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U. S. ENVIRONMENTAL PROTECTION AGENCY
Washington, D.C. 20460

OFFICE OF CHEMICAL
SAFETY AND
POLLUTION PREVENTION

Decision # 432482

Date: November 18, 2010
Chemical: Novaluron
PC Code: 124002
DP Barcode: 378620

MEMORANDUM:

SUBJECT: Ecological Risk Assessment to Support the Proposed New Use of Novaluron on Sweet Corn

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1. Executive Summary

The Environmental Fate and Effects Division (EFED) has completed the analysis and review of the Section 3 new use registration of RIMON 0.83 EC containing the benzoylurea insecticide novaluron (9.3 % ai) on sweet corn. According to the Health Effects Division, the degradates chlorophenyl urea and chloroaniline are residues of potential concern; therefore, these degradates are included in this environmental risk assessment. However, there was no terrestrial or aquatic ecotoxicity and/or toxicity data submitted by the registrant for chloroaniline.

The proposed maximum application rate for novaluron on sweet corn is 5 applications of 0.078 lbs. a.i./acre at a minimum of 7 day intervals using ground and aerial equipment. Because the proposed application rate is significantly less than rates assessed in previous risk assessments for novaluron and the aquatic and terrestrial organism toxicity endpoints

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have not changed, the aquatic and terrestrial risks posed by use on sweet corn is expected to be less than those reported in previous assessments (DP 285477+, 340579+ and 358376).

Table 1 lists the LOC exceedences for the proposed new use of novaluron to sweet corn.

Table 1. Summary of LOC Exceedences for the Proposed New Use of Novaluron to Sweet Corn

Effect	Taxonomic Group						
	Birds	Mammals	Terrest. Plants	Terrest. Inverts	Fish	Aquatic Inverts	Aquatic Plants
Direct Effect LOC Exceedences	Yes	None	N/A	None	None	Yes	Yes
Indirect Effect Exceedances	Yes	None	N/A	None	None	Yes	Yes

Risk Summary for This Assessment:

- The proposed new novaluron use on sweet corn has the potential to cause adverse acute effects to both listed and non-listed freshwater and estuarine/marine invertebrates and estuarine/marine mollusks. Acute levels of concern for freshwater and estuarine/marine invertebrates and estuarine/marine mollusks were exceeded at the following risk presumption categories: (1) Acute Risk Use; (2) Acute Restricted Use; and (3) Acute Listed Species Use.

Also, the proposed new use of aerial and/or ground application of novaluron has the potential to cause adverse dietary chronic effects to:

- Birds- Chronic RQs exceeded the Agency's dietary levels of concern (LOC) for birds (RQ = 3.40-7.40) suggesting potential chronic risk to birds consuming novaluron treated short grass, tall grass, and broadleaf plants/small insect food items. Avian dietary chronic risk quotients ranged from 0.50-7.38.

- No terrestrial plant toxicity data is available for novaluron. Novaluron is not expected to cause adverse effects on terrestrial plants due to the absence of chitin in the cell walls of terrestrial plants. However, the lack of submitted Tier I terrestrial plant toxicity data is considered a data gap, and potential risk cannot be precluded. Available studies on non-target insects suggest that adverse impacts are possible on developing insects due to the novaluron's mode of action, which is targeted against chitin development and cuticle formation of insect larvae

Data Gaps

The following data gaps are identified based on the current and previous assessments:

1. Tier I Terrestrial Plant Toxicity Study on Seedling Emergence (850.4100): Testing with a typical end-use product (TEP) should be conducted for all pesticides having outdoor uses at the proposed maximum application rate. Since novaluron is proposed for

outdoor use, a seedling emergence study is required on terrestrial plants. Because novaluron is an insecticide and is not known to have phytotoxic effects, Tier II studies are not required unless Tier I studies indicate a ≥ 25% effect to various growth parameters relative to the control.

2. Tier I Terrestrial Plant Toxicity Study on Vegetative Vigor (850.4150): Testing with a typical end-use product (TEP) should be conducted for all pesticides having outdoor uses at the proposed maximum application rate. Since novaluron is proposed for outdoor use, a vegetative vigor study is required on terrestrial plants. Because novaluron is an insecticide and is not known to have phytotoxic effects, Tier II studies are not required unless Tier I studies indicate a ≥ 25% effect to various growth parameters relative to the control.

3. Field Test for Pollinators (850.3040): The registrant-submitted studies on brood development of honey bees did not test the maximum commercial application rate for novaluron. In view of novaluron's mode of action which targets the developmental stages of insects, the Environmental Fate and Effects Division recommends that field studies at maximum proposed label rates (0.32 lb ai/A) using a crop attractive to bees (e.g., pears or apples) be conducted. The study should be conducted according to EPA-approved protocols and should examine the exposure and effects to honey bee adults and brood.

4. **Avian Oral Toxicity (850.2100)** Avian acute oral toxicity data are not available for a passerine species, which are required under the new 40 CFR Part 158. An acute oral toxicity study using passerines must be submitted to fulfill this data requirement.

5. **Acute sediment Toxicity Test (850.1735)**: Studies are not available to document the toxic effects of novaluron on benthic organisms. Environmental fate data indicate that novaluron and its degradation products partition to sediment. Risk to this compartment could be better characterized only if such data were available. Therefore, a whole sediment acute study with freshwater invertebrates is required.

6. The acute exposure effects of novaluron on freshwater invertebrate species are uncertain as data is not available on the technical grade product. To properly characterize risk to freshwater invertebrates and also to compare the toxicity of parent and degradates of novaluron, this study is a requirement

7. Unlike chlorophenyl urea, no ecotoxicity studies were submitted for chloroaniline which is also a major degradate of novaluron. As a first step, acute studies are required on freshwater fish and birds to determine the comparative toxicities of the parent versus chloroaniline.

2. Scope of This Assessment

An abbreviated review was conducted by EFED for the following reasons.

- No new data have been submitted that affect the environmental fate or effects conclusions or modeling inputs;
- No new exposure methods have been approved for standard risk assessments since the last chemical environmental risk assessment was performed in 2009.

3. Findings of Prior Risk Assessments

3.1 Aquatic Assessments of Prior Assessments

The highest PRZM/EXAMS generated EECs from prior assessments for stone fruit, sugarcane and pome fruit are listed in **Table 2**. The pome fruit scenario generated the highest EECs in the 2004 assessment of 5.04µg/L for the peak concentration, 3.18 µg/L for the 21-day average and 2.24 µg/L for the 60-day average for airblast applications (DP: Barcode: 285477+).

Table 2. PRZM/EXAMS- Estimated Concentrations of Novaluron in Surface Water

Scenario	Application Type	Peak µg/L	21-day Average µg/L	60-Day Average µg/L
GA Peach[1]	Aerial	1.67	1.05	0.69
	Airblast	0.61	0.35	0.25
LA Sugarcane[2]	Aerial	2.27	1.36	0.87
	Airblast	2.04	1.15	0.76
PA Pome Fruit[3]	Airblast	5.04	3.18	2.24

[1] EEC values account for a 25 foot buffer zone between the edge of a field and bodies of water for ground applications (including airblast) and buffer of 150 feet for aerial applications.
[2] EEC values account for a 25 foot buffer zone between the edge of a field and bodies of water for ground application (including airblast), and buffer of 250 feet for aerial application.
[3] Label did not require a buffer zone at time of assessment.

The highest generated chlorophenyl urea and chloroaniline GENEEC generated EECs for stone fruit, sugarcane and pome fruit from prior novaluron risk assessments are listed in **Table 3**. GENEEC EECs for sweet corn are expected to be less because of the lower application rate.

Table 3. GENEEC Estimated Concentrations of Novaluron in Surface Water

Scenario	Peak µg/L	21-day Average µg/L	60-Day Average µg/L
Chlorophenyl Urea			
Stone Fruit	2.52	2.32	1.98
Sugarcane	0.93	0.85	0.85
Pome Fruit	2.39	2.00	1.47
Chloroaniline			
Stone Fruit	4.00	3.50	2.75
Sugarcane	1.60	1.40	1.10
Pome Fruit	N/A	N/A	N/A

The highest exposure associated with the formulated product in prior assessments was addressed using Tier I AgDRIFT spray drift model (**Table 4**).

Table 4. Estimated Surface Water Concentrations of the Formulated Product of Novaluron, Rimon 0.83				
Application Rate (Lbs ai/A)	**Per Cent Active Ingredient**	**Application Rate of Formulated Product (Lbs ai/A)**	**Initial Average Deposition of Formulated Product to Pond (lbs/A (%)**	**Concentration of Formulated Product in Farm Pond (ppb)**
Stone Fruit[1]				
0.32	0.0083	39.04	1.53(3.92)	34.74
Tomato and Brassica Vegetables[2]				
0.078	0.0083	9.40	0.87	19.75

[1] Percent of initial average deposition was estimated via AGDRIFT (Tier I), modeling taking into account a 150 ft buffer zone for aerial application to stone fruit.
[2] Percent of initial average deposition was estimated via AGDRIFT (Tier I), modeling taking into account a 250 ft buffer zone for aerial application to stone fruit.

3.2 Risk Characterization of Prior Assessment

Following are the results of the previous ecological risk assessment:

Aquatic Organisms: RQs did not exceed LOCs for either acute and/or chronic direct effects to listed and non-listed fish in freshwater and estuarine/marine environments or acute direct effects to vascular and non-vascular plants (**Table 3**). However, invertebrates (both in freshwater and estuarine/marine media) were found to be highly sensitive to novaluron. Proposed new novaluron uses have the potential to cause adverse acute and chronic impacts to both listed and non-listed freshwater and estuarine/marine invertebrates. Risk quotients were greater for invertebrates in estuarine/marine media (range of acute RQs = 0.2 - 26.7) compared to those in freshwater (range of acute RQs = 1.1 - 11.1).

Terrestrial Organisms: Acute RQs did not exceed LOCs for birds and mammals from the new novaluron uses (Table 1). However, chronic RQs exceeded the Agency's levels of concern (LOC) for birds (RQ = 1.0 - 20.6) and mammals (RQ = 1.0 - 1.8), suggesting potential chronic risk to birds. No terrestrial plant toxicity data is available for novaluron; therefore, potential risk cannot be precluded. Available studies on non-target insects suggest that adverse impacts are possible on developing insects due to the novaluron's mode of action, which is targeted against chitin development and cuticle formation of insect larvae.

4. Summary of Proposed and Registered Uses

The proposed maximum aerial application rate for novaluron use on sweet corn is 5 applications of 0.078 lbs. a.i./acre at a minimum of 7 day intervals. **Table 5** summarizes the proposed application rate for sweet corn and the registered application rates for stone fruits, pome fruit and sugar cane (included in the table for comparison purposes because these uses produced the highest PRZM/EXAMS EECs).

Table 5. Highest Application Rates, Maximum Number of Applications, Minimum Interval and Application Method for Proposed and Registered Novaluron Uses					
Crop or Crop Group	Maximum Application Rate (lbs a.i./acre)		Maximum Number of Applications Per Year	Minimum Application Interval (Days)	Application Method[1]
	Single	Annual			
Proposed					
Corn	0.078	0.39	5	7[3]	G, A
Registered					
Stone Fruit	0.324	0.972	3	7[3]	G, A
Sugar Cane	0.078	0.39	5	NS[2]	G,A
Pome fruit	0.32	0.96	3	10	Airblast

[1] G- Ground applied, A- Aerially applied
[2] NS – Not Specified;
[3] 7 days was assumed for modeling purposes.

5 Exposure Summary

5.1 Aquatic Modeling

The input parameters for PRZM/EXAMS modeling are similar to inputs used in the 2009 risk assessment (DP: 338376). PRZM/EXAMS input parameters are located in **Appendix A**.

For aerial and ground applications, buffer zones of 150 feet and 25 feet are required, respectively, between the edge of the field and bodies of water. In AgDRIFT, initial average depositions of 0.039 and 0.006 were used for aerial and ground applications, respectively. The AgDRIFT output files are located in **Appendix A**. The initial average depositions for aerial and ground applications were input as the spray drift fraction in PRZM/EXAMS.

Chlorophenyl urea and chloroaniline are residues of potential concern according to the Health Effects Division and, therefore, were modeled for this risk assessment. GENEEC Tier 1 modeling was conducted for both chlorophenyl urea and chloroaniline because of limited fate data. RQ's were not calculated for chloroaniline since there was no terrestrial or aquatic ecotoxicity and/or toxicity data available.

5.2 Aquatic Modeling Results

Peak EECs ranged from 0.03 µg/L to 1.40 µg/L for the proposed novaluron use on sweet corn. The IL corn scenario generated the highest peak EEC (1.40 µg/L) aerial and the MS corn ground scenario produced the highest 21-day (0.78 µg/L) and 60-day (0.50 µg/L) averages. Results of the PRZM/EXAMS modeling are displayed in **Table 6.** EECs from the proposed new use on sweet corn are lower than EECs from previous assessments.

Table 6. PRZM/EXAMS Estimated Environmental Concentrations (µg/L) for Novaluron with Buffers[1]			
Crop Scenario/ Application Method	**Peak**	**21-day Average**	**60-day Average**
CA Corn			
Aerial Spray	0.30	0.20	0.13
Ground Spray	0.08	0.05	0.03
IL Corn			
Aerial Spray	**1.40**	0.64	0.39
Ground Spray	1.31	0.57	0.32
MS Corn			
Aerial Spray	1.37	**0.78**	**0.50**
Ground Spray	1.29	0.67	0.43
NC Corn			
Aerial Spray	1.12	0.57	0.35
Ground Spray	1.03	0.48	0.27
PA Corn			
Aerial Spray	0.80	0.51	0.37
Ground Spray	0.64	0.39	0.29

[1] EEC values account for a 25 foot buffer zone between the edge of a field and bodies of water for ground application (including airblast) and buffer of 150 feet for aerial application

Tier I GENEEC modeling predicted the peak concentrations of 0.93 µg/L and 0.51 µg/L for chlorophenyl urea and chloroaniline, respectively for sweet corn (**Table 7**). The 21-day average concentrations were 0.73 µg/L for chlorophenyl urea and 0.22 µg/L for chloroaniline. Predicted degradate EECs for sweet corn were lower than the EECs reported in the earlier assessment. The GENEEC output files are provided in **Appendix B** of this document.

Table 7. GENEEC Estimated Environmental Concentrations (µg/L) for Chlorophenyl Urea on Sweet Corn			
Chemical	**Peak**	**21-day Average**	**60-day Average**
Chlorophenyl Urea	0.93	0.73	0.65
Chloroaniline	0.51	0.22	0.14

Aquatic exposure from the formulated product was addressed assuming exposure through spray drift alone. The impact of the formulated product from runoff would be negligible due to microbial degradation and soil sorption of the formulated product. The initial average deposition of formulated product to the pond was estimated using AgDRFIT Tier I aquatic assessment. In this modeling, a 250 ft buffer zone was used for aerial application.

The exposure for sweet corn with 2.72% drift of the formulated product into the standard pond (aerial application) yielded the highest concentration of the formulated product. The influence of multiple applications was not considered in this estimate. Estimated concentrations are provided in **Table 8** below. Because the proposed application rate is

less than previously rates assessed spray drift of the formulated product from use on sweet corn is less than those reported in previous assessments.

Table 8. Estimated Surface Water Concentrations of the Formulated Product of Novaluron, Rimon 0.83

Application Rate (Lbs ai/A)	Per Cent Active Ingredient	Application Rate of Formulated Product (Lbs ai/A)	Initial Average Deposition of Formulated Product to Pond (lbs/A (%)	Concentration of Formulated Product in Farm Pond (ppb)
Sweet Corn[1]				
0.078	0.0083	9.40	0.256 (2.72)	5.81

[1] Percent of initial average deposition was estimated via AGDRIFT (Tier I), modeling taking into account a 250 ft buffer zone for aerial application to sweet corn.

5.3 Terrestrial Exposure

Exposure to animals was modeled by TERRPLANT (Version 1.2.2) and TREX (Version 1.4.1), respectively. Inputs for TREX included the application rates and intervals from **Table A** in **Appendix E**, a default foliar dissipation half-life of 35 days, which represents EFED's default foliar half-life value in absence of foliar dissipation data. **Table 9, 10, 11** and **12** lists the input values for the T-REX model.

Table 9. TREX Input Values Used to Calculate Terrestrial Animal Exposure and Risk Quotient Values Based on the Maximum Proposed Use Rates

Use Rate	RimOn 0.83 EC for Use on Sweet Corn
Application Rate	0.078 lbs ai/A
Half-life	35 days[1]
Minimum Application Interval	7 days
Maximum # Apps./Year	5

[1] This value represents EFED's default foliar half-life value in substitution for the absence of foliar dissipation data for novaluron.

Table 10 provides the estimated terrestrial animal estimated environmental concentration values based on the proposed maximum proposed use rate on sweet corn.

Table 10. Terrestrial Animal Exposure Values Calculated by TREX Model Version 1.4.1 Based on the Maximum Proposed Use Rate

Food Item	RimOn 0.83 EC for Use on Sweet Corn
Short Grass	72.31
Tall Grass	33.14
Broadleaf plants/sm Insects	40.67
Fruits/pods/seeds/lg insects	4.52

Table 11-Estimates of Avian Dose-based Maximum Kenega EECs for Foliar Residues of Novaluron on Sweet Corn			
Food Items	**20-gram**	**100-gram**	**1000-gram**
Short grass	82.35	46.96	21.02
Tall grass	37.74	21.52	9.64
Broadleaf plants/small insects	46.32	26.41	11.83
Fruits/pods/seeds/large insects	5.15	2.93	1.31
Granivores	1.14	0.65	0.30

Table 12- Estimates of Mammalian Dose-based Maximum Kenega EECs for Foliar Residues of Novaluron on Sweet Corn using a 35 day Default Half-life Value			
Food Items	**15-gram**	**35-gram**	**1000-gram**
Short grass	109.98	47.65	11.05
Tall grass	50.41	21.84	5.06
Broadleaf plants/small insects	61.87	26.80	6.21
Fruits/pods/seeds/large insects	6.87	3.00	0.70
Granivores	1.53	0.70	0.15

For terrestrial plants exposed to novaluron and its major degradates, chlorophenyl urea and chloroaniline, the TERRPLANT model is generally used. However, the registrant did not submit any terrestrial plant toxicity data for terrestrial plants exposed to the parent novaluron or its major degradates - chlorophenyl urea and chloroaniline. Therefore, the risk that novaluron and its associated major degradates may potentially pose to terrestrial plants is unknown at this time but cannot be precluded.

6. Ecological Effects Summary

A summary of the available acute and chronic toxicity data for aquatic and terrestrial organisms used to calculate RQs for both the parent and one of the major degradates, chlorophenyl urea, is presented in **Tables 13 and 14**. A more detailed description of the toxicity data can be found in the previous assessment (D358376).

Table 13. Summary of Aquatic Toxicity Data Used in Risk Determination for Novaluron Parent[1]					
Species	**Acute Toxicity**			**Chronic Toxicity**	
	LC_{50} (µg ai/L)	**EC_{50} (µg ai/L)**	**MRID Toxicity Category**	**NOAEC / LOAEC (µg ai/L), Most Sensitive Endpoint(s)**	**MRID**
Freshwater Fish Rainbow trout	>960 (96-hr)		45499004/ 45499005	6.16/>6.16	45638216
Freshwater Invertebrate Water flea	0.15[2]		-	0.03/0.06 Parental survival and offspring production	45638211
Estuarine/Marine Fish Sheepshead minnow	>2 (96-hr)		45638210	-	-

Estuarine/Marine Invertebrate	Mysid shrimp: 0.13	Eastern oyster: 1.5	45638209 45638208	Mysid shrimp: 0.03/0.06 Reduction in terminal male body length	45638212

[1]As reported in the most recent risk assessment for novaluron, dated 2/5/08 (DP340579, 340581, 340583, 340672);
[2]Calculated based on Acute to Chronic Ratio approach [An estimated acute LC_{50} of 0.15 ppb was derived for freshwater invertebrates using the equation: $Acute\ toxicity_{fw} = Chronic\ toxicity_{fw} \times Acute\ toxicity_{est\text{-}mar} / Chronic\ toxicity_{est}$(0.0299 x 0.13 / 0.026 = 0.15)

Table 14. Summary of Aquatic Acute Toxicity Data Used in Risk Determination for the Novaluron Degradate, Chlorophenyl Urea

Species	LC_{50} or EC_{50}/NOAEC (µg ai/L)	MRID
Freshwater Fish Rainbow trout	530/144	45499006
Freshwater Invertebrate Water flea	1910/690	45499007
Non-Vascular Plant Green algae	330/105	45638222

None of the acute fish (freshwater or estuarine/marine) studies established definitive endpoints for novaluron (**Table 13**). However, no acute effects are expected for fish in either media as the reported NOAEC values were close to or greater than the solubility limit for novaluron (3 ppb).

Novaluron (parent and formulated product), on the other hand, is very highly toxic to both fresh water and marine invertebrates on acute exposure basis (**Tables 13 and 15**). In chronic studies, adverse effects were noted in fish (based on survival and terminal growth of rainbow trout) and invertebrates (based on parental survival and offspring production in water flea) (**Table 15**). The registrant submitted a prolonged sediment toxicity test with *Chironomus riparius* to demonstrate the impact of novaluron on benthic organisms (MRID 47621902; OECD 218). However, toxicity data from this study was not used in risk estimation as the study is currently under review.

Table 15. Summary of Aquatic Acute Toxicity Data Used in Risk Determination for the Formulated Product of Novaluron

Species	LC_{50} or EC_{50}/NOAEC (µg ai/L)	MRID
Freshwater Fish Rainbow trout	5740/499	45638314
Freshwater Invertebrate Water flea	0.4/0.12	45638313
Estuarine/Marine Invertebrate Mysid shrimp	0.12/0.03	46086203
Non-Vascular Plant Green algae	3549/2475	45638411
Vascular Plant Duckweed	>75.4/75.4	45638223

The most sensitive EC_{50} values for aquatic vascular plants and non-vascular plants are >75.4 (*Lemna gibba*) (based on formulated product) **(Table 12)** and 330 (*Selenastrum capricornutum*) (based on the major degradate chlorophenyl urea) **(Table 13)** ug ai/L, respectively. The respective NOAEC values are 75.4 and 2475 µg ai/L. Toxicity data is not available for aquatic plants.

Novaluron is practically non-toxic to birds and mammals on an acute oral basis and to birds on sub-acute dietary basis (**Table 16**). On chronic exposure basis, significant reduction in the number of viable embryos per pen and viable embryos of eggs set were noted in Northern bobwhite quail. Decreased sperm counts in male F1 generation and increased absolute and relative spleen weights in the parental generation were noted in rats. Novaluron is practically non-toxic to honeybees on an acute contact basis (**Table 16**).

Table 16. Summary of Terrestrial Toxicity Data Used in Risk Determination for Novaluron[1]

Species	Acute Toxicity				Chronic Toxicity	
	LD_{50}	Acute Oral Toxicity (MRID)	LC_{50}	Sub-acute Dietary Toxicity (MRID)	NOAEC(L)/ LOAEC(L)	Affected Endpoints (MRID)
Northern Bobwhite Quail	>2000 mg ai/kg-bwt	Practically nontoxic (45476801)	>5200 mg ai kg diet	Practically nontoxic (45499002)	Mallard duck: 9.8/30 mg ai/kg-diet	Number of viable embryos per pen and viable 14-day embryos set (45638219)
Laboratory rat	>5000 mg ai/kg-bwt	Practically nontoxic (44961001)			1000/4000 mg ai/kg-diet	Decreased sperm counts in male F1 generation (45651505)
Honey bee	Contact (96 h): LD_{50} = >100 µg ai/bee (45638220)					

[1]As reported in the most recent risk assessment for novaluron, dated 2/5/08 (DP340579, 340581, 340583, 340672)

7. Ecological Risk Summary

Tables 17 and 18 show the estimated aquatic and terrestrial organism acute and chronic risk quotients for aerial application of RIMON 0.83 EC and one of the major degradates - chlorophenyl urea. While there are both aerial and ground aquatic EECs (Estimated Environmental Concentrations) for Novaluron use on sweet corn, the most conservative set of EECs, that being aerial EECs for aquatic organisms, were used in this assessment for aquatic organisms in terms of estimating the acute and chronic risk quotients.

Table 17. Aquatic Organism Acute and Chronic Risk Quotients for exposure to Parent Novaluron and formulated product							
Taxa	**Acute Toxicity Value (µg/L)**	**Peak EEC Value (µg/L)**	**Acute Risk Quotient**	**Chronic Toxicity Value (µg/L)**	**21-Day EEC (µg/L)**	**60-Day EEC (µg/L)**	**Chronic Risk quotient**
Freshwater Fish	LC_{50}: >960	1.40	N/A[1]	NOAEC= 6.16	N/A	0.39	0.06
Estuarine/marine Fish	LC_{50}: >2	1.40	N/A[1]				
Freshwater Invertebrates	[2]48-hr EC_{50}: 0.15 (ACR-calculated)	1.40	9.33[3]	NOAEC=0.03	0.64	N/A	21.33[4]
Estuarine/marine Invertebrates	LC_{50}=0.13	1.40	10.80[3]	NOAEC= 0.03	0.64	N/A	21.3[4]
Estuarine/marine Mollusks	LC_{50}= 1.5	1.40	0.93[3]				
Non-vascular Aquatic Plants	EC_{50}: >9680 NOAEC: 9680	5.81[5]	<<0.01				
Vascular Aquatic Plants	EC_{50}: >75.4 NOAEC: 75.4	5.81[5]	<<0.01				

[1]Was not calculated due to non-definitive endpoints

[2] Calculated based on the assumption that acute to chronic ratio for estuarine/marine invertebrates applies to freshwater invertebrates also;

[3]. Aquatic acute levels of concern for freshwater and estuarine/marine organisms are exceeded at the Acute Risk, Acute restricted Use, and Acute Listed Species Risk presumption categories based on Novaluron use on sweet corn.

[4]. Chronic levels of concern for freshwater and estuarine/marine invertebrates were exceeded when aerial applications of Novaluron were made to sweet corn.

[5]. EEC estimated for the formulated product of novaluron aerial application to sweet corn

Based on the data presented in **Table 17**, acute risk quotients for freshwater and estuarine/marine fishes could not be determined due to non-definitive endpoints in the toxicity values of the original studies. Though a definitive acute LC_{50} could not be established for freshwater fish, the established NOAEC value of 960 ppb is several orders of magnitude greater than the water solubility of parent novaluron (3 ppb). Therefore, it is not expected that novaluron is acutely toxic to freshwater fish at the limit of its water solubility. Moreover, chronic risk quotients for estuarine/marine fishes could not be determined as the estuarine/marine Fish Lifecycle Toxicity test was not submitted by the registrant. For freshwater fishes (using the rainbow trout as the most sensitive freshwater fish) exposed chronically to Novaluron through aerial applications to sweet corn, no chronic levels of concern were exceeded. Chronic risk quotients for freshwater fishes were estimated to be 0.06.

Since the registrants did not submit acute toxicity data for freshwater invertebrates exposed to Novaluron, the ACR method was used to estimate an acute toxicity value for freshwater invertebrates. When the ACR method is used, the EC_{50} value for Daphnids was estimated to be 0.15. The following equation was used to estimate an acute EC50 value for freshwater invertebrates:

$$Acute\ toxicity_{fw} = Chronic\ toxicity_{fw} \times Acute\ toxicity_{est\text{-}mar} / Chronic\ toxicity_{est\text{-}mar}$$

When the PEAK EEC value of 1.40µg/L is divided by the ACR-derived EC_{50} value for freshwater invertebrates, the acute risk quotient was 9.33, meaning that acute levels of concern for freshwater invertebrates were exceeded at the Acute Risk, Acute Restricted Use, and Acute Listed Species Use risk presumption categories. It must be noted that the resulting acute risk quotient value may have a high degree of uncertainty based on the use of the ACR method to determine the missing EC_{50} toxicity value.

For estuarine/marine invertebrates (using the mysid shrimp as the surrogate estuarine/marine invertebrate species) and the mollusk (using the estuarine/marine oyster as the surrogate mollusk), acute risk quotients ranged from 0.93 (for the oyster after dividing the PEAK EEC value of 1.40µg/L by the LC_{50} toxicity value of 1.50µg/L) to 10.80 (for the mysid shrimp after dividing the PEAK EEC value of 1.40µg/L by the LC_{50} toxicity value of 0.13µg/L). Thus, acute risk quotients for estuarine/marine invertebrates (RQ=10.8) and estuarine/marine mollusks (RQ=0.93) exceed the acute levels of concern for estuarine/marine mollusks and invertebrates at the Acute Risk, Acute Restricted Use, and Acute Listed Species Use risk presumption categories.

On a chronic basis, levels of concern are exceeded for freshwater and estuarine/marine invertebrates based on the estimated chronic risk quotient values that range 21.30when novaluron is aerially applied at the maximum label application rate to sweet corn.

Since the avian acute dose-based LD_{50} and avian acute dietary-based LC_{50} values contained non-definitive numerical values and endpoints, no acute risk quotients could be estimated. **Table 18** below shows the estimated avian chronic dietary risk quotients using the suggested label application of 0.078 lbs ai/A applied 5 times per year with a 7-day application interval.

Table 18. Avian Dietary-Based EECs and Chronic Risk Quotients

Food Items	Dietary EECs	Avian NOAEC (mg/kg/diet)	Chronic Risk Quotient	Chronic LOC exceeded
Short grass	72.31	9.8	**7.38**	Yes
Tall grass	33.14	9.8	**3.40**	Yes
Broadleaf plants/small insects	40.67	9.8	**4.20**	Yes
Fruits/pods/seedlings/Large insects	4.52	9.8	0.50	No

Based on the data presented in **Table 17** of this assessment, chronic levels of concern are exceeded for birds consuming novaluron-treated short grass, tall grass, and broadleaf plants/small insects. Avian-dietary chronic risk quotients ranged from 0.50-7.38.

Based on the non-definitive acute oral-dose-based LD_{50} toxicity value for 20-1000 gram birds and the non-definitive LC_{50} toxicity value for birds exposed to novaluron from aerial and/or ground application to sweet corn, avian acute oral-dose-based risk quotients for 20-1000 gram birds and avian dietary acute risk quotients were estimated to non-definitive in value. These avian acute oral-dose-based risk quotients ranged from <0.01-<0.08 while the avian acute dietary risk quotients ranged from <0.01-<0.01.

For mammals feeding on food items treated with Novaluron on an oral acute-dose-based basis, no oral acute dose-based levels of concern were exceeded for 15-1000 gram mammals. Acute oral-dose-based risk quotients for 15-1000 gram mammals ranged from <0.01-0.01.

On chronic exposure basis, no mammalian oral-dose-based chronic levels of concern for 15-1000 gram mammals were exceeded for the proposed use of aerial and/or ground application of Novaluron to sweet corn. Mammalian oral-dose-based chronic risk quotients for 15-1000 gram mammals ranged from <0.01-0.42, below the Mammalian Chronic LOC trigger of 1.0.

Table 19 represents the aquatic acute risk quotients from aquatic organisms exposed to the degradate chlorophenyl urea.

Table 19. Aquatic Organisms Exposed to Chlorophenyl Urea

Taxa	Acute Toxicity Value (µg/L)	Peak EEC Value (µg/L)	Acute Risk Quotient
Freshwater Fish	530	0.93	<0.01
Freshwater Invertebrates	1910	0.93	<0.01
Non-vascular Aquatic Plants	EC50=330 NOAEC=105	0.93	<0.01

8. Endangered and Threatened Species

Table 20 summarizes the conclusions of potential concerns for direct and indirect effects to federally-listed threatened and endangered species (listed species) .

Table 20. Potential Risk to Federally Listed Taxa

Listed Taxa	Direct Effects	Indirect Effects
Terrestrial and semi-aquatic plants - monocots	Yes	Yes
Terrestrial and semi-aquatic plants - dicots	Yes	Yes
Terrestrial invertebrates	Yes	Yes

Table 20. Potential Risk to Federally Listed Taxa		
Listed Taxa	**Direct Effects**	**Indirect Effects**
Birds	Yes-Direct Chronic Effects	Yes
Terrestrial phase amphibians	Yes	**Yes**
Reptiles	Yes	**Yes**
Mammals	None	Yes
Aquatic vascular plants	None	Yes
Freshwater fish	None	Yes
Aquatic phase amphibians	**No**	**Yes**
Freshwater crustaceans	Yes-Acute and Chronic	Yes
Freshwater invertebrates	Yes	Yes
Mollusks	Yes-Acute	Yes
Marine/estuarine fish	N/A Acute Effects can not be estimated due to non-definitive toxicity endpoints	N/A
Marine/estuarine invertebrates	Yes-Acute and Chronic	Yes

LOCATES is used to identify listed species that may be located within the same county as the proposed new uses. Appendix E provides a list of listed species within the same location as the proposed new uses.

9. Incident Database Review

The Environmental Protection Agency maintains an incident database system called the Ecological Incident Information System (EIIS) to track and evaluate accidental kills associated with pesticide use. Based on the information contained in the incident report, the likelihood of a particular pesticide causing the incident is classified as highly probable, probable, possible, or unlikely. If there are incidents, this information will be reviewed and considered in conjunction with the degree to which the LOCs were exceeded, information on sales, local use practices, and monitored levels in the environment to determine whether the predicted effect based on labeled use of the product, is likely to occur or not.

A search of the EIIS database (on 1 October, 2010) identified no adverse ecological incidents involving novaluron.

Appendix A. PRZM/EXAMS Input Parameters, PRZM/EXAMS Example Output Files and AgDRIFT Output Files

Table A. PRZM/EXAMS Input Parameters for Novaluron for Use on Sweet Corn		
Parameter	**Input Value and Unit**	**Source**
Application Rate	0.078 lbs ai/A	Product Label: RimOn 0.83EC, EPA Reg. No. 66222-35
Number of Applications	5	Product Label
Minimum Interval Between Applications	7	Product Label
First Application Date (day-month)	CA 15-05 IL 01-06 MS 10-05 NC 15-05 PA 16-05	Assumed on crop profile and possible target insect infestation
Molecular Weight	492.7 g/mole	Registrant Data
Water Solubility @ 20° C	0.003 mg/L (ppm)	Registrant Data
Vapor Pressure	1.2×10^{-7} torr	Registrant Data
Soil Partition Co-efficient K_d[1]	165 ml/g	MRID 44961012
Hydrolysis	$t_{½}$ = 0 days	MRID 44961008
Aqueous Photolysis[2]	$t_{½}$ = 187 days	MRID 45638203
Aerobic Soil Metabolism[3]	$t_{½}$ = 15.6 days	MRIDs 44961009 and 44961010
Aerobic Aquatic Metabolism Half-life[4]	21.9 days	MRID 45638206
Anaerobic Aquatic Metabolism Half-life	56.9 days	MRIDs 45638205 and 45789203
Application Fraction (percent applied)	Ground – 0.99 Aerial 0.95	Guidance for Selecting Input parameters in Modeling the Environmental Fate and Transport of pesticides (2009)
Spray Drift Fraction	Ground – 0.01 Aerial – 0.05	Guidance for Selecting Input parameters in Modeling the Environmental Fate and Transport of pesticides (2009)

[1] An average soil adsorption constant, K_d, out of fur soil adsorption K_d values (133, 247, 184, and 95) was used.

[2] The aqueous photolysis half-life is assumed stable for modeling purposes. The half-life of photodegradation in water half-life was estimated from extremely variable data within and between labeled study concentration data (r2 ranged from 0.0039 to 0.65 16). Because novaluron has a very long photodegradation half-life, it is
not expected to impact the confidence in estimating environmental concentrations.

[3] Upper confidence bound on the mean of the aerobic soil metabolism half-life was used.

[4] Since n=2 (aerobic $t_{1/2}$: 15.7 and 9.7 days; anaerobic $t_{1/2}$: 50.6 and 53.7 days), the upper confidence bound on the mean aquatic metabolism half-life was used.

Novaluron

IL Corn – Aerial Spray

```
stored as NoILA.out
Chemical: Novaluron
PRZM environment: ILCornSTD.txt     modified Tueday, 29 May 2007 at
13:55:34
EXAMS environment: pond298.exv      modified Tueday, 26 August 2008 at
06:14:08
Metfile: w14842.dvf     modified Tueday, 26 August 2008 at 06:15:08
Water segment concentrations (ppb)

Year  Peak  96 hr 21 Day      60 Day      90 Day      Yearly
1961  0.7702      0.6085      0.3221      0.2331      0.1892
      0.06313
1962  0.5315      0.4237      0.2663      0.189 0.1456      0.05588
1963  0.5092      0.4084      0.2367      0.2121      0.1704
      0.0609
1964  0.7309      0.6272      0.3989      0.2233      0.1705
      0.0608
1965  0.3969      0.3174      0.2203      0.156 0.1293      0.05206
1966  0.4164      0.3295      0.2027      0.1565      0.139 0.05347
1967  0.4386      0.3448      0.2788      0.2101      0.1733
      0.06506
1968  1.431 1.118 0.6547      0.364 0.283 0.09934
1969  0.9401      0.7431      0.4919      0.2925      0.2383
      0.09197
1970  0.7206      0.5989      0.393 0.2436      0.2034      0.07992
1971  0.6768      0.5541      0.315 0.216 0.1781      0.06808
1972  0.6637      0.5711      0.407 0.2602      0.2055      0.07359
1973  0.8295      0.702 0.5005      0.3186      0.2531      0.09065
1974  2.291 1.824 1     0.5506      0.425 0.1469
1975  0.4426      0.3515      0.2915      0.2137      0.1812
      0.08007
1976  0.6647      0.5475      0.3001      0.1918      0.1553
      0.05946
1977  0.2956      0.2386      0.1958      0.1408      0.1305
      0.05222
1978  0.5195      0.4074      0.2946      0.2137      0.1659
      0.05899
1979  0.3201      0.2631      0.1893      0.1668      0.1388
      0.05207
1980  0.9904      0.7837      0.5396      0.3293      0.255 0.08544
1981  1.032 0.8185      0.5338      0.3535      0.2859      0.1038
1982  1.077 0.8496      0.4894      0.3134      0.2506      0.09623
1983  0.6391      0.5147      0.2931      0.1874      0.1437
      0.05322
1984  0.3802      0.3173      0.2405      0.1673      0.1272
      0.04272
1985  0.5805      0.4836      0.3016      0.1919      0.1512
      0.05146
1986  0.8673      0.6888      0.4845      0.3878      0.3037
      0.1031
1987  0.4962      0.391 0.2926      0.1905      0.1554      0.0602
1988  0.2859      0.2244      0.1829      0.118 0.08565     0.03024
```

1989 0.2989 0.2387 0.1948 0.13 0.09782 0.03203
1990 1.564 1.244 0.6991 0.4525 0.3587 0.1208

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly	
0.032258064516129	2.291	1.824	1	0.5506	0.425	0.1469	
0.0645161290322581		1.564	1.244	0.6991	0.4525	0.3587	0.1208
0.0967741935483871		1.431	1.118	0.6547	0.3878	0.3037	0.1038
0.129032258064516	1.077	0.8496	0.5396	0.364	0.2859		0.1031
0.161290322580645	1.032	0.8185	0.5338	0.3535	0.283		0.09934
0.193548387096774	0.9904	0.7837	0.5005	0.3293	0.255		0.09623
0.225806451612903	0.9401	0.7431	0.4919	0.3186	0.2531	0.09197	
0.258064516129032	0.8673	0.702	0.4894	0.3134	0.2506		0.09065
0.290322580645161	0.8295	0.6888	0.4845	0.2925	0.2383	0.08544	
0.32258064516129	0.7702	0.6272	0.407	0.2602	0.2055		0.08007
0.354838709677419	0.7309	0.6085	0.3989	0.2436	0.2034	0.07992	
0.387096774193548	0.7206	0.5989	0.393	0.2331	0.1892		0.07359
0.419354838709677	0.6768	0.5711	0.3221	0.2233	0.1812	0.06808	
0.451612903225806	0.6647	0.5541	0.315	0.216	0.1781		0.06506
0.483870967741936	0.6637	0.5475	0.3016	0.2137	0.1733	0.06313	
0.516129032258065	0.6391	0.5147	0.3001	0.2137	0.1705	0.0609	
0.548387096774194	0.5805	0.4836	0.2946	0.2121	0.1704	0.0608	
0.580645161290323	0.5315	0.4237	0.2931	0.2101	0.1659	0.0602	
0.612903225806452	0.5195	0.4084	0.2926	0.1919	0.1554	0.05946	
0.645161290322581	0.5092	0.4074	0.2915	0.1918	0.1553	0.05899	
0.67741935483871	0.4962	0.391	0.2788	0.1905	0.1512		0.05588
0.709677419354839	0.4426	0.3515	0.2663	0.189	0.1456		0.05347
0.741935483870968	0.4386	0.3448	0.2405	0.1874	0.1437	0.05322	
0.774193548387097	0.4164	0.3295	0.2367	0.1673	0.139		0.05222
0.806451612903226	0.3969	0.3174	0.2203	0.1668	0.1388	0.05207	
0.838709677419355	0.3802	0.3173	0.2027	0.1565	0.1305	0.05206	

```
0.870967741935484 0.3201      0.2631      0.1958      0.156 0.1293
      0.05146
0.903225806451613 0.2989      0.2387      0.1948      0.1408
      0.1272      0.04272
0.935483870967742 0.2956      0.2386      0.1893      0.13  0.09782
      0.03203
0.967741935483871 0.2859      0.2244      0.1829      0.118 0.08565
      0.03024

0.1   1.3956      1.09116     0.64319     0.38542     0.30192
      0.10373
                                Average of yearly averages:   0.07146

Inputs generated by pe5.pl - Novemeber 2006

Data used for this run:
Output File: NoILA
Metfile:    w14842.dvf
PRZM scenario:    ILCornSTD.txt
EXAMS environment file: pond298.exv
Chemical Name:    Novaluron
Description Variable Name     Value Units Comments
Molecular weight  mwt   492.7 g/mol
Henry's Law Const.      henry       atm-m^3/mol
Vapor Pressure    vapr  1.2e-7      torr
Solubility  sol   0.003 mg/L
Kd    Kd    165   mg/L
Koc   Koc         mg/L
Photolysis half-life    kdp   0     days  Half-life
Aerobic Aquatic Metabolism    kbacw 21.9  days  Halfife
Anaerobic Aquatic Metabolism  kbacs 56.9  days  Halfife
Aerobic Soil Metabolism asm   15.6  days  Halfife
Hydrolysis: pH 7  0     days  Half-life
Method:     CAM   2     integer     See PRZM manual
Incorporation Depth:    DEPI  0     cm
Application Rate: TAPP  0.087 kg/ha
Application Efficiency: APPEFF      0.95  fraction
Spray Drift DRFT  0.039 fraction of application rate applied to pond
Application Date  Date  01-06 dd/mm or dd/mmm or dd-mm or dd-mmm
Interval 1  interval    7     days  Set to 0 or delete line for single
app.
app. rate 1 apprate     0.087 kg/ha
Interval 2  interval    7     days  Set to 0 or delete line for single
app.
app. rate 2 apprate     0.087 kg/ha
Interval 3  interval    7     days  Set to 0 or delete line for single
app.
app. rate 3 apprate     0.087 kg/ha
Interval 4  interval    7     days  Set to 0 or delete line for single
app.
app. rate 4 apprate     0.087 kg/ha
Record 17:  FILTRA
      IPSCND      1
      UPTKF
Record 18:  PLVKRT
      PLDKRT
      FEXTRC      0.5
```

Flag for Index Res. Run IR EPA Pond
Flag for runoff calc. RUNOFF none none, monthly or total(average of entire run)

MS Corn – Ground Spray

stored as NoMSG.out
Chemical: Novaluron
PRZM environment: MScornSTD.txt modified Tueday, 29 May 2007 at 13:57:40
EXAMS environment: pond298.exv modified Tueday, 26 August 2008 at 06:14:08
Metfile: w03940.dvf modified Tueday, 26 August 2008 at 06:14:14
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	0.8371	0.6783	0.3651	0.2212	0.1721	0.05568
1962	0.2008	0.1635	0.1099	0.06377	0.04995	0.01907
1963	0.5853	0.468	0.2499	0.1741	0.1319	0.0436
1964	0.5752	0.4523	0.2353	0.1465	0.1154	0.03874
1965	0.08838	0.07019	0.05431	0.03823	0.0288	0.01195
1966	1.172	0.993	0.6046	0.3118	0.2383	0.07273
1967	1.006	0.8107	0.5886	0.3621	0.2806	0.0902
1968	0.8977	0.7298	0.4853	0.3136	0.2371	0.07442
1969	0.1204	0.09467	0.06863	0.04357	0.04051	0.01691
1970	0.2372	0.1953	0.1131	0.06364	0.04945	0.0176
1971	0.8065	0.6676	0.4079	0.2707	0.2133	0.06524
1972	0.1778	0.1539	0.1165	0.08089	0.06251	0.02088
1973	0.2746	0.2434	0.1564	0.08137	0.06092	0.01897
1974	0.854	0.6969	0.3594	0.1844	0.1431	0.04653
1975	0.6272	0.5394	0.3912	0.243	0.2052	0.06794
1976	1.118	0.9131	0.5969	0.3949	0.3137	0.09913
1977	0.4121	0.3414	0.1724	0.1104	0.09004	0.03396
1978	0.8452	0.6814	0.4238	0.2468	0.1925	0.05849
1979	1.33	1.093	0.585	0.3919	0.316	0.107
1980	0.5103	0.4305	0.3233	0.1899	0.1456	0.04913
1981	1.044	0.9024	0.6727	0.4394	0.3389	0.1023
1982	1.228	0.9697	0.4917	0.2799	0.2127	0.07026
1983	1.284	1.1	0.6548	0.3543	0.2669	0.08191
1984	0.2862	0.2384	0.1342	0.1181	0.09823	0.03491

1985	0.1451	0.1157	0.06358	0.05219	0.04867	0.02007
1986	1.286	1.121	0.8013	0.4621	0.3529	0.1039
1987	0.915	0.8077	0.4413	0.2204	0.1652	0.0564
1988	0.114	0.09062	0.05161	0.03545	0.03445	0.01686
1989	1.736	1.395	0.8164	0.552	0.4279	0.13
1990	0.6971	0.5656	0.3526	0.2572	0.1953	0.06325

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly	
0.032258064516129	1.736	1.395	0.8164	0.552	0.4279	0.13	
0.0645161290322581	1.33	1.121	0.8013	0.4621	0.3529	0.107	
0.0967741935483871	1.286	1.1	0.6727	0.4394	0.3389	0.1039	
0.129032258064516	1.284	1.093	0.6548	0.3949	0.316	0.1023	
0.161290322580645	1.228	0.993	0.6046	0.3919	0.3137	0.09913	
0.193548387096774	1.172	0.9697	0.5969	0.3621	0.2806	0.0902	
0.225806451612903	1.118	0.9131	0.5886	0.3543	0.2669	0.08191	
0.258064516129032	1.044	0.9024	0.585	0.3136	0.2383	0.07442	
0.290322580645161	1.006	0.8107	0.4917	0.3118	0.2371	0.07273	
0.32258064516129	0.915	0.8077	0.4853	0.2799	0.2133	0.07026	
0.354838709677419	0.8977	0.7298	0.4413	0.2707	0.2127	0.06794	
0.387096774193548	0.854	0.6969	0.4238	0.2572	0.2052	0.06524	
0.419354838709677	0.8452	0.6814	0.4079	0.2468	0.1953	0.06325	
0.451612903225806	0.8371	0.6783	0.3912	0.243	0.1925	0.05849	
0.483870967741936	0.8065	0.6676	0.3651	0.2212	0.1721	0.0564	
0.516129032258065	0.6971	0.5656	0.3594	0.2204	0.1652	0.05568	
0.548387096774194	0.6272	0.5394	0.3526	0.1899	0.1456	0.04913	
0.580645161290323	0.5853	0.468	0.3233	0.1844	0.1431	0.04653	
0.612903225806452	0.5752	0.4523	0.2499	0.1741	0.1319	0.0436	
0.645161290322581	0.5103	0.4305	0.2353	0.1465	0.1154	0.03874	
0.67741935483871	0.4121	0.3414	0.1724	0.1181	0.09823	0.03491	
0.709677419354839	0.2862	0.2434	0.1564	0.1104	0.09004	0.03396	
0.741935483870968	0.2746	0.2384	0.1342	0.08137	0.06251	0.02088	
0.774193548387097	0.2372	0.1953	0.1165	0.08089	0.06092	0.02007	

```
0.806451612903226 0.2008      0.1635      0.1131      0.06377
      0.04995     0.01907
0.838709677419355 0.1778      0.1539      0.1099      0.06364
      0.04945     0.01897
0.870967741935484 0.1451      0.1157      0.06863     0.05219
      0.04867     0.0176
0.903225806451613 0.1204      0.09467     0.06358     0.04357
      0.04051     0.01691
0.935483870967742 0.114 0.09062     0.05431     0.03823     0.03445
      0.01686
0.967741935483871 0.08838     0.07019     0.05161     0.03545
      0.0288      0.01195

0.1   1.2858      1.0993      0.67091     0.43495     0.33661
      0.10374
                              Average of yearly averages:
      0.0562676666666667

Inputs generated by pe5.pl - Novemeber 2006

Data used for this run:
Output File: NoMSG
Metfile:    w03940.dvf
PRZM scenario:    MScornSTD.txt
EXAMS environment file: pond298.exv
Chemical Name:    Novaluron
Description Variable Name     Value Units Comments
Molecular weight  mwt   492.7 g/mol
Henry's Law Const.      henry       atm-m^3/mol
Vapor Pressure    vapr  1.2e-7      torr
Solubility  sol   0.003 mg/L
Kd    Kd    165   mg/L
Koc   Koc         mg/L
Photolysis half-life    kdp   0     days  Half-life
Aerobic Aquatic Metabolism    kbacw 21.9  days  Halfife
Anaerobic Aquatic Metabolism  kbacs 56.9  days  Halfife
Aerobic Soil Metabolism asm   15.6  days  Halfife
Hydrolysis: pH 7  0     days  Half-life
Method:     CAM   2     integer     See PRZM manual
Incorporation Depth:    DEPI  0     cm
Application Rate: TAPP  0.087 kg/ha
Application Efficiency: APPEFF      0.99  fraction
Spray Drift DRFT  0.01  fraction of application rate applied to pond
Application Date  Date  10-05 dd/mm or dd/mmm or dd-mm or dd-mmm
Interval 1  interval    7     days  Set to 0 or delete line for single
app.
app. rate 1 apprate     0.087 kg/ha
Interval 2  interval    7     days  Set to 0 or delete line for single
app.
app. rate 2 apprate     0.087 kg/ha
Interval 3  interval    7     days  Set to 0 or delete line for single
app.
app. rate 3 apprate     0.087 kg/ha
Interval 4  interval    7     days  Set to 0 or delete line for single
app.
app. rate 4 apprate     0.087 kg/ha
Record 17:  FILTRA
```

```
      IPSCND      1
      UPTKF
Record 18:  PLVKRT
      PLDKRT
      FEXTRC      0.5
Flag for Index Res. Run IR    EPA Pond
Flag for runoff calc.   RUNOFF      none  none, monthly or
total(average of entire run)
```

AgDRIFT Aerial Output File

```
AgDRIFT®  2.01                                                    Page 1


AgDRIFT® Aquatic Assessment

Aquatic Body: EPA-Defined Pond
  Downwind Water Body Width: 208.7 ft
  Average Depth: 6.56 ft

Active Rate:
  Active Rate: 0.078 lb/ac

Calculations:
  Distance To Water Body From Edge of Field: 150 ft (input)
  Initial Average Deposition: 0.0392 Fraction of Applied
  Initial Average Deposition: 3.43 g/ha
  Initial Average Concentration: 0.0031 lb/ac

Tier: I
RunID:
  AgDRIFT®  2.01
```

AgDRIFT Ground Output File

```
AgDRIFT® Aquatic Assessment

Aquatic Body: EPA-Defined Pond
  Downwind Water Body Width: 208.7 ft
  Average Depth: 6.56 ft

Active Rate:
  Active Rate: 0.078 lb/ac

Calculations:
  Distance To Water Body From Edge of Field: 25 ft (input)
  Initial Average Deposition: 0.01 Fraction of Applied
  Initial Average Deposition: 0.8742 g/ha
  Initial Average Concentration: 0.0008 lb/ac

Tier: I
RunID:
  AgDRIFT®  2.01
```

Appendix B. GENEEC Input Parameters and Output Files for Chlorophenyl Urea and Chloroaniline

Chlorophenyl Urea – Input Parameters

Table B1. GENEEC Input Parameters for Chlorophenyl Urea Use on Sweet Corn		
Parameter	**Input Value and Unit**	**Source**
Application Rate[1]	0.015 lbs ai/A	(MWdeg/MWparen0 * 0.266 (max. %formation rate/l00)
Number of Applications	5	Product Label
Minimum Interval Between Applications	7 days	Product Label
Soil Partition Co-efficient K_d[2]	16.7 ml/g	MRID 45638201
Aerobic Soil Metabolism[3]	47.1 days	MRID 44961009
Wetted In	No	Product label
Depth of Incorporation	0	Product label
Method of Application	Granular	Assumed: Degradate
Water Solubility @ 20° C	33 ppm	MRID 45638201
Aerobic Aquatic Metabolism Half-life[4]	79.8 days (26.3 x 3 EFED Guidance)	MRID 45638206
Aqueous Photolysis	Stable	Assumed data not available
Molecular weight	352.6 g/mole	Product Chemistry

[1] Application rate for chlorophenyl urea is based on the maximum formation rate of 26.6 % from parent novaluron found in the aerobic soil metabolism study (MIRD 44961009) and molecular weight conversion (MW, = 492.7; MWd,= 352.6)

[2] Out of four K values (35.1; 16.7; 61.5; and 47.6) the lowest non-sand K_f for sandy loam was used (K_f may not equal K_d)

[3] First order non-linear half-lives were estimated from formation and decline curves using the maximum concentration as the initial concentration; since there were two valid half-lives estimated, i.e. 46.5 and 45.9 days, therefore the upper confidence bound on the mean metabolism half-life was used as the model input value

[4] A first order non-linear half-life was calculated from formation and decline curve using the maximum concentration as the initial concentration; since there was only one valid half-life (26.6 days; in Houghton Meadow water-loamy sand sediment) available as a model value $t_{1/2}$ x3 = 79.8 was used.

Chloroaniline – Input Parameters

Table B2. GENEEC Input Parameters for Chloroaniline Use on Sweet Corn		
Parameter	**Input Value and Unit**	**Source**
Application Rate[1]	0.049 lbs ai/A	(MWdeg/MWparen0 * 1.00 (max. %formation rate/l00)
Number of Applications	3	Product Label
Minimum Interval Between Applications	7 days	Product Label
Soil Partition Co-efficient K_d	5,899 ml/g	Estimated[2]
Aerobic Soil Metabolism[3]	Stable	Assumed; data not available
Wetted In	No	Product Label
Depth of Incorporation	0	Product Label
Method of Application	Granular	Assumed
Water Solubility @ 20° C	10.6 ppm	Estimated[2]
Aerobic Aquatic Metabolism Half-life	Stable	Assumed; data not available
Aqueous Photolysis	Stable	Assumed; data not available
Molecular weight	310.6 g/mole	

[1] Application rate of chloroaniline is based on 100% formation from parent novaluron

multiplied by the molecular weight conversion (310.6 MW_{deg}) /492.7(MW_{par}).

[2] Estimated using substructure/chemical property computer program (Howard and Meyland, 1995).

Chlorophenyl Urea - GENEEC Output File

```
RUN No.  1 FOR Chlorophenyl Ure ON  Sweet Corn   * INPUT VALUES *
 ---------------------------------------------------------------
 RATE (#/AC)  No.APPS &  SOIL  SOLUBIL  APPL TYPE  NO-SPRAY INCORP
 ONE(MULT)   INTERVAL    Kd  (PPM )  (%DRIFT)  ZONE(FT)  (IN)
 ---------------------------------------------------------------
 .015(  .062)  5  7    16.7  33.0  GRANUL(  .0)  .0   .0

 FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)
 ---------------------------------------------------------------
 METABOLIC  DAYS UNTIL  HYDROLYSIS  PHOTOLYSIS  METABOLIC  COMBINED
 (FIELD)  RAIN/RUNOFF  (POND)   (POND-EFF)  (POND)   (POND)
 ---------------------------------------------------------------
  47.10      2       N/A   999.00-********   79.80   79.75

 GENERIC EECs (IN NANOGRAMS/LITER (PPTr))    Version 2.0 Aug 1, 2001
 ---------------------------------------------------------------
   PEAK     MAX 4 DAY    MAX 21 DAY   MAX 60 DAY   MAX 90 DAY
   GEEC     AVG GEEC     AVG GEEC     AVG GEEC     AVG GEEC
 ---------------------------------------------------------------
  926.46    914.49       850.60       726.27       647.96
```

Chloroaniline - GENEEC Output File

```
RUN No.  5 FOR Chloroaniline  ON  Sweet corn   * INPUT VALUES *
 ---------------------------------------------------------------
 RATE (#/AC)  No.APPS &  SOIL  SOLUBIL  APPL TYPE  NO-SPRAY INCORP
 ONE(MULT)   INTERVAL    Kd  (PPM )  (%DRIFT)  ZONE(FT)  (IN)
 ---------------------------------------------------------------
 .049(  .245)  5  7   5899.0  10.6  GRANUL(  .0)  .0   .0

 FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)
 ---------------------------------------------------------------
 METABOLIC  DAYS UNTIL  HYDROLYSIS  PHOTOLYSIS  METABOLIC  COMBINED
 (FIELD)  RAIN/RUNOFF  (POND)   (POND-EFF)  (POND)   (POND)
 ---------------------------------------------------------------
   .00      2       N/A    .00-    .00    .00    .00

 GENERIC EECs (IN NANOGRAMS/LITER (PPTr))    Version 2.0 Aug 1, 2001
 ---------------------------------------------------------------
   PEAK     MAX 4 DAY    MAX 21 DAY   MAX 60 DAY   MAX 90 DAY
   GEEC     AVG GEEC     AVG GEEC     AVG GEEC     AVG GEEC
 ---------------------------------------------------------------
  509.15    277.70       61.06        21.54        14.45
```

Appendix C: Risk Quotient Method

The Risk Quotient Method is the means by which the Environmental Fate and Effects Division (EFED) integrates the results of exposure and ecotoxicity data. In this method, both acute and chronic risk quotients (RQs) are calculated by dividing exposure estimates by the most sensitive ecotoxicity values or toxicity endpoints derived from the studies. Calculated RQs are then compared to OPP's levels of concern (LOCs). The LOCs are the criteria used by OPP to indicate potential risk to non-target organisms and the need to consider regulatory action. EFED has defined LOCs for acute risk, potential restricted use, and for listed species. Risk presumptions, along with the corresponding RQs and LOCs are summarized in the table below.

Risk Presumption	RQ	LOC
Birds		
Acute Risk	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day	0.5
Acute Restricted Use	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day (or LD_{50} < 50 mg/kg)	0.2
Acute Listed Species	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day	0.1
Chronic Risk	EEC/NOAEC	1
Mammals		
Acute Risk	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day	0.5
Acute Restricted Use	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day (or LD_{50} < 50 mg/kg)	0.2
Acute Listed Species	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day	0.1
Chronic Risk	EEC/NOAEC	1
Aquatic Animals		
Acute Risk	EEC/LC_{50} or EC_{50}	0.5
Acute Restricted Use	EEC/LC_{50} or EC_{50}	0.1
Acute Listed Species	EEC/LC_{50} or EC_{50}	0.05
Chronic Risk	EEC/NOAEC	1
Terrestrial and Semi-Aquatic Plants		
Acute Risk	EEC/EC_{25}	1
Acute Listed Species	EEC/EC_{05} or NOAEC	1
Aquatic Plants		
Acute Risk	EEC/EC_{50}	1
Acute Listed Species	EEC/EC_{05} or NOAEC	1

Appendix D. Risk Quotient Calculations for Aquatic Animals

Estimated Environmental Concentrations (EECs) in surface water resulting from novaluron use were predicted using the TIER II PRZM/EXAMS model. Tier I GENEEC model was used to predict surface water concentrations of the degradate chlorophenyl urea. Both models generate peak, 21-day average, and 60-day average concentrations of novaluron in surface water. Acute RQs were derived by comparing peak EECs with the acute toxicity endpoints. The 60-day average and 21-day average EECs are compared to chronic toxicity endpoints (NOAEC values) to derive chronic RQs for fish and invertebrates, respectively.

Appendix E: Terrestrial Exposure Runs for Novaluron use on Sweet Corn:

TREX MODEL INPUTS

These values will be used in the calculation of exposure estimates for foliar, granular, liquid and/or seed applications of pesticides.

Chemical Identity and Application Information

Chemical Name: [redacted]
Use:
Product name and form:
% A.I. (leading zero must be entered for formulations <1% a.i.):
Application Rate (lbs/A):
Half-life (days):
Application Interval (days):
Number of Applications:

Assessed Species Inputs (optional, use defaults for RQs for national level assessments)

What body weight range is assessed (grams)?	Birds	Mammals
Small	20	15
Medium	100	35
Large	1000	1000

Note: Sources of wildlife diet are assumed to be available for less than one year for this model.

Endpoints

Avian

Endpoint	Toxicity value	Indicate test species below	Optional Test Organism Body weight (g)	Optional Test Species Name
LD50 (mg/kg-bw)	2000.00	Mallard duck		
LC50 (mg/kg-diet)	5000.00	Mallard duck		
NOAEL (mg/kg-bw)		Mallard duck		
NOAEC (mg/kg-diet)	0.50	Bobwhite quail		
Enter the Mineau et al. Scaling Factor	1.15			

Mammalian

	Acute Study	Chronic Study
Size (g) of mammal used in toxicity study Default rat body weight is 350 grams	350	350

Endpoint	Toxicity value		Reference (MRID)
LD50 (mg/kg-bw)	5000.00		
LC50 (mg/kg-diet)			
Reported Chronic Endpoint	74.00	mg/kg-bw	
Is dietary concentration (mg/kg-diet) reported from the available chronic mammal study? (yes or no)	yes		
Enter dietary concentration (mg/kg-diet)			

Upper Bound Kenaga Residues For RQ Calculation

Chemical Name:	Novaluron
Use	Sweet Corn
Formulation	RIMON EC
Application Rate	0.078 lbs a.i./acre
Half-life	35 days
Application Interval	7 days
Maximum # Apps./Year	5
Length of Simulation	1 year

Acute and Chronic RQs are based on the Upper Bound Kenaga Residues.

The maximum single day residue estimation is used for both the acute and reproduction RQs.

RQs reported as "0.00" in the RQ tables below should be noted as <0.01 in your assessment. This is due to rounding and significant figure issues in Excel.

Endpoints			
Avian	Mallard duck	LD50 (mg/kg-bw)	2000.00
	Mallard duck)	LC50 (mg/kg-diet)	5200.00
	Mallard duck	NOAEL(mg/kg-bw)	0.00
	Bobwhite quail	NOAEC (mg/kg-diet)	9.80
Mammals		LD50 (mg/kg-bw)	5000.00
		LC50 (mg/kg-diet)	0.00
		NOAEL (mg/kg-bw)	74.00
		NOAEC (mg/kg-diet)	0.00

Dietary-based EECs (ppm)	Kenaga Values
Short Grass	72.31
Tall Grass	33.14
Broadleaf plants/sm insects	40.67
Fruits/pods/seeds/lg insects	4.52

Avian Results

Avian Class	Body Weight (g)	Ingestion (Fdry) (g bw/day)	Ingestion (Fwet) (g/day)	% body wgt consumed	FI (kg-diet/day)
Small	20	5	23	114	2.28E-02
Mid	100	13	65	65	6.49E-02
Large	1000	58	291	29	2.91E-01
Granivores	20	5	5	25	5.06E-03
	100	13	14	14	1.44E-02
	1000	58	65	6	6.46E-02

Avian Body Weight (g)	Adjusted LD50 (mg/kg-bw)
20	1038.45
100	1322.00
1000	1867.37

Dose-based EECs (mg/kg-bw)	Avian Classes and Body Weights (grams)					
	small 20	mid 100	large 1000	Granivores(grams) 20	100	1000
Short Grass	82.35	46.96	21.02			
Tall Grass	37.74	21.52	9.64			
Broadleaf plants/sm insects	46.32	26.41	11.83			
Fruits/pods/seeds/lg insects	5.15	2.93	1.31	1.14	0.65	0.29

Dose-based RQs (Dose-based EEC/adjusted LD50)	Avian Acute RQs Size Class (grams)		
	20	100	1000
Short Grass	0.08	0.04	0.01
Tall Grass	0.04	0.02	0.01
Broadleaf plants/sm insects	0.04	0.02	0.01
Fruits/pods/seeds/lg insects	0.00	0.00	0.00
Seeds (granivore)	0.00	0.00	0.00

Dietary-based RQs (Dietary-based EEC/LC50 or NOAEC)	RQs	
	Acute	Chronic
Short Grass	0.01	7.38
Tall Grass	0.01	3.38
Broadleaf plants/sm insects	0.01	4.15
Fruits/pods/seeds/lg insects	0.00	0.46

Mammalian Results

Mammalian Class	Body Weight	Ingestion (Fdry) (g bwt/day)	Ingestion (Fwet) (g/day)	% body wgt consumed	FI (kg-diet/day)
Herbivores/ insectivores	15	3	14	95	1.43E-02
	35	5	23	66	2.31E-02
	1000	31	153	15	1.53E-01
Grainvores	15	3	3	21	3.18E-03
	35	5	5	15	5.13E-03
	1000	31	34	3	3.40E-02

Mammalian Class	Body Weight	Adjusted LD50	Adjusted NOAEL
Herbivores/ insectivores	15	10989.15	162.64
	35	8891.40	131.59
	1000	3845.80	56.92
Grainvores	15	10989.15	162.64
	35	8891.40	131.59
	1000	3845.80	56.92

Dose-Based EECs (mg/kg-bw)	Mammalian Classes and Body weight					
	Herbivores/ insectivores (grams)			Granivores(grams)		
	15	35	1000	15	35	1000
Short Grass	68.94	47.65	11.05			
Tall Grass	31.60	21.84	5.06			
Broadleaf plants/sm Insects	38.78	26.80	6.21			
Fruits/pods/seeds/lg insects	4.31	2.98	0.69	0.96	0.66	0.15

Dose-based RQs (Dose-based EEC/LD50 or NOAEL)	Small mammal 15 grams		Medium mammal 35 grams		Large mammal 1000 grams	
	Acute	Chronic	Acute	Chronic	Acute	Chronic
Short Grass	0.01	0.42	0.01	0.36	0.00	0.19
Tall Grass	0.00	0.19	0.00	0.17	0.00	0.09
Broadleaf plants/sm insects	0.00	0.24	0.00	0.20	0.00	0.11
Fruits/pods/lg insects	0.00	0.03	0.00	0.02	0.00	0.01
Seeds (granivore)	0.00	0.01	0.00	0.01	0.00	0.00

Dietary-based RQs (Dietary-based EEC/LC50 or NOAEC)	Mammal RQs	
	Acute	Chronic
Short Grass	#DIV/0!	#DIV/0!
Tall Grass	#DIV/0!	#DIV/0!
Broadleaf plants/sm insects	#DIV/0!	#DIV/0!
Fruits/pods/seeds/lg insects	#DIV/0!	#DIV/0!

Appendix F: Aquatic Risk Quotients for Novaluron aerial and/or ground application to Sweet Corn:

Table F-1-Aquatic Risk Quotients

Species	Acute Toxicity Value	Peak EEC Value	Acute Risk Quotient	Chronic Toxicity Value	21-Day EEC	60-Day EEC	Chronic Risk quotient
Rainbow Trout (*Oncorhynchus mykiss*)	LC_{50}: >960	1.40	N/A[1]	NOAEC= 6.16	N/A	0.39	0.06
Sheepshead minnow (*Cyprinodon variegatus*)	LC_{50}: >2	1.40	N/A[1]				
Water flea- (*Daphnia magna*)	[2]48-hr EC_{50}: 0.15 (calculated)	1.40	9.33[3]	NOAEC=0.03	0.64	N/A	21.33[4]
Mysid shrimp (*Americamysis bahia*)	LC_{50}=0.13	1.40	10.80[3]	NOAEC= 0.03	0.64	N/A	21.3[4]
Eastern oyster (*Crassostrea virginica*)	LC_{50}= 1.5	1.40	0.93[3]				
Green algae (*Selenastrum capricornutum*)	EC_{50}: >9680 NOAEC: 9680	1.40	<<0.01				
Duckweed (*Lemna gibba*)	[5]EC_{50}: >75.4 [5]NOAEC: 75.4	1.40	<<0.01				

[1]Cannot be categorized due to non-definitive endpoints

[2] Calculated based on the assumption that acute to chronic ratio for estuarine/marine invertebrates applies to freshwater invertebrates also; [2]Endpoints adjusted on ai basis (LC_{50} and NOAEC values were 4.31 and 1.26 ppb, respectively, on formulated product basis); *denotes values used to calculate RQs.

[3]. Aquatic acute levels of concern for freshwater and estuarine/marine organisms (mainly Daphnids, mysids, and oysters) are exceeded at the Acute Risk, Acute restricted Use, and Acute Listed Species Risk presumption categories based on Novaluron use on sweet corn.

[4]. Chronic levels of concern for freshwater and estuarine/marine invertebrates were exceeded when aerial applications of Novaluron were made to sweet corn.

[5]. Endpoints adjusted on ai basis (EC_{50} and NOAEC values were 39,000 and 27,200 ppb, respectively, on formulated product basis);

Appendix G: LOCATES Runs:

305 Species Affected:

Inverse Name:	Taxa:	Co.	Status:
Arrowhead, Bunched	Monocot	2	Endangered
Aster, Florida Golden	Dicot	2	Endangered
Avens, Spreading	Dicot	9	Endangered
Bat, Gray	Mammal	38	Endangered
Bat, Indiana	Mammal	151	Endangered
Bat, Virginia Big-eared	Mammal	16	Endangered
Beargrass, Britton's	Monocot	5	Endangered
Beetle, American Burying	Insect	1	Endangered
Bellflower, Brooksville	Dicot	1	Endangered
Bittercress, Small-anthered	Dicot	4	Endangered
Blazing Star, Scrub	Dicot	2	Endangered
Bluet, Roan Mountain	Dicot	5	Endangered
Bulrush, Northeastern (=Barbed Bristle)	Monocot	6	Endangered
Butterfly, Fender's Blue	Insect	8	Endangered
Butterfly, Karner Blue	Insect	22	Endangered
Butterfly, Mitchell's Satyr	Insect	4	Endangered
Butterfly, Saint Francis' Satyr	Insect	3	Endangered
Butterfly, Schaus Swallowtail	Insect	1	Endangered
Campeloma, Slender	Gastropod	1	Endangered
Campion, Fringed	Dicot	6	Endangered
Cavefish, Alabama	Fish	1	Endangered
Chaffseed, American	Dicot	10	Endangered
Checker-mallow, Wenatchee Mountains	Dicot	1	Endangered
Chub, Oregon	Fish	10	Endangered
Cladonia, Florida Perforate	Lichen	5	Endangered
Clover, Leafy Prairie	Dicot	4	Endangered
Combshell, Southern (=Penitent mussel)	Bivalve	1	Endangered
Combshell, Upland	Bivalve	9	Endangered
Coneflower, Smooth	Dicot	31	Endangered
Crane, Whooping	Bird	22	Endangered
Daisy, Willamette	Dicot	9	Endangered
Darter, Amber	Fish	5	Endangered
Darter, Boulder	Fish	1	Endangered
Darter, Duskytail	Fish	1	Endangered
Darter, Etowah	Fish	4	Endangered
Darter, Okaloosa	Fish	2	Endangered
Darter, Vermilion	Fish	1	Endangered
Darter, Watercress	Fish	1	Endangered
Deer, Columbian White-tailed	Mammal	6	Endangered
Dragonfly, Hine's Emerald	Insect	3	Endangered
Dropwort, Canby's	Dicot	6	Endangered
Elktoe, Appalachian	Bivalve	10	Endangered
Fanshell	Bivalve	2	Endangered
Fringe Tree, Pygmy	Dicot	4	Endangered
Fritillary, Gentner's	Monocot	2	Endangered
Gourd, Okeechobee	Dicot	2	Endangered
Grass, Tennessee Yellow-eyed	Monocot	4	Endangered
Harebells, Avon Park	Dicot	2	Endangered
Harperella	Dicot	14	Endangered
Hypericum, Highlands Scrub	Dicot	2	Endangered
Irisette, White	Monocot	3	Endangered
Isopod, Lee County Cave	Crustacean	1	Endangered
Jacquemontia, Beach	Dicot	3	Endangered
Kidneyshell, Triangular	Bivalve	14	Endangered
Kite, Everglade Snail	Bird	14	Endangered
Lead-plant, Crenulate	Dicot	1	Endangered
Leather-flower, Alabama	Dicot	3	Endangered
Leather-flower, Morefield's	Dicot	1	Endangered
Lichen, Rock Gnome	Lichen	11	Endangered
Logperch, Conasauga	Fish	2	Endangered
Logperch, Roanoke	Fish	13	Endangered

Lomatium, Bradshaw's	Dicot	9	Endangered
Lomatium, Cook's	Dicot	2	Endangered
Loosestrife, Rough-leaved	Dicot	15	Endangered
Lupine, Scrub	Dicot	2	Endangered
Mallow, Peter's Mountain	Dicot	1	Endangered
Manatee, West Indian	Marine mml	43	Endangered
Meadowfoam, Large-flowered Woolly	Dicot	1	Endangered
Meadowrue, Cooley's	Dicot	6	Endangered
Milkpea, Small's	Dicot	1	Endangered
Milk-vetch, Applegate's	Dicot	1	Endangered
Mint, Garrett's	Dicot	1	Endangered
Mint, Longspurred	Dicot	1	Endangered
Mint, Scrub	Dicot	1	Endangered
Mouse, Alabama Beach	Mammal	1	Endangered
Mouse, Anastasia Island Beach	Mammal	1	Endangered
Mouse, Choctawhatchee Beach	Mammal	2	Endangered
Mouse, Perdido Key Beach	Mammal	2	Endangered
Mucket, Pink (Pearlymussel)	Bivalve	9	Endangered
Mussel, Acornshell Southern	Bivalve	5	Endangered
Mussel, Coosa Moccasinshell	Bivalve	7	Endangered
Mussel, Cumberland Combshell	Bivalve	4	Endangered
Mussel, Cumberland Elktoe	Bivalve	1	Endangered
Mussel, Dark Pigtoe	Bivalve	4	Endangered
Mussel, Dwarf Wedge	Bivalve	32	Endangered
Mussel, Fine-rayed Pigtoe	Bivalve	9	Endangered
Mussel, Flat Pigtoe (=Marshall's Mussel)	Bivalve	1	Endangered
Mussel, Gulf Moccasinshell	Bivalve	19	Endangered
Mussel, Heavy Pigtoe (=Judge Tait's Mussel)	Bivalve	6	Endangered
Mussel, Heelsplitter Carolina	Bivalve	5	Endangered
Mussel, Ochlockonee Moccasinshell	Bivalve	3	Endangered
Mussel, Oval Pigtoe	Bivalve	24	Endangered
Mussel, Ovate Clubshell	Bivalve	15	Endangered
Mussel, Oyster	Bivalve	8	Endangered
Mussel, Ring Pink (=Golf Stick Pearly)	Bivalve	2	Endangered
Mussel, Rough Pigtoe	Bivalve	8	Endangered
Mussel, Shiny Pigtoe	Bivalve	9	Endangered
Mussel, Shiny-rayed Pocketbook	Bivalve	23	Endangered
Mussel, Southern Clubshell	Bivalve	17	Endangered
Mussel, Southern Pigtoe	Bivalve	9	Endangered
Mussel, Winged Mapleleaf	Bivalve	1	Endangered
Mustard, Carter's	Dicot	3	Endangered
Panther, Florida	Mammal	7	Endangered
Pawpaw, Beautiful	Dicot	2	Endangered
Pawpaw, Four-petal	Dicot	2	Endangered
Pawpaw, Rugel's	Dicot	1	Endangered
Pearlymussel, Alabama Lamp	Bivalve	1	Endangered
Pearlymussel, Appalachian Monkeyface	Bivalve	2	Endangered
Pearlymussel, Birdwing	Bivalve	5	Endangered
Pearlymussel, Cracking	Bivalve	4	Endangered
Pearlymussel, Cumberland Bean	Bivalve	4	Endangered
Pearlymussel, Cumberland Monkeyface	Bivalve	5	Endangered
Pearlymussel, Dromedary	Bivalve	2	Endangered
Pearlymussel, Fat Pocketbook	Bivalve	2	Endangered
Pearlymussel, Green-blossom	Bivalve	1	Endangered
Pearlymussel, Higgins' Eye	Bivalve	24	Endangered
Pearlymussel, Little-wing	Bivalve	9	Endangered
Pearlymussel, Orange-footed	Bivalve	3	Endangered
Pearlymussel, Pale Lilliput	Bivalve	1	Endangered
Pearlymussel, Turgid-blossom	Bivalve	1	Endangered
Pearlymussel, White Wartyback	Bivalve	2	Endangered
Pebblesnail, Flat	Gastropod	2	Endangered
Pinkroot, Gentian	Dicot	1	Endangered
Pitcher-plant, Alabama Canebrake	Dicot	3	Endangered
Pitcher-plant, Green	Dicot	10	Endangered
Pitcher-plant, Mountain Sweet	Dicot	3	Endangered
Plover, Piping	Bird	43	Endangered
Plum, Scrub	Dicot	3	Endangered
Polygala, Lewton's	Dicot	4	Endangered
Polygala, Tiny	Dicot	4	Endangered
Pondberry	Dicot	4	Endangered

Popcornflower, Rough	Dicot	1	Endangered
Purple Bean	Bivalve	6	Endangered
Quillwort, Black-spored	Ferns	9	Endangered
Quillwort, Louisiana	Ferns	2	Endangered
Quillwort, Mat-forming	Ferns	8	Endangered
Rabbit, Pygmy	Mammal	9	Endangered
Rabbitsfoot, Rough	Bivalve	5	Endangered
Rattleweed, Hairy	Dicot	2	Endangered
Rhododendron, Chapman	Dicot	2	Endangered
Riffleshell, Tan	Bivalve	4	Endangered
Riversnail, Anthony's	Gastropod	2	Endangered
Rock-cress, Shale Barren	Dicot	6	Endangered
Rocksnail, Plicate	Gastropod	2	Endangered
Rosemary, Etonia	Dicot	1	Endangered
Rosemary, Short-leaved	Dicot	2	Endangered
Salamander, Shenandoah	Amphibian	3	Endangered
Salmon, Chinook (Upper Columbia River Spring)	Fish	25	Endangered
Salmon, Sockeye (Snake River population)	Fish	19	Endangered
Sandlace	Dicot	3	Endangered
Sawfish, Smalltooth	Fish	3	Endangered
Sea turtle, green	Reptile	27	Endangered
Sea turtle, hawksbill	Reptile	11	Endangered
Sea turtle, Kemp's ridley	Reptile	6	Endangered
Sea turtle, leatherback	Reptile	28	Endangered
Sedge, Golden	Monocot	2	Endangered
Shiner, Cahaba	Fish	5	Endangered
Shiner, Cape Fear	Fish	5	Endangered
Shiner, Palezone	Fish	1	Endangered
Shiner, Topeka	Fish	10	Endangered
Shrimp, Alabama Cave	Crustacean	1	Endangered
Snail, Armored	Gastropod	1	Endangered
Snail, Iowa Pleistocene	Gastropod	6	Endangered
Snail, Lioplax Cylindrical	Gastropod	2	Endangered
Snail, Tulotoma	Gastropod	5	Endangered
Snakeroot	Dicot	2	Endangered
Sparrow, Cape Sable Seaside	Bird	1	Endangered
Sparrow, Florida Grasshopper	Bird	4	Endangered
Spider, Spruce-fir Moss	Arachnid	7	Endangered
Spinymussel, James River	Bivalve	14	Endangered
Spinymussel, Tar River	Bivalve	7	Endangered
Spurge, Deltoid	Dicot	1	Endangered
Squirrel, Carolina Northern Flying	Mammal	12	Endangered
Squirrel, Delmarva Peninsula Fox	Mammal	2	Endangered
Stickseed, Showy	Dicot	1	Endangered
Stirrupshell	Bivalve	3	Endangered
Stork, Wood	Bird	137	Endangered
Sturgeon, Alabama	Fish	4	Endangered
Sturgeon, Pallid	Fish	8	Endangered
Sturgeon, Shortnose	Fish	42	Endangered
Sucker, Lost River	Fish	1	Endangered
Sucker, Shortnose	Fish	1	Endangered
Sumac, Michaux's	Dicot	28	Endangered
Sunflower, Schweinitz's	Dicot	12	Endangered
Tern, Interior (population) Least	Bird	2	Endangered
Tern, Roseate	Bird	1	Endangered
Threeridge, Fat (Mussel)	Bivalve	4	Endangered
Torreya, Florida	Conf/cycds	3	Endangered
Trillium, Persistent	Monocot	2	Endangered
Trillium, Relict	Monocot	11	Endangered
Turtle, Alabama Red-bellied	Reptile	2	Endangered
Vole, Florida Salt Marsh	Mammal	1	Endangered
Warbler (=Wood), Kirtland's	Bird	11	Endangered
Warea, Wide-leaf	Dicot	2	Endangered
Water-willow, Cooley's	Dicot	1	Endangered
Wireweed	Dicot	2	Endangered
Woodpecker, Red-cockaded	Bird	228	Endangered
Ziziphus, Florida	Dicot	2	Endangered
Amaranth, Seabeach	Dicot	9	Threatened
Amphianthus, Little	Dicot	20	Threatened
Bankclimber, Purple	Bivalve	15	Threatened

Barbara Buttons, Mohr's	Dicot	5	Threatened
Bear, Grizzly	Mammal	13	Threatened
Beetle, Northeastern Beach Tiger	Insect	6	Threatened
Birch, Virginia Round-leaf	Dicot	1	Threatened
Birds-in-a-nest, White	Dicot	1	Threatened
Bladderpod, Lyrate	Dicot	3	Threatened
Blazing Star, Heller's	Dicot	6	Threatened
Bonamia, Florida	Dicot	7	Threatened
Buckwheat, Scrub	Dicot	5	Threatened
Butterfly, Oregon Silverspot	Insect	7	Threatened
Butterwort, Godfrey's	Dicot	1	Threatened
Caracara, Audubon's Crested	Bird	12	Threatened
Catchfly, Spalding's	Dicot	6	Threatened
Checker-mallow, Nelson's	Dicot	11	Threatened
Chub, Slender	Fish	4	Threatened
Chub, Spotfin	Fish	9	Threatened
Clover, Prairie Bush	Dicot	91	Threatened
Crocodile, American	Reptile	2	Threatened
Dace, Blackside	Fish	1	Threatened
Darter, Cherokee	Fish	4	Threatened
Darter, Goldline	Fish	6	Threatened
Darter, Slackwater	Fish	3	Threatened
Darter, Snail	Fish	2	Threatened
Elimia, Lacy	Gastropod	1	Threatened
Fairy Shrimp, Vernal Pool	Crustacean	1	Threatened
Fern, Alabama Streak-sorus	Ferns	1	Threatened
Fern, American hart's-tongue	Ferns	3	Threatened
Four-o'clock, Macfarlane's	Dicot	1	Threatened
Goldenrod, Blue Ridge	Dicot	4	Threatened
Gooseberry, Miccosukee	Dicot	1	Threatened
Heartleaf, Dwarf-flowered	Dicot	7	Threatened
Heather, Mountain Golden	Dicot	2	Threatened
Howellia, Water	Dicot	5	Threatened
Iris, Dwarf Lake	Monocot	2	Threatened
Isopod, Madison Cave	Crustacean	2	Threatened
Joint-vetch, Sensitive	Dicot	20	Threatened
Locoweed, Fassett's	Dicot	3	Threatened
Lupine, Kincaid's	Dicot	11	Threatened
Lynx, Canada	Mammal	11	Threatened
Madtom, Yellowfin	Fish	5	Threatened
Milkweed, Mead's	Dicot	7	Threatened
Monkshood, Northern Wild	Dicot	11	Threatened
Mouse, Southeastern Beach	Mammal	1	Threatened
Mucket, Orangenacre	Bivalve	9	Threatened
Murrelet, Marbled	Bird	22	Threatened
Mussel, Alabama Moccasinshell	Bivalve	12	Threatened
Mussel, Fine-lined Pocketbook	Bivalve	26	Threatened
Mussel, Heelsplitter Inflated	Bivalve	10	Threatened
Orchid, Eastern Prairie Fringed	Monocot	31	Threatened
Orchid, Western Prairie Fringed	Monocot	83	Threatened
Owl, Northern Spotted	Bird	43	Threatened
Paintbrush, Golden	Dicot	3	Threatened
Pink, Swamp	Monocot	13	Threatened
Plover, Western Snowy	Bird	8	Threatened
Pogonia, Small Whorled	Monocot	48	Threatened
Potato-bean, Price's	Dicot	3	Threatened
Rocksnail, Painted	Gastropod	4	Threatened
Rocksnail, Round	Gastropod	2	Threatened
Salamander, Flatwoods	Amphibian	19	Threatened
Salamander, Red Hills	Amphibian	5	Threatened
Salmon, Chinook (Lower Columbia River)	Fish	9	Threatened
Salmon, Chinook (Puget Sound)	Fish	14	Threatened
Salmon, Chinook (Snake River Fall Run)	Fish	19	Threatened
Salmon, Chinook (Snake River spring/summer)	Fish	21	Threatened
Salmon, Chinook (Upper Willamette River)	Fish	19	Threatened
Salmon, Chum (Columbia River population)	Fish	7	Threatened
Salmon, Chum (Hood Canal Summer population)	Fish	4	Threatened
Salmon, Coho (Southern OR/Northern CA Coast)	Fish	4	Threatened
Salmon, Sockeye (Ozette Lake population)	Fish	1	Threatened
Scrub-Jay, Florida	Bird	29	Threatened

Sculpin, Pygmy	Fish	1	Threatened
Sea turtle, loggerhead	Reptile	50	Threatened
Seagrass, Johnson's	Monocot	4	Threatened
Shiner, Blue	Fish	8	Threatened
Shrimp, Squirrel Chimney Cave	Crustacean	1	Threatened
Silverside, Waccamaw	Fish	1	Threatened
Skink, Blue-tailed Mole	Reptile	2	Threatened
Skink, Sand	Reptile	5	Threatened
Skullcap, Large-flowered	Dicot	5	Threatened
Slabshell, Chipola	Bivalve	1	Threatened
Snail, Noonday	Gastropod	1	Threatened
Snake, Atlantic Salt Marsh	Reptile	2	Threatened
Snake, Eastern Indigo	Reptile	122	Threatened
Sneezeweed, Virginia	Dicot	3	Threatened
Spiraea, Virginia	Dicot	21	Threatened
Spurge, Garber's	Dicot	1	Threatened
Spurge, Telephus	Dicot	1	Threatened
Steelhead, (Lower Columbia River population)	Fish	10	Threatened
Steelhead, (Middle Columbia River population)	Fish	21	Threatened
Steelhead, (Snake River Basin population)	Fish	21	Threatened
Steelhead, (Upper Columbia River population)	Fish	25	Threatened
Steelhead, (Upper Willamette River population)	Fish	18	Threatened
Steelhead, Puget Sound	Fish	18	Threatened
Sturgeon, Gulf	Fish	39	Threatened
Thelypody, Howell's Spectacular	Dicot	2	Threatened
Thistle, Pitcher's	Dicot	3	Threatened
Tortoise, Gopher	Reptile	4	Threatened
Trout, Bull	Fish	55	Threatened
Trout, Bull (Columbia River population)	Fish	39	Threatened
Trout, Bull (Klamath River population)	Fish	39	Threatened
Turtle, Flattened Musk	Reptile	8	Threatened
Water-plantain, Kral's	Monocot	3	Threatened
Whitlow-wort, Papery	Dicot	4	Threatened
Wings, Pigeon	Dicot	3	Threatened