

Table A: Review of candidate ecosystem indicators for 2009 reporting by the Puget Sound Partnership

Goal	Ecosystem indicator ¹	Specific metrics considered for 2009 reporting		
		included in 2007 State of the Sound ²	recommended for Partnership as "good" ³	recommended for Partnership as "potential" ⁴
Human health	Fish and shellfish safety	Acres and trends in commercial shellfish growing area closed for bacterial contamination (#10)		
			Shellfish closures for biotoxins (domoic acid #201 & PSP #757)	
			Fish consumption advisories for marine areas (#198)	Shellfish consumption advisories (#760 evaluate/modify)
				Freshwater fish consumption advisories (#759 modify/expand)
	Air quality		Air quality – particulates (#28)	
			Air quality index – good days (#271a)	
	Drinking water quality		Drinking water quality relative to standards (#540)	Groundwater drinking water quality (CB #8)
Contact recreation safety	Swimming beaches meet safe swimming standards at all times during the summer (#9 modify/expand)		Fecal bacteria in lake swimming beaches (#44b expand)	
Human well-being	Aesthetic values, opportunities for recreation, and access		Recreational shellfish harvests (HWB)	
	Resources sustain tribal rights and needs		Commercial tribal finfish and shellfish harvests (HWB)	
	Ecosystem supports thriving natural resource and marine industry uses		Commercial finfish and shellfish harvest – wild and aquaculture (HWB)	
			Scenic and sightseeing water transportation in each county (HWB)	
			Number of marinas in each county (HWB)	
Economic prosperity compatible with ecosystem protection and restoration				
Species and biodiversity	Viable biological communities	Marine species at risk** (#33)	Species at risk: federal & state listings, conservation concern & need (#147, #148, #149, #687)	
			Abundance of fish & invertebrates at marine reserves (San Juan; Central PS) (#738)	Marine fish & invertebrates at rocky habitats (#739 modify)

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			Backyard wildlife trends (#684b)	
			Terrestrial breeding bird counts (#684c)	
			Marine bird mortality (#680)	Avian flu (#680b evaluate)
			Marine benthic infaunal communities (#88)	Freshwater benthic IBI (CR# 19 expand)
				Harbor seal food web interactions (#675 evaluate/expand)
	Viable populations and biodiversity	Trends In population of southern resident orca whales (#16)	Harbor & Dall's porpoise (#679a)	
			Harbor seals (#674),	
			Gray whales (#679b)	
		Groundfish species status and trends (#18a)		Groundfish status & trends (#18 evaluate)
		Salmon and steelhead status and trends** ++ (#97)		Total run size: hatchery & wild (CR#11 evaluate/expand)
				Spawning adults: hatchery & wild (CR#12 evaluate/expand)
				Egg to smolt survival (CR#13 evaluate/expand)
				Smolt to adult return survival (CR#14 evaluate/expand)
				Recruits per spawner (CR#15 evaluate/expand)
				Population growth rate (#785 evaluate/expand)
				Salmonid diversity (#791)
		Herring stocks status and trends ** (#19a)	Hake and other mid-water trawl species (#744)	
		Abundance of pinto abalone (#20)		Dungeness crab abundance (#730 expand)
	Marine birds -non breeding ** (#671a)		Midwinter waterfowl status & trends (#671g evaluate)	
			Bald eagles (CR#10)	
			Pigeon guillemot (#670f) and their nesting colonies (#670b)	
			Black oystercatcher (#670a)	
			Rhinoceros auklet (#670f) and their reproductive success & diet (#672)	

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			Marbled murrelet (#670f)	Marbled murrelet presence at occupied sites (#688d)	
			Cormorant (#670f)		
			Breeding waterfowl (#764)	Marine birds breeding abundance in BC (#599 evaluate)	
			Peregrine falcon (#688f),		
			Band-tailed pigeon (#684d)		
				Christmas bird counts (#684a evaluate)	
			Taylor's checkerspot butterfly (#688e)		
			Mountain goat (#765),		
			Deer (#684f)	Elk (#684e evaluate)	
				Stillwater breeding amphibians (#662 expand)	
	<i>Balanced, viable, and ecosystem-based harvests</i>		Sea duck harvest (#671c)		
			Game species harvest (#676a)		
			Dungeness crab harvest (#729)		
				Recreational marine bottomfish harvest (#741 evaluate)	
			Exploitation rates of wild salmonid populations (CR#17 evaluate/expand)		
Habitat	<i>Sustained nearshore and marine habitats</i>	Eelgrass status and trends ** (#3)			
				Kelp (#5 evaluate)	
				Saltmarshes (CR#6 evaluate)	
				Intertidal community (#CR7)	
				Shoreline geomorphology (#788 evaluate)	
			Shoreline armoring (CR#4 evaluate)		
	<i>Sustained freshwater habitats</i>		Miles of road & crossings within 1 mi. of streams and shorelines (#68)		
			Stream physical habitat (#78)		
					Maximum stream temperature (#620 modify/expand)
					Changes in wetland acres (CR#2 evaluate/expand)
				Artificial fish barriers (#628 evaluate)	
			Fish barrier improvements (#100 modify)		
			Channel armoring (#624 expand)		

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				Floodplain connectivity (#630 expand)	
	Sustained terrestrial habitats	Percent increase in impervious surface below 1,000 feet ** ++ (part of CR#11)	Other (broader) terrestrial land cover trends (part of CR#11)		
		Percent change in forest cover below 1,000 feet ** ++ (part of CR#11)			
			Road densities (#750)		
			Change in old growth forest (#681)		
	Non-native species	Non-native invasive aquatic marine species (<i>Spartina</i> & tunicates = #15 expand)		Non-native nearshore species (#657 evaluate)	
Water quantity	Sufficient freshwater quantity	Snow pack (#25)			
				Flow conditions for 10 streams: annual max daily (#95d), annual mean (#95a), TQmean (#95b), annual 7-day low (#95c)	
			Glacial mass balance (#780)	Violations of instream flows (#93 modify/expand)	
	Sufficient freshwater delivery to marine system	Stream flow ++ (#24)			
	Flooding hazards		Frequency of flood events (#267)		
Water quality	Pollutant loadings	Oil spills (#8)			
				Toxics in biosolids from WWTP (#774 evaluate/expand)	
				Microbial pollution assessment (#209 expand)	
				Nutrient loadings to rivers (#246 evaluate/expand)	
	Toxics in marine system	Liver disease in English sole (#7)			
		Toxics in mussels (#5)			Toxics in clams (#770 evaluate/modify)
		Toxics in harbor seals (#6)			
		Sediment quality triad index ** (#86, 87, 87a, 88)			
		Toxics in adult Chinook and coho salmon ** (part of #4a)			Toxics in juvenile salmon (#773 expand)
			Toxics in herring (part of #4a)		
			Toxics in English sole (#4b)		
			Toxics in freshwater fish (#772 modify/expand)		

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				Toxics in whole fish (#?? evaluate)
				Fish tissue contaminants index (#92 modify)
				Toxics in osprey eggs (#604 expand)
	Nutrients and pathogens in marine system	Index of marine water quality (#784)		
			Marine water quality parameters (#782)	
			Marine parameters (#751)	
			Fecal pollution index (#166)	
				Sensitivity to eutrophication (#41 evaluate)
				Water quality concern (CR#18 evaluate/modify)
	Quality of freshwaters		Stream water quality (#9)	Fecal bacteria in streams (#169 expand)
				DO/temp in urban streams (#168 expand)
				Fecal bacteria in lake non-swimming beaches (#44d expand)
				Phosphorus in large (#44c) and small (#44a) lakes
				Water quality index (#96 evaluate/expand)
				Toxics in freshwater (#170 evaluate)
Other		Population growth by county & WRIA (HWB)		

Provisional indicators not shown in this table because they were not evaluated in 2008: #184 forest and forestry natural disasters; #73 sediment input loadings rate; #154 non-native invasive species threat (O'Neill et al. 2008)

¹ Proposed indicator category proposed for consistent Partnership reporting of progress toward ecosystem recovery. Proposal follows the ecosystem outcomes identified in the 2008 Action Agenda, which are a modification of the outcomes proposed by the 2006 PS Partnership ("blue ribbon commission").

² Metrics (specific indicators) in this column were reported in the Puget Sound Action Team's 2007 State of the Sound and were recommended by the 2008 indicators evaluation projects (O'Neill et al. 2008; Schneider & Plummer 2009) as appropriate for use by the Puget Sound Partnership. Assignments of metrics to indicator categories generally follow the approach presented in the indicator evaluation project reports but some deviations are presented (e.g., population growth not

associated with 4th human well-being outcome, different set of water quality outcomes) consistent with the assignments made in the 2008 Action Agenda. Provisional indicators from O'Neill et al. (2008) are identified by their record number. Possible human-well being indicators from Schneidler & Plummer (2009) are identified by the "HWB" code.

** indicates that the indicator evaluation project appears to favor an approach somewhat different than that used in 2007 State of the Sound.

++ indicates that modified approach may be needed to align with Washington Monitoring Forum's high-level indicators.

³ Recommended and evaluated as "good" (i.e., immediately available) by the 2008 indicator evaluation projects (O'Neill et al. 2008; Schneidler & Plummer 2009) but not reported in 2007 State of the Sound. Provisional indicators from O'Neill et al. (2008) are identified by their record number. Possible human-well being indicators from Schneidler & Plummer (2009) are identified by the "HWB" code.

⁴ Recommended and evaluated as "potential" (i.e., potentially usable but has some limitations) by the 2008 environmental indicator evaluation project (O'Neill et al. 2008) but not reported in 2007 State of the Sound. Indicators are identified by their record number along with the evaluation project's recommendation for the type of work needed to develop the indicator so that it would be available for use.

References

O'Neill, S.M., C.F. Bravo, T.K. Collier. 2008. Environmental Indicators for the Puget Sound Partnership: A Regional Effort to Select Provisional Indicators (Phase I). Summary Report – December 2008. Not peer reviewed. NOAA Fisheries Northwest Fisheries Science Center.

Schneidler, M.M and M.L. Plummer. 2009. Human Well-being Indicators: Background and Applications for the Puget Sound Partnership. February 2009. Northwest Fisheries Science Center Processed Report. NOAA Fisheries.