Puget Sound Pressure Assessment - Stressor Definitions

Stressor	Definition
A. Habitat conversion due to human land-use change	
A1. Conversion of land cover for residential, commercial, and industrial use	Conversion of land cover to one dominated by residential, commercial, and/or industrial development. This stressor has to do with the reduction in extent and quality of habitat due to conversion. In the terrestrial and nearshore environments sources include residential and commercial development; in the marine environment consider conversion for marinas and other marine uses. Agriculture and aquaculture (see A2) and dredging (see A3) are assessed separately. Stress associated with disturbance due to human activities (including in developed areas) is addressed separately (see G). Terrestrial habitat fragmentation (see B), shoreline hardening (see C), and barriers to terrestrial animal movement and migration (see F) are addressed as separate stressors. Pollution impacts are assessed through separate stressors (see V through W). Note that conversion can be step-wise process where, for example, native forest land is converted to managed forests which are then under stress for further conversion to agriculture or residential and commercial development.
A2. Conversion of land cover for natural resource production	Conversion of land cover to one dominated by natural resource production such as through agriculture and timber production in terrestrial environments and aquaculture in marine and nearshore environments. This stressor has to do with the reduction in extent and quality of habitat due to conversion. Stress associated with disturbance due to human activities (including in developed areas) is addressed separately (see G). Terrestrial habitat fragmentation (see B), shoreline hardening (see C), and barriers to terrestrial animal movement and migration (see F) are addressed as separate stressors. Pollution impacts are assessed through separate stressors (see V through W). Note that conversion can be step-wise process where, for example, native forest land is converted to managed forests which are then under stress for further conversion to agriculture or residential and commercial development.
A3. Conversion of land cover for transportation & utilities	Conversion of land cover to one dominated by transportation and service corridors. This stressor has to do with the reduction in extent and quality of habitat due to conversion, including conversion by dredging. Stress associated with disturbance due to human activities (including in developed areas) is addressed separately (see G). Terrestrial habitat fragmentation (see B), shoreline hardening (see C), and barriers to terrestrial animal movement and migration (see F) are addressed as separate stressors. Pollution impacts are assessed through separate stressors (see V through W).

B. Terrestrial habitat fragmentation	Division of contiguous habitat into smaller discontiguous patches or different habitat types. Sources of this stressor include development of lands for agriculture, residential, commercial, or industrial uses, or roads and utility corridors. Expressions of this stressor will depend on the endpoint one is assessing. For example, bobcat and certain small passerine birds may have minimum patch size requirements on the order of 25 ha and 3 ha, respectively. Landscapes in which habitat patches are predominantly smaller than these minimums are unlikely to support these species. Disturbance due to human activities (see G) and habitat conversion (see A) are evaluated as separate stressors.
C. Shoreline hardening	Change of shoreline habitat or features to conditions that reduce habitat extent and/or disrupt shoreline processes. The primary source of this stressor is the construction of shoreline infrastructure that produces a hard linear surface along the beach or stream bank to reduce erosion (e.g., sea walls, revetments, rip-rap, and rock piles). Habitat conversion for residential, commercial and industrial development and other uses is evaluated separately (see A).
D. Shading of shallow water habitat	Decreased light transmitted into shallow waters. This stressor causes species stresses related to productivity or altered predator-prey relationships. The primary source of this stressor is construction of overwater and on-shore structures.
E. Fish passage barriers	
E1. Dams as fish passage barriers	Dams that block or impede movements and migrations of fish and other aquatic animals. This stressor is intended to evaluate only effects on fish and other aquatic species; effects on flow regulation (see L) and physical processes (see M) are evaluated as separate stressors. Fish passage barriers created by culverts and other structures are evaluated as separate stressors (see E2).
E2. Culverts and other fish passage barriers	Structures other than dams that block or impede movements and migrations of fish and other aquatic animals. Includes structures in, along-side, and across water bodies. This stressor is intended to evaluate only effects on fish and other aquatic species; effects on flow regulation (see L) and physical processes (see M) are evaluated separately. Fish passage barriers created by dams are evaluated as separate stressors (see E1).
F. Barriers to terrestrial animal movement and migration	Structures that block or impede movements and migrations of terrestrial animals such as roads and utility infrastructure. Expressions of this stressor will depend on the endpoint one is assessing. For example for terrestrial species such as elk a strong expression of the stressor may be structures such as multi-lane roads; for avian species a strong expression of the stressor may be energy infrastructure such as wind turbines. Disturbance due to human activities (see G) and terrestrial habitat fragmentation (see B) are evaluated as separate stressors.
G. Species disturbance - terrestrial and freshwater	
G1. Terrestrial and freshwater species disturbance in human dominated areas	Alteration in the feeding, breeding, or resting behaviors of fish or wildlife due to human presence or activities associated with landscapes dominated by man-made structures, such as light and sound disturbances associated with developed areas. Includes artifacts and debris associated with human activities, except pollution impacts are evaluated through separate stressors (see V through W).

G2. Terrestrial and freshwater species disturbance in natural landscapes	Alteration in the feeding, breeding, or resting behaviors of fish or wildlife and adverse impacts on plant communities due to human presence or activities in more natural landscapes such as disturbance associated with recreation and vehicle traffic on forest roads. Includes artifacts and debris associated with human activities, except pollution impacts are assessed through separate stressors (see V through W).
H. Species disturbance - marine	Alteration in the feeding, breeding, or resting behaviors of marine birds, fish, or other aquatic species due to human presence or activities (e.g., recreation, vessel traffic, military exercises) or artifacts and debris associated with activities except pollution impacts (see V through W) and derelict fishing gear (see I) are assessed through separate stressors.
I. Derelict fishing gear	Mortality associated with entanglement in abandoned nets and other fishing gear.
J. Increased frequency and magnitude of storm flow	
J1. Altered peak flows from land cover change	Altered peak flows into and in surface waters related to changes in land cover and the associated surface hardening and associated impacts such as changes in sediment and debris delivery. Stress from pollution impacts is evaluated separately (see V through W). Altered peak flow from climate change is evaluated separately (see J2)
J2. Altered peak flows from climate change	Altered peak flows into and in surface waters related to changes in precipitation volume and timing due to climate change and associated impacts such as changes in sediment and debris delivery. Stress from pollution impacts is evaluated separately (see V through W). Altered peak flow from land cover change is evaluated separately (see J1). In assessing the intrinsic vulnerability of any endpoint to this stressor please assume a relatively intense or strong level of predicted strength of this stressor, e.g., an expression of the stressor reflecting mid-range estimates of late century conditions for status quo scenarios of greenhouse gas emissions.
K. Reduction in base flows	
K1. Altered low flows from land cover change	Reduction of low flows in surface waters related to changes in land cover and the associated surface hardening and changes in hydrology. Other reductions of low flows are evaluated separately (see K2 and K3)
K2. Altered low flows from climate change	Reduction of low flows in surface water related to changes in precipitation volume and timing due to climate change resulting in reduced glacial coverage and snow pack and/or changes in the timing and rate of snow melt. Other reductions of low flows are evaluated separately (see K1 and K3). In assessing the intrinsic vulnerability of any endpoint to this stressor please assume a relatively intense or strong level of predicted strength of this stressor, e.g., an expression of the stressor reflecting mid-range estimates of late century conditions for status quo scenarios of greenhouse gas emissions.
K3. Altered low flows from withdrawals	Reduction of low flows in surface waters related to water withdrawals for human use and consumption. Other reductions of low flows are evaluated separately (see K1 and K2)

L. Flow regulation -- prevention of flood flows	Modification of flood flows by flow regulation in river and stream systems. Sources of this stressor are the impoundment of water by dams and the operation of dams for flood control and/or hydroelectric power production. These structures may also be barriers to movement and migration of fish and aquatic animals, this is evaluated separately (see E1).
M. Structural barriers to water, sediment, debris flow (including flood flows)	
M1. In channel structural barriers to water, sediment, debris flows	Structures that block or restrict movement of water, sediment, or debris flow in the river or stream channel and associated impacts such as changes in sediment and debris delivery. These structures may also be barriers to movement and migration of fish and aquatic animals, this stress is evaluated separately see E2. Impacts associated with dams also are evaluated separately (see E1 and L).
M2. Other structural barriers to water, sediment, debris flows	Structures that block or restrict movement of water, sediment, or debris flow into the floodplain, such as levees and associated impacts such as changes in sediment and debris delivery. These structures may also be barriers to movement and migration of fish and aquatic animals, this stress is evaluated separately see E2. Impacts associated with dams also are evaluated separately (see E1 and L).
N. Animal harvest	Removal of fish, invertebrates, or wildlife for human use. This stressor includes intentional harvest or removals only and is meant to assess the effect of intentional harvest on species. Sources of this stressor include fishing, hunting, and collections in support of species' management or investigation. Stress from bycatch is evaluated separately (see O). Stress from disturbance associated with harvest activities also is evaluated separately (see G2).
O. Bycatch	Removal of non-target species of fish, invertebrates, or wildlife caught during commercial or recreational fishing.
P. Plant Harvest	
P1. Timber harvest	Removal of timber for human use. The strong expression of this stressor is clear cutting. Stress from harvest of other types of plants is evaluated separately (see P2). Stress associated with disturbance is evaluated separately (see G2).
P2. Non-timber plant harvest	Removal or harvest of non-timber plants, including mushrooms, floral greens, food plants, algae, and aquatic plants, for human use. Stress from timber harvest is evaluated separately (see P1). Stress associated with disturbance is evaluated separately (see G2).
Q. Increase in native species	
Q1. Predation from increased native species	Increased predation resulting from the increase / spread of native fish, wildlife, invertebrates, and/or plants. Includes increased predation from synanthropic species such as corvids, gulls, cowbirds, raccoons, and native species from hatcheries.
Q2. Displacement by increased native species	Displacement and/or decrease in abundance or decrease in population growth rates resulting from the increase/spread of native fish, wildlife, invertebrates, and/or plants. Includes displacement by synanthropic species such as corvids, gulls, cowbirds, raccoons, and native fish species released from hatcheries.
R. Introduction of new and/or increase in non-	

native species	
R1. Predation from non-native species	Increased predation resulting from the addition or increase of non-native fish, wildlife, domestic animals and pets, invertebrates, and/or plants.
R2. Displacement by non-natives	Displacement and/or decrease in abundance or decrease in population growth rates resulting from the addition or increase of non-native fish, wildlife, domestic animals and pets, invertebrates, and/or plants.
R3. Non-native genetic material	Introduction and spread of extra or new genetic material that includes transgenetic material introduced through a variety of genetic engineering methods and purposes (for example, genetically modified agricultural crops), intentional or unintentional hybridization of different species because of management actions, and hybridization of introduced, exotic shellfish or fish with native forms through aquaculture.
S. Disease and parasite introduction, spread or amplification	
S1. Spread of disease and parasites to native species	Introduction, spread, or amplification of disease or parasites from human and animal waste, aquaculture, or non-native species to native species. This is meant to assess the effects of diseases and parasites that affect~~ing~~ species other than humans; diseases affecting humans is evaluated separately (see S2).
S2. Introduction, spread, or amplification of human pathogens	Introduction, spread, or amplification of disease-causing or parasitic organisms to humans. Sources of this stressor include release human and animal waste. This is intended to evaluate effects on humans due to, for example, degradation in water quality and the associated degradation in the quality of aquatic species, such as shellfish, consumed by people.
T. Air pollution	
T1. Air pollution from mobile sources	Presence or loading of chemicals or particles in the atmosphere that can cause discomfort, disease, or death to humans and harm the natural environment, (including via deposition to land and water) resulting from mobile sources such as car, truck, and vessel traffic. Noise and light pollution are evaluated separately (see G1).
T2. Air pollution from stationary sources	Presence or loading of chemicals or particles in the atmosphere that can cause discomfort, disease, or death to humans and harm the natural environment, (including via deposition to land and water) resulting from stationary sources such as industrial and commercial emissions. Noise and light pollution are evaluated separately (see G1).
U. Persistent toxic chemicals in aquatic systems	
U1. Point source, persistent toxic chemicals in aquatic systems	Presence or loading of persistent toxics from point sources. Sources of this stressor include activities that generate wastewater that is discharged from municipal and industrial sewers and treatment plants. Include stress from persistent chemical cycling here (e.g., PCB and Hg cycling). Stress from non-point sources is evaluated separately, see U2.

U2. Non-point source, persistent toxic chemicals in aquatic systems	Presence or loading of persistent toxics from non-point sources, such as runoff from developed areas and roads, including from historic (legacy) sources and small (less than 10 gallons) spill events. Sources of this stressor include activities that contribute pollutants to surface water runoff, including that discharged through stormwater conveyance systems. Stress from point sources is evaluated separately, see U1.
V. Non-persistent toxic chemicals in aquatic systems	
V1. Point source, non-persistent toxic chemicals in aquatic systems	Presence or loading of non-persistent toxics from point sources, including historic sources and small spill (less than 10 gallons) events. Sources of this stressor include activities that generate wastewater that is discharged from municipal and industrial sewers and treatment plants. Stress from non-point sources is evaluated separately (see V2).
V2. Non-point source, non-persistent toxic chemicals in aquatic systems	Presence or loading of non-persistent toxics from non-point sources, such as runoff from developed areas and roads, including from historic (legacy) sources and small (less than 10 gallons) spill events. Sources of this stressor include activities that contribute pollutants to surface water runoff, including that discharged through stormwater conveyance systems. Stress from point sources is evaluated separately (see V1).
W. Large spills	Spills of large amounts of oil & hazardous substances, greater than 100 gallons. Sources include large oil spills from large events related to vessels (including derelict vessels), road and rail traffic, pipelines, and industrial facilities. Stress from smaller more routine spills and releases such as those that might occur at gas stations and marinas is evaluated separately (see U and V).
X. Conventional water pollutants	
X1. Point source conventional water pollutants	Presence or loading of nutrients, sediment, turbidity and oxygen demanding substances from point sources. Sources of this stressor include activities that generate wastewater that is discharged from municipal and industrial sewers and treatment plants. Stress from non-point sources (see X2) and temperature changes (see X) are evaluated separately.
X2. Non-point source conventional water pollutants	Presence or loading of nutrients, sediment, turbidity and oxygen demanding substances from non-point sources. Sources of this stressor include activities that contribute pollutants, including that discharged through stormwater conveyance systems. Stress from point sources (see X1) and temperature changes (see X3) are evaluated separately.
X3. Changes in water temperature from local causes	Changes in water temperature. Changes in temperature of marine water from human-caused climate change (see CC) is evaluated separately.
Y. Harmful algal blooms	Presence of biological and chemical agents associated with blooms of algae in marine and freshwater systems.
Z. Changing air temperature	Changes in air temperature resulting from increased greenhouse gas concentrations in atmosphere. This is a proximate agent on terrestrial species and a source of other stressors. Stress associated with changing water temperature (see X3) and changes in air temperature associated with the built environment (see G1) are evaluated separately. In assessing the intrinsic vulnerability of any

	endpoint to this stressor please assume a relatively intense or strong level of predicted strength of this stressor, e.g., an expression of the stressor reflecting mid-range estimates of late century conditions for status quo scenarios of greenhouse gas emissions.
AA. Changing precipitation amounts and patterns	Changes in amount, form, and quantity of precipitation. This is a proximate agent on terrestrial systems and species but an indirect influence (e.g., via altered flows) on other endpoints and a source of other stressors. Changes in peak (see J) and base (see K) flows associated with changing precipitation are evaluated separately. In assessing the intrinsic vulnerability of any endpoint to this stressor please assume a relatively intense or strong level of predicted strength of this stressor, e.g., an expression of the stressor reflecting mid-range estimates of late century conditions for status quo scenarios of greenhouse gas emissions.
BB. Sea level rise	The rise in sea level in Puget Sound related to human-induced climate change. In assessing the intrinsic vulnerability of any endpoint to this stressor please assume a relatively intense or strong level of predicted strength of this stressor, e.g., an expression of the stressor reflecting mid-range estimates of late century conditions for status quo scenarios of greenhouse gas emissions.
CC. Changing ocean condition	Changes in water temperature, patterns and magnitude of upwelling events, nutrient and oxygen levels, and decrease in pH of Puget Sound waters related to increased greenhouse gas concentrations in the atmosphere and human-induced climate change. In assessing the intrinsic vulnerability of any endpoint to this stressor please assume a relatively intense or strong level of predicted strength of this stressor, e.g., an expression of the stressor reflecting mid-range estimates of late century conditions for status quo scenarios of greenhouse gas emissions.