Relative Potency Factors for Carcinogenic PAHs

Presented to:

Cleanup Standards Scientific Advisory Board

June 30, 2022

Workgroup History & Charge

- EPA and CalEPA use RPFs to quantify cancer risk relative to B[a]P
- The BaP IRIS values were updated in 2017
- CSF_o and IUR for other cPAHs listed in Table 5 should scale with B[a]P
- DEP asked for support and guidance from CSSAB on how RPFs could be applied to the calculation of MSCs:
  - Is the use of RPFs appropriate outside of a cumulative risk assessment?

Workgroup History & Charge

- PAH Workgroup formed in September 2021 with the following members:

CSSAB Members	PADEP Members	Non-CSSAB Members
Colleen Costello	Michael Maddigan	Will Hitchcock (Chair)
Chuck Campbell	Brie Sterling	Neil Ketchum
Tina Serafini	Pam Trowbridge	Francis Ramacciotti
Joel Bolstein		Steph Gundling
Annette Guiseppi-Elie		Michael Fuerte
Michael Meloy		

Background and Development of RPFs

- EPA 1993 - Provisional Guidance for Quantitative Risk Assessment of PAHs
- CalEPA 1994 – B[a]P as a Toxic Air Contaminant
- EPA 2000 – Supplementary Guidance for Conducting Health Risk Assessment of Chemical Mixtures
- EPA 2001 – Peer Consultation Workshop on Approaches to PAH Health Assessment
- EPA 2005 – Guidelines for Carcinogen Risk Assessment
- CalEPA 2005 – Air Toxics Hot Spots Program Risk Assessment Guidelines
- CalEPA 2009 – Technical Support Document for Cancer Potency Factors
- EPA 2010 – Development of a RPF Approach for PAHs (External Review DRAFT)
- EPA 2011 – SAB Review of Draft Development of a RPF Approach for PAHs
- CalEPA 2011 – Technical Support Document for Cancer Potency Factors (Appendix B update)
- EPA 2017 – IRIS Toxicological Review of B[a]P
- EPA 2019 – April 2019 IRIS Program Outlook
- ATSDR 2022 – Guidance for Calculating B[a]P Equivalents for Cancer Evaluations of PAHs

Background and Development of RPFs

cPAH	EPA 1993	CalEPA 2011	EPA 2010 (draft)
Benzo[a]anthracene	0.1	0.1	0.2
Benzo[a]pyrene	1.0 (index)	1.0 (index)	1.0 (index)
Benzo[b]fluoranthene	0.1	0.1	0.8
Benzo[k]fluoranthene	0.01	0.1	0.03
Chrysene	0.001	0.01	0.1
Dibenz[a,h]anthracene	1.0		10
Indeno[1,2,3-c,d]pyrene	0.1	0.1	0.07

Use of RPFs to Calculate MSCs

- Several other agencies use this approach:
  - US EPA - Calculates Regional Screening Levels ("RSLs") using the EPA 1993 RPFs (CR = $1x10^{-5}$ and $1x10^{-6}$)
  - CA DTSC – Calculates screening levels ("SLs") using a combination of the EPA 1993 RPFs and the CalEPA 2011 RPFs relative to B[a]P (CR = $1x10^{-6}$)
  - NYSDEC – Calculates Soil Cleanup Objectives ("SCOs") using a combination of the EPA 1993 RPFs and the CalEPA 2011 RPFs relative to B[a]P (CR = $1x10^{-6}$)
  - NJDEP - Calculates Soil Remediation Standards ("SRS") using the EPA 1993 RPFs (CR = $1x10^{-6}$)

Discussion of Cumulative Risk

- Act 2 Cancer Risk Range $1x10^{-4}$ to $1x10^{-6}$
- MSCs are calculated at $1x10^{-5}$
- Inherent assumption that no more than 10 carcinogens will be detected at their maximum allowable concentration at a site
- Cumulative cancer risk is already addressed under the SHS
- Nothing about the use of RPFs requires an alternate approach
- The 2017 IRIS values for B[a]P are already conservative

Recommendations for Implementation

- Options:
  - ~~EPA 2010 RPFs never released from draft~~
  - EPA 1993 RPFs
  - CalEPA 2011 RPFs
  - Some combination thereof… would require tox review and explanation
- EPA 1993 RPFs more consistent with established hierarchy and RSL process used under the SSS
- MSCs for cPAHs would increase, because these have only ever been assessed relative to B[a]P, and B[a]P was recently determined to be less potent (IRIS 2017)

Recommendations for Implementation

		Benzo[a]pyrene	Benzo[a]anthracene	Benzo[b]fluoranthene	Benzo[k]fluoranthene	Chrysene	Dibenz[a,h]anthracene	Indeno[1,2,3-c,d]pyrene
PADEP Table 5a (current)	**CSF_o $(mg/kg\text{-}d)^{-1}$**	1 I	0.7 X	1.2 C	1.2 C	0.12 C	4.1 C	1.2 C
	IUR $(\mu g/m^3)^{-1}$	0.0006 I	0.00011 C	0.00011 C	0.00011 C	0.000011 C	0.0012 C	0.00011 C
PADEP Table 5a (proposed by PAH Workgroup)	**CSF_o $(mg/kg\text{-}d)^{-1}$**	1 I	0.1 R*	0.1 R*	0.01 R*	0.001 R*	1 R*	0.1 R*
	IUR $(\mu g/m^3)^{-1}$	0.0006 I	0.00006 R*	0.00006 R*	0.000006 R*	0.0000006 R*	0.0006 R*	0.00006 R*
	RPF used	none (index)	0.1	0.1	0.01	0.001	1.0	0.1
CA DTSC-SLs	**CSF_o $(mg/kg\text{-}d)^{-1}$**	1	0.1	0.1	0.01	0.001	4.1	0.1
	IUR $(\mu g/m^3)^{-1}$	0.0011	0.00011	0.00011	0.00011	0.000011	0.0012	0.00011
	RPF used	none (index)	0.1	0.1	varies by route	varies by route	none (CA-developed)	0.1
NYSDEC SCOs	**CSF_o $(mg/kg\text{-}d)^{-1}$**	9.03	0.903	0.903	0.0903	0.0903	9.03	0.903
	IUR $(\mu g/m^3)^{-1}$	0.0011	0.00011	0.00011	0.000011	0.000011	0.0011	0.00011
	RPF used	none (index)	0.1	0.1	0.01	0.01	1	0.1
NJDEP SRS	**CSF_o $(mg/kg\text{-}d)^{-1}$**	1	0.1	0.1	0.01	0.001	1	0.1
	IUR $(\mu g/m^3)^{-1}$	0.0006	0.00006	0.00006	0.000006	0.0000006	0.0006	0.00006
	RPF used	none (index)	0.1	0.1	0.01	0.001	1.0	0.1
USEPA RSLs	**CSF_o $(mg/kg\text{-}d)^{-1}$**	1	0.1	0.1	0.01	0.001	1	0.1
	IUR $(\mu g/m^3)^{-1}$	0.0006	0.00006	0.00006	0.000006	0.0000006	0.0006	0.00006
	RPF used	none (index)	0.1	0.1	0.01	0.001	1	0.1

Recommendations for Implementation

		Table 1 - Groundwater						Table 3a - Soil Direct Contact			Table 3b - Soil to Groundwater											
		Used Aquifers				Nonuse Aquifers		Surface Soil		Subsurface Soil	Used Aquifers								Nonuse Aquifers			
		TDS ≤ 2500		TDS > 2500							TDS ≤ 2500				TDS > 2500							
		R	NR	R	NR	R	NR	R	NR	NR	R		NR		R		NR		R		NR	
											100xGW MSC	Generic Value	100xGW MSC	Generic Value	100xGW MSC	Generic Value	100xGW MSC	Generic Value	100xGW MSC	Generic Value	100xGW MSC	Generic Value
		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Benzo[a]pyrene	**current**	0.2 M	0.2 M	3.8 S	3.8 S	3.8 S	3.8 S	4.2 G	91 G	190000 C	0.02	46 E	0.02	46 E	0.38	860 E	0.38	860 E	0.38	860 E	0.38	860 E
	proposed*	0.2 M	0.2 M	3.8 S	3.8 S	3.8 S	3.8 S	4.2 G	91 G	190000 C	0.02	46 E	0.02	46 E	0.38	860 E	0.38	860 E	0.38	860 E	0.38	860 E
Benzo[a]anthracene	**current**	0.3 G	3.9 G	11 S	11 S	11 S	11 S	6.1	130	190000 C	0.03	26 E	0.39	340 E	1.1	960 E	1.1	960 E	1.1	960 E	1.1	960 E
	proposed*	2.1 G	11 S	11 S	11 S	11 S	11 S	42 G	910 G	190000 C	0.21	180 E	1.1	960 E	1.1	960 E	1.1	960 E	1.1	960 E	1.1	960 E
Benzo[b]fluoranthene	**current**	0.18 G	1.2 S	1.2 S	1.2 S	1.2 S	1.2 S	3.5	76	190000 C	0.018	25 E	0.12	170 E	0.12	170 E	0.12	170 E	0.12	170 E	0.12	170 E
	proposed*	1.2 S	1.2 S	1.2 S	1.2 S	1.2 S	1.2 S	42 G	910 G	190000 C	0.12	170 E	0.12	170 E	0.12	170 E	0.12	170 E	0.12	170 E	0.12	170 E
Benzo[k]fluoranthene	**current**	0.18 G	0.55 S	0.55 S	0.55 S	0.55 S	0.55 S	3.5	76	190000 C	0.018	200 E	0.055	610 E	0.055	610 E	0.055	610 E	0.055	610 E	0.055	610 E
	proposed*	0.55 S	0.55 S	0.55 S	0.55 S	0.55 S	0.55 S	420 G	9100 G	190000 C	0.055	610 E	0.055	610 E	0.055	610 E	0.055	610 E	0.055	610 E	0.055	610 E
Chrysene	**current**	1.8 G	1.9 S	1.9 S	1.9 S	1.9 S	1.9 S	35	760	190000 C	0.18	220 E	0.19	230 E	0.19	230 E	0.19	230 E	0.19	230 E	0.19	230 E
	proposed*	1.9 S	1.9 S	1.9 S	1.9 S	1.9 S	1.9 S	4200 G	91000 G	190000 C	0.19	230 E	0.19	230 E	0.19	230 E	0.19	230 E	0.19	230 E	0.19	230 E
Dibenz[a,h]anthracene	**current**	0.052 G	0.6 S	0.6 S	0.6 S	0.6 S	0.6 S	1	22	190000 C	0.0052	23 E	0.06	270 E	0.06	270 E	0.06	270 E	0.06	270 E	0.06	270 E
	proposed*	0.21 G	0.6 S	0.6 S	0.6 S	0.6 S	0.6 S	4.2 G	91 G	190000 C	0.021	95 E	0.06	270 E	0.06	270 E	0.06	270 E	0.06	270 E	0.06	270 E
Indeno[1,2,3-c,d]pyrene	**current**	0.18 G	2.3 G	18 G	62 S	62 S	62 S	3.5	76	190000 C	0.018	1400 E	0.23	18000 E	1.8	140000 E	6.2	190000 C	6.2	190000 C	6.2	190000 C
	proposed*	2.1 G	27 G	62 S	62 S	62 S	62 S	42 G	910 G	190000 C	0.21	16000 E	2.7	190000 C	6.2	190000 C	6.2	190000 C	6.2	190000 C	6.2	190000 C

*Numeric values proposed by the PAH Workgroup

Recommendations for Transparency

- A footnote to Table 5a:
  - *R = EPA 1993 Relative Potency Factors (relative to benzo[a]pyrene) per 250.605(a)(1)(i)*
- Chapter 250 regulatory language:
  - *250.605(a)(1)(i): Cancer slope factors and inhalation unit risk factors for carcinogenic PAHs are derived using Relative Potency Factors contained in United States Environmental Protection Agency July 1993 Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons (EPA/600/R-93/089).*
- Act 2 TGM:
  - *Section III.H.3.c.i.a: Cancer slope factors and inhalation unit risk factors for carcinogenic PAHs are derived using Relative Potency Factors contained in United States Environmental Protection Agency July 1993 Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons (EPA/600/R-93/089).*