)	Mixed crops, corn, soybeans	2012	0.002	11	11	100	0.062	0.07	0.041	0.26	11 (100%)	8 (92%)	0 (0%)	0 (0%)
Bayonne River (PMRA #2523837, #2561884)	Mixed crops, corn, soybeans	2012	0.002	11	10	91	0.012	0.014	0.006	0.043	10 (91%)	2 (18%)	0 (0%)	0 (0%)

Waterbody (Data source)	Major land use	Year	LOD (µg/L)	N	N detects	% Detection	Average (µg/L)	Stdev	Median (µg/L)	Max (µg/L)	N (% of samples) exceeding the toxicity endpoints			
											Chronic HC_5 of 0.0015 µg/L	Chronic EC_{20} of 0.02 µg/L	Mesocosm NOEC of 0.281 µg/L	Acute HC_5 of 1.5 µg/L
Bécancour River (PMRA #2561884)	Mixed crops, corn, soybeans	2014	0.001	11	2	18	0.004	0.008	0.0005	0.021	2 (18%)	1 (9%)	0 (0%)	0 (0%)
La Chaloupe River (PMRA #2523837, #2561884)	Mixed crops, corn, soybeans	2012	0.002	10	10	100	0.045	0.051	0.021	0.16	10 (100%)	5 (50%)	0 (0%)	0 (0%)
Champlain River (PMRA #2561884)	Mixed crops, corn, soybeans	2013	0.002	11	11	100	0.007	0.004	0.007	0.017	11 (100%)	0 (0%)	0 (0%)	0 (0%)
Châteauguay River (PMRA #2523837, #2561884)	Mixed crops, corn, soybeans	2012	0.002	11	11	100	0.024	0.03	0.012	0.11	11 (100%)	3 (27%)	0 (0%)	0 (0%)
De l'Achigan River (PMRA #2523837, #2561884)	Mixed crops, corn, soybeans	2012	0.002	10	10	100	0.013	0.009	0.008	0.035	10 (100%)	2 (20%)	0 (0%)	0 (0%)
L'Assomption River (PMRA #2523837, #2561884)	Mixed crops, corn, soybeans	2012	0.002	11	9	82	0.007	0.007	0.005	0.025	9 (82%)	1 (9%)	0 (0%)	0 (0%)
Chicot River (PMRA #2523837, #2561884)	Mixed crops, corn, soybeans	2012	0.002	11	8	73	0.005	0.005	0.004	0.018	8 (73%)	0 (0%)	0 (0%)	0 (0%)
Delisle River (PMRA #2523837, #2561884)	Mixed crops, corn, soybeans	2012	0.002	11	7	64	0.012	0.021	0.004	0.07	7 (64%)	2 (18%)	0 (0%)	0 (0%)
Rouge River (PMRA #2523837, #2561884)	Mixed crops, corn, soybeans	2012	0.002	10	10	100	0.031	0.04	0.015	0.13	10 (100%)	3 (30%)	0 (0%)	0 (0%)
Du Loup River (PMRA #2561884)	Mixed crops, corn, soybeans	2013	0.001	10	10	100	0.008	0.005	0.008	0.016	10 (100%)	0 (0%)	0 (0%)	0 (0%)
Gentilly River (PMRA #2561884)	Mixed crops, corn, soybeans	2014	0.001	11	4	36	0.003	0.004	0.0005	0.015	4 (36%)	0 (0%)	0 (0%)	0 (0%)
L'Acadie River (PMRA #2561884)	Mixed crops, corn, soybeans	2013	0.002	10	10	100	0.04	0.03	0.030	0.096	10 (100%)	6 (60%)	0 (0%)	0 (0%)
Mascouche River (PMRA #2561884)	Mixed crops, corn, soybeans	2013	0.002	10	10	100	0.016	0.013	0.012	0.039	10 (100%)	3 (30%)	0 (0%)	0 (0%)
Maskinongé River (PMRA #2561884)	Mixed crops, corn, soybeans	2013	0.002	11	3	27	0.003	0.006	0.001	0.021	3 (27%)	1 (9%)	0 (0%)	0 (0%)
Nicolet River (PMRA #2561884)	Mixed crops, corn, soybeans	2014	0.001	11	8	73	0.007	0.012	0.003	0.041	8 (73%)	1 (9%)	0 (0%)	0 (0%)
Noire River (PMRA# 2561884)	Mixed crops, corn, soybeans	2013	0.002	11	11	100	0.012	0.006	0.012	0.022	11 (100%)	1 (9%)	0 (0%)	0 (0%)

Waterbody (Data source)	Major land use	Year	LOD (µg/L)	N	N detects	% Detection	Average (µg/L)	Stdev	Median (µg/L)	Max (µg/L)	N (% of samples) exceeding the toxicity endpoints			
											Chronic HC_5 of 0.0015 µg/L	Chronic EC_{20} of 0.02 µg/L	Mesocosm NOEC of 0.281 µg/L	Acute HC_5 of 1.5 µg/L
Saint-François River (PMRA #2561884)	Mixed crops, corn, soybeans	2014	0.001	11	2	18	0.002	0.003	0.001	0.009	2 (18%)	0 (0%)	0 (0%)	0 (0%)
Saint-Germain River (PMRA #2561884)	Mixed crops, corn, soybeans	2013	0.002	11	9	82	0.009	0.008	0.007	0.022	9 (82%)	1 (9%)	0 (0%)	0 (0%)
Yamachiche River (PMRA #2561884)	Mixed crops, corn, soybeans	2013	0.002	11	11	100	0.005	0.002	0.005	0.01	11 (100%)	0 (0%)	0 (0%)	0 (0%)
À l'Ours River (PMRA #2821395)	Mixed crops	2017	0.005	10	10	100	0.023	0.006	0.022	0.036	10 (100%)	6 (60%)	0 (0%)	0 (0%)
Beaurivage River (PMRA #2709792)	Mixed crops	2015	0.002	11	11	100	0.015	0.012	0.01	0.038	11 (100%)	3 (27%)	0 (0%)	0 (0%)
Boyer River (PMRA #2709792, #2821395)	Mixed crops	2016	0.002	11	11	100	0.031	0.015	0.031	0.068	11 (100%)	8 (73%)	0 (0%)	0 (0%)
Chaudière River (2 sites) (PMRA #2709792)	Mixed crops	2015	0.002	11	8	73	0.005	0.004	0.004	0.016	8 (73%)	0 (0%)	0 (0%)	0 (0%)
Du Chêne River (PMRA #2709792)	Mixed crops	2015	0.002	11	10	91	0.012	0.015	0.006	0.044	10 (91%)	2 (18%)	0 (0%)	0 (0%)
Du Sud River (PMRA #2709792, #2821395)	Mixed crops	2016	0.002	11	2	18	0.002	0.002	0.001	0.005	2 (18%)	0 (0%)	0 (0%)	0 (0%)
Etchemin River (PMRA #2709792)	Mixed crops	2015	0.002	11	9	82	0.014	0.021	0.005	0.067	9 (82%)	2 (18%)	0 (0%)	0 (0%)
Le Bras River (PMRA #2709792)	Mixed crops	2015	0.002	11	11	100	0.037	0.037	0.022	0.12	11 (100%)	7 (64%)	0 (0%)	0 (0%)
Mistassini River (PMRA #2821395)	Mixed crops	2017	0.005	11	0	0	0.003	0	0.003	0.003	0 detects, 11 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Mistouk River (PMRA #2821395)	Mixed crops	2017	0.005	11	0	0	0.003	0	0.003	0.003	0 detects, 11 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Moreau River (PMRA #2821395)	Mixed crops	2017	0.005	11	0	0	0.003	0	0.003	0.003	0 detects, 11 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Richelieu River (PMRA #2709792, #2821395)	Mixed crops	2016	0.002	10	2	20	0.004	0.007	0.001	0.024	2 (20%)	1 (10%)	0 (0%)	0 (0%)
Ruisseau puant près du rang Sainte-Anne (PMRA #2821395)	Mixed crops	2017	0.005	11	0	0	0.003	0	0.003	0.003	0 detects, 11 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)

Waterbody (Data source)	Major land use	Year	LOD (µg/L)	N	N detects	% Detection	Average (µg/L)	Stdev	Median (µg/L)	Max (µg/L)	N (% of samples) exceeding the toxicity endpoints			
											Chronic HC_5 of 0.0015 µg/L	Chronic EC_{20} of 0.02 µg/L	Mesocosm NOEC of 0.281 µg/L	Acute HC_5 of 1.5 µg/L
Ticouapé River (PMRA #2821395)	Mixed crops	2017	0.005	11	0	0	0.003	0	0.003	0.003	0 detects, 11 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Saint-Pierre Lake (3 sites) (PMRA #2821395)	Corn, soybeans, wheat, potatoes, urban	2017	0.005	33	3	9	0.003	0.003	0.003	0.02	3 detects, 33 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Ditch (PMRA #2548877)	Agriculture	2013	0.001 (LOQ)	1	0	0	0.0005	NA	0.0005	0.0005	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Stream (PMRA #2548876)	Agriculture	2014	0.0022	1	1	100	0.084	NA	0.084	0.084	1 (100%)	1 (100%)	0 (0%)	0 (0%)

LOD = limit of detection;
N = sample size;
Stdev = standard deviation;
Chronic HC_5 = the 5th percentile of the species sensitivity distribution for the NOEC at 50% confidence intervals;
EC_{20} = effective concentration on 20% of the population (it is the most sensitive single species chronic endpoint for clothianidin);
NOEC = no observable effect concentration;
Acute HC_5 = the 5th percentile of the species sensitivity distribution for the LC_{50} (the median lethal concentration) at 50% confidence intervals
[1]The LOD is more than two times higher than the chronic HC_5 of 0.0015 µg/L. Assigning half the limit of detection to non-detected samples still results in a concentration exceeding the toxicity endpoint. Thus, all samples, including non-detects at half the limit of detection, exceed the toxicity endpoint.

Table A.7-4 Risk quotients for clothianidin measured in waterbodies located in Quebec.

NOTES:

-Shaded cells indicate the level of concern is exceeded, meaning that the risk quotient is equal to or greater than a value of 1.

-The frequency of sampling and the length of the sampling period varied between data sets. Sampling generally occurred one to three times per week between May and August. Sampling at two sites occurred only once, and values measured at these sites may not represent concentrations throughout the growing season.

Waterbody (Data source)	Major land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Acute HC_5 (1.5 µg/L)
Chibouet River (PMRA #2523837,	Corn, soybeans	2012	30	17	1.3	0.1	11	0.9	0.1	0.1
		2013	30	21	1.5	0.1	12	0.9	0.1	0.1

Waterbody (Data source)	Major land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Acute HC_5 (1.5 µg/L)
#2561884, #2709791, #2821395)		2014	29	18	1.4	0.1	12	0.9	0.1	0.1
		2015	29	43	3.2	0.2	23	1.7	0.1	0.3
		2016	30	33	2.5	0.2	24	1.8	0.1	0.2
		2017	22	15	1.1	0.1	16	1.2	0.1	0.1
Des Hurons River (PMRA #2523837, #2561884, #2709791, #2821395)	Corn, soybeans	2012	29	27	2	0.1	13	1	0.1	0.2
		2013	29	11	0.9	0.1	6.7	0.5	< 0.1	0.1
		2014	30	27	2	0.1	10	0.8	0.1	0.3
		2015	30	34	2.5	0.2	29	2.2	0.2	0.1
		2016	29	39	2.9	0.2	19	1.4	0.1	0.2
		2017	23	21	1.5	0.1	17	1.3	0.1	0.1
Saint-Régis River (PMRA #2523837, #2561884, #2709791, #2821395)	Corn, soybeans	2012	30	19	1.4	0.1	5.3	0.4	< 0.1	0.2
		2013	30	22	1.7	0.1	6	0.5	< 0.1	0.1
		2014	29	22	1.6	0.1	6	0.5	< 0.1	0.1
		2015	30	16	1.2	0.1	10	0.8	0.1	0.1
		2016	30	21	1.6	0.1	10	0.8	0.1	0.1
		2017	24	12	0.9	0.1	10	0.8	0.1	0.1
Saint-Zéphirin River (PMRA #2523837, #2561884, #2709791, #2821395)	Corn, soybeans	2012	30	26	2	0.1	15	1.2	0.1	0.1
		2013	30	20	1.5	0.1	13	1	0.1	0.1
		2014	29	16	1.2	0.1	11	0.9	0.1	0.1
		2015	30	35	2.6	0.2	25	1.9	0.1	0.1
		2016	30	44	3.3	0.2	34	2.6	0.2	0.2
		2017	23	28	2.1	0.1	23	1.8	0.1	0.1
Blanche River (PMRA #2544468, #2821395)	Potatoes, corn, cereals	2012	24	47	3.5	0.2	48	3.6	0.3	0.1
		2017	30	161	12	0.9	157	12	0.8	0.2
Chartier Creek (PMRA #2523837, #2544468, #2821395)	Potatoes, corn, cereals	2010	27	21	1.5	0.1	11	0.9	0.1	0.1
		2012	28	68	5.1	0.4	45	3.4	0.2	0.2
		2017	30	125	9.4	0.7	123	9.3	0.7	0.3
Point-du-Jour Creek (PMRA #2523837, #2544468, #2821395)	Potatoes, corn, soybeans, cereals	2010	27	3.6	0.3	< 0.1	3.3	0.3	< 0.1	< 0.1
		2012	28	15	1.1	0.1	11	0.8	0.1	0.1
		2017	29	41	3.1	0.2	28	2.1	0.1	0.5
Déversant-du-Lac Creek (PMRA #2523837,	Orchards, corn, soybeans, cereals	2010	30	3.6	0.3	< 0.1	1.7	0.1	< 0.1	< 0.1
		2011	31	4.8	0.4	< 0.1	3.3	0.3	< 0.1	< 0.1
		2015	28	6.3	0.5	< 0.1	0.3	< 0.1	< 0.1	0.1

Waterbody (Data source)	Major land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Acute HC_5 (1.5 µg/L)
#2544468, #2821394, #2821395)		2016	30	3.1	0.2	< 0.1	0.3	< 0.1	< 0.1	< 0.1
Rousse Creek (PMRA #2523837, #2544468, #2821394, #2821395)	Orchards, corn, soybeans, vegetables	2010	29	0.4	< 0.1	< 0.1	0.3	< 0.1	< 0.1	< 0.1
		2011	27	1.1	0.1	< 0.1	0.3	< 0.1	< 0.1	< 0.1
		2015	29	0.3	< 0.1	< 0.1	0.3	< 0.1	< 0.1	< 0.1
		2016	30	0.4	< 0.1	< 0.1	0.3	< 0.1	< 0.1	< 0.1
Gibeault-Delisle Creek (PMRA #2709793, #2821394)	Vegetables, potatoes, corn, soybeans	2013	28	590	44	3.1	213	16	1.1	7.3
		2014	30	367	28	2	167	13	0.9	4.6
Norton Creek (PMRA #2709793, #2821394)	Vegetables, potatoes, corn, soybeans	2013	27	38	2.9	0.2	25	1.9	0.1	0.3
		2014	30	32	2.4	0.2	25	1.9	0.1	0.1
Yamaska River (PMRA #2561884, #2821395)	Mixed crops, corn, soybeans	2014	10	19	1.4	0.1	10	0.8	0.1	0.1
		2016	9	31	2.3	0.2	13	1	0.1	0.2
		2017	9	17	1.3	0.1	12	0.9	0.1	0.1
À la Barbue River (PMRA #2561884)	Mixed crops, corn, soybeans	2013	10	26	1.9	0.1	19	1.4	0.1	0.1
À la Tortue River (PMRA #2523837, #2561884)	Mixed crops, corn, soybeans	2012	11	41	3.1	0.2	27	2.1	0.1	0.2
Bayonne River (PMRA #2523837, #2561884)	Mixed crops, corn, soybeans	2012	11	7.9	0.6	< 0.1	4	0.3	< 0.1	< 0.1
Bécancour River (PMRA #2561884)	Mixed crops, corn, soybeans	2014	11	2.6	0.2	< 0.1	0.3	< 0.1	< 0.1	< 0.1
La Chaloupe River (PMRA #2523837, #2561884)	Mixed crops, corn, soybeans	2012	10	30	2.3	0.2	14	1.1	0.1	0.1
Champlain River (PMRA #2561884)	Mixed crops, corn, soybeans	2013	11	4.7	0.4	< 0.1	4.7	0.4	< 0.1	< 0.1
Châteauguay River (PMRA #2523837, #2561884)	Mixed crops, corn, soybeans	2012	11	16	1.2	0.1	8	0.6	< 0.1	0.1

Waterbody (Data source)	Major land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Acute HC_5 (1.5 µg/L)
De l'Achigan River (PMRA #2523837, #2561884)	Mixed crops, corn, soybeans	2012	10	8.3	0.6	< 0.1	5.3	0.4	< 0.1	< 0.1
L'Assomption River (PMRA #2523837, #2561884)	Mixed crops, corn, soybeans	2012	11	4.5	0.3	< 0.1	3.3	0.3	< 0.1	< 0.1
Chicot River (PMRA #2523837, #2561884)	Mixed crops, corn, soybeans	2012	11	3.2	0.2	< 0.1	2.7	0.2	< 0.1	< 0.1
Delisle River (PMRA #2523837, #2561884)	Mixed crops, corn, soybeans	2012	11	8.1	0.6	< 0.1	2.7	0.2	< 0.1	< 0.1
Rouge River (PMRA #2523837, #2561884)	Mixed crops, corn, soybeans	2012	10	21	1.5	0.1	9.7	0.7	< 0.1	0.1
Du Loup River (PMRA #2561884)	Mixed crops, corn, soybeans	2013	10	5.3	0.4	< 0.1	5	0.4	< 0.1	< 0.1
Gentilly River (PMRA #2561884)	Mixed crops, corn, soybeans	2014	11	1.8	0.1	< 0.1	0.3	< 0.1	< 0.1	< 0.1
L'Acadie River (PMRA #2561884)	Mixed crops, corn, soybeans	2013	10	27	2	0.1	20	1.5	0.1	0.1
Mascouche River (PMRA #2561884)	Mixed crops, corn, soybeans	2013	10	11	0.8	0.1	8	0.6	< 0.1	< 0.1
Maskinongé River (PMRA #2561884)	Mixed crops, corn, soybeans	2013	11	2	0.2	< 0.1	0.7	0.1	< 0.1	< 0.1
Nicolet River (PMRA #2561884)	Mixed crops, corn, soybeans	2014	11	4.4	0.3	< 0.1	2	0.2	< 0.1	< 0.1
Noire River (PMRA #2561884)	Mixed crops, corn, soybeans	2013	11	7.8	0.6	< 0.1	8	0.6	< 0.1	< 0.1
Saint-François River (PMRA #2561884)	Mixed crops, corn, soybeans	2014	11	1.5	0.1	< 0.1	0.7	0.1	< 0.1	< 0.1
Saint-Germain River (PMRA #2561884)	Mixed crops, corn, soybeans	2013	11	6.2	0.5	< 0.1	4.7	0.4	< 0.1	< 0.1
Yamachiche River (PMRA #2561884)	Mixed crops, corn, soybeans	2013	11	3.3	0.3	< 0.1	3.3	0.3	< 0.1	< 0.1

Waterbody (Data source)	Major land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Acute HC_5 (1.5 µg/L)
À l'Ours River (PMRA #2821395)	Mixed crops	2017	10	15	1.1	0.1	15	1.1	0.1	< 0.1
Beaurivage River (PMRA #2709792)	Mixed crops	2015	11	10	0.8	< 0.1	6.7	0.8	< 0.1	< 0.1
Boyer River (PMRA #2709792, #2821395)	Mixed crops	2016	11	21	1.5	0.1	20	1.5	0.1	< 0.1
Chaudière River (2 sites) (PMRA #2709792)	Mixed crops	2015	11	3	0.2	< 0.1	2.7	0.2	< 0.1	< 0.1
Du Chêne River (PMRA #2709792)	Mixed crops	2015	11	8	0.6	< 0.1	4	0.3	< 0.1	< 0.1
Du Sud River (PMRA #2709792, #2821395)	Mixed crops	2016	11	1.2	0.1	< 0.1	0.7	0.1	< 0.1	< 0.1
Etchemin River (PMRA #2709792)	Mixed crops	2015	11	9.2	0.7	< 0.1	3.3	0.3	< 0.1	< 0.1
Le Bras River (PMRA #2709792)	Mixed crops	2015	11	25	1.9	0.1	15	1.1	0.1	0.1
Mistassini River (PMRA #2821395)	Mixed crops	2017	11	1.7[4]	0.1	< 0.1	1.7[4]	0.1	< 0.1	< 0.1
Mistouk River (PMRA #2821395)	Mixed crops	2017	11	1.7[4]	0.1	< 0.1	1.7[4]	0.1	< 0.1	< 0.1
Moreau River (PMRA #2821395)	Mixed crops	2017	11	1.7[4]	0.1	< 0.1	1.7[4]	0.1	< 0.1	< 0.1
Richelieu River (PMRA #2709792, #2821395)	Mixed crops	2016	10	2.5	0.2	< 0.1	0.7	0.1	< 0.1	< 0.1
Ruisseau puant près du rang Sainte-Anne (PMRA #2821395)	Mixed crops	2017	11	1.7[4]	0.1	< 0.1	1.7[4]	0.1	< 0.1	< 0.1
Ticouapé River (PMRA #2821395)	Mixed crops	2017	11	1.7[4]	0.1	< 0.1	1.7[4]	0.1	< 0.1	< 0.1
Saint-Pierre Lake (3 sites) (PMRA #2821395)	Corn, soybeans, wheat, potatoes, urban	2017	33	2.2	0.2	< 0.1	1.7	0.1	< 0.1	< 0.1

Waterbody (Data source)	Major land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Acute HC_5 (1.5 µg/L)
Ditch (PMRA #2548877)	Agriculture	2013	1	0.3	< 0.1	< 0.1	0.3	< 0.1	< 0.1	< 0.1
Stream (PMRA #2548876)	Agriculture	2014	1	56	4.2	0.3	56	4.2	0.3	0.1

N = sample size;
Chronic HC_5 = the 5th percentile of the species sensitivity distribution for the NOEC at 50% confidence intervals;
EC_{20} = effective concentration on 20% of the population (it is the most sensitive single species chronic endpoint for clothianidin);
NOEC = no observable effect concentration;
Acute HC_5 = the 5th percentile of the species sensitivity distribution for the LC_{50} (the median lethal concentration) at 50% confidence intervals
[1]Risk Quotient = concentration ÷ toxicity endpoint
[2]Average, median and maximum concentrations over the sampling period are reported in Table A.7-3.
[3]Because monitoring may not capture peak concentrations, maximum concentrations may be underestimated.
[4]The limit of detection for these samples was more than two times higher than the chronic endpoint. Even though clothianidin was not detected in any samples, assigning half the limit of detection to non-detected samples still results in average and median concentrations which exceed the chronic toxicity endpoint. Thus, calculated risk quotients exceed the level of concern.

Table A.7-5 Summary statistics for clothianidin measured in waterbodies from Ontario.

NOTES:

-In calculations, the PMRA assigned a value equal to half the limit of detection to samples that showed no detection.

-The frequency of sampling and the length of the sampling period varied between data sets. Sampling generally occurred one to four times per month between April and November. Sampling at some sites occurred only a few times over a short time period, and values measured may not represent concentrations throughout the growing season.

Waterbody (Data source)	Major land use	Year	LOD (µg/L)	N	N detects	% Detection	Average (µg/L)	Stdev	Median (µg/L)	Max (µg/L)	N (% of samples) exceeding the toxicity endpoints			
											Chronic HC_5 of 0.0015 µg/L	Chronic EC_{20} of 0.02 µg/L	Mesocosm NOEC of 0.281 µg/L	Acute HC_5 of 1.5 µg/L
Two Mile Creek (PMRA #2523839, #2532563, #2681876,	Vineyards, orchards	2012	0.00176	15	3	20	0.001	0.001	0.0009	0.006	3 (20%)	0 (0%)	0 (0%)	0 (0%)
		2013	0.00176	14	5	36	0.007	0.017	0.0009	0.065	4 (29%)	1 (7%)	0 (0%)	0 (0%)
		2014	0.00176	12	6	50	0.036	0.11	0.002	0.4	6 (50%)	1 (8%)	1 (8%)	0 (0%)
		2015	0.00176	13	6	46	0.004	0.004	0.0009	0.013	6 (46%)	0 (0%)	0 (0%)	0 (0%)

Waterbody (Data source)	Major land use	Year	LOD (µg/L)	N	N detects	% Detection	Average (µg/L)	Stdev	Median (µg/L)	Max (µg/L)	N (% of samples) exceeding the toxicity endpoints			
											Chronic HC_5 of 0.0015 µg/L	Chronic EC_{20} of 0.02 µg/L	Mesocosm NOEC of 0.281 µg/L	Acute HC_5 of 1.5 µg/L
#2703534, #2834287)		2016	0.00176	6	6	100	0.005	0.001	0.004	0.007	6 (100%)	0 (0%)	0 (0%)	0 (0%)
Twenty Mile Creek (3 sites) (PMRA #2523839, #2532563, #2681876, #2703534, #2834287; 2011 data are from ECCC, as cited in PMRA #2526820)	Soybeans, corn	2011	0.00176	1	1	100	0.033	NA	0.033	0.033	1 (100%)	1 (100%)	0 (0%)	0 (0%)
		2012	0.00176	11	10	91	0.01	0.006	0.010	0.022	10 (91%)	1 (9%)	0 (0%)	0 (0%)
		2013	0.00176	12	12	100	0.048	0.035	0.036	0.13	12 (100%)	10 (83%)	0 (0%)	0 (0%)
		2014	0.00176	14	14	100	0.036	0.02	0.033	0.07	14 (100%)	11 (79%)	0 (0%)	0 (0%)
		2015	0.00176	14	14	100	0.03	0.037	0.016	0.14	14 (100%)	6 (43%)	0 (0%)	0 (0%)
		2016	0.00176	5	5	100	0.012	0.011	0.006	0.032	5 (100%)	1 (20%)	0 (0%)	0 (0%)
Four Mile Creek (PMRA #2523839, #2532563, #2681876, #2703534, #2834287)	Vineyards, orchards, soybeans	2012	0.00176	14	9	64	0.004	0.004	0.003	0.011	9 (64%)	0 (0%)	0 (0%)	0 (0%)
		2013	0.00176	12	9	75	0.024	0.05	0.005	0.18	9 (75%)	2 (17%)	0 (0%)	0 (0%)
		2014	0.00176	14	13	93	0.014	0.031	0.004	0.12	13 (93%)	1 (7%)	0 (0%)	0 (0%)
		2015	0.00176	13	8	62	0.01	0.012	0.002	0.034	8 (62%)	2 (15%)	0 (0%)	0 (0%)
		2016	0.00176	6	4	67	0.006	0.005	0.005	0.012	4 (67%)	0 (0%)	0 (0%)	0 (0%)
Big Creek (PMRA #2523839, #2703534, #2834287)	Corn, soybeans, wheat	2012	0.00176	14	5	36	0.004	0.008	0.0009	0.033	5 (36%)	1 (7%)	0 (0%)	0 (0%)
Innisfil Creek (PMRA #2523839, #2703534, #2834287; 2011 data are from ECCC, as cited in PMRA #2526820)	Soybeans, corn, wheat	2011	0.00176	1	0	0	0.0009	NA	0.0009	0.0009	0 (0%)	0 (0%)	0 (0%)	0 (0%)
		2012	0.00176	13	10	77	0.004	0.003	0.005	0.012	10 (77%)	0 (0%)	0 (0%)	0 (0%)
		2013	0.00176	11	11	100	0.011	0.011	0.007	0.043	11 (100%)	1 (9%)	0 (0%)	0 (0%)
Lebo Drain (PMRA #2523839, #2532563, #2681876, #2703534, #2834287)	Soybeans, corn, tomatoes, wheat, greenhouses	2013	0.00176	12	12	100	0.044	0.037	0.03	0.13	12 (100%)	9 (75%)	0 (0%)	0 (0%)
		2014	0.00176	14	14	100	0.04	0.02	0.036	0.081	14 (100%)	12 (86%)	0 (0%)	0 (0%)
		2015	0.00176	13	13	100	0.033	0.036	0.021	0.14	13 (100%)	7 (54%)	0 (0%)	0 (0%)
		2016	0.00176	6	6	100	0.04	0.019	0.043	0.067	6 (100%)	5 (83%)	0 (0%)	0 (0%)
Lebo Drain 1 (PMRA #2818733)	Corn, soybeans, greenhouses	2017	0.01	13	12	92	0.076	0.066	0.058	0.21	12 detects, 13 samples (100%)[1]	11 (85%)	0 (0%)	0 (0%)
Lebo Drain 10 (PMRA #2818733)	Greenhouses, soybeans, tomatoes	2017	0.01	9	6	67	0.13	0.15	0.065	0.41	6 detects, 9 samples (100%)[1]	5 (56%)	2 (22%)	0 (0%)

Waterbody (Data source)	Major land use	Year	LOD (µg/L)	N	N detects	% Detection	Average (µg/L)	Stdev	Median (µg/L)	Max (µg/L)	N (% of samples) exceeding the toxicity endpoints			
											Chronic HC_5 of 0.0015 µg/L	Chronic EC_{20} of 0.02 µg/L	Mesocosm NOEC of 0.281 µg/L	Acute HC_5 of 1.5 µg/L
Lebo Drain 2 (PMRA #2818733)	Soybeans, tomatoes, greenhouses	2017	0.01	13	10	77	0.036	0.03	0.027	0.099	10 detects, 13 samples (100%)[1]	7 (54%)	0 (0%)	0 (0%)
Site 200m downstream from Lebo Drain 2 (PMRA #2818733)	Soybeans, tomatoes, greenhouses	2017	0.01	5	4	80	0.022	0.011	0.019	0.036	4 detects, 5 samples (100%)[1]	2 (40%)	0 (0%)	0 (0%)
Lebo Drain 3 (PMRA #2818733)	Soybeans, wheat, tomatoes	2017	0.01	8	7	88	0.083	0.076	0.061	0.27	7 detects, 8 samples (100%)[1]	7 (88%)	0 (0%)	0 (0%)
Lebo Drain 4 (PMRA #2818733)	Soybeans, tomatoes	2017	0.01	13	13	100	0.18	0.13	0.13	0.5	13 (100%)	12 (92%)	3 (23%)	0 (0%)
Lebo Drain 5 (PMRA #2818733)	Greenhouses, soybeans, tomatoes	2017	0.01	12	11	92	0.11	0.07	0.097	0.24	11 detects, 12 samples (100%)[1]	10 (91%)	0 (0%)	0 (0%)
Lebo Drain 6 (PMRA #2818733)	Soybeans, tomatoes, wheat	2017	0.01	11	10	91	0.14	0.076	0.13	0.26	10 detects, 11 samples (100%)[1]	10 (91%)	0 (0%)	0 (0%)
Lebo Drain 7 (PMRA #2818733)	Corn, tomatoes	2017	0.01	10	9	90	0.051	0.034	0.051	0.14	9 detects, 10 samples (100%)[1]	9 (90%)	0 (0%)	0 (0%)
Lebo Drain 8 (PMRA #2818733)	Greenhouses, tomatoes, corn	2017	0.01	10	10	100	0.047	0.055	0.028	0.21	10 (100%)	8 (80%)	0 (0%)	0 (0%)
Lebo Drain 9 (PMRA #2818733)	Greenhouses, soybeans, corn	2017	0.01	9	8	89	0.063	0.068	0.036	0.24	8 detects, 9 samples (100%)[1]	8 (89%)	0 (0%)	0 (0%)
Nissouri Creek (PMRA #2523839, #2681876, #2703534, #2834287)	Corn, soybeans	2013	0.00176	12	12	100	0.023	0.028	0.012	0.1	12 (100%)	5 (42%)	0 (0%)	0 (0%)
		2015	0.00176	12	12	100	0.018	0.021	0.011	0.065	12 (100%)	3 (25%)	0 (0%)	0 (0%)
		2016	0.00176	6	6	100	0.016	0.009	0.012	0.03	6 (100%)	2 (33%)	0 (0%)	0 (0%)
Nottawasaga River (PMRA #2523839, #2703534, #2834287)	Soybeans, corn, wheat	2012	0.00176	13	7	54	0.007	0.007	0.003	0.024	7 (54%)	1 (8%)	0 (0%)	0 (0%)
		2013	0.00176	11	10	91	0.015	0.015	0.008	0.051	10 (91%)	3 (27%)	0 (0%)	0 (0%)
Prudhomme Creek (Old Vineland Creek) (PMRA #2523839, #2532563,	Orchards, vineyards, urban/developed	2011	0.00176	1	1	100	0.035	NA	0.035	0.035	1 (100%)	1 (100%)	0 (0%)	0 (0%)
		2012	0.00176	13	13	100	0.033	0.041	0.009	0.12	13 (100%)	5 (38%)	0 (0%)	0 (0%)
		2013	0.00176	11	11	100	0.024	0.037	0.008	0.13	11 (100%)	4 (36%)	0 (0%)	0 (0%)
		2014	0.00176	14	13	93	0.012	0.014	0.006	0.039	13 (93%)	3 (21%)	0 (0%)	0 (0%)
		2015	0.00176	14	13	93	0.039	0.098	0.011	0.38	13 (93%)	4 (29%)	1 (7%)	0 (0%)

Waterbody (Data source)	Major land use	Year	LOD (µg/L)	N	N detects	% Detection	Average (µg/L)	Stdev	Median (µg/L)	Max (µg/L)	N (% of samples) exceeding the toxicity endpoints			
											Chronic HC_5 of 0.0015 µg/L	Chronic EC_{20} of 0.02 µg/L	Mesocosm NOEC of 0.281 µg/L	Acute HC_5 of 1.5 µg/L
#2681876, #2703534, #2834287; 2011 data are from ECCC, as cited in PMRA #2526820)		2016	0.00176	6	6	100	0.05	0.071	0.023	0.19	6 (100%)	3 (50%)	0 (0%)	0 (0%)
Sturgeon Creek (PMRA #2523839, #2532563, #2681876, #2703534, #2834287)	Soybeans, corn, greenhouses, wheat, tomatoes	2012	0.00176	12	6	50	0.003	0.002	0.001	0.008	6 (50%)	0 (0%)	0 (0%)	0 (0%)
		2013	0.00176	12	9	75	0.008	0.008	0.005	0.028	9 (75%)	1 (8%)	0 (0%)	0 (0%)
		2014	0.00176	14	13	93	0.004	0.002	0.004	0.008	13 (93%)	0 (0%)	0 (0%)	0 (0%)
		2015	0.00176	13	11	85	0.014	0.034	0.004	0.13	11 (85%)	2 (15%)	0 (0%)	0 (0%)
		2016	0.00176	6	6	100	0.13	0.16	0.043	0.39	6 (100%)	4 (67%)	1 (17%)	0 (0%)
Sturgeon Creek 1 (PMRA #2818733)	Greenhouses, soybeans, tomatoes	2017	0.01	13	12	92	0.028	0.021	0.019	0.077	12 detects, 13 samples (100%)[1]	6 (46%)	0 (0%)	0 (0%)
Sturgeon Creek 2 (PMRA #2818733)	Soybeans	2017	0.01	8	4	50	0.013	0.01	0.009	0.03	4 detects, 8 samples (100%)[1]	2 (25%)	0 (0%)	0 (0%)
Sturgeon Creek 3 (PMRA #2818733)	Greenhouses, soybeans	2017	0.01	13	9	69	0.013	0.008	0.01	0.034	9 detects, 13 samples (100%)[1]	2 (15%)	0 (0%)	0 (0%)
Sturgeon Creek 4 (PMRA #2818733)	Greenhouses, tomatoes	2017	0.01	9	4	44	0.011	0.008	0.005	0.029	4 detects, 9 samples (100%)[1]	1 (11%)	0 (0%)	0 (0%)
LE1 (PMRA #2818733)	Corn, tomatoes	2017	0.01	13	12	92	0.042	0.021	0.042	0.075	12 detects, 13 samples (100%)[1]	12 (92%)	0 (0%)	0 (0%)
Sydenham River (PMRA #2523839, #2532563, #2681876, #2703534, #2834287)	Soybeans, corn, wheat	2012	0.00176	17	17	100	0.023	0.028	0.014	0.1	17 (100%)	4 (24%)	0 (0%)	0 (0%)
		2013	0.00176	10	10	100	0.044	0.05	0.036	0.18	10 (100%)	8 (80%)	0 (0%)	0 (0%)
		2014	0.00176	14	14	100	0.03	0.023	0.019	0.085	14 (100%)	6 (43%)	0 (0%)	0 (0%)
		2015	0.00176	13	13	100	0.034	0.047	0.016	0.18	13 (100%)	6 (46%)	0 (0%)	0 (0%)
		2016	0.00176	6	6	100	0.023	0.007	0.024	0.032	6 (100%)	4 (67%)	0 (0%)	0 (0%)
Thames River (PMRA #2523839, #2532563, #2681876,	Corn, soybeans, wheat	2011	0.00176	1	1	100	0.02	NA	0.02	0.02	1 (100%)	0 (0%)	0 (0%)	0 (0%)
		2012	0.00176	17	17	100	0.01	0.007	0.007	0.022	17 (100%)	2 (12%)	0 (0%)	0 (0%)
		2013	0.00176	11	11	100	0.03	0.019	0.033	0.061	11 (100%)	7 (64%)	0 (0%)	0 (0%)
		2015	0.00176	12	12	100	0.052	0.098	0.011	0.35	12 (100%)	5 (42%)	1 (8%)	0 (0%)

Waterbody (Data source)	Major land use	Year	LOD (µg/L)	N	N detects	% Detection	Average (µg/L)	Stdev	Median (µg/L)	Max (µg/L)	N (% of samples) exceeding the toxicity endpoints			
											Chronic HC_5 of 0.0015 µg/L	Chronic EC_{20} of 0.02 µg/L	Mesocosm NOEC of 0.281 µg/L	Acute HC_5 of 1.5 µg/L
#2703534, #2834287; 2011 data are from ECCC, as cited in PMRA #2526820)		2016	0.00176	6	6	100	0.016	0.013	0.012	0.04	6 (100%)	2 (33%)	0 (0%)	0 (0%)
West Holland River (PMRA #2523839, #2703534, #2834287)	Soybeans, corn, vegetables, wheat	2013	0.00176	13	12	92	0.008	0.006	0.007	0.019	12 (92%)	0 (0%)	0 (0%)	0 (0%)
Indian Creek (PMRA #2523839, #2532563, #2681876, #2703534, #2834287; 2011 data are from ECCC, as cited in PMRA #2526820)	Urban/developed	2011	0.00176	2	0	0	0.0009	0	0.0009	0.0009	0 (0%)	0 (0%)	0 (0%)	0 (0%)
		2012	0.00176	14	1	7	0.001	0.001	0.0009	0.004	1 (7%)	0 (0%)	0 (0%)	0 (0%)
		2013	0.00176	11	3	27	0.002	0.003	0.0009	0.009	3 (27%)	0 (0%)	0 (0%)	0 (0%)
		2014	0.00176	8	1	13	0.001	0.001	0.0009	0.003	1 (13%)	0 (0%)	0 (0%)	0 (0%)
		2015	0.00176	12	2	17	0.001	0.001	0.0009	0.004	2 (17%)	0 (0%)	0 (0%)	0 (0%)
		2016	0.00176	5	4	80	0.002	0.001	0.002	0.003	4 (80%)	0 (0%)	0 (0%)	0 (0%)
Credit River (data from ECCC, as cited in PMRA #2526820)	Urban or turf	2011	0.00176	1	0	0	0.0009	NA	0.0009	0.0009	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Highland Creek (data from ECCC, as cited in PMRA #2526820)	Urban or turf	2011	0.00176	1	0	0	0.0009	NA	0.0009	0.0009	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Kossuth (data from ECCC, as cited in PMRA #2526820)	Urban or turf	2011	0.00176	1	1	100	0.002	NA	0.002	0.002	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Lake Erie (4 stations) (PMRA #2523839)	Not applicable; sites were not near the shore	2013	0.00176	4	1	25	0.013	0.025	0.0009	0.051	1 (25%)	1 (25%)	0 (0%)	0 (0%)
Lgrand (data from ECCC, as cited in PMRA #2526820)	Row crops	2011	0.00176	1	1	100	0.008	NA	0.008	0.008	1 (100%)	0 (0%)	0 (0%)	0 (0%)
Mimico Creek (data from ECCC, as cited in PMRA #2526820)	Urban or turf	2011	0.00176	1	0	0	0.0009	NA	0.0009	0.0009	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Waterbody (Data source)	Major land use	Year	LOD (µg/L)	N	N detects	% Detection	Average (µg/L)	Stdev	Median (µg/L)	Max (µg/L)	N (% of samples) exceeding the toxicity endpoints			
											Chronic HC_5 of 0.0015 µg/L	Chronic EC_{20} of 0.02 µg/L	Mesocosm NOEC of 0.281 µg/L	Acute HC_5 of 1.5 µg/L
Nott-baxter and Nott-SR10 sites (2 sites) (data from ECCC, as cited in PMRA #2526820)	Potatoes	2011	0.00176	2	1	50	0.001	0.001	0.001	0.002	1 (50%)	0 (0%)	0 (0%)	0 (0%)
Spencer Creek (data from ECCC, as cited in PMRA #2526820)	Urban or turf	2011	0.00176	1	1	100	0.002	NA	0.002	0.002	1 (100%)	0 (0%)	0 (0%)	0 (0%)
Spring Creek (PMRA #2523839, #2532563, #2681876, #2703534, #2834287)	Reference site; no pesticide use	2012	0.00176	5	0	0	0.0009	0	0.0009	0.0009	0 (0%)	0 (0%)	0 (0%)	0 (0%)
		2013	0.00176	5	0	0	0.0009	0	0.0009	0.0009	0 (0%)	0 (0%)	0 (0%)	0 (0%)
		2014	0.00176	7	0	0	0.0009	0	0.0009	0.0009	0 (0%)	0 (0%)	0 (0%)	0 (0%)
		2015	0.00176	6	0	0	0.0009	0	0.0009	0.0009	0 (0%)	0 (0%)	0 (0%)	0 (0%)
		2016	0.00176	4	0	0	0.0009	0	0.0009	0.0009	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Taylor Creek (data from ECCC, as cited in PMRA #2526820)	Urban or turf	2011	0.00176	1	0	0	0.0009	NA	0.0009	0.0009	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Welland (data from ECCC, as cited in PMRA #2526820)	Row crops	2011	0.00176	1	1	100	0.002	NA	0.002	0.002	1 (100%)	0 (0%)	0 (0%)	0 (0%)
Batteaux River (PMRA #2523836, #2759002)	Urban, shrubland, forest	2012—2014	0.08	18	0	0	0.04	0	0.04	0.04	0 detects, 18 samples (100%)[1]	0 detects, 18 samples (100%)[2]	0 (0%)	0 (0%)
Boomer Creek (PMRA #2523836, #2759002)	Corn, pasture, wheat, hemp	2012–2014	0.08	18	0	0	0.04	0	0.04	0.04	0 detects, 18 samples (100%)[1]	0 detects, 18 samples (100%)[2]	0 (0%)	0 (0%)
Decker Creek (PMRA #2523836, #2759002)	Corn, soybean cereals, orchards	2012–2014	0.08	17	0	0	0.04	0	0.04	0.04	0 detects, 17 samples (100%)[1]	0 detects, 17 samples (100%)[2]	0 (0%)	0 (0%)
Don River (PMRA #2523836, #2759002)	Urban	2012	0.08	1	0	0	0.04	0	0.04	0.04	0 detects, 1 sample (100%)[1]	0 detects, 1 sample (100%)[2]	0 (0%)	0 (0%)
Four Mile Creek (PMRA #2523836, #2759002)	Orchards, corn, soybeans, vineyards, greenhouses	2012–2014	0.08	18	0	0	0.04	0	0.04	0.04	0 detects, 18 samples (100%)[1]	0 detects, 18 samples (100%)[2]	0 (0%)	0 (0%)

Waterbody (Data source)	Major land use	Year	LOD (µg/L)	N	N detects	% Detection	Average (µg/L)	Stdev	Median (µg/L)	Max (µg/L)	N (% of samples) exceeding the toxicity endpoints			
											Chronic HC_5 of 0.0015 µg/L	Chronic EC_{20} of 0.02 µg/L	Mesocosm NOEC of 0.281 µg/L	Acute HC_5 of 1.5 µg/L
Grand River (PMRA #2523836, #2759002)	Urban, forest, pasture, corn, soybeans	2012-–2014	0.08	17	0	0	0.04	0	0.04	0.04	0 detects, 17 samples (100%)[1]	0 detects, 17 samples (100%)[2]	0 (0%)	0 (0%)
Gregory Creek (PMRA #2523836, #2759002)	Corn, soybeans, wheat, cereals	2012–2014	0.08	14	0	0	0.04	0	0.04	0.04	0 detects, 14 samples (100%)[1]	0 detects, 14 samples (100%)[2]	0 (0%)	0 (0%)
Griffins Creek (PMRA #2523836, #2759002)	Corn, soybeans, cereals, wheat	2012–2014	0.08	16	0	0	0.04	0	0.04	0.04	0 detects, 16 samples (100%)[1]	0 detects, 16 samples (100%)[2]	0 (0%)	0 (0%)
Humber River (PMRA #2523836, #2759002)	Urban	2012–2014	0.08	20	0	0	0.04	0	0.04	0.04	0 detects, 20 samples (100%)[1]	0 detects, 20 samples (100%)[2]	0 (0%)	0 (0%)
Lebo Drain (PMRA #2523836, #2759002)	Corn, soybeans, wheat, vegetables	2012–2014	0.08	16	0	0	0.04	0	0.04	0.04	0 detects, 16 samples (100%)[1]	0 detects, 16 samples (100%)[2]	0 (0%)	0 (0%)
Little Ausable River (PMRA #2523836, #2759002)	Corn, soybeans, cereals, hemp	2012	0.08	2	0	0	0.04	0	0.04	0.04	0 detects, 2 samples (100%)[1]	0 detects, 2 samples (100%)[2]	0 (0%)	0 (0%)
McGregor Creek (PMRA #2523836, 2759002)	Corn, soybeans, cereals, vegetables	2012–2014	0.08	18	1	6	0.058	0.078	0.04	0.37	1 detect, 18 samples (100%)[1]	1 detect, 18 samples (100%)[2]	1 (6%)	0 (0%)
McKillop Drain (PMRA #2523836, #2759002)	Corn, soybeans, cereals, wheat	2012–2014	0.08	18	0	0	0.04	0	0.04	0.04	0 detects, 18 samples (100%)[1]	0 detects, 18 samples (100%)[2]	0 (0%)	0 (0%)
Nissouri Creek (PMRA #2523836, #2759002)	Corn, soybeans, wheat, pasture	2013	0.08	2	1	50	0.20	0.23	0.20	0.37	1 detect, 2 samples (100%)[1]	1 detect, 2 samples (100%)[2]	1 (50%)	0 (0%)
Otter Creek (PMRA #2523836, #2759002)	Corn, soybeans, cereals, wheat	2012–2014	0.08	16	0	0	0.04	0	0.04	0.04	0 detects, 16 samples (100%)[1]	0 detects, 16 samples (100%)[2]	0 (0%)	0 (0%)
Reynolds Creek (PMRA #2523836, #2759002)	Corn, soybeans, cereals, wheat, hemp	2012-–2014	0.08	17	0	0	0.04	0	0.04	0.04	0 detects, 17 samples (100%)[1]	0 detects, 17 samples (100%)[2]	0 (0%)	0 (0%)
Saugeen River (PMRA #2523836, #2759002)	Corn, soybeans, cereals, wheat	2012–2014	0.08	17	0	0	0.04	0	0.04	0.04	0 detects, 17 samples (100%)[1]	0 detects, 17 samples (100%)[2]	0 (0%)	0 (0%)
Thames River (PMRA #2523836, #2759002)	Corn, soybeans, cereals, wheat	2012–2014	0.08	18	0	0	0.04	0	0.04	0.04	0 detects, 18 samples (100%)[1]	0 detects, 18 samples (100%)[2]	0 (0%)	0 (0%)

Waterbody (Data source)	Major land use	Year	LOD (µg/L)	N	N detects	% Detection	Average (µg/L)	Stdev	Median (µg/L)	Max (µg/L)	N (% of samples) exceeding the toxicity endpoints			
											Chronic HC_5 of 0.0015 µg/L	Chronic EC_{20} of 0.02 µg/L	Mesocosm NOEC of 0.281 µg/L	Acute HC_5 of 1.5 µg/L
Venison Creek (PMRA #2523836, #2759002)	Corn, soybeans, forest, wheat, orchards	2012–2014	0.08	17	0	0	0.04	0	0.04	0.04	0 detects, 17 samples (100%)[1]	0 detects, 17 samples (100%)[2]	0 (0%)	0 (0%)
Whitemans Creek (PMRA #2523836, #2759002)	Corn, soybeans, tobacco, other crops	2012–2014	0.08	18	0	0	0.04	0	0.04	0.04	0 detects, 18 samples (100%)[1]	0 detects, 18 samples (100%)[2]	0 (0%)	0 (0%)
Big Creek (PMRA #2712893)	Corn, soybeans, wheat	2015	0.005	23	23	100	0.064	0.055	0.055	0.29	23 (100%)	21 (91%)	1 (4%)	0 (0%)
Garvey Glenn (PMRA #2712893)	Corn, soybeans, wheat	2015	0.005	19	17	89	0.042	0.054	0.026	0.24	17 detects, 19 samples (100%)[1]	10 (53%)	0 (0%)	0 (0%)
Little Ausable Creek (PMRA #2712893)	Corn, soybeans, wheat	2015	0.005	17	17	100	0.085	0.097	0.044	0.36	17 (100%)	13 (76%)	1 (6%)	0 (0%)
North Creek (PMRA #2712893)	Corn, soybeans, wheat	2015	0.005	19	14	74	0.08	0.14	0.012	0.52	14 detects, 19 samples (100%)[1]	8 (42%)	2 (11%)	0 (0%)
White Ash Creek (PMRA #2712893)	Corn, soybeans, wheat	2015	0.005	18	16	89	0.036	0.065	0.011	0.27	16 detects, 18 samples (100%)[1]	4 (22%)	0 (0%)	0 (0%)
Hamilton Harbour, WWTP influent and effluent (PMRA #2710505)	Urban	2016	0.005	6	0	0	0.003	0	0.003	0.003	0 detects, 6 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Grand River, WWTP influent and effluent (PMRA #2710505)	Urban, corn, soybeans	2016	0.005	12	0	0	0.003	0	0.003	0.003	0 detects, 12 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Detroit River, WWTP influent and effluent (PMRA #2710505)	Urban	2016	0.005	6	0	0	0.003	0	0.003	0.003	0 detects, 6 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Little River, WWTP influent and effluent (PMRA #2710505)	Urban	2016	0.005	6	0	0	0.003	0	0.003	0.003	0 detects, 6 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Presqu'île Bay, WWTP influent and effluent (PMRA #2710505)	Urban, corn, soybeans	2016	0.005	2	0	0	0.003	0	0.003	0.003	0 detects, 2 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)

Waterbody (Data source)	Major land use	Year	LOD (µg/L)	N	N detects	% Detection	Average (µg/L)	Stdev	Median (µg/L)	Max (µg/L)	N (% of samples) exceeding the toxicity endpoints			
											Chronic HC_5 of 0.0015 µg/L	Chronic EC_{20} of 0.02 µg/L	Mesocosm NOEC of 0.281 µg/L	Acute HC_5 of 1.5 µg/L
Cootes Paradise, WWTP influent and effluent (PMRA #2710505)	Urban, forest, corn, soybeans	2016	0.005	6	0	0	0.003	0	0.003	0.003	0 detects, 6 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Ditches around corn fields[3] (PMRA #2526184)	Corn	2013	0.017	22	22	100	2.3[3]	3.7[3]	0.93[3]	16.2[3]	22 (100%)[3]	22 (100%)[3]	15 (68%)[3]	7 (32%)[3]
Drainage tile outlets around corn fields[3] (PMRA #2526184)	Corn	2013	0.017	8	8	100	0.63[3]	1.2[3]	0.097[3]	3.6[3]	8 (100%)[3]	8 (100%)[3]	3 (38%)[3]	1 (13%)[3]
Creeks, streams, ponds (PMRA #2548877)	Agriculture	2013	0.001 (LOQ)	42	2	5	0.08	0.51	0.0005	3.3	2 (5%)	1 (2%)	1 (2%)	1 (2%)
		2014	0.0022	14	9	64	0.018	0.025	0.005	0.079	9 (64%)	4 (29%)	0 (0%)	0 (0%)
Streams, culverts, ditches (PMRA #2548876)	Agriculture	2014	0.0022	5	5	100	0.033	0.047	0.016	0.12	5 (100%)	1 (20%)	0 (0%)	0 (0%)
Black Creek (PMRA #2785041)	Corn, soybeans, wheat	2015	0.0001	2	2	100	0.035	0.023	0.035	0.051	2 (100%)	1 (50%)	0 (0%)	0 (0%)
		2016	0.0001	2	2	100	0.019	0.007	0.019	0.024	2 (100%)	1 (50%)	0 (0%)	0 (0%)
Beckstead (PMRA #2785041)	Corn, soybeans, wheat	2015	0.0001	2	0	0	0.00005	0	0.00005	0.00005	0 (0%)	0 (0%)	0 (0%)	0 (0%)
		2016	0.0001	2	1	50	0.0004	0.0005	0.0004	0.0008	0 (0%)	0 (0%)	0 (0%)	0 (0%)
East Branch Scotch River (PMRA #2785041)	Forest, corn, soybeans, wheat	2015	0.0001	2	1	50	0.0005	0.0006	0.0005	0.0009	0 (0%)	0 (0%)	0 (0%)	0 (0%)
		2016	0.0001	2	1	50	0.0005	0.0007	0.0005	0.001	0 (0%)	0 (0%)	0 (0%)	0 (0%)
East Castor (PMRA #2785041)	Corn, soybeans, pasture, wheat	2015	0.0001	2	2	100	0.043	0.027	0.043	0.062	2 (100%)	2 (100%)	0 (0%)	0 (0%)
		2016	0.0001	2	2	100	0.006	0.0007	0.006	0.006	2 (100%)	0 (0%)	0 (0%)	0 (0%)
Greenough (PMRA #2785041)	Corn, soybeans, pasture	2015	0.0001	1	0	0	0.00005	NA	0.00005	0.00005	0 (0%)	0 (0%)	0 (0%)	0 (0%)
		2016	0.0001	2	1	50	0.0004	0.0005	0.0004	0.0007	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Kirkwood (PMRA #2785041)	Corn, soybeans, wheat	2015	0.0001	2	2	100	0.14	0.035	0.14	0.16	2 (100%)	2 (100%)	0 (0%)	0 (0%)
		2016	0.0001	2	2	100	0.009	0.005	0.009	0.012	2 (100%)	0 (0%)	0 (0%)	0 (0%)
Little Castor (PMRA #2785041)	Corn, soybeans, wheat	2015	0.0001	2	2	100	0.034	0.027	0.034	0.053	2 (100%)	1 (50%)	0 (0%)	0 (0%)
		2016	0.0001	2	2	100	0.006	0.003	0.006	0.008	2 (100%)	0 (0%)	0 (0%)	0 (0%)
McLeod (PMRA #2785041)	Corn, soybeans, wheat	2015	0.0001	2	0	0	0.00005	0	0.00005	0.00005	0 (0%)	0 (0%)	0 (0%)	0 (0%)
		2016	0.0001	2	1	50	0.0005	0.0007	0.0005	0.001	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Middle Castor River (PMRA #2785041)	Corn, soybeans, wheat	2015	0.0001	2	1	50	0.034	0.045	0.034	0.066	2 (100%)	1 (50%)	0 (0%)	0 (0%)
		2016	0.0001	2	2	100	0.001	0.001	0.001	0.002	1 (50%)	0 (0%)	0 (0%)	0 (0%)
North Branch South Nation (PMRA #2785041)	Corn, soybeans, wheat	2015	0.0001	2	2	100	0.009	0.007	0.009	0.014	2 (100%)	0 (0%)	0 (0%)	0 (0%)
		2016	0.0001	2	2	100	0.018	0.021	0.018	0.032	2 (100%)	1 (50%)	0 (0%)	0 (0%)

Waterbody (Data source)	Major land use	Year	LOD (µg/L)	N	N detects	% Detection	Average (µg/L)	Stdev	Median (µg/L)	Max (µg/L)	N (% of samples) exceeding the toxicity endpoints			
											Chronic HC_5 of 0.0015 µg/L	**Chronic EC_{20} of 0.02 µg/L**	**Mesocosm NOEC of 0.281 µg/L**	**Acute HC_5 of 1.5 µg/L**
Nugent (PMRA #2785041)	Corn, soybeans, wheat	2015	0.0001	2	2	100	0.006	0.006	0.006	0.01	2 (100%)	0 (0%)	0 (0%)	0 (0%)
		2016	0.0001	2	1	50	0.002	0.002	0.002	0.003	1 (50%)	0 (0%)	0 (0%)	0 (0%)
Payne River (PMRA #2785041)	Corn, soybeans, wheat	2015	0.0001	2	2	100	0.019	0.014	0.019	0.029	2 (100%)	1 (50%)	0 (0%)	0 (0%)
		2016	0.0001	2	2	100	0.018	0.009	0.018	0.024	2 (100%)	1 (50%)	0 (0%)	0 (0%)
Shane (PMRA #2785041)	Corn, soybeans, wheat	2015	0.0001	2	2	100	0.004	0.004	0.004	0.007	1 (50%)	0 (0%)	0 (0%)	0 (0%)
		2016	0.0001	2	0	0	0.00005	0	0.00005	0.00005	0 (0%)	0 (0%)	0 (0%)	0 (0%)
St. Edouard Road (PMRA #2785041)	Corn, soybeans, wheat	2015	0.0001	2	1	50	0.0005	0.0007	0.0005	0.001	0 (0%)	0 (0%)	0 (0%)	0 (0%)
		2016	0.0001	2	0	0	0.00005	0	0.00005	0.00005	0 (0%)	0 (0%)	0 (0%)	0 (0%)
West Branch Scotch River (PMRA #2785041)	Corn, soybeans, wheat	2015	0.0001	2	2	100	0.014	0.008	0.014	0.019	2 (100%)	0 (0%)	0 (0%)	0 (0%)
		2016	0.0001	2	2	100	0.014	0.015	0.014	0.024	2 (100%)	1 (50%)	0 (0%)	0 (0%)
Whittaker (PMRA #2785041)	Corn, soybeans	2015	0.0001	2	1	50	0.003	0.004	0.003	0.005	1 (50%)	0 (0%)	0 (0%)	0 (0%)
		2016	0.0001	2	1	50	0.002	0.003	0.002	0.004	1 (50%)	0 (0%)	0 (0%)	0 (0%)

LOD = limit of detection;
N = sample size;
Stdev = standard deviation;
Chronic HC_5 = the 5th percentile of the species sensitivity distribution for the NOEC at 50% confidence intervals;
EC_{20} = effective concentration on 20% of the population (it is the most sensitive single species chronic endpoint for clothianidin);
NOEC = no observable effect concentration;
Acute HC_5 = the 5th percentile of the species sensitivity distribution for the LC_{50} (the median lethal concentration) at 50% confidence intervals;
ECCC = Environment and Climate Change Canada;
WWTP = waste water treatment plant

[1]The LOD is more than two times higher than the chronic HC_5 of 0.0015 µg/L. Assigning half the limit of detection to non-detected samples still results in a concentration exceeding the toxicity endpoint. Thus, all samples, including non-detects at half the limit of detection, exceed the toxicity endpoint.

[2]The LOD is more than two times higher than the chronic EC_{20} of 0.02 µg/L. Assigning half the limit of detection to non-detected samples still results in a concentration exceeding the toxicity endpoint. Thus, all samples, including non-detects at half the limit of detection, exceed the toxicity endpoint.

[3]Ditches and tile drain outlets around corn fields may not represent aquatic habitat.

Table A.7-6 Risk quotients for clothianidin measured in waterbodies located in Ontario.

NOTES:

-Shaded cells indicate the level of concern is exceeded, meaning that the risk quotient is equal to or greater than a value of 1.

-The frequency of sampling and the length of the sampling period varied between data sets. Sampling generally occurred one to four times per month between April and November. Sampling at some sites occurred only a few times over a short time period, and values measured may not represent concentrations throughout the growing season.

Waterbody (Data source)	Major land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Acute HC_5 (1.5 µg/L)
Two Mile Creek (PMRA #2523839, #2532563, #2681876, #2703534, #2834287)	Vineyards, orchards	2012	15	0.9	0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
		2013	14	4.7	0.4	< 0.1	0.6	< 0.1	< 0.1	< 0.1
		2014	12	24	1.8	0.1	1	0.1	< 0.1	0.3
		2015	13	2.3	0.2	< 0.1	0.6	< 0.1	< 0.1	< 0.1
		2016	6	3.1	0.2	< 0.1	2.9	0.2	< 0.1	< 0.1
Twenty Mile Creek (3 sites) (PMRA #2523839, #2532563, #2681876, #2703534, #2834287; 2011 data are from ECCC, as cited in PMRA #2526820)	Soybeans, corn	2011	1	22	1.6	0.1	22	1.6	0.1	< 0.1
		2012	11	6.7	0.5	< 0.1	6.5	0.5	< 0.1	< 0.1
		2013	12	32	2.4	0.2	24	1.8	0.1	0.1
		2014	14	24	1.8	0.1	22	1.6	0.1	< 0.1
		2015	14	20	1.5	0.1	11	0.8	0.1	0.1
		2016	5	8	0.6	< 0.1	4.3	0.3	< 0.1	< 0.1
Four Mile Creek (PMRA #2523839, #2532563, #2681876, #2703534, #2834287)	Vineyards, orchards, soybeans	2012	14	2.6	0.2	< 0.1	1.9	0.1	< 0.1	< 0.1
		2013	12	16	1.2	0.1	3.5	0.3	< 0.1	0.1
		2014	14	9.1	0.7	< 0.1	2.4	0.2	< 0.1	0.1
		2015	13	6.5	0.5	< 0.1	1.6	0.1	< 0.1	< 0.1
		2016	6	3.1	0.2	< 0.1	3.1	0.2	< 0.1	< 0.1

Waterbody (Data source)	Major land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Acute HC_5 (1.5 µg/L)
Big Creek (PMRA #2523839, #2703534, #2834287)	Corn, soybeans, wheat	2012	14	2.4	0.2	< 0.1	0.6	< 0.1	< 0.1	< 0.1
Innisfil Creek (PMRA #2523839, #2703534, #2834287; 2011 data are from ECCC, as cited in PMRA #2526820)	Soybeans, corn, wheat	2011	1	0.6	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
		2012	13	2.9	0.2	< 0.1	3.1	0.2	< 0.1	< 0.1
		2013	11	7.2	0.5	< 0.1	4.7	0.4	< 0.1	< 0.1
Lebo Drain (PMRA #2523839, #2532563, #2681876, #2703534, #2834287)	Soybeans, corn, tomatoes, wheat, greenhouses	2013	12	29	2.2	0.2	20	1.5	0.1	0.1
		2014	14	27	2	0.1	24	1.8	0.1	0.1
		2015	13	22	1.7	0.1	14	1	0.1	0.1
		2016	6	27	2	0.1	29	2.1	0.2	< 0.1
Lebo Drain 1 (PMRA #2818733)	Corn, soybeans, greenhouses	2017	13	51	3.8	0.3	39	2.9	0.2	0.1
Lebo Drain 10 (PMRA #2818733)	Greenhouses, soybeans, tomatoes	2017	9	87	6.5	0.5	43	3.3	0.2	0.3
Lebo Drain 2 (PMRA #2818733)	Soybeans, tomatoes, greenhouses	2017	13	24	1.8	0.1	18	1.4	0.1	0.1
Site 200m downstream from Lebo Drain 2 (PMRA #2818733)	Soybeans, tomatoes, greenhouses	2017	5	15	1.1	0.1	13	1	0.1	< 0.1
Lebo Drain 3 (PMRA #2818733)	Soybeans, wheat, tomatoes	2017	8	55	4.1	0.3	41	3.1	0.2	0.2
Lebo Drain 4 (PMRA #2818733)	Soybeans, tomatoes	2017	13	122	9.1	0.6	88	6.6	0.5	0.3
Lebo Drain 5 (PMRA #2818733)	Greenhouses, soybeans, tomatoes	2017	12	71	5.3	0.4	65	4.8	0.3	0.2

Waterbody (Data source)	Major land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Acute HC_5 (1.5 µg/L)
Lebo Drain 6 (PMRA #2818733)	Soybeans, tomatoes, wheat	2017	11	95	7.1	0.5	86	6.5	0.5	0.2
Lebo Drain 7 (PMRA #2818733)	Corn, tomatoes	2017	10	34	2.6	0.2	34	2.5	0.2	0.1
Lebo Drain 8 (PMRA #2818733)	Greenhouses, tomatoes, corn	2017	10	32	2.4	0.2	18	1.4	0.1	0.1
Lebo Drain 9 (PMRA #2818733)	Greenhouses, soybeans, corn	2017	9	42	3.2	0.2	24	1.8	0.1	0.2
Nissouri Creek (PMRA #2523839, #2681876, #2703534, #2834287)	Corn, soybeans	2013	12	15	1.1	0.1	8.1	0.6	< 0.1	0.1
		2015	12	12	0.9	0.1	7	0.5	< 0.1	< 0.1
		2016	6	11	0.8	0.1	8.3	0.6	< 0.1	< 0.1
Nottawasaga River (PMRA #2523839, #2703534, #2834287)	Soybeans, corn, wheat	2012	13	4.4	0.3	< 0.1	2.1	0.2	< 0.1	< 0.1
		2013	11	9.8	0.7	< 0.1	5.2	0.4	< 0.1	< 0.1
Prudhomme Creek (Old Vineland Creek) (PMRA #2523839, #2532563, #2681876, #2703534, #2834287; 2011 data are from ECCC, as cited in PMRA #2526820)	Orchards, vineyards, urban/developed	2011	1	23	1.7	0.1	23	1.7	0.1	< 0.1
		2012	13	22	1.7	0.1	5.8	0.4	< 0.1	0.1
		2013	11	16	1.2	0.1	5.6	0.4	< 0.1	0.1
		2014	14	8.1	0.6	< 0.1	4.2	0.3	< 0.1	< 0.1
		2015	14	26	2	0.1	7.6	0.6	< 0.1	0.3
		2016	6	33	2.5	0.2	15	1.2	0.1	0.1
Sturgeon Creek (PMRA #2523839, #2532563, #2681876, #2703534, #2834287)	Soybeans, corn, greenhouses, wheat, tomatoes	2012	12	1.7	0.1	< 0.1	0.9	0.1	< 0.1	< 0.1
		2013	12	5.2	0.4	< 0.1	3	0.2	< 0.1	< 0.1
		2014	14	2.8	0.2	< 0.1	2.8	0.2	< 0.1	< 0.1
		2015	13	9.5	0.7	< 0.1	2.9	0.2	< 0.1	0.1
		2016	6	85	6.4	0.5	28	2.1	0.2	0.3
Sturgeon Creek 1 (PMRA #2818733)	Greenhouses, soybeans, tomatoes	2017	13	19	1.4	0.1	13	1	0.1	0.1

Waterbody (Data source)	Major land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Acute HC_5 (1.5 µg/L)
Sturgeon Creek 2 (PMRA #2818733)	Soybeans	2017	8	8.7	0.6	< 0.1	5.8	0.4	< 0.1	< 0.1
Sturgeon Creek 3 (PMRA #2818733)	Greenhouses, soybeans	2017	13	8.4	0.6	< 0.1	6.8	0.5	< 0.1	< 0.1
Sturgeon Creek 4 (PMRA #2818733)	Greenhouses, tomatoes	2017	9	7.1	0.5	< 0.1	3.3	0.3	< 0.1	< 0.1
LE1 (PMRA #2818733)	Corn, tomatoes	2017	13	28	2.1	0.1	28	2.1	0.1	< 0.1
Sydenham River (PMRA #2523839, #2532563, #2681876, #2703534, #2834287)	Soybeans, corn, wheat	2012	17	16	1.2	0.1	9.5	0.7	0.1	0.1
		2013	10	30	2.2	0.2	24	1.8	0.1	0.1
		2014	14	20	1.5	0.1	13	1	0.1	0.1
		2015	13	23	1.7	0.1	10	0.8	0.1	0.1
		2016	6	15	1.1	0.1	16	1.2	0.1	< 0.1
Thames River (PMRA #2523839, #2532563, #2681876, #2703534, #2834287; 2011 data are from ECCC, as cited in PMRA #2526820)	Corn, soybeans, wheat	2011	1	13	1	0.1	13	1	0.1	< 0.1
		2012	17	6.4	0.5	< 0.1	4.8	0.4	< 0.1	< 0.1
		2013	11	20	1.5	0.1	22	1.7	0.1	0.1
		2015	12	34	2.6	0.2	7.3	0.5	< 0.1	0.3
		2016	6	10	0.8	0.1	8	0.6	< 0.1	< 0.1
West Holland River (PMRA #2523839, #2703534, #2834287)	Soybeans, corn, vegetables, wheat	2013	13	5.1	0.4	< 0.1	4.5	0.3	< 0.1	< 0.1
Indian Creek (PMRA #2523839, #2532563, #2681876, #2703534, #2834287; 2011 data are from ECCC, as cited in PMRA #2526820)	Urban/developed	2011	2	0.6	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
		2012	14	0.7	0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
		2013	11	1.6	0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
		2014	8	0.8	0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
		2015	12	0.9	0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
		2016	5	1.4	0.14	< 0.1	1.6	0.1	< 0.1	< 0.1

Waterbody (Data source)	Major land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Acute HC_5 (1.5 µg/L)
Credit River (data from ECCC, as cited in PMRA #2526820)	Urban or turf	2011	1	0.6	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
Highland Creek (data from ECCC, as cited in PMRA #2526820)	Urban or turf	2011	1	0.6	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
Kossuth (data from ECCC, as cited in PMRA #2526820)	Urban or turf	2011	1	1.2	0.1	< 0.1	1.2	0.1	< 0.1	< 0.1
Lake Erie (4 stations) (PMRA #2523839)	Not applicable; sites were not near the shore	2013	4	8.9	0.7	< 0.1	0.6	< 0.1	< 0.1	< 0.1
Lgrand (data from ECCC, as cited in PMRA #2526820)	Row crops	2011	1	5	0.4	< 0.1	5	0.4	< 0.1	< 0.1
Mimico Creek (data from ECCC, as cited in PMRA #2526820)	Urban or turf	2011	1	0.6	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
Nott-baxter and Nott-SR10 sites (2 sites) (data from ECCC, as cited in PMRA #2526820)	Potatoes	2011	2	0.9	0.1	< 0.1	0.9	0.1	< 0.1	< 0.1
Spencer Creek (data from ECCC, as cited in PMRA #2526820)	Urban or turf	2011	1	1.2	0.1	< 0.1	1.2	0.1	< 0.1	< 0.1
Spring Creek (PMRA #2523839, #2532563, #2681876,	Reference site; no pesticide use	2012	5	0.6	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
		2013	5	0.6	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
		2014	7	0.6	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
		2015	6	0.6	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1

Waterbody (Data source)	Major land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Acute HC_5 (1.5 µg/L)
#2703534, #2834287)		2016	4	0.6	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
Taylor Creek (data from ECCC, as cited in PMRA #2526820)	Urban or turf	2011	1	0.6	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
Welland (data from ECCC, as cited in PMRA #2526820)	Row crops	2011	1	1.5	0.1	< 0.1	1.5	0.1	< 0.1	< 0.1
Batteaux River (PMRA #2523836, #2759002)	Urban, shrubland, forest	2012–2014	18	27[4]	2[4]	0.1	27[4]	2[4]	0.1	< 0.1
Boomer Creek (PMRA #2523836, #2759002)	Corn, pasture, wheat, hemp	2012–2014	18	27[4]	2[4]	0.1	27[4]	2[4]	0.1	< 0.1
Decker Creek (PMRA #2523836, #2759002)	Corn, soybean cereals, orchards	2012–2014	17	27[4]	2[4]	0.1	27[4]	2[4]	0.1	< 0.1
Don River (PMRA #2523836, #2759002)	Urban	2012	1	27[4]	2[4]	0.1	27[4]	2[4]	0.1	< 0.1
Four Mile Creek (PMRA #2523836, #2759002)	Orchards, corn, soybeans, vineyards, greenhouses	2012–2014	18	27[4]	2[4]	0.1	27[4]	2[4]	0.1	< 0.1
Grand River (PMRA #2523836, #2759002)	Urban, forest, pasture, corn, soybeans	2012–2014	17	27[4]	2[4]	0.1	27[4]	2[4]	0.1	< 0.1
Gregory Creek (PMRA #2523836, #2759002)	Corn, soybeans, wheat, cereals	2012–2014	14	27[4]	2[4]	0.1	27[4]	2[4]	0.1	< 0.1
Griffins Creek (PMRA #2523836, #2759002)	Corn, soybeans, cereals, wheat	2012–2014	16	27[4]	2[4]	0.1	27[4]	2[4]	0.1	< 0.1

Waterbody (Data source)	Major land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Acute HC_5 (1.5 µg/L)
Humber River (PMRA #2523836, #2759002)	Urban	2012–2014	20	27[4]	2[4]	0.1	27[4]	2[4]	0.1	< 0.1
Lebo Drain (PMRA #2523836, #2759002)	Corn, soybeans, wheat, vegetables	2012–2014	16	27[4]	2[4]	0.1	27[4]	2[4]	0.1	< 0.1
#Little Ausable River (PMRA #2523836, #2759002)	Corn, soybeans, cereals, hemp	2012	2	27[4]	2[4]	0.1	27[4]	2[4]	0.1	< 0.1
McGregor Creek (PMRA #2523836, #2759002)	Corn, soybeans, cereals, vegetables	2012–2014	18	39[5]	2.9[5]	0.2	27[5]	2[5]	0.1	0.3
McKillop Drain (PMRA #2523836, #2759002)	Corn, soybeans, cereals, wheat	2012–2014	18	27[4]	2[4]	0.1	27[4]	2[4]	0.1	< 0.1
Nissouri Creek (PMRA #2523836, #2759002)	Corn, soybeans, wheat, pasture	2013	2	136[5]	10[5]	0.7	136[5]	10[5]	0.7	0.3
Otter Creek (PMRA #2523836, #2759002)	Corn, soybeans, cereals, wheat	2012–2014	16	27[4]	2[4]	0.1	27[4]	2[4]	0.1	< 0.1
Reynolds Creek (PMRA #2523836, #2759002)	Corn, soybeans, cereals, wheat, hemp	2012–2014	17	27[4]	2[4]	0.1	27[4]	2[4]	0.1	< 0.1
Saugeen River (PMRA #2523836, #2759002)	Corn, soybeans, cereals, wheat	2012-–2014	17	27[4]	2[4]	0.1	27[4]	2[4]	0.1	< 0.1
Thames River (PMRA #2523836, #2759002)	Corn, soybeans, cereals, wheat	2012–2014	18	27[4]	2[4]	0.1	27[4]	2[4]	0.1	< 0.1
Venison Creek (PMRA #2523836, #2759002)	Corn, soybeans, forest, wheat, orchards	2012–2014	17	27[4]	2[4]	0.1	27[4]	2[4]	0.1	< 0.1
Whitemans Creek (PMRA #2523836, #2759002)	Corn, soybeans, tobacco, other crops	2012–2014	18	27[4]	2[4]	0.1	27[4]	2[4]	0.1	< 0.1

Waterbody (Data source)	Major land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Acute HC_5 (1.5 µg/L)
Big Creek (PMRA #2712893)	Corn, soybeans, wheat	2015	23	43	3.2	0.2	37	2.8	0.2	0.2
Garvey Glenn (PMRA #2712893)	Corn, soybeans, wheat	2015	19	28	2.1	0.1	17	1.3	0.1	0.2
Little Ausable Creek (PMRA #2712893)	Corn, soybeans, wheat	2015	17	57	4.2	0.3	29	2.2	0.2	0.2
North Creek (PMRA #2712893)	Corn, soybeans, wheat	2015	19	53	4	0.3	8	0.6	< 0.1	0.3
White Ash Creek (PMRA #2712893)	Corn, soybeans, wheat	2015	18	24	1.8	0.1	7	0.5	< 0.1	0.2
Hamilton Harbour, WWTP influent and effluent (PMRA #2710505)	Urban	2016	6	1.7[4]	0.1	< 0.1	1.7[4]	0.1	< 0.1	< 0.1
Grand River, WWTP influent and effluent (PMRA #2710505)	Urban, corn, soybeans	2016	12	1.7[4]	0.1	< 0.1	1.7[4]	0.1	< 0.1	< 0.1
Detroit River, WWTP influent and effluent (PMRA #2710505)	Urban	2016	6	1.7[4]	0.1	< 0.1	1.7[4]	0.1	< 0.1	< 0.1
Little River, WWTP influent and effluent (PMRA #2710505)	Urban	2016	6	1.7[4]	0.1	< 0.1	1.7[4]	0.1	< 0.1	< 0.1
Presqu'île Bay, WWTP influent and effluent (PMRA #2710505)	Urban, corn, soybeans	2016	2	1.7[4]	0.1	< 0.1	1.7[4]	0.1	< 0.1	< 0.1
Cootes Paradise, WWTP influent and effluent (PMRA #2710505)	Urban, forest, corn, soybeans	2016	6	1.7[4]	0.1	< 0.1	1.7[4]	0.1	< 0.1	< 0.1
Ditches around corn fields[6] (PMRA #2526184)	Corn	2013	22	1546[6]	116[6]	8.3[6]	618[6]	46[6]	3.3[6]	11[6]

Waterbody (Data source)	Major land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Acute HC_5 (1.5 µg/L)
Drainage tile outlets around corn fields[6] (PMRA #2526184)	Corn	2013	8	417[6]	32[6]	2.2[6]	65[6]	4.8[6]	0.3[6]	2.4[6]
Creeks, streams, ponds (PMRA #2548877)	Agriculture	2013	42	53	4	0.3	0.3	< 0.1	< 0.1	2.2
		2014	14	12	0.9	0.1	3.2	0.2	< 0.1	0.1
Streams, culverts, ditches (PMRA #2548876)	Agriculture	2014	5	22	1.7	0.1	10	0.8	0.1	0.1
Black Creek (PMRA #2785041)	Corn, soybeans, wheat	2015	2	23	1.8	0.1	23	1.8	0.1	< 0.1
		2016	2	13	1	0.1	13	1	0.1	< 0.1
Beckstead (PMRA #2785041)	Corn, soybeans, wheat	2015	2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
		2016	2	0.3	< 0.1	< 0.1	0.3	< 0.1	< 0.1	< 0.1
East Branch Scotch River (PMRA #2785041)	Forest, corn, soybeans, wheat	2015	2	0.3	< 0.1	< 0.1	0.3	< 0.1	< 0.1	< 0.1
		2016	2	0.4	< 0.1	< 0.1	0.4	< 0.1	< 0.1	< 0.1
East Castor (PMRA #2785041)	Corn, soybeans, pasture, wheat	2015	2	29	2.1	0.2	29	2.1	0.2	< 0.1
		2016	2	3.7	0.3	< 0.1	3.7	0.3	< 0.1	< 0.1
Greenough (PMRA #2785041)	Corn, soybeans, pasture	2015	1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
		2016	2	0.3	< 0.1	< 0.1	0.3	< 0.1	< 0.1	< 0.1
Kirkwood (PMRA #2785041)	Corn, soybeans, wheat	2015	2	90	6.8	0.5	90	6.8	0.5	0.1
		2016	2	5.7	0.4	< 0.1	5.7	0.4	< 0.1	< 0.1
Little Castor (PMRA #2785041)	Corn, soybeans, wheat	2015	2	23	1.7	0.1	23	1.7	0.1	< 0.1
		2016	2	4	0.3	< 0.1	4	0.3	< 0.1	< 0.1
McLeod (PMRA #2785041)	Corn, soybeans, wheat	2015	2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
		2016	2	0.4	< 0.1	< 0.1	0.4	< 0.1	< 0.1	< 0.1
Middle Castor River (PMRA #2785041)	Corn, soybeans, wheat	2015	2	23	1.7	0.1	23	1.7	0.1	< 0.1
		2016	2	0.7	0.1	< 0.1	0.7	0.1	< 0.1	< 0.1
North Branch South Nation (PMRA #2785041)	Corn, soybeans, wheat	2015	2	6.2	0.5	< 0.1	6.2	0.5	< 0.1	< 0.1
		2016	2	12	0.9	0.1	12	0.9	0.1	< 0.1
Nugent (PMRA #2785041)	Corn, soybeans, wheat	2015	2	4	0.3	< 0.1	4	0.3	< 0.1	< 0.1
		2016	2	1	0.1	< 0.1	1	0.1	< 0.1	< 0.1
Payne River (PMRA #2785041)	Corn, soybeans, wheat	2015	2	13	1	0.1	13	0.9	0.1	< 0.1
		2016	2	12	1	0.1	12	0.9	0.1	< 0.1
Shane	Corn, soybeans,	2015	2	2.6	0.2	< 0.1	2.6	0.2	< 0.1	< 0.1

Waterbody (Data source)	Major land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Acute HC_5 (1.5 µg/L)
(PMRA #2785041)	wheat	2016	2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
St. Edouard Road (PMRA #2785041)	Corn, soybeans, wheat	2015	2	0.4	< 0.1	< 0.1	0.4	< 0.1	< 0.1	< 0.1
		2016	2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
West Branch Scotch River (PMRA #2785041)	Corn, soybeans, wheat	2015	2	9.1	0.7	< 0.1	9.1	0.7	< 0.1	< 0.1
		2016	2	9	0.7	< 0.1	9	0.7	< 0.1	< 0.1
Whittaker (PMRA #2785041)	Corn, soybeans	2015	2	1.8	0.1	< 0.1	1.8	0.1	< 0.1	< 0.1
		2016	2	1.4	0.1	< 0.1	1.4	0.1	< 0.1	< 0.1

LOD = limit of detection;
N = sample size;
Stdev = standard deviation;
Chronic HC_5 = the 5^{th} percentile of the species sensitivity distribution for the NOEC at 50% confidence intervals;
EC_{20} = effective concentration on 20% of the population (it is the most sensitive single species chronic endpoint for clothianidin);
NOEC = no observable effect concentration;
Acute HC_5 = the 5^{th} percentile of the species sensitivity distribution for the LC_{50} (the median lethal concentration) at 50% confidence intervals;
ECCC = Environment and Climate Change Canada;
WWTP = waste water treatment plant

[1]Risk Quotient = concentration ÷ toxicity endpoint

[2]Average, median and maximum concentrations over the sampling period are reported in Table A.7-5.

[3]Because monitoring may not capture peak concentrations, maximum concentrations may be underestimated.

[4]The limit of detection for these samples was more than two times higher than the chronic endpoint. Even though clothianidin was not detected in any samples, assigning half the limit of detection to non-detected samples still results in average and median concentrations which exceed the chronic toxicity endpoint. Thus, calculated risk quotients exceed the level of concern.

[5]The limit of detection for these samples was more than two times higher than the chronic endpoint. Even though clothianidin was not detected in most samples, assigning half the limit of detection to non-detected samples still results in average and median concentrations which exceed the chronic toxicity endpoint. Thus, calculated risk quotients exceed the level of concern.

[6]Ditches and tile drain outlets around corn fields may not represent aquatic habitat.

Table A.7-7 Summary statistics for clothianidin measured in waterbodies from Manitoba, Saskatchewan and Alberta.

NOTES:

-In calculations, the PMRA assigned a value equal to half the limit of detection to samples that showed no detection.

-The frequency of sampling and the length of the sampling period varied between data sets. Some waterbodies were sampled one to three times between May and October, while others were sampled one to three times per month between April and December. Values measured at sites where only a few samples were collected may not represent concentrations throughout the growing season.

Waterbody (Data source)	Major land use	Year	LOD (µg/L)	N	N detects	% Detection	Average (µg/L)	Stdev	Median (µg/L)	Max (µg/L)	N (% of samples) exceeding the toxicity endpoints			
											Chronic HC_5 of 0.0015 µg/L	Chronic EC_{20} of 0.02 µg/L	Mesocosm NOEC of 0.281 µg/L	Acute HC_5 of 1.5 µg/L
Manitoba														
Red River at Emerson (PMRA #2745819)	Soybeans, wheat, canola, oats, corn	2014	0.00176	7	7	100	0.019	0.016	0.017	0.046	7 (100%)	3 (43%)	0 (0%)	0 (0%)
		2015	0.00176	6	5	83	0.009	0.007	0.01	0.017	5 (83%)	0 (0%)	0 (0%)	0 (0%)
		2016	0.00176	1	1	100	0.01	NA	0.01	0.01	1 (100%)	0 (0%)	0 (0%)	0 (0%)
Red River at Emerson (PMRA #2849359, #2849370)	Soybeans, wheat, canola, oats, corn	2017	0.0054	3	2	67	0.031	0.024	0.042	0.047	2 detects, 3 samples (100%)[1]	2 (67%)	0 (0%)	0 (0%)
Red River at Selkirk (PMRA #2745819)	Soybeans, wheat, canola, oats	2014	0.00176	1	1	100	0.012	NA	0.012	0.012	1 (100%)	0 (0%)	0 (0%)	0 (0%)
Red River at Selkirk (PMRA #2849359, #2849370)	Soybeans, wheat, canola, oats	2017	0.0054	3	2	67	0.025	0.027	0.016	0.055	2 detects, 3 samples (100%)[1]	1 (33%)	0 (0%)	0 (0%)
Red River at Norbert (PMRA #2849359, #2849370)	Soybeans, wheat, canola, corn, oats	2017	0.0054	3	2	67	0.025	0.02	0.032	0.041	2 detects, 3 samples (100%)[1]	2 (67%)	0 (0%)	0 (0%)
Assiniboine River Northwest of Treesbank (PMRA #2849359, #2849370)	Canola, wheat, soybeans, corn	2017	0.0054	3	0	0	0.003	0	0.003	0.003	0 detects, 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Assiniboine River at Happy Hollow Farm (PMRA #2849359, #2849370)	Canola, wheat, soybeans, corn	2017	0.0054	3	0	0	0.003	0	0.003	0.003	0 detects, 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)

Waterbody (Data source)	Major land use	Year	LOD (µg/L)	N	N detects	% Detection	Average (µg/L)	Stdev	Median (µg/L)	Max (µg/L)	N (% of samples) exceeding the toxicity endpoints			
											Chronic HC_5 of 0.0015 µg/L	Chronic EC_{20} of 0.02 µg/L	Mesocosm NOEC of 0.281 µg/L	Acute HC_5 of 1.5 µg/L
Assiniboine River downstream of Portage la Prairie (PMRA #2849359, #2849370)	Soybeans, wheat, canola	2017	0.0054	3	0	0	0.003	0	0.003	0.003	0 detects, 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Assiniboine River at Headingley (PMRA #2849359, #2849370)	Soybeans, canola, wheat, oats, barley, corn	2017	0.0054	3	0	0	0.003	0	0.003	0.003	0 detects, 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Assiniboine River at Provincial Trunk Highway 21, North of Griswold (PMRA #2849359, #2849370)	Canola, wheat, soybeans, barley	2017	0.0054	3	1	33	0.006	0.005	0.003	0.012	1 detect, 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Assiniboine River at Provincial Trunk Highway 83, South of Miniota (PMRA #2849359, #2849370)	Canola, wheat, soybeans, barley	2017	0.0054	3	1	33	0.013	0.019	0.003	0.035	1 detect, 3 samples (100%)[1]	1 (33%)	0 (0%)	0 (0%)
Boyne River (PMRA #2849359, #2849370)	Soybeans, corn, wheat, canola, oats	2017	0.0054	3	3	100	0.022	0.009	0.021	0.032	3 (100%)	2 (67%)	0 (0%)	0 (0%)
Cooks Creek at Rural Municipality Boundary Road (PMRA #2849359, #2849370)	Soybeans, canola, oats, corn, wheat	2017	0.0054	3	0	0	0.003	0	0.003	0.003	0 detects, 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Cooks Creek south of Millbrook (PMRA #2849359, #2849370)	Soybeans, canola, oats, corn, wheat	2017	0.0054	3	1	33	0.012	0.016	0.003	0.031	1 detect, 3 samples (100%)[1]	1 (33%)	0 (0%)	0 (0%)
Edwards Creek (PMRA #2849359, #2849370)	Canola, soybeans, wheat	2017	0.0054	3	0	0	0.003	0	0.003	0.003	0 detects, 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Icelandic River (PMRA #2849359, #2849370)	Soybeans, wheat, canola, oats	2017	0.0054	3	0	0	0.003	0	0.003	0.003	0 detects, 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
La Salle River at the town of La Salle (PMRA #2849359, #2849370)	Soybeans, canola, wheat, oats, corn	2017	0.0054	3	1	33	0.007	0.008	0.003	0.017	1 detect, 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)

Waterbody (Data source)	Major land use	Year	LOD (µg/L)	N	N detects	% Detection	Average (µg/L)	Stdev	Median (µg/L)	Max (µg/L)	N (% of samples) exceeding the toxicity endpoints			
											Chronic HC_5 of 0.0015 µg/L	Chronic EC_{20} of 0.02 µg/L	Mesocosm NOEC of 0.281 µg/L	Acute HC_5 of 1.5 µg/L
La Salle River at La Barriere (PMRA #2849359, #2849370)	Soybeans, wheat, canola, corn, oats	2017	0.0054	3	1	33	0.009	0.011	0.003	0.022	1 detect, 3 samples (100%)[1]	1 (33%)	0 (0%)	0 (0%)
Lake Manitoba (PMRA #2849359, #2849370)	Soybeans, wheat, canola	2017	0.0054	2	0	0	0.003	0	0.003	0.003	0 detects, 2 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Lake Winnipeg (PMRA #2849359, #2849370)	Soybeans, wheat, canola, oats	2017	0.0054	3	1	33	0.006	0.006	0.003	0.013	1 detect, 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Little Saskatchewan River (PMRA #2849359, #2849370)	Canola, wheat, soybeans, barley	2017	0.0054	3	0	0	0.003	0	0.003	0.003	0 detects, 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Morris River (PMRA #2849359, #2849370)	Soybeans, canola, wheat, corn, oats	2017	0.0054	3	3	100	0.033	0.02	0.032	0.054	3 (100%)	2 (67%)	0 (0%)	0 (0%)
Oak River (PMRA #2849359, #2849370)	Canola, wheat, soybeans, barley	2017	0.0054	3	0	0	0.003	0	0.003	0.003	0 detects, 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Pelican Lake (PMRA #2849359, #2849370)	Wheat, canola, soybeans	2017	0.0054	2	0	0	0.003	0	0.003	0.003	0 detects, 2 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Pipestone Creek (PMRA #2849359, #2849370)	Canola, wheat, soybeans, barley	2017	0.0054	3	0	0	0.003	0	0.003	0.003	0 detects, 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Rat River (PMRA #2849359, #2849370)	Soybeans, wheat, canola, corn, oats	2017	0.0054	3	2	67	0.022	0.02	0.021	0.043	2 detects, 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Rock Lake (PMRA #2849359, #2849370)	Canola, soybeans, wheat, barley	2017	0.0054	3	0	0	0.003	0	0.003	0.003	0 detects, 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Roseau River (PMRA #2849359, #2849370)	Soybeans, wheat, canola, oats, corn	2017	0.0054	3	1	33	0.007	0.007	0.003	0.014	1 detect, 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Seine River (PMRA #2849359, #2849370)	Soybeans, wheat, canola, corn, oats	2017	0.0054	2	0	0	0.003	0	0.003	0.003	0 detects, 2 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Souris River at the Town of Souris (PMRA #2849359, #2849370)	Canola, soybeans, wheat, corn	2017	0.0054	2	1	50	0.011	0.012	0.011	0.02	1 detect, 2 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Souris River at Melita (PMRA #2849359, #2849370)	Canola, wheat, soybeans, oats	2017	0.0054	2	0	0	0.003	0	0.003	0.003	0 detects, 2 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)

Waterbody (Data source)	Major land use	Year	LOD (µg/L)	N	N detects	% Detection	Average (µg/L)	Stdev	Median (µg/L)	Max (µg/L)	N (% of samples) exceeding the toxicity endpoints			
											Chronic HC_5 of 0.0015 µg/L	Chronic EC_{20} of 0.02 µg/L	Mesocosm NOEC of 0.281 µg/L	Acute HC_5 of 1.5 µg/L
Sturgeon Creek (PMRA #2849359, #2849370)	Soybeans, canola, wheat, oats, barley, corn	2017	0.0054	3	0	0	0.003	0	0.003	0.003	0 detects, 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Swan River (PMRA #2849359, #2849370)	Canola, wheat, soybeans	2017	0.0054	3	0	0	0.003	0	0.003	0.003	0 detects, 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Willow Creek (PMRA #2849359, #2849370)	Soybeans, wheat, canola	2017	0.0054	3	0	0	0.003	0	0.003	0.003	0 detects, 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Woody River (PMRA #2849359, #2849370)	Canola, wheat, soybeans	2017	0.0054	3	0	0	0.003	0	0.003	0.003	0 detects, 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Seasonal (Class III) and semi-permanent (Class IV) wetlands[2,3] (PMRA #2847073, #2847083)	Canola, wheat, oats, pasture, corn	Summer 2017	0.01	12	2	17	NC	NC	NC	Overall range: 0.005–0.037; Range of detects: 0.031–0.037	2 wetlands with detects, 12 wetlands sampled (100%)[1]	2 wetlands (17%)	0 wetlands (0%)	0 wetlands (0%)
		Fall 2017	0.01	5	0	0	NC	NC	NC	0.005	0 wetlands with detects, 5 wetlands sampled (100%)[1]	0 wetlands (0%)	0 wetlands (0%)	0 wetlands (0%)
Creek (PMRA #2548877)	Agriculture	2013	0.001 (LOQ)	1	0	0	0.0005	NA	0.0005	0.0005	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Streams, culverts, ditches (PMRA #2548876)	Agriculture	2014	0.0022	3	0	0	0.0011	0	0.0011	0.0011	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Saskatchewan														
Assiniboine River (PMRA #2745819)	Canola and rapeseed, wheat	2014	0.00176	6	6	100	0.006	0.005	0.004	0.016	6 (100%)	0 (0%)	0 (0%)	0 (0%)
		2015	0.00176	8	1	13	0.001	0.0004	0.0009	0.002	1 (13%)	0 (0%)	0 (0%)	0 (0%)
Battle River (PMRA #2745819)	Canola and rapeseed, rye, wheat	2015	0.00176	6	1	17	0.001	0.001	0.0009	0.004	1 (17%)	0 (0%)	0 (0%)	0 (0%)
		2016	0.00176	2	0	0	0.0009	0	0.0009	0.0009	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Avonlea Creek (PMRA #2849265, #2849266)	Canola, peas, lentils, wheat	2017	0.0054	8	0	0	0.003	0	0.003	0.003	0 detects, 3 samples (1000%)[1]	0 (0%)	0 (0%)	0 (0%)
Lanigan Creek (PMRA #2849265, #2849266)	Mainly canola, with some peas, wheat	2017	0.0054	8	3	38	0.008	0.008	0.003	0.023	3 detects, 8 samples (100%)[1]	1 (13%)	0 (0%)	0 (0%)
Lightning Creek (PMRA #2849265, #2849266)	Canola with some soybeans, wheat	2017	0.0054	10	3	30	0.005	0.004	0.003	0.013	3 detects, 10 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)

Waterbody (Data source)	Major land use	Year	LOD (µg/L)	N	N detects	% Detection	Average (µg/L)	Stdev	Median (µg/L)	Max (µg/L)	N (% of samples) exceeding the toxicity endpoints			
											Chronic HC_5 of 0.0015 µg/L	Chronic EC_{20} of 0.02 µg/L	Mesocosm NOEC of 0.281 µg/L	Acute HC_5 of 1.5 µg/L
McDonald Creek (PMRA #2849265, #2849266)	Mainly lentils, with wheat	2017	0.0054	7	0	0	0.003	0	0.003	0.003	0 detects, 7 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Moose Jaw River (PMRA #2849265, #2849266)	Lentils, canola, with wheat	2017	0.0054	9	2	22	0.006	0.006	0.003	0.02	2 detects, 9 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Moose Mountain Creek (PMRA #2849265, #2849266)	Mainly canola, with wheat	2017	0.0054	9	1	11	0.009	0.019	0.003	0.059	1 detect, 9 samples (100%)[1]	1 (11%)	0 (0%)	0 (0%)
Oscar Creek (PMRA #2849265, #2849266)	Mainly canola	2017	0.0054	10	0	0	0.003	0	0.003	0.003	0 detects, 10 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Pipestone Creek (PMRA #2849265, #2849266)	Mainly canola, with wheat	2017	0.0054	12	3	25	0.006	0.01	0.003	0.038	3 detects, 12 samples (100%)[1]	1 (8%)	0 (0%)	0 (0%)
Saline Creek (PMRA #2849265, #2849266)	Mainly canola, with wheat	2017	0.0054	10	0	0	0.003	0	0.003	0.003	0 detects, 10 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Souris River (PMRA #2849265, #2849266)	Mainly canola, lentils, with wheat	2017	0.0054	9	4	44	0.011	0.01	0.003	0.024	4 detects, 9 samples (100%)[1]	3 (33%)	0 (0%)	0 (0%)
Spirit Creek (PMRA #2849265, #2849266)	Mainly canola, with wheat	2017	0.0054	10	0	0	0.003	0	0.003	0.003	0 detects, 10 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Swift Current Creek (2 sites) (PMRA #2849265, #2849266)	Mainly lentils, with some peas, canola, wheat	2017	0.0054	17	0	0	0.003	0	0.003	0.003	0 detects, 17 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Willowbrook Creek (PMRA #2849265, #2849266)	Mainly canola	2017	0.0054	9	0	0	0.003	0	0.003	0.003	0 detects, 9 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Wood River (PMRA #2849265, #2849266)	Mainly lentils, peas, with wheat	2017	0.0054	9	0	0	0.003	0	0.003	0.003	0 detects, 9 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Temporary (Class II), seasonal (Class III), semi-permanent (Class IV) and permanent (Class V) wetlands[2,3] (PMRA #2526133,	Barley, canola, oats, wheat, grassland (previous year's crops)	Spring (pre-seed) 2012	0.0011 (LOQ)	138	49	36	NC	NC	NC	Overall range: 0.0006–0.14; Range of detects: 0.002–0.14	49 wetlands (36%)	15 wetlands (11%)	0 wetlands (0%)	0 wetlands (0%)

Waterbody (Data source)	Major land use	Year	LOD (µg/L)	N	N detects	% Detection	Average (µg/L)	Stdev	Median (µg/L)	Max (µg/L)	N (% of samples) exceeding the toxicity endpoints			
											Chronic HC_5 of 0.0015 µg/L	Chronic EC_{20} of 0.02 µg/L	Mesocosm NOEC of 0.281 µg/L	Acute HC_5 of 1.5 µg/L
#2572395, #2608629, #2612760, #2612761, #2612762, #2712896)	Barley, canola, oats, wheat, peas, grassland	Summer 2012	0.0011 (LOQ)	134	69	51	NC	NC	NC	Overall range: 0.0006–3.1; Range of detects: 0.003–3.1	69 wetlands (51%)	52 wetlands (39%)	9 wetlands (7%)	1 wetland (1%)
	Barley, canola, oats, wheat, peas, grassland	Fall 2012	0.0011 (LOQ)	80	4	5	NC	NC	NC	Overall range: 0.0006–0.031; Range of detects: 0.007–0.031	4 wetlands (5%)	1 wetland (1%)	0 wetlands (0%)	0 wetlands (0%)
	Barley, canola, oats, wheat, peas, grassland (previous year's crops)	Spring (pre-seed) 2013	0.0026 (LOQ)	90	78	87	NC	NC	NC	Overall range: 0.001–0.17; Range of detects: 0.005–0.17	78 wetlands (87%)	56 wetlands (62%)	0 wetlands (0%)	0 wetlands (0%)
	Barley, canola, oats, peas, wheat, flax, grassland, chemfallow	Summer 2013	0.0011 (LOQ)	144	109	76	NC	NC	NC	Overall range: 0.0006–0.58; Range of detects: 0.004–0.58	109 wetlands (76%)	80 wetlands (56%)	7 wetlands (5%)	0 wetlands (0%)
	Canola, oats (previous year's crops)	Spring (pre-seed) 2014	0.0008	16	16	100	NC	NC	NC	Overall range: 0.0004–0.11; Range of detects: 0.004–0.11	16 wetlands (100%)	11 wetlands (69%)	0 wetlands (0%)	0 wetlands (0%)
	Barley, canola, flax,	Summer	0.0012–	All wetlands										

Waterbody (Data source)	Major land use	Year	LOD (µg/L)	N	N detects	% Detection	Average (µg/L)	Stdev	Median (µg/L)	Max (µg/L)	N (% of samples) exceeding the toxicity endpoints			
											Chronic HC_5 of 0.0015 µg/L	Chronic EC_{20} of 0.02 µg/L	Mesocosm NOEC of 0.281 µg/L	Acute HC_5 of 1.5 µg/L
	oats, lentils, wheat, peas, soybeans, chemfallow, pasture, grassland	2014	0.0016	115	51	44	NC	NC	NC	Overall range: 0.0006–2.1; Range of detects: 0.006–2.1	51 wetlands (44%)	27 wetlands (23%)	4 wetlands (3%)	2 wetlands (2%)
				Relevant wetlands based on additional site information provided in PMRA #2870577 and #2870578										
				46	13	28	NC	NC	NC	Overall range: 0.0006–0.39; Range of detects: 0.006–0.39	13 wetlands (28%)	4 wetlands (9%)	1 wetland (2%)	0 wetlands (0%)
Seasonal (Class III) and semi-permanent (Class IV) wetlands[2,3] (PMRA #2847073, – 2847083)	Wheat, canola, barley, pasture, lentils, summer fallow	Summer 2017	0.01	30	5	17	NC	NC	NC	Overall range: 0.005 – 0.51; Range of detects: 0.015 – 0.51	5 wetlands with detects, 30 wetlands sampled (100%)[1]	4 wetlands (13%)	1 wetland (3%)	0 wetlands (0%)
		Fall 2017	0.01	8	0	0	NC	NC	NC	0.005	0 wetlands with detects, 8 wetlands sampled (100%)[1]	0 wetlands (0%)	0 wetlands (0%)	0 wetlands (0%)
Alberta														
South Saskatchewan River (PMRA #2745819)	Grassland, peas, wheat	2014	0.00176	5	0	0	0.0009	0	0.0009	0.0009	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Oldman River (3 sites) (PMRA #2842307, #2842433)	Low disturbance, agriculture, developed land	2017	0.0054	12	0	0	0.003	0	0.003	0.003	0 detects, 12 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
South Saskatchewan River (PMRA #2842307, #2842433)	Low disturbance, developed land, agriculture	2017	0.0054	4	0	0	0.003	0	0.003	0.003	0 detects, 4 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Bow River (4 sites) (PMRA #2842307, #2842433)	Low disturbance, agriculture, developed land	2017	0.0054	16	0	0	0.003	0	0.003	0.003	0 detects, 16 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)

Waterbody (Data source)	Major land use	Year	LOD (µg/L)	N	N detects	% Detection	Average (µg/L)	Stdev	Median (µg/L)	Max (µg/L)	N (% of samples) exceeding the toxicity endpoints			
											Chronic HC_5 of 0.0015 µg/L	Chronic EC_{20} of 0.02 µg/L	Mesocosm NOEC of 0.281 µg/L	Acute HC_5 of 1.5 µg/L
Elbow River (PMRA #2842307, #2842433)	Developed land, low disturbance	2017	0.0054	4	0	0	0.003	0	0.003	0.003	0 detects, 4 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Red Deer River (PMRA #2745819)	Grassland, peas, wheat, canola, rapeseed	2015	0.00176	5	0	0	0.0009	0	0.0009	0.0009	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Red Deer River at Sundre (PMRA #2842307, #2842433)	Low disturbance, agriculture, developed land	2017	0.0054	4	0	0	0.003	0	0.003	0.003	0 detects, 4 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Red Deer River 1 kilometre upstream of Highway 2 Bridge (PMRA #2842307, #2842433)	Agriculture, developed land, low disturbance	2017	0.0054	4	0	0	0.003	0	0.003	0.003	0 detects, 4 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Red Deer River at Nevis Bridge (PMRA #2842307, #2842433)	Agriculture, low disturbance	2017	0.0054	4	0	0	0.003	0	0.003	0.003	0 detects, 4 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Red Deer River at Morrin Bridge (PMRA #2842307, #2842433)	Agriculture, low disturbance, developed land	2017	0.0054	4	1	25	0.005	0.004	0.003	0.011	1 detect, 4 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Red Deer River downstream of Dinosaur Provincial Park (PMRA #2842307, #2842433)	Low disturbance, agriculture	2017	0.0054	4	1	25	0.009	0.013	0.003	0.029	1 detect, 4 samples (100%)[1]	1 (25%)	0 (0%)	0 (0%)
North Saskatchewan River (3 sites) (PMRA #2842307, #2842433)	Low disturbance, agriculture, developed land	2017	0.0054	11	0	0	0.003	0	0.003	0.003	0 detects, 11 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Battle River (2 sites) (PMRA #2842307, #2842433)	Agriculture, low disturbance, developed land	2017	0.0054	8	0	0	0.003	0	0.003	0.003	0 detects, 8 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Beaver River (3 sites) (PMRA #2842307, 2842433)	Agriculture, low disturbance, developed land	2017	0.0054	12	0	0	0.003	0	0.003	0.003	0 detects, 12 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Athabasca River (PMRA #2842307, #2842433)	Agriculture, low disturbance, developed land	2017	0.0054	4	0	0	0.003	0	0.003	0.003	0 detects, 4 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)

Waterbody (Data source)	Major land use	Year	LOD (µg/L)	N	N detects	% Detection	Average (µg/L)	Stdev	Median (µg/L)	Max (µg/L)	N (% of samples) exceeding the toxicity endpoints			
											Chronic HC_5 of 0.0015 µg/L	Chronic EC_{20} of 0.02 µg/L	Mesocosm NOEC of 0.281 µg/L	Acute HC_5 of 1.5 µg/L
Peace River (PMRA #2842307, #2842433)	Agriculture, low disturbance	2017	0.0054	3	0	0	0.003	0	0.003	0.003	0 detects 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Wapiti River (2 sites) (PMRA #2842307, #2842433)	Agriculture, low disturbance, developed land	2017	0.0054	8	0	0	0.003	0	0.003	0.003	0 detects, 8 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Smoky River (PMRA #2842307, #2842433)	Agriculture, low disturbance	2017	0.0054	4	0	0	0.003	0	0.003	0.003	0 detects, 4 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Milk River (PMRA #2842307, #2842433)	Low disturbance, agriculture	2017	0.0054	4	0	0	0.003	0	0.003	0.003	0 detects, 4 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Bigknife Creek (PMRA #2842307, #2842433)	Agriculture, low disturbance	2017	0.0054	1	1	100	0.009	NA	0.009	0.009	1 (100%)	0 (0%)	0 (0%)	0 (0%)
Birch Creek (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, low disturbance, developed land	2017	0.0054	3	0	0	0.003	0	0.003	0.003	0 detects, 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Buffalo Creek (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, low disturbance	2017	0.0054	3	0	0	0.003	0	0.003	0.003	0 detects, 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Beaverhill Creek (PMRA #2842307, #2842433)	Canola, cereals, mixed animal use, low disturbance	2017	0.0054	3	1	33	0.006	0.005	0.003	0.012	1 detect, 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Big Valley Creek (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, low disturbance, developed land	2017	0.0054	2	0	0	0.003	0	0.003	0.003	0 detects, 2 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Egg Creek (PMRA #2842307, #2842433)	Canola, cereals, pulse crops, mixed animal use, low disturbance, developed land	2017	0.0054	3	0	0	0.003	0	0.003	0.003	0 detects, 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Grizzlybear Creek (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, low disturbance	2017	0.0054	3	0	0	0.003	0	0.003	0.003	0 detects, 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Haynes Creek (PMRA #2842307, #2842433)	Cereals, canola, pulse crops, mixed animal use, low disturbance	2017	0.0054	3	0	0	0.003	0	0.003	0.003	0 detects, 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Kneehills Creek (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, low disturbance, developed land	2017	0.0054	2	0	0	0.003	0	0.003	0.003	0 detects, 2 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)

Waterbody (Data source)	Major land use	Year	LOD (µg/L)	N	N detects	% Detection	Average (µg/L)	Stdev	Median (µg/L)	Max (µg/L)	N (% of samples) exceeding the toxicity endpoints			
											Chronic HC_5 of 0.0015 µg/L	Chronic EC_{20} of 0.02 µg/L	Mesocosm NOEC of 0.281 µg/L	Acute HC_5 of 1.5 µg/L
Michichi Creek (PMRA #2842307, #2842433)	Cereals, canola, pulse crops, mixed animal use, low disturbance	2017	0.0054	2	0	0	0.003	0	0.003	0.003	0 detects, 2 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Mosquito Creek (PMRA #2842307, #2842433)	Canola, cereals, pulse crops, mixed animal use, low disturbance	2017	0.0054	2	0	0	0.003	0	0.003	0.003	0 detects, 2 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Meeting Creek (PMRA #2842307, #2842433)	Cereals, mixed animal use, low disturbance	2017	0.0054	2	0	0	0.003	0	0.003	0.003	0 detects, 2 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Seven Persons Creek (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, low disturbance	2017	0.0054	2	0	0	0.003	0	0.003	0.003	0 detects, 2 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Pipestone Creek (PMRA #2842307, #2842433)	Cereals, canola, pulse crops, mixed animal use, low disturbance, developed land	2017	0.0054	2	0	0	0.003	0	0.003	0.003	0 detects, 2 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Parlby Creek (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, unknown agricultural use, low disturbance	2017	0.0054	2	0	0	0.003	0	0.003	0.003	0 detects, 2 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Pothole Creek (PMRA #2842307, #2842433)	Cereals, canola, pulse crops, mixed animal use, low disturbance	2017	0.0054	1	0	0	0.003	NA	0.003	0.003	0 detects, 1 sample (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Queenie Creek (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, low disturbance, developed land	2017	0.0054	3	0	0	0.003	0	0.003	0.003	0 detects, 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Ray Creek (PMRA #2842307, #2842433)	Canola, cereals, mixed animal use, low disturbance	2017	0.0054	3	0	0	0.003	0	0.003	0.003	0 detects, 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Ribstone Creek (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, low disturbance	2017	0.0054	3	0	0	0.003	0	0.003	0.003	0 detects, 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Redwillow Creek (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, low disturbance	2017	0.0054	2	0	0	0.003	0	0.003	0.003	0 detects, 2 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Rosebud Creek (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, low disturbance	2017	0.0054	2	0	0	0.003	0	0.003	0.003	0 detects, 2 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)

Waterbody (Data source)	Major land use	Year	LOD (µg/L)	N	N detects	% Detection	Average (µg/L)	Stdev	Median (µg/L)	Max (µg/L)	N (% of samples) exceeding the toxicity endpoints			
											Chronic HC_5 of 0.0015 µg/L	Chronic EC_{20} of 0.02 µg/L	Mesocosm NOEC of 0.281 µg/L	Acute HC_5 of 1.5 µg/L
Scandia Creek (PMRA #2842307, #2842433)	Cereals, mixed animal use, low disturbance	2017	0.0054	1	0	0	0.003	NA	0.003	0.003	0 detects, 1 sample (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Sturgeon River (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, low disturbance, developed land	2017	0.0054	3	0	0	0.003	0	0.003	0.003	0 detects, 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Serviceberry Creek (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, low disturbance	2017	0.0054	2	0	0	0.003	0	0.003	0.003	0 detects, 2 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Threehills Creek (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, low disturbance	2017	0.0054	3	0	0	0.003	0	0.003	0.003	0 detects, 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Vermilion River (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, low disturbance, developed land	2017	0.0054	3	0	0	0.003	0	0.003	0.003	0 detects, 3 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Weiller Creek (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, low disturbance, developed land	2017	0.0054	2	0	0	0.003	0	0.003	0.003	0 detects, 2 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
West Michichi Creek (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, low disturbance	2017	0.0054	2	1	50	0.012	0.013	0.012	0.02	1 detect, 2 samples (100%)[1]	1 (50%)	0 (0%)	0 (0%)
Yellow Lake Tributary (PMRA #2842307, #2842433)	Cereals, sugar beet, pulse crops, potatoes, mixed animal use, low disturbance	2017	0.0054	1	0	0	0.003	NA	0.003	0.003	0 detects, 1 sample (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Seasonal (Class III) and semi-permanent (Class IV) wetlands[2, 3] (PMRA #2847073, #2847083)	Wheat, canola, oats, barley, pasture	Summer 2017	0.01	18	3	17	NC	NC	NC	Overall range: 0.005–0.038; Range of detects:0.022–0.038	3 wetlands with detects, 18 wetlands sampled (100%)[1]	3 wetlands (17%)	0 wetlands (0%)	0 wetlands (0%)
		Fall 2017	0.01	10	0	0	NC	NC	NC	0.005	0 wetlands with detects, 10 wetlands sampled (100%)[1]	0 wetlands (0%)	0 wetlands (0%)	0 wetlands (0%)
50 irrigation canals and returns[5] (PMRA #2842307, 2842433)	Agriculture	2017	0.0054	194	0	0	0.003[4]	0[4]	0.003[4]	0.003[4]	0 detects, 194 samples (100%)[1,4]	0 (0%)[4]	0 (0%)[4]	0 (0%)[4]

Waterbody (Data source)	Major land use	Year	LOD (µg/L)	N	N detects	% Detection	Average (µg/L)	Stdev	Median (µg/L)	Max (µg/L)	N (% of samples) exceeding the toxicity endpoints			
											Chronic HC_5 of 0.0015 µg/L	Chronic EC_{20} of 0.02 µg/L	Mesocosm NOEC of 0.281 µg/L	Acute HC_5 of 1.5 µg/L
3 tile drain sites[5] (PMRA #2842307, #2842433)	Irrigated agricultural area	2017	0.0054	8	3	38	0.008[4]	0.008[4]	0.003[4]	0.023[4]	3 detects, 8 samples (100%)[1,4]	1 (13%)[4]	0 (0%)[4]	0 (0%)[4]

LOD = limit of detection;
N = sample size;
Stdev = standard deviation;
Chronic HC_5 = the 5th percentile of the species sensitivity distribution for the NOEC at 50% confidence intervals;
EC_{20} = effective concentration on 20% of the population (it is the most sensitive single species chronic endpoint for clothianidin);
NOEC = no observable effect concentration;
Acute HC_5 = the 5th percentile of the species sensitivity distribution for the LC_{50} (the median lethal concentration) at 50% confidence intervals;
LOQ = limit of quantification;
NA = not applicable;
NC = not calculated

[1]The LOD is more than two times higher than the chronic HC_5 of 0.0015 µg/L. Assigning half the limit of detection to non-detected samples still results in a concentration exceeding the toxicity endpoint. Thus, all samples, including non-detects at half the limit of detection, exceed the toxicity endpoint.

[2]The wetlands were classified by the researchers using the classification system defined in Stewart, R.E. and H.A. Kantrud. 1971. Classification of natural ponds and lakes in the glaciated prairie region. Bureau of Sport Fisheries and Wildlife, U.S. Fish and Wildlife Service, Washington, D.C., USA. Resource Publication 92. 57 pp.

[3]Each wetland in these data sets was sampled only once during the time period, with the following exceptions:

a) For summer 2013 in the data set from PMRA #2526133 and #2612760, 11 wetlands in canola-growing areas were sampled three times between the months of June and July 2013. The average of the three values was used in calculations for each of the wetlands to represent concentrations for the sampling period.

b) For spring 2014 in the data set from PMRA #2572395, #2612761, 16 wetlands were sampled three to five times between May and June 2014. The averages over the four-week period were used in calculations for each of the wetlands to represent concentrations for the sampling period.

Average, standard deviation and median concentrations to estimate chronic exposure were not calculated because most wetlands were sampled only once during each time period.

[4]Irrigation canals and returns and tile drain sites may not represent aquatic habitat.

Table A.7-8 Risk quotients for clothianidin measured in waterbodies located in Manitoba, Saskatchewan and Alberta.

NOTES:

-Shaded cells indicate the level of concern is exceeded, meaning that the risk quotient is equal to or greater than a value of 1.

-The frequency of sampling and the length of the sampling period varied between data sets. Some waterbodies were sampled one to three times between May and October, while others were sampled one to three times per month between April and December. Values measured at sites where only a few samples were collected may not represent concentrations throughout the growing season.

Waterbody (Data source)	Major land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Acute HC_5 (1.5 µg/L)
Manitoba										
Red River at Emerson (PMRA #2745819)	Soybeans, wheat, canola, oats, corn	2014	7	13	1	0.1	11	0.9	0.1	< 0.1
		2015	6	6.2	0.5	< 0.1	6.7	0.5	< 0.1	< 0.1
		2016	1	6.4	0.5	< 0.1	6.4	0.5	< 0.1	< 0.1
Red River at Emerson (PMRA #2849359, #2849370)	Soybeans, wheat, canola, oats, corn	2017	3	20	1.5	0.1	28	2.1	0.2	< 0.1
Red River at Selkirk (PMRA #2745819)	Soybeans, wheat, canola, oats	2014	1	8.1	0.6	< 0.1	8.1	0.6	< 0.1	< 0.1
Red River at Selkirk (PMRA #2849359, #2849370)	Soybeans, wheat, canola, oats	2017	3	16	1.2	0.1	10	0.8	0.1	< 0.1
Red River at Norbert (PMRA #2849359, #2849370)	Soybeans, wheat, canola, corn, oats	2017	3	17	1.2	0.1	22	1.6	0.1	< 0.1
Assiniboine River Northwest of Treesbank (PMRA #2849359, #2849370)	Canola, wheat, soybeans, corn	2017	3	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Assiniboine River at Happy Hollow Farm (PMRA #2849359, #2849370)	Canola, wheat, soybeans, corn	2017	3	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Assiniboine River downstream of Portage la Prairie (PMRA #2849359, #2849370)	Soybeans, wheat, canola	2017	3	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1

Waterbody (Data source)	Major land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Acute HC_5 (1.5 µg/L)
Assiniboine River at Headingley (PMRA #2849359, #2849370)	Soybeans, canola, wheat, oats, barley, corn	2017	3	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Assiniboine River at Provincial Trunk Highway 21, North of Griswold (PMRA #2849359, #2849370)	Canola, wheat, soybeans, barley	2017	3	3.9	0.3	< 0.1	1.8	0.1	< 0.1	< 0.1
Assiniboine River at Provincial Trunk Highway 83, South of Miniota (PMRA #2849359, #2849370)	Canola, wheat, soybeans, barley	2017	3	8.9	0.7	< 0.1	1.8	0.1	< 0.1	< 0.1
Boyne River (PMRA #2849359, #2849370)	Soybeans, corn, wheat, canola, oats	2017	3	15	1.1	0.1	14	1.1	0.1	< 0.1
Cooks Creek at Rural Municipality Boundary Road (PMRA #2849359, #2849370)	Soybeans, canola, oats, corn, wheat	2017	3	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Cooks Creek south of Millbrook (PMRA #2849359, #2849370)	Soybeans, canola, oats, corn, wheat	2017	3	8.1	0.6	< 0.1	1.8	0.1	< 0.1	< 0.1
Edwards Creek (PMRA #2849359, #2849370)	Canola, soybeans, wheat	2017	3	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Icelandic River (PMRA #2849359, #2849370)	Soybeans, wheat, canola, oats	2017	3	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
La Salle River at the town of La Salle (PMRA #2849359, #2849370)	Soybeans, canola, wheat, oats, corn	2017	3	4.9	0.4	< 0.1	1.8	0.1	< 0.1	< 0.1
La Salle River at La Barriere (PMRA #2849359, #2849370)	Soybeans, wheat, canola, corn, oats	2017	3	6.1	0.5	0.1	1.8	0.1	< 0.1	< 0.1
Lake Manitoba (PMRA #2849359, #2849370)	Soybeans, wheat, canola	2017	2	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1

Waterbody (Data source)	Major land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Acute HC_5 (1.5 µg/L)
Lake Winnipeg (PMRA #2849359, #2849370)	Soybeans, wheat, canola, oats	2017	3	4.1	0.3	< 0.1	1.8	0.1	< 0.1	< 0.1
Little Saskatchewan River (PMRA #2849359, #2849370)	Canola, wheat, soybeans, barley	2017	3	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Morris River (PMRA #2849359, #2849370)	Soybeans, canola, wheat, corn, oats	2017	3	22	1.7	0.1	21	1.6	0.1	< 0.1
Oak River (PMRA #2849359, #2849370)	Canola, wheat, soybeans, barley	2017	3	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Pelican Lake (PMRA #2849359, #2849370)	Wheat, canola, soybeans	2017	2	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Pipestone Creek (PMRA #2849359, #2849370)	Canola, wheat, soybeans, barley	2017	3	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Rat River (PMRA #2849359, #2849370)	Soybeans, wheat, canola, corn, oats	2017	3	15	1.1	0.1	14	1.1	0.1	< 0.1
Rock Lake (PMRA #2849359, #2849370)	Canola, soybeans, wheat, barley	2017	3	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Roseau River (PMRA #2849359, #2849370)	Soybeans, wheat, canola, oats, corn	2017	3	4.4	0.3	< 0.1	1.8	0.1	< 0.1	< 0.1
Seine River (PMRA #2849359, #2849370)	Soybeans, wheat, canola, corn, oats	2017	2	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Souris River at the Town of Souris (PMRA #2849359, #2849370)	Canola, soybeans, wheat, corn	2017	2	7.5	0.6	< 0.1	7.5	0.6	< 0.1	< 0.1
Souris River at Melita (PMRA #2849359, #2849370)	Canola, wheat, soybeans, oats	2017	2	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Sturgeon Creek (PMRA #2849359, #2849370)	Soybeans, canola, wheat, oats, barley, corn	2017	3	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Swan River (PMRA #2849359, #2849370)	Canola, wheat, soybeans	2017	3	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1

Waterbody (Data source)	Major land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Acute HC_5 (1.5 µg/L)
Willow Creek (PMRA #2849359, #2849370)	Soybeans, wheat, canola	2017	3	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Woody River (PMRA #2849359, #2849370)	Canola, wheat, soybeans	2017	3	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Seasonal (Class III) and semi-permanent (Class IV) wetlands[5,6] (PMRA #2847073, #2847083)	Canola, wheat, oats, pasture, corn	Summer 2017	12	Using range of concentrations: 3.3[4]–25	Using range of concentrations: 0.3–1.8	Using range of concentrations: < 0.1–0.1	Using range of concentrations: 3.3[4]–25	Using range of concentrations: 0.3–1.8	Using range of concentrations: < 0.1–0.1	Using range of concentrations: < 0.1
		Fall 2017	5	Using range of concentrations: 3.3[4]	Using range of concentrations: 0.3	Using range of concentrations: < 0.1	Using range of concentrations: 3.3[4]	Using range of concentrations: 0.3	Using range of concentrations: < 0.1	Using range of concentrations: < 0.1
Creek (PMRA #2548877)	Agriculture	2013	1	0.3	< 0.1	< 0.1	0.3	< 0.1	< 0.1	< 0.1
Streams, culverts, ditches (PMRA #2548876)	Agriculture	2014	3	0.7	0.1	< 0.1	0.7	0.1	< 0.1	< 0.1
Saskatchewan										
Assiniboine River (PMRA #2745819)	Canola and rapeseed, wheat	2014	6	4	0.3	< 0.1	2.8	0.2	< 0.1	< 0.1
		2015	8	0.7	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
Battle River (PMRA #2745819)	Canola and rapeseed, rye, wheat	2015	6	0.9	0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
		2016	2	0.6	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
Avonlea Creek (PMRA #2849265, #2849266)	Canola, peas, lentils, wheat	2017	8	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Lanigan Creek (PMRA #2849265, #2849266)	Mainly canola, with some peas, wheat	2017	8	5.1	0.4	< 0.1	1.8	0.1	< 0.1	< 0.1
Lightning Creek (PMRA #2849265, # 2849266)	Canola with some soybeans, wheat	2017	10	3.3	0.2	< 0.1	1.8	0.1	< 0.1	< 0.1
McDonald Creek (PMRA #2849265, #2849266)	Mainly lentils, with wheat	2017	7	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Moose Jaw River (PMRA #2849265, #2849266)	Lentils, canola, with wheat	2017	9	3.9	0.3	< 0.1	1.8	0.1	< 0.1	< 0.1
Moose Mountain Creek (PMRA #2849265, #2849266)	Mainly canola, with wheat	2017	9	6	0.4	< 0.1	1.8	0.1	< 0.1	< 0.1

Waterbody (Data source)	Major land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Acute HC_5 (1.5 µg/L)
Oscar Creek (PMRA #2849265, #2849266)	Mainly canola	2017	10	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Pipestone Creek (PMRA #2849265, #2849266)	Mainly canola, with wheat	2017	12	4.2	0.3	< 0.1	1.8	0.1	< 0.1	< 0.1
Saline Creek (PMRA #2849265, #2849266)	Mainly canola, with wheat	2017	10	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Souris River (PMRA #2849265, #2849266)	Mainly canola, lentils, with wheat	2017	9	7.3	0.5	< 0.1	1.8	0.1	< 0.1	< 0.1
Spirit Creek (PMRA #2849265, #2849266)	Mainly canola, with wheat	2017	10	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Swift Current Creek (2 sites) (PMRA #2849265, #2849266)	Mainly lentils, with some peas, canola, wheat	2017	17	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Willowbrook Creek (PMRA #2849265, #2849266)	Mainly canola	2017	9	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Wood River (PMRA #2849265, #2849266)	Mainly lentils, peas, with wheat	2017	9	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Temporary (Class II), seasonal (Class III), semi-permanent (Class IV) and permanent (Class V) wetlands[5,6] (PMRA #2526133, #2572395, #2608629, #2612760, #2612761, #2612762, #2712896)	Barley, canola, oats, wheat, grassland (previous year's crops)	Spring (pre-seed) 2012	138	Using range of concentrations: 0.4–96	Using range of concentrations: < 0.1–7.2	Using range of concentrations: < 0.1–0.5	Using range of concentrations: 0.4–96	Using range of concentrations: < 0.1–7.2	Using range of concentrations: < 0.1–0.5	Using range of concentrations: < 0.1–0.1
	Barley, canola, oats, wheat, peas, grassland	Summer 2012	134	Using range of concentrations: 0.4–2072	Using range of concentrations: < 0.1–155	Using range of concentrations: < 0.1–11	Using range of concentrations: 0.4–2072	Using range of concentrations: < 0.1–155	Using range of concentrations: < 0.1–11	Using range of concentrations: < 0.1–2.1
	Barley, canola, oats, wheat, peas, grassland	Fall 2012	80	Using range of concentrations: 0.4–21	Using range of concentrations: < 0.1–1.6	Using range of concentrations: < 0.1–0.1	Using range of concentrations: 0.4–21	Using range of concentrations: < 0.1–1.6	Using range of concentrations: < 0.1–0.1	Using range of concentrations: < 0.1
	Barley, canola, oats, wheat, peas, grassland (previous year's crops)	Spring (pre-seed) 2013	90	Using range of concentrations: 0.9–116	Using range of concentrations: 0.1–8.7	Using range of concentrations: < 0.1–0.6	Using range of concentrations: 0.9–116	Using range of concentrations: 0.1–8.7	Using range of concentrations: < 0.1–0.6	Using range of concentrations: < 0.1–0.1

Waterbody (Data source)	Major land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Acute HC_5 (1.5 µg/L)
	Barley, canola, oats, peas, wheat, flax, grassland, chemfallow	Summer 2013	144	Using range of concentrations: 0.4–386	Using range of concentrations: < 0.1–29	Using range of concentrations: < 0.1–2.1	Using range of concentrations: 0.4–386	Using range of concentrations: < 0.1–29	Using range of concentrations: < 0.1–2.1	Using range of concentrations: < 0.1–0.4
	Canola, oats (previous year's crops)	Spring (pre-seed) 2014	16	Using range of concentrations: 0.3–75	Using range of concentrations: < 0.1–5.6	Using range of concentrations: < 0.1–0.4	Using range of concentrations: 0.3–75	Using range of concentrations: < 0.1–5.6	Using range of concentrations: < 0.1–0.4	Using range of concentrations: < 0.1–0.1
	Barley, canola, flax, oats, lentils, wheat, peas, soybeans, chemfallow, pasture, grassland	Summer 2014	All wetlands							
			115	Using range of concentrations: 0.4–1373	Using range of concentrations: < 0.1–103	Using range of concentrations: < 0.1–7.3	Using range of concentrations: 0.4–1373	Using range of concentrations: < 0.1–103	Using range of concentrations: < 0.1–7.3	Using range of concentrations: < 0.1–1.4
			Relevant wetlands based on additional site information provided in PMRA #2870577 and #2870578							
			46	Using range of concentrations: 0.4–259	Using range of concentrations: < 0.1–19	Using range of concentrations: < 0.1–1.4	Using range of concentrations: 0.4–259	Using range of concentrations: < 0.1–19	Using range of concentrations: < 0.1–1.4	Using range of concentrations: < 0.1–0.3
Seasonal and semi-permanent wetlands[5,6] (PMRA #2847073, #2847083)	Wheat, canola, barley, pasture, lentils, summer fallow	Summer 2017	30	Using range of concentrations: 3.3[4]–342	Using range of concentrations: 0.3–26	Using range of concentrations: < 0.1–1.8	Using range of concentrations: 3.3[4]–342	Using range of concentrations: 0.3–26	Using range of concentrations: < 0.1–1.8	Using range of concentrations: < 0.1–0.3
		Fall 2017	8	Using range of concentrations: 3.3[4]	Using range of concentrations: 0.3	Using range of concentrations: < 0.1	Using range of concentrations: 3.3[4]	Using range of concentrations: 0.3	Using range of concentrations: < 0.1	Using range of concentrations: < 0.1
Alberta										
South Saskatchewan River (PMRA #2745819)	Grassland, peas, wheat	2014	5	0.6	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
Oldman River (3 sites) (PMRA #2842307, #2842433)	Low disturbance, agriculture, developed land	2017	12	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
South Saskatchewan River (PMRA #2842307, #2842433)	Low disturbance, developed land, agriculture	2017	4	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Bow River (4 sites) (PMRA #2842307, #2842433)	Low disturbance, agriculture, developed land	2017	16	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Elbow River (PMRA #2842307, # 2842433)	Developed land, low disturbance	2017	4	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Red Deer River (PMRA #2745819)	Grassland, peas, wheat, canola, rapeseed	2015	5	0.6	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1

Waterbody (Data source)	Major land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Acute HC_5 (1.5 µg/L)
Red Deer River at Sundre (PMRA #2842307, #2842433)	Low disturbance, agriculture, developed land	2017	4	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Red Deer River 1 kilometre upstream of Highway 2 Bridge (PMRA #2842307, #2842433)	Agriculture, developed land, low disturbance	2017	4	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Red Deer River at Nevis Bridge (PMRA #2842307, #2842433)	Agriculture, low disturbance	2017	4	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Red Deer River at Morrin Bridge (PMRA #2842307, #2842433)	Agriculture, low disturbance, developed land	2017	4	3.2	0.2	< 0.1	1.8	0.1	< 0.1	< 0.1
Red Deer River downstream of Dinosaur Provincial Park (PMRA #2842307, #2842433)	Low disturbance, agriculture	2017	4	6.1	0.5	< 0.1	1.8	0.1	< 0.1	< 0.1
North Saskatchewan River (3 sites) (PMRA #2842307, #2842433)	Low disturbance, agriculture, developed land	2017	11	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Battle River (2 sites) (PMRA #2842307, #2842433)	Agriculture, low disturbance, developed land	2017	8	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Beaver River (3 sites) (PMRA #2842307, #2842433)	Agriculture, low disturbance, developed land	2017	12	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Athabasca River (PMRA #2842307, #2842433)	Agriculture, low disturbance, developed land	2017	4	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Peace River (PMRA #2842307, #2842433)	Agriculture, low disturbance	2017	3	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Wapiti River (2 sites) (PMRA #2842307, #2842433)	Agriculture, low disturbance, developed land	2017	8	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1

Waterbody (Data source)	Major land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Acute HC_5 (1.5 µg/L)
Smoky River (PMRA #2842307, #2842433)	Agriculture, low disturbance	2017	4	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Milk River (PMRA #2842307, #2842433)	Low disturbance, agriculture	2017	4	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Bigknife Creek (PMRA #2842307, #2842433)	Agriculture, low disturbance	2017	1	6.2	0.5	< 0.1	6.2	0.5	< 0.1	< 0.1
Birch Creek (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, low disturbance, developed land	2017	3	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Buffalo Creek (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, low disturbance	2017	3	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Beaverhill Creek (PMRA #2842307, #2842433)	Canola, cereals, mixed animal use, low disturbance	2017	3	3.8	0.3	< 0.1	1.8	0.1	< 0.1	< 0.1
Big Valley Creek (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, low disturbance, developed land	2017	2	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Egg Creek (PMRA #2842307, #2842433)	Canola, cereals, pulse crops, mixed animal use, low disturbance, developed land	2017	3	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Grizzlybear Creek (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, low disturbance	2017	3	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Haynes Creek (PMRA #2842307, #2842433)	Cereals, canola, pulse crops, mixed animal use, low disturbance	2017	3	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Kneehills Creek (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, low disturbance, developed land	2017	2	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Michichi Creek (PMRA #2842307, #2842433)	Cereals, canola, pulse crops, mixed animal use, low disturbance	2017	2	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1

Waterbody (Data source)	Major land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Acute HC_5 (1.5 µg/L)
Mosquito Creek (PMRA #2842307, #2842433)	Canola, cereals, pulse crops, mixed animal use, low disturbance	2017	2	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Meeting Creek (PMRA #2842307, #2842433)	Cereals, mixed animal use, low disturbance	2017	2	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Seven Persons Creek (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, low disturbance	2017	2	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Pipestone Creek (PMRA #2842307, #2842433)	Cereals, canola, pulse crops, mixed animal use, low disturbance, developed land	2017	2	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Parlby Creek (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, unknown agricultural use, low disturbance	2017	2	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Pothole Creek (PMRA #2842307, #2842433)	Cereals, canola, pulse crops, mixed animal use, low disturbance	2017	1	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Queenie Creek (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, low disturbance, developed land	2017	3	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Ray Creek (PMRA #2842307, #2842433)	Canola, cereals, mixed animal use, low disturbance	2017	3	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Ribstone Creek (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, low disturbance	2017	3	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Redwillow Creek (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, low disturbance	2017	2	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Rosebud Creek (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, low disturbance	2017	2	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1

Waterbody (Data source)	Major land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	**Chronic EC_{20} (0.02 µg/L)**	**Mesocosm NOEC (0.281 µg/L)**	**Chronic HC_5 (0.0015 µg/L)**	**Chronic EC_{20} (0.02 µg/L)**	**Mesocosm NOEC (0.281 µg/L)**	**Acute HC_5 (1.5 µg/L)**
Scandia Creek (PMRA #2842307, #2842433)	Cereals, mixed animal use, low disturbance	2017	1	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Sturgeon River (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, low disturbance, developed land	2017	3	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Serviceberry Creek (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, low disturbance	2017	2	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Threehills Creek (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, low disturbance	2017	3	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Vermilion River (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, low disturbance, developed land	2017	3	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Weiller Creek (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, low disturbance, developed land	2017	2	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
West Michichi Creek (PMRA #2842307, #2842433)	Cereals, canola, mixed animal use, low disturbance	2017	2	7.7	0.6	< 0.1	7.7	0.6	< 0.1	< 0.1
Yellow Lake Tributary (PMRA #2842307, #2842433)	Cereals, sugar beet, pulse crops, potatoes, mixed animal use, low disturbance	2017	1	1.8[4]	0.1	< 0.1	1.8[4]	0.1	< 0.1	< 0.1
Seasonal (Class III) and semi-permanent (Class IV) wetlands[5,6] (PMRA #2847073, #2847083)	Wheat, canola, oats, barley, pasture	Summer 2017	18	Using range of concentrations: 3.3[4]–25	Using range of concentrations: 0.3–1.9	Using range of concentrations: < 0.1–0.1	Using range of concentrations: 3.3[4]–25	Using range of concentrations: 0.3–1.9	Using range of concentrations: < 0.1–0.1	Using range of concentrations: < 0.1
		Fall 2017	10	Using range of concentrations: 3.3[4]	Using range of concentrations: 0.3	Using range of concentrations: < 0.1	Using range of concentrations: 3.3[4]	Using range of concentrations: 0.3	Using range of concentrations: < 0.1	Using range of concentrations: < 0.1
50 irrigation canals and returns[7] (PMRA #2842307, #2842433)	Agriculture	2017	194	1.8[4,7]	0.1[7]	< 0.1[7]	1.8[4,7]	0.1[7]	< 0.1[7]	< 0.1[7]
3 tile drain sites[7] (PMRA #2842307, #2842433)	Irrigated agricultural area	2017	8	5.3[7]	0.4[7]	< 0.1[7]	1.8[7]	0.1[7]	< 0.1[7]	< 0.1[7]

N = sample size;
Chronic HC_5 = the 5th percentile of the species sensitivity distribution for the NOEC at 50% confidence intervals;
EC_{20} = effective concentration on 20% of the population (it is the most sensitive single species chronic endpoint for clothianidin);
NOEC = no observable effect concentration;
Acute HC_5 = the 5th percentile of the species sensitivity distribution for the LC_{50} (the median lethal concentration) at 50% confidence intervals
[1]Risk Quotient = concentration ÷ toxicity endpoint
[2]Average, median and maximum concentrations over the sampling period are reported in Table A.7-7.
[3]Because monitoring may not capture peak concentrations, maximum concentrations may be underestimated.
[4]The limit of detection for these samples was more than two times higher than the chronic endpoint. Even though clothianidin was not detected in any sample, assigning half the limit of detection to non-detected samples still results in average and median concentrations that exceed the chronic toxicity endpoint. Thus, calculated risk quotients exceed the level of concern.
[5]The wetlands were classified by the researchers using the classification system defined in Stewart, R.E. and H.A. Kantrud. 1971. Classification of natural ponds and lakes in the glaciated prairie region. Bureau of Sport Fisheries and Wildlife, U.S. Fish and Wildlife Service, Washington, D.C., USA. Resource Publication 92. 57 pp.
[6]Each wetland in these data sets was sampled only once during the time period, with the following exceptions:
a) For summer 2013 in the data set from PMRA #2526133 and #2612760, 11 wetlands in canola-growing areas were sampled three times between the months of June and July 2013. The average of the three values was used in calculations for each of the wetlands.
b) For spring 2014 in the data set from PMRA #2572395, #2612761, 16 wetlands were sampled three to five times between May and June 2014. The averages over the four-week period were used in calculations for each of the wetlands.
Average, standard deviation and median concentrations to estimate chronic exposure were not calculated because most wetlands were sampled only once during each time period. Risk quotients were calculated using the range of concentrations in the absence of a chronic exposure level.
[7]Irrigation canals and returns and tile drain sites may not represent aquatic habitat.

Table A.7-9 Summary statistics for clothianidin measured in waterbodies from British Columbia.

NOTES:

-In calculations, the PMRA assigned a value equal to half the limit of detection to samples that showed no detection.

-The frequency of sampling and the length of the sampling period varied between data sets. Sampling generally occurred one to three times per month between May and December. Sampling at some sites occurred only a few times over a short time period, and values measured may not represent concentrations throughout the growing season.

Waterbody (Data source)	Major land use	Year	LOD (µg/L)	N	N detects	% Detection	Average (µg/L)	Stdev	Median (µg/L)	Max (µg/L)	N (% of samples) exceeding the toxicity endpoints			
											Chronic HC_5 of 0.0015 µg/L	Chronic EC_{20} of 0.02 µg/L	Mesocosm NOEC of 0.281 µg/L	Acute HC_5 of 1.5 µg/L
Alouette River (PMRA #2707947)	Urban, corn, berries	2014	0.00176	7	0	0	0.0009	0	0.0009	0.0009	0 (0%)	0 (0%)	0 (0%)	0 (0%)
		2015	0.00176	9	0	0	0.0009	0	0.0009	0.0009	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Chilliwack River (PMRA #2707947)	Urban, forest	2015	0.00176	9	0	0	0.0009	0	0.0009	0.0009	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Coquitlam River (PMRA #2707947)	Urban, forest	2014	0.00176	7	0	0	0.0009	0	0.0009	0.0009	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Fishtrap Creek (PMRA #2707947)	Berries, corn, greenhouses	2014	0.00176	7	0	0	0.0009	0	0.0009	0.0009	0 (0%)	0 (0%)	0 (0%)	0 (0%)
		2015	0.00176	8	0	0	0.0009	0	0.0009	0.0009	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Harrison River (PMRA #2707947)	Agriculture	2015	0.00176	9	0	0	0.0009	0	0.0009	0.0009	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Hope Slough (PMRA #2707947)	Urban, forest, corn	2014	0.00176	7	0	0	0.0009	0	0.0009	0.0009	0 (0%)	0 (0%)	0 (0%)	0 (0%)
		2015	0.00176	8	3	38	0.003	0.003	0.009	0.011	3 (38%)	0 (0%)	0 (0%)	0 (0%)
Murdo Creek (PMRA #2707947)	Forest	2014	0.00176	7	0	0	0.0009	0	0.0009	0.0009	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Okanagan River (PMRA #2707947)	Orchards, vineyards, vegetables, fruit	2015	0.00176	2	0	0	0.0009	0	0.0009	0.0009	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Okanagan River; upstream (PMRA #2842180)	Urban, forest, corn, blueberries	2017	0.005	8	0	0	0.003	0	0.003	0.003	0 detects, 8 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)

Waterbody (Data source)	Major land use	Year	LOD (µg/L)	N	N detects	% Detection	Average (µg/L)	Stdev	Median (µg/L)	Max (µg/L)	N (% of samples) exceeding the toxicity endpoints			
											Chronic HC_5 of 0.0015 µg/L	Chronic EC_{20} of 0.02 µg/L	Mesocosm NOEC of 0.281 µg/L	Acute HC_5 of 1.5 µg/L
Okanagan River; downstream (PMRA #2842180)	Fruit trees, grapes	2017	0.005	8	0	0	0.003	0	0.003	0.003	0 detects, 8 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Vedder Canal (PMRA #2707947)	Urban, forest, agriculture	2015	0.00176	9	0	0	0.0009	0	0.0009	0.0009	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Gold Creek (PMRA #2889992)	No agriculture in the watershed	2016	0.00176	5	0	0	0.0009	0	0.0009	0.0009	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Katzie Slough (PMRA #2889992)	Berries, grass, forage, ornamentals and shrubs	2016	0.00176	5	0	0	0.0009	0	0.0009	0.0009	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Matsqui Slough (PMRA #2889992)	Berries, grass, forage, corn, nurseries	2016	0.00176	5	0	0	0.0009	0	0.0009	0.0009	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Scott Creek (PMRA #2889992)	Residential, golf course	2016	0.00176	5	0	0	0.0009	0	0.0009	0.0009	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Sumas Drainage Canal (PMRA #2889992)	Potatoes, vegetables, forage crops (corn or peas), berries, turf, sweet corn, cereals, oilseed and fallow, floriculture, nurseries	2016	0.00176	5	1	20	0.001	0.0005	0.0009	0.002	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Sumas Lake Canal; upstream (PMRA #2842180)	Urban, forest, corn, blueberries, potatoes, vegetables	2017	0.005	8	0	0	0.003	0	0.003	0.003	0 detects, 8 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Sumas Lake Canal; downstream (PMRA #2842180)	Potatoes, vegetables, corn, berries, cereals, oilseeds	2017	0.005	8	1	13	0.003	0.002	0.003	0.009	1 detect, 8 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)

Waterbody (Data source)	Major land use	Year	LOD (µg/L)	N	N detects	% Detection	Average (µg/L)	Stdev	Median (µg/L)	Max (µg/L)	N (% of samples) exceeding the toxicity endpoints			
											Chronic HC_5 of 0.0015 µg/L	Chronic EC_{20} of 0.02 µg/L	Mesocosm NOEC of 0.281 µg/L	Acute HC_5 of 1.5 µg/L
Sumas River at the Border (PMRA #2889992)	River flows into Canada from the United States	2016	0.00176	5	0	0	0.0009	0	0.0009	0.0009	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Cohilukthan Slough (PMRA #2842180)	Potatoes, vegetables, berries, cereals, oilseeds, corn	2017	0.005	8	0	0	0.003	0	0.003	0.003	0 detects, 8 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Middle Vernon Creek; upstream (PMRA #2842180)	Urban, wheat, orchards	2017	0.005	8	2	25	0.004	0.002	0.003	0.008	2 detects, 8 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Middle Vernon Creek; downstream (PMRA #2842180)	Fruit trees, berries, grapes, potatoes, vegetables	2017	0.005	8	0	0	0.003	0	0.003	0.003	0 detects, 8 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Mission Creek; upstream (PMRA #2842180)	Urban, forest, wheat, orchards	2017	0.05	8	0	0	0.003	0	0.003	0.003	0 detects, 8 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Mission Creek; downstream (PMRA #2842180)	Fruit trees, grapes	2017	0.05	8	0	0	0.003	0	0.003	0.003	0 detects, 8 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Naramata Creek; upstream (PMRA #2842180)	Urban, forest, orchards, vineyards	2017	0.005	8	0	0	0.003	0	0.003	0.003	0 detects, 8 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Naramata Creek; downstream (PMRA #2842180)	Grapes, fruit trees	2017	0.005	8	0	0	0.003	0	0.003	0.003	0 detects, 8 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Nicomekl River; upstream (PMRA #2842180)	Berries, nurseries and ornamentals	2017	0.005	8	0	0	0.003	0	0.003	0.003	0 detects, 8 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Nicomekl River; downstream (PMRA #2842180)	Berries, potatoes, vegetables, corn	2017	0.005	8	4	50	0.026	0.056	0.004	0.16	4 detects, 8 samples (100%)[1]	2 (25%)	0 (0%)	0 (0%)

Waterbody (Data source)	Major land use	Year	LOD (µg/L)	N	N detects	% Detection	Average (µg/L)	Stdev	Median (µg/L)	Max (µg/L)	N (% of samples) exceeding the toxicity endpoints			
											Chronic HC_5 of 0.0015 µg/L	Chronic EC_{20} of 0.02 µg/L	Mesocosm NOEC of 0.281 µg/L	Acute HC_5 of 1.5 µg/L
Trout Creek; upstream (PMRA #2842180)	Wheat, forest, shrubland	2017	0.005	8	0	0	0.003	0	0.003	0.003	0 detects, 8 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Trout Creek; downstream (PMRA #2842180)	Fruit trees, grapes, potatoes, vegetables	2017	0.005	8	0	0	0.003	0	0.003	0.003	0 detects, 8 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Flowing waterbody with no pesticide application (PMRA #2842180)	No crops	2017	0.005	8	0	0	0.003	0	0.003	0.003	0 detects, 8 samples (100%)[1]	0 (0%)	0 (0%)	0 (0%)
Slough, water at the edge of a field (PMRA #2548876)	Agriculture	2014	0.0022	2	1	50	0.019	0.025	0.019	0.037	1 (50%)	1 (50%)	0 (0%)	0 (0%)

LOD = limit of detection;
N = sample size;
Stdev = standard deviation;
Chronic HC_5 = the 5th percentile of the species sensitivity distribution for the NOEC at 50% confidence intervals;
EC_{20} = effective concentration on 20% of the population (it is the most sensitive single species chronic endpoint for clothianidin);
NOEC = no observable effect concentration;
Acute HC_5 = the 5th percentile of the species sensitivity distribution for the LC_{50} (the median lethal concentration) at 50% confidence intervals

[1] The LOD is more than two times higher than the chronic HC_5 of 0.0015 µg/L. Assigning half the limit of detection to non-detected samples still results in a concentration exceeding the toxicity endpoint. Thus, all samples, including non-detects at half the limit of detection, exceed the toxicity endpoint.

Table A.7-10 Risk quotients for clothianidin measured in waterbodies located in British Columbia.

NOTES:

-Shaded cells indicate the level of concern is exceeded, meaning that the risk quotient is equal to or greater than a value of 1.

-The frequency of sampling and the length of the sampling period varied between data sets. Sampling generally occurred one to three times per month between May and December. Sampling at some sites occurred only a few times over a short time period, and values measured may not represent concentrations throughout the growing season.

Waterbody (Data source)	Land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Acute HC_5 (1.5 µg/L)
Alouette River (PMRA #2707947)	Urban, corn, berries	2014	7	0.6	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
		2015	9	0.6	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
Chilliwack River (PMRA #2707947)	Urban, forest	2015	9	0.6	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
Coquitlam River (PMRA #2707947)	Urban, forest	2014	7	0.6	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
Fishtrap Creek (PMRA #2707947)	Berries, corn, greenhouses	2014	7	0.6	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
		2015	8	0.6	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
Harrison River (PMRA #2707947)	Agriculture	2015	9	0.6	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
Hope Slough (PMRA #2707947)	Urban, forest, corn	2014	7	0.6	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
		2015	8	1.7	0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
Murdo Creek (PMRA #2707947)	Forest	2014	7	0.6	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
Okanagan River (PMRA #2707947)	Orchards, vineyards, vegetables, fruit	2015	2	0.6	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
Okanagan River; upstream (PMRA #2842180)	Urban, forest, corn, blueberries	2017	8	1.7[4]	0.1	< 0.1	1.7[4]	0.1	< 0.1	< 0.1
Okanagan River; downstream (PMRA #2842180)	Fruit trees, grapes	2017	8	1.7[4]	0.1	< 0.1	1.7[4]	0.1	< 0.1	< 0.1

Waterbody (Data source)	Land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Acute HC_5 (1.5 µg/L)
Vedder Canal (PMRA #2707947)	Urban, forest, agriculture	2015	9	0.6	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
Gold Creek (PMRA #2889992)	No agriculture in the watershed	2016	5	0.6	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
Katzie Slough (PMRA #2889992)	Berries, grass, forage, ornamentals and shrubs	2016	5	0.6	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
Matsqui Slough (PMRA #2889992)	Berries, grass, forage, corn, nurseries	2016	5	0.6	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
Scott Creek (PMRA #2889992)	Residential, golf course	2016	5	0.6	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
Sumas Drainage Canal (PMRA #2889992)	Potatoes, vegetables, forage crops (corn or peas), berries, turf, sweet corn, cereals, oilseed and fallow, floriculture, nurseries	2016	5	0.7	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1
Sumas Lake Canal; upstream (PMRA #2842180)	Urban, forest, corn, blueberries, potatoes, vegetables	2017	8	1.7[4]	0.1	< 0.1	1.7[4]	0.1	< 0.1	< 0.1
Sumas Lake Canal; downstream (PMRA #2842180)	Potatoes, vegetables, corn, berries, cereals, oilseeds	2017	8	2.2[5]	0.2	< 0.1	1.7[5]	0.1	< 0.1	< 0.1
Sumas River at the Border (PMRA #2889992)	River flows into Canada from the United States	2016	5	0.6	< 0.1	< 0.1	0.6	< 0.1	< 0.1	< 0.1

Waterbody (Data source)	Land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Acute HC_5 (1.5 µg/L)
Cohilukthan Slough (PMRA #2842180)	Potatoes, vegetables, berries, cereals, oilseeds, corn	2017	8	1.7[4]	0.1	< 0.1	1.7[4]	0.1	< 0.1	< 0.1
Middle Vernon Creek; upstream (PMRA #2842180)	Urban, wheat, orchards	2017	8	2.4[5]	0.1	< 0.1	1.7[5]	0.1	< 0.1	< 0.1
Middle Vernon Creek; downstream (PMRA #2842180)	Fruit trees, berries, grapes, potatoes, vegetables	2017	8	1.7[4]	0.1	< 0.1	1.7[4]	0.1	< 0.1	< 0.1
Mission Creek; upstream (PMRA #2842180)	Urban, forest, wheat, orchards	2017	8	1.7[4]	0.1	< 0.1	1.7[4]	0.1	< 0.1	< 0.1
Mission Creek; downstream (PMRA #2842180)	Fruit trees, grapes	2017	8	1.7[4]	0.1	< 0.1	1.7[4]	0.1	< 0.1	< 0.1
Naramata Creek; upstream (PMRA #2842180)	Urban, forest, orchards, vineyards	2017	8	1.7[4]	0.1	< 0.1	1.7[4]	0.1	< 0.1	< 0.1
Naramata Creek; downstream (PMRA #2842180)	Grapes, fruit trees	2017	8	1.7[4]	0.1	< 0.1	1.7[4]	0.1	< 0.1	< 0.1
Nicomekl River; upstream (PMRA #2842180)	Berries, nurseries and ornamentals	2017	8	1.7[4]	0.1	< 0.1	1.7[4]	0.1	< 0.1	< 0.1
Nicomekl River; downstream (PMRA #2842180)	Berries, potatoes, vegetables, corn	2017	8	18	1.3	0.1	2.7	0.2	< 0.1	0.1
Trout Creek; upstream (PMRA #2842180)	Wheat, forest, shrubland	2017	8	1.7[4]	0.1	< 0.1	1.7[4]	0.1	< 0.1	< 0.1
Trout Creek; downstream (PMRA #2842180)	Fruit trees, grapes, potatoes, vegetables	2017	8	1.7[4]	0.1	< 0.1	1.7[4]	0.1	< 0.1	< 0.1

Waterbody (Data source)	Land use	Year	N	Chronic Risk Quotients[1] calculated using average[2] concentrations and chronic toxicity endpoints			Chronic Risk Quotients[1] calculated using median[2] concentrations and chronic toxicity endpoints			Acute Risk Quotients[1] calculated using maximum[2,3] concentrations and the acute toxicity endpoint
				Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Chronic HC_5 (0.0015 µg/L)	Chronic EC_{20} (0.02 µg/L)	Mesocosm NOEC (0.281 µg/L)	Acute HC_5 (1.5 µg/L)
Flowing waterbody with no pesticide application (PMRA #2842180)	No crops	2017	8	1.7[4]	0.1	< 0.1	1.7[4]	0.1	< 0.1	< 0.1
Slough, water at the edge of a field (PMRA #2548876)	Agriculture	2014	2	13	0.9	0.1	13	0.9	0.1	< 0.1

N = sample size;
Chronic HC_5 = the 5th percentile of the species sensitivity distribution for the NOEC at 50% confidence intervals;
EC_{20} = effective concentration on 20% of the population (it is the most sensitive single species chronic endpoint for clothianidin);
NOEC = no observable effect concentration;
Acute HC_5 = the 5th percentile of the species sensitivity distribution for the LC_{50} (the median lethal concentration) at 50% confidence intervals
[1]Risk Quotient = concentration ÷ toxicity endpoint
[2]Average, median and maximum concentrations over the sampling period are reported in Table A.7-9.
[3]Because monitoring may not capture peak concentrations, maximum concentrations may be underestimated.
[4]The limit of detection for these samples was more than two times higher than the chronic endpoint. Even though clothianidin was not detected in any samples, assigning half the limit of detection to non-detected samples still results in average and median concentrations which exceed the chronic toxicity endpoint. Thus, calculated risk quotients exceed the level of concern.
[5]The limit of detection for these samples was more than two times higher than the chronic endpoint. Even though clothianidin was not detected in most samples, assigning half the limit of detection to non-detected samples still results in average and median concentrations which exceed the chronic toxicity endpoint. Thus, calculated risk quotients exceed the level of concern.

Appendix VIII Proposed Label Amendments for Products Containing Clothianidin

The label amendments proposed below do not include all label requirements for individual products, such as disposal statements, and precautionary statements. Information on labels of currently registered products should not be removed unless it contradicts the following label statements.

Add to ENVIRONMENTAL PRECAUTIONS:

TOXIC to aquatic organisms and non-target terrestrial plants. Observe buffer zones specified under DIRECTIONS FOR USE.

To reduce runoff from treated areas into aquatic habitats avoid application to areas with a moderate to steep slope, compacted soil, or clay.

Avoid application when heavy rain is forecast.

Contamination of aquatic areas as a result of runoff may be reduced by including a vegetative strip between the treated area and the edge of the water body.

Add to DIRECTIONS FOR USE:

As this product is not registered for the control of pests in aquatic systems, **DO NOT** use to control aquatic pests.

DO NOT contaminate irrigation or drinking water supplies or aquatic habitats by cleaning of equipment or disposal of wastes.

<u>Field sprayer application</u>: **DO NOT** apply during periods of dead calm. Avoid application of this product when winds are gusty. **DO NOT** apply with spray droplets smaller than the American Society of Agricultural Engineers (ASAE S572.1) fine classification. Boom height must be 60 cm or less above the crop or ground.

<u>Airblast application</u>: **DO NOT** apply during periods of dead calm. Avoid application of this product when winds are gusty. **DO NOT** direct spray above plants to be treated. Turn off outward pointing nozzles at row ends and outer rows. **DO NOT** apply when wind speed is greater than 16 km/h at the application site as measured outside of the treatment area on the upwind side.

<u>Aerial application</u>: **DO NOT** apply during periods of dead calm. Avoid application of this product when winds are gusty. **DO NOT** apply when wind speed is greater than 16 km/h at flying height at the site of application. **DO NOT** apply with spray droplets smaller than the American Society of Agricultural Engineers (ASAE S572.1) fine classification. Reduce drift caused by turbulent wingtip vortices. Nozzle distribution along the spray boom length MUST NOT exceed 65% of the wing- or rotorspan.

Buffer zones:

Spot treatments using hand-held equipment **DO NOT** require a buffer zone. In-furrow application and soil drench or soil incorporation **DO NOT** require a buffer zone.

The buffer zones specified in the table below are required between the point of direct application and the closest downwind edge of sensitive terrestrial habitats (such as grasslands, forested areas, shelter belts, woodlots, hedgerows, riparian areas and shrublands), sensitive freshwater habitats (such as lakes, rivers, sloughs, ponds, prairie potholes, creeks, marshes, streams, reservoirs and wetlands) and estuarine/marine habitats.

Method of application	Crop		Buffer Zones (metres) Required for the Protection of:				
			Freshwater Habitat of Depths:		Estuarine/Marine Habitat of Depths:		Terrestrial Habitat:
			Less than 1 m	Greater than 1 m	Less than 1 m	Greater than 1 m	
Field sprayer	Grape		50	25	1	1	0
	Potato		70	35	1	0	0
	Cucurbit vegetables		85	45	1	1	0
	Sweet potato, strawberry		90	45	2	1	1
	Turf		120	65	2	1	1
Airblast	Grape	Early growth stage	50	45	2	1	0
		Late growth stage	40	35	1	1	0
	Pome fruit, stone fruit	Early growth stage	60	50	5	2	0
		Late growth stage	50	40	3	1	0
Aerial	Potato	Fixed wing	800	800	1	0	0
		Rotary wing	800	800	1	0	0

For tank mixes, consult the labels of the tank-mix partners and observe the largest (most restrictive) buffer zone of the products involved in the tank mixture and apply using the coarsest spray (ASAE) category indicated on the labels for those tank mix partners.

The buffer zones for this product, with the following exceptions, can be modified based on weather conditions and spray equipment configuration by accessing the Buffer Zone Calculator on the Pest Management Regulatory Agency web site. Buffer zones of 120 m (field sprayer) or 800 m (aerial sprayer) CANNOT be modified.

List of References

A. Registrant Submitted Studies/Information

A.1 Environmental Fate and Effects Assessment

Published Information

PMRA Document Number	Reference
2712665	Li, D. et al., 2013, Acute immobilization of four neonicotinoid insecticides to Daphnia magna Straus, DACO: 9.3.2
2712666	de Perre, C., Murphy, T.M., Lydy, M.J., 2015, Fate and effects of clothianidin in fields using conservation practices, DACO: 9.3.2,9.3.4
2712667	Hayasaka, D., 2013, Comparison of acute toxicity of two neonicotinoid insecticides, imidacloprid and clothianidin to five cladoceran species, DACO: 9.3.2,9.3.5
2712686	Barbee, G.C. and Stout, M.J., 2009, Comparative acute toxicity of neonicotinoid and pyrethroid insecticides to non-target crayfish (Procambarus clarkia) associated with rice-crayfish crop rotations, DACO: 9.3.4
2712687	Cavallaro, M.C., C.A. Morrissey, J.V. Headley, K.M. Peru, and K. Liber, 2017, Comparative chronic toxicity of imidacloprid, clothianidin, and thiamethoxam to Chironomus dilutus and estimation of toxic equivalency factors, Environmental Toxicology and Chemistry. 36(2): 372-382, DACO: 9.3.4
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B. Additional Information Considered

B.1 Environmental Fate and Effects Assessment

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