Draft Assessment and Measurement Endpoints, Including LOEs

Receptor of Concern	Assessment Endpoint	Measures of Effect and Exposure (Measurement Endpoints)	Lines of Evidence in Support of ME
Benthic			
The benthic community	Survival, growth and reproduction	Sediment toxicity testing to empircally assess adverse effects	*Concentration in sediment compared to levels estimated by the empircally derived Portland Harbor predictive model to exhibit effects. Model should include pooled endpoints for both species*
			Sediment toxicity testing, lethal and sublethal
		Water exposure concentrations compared to AWQC or TRVs	*Concentration in surface water relative to reported AWQC or literature TRVs*
			Concentration in TZW relative to reported AWQC or literature TRVs [8]
		Benthic tissue data (modeled, lab, and field-collected) compared to tissue-based TRVs	*Empirical (field-collected, R2) whole body concentration relative to tissue TRVs*
			Empirical (laboratory, R2) whole body concentration relative to tissue TRVs
			Predicted (BSAF or FWM) whole body concentration relative to tissue TRVs
		Bulk sediment concentrations vs. sediment quality guidelines (SQGs)	*Consensus Based SQGs (TECs / PECs)*
			Mechanistic-based SQGs; Equilibrium Partitioning
			Empirical SQGs; PELs / TELs, ERLs / ERMs, AETs, LRM, SGG quotients
Shellfish (bivalves)	Survival, growth and reproduction	Benthic tissue data (modeled, lab, and field-collected) compared to tissue-based TRVs	*Empirical (field-collected, R2) whole body concentration relative to tissue TRVs*
			Empirical (laboratory, R2) whole body concentration relative to tissue TRVs
			Predicted (BSAF or FWM) whole body concentration relative to tissue TRVs. For TBT, derive a site specific biota-sediment accumulation factor or use screening value based on sediment concentrations1

		(Measurement Endpoints)	
		Sediment toxicity testing to empircally assess adverse effects	Hyalella *and* Chironomus *results used as bivalve surrogates*
		Water exposure concentrations compared to AWQC or TRVs	*Concentration in surface water relative to reported AWQC or literature TRVs*
			Concentration in TZW relative to reported AWQC or literature TRVs[8]
Crayfish	Survival, growth and reproduction	Tissue data compared to tissue-based TRVs (chemical-dependent)	*Empirical whole body concentration relative to tissue TRVs*
			Predicted (BSAF or FWM) whole body concentration relative to tissue TRVs
		Water exposure concentrations compared to AWQC or TRVs	*Concentration in surface water relative to reported AWQC or literature TRVs*
			Concentration in TZW relative to reported AWQC or literature TRVs[8]
Fish			
Invertivore			
Juvenile Chinook Salmon[2]	Survival, growth, and reproduction (including reproduction as a surrogate for growth for juvenile chinooks)	Water exposure concentrations compared to AWQC or TRVs	*Concentration in surface water relative to reported AWQC or literature values*
		Tissue data compared to tissue-based TRVs (chemical-dependent)	*Empirical whole body concentration relative to tissue TRVs*
			Predicted (BSAF or FWM) whole body concentration relative to tissue TRVs
		Dietary dose compared to dietary TRVs (chemical-dependent)	*Dietary Dose compared to dietary toxicity reference values*
			Dietary Dose compared to dietary toxicity reference values to also include stomach content data or other approaches refined specifically for PAHs. Existing data will be used initially (specific approach to be developed).
		Fish condition or incidence of lesions (primarily for PAHs)	*Compare lesion incidence to areas of contamination and/or lesion-based TRVs (if relevant to receptor sps.)*

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		(Measurement Endpoints)	
Adult Chinook Salmon	Survival, growth and reproduction [10]	Comparsion of surface water concentrations to olfaction-based TRVs for metals	*Surface water data will be evaluated to determine if contaminant concentrations exceed concentrations known to be associated with changes to olfactory function that affect swimming, homing behavior and, ultimately, reproduction.*
Peamouth	Survival, growth, and reproduction	Water exposure concentrations compared to AWQC or TRVs	*Concentration in surface water relative to reported AWQC or literature values*
		Tissue data compared to tissue-based TRVs (chemical-dependent)	*Empirical whole body concentration relative to tissue TRVs*
			Predicted (BSAF or FWM) whole body concentration relative to tissue TRVs
		Dietary dose compared to dietary TRVs (chemical-dependent)	*Dietary Dose compared to dietary toxicity reference values*
			Dietary Dose compared to dietary toxicity reference values.
		Fish condition or incidence of lesions (primarily for PAHs)	*Compare lesion incidence to areas of contamination and/or lesion-based TRVs (if relevant to receptor sps.)*
Sculpin[2]	Survival, growth, and reproduction	Water exposure concentrations compared to AWQC or TRVs	*Concentration in surface water relative to reported AWQC or literature values*
			Concentration in transition zone water relative to reported AWQC or literature values [9]
		Tissue data compared to tissue-based TRVs (chemical-dependent)	*Empirical whole body concentration relative to tissue TRVs*
			Predicted (BSAF or FWM) whole body concentration relative to tissue TRVs

		(Measurement Endpoints)	
		Dietary dose compared to dietary TRVs (chemical-dependent)	*Dietary Dose compared to dietary toxicity reference values*
			Dietary Dose compared to dietary toxicity reference values to also include stomach content data or other approaches refined specifically for PAHs. Existing data will be used initially (specific approach to be developed).
		Fish condition or incidence of lesions (primarily for PAHs)	*Compare lesion incidence to areas of contamination and/or lesion-based TRVs (if relevant to receptor sps.)*
Omnivore/Herbivore			
Carp (Surrogate Fish Tissue)[3,4]	Survival, growth and reproduction	Tissue data compared to tissue-based TRVs (chemical-dependent)	*Tissue-based TRV approach for dioxin-likecontaminants using literature values and incorporating toxic equivalent (TEQs) based on the World Health Organization toxic equivalent factors (TEFs). Risk from other compounds assessed in uncertainty analysis.*
White sturgeon (further refinement TBD)	Survival, growth and reproduction	Water exposure concentrations compared to AWQC or TRVs	*Concentration in surface water relative to reported AWQC or literature values*
		Tissue data compared to tissue-based TRVs (chemical-dependent)	*Empirical whole body concentration relative to tissue TRVs*
			Predicted (BSAF or FWM) whole body concentration relative to tissue TRV. Specific approaches for modeling adult tissue concentrations to be developed.
		Dietary dose compared to dietary TRVs (chemical-dependent)	*Dietary Dose compared to dietary toxicity reference values*
			Dietary Dose compared to dietary toxicity reference value
		Fish condition or incidence of lesions (primarily for PAHs)	*Compare lesion incidence to areas of contamination and/or lesion-based TRVs (if relevant to receptor sps.)*

		(Measurement Endpoints)	
Largescale Sucker[2,3,5]	Survival, growth and reproduction	Water exposure concentrations compared to AWQC or TRVs	*Concentration in surface water relative to reported AWQC or literature values*
		Tissue data compared to tissue-based TRVs (chemical-dependent)	*Empirical whole body concentration relative to tissue TRVs*
			Predicted (BSAF or FWM) whole body concentration relative to tissue TRV.
		Dietary dose compared to dietary TRVs (chemical-dependent)	*Dietary Dose compared to dietary toxicity reference values*
			Dietary Dose compared to dietary toxicity reference values to also include stomach content data or other approaches refined specifically for PAHs. Existing data will be used initially (specific approach to be developed).
		Fish condition or incidence of lesions (primarily for PAHs)	*Compare lesion incidence to areas of contamination and/or lesion-based TRVs (if relevant to receptor sps.)*
Smallmouth Bass	Survival, growth and reproduction	Water exposure concentrations compared to AWQC or TRVs	*Concentration in surface water relative to reported AWQC or literature values*
		Tissue data compared to tissue-based TRVs (chemical-dependent)	*Empirical whole body concentration relative to tissue TRVs*
			Predicted (BSAF or FWM) whole body concentration relative to tissue TRV.
		Dietary dose compared to dietary TRVs (chemical-dependent)	*Dietary Dose compared to dietary toxicity reference values*
			Dietary Dose compared to dietary toxicity reference values
		Fish condition or incidence of lesions (primarily for PAHs)	*Compare lesion incidence to areas of contamination and/or lesion-based TRVs (if relevant to receptor sps.)*

		(Measurement Endpoints)	
Piscivores			
Northern Pikeminnow	Survival, growth and reproduction	Water exposure concentrations compared to AWQC or TRVs	*Concentration in surface water relative to reported AWQC or literature values*
		Tissue data compared to tissue-based TRVs (chemical-dependent)	*Empirical whole body concentration relative to tissue TRVs*
			Predicted (BSAF or FWM) whole body concentration relative to tissue TRVs
		Dietary dose compared to dietary TRVs (chemical-dependent)	*Dietary Dose compared to dietary toxicity reference values*
Detritivores			
Pacific Lamprey Amocoetes (further refinement and approach for adults TBD.	Survival and growth	Tissue data compared to tissue-based TRVs (chemical-dependent)	*Empirical whole body concentration relative to tissue TRV or surrogate (to potentially include most sensitive of all aquatic species, not just fish)*
			Predicted (BSAF or FWM) whole body concentration relative to tissue TRVs
		Water exposure concentrations compared to AWQC or TRVs	*Compare water concentrations to literature-based or AWQC criteria for protection of early life stages.*
			Concentration in transition zone water relative to reported AWQC or literature values [9]
			Compare water concentrations to reported AWQC or literature TRVs. Relevance of TRVs to lamprey to be confirmed following acute lab studies with ammocoetes.
Wildlife			
Bald Eagle	Survival, growth and reproduction	Dietary dose (empirical or modeled via food chain or FWM) compared to dietary TRVs	*Dietary-based approach incorporating food chain transfer of contaminants from appropriate fish species (assuming all exposure comes from prey fish). Assess dioxin-like contaminants using a TEQ approach based on appropriate surrogate fish tissue data. Use TRVs based on the most sensitive life stages. Consider water intake as component of dietary exposure models, but TBD whether seeps would be considered an element of water exposure.*

		(Measurement Endpoints)	
			Dietary-based approach to include egg or embryo-based TRVs for DDT and metabolites, PCBs, and dioxin-like compounds. Egg concentrations will be determined by egg analysis or by food chain modeling.
Hooded Merganser	Survival, growth and reproduction	Dietary dose (empirical or modeled via food chain or FWM) compared to dietary TRVs	*Dietary based TRV approach. Dietary based analysis using sculpin and/or invertebrate tissue data to represent feeding guild. In the absence of appropriate fish and invertebrate tissue concentrations, modeled concentrations will be used. For dioxin like contaminants (carp or appropriate prey species), use a TEQ-based approach to assess reproductive effects.*
Osprey	Survival, growth and reproduction	Dietary dose (empirical or modeled via food chain or FWM) compared to dietary TRVs	*Dietary-based approach incorporating food chain transfer of contaminants from appropriate fish species (assuming all exposure comes from prey fish). Assess dioxin-like contaminants using a TEQ approach based on appropriate surrogate fish tissue data. Use TRVs based on the most sensitive life stages. Consider water intake as component of dietary exposure models?*
			Dietary-based approach to include egg or embryo-based TRVs for DDT and metabolites, PCBs, and dioxin-like compounds. Egg concentrations will be determined by egg analysis or by food chain modeling.
Spotted Sandpiper[3]	Survival, growth and reproduction	Dietary dose (empirical or modeled via food chain or FWM) compared to dietary TRVs	*Dietary based TRV approach. Sediment concentrations determined from site specific evaluation. In the absence of appropriate invertebrate tissue concentrations, use modeled invertebrate tissue concentrations.*
Mink [6]	Survival, growth and reproduction	Dietary dose (empirical or modeled via food chain or FWM) compared to dietary TRVs	*Dietary based TRV approach, considering both relevant fish species concentrations and invertebrate (crayfish) components of the diet. For dioxin-like contaminants (carp or appropriate prey species), use a TEQ-based approach to assess reproductive effects.*

		(Measurement Endpoints)	
Amphibians			
Amphibians	Survival, growth and reproduction	Water exposure concentrations compared to AWQC or TRVs	*Water concentrations compared to literature-based values or AWQC to protect sensitive life stage.*
Plants			
Aquatic Plants	Survival, growth and reproduction	Bulk sediment concentrations vs. plant TRVs from sediment exposure (if available)	*Comparison of emergent aquatic plant exposure based on concentrations of chemicals in sediment and relevant toxicological data.TRVs from Calcasieu BERA will be evaulated for possible relevance and use.*
		Water exposure concentrations compared to AWQC or TRVs	*Water concentrations compared to literature-based values or AWQC to protect sensitive life stage (e.g., germination, emergence, early life stage growth).*
		Transition zone water concentrations compared to AWQC or TRVs	*Water concentrations compared to literature-based values or AWQC to protect sensitive life stage (e.g., germination, emergence, early life stage growth).*

Footnotes:

[1] For TBT, suggested screening value of 6,000 ng/g OC (based on 2 % OC), which represents a dry wt concencentration of 120 ng/g.

[2] Considered representative of fish exposure to PAHs. Analysis should include an analysis of whether these compounds are found in the diet of the fish receptors, as well as if found in tissue analysis.

[3] Considered representative of sediment ingestion.

[4] Carp is not a receptor of concern for the ecological risk assessment.; whole-body fish tissue (I.e., carp) was analyzed for dioxin-like chemicals, including PCB congener analysis, and is a surrogate for other fish species for these chemicals.

[5]Represents a resident broadcast spawner. Therefore, exposure to sensitive early life stages and eggs will be assessed to all contaminants, including PAHs and dioxin like compounds.

[6]Mink was selected to also represent river otter. Therefore, the dietary requirements of the river otter, which include a fish diet, must be

[7]Possible approaches for sturgeon will be developed through the ecological risk assessment TM process and the approach for the site will be selected following discussions between the LWG, EPA and its partners.

[8] Although not included in Round 2 report owing to lack of data, consideration might be given to toxicity testing with TZW in Round 3, depending on the outcome of data gaps analysis.

[9] TZW exposure for fish receptors only included for sculpin and lamprey ammocoetes at this time. EPA-proposed CSM also shows possible TZW exposure to suckers, carp, and sturgeon, but the significance of this pathway is as yet unknown. To be addressed in Round 3 data gaps and uncertainty analysis.

[10] Potential impacts on reproduction via this assessment endpoint linked to management objective of maintaining an open migration corridor.