Ecological Soil Screening Levels for Dieldrin

Interim Final

OSWER Directive 9285.7-56

U.S. Environmental Protection Agency
Office of Solid Waste and Emergency Response
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

March 2005
Revised April 2007

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1.0 INTRODUCTION

Ecological Soil Screening Levels (Eco-SSLs) are concentrations of contaminants in soil that are protective of ecological receptors that commonly come into contact with and/or consume biota that live in or on soil. Eco-SSLs are derived separately for four groups of ecological receptors: plants, soil invertebrates, birds, and mammals. As such, these values are presumed to provide adequate protection of terrestrial ecosystems. Eco-SSLs are derived to be protective of the conservative end of the exposure and effects species distribution, and are intended to be applied at the screening stage of an ecological risk assessment. These screening levels should be used to identify the contaminants of potential concern (COPCs) that require further evaluation in the site-specific baseline ecological risk assessment that is completed according to specific guidance (U.S. EPA, 1997, 1998, and 1999). The Eco-SSLs are not designed to be used as cleanup levels and the United States (U.S.) Environmental Protection Agency (EPA) emphasizes that it would be inappropriate to adopt or modify the intended use of these Eco-SSLs as national cleanup standards.

The detailed procedures used to derive Eco-SSL values are described in separate documentation (U.S. EPA, 2003). The derivation procedures represent the group effort of a multi-stakeholder group consisting of federal, state, consulting, industry, and academic participants led by the U.S. EPA Office of Solid Waste and Emergency Response.

This document provides the Eco-SSL values for dieldrin and the documentation for their derivation. This document provides guidance and is designed to communicate national policy on identifying dieldrin concentrations in soil that may present an unacceptable ecological risk to terrestrial receptors. The document does not, however, substitute for EPA's statutes or regulations, nor is it a regulation itself. Thus, it does not impose legally-binding requirements on EPA, states, or the regulated community, and may not apply to a particular situation based upon the circumstances of the site. EPA may change this guidance in the future, as appropriate. EPA and state personnel may use and accept other technically sound approaches, either on their own initiative, or at the suggestion of potentially responsible parties, or other interested parties. Therefore, interested parties are free to raise questions and objections about the substance of this document and the appropriateness of the application of this document to a particular situation. EPA welcomes public comments on this document at any time and may consider such comments in future revisions of this document.

2.0 SUMMARY OF ECO-SSLs FOR DIELDRIN

Aldrin (1,2,3,4,10,10-hexachloro-1,4,4",5,8,8"-exo-1,4-endo-5,8-dimethano-naphthalene or HHDN) and its epoxide derivative dieldrin (1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4",5,6,7,8,8"-octahydro-1,4-endo,exo-5,8-dimethanonaphthalene, or HEOD), are man-made chlorinated cyclodiene insecticide used extensively in the United States from the 1950s to the early 1970s. Aldrin is discussed along with dieldrin as it readily changes into dieldrin when it enters the environment. The trade names used for dieldrin included Alvit, Dieldrix, Octalox, Quintox and Red Shield (ATSDR, 2002).

Aldrin and dieldrin were used primarily for the control of termites around buildings, corn pests by application to soil and in the citrus industry (U.S. EPA, 1980). Other uses included crop protection from insects, timber preservation and termite-proofing of plastic and rubber coverings of electrical and telecommunication cables and of plywood and building boards (Worthing and Walker, 1983). The U.S. Department of agriculture canceled all uses of aldrin and dieldrin in 1970. In 1972, however, EPA approved aldrin and dieldrin for use in three instances: 1) subsurface ground insertion for termite control; 2) dipping of non-food plant roots and tops; and 3) moth-proofing in manufacturing processes using completely closed systems (U.S. EPA, 1980 and 1986). Use for termite control continued until 1987 when the manufacturer voluntarily canceled the registration for use in controlling termites. Manufacture in the U.S. ceased in 1989 (ATSDR, 2002).

Dieldrin in the soil environment has low to no mobility. Dieldrin is nonpolar, has a strong affinity for organic matter and sorbs tightly to soil particles. Volatilization is the principal loss process but is slow due to its low vapor pressure and strong sorption. Dieldrin degrades slowly in soil surfaces with a reported half-life of about 7 years in field studies. Dieldrin (and aldrin) applied to soil may also under degradation by ultraviolet light to form photodieldrin and this reaction may also occur as a result of microbial activity. In soil, aldrin is converted to dieldrin by epoxidation (ATSDR, 2002).

Dieldrin bioaccumulates in both terrestrial and aquatic systems. As both plants and animals metabolize aldrin to dieldrin via epoxidation, significant levels of aldrin are seldom found in biological matrices. Therefore, most studies focus on dieldrin rather than aldrin. In plants, dieldrin is accumulated primarily in the roots with aerial parts containing smaller concentrations (ATSDR, 2002). In terrestrial organisms, accumulation of dieldrin in fat tissues is known to increase with increasing trophic level of the organism with predators at the top of the food chain tending to have the highest exposure and greatest risk (HSDB).

In mammals, dieldrin is accumulated in adipose tissue, liver and brain. The neurotoxicity of dieldrin to the central nervous system (CNS) is well documented. CNS manifestations originate in neural synapses. Dieldrin prevents the action of the neurotransmitter gamma-aminobutyric acid (GABA) by binding to the picrotoxin binding site of the GABA-receptor-ionophore complex (Matsurmura and Giashudding, 1983). GABA is secreted only by nerve terminals in the spinal cord, the cerebellum, the basal ganglia, the retina, and areas of the cortex. It is thought to cause inhibition of neurotransmission by binding the complex and creating a structural alteration preventing influx of Cl- and repolarization of the membrane (Bloomquist and Soderlund, 1985). Basal ganglia innervation by GABA neurons originating from the cortex provide inhibitory input. GABA, therefore, lends stability to motor control systems (Guyton 1991). Without the inhibitory effect of the GABA transmitter, there is uncontrolled motor stimulation leading to convulsions and other CNS manifestations of dieldrin. In mammals, clinical signs of toxicity include depressed activity, followed by hyperexcitability, tremors and convulsions (Coats, 1990; Matsurmura and Giashudding, 1983).

Table 2.1 Dieldrin Eco-SSLs (mg/kg dry weight in soil)			
Plants	Soil Invertebrates	Wildlife	
		Avian	Mammalian
NA	NA	0.022	0.0049
NA = Not Available. Data were insufficient to derive an Eco-SSL.			

Eco-SSL values were derived for dieldrin for avian and mammalian wildlife. Eco-SSL values for dieldrin could not be derived for plants or soil invertebrates. For these receptor groups, data were insufficient to derive soil screening values. Eco-SSL values calculated for avian and mammalian wildlife are equal to 0.022 mg/kg dry weight (dw) and 0.0049 mg/kg dw, respectively.

3.0 ECO-SSL FOR TERRESTRIAL PLANTS

Of the papers identified from the literature search process, 95 were selected for acquisition for further review. Of those papers acquired, five met all 11 Study Acceptance Criteria (U.S. EPA, 2003; Attachment 3-1). Each of these papers were reviewed and the studies were scored according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 3-2). Twenty-four studies received an Evaluation Score greater than ten. These studies are listed in Table 3.1.

There were no studies that were eligible to derive an Eco-SSL according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 3-2). An Eco-SSL could not be derived for plants for dieldrin.

4.0 ECO-SSL FOR SOIL INVERTEBRATES

Of the papers identified from the literature search process, 82 papers were acquired for further review. Of those papers acquired none met all 11 Study Acceptance Criteria (U.S. EPA, 2003; Attachment 3-1). A soil invertebrate Eco-SSL could not be derived for dieldrin.

5.0 ECO-SSL FOR AVIAN WILDLIFE

The derivation of the Eco-SSL for avian wildlife was completed as two parts. First, the toxicity reference value (TRV) was derived according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-5). Second, the Eco-SSL (soil concentration) was back-calculated for each of three surrogate species based on the wildlife exposure model and the TRV (U.S. EPA, 2003).

Table 3.1 Plant Toxicity Data - Dieldrin

Reference	Study ID	Test Organism		Soil pH	OM %	Bio-availability Score	ERE	Tox Parameter	Tox Value (Soil Conc. mg/kg dw)	Total Evaluation Score	Eligible for Eco-SSL Derivation	Used for Eco-SSL	Comments*
Rajanna, B. 1977	q	Cotton	*Gossypium hirsutum*	6.6	0.85	1	GRO	NOAEC	50	14	N	N	High vigor seeds. Seedling height.
Rajanna, B. 1977	r	Soybean	*Glycine max*	6.6	0.85	1	GRO	NOAEC	50	14	N	N	High vigor seeds. Seedling height.
Rajanna, B. 1977	s	Corn	*Zea mays*	6.6	0.85	1	GRO	NOAEC	50	14	N	N	High vigor seeds. Seedling height.
Rajanna, B. 1977	t	Wheat	*Triticum aestivum*	6.6	0.85	1	GRO	NOAEC	50	14	N	N	High vigor seeds. Seedling height.
Rajanna, B. 1977	u	Cotton	*Gossypium hirsutum*	6.6	0.85	1	GRO	NOAEC	50	14	N	N	High vigor seeds. Seedling dry weight.
Rajanna, B. 1977	v	Soybean	*Glycine max*	6.6	0.85	1	GRO	NOAEC	50	14	N	N	High vigor seeds. Seedling dry weight.
Rajanna, B. 1977	w	Corn	*Zea mays*	6.6	0.85	1	GRO	NOAEC	50	14	N	N	High vigor seeds. Seedling dry weight.
Rajanna, B. 1977	x	Wheat	*Triticum aestivum*	6.6	0.85	1	GRO	NOAEC	50	14	N	N	High vigor seeds. Seedling dry weight.
Rajanna, B. 1977	a	Cotton	*Gossypium hirsutum*	6.6	0.85	1	GRO	MATC	34.6	14	N	N	Medium vigor seeds. Seedling height.
Rajanna, B. 1977	b	Soybean	*Glycine max*	6.6	0.85	1	GRO	MATC	14.1	14	N	N	Medium vigor seeds. Seedling height.
Rajanna, B. 1977	c	Corn	*Zea mays*	6.6	0.85	1	GRO	MATC	24.5	14	N	N	Medium vigor seeds. Seedling height.
Rajanna, B. 1977	d	Wheat	*Triticum aestivum*	6.6	0.85	1	GRO	MATC	34.6	14	N	N	Medium vigor seeds. Seedling height.
Rajanna, B. 1977	e	Cotton	*Gossypium hirsutum*	6.6	0.85	1	GRO	MATC	44.7	14	N	N	Medium vigor seeds. Seedling dry weight.
Rajanna, B. 1977	f	Soybean	*Glycine max*	6.6	0.85	1	GRO	MATC	34.6	14	N	N	Medium vigor seeds. Seedling dry weight.
Rajanna, B. 1977	g	Corn	*Zea mays*	6.6	0.85	1	GRO	MATC	24.5	14	N	N	Medium vigor seeds. Seedling dry weight.
Rajanna, B. 1977	h	Wheat	*Triticum aestivum*	6.6	0.85	1	GRO	MATC	7.1	14	N	N	Medium vigor seeds. Seedling dry weight.
Rajanna, B. 1977	i	Cotton	*Gossypium hirsutum*	6.6	0.85	1	GRO	MATC	34.6	14	N	N	Low vigor seeds. Seedling height.
Rajanna, B. 1977	j	Soybean	*Glycine max*	6.6	0.85	1	GRO	MATC	24.5	14	N	N	Low vigor seeds. Seedling height.
Rajanna, B. 1977	k	Corn	*Zea mays*	6.6	0.85	1	GRO	MATC	34.6	14	N	N	Low vigor seeds. Seedling height.
Rajanna, B. 1977	l	Wheat	*Triticum aestivum*	6.6	0.85	1	GRO	MATC	7.1	14	N	N	Low vigor seeds. Seedling height.
Rajanna, B. 1977	m	Cotton	*Gossypium hirsutum*	6.6	0.85	1	GRO	MATC	7.1	14	N	N	Low vigor seeds. Seedling dry weight.
Rajanna, B. 1977	n	Soybean	*Glycine max*	6.6	0.85	1	GRO	MATC	14.1	14	N	N	Low vigor seeds. Seedling dry weight.
Rajanna, B. 1977	o	Corn	*Zea mays*	6.6	0.85	1	GRO	MATC	7.1	14	N	N	Low vigor seeds. Seedling dry weight.
Rajanna, B. 1977	p	Wheat	*Triticum aestivum*	6.6	0.85	1	GRO	MATC	7.1	14	N	N	Low vigor seeds. Seedling dry weight.

ERE = Ecologically relevant endpoint
GRO = growth
LOAEC = Lowest observed adverse effect concentration
MATC = Maximum acceptable toxicant concentration. Geometric mean of NOAEC and LOAEC.
N = No
NOAEC = No observed adverse effect concentration
OM = Organic matter content
Bioavailability Score described in *Guidance for Developing Eco-SSLs* (U.S. EPA, 2003)
Total Evaluation Score described in *Guidance for Developing Eco-SSLs* (U.S. EPA, 2003)
*High vigor seeds were untreated. Medium vigor seeds were raised in moisture content to 16% stored for 15 days and then heated to 40 degrees C for two days. The Low vigor seeds were heated for five days instead of two.

5.1 Avian TRV

The literature search completed according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-2) identified 669 papers with possible toxicity data for either avian or mammalian species. Of these papers, 585 papers were rejected for use as described in Section 7.5. Of the remaining papers, 35 contained data for avian test species. These papers were reviewed and the data were extracted and scored according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-3 and 4-4). The results of the data extraction and review are summarized in Table 5.1. The complete results are included as Appendix 5-1.

Within the 36 papers there are 90 results for biochemical (BIO), behavior (BEH), physiology (PHY), pathology (PTH), reproduction (REP), growth (GRO), and survival (MOR) endpoints that meet the Data Evaluation Score of > 65 for use to derive the TRV. These data are plotted in Figure 5.1 and correspond directly with the data presented in Table 5.1. The no-observed adverse effect level (NOAEL) results for growth and reproduction are used to calculate a geometric mean NOAEL. This mean NOAEL is examined in relationship to the lowest bounded lowest-observed adverse effect level (LOAEL) for reproduction, growth, and survival to derive the TRV according to procedures in the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-5).

A geometric mean of the NOAEL values for growth is calculated at 0.889 mg dieldrin /kg bw/day. However, this value is higher than the lowest bounded LOAEL for either reproduction, growth, or survival results. Therefore, the TRV is equal to the highest bounded NOAEL lower than the lowest bounded LOAEL for reproduction, growth, and survival results and is equal to 0.0709 mg dieldrin/kg bw/day.

5.2 Estimation of Dose and Calculation of the Eco-SSL

Three separate Eco-SSL values were calculated for avian wildlife, one for each of three surrogate species representing different trophic groups. The avian Eco-SSLs were calculated according to the Eco-SSL guidance (U.S. EPA, 2003) and are summarized in Table 5.2.

Table 5.1 Avian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Dieldrin
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Result #	Reference	Ref No.	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)*	LOAEL Dose (mg/kg bw/day)*	Data Evaluation Score
Biochemical																		
1	Heinz et al., 1980	990	Ring dove (*Streptopelia risoria*)	4	M	FD	8	w	NR	NR	AD	B	HRM	DOPA	BR	0.084	0.326	76
2	Sell et al., 1971	1106	Chicken (*Gallus domesticus*)	3	U	FD	12	w	30	w	SM	F	ENZ	GENZ	LI	0.563	1.13	79
3	Davison and Sell, 1974	40	Mallard duck (*Anas platyrhynchos*)	4	U	FD	48	w	2	yr	MA	F	ENZ	AHDX	LI	0.563		68
4	Muller and Lockman, 1973	1054	Chicken (*Gallus domesticus*)	3	U	OR	28	d	7	d	JV	NR	CHM	CALC	BO	10.0		68
5	Call and Call, 1974	930	Japanese quail (*Coturnix japonica*)	5	U	FD	14	d	7	w	JV	B	CHM	LIPD	SR	10.1		67
6	Gillett and Arscott, 1969	975	Japanese quail (*Coturnix japonica*)	2	U	FD	35	d	7	d	JV	B	ENZ	AEPX	LI		0.650	74
7	Andujar et al., 1978	908	Japanese quail (*Coturnix japonica*)	2	U	FD	48	d	NR	NR	SM	F	CHM	CALC	EG		2.60	69
Behavior																		
8	Watkins et al., 1978	1151	Bobwhite quail (*Colinus virginianus*)	4	U	GV	10	d	NR	NR	AD	M	FDB	FCNS	WO	0.075		67
9	Atkins and Linder, 1967	909	Ring-necked pheasant (*Phasianus colchicus*)	4	U	OR	13	w	1-12	mo	JV	F	FDB	FCNS	WO	0.225	0.450	83
10	Atkins and Linder, 1967	909	Ring-necked pheasant (*Phasianus colchicus*)	3	U	OR	13	w	1 - 12	mo	JV	F	FDB	FCNS	WO	0.519		70
11	Gillett and Arscott, 1969	975	Japanese quail (*Coturnix japonica*)	2	U	FD	35	d	7	d	JV	B	FDB	FCNS	WO	0.650		68
12	Heinz et al., 1980	990	Ring dove (*Streptopelia risoria*)	4	M	FD	8	w	NR	NR	AD	B	FDB	FCNS	WO	1.00		74
13	Gesell et al., 1979	974	Bobwhite quail (*Colinus virginianus*)	6	U	OR	42	d	NR	NR	AD	M	BEH	NVOC	WO		0.313	72
14	Ahmed et al., 1978	904	Chicken (*Gallus domesticus*)	3	U	FD	20	w	NR	NR	SM	M	FDB	FCNS	WO		0.651	70
15	Genelly and Rudd, 1955	14919	Ring-necked pheasant (*Phasianus colchicus*)	3	U	FD	74	d	6	mo	JV	B	FDB	FCNS	WO		1.18	73
16	Genellly and Rudd, 1956	14920	Pheasant (*Phasianus colchicus*)	3	U	FD	6	mo	NR	NR	NR	F	FDB	FCNS	WO		1.18	67
17	Kreitzer and Heinz, 1974	3362	Quail (*Coturnix coturnix*)	2	U	FD	8	d	7	d	JV	NR	AVO	STIM	WO		1.36	72
Physiology																		
18	Watkins et al., 1978	1151	Bobwhite quail (*Colinus virginianus*)	4	U	GV	10	d	NR	NR	AD	M	PHY	EXCR	WO	0.0750		67
Pathology																		
19	Watkins et al., 1978	1151	Bobwhite quail (*Colinus virginianus*)	4	U	GV	10	d	NR	NR	AD	M	GRS	BDWT	WO	0.0500	0.0750	82
20	Wiese et al., 1968	1158	Crowned guinea fowl (*Numida meleagris*)	7	U	FD	21	mo	6	mo	SM	B	ORW	ORWT	LI	0.224	0.671	80
21	Heinz et al., 1980	990	Ring dove (*Streptopelia risoria*)	4	M	FD	8	w	NR	NR	AD	B	GRS	BDWT	WO	0.331	1.00	78
22	Davison and Sell, 1974	40	Mallard duck (*Anas platyrhynchos*)	4	U	FD	48	w	2	yr	MA	F	ORW	ORWT	LI	0.563		73
23	Dahlgren and Linder, 1974	1166	Pheasant (*Phasianus colchicus*)	3	U	OR	17	w	1	yr	AD	M	GRS	BDWT	WO	0.662		66
24	Brown et al., 1974	926	Chicken (*Gallus domesticus*)	3	U	FD	13	mo	6	w	JV	B	HIS	GLSN	LI	0.880		70
25	Sell et al., 1971	1106	Chicken (*Gallus domesticus*)	3	U	FD	12	w	30	w	SM	F	ORW	ORWT	LI	1.13		73
26	Nusz et al., 1976	38	Bobwhite quail (*Colinus virginianus*)	3	U	GV	10	d	NR	NR	AD	M	GRS	BDWT	WO		0.008	86
27	Nusz et al., 1976	38	Bobwhite quail (*Colinus virginianus*)	3	U	GV	10	d	NR	NR	AD	M	GRS	BDWT	WO		0.150	86
28	Jefferies and French, 1972	1010	Homing pigeon (*Columba livia*)	4	U	OR	8	w	NR	NR	NR	B	ORW	ORWT	TY		1.00	76
29	Genellly and Rudd, 1956	14920	Pheasant (*Phasianus colchicus*)	3	U	FD	6	mo	NR	NR	NR	F	GRS	BDWT	WO		1.18	73
Reproduction																		
30	Wiese et al., 1968	1158	Crowned guinea fowl (*Numida meleagris*)	7	U	FD	21	mo	6	mo	LB	F	REP	PROG	WO	0.0671	0.223	84
31	Shellenberger, 1978	1111	Japanese quail (*Coturnix japonica*)	3	U	FD	10	w	3-4	d	LB	F	REP	TPRD	WO	0.118		68
32	Atkins and Linder, 1967	909	Ring-necked pheasant (*Phasianus colchicus*)	3	U	OR	13	w	1-12	mo	JV	F	EGG	EGWT	WO	0.260	0.519	89
33	Atkins and Linder, 1967	909	Ring-necked pheasant (*Phasianus colchicus*)	4	U	OR	13	w	1-12	mo	LB	F	REP	TPRD	WO	0.450	0.675	89
34	Davison and Sell, 1974	40	Mallard duck (*Anas platyrhynchos*)	4	U	FD	48	w	2	yr	LB	F	REP	EGPN	WO	0.563		70
35	Reading et al., 1976	1092	Japanese quail (*Coturnix japonica*)	4	U	FD	16	w	6	w	SM	B	REP	RSUC	WO	0.852	1.70	86
36	Brown et al., 1974	926	Chicken (*Gallus domesticus*)	3	U	FD	13	mo	6	w	LB	B	EGG	ESTH	WO	0.880		76
37	Cool et al, 1972	935	Pheasant (*Phasianus colchicus*)	2	U	OR	22	d	NR	NR	LB	F	REP	CYNG	WO	0.900		77
38	Dahlgren and Linder, 1974	1166	Pheasant (*Phasianus colchicus*)	3	U	OR	17	w	1	yr	LB	F	EGG	FTEG	WO	0.905	1.51	87
39	Stromborg, 1977	1130	Ring-necked pheasant (*Phasianus colchicus*)	2	U	FD	42	d	1	yr	LB	F	REP	HTCH	WO	1.05		69
40	Ahmed et al., 1978	904	Chicken (*Gallus domesticus*)	3	U	FD	20	w	NR	NR	SM	M	REP	SPCL	WO	1.09		72
41	Davison and Sell, 1972	944	Chicken (*Gallus domesticus*)	3	U	FD	12	w	28	w	LB	F	REP	TPRD	WO	1.17		69
42	Hill et al., 1976	995	Japanese quail (*Coturnix japonica*)	4	U	FD	75	d	6	mo	LB	F	EGG	ESTH	EG	1.17		78
43	Walker et al., 1969	1145	Japanese quail (*Coturnix japonica*)	5	U	FD	18	w	4	w	LB	B	REP	RSUC	WO	1.30	2.60	84
44	Fergin and Schafer, 1977	959	Bobwhite quail (*Colinus virginianus*)	6	U	FD	34	w	6	mo	LB	F	REP	TPRD	WO	4.32		75
45	Davison and Sell, 1974	942	Mallard (*Anas platyrhynchos*)	4	U	FD	48	w	2	yr	LB	F	REP	TPRD	WO	4.42		71
46	Dahlgren and Linder, 1970	941	Ring-necked pheasant (*Phasianus colchicus*)	3	U	OR	16	w	NR	NR	LB	F	EGG	ESTH	EG	10.5		81
47	Mendenhall et al., 1983	1042	Barn owl (*Tyto alba*)	2	M	FD	2	yr	4	yr	MA	B	EGG	EGWT	EG		0.0445	89
48	Lehner and Egbert, 1969	14885	Mallard duck (*Anas platyrhynchos*)	4	U	FD	42	d	NR	NR	LB	F	EGG	ESTH	EG		0.122	78
49	Muller and Lockman, 1972	1052	Mallard (*Anas platyrhynchos*)	2	U	FD	90	d	1	yr	LB	F	REP	RSUC	WO		0.226	78
50	Call and Harrell, 1974	931	Japanese quail (*Coturnix japonica*)	3	U	FD	21	d	7	w	LB	F	REP	TPRD	WO		0.403	78
51	Call and Call, 1974	930	Japanese quail (*Coturnix japonica*)	5	U	FD	14	d	7	w	LB	F	REP	TPRD	WO		0.674	78
52	Genellly and Rudd, 1956	14920	Pheasant (*Phasianus colchicus*)	3	U	FD	6	mo	NR	NR	LB	F	REP	PROG	WO		1.18	73
53	Reading et al., 1976	1092	Japanese quail (*Coturnix japonica*)	3	U	FD	24	w	6	w	SM	B	REP	RSUC	WO		1.52	80
54	Andujar et al., 1978	908	Japanese quail (*Coturnix japonica*)	2	U	FD	20	d	NR	NR	LB	B	REP	PROG	WO		2.60	78

Table 5.1 Avian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Dieldrin
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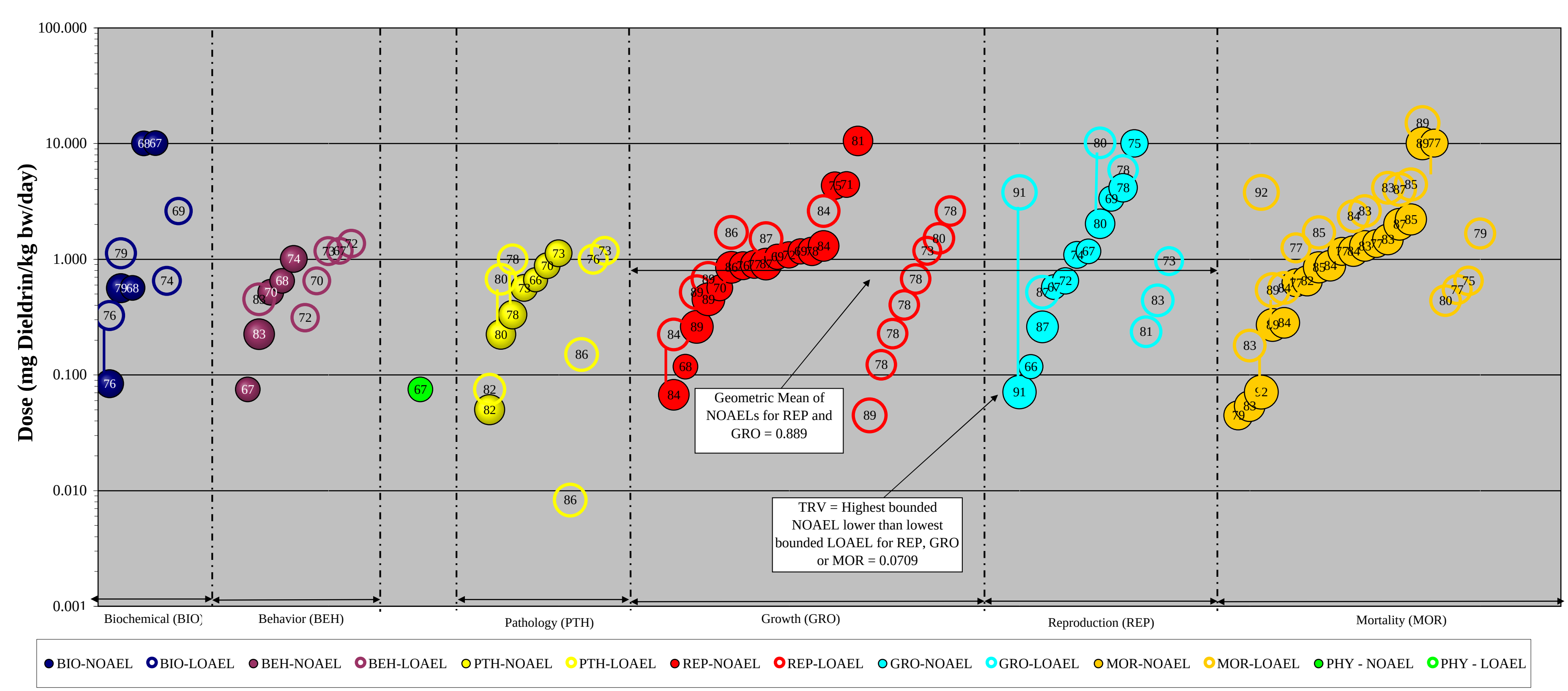
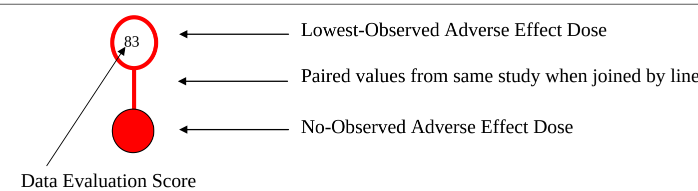
Result #	Reference	Ref No.	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)*	LOAEL Dose (mg/kg bw/day)*	Data Evaluation Score
Growth																		
55	Nebeker et al., 1992	1057	Mallard (*Anas platyrhynchos*)	7	M	FD	24	d	1	d	JV	B	GRO	BDWT	WO	0.0709	3.78	91
56	Shellenberger, 1978	1111	Japanese quail (*Coturnix japonica*)	3	U	FD	10	w	3-5	d	JV	B	GRO	BDWT	WO	0.118		66
57	Atkins and Linder, 1967	909	Ring-necked pheasant (*Phasianus colchicus*)	3	U	OR	13	w	1-12	mo	JV	F	GRO	BDWT	WO	0.260	0.519	87
58	Muller and Lockman, 1973	1054	Chicken (*Gallus domesticus*)	3	U	FD	28	d	7	d	JV	NR	GRO	BDWT	WO	0.574		67
59	Gillett and Arscott, 1969	975	Japanese quail (*Coturnix japonica*)	2	U	FD	35	d	7	d	JV	B	GRO	BDWT	WO	0.650		72
60	Ahmed et al., 1978	904	Chicken (*Gallus domesticus*)	3	U	FD	20	w	NR	NR	SM	M	GRO	BDWT	WO	1.09		74
61	Davison and Sell, 1972	944	Chicken (*Gallus domesticus*)	3	U	FD	12	w	28	w	LB	F	GRO	BDWT	WO	1.17		67
62	Call and Call, 1974	930	Japanese quail (*Coturnix japonica*)	5	U	FD	14	d	7	w	JV	B	GRO	BDWT	WO	2.02	10.1	80
63	Reading et al., 1976	1092	Japanese quail (*Coturnix japonica*)	3	U	FD	24	w	6	w	SM	B	GRO	BDWT	WO	3.33		69
64	Genelly and Rudd, 1955	14919	Ring-necked pheasant (*Phasianus colchicus*)	5	U	FD	90	d	6	mo	JV	F	GRO	BDWT	WO	4.15	5.93	78
65	Muller and Lockman, 1973	1054	Chicken (*Gallus domesticus*)	3	U	OR	28	d	7	d	JV	NR	GRO	BDWT	WO	10.0		75
66	Atkins and Linder, 1967	909	Ring-necked pheasant (*Phasianus colchicus*)	4	U	OR	13	w	1-12	mo	JV	F	GRO	BDWT	WO		0.236	81
67	Brown et al., 1974	926	Chicken (*Gallus domesticus*)	3	U	FD	5	mo	6	w	JV	B	GRO	BDWT	WO		0.439	83
68	Genelly and Rudd, 1955	14919	Ring-necked pheasant (*Phasianus colchicus*)	3	U	FD	74	d	6	mo	JV	F	GRO	BDWT	WO		0.960	73
Survival																		
69	Mendenhall et al., 1983	1042	Barn owl (*Tyto alba*)	2	M	FD	2	yr	4	yr	MA	B	MOR	MORT	WO	0.0445		79
70	Wiese et al., 1968	1158	Crowned guinea fowl (*Numida meleagris*)	7	U	FD	21	mo	6	mo	SM	F	MOR	MORT	WO	0.0537	0.179	83
71	Nebeker et al., 1992	1057	Mallard (*Anas platyrhynchos*)	7	M	FD	24	d	1	d	JV	B	MOR	MORT	WO	0.0709	3.78	92
72	Fergin and Schafer, 1977	959	Bobwhite quail (*Colinus virginianus*)	6	U	FD	34	w	6	mo	SM	B	MOR	MORT	WO	0.270	0.540	89
73	Davison and Sell, 1974	40	Mallard duck (*Anas platyrhynchos*)	4	U	FD	48	w	2	yr	MA	F	MOR	SURV	WO	0.281	0.563	84
74	Gesell et al., 1979	974	Bobwhite quail (*Colinus virginianus*)	6	U	OR	42	d	NR	NR	AD	M	MOR	MORT	WO	0.625	1.25	77
75	Gillett and Arscott, 1969	975	Japanese quail (*Coturnix japonica*)	2	U	FD	35	d	7	d	JV	B	MOR	MORT	WO	0.650		82
76	Reading et al., 1976	1092	Japanese quail (*Coturnix japonica*)	4	U	FD	16	w	6	w	SM	F	MOR	MORT	WO	0.852	1.70	85
77	Brown et al., 1974	926	Chicken (*Gallus domesticus*)	3	U	FD	13	mo	6	w	JV	B	MOR	MORT	WO	0.880		84
78	Davison and Sell, 1972	944	Chicken (*Gallus domesticus*)	3	U	FD	12	w	28	w	LB	F	MOR	MORT	WO	1.17		77
79	Genelly and Rudd, 1955	14919	Ring-necked pheasant (*Phasianus colchicus*)	3	U	FD	60	d	6	mo	JV	B	MOR	MORT	WO	1.17	2.35	84
80	Walker et al., 1969	1145	Japanese quail (*Coturnix japonica*)	5	U	FD	18	w	4	w	LB	B	MOR	MORT	WO	1.30	2.60	83
81	Kreitzer and Heinz, 1974	3362	Quail (*Coturnix coturnix*)	2	U	FD	8	d	7	d	JV	NR	MOR	MORT	WO	1.36		77
82	Genelly and Rudd, 1955	14919	Ring-necked pheasant (*Phasianus colchicus*)	5	U	FD	90	d	6	mo	JV	F	MOR	MORT	WO	1.48	4.15	83
83	Jefferies and French, 1972	1010	Homing pigeon (*Columba livia*)	4	U	OR	8	w	NR	NR	NR	B	MOR	MORT	WO	2.00	4.00	87
84	Davison and Sell, 1974	942	Mallard (*Anas platyrhynchos*)	4	U	FD	48	w	2	yr	AD	F	MOR	SURV	WO	2.21	4.42	85
85	Eden, 1951	14939	Chicken (*Gallus domesticus*)	4	U	OR	90	d	3	w	JV	NR	MOR	MORT	WO	10.00	15.00	89
86	Call and Call, 1974	930	Japanese quail (*Coturnix japonica*)	5	U	FD	14	d	7	w	JV	B	MOR	MORT	WO	10.1		77
87	Dahlgren and Linder, 1974	1166	Pheasant (*Phasianus colchicus*)	3	U	OR	17	w	1	yr	AD	M	MOR	MORT	WO		0.438	80
88	Lehner and Egbert, 1969	14885	Mallard duck (*Anas platyrhynchos*)	4	U	FD	491	d	NR	NR	AD	B	MOR	MORT	WO		0.546	77
89	Ahmed et al., 1978	904	Chicken (*Gallus domesticus*)	3	U	FD	12	w	NR	NR	SM	M	MOR	MORT	WO		0.651	75
90	Reading et al., 1976	1092	Japanese quail (*Coturnix japonica*)	3	U	FD	24	w	6	w	SM	M	MOR	MORT	WO		1.67	79

AD = adult; ADL = ad litum; AEPX = aldrin epoxidase; AHDX = aniline hydroxylase; AVO = avoidance; B = both; BDWT = body weight changes; BEH = behavior; BO = bone; BR = brain; bw = body weight; C = concurrent control; CALC = calcium; CHM = chemical changes; CYNG = care of young; d = days; DLY = daily; DOPA = dopamine; DR = Drinking water; EG = egg; EGG = effects on eggs; EGPN = egg production; EGWT = egg weight; ENZ = enzyme changes; EOD = every other day; ESTH = eggshell thinning; EXCR = excretion; F = female; FCNS = food consumption; FD = food; FDB = feeding behavior changes; FEFF = feed effeciency; FTEG = fertile egg; FieldA = simulated field conditions; g = grams; GE = gestation; GHIS = general histology; GLBM = glomerular basement membrane; GLSN = gross lesions; GRO = growth; GRS = gross body weight changes; GV = gavage; HIS = histology; HRM = hormone changes; HTCH = hatchability; JV = juvenile; kg = kilograms; L = liters; Lab = laboratory exposures; LB = laying bird; LI = liver; LIPD = lipid; LOAEL = lowest observed adverse effect level; M = multiple controls; M = male; M = measured; MA = mature; mg = milligrams; ml = milliliters; mo = months; MOR = effects on survival; MORT = mortality; N= no; NOAEL = No Observed Advese Effect Level; NR = Not reported; NVOC = number of vocalizations; OR = other oral; ORW = organ weight changes; ORWT = organ weight; PCLV = packed cell volume; PHY = physiology; PL = plasma; PROG = progeny counts or numbers; REP = reproduction; RSUC = reproductive success; SM = sexually mature; SPCL = sperm cell counts; STIM = stimulus avoidance; SR = serum; SURV = survival; TPRD = total production; TY = thyroid; U = unmeasured; ug = micrograms; w = weeks; WO = whole organism; Y = yes; yr = years.

*NOAEL and LOAEL values that are equal and from the same reference represent different experimental designs.

Figure 5.1 Avian TRV Derivation for Dieldrin





Wildlife TRV Derivation Process

1) There are at least three results available for two test species within the growth, reproduction, and mortality effect groups. There are enough data to derive a TRV.

2) There are at least three NOAEL results available for calculation of a geometric mean.

4) The geometric mean of NOAEL results for reproduction and growth is equal to 0.889 mg/ dieldrin/kg bw/d but this value is higher than the lowest bounded LOAEL for reproduction, growth or survival results.

6) The avian wildlife TRV for dieldrin is equal to 0.0709 mg dieldrin/kg bw/day which is the highest bounded NOAEL below the lowest bounded LOAEL for reproduction, growth, or survival.

Table 5.2 Calculation of the Avian Eco-SSLs for Dieldrin						
Surrogate Receptor Group	**TRV for Dieldrin (mg dw/kg bw/d)** [1]	**Food Ingestion Rate (FIR)**[2] **(kg dw/kg bw/d)**	**Soil Ingestion as Proportion of Diet (P_s)**[2]	**Concentration of Dieldrin in Biota Type (i)**[2,3] **(B_i) (mg/kg dw)**	**Dieldrin in Diet of Prey** [4] **(C_{diet})**	**Eco-SSL (mg/kg dw)**[5]
Avian herbivore (dove)	0.0709	0.190	0.139	B_i = 0.41 * $Soil_j$ where i = plants	NA	0.68
Avian ground insectivore (woodcock)	0.0709	0.214	0.164	B_i = 14.7 * $Soil_j$ where i = earthworms	NA	0.022
Avian carnivore (hawk)	0.0709	0.0353	0.057	B_i = 1.2 * C_{diet} where i = mammals	C_{diet}= 14.7 * $Soil_j$	0.11

[1] The process for derivation of wildlife TRVs is described in Attachment 4-5 of U.S. EPA (2003).
[2] Parameters (FIR, P_s, B_i values, regressions) are provided in U.S. EPA (2003) Attachment 4-1 (revised February 2005).
[3] B_i = Concentration in biota type (i) which represents 100% of the diet for the respective receptor.
[4] C_{diet} = Concentration in the diet of small mammals consumed by predatory species (hawk).
[5] HQ = FIR * ($Soil_j$ * P_s + B_i) / TRV solved for HQ=1 where $Soil_j$ = Eco-SSL (Equation 4-2; U.S. EPA, 2003).
NA = Not Applicable

6.0 ECO-SSL FOR MAMMALIAN WILDLIFE

The derivation of the Eco-SSL for mammalian wildlife was completed as two parts. First, the TRV was derived according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-5). Second, the Eco-SSL (soil concentration) was back-calculated for each of three surrogate species based on the wildlife exposure model and the TRV (U.S. EPA, 2003).

6.1 Mammalian TRV

The literature search completed according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-2) identified 669 papers with possible toxicity data for dieldrin for either avian or mammalian species. Of these papers, 585 were rejected for use as described in Section 7.5. Of the remaining papers, 48 contained data for mammalian test species. These papers were reviewed and the data were extracted and scored according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-3 and 4-4). The results of the data extraction and review are summarized in Table 6.1. The complete results are provided in Appendix 6-1.

Within the 48 papers there are 116 results for biochemical (BIO), behavioral (BEH), physiology (PHY), pathology (PTH), reproduction (REP), growth (GRO), and survival (MOR) endpoints with a total Data Evaluation Score >65 that were used to derive the TRV (U.S. EPA, 2003; Attachment 4-4). These data are plotted in Figure 6.1 and correspond directly with the data presented in Table 6.1. The NOAEL results for growth and reproduction are used to calculate a geometric mean NOAEL. This mean NOAEL is examined in relationship to the lowest bounded LOAEL for reproduction, growth, and survival to derive the TRV according to procedures in the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-5).

A geometric mean of the NOAEL values for growth and reproduction was calculated at 1.05 mg dieldrin/kg bw/day. However, this value is higher than the lowest bounded LOAEL for reproduction, growth, or mortality. Therefore, the TRV is equal to the highest bounded NOAEL below the lowest bounded LOAEL for reproduction, growth, or survival and is equal to 0.015 mg dieldrin/kg bw/day.

6.2 Estimation of Dose and Calculation of the Eco-SSL

Three separate Eco-SSL values were calculated for mammalian wildlife, one for each of three surrogate species representing different trophic groups. The mammalian Eco-SSLs derived for dieldrin were calculated according to the Eco-SSL guidance (U.S. EPA, 2003) and are summarized in Table 6.2.

Result #	Reference	Ref No.	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)*	LOAEL Dose (mg/kg bw/day)*	Data Evaluation Score
Biochemical																		
1	Walker et al., 1969	1146	Dog (*Canis familiaris*)	3	M	OR	32	w	4-7	mo	JV	M	ENZ	ALPH	PL	0.005	0.050	79
2	Stevenson et al., 1995	1122	Mouse (*Mus musculus*)	4	U	FD	28	d	4	w	JV	M	ENZ	EROD	LI	0.127	0.381	71
3	van Ravenzwaay et al., 1988	1139	Mouse (*Mus musculus*)	4	U	FD	14	mo	4	w	JV	F	ENZ	AATT	LI	0.129	0.646	73
4	Davison, 1970	943	Sheep (*Ovis aries*)	5	UX	FD	32	w	NR	NR	JV	M	CHM	HMCT	PL	1.74		70
5	Foster, 1968	961	Rat (*Rattus novegicus*)	3	U	FD	7	d	NR	NR	JV	M	HRM	CRTS	AR	9.02	18.9	70
6	Krampl and Hladka, 1975	1026	Rat (*Rattus novegicus*)	5	U	GV	13	d	NR	NR	JV	M	ENZ	PNAD	LI		0.050	77
7	Shakoori et al., 1984	1108	Rat (*Rattus novegicus*)	2	U	FD	1	mo	10	mo	SM	M	CHM	TLBL	SR		0.400	74
8	Virgo and Bellward, 1975	1141	Mouse (*Mus musculus*)	5	U	FD	10	w	13	w	NR	F	CHM	PRTL	MC		0.556	69
9	Mehrotra et al., 1988	1040	Rat (*Rattus novegicus*)	2	U	FD	50	d	NR	NR	JV	M	ENZ	GENZ	BR		0.700	71
10	Schein and Thomas, 1975	1103	Mouse (*Mus musculus*)	4	U	GV	5	d	NR	NR	MA	M	HRM	TSTR	TE		1.25	71
11	Thomas, 1974	1133	Mouse (*Mus musculus*)	4	U	GV	10	d	NR	NR	AD	M	HRM	TSTR	PG		1.25	73
12	Shakoori et al., 1982	1107	Rat (*Rattus novegicus*)	2	U	FD	3	mo	NR	NR	AD	M	ENZ	ALPH	LI		2.00	74
13	Zemaitis et al., 1976	1163	Rat (*Rattus novegicus*)	2	U	FD	8	w	NR	NR	JV	F	ENZ	CEST	PL		4.77	70
14	Bandyopadhyay et al., 1982	911	Rat (*Rattus novegicus*)	2	U	GV	15	d	NR	NR	JV	M	ENZ	GENZ	LI		5.00	77
Behavior																		
15	Harr et al.,1970	988	Rat (*Rattus novegicus*)	11	UX	FD	750	d	28	d	JV	B	FDB	FCNS	WO	0.057	0.113	83
16	Murphy and Korschgen, 1970	1056	White-tailed deer (*Odocoileus virginianus*)	3	U	FD	3	yr	6-7	mo	JV	F	FDB	FCNS	WO	0.720		68
17	Krishnamurthy et al., 1965	1027	Rat (*Rattus novegicus*)	2	U	FD	24	w	NR	NR	JV	B	FDB	FCNS	WO	1.43		68
18	Schnorr, 1975	1104	Sheep (*Ovis aries*)	4	U	OR	35	d	24-30	mo	AD	F	BEH	GBHV	WO	2.50	5.00	82
19	Foster, 1968	961	Rat (*Rattus novegicus*)	2	U	FD	16	d	NR	NR	JV	M	FDB	FCNS	WO	16.5		74
20	Virgo and Bellward, 1975	1141	Mouse (*Mus musculus*)	5	U	FD	10	w	13	w	NR	F	BEH	RRSP	WO		0.556	73
21	Mehrotra et al., 1988	1040	Rat (*Rattus novegicus*)	2	U	FD	40	d	NR	NR	JV	M	FDB	FCNS	WO		0.750	74
22	Bildstein and Forsyth, 1979	918	White-footed mouse (*Peromyscus leucopus*)	2	U	FD	3	mo	3-4	mo	AD	NR	BEH	FRZG	WO		1.14	72
23	Keane and Zavon, 1969	14987	Dog (*Canis familiaris*)	2	U	OR	25	d	24-27	mo	AD	B	FDB	FCNS	WO		1.98	73
24	Kimbrough et al., 1971	1020	Rat (*Rattus novegicus*)	3	U	FD	8	w	4	mo	JV	M	BEH	INST	WO		2.64	73
25	Stoewsand et al., 1970	1127	Rat (*Rattus novegicus*)	2	U	FD	7	d	NR	NR	JV	B	FDB	FCNS	WO		5.82	69
Physiology																		
26	Blend and Visek, 1972	919	Dog (*Canis familiaris*)	2	U	FD	6	mo	16-36	mo	AD	NR	PHY	EXCR	PG	0.015		73
27	Hurkat and Joshi, 1977	1000	Rabbit (*Oryctolagus cuniculus*)	2	U	GV	3	mo	NR	NR	NR	B	PHY	RPRT	WO	1.25		80
28	Khairy 1960	14952	Rat (*Rattus novegicus*)	3	U	FD	60	d	75	d	JV	M	PHY	GPHY	MU		12.5	77
Pathology																		
29	Walker et al., 1969	1146	Rat (*Rattus novegicus*)	4	M	FD	104	w	5	w	JV	B	ORW	SMIX	LI	0.00919	0.0836	82
30	Krampl and Hladka, 1975	1026	Rat (*Rattus novegicus*)	5	U	GV	13	d	NR	NR	JV	M	ORW	SMIX	LI	0.050	0.250	84
31	Stevenson et al., 1995	1122	Mouse (*Mus musculus*)	4	U	FD	28	d	4	w	JV	M	HIS	GHIS	LI	0.127	0.381	74
32	Murphy and Korschgen, 1970	1056	White-tailed deer (*Odocoileus virginianus*)	3	U	FD	3	yr	18-19	mo	JV	F	ORW	ORWT	LI	0.140	0.720	81
33	Treon et al, 1951	14960	Rat (*Rattus novegicus*)	6	M	FD	16	w	NR	NR	JV	B	ORW	ORWT	LI	0.196	0.392	84
34	Schnorr, 1975	1104	Sheep (*Ovis aries*)	4	U	OR	35	d	24-30	mo	AD	F	ITX	GITX	WO	0.500	2.50	80
35	Kolaja et al., 1996	1023	Rat (*Rattus novegicus*)	5	UX	FD	90	d	8	w	JV	M	ORW	SMIX	LI	0.839		72
36	Chernoff et al., 1975	932	Mouse (*Mus musculus*)	4	U	GV	10	d	NR	NR	GE	F	ORW	SMIX	LI	1.31	2.61	86
37	Uzoukwu et al., 1972	1137	Guinea pig (*Cavia porcellus*)	5	U	FD	53	d	NR	NR	GE	F	HIS	NCRO	UT	3.53	7.06	78
38	Chernoff et al., 1975	932	Rat (*Rattus novegicus*)	4	U	GV	10	d	NR	NR	GE	F	ORW	SMIX	LI	5.22		80
39	Foster, 1968	961	Rat (*Rattus novegicus*)	3	U	FD	21	d	NR	NR	JV	M	ORW	SMIX	AR	9.02	18.0	79
40	Walker et al., 1969	1146	Dog (*Canis familiaris*)	3	M	OR	104	w	6	w	JV	M	ORW	ORWT	HE		0.0050	80
41	Kolaja et al., 1996	1023	Mouse (*Mus musculus*)	5	UX	FD	7	d	8	w	JV	M	ORW	SMIX	LI		0.013	81
42	Reuber, 1980	1096	Rat (*Rattus novegicus*)	8	U	FD	2	yr	3	w	JV	B	HIS	NPHR	KI		0.040	72
43	Fitzhugh et al., 1964	960	Rat (*Rattus novegicus*)	7	U	FD	2	yr	NR	NR	JV	B	ORW	SMIX	LI		0.0420	73
44	Virgo and Bellward, 1975	1141	Mouse (*Mus musculus*)	5	U	FD	10	w	13	w	NR	F	ORW	SMIX	LI		0.556	72
45	Keane et al., 1969	1018	Dog (*Canis familiaris*)	2	U	OR	24	d	24 - 27	mo	AD	NR	ITX	CONV	WO		1.00	71
46	Mehrotra et al., 1988	1040	Rat (*Rattus novegicus*)	2	U	FD	5	d	NR	NR	JV	M	ITX	INTX	WO		1.15	74
47	Davis and Fitzhugh, 1962	14937	Mouse (*Mus musculus*)	2	U	FD	2	yr	NR	NR	YO	B	HIS	GHIS	LI		1.19	70
48	Hurkat and Joshi, 1977	1000	Rabbit (*Oryctolagus cuniculus*)	2	U	GV	3	mo	NR	NR	NR	B	ITX	CONV	WO		1.25	80
49	Reuber, 1977	1095	Mouse (*Mus musculus*)	2	U	FD	104	w	3	w	JV	B	HIS	GHIS	LI		1.28	72
50	Krishnamurthy et al., 1965	1027	Rat (*Rattus novegicus*)	2	U	FD	24	w	NR	NR	JV	B	ORW	ORWT	LI		1.43	77
51	Keane and Zavon, 1969	14987	Dog (*Canis familiaris*)	2	U	OR	33	d	24-27	mo	AD	B	GRS	BDWT	WO		1.98	73
52	Shakoori et al., 1982	1107	Rat (*Rattus novegicus*)	2	U	FD	1	mo	NR	NR	AD	M	HIS	GHIS	LI		2.00	77
53	Kimbrough et al., 1971	1020	Rat (*Rattus novegicus*)	3	U	FD	8	w	4	mo	JV	M	ORW	SMIX	LI		2.64	73
54	Bandyopadhyay et al., 1982	911	Rat (*Rattus novegicus*)	2	U	GV	15	d	NR	NR	JV	M	ORW	SMIX	LI		5.00	80
55	Jones et al., 1974	1016	Rat (*Rattus novegicus*)	2	U	FD	8	w	5	w	JV	M	HIS	NCRO	BR		7.00	73
56	Sandler et al., 1968	1101	Sheep (*Ovis aries*)	2	U	OR	7	d	NR	NR	AD	F	ITX	GITX	WO		15.0	67
57	Foster, 1968	961	Rat (*Rattus novegicus*)	2	U	FD	7	d	NR	NR	JV	M	ORW	ORWT	AR		19.3	72

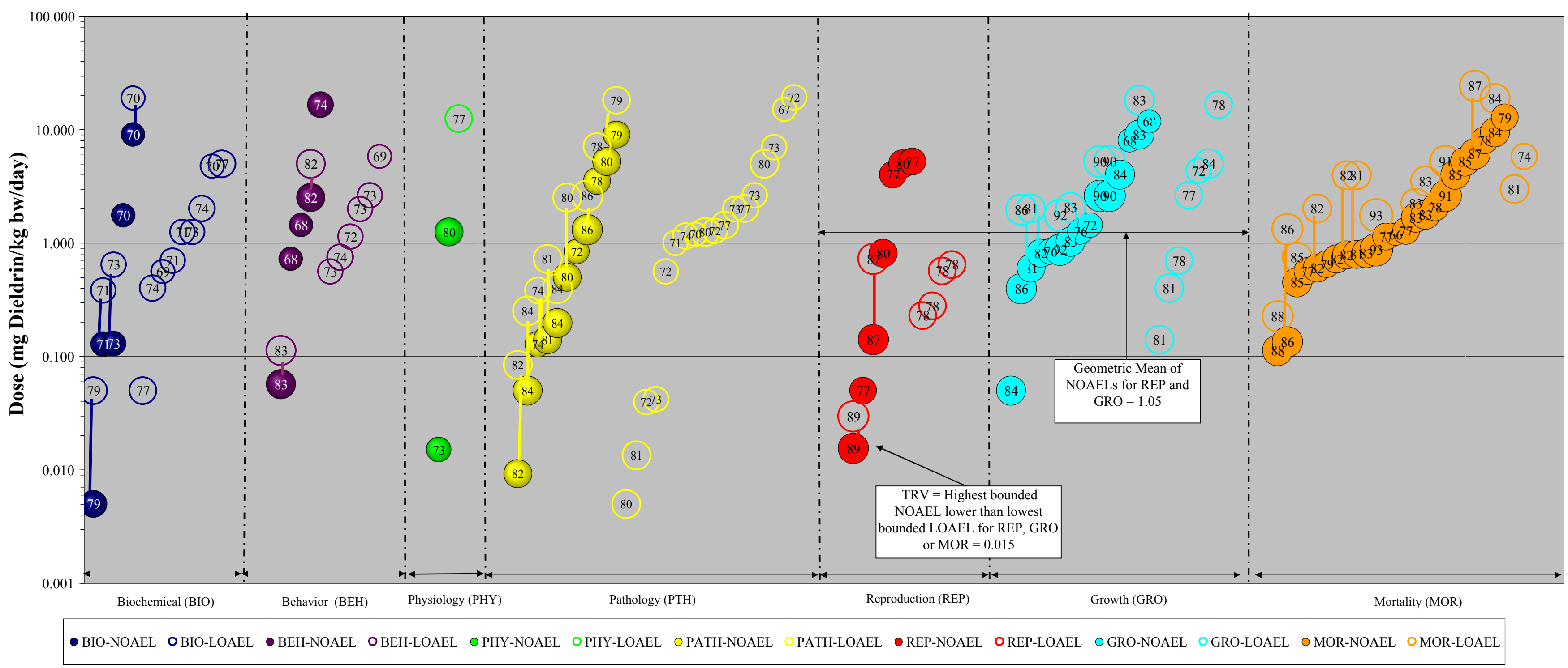
Result #	Reference	Ref No.	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)*	LOAEL Dose (mg/kg bw/day)*	Data Evaluation Score
Reproduction																		
58	Harr et al.,1970	988	Rat (*Rattus novegicus*)	11	UX	FD	750	d	28	d	JV	B	REP	PROG	WO	0.015	0.030	89
59	Walker et al., 1969	1146	Dog (*Canis familiaris*)	3	M	OR	104	w	6	mo	JV	M	REP	TEWT	TE	0.050		77
60	Murphy and Korschgen, 1970	1056	White-tailed deer (*Odocoileus virginianus*)	3	U	FD	3	yr	6-7	mo	JV	F	REP	PRWT	WO	0.140	0.720	87
61	Walker et al., 1969	1146	Rat (*Rattus novegicus*)	4	M	FD	2	yr	5	w	JV	M	REP	TEWT	TE	0.810		80
62	Dix et al., 1977	953	Mouse (*Mus musculus*)	3	U	GV	9	d	7	w	GE	F	REP	PLBR	WO	4.00		77
63	Schein and Thomas, 1975	1103	Mouse (*Mus musculus*)	4	U	GV	5	d	NR	NR	MA	M	REP	TEST	TE	5.00		80
64	Chernoff et al., 1975	932	Rat (*Rattus novegicus*)	4	U	GV	10	d	NR	NR	GE	F	REP	PRFM	WO	5.22		77
65	Treon et al, 1954	14965	Rat (*Rattus novegicus*)	4	U	FD	127	d	28	d	GE	F	REP	FERT	WO		0.228	78
66	Virgo and Bellward, 1975	1143	Mouse (*Mus musculus*)	7	U	FD	13	w	10-12	w	LC	F	REP	RSUC	WO		0.278	78
67	Good and Ware, 1969	978	Mouse (*Mus musculus*)	2	U	FD	120	d	6	w	SM	B	REP	PROG	WO		0.564	78
68	Virgo and Bellward, 1977	1142	Mouse (*Mus musculus*)	4	U	FD	60	d	4	w	GE	F	REP	RSUC	WO		0.646	78
Growth																		
69	Walker et al., 1969	1146	Dog (*Canis familiaris*)	3	M	OR	104	w	6	mo	JV	M	GRO	BDWT	WO	0.050		84
70	Treon et al, 1951	14960	Rat (*Rattus novegicus*)	6	M	FD	20	w	NR	NR	JV	M	GRO	BDWT	WO	0.392	1.96	86
71	Kitselman and Borgmann, 1952	14954	Dog (*Canis familiaris*)	4	U	FD	47	d	NR	NR	NR	B	GRO	BDWT	WO	0.600	2.00	81
72	Walker et al., 1969	1146	Rat (*Rattus novegicus*)	4	M	FD	2	yr	5	w	JV	B	GRO	BDWT	WO	0.810		82
73	Kolaja et al., 1996	1023	Rat (*Rattus novegicus*)	5	UX	FD	90	d	8	w	JV	M	GRO	BDWT	WO	0.839		76
74	Davison, 1970	943	Sheep (*Ovis aries*)	5	UX	FD	32	w	NR	NR	JV	M	GRO	BDWT	WO	0.87	1.74	92
75	Treon et al, 1953	14964	Rat (*Rattus novegicus*)	4	U	FD	28	w	NR	NR	JV	B	GRO	BDWT	WO	1.02	2.05	83
76	Kolaja et al., 1996	1023	Mouse (*Mus musculus*)	5	UX	FD	90	d	8	w	JV	M	GRO	BDWT	WO	1.26		76
77	Krishnamurthy et al., 1965	1027	Rat (*Rattus novegicus*)	2	U	FD	24	w	NR	NR	JV	B	GRO	BDWT	WO	1.43		72
78	Chernoff et al., 1975	932	Rat (*Rattus novegicus*)	4	U	GV	10	d	NR	NR	GE	F	GRO	BDWT	WO	2.61	5.22	90
79	Chernoff et al., 1975	932	Mouse (*Mus musculus*)	4	U	GV	10	d	NR	NR	GE	F	GRO	BDWT	WO	2.61	5.22	90
80	Dix et al., 1977	953	Mouse (*Mus musculus*)	3	U	GV	9	d	7	w	GE	F	GRO	BDWT	WO	4.00		84
81	Jones et al., 1974	1016	Rat (*Rattus novegicus*)	2	U	FD	8	w	5	w	JV	F	GRO	BDWT	WO	8.0		68
82	Foster, 1968	961	Rat (*Rattus novegicus*)	3	U	FD	4	d	NR	NR	JV	M	GRO	BDWT	WO	9.02	18.0	83
83	Fitzhugh et al., 1964	960	Rat (*Rattus novegicus*)	7	U	FD	2	yr	NR	NR	JV	B	GRO	BDWT	WO	11.8		68
84	Murphy and Korschgen, 1970	1056	White-tailed deer (*Odocoileus virginianus*)	3	U	FD	3	yr	6-7	mo	JV	F	GRO	BDWT	WO		0.140	81
85	Shakoori et al., 1984	1108	Rat (*Rattus novegicus*)	2	U	FD	6	mo	10	mo	SM	M	GRO	BDWT	WO		0.400	81
86	Mehrotra et al., 1988	1040	Rat (*Rattus novegicus*)	2	U	FD	50	d	NR	NR	JV	M	GRO	BDWT	WO		0.700	78
87	Kimbrough et al., 1971	1020	Rat (*Rattus novegicus*)	3	U	FD	8	w	4	mo	JV	M	GRO	BDWT	WO		2.64	77
88	Wasserman et al., 1972	1150	Rabbit (*Oryctolagus cuniculus*)	2	U	DR	5	w	NR	NR	YO	M	GRO	BDWT	WO		4.31	72
89	Bandyopadhyay et al., 1982	911	Rat (*Rattus novegicus*)	2	U	GV	15	d	NR	NR	JV	M	GRO	BDWT	WO		5.00	84
90	Foster, 1968	961	Rat (*Rattus novegicus*)	2	U	FD	16	d	NR	NR	JV	M	GRO	BDWT	WO		16.5	78
Survival																		
91	Harr et al.,1970	988	Rat (*Rattus novegicus*)	11	UX	FD	750	d	28	d	JV	B	MOR	MORT	WO	0.113	0.225	88
92	Walker et al., 1972	1147	Mouse (*Mus musculus*)	4	M	FD	25-28	w	3	w	JV	F	MOR	MORT	WO	0.133	1.33	86
93	Wiese et al., 1973	1157	Blesbuk (*Damaliscus pygargus*)	6	UX	FD	90	d	15	mo	NR	B	MOR	MORT	WO	0.449	0.749	85
94	Good and Ware, 1969	978	Mouse (*Mus musculus*)	2	U	FD	120	d	6	w	JV	B	MOR	MORT	WO	0.564		77
95	Kitselman and Borgmann, 1952	14954	Dog (*Canis familiaris*)	4	U	FD	47	d	NR	NR	NR	B	MOR	MORT	WO	0.600	2.00	82
96	Mehrotra et al., 1988	1040	Rat (*Rattus novegicus*)	2	U	FD	60	d	NR	NR	JV	M	MOR	MORT	WO	0.650		79
97	Murphy and Korschgen, 1970	1056	White-tailed deer (*Odocoileus virginianus*)	3	U	FD	3	yr	6-7	mo	JV	F	MOR	MORT	WO	0.720		82
98	Fitzhugh et al., 1964	960	Rat (*Rattus novegicus*)	7	U	FD	2	yr	NR	NR	JV	B	MOR	SURV	WO	0.784	3.92	82
99	Reuber, 1980	1096	Rat (*Rattus novegicus*)	8	U	FD	2	yr	3	w	JV	B	MOR	MORT	WO	0.791	3.96	81
100	Walker et al., 1969	1146	Rat (*Rattus novegicus*)	4	M	FD	2	yr	5	w	JV	B	MOR	MORT	WO	0.810		83
101	Davison, 1970	943	Sheep (*Ovis aries*)	5	UX	FD	32	w	NR	NR	JV	M	MOR	MORT	WO	0.87	1.74	93
102	Bildstein and Forsyth, 1979	918	White-footed mouse (*Peromyscus leucopus*)	2	U	FD	3	mo	3-4	mo	AD	NR	MOR	MORT	WO	1.14		77
103	Davis and Fitzhugh, 1962	14937	Mouse (*Mus musculus*)	2	U	FD	18	mo	NR	NR	YO	B	MOR	SURV	WO	1.19		66
104	Reuber, 1977	1095	Mouse (*Mus musculus*)	2	U	FD	104	w	3	w	JV	B	MOR	SURV	WO	1.28		77
105	Virgo and Bellward, 1975	1143	Mouse (*Mus musculus*)	7	U	FD	4	w	10-12	w	LC	F	MOR	SURV	WO	1.67	2.23	83
106	Uzoukwu et al., 1972	1137	Guinea pig (*Cavia porcellus*)	2	U	FD	53	d	NR	NR	GE	F	MOR	MORT	WO	1.76	3.53	83
107	Treon et al, 1953	14964	Rat (*Rattus novegicus*)	4	U	FD	28	w	NR	NR	JV	B	MOR	MORT	WO	2.05		78
108	Chernoff et al., 1975	932	Rat (*Rattus novegicus*)	4	U	GV	10	d	NR	NR	GE	F	MOR	MORT	WO	2.61	5.22	91
109	Dix et al., 1977	953	Mouse (*Mus musculus*)	3	U	GV	9	d	7	w	JV	F	MOR	MORT	WO	4.00		85
110	Chernoff et al., 1975	932	Mouse (*Mus musculus*)	4	U	GV	10	d	NR	NR	GE	F	MOR	MORT	WO	5.22		85
111	Treon et al, 1951	14960	Rat (*Rattus novegicus*)	6	M	FD	2	w	NR	NR	JV	B	MOR	MORT	WO	6.05	24.2	87
112	Jones et al., 1974	1016	Rat (*Rattus novegicus*)	2	U	FD	8	w	5	w	JV	F	MOR	MORT	WO	8.0		78
113	Foster, 1968	961	Rat (*Rattus novegicus*)	3	U	FD	7	d	NR	NR	JV	M	MOR	MORT	WO	9.42	18.8	84
114	Foster, 1968	961	Rat (*Rattus novegicus*)	2	U	FD	16	d	NR	NR	JV	M	MOR	MORT	WO	12.8		79
115	Uzoukwu et al., 1972	1137	Guinea pig (*Cavia porcellus*)	2	U	OR	75	d	NR	NR	GE	F	MOR	MORT	WO		3.00	81
116	Stoewsand et al., 1970	1127	Rat (*Rattus novegicus*)	2	U	FD	7	d	NR	NR	JV	B	MOR	MORT	WO		5.82	74

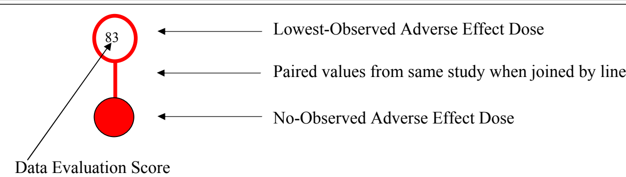
Result #	Reference	Ref No.	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)*	LOAEL Dose (mg/kg bw/day)*	Data Evaluation Score

AATT =alanine aminotransferase; AD = adult; ALPH = alkaline phosphatase; AR = adrenal gland; B = both; BDWT = body weight changes; BEH = behavior; BR = brain; bw = body weight; CEST = cholinesterase; CHM = chemical changes; CHOL = cholesterol; CONV = convulsions; CRTS = cortisol; CYNG = care of young, nest attentiveness; d = days; DR = drinking water; ENZ = enyzme level changes; EROD = 7-ethoxyresorufin-O-deethylase; EXCR = excretion; F = female; FCNS = food consumption; FD = food; FDB = feeding behavior; FERT = fertility; FRGZ = freezing behavior; g = grams; GBHV = general behavior; GE = gestation; GENZ = general enzyme; GHIS = general histology; GITX = general intoxication; GRO = growth; GRS = gross body weight changes; GLSN = gross lesions; GPHY = general physiology; GV = gavage; HE = heart; HIS = histology; HMCT = hematocrit; HRM = hormone changes; INST = induced sleeping time; INTX = intoxication; ITX = intoxication; JV = juvenile; kg = kilograms; KI = kidney; L = liter; LC= lactation;LACT = lactate; lf = lifetime; LI = liver; LOAEL = lowest observed adverse effect level; mo = months; M = male; M = measured; MA = mature; MC = microsome; mg = milligrams; mo = months; MOR = effects on mortality and survival; MORT = mortality; MT = multiple tissu MU = muscle; na = not applicable; NCRO = necrosis; NOAEL = No Observed Advese Effect Level; NPHR = nephrososy; NR = Not reported; OR = other oral; ORW = organ weight changes; ORWT = organ weight changes; PG = prostate gland; PHY = physiology; PL = plasma; PLBR = pairs with litter or brood; PNAD = p-nitroanisole demethylase; POTA = potassium; PRFM = sexual performance; PROG = progeny numbers/counts; PRTL = protein level; PRWT = progeny weight; PTH = pathology; RBEH = reproductive behavior; REP = reproduction; RPRD = reproductive capacity; RPRT = respiratory rate; RRSP = righting response; RSEM = resorbed embryos; RSUC = reproductive success (general); SM = sexually mature; SMIX = weight relative to body weight; SR = serum; SURV = survival; TE = testes; TEDG = testes degeneration; TERA = teratogenic measurements; TLBL = bilirubin, total; TOPR = total protein; TSTR = testosterone; U = unmeasured; ug = micrograms; UX = reported as measured but measured values not provided; w = weeks; WO = whole organism; YO = young; yr = year

*NOAEL and LOAEL values that are equal and from the same reference represent different experimental designs.

Figure 6.1 Mammalian TRV Derivation for Dieldrin





Wildlife TRV Derivation Process

1) There are at least three results available for two test species within the growth, reproduction, and mortality effect groups. There are enough data to derive a TRV.

2) There are three NOAEL results for growth and reproduction effect groups available for calculation of a geometric mean. The geometric mean is equal to 1.05 mg dieldrin/kg bw/day.

4) The geometric mean NOAEL is however greater than the lowest bounded LOAEL for growth, reproduction, or survival effect groups.

5) The TRV is equal to the highest bounded NOAEL below the lowest bounded LOAEL for reproduction, growth, and survival effect groups equal to 0.015 mg dieldrin per kg bw per day.

Table 6.2 Calculation of the Mammalian Eco-SSL for Dieldrin						
Surrogate Receptor Group	**TRV for Dieldrin (mg dw/kg bw/d)** [1]	**Food Ingestion Rate (FIR)**[2] **(kg dw/kg bw/d)**	**Soil Ingestion as Proportion of Diet (P_s)**[2]	**Concentration of Dieldrin in Biota Type (i)**[2,3] **(B_i) (mg/kg dw)**	**Dieldrin in Diet of Prey** [4] **(C_{diet})**	**Eco-SSL (mg/kg dw)**[5]
Mammalian herbivore (vole)	0.015	0.0875	0.032	B_i = 0.41 * $Soil_j$ where i = plants	NA	0.39
Mammalian ground insectivore (shrew)	0.015	0.209	0.030	B_i = 14.7 * $Soil_j$ where i = earthworms	NA	0.0049
Mammalian carnivore (weasel)	0.015	0.130	0.043	B_i = 1.2 * C_{diet} where i = mammals	C_{diet}= 14.7 * $Soil_j$	0.0065

[1] The process for derivation of wildlife TRVs is described in Attachment 4-5 of U.S. EPA (2003).
[2] Parameters (FIR, P_s, B_i values, regressions) are provided in U.S. EPA (2003) Attachment 4-1 (revised February 2005).
[3] B_i = Concentration in biota type (i) which represents 100% of the diet for the respective receptor.
[4] C_{diet} = Concentration in the diet of small mammals consumed by predatory species (weasel).
[5] HQ = FIR * ($Soil_j$ * P_s + B_i) / TRV solved for HQ=1 where $Soil_j$ = Eco-SSL (Equation 4-2; U.S. EPA, 2003).
NA = Not Applicable

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Literature Rejection Categories		
Rejection Criteria	**Description**	**Receptor**
ABSTRACT (Abstract)	Abstracts of journal publications or conference presentations.	Wildlife Plants and Soil Invertebrates
ACUTE STUDIES (Acu)	Single oral dose or exposure duration of three days or less.	Wildlife
AIR POLLUTION (Air P)	Studies describing the results for air pollution studies.	Wildlife Plants and Soil Invertebrates
ALTERED RECEPTOR (Alt)	Studies that describe the effects of the contaminant on surgically-altered or chemically-modified receptors (e.g., right nephrectomy, left renal artery ligature, hormone implant, etc.).	Wildlife
AQUATIC STUDIES (Aquatic)	Studies that investigate toxicity in aquatic organisms.	Wildlife Plants and Soil Invertebrates
ANATOMICAL STUDIES (Anat)	Studies of anatomy. Instance where the contaminant is used in physical studies (e.g., silver nitrate staining for histology).	Wildlife
BACTERIA (Bact)	Studies on bacteria or susceptibility to bacterial infection.	Wildlife Plants and Soil Invertebrates
BIOACCUMULATION SURVEY (Bio Acc)	Studies reporting the measurement of the concentration of the contaminant in tissues.	Wildlife Plants and Soil Invertebrates
BIOLOGICAL PRODUCT (BioP)	Studies of biological toxicants, including venoms, fungal toxins, *Bacillus thuringiensis*, other plant, animal, or microbial extracts or toxins.	Wildlife Plants and Soil Invertebrates
BIOMARKER (Biom)	Studies reporting results for a biomarker having no reported association with an adverse effect and an exposure dose (or concentration).	Wildlife
CARCINOGENICITY STUDIES (Carcin)	Studies that report data only for carcinogenic endpoints such as tumor induction. Papers that report systemic toxicity data are retained for coding of appropriate endpoints.	Wildlife Plants and Soil Invertebrates
CHEMICAL METHODS (Chem Meth)	Studies reporting methods for determination of contaminants, purification of chemicals, etc. Studies describing the preparation and analysis of the contaminant in the tissues of the receptor.	Wildlife Plants and Soil Invertebrates
CONFERENCE PROCEEDINGS (CP)	Studies reported in conference and symposium proceedings.	Wildlife Plants and Soil Invertebrates
DEAD (Dead)	Studies reporting results for dead organisms. Studies reporting field mortalities with necropsy data where it is not possible to establish the dose to the organism.	Wildlife Plants and Soil Invertebrates
DISSERTATIONS (Diss)	Dissertations are excluded. However, dissertations are flagged for possible future use.	Wildlife
DRUG (Drug)	Studies reporting results for testing of drug and therapeutic effects and side-effects. Therapeutic drugs include vitamins and minerals. Studies of some minerals may be included if there is potential for adverse effects.	Wildlife Plants and Soil Invertebrates
DUPLICATE DATA (Dup)	Studies reporting results that are duplicated in a separate publication. The publication with the earlier year is used.	Wildlife Plants and Soil Invertebrates

Literature Rejection Categories		
Rejection Criteria	**Description**	**Receptor**
ECOLOGICAL INTERACTIONS (Ecol)	Studies of ecological processes that do not investigate effects of contaminant exposure (e.g., studies of "silver" fox natural history; studies on ferrets identified in iron search).	Wildlife Plants and Soil Invertebrates
EFFLUENT (Effl)	Studies reporting effects of effluent, sewage, or polluted runoff.	Wildlife Plants and Soil Invertebrates
ECOLOGICALLY RELEVANT ENDPOINT (ERE)	Studies reporting a result for endpoints considered as ecologically relevant but is not used for deriving Eco-SSLs (e.g., behavior, mortality).	Plants and Soil Invertebrates
CONTAMINANT FATE/METABOLISM (Fate)	Studies reporting what happens to the contaminant, rather than what happens to the organism. Studies describing the intermediary metabolism of the contaminant (e.g., radioactive tracer studies) without description of adverse effects.	Wildlife Plants and Soil Invertebrates
FOREIGN LANGUAGE (FL)	Studies in languages other than English.	Wildlife Plants and Soil Invertebrates
FOOD STUDIES (Food)	Food science studies conducted to improve production of food for human consumption.	Wildlife
FUNGUS (Fungus)	Studies on fungus.	Wildlife Plants and Soil Invertebrates
GENE (Gene)	Studies of genotoxicity (chromosomal aberrations and mutagenicity).	Wildlife Plants and Soil Invertebrates
HUMAN HEALTH (HHE)	Studies with human subjects.	Wildlife Plants and Soil Invertebrates
IMMUNOLOGY (IMM)	Studies on the effects of contaminants on immunological endpoints.	Wildlife Plants and Soil Invertebrates
INVERTEBRATE (Invert)	Studies that investigate the effects of contaminants on terrestrial invertebrates are excluded.	Wildlife
IN VITRO (In Vit)	*In vitro* studies, including exposure of cell cultures, excised tissues and/or excised organs.	Wildlife Plants and Soil Invertebrates
LEAD SHOT (Lead shot)	Studies administering lead shot as the exposure form. These studies are labeled separately for possible later retrieval and review.	Wildlife
MEDIA (Media)	Authors must report that the study was conducted using natural or artificial soil. Studies conducted in pore water or any other aqueous phase (e.g., hydroponic solution), filter paper, petri dishes, manure, organic or histosoils (e.g., peat muck, humus), are not considered suitable for use in defining soil screening levels.	Plants and Soil Invertebrates
METHODS (Meth)	Studies reporting methods or methods development without usable toxicity test results for specific endpoints.	Wildlife Plants and Soil Invertebrates
MINERAL REQUIREMENTS (Mineral)	Studies examining the minerals required for better production of animals for human consumption, unless there is potential for adverse effects.	Wildlife
MIXTURE (Mix)	Studies that report data for combinations of single toxicants (e.g. cadmium and copper) are excluded. Exposure in a field setting from contaminated natural soils or waste application to soil may be coded as Field Survey.	Wildlife Plants and Soil Invertebrates

Literature Rejection Categories		
Rejection Criteria	**Description**	**Receptor**
MODELING (Model)	Studies reporting the use of existing data for modeling, i.e., no new organism toxicity data are reported. Studies which extrapolate effects based on known relationships between parameters and adverse effects.	Wildlife Plants and Soil Invertebrates
NO CONTAMINANT OF CONCERN (No COC)	Studies that do not examine the toxicity of Eco-SSL contaminants of concern.	Wildlife Plants and Soil Invertebrates
NO CONTROL (No Control)	Studies which lack a control or which have a control that is classified as invalid for derivation of TRVs.	Wildlife Plants and Soil Invertebrates
NO DATA (No Data)	Studies for which results are stated in text but no data is provided. Also refers to studies with insufficient data where results are reported for only one organism per exposure concentration or dose (wildlife).	Wildlife Plants and Soil Invertebrates
NO DOSE or CONC (No Dose)	Studies with no usable dose or concentration reported, or an insufficient number of doses/concentrations are used based on Eco-SSL SOPs. These are usually identified after examination of full paper. This includes studies which examine effects after exposure to contaminant ceases. This also includes studies where offspring are exposed in utero and/or lactation by doses to parents and then after weaning to similar concentrations as their parents. Dose cannot be determined.	Wildlife Plants and Soil Invertebrates
NO DURATION (No Dur)	Studies with no exposure duration. These are usually identified after examination of full paper.	Wildlife Plants and Soil Invertebrates
NO EFFECT (No Efct)	Studies with no relevant effect evaluated in a biological test species or data not reported for effect discussed.	Wildlife Plants and Soil Invertebrates
NO ORAL (No Oral)	Studies using non-oral routes of contaminant administration including intraperitoneal injection, other injection, inhalation, and dermal exposures.	Wildlife
NO ORGANISM (No Org) or NO SPECIES	Studies that do not examine or test a viable organism (also see in vitro rejection category).	Wildlife Plants and Soil Invertebrates
NOT AVAILABLE (Not Avail)	Papers that could not be located. Citation from electronic searches may be incorrect or the source is not readily available.	Wildlife Plants and Soil Invertebrates
NOT PRIMARY (Not Prim)	Papers that are not the original compilation and/or publication of the experimental data.	Wildlife Plants and Soil Invertebrates
NO TOXICANT (No Tox)	No toxicant used. Publications often report responses to changes in water or soil chemistry variables, e.g., pH or temperature. Such publications are not included.	Wildlife Plants and Soil Invertebrates
NO TOX DATA (No Tox Data)	Studies where toxicant used but no results reported that had a negative impact (plants and soil invertebrates).	Plants and Soil Invertebrates
NUTRIENT (Nutrient)	Nutrition studies reporting no concentration related negative impact.	Plants and Soil Invertebrates
NUTRIENT DEFICIENCY (Nut def)	Studies of the effects of nutrient deficiencies. Nutritional deficient diet is identified by the author. If reviewer is uncertain then the administrator should be consulted. Effects associated with added nutrients are coded.	Wildlife
NUTRITION (Nut)	Studies examining the best or minimum level of a chemical in the diet for improvement of health or maintenance of animals in captivity.	Wildlife
OTHER AMBIENT CONDITIONS (OAC)	Studies which examine other ambient conditions: pH, salinity, DO, UV, radiation, etc.	Wildlife Plants and Soil Invertebrates

Literature Rejection Categories		
Rejection Criteria	**Description**	**Receptor**
OIL (Oil)	Studies which examine the effects of oil and petroleum products.	Wildlife Plants and Soil Invertebrates
OM, pH (OM, pH)	Organic matter content of the test soil must be reported by the authors, but may be presented in one of the following ways; total organic carbon (TOC), particulate organic carbon (POC), organic carbon (OC), coarse particulate organic matter (CPOM), particulate organic matter (POM), ash free dry weight of soil, ash free dry mass of soil, percent organic matter, percent peat, loss on ignition (LOI), organic matter content (OMC). With the exception of studies on non-ionizing substances, the study must report the pH of the soil, and the soil pH should be within the range of $4 and #8.5. Studies that do not report pH or report pH outside this range are rejected.	Plants and Soil Invertebrates
ORGANIC METAL (Org Met)	Studies which examine the effects of organic metals. This includes tetraethyl lead, triethyl lead, chromium picolinate, phenylarsonic acid, roxarsone, 3-nitro-4-phenylarsonic acid,, zinc phosphide, monomethylarsonic acid (MMA), dimethylarsinic acid (DMA), trimethylarsine oxide (TMAO), or arsenobetaine (AsBe) and other organo metallic fungicides. Metal acetates and methionines are not rejected and are evaluated.	Wildlife
LEAD BEHAVIOR OR HIGH DOSE MODELS (Pb Behav)	There are a high number of studies in the literature that expose rats or mice to high concentrations of lead in drinking water (0.1, 1 to 2% solutions) and then observe behavior in offspring, and/or pathology changes in the brain of the exposed dam and/or the progeny. Only a representative subset of these studies were coded. Behavior studies examining complex behavior (learned tasks) were also not coded.	Wildlife
PHYSIOLOGY STUDIES (Phys)	Physiology studies where adverse effects are not associated with exposure to contaminants of concern.	Wildlife
PLANT (Plant)	Studies of terrestrial plants are excluded.	Wildlife
PRIMATE (Prim)	Primate studies are excluded.	Wildlife
PUBL AS (Publ as)	The author states that the information in this report has been published in another source. Data are recorded from only one source. The secondary citation is noted as Publ As.	Wildlife Plants and Soil Invertebrates
QSAR (QSAR)	Derivation of Quantitative Structure-Activity Relationships (QSAR) is a form of modeling. QSAR publications are rejected if raw toxicity data are not reported or if the toxicity data are published elsewhere as original data.	Wildlife Plants and Soil Invertebrates
REGULATIONS (Reg)	Regulations and related publications that are not a primary source of data.	Wildlife Plants and Soil Invertebrates
REVIEW (Rev)	Studies in which the data reported in the article are not primary data from research conducted by the author. The publication is a compilation of data published elsewhere. These publications are reviewed manually to identify other relevant literature.	Wildlife Plants and Soil Invertebrates

Literature Rejection Categories		
Rejection Criteria	**Description**	**Receptor**
SEDIMENT CONC (Sed)	Studies in which the only exposure concentration/dose reported is for the level of a toxicant in sediment.	Wildlife Plants and Soil Invertebrates
SCORE (Score)	Papers in which all studies had data evaluation scores at or lower then the acceptable cut-off (#10 of 18) for plants and soil invertebrates).	Plants and Soil Invertebrates
SEDIMENT CONC (Sed)	Studies in which the only exposure concentration/dose reported is for the level of a toxicant in sediment.	Wildlife Plants and Soil Invertebrates
SLUDGE	Studies on the effects of ingestion of soils amended with sewage sludge.	Wildlife Plants and Soil Invertebrates
SOIL CONC (Soil)	Studies in which the only exposure concentration/dose reported is for the level of a toxicant in soil.	Wildlife
SPECIES	Studies in which the species of concern was not a terrestrial invertebrate or plant or mammal or bird.	Plants and Soil Invertebrates Wildlife
STRESSOR (QAC)	Studies examining the interaction of a stressor (e.g., radiation, heat, etc.) and the contaminant, where the effect of the contaminant alone cannot be isolated.	Wildlife Plants and Soil Invertebrates
SURVEY (Surv)	Studies reporting the toxicity of a contaminant in the field over a period of time. Often neither a duration nor an exposure concentration is reported.	Wildlife Plants and Soil Invertebrates
REPTILE OR AMPHIBIAN (Herp)	Studies on reptiles and amphibians. These papers flagged for possible later review.	Wildlife Plants and Soil Invertebrates
UNRELATED (Unrel)	Studies that are unrelated to contaminant exposure and response and/or the receptor groups of interest.	Wildlife
WATER QUALITY STUDY (Wqual)	Studies of water quality.	Wildlife Plants and Soil Invertebrates
YEAST (Yeast)	Studies of yeast.	Wildlife Plants and Soil Invertebrates

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Appendix 5-1

Avian Toxicity Data Extracted and Reviewed for Wildlife Toxicity Reference Value (TRV) - Dieldrin

March 2005
Revised April 2007

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Ref			Exposure																	Effects					Conversion to mg/kg bw/day				Result		Data Evaluation Score										
Result #	Ref No.		MW%	Test Species	# of Conc/ Doses	Conc/ Doses	Conc/Dose Units	Wet Weight Reported?	Application Frequency	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Control Type	Test Location	Effect Type	Effect Measure	Response Site	Study NOAEL	Study LOAEL	Body Weight Reported?	Body Weight in kg	Ingestion Rate Reported?	Ingestion Rate in kg/day or L/day	NOAEL Dose (mg/kg/day)*	LOAEL Dose (mg/kg/day)*	Data Source	Dose Route	Test Concentrations	Chemical form	Dose Quantification	Endpoint	Dose Range	Statistical Power	Exposure Duration	Test Conditions	Total
Biochemical																																									
1	990	Heinz et al., 1980	100	Ring dove (*Streptopelia risoria*)	4	0/1.12/4.36/13.2	mg/kg diet	N	ADL	M	FD	8	w	NR	NR	AD	B	C	Lab	HRM	DOPA	BR	1.1	4.4	Y	0.149	Y	0.0111	0.084	0.326	10	10	10	10	7	1	8	10	6	4	76
2	1106	Sell et al., 1971	100	Chicken (*Gallus domesticus*)	3	0/10/20	mg/kg diet	N	DLY	U	FD	12	w	30	w	SM	F	C	Lab	ENZ	GENZ	LI	10.0	20.0	Y	1.6	Y	0.0900	0.563	1.13	10	10	5	10	7	1	10	10	10	4	77
3	40	Davison and Sell, 1974	100	Mallard duck (*Anas platyrhynchos*)	4	0/1/5/10	mg/kg diet	N	ADL	U	FD	48	w	2	yr	MA	F	C	Lab	ENZ	AHDX	LI	10		Y	1.1	N	0.0619	0.563		10	10	5	10	6	1	4	8	10	4	68
4	1054	Muller and Lockman, 1973	100	Chicken (*Gallus domesticus*)	3	0/5/10	mg/kg bw/d	N	ADL	U	OR	28	d	7	d	JV	NR	C	Lab	CHM	CALC	BO	10.0		N	1.042	N	0.0598	10.0		10	8	10	10	10	1	4	1	10	4	68
5	930	Call and Call, 1974	100	Japanese quail (*Coturnix japonica*)	5	0/5/10/15/75	mg/kg diet	N	ADL	U	FD	14	d	7	w	JV	B	V	Lab	CHM	LIPD	SR	75.0		N	0.09	N	0.0121	10.1		10	10	5	10	5	1	4	8	10	4	67
6	975	Gillett and Arscott, 1969	100	Japanese quail (*Coturnix japonica*)	2	0/0.650	mg/kg bw/d	N	ADL	U	FD	35	d	7	d	JV	B	V	Lab	ENZ	AEPX	LI		0.650	Y	0.103	Y	0.0938		0.650	10	10	5	10	10	1	4	10	10	4	74
7	908	Andujar et al., 1978	100	Japanese quail (*Coturnix japonica*)	2	0/20	mg/kg diet	N	ADL	U	FD	48	d	NR	NR	SM	F	C	Lab	CHM	CALC	EG		20	N	0.100	N	0.0130		2.60	10	10	5	10	5	1	4	10	10	4	69
Behavior																																									
8	1151	Watkins et al., 1978	100	Bobwhite quail (*Colinus virginianus*)	4	0/25/50/75	ug/kg bw	N	EOD	U	GV	10	d	NR	NR	AD	M	C	Lab	FDB	FCNS	WO	75.0		Y	0.1661	Y	0.0097	0.0750		10	8	10	10	10	4	4	1	6	4	67
9	909	Atkins and Linder, 1967	100	Ring-necked pheasant (*Phasianus colchicus*)	4	0/0.2858/0.5714/0.8571	mg/d	N	1 per w	U	OR	13	w	1-12	mo	JV	F	C	Lab	FDB	FCNS	WO	0.286	0.571	Y	1.27	N	0.0680	0.225	0.450	10	8	10	10	7	4	10	10	10	4	83
10	909	Atkins and Linder, 1967	100	Ring-necked pheasant (*Phasianus colchicus*)	3	0/0.2858/0.5714	mg/d	N	1 per w	U	OR	13	w	1 - 12	mo	JV	F	C	Lab	FDB	FCNS	WO	0.57		Y	1.101	N	0.0620	0.519		10	8	10	10	7	4	4	3	10	4	70
11	975	Gillett and Arscott, 1969	100	Japanese quail (*Coturnix japonica*)	2	0/0.650	mg/kg bw/d	N	ADL	U	FD	35	d	7	d	JV	B	V	Lab	FDB	FCNS	WO	0.650		Y	0.103	Y	0.0938	0.650		10	10	5	10	10	4	4	1	10	4	68
12	990	Heinz et al., 1980	100	Ring dove (*Streptopelia risoria*)	4	0/1.12/4.36/13.2	mg/kg diet	N	ADL	M	FD	8	w	NR	NR	AD	B	C	Lab	FDB	FCNS	WO	13.2		N	0.149	Y	0.0113	1.00		10	10	10	10	6	4	4	10	6	4	74
13	974	Gesell et al., 1979	100	Bobwhite quail (*Colinus virginianus*)	6	0/50/100/200/250/300	ug/org	N	EOD	U	OR	42	d	NR	NR	AD	M	V	Lab	BEH	NVOC	WO		50.0	N	0.160	N	0.0177		0.313	10	8	5	10	5	4	4	10	6	10	72
14	904	Ahmed et al., 1978	100	Chicken (*Gallus domesticus*)	3	0/25/50	mg/kg diet	N	ADL	U	FD	20	w	NR	NR	SM	M	V	Lab	FDB	FCNS	WO		25.0	Y	2.62	Y	0.0682		0.651	10	10	5	10	7	4	4	10	6	4	70
15	14919	Genelly and Rudd, 1955	100	Ring-necked pheasant (*Phasianus colchicus*)	3	0/25/50	mg/kg diet	N	NR	U	FD	74	d	6	mo	JV	B	C	Lab	FDB	FCNS	WO		25	N	0.950	Y	0.04466		1.18	10	10	5	10	6	4	4	10	10	4	73
16	14920	Genellly and Rudd, 1956	100	Pheasant (*Phasianus colchicus*)	3	0/1.12/1.83	mg/org/d	N	NR	U	FD	6	mo	NR	NR	NR	F	C	Lab	FDB	FCNS	WO		1.12	N	0.950	Y	0.0563		1.18	10	10	5	4	6	4	4	10	10	4	67
17	3362	Kreitzer and Heinz, 1974	100	Quail (*Coturnix coturnix*)	2	0/5	mg/kg diet	N	ADL	U	FD	8	d	7	d	JV	NR	V	Lab	AVO	STIM	WO		5.0	N	0.012	N	0.0033		1.36	10	10	5	10	5	4	4	10	10	4	72
Physiology																																									
18	1151	Watkins et al., 1978	100	Bobwhite quail (*Colinus virginianus*)	4	0/25/50/75	ug/kg bw	N	EOD	U	GV	10	d	NR	NR	AD	M	C	Lab	PHY	EXCR	WO	75.0		Y	0.1661	Y	0.0097	0.0750		10	8	10	10	10	4	4	1	6	4	67
Pathology																																									
19	1151	Watkins et al., 1978	100	Bobwhite quail (*Colinus virginianus*)	4	0/25/50/75	ug/kg bw	N	EOD	U	GV	10	d	NR	NR	AD	M	C	Lab	GRS	BDWT	WO	50.0	75.0	Y	0.1792	Y	0.0097	0.0500	0.0750	10	8	10	10	10	4	10	10	6	4	82
20	1158	Wiese et al., 1968	85	Crowned guinea fowl (*Numida meleagris*)	7	0/0.05/0.15/0.5/1.5/5/15	mg/kg diet	N	ADL	U	FD	21	mo	6	mo	SM	B	C	FieldA	ORW	ORWT	LI	5.00	15.0	Y	1.28	Y	0.0674	0.224	0.671	10	10	5	10	7	4	10	10	10	4	80
21	990	Heinz et al., 1980	100	Ring dove (*Streptopelia risoria*)	4	0/1.12/4.36/13.2	mg/kg diet	N	ADL	M	FD	8	w	NR	NR	AD	B	C	Lab	GRS	BDWT	WO	4.36	13.2	N	0.1490	Y	0.0113	0.331	1.00	10	10	10	10	6	4	8	10	6	4	78
22	40	Davison and Sell, 1974	100	Mallard duck (*Anas platyrhynchos*)	4	0/1/5/10	mg/kg diet	N	ADL	U	FD	48	w	2	yr	MA	F	C	Lab	ORW	ORWT	LI	10		Y	1.1	N	0.0619	0.563		10	10	5	10	6	4	4	10	10	4	73
23	1166	Dahlgren and Linder, 1974	100	Pheasant (*Phasianus colchicus*)	3	0/0.57/0.86	mg/org/d	N	1 per w	U	OR	17	w	1	yr	AD	M	C	Lab	GRS	BDWT	WO	0.86		N	1.3	N	0.0690	0.662		10	8	10	10	5	4	4	1	10	4	66
24	926	Brown et al., 1974	100	Chicken (*Gallus domesticus*)	3	0/10/20	mg/kg diet	N	ADL	U	FD	13	mo	6	w	JV	B	C	Lab	HIS	GLSN	LI	20.0		Y	2.229	N	0.0981	0.880		10	10	5	10	6	4	4	1	10	10	70
25	1106	Sell et al., 1971	100	Chicken (*Gallus domesticus*)	3	0/10/20	mg/kg diet	N	DLY	U	FD	12	w	30	w	SM	F	C	Lab	ORW	ORWT	LI	20.0		Y	1.6	Y	0.0900	1.13		10	10	5	10	6	4	4	10	10	4	73
26	38	Nusz et al., 1976	100	Bobwhite quail (*Colinus virginianus*)	3	0/1.56/3.13	ug/org/d	N	0.25 per d	U	GV	10	d	NR	NR	AD	M	V	Lab	GRS	BDWT	WO		1.56	Y	0.1891	N	0.0197		0.008	10	8	10	10	10	4	4	10	10	10	86
27	38	Nusz et al., 1976	100	Bobwhite quail (*Colinus virginianus*)	3	0/25/50	ug/org/d	N	EOD	U	GV	10	d	NR	NR	AD	M	V	Lab	GRS	BDWT	WO		25.0	Y	0.167	N	0.0181		0.150	10	8	10	10	10	4	4	10	10	10	86
28	1010	Jefferies and French, 1972	100	Homing pigeon (*Columba livia*)	4	0/1/2/4	mg/kg bw/d	N	DLY	U	OR	8	w	NR	NR	NR	B	V	Lab	ORW	ORWT	TY		1.0	Y	0.397	N	0.0319		1.00	10	8	10	10	10	4	4	10	6	4	76
29	14920	Genellly and Rudd, 1956	100	Pheasant (*Phasianus colchicus*)	3	0/1.12/1.83	mg/org/d	N	NR	U	FD	6	mo	NR	NR	NR	F	C	Lab	GRS	BDWT	WO		1.12	N	0.95	N	0.0563		1.18	10	10	5	4	6	10	4	10	10	4	73
Reproduction																																									
30	1158	Wiese et al., 1968	85	Crowned guinea fowl (*Numida meleagris*)	7	0/0.05/0.15/0.5/1.5/5/15	mg/kg diet	N	ADL	U	FD	21	mo	6	mo	LB	F	C	FieldA	REP	PROG	WO	1.50	5.00	Y	1.28	Y	0.0674	0.0671	0.223	10	10	5	10	7	10	8	10	10	4	84
31	1111	Shellenberger, 1978	100	Japanese quail (*Coturnix japonica*)	3	0/0.1/1	mg/kg diet	N	NR	U	FD	10	w	3-4	d	LB	F	C	Lab	REP	TPRD	WO	1.0		Y	0.1335	N	0.0157	0.118		10	10	5	10	6	10	4	1	10	2	68
32	909	Atkins and Linder, 1967	100	Ring-necked pheasant (*Phasianus colchicus*)	3	0/0.2858/0.5714	mg/d	N	1 per w	U	OR	13	w	1-12	mo	JV	F	C	Lab	EGG	EGWT	WO	0.286	0.571	Y	1.101	N	0.0620	0.260	0.519	10	8	10	10	7	10	10	10	10	4	89
33	909	Atkins and Linder, 1967	100	Ring-necked pheasant (*Phasianus colchicus*)	4	0/0.2858/0.5714/0.8571	mg/d	N	1 per w	U	OR	13	w	1-12	mo	LB	F	C	Lab	REP	TPRD	WO	0.571	0.857	Y	1.270	N	0.0680	0.450	0.675	10	8	10	10	7	10	10	10	10	4	89
34	40	Davison and Sell, 1974	100	Mallard duck (*Anas platyrhynchos*)	4	0/1/5/10	mg/kg diet	N	ADL	U	FD	48	w	2	yr	LB	F	C	Lab	REP	EGPN	WO	10		Y	1.1	N	0.0619	0.563		10	10	5	10	6	10	4	1	10	4	70
35	1092	Reading et al., 1976	100	Japanese quail (*Coturnix japonica*)	4	0/5/10/25	mg/kg diet	N	ADL	U	FD	16	w	6	w	SM	B	C	Lab	REP	RSUC	WO	5.0	10	Y	0.135	Y	0.0230	0.852	1.70	10	10	5	10	7	10	10	10	10	4	86
36	926	Brown et al., 1974	100	Chicken (*Gallus domesticus*)	3	0/10/20	mg/kg diet	N	ADL	U	FD	13	mo	6	w	LB	F	C	Lab	EGG	ESTH	WO	20.0		Y	2.229	N	0.0981	0.880		10	10	5	10	6	10	4	1	10	10	76
37	935	Cool et al, 1972	100	Pheasant (*Phasianus colchicus*)	2	0/0.9	mg/kg bw/d	NR	1 per w	U	OR	22	d	NR	NR	LB	F	C	Lab	REP	CYNG	WO	0.900		N	0.95	N	0.0563	0.900		10	8	10	10	10	10	4	1	10	4	77
38	1166	Dahlgren and Linder, 1974	100	Pheasant (*Phasianus colchicus*)	3	0/0.86/1.43	mg/org/d	N	1 per w	U	OR	17	w	1	yr	LB	F	C	Lab	EGG	FTEG	WO	0.86	1.43	N	0.95	N	0.0563	0.905	1.5	10	8	10	10	5	10	10	10	10	4	87
39	1130	Stromborg, 1977	100	Ring-necked pheasant (*Phasianus colchicus*)	2	0/1	mg/d	N	DLY	U	FD	42	d	1	yr	LB	F	C	Lab	REP	HTCH	WO	1.00		N	0.953	N	0.0564	1.05		10	10	5	10	5	10	4	1	10	4	69
40	904	Ahmed et al., 1978	100	Chicken (*Gallus domesticus*)	3	0/25/50	mg/kg diet	N	ADL	U	FD	20	w	NR	NR	SM	M	V	Lab	REP	SPCL	WO	50.0		Y	2.41	Y	0.0524	1.09		10	10	5	10	7	10	4	6	6	4	72
41	944	Davison and Sell, 1972	100	Chicken (*Gallus domesticus*)	3	0/10/20	mg/kg diet	N	NR	U	FD	12	w	28	w	LB	F	C	Lab	REP	TPRD	WO	20		Y	1.541	Y	0.0900	1.17		10	10	5	10	7	10	4	1	10	2	69
42	995	Hill et al., 1976	100	Japanese quail (*Coturnix japonica*)	4	0/1/3/9	mg/kg diet	N	NR	U	FD	75	d	6	mo	LB	F	V	Lab	EGG	ESTH	EG	9.0		N	0.10	N	0.0130	1.17		10	10	5	10	5	10	4	10	10	4	78
43	1145	Walker et al., 1969	100	Japanese quail (*Coturnix japonica*)	5	0/10/20/30/40	mg/kg diet	N	NR	U	FD	18	w	4	w	LB	B	C	Lab	REP	RSUC	WO	10	20	N	0.10	N	0.0130	1.30	2.60	10	10	5	10	5	10	10	10	10	4	84
44	959	Fergin and Schafer, 1977	100	Bobwhite quail (*Colinus virginianus*)	6	0/2.5/5/10/20/40	mg/kg diet	N	ADL	U	FD	34	w	6	mo	LB	F	C	Lab	REP	TPRD	WO	40		N	0.17	N	0.0184	4.32		10	10	5	10	5	10	4	1	10	10	75
45	942	Davison and Sell, 1974	100	Mallard (*Anas platyrhynchos*)	4	0/1/5/10	mg/kg diet	N	ADL	U	FD	48	w	2	yr	LB	F	V	Lab	REP	TPRD	WO	10.0		Y	1.33	Y	0.5880	4.42		10	10	5	10	7	10	4	1	10	4	71
46	941	Dahlgren and Linder, 1970	100	Ring-necked pheasant (*Phasianus colchicus*)	3	0/0.86/1.43	mg/d	N	1 per w	U	OR	16	w	NR	NR	LB	F	C	Lab	EGG	ESTH	EG	10		Y	0.95	N	0.0563	10.5		10	8	5	10	10	10	4	10	10	4	81
47	1042	Mendenhall et al., 1983	100	Barn owl (*Tyto alba*)	2	0/0.58	mg/kg diet	Y	NR	M	FD	2	yr	4	yr	MA	B	V	Lab	EGG	EGWT	EG		0.580	N	0.524	N	0.0382		0.0445	10	10	10	10	5	10	4	10	10	10	89
48	14885	Lehner and Egbert, 1969	100	Mallard duck (*Anas platyrhynchos*)	4	0/1.6/4/10	mg/kg diet	N	NR	U	FD	42	d	NR	NR	LB	F	V	FieldA	EGG	ESTH	WO		1.6	N	0.46	N	0.0351		0.122	10	10	5	10	5	10	4	10	10	4	78
49	1052	Muller and Lockman, 1972	100	Mallard (*Anas platyrhynchos*)	2	0/4	mg/kg diet	N	ADL	U	FD	90	d	1	yr	LB	F	C	FieldA	REP	RSUC	WO		4.0	Y	1.1	N	0.0619		0.226	10	10	5	10	5	10	4	10	10	4	78

Ref			Exposure																	Effects					Conversion to mg/kg bw/day				Result		Data Evaluation Score										
Result #	Ref No.		MW%	Test Species	# of Conc/ Doses	Conc/ Doses	Conc/Dose Units	Wet Weight Reported?	Application Frequency	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Control Type	Test Location	Effect Type	Effect Measure	Response Site	Study NOAEL	Study LOAEL	Body Weight Reported?	Body Weight in kg	Ingestion Rate Reported?	Ingestion Rate in kg/day or L/day	NOAEL Dose (mg/kg/day)*	LOAEL Dose (mg/kg/day)*	Data Source	Dose Route	Test Concentrations	Chemical form	Dose Quantification	Endpoint	Dose Range	Statistical Power	Exposure Duration	Test Conditions	Total
50	931	Call and Harrell, 1974	100	Japanese quail (*Coturnix japonica*)	3	0/3.1/50	mg/kg diet	N	ADL	U	FD	21	d	7	w	LB	F	V	Lab	REP	TPRD	WO		3.1	N	0.10	N	0.0130		0.403	10	10	5	10	5	10	4	10	10	4	78
51	930	Call and Call, 1974	100	Japanese quail (*Coturnix japonica*)	5	0/5/10/15/75	mg/kg diet	N	ADL	U	FD	14	d	7	w	LB	F	V	Lab	REP	TPRD	WO		5.00	N	0.090	N	0.0121		0.674	10	10	5	10	5	10	4	10	10	4	78
52	14920	Genellly and Rudd, 1956	100	Pheasant (*Phasianus colchicus*)	3	0/1.12/1.83	mg/org/d	N	NR	U	FD	6	mo	NR	NR	LB	F	C	Lab	REP	PROG	WO		1.12	N	0.95	Y	0.0563		1.18	10	10	5	4	6	10	4	10	10	4	73
53	1092	Reading et al., 1976	100	Japanese quail (*Coturnix japonica*)	3	0/10/25	mg/kg diet	N	ADL	U	FD	24	w	6	w	SM	B	C	Lab	REP	RSUC	WO		10	Y	0.132	Y	0.0200		1.52	10	10	5	10	7	10	4	10	10	4	80
54	908	Andujar et al., 1978	100	Japanese quail (*Coturnix japonica*)	2	0/20	mg/kg diet	N	ADL	U	FD	20	d	NR	NR	LB	B	C	Lab	REP	PROG	WO		20	N	0.10	N	0.0130		2.60	10	10	5	10	5	10	4	10	10	4	78
Growth																																									
55	1057	Nebeker et al., 1992	100	Mallard (*Anas platyrhynchos*)	7	0/0.3/16.4/48/155/272/606	ug/g diet	Y	NR	M	FD	24	d	1	d	JV	B	V	Lab	GRO	BDWT	WO	0.300	16.4	Y	0.334	Y	0.0750	0.071	3.78	10	10	10	10	7	8	6	10	10	10	91
56	1111	Shellenberger, 1978	100	Japanese quail (*Coturnix japonica*)	3	0/0.1/1	mg/kg diet	N	NR	U	FD	10	w	3-5	d	JV	B	C	Lab	GRO	BDWT	WO	1.0		Y	0.1335	N	0.0157	0.118		10	10	5	10	6	8	4	1	10	2	66
57	909	Atkins and Linder, 1967	100	Ring-necked pheasant (*Phasianus colchicus*)	3	0/0.2858/0.5714	mg/d	N	1 per w	U	OR	13	w	1-12	mo	JV	F	C	Lab	GRO	BDWT	WO	0.286	0.571	Y	1.101	N	0.0620	0.260	0.519	10	8	10	10	7	8	10	10	10	4	87
58	1054	Muller and Lockman, 1973	100	Chicken (*Gallus domesticus*)	3	0/5.0/10.0	mg/kg diet	N	ADL	U	FD	28	d	7	d	JV	NR	C	Lab	GRO	BDWT	WO	10.0		N	1.042	N	0.0598	0.574		10	10	5	10	5	8	4	1	10	4	67
59	975	Gillett and Arscott, 1969	100	Japanese quail (*Coturnix japonica*)	2	0/0.650	mg/kg bw/d	N	ADL	U	FD	35	d	7	d	JV	B	V	Lab	GRO	BDWT	WO	0.650		Y	0.103	Y	0.0938	0.650		10	10	5	10	10	8	4	1	10	4	72
60	904	Ahmed et al., 1978	100	Chicken (*Gallus domesticus*)	3	0/25/50	mg/kg diet	N	ADL	U	FD	20	w	NR	NR	SM	M	V	Lab	GRO	BDWT	WO	50.0		Y	2.41	Y	0.0524	1.09		10	10	5	10	7	8	4	10	6	4	74
61	944	Davison and Sell, 1972	100	Chicken (*Gallus domesticus*)	3	0/10/20	mg/kg diet	N	NR	U	FD	12	w	28	w	LB	F	C	Lab	GRO	BDWT	WO	20		Y	1.541	Y	0.0900	1.17		10	10	5	10	7	8	4	1	10	2	67
62	930	Call and Call, 1974	100	Japanese quail (*Coturnix japonica*)	5	0/5/10/15/75	mg/kg diet	N	ADL	U	FD	14	d	7	w	JV	B	V	Lab	GRO	BDWT	WO	15.0	75.0	N	0.09	N	0.0121	2.02	10.1	10	10	5	10	5	8	8	10	10	4	80
63	1092	Reading et al., 1976	100	Japanese quail (*Coturnix japonica*)	3	0/10/25	mg/kg diet	N	ADL	U	FD	24	w	6	w	SM	B	C	Lab	GRO	BDWT	WO	25		Y	0.135	Y	0.0180	3.33		10	10	5	10	7	8	4	1	10	4	69
64	14919	Genelly and Rudd, 1955	100	Ring-necked pheasant (*Phasianus colchicus*)	5	0/25/70/100/200	mg/kg diet	N	NR	U	FD	90	d	6	mo	JV	F	C	Lab	GRO	BDWT	WO	70	100	N	0.95	N	0.0563	4.15	5.93	10	10	5	10	5	8	10	10	6	4	78
65	1054	Muller and Lockman, 1973	100	Chicken (*Gallus domesticus*)	3	0/5/10	mg/kg bw/d	N	ADL	U	OR	28	d	7	d	JV	NR	C	Lab	GRO	BDWT	WO	10.0		N	1.042	N	0.0598	10		10	8	10	10	10	8	4	1	10	4	75
66	909	Atkins and Linder, 1967	100	Ring-necked pheasant (*Phasianus colchicus*)	4	0/0.2858/0.5714/0.8571	mg/d	N	1 per w	U	OR	13	w	1-12	mo	JV	F	C	Lab	GRO	BDWT	WO		0.286	Y	1.212	N	0.0660		0.236	10	8	10	10	7	8	4	10	10	4	81
67	926	Brown et al., 1974	100	Chicken (*Gallus domesticus*)	3	0/10/20	mg/kg diet	N	ADL	U	FD	5	mo	6	w	JV	B	C	Lab	GRO	BDWT	WO		10.0	Y	2.236	N	0.0983		0.439	10	10	5	10	6	8	4	10	10	10	83
68	14919	Genelly and Rudd, 1955	100	Ring-necked pheasant (*Phasianus colchicus*)	3	0/25/50	mg/kg diet	N	NR	U	FD	74	d	6	mo	JV	F	C	Lab	GRO	BDWT	WO		25.0	N	0.95	Y	0.0366		0.960	10	10	5	10	6	8	4	10	6	4	73
Survival																																									
69	1042	Mendenhall et al., 1983	100	Barn owl (*Tyto alba*)	2	0/0.58	mg/kg diet	Y	NR	M	FD	2	yr	4	yr	MA	B	V	Lab	MOR	MORT	WO	0.580		N	0.524	N	0.0382	0.0445		10	10	10	10	5	9	4	1	10	10	79
70	1158	Wiese et al., 1968	85	Crowned guinea fowl (*Numida meleagris*)	7	0/0.05/0.15/0.5/1.5/5/15	mg/kg diet	N	ADL	U	FD	21	mo	6	mo	SM	F	C	FieldA	MOR	MORT	WO	1.50	5.00	Y	1.28	Y	0.0539	0.0537	0.179	10	10	5	10	7	9	8	10	10	4	83
71	1057	Nebeker et al., 1992	100	Mallard (*Anas platyrhynchos*)	7	0/0.3/16.4/48/155/272/606	ug/g diet	Y	NR	M	FD	24	d	1	d	JV	B	V	Lab	MOR	MORT	WO	0.300	16.4	Y	0.334	Y	0.0750	0.071	3.78	10	10	10	10	7	9	6	10	10	10	92
72	959	Fergin and Schafer, 1977	100	Bobwhite quail (*Colinus virginianus*)	6	0/2.5/5/10/20/40	mg/kg diet	N	ADL	U	FD	34	w	6	mo	SM	B	C	Lab	MOR	MORT	WO	2.5	5.0	N	0.17	N	0.0184	0.27	0.54	10	10	5	10	5	9	10	10	10	10	89
73	40	Davison and Sell, 1974	100	Mallard duck (*Anas platyrhynchos*)	4	0/1/5/10	mg/kg diet	N	ADL	U	FD	48	w	2	yr	MA	F	C	Lab	MOR	SURV	WO	5.0	10	Y	1.1	N	0.0619	0.28	0.56	10	10	5	10	6	9	10	10	10	4	84
74	974	Gesell et al., 1979	100	Bobwhite quail (*Colinus virginianus*)	6	0/50/100/200/250/300	ug/org	N	EOD	U	OR	42	d	NR	NR	AD	M	V	Lab	MOR	MORT	WO	100	200	N	0.16	N	0.0177	0.625	1.25	10	8	5	10	5	9	10	10	6	10	83
75	975	Gillett and Arscott, 1969	100	Japanese quail (*Coturnix japonica*)	2	0/0.650	mg/kg bw/d	N	ADL	U	FD	35	d	7	d	JV	B	V	Lab	MOR	MORT	WO	0.650		Y	0.103	Y	0.0938	0.650		10	10	5	10	10	9	4	10	10	4	82
76	1092	Reading et al., 1976	100	Japanese quail (*Coturnix japonica*)	4	0/5/10/25	mg/kg diet	N	ADL	U	FD	16	w	6	w	SM	F	C	Lab	MOR	MORT	WO	5.0	10	Y	0.135	Y	0.0230	0.852	1.70	10	10	5	10	7	9	10	10	10	4	85
77	926	Brown et al., 1974	100	Chicken (*Gallus domesticus*)	3	0/10/20	mg/kg diet	N	ADL	U	FD	13	mo	6	w	JV	B	C	Lab	MOR	MORT	WO	20.0		Y	2.229	N	0.0981	0.880		10	10	5	10	6	9	4	10	10	10	84
78	944	Davison and Sell, 1972	100	Chicken (*Gallus domesticus*)	3	0/10/20	mg/kg diet	N	NR	U	FD	12	w	28	w	LB	F	C	Lab	MOR	MORT	WO	20		Y	1.541	Y	0.0900	1.17		10	10	5	10	7	9	4	10	10	2	77
79	14919	Genelly and Rudd, 1955	100	Ring-necked pheasant (*Phasianus colchicus*)	3	0/25/50	mg/kg diet	N	NR	U	FD	60	d	6	mo	JV	B	C	Lab	MOR	MORT	WO	25	50	N	0.95	Y	0.0446	1.17	2.35	10	10	5	10	6	9	10	10	10	4	84
80	1145	Walker et al., 1969	100	Japanese quail (*Coturnix japonica*)	5	0/10/20/30/40	mg/kg diet	N	NR	U	FD	18	w	4	w	LB	B	C	Lab	MOR	MORT	WO	10	20	N	0.100	N	0.0130	1.3	2.6	10	10	5	10	5	9	10	10	10	4	83
81	3362	Kreitzer and Heinz, 1974	100	Quail (*Coturnix coturnix*)	2	0/5	mg/kg diet	N	ADL	U	FD	8	d	7	d	JV	NR	V	Lab	MOR	MORT	WO	5.0		N	0.01	N	0.0033	1.4		10	10	5	10	5	9	4	10	10	4	77
82	14919	Genelly and Rudd, 1955	100	Ring-necked pheasant (*Phasianus colchicus*)	5	0/25/70/100/200	mg/kg diet	N	NR	U	FD	90	d	6	mo	JV	F	C	Lab	MOR	MORT	WO	25	70	N	0.95	N	0.0563	1.48	4.15	10	10	5	10	5	9	10	10	10	4	83
83	1010	Jefferies and French, 1972	100	Homing pigeon (*Columba livia*)	4	0/1/2/4	mg/kg bw/d	N	DLY	U	OR	8	w	NR	NR	NR	B	V	Lab	MOR	MORT	WO	2.0	4.0	Y	0.397	N	0.0319	2.0	4.0	10	8	10	10	10	9	10	10	6	4	87
84	942	Davison and Sell, 1974	100	Mallard (*Anas platyrhynchos*)	4	0/1/5/10	mg/kg diet	N	ADL	U	FD	48	w	2	yr	AD	F	V	Lab	MOR	SURV	WO	5.00	10.0	N	1.33	Y	0.5880	2.21	4.42	10	10	5	10	7	9	4	10	10	4	85
85	14939	Eden, 1951	100	Chicken (*Gallus domesticus*)	4	0/5/10/15/17.5/20.0/22.5/25/3(	mg/kg bw	N	NR	U	OR	90	d	3	w	JV	NR	C	NR	MOR	MORT	WO	10.00	15.00	Y	1.694	N	0.0820	10.00	15.00	10	8	10	10	10	9	10	10	10	2	89
86	930	Call and Call, 1974	100	Japanese quail (*Coturnix japonica*)	5	0/5/10/15/75	mg/kg diet	N	ADL	U	FD	14	d	7	w	SM	B	V	Lab	MOR	MORT	WO	75.0		N	0.09	N	0.0121	10.1		10	10	5	10	5	9	4	10	10	4	77
87	1166	Dahlgren and Linder, 1974	100	Pheasant (*Phasianus colchicus*)	3	0/0.57/0.86	mg/org/d	N	1 per w	U	OR	17	w	1	yr	AD	M	C	Lab	MOR	MORT	WO		0.57	N	1.3	N	0.0690		0.44	10	8	10	10	5	9	4	10	10	4	80
88	14885	Lehner and Egbert, 1969	100	Mallard duck (*Anas platyrhynchos*)	4	0/1.6/4/10	mg/kg diet	N	NR	U	FD	491	d	NR	NR	AD	B	V	FieldA	MOR	MORT	WO		10	N	1.2	N	0.0655		0.55	10	10	5	10	5	9	4	10	10	4	77
89	904	Ahmed et al., 1978	100	Chicken (*Gallus domesticus*)	3	0/25/50	mg/kg diet	N	ADL	U	FD	12	w	NR	NR	SM	M	V	Lab	MOR	MORT	WO		25.0	Y	2.62	Y	0.0682		0.651	10	10	5	10	7	9	4	10	6	4	75
90	1092	Reading et al., 1976	100	Japanese quail (*Coturnix japonica*)	3	0/10/25	mg/kg diet	N	ADL	U	FD	24	w	6	w	SM	M	C	Lab	MOR	MORT	WO		10	Y	0.120	Y	0.0200		1.67	10	10	5	10	7	9	4	10	10	4	79
Data Not Used to Derive Wildlife Toxicity Reference Value																																									
91	14919	Genelly and Rudd, 1955	100	Ring-necked pheasant (*Phasianus colchicus*)	3	0/25/50	mg/kg diet	N	NR	U	FD	74	d	6	mo	JV	F	C	Lab	HIS	GHIS	LI	50		N	0.950	Y	0.0000366	0.0019		10	10	5	10	6	4	4	1	10	4	64
92	1054	Muller and Lockman, 1973	100	Chicken (*Gallus domesticus*)	3	0/5.0/10.0	mg/kg diet	N	ADL	U	FD	28	d	7	d	JV	NR	C	Lab	CHM	CALC	BO	10.0		N	1.042	N	0.0598	0.574		10	10	5	10	5	1	4	1	10	4	60
93	1158	Wiese et al., 1968	85	Crowned guinea fowl (*Numida meleagris*)	7	0/0.05/0.15/0.5/1.5/5/15	mg/kg diet	N	ADL	U	FD	21	mo	6	mo	SM	B	C	FieldA	FDB	FCNS	WO	15.0		Y	1.28	Y	0.0674	0.6714		10	10	5	10	7	4	4	1	10	4	65
94	1130	Stromborg, 1977	100	Ring-necked pheasant (*Phasianus colchicus*)	2	0/1	mg/d	N	DLY	U	FD	42	d	1	yr	SM	F	C	Lab	FDB	FCNS	WO	1.00		N	0.953	N	0.0564	1.05		10	10	5	10	5	4	4	1	10	4	63
95	1092	Reading et al., 1976	100	Japanese quail (*Coturnix japonica*)	3	0/10/25	mg/kg diet	N	ADL	U	FD	24	w	6	w	SM	F	C	Lab	FDB	FCNS	WO	25		Y	0.135	Y	0.0180	3.33		10	10	5	10	7	4	4	1	10	4	65
96	942	Davison and Sell, 1974	100	Mallard (*Anas platyrhynchos*)	4	0/1/5/10	mg/kg diet	N	ADL	U	FD	48	w	2	yr	LB	F	V	Lab	PTH	BDWT	WO	10.0		Y	1.33	Y	0.5880	4.42		10	10	5	10	7	4	4	1	10	4	65
97	942	Davison and Sell, 1974	100	Mallard (*Anas platyrhynchos*)	4	0/1/5/10	mg/kg diet	N	ADL	U	FD	48	w	2	yr	LB	F	V	Lab	FDB	FCNS	WO	10.0		Y	1.33	Y	0.5880	4.42		10	10	5	10	7	4	4	1	10	4	65

The abbreviations and definitions used in coding data are provided in Attachment 4-3 of the Eco-SSL Guidance (U.S.EPA, 2003).

*Duplicate values for NOAELs and LOAELs for the same reference represent results from different experimental designs.

Appendix 6-1

Mammalian Toxicity Data Extracted and Reviewed for Wildlife Toxicity Reference Value (TRV) - Dieldrin

March 2005
Revised April 2007

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Ref			Exposure																Effects					Conversion to mg/kg bw/day				Result		Data Evaluation Score										
Result #	Ref. No.		MW%	Test Species	# of Conc/ Doses	Conc/ Doses	Conc/Dose Units	Application Frequency	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Control Type	Test Location	Effect Type	Effect Measure	Response Site	Study NOAEL	Study LOAEL	Body Weight Reported?	Body Weight in kg	Ingestion Rate Reported?	Ingestion Rate in kg/day	NOAEL Dose (mg/kg/day)*	LOAEL Dose (mg/kg/day)*	Data Source	Dose Route	Test Concentrations	Chemical form	Dose Quantification	Endpoint	Dose Range	Statistical Power	Exposure Duration	Test Conditions	Total
Biochemical																																								
1	1146	Walker et al., 1969	100	Dog (*Canis familiaris*)	3	0/0.005/0.05	mg/kg bw/d	DLY	M	OR	32	w	4-7	mo	JV	M	V	Lab	ENZ	ALPH	PL	0.005	0.050	Y	14	N	0.6013	0.005	0.050	10	8	10	10	10	1	6	10	10	4	79
2	1122	Stevenson et al., 1995	100	Mouse (*Mus musculus*)	4	0/1/3/10	mg/kg diet	ADL	U	FD	28	d	4	w	JV	M	C	Lab	ENZ	EROD	LI	1.00	3.00	N	0.0316	N	0.0040	0.127	0.381	10	10	5	10	5	1	10	10	6	4	69
3	1139	van Ravenzwaay et al., 1988	100	Mouse (*Mus musculus*)	4	0/1/5/10	mg/kg diet	NR	U	FD	14	mo	4	w	JV	F	C	Lab	ENZ	AATT	LI	1.0	5.0	N	0.0288	N	0.0037	0.129	0.646	10	10	5	10	5	1	8	10	10	4	73
4	943	Davison, 1970	87	Sheep (*Ovis aries*)	5	0/0.5/1/2/4	mg/kg bw/d	NR	UX	FD	32	w	NR	NR	JV	M	V	Lab	CHM	HMCT	PL	2.0		Y	40	N	1.4251	1.74		10	10	10	10	10	1	4	1	10	4	70
5	961	Foster, 1968	100	Rat (*Rattus novegicus*)	3	0/100/200	mg/kg diet	NR	U	FD	7	d	NR	NR	JV	M	C	Lab	HRM	CRTS	AR	100	200	Y	0.166	N	0.0157	9.02	18.9	10	10	5	10	6	1	4	10	10	4	70
6	1026	Krampl and Hladka, 1975	100	Rat (*Rattus novegicus*)	5	0/0.05/0.25/1.25/2.5	mg/kg bw	DLY	U	GV	13	d	NR	NR	JV	M	V	Lab	ENZ	PNAD	LI		0.050	Y	0.15	N	0.0144		0.050	10	8	10	10	10	1	4	10	10	4	77
7	1108	Shakoori et al., 1984	20	Rat (*Rattus novegicus*)	2	0/2	mg/kg bw/d	ADL	U	FD	1	mo	10	mo	SM	M	C	Lab	CHM	TLBL	SR		2.00	Y	0.35	Y	0.0400		0.400	10	10	5	10	10	1	4	10	10	4	74
8	1141	Virgo and Bellward, 1975	86.1	Mouse (*Mus musculus*)	5	0/5/10/15/20	mg/kg diet	NR	U	FD	10	w	13	w	NR	F	C	Lab	CHM	PRTL	MC		5.00	N	0.0288	N	0.0037		0.556	10	10	5	10	5	1	4	10	10	4	69
9	1040	Mehrotra et al., 1988	100	Rat (*Rattus novegicus*)	2	0/10	mg/kg diet	DLY	U	FD	50	d	NR	NR	JV	M	V	Lab	ENZ	GENZ	BR		10.0	Y	0.480	Y	0.0336		0.700	10	10	5	10	7	1	4	10	10	4	71
10	1103	Schein and Thomas, 1975	100	Mouse (*Mus musculus*)	4	0/1.25/2.5/5	mg/kg bw/d	DLY	U	GV	5	d	NR	NR	MA	M	V	Lab	HRM	TSTR	TE		1.25	Y	0.04	N	0.0049		1.25	10	8	10	10	10	1	4	10	6	2	71
11	1133	Thomas, 1974	100	Mouse (*Mus musculus*)	4	0/1.25/2.5/5	mg/kg bw/d	DLY	U	GV	10	d	NR	NR	AD	M	V	Lab	HRM	TSTR	PG		1.3	Y	0.04	N	0.0049		1.25	10	8	10	10	10	1	4	10	6	4	73
12	1107	Shakoori et al., 1982	100	Rat (*Rattus novegicus*)	2	0/2	mg/kg bw/d	NR	U	FD	3	mo	NR	NR	AD	M	C	Lab	ENZ	ALPH	LI		2.0	Y	0.40	N	0.0323		2.00	10	10	5	10	10	1	4	10	10	4	74
13	1163	Zemaitis et al., 1976	99	Rat (*Rattus novegicus*)	2	0/50	mg/kg diet	ADL	U	FD	8	w	NR	NR	JV	F	C	Lab	ENZ	CEST	PL		50.0	Y	0.15	N	0.0144		4.77	10	10	5	10	6	1	4	10	10	4	70
14	911	Bandyopadhyay et al., 1982	100	Rat (*Rattus novegicus*)	2	0/5	mg/kg bw/d	DLY	U	GV	15	d	NR	NR	JV	M	V	Lab	ENZ	GENZ	LI		5.0	Y	0.067	N	0.0074		5.00	10	8	10	10	10	1	4	10	10	4	77
Behavior																																								
15	988	Harr et al.,1970	100	Rat (*Rattus novegicus*)	11	0/0.08/0.16/0.31/0.63/1.25/2.5/5.0/10/20/40	mg/kg diet	ADL	UX	FD	750	d	28	d	JV	B	C	Lab	FDB	FCNS	WO	0.630	1.25	N	0.217	N	0.0196	0.0568	0.113	10	10	10	10	5	4	10	10	10	4	83
16	1056	Murphy and Korschgen, 1970	100	White-tailed deer (*Odocoileus virginianus*)	3	0/0.14/0.72	mg/kg bw/d	ADL	U	FD	3	yr	6-7	mo	JV	F	V	FieldA	FDB	FCNS	WO	0.720		Y	36.78	Y	1.0430	0.720		10	10	5	10	10	4	4	1	10	4	68
17	1027	Krishnamurthy et al., 1965	100	Rat (*Rattus novegicus*)	2	0/1.43	mg/kg bw/d	ADL	U	FD	24	w	NR	NR	JV	B	C	Lab	FDB	FCNS	BL	1.43		Y	0.200	Y	0.0103	1.43		10	10	5	10	10	4	4	1	10	4	68
18	1104	Schnorr, 1975	100	Sheep (*Ovis aries*)	4	0/0.5/2.5/5.0	mg/kg bw/d	DLY	U	OR	35	d	24-30	mo	AD	F	C	NR	BEH	GBHV	WO	2.5	5.0	N	32	N	1.1863	2.50	5.00	10	8	10	10	10	4	10	10	6	4	82
19	961	Foster, 1968	100	Rat (*Rattus novegicus*)	2	0/200	mg/kg diet	NR	U	FD	16	d	NR	NR	JV	M	C	Lab	FDB	FCNS	WO	200		Y	0.1662	Y	0.0137	16.5		10	10	5	10	7	4	4	10	10	4	74
20	1141	Virgo and Bellward, 1975	86.1	Mouse (*Mus musculus*)	5	0/5/10/15/20	mg/kg diet	NR	U	FD	10	w	13	w	NR	F	C	Lab	BEH	RRSP	WO		5.00	Y	0.0288	N	0.0037		0.556	10	10	5	10	6	4	4	10	10	4	73
21	1040	Mehrotra et al., 1988	100	Rat (*Rattus novegicus*)	2	0/10	mg/kg diet	DLY	U	FD	40	d	NR	NR	JV	M	V	Lab	FDB	FCNS	WO		10.0	Y	0.460	Y	0.0345		0.750	10	10	5	10	7	4	4	10	10	4	74
22	918	Bildstein and Forsyth, 1979	87	White-footed mouse (*Peromyscus leucopus*)	2	0/10	mg/kg diet	ADL	U	FD	3	mo	3-4	mo	AD	NR	V	Lab	BEH	FRZG	WO		10.0	N	0.027	N	0.0035		1.14	10	10	5	10	5	4	4	10	10	4	72
23	14987	Keane and Zavon, 1969	99	Dog (*Canis familiaris*)	2	0/2.0	mg/kg bw/d	5 per w	U	OR	25	d	24-27	mo	AD	B	V	Lab	FDB	FCNS	WO		2.00	N	14	N	0.6013		1.98	10	8	10	10	10	4	4	10	3	4	73
24	1020	Kimbrough et al., 1971	100	Rat (*Rattus novegicus*)	3	0/2.64/5.33	mg/kg bw/d	ADL	U	FD	8	w	4	mo	JV	M	C	Lab	BEH	INST	WO		2.64	Y	0.512	N	0.0396		2.64	10	10	5	10	10	4	4	10	6	4	73
25	1127	Stoewsand et al., 1970	100	Rat (*Rattus novegicus*)	2	0/150	mg/kg diet	NR	U	FD	7	d	NR	NR	JV	B	C	Lab	FDB	FCNS	WO		150	N	0.2187	Y	0.0085		5.82	10	10	5	10	6	4	4	10	6	4	69
Physiology																																								
26	919	Blend and Visek, 1972	100	Dog (*Canis familiaris*)	2	0/15	ug/kg bw/d	DLY	U	FD	6	mo	16-36	mo	AD	NR	C	Lab	PHY	EXCR	PG	15		Y	16	N	0.6710	0.0150		10	10	5	10	10	4	4	10	6	4	73
27	1000	Hurkat and Joshi, 1977	100	Rabbit (*Oryctolagus cuniculus*)	2	0/1.25	mg/kg bw	EOD	U	GV	3	mo	NR	NR	NR	B	C	Lab	PHY	RPRT	WO	1.3		Y	1.923	N	0.1176	1.25		10	8	10	10	10	4	4	10	10	4	80
28	14952	Khairy 1960	100	Rat (*Rattus novegicus*)	3	0/12.5/25	mg/kg bw/d	DLY	U	FD	60	d	75	d	JV	M	C	Lab	PHY	GPHY	MU		12.5	N	0.235	N	0.0209		12.5	10	10	5	10	10	4	4	10	10	4	77
Pathology																																								
29	1146	Walker et al., 1969	100	Rat (*Rattus novegicus*)	4	0/0.11/1/9.66	mg/kg diet	NR	M	FD	104	w	5	w	JV	B	C	Lab	ORW	SMIX	LI	0.110	1.00	Y	0.333	N	0.0278	0.00919	0.0836	10	10	10	10	6	4	8	10	10	4	82
30	1026	Krampl and Hladka, 1975	100	Rat (*Rattus novegicus*)	5	0/0.05/0.25/1.25/2.5	mg/kg diet	DLY	U	GV	13	d	NR	NR	JV	M	V	Lab	ORW	SMIX	LI	0.050	0.250	Y	0.15	N	0.0144	0.050	0.250	10	8	10	10	10	4	8	10	10	4	84
31	1122	Stevenson et al., 1995	100	Mouse (*Mus musculus*)	4	0/1/3/10	mg/kg diet	ADL	U	FD	28	d	4	w	JV	M	C	Lab	HIS	GHIS	LI	1.00	3.00	Y	0.0316	N	0.0040	0.127	0.381	10	10	5	10	5	4	10	10	6	4	74
32	1056	Murphy and Korschgen, 1970	100	White-tailed deer (*Odocoileus virginianus*)	3	0/0.14/0.72	mg/kg bw/d	ADL	U	FD	3	yr	18-19	mo	JV	F	V	FieldA	ORW	ORWT	LI	0.140	0.720	Y	36.78	Y	1.0430	0.140	0.720	10	10	5	10	10	4	8	10	10	4	81
33	14960	Treon et al, 1951	99	Rat (*Rattus novegicus*)	6	0/2.5/5.0/25/75/300	mg/kg diet	DLY	M	FD	16	w	NR	NR	JV	B	V	Lab	ORW	ORWT	LI	2.5	5.0	Y	0.4469	N	0.0354	0.196	0.392	10	10	10	10	6	4	10	10	10	4	84
34	1104	Schnorr, 1975	100	Sheep (*Ovis aries*)	4	0/0.5/2.5/5.0	mg/kg bw/d	DLY	U	OR	35	d	24-30	mo	AD	F	C	NR	ITX	GITX	WO	0.500	2.5	N	35	N	1.2770	0.500	2.50	10	8	10	10	10	4	8	10	6	4	80
35	1023	Kolaja et al., 1996	100	Rat (*Rattus novegicus*)	5	0/0.1/1.0/3.0/10.0	mg/kg diet	ADL	UX	FD	90	d	8	w	JV	M	C	Lab	ORW	SMIX	LI	10.0		Y	0.325	N	0.0273	0.839		10	10	10	10	6	4	4	1	10	7	72
36	932	Chernoff et al., 1975	87	Mouse (*Mus musculus*)	4	0/1.5/3/6	mg/kg bw/d	DLY	U	GV	10	d	NR	NR	GE	F	V	Lab	ORW	SMIX	LI	1.50	3.00	N	0.0288	N	0.0037	1.31	2.61	10	8	10	10	10	4	10	10	10	4	86
37	1137	Uzoukwu et al., 1972	100	Guinea pig (*Cavia porcellus*)	5	0/10/25/50/100	mg/kg diet	NR	U	FD	53	d	NR	NR	GE	F	C	Lab	HIS	NCRO	UT	50.0	100	N	0.86	N	0.0607	3.53	7.06	10	10	5	10	5	4	10	10	10	4	78
38	932	Chernoff et al., 1975	87	Rat (*Rattus novegicus*)	4	0/1.5/3/6	mg/kg bw/d	DLY	U	GV	10	d	NR	NR	GE	F	V	Lab	ORW	SMIX	LI	6.00		N	0.3846	N	0.0313	5.22		10	8	10	10	10	4	4	10	10	4	80
39	961	Foster, 1968	100	Rat (*Rattus novegicus*)	3	0/100/200	mg/kg diet	NR	U	FD	7	d	NR	NR	JV	M	C	Lab	ORW	SMIX	AR	100	200	Y	0.216	N	0.0195	9.02	18.0	10	10	5	10	6	4	10	10	10	4	79
40	1146	Walker et al., 1969	100	Dog (*Canis familiaris*)	3	0/0.005/0.05	mg/kg bw/d	DLY	M	OR	104	w	6	w	JV	M	V	Lab	ORW	ORWT	HE		0.005	Y	14.8	N	0.6294		0.0050	10	8	10	10	10	4	4	10	10	4	80
41	1023	Kolaja et al., 1996	100	Mouse (*Mus musculus*)	5	0/0.1/1/3/10	mg/kg diet	ADL	UX	FD	7	d	8	w	JV	M	C	Lab	ORW	SMIX	LI		0.100	Y	0.024	N	0.0032		0.0133	10	10	10	10	6	4	4	10	10	7	81
42	1096	Reuber, 1980	100	Rat (*Rattus novegicus*)	8	0/0.5/1/2/10/50/100/150	mg/kg diet	NR	U	FD	2	yr	3	w	JV	B	C	Lab	HIS	NPHR	KI		0.500	N	0.451	N	0.0357		0.0396	10	10	5	10	5	4	4	10	10	4	72
43	960	Fitzhugh et al., 1964	100	Rat (*Rattus novegicus*)	7	0/0.5/2/10/50/100/150	mg/kg diet	ADL	U	FD	2	yr	NR	NR	JV	B	V	Lab	ORW	SMIX	LI		0.500	Y	0.325	N	0.0273		0.0420	10	10	5	10	6	4	4	10	10	4	73
44	1141	Virgo and Bellward, 1975	86.1	Mouse (*Mus musculus*)	5	0/5/10/15/20	mg/kg diet	NR	U	FD	10	w	13	w	NR	F	C	Lab	ORW	SMIX	LI		5.00	N	0.0288	N	0.0037		0.556	10	10	5	10	5	4	4	10	10	4	72
45	1018	Keane et al., 1969	100	Dog (*Canis familiaris*)	2	0/2	mg/kg bw/d	5 per w	U	OR	24	d	24 - 27	mo	AD	NR	C	Lab	ITX	CONV	WO		1.0	Y	10.26	N	0.4657		1.00	10	8	5	10	10	4	4	10	6	4	71
46	1040	Mehrotra et al., 1988	100	Rat (*Rattus novegicus*)	2	0/10	mg/kg diet	DLY	U	FD	5	d	NR	NR	NR	M	V	Lab	ITX	INTX	WO		10.0	Y	0.280	Y	0.0322		1.15	10	10	5	10	7	4	4	10	10	4	74
47	14937	Davis and Fitzhugh, 1962	100	Mouse (*Mus musculus*)	2	0/10	mg/kg diet	NR	U	FD	2	yr	NR	NR	YO	B	C	Lab	HIS	GHIS	LI		10.0	N	0.045	N	0.0054		1.19	10	10	5	10	5	4	4	10	10	2	70
48	1000	Hurkat and Joshi, 1977	100	Rabbit (*Oryctolagus cuniculus*)	2	0/1.25	mg/kg bw	EOD	U	GV	3	mo	NR	NR	NR	B	C	Lab	ITX	CONV	WO		1.3	Y	1.861	N	0.1145		1.25	10	8	10	10	10	4	4	10	10	4	80
49	1095	Reuber, 1977	100	Mouse (*Mus musculus*)	2	0/10	mg/kg diet	NR	U	FD	104	w	3	w	JV	B	C	Lab	HIS	GHIS	LI		10.0	N	0.0302	N	0.0039		1.28	10	10	5	10	5	4	4	10	10	4	72
50	1027	Krishnamurthy et al., 1965	100	Rat (*Rattus novegicus*)	2	0/1.43	mg/kg bw/d	ADL	U	FD	24	w	NR	NR	JV	B	C	Lab	ORW	ORWT	LI		1.43	Y	0.200	Y	0.0103		1.43	10	10	5	10	10	4	4	10	10	4	77
51	14987	Keane and Zavon, 1969	99	Dog (*Canis familiaris*)	2	0/2.0	mg/kg bw/d	5 per w	U	OR	33	d	24-27	mo	AD	B	V	Lab	GRS	BDWT	WO		2.00	N	14	N	0.6013		1.98	10	8	10	10	10	4	4	10	3	4	73
52	1107	Shakoori et al., 1982	100	Rat (*Rattus novegicus*)	2	0/2	mg/kg bw/d	NR	U	FD	1	mo	NR	NR	AD	M	C	Lab	HIS	GHIS	LI		2.0	Y	0.400	N	0.0323		2.00	10	10	5	10	10	4	4	10	10	4	77
53	1020	Kimbrough et al., 1971	100	Rat (*Rattus novegicus*)	3	0/2.64/5.33	mg/kg bw/d	ADL	U	FD	8	w	4	mo	JV	M	C	Lab	ORW	SMIX	LI		2.64	Y	0.512	N	0.0396		2.64	10	10	5	10	10	4	4	10	6	4	73
54	911	Bandyopadhyay et al., 1982	100	Rat (*Rattus novegicus*)	2	0/5	mg/kg bw/d	DLY	U	GV	15	d	NR	NR	JV	M	V	Lab	ORW	SMIX	LI		5.0	Y	0.067	N	0.0074		5.00	10	8	10	10	10	4	4	10	10	4	80

Ref			Exposure																Effects					Conversion to mg/kg bw/day				Result		Data Evaluation Score										
Result #	Ref. No.		MW%	Test Species	# of Conc/ Doses	Conc/ Doses	Conc/Dose Units	Application Frequency	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Control Type	Test Location	Effect Type	Effect Measure	Response Site	Study NOAEL	Study LOAEL	Body Weight Reported?	Body Weight in kg	Ingestion Rate Reported?	Ingestion Rate in kg/day	NOAEL Dose (mg/kg/day)*	LOAEL Dose (mg/kg/day)*	Data Source	Dose Route	Test Concentrations	Chemical form	Dose Quantification	Endpoint	Dose Range	Statistical Power	Exposure Duration	Test Conditions	Total
55	1016	Jones et al., 1974	100	Rat (*Rattus novegicus*)	2	0/7to14	mg/kg bw/d	ADL	U	FD	8	w	5	w	JV	M	V	Lab	HIS	NCRO	BR		7.00	Y	0.235	Y	0.0167		7.00	10	10	5	10	10	4	4	10	6	4	73
56	1101	Sandler et al., 1968	100	Sheep (*Ovis aries*)	2	0/15	mg/kg bw/d	DLY	U	OR	7	d	NR	NR	AD	F	C	Lab	ITX	GITX	WO		15.0	N	32	Y	1.1863		15.0	10	8	5	4	10	4	4	10	3	4	67
57	961	Foster, 1968	100	Rat (*Rattus novegicus*)	2	0/200	mg/kg diet	NR	U	FD	7	d	NR	NR	JV	M	C	Lab	ORW	ORWT	AR		200	N	0.150	N	0.0144		19.3	10	10	5	10	5	4	4	10	10	4	72
Reproduction																																								
58	988	Harr et al.,1970	100	Rat (*Rattus novegicus*)	11	0/0.08/0.16/0.31/0.63/1.25/2.5/5.0/10/20/40	mg/kg diet	ADL	UX	FD	750	d	28	d	JV	B	C	Lab	REP	PROG	WO	0.160	0.310	N	0.156	N	0.0149	0.015	0.030	10	10	10	10	5	10	10	10	10	4	89
59	1146	Walker et al., 1969	100	Dog (*Canis familiaris*)	3	0/0.005/0.05	mg/kg bw/d	DLY	M	OR	104	w	6	mo	JV	M	C	Lab	REP	TEWT	TE	0.050		Y	14	N	0.6013	0.050		10	8	10	10	10	10	4	1	10	4	77
60	1056	Murphy and Korschgen, 1970	100	White-tailed deer (*Odocoileus virginianus*)	3	0/0.14/0.72	mg/kg bw/d	ADL	U	FD	3	yr	6-7	mo	JV	F	V	FieldA	REP	PRWT	WO	0.140	0.720	Y	36.78	Y	1.0430	0.140	0.720	10	10	5	10	10	10	4	10	10	4	87
61	1146	Walker et al., 1969	100	Rat (*Rattus novegicus*)	4	0/0.11/1/9.66	mg/kg diet	NR	M	FD	2	yr	5	w	JV	M	C	Lab	REP	TEWT	TE	9.66		Y	0.397	N	0.0321	0.810		10	10	10	10	6	10	4	6	10	4	80
62	953	Dix et al., 1977	100	Mouse (*Mus musculus*)	3	0/1.5/4	mg/kg bw/d	DLY	U	GV	9	d	7	w	GE	F	V	Lab	REP	PLBR	WO	4.00		Y	0.0285	N	0.0037	4.00		10	8	10	10	10	10	4	1	10	4	77
63	1103	Schein and Thomas, 1975	100	Mouse (*Mus musculus*)	4	0/1.25/2.5/5	mg/kg bw/d	DLY	U	GV	5	d	NR	NR	MA	M	V	Lab	REP	TEWT	TE	5.00		Y	0.04	N	0.0049	5.00		10	8	10	10	10	10	4	10	6	2	80
64	932	Chernoff et al., 1975	87	Rat (*Rattus novegicus*)	4	0/1.5/3/6	mg/kg bw/d	DLY	U	GV	10	d	NR	NR	GE	F	V	Lab	REP	PRFM	WO	6.00		N	0.3846	N	0.0313	5.22		10	8	10	10	10	10	4	1	10	4	77
65	14965	Treon et al, 1954	100	Rat (*Rattus novegicus*)	4	0/2.5/12.5/25.0	mg/kg diet	DLY	U	FD	127	d	28	d	GE	F	C	Lab	REP	FERT	WO		2.5	N	0.2024	N	0.0185		0.228	10	10	5	10	5	10	4	10	10	4	78
66	1143	Virgo and Bellward, 1975	86.1	Mouse (*Mus musculus*)	7	0/2.5/5/10/15/20/25	mg/kg diet	ADL	U	FD	13	w	10-12	w	LC	F	C	Lab	REP	RSUC	WO		2.50	N	0.0288	N	0.0037		0.278	10	10	5	10	5	10	4	10	10	4	78
67	978	Good and Ware, 1969	85	Mouse (*Mus musculus*)	2	0/5	mg/kg diet	NR	U	FD	120	d	6	w	SM	B	C	Lab	REP	PROG	WO		5.0	N	0.0247	N	0.0033		0.564	10	10	5	10	5	10	4	10	10	4	78
68	1142	Virgo and Bellward, 1977	100	Mouse (*Mus musculus*)	4	0/5/10/15	mg/kg diet	NR	U	FD	60	d	4	w	GE	F	C	Lab	REP	RSUC	WO		5.0	N	0.0288	N	0.0037		0.646	10	10	5	10	5	10	4	10	10	4	78
Growth																																								
69	1146	Walker et al., 1969	100	Dog (*Canis familiaris*)	3	0/0.005/0.05	mg/kg bw/d	DLY	M	OR	104	w	6	mo	JV	M	V	Lab	GRO	BDWT	WO	0.050		Y	14	N	0.6013	0.050		10	8	10	10	10	8	4	10	10	4	84
70	14960	Treon et al, 1951	99	Rat (*Rattus novegicus*)	6	0/2.5/5.0/25/75/300	mg/kg diet	DLY	M	FD	20	w	NR	NR	JV	M	V	Lab	GRO	BDWT	WO	5.0	25.0	Y	0.447	N	0.0354	0.392	1.96	10	10	10	10	6	8	8	10	10	4	86
71	14954	Kitselman and Borgmann, 1952	100	Dog (*Canis familiaris*)	4	0/0.2/0.6/2.0	mg/kg bw	DLY	U	FD	47	d	NR	NR	NR	B	C	NR	GRO	BDWT	WO	0.600	2.0	Y	11.34	N	0.5056	0.600	2.0	10	10	5	10	10	8	8	10	6	4	81
72	1146	Walker et al., 1969	100	Rat (*Rattus novegicus*)	4	0/0.11/1/9.66	mg/kg diet	NR	M	FD	2	yr	5	w	JV	B	C	Lab	GRO	BDWT	WO	9.66		Y	0.397	N	0.0321	0.810		10	10	10	10	6	8	4	10	10	4	82
73	1023	Kolaja et al., 1996	100	Rat (*Rattus novegicus*)	5	0/0.1/1.0/3.0/10.0	mg/kg diet	ADL	UX	FD	90	d	8	w	JV	M	C	Lab	GRO	BDWT	WO	10.0		Y	0.325	N	0.0273	0.839		10	10	10	10	6	8	4	1	10	7	76
74	943	Davison, 1970	87	Sheep (*Ovis aries*)	5	0/0.5/1/2/4	mg/kg bw/d	NR	UX	FD	32	w	NR	NR	JV	M	V	Lab	GRO	BDWT	WO	1.0	2.0	Y	40	N	1.4251	0.870	1.74	10	10	10	10	10	8	10	10	10	4	92
75	14964	Treon et al, 1953	99	Rat (*Rattus novegicus*)	4	0/2.5/12.5/25.0	mg/kg diet	DLY	U	FD	28	w	NR	NR	JV	B	C	Lab	GRO	BDWT	WO	12.5	25.0	Y	0.3537	N	0.0292	1.02	2.05	10	10	5	10	6	8	10	10	10	4	83
76	1023	Kolaja et al., 1996	100	Mouse (*Mus musculus*)	5	0/0.1/1/3/10	mg/kg diet	ADL	UX	FD	90	d	8	w	JV	M	C	Lab	GRO	BDWT	WO	10.0		Y	0.0325	N	0.0041	1.26		10	10	10	10	6	8	4	1	10	7	76
77	1027	Krishnamurthy et al., 1965	100	Rat (*Rattus novegicus*)	2	0/1.43	mg/kg bw/d	ADL	U	FD	24	w	NR	NR	JV	B	C	Lab	GRO	BDWT	WO	1.43		Y	0.200	Y	0.0103	1.43		10	10	5	10	10	8	4	1	10	4	72
78	932	Chernoff et al., 1975	87	Rat (*Rattus novegicus*)	4	0/1.5/3/6	mg/kg bw/d	DLY	U	GV	10	d	NR	NR	GE	F	V	Lab	GRO	BDWT	WO	3.00	6.00	Y	0.3846	N	0.0313	2.61	5.22	10	8	10	10	10	8	10	10	10	4	90
79	932	Chernoff et al., 1975	87	Mouse (*Mus musculus*)	4	0/1.5/3/6	mg/kg bw/d	DLY	U	GV	10	d	NR	NR	GE	F	V	Lab	GRO	BDWT	WO	3.00	6.00	N	0.0288	N	0.0037	2.61	5.22	10	8	10	10	10	8	10	10	10	4	90
80	953	Dix et al., 1977	100	Mouse (*Mus musculus*)	3	0/1.5/4	mg/kg bw/d	DLY	U	GV	9	d	7	w	GE	F	V	Lab	GRO	BDWT	WO	4.00		Y	0.0285	N	0.0037	4.00		10	8	10	10	10	8	4	10	10	4	84
81	1016	Jones et al., 1974	100	Rat (*Rattus novegicus*)	2	0/7to14	mg/kg bw/d	ADL	U	FD	8	w	5	w	JV	F	V	Lab	GRO	BDWT	WO	8.0		Y	0.152	Y	0.0111	8.0		10	10	5	10	10	8	4	1	6	4	68
82	961	Foster, 1968	100	Rat (*Rattus novegicus*)	3	0/100/200	mg/kg diet	NR	U	FD	4	d	NR	NR	JV	M	C	Lab	GRO	BDWT	WO	100	200	Y	0.216	N	0.0195	9.02	18.0	10	10	5	10	6	8	10	10	10	4	83
83	960	Fitzhugh et al., 1964	100	Rat (*Rattus novegicus*)	7	0/0.5/2/10/50/100/150	mg/kg diet	ADL	U	FD	2	yr	NR	NR	JV	B	V	Lab	GRO	BDWT	WO	150		Y	0.475	N	0.0373	11.8		10	10	5	10	6	8	4	1	10	4	68
84	1056	Murphy and Korschgen, 1970	100	White-tailed deer (*Odocoileus virginianus*)	3	0/0.14/0.72	mg/kg bw/d	ADL	U	FD	3	yr	6-7	mo	JV	F	V	FieldA	GRO	BDWT	WO		0.140	Y	32.2	Y	0.9979		0.140	10	10	5	10	10	8	4	10	10	4	81
85	1108	Shakoori et al., 1984	20	Rat (*Rattus novegicus*)	2	0/2	mg/kg bw/d	ADL	U	FD	6	mo	10	mo	SM	M	C	Lab	GRO	BDWT	WO		2.00	Y	0.35	Y	0.0400		0.400	10	10	5	10	10	8	4	10	10	4	81
86	1040	Mehrotra et al., 1988	100	Rat (*Rattus novegicus*)	2	0/10	mg/kg diet	DLY	U	FD	50	d	NR	NR	JV	M	V	Lab	GRO	BDWT	WO		10.0	Y	0.480	Y	0.0336		0.700	10	10	5	10	7	8	4	10	10	4	78
87	1020	Kimbrough et al., 1971	100	Rat (*Rattus novegicus*)	3	0/2.64/5.33	mg/kg bw/d	ADL	U	FD	8	w	4	mo	JV	M	C	Lab	GRO	BDWT	WO		2.64	Y	0.512	N	0.0396		2.64	10	10	5	10	10	8	4	10	6	4	77
88	1150	Wasserman et al., 1972	95	Rabbit (*Oryctolagus cuniculus*)	2	0/50	mg/L	ADL	U	DR	5	w	NR	NR	YO	M	V	Lab	GRO	BDWT	WO		50.0	Y	2.4	N	0.2177		4.31	10	5	5	10	6	8	4	10	10	4	72
89	911	Bandyopadhyay et al., 1982	100	Rat (*Rattus novegicus*)	2	0/5	mg/kg bw/d	DLY	U	GV	15	d	NR	NR	JV	M	V	Lab	GRO	BDWT	WO		5	Y	67	N	2.1777		5.00	10	8	10	10	10	8	4	10	10	4	84
90	961	Foster, 1968	100	Rat (*Rattus novegicus*)	2	0/200	mg/kg diet	NR	U	FD	4	d	NR	NR	JV	M	C	Lab	GRO	BDWT	WO		200	Y	0.1662	Y	0.0137		16.5	10	10	5	10	7	8	4	10	10	4	78
Survival																																								
91	988	Harr et al.,1970	100	Rat (*Rattus novegicus*)	11	0/0.08/0.16/0.31/0.63/1.25/2.5/5.0/10/20/40	mg/kg diet	ADL	UX	FD	750	d	28	d	JV	B	C	Lab	MOR	MORT	WO	1.25	2.50	N	0.217	N	0.0196	0.113	0.225	10	10	10	10	5	9	10	10	10	4	88
92	1147	Walker et al., 1972	100	Mouse (*Mus musculus*)	4	0/0.1/0.986/9.83	mg/kg diet	NR	M	FD	25-28	w	3	w	JV	F	C	Lab	MOR	MORT	WO	0.986	9.83	N	0.0225	N	0.0030	0.133	1.33	10	10	10	10	5	9	8	10	10	4	86
93	1157	Wiese et al., 1973	85	Blesbuk (*Damaliscus pygargus*)	6	0/5/15/25/35/50	mg/kg diet	ADL	UX	FD	90	d	15	mo	NR	B	C	FieldA	MOR	MORT	WO	15.0	25.0	Y	42.6	N	1.5008	0.449	0.749	10	10	10	10	6	9	10	10	6	4	85
94	978	Good and Ware, 1969	85	Mouse (*Mus musculus*)	2	0/5	mg/kg diet	NR	U	FD	120	d	6	w	JV	B	C	Lab	MOR	MORT	WO	5.0		N	0.0247	N	0.0033	0.564		10	10	5	10	5	9	4	10	10	4	77
95	14954	Kitselman and Borgmann, 1952	100	Dog (*Canis familiaris*)	4	0/0.2/0.6/2.0	mg/kg bw	DLY	U	FD	47	d	NR	NR	NR	B	C	NR	MOR	MORT	WO	0.6	2.0	Y	11.3	N	0.5056	0.600	2.00	10	10	5	10	10	9	8	10	6	4	82
96	1040	Mehrotra et al., 1988	100	Rat (*Rattus novegicus*)	2	0/10	mg/kg diet	DLY	U	FD	60	d	NR	NR	JV	M	V	Lab	MOR	MORT	WO	10.0		Y	0.530	Y	0.0345	0.650		10	10	5	10	7	9	4	10	10	4	79
97	1056	Murphy and Korschgen, 1970	100	White-tailed deer (*Odocoileus virginianus*)	3	0/0.14/0.72	mg/kg bw/d	ADL	U	FD	3	yr	6-7	mo	JV	F	V	FieldA	MOR	MORT	WO	0.720		Y	36.78	Y	1.0430	0.720		10	10	5	10	10	9	4	10	10	4	82
98	960	Fitzhugh et al., 1964	100	Rat (*Rattus novegicus*)	7	0/0.5/2/10/50/100/150	mg/kg diet	ADL	U	FD	2	yr	NR	NR	JV	B	V	Lab	MOR	SURV	WO	10.0	50.0	Y	0.475	N	0.0373	0.784	3.92	10	10	5	10	6	9	8	10	10	4	82
99	1096	Reuber, 1980	100	Rat (*Rattus novegicus*)	8	0/0.5/1/2/10/50/100/150	mg/kg diet	NR	U	FD	2	yr	3	w	JV	B	C	Lab	MOR	MORT	WO	10.0	50.0	N	0.4515	N	0.0357	0.791	3.96	10	10	5	10	5	9	8	10	10	4	81
100	1146	Walker et al., 1969	100	Rat (*Rattus novegicus*)	4	0/0.11/1/9.66	mg/kg diet	NR	M	FD	2	yr	5	w	JV	B	C	Lab	MOR	MORT	WO	9.66		Y	0.397	N	0.0321	0.810		10	10	10	10	6	9	4	10	10	4	83
101	943	Davison, 1970	87	Sheep (*Ovis aries*)	5	0/0.5/1/2/4	mg/kg bw/d	NR	UX	FD	32	w	NR	NR	JV	M	V	Lab	MOR	MORT	WO	1.0	2.0	Y	40	N	1.4251	0.87	1.74	10	10	10	10	10	9	10	10	10	4	93
102	918	Bildstein and Forsyth, 1979	87	White-footed mouse (*Peromyscus leucopus*)	2	0/10	mg/kg diet	ADL	U	FD	3	mo	3-4	mo	AD	NR	V	Lab	MOR	MORT	WO	10.0		N	0.027	N	0.0035	1.14		10	10	5	10	5	9	4	10	10	4	77
103	14937	Davis and Fitzhugh, 1962	100	Mouse (*Mus musculus*)	2	0/10	mg/kg diet	NR	U	FD	18	mo	NR	NR	YO	B	C	Lab	MOR	SURV	WO	10.0		N	0.045	N	0.0054	1.19		10	10	5	10	5	9	4	1	10	2	66
104	1095	Reuber, 1977	100	Mouse (*Mus musculus*)	2	0/10	mg/kg diet	NR	U	FD	104	w	3	w	JV	B	C	Lab	MOR	SURV	WO	10.0		N	0.0302	N	0.0039	1.28		10	10	5	10	5	9	4	10	10	4	77
105	1143	Virgo and Bellward, 1975	86.1	Mouse (*Mus musculus*)	7	0/2.5/5/10/15/20/25	mg/kg diet	ADL	U	FD	4	w	10-12	w	LC	F	C	Lab	MOR	SURV	WO	15.0	20.0	N	0.0288	N	0.0037	1.67	2.23	10	10	5	10	5	9	10	10	10	4	83
106	1137	Uzoukwu et al., 1972	100	Guinea pig (*Cavia porcellus*)	5	0/10/25/50/100	mg/kg diet	NR	U	FD	53	d	NR	NR	GE	F	C	Lab	MOR	MORT	WO	25.0	50.0	N	0.86	N	0.0607	1.76	3.53	10	10	5	10	5	9	10	10	10	4	83
107	14964	Treon et al, 1953	99	Rat (*Rattus novegicus*)	4	0/2.5/12.5/25.0	mg/kg diet	DLY	U	FD	28	w	NR	NR	JV	B	C	Lab	MOR	MORT	WO	25.0		Y	0.3537	N	0.0292	2.05		10	10	5	10	6	9	4	10	10	4	78
108	932	Chernoff et al., 1975	87	Rat (*Rattus novegicus*)	4	0/1.5/3/6	mg/kg bw/d	DLY	U	GV	10	d	NR	NR	GE	F	V	Lab	MOR	MORT	WO	3.00	6.00	N	0.3846	N	0.0313	2.61	5.22	10	8	10	10	10	9	10	10	10	4	91
109	953	Dix et al., 1977	100	Mouse (*Mus musculus*)	3	0/1.5/4	mg/kg bw/d	DLY	U	GV	9	d	7	w	JV	F	V	Lab	MOR	MORT	WO	4.00		Y	0.0285	N	0.0037	4.00		10	8	10	10	10	9	4	10	10	4	85

Ref			Exposure																Effects					Conversion to mg/kg bw/day				Result		Data Evaluation Score										
Result #	Ref. No.		MW%	Test Species	# of Conc/ Doses	Conc/ Doses	Conc/Dose Units	Application Frequency	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Control Type	Test Location	Effect Type	Effect Measure	Response Site	Study NOAEL	Study LOAEL	Body Weight Reported?	Body Weight in kg	Ingestion Rate Reported?	Ingestion Rate in kg/day	NOAEL Dose (mg/kg/day)*	LOAEL Dose (mg/kg/day)*	Data Source	Dose Route	Test Concentrations	Chemical form	Dose Quantification	Endpoint	Dose Range	Statistical Power	Exposure Duration	Test Conditions	Total
110	932	Chernoff et al., 1975	87	Mouse (*Mus musculus*)	4	0/1.5/3/6	mg/kg bw/d	DLY	U	GV	10	d	NR	NR	GE	F	V	Lab	MOR	MORT	WO	6.00		N	0.0288	N	0.0037	5.22		10	8	10	10	10	9	4	10	10	4	85
111	14960	Treon et al, 1951	99	Rat (*Rattus novegicus*)	6	0/2.5/5.0/25/75/300	mg/kg diet	DLY	M	FD	2	w	NR	NR	JV	B	V	Lab	MOR	MORT	WO	75	300	Y	0.384	N	0.0313	6.05	24.2	10	10	10	10	6	9	8	10	10	4	87
112	1016	Jones et al., 1974	100	Rat (*Rattus novegicus*)	2	0/7to14	mg/kg bw/d	ADL	U	FD	8	w	5	w	JV	F	V	Lab	MOR	MORT	WO	8.0		Y	0.152	Y	0.0111	8.0		10	10	5	10	10	9	4	10	6	4	78
113	961	Foster, 1968	100	Rat (*Rattus novegicus*)	3	0/100/200	mg/kg diet	NR	U	FD	7	d	NR	NR	JV	M	C	Lab	MOR	MORT	WO	100	200	Y	0.170	N	0.0160	9.42	18.8	10	10	5	10	6	9	10	10	10	4	84
114	961	Foster, 1968	100	Rat (*Rattus novegicus*)	2	0/200	mg/kg diet	NR	U	FD	16	d	NR	NR	JV	M	C	Lab	MOR	MORT	WO	200		Y	0.1662	Y	0.0106	12.8		10	10	5	10	7	9	4	10	10	4	79
115	1137	Uzoukwu et al., 1972	100	Guinea pig (*Cavia porcellus*)	2	0/3	mg/kg bw/d	0.2 per d	U	OR	75	d	NR	NR	GE	F	V	Lab	MOR	MORT	WO		3.00	N	0.86	N	0.0607		3.00	10	8	10	10	10	9	4	10	6	4	81
116	1127	Stoewsand et al., 1970	100	Rat (*Rattus novegicus*)	2	0/150	mg/kg diet	NR	U	FD	7	d	NR	NR	JV	B	C	Lab	MOR	MORT	WO		150	N	0.2187	Y	0.0085		5.82	10	10	5	10	6	9	4	10	6	4	74
Data Not Used to Derive Wildlife Toxicity Reference Value																																								
117	919	Blend and Visek, 1972	100	Dog (*Canis familiaris*)	2	0/15	ug/kg bw/d	DLY	U	FD	6	mo	16-36	mo	AD	NR	C	Lab	ENZ	ACPH	PG	15		Y	16	N	0.6710	0.015		10	10	5	10	10	1	4	3	3	4	60
118	1025	Kotonya and Jensen, 1993	100	Pig (*Sus scrofa*)	2	0/40	mg/kg diet	2 per d	U	FD	60	d	8	mo	JV	F	C	Lab	HRM	PROH	SR	40		Y	104	N	3.1258	1.20		10	10	5	10	6	1	4	1	10	4	61
119	1027	Krishnamurthy et al., 1965	100	Rat (*Rattus novegicus*)	2	0/1.43	mg/kg bw/d	ADL	U	FD	24	w	NR	NR	JV	B	C	Lab	CHM	HMGL	BL	1.43		Y	0.200	Y	0.0103	1.43		10	10	5	10	10	1	4	1	10	4	65
120	14964	Treon et al, 1953	99	Rat (*Rattus novegicus*)	4	0/2.5/12.5/25.0	mg/kg diet	DLY	U	FD	28	w	NR	NR	JV	B	C	Lab	ORW	SMIX	LI	25		Y	0.3537	N	0.0292	2.05		10	10	5	10	6	4	4	1	10	4	64
121	1101	Sandler et al., 1968	100	Sheep (*Ovis aries*)	2	0/15	mg/kg bw/d	DLY	U	OR	7	d	NR	NR	AD	F	C	Lab	BEH	GBHV	WO	15		N	32	N	1.1863	15.0		10	8	5	4	10	4	4	1	3	4	53
122	961	Foster, 1968	100	Rat (*Rattus novegicus*)	2	0/200	mg/kg diet	NR	U	FD	8	d	NR	NR	JV	M	C	Lab	HRM	CRTS	AR	200		Y	0.150	N	0.0144	19.3		10	10	5	10	6	1	4	3	10	4	63
123	1150	Wasserman et al., 1972	95	Rabbit (*Oryctolagus cuniculus*)	2	0/50	mg/L	ADL	U	DR	5	w	NR	NR	YO	M	V	Lab	CHM	GCHM	SR		50.0	Y	2.4	N	0.2177		4.31	10	5	5	10	6	1	4	10	10	4	65
Data Not Used to Derive Wildlife Toxicity Reference Value - Measurements of biochemical, behavioral or pathology changes in progeny of exposed parents																																								
124	932	Chernoff et al., 1975	87	Mouse (*Mus musculus*)	4	0/1.5/3/6	mg/kg bw/d	DLY	U	GV	10	d	NR	NR	GE	F	V	Lab	REP	Other	PY	1.50	3.00	N	0.0288	N	0.0037	1.31	2.61	10	8	10	10	10	10	10	10	10	4	92
125	936	Costella and Virgo, 1980	86.1	Mouse (*Mus musculus*)	2	0/2	mg/kg bw/d	DLY	U	GV	9	d	8-10	w	GE	F	V	Lab	REP	Other	PY		2.0	N	0.0225	N	0.0030		1.72	10	8	10	10	10	10	4	10	10	4	86

The abbreviations and definitions used in coding data are provided in Attachment 4-3 of the Eco-SSL Guidance (U.S.EPA, 2003).

*Duplicate values for NOAELs and LOAELs for the same reference represent results from different experimental designs