

Appendix F
Ecological Effects Data

Table F-1. Acute freshwater fish toxicity to 2,4-D							
Species	% ai	96-hour LC50 (95% CI)		Measured/ Nominal Test Concentrations	Toxicity Category (based on ae)	MRID No. Author/Year	Study Classification
		(mg ai/L)	(mg ae/L)				
2,4-D acid (PC Code: 030001)							
Rainbow trout (<i>Oncorhynchus mykiss</i>)	98.7	358	358	Measured	Practically non-toxic	411583-01, Alexander et. al., 1983	Supplemental
Bluegill sunfish (<i>Lepomis macrochirus</i>)	98.7	263	263	Measured	Practically non-toxic	411583-01, Alexander et. al., 1983	Supplemental
Fathead minnow (<i>Pimephales promelas</i>)	98.7	320	320	Measured	Practically non-toxic	411583-01, Alexander et. al., 1983	Supplemental
2,4-D Sodium Salt (PC Code: 030004)							
Rainbow trout (<i>Oncorhynchus mykiss</i>)	80	>100	>91	Nominal	Practically non-toxic	53986, McCann, 1973	Acceptable
2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)							
Rainbow trout (<i>Oncorhynchus mykiss</i>)	73.1	>120	>81.6	Measured	Practically non-toxic	419751-05, Graves. et. al., 1991.	Acceptable
Bluegill sunfish (<i>Lepomis macrochirus</i>)	73.1	>121	>82.3	Measured	Practically non-toxic	419751-04, Graves. et. al., 1991.	Acceptable
Fatahead minnow (<i>Pimephales promelas</i>)	73.1	344	234	Measured	Practically non-toxic	41975`-04, Graves, et. al, 1991	Acceptable
Bluegill sunfish (<i>Lepomis macrochirus</i>)	Not Reported	149	101	Measured	Practically non-toxic	0073-091-01, Sleight, B., 1971.	Supplemental
2,4-D Dimethylamine (DMA) Salt (PC Code: 030019)							
Rainbow trout (<i>Oncorhynchus mykiss</i>)	67.3	>1000	>830	Measured	Practically non-toxic	233350, Vilkas, A,G., 1977.	Acceptable

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Species	% ai	96-hour LC50 (95% CI)		Measured/ Nominal Test Concentrations	Toxicity Category (based on ae)	MRID No. Author/Year	Study Classification
		(mg ai/L)	(mg ae/L)				
Bluegill sunfish (<i>Lepomis macrochirus</i>)	73.1	>121	>100	Measured	Practically non-toxic	419751-04, Graves, et. al., 1991.	Acceptable
Bluegill sunfish (<i>Lepomis macrochirus</i>)	67.3	250	207.5	Measured	Practically non-toxic	411583-11, Alexander, et. al., 1983.	Acceptable
Bluegill sunfish (<i>Lepomis macrochirus</i>)	51.1 9TEP)	>1000	>830	Measured	Practically non-toxic	234027, Vilkas, A.G., 1978.	Supplemental
Fathead minnow (<i>Pimephales promelas</i>)	67.3	318	264	Measured	Practically non-toxic	419751-04, Graves. et. al., 1991.	Acceptable
2,4-D Isoproylamine (IPA) (PC Code: 030025)							
Rainbow trout (<i>Oncorhynchus mykiss</i>)	48.7 (TEP)	2840	2244	Measured	Practically non-toxic	01338869, 1983.	Acceptable
Bluegill sunfish (<i>Lepomis macrochirus</i>)	48.7 (TEP)	1700	1343	Measured	Practically non-toxic	01338869, 1983.	Acceptable
Fathead minnow (<i>Pimephales promelas</i>)	48.7 (TEP)	2180	1722	Measured	Practically non-toxic	01338869, 1983.	Supplemental
2,4-D Triisopropanolamine (TIPA) Salt (PC Code: 030035)							
Rainbow trout (<i>Oncorhynchus mykiss</i>)	69.2	300	162	Measured	Practically non-toxic	413538-03, Mayes, et. al., 1989.	Acceptable
Bluegill sunfish (<i>Lepomis macrochirus</i>)	69.2	401	217	Measured	Practically non-toxic	413538-04, Mayes, et al., 1989	Acceptable
2,4-D Butoxyethyl (BEE) Ester (PC code: 030053)							
Rainbow trout (<i>Oncorhynchus mykiss</i>)	97.4	2.09	1.44	Measured	Moderately toxic	413538-01, Alexander, et. al, 1983.	Acceptable

Table F-1. Acute freshwater fish toxicity to 2,4-D							
Species	% ai	96-hour LC50 (95% CI)		Measured/ Nominal Test Concentrations	Toxicity Category (based on ae)	MRID No. Author/Year	Study Classification
		(mg ai/L)	(mg ae/L)				
Rainbow trout (<i>Oncorhynchus mykiss</i>) static	77.5	0.65 (56- hour LC50)	0.45	Measured	Highly toxic	00050674, Pitcher, F.G., 1974.	Supplemental
Bluegill sunfish (<i>Lepomis macrochirus</i>)	Not reported	1.2	0.828	Measured	Moderately toxic	400980-01, Mayer, 1986.	Supplemental
Bluegill sunfish (<i>Lepomis macrochirus</i>)	97.4	0.62	0.428	Measured	Highly toxic	413538-01, Alexander, et. al, 1983.	Acceptable
Bluegill sunfish (<i>Lepomis macrochirus</i>)	29.0 (TEP)	>100	0.69	Measured	Practically non- toxic	400980-01, Mayer, 1986 J.A.,1969	Supplemental
Fathead minnow (<i>Pimephales promelas</i>)	97.4	2.60	1.79	Measured	Moderately toxic	413538-01, Alexander, et. al, 1983.	Acceptable
2,4-D 2-Ethylhexyl Ester (2-EHE) (PC code: 030063)							
Rainbow trout (<i>Oncorhynchus mykiss</i>)	66.9 (TEP)	4.82	3.2	Measured EHE	Moderately toxic	417373-03, Mayes, et. al., 1990.	Acceptable
Rainbow trout (<i>Oncorhynchus mykiss</i>)	92	22	14.5	Nominal	Slightly toxic	45068, Buccafusco, R.J., 1976.	Acceptable
Bluegill sunfish (<i>Lepomis macrochirus</i>)	92	18	11.9	Nominal	Slightly toxic	45069, Buccafusco, R.J., 1976.	Acceptable
2,4-D Isopropyl Ester (IPE) (PC code: 030066)							
Rainbow trout (<i>Oncorhynchus mykiss</i>) static	98.2	0.69	0.58	Measured	Highly toxic	439331-01, Drottar, et. al., 1996.	Acceptable

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Species	% ai	96-hour LC50 (95% CI)		Measured/ Nominal Test Concentrations	Toxicity Category (based on ae)	MRID No. Author/Year	Study Classification
		(mg ai/L)	(mg ae/L)				
Rainbow trout (<i>Oncorhynchus mykiss</i>) static	45.8 (TEP)	0.78	0.66	Measured	Highly toxic	439332-01, Drottar, et. al., 1996.	Acceptable
Bluegill sunfish (<i>Lepomis macrochirus</i>) static	98.2	0.31	0.26	Measured	Highly toxic	439307-01, Drottar, et. al., 1996.	Acceptable
Bluegill sunfish (<i>Lepomis macrochirus</i>)	45.8 (TEP)	0.31	0.26	Measured	Slightly toxic	439103-01, Drottar, et. al., 1996.	Acceptable

Table F-2. Chronic (early life cycle) freshwater fish toxicity to 2,4-D						
Species	% ai	Toxicity Value (mg ae/L)		Most sensitive endpoint	MRID No. Author/Year	Study Classification
		NOAEC	LOAEC			
2,4-D acid (PC Code: 030001)*						
Fathead minnow (<i>Pimephales promelas</i>)	96.1	63.4	102	Larval survival	417373-04, Mayes, et. al.,1990.	Acceptable
2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)*						
Fathead minnow (<i>Pimephales promelas</i>)	73.8	19.8	66.6	Larval survival	420183-04, Graves, et. al., 1991.	Acceptable
2,4-D Dimethylamine (DMA)Salt (PC Code: 030019)*						
Fathead minnow (<i>Pimephales promelas</i>)	66.5	14.2	23.6	Length	417677-01, Dill, et. al., 1990.	Acceptable

* No early life cycle freshwater fish studies using forms of 2,4-D other than acid, DEA, and DMA were submitted to the Agency.

Table F-3. Chronic (full life cycle) freshwater fish toxicity to 2,4-D						
Species	% ai	Toxicity Value (mg ae/L)		Most sensitive endpoint	MRID No. Author/Year	Study Classification
		NOAEC	LOAEC			
2,4-D Ethylhexyl Ester (EHE) (PC code: 030063)*						
Fathead minnow (<i>Pimephales promelas</i>)	94.7	0.0792	0.1452	Larval fish survival	417373-05, Mayes, et. al., 1990.	Supplemental

* No full life cycle freshwater fish studies using forms of 2,4-D other than EHE were submitted to the Agency.

Table F-4. Acute freshwater invertebrate toxicity to 2,4-D							
Species	% ai	96-hour LC50 (95% CI)		Measured/ Nominal Test Concentrations	Toxicity Category (based on ae)	MRID No. Author/Year	Study Classification
		(mg ai/L)	(mg ae/L)				
2,4-D acid (PC Code: 030001)							
Waterflea (<i>Daphnia magna</i>)	98.7	25	25	Measured	Slightly toxic	411583-01, Alexander et. al., 1983	Acceptable
2,4-D Sodium Salt (PC Code: 030004)							
No data							
2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)							
Waterflea (<i>Daphnia magna</i>)	71.3	>100	>68	measured	Practically non-toxic	419751-06, Graves, et. al., 1991.	Acceptable
2,4-D Dimethylamine (DMA) Salt (PC Code: 030019)							
Waterflea (<i>Daphnia magna</i>)	51.1 (TEP)	774.5	642.8	NA	Practically non-toxic	232630, Vilkas, A.G., 1977.	Acceptable
Waterflea (<i>Daphnia magna</i>)	67.3	184	153	NA	Practically non-toxic	411583-11	Acceptable
2,4-D Isoproylamine (IPA) (PC Code: 030025)							
Waterflea (<i>Daphnia magna</i>)	48.7	583	461	NA	Practically non-toxic	00138869, Alexander et. al., 1983.	Acceptable
2,4-D Triisopropanolamine (TIPA) Salt (PC Code: 030035)							
Waterflea (<i>Daphnia magna</i>)	69.2	630	340.2	measured	Practically non-toxic	413538-05, Mayes, 1989	Acceptable
2,4-D Butoxyethyl (BEE) Ester (PC code: 030053)							

Table F-4. Acute freshwater invertebrate toxicity to 2,4-D							
Species	% ai	96-hour LC50 (95% CI)		Measured/ Nominal Test Concentrations	Toxicity Category (based on ae)	MRID No. Author/Year	Study Classification
		(mg ai/L)	(mg ae/L)				
Waterflea (<i>Daphnia magna</i>)	97.4	7.2	4.97	measured	Moderately toxic	413538-01, Alexander, et. al, 1983.	Acceptable
2,4-D 2-Ethylhexyl Ester (2-EHE) (PC code: 030063)							
Waterflea (<i>Daphnia magna</i>)	92	18	11.88	Measured	Slightly toxic	67328, Kuc, W.J., 1977.	Acceptable
Waterflea (<i>Daphnia magna</i>)	96.2	5.2	3.4	measured	Moderately toxic	411583-06, Alexander, et. al., 1983.	Acceptable
2,4-D Isopropyl Ester (IPE) (PC code: 030066)							
Waterflea (<i>Daphnia magna</i>)	98.2	2.6	2.2	Measured	Moderately toxic	439306-01, Drottar, et.al., 1996.	Acceptable
NA = Not available							

Table F-5. Chronic (life cycle) freshwater invertebrate toxicity to 2,4-D						
Species	% ai	Toxicity Value (mg ae/L)		Most sensitive endpoint	MRID No. Author/Year	Study Classification
		NOAEC	LOAEC			
2,4-D acid (PC Code: 030001)*						
Waterflea (<i>Daphnia magna</i>)	91.3	79	151	No of young	418352-11, Ward T.J. et.al., 1991	Acceptable
2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)*						
Waterflea (<i>Daphnia magna</i>)	73.8	16.05	25.64	Survival & Reproduction	420183-03, Holmes, et. al., 1991	Acceptable
2,4-D Dimethylamine (DMA)Salt (PC Code: 030019)*						
Waterflea (<i>Daphnia magna</i>)	66.8	LC50=75.7	N/A	Survival (NOAEC not established)	418352-10, Ward, S. C., 1991.	Supplemental
2,4-D Butoxyethyl (BEE) Ester (030053)*						
Waterflea (<i>Daphnia magna</i>)	96	LC50>0.869 NOAEC = 0.20	0.483	Survival and reproduction	413538-02, Gersich, et. al.,, 1989.	Acceptable

* No full life cycle freshwater invertebrate studies using forms of 2,4-D other than acid, DEA, DMA, and BEE were submitted to the Agency.

Table F-6. Acute freshwater amphibian toxicity to 2,4-D							
Species	% ai	96-hour LC50 (95% CI)		Measured/ Nominal Test Concentrations	Toxicity Category (based on ae)	MRID No. Author/Year	Study Classification
		(mg ai/L)	(mg ae/L)				
2,4-D acid (PC Code: 030001)*							
Leopard frog tadpoles (<i>Rana pipiens</i>)	97.5	359	359	Measured	Practically non-toxic	445173-07, Palmer, S.J. et. al., 1997.	Supplemental
2,4-D Dimethylamine (DMA) Salt (PC Code: 030019)*							
Leopard frog tadpoles (<i>Rana pipiens</i>)	67.3	337	278	Measured	Practically non-toxic	445173-06, Palmer, S.J. et. al., 1997.	Supplemental

* No acute freshwater amphibian studies using forms of 2,4-D other than acid and DMA were submitted to the Agency.

Table F-7. Non-vascular aquatic plant toxicity to 2,4-D (Tier 1 studies)						
Species	% ai	Tested Concentration		Percent Response (inhibition)	MRID No. Author/Year	Study Classification
		(mg ai/L)	(mg ae/L)			
2,4-D acid (PC Code: 030001)*						
Green algae <i>Selenastrum capricornutum</i>	96.1	26.4	26.4	24	414200-01, Hughes, 1990	Acceptable
Blue-green algae <i>Anabaena flos-aquae</i>	96.9	>2.02	>2.02	0.488	433079-01, Hughes, 1994	Acceptable
Freshwater diatom <i>Navicula pelliculosa</i>	96.9	>2.13	>2.13	24	433079-02, Hughes, 1990	Acceptable
Marine diatom <i>Skeletonema costatum</i>	96.9	2.08	2.08	-10	433079-03, Hughes, 1990	Acceptable
2,4-D Isopropyl Ester (IPE) (PC code: 030066)*						
Green algae <i>Selenastrum capricornutum</i>	98.2		0.13	-11 %	437680-01, Hughes, et. al., 1995.	Acceptable

* No Tier I non-vascular aquatic plant studies using forms of 2,4-D other than acid and IPA were submitted to the Agency.

Table F-8. Non-vascular aquatic plant toxicity to 2,4-D (Tier II studies)					
Species	% ai	EC50 / NOAEC		MRID No. Author/Year	Study Classification
		(mg ai/L)	(mg ae/L)		
2,4-D acid (PC Code: 030001)					
No data					
2,4-D Sodium Salt (PC Code: 030004)					
No data					
2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)					
Green Algae <i>Selnastrum capricornutum</i>	73.8	11/ 0.50	7.48/ 0.34	427122-05, Thompson et. al., 1993.	Acceptable
Marine diatom <i>Skeletonema costatum</i>	73.8	>95/ 95	>64.6/ 64.6	427122-01, Thompson et. al., 1993	Acceptable
Freshwater diatom <i>Navicula pelliculosa</i>	73.8	>97/ 97	>66/ 66	427122-02, Thompson et. al., 1993.	Acceptable
Blue-green algae <i>Anabaena flos-aquae</i>	73.8	>96/ 96	>65.3/ 65.3	427122-03, Thompson et. al., 1993.	Acceptable
2,4-D Dimethylamine (DMA) Salt (PC Code: 030019)					
Green Algae <i>Selnastrum capricornutum</i>	66.7	51.2/ 19.2	42.5/ 16	414200-02, Hughes, J.sS, 1990.	Acceptable
Marine diatom <i>Skeletonema costatum</i>	66.7	148.5/ 96.25	123.3/ 79.89	415059-01, Hughes, J.sS, 1990.	Acceptable
Freshwater diatom <i>Navicula pelliculosa</i>	66.7	4.67/ 1.70	3.88/ 1.41	415059-03, Hughes, J.S., 1990.	Acceptable
Blue-green algae <i>Anabaena flos-aquae</i>	66.7	188.5/ 67.86	156.5/ 56.32	415059-02, Hughes, J.S., 1990.	Acceptable

Table F-8. Non-vascular aquatic plant toxicity to 2,4-D (Tier II studies)					
Species	% ai	EC50 / NOAEC		MRID No. Author/Year	Study Classification
		(mg ai/L)	(mg ae/L)		
2,4-D Isoproylamine (IPA) (PC Code: 030025)					
Green Algae <i>Selenastrum capricornutum</i>	51.3	43.4/ 13.9	34.29/ 10.98	417321-02, Hughes, J.S., 1990.	Acceptable
2,4-D Triisopropanolamine (TIPA) Salt (PC Code: 030035)					
Green Algae <i>Selenastrum capricornutum</i>	73.8	75.7 55.4	40.88/ 29.92	417321-01, Hughes, J.S., 1990.	Acceptable
Marine diatom <i>Skeletonema costatum</i>	70.9	79.7 50.4	38.29/	434886-03, Hughes, et. al., 1994	Acceptable
Freshwater diatom <i>Navicula pelliculosa</i>	70.9	94.4 5.35	50.98/ 2.89	434886-01, Hughes, et. al., 1994.	Acceptable
Blue-green algae <i>Anabaena flos-aquae</i>	70.9	133 47.9	71.82/ 25.87	434886-04, Hughes, et. al., 1994.	Acceptable
2,4-D Butoxyethyl (BEE) Ester (PC code: 030053)					
Green Algae <i>Selenastrum capricornutum</i>	96	24.9/ 12.5	17.14/ 8.6	431882-01, Hughes, J.S., 1990.	Acceptable
Marine diatom <i>Skeletonema costatum</i>	96	1.48/ 0.78	1.02/ 0.538	42-684-04, Hughes,J.S., 1990.	Acceptable
Freshwater diatom <i>Navicula pelliculosa</i>	96	1.86/ 0.86	1.28/ 0.59	420684-03, Hughes, J.S., 1990	Acceptable
Blue-green algae <i>Anabaena flos-aquae</i>	96	6.37/ 3.14	4.4/ 2.2	420684-03, Hughes, J.S., 1990.	Acceptable
2,4-D 2-Ethylhexyl Ester (2-EHE) (PC code: 030063)					

Table F-8. Non-vascular aquatic plant toxicity to 2,4-D (Tier II studies)					
Species	% ai	EC50 / NOAEC		MRID No. Author/Year	Study Classification
		(mg ai/L)	(mg ae/L)		
Green algae <i>Selenastrum capricornutum</i>	94.7 (62.8 a. eq.)	>30 / 3.75	19.8/ 2.48	417352-06, Hughes, J.S., 1990.	Acceptable
Marine diatom <i>Skeletonema costatum</i>	94.7 (62.8 a. eq.)	0.10 / 0.0938	0.066/ 0.062	417352-04, Hughes, J.S., 1990.	Acceptable
Freshwater diatom <i>Navicula pelliculosa</i>	94.7 (62.8 a. eq.)	1.9 / 1.875	1.25/ 1.24	417352-05, Hughes, J.S., 1990.	Acceptable
Blue-green algae <i>Anabaena flos-aquae</i>	94.7 (62.8 a. eq.)	>0.32 / 0.32	>0.21/ 0.21	417352-02, Hughes, J.S., 1990.	Acceptable
2,4-D Isopropyl Ester (IPE) (PC code: 030066)					
No data					

Table F-9. Vascular aquatic plant toxicity to 2,4-D (Tier II studies)					
Species	% ai	EC50 / NOAEC		MRID No. Author/Year	Study Classification
		(mg ai/L)	(mg ae/L)		
2,4-D acid (PC Code: 030001)					
Duckweed , <i>Lemna gibba</i>	96.2	0.695 / 0.0581	0.695 / 0.0581	442951-01, Hughes et al, 1997	Acceptable
2,4-D Sodium Salt (PC Code: 030004)					
No data					
2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)					
Duckweed , <i>Lemna gibba</i>	73.8	0.44/ 0.07	0.2992/ 0.0476	427122-04, Thompson et. al., 1993.	Acceptable
2,4-D Dimethylamine (DMA) Salt (PC Code: 030019)					
Duckweed , <i>Lemna gibba</i>	66.7	0.58/ 0.27	0.48/ 0.23	415059-04, Hughes, J.S., 1990.	Acceptable
2,4-D Isoproylamine (IPA) (PC Code: 030025)					
No data					
2,4-D Triisopropanolamine (TIPA) Salt (PC Code: 030035)					
Duckweed , <i>Lemna gibba</i>	70.9	2.37/ 2.38	1.28/ 1.28	434886-02, Hughes, et. al., 1994.	Acceptable
2,4-D Butoxyethyl (BEE) Ester (PC code: 030053)					
Duckweed, <i>Lemna gibba</i>	96	0.576/ 0.204	0.3974/ 0.141	4206884-02, Hughes, J.S., 1990.	Acceptable
2,4-D 2-Ethylhexyl Ester (2-EHE) (PC code: 030063)					
Duckweed , <i>Lemna gibba</i>	94.7	0.50 / <0.0938	0.33/ 0.062	417352-03, Hughes, J.S., 1990.	Acceptable
2,4-D Isopropyl Ester (IPE) (PC code: 030066)					
No data					

Table F-10. Acute bird toxicity (gavage) to 2,4-D						
Species	% ai	LD50		Toxicity Category (based on ae)	MRID No. Author/Year	Study Classification
		(mg ai/kg- bwt)	(mg ae/kg- bwt)			
2,4-D acid (PC Code: 030001)						
Mallard duck (<i>Anas platyrhynchos</i>)	96.1	>5620	>5620	Practically non-toxic	415462-02, Culotta et.al., 1990	Acceptable
2,4-D Sodium Salt (PC Code: 030004)						
No data						
2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)						
Northern bobwhite quail (<i>Colinus virginianus</i>)	73.1	595	404.6	Moderately toxic	419751-01, Cambell, et. al, 1991.	Acceptable
2,4-D Dimethylamine (DMA) Salt (PC Code: 030019)						
Northern bobwhite quail (<i>Colinus virginianus</i>)	66.8	500	415	Moderately toxic	415462-01, Hoxter et. all., 1990.	Acceptable
Mallard duck (<i>Anas platyrhynchos</i>)	100	>4640	>3851.2	Practically non-toxic	233351, Fink, R., 1978	Acceptable
2,4-D Isoproylamine (IPA) (PC Code: 030025)						
Mallard duck (<i>Anas platyrhynchos</i>)	48.7	>398	>314.4	Moderately toxic	00138871, Beavers, et. al., 1983,	Supplemental
Northern bobwhite quail (<i>Colinus virginianus</i>)	49%	377	298	Moderately toxic	442757-01 Beavers 1985	Acceptable
2,4-D Triisopropanolamine (TIPA) Salt (PC Code: 030035)						
Northern bobwhite quail (<i>Colinus virginianus</i>)	70.4	>405	>218.7	Moderately toxic	416444-01, Hoxter, K.A., 1990.	Acceptable
2,4-D Butoxyethyl (BEE) Ester (PC code: 030053)						

Table F-10. Acute bird toxicity (gavage) to 2,4-D						
Species	% ai	LD50		Toxicity Category (based on ae)	MRID No. Author/Year	Study Classification
		(mg ai/kg- bwt)	(mg ae/kg- bwt)			
Northern bobwhite quail (<i>Colinus virginianus</i>)	96	>2000	>1380	Slightly toxic	414541-01, Lloyd, D., 1989.	Acceptable
2,4-D 2-Ethylhexyl Ester (2-EHE) (PC code: 030063)						
Northern bobwhite quail (<i>Colinus virginianus</i>)	96.2	633	417.78	Moderately toxic	411583-03, Beavers, J.B., 1984.	Acceptable
Mallard duck (<i>Anas platyrhynchos</i>)	92	.>3000	>1980	Slightly toxic	72472, Fink, R., 1976.	Acceptable
Mallard duck (<i>Anas platyrhynchos</i>)	92	.>4640	>3062	Practically non-toxic	226397, Fink, R., 1976.	Acceptable
2,4-D Isopropyl Ester (IPE) (PC code: 030066)						
Northern bobwhite quail (<i>Colinus virginianus</i>)	98.2	1879	1578	Slightly toxic	439350-01, Palmer, et. al., 1996.	Acceptable

Table F-11. Acute bird toxicity (dietary) to 2,4-D						
Species	% ai	LD50		Toxicity Category (based on ae)	MRID No. Author/Year	Study Classification
		(mg ai/kg- diet)	(mg ae/kg- diet)			
2,4-D acid (PC Code: 030001)						
Northern bobwhite quail (<i>Colinus virginianus</i>)	96.1	>5620	>5620	Practically nontoxic	415861-01, Culotta J., 1989.	Acceptable
Mallard duck (<i>Anas platyrhynchos</i>)	96.1	>5620	>5620	Practically non-toxic	415462-02, Culotta et.al., 1990	Acceptable
2,4-D Sodium Salt (PC Code: 030004)						
No data						
2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)						
Northern bobwhite quail (<i>Colinus virginianus</i>)	73.1	>5620	>3821.6	Slightly toxic	419751-02, Hoxter, et. al., 1991.	Acceptable
Mallard duck (<i>Anas platyrhynchos</i>)	73.1	>5620	>3820.6	Slightly toxic	419751-03, Hoxter, et. al., 1991.	Acceptable
2,4-D Dimethylamine (DMA) Salt (PC Code: 030019)						
Northern bobwhite quail (<i>Colinus virginianus</i>)	66.8	>5620	>4665	Slightly toxic	417495-01, Long, et. al., 1990.	Acceptable
Northern bobwhite quail (<i>Colinus virginianus</i>)	100	>10,000	>8300	Practically non-toxic	233351, Fink, R., 1978.	Acceptable
Mallard duck (<i>Anas platyrhynchos</i>)	66.8	>5620	>4665	Slightly toxic	417495-02, Long, et. al., 1990.	Acceptable
2,4-D Isoproylamine (IPA) (PC Code: 030025)						
Northern bobwhite quail (<i>Colinus virginianus</i>)	48.7	>5620	>4440	Slightly toxic	00138870, Beavers, J.B., 1983.	Acceptable

Table F-11. Acute bird toxicity (dietary) to 2,4-D						
Species	% ai	LD50		Toxicity Category (based on ae)	MRID No. Author/Year	Study Classification
		(mg ai/kg- diet)	(mg ae/kg- diet)			
Mallard duck (<i>Anas platyrhynchos</i>)	48.7	>5620	>4440	Slightly toxic	00138872, Beavers, J.B., 1983.	Acceptable
2,4-D Triisopropanolamine (TIPA) Salt (PC Code: 030035)						
Northern bobwhite quail (<i>Colinus virginianus</i>)	70.4	>5620	>3035	Slightly toxic	416444-02, Driscoll, et., al. 1990.	Acceptable
Mallard duck (<i>Anas platyrhynchos</i>)	70.4	>5620	>3035	Slightly toxic	416444-03, Driscoll, et., al. 1990.	Acceptable
2,4-D Butoxyethyl (BEE) Ester (PC code: 030053)						
Northern bobwhite quail (<i>Colinus virginianus</i>)	96	>5620	>3878	Slightly toxic	414484-01, Grimes, J., 1989.	Acceptable
Mallard duck (<i>Anas platyrhynchos</i>)	96	>5620	>3866	Slightly toxic	414290-07, Grimes, J., 1989.	Acceptable
2,4-D 2-Ethylhexyl Ester (2-EHE) (PC code: 030063)						
Northern bobwhite quail (<i>Colinus virginianus</i>)	96	>5620	>3878	Slightly toxic	414484-01, Grimes, J., 1989.	Acceptable
Mallard duck (<i>Anas platyrhynchos</i>)	96	>5620	>3866	Slightly toxic	414290-07, Grimes, J., 1989.	Acceptable
2,4-D Isopropyl Ester (IPE) (PC code: 030066)						
Northern bobwhite quail (<i>Colinus virginianus</i>)	98.2	>5456	>4583	Slightly toxic	439349-01, Palmer, et. al., 1996.	Acceptable
Mallard duck (<i>Anas platyrhynchos</i>)	98.2	>5218	>4383	Slightly toxic	439352-01, Palmer, et. al., 1996.	Acceptable

Table F-12. Chronic bird toxicity (reproductive) to 2,4-D						
Species	% ai	NOAEC / LOAEC		Most sensitive endpoints	MRID No. Author/Year	Study Classification
		(mg ai/kg-diet)	(mg ae/kg-diet)			
2,4-D acid (PC Code: 030001) *						
Northern bobwhite quail (<i>Colinus virginianus</i>)	96.9	962/>962	962/>962	No effects	415861-01, Culotta J., 1989.	Acceptable

* No avian reproduction studies using forms of 2,4-D other than the acid were submitted to the Agency.

Table F-13. Acute mammal toxicity (gavage) to 2,4-D						
Species	% ai	LD ₅₀ (mg ae/kg- bwt) ¹	Toxicity Category (based on ae)	MRID No.	Study Classification ²	Comments
2,4-D acid (PC Code: 030001)						
Laboratory rat (<i>Rattus norvegicus</i>)	NA	699	Slightly toxic	00101605	Acceptable	
2,4-D Sodium Salt (PC Code: 030004)						
No data						
2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)						
Laboratory rat (<i>Rattus norvegicus</i>)	100% (assumed by study author)	619	Slightly toxic	41920901	Acceptable	Study author assumed test material was 100% DEA salt, dose listed in terms of test material administered.
2,4-D Dimethylamine (DMA) Salt (PC Code: 030019)						
Laboratory rat (<i>Rattus norvegicus</i>)	57.9% a.e.	>579	Slightly toxic	00157512	Acceptable	Chemical analysis confirmed 57.9% a.e., administered dose listed in terms of test material (an end-use product), total mortality at highest dose was 4/12 (no other mortality)
2,4-D Isopropylamine (IPA) Salt (PC Code: 030025)						
Laboratory rat (<i>Rattus norvegicus</i>)	39.4% a.e.	747	Slightly toxic	00252291	Acceptable	Administered dose listed in terms of test material (technical), technical label indicated 39.4% a.e.
2,4-D Triisopropanolamine (TIPA) Salt (PC Code: 030035)						

Table F-13. Acute mammal toxicity (gavage) to 2,4-D						
Species	% ai	LD₅₀ (mg ae/kg- bwt)¹	Toxicity Category (based on ae)	MRID No.	Study Classification²	Comments
Laboratory rat (<i>Rattus norvegicus</i>)	37.7% a.e.	441	Slightly toxic	41413501	Acceptable	Administered dose listed in terms of test material. Study author stated test material was 37.7% ae.
2,4-D Butoxyethyl (BEE) Ester (PC code: 030053)						
Laboratory rat (<i>Rattus norvegicus</i>)	NA	573	Slightly toxic	40629801	Acceptable	Administered dose listed in terms of test material, chemical analysis confirmed 66.1% ae
2,4-D 2-Ethylhexyl Ester (EHE) (PC code: 030063)						
Laboratory rat (<i>Rattus norvegicus</i>)	NA	NA	NA	41209001	Acceptable	Study conducted using end-use product EPA Reg. 34704-607. Label stated product contained 33.18% 2,4-D EHE and 32.52% 2,4-DP EHE (PCcode 31464). Because this product is a mixture, it will not be considered.
2,4-D Isopropyl Ester (IPE) (PC code: 030066)						
Laboratory rat (<i>Rattus norvegicus</i>)	37% a.e.	458	Slightly toxic	41709901	Acceptable	Administered dose listed in terms of test material, material was an end-use product, EPA Reg. 400-444. Label stated material 37% ae.

Table F-13. Acute mammal toxicity (gavage) to 2,4-D						
Species	% ai	LD ₅₀ (mg ae/kg-bwt) ¹	Toxicity Category (based on ae)	MRID No.	Study Classification ²	Comments
¹ All LD ₅₀ s were calculated by EFED using data provided in the original study reports. Clarifications regarding the calculations are made in the “Comments” column. ² Classifications determined by HED.						

Table F-14. Chronic mammalian toxicity (reproductive) to 2,4-D							
Species	% ai	Endpoint (mg ae/kg-bwt/day)			Affected parameters (most sensitive)	MRID No.	Study Classification
			NOAEL	LOAEL			
2,4-D acid (PC Code: 030001) *							
Laboratory rat (<i>Rattus norvegicus</i>)		Parental	Target =5 Actual (3.5-13.5)	Target =20 Actual (14-48)	Decreased female body wt gain(F1) and male renal tubule alteration (F0 and F1)	00150557; 00163996	Acceptable, determined by HED
		Reproductive	Target =20 Actual (18-35)	Target =80 Actual (69-114)	increase in gestation length		
		Offspring	Target =5 Actual (7.2-13.5)	Target =20 Actual (26-48)	decreased pup body weight; increase in pup deaths at 80 mg ae/kg-bwt/day		

* No mammalian reproduction studies using forms of 2,4-D other than the acid were submitted to the Agency.

Table F-15. Acute honey bee toxicity (contact) to 2,4-D						
Species	% ai	96-hour LD50 (95% CI)		Toxicity Category (based on ae)	MRID No. Author/Year	Study Classification
		(µg ai/bee)	(µg ae/bee)			
2,4-D Dimethylamine (DMA) Salt (PC Code: 030019) *						
Honey bee (Apis mellifera)	67.3	>100	>83	Practically non-toxic	445173-04, Palmer S. et al., 1997	Acceptable
2,4-D 2-Ethylhexyl Ester (2-EHE) (PC code: 030063) *						
Honey bee (Apis mellifera)	96.96	>100	>66	Practically non-toxic	445173-01, Palmer S. et al., 1997	Acceptable

* No contact honey bee studies using forms of 2,4-D other than DMAS and EHE were submitted to the Agency.

Table F-16. Terrestrial plant toxicity (seedling emergence, most sensitive monocot) to 2,4-D - all available forms, technical only					
Species	% ai	EC25 (lbs ae/acre)	Most sensitive endpoint	MRID No. Author/Year	Study Classification
2,4-D acid (PC Code: 030001)					
Onion and sorghum	96.7	2.1	Fresh weight	424168-02, Backus, 1992	Acceptable
2,4-D Sodium Salt (PC Code: 030004)					
No data					
2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)					
Onion	50.2	0.38	Fresh weight	426091-01, Backus, 1992	Acceptable
2,4-D Dimethylamine (DMA) Salt (PC Code: 030019)					
Sorghum	55.5	0.026	Fresh weight	423895-01, Backus, 1992	Acceptable
2,4-D Isopropylamine (IPA) Salt (PC Code: 030025)					
No data					
2,4-D Triisopropanolamine (TIPA) Salt (PC Code: 030035)					
No data					
2,4-D Butoxyethyl (BEE) Ester (PC code: 030053)					
Onion	65.6	0.36	Survival	431970-01, Narnish, 1994	Supplemental
2,4-D 2-Ethylhexyl Ester (2-EHE) (PC code: 030063)					
Onion	63.5	0.218	Fresh shoot weight	435269-01, Backus, 1995	Acceptable
2,4-D Isopropyl Ester (IPE) (PC code: 030066)					
Onion	98.2	0.010	Shoot length	439821-01, Hoberg, 1996	Acceptable

Table F-17. Terrestrial plant toxicity (seedling emergence, most sensitive dicots) to 2,4-D - all available forms, technical only					
Species	% ai	EC25 (lbs ae/acre)	Most sensitive endpoint	MRID No. Author/Year	Study Classification
2,4-D acid (PC Code: 030001)					
Mustard	96.7	0.033	Fresh weight	424168-02, Backus, 1992	Acceptable
2,4-D Sodium Salt (PC Code: 030004)					
No data					
2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)					
Mustard	50.2	0.045	Fresh weight	426091-01, Backus, 1992	Acceptable
2,4-D Dimethylamine (DMA) Salt (PC Code: 030019)					
Mustard	55.5	0.00953	Fresh weight	423895-01, Backus, 1992	Acceptable
2,4-D Isoproylamine (IPA) Salt (PC Code: 030025)					
No data					
2,4-D Triisopropanolamine (TIPA) Salt (PC Code: 030035)					
No data					
2,4-D Butoxyethyl (BEE) Ester (PC code: 030053)					
Tomato	65.6	0.05	Dry weight	431970-01, Narnish, 1994	Supplemental
2,4-D 2-Ethylhexyl Ester (2-EHE) (PC code: 030063)					
Radish	63.5	0.037	Fresh shoot weight	424492-01, Backus, 1992	Acceptable
2,4-D Isopropyl Ester (IPE) (PC code: 030066)					
Lettuce	98.2	0.00081	Shoot length	439821-01, Hoberg, 1996	Supplemental

Table F-18. Terrestrial plant toxicity (vegetative vigor, most sensitive monocot) to 2,4-D - all available forms, technical only					
Species	% ai	EC25 (lbs ae/acre)	Most sensitive endpoint	MRID No. Author/Year	Study Classification
2,4-D acid (PC Code: 030001)					
Onion	96.7	<0.0075	Fresh weight	424168-01, Backus, 1991	Acceptable
2,4-D Sodium Salt (PC Code: 030004)					
No data					
2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)					
Onion	50.2	0.04	Fresh weight	426091-02 Backus 1992	Acceptable
2,4-D Dimethylamine (DMA) Salt (PC Code: 030019)					
No data					
2,4-D Isoproylamine (IPA) Salt (PC Code: 030025)					
No data					
2,4-D Triisopropanolamine (TIPA) Salt (PC Code: 030035)					
No data					
2,4-D Butoxyethyl (BEE) Ester (PC code: 030053)					
Onion	65.6	0.19	Dry weight	430671-03, Narnish, 1993	Supplemental
2,4-D 2-Ethylhexyl Ester (2-EHE) (PC code: 030063)					
Sorghum	63.5	0.218	Fresh weight	423439-02, Backus, 1992	Acceptable
2,4-D Isopropyl Ester (IPE) (PC code: 030066)					
Corn	82.7	0.2016	Shoot weight	437882-01, Hoberg, 1995	Acceptable

Table F-19. Terrestrial plant toxicity (vegetative vigor, most sensitive dicots) to 2,4-D - all available forms, technical only					
Species	% ai	EC25 (lbs ae/acre)	Most sensitive endpoint	MRID No. Author/Year	Study Classification
2,4-D acid (PC Code: 030001)					
Tomato	96.7	0.0075	Fresh weight	424168-01, Backus, 1991	Acceptable
2,4-D Sodium Salt (PC Code: 030004)					
No data					
2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)					
Tomato	50.2	0.003	Fresh weight	426091-02 Backus, 1992	Acceptable
2,4-D Dimethylamine (DMA) Salt (PC Code: 030019)					
No data					
2,4-D Isopropylamine (IPA) Salt (PC Code: 030025)					
No data					
2,4-D Triisopropanolamine (TIPA) Salt (PC Code: 030035)					
No data					
2,4-D Butoxyethyl (BEE) Ester (PC code: 030053)					
Radish	65.6	0.02	survival	430671-03, Narnish, 1993	Supplemental
2,4-D 2-Ethylhexyl Ester (2-EHE) (PC code: 030063)					
Soybean	63.5	0.02	Fresh weight	423439-02, Backus, 1992	Acceptable
2,4-D Isopropyl Ester (IPE) (PC code: 030066)					
Radish	82.7	0.0042	Root weight	437882-01, Hoberg, 1995	Acceptable

Table F-20. Summary of seedling emergence study conducted with Gordon's Amine 4000 2,4-D Weed Killer, a TEP of 2,4-D DMAS¹

Species	Most sensitive Endpoint	Value (lbs ae/acre)			
		NOAEC	EC ₀₅	EC ₂₅	EC ₅₀
Corn	Plant Height	4.0	2.4	>4.0	>4.0
Onion	Dry Weight	0.091	<0.0014	0.097	>0.35
Ryegrass	Plant Height	4.0	2.2	>4.0	>4.0
Wheat	Dry Weight	0.35	0.0054	0.20	>0.35
Cabbage	Dry Weight	0.020	0.010	0.043	0.12
Lettuce	Dry Weight	0.020	0.0054	0.026	0.078
Radish	Dry Weight	0.020	0.0087	0.033	0.082
Soybean	Dry Weight	0.26	<0.26	0.37	1.2
Tomato	None	0.34	N.D.	>0.34	>0.34
Turnip	Dry Weight	0.020	0.035	0.13	0.34

¹ MRID 471060-01, Porch et al. 2006, 39.21%ai, Acceptable

Table F-21. Summary of vegetative vigor study conducted with Gordon's Amine 4000 2,4-D Weed Killer, a TEP of 2,4-D DMAS¹

Species	Most sensitive Endpoint	Value (lbs ae/acre)			
		NOAEC	EC ₀₅	EC ₂₅	EC ₅₀
Onion	Dry Weight	0.0335	0.034	0.14	0.37
Ryegrass	Dry Weight	2.07	1.0	>2.07	>2.07
Wheat	Dry Weight	0.133	0.32	1.1	>2.03
Cabbage	Dry Weight	0.0981	0.079	0.18	0.31
Lettuce	Dry Weight	0.0017	<0.0017	0.0038	0.015
Radish	Dry Weight	0.0016	<0.0016	0.0012	>0.0266
Soybean	Dry Weight	0.0072	0.0093	0.039	>0.0998
Tomato	Dry Weight	0.0016	0.0018	0.0074	0.020
Turnip	Dry Weight	0.0015	<0.0015	0.011	0.065

¹ MRID 471060-02, Porch et al. 2006, 39.21%ai, Acceptable

Table F-22. Summary of seedling emergence study conducted with Gordon's LV400 2,4-D Weed Killer, a TEP of 2,4-D EHE¹					
Species	Most sensitive Endpoint	Value (lbs ae/acre)			
		NOAEC	EC₀₅	EC₂₅	EC₅₀
Corn	Dry Weight	1.9	1.7	3.4	>3.8
Onion	Plant height	0.019	0.047	0.17	>0.34
Ryegrass	Dry Weight	0.26	<0.26	0.27	2.8
Wheat	None	4.0	<0.26	>4.0	>4.0
Cabbage	Dry Weight	0.0015	0.0056	0.021	0.053
Lettuce	Dry Weight	0.0058	0.0061	0.018	0.039
Radish	Dry Weight	0.0058	0.0061	0.036	0.12
Soybean	Dry Weight	0.47	<0.25	0.85	2.3
Tomato	Dry Weight	0.0058	<0.0015	0.012	0.29
Turnip	Dry Weight	0.0058	0.021	0.062	0.13
¹ MRID 471060-03, Porch et al. 2006, 44.9%ai, Acceptable					

Table F-23. Summary of vegetative vigor study conducted with Gordon's LV400 2,4-D Weed Killer, a TEP of 2,4-D EHE¹					
Species	Most sensitive Endpoint	Value (lbs ae/acre)			
		NOAEC	EC₀₅	EC₂₅	EC₅₀
Corn	Dry Weight	0.0289	<0.00803	0.17	1.6
Onion	Dry Weight	0.0254	0.025	0.088	0.21
Ryegrass	None	2.03	N.D.	>2.03	>2.03
Wheat	Dry Weight	0.0356	0.043	0.34	1.4
Cabbage	Dry Weight	0.00167	0.012	0.027	0.047
Lettuce	Dry Weight	0.00167	<0.00167	0.0021	0.0076
Radish	Survival	0.00527	0.0026	0.0068	0.013
Soybean	Dry Weight	0.0259	0.014	0.058	>0.0992
Tomato	Dry Weight	<0.00134	<0.00134	0.0044	0.016
Turnip	Dry Weight	<0.00134	<0.00134	0.0021	0.042
¹ MRID 471060-04, Porch et al. 2006, 44.9%ai, Acceptable					