United States
Environmental Protection Agency

Office of Chemical Safety and
Pollution Prevention

Final Risk Evaluation for Cyclic Aliphatic Bromides Cluster (HBCD)

Systematic Review Supplemental File:

Data Extraction Tables for Environmental Fate and Transport Studies

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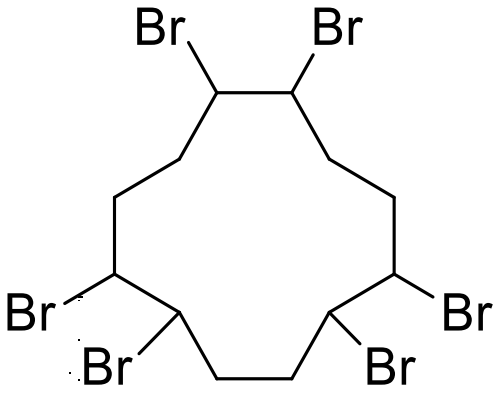

September 2020

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Table 1. Biodegradation Study Summary for HBCD

Study Type (year)	Initial Concentration	Inoculum Source	(An)aerobic Status	Duration	Result	Comments	HERO	Data Quality Rating
Water								
OECD Guideline 301 D (Ready Biodegradability: Closed Bottle Test)	7.7 mg/L	activated sludge, domestic, adapted	aerobic	28 days	0% based on Theoretical oxygen demand (0.75 mg/O_2 mg)		3970217	High
OECD Guideline 302 B (Inherent biodegradability: Zahn-Wellens/EMPA Test)	3.64 mg/L	activated sludge, domestic, non-adapted	aerobic	56 days	After 56 days: Viable sludge mixtures [21%] with less than 2% [14C] products throughout the study; biologically inhibited controls = 40% [14C] HBCD with 25% [14C] products at 25 days and 44% [14C] products at 56 days.		3970739	High
Digested sewage sludge under anaerobic conditions	3.9 nmol	sewage, domestic, non-adapted	anaerobic	238 days	(±)-alpha-HBCD degraded more slowly than (±)-beta-HBCD and (±)-gamma-HBCD by an estimated factor of 1.6 and 1.8, respectively		1443845	High
Digested sewage sludge under anaerobic conditions	3.9 nmol	sewage, domestic, non-adapted	anaerobic	238 days	(±)-beta-HBCD degraded more rapidly than (±)-alpha-HBCD by an estimated factor of 1.6		1443845	High
Digested sewage sludge under anaerobic conditions	3.9 nmol	sewage, domestic, non-adapted	anaerobic	238 days	(±)-gamma-HBCD degraded more rapidly than (±)-alpha-HBCD by an estimated factor of 1.8		1443845	High
Digested sewage sludge under anaerobic conditions	10 to 11 nmol	sewage, domestic, non-adapted	anaerobic	238 days	half-life = 0.66d		1443845	High
OECD Guideline 301 D (Ready	7.7 mg/L	activated sludge,	aerobic	28 days	0% based on Theoretical oxygen demand	Although this IUCLID summary omits several	3970216	High

Study Type (year)	Initial Concentration	Inoculum Source	(An)aerobic Status	Duration	Result	Comments	HERO	Data Quality Rating
Biodegradability: Closed Bottle Test)		domestic (adaptation not specified)				details concerning test conditions and sampling methods, the OECD and OPPTS guidelines followed suggest appropriate conditions were met even if not reported in this study.		
ISO 11734 Water quality - Evaluation of the "ultimate" anaerobic biodegradability of organic compounds in digested sludge - Method by measurement of the biogas production	ca. 0.220 µmol/L	digested sludge	anaerobic	113 days	Decay rates: aerobic: alpha-HBCD = 0.0054; beta-HBCD = 0.0097; gamma-HBCD = 0.0075; anaerobic: alpha-HBCD = 0.0060; beta-HBCD = 0.0140; gamma-HBCD = 0.0034; (data in supp info)		1443842	High
OECD Guideline 301 D (Ready Biodegradability: Closed Bottle Test)	7.7 mg/L	not specified	aerobic	28 days	0% based on dissolved oxygen demand as %Theoretical Oxygen Demand	This is a secondary source and the summary is sparse on details; it is a robust summary and a routine OECD guideline was cited along with primary reference (BFRIP 1996Schaefer, E and Haberlein, D., 1996, Hexabromocyclododecane (HBCD): Closed Bottle Test. Project No.: 439E-102. Wildlife International Ltd. Easton, MD).	1443881	Medium
OECD Guideline 302 B (Inherent biodegradability: Zahn-	ca.1.7 µmol/L	activated sludge (adaptation not specified)	aerobic	113 days	192 nM decreased to 74 nM after 113 days (degradation products accounted for ca. 120 nM); concentrations of		1443842	Medium

Study Type (year)	Initial Concentration	Inoculum Source	(An)aerobic Status	Duration	Result	Comments	HERO	Data Quality Rating
Wellens/EMPA Test)					individual diastereoisomers normalized to initial concentration and analysis of loss indicated that degradation rates of the individual isomers increased from gamma to alpha to beta; however, it was not considered a significant variation of the rates			
OECD Guideline 302 B (Inherent biodegradability: Zahn-Wellens/EMPA Test)	≥3 to ≤5 mg/L	not specified	Not reported	60 to 112 days	Not reported; Biotransformation was observed in anaerobic digester sludge as well as freshwater aerobic and anaerobic sediment microcosms; no degradation was observed in aerobic soil microcosms. Products identified: tetrabromocyclododecene, dibromocyclododecadiene, and cyclododecatriene	Limited details are provided in the robust summary with limits the value of this study from this source; work cited may be more valuable: Davis JW, Gonsior SJ, Markham DA, and Marty GT. 2004. Investigation of the biodegradation of [14C]hexabromocyclododecane in sludge, sediment, and soil. Laboratory Project Study ID 031178. Toxicology & Environmental Research and Consulting. The Dow Chemical Company, Midland, MI.	1443881	Medium
not reported		other		15d	50%/15 days	Study method details were omitted making the data unusable.	4270831	Unacceptable
OECD Guideline 302 B (Inherent biodegradability: Zahn-Wellens/EMPA Test)	180 to ca.1700 nM	Other; parallel studies in soil and freshwater aquatic	aerobic/ anaerobic	113 days aerobic, 28 days anaerobic	total [14C]HBCD decrease: Anaerobic (28 d): from 225 nM to 22 nM with production of ca. 93 nM of [14C]products; Aerobic (113 d): from 192 to 74 nM	Due to the reported abiotic degradation, the identified products and their distribution cannot be assured to be a result biodegradation.	4140454	Unacceptable

Study Type (year)	Initial Concentration	Inoculum Source	(An)aerobic Status	Duration	Result	Comments	HERO	Data Quality Rating
		sediments in microcosms prepared under aerobic and low redox conditions			with production of 192 to 74 nM of [14C]products			
Sediment								
OECD Guideline 308 (Aerobic and Anaerobic Transformation in Aquatic Sediment Systems); starts on page 440 of article with changes to the protocol on page 525	34 to 89 ng/g dw	natural water/sediment: freshwater	aerobic/ anaerobic	119 days	aerobic: 90% decrease/21 days; anaerobic: ca. 100% decrease/7 days		4269929	High
OECD Guideline 308 (Aerobic and Anaerobic Transformation in Aquatic Sediment Systems); GLP	≥34 to ≤89 ng/g nominal	not specified	aerobic /anaerobic	119 days	anaerobic half-life = 1.1-1.5 days; aerobic half-life = 11-32 days	This is a secondary source, it is a robust summary and a routine OECD guideline was cited and primary reference (BFRIP, Dow, 2003Davis J, Gonsior S and Marty G. Evaluation of Aerobic and Anaerobic Transformation Of Hexabromocyclododecane In Aquatic Sediment	1443881	High
OECD Guideline 308 (Aerobic and Anaerobic Transformation in Aquatic Sediment Systems); *This report starts on the bottom of page 26	≥34 to ≤89 ng/g	natural water / sediment	aerobic/ anaerobic	119 days	Viable aerobic: 90% decrease in 21 days. Abiotic aerobic: 7-62% decrease in 21 days. Viable anaerobic: <LOD in 7 days. Abiotic anaerobic: 48-62% decrease after 14 days.		3970216	High

Study Type (year)	Initial Concentration	Inoculum Source	(An)aerobic Status	Duration	Result	Comments	HERO	Data Quality Rating
of HERO ID: 3970216*								
other; *This entry has been moved to Misc. Fate*		other	aerobic	Samples were composites over 24-48 hours periods based on the hydraulic retention time of each plant.	HBCD [Effluent]/[Influent]: Human waste treatment plant = 0.39-0.92; Sewage treatment plant = 0.54-0.63; Waste water treatment plant = 0.36-0.84.		3545985	High
OECD Guideline 308 (Aerobic and Anaerobic Transformation in Aquatic Sediment Systems)	ca.10 to ≤80 (nominal range; actual not specified) other	natural water / sediment: freshwater	aerobic	Up to 119 days (including a 35-49-day stabilization period)	HBCD decreased from 31.9 ng/g to not detected levels (dry wt; measured) after 64 days.		1443846	High
OECD Guideline 308 (Aerobic and Anaerobic Transformation in Aquatic Sediment Systems)	27.2 to 27.7 (measured) other	natural water / sediment: freshwater	anaerobic	Up to 119 days (including a 35-49-day stabilization period)	Half-life 1.5 days		1443846	High
OECD Guideline 308 (Aerobic and Anaerobic Transformation in Aquatic Sediment Systems);	ca.10 to ≤80 (nominal range; actual not specified) other	natural water / sediment: freshwater	aerobic	Up to 119 days (including a 35-49-day stabilization period)	Half-life 32 days		1443846	High
OECD Guideline 308 (Aerobic and Anaerobic Transformation in Aquatic Sediment Systems);	39.1 ng/g (measured) other	natural water / sediment: freshwater	anaerobic	Up to 119 days (including a 35-49-day stabilization period)	Half-life 1.1 days		1443846	High

Study Type (year)	Initial Concentration	Inoculum Source	(An)aerobic Status	Duration	Result	Comments	HERO	Data Quality Rating
other	≥19.6 to ≤23.9 ng/g dw	activated sludge (adaptation not specified)	anaerobic	15 months	HBCD was not detected after 3 months of incubation		3350527	High
other; OECD 209. *This report starts on page 25 of HERO ID: 3970216.*	≤15 mg/L	activated sludge (adaptation not specified)	aerobic	3 hours	29% inhibition average in treatment group.		3970216	Medium
OECD Guideline 308 (Aerobic and Anaerobic Transformation in Aquatic Sediment Systems);	≥3 to ≤5 mg/L	natural water/sediment: freshwater	aerobic/ anaerobic	60-112 days	Degradation rate not reported, only transformation products.		3970216	Low
OECD Guideline 308 (Aerobic and Anaerobic Transformation in Aquatic Sediment Systems);	>3 to <5 mg/L	digested sludge	anaerobic	60-112 days	'Substantial degradation' was reported, and transformation products were identified.		3970216	Low
OECD Guideline 308 (Aerobic and Anaerobic Transformation in Aquatic Sediment Systems);	≥0.190 to ≤0.224 µmol/L	natural water/sediment: freshwater	aerobic/ anaerobic	28 days	Decay rates: alpha-HBCD = 0.1327; beta-HBCD = 0.1522; gamma-HBCD = 0.1248	Loss due to abiotic processes and/or adsorption were not controlled; low recovery reported.	1443842	High
Soil								
OECD Guideline 307 (Aerobic and Anaerobic Transformation in Soil); starts on page 379 of article with changes to the protocol on page 438	25 µg/g dw		aerobic /anaerobic	119 days	aerobic: decreased 75%/119 days; anaerobic: 92% decrease/21 days		4269929	High

Study Type (year)	Initial Concentration	Inoculum Source	(An)aerobic Status	Duration	Result	Comments	HERO	Data Quality Rating
OECD Guideline 307 (Aerobic and Anaerobic Transformation in Soil);	15.9 to 18.0 ng/g (based on dry weight of soil)		aerobic	119 days (including a 35-49-day stabilization period)	Half-life 63 days		1443846	High
OECD Guideline 307 (Aerobic and Anaerobic Transformation in Soil); No deviations	25 ng/g	5 mg/g activated domestic sewage sludge	anaerobic	119 days	92% over 21 days in viable aerobic samples. Only 3% decrease in abiotic controls.		3970740	High
other; This study analyzes HBCD degradation under anaerobic and aerobic conditions in two types of soils and also in the presence of glucose, humic acid, neither, and both.	60 mg/kg	Soil and Rhizosphere soil	aerobic	40 days	Rhizosphere soil and glucose: <60%. Non-rhizosphere soil and glucose: 42%.		3575047	High
OECD Guideline 307 (Aerobic and Anaerobic Transformation in Soil);	11.0 to 17.2 other		anaerobic	119 days (including a 35-49-day stabilization period)	Half-life 6.9 days		1443846	High
OECD Guideline 307 (Aerobic and Anaerobic Transformation in Soil); No deviations	25 ng/g	5 mg/g activated domestic sewage sludge	aerobic	119 days	75% over 119 days in viable aerobic samples. Only 3% decrease in abiotic controls.		3970740	High
other; This study analyzes HBCD degradation under anaerobic and aerobic conditions in two types of soils and also in	60 mg/kg	Soil and Rhizosphere soil	anaerobic	21 days	Rhizosphere soil + Humic Acid = 35%. Non-rhizosphere soil only = 35%.		3575047	High

Study Type (year)	Initial Concentration	Inoculum Source	(An)aerobic Status	Duration	Result	Comments	HERO	Data Quality Rating
the presence of glucose, humic acid, neither, and both.								
OECD Guideline 307 (Aerobic and Anaerobic Transformation in Soil)	0.025 mg/kg	274 ug/g d.w. soil	aerobic/ anaerobic	119 days	Viable aerobic soil: 75% over 119 days; abiotic controls: <3% over 119 days. Anaerobic conditions: 92% over 21 days - abiotic controls: <1% over 21 days.		3970216	High
OECD Guideline 307 (Aerobic and Anaerobic Transformation in Soil)	25 ng/g	Soil	aerobic/ anaerobic	119 days	Viable aerobic: 75% decrease in 119 days. Abiotic aerobic: 3% decrease over 119 days. Viable anaerobic: 92% decrease over 21 days. Abiotic anaerobic: <1% decrease over 21 days.		3970216	High
OECD Guideline 307 (Aerobic and Anaerobic Transformation in Soil)	25 ng/g (nominal)	Soil	aerobic/ anaerobic	119 days	anaerobic half-life = 6.9 days; aerobic half-life = 63 days	Primary reference (BFRIP, Dow, 2003 Davis J, Gonsior S and Marty G. 2003. Evaluation of Aerobic and Anaerobic Transformation Of Hexabromocyclododecane In Soil. Study Number 021082. Environmental Chemistry Research Laboratory. Toxicology & Environmental Research and Consulting. The Dow Chemical Company. Midland, MI).	1443881	High
OECD Guideline 307 (Aerobic and Anaerobic			aerobic	60-112 days			3970216	Low

Study Type (year)	Initial Concentration	Inoculum Source	(An)aerobic Status	Duration	Result	Comments	HERO	Data Quality Rating
Transformation in Soil)								

Table 2. Bioconcentration Study Summary for HBCD

Study Type (year)	Initial Concentration	Species	Duration	Result	Comments	HERO ID	Data Quality Rating
Non-guideline flow-through bioconcentration test; US EPA Committee on Methods for Toxicity with Aquatic Organisms (1975) was used in the handling, holding, and acclimation procedures for the fish	6.2 µg HBCDD/L	Fathead minnows (Pimephales promelas)	32 days	Log BCF 4.26		58136	High
Biomagnification of HBCD in pelagic and benthic aquatic animals (invertebrates and fish) in a near-shore estuary environment of the southeastern North Sea.	≥0.03 to ≤1.06 other	Calanoid copepods (Calanus spp.), polychaete lugworm (Arenicola marina); Palaemon adspersus/Palaemon elegans (shore shrimp), sand gobies (Pomatoschitus microps/Pomatoschitus minutus), black goby (Gobius niger), and 0-stage sandeels (Ammodytes spp.)	Not applicable	HBCD was found to biomagnify in a marine food-web of aquatic gill-breathing organisms. Body burdens of HBCD increased with trophic position and with increasing lipid content. HBCD in Pelagic species (n=11): 0.03- 0.83 ng/g; Benthic species (n=28):<0.02-1.06 ng/g	Non-guideline qualitative assessment of biomagnification in natural environment.	947918	High
Trophic magnification and biomagnification		Walleye (n=5), Emerald shiner (n=5), White sucker (n=5), Burbot (n=5), White fish (n=5), Goldeye (n=3), zooplankton (n=5), mussels (n=5)	Not applicable	total TMF = 3.1; Lipid-adjusted BMFs in predator/prey feeding relationship ranged from 0.1 to 8.2 (alpha), 0.3 to 5.0 (beta), 0.1 to 6.3 (gamma); TMF = 2.3 (alpha), 2.3 (beta), 4.8 (gamma)		999306	High
Field determined bioaccumulation factors		Chinese mystery snail, Prawn, Mud carp, Crucian carp, Northern snakehead, Water snake	Not applicable	log BAF: Chinese mystery snail: 3; Prawn 5.1; Mud carp 5.2; Crucian carp 4.6; Northern snakehead 4.4; Water snake 4.6 and 5.2		1443814	High
Field determined bioaccumulation factors		Chinese mystery snail, Prawn, Mud		log BAF: Chinese mystery snail: 3.2; Prawn 4.9; Mud		1443814	High

Study Type (year)	Initial Concentration	Species	Duration	Result	Comments	HERO ID	Data Quality Rating
		carp, Crucian carp, Northern snakehead, Water snake	Not applicable	carp 4.95; Crucian carp 4.2; Northern snakehead 3.9; Water snake 4.6 and 4.0			
Field determined bioaccumulation factors		Chinese mystery snail, Prawn, Mud carp, Crucian carp, Northern snakehead, Water snake	Not applicable	log BAF: Chinese mystery snail: 3.5; Prawn 5.5; Mud carp 5.3; Crucian carp 4.5; Northern snakehead 4.1; Water snake 5.0 and 4.5		1443814	High
EPA OPPTS 850.1730 (Fish Bioconcentration Test) OECD Guideline 305 (Bioconcentration: Flow-through Fish Test)	Nominal: 0.34 and 3.4 µg HBCD/L; Means measured: 0.18 and 1.8 µg HBCD/L	Oncorhynchus mykiss (previous name: Salmo gairdneri) (Rainbow trout)	70 days (35 days of exposure/uptake and 35 days of depuration)	Edible tissues: yes, 50% depuration time 19 days. Non-edible tissues: yes, 50% depuration time 20 days. Whole fish: yes, 50% depuration time 19 days.		3970741	High
Non-guideline field study assessing the long-term trends of HBCD in lake trout		Lake trout (Salvelinus namaycush)	1979-2004	40Lipid-normalized basis (95% CI 19.7-1019) Common first-order growth and decay models used to describe trends: half-life = -ln(2)/k2		1443833	High
Non-guideline field study assessing the long-term trends of HBCD in lake trout		Lake trout (Salvelinus namaycush)	1979-2004	14Lipid-normalized basis (95% CI 9.6-24.4) Common first-order growth and decay models used to describe trends: half-life = -ln(2)/k2		1443833	High
Non-guideline field study assessing the long-term trends of HBCD in lake trout		Lake trout (Salvelinus namaycush)	1979-2004	16Lipid-normalized basis (95% CI 9.5-48.7) Common first-order growth and decay models used to describe trends: half-life = -ln(2)/k2		1443833	High
Bioaccumulation in a Marine food web	≥0.0004 to ≤9.16 ng/g other	Beluga whale(Delphinapterus leucas), narwhal(Monodon monocero), walrus(Odobenus rosmarus), arctic cod (Boreogadus saida), shrimp(Pandalus borealis;Hymenodora	Not applicable	TMF: alpha-HBCD 2.1 (lower-upper 95% CI: 1.3–3.4), gamma-HBCD 0.5 (lower-upper 95% CI: 0.3-0.9); BMF gamma-HBCD: <1 to 17; alpha-HBCD: <1 to 4 trophic level and lipid adjust BMFs are reported for predator/prey relationships;		1443836	High

Study Type (year)	Initial Concentration	Species	Duration	Result	Comments	HERO ID	Data Quality Rating
		glacialis), clams (Mya truncate; Serripes groenlandica), redfish(Sebastes mentalla), zooplankton		beta-HBCD was not detected above the MDL in any samples; additional info on enantiomers			
Dietary accumulation in juvenile rainbow trout	≥11.84 to ≤29.14 ng/g other	Juvenile rainbow trout (Oncorhynchus mykiss)	168 days	beta-HBCD = 157+/-71 days; gamma-HBCD = 144+/-60 days; both first-order depuration kinetics; alpha-HBCD = Not determined BMF: alpha-HBCD = 9.2; beta-HBCD = 4.3; gamma-HBCD = 7.2;		1443861	High
OECD Guideline 305 (Bioconcentration: Flow-through Fish Test) - [before 2 Oct 2012]	≥0 to ≤1.8 µg/L	Rainbow Trout (Oncorhynchus mykiss)	70 day (35d uptake; 35d depuration)	BCF = 8974; BCF in edible tissue = 4650; BCF in non-edible tissue = 12866 Steady state was not reached	This is a secondary source, it is a robust summary and a routine OECD guideline was cited and primary reference may provide validation; Drottar K. and Krueger H. 2000. Hexabromocyclododecane (HBCD): Flow-through bioconcentration test with rainbow trout (Oncorhynchus mykiss). Project No.: 439A-111. Wildlife International, Ltd. Easton, MD.	1443881	High
Bioaccumulation in 3 fish species collected from South China	≥58.3 to ≤361 (ng/g lw, in fish) other	Mud carp (Cirrhina molitorella), Nile tilapia (Tilapia nilotica),	Not applicable	4.8-7.7log BAF based on average of HBCD isomers in the dissolved phase; alpha-HBCD had the greatest BAF		1927551	High

Study Type (year)	Initial Concentration	Species	Duration	Result	Comments	HERO ID	Data Quality Rating
		Plecostomus (Hypostomus plecostomus)					
Depuration study in Juvenile zebrafish.		Juvenile zebrafish (Danio rerio)	28 days	Depuration rate of alpha, beta, and gamma isomers of HBCD-alpha and beta isomers after 9 days = 46% and 27%, respectively. Gamma isomer depuration rate = 70% and 77% after 9 and 16 days, respectively.		3575325	High
Accumulation in bivalves and gastropods	≥351 to ≤338000 (ng g-1 TOC)	bivalve (Corbicula fluminea) and gastropod (Elimia proxima)	Not applicable	BASF -1.5 to <1; BAF 3.2 to 5.4log BASF for gamma-HBCD in both species was -1.5 to 0; log BASF for alpha-HBCD ca. 0.4 to <1 in Corbicula fluminea and -0.2 to 0.9 in Elimia proxima; log BAF alpha and beta-HBCD 4.2 to 5.4, log BAF gamma-HBCD 3.2 to 4.7		1927601	High
Bioaccumulation of HBCD in fish samples (Barbus graellsi)		barbel (Barbus graellsi)	Not applicable	bioaccumulation indicated by presence in fish HBCD was detected at only two of the 4 sites tested: 215-1127 ng/g ww for muscles and 161-1172 ng/g ww for livers and 42-135 ng/g ww for muscles and 49-180 ng/g ww for livers; correlation coefficients for concentration vs. fish length (indicator for age) were 0.6 for muscle and 0.1 for liver	Results reported without quantification and other study limitations (i.e., depuration not performed).	999290	Unacceptable
OECD Guideline 305 (Bioconcentration: Flow-through Fish Test) - [before 2 Oct 2012]	0.34 to 3.4 µg/L	Rainbow trout (Oncorhynchus mykiss) from Thomas Fish Company, Anderson, California	35 days uptake	low concentration: BCF (kinetic): 14,039 (edible), 30,242 (nonedible), and 21,940 (whole fish); high concentration: BCF (steady state): 4,650 (edible), 12,866		1928244	High

Study Type (year)	Initial Concentration	Species	Duration	Result	Comments	HERO ID	Data Quality Rating
				(nonedible), 8,974 (whole fish)low concentration: 99.3-118 days to reach 90% steady state and 29.9-35.4 days to reach 50% clearance; high concentration: 62.5-65.4 days to reach 90% steady state and 18.8-19.3 days to reach 50% clearance; Steady State was only achieved at the high concentration; LC50 (96 hr.) > 6.8 µg HBCD/L			
Biomagnification of α-HBCD and γ-HBCD in an aquatic food web based on concentrations in predator/prey		Walleye (Stizostedion vitreum), whitefish (Coregonus clupeaformis), emerald shiner (Notropis atherinoides), burbot (Lota lota), white sucker (Catostomus commersoni), goldeye (Hiodon alosoides), Mussels (Lampsilis radiata), and Plankton	Not applicable	TMF for total HBCD/α-HBCD/β-HBCD/γ-HBCD: 3.1/2.3/2.3/4.8; BMF for α-HBCD/β-HBCD/γ-HBCD: 0.1-8.2/0.3-5/0.1-6.3lipid normalized BMFs (α/β/γ) based on concentrations in predator relative to prey: Walleye/emerald shiner: 1.1/0.8/0.6; Walleye/white suckers: 1.8/2.2/1.1; Walleye/white fish: 5.3/2.4/4.1; Walleye/goldeye: 0.8/1.1/0.8; Emerald shiner/zooplankton:0.7/1.9/5; White suckers/zooplankton: 0.4/0.6/2.8; White suckers/mussels: 0.4/0.5/0.3; Burbot/emerald shiner: 2.7/3.4/6.3; Burbot/mussels: 1.9/5/2.9; White fish/zooplankton: 0.1/0.6/0.9; White fish/emerald shiner: 0.2/0.3/0.1; Goldeye/zooplankton:		4140418	High

Study Type (year)	Initial Concentration	Species	Duration	Result	Comments	HERO ID	Data Quality Rating
				1/1.3/3.6; Goldeye/mussels: 8.2/1/0.3.			
OECD Guideline 305 C (Bioaccumulation: Test for the Degree of Bioconcentration in Fish) - [before 14 June 1996]		carp (Cyprinus carpio)	14 weeks	Low/high BCFs for 3 isomers: 3390-16100/834-3070, 3350-8950/816-1780, and 479-2030/118-418; Low/high DT50s for 3 isomers: 38.3/38.6 days, 10.5/16.2 days, and 15.2/22.6 days steady state had been reached by 14 weeks; specific BCF for fillet, head, integument, and viscera were also reported		4140430	High
Diastereomer-specific accumulation and trophic transfer of HBCD in a Norwegian coastal food web	≤280 ng/g lw	Blue mussel (Mytilus edulis), lugworm (Arenicola marina), shore crab (Carcinus maenas), common eider (Somateria mollissima), great black-backed gull (Larus marinus)	Not applicable	TMF alpha-HBCD = 9.1 (ww) and 2.6 (lw), gamma-HBCD = 0.9 (ww) and 0.3 (lw); BMFs = 0.1 to 1285 (ww); 0.1 to 26 (lw); specific values in report, corrected for trophic level Predator/prey BMF wet weight: alpha-HBCD range 0.1-1285 and gamma-HBCD 0.2-116 (Sum HBCD = 0.2-425); BMF lipid-normalized alpha-HBCD range 0.2-26 and gamma-HBCD 0.1-2.0 (Sum HBCD = 0.5-7.9)		1927667	High
Accumulation in a freshwater food web	≥11 to ≤2370 ng/g lw (in aquatic species)	Chinese mystery snail, Prawn, Mud carp, Crucian carp, Northern snakehead, Water snake	Not applicable	TMF (+)-alpha-HBCD = 2.22; TMF (±)-alpha-HBCD = 2.19; TMF = 2.18 (-)-alpha-HBCDTMF basis: concentration and TL correlation, considered not significant for (-)-alpha-HBCD		1927678	High
Accumulation in a freshwater food web	≥11 to ≤2370 ng/g lw (in aquatic species)	Chinese mystery snail, Prawn, Mud carp, Crucian carp,	Not applicable	TMF = 1.83 TMF basis: concentration and TL correlation, considered not		1927678	High

Study Type (year)	Initial Concentration	Species	Duration	Result	Comments	HERO ID	Data Quality Rating
		Northern snakehead, Water snake		significant; (±)-beta-HBCD not detected at levels appropriate for quantification and accumulation analysis			
Accumulation in a freshwater food web	≥11 to ≤2370 ng/g lw (in aquatic species)	Chinese mystery snail, Prawn, Mud carp, Crucian carp, Northern snakehead, Water snake	Not applicable	No correlations between TL and (±)-gamma-HBCD, (-)-gamma-HBCD or (+)-gamma-HBCD		1927678	High
EPA OPPTS 850.1730 (Fish Bioconcentration Test)*This report starts on the bottom half of page 37 of HERO ID: 3970216.	0.34 to 3.4 µg/L	Oncorhynchus mykiss (Fish, fresh water)	70 days: 35 uptake, 35 days depuration	BCF values. 3.4ug/L: Whole fish = 8,974; Edible tissue = 4,650; Non-edible tissue: 12,866.Steady state not achieved for 0.34ug/L test, no BCF reported.		3970216	High
Freshwater BAF		Oncorhynchus mykiss; Perca fluviatilis; Carassius carassius; Rutilus rutilus; Cyprinus carpio; Scardinius erythrophthalmus; Rudd/Roach hybrid; Tinca tinca; Esox lucius	Not applicable	1300 (250-3500)Average BAF based on fish muscle samples (range); steady-state/equilibrium not confirmed		1927694	High
Biota monitoring/metabolism		Japanese common squid (Todarodes pacificus)	Not applicable	alpha-HBCD: 85-89%, beta-HBCD: 1.2-1.4%, gamma-HBCD: 9.4-14%Proportion of each stereoisomer to total HBCD from the two sites	Monitoring study where BAF/BCF values were not reported.	1927684	Unacceptable
Freshwater BAF		Oncorhynchus mykiss; Perca fluviatilis; Carassius; Rutilus rutilus; Cyprinus carpio; Scardinius erythrophthalmus; Rudd/Roach hybrid; Tinca tinca; Esox lucius	Not applicable	810 (110-3200)Average BAF based on fish muscle samples (range); steady-state/equilibrium not confirmed		1927694	High

Study Type (year)	Initial Concentration	Species	Duration	Result	Comments	HERO ID	Data Quality Rating
Freshwater BAF		Oncorhynchus mykiss; Perca fluviatilis; Carassius carassius; Rutilus rutilus; Cyprinus carpio; Scardinius erythrophthalmus; Rudd/Roach hybrid; Tinca tinca; Esox lucius	Not applicable	2100 (3100-6000)Average BAF based on fish muscle samples (range); steady-state/equilibrium not confirmed		1927694	High
Freshwater BAF		Oncorhynchus mykiss; Perca fluviatilis; Carassius carassius; Rutilus rutilus; Cyprinus carpio; Scardinius erythrophthalmus; Rudd/Roach hybrid; Tinca tinca; Esox lucius	Not applicable	5900 (1200-23000)Average BAF based on fish muscle samples (range); steady-state/equilibrium not confirmed		1927694	High
This study investigated total HBCD concentration and enantiomeric fractions of (+)- and (-)-alpha-HBCD in mud carp and northern snakehead in a contaminated pond in South China.		Prey fish: mud carp, Cirrhinus molitorella. Predator fish: northern snakehead, Ophicephalus argus.	Not applicable	Mop carp = 625, northern snakehead = 6431.enantiomeric fraction (EF, expressed as (+) concentration over (-) concentration) in mud carp = 0.53-0.62 (greater than standard solution of 0.5). Northern snakehead EF = 0.35-0.50. Results indicate metabolism of enantiomers varies between species since EF values changed between prey fish (mud carp) and predator fish (northern snakehead)		3350534	High
Measured concentrations of (+) and (-) α-, β-, and γ-HBCD in several marine organisms and field plants.		Several organisms	Not applicable	α-HBCD comprised more than 60% of HBCD concentration in all but 3 species at site A and 2 at site		2343741	High

Study Type (year)	Initial Concentration	Species	Duration	Result	Comments	HERO ID	Data Quality Rating
This report addresses to the marine organism portion.				B. γ-HBCD was the next most abundant. Trophic magnification factor for α-HBCD = 2.58. TMF for total HBCD = 2.44. Enantiomeric fractions for α-, β-, and γ-HBCD were 0.495-0.688, 0.290-0.431, 0.244-0.531 (ND in half of the γ-HBCD samples), respectively.			
EPA OPPTS 850.1730 (Fish BioconcentrationTest)Non-steady state BCF test.		Oncorhynchus mykiss (previous name: Salmo gairdneri) (Rainbow trout)	70 days (35 days of exposure/uptake and 35 days of depuration)	Edible fraction: 14,039, Non-edible fraction: 30,242, Whole body d.w.: 21,940.No mortalities observed. No treatment-related clinical signs of toxicity observed during test.		3970741	High
EPA OPPTS 850.1730 (Fish Bioconcentration Test)Steady-state bioconcentration factor (BCF) test		Oncorhynchus mykiss (previous name: Salmo gairdneri) (Rainbow trout)	70 days (35 days of exposure/uptake and 35 days of depuration)	Edible fraction: 4,650, Non-edible frac: 12,866, Whole body d.w.: 8,974.		3970741	High
Biomagnification from a simple food chain model	≥1.08 to ≤50.5 other	Atlantic cod (Gadus morhua); polar cod (Boreogadus saida); harbor seal (Phoca vitulina); ringed seal (Phoca vitulina); Eggs of common tern (Sterna hirundo); eggs of arctic terns (Sterna paradisaea)	Not applicable	BMF = 2.0 (Atlantic Cod:Oslofjord Seal), BMF = 1.2 (Atlantic Cod:Froan Seal), BMF = 2.0 (Polar Cod:Spitsbergen Seal)Simple cod-harbor seal food chain model BMF = [concentration in predator]/[concentration prey]		1927762	High
		benthivorous barbel (Barbus graellsii); pelagic bleak (Alburnus alburnus)	Not applicable	Dynamic BSAF = 0.7 (Bleak) 0.9 (Barbel); Steady state BSAF = 0.75 (Bleak) 0.9 (Barbel) BSAF = Measured BSAF = 0.7 (measured range 0.10-1.44)		1927786	High

Study Type (year)	Initial Concentration	Species	Duration	Result	Comments	HERO ID	Data Quality Rating
				(Bleak); 0.5 (measured range 0.14-1.23) (Barbel)Average BSAFs per chemical per species (approximation from bar graphs); Lipid and organic-matter normalized BSAF			
Biomagnification of α-HBCD and γ-HBCD in an aquatic food web based on concentrations in predator/prey		Lake Trout (Salvelinus namaycush); Rainbow smelt (Osmerus mordax); Slimy sculpin (Cottus cognatus); Alewife (Alos pseudoharengus); Mysids (Mysis relicta); amphipods (Diporeia hoyi); Plankton	Not applicable	TMF = 6.3 (Total HBCD); BMF = 0.4-10.8 (α-HBCD), 0.2-9.9 (γ-HBCD)lipid normalized BMFs based on concentrations in predator relative to prey; trout/alewife α-HBCD = 4.8, γ-HBCD = 7.5; trout/smelt α-HBCD = 1.0, γ-HBCD = 1.5; trout/sculpin α-HBCD = 1.1, γ-HBCD = 0.8; sculpin/Diporeia α-HBCD = 3.5, γ-HBCD = 2.5; sculpin/Mysis α-HBCD = 9.7, γ-HBCD = 9.9; smelt/Mysis α-HBCD = 10.8, γ-HBCD = 5.5; smelt/Diporeia α-HBCD = 4.0, γ-HBCD = 1.4; alewife/plankton α-HBCD = 0.4, γ-HBCD = 0.2		1927822	High
Non-guideline food chain study		mysid shrimp, gudgeon, pranunus, copepods	Not applicable	BMF = 10-12 mysid shrimp to gudgeon	(Related to HERO ID 4269983).	4269990	High
Accumulation in microalgae	≤2 ng/mL	Spirulina subsalsa and Scenedesmus obliquus	168 h	BCF: S. sub salsa; alpha: 350, beta: 270, gamma: 174. S. obliquus; alpha: 407, beta: 469, gamma: 390.		2343690	High
Samples collected near an expanded polystyrene material manufacturing plant		mantis shrimp (Oratosquilla oratoria), helice crab (Helice tridens tientsinensis) and	Not applicable	aquatic trophic magnification factor = 1.75, 1.83, 1.64 and 1.72 for alpha-, beta-, gamma-, and total HBCDs, respectively		3546055	High

Study Type (year)	Initial Concentration	Species	Duration	Result	Comments	HERO ID	Data Quality Rating
		bartial flathead (Platycephalus indicus)					
Benthic macrofauna accumulation in experimental coastal ecosystems	0.043 to 0.079 ug/mg other	M. balthica	three tests: 21d, 13/14d, and 231 day	log BSAF > 1.25 Total HBCD; α-HBCD: log BASF 2.1-5.2; β-HBCD log BSAF < 1.8; γ-HBCD log BSAF 0.4Calculation details in supplemental data		3013490	Low
Terrestrial							
bioaccumulation: terrestrial	Mean measured concentration in soil (ng/g soil d.w..): α-HBCD = 186; β-HBCD = 156; γ-HBCD = 172.	Eisenia fetida - [Annelida]	21 days	BSAF for E. fetida and M. Guillelmi: α-HBCD: 2.58 and 1.1; β-HBCD: 0.270 and 0.497; γ-HBCD: 0.444 and 0.205, respectively.		3350510	High
Monitoring study		Adipose, brain, liver collected from m/f East Greenland polar bears (Ursus maritimus) between 1999-2000; blubber tissue from m/f ringed seals (Pusa hispida) between 2001-2002 in same area as bears	Not applicable	BMF in polar bear adipose 1.7; alpha-HBCD was not detected in brain or liver tissue		1443826	High
Biomagnification in predatory terrestrial food chains		Predators: common kestrel (Falco tinnunculus), eagle owl (Bubo bubo), little owl (Athene noctua), prey: sparrow (Passer montanus) and rats (Rattus norvegicus)	Not applicable	Appears to be in the supplemental report which was not readily available	Biomagnification was not reported.	1927541	Low

Study Type (year)	Initial Concentration	Species	Duration	Result	Comments	HERO ID	Data Quality Rating
Inter-species Biomagnification from bird samples collected at e-waste, urban and rural sites in South China		Samples collected from 3 South China sites		BMF in OMR: e-waste = 0.04 - 2.7 (median 0.05), urban = 2.3, rural = 1.4, LVB: rural = 30; TMF of gamma could not be determined		1927580	High
Inter-species Biomagnification from bird samples collected at e-waste, urban and rural sites in South China		Samples collected from 3 South China sites	Not applicable	BMF range 0.32 - 158; LTS: e-waste = 2.6, rural = 1.1, OMR: e-waste = 1.3, urban = 4.9, rural = 1.4, LVB: rural = 30; TMF of the alpha-isomer was implied by the data but not quantified		1927580	High
Inter-species Biomagnification from bird samples collected at e-waste, urban and rural sites in South China		Samples collected from 3 South China sites	Not applicable	BMF could not be determined as the beta isomer was only present in one sample		1927580	High
Kinetic study of gamma-HBCD oral administration to laying hens; conducted under the guidelines of the French Ministry of Agriculture for Animal Research		48 Laying hens (Gallus domesticus) Isa Brown, 22 weeks old, 1.78+/-0.09 kg	39 day	0.4 pg/g lipid relative to pg/g diet in egg yolk and 0.3 pg/g lipid relative to pg/g diet in liver; Half-lives for gamma-HBCD in egg yolk = 2.9 days, abdominal fat = 13 days and liver tissue = 0.41 days		1927629	High
Aquatic and terrestrial BMF of HBCD via analysis of food webs in South China		40 samples collected from 6 bird species between 2005 and 2008 in Qingyuan County e-waste recycling region in Pearl River Delta; further detail referenced	Not applicable	BMF alpha-HBCD fish to fish-eating bird: 4.1 to 50 lw, BMF grain to terrestrial bird: 2.8 to 75 ww		1927673	High
Aquatic and terrestrial BMF of HBCD via analysis of food webs in South China		40 samples collected from 6 bird species between 2005 and 2008 in Qingyuan County e-waste	Not applicable	BMF gamma-HBCD: fish to fish-eating bird: 1.6 to 3.0 lw and BMF grain to terrestrial bird; 7.1 to 51		1927673	High

Study Type (year)	Initial Concentration	Species	Duration	Result	Comments	HERO ID	Data Quality Rating
		recycling region in Pearl River Delta; further detail referenced					
No guideline reported. *This report is found on page 38 of HERO ID: 3970216.		Earthworm	28 days	4.5		3970216	High
Accumulation of HBCD in eggs of predatory birds		peregrine falcon eggs (Falco peregrinus), white-tailed sea eagle (Haliaeetus albicilla), guillemot (Uria algae), common tern (Sternahirundo), herring (Clupea harengus)	Not applicable	% HBCD in Herring: α-HBCD 65-70% β-HBCD 5-9%, γ-HBCD: 25.33%; Common tern α-HBCD 96% β-HBCD nd, γ-HBCD: nd; Guillemont: α-HBCD 100% β-HBCD nd, γ-HBCD: <1%; White-tailed sea eagle and Peregrine falcon: α-HBCD 100% β-HBCD nd, γ-HBCD: nd	Limitations in the analytical methods were reported and samples were collected at various times in multiple monitoring efforts previously reported; storage and handling of the samples were not reported; stability of the sample integrity not reported or confirmed.	1927746	Unacceptable
Biomagnification in polar bear marine food web		amphipods Gammarus wilkitzkii; polar cod (Boreogadus saida); ringed seals (Pusa hispida); polar bears (Ursus maritimus)	Not applicable	BMF = 36.4 (ww) and 10.9 (lw) for Ringed seal/polar cod; BMF = 0.6 (ww) and 0.7 (lw) for Polar bear/ringed seal; amphipod BMF between higher species could not be calculated due to no detection of HBCD in the lower trophic level species		1927787	High

Table 3. Hydrolysis Study Summary for HBCD

Study Type (year)	pH	Temperature	Duration	Results	Comments	HERO ID	Data Quality Rating
Bromide ion (detection limit = 200 ppm)	Tested, no significant trend		39 days	No degradation reported		4270831	High
No guideline followed			39 days	No other data is reported besides what is shown in the previous fields.	Several deficiencies were noted. Neither target chemical or transformation product concentrations were reported. Percent recovery was not reported.	3970738	Unacceptable

Table 4. Sorption Study Summary for HBCD

Study Type (year)	Sorbent Source	Sorbent Qualities (clay/silt/sand, OC, pH)	Duration	Results	Comments	HERO ID	Data Quality Rating
OECD Guideline 121 (Estimation of the Adsorption Coefficient (Koc) on Soil and on Sewage Sludge using High Performance Liquid Chromatography (HPLC))	soil/sewage sludge		Not applicable	Log Koc >5.0 at 22ºC. The retention time of HBCD was outside the calibration range so no accurate value could be estimated (12.95 min retention, last reference substance was 9.46 min.)		3970742	High

Table 5. Other Fate Endpoints Study Summary for HBCD

Study Type (year)	System	Results	Comments	HERO ID	Data Quality Rating
Concentrations of HBCD measured in air and precipitation samples from October 2008 to July 2010 in the Northern Lake Victoria Region, East Africa.	PUF+filters extracted with 70:30 hexane:acetone (ASE 200, Dionex) and eluted over 10% deactivated silica with 5% MeOH in DCM. Fractionated on activated silica using hexane and hex:DCM 1:1.	HBCD was below the MDL in 2008 and 2009 samples. In 2010, HBCD was detected in 71% of the samples. Arithmetic mean: 1.47 pg/m3; geometric mean; 0.82 pg/m3; median: 1.15 pg/m3.		2343716	High
thermal degradation study	thermogravimetric analyzers and a laboratory-scale fixed-bed reactor	75% Bromine by weight is released as HBr		3575301	High
Study investigates the uptake pathway, translocation, and isomerization of HBCD by Wheat.	In exposure chamber: 4 plants tested in unspiked and spiked soil. In control chamber (no HBCD): 4 plants tested in unspiked soil.	BCFs in the roots (RCF), stems (SCF), and leaves (LCF) were calculated for α-, β-, and γ-HBCD: RCFs were all between 1-3 except for γ in weeks 1 and 2 (0.55 and 0.96). All SCFs and LCFs were between 0.100 and 0.880. All BCFs increased from week to week. For RCFs and SCFs: α- > β- > γ-HBCD, however for LCFs: γ- > β- > α-HBCD.		3350492	High
Global screening of atmospheric HBCD concentrations from 2005-2006.	Passive air sampling	HBCD detected in 56% of samples. Samples ranged from <0.1-190 pg/m^3 (includes all HBCD isomers).		3350487	High
Abiotic degradation of HBCD in indoor dust in the presence and absence of light		Loss of HBCD was observed in all samples with greater degradation observed in the presence of light with t1/2= 12.2wks vs. t1/2 = 26wks in its absence; isomerization of γ-HBCD to α-HBCD was observed and net degradation of standards in the presence of light varied from 5.5%/7d for α-HBCD and 8.5%/7d for γ-HBCD; no change was		1927725	High

Study Type (year)	System	Results	Comments	HERO ID	Data Quality Rating
		observed for enantiomeric fractions in all samples			
Sediment/water partitioning study that tested the impact of bioturbating microfauna on HBCD distribution.	Four experiments were done to test each combination of HBCD spiked/non-spiked phytoplankton in the presence/absence of benthic microfauna. Treatment a and c: unspiked phytoplankton, treatment c and d: macrofauna present. Nominal [HBCD]: 43ug/container.	[HBCD] was lower in filtered water than unfiltered, both showed decreases over 3 weeks however. Sediment concentrations increased largely over 3 weeks. [HBCD] in M. Balthica increased greatly after 7 days but changed very little from day 7-21. Filtered water was more enriched in alpha and beta HBCD. Sediment with microfauna had decreased beta and increased gamma than without microfauna. M. Balthica had decreased gamma and increased alpha over 21 days. After 21 days, 88% of HBCD was in the sediment, 11% was in the bivalves; and <1% was in the particulate or dissolved.		3013490	High
Partitioning/transport from household dust to laundry wastewater	Not applicable	HBCD was detected in 95% of dust samples <1 to 3160 ng/g (median 300 ng/g), alpha-HBCD accounted for 69% of total-HBCD; HBCD was detected in 26% of laundry wastewaters <1 to 1270 ng/L, alpha-HBCD accounted for 63% of total-HBCD (after removal of one outlier sample)		2528320	High
Measured HBCD enantiomer and diastereomer profiles in terrestrial plants.		Total HBCD concentrations: Leaf > root > soil. In all plants, alpha HBCD concentrations followed a trend of leaf < root < soil. Enantioselectivity was		2343741	High

Study Type (year)	System	Results	Comments	HERO ID	Data Quality Rating
		seen in most of the plants but not in the roots.			
Waste-water removal	Sewage treatment systems not described	Water treatment systems removal rate at 12-STP located in Japan was on average 93% (range 80-99%); the author suggests that HBCDs passed into sewage sludge during the treatment process, but no analysis was performed		2343678	High
Stereo-isomer specific bioaccumulation in marine mammals	25ml Erlenmeyer flasks, shaking water bath	Biotransformation: beta-isomer 69±16%; gamma-isomer 60±10%, alpha-HBCD 17±14% after 90 mins		4140500	High
Behavior of HBCD during incineration of solid wastes	Pilot-scale incinerator with rotary kiln, primary combustion unit and vertical secondary combustion chamber connected to gas cooling zone; air pollution control until includes filter bag, activated carbon adsorption tower and wet scrubber.	HBCD was steadily degraded for an overall removal of 99.99% along the gas treatment flow line and all isomers behaved similarly		2343703	High
Monitoring influent/effluent concentration at several WWTPs.	Treatment system types included: Conventional-activated sludge process; SYMIO; Bio-Best-Bacillus process; Aerobic digestion (bacillus sp.); Modified Ludzach-Ettinger.	41.3% removal efficiency; HBCD [Effluent[/[Influent]: Human waste treatment plant = 0.39-0.92; sewage treatment plant =0.54-0.63; waste water treatment plant = 0.36-0.84.	Study results not relevant to a specific/designated fate endpoint.	3545985	High
HBCD concentrations in sediment and wildlife	Regional Monitoring Program	HBCD was detected in sediments (0.1 to 2 ng/g; median 0.3 ng/g; gamma 51-100%; beta 0-27%; alpha 0-36%) and all wildlife matrices, eggs 22-39 ng/g; shiner surfperch 3-25 ng/g; seal adults and pups 4-19 ng/g and 2-12 ng/g; white croaker <6-	Not a designated/specific Fate endpoint; monitoring study with a qualitative assessment of the results.	1443796	High

Study Type (year)	System	Results	Comments	HERO ID	Data Quality Rating
		5ng/g. Increase in HBCD conc between seal adults and one of its prey suggest that biomagnification may be occurring.			
Trophodynamics in a marine food-web		alpha-HBCD trophic level adjusted BMF in predator/prey feeding relationships ranged from 0.1 to 1.7; the alpha isomer accounted for ca. 90% of the body burden for beluga while it was only 20% in its primary prey the arctic cod (beta: 4% and gamma 78%), indicating that the beluga can bioprocess the gamma isomer to the alpha-isomer.	Not a designated/specific Fate endpoint; non-guideline monitoring data field sampling used appropriately.	1279130	High
Accumulation and biotransformation in two Dutch food chains		HBCD levels increased from invertebrates to fish but decreased from fish to tern egg; ca. 200 ng/g lw HBCD in tern egg; ca. 400 ng/g lw HBCD in sandeel (dominant food for terns); and ca. 100 ng/g lw HBCD in invertebrates; alpha-HBCD diastereomer is the primary isomer in tern eggs and fish	Study results not relevant to a specific/designated Fate endpoint.	4140495	Medium
Activated Sludge Respiration Inhibition		29.1% inhibition was observed for HBCD treatment group.	This is a secondary source and does not apply to a specific/designate Fate endpoint; it is a robust summary and a reference was provided Schaefer E and Siddiqui A. 2003. Hexabromocyclododecane (HBCD): An Activated Sludge, Respiration Inhibition Test. Project	1443881	Medium

Study Type (year)	System	Results	Comments	HERO ID	Data Quality Rating
			Number: 439E-108A. Wildlife International, Ltd. Easton, MD.		
Spatial trends of brominated flame retardants evaluated from the generation of backward air trajectories and air samples collected from Lake Michigan through the US Midwest to the Gulf of Mexico		Backward trajectories of HBCD were not included or reported. HBCD was only detected in particle-phase samples at concentrations ranging from 0.2-8.0 pg/m3 (MI), 0.9-9.6 pg/m3 (CH, 0.2-3.6 pg/m3 (IN), 0.2-11 pg/m3 (AR), 0.16-6.2 pg/m3 (LA); gamma and alpha isomers varied within samples and were the most abundant overall while the beta accounted for 6-17%.	Air-transport modeling was not applied/reported for HBCD; however, informative data was reported on isomeric mixture in air.	999242	Medium
In-house test chamber experiment for migration to dust of HBCDs from source material via volatilization and deposition	Stainless steel cylindrical test chamber	Migration of HBCD from point sources to dust was observed but not quantified	Overall this test is an indicator of the importance of sink effects when studying migration to dust since steady-state was not achieved due to limited study time.	2528329	Medium
Evaluation of Arctic ice core to identify atmospheric deposition history	Field monitoring	HBCD was not detected in core samples representing 1953-1962 or 1971-1980; HBCD was detected in 1962-1971 ca. 6.07 ng/L, 1980-1988 ca. 11.97 ng/L, 1988-1996 ca. 9.01 ng/L, 1995-2005 ca. 19.53 ng/L; deposition trends show an increase over time and the peak input flux was calculated as 910 pg/cm2 yr in 1995-2005; air-mass trajectories suggested that Europe is an important haze-season source and air mass	Study results not relevant to a specific/designated Fate endpoint.	1927665	Medium

Study Type (year)	System	Results	Comments	HERO ID	Data Quality Rating
		flow from northern Russia and Siberia dominate year round.			
Estimating the amount of HBCD in air using established octanol/air partition coefficients and known concentration in tree bark.	Calculated octanol/air partition coefficients from log KOA = 0.98784 log P + 6.6914 to estimate amount of HBCD in air with known concentrations in tree barks via K(BA) C(B)/C(A).	Estimated K(OA) at 25 deg C: alpha-HBCD = 14.5; beta-HBCD = 15.2; gamma-HBCD = 14.6	Study does not lend new insight or valid data to an existing model. Studies that apply an existing model to a specific site/situation should be excluded unless it's also presented alongside new data. Could be considered for monitoring data.	1927637	Low
photodegradation study		No loss after 371 d in two textile samples	Data not likely useful for photodegradation in the environment.	3809158	Low
Temperature effects of water temperature on HBCD partitioning in the environment	Study conducted outside with natural light, sheltered from rain in 5-L polypropylene buckets with 3.75 L of Baltic Sea water (Salinity: 7.5) and ca. 2 cm of 1mm-seived sediment and 4 M.balthic, 2 C. gluacum and 10 Hydrobiidae added	Significant differences were found in filtered and unfiltered water fractions at day 1: α-HBCD and β-HBCD were enriched in filtered water while γ-HBCD was depleted; an increase in α-HBCD was observed in the warmer water; No significant differences or trends were found in filtered and unfiltered water fractions at day 13; in sediment γ-HBCD was enriched and β-HBCD was depleted with no significance correlated to time or temperature; M. balthica were γ-HBCD depleted and α-HBCD enriched, a trend not seen in the bivalves.	Analytical details were not included. Supplemental data should be evaluated for a more thorough assessment	3013490	Unacceptable
Arctic marine food chain monitoring		HBCD concentration: in polar cod: 5-25 ng/g lw; ringed seal: 15-35 ng/g lw; polar bear: 5-15 ng/g lw; not detected in lower pelagic zooplankton	Study results not relevant to a specific/designated Fate endpoint. Limited details reported (i.e., no details were provided regarding the sampling,	4140373	Unacceptable

Study Type (year)	System	Results	Comments	HERO ID	Data Quality Rating
			work-up, or analytical techniques).		
Accumulation (and disposition) of HBCD in Oncorhynchus mykiss via dietary exposure	Duration of test: 15 days	Diastereomer composition found in fish at 6h was similar to 0h but changed through the remainder of the experiment	BCF not reported. Disposition data may be useful to other disciplines; however, the analytical method may not be suitable for meaningful detection of the test substance.	1927701	Unacceptable