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WASTE ASSESSMENT GUIDANCE

Final report of the Correspondence Group on Development of Interim, Default Action Levels and Guidance for Dredged Material

Submitted by the Chair of the Correspondence Group

SUMMARY

Executive summary:	This document presents, in the annex, the final report of the Correspondence Group on Development of Interim, Default Action Levels and Guidance for Dredged Material, summarizing the derivation of IALs and guidance for their application to include associated assumptions and other considerations (e.g., recommended review cycle)
Action to be taken:	Paragraph 2
Related documents:	LC/SG 43/2/2

Introduction

1 The annex to this document presents the final report of the Correspondence Group on Development of Interim, Default Action Levels and Guidance for Dredged Material, summarizing the derivation of interim action levels (IALs) and guidance for their application to include associated assumptions and other considerations (e.g. recommended review cycle). Background information on the final report can be found in document LC/SG 43/2/2, which provides a progress report of the Correspondence Group.

Action requested of the Scientific Groups

2 The Scientific Groups are invited to take note of the information provided, and take action as deemed appropriate.

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ANNEX

Interim Action Levels (IALs) for dredged materials

Purpose:

1 To provide those countries which currently lack country-specific sediment chemistry action levels a set of interim (i.e., temporary) action levels (IALs) for sediment-associated chemical constituents to support dredged material management decision-making, until such time as those countries are able to develop their own, regionally appropriate, levels.

Approach:

2 Consistent with the *Guidance for the Development of Action Lists and Action Levels for Dredged Material* (IMO 2009), two action levels are derived, a lower level sediment concentration (Level 1), below which it is expected that there is a low probability of unacceptable contaminant-related effects associated with ocean disposal of dredged material, and an upper level sediment concentration (Level 2) above which ocean disposal of dredged material may pose an unacceptable contaminant-related risk without additional evaluation and/or the application of special engineering controls. In developing this interim set of action levels, a comprehensive literature review and survey was undertaken to compile existing, published international action levels for dredged material management in a marine environment. Results of the compilation are summarized in tables 1 & 2 along with empirically derived effect levels and published naturally occurring background values (metals only), provided for comparative purposes.

3 To derive IALs, the published action levels summarized in the tables 1 & 2 were pre-screened on a constituent-by-constituent basis. Only those constituents with four or more published action levels measured on mass dry weight basis (e.g., mg/kg) were utilized in the derivation of IALs. As a consequence, the interim list includes values for metals (Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, and Zinc), total tributyltin (TBT), total polyaromatic hydrocarbons (PAHs) (based on a summation of 16 PAHs), total DDT, Lindane, and total polychlorinated biphenyls (PCBs) (based on summation of 7 ICES congeners). An outlier analysis was also performed on each constituent data set using Iglewicz and Hoaglin's mutliple outlier test with modified z score outlier criteria of 3.5. If no outliers or a single outlier was detected the data was re-analysed using the Grubb's test (4 or more data points) or Dixon's test (3 data points).

4 Outliers identified through this analysis (red shaded cells in tables 1 & 2) were excluded in the subsequent derivation of the IALs. It is important to note that although certain values identified as statistical outliers based on the data distribution were excluded in the derivation of IALs, this does not imply that these values are inappropriate for their intended regional application.

Table 1: Compendium of Published Lower Action Levels used in the derivation of the Level 1 IALs (Table 3), relevant lower effect levels and background concentrations (metals only). Red shaded cells indicate statistical outliers not included in derivation of IALs.

Contaminant Class	Constituent	Lower Effect Levels - Technically Derived[A]			Lower Action Limits - Country[B] Specific																					Published Crustal Abundance Concentrations (Metals)									
		ERL[1]	TEL[2]	T20[3]	AU[20]	BE[15,17,22]	BR[25]	CA[17,27]	CN	DK[15,17]	EE[25]	FL[15,17,22]	FR[15,17,22]	DE[15,17]	HK[18,22]	IE[15,17]	IT[24]	KR[22]	LV[25]	NL[15,17]	NO[16,17,23]	PT[17]	ES[C 19]	ZA[21]	UK[15,17]	Shaw et al.[4,5]	Eade and Fahrig[6]	Condie[7]	Gao et al.[8]	Sims et al.[9]	Taylor and McLennan[10,11]	Wedepohl[12]	Rudnick and Gao[13]	Median	Upper Quartile
Metals (mg/kg)	Antimony				2																														
	Arsenic	8.2	7.24	7.4	20	20	19		20	20	20	15[T]	25	40	12	9	12	20	20	29	52	50	70[V,W]	57	20				4.4	5.1	1.5	2	4.8	4.4	4.8
	Cadmium	1.2	0.676	0.38	1.5	2.5	1.2	0.6	0.8	0.4	1	0.5[T]	1.2	1.5	1.5	0.7	0.3	2.5	1	0.8	2.6	3	2.4[V]	5.1	0.4	0.075			0.079		0.098	0.102	0.09	0.1	0.1
	Chromium	81	52.3	49	80	60	81		80	50	100	65[T]	90	120	80	120	50	80	100	100	560[W]	100	340[V,W]	260[W]	40	35	76	112	80		85	35	92	80.0	88.5
	Copper	34	18.7	32	65	20	34		50	20	100	50[T]	45	30	65	40	40	65	100	36	51	150[W]	168[V,W]	230[W]	40	14	26		32		25	14	28	25.5	27.5
	Lead	46.7	30.2	30	50	70	46.7		75	40	50	40[T]	100	90	75	60	30	50	100	85	83	150	218[V,W]	218[W]	50	17	18	17	18		17	17	17	17.0	17.5
	Mercury	0.15	0.13	0.14	0.15	0.3	0.3	0.75	0.3	0.25	0.5	0.1[T]	0.4	0.7	0.5	0.2	0.3	0.3	0.5	0.3	0.63	1.5[W]	0.71[V]	0.84	0.3	0.096			0.0123			0.056	0.05	0.1	0.1
	Nickel	20.9	15.9	15	21	70	20.9			30	50	45[T]	37	70	40	21	30	35	20	35	46	75	63[V]	140[W]	20	19	19	60	38		44	19	47	38.0	45.5
	Selenium																																		
	Silver	1	0.73	0.23	1										1														0.055		0.05	0.055	0.053	0.1	0.1
	Zinc	150	124	94	200	160	150		200	130	200	170[T]	276	300	200	160	100	200	200	140	360	600[W]	410[V]	410	130	52	60		70		71	52	67	63.5	69.3
Butyltins (µg/kg)	Monobutyltin																																		
	Dibutyltin																																		
	Tributyltin																																		
	Tetrabutyltin																																		
	Total TBT[D]				9[R]	3	100			7		3[T]	100[W]	20		100[W]	5		3	0.000007[W]	5		100[V,W]		100[W]										
PAHs (µg/kg)	Acenapthene	16	6.71	19			16						15												100										
	Acenapthylene	44	5.87	14			44						40												100										
	Anthracene	85.3	46.9	34			85.3					10[T]	85				24								100										
	Fluorene	19	21.2	19			19						20				21		10						100										
	Napthalene	160	34.6	30			160					10[T]	160				35								100										
	2-Methylnapthalene	70	20.2	21			70												10						100										
	Phenanthrene	240	86.7	68			240					50[T]	240				87								100										
	Total LMW PAHs[E]	552	312												550				50																
	Benz(a)anthracene	261	74.8	61			280					30[T]	260				75		30						100										
	Benzo(a)pyrene	430	88.8	69			230					300[T]	430				30		300						100										
	Benzo(ghi)perylene											800[T]	1700				55		800																
	Benzo(b)fluoranthene												400				40																		
	Benzo(k)fluoranthene											200[T]	200				20		200																
	Chrysene	384	108	82			300					1100[T]	380				108		1100						100										
	Indeno(123-cd)pyrene											600[T]	1700				70		600																
	Dibenz(a,h)anthracene	63.4	6.22	19			43						60												10										
	Flouranthene	600	113	119			600					300[T]	600				110		300						100										
	Pyrene	665	153	125			665						500				153								100										
	Total HMW PAHs[F]	1700	655												1700																				
	Total PAHs[G]	4022	1684		10000	70000[S]																			100000										
	Total PAHs 6[H]																																		
	Total PAHs 9[I]									3000	5000							4000					3.76[V]												
	Total PAHs 10[J]																			1000															
	Total PAHs 16[K]					2542	4000	2500		4789		5426[T]	6790	1800		4000	900				2000	2000			3712										
	Total PAHS 18[L]																																		
Pesticides (µg/kg)	Chlordane	0.5	2.26		0.5												2.3																		
	Dieldrin	0.02	0.72	0.83	280[W]		2.67										0.7								5										
	DDD	2	1.22	2.2	2		2.07							3			0.8																		
	DDE	2.2	2.07	3.1	2.2		1.19							1			1.8																		
	DDT	1	1.19	1.7			0.71							1			1																		
	Total DDT[M]	1.58	3.89		1.6				20		0.1	10[T]		4					10	10	20				1										
	Endrin				10												2.7																		
	Lindane (BHC, gamma)		0.32		0.32		2.26							0.5		0.3	0.2				1.1														
	PCB IUPAC 28											1[T]	5			1			1																
	PCB IUPAC 52											1[T]	5			1			1																
	PCB IUPAC 101											4[T]	10			1			4																
	PCB IUPAC 118											4[T]	10			1			4																
	PCB IUPAC 138											4[T]	20			1			4																
	PCB IUPAC 153											4[T]	20			1			4																
	PCB IUPAC 180											3[T]	10			1			3																
	Total PCBs Sum of Individual Congeners (ICES 7)[N]					50	22.7	34[U]	20	20		22[T]	80	13	23	7				20	17	25	180[V,W]		10										
	Total PCBs as Arochlors[O]																																		
	Total PCBs[P]	22.7	21.6	35	23	2000[X]											8	23			0.03				20										
Dioxins/furans (ng/kg)	Total TEQ[Q]		0.85									20[T]					2																		

[A] ERL- Effect Range Low, TEL- Threshold Effects Level, T20 Threshold 20th Percentile; [B] ISO 3166 Country Codes: AU-Australia, BE-Belgium, BR-Brazil, CA-Canada, CN-China, DK-Denmark, EE-Estonia, FL-Finland, FR-France, DE-Germany, HK-Hong Kong, IE-Ireland, IT-Italy, KR- South Korea, LV-Latvia, NL-Nettherlands, NO-Norway, PT-Portugal, ES-Spain, ZA-South Africa, UK-United Kingdom; [C] Action Level "B" utilized for lower threshold value; [D] Summation of Mono, Di, Tri, and Tetrabutyltin; [E] Summation of Low Molecular Weight PAHS (i.e., summation of PAHs with 3 or fewer rings); [F] Summation of High Molecular Weight PAHs (i.e., summation of PAHs with 4 or more rings); [G] Summation of PAHs indeterminate; [H] Summation of 6 PAHs (fluoranthene, benzo(b)fluoranthene, benzo(k)fluoranthene), benzo(a)pyrene, benzo(ghi)perylene, indeno(1,2,3-cd)pyrene); [I] Summation of 9 PAHs (anthracene, benzo(a)anthracene, benz(ghi)perylene, benz(a)pyrene, chysene, fluoranthene, indeno(123-cd)pyrene, pyrene, phenthanthrene); [J] Summation of 10 PAHs (anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(ghi)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, phenanthrene, indeno(123cd)pyrene, naphthalene); [K] Summation of 16 PAHs (Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benz(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene and Benzo(ghi)perylene); [L] Summation of 18 PAHs (Naphthalene, Acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, 2-methylnaphthalene, 1-methylnaphthalene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene and benzo(ghi)perylene); [M] Summation of DDD, DDE and DDT; [N] Summation of IUPAC Congeners (28,52,101,118,138,153, and 180); [O] Summation of PCBs measured as Arochlors; [P] Summation of PCBs indeterminate; [Q] Sum of Dioxins and Dibenzofurans as WHO Toxic Equivalents; [R] µg Sn/Kg dry weight 1% TOC; [S] normalized to Organic Carbon content of sediment; [T] normalized to a "standard soil" with 10% organic content and 25% clay; [U] Based on total PCBs as Arochlors coverted to PCB ICES 7 per Apitz and Agius 2013 to enable comparison; [V] Sediment concentrations measured in the <2mm grain size fraction; [W] Values identified as statistical outliers and excluded from data set used to derive default lower action level. It is important to note that values were derived for regionally specific (country) purposes and their exclusion from this analysis in no way impunes the validity of these values for their intended purpose.

Table 2: Compendium of Published Upper Action Levels used in the derivation of the Level 2 IALs (Table 3) and relevant upper effect levels. Note: No statistical outliers identified.

Contaminant Class	Constituent	Upper Effect Levels - Technically Derived[A]				Upper Action Limits - Country[B] Specific																					
		ERM[1]	PEL[2]	AET[14]	T80[3]	AU[20]	BE[15,17,22]	BR[25]	CA[17]	CN	DK[15,17]	EE[25]	FL[15,17,22]	FR[15,17,22,23]	DE[15,17]	HK[18,22]	IE[15,17]	IT[24]	KR[22]	LV[25]	NL[15,17]	NO[16,17,24]	PT[17]	ES[C 19]	ZA[21]	UK[15,17]	Upper Quartile[Y]
Metals (mg/kg)	Antimony					25																					
	Arsenic	70	41.6	35	56	70	100	70		100	60	50	60[T]	50	120	42	70	20	70	150	29	76	500[W]	280[V,W]	93	100	100.0
	Cadmium	9.6	4.21	3	4.9	10	7	7.2		5	2.5	20	2.5[T]	2.4	4.5	4	4.2	0.8	10	12.5	4	15	10	9.6	9.6	5	10.0
	Chromium	370	160	62	410	370	220	370		300	270	800	270[T]	180	380	160	370	150	370	750	120	5900[W]	1000[W]	1000[V,W]	370	400	370.0
	Copper	270	108	390	280	270	100	270		300	90	500	90[T]	90	90	110	110	52	270	200	60	55	500[W]	675[V,W]	390	400[W]	367.5
	Lead	218	112	400	297	220	350	218		250	200	600	200[T]	200	270	110	218	70	220	500	110	100	1000[W]	600	530	500	500.0
	Mercury	0.71	0.696	0.41	1.7	1	1.5	1		1	1	10	1[T]	0.8	2.1[W]	1	0.7	0.8	1.2	5	1.2	0.86	10[W]	2.84	1.5	1.5	1.2
	Nickel	51.6	42.8	110	147	52	280[W]	51.6			60	500	60[T]	74	210	40	60	75	52	250	45	120	250[W]	234[V,W]	370[W]	200	140.0
	Selenium																										
	Silver	3.7	1.77	3.1	5.8	3.7										2											
	Zinc	410	271	410	636	410	500	410		600	500	1500	500[T]	552	900	270	410	150	410	1750	365	590	5000[W]	1640[V,W]	960	800	597.5
Butyltins (µg/kg)	Monobutyltin																										
	Dibutyltin																										
	Tributyltin																										
	Tetrabutyltin																										
	Total TBT[D]					70[R]	7	1000			200		200[T]	4000[W]	300	150	500	72		60	250	20		200[V]		1000[W]	500.0
PAHs (µg/kg)	Acenapthene	500	88.9	130	714			500						260													
	Acenapthylene	640	128	71	1418			640						340													
	Anthracene	1100	245	280	2486			1100					100[T]	590				245									
	Fluorene	540	144	120	665			540						280				144									
	Napthalene	2100	391	230	1569			2100					100[T]	1130				391									
	2-Methylnapthalene	670	201	64	767			670																			
	Phenanthrene	1500	544	660	3056			1500					500[T]	870				544									
	Total LMW PAHs[E]	3160	1442	1200												3160											
	Benz(a)anthracene	1600	693	960	3535			690					400[T]	930				500									
	Benzo(a)pyrene	1600	763	1100	3908			760					3000[T]	1015				100									
	Benzo(ghi)perylene												8000[T]	5650				100									
	Benzo(b)fluoranthene													900													
	Benzo(k)fluoranthene												2000[T]	400													
	Chrysene	2800	846	950	5186			850					11000[T]	1590				846									
	Indeno(123-cd)pyrene												6000[T]	5650				100									
	Dibenz(a,h)anthracene	260	135	230	685			140						160													
	Flouranthene	5100	1494	1300	8952			5100					3000[T]	2850				1494									
	Pyrene	2600	1398	2400	6982			2600						1500				1398									
	Total HMW PAHs[F]	9600	6676	7900												9800											
	Total PAHs[G]	44792	16770			50000																					
	Total PAHs 6[H]																										
	Total PAHs 9[I]										30000	200000							45000					18800[V]			
	Total PAHs 10[J]																				8000						
	Total PAHs 16[K]						6478				47805		44410[T]	24115	5500						11481	8618	20000			12760	34262.5
	Total PAHS 18[L]																										
Pesticides (µg/kg)	Chlordane	6	4.79	2.8		6												4.8									
	Dieldrin	8	4.3	1.9	10	270		62.4										4.3									
	DDD	20	7.81	16	159	20		374							3			7.8		10							17.5
	DDE	27	374	9	3414	27		4.77							6			3.7		3							5.7
	DDT	7	4.77	12	76			4.3							3			4.8		3							
	Total DDT[M]	46.1	51.7	11		46				100		5	30[T]		12						20	490[W]					73.0
	Endrin					120												10									
	Lindane (BHC, gamma)		0.99	4.8		1		4.79							1.5		1	1									1.4
PCBs	PCB IUPAC 28												30[T]	10						6							
	PCB IUPAC 52												30[T]	10			180			3							
	PCB IUPAC 101												30[T]	20			180			3							
	PCB IUPAC 118												30[T]	20			180			10							
	PCB IUPAC 138												30[T]	40			180			12							
	PCB IUPAC 153												30[T]	40			180			15							
	PCB IUPAC 180												30[T]	20			180			6							
	Total PCBs Sum of Individual Congeners (ICES 7)[N]						50	180		600	200		210[T]	160	40		1260[W]				100	190	300	540[V]		140	210.0
	Total PCBs as Arochlors[O]															180											
	Total PCBs[P]	180	189	130	3926													60	180							180	
Dioxins/furans (ng/kg)	Total TEQ[Q]		21.5	3.6									500[T]	1000				10									1000.0

[A] ERM- Effect Range Median, PEL- Probable Effects Level, AET- Apparent Effects THreshold, T80-Threshold 80th Percentile; [B] ISO 3166 Country Codes: AU-Australia, BE-Belgium, BR-Brazil, CA-Canada, CN-China, DK-Denmark, EE-Estonia, FL-Finland, FR-France, DE-Germany, HK-Hong Kong, IE-Ireland, IT-Italy, KR-South Korea, LV-Latvia, NL-Nettherlands, NO-Norway, PT-Portugal, ES-Spain, ZA-South Africa, UK-United Kingdom; [C] Action Level "B" utilized for lower threshold value; [D] Summation of Mono, Di, Tri, and Tetrabutyltin; [E] Summation of Low Molecular Weight PAHS (i.e., summation of PAHs with 3 or fewer rings); [F] Summation of High Molecular Weight PAHs (i.e., summation of PAHs with 4 or more rings); [G] Summation of PAHs indeterminate; [H] Summation of 6 PAHs (fluoranthene, benzo(b)fluoranthene, benzo(k)fluoranthene), benzo(a)pyrene, benzo(ghi)perylene, indeno(1,2,3-cd)pyrene); [I] Summation of 9 PAHs (anthracene, benzo[a]anthracene, benz[ghi]perylene, benz[a]pyrene, chysene, fluoranthene, indeno[123-cd]pyrene, pyrene, phenthanthrene); [J] Summation of 10 PAHs (anthracene, benzo[a]anthracene, benzo[a]pyrene, benzo[ghi]perylene, benzo[k]fluoranthene, chrysene, fluoranthene, phenanthrene, indeno[123cd]pyrene, naphthalene); [K] Summation of 16 PAHs (Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benz[a]anthracene, Chrysene, Benzo[b]fluoranthene, Benzo[k]fluoranthene, Benzo[a]pyrene, Indeno[1,2,3-cd]pyrene, dibenzo[a,h]anthracene and Benzo[ghi]perylene); [L] Summation of 18 PAHs (Naphthalene, Acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, 2-methylnaphthalene, 1-methylnaphthalene, pyrene, benz[a]anthracene, chrysene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, indeno[1,2,3-cd]pyrene, dibenzo[a,h]anthracene and benzo[ghi]perylene); [M] Summation of DDD, DDE and DDT; [N] Summation of IUPAC Congeners (28, 52, 101, 118, 138, 153, and 180); [O] Summation of PCBs measured as Arochlors; [P] Summation of PCBs indeterminate; [Q] Sum of Dioxins and Dibenzofurans as WHO Toxic Equivalents; [R] µg Sn/Kg dry weight 1% TOC; [S] normalized to Organic Carbon content of sediment; [T] normalized to a "standard soil" with 10% organic content and 25% clay; [U] Based on total PCBs as Arochlors coverted to PCB ICES 7 per Apitz and Agius 2013 to enable comparison; [V] Sediment concentrations measured in the <2mm grain size fraction; [W] Values identified as statistical outliers and excluded from data set used to derive default lower action level. It is important to note that values were derived for regionally specific (country) purposes and their exclusion from this analysis in no way impunes the validity of these values for their intended purpose; [Y] Upper Quartile value only calculated for constituents with 4 or more values after exclusion of statistically identified outliers.

5 Four alternative approaches for the derivation of IALs were assessed:

Alternative 1: Lower IAL (Level 1) calculated as the lower 25th percentile of the pre-screened, published lower action levels for each constituent and upper IAL (Level 2) calculated as the upper 75th percentile of the pre-screened, published upper limits;

Alternative 2: Level 1 and level 2 IALs calculated as the median of the pre-screened lower and upper limits;

Alternative 3: Level 1 calculated as the upper 75th percentile of the published lower action levels for each constituent and level 2 calculated as the lower 25th percentile of the pre-screened upper limits: and

Alternative 4: Level 1 and level 2 IALs calculated as the lower 10th percentile of the pre-screened lower and upper limits.

6 Among the four alternative derivation methods evaluated, Alternative 1 (i.e. lower 25th; upper 75th) provided for a higher level of confidence in accurately identifying toxic and non-toxic samples but yielded a larger percentage of samples potentially falling between the two limits and therefore requiring further evaluation. Alternative 3 (i.e. upper 75th; lower 25th) provided for the smallest number of samples potentially requiring further evaluation at the possible expense of incorrectly identifying non-toxic samples as toxic and toxic samples as non-toxic. The remaining two approaches (Alternative 2 [median] and Alternative 4 [lower 10th percentile]) attempted to strike a balance between the two extremes (i.e., ensure environmental protection [correct identification of toxic and non-toxic samples] while maximizing practical utility [smaller number of samples potentially requiring further evaluation]).

7 An additional "ground-truthing" step for each of the derivation alternatives included comparison of the derived interim Level 1 concentrations for metals to published crustal abundance concentrations (table 1) for metals to ensure that the calculated lower level concentrations were elevated relative to published, naturally occurring, concentrations. For those metals where the derived Level 1 concentration was within the range of reported naturally occurring levels (chromium and nickel [Alternatives 1 & 2]), the upper 75th percentile of the background range was utilized as the Level 1 threshold. A comparison to other, empirically derived, effect levels was also conducted to ensure that the levels were consistent (i.e. within a factor of 2-3) with published low probability of effect concentrations (e.g., ERL, TEL's etc.) and higher probability of effect concentrations (ERM, PEL's etc.). IALs derived utilizing the four different approaches are summarized in table 3.

8 An evaluation of the four approaches was conducted by Canada utilizing a database of 1,079 co-located sediment chemistry and toxicity test results from ambient monitoring studies conducted around the coasts of the United States (as described in document LC/SG 41/INF.8). The sediment results were used to compare the performance of the four alternative IAL derivation methods and various national action levels for the same list of contaminants. Results of this analysis are summarized in LC/SG 42/2/4.

9 Based on results of this analysis, the correspondence group determined that the approach utilizing the median values (Alternative 2 – highlighted columns in table 3 struck an appropriate balance between environmental protection and practical utility and recommended that this alternative be utilized for calculation of IALs moving forward.

Application of IALs:

10 IALs (those values presented in table 3; the shaded columns) may be utilized on a temporary basis to support dredged material management decision-making and should be applied in a manner consistent with the approaches outlined in LC/SG 40/WP.6 Annex (2017), the guidance document for the development of action list and action levels (IMO 2009) and the Waste Assessment Guidelines (IMO 2014).

Other Considerations and Recommendations:

11 It must be emphasized that the interim values provided in table 3 are intended for use only until such time as a country can develop more regionally appropriate values. Further, while a certain level of conservatism was utilized in the derivation of IALs, no guarantee can be given as to the level of protectiveness for any particular region, without additional regional-specific validation.

12 It is recommended that IALs be reviewed every five years (at a minimum) to accommodate any revisions/additions to published country-specific ALs used in their derivation and provide opportunity for consideration of any relevant scientific advances. During this review period, additional constituents may be considered as well as alternative approaches (providing there is sufficient technical justification). Finally, while the current set of IALs do not address the potential for indirect effects via bioaccumulation, it is possible that in the future, such an approach may be developed at which time development of IALs for protection against potential indirect effects may be considered.

Table 3: Summary of Interim Action Levels (IALs) derived via four different approaches. (shaded columns indicate IALs derived using the preferred approach).

Constituent	Level 1					Level 2				
	Alt. 1	Alt. 2	Alt. 3	Alt. 4	N[E]	Alt. 1	Alt. 2	Alt. 3	Alt. 4	N[E]
Arsenic (mg/Kg)	16	20	20	11	16	100	70	50	38	18
Cadmium (mg/Kg)	0.6	1.1	2.2	0.4	20	10	6	4	2.5	20
Chromium (mg/Kg)	89[F]	89[F]	100	48	7	370	360	200	156	17
Copper (mg/Kg)	35	45	65	20	17	368	155	90	60	20
Lead (mg/Kg)	49	65	86.3	39	18	500	220	200	108	19
Mercury (mg/Kg)	0.3	0.3	0.6	0.2	20	1.2	1	0.9	0.8	15
Nickel (mg/Kg)	45[F]	45[F]	53	20	7	140	60	52	47	14
Zinc (mg/Kg)	150	200	276	130	19	600	500	410	318	16
Total TBT (µg/Kg)[A]	3	5	8	7×10^{-6}	9	500	200	72	60	11
Total PAHs 16 (µg/Kg)[B]	2000	3100	4600	1200	12	34000	12800	7500	6200	9
Total DDT (µg/Kg)[C]	1.3	10	15	0.1	9	73	20	8.5	7.8	5
Lindane (µg/Kg)	0.3	0.4	0.4[G]	0.3	6	1.4	1	1	1	4
Total PCBs (µg/Kg)[D]	14	20	23	7.9	12	210	180	100	50	11

[A] Summation of Mono-, Di-, Tri-, and Tetrabutyltins.
[B] Summation of 16 PAHs (Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benz[a]anthracene, Chrysene, Benzo[b]fluoranthene, Benzo[k]fluoranthene, Benzo[a]pyrene, Dibenz[a,h]anthracene, Benzo[ghi]perylene, Indeno[1,2,3-cd]pyrene).
[C] Summation of DDD, DDE, and DDT isomers.
[D] Summation of the ICES-7 PCBs (CB28, 52, 101, 118, 138, 153, and 180).
[E] Number of values used in derivation.
[F] Lower limit based on upper 75th percentile of crustal abundance distribution.
[G] Median used in lieu of upper 75th percentile for level 1 value as value based on 75th percentile would be higher than level 2 value as a consequence of differences in the data distributions of the country specific ALs in tables 1 & 2 for Lindane.

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