# Northwest Indian Fisheries Commission

6730 Martin Way E., Olympia, Washington 98516-5540
Phone (360) 438-1180 www.nwifc.org FAX # 753-8659

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Karen Urelius
US Army Corps of Engineers
Regulatory Branch
P.O. Box 3755
Seattle, WA 98124-3755
Karen.m.urelius@usace.army.mil

RE: Draft Regional Conditions for 2017 Nationwide Permits

Dear Ms. Urelius:

The Northwest Indian Fisheries Commission appreciates this opportunity to provide comments on the Corps of Engineers' draft regional conditions for 2017 nationwide permits (NWPs). These comments incorporate by reference and build upon the comments provided by the Commission to the Corps as part of the process leading to the adoption of the 2012 NWPs.[1]

**The Clean Water Act does not authorize the issuance of NWPs which obstruct recovery of Puget Sound or adversely affect treaty-protected fish, including shellfish and finfish.**

As the Commission has noted in prior comments, section 404(e) Clean Water Act provides that general permits, including NWPs, may only be used to authorize activities resulting in discharges of dredge and fill material into waters of the United States when those activities are:

1) Similar in nature;
2) Cause only minimal adverse environmental effects when performed separately; and
3) Will have only minimal cumulative adverse effects on the environment.

The Corps has also adopted rules (known as the §404(b)(1) guidelines) which provide additional guidance regarding discharges. These rules, codified at 40 CFR §230, limit the use of general permits, such as NWPs, if:

1) There is a practicable alternative to the proposed discharge.[2]

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[1] *See* NWIFC letter to Kristina Tong, Corps of Engineers (April 4, 2011) (draft regional conditions); *see also* NWIFC letter to Kristina Tong, Corps of Engineers (September 30, 2011) (final regional conditions).
[2] 40 CFR §230.10(a).

2) The discharge causes or contributes to violations of any applicable state water quality standard.[3]
3) The discharge jeopardizes the continued existence of species listed as endangered or threatened under the ESA or results in likelihood of the destruction or adverse modification of habitat which is determined to be critical habitat under the ESA.[4]
4) The discharge contributes to significant degradation of the waters of the state, including impacts to human health and welfare, fish, shellfish, as well as, aquatic ecosystem diversity, productivity and stability, determined in part by loss of fish and wildlife habitat.[5]

The §404(b)(1) guidelines provide further that factual determinations of a permit's impacts must include a look at the short and long term effects on the structure and function of the aquatic ecosystem and organisms,"[6] including a determination of the cumulative effects of discharges and the activities' secondary effects on the aquatic ecosystem.[7] In other words, the Corps must look not only at the immediate impacts of the dredge and fill, but the net effects of the dredge and fill, both during and after placement has occurred.

**NWPs need to support, not undermine, salmon recovery and water quality improvement efforts.**

There are significant efforts in western Washington to both restore polluted waters and to recover salmon and shellfish populations to which the Commission's member tribes possess treaty-reserved rights. Examples include the Puget Sound Chinook Recovery Plan,[8] the Puget Sound Partnership Action Agenda,[9] and multiple total maximum daily loads (developed pursuant to the Clean Water Act).[10] These plans exist, in part, because of the incremental impacts, both large and small, of activities permitted by the Corps of Engineers and others. For example, the Chinook Recovery Plan makes clear that salmon habitat productivity must increase – not continue to incrementally decrease.[11] Additionally, recovery efforts, such as the

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[3] *Id.* at §230.10(b)(1).
[4] *Id.* at §230.10(b)(3).
[5] *Id.* at §230.10(c)(1) and (3).
[6] *Id.* at §230.13(e).
[7] *Id.* at §230.13(g) and (h).
[8] NMFS, NMFS, Puget Sound Chinook Salmon Recovery Plan (January 19, 2007), available at: http://www.westcoast.fisheries.noaa.gov/protected_species/salmon_steelhead/recovery_planning_and_implementation/puget_sound/puget_sound_chinook_recovery_plan.html
[9] Available at: http://www.psp.wa.gov/action_agenda_center.php.
[10] *See e.g.*, http://www.ecy.wa.gov/programs/wq/tmdl/overview.html
[11] The Puget Sound Technical Recovery Team found "that protecting existing habitat and the ecological processes that create it is the most important action needed in the short-term to increase the certainty of achieving plan outcomes. Protection must occur in both urban and rural areas if we are to ensure the long-term persistence of salmon in Puget Sound." *See* NMFS, Puget Sound Chinook Salmon Recovery Plan, Volume 1, (January 19, 2007) at 354 (emphasis added). *See also id.*at 353: "Puget Sound is like a large water bucket, full of habitat and life. Habitat losses are the holes in the bucket, and many small holes can eventually drain it. Restoration is the process of plugging the holes while protection is to prevent new holes from being formed, allowing the bucket to fill once again through natural processes."

Chinook Recovery Plan, the PSP's Action Agenda, and TMDLs are intended to restore the health of western Washington aquatic resources – they are not intended to provide mitigation for Corps-approved dredge and fill activities. Western Washington fresh and marine waters have already absorbed all of the incremental impacts from NWPs that they can withstand.

The Tribes recently released their 2016 State of Our Watersheds[12] analysis which documents the degraded state of western Washington watersheds. Current watershed conditions reflect the cumulative impacts of dredge and fill actions permitted by NWPs, along with non-federal actions that adversely affect floodplains, fish habitat, and water quality. Many of these impacts have been facilitated by or are interrelated with Corps-permitted dikes, levees, streambank and shoreline stabilization measures, linear transportation projects, including related fish-blocking culverts, ongoing maintenance and repair of these structures, residential and commercial developments, stormwater outfalls, utility corridors, agricultural activities, and poorly designed buffers. The 2016 State of the Watersheds report illustrates, watershed-by-watershed how activities permitted by the Corps of Engineers have cumulatively resulted in significant impacts to the tribes' treaty-secured salmon and shellfish resources and that the use of the nationwide permitting process needs to be significantly curtailed.

The Corps of Engineers' proposed reauthorization of 2017 NWPs will result in additional incremental impacts to a system that is ill-equipped to absorb further impacts. For example, the following table (excerpted from a July 2015 biological opinion on Corps-funded levee repair and riprapping in the Snohomish basin[13]) illustrates how far Puget Sound salmon populations are from their recovery targets and the low productivity levels that stand between these treaty-reserved salmon populations and delisting. The productivity in several watersheds is so low that their populations are either declining or barely replacing themselves one-for-one. These watersheds include: the Nooksack, Stillaguamish, Sammamish, Puyallup, Skokomish, and Dungeness. NMFS has already noted that additional restrictions on harvest of salmon from these populations would have virtually no benefit because habitat productivity is the limiting factor.[14]

**Table 2.**Estimates of escapement and productivity for PS Chinook populations. Natural origin escapement information is provided where available. (Excerpted from Lord Hill Levee Biop).

[12] Available at: https://geo.nwifc.org/sow/

[13] *See* NMFS, Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Lord Hill Levee Dike Repair Project located on the Pilchuck and Snohomish Rivers, Snohomish County, WA, NMFS No.: WCR-2015-2693 (July 31, 2015) at 10, Table 2. Hereinafter, this document will be referred to as the "Lord Hill Levee biop."

[14] *See* 2014 Harvest Biop at 62 (poor habitat conditions limiting recovery of Nooksack salmon); *id.*at 64 (S.F. Stillaguamish limited by productivity); *id.*at 67 (habitat conditions limiting recovery of Sammamish and Puyallup salmon); *id.* at 72-73 (additional harvest restrictions on Skokomish chinook will provide little benefit until productivity increases); *id.* at 74-75 (Dungeness productivity limited by poor habitat conditions).

| [redacted] | [redacted] | [redacted] | | [redacted] |
|---|---|---|---|---|
| | | [redacted] | [redacted] | |
| [redacted] | NF Nooksack | 1,701 | 227[4] (0.7) | 3,800 (3.4) |
| | SF Nooksack | 376 | 56[4] (1.0) | 2,000 (3.6) |
| [redacted] | Upper Skagit River | 10,092 | 9,585 (2.4) | 5,380 (3.8) |
| | Lower Sauk River | 618 | 599[3] (1.7) | 1,400 (3.0) |
| | Lower Skagit River | 2,245 | 2,144[3] (1.9) | 3,900 (3.0) |
| | Upper Sauk River | 423 | 418 (1.8) | 750 (3.0) |
| | Suiattle River | 312 | 312 (1.9) | 160 (3.2) |
| | Upper Cascade River | 308 | 302 (1.6) | 290 (3.0) |
| | NF Stillaguamish R. | 959 | 551[4] (1.2) | 4,000 (3.4) |
| | SF Stillaguamish R. | 152 | 152 (0.9) | 3,600 (3.3) |
| | Skykomish River | 3,918 | 2,578[3] (1.4) | 8,700 (3.4) |
| | Snoqualmie River | 1,906 | 1,731[3] (1.9) | 5,500 (3.6) |
| [redacted] | Cedar River | 555 | 605[3] (1.7) | 2,000 (3.1) |
| | Sammamish River | 1,148 | 221[3] (0.3) | 1,000 (3.0) |
| | Duwamish-Green R. | 6,754 | 3,615[4] (1.9) | - |
| | White River[5] | 1,457 | 1,349[3] (1.8) | - |
| | Puyallup River | 1,809 | 969[3] (0.6) | 5,300 (2.3) |
| | Nisqually River | 1,550 | | 3,400 (3.0) |
| [redacted] | Skokomish River | 1,311 | 434[4] (1.1) | - |
| | Mid-Hood Canal Rivers[6] | 150 | | 1,300 (3.0) |
| [redacted] | Dungeness River | 376 | 114[3] (0.6) | 1,200 (3.0) |
| | Elwha River[7] | 1,748 | | 6,900 (4.6) |

[1] Includes naturally spawning hatchery fish.

[2] Source for 1999-2009 productivity is Abundance and Productivity Tables from Puget Sound TRT database; measured as the mean of observed recruits/observed spawners over the 1999-2009 period. Sammamish productivity estimate has not been revised to include Issaquah Creek. Source for Recovery Planning productivity target is the final supplement to the Puget Sound Salmon Recovery Plan (NMFS 2006a); measured as recruits/spawner associated with the number of spawners at Maximum Sustained Yield under recovered conditions.

[3] Estimates of natural-origin escapement for Snohomish available only for 1999-2001, 2004, and 2006-2007; for Lake Washington for 2003-2009; for White River 2004-2009; for Puyallup 2002-2009; and for Dungeness 2001-2009.

[4] Estimates of natural-origin escapement available only for 1999-2008.

[5] Captive broodstock program for early run Chinook salmon ended in 2000; estimates of natural spawning escapement include an unknown fraction of naturally spawning hatchery-origin fish from late- and early run hatchery programs in the White and Puyallup River basins.

[6] The Puget Sound TRT considers Chinook salmon spawning in the Dosewallips, Duckabush, and Hamma Hamma rivers to be subpopulations of the same historically independent population; annual counts in those three streams are variable due to inconsistent visibility during spawning ground surveys.

[7] Estimates of natural escapement do not include volitional returns to the hatchery or those fish gaffed or seined from spawning grounds for broodstock collection.

**Corps-permitted Activities Have Directly, Indirectly, and Cumulatively Contributed to the Adverse Habitat Conditions that Limit Salmon Productivity.**

Activities permitted by the Corps are high on the list of activities that individually and cumulatively have decimated the salmon populations that are the backbone of the fisheries for many of the NWIFC's member tribes, particularly in Puget Sound. At the same time, we understand that some very local shoreline armoring is essential to protect human lives and structures from major storm and wave impacts (notably on the Pacific Coast). Puget Sound-wide habitat impacts are described as follows by NMFS in its June 2016 biological opinion on treaty Indian fisheries:

> Human activities have degraded extensive areas of salmon spawning and rearing habitat in Puget Sound. Most devastating to the long term viability of salmon has been the modification of the fundamental natural processes which allowed habitat to form and recover from disturbances such as floods, landslides, and droughts. Among the physical and chemical processes basic to habitat formation and salmon persistence are floods and droughts, sediment transport, heat and light, nutrient cycling, water chemistry, woody debris recruitment and floodplain structure (SSPS 2007).
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> Development activities have limited access to historical spawning grounds and altered downstream flow and thermal conditions. Watershed development and associated urbanization throughout the Puget Sound, Hood Canal, and Strait of Juan de Fuca regions have resulted in direct loss of riparian vegetation and soils, significantly altered hydrologic and erosion rates and processes by creating impermeable surfaces (roads, buildings, parking lots, sidewalks etc.), and polluting waterways, raised water temperatures, decreased large woody debris recruitment, decreased gravel recruitment, reduced river pools and spawning areas, and dredged and filled estuarine rearing areas (Bishop and Morgan 1996). Hardening of nearshore bank areas with riprap or other material has altered marine shorelines; changing sediment transport patterns and reducing important juvenile habitat (SSPS 2005b). The development of land for agricultural purposes has resulted in reductions in river braiding, sinuosity, and side channels through the construction of dikes, hardening of banks with riprap, and channelization of the river mainstems (EDPU 2005, SSPS 2005b). Poor forest practices in upper watersheds have resulted in bank destabilization, excessive sedimentation and removal of riparian and other shade vegetation important for water quality, temperature regulation and other aspects of salmon rearing and spawning habitat (SSPS 2005b, SSPS 2007). There are substantial habitat blockages by dams in the Skagit and Skokomish River basins, in the Elwha until 2013, and minor blockages, including impassable culverts, throughout the region. In general, habitat has been degraded from its pristine condition, and this trend is likely to continue with further population growth and resultant urbanization in the Puget Sound region.
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> Habitat utilization by steelhead in the Puget Sound area has been dramatically affected by large dams and other manmade barriers in a number of drainages, including the

Nooksack, Skagit, White, Nisqually, Skokomish, and Elwha river basins (Appendix B in NMFS 2012a). In addition to limiting habitat accessibility, dams affect habitat quality through changes in river hydrology, altered temperature profile, reduced downstream gravel recruitment, and the reduced recruitment of large woody debris. Such changes can have significant negative impacts on salmonids (e.g., increased water temperatures resulting in decreased disease resistance) (Spence et al. 1996; McCullough 1999). Many upper tributaries in the Puget Sound region have been affected by poor forestry practices, while many of the lower reaches of rivers and their tributaries have been altered by agriculture and urban development (Appendix B in NMFS 2012a). Urbanization has caused direct loss of riparian vegetation and soils, significantly altered hydrologic and erosional rates and processes (e.g., by creating impermeable surfaces such as roads, buildings, parking lots, sidewalks etc.), and polluted waterways with stormwater and point-source discharges (Appendix B in NMFS 2012a). The loss of wetland and riparian habitat has dramatically changed the hydrology of many streams, with increases in flood frequency and peak low during storm events and decreases in groundwater driven summer flows (Moscrip and Montgomery 1997; Booth et al. 2002; May et al. 2003). River braiding and sinuosity have been reduced in Puget Sound through the construction of dikes, hardening of banks with riprap, and channelization of the mainstem (NMFS 2012a). Constriction of river flows, particularly during high flow events, increases the likelihood of gravel scour and the dislocation of rearing juveniles. The loss of side-channel habitats has also reduced important areas for spawning, juvenile rearing, and overwintering habitats. Estuarine areas have been dredged and filled, resulting in the loss of important juvenile rearing areas (NMFS 2012a). In addition to being a factor that contributed to the present decline of Puget Sound steelhead populations, the continued destruction and modification of steelhead habitat is the principal factor limiting the viability of the Puget Sound steelhead DPS into the foreseeable future (72 Fed. Reg. 26722, May 11, 2007). Because of their limited distribution in upper tributaries, summer run steelhead may be at higher risk than winter run steelhead from habitat degradation in larger, more complex watersheds (Appendix B in NMFS 2012a).[15]

Many of the above mentioned impacts are related to Corps-permitted activities. In its decision to list Puget Sound Chinook as "threatened" under the ESA, NMFS cites to the Puget Sound Salmon Stock Review Group, which "concluded that reductions in habitat capacity and quality have contributed to escapement problems for Puget Sound Chinook salmon citing evidence of curtailment of tributary and mainstem habitat due to dams, and losses of slough and side-

[15] *See* NMFS, Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation (June 6, 2016) (NMFS Consultation No. F/WCR-2016-4418) at 64-65 (hereinafter Puget Sound 2016 Treaty Harvest Biop) (emphasis added). *Accord* Lord Hill Levee Biop at 11, 13-14 (Impacts to listed Chinook and steelhead from loss of floodplain connectivity and function, channel structure and complexity, impacts to riparian areas, large wood supply, stream substrate and water quality, increased flood frequency, and increased gravel scour and bank erosion). *See also id.* at 13 (Regarding steelhead, NMFS was pointedly concerned about dikes, hardening of banks with riprap, and stream channelization, all of which have increased the likelihood of gravel scour and dislocation of rearing juveniles).

channel habitat due to diking, dredging, and hydromodification."[16] NMFS also states that it believes "altering and hardening stream banks, removing riparian vegetation, constricting channels and floodplains, and regulating flows are primary causes of anadromous fish declines."[17] That these various actions have cumulatively resulted in significant impacts on treaty-reserved resources is starkly reflected in the following statement by NMFS in its biological opinion on the Corps' NWP program:

> In addition to the direct loss of wetlands, the information available demonstrates that the aggregate impacts of the activities historically authorized by Nationwide Permits have been sufficiently large to change the flow regimes and physical structure of river systems and simplify or degrade aquatic ecosystems. These changes have resulted in declines in the abundance of endangered or threated species (Beechie *et al.* 1994, Lichatowich 1989, Lucchetti and Fuerstenberg 1993, May *et al.* 1997, Moscrip and Montgomery 1997, Scott *et al.* 1986).[18]

While the biological opinion was discussing the impacts of Corps permits on a national level, most of the studies it cites come from Western Washington: Beechie at al. (Skagit River); Lucchetti and Fuerstenberg (King County); May et al. (Puget Sound); Moscrip and Montgomery (Puget Sound); Scott et al. (Kelsey Cr., Washington) The following are among the Corps nationwide permits that contribute to the adverse impacts on salmon described above in one or more basins in western Washington: NWP 3 (maintenance); NWP 12 (utility corridors); NWP 13 (marine and freshwater bank stabilization); NWP 14 (linear transportation projects); NWP 19 (minor dredging); NWP 29 (residential developments); NWP 31 (maintenance of existing flood ontrol facilities); NWP 39 (commercial and institutional development); NWP 40 (agricultural activities); NWP 42 (reshaping drainage ditches; and NWP 43 (stormwater management facilities).

**NWP 13 and Marine Shoreline Armoring**

The NWIFC commends the Seattle District for proposing regional general condition 3 which, if adopted by the Corps of Engineers Northwest Division, would mean that NWP 13 could no longer be used to authorize new bank stabilization in tidal waters of the Salish Sea. This is an

[16] *See* 63 Fed. Reg. 11482, 11494 (March 9, 1998) (proposed Chinook listings).
[17] *See* 65 Fed. Reg. 42422, 42450-51 (July 10, 2000)(4(d) rule). While the commentary in the 4(d) rule indicates some hope that the Corps and NMFS would identify conditions for Corps permits to adequately mitigate impacts, NMFS later concluded that mitigation has not been successful. *See* NMFS, Endangered Species Act Section 7 Consultation Biological Opinion and Conference Biological Opinion Regarding Authorization of discharges of dredged and fill material or other structures or work into waters of the United States under the Corps' Nationwide Permit Program November 24, 2014) at 282 (hereinafter "NMFS NWP Biop"). *See also id* at 276 (discussing compliance of projects permitted by the Seattle District in western Washington with the performance standards contained in their permits – 39% of the projects met all their standards while 43% met none of their performance standards). *See also id.* at 275 (National Research Council concluded that the "virtual absence of compliance inspections by the Corps made it possible for substantial numbers of permittees to ignore the conditions of their permits").
[18] NMFS NWP Biop at 272.

important step and we want to recognize that the Seattle District has worked hard to get to the point where it felt able to propose this step. There is ample data and analysis to support this decision.

Comments submitted five years ago for the 2012 reauthorization of nationwide permits were replete with data and analysis demonstrating that it was past time for the Seattle District to stop authorizing new marine shoreline armor in Puget Sound. Comments provided by the NWIFC, its member tribes, NMFS, EPA, and the Washington Governor all strongly recommended that the Corps stop using a general permit (NWP 13) to authorize marine shoreline armoring.[19] Since then, there has been a significant amount of additional analysis and the results demonstrate that Salish Sea shoreline armoring has resulted in cumulative impacts to shorelines and their ecosystems.[20] The following discussion provides additional background and citations to the technical literature on the impacts of shoreline armoring in Puget Sound and the need to adopt regulatory approaches that foster armor removal along with much greater reliance on "soft" shoreline stabilization approaches.[21]

**Background:**

**The Nearshore of Puget Sound**

The nearshore is the zone where marine water, fresh water, and terrestrial landscapes interact in a complex mosaic of habitats and processes. The nearshore encompasses the shoreline from the top of the upland bank or bluff on the landward side down to the depth of water that light can penetrate and where plants can photosynthesize, called the photic zone (Figure 1). The upper extent of the nearshore covers the terrestrial upland that contributes sediment, shade, organic material like leaf litter, and even the insects that fish eat. The lower range of the photic zone depends on water clarity; in Puget Sound underwater vegetation can be found to depths

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[19] *See* Letter to Colonel Bruce Estok, Seattle District, Corps of Engineers, from Kate Kelly, Director, Office of Ecosystems, Tribal and Public Affairs, EPA Region 10 (Oct. 3, 2011) at 2 (recommending barring the use of NWP 13 along both marine waters and fish-bearing freshwaters); Letter to Michelle Walker, Regulatory Branch Seattle District, Corps of Engineers, from Steven Landino, Washington State Habitat Director, NMFS (December 20, 2011) at 2 (recommends precluding new shoreline armor or bank stabilization activities in all designated critical habitat and all waters containing ESA-listed species); Letter from Washington Governor Christine Gregoire and Peter Goldmark, Commissioner of Washington Public Lands, to Christine Godfrey , Acting Chief, Environmental Community of Practice, Corps of Engineers, and General John McMahon, Division Commander, Corps of Engineers (March 7, 2012) (requesting that all new marine shoreline armoring projects be processed via individual permits rather than NWP 13); Letter to Kristina Tong, Seattle District, Corps of Engineers, from Michael Grayum, Executive Director, NWIFC (April 8, 2011) at 3-6 (documenting the impacts of shoreline armor and bank stabilization actions and recommending that no new projects be authorized by nationwide permit within the fresh or marine waters of the Seattle District).

[20] *See e.g.*, Dethier, M.N., Raymond, McBride, A.N., Toft, J.D., Cordell, J.R., Ogston, A.S., Heerhartz, S.M., Berry, H.D. Multiscale impacts of armoring on Salish Sea shorelines: Evidence for cumulative and threshold effects. 175 Journal of Estuarine, Coastal and Shelf Science (2016) 106-117.

[21] This discussion is largely excerpted from a larger report to the Salmon Recovery Council, prepared by the NWIFC, providing analysis and recommendations for improving management of shoreline armoring.

of 30 to 100 feet below Mean Lower Low Water (MLLW).[22] The nearshore includes a variety of environments: marine shallows, eelgrass meadows, kelp forests, mudflats, beaches, salt marshes, rocky shores, river deltas, estuaries, barrier islands, spits, marine riparian zones, and bluffs. This wide range of habitats supports many species of birds, mammals, fish, and aquatic life. A number of these species are economically important to our region, such as salmon, herring, crabs, clams, mussels, and abalone to name just a few. These species and many of the other plants and animals that owe their existence to nearshore processes are also vital components of tribal culture, spirituality, subsistence, and way of life. The nearshore forms the basis for the productivity of the Puget Sound basin and for the goods and services on which all our communities rely. These goods and services drive the economy, provide opportunities for recreation, keep people healthy, and are a large part of what makes the Puget Sound region such a desirable place to live.

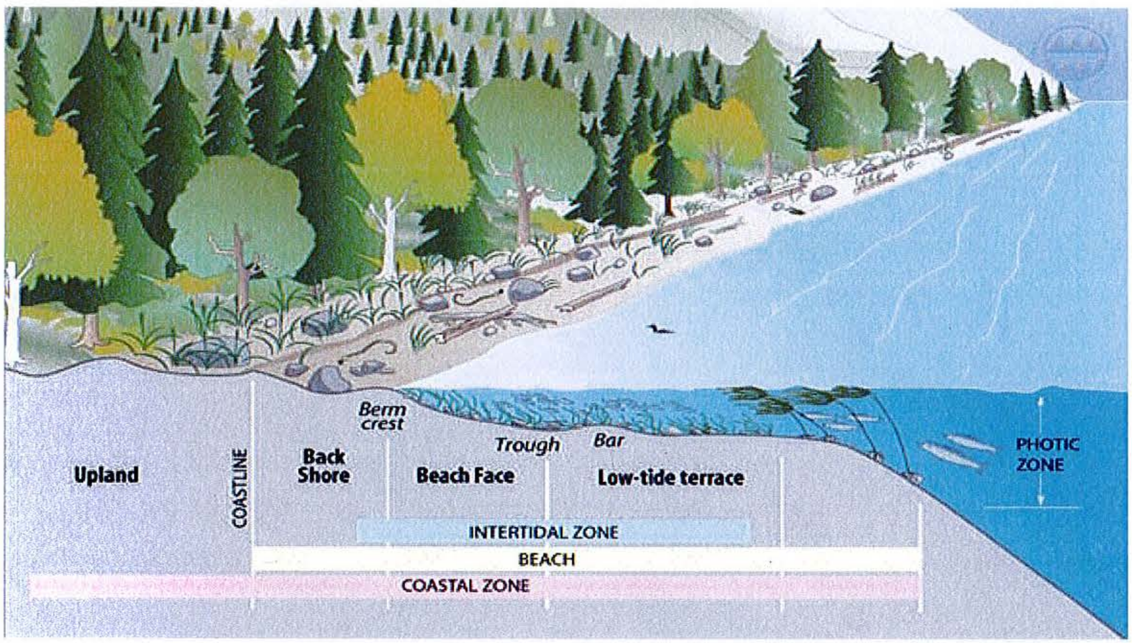


Figure 1: An example of the components of the nearshore. Illustration from Williams et al. 2001.[23]

Modifying the shoreline with buildings, roads, and other structures disrupts the physical, biological, and chemical interactions that are vital for creating and sustaining the diverse ecosystems of Puget Sound. The human shoreline modifications addressed by this report are

[22] Williams, G.D. and R. M. Thom. 2001. Marine and Estuarine Shoreline Modifications Issues. Submitted to Washington Department of Fish and Wildlife, Washington Department of Ecology, and Washington Department of Transportation. 136 pp.

[23] Williams, G.D., R.M. Thom, J.E. Starkes, J.S. Brennan, J. P. Houghton, D. Woodruff, P.L. Striplin, M. Miller, M. Pedersen, A. Skillman, R. Kropp, A. Borde, C. Freeland, K. McArthur, V. Fagerness, S. Blanton, and L. Blackmore. 2001. Reconnaissance Assessment of the State of the Nearshore Ecosystem: Eastern Shore of Central Puget Sound, Including Vashon and Maury Islands (WRIAs 8 and 9). J.S. Brennan, *Ed.* Report prepared for King County Department of Natural Resources, Seattle, WA.

usually intended for erosion control, flood protection, sediment management, or for commercial, navigational, and recreational uses. Seventy-four percent of shoreline modification in Puget Sound consists of shoreline armoring,[24] which usually refers to bulkheads, seawalls, or groins made of rock, concrete, or wood. Other modifications include jetties and breakwaters designed to dissipate wave energy, and structures such as tide gates, dikes, marinas, overwater structures, railways, roads, causeways, and artificial fill. It should be noted that shoreline stabilization can also use techniques that seek to maintain natural processes. These include passive approaches, such as managing surface water, groundwater, and vegetation, and "soft shore protection," such as beach nourishment or driftwood placements.

**Physical Processes**

Broad regional factors like geology, climate, wave energy, sea level, and tidal regime drive the long-term physical processes that create and maintain the habitats of the nearshore. These in turn influence the local and short-term factors that human actions in the nearshore are generally intended to affect. The geology and topography of Puget Sound form the basis for many physical shoreline processes. The modern landscape is primarily a result of a series of glaciations that covered the Puget Lowland in up to a thousand of feet of ice. Most Puget Sound shorelines and river valleys consist of sediments from glacial sources in the form of clay, sand, gravel, and glacial till—a mixture of particles of different sizes. Depending on the age and level of compaction, till can be well consolidated or quite loose.

The erosion of shorelines is a natural process that is important to the formation and maintenance of many shoreforms, such as beaches, spits, and barrier islands. The dominant source of sediment to Puget Sound beaches are eroding bluffs, known as "feeder bluffs."[25] About 50 percent of the Puget Sound shoreline consists of beaches; of these, 78 percent are backed by bluffs.[26] Streams and rivers also supply some sediment from terrestrial sources. The stability and erosion of coastal slopes and shorelines depend on a suite of related processes. Along with wave action during high tides and storms, the movement of surface and groundwater in coastal slopes also plays a key role. When coarse, loose layers of glacial sediment sit on top of clay or bedrock, water infiltrating through the top material will be trapped by the denser layers below. This water acts like a lubricant and weakens the top layers, leading to landslides and other forms of mass movement. Land use practices also contribute to shoreline erosion; for example, removing vegetation reduces slope stability since roots

[24] Simenstad, C. A., M. Ramirez, J. Burke, M. Logsdon, H. Shipman, C. Tanner, C. Davis, J. Fung, P. Bloch, K. Fresh, D. Myers, E. Iverson, A. Bailey, P. Schlenger, C. Kiblinger, P. Myre, W. Gerstel, and A. MacLennan. 2011. Historic Change of Puget Sound Shorelines: Puget Sound Nearshore Ecosystem Project Change Analysis. Puget Sound Nearshore Report No. 2011-01, Published by Washington Department of Fish and Wildlife, Olympia, Washington, and U.S. Army Corps of Engineers, Seattle, Washington.

[25] Johannessen, J.W., and A.J. MacLennan. 2007. Beaches and Bluffs of Puget Sound: Seattle, Wash., University of Washington, Washington Sea Grant Program, Puget Sound Nearshore Partnership Report 2007-04

[26] Fresh, K., M. Dethier, C. Simenstad, M. Logsdon, H. Shipman, C. Tanner, T. Leschine, T. Mumford, G. Gelfenbaum, R. Shuman, J. Newton. 2011. Implications of Observed Anthropogenic Changes to the Nearshore Ecosystems in Puget Sound. Prepared for the Puget Sound Nearshore Ecosystem Restoration Project. Technical Report 2011-03.

physically bind the soil and plants draw water out of the soil through a process called evapotranspiration. These upland processes contribute to mass movement and erosion that are not effectively addressed by shoreline armoring.

Sediments in the nearshore are transported in two ways: through beach drift, which moves sediment toward and away from the beach perpendicular to the shore, and through longshore drift, which moves sediment parallel to the shore. This can occur gradually or episodically in large, rapid events. The direction of longshore, or littoral, drift may vary as the direction of wind and waves change with the seasons, but a net transport of sediment will take place in the dominant wave direction. Longshore drift tends to occur in a unit called the drift cell, which includes the source of the sediment, the transport zone and the depositional zone. Drift cells are usually complex and may exhibit multiple sources and depositional areas.

**Ecological Function**

The Puget Sound nearshore forms the basis for many marine and aquatic food webs. The great variety of nearhore ecosystems are too numerous to detail in this report. Instead, a selection of key ecosystem functions that are particularly sensitive to disturbance from shoreline modification and that provide valued goods and services in Puget Sound are outlined in this section.

The vegetation of the nearshore provides habitat for wildlife, shades intertidal organisms to keep them from drying out or overheating, and introduces organic material like wood and leaf litter. Vegetated areas also aid in water quality through absorption and filtration of organic and chemical contaminants in runoff before it reaches Puget Sound. Salt marshes and tidal wetlands absorb floodwaters and can enhance sediment deposition, stabilize sediments, and reduce tidal energy through surface roughness. Terrestrial insects that fall into Puget Sound from marine riparian and salt marsh vegetation provide food for juvenile salmon. For example, juvenile Chinook salmon stomach contents in the nearshore ranged from 50 to 80 percent terrestrial insects by weight, depending on the size of the fish.[27]

Eelgrass forms meadows in the sub-tidal zone and plays a key role in numerous ecological processes. Organic matter from eelgrass acts as a foundation for nearshore food webs and feeds fish such as juvenile salmon. Epiphyte plants grow attached to eelgrass leaves and invertebrates gather to graze on them. Eelgrass meadows act as critical feeding areas for juvenile salmon and as egg-laying areas for Pacific herring. Eelgrass grows preferentially on medium-fine sand and will die back with disturbance to the substrate.[28]

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[27] Brennan J.S., K.F. Higgins, J.R. Cordell, and V.A. Stamatiou. 2004. Juvenile Salmon Composition, Timing, Distribution, and Diet in Marine Nearshore Waters of Central Puget Sound in 2001-2002. King County Department of Natural Resources and Parks.

[28] Simenstad, C.A. 2000. Estuarine landscape impacts on Hood Canal and Strait of Juan de Fuca summer chum salmon and recommended actions. Appendix Report 3.5. *In* J. Ames, G. Graves, and C. Weller (*Eds.*), Summer Chum Salmon Conservation Initiative: An Implementation Plan to Recover Summer Chum in the Hood Canal and Strait of Juan de Fuca Region. Washington Department of Fish and Wildlife and Point-No-Point Treaty Tribes.

Many organisms in the marine food web spend the early part of their life in the nearshore, including the larvae or juveniles of species that have commercial and cultural importance such as salmon, Pacific herring, and Dungeness crab. For juvenile fish, estuaries provide cover from predators, sources of prey, places to wait out the low tide, and opportunities for the physiological transition that occurs in migration between freshwater and marine environments.[29] The larger juvenile salmon are, the better their marine survival rates, so spending time in estuaries feeding and growing can strongly influence population resilience.[30] This is especially true for chinook and chum. The overall survival rates of chinook decrease without estuary access.[31] In addition, the estuarine rearing phase of chum is a major factor in the size of the adult population.[32] The fry move into tidal marshes as they migrate along the nearshore, coming in on the high tide and departing on the ebb tide.

Another key group of species of the nearshore are the forage fish. They are small, schooling fish that act as a link in the marine food web between plankton and the larger fish, birds, marine mammals, and squid that prey upon them. Examples of forage fish are herring, smelt, anchovy, and sardine. They are important prey for salmon, lingcod, and rockfish and they feed several species listed under the Endangered Species Act, such as chinook, Southern Resident orca whales, and marbled murrelets.[33] Both commercial and recreational fisheries exist for forage fish and they are important tribal traditional foods.

Forage fish such as surf smelt and Pacific sand lance spawn in the intertidal zone on mixed sand-gravel beaches, which makes them particularly vulnerable to shoreline development. Surf smelt spawning studies in the San Juan Islands found that 80 percent of incubating eggs were in the upper third of the beach.[34] They can even spawn at highest part of the beach at the toe of the upland bank, and nearly a third of the eggs were found above the Mean Higher High Water

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[29] Beamer, E. A. McBride, C. Greene, R. Henderson, G. Hood, K. Wolf, K. Larsen, C. Rice, and K. Fresh. 2005. Delta and Nearshore Restoration for the Recovery Of Wild Skagit River Chinook Salmon: Linking Estuary Restoration To Wild Chinook Salmon Populations. Prepared as a supplement to the Skagit Chinook Recovery Plan..

[30] Fresh, K., M. Dethier, C. Simenstad, M. Logsdon, H. Shipman, C. Tanner, T. Leschine, T. Mumford, G. Gelfenbaum, R. Shuman, J. Newton. 2011. Implications of Observed Anthropogenic Changes to the Nearshore Ecosystems in Puget Sound. Prepared for the Puget Sound Nearshore Ecosystem Restoration Project. Technical Report 2011-03.

[31] Aitken, J.K. 1998. The Importance of Estuarine Habitats to Anadromous Salmonids of the Pacific Northwest: A Literature Review. U.S. Fish and Wildlife Service. Lacey, Washington.

[32] Johnson, O.W., W.S. Grant, R.G. Kope, K. Neely, F.W. Waknitz, and R.S. Waples. 1997. Status review of chum salmon from Washington, Oregon, and California. U.S. Dept. Commerce, NOAA Technical Memorandum. NMFS-NWFSC-32.

[33] Whitman, T., D. Penttila, K. Krueger, P. Dionne, K. Pierce, Jr. and T. Quinn. 2014. Tidal elevation of surf smelt spawn habitat study for San Juan County Washington. Friends of the San Juans, Salish Sea Biological and Washington Department of Fish and Wildlife.

[34] Whitman, T., D. Penttila, K. Krueger, P. Dionne, K. Pierce, Jr. and T. Quinn. 2014. Tidal elevation of surf smelt spawn habitat study for San Juan County Washington. Friends of the San Juans, Salish Sea Biological and Washington Department of Fish and Wildlife.

(MHHW) line.[35] With sea level rise, the loss of forage fish habitat will get worse unless beaches are able to migrate inland; a result precluded at those locations that have shoreline armor.

Additional analysis indicates that existing shoreline armor, when combined with the effects of sea level rise, will likely eliminate a large amount of existing Puget Sound forage fish habitat by the turn of the century. A recent study, making conservative assumptions[36] found that 75% of surf smelt eggs located on armored shorelines would be inundated [adversely affected].[37] Rising sea levels will also likely prompt increased requests for permits to install shoreline armor, thereby exacerbating the potential direct, indirect, and cumulative impacts to forage fish (and salmon). Preservation and expansion of existing, already degraded, nearshore habitat, as needed for salmon recovery, will require not only inclusion within Corps jurisdiction of all existing nearshore habitat, but also consideration and protection for lands that will eventually become forage fish and salmon habitat (due to sea level rise).

Recognizing that it has the discretion – and arguably the obligation – to take action to mitigate the impacts of sea level rise and to protect a significant portion of Seattle District beaches, the Corps of Engineers, in consultation with EPA and NOAA, recently conducted a process to determine whether it should reinterpret its geographic jurisdictional line for §404 permitting in marine waters.[38] As of the deadline for submitting these comments, we do not yet know what the agencies' decision on this is. However, it is clear that such beneficial uses as forage fish spawning could be better protected by the Corps adopting the highest astronomical tide as its interpretation of the "high tide line" by which it delineates its marine water jurisdiction. Protecting forage fish spawning, as well as more of the beach will result in better protection for treaty-reserved salmon and shellfish, as well.[39]

**Causes and Consequences of Nearshore Modification**

Development in the nearshore that is improperly designed or placed can have devastating effects on natural habitat-forming processes. Although shoreline modification may occur on the site scale, the cumulative impacts can affect entire ecosystems on the landscape scale.

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[35] Penttila, D. 2011. Pilot tidal elevation of Surf Smelt spawn study. Prepared for Friends of the San Juans. Friday Harbor, WA.

[36] These assumptions include that: (1) beach morphology (shape and substrate) would remain unchanged by sea level rise; (2) shoreline armor is located at MHHW +1.5 feet; and (3) sea level would not rise more than 27.3 inches. *See infra*, note 31 (Krueger et al. 2010).

[37] *See* Krueger, K.L, Pierce, Jr., K.B., Quinn, Timothy., and Penttila, D.E., 2010 Anticipated Effects of Sea Level Rise in Puget Sound on Two Beach-Spawning Fishes, *in* Shipman, H., Dethier, M.N., Gelfenbaum, G., Fresh, K.L., and Dinicola, R.S., eds., 2010, Puget Sound Shorelines and the Impacts of Armoring – Proceedings of the State of the Science Workshop, May 2009: U.S. Geological Survey Scientific Investigations Report 2010-5224, p.171-178 (accessed on April 21, 2016 at: http://pubs.usgs.gov/sir/2010/5254/pdf/sir20105254_chap17.pdf).

[38] *See* Corps of Engineers, Informational Briefing for Interagency Shoreline Habitat Protection Project (June 1, 2016). Commission and tribal staff have provided comments to this process, which we incorporate by reference. Comments were sent to Jim Jacobsen, Corps of Engineers, via email from James Weber, NWIFC, on June 23, 2016.

[39] *See* Letter to Gina McCarthy and Dennis McLerran (EPA) from Lorraine Loomis (NWIFC) (April 22, 2016) (calling for EPA to exercise its authority to require the Corps to fully exercise its CWA §404 jurisdiction to protect treaty-reserved resources).

Shoreline modification can cause fragmentation of the landscape that disrupts connectivity and reduces the productivity and biological diversity of Puget Sound watersheds. These impacts leave ecosystems less resilient to future disturbance, including the pressures of human population growth.

**Historical Changes to the Nearshore**

In the last 150 years, development and modification of shoreline habitats has disrupted ecological function and structure in all segments of the nearshore. According to analyses conducted in 2011 though the Puget Sound Nearshore Ecosystem Restoration Project[40,41] the following changes have occurred to the nearshore in the years since 1850:

- Shoreline armoring has been installed on 27 percent of Puget Sound shores.
- One-third of bluff-backed beaches are armored along half their length. Roads and nearshore fill have each affected about 10 percent of the length of bluff-backed beaches.
- Forty percent of Puget Sound shorelines have some type of structure that impacts habitat quality.
- Conversion of natural shorelines to artificial shoreforms in 10 percent of Puget Sound.
- Of the approximately 2,470 miles of Puget Sound shoreline, only 31 percent has not been modified in some way.
- A 93 percent loss of freshwater tidal and brackish marshes. The Duwamish and Puyallup rivers have lost nearly all of this type of habitat.
- A net decline in shoreline length of 15 percent as the naturally convoluted and complex shorelines were straightened and simplified. This represents a loss of 1,062 km or 660 miles of overall shoreline length.
- Elimination of small coastal embayments has led to a decline of 46 percent in shoreline length in these areas.
- A 27 percent decline in shoreline length in the deltas of the 16 largest rivers and a 56 percent loss of tidal wetlands in the deltas of these rivers.

[40] Fresh, K., M. Dethier, C. Simenstad, M. Logsdon, H. Shipman, C. Tanner, T. Leschine, T. Mumford, G. Gelfenbaum, R. Shuman, J. Newton. 2011. Implications of Observed Anthropogenic Changes to the Nearshore Ecosystems in Puget Sound. Prepared for the Puget Sound Nearshore Ecosystem Restoration Project. Technical Report 2011-03.

[41] Simenstad, C.A., M. Ramirez, J. Burke, M. Logsdon, H. Shipman, C. Tanner, J. Toft, B. Craig, C. Davis, J. Fung, P. Bloch, K. Fresh, S. Campbell, D. Myers, E. Iverson, A. Bailey, P. Schlenger, C. Kiblinger, P. Myre, W. Gerstel, and A. MacLennan. 2011. Historical Change of Puget Sound Shorelines: Puget Sound Nearshore Ecosystem Project Change Analysis. Puget Sound Nearshore Report No. 2011-01. Published by Washington Department of Fish and Wildlife, Olympia, Washington, and U.S. Army Corps of Engineers, Seattle, Washington.

From 2005 to 2011, an average of 1.1 miles per year of new shoreline armoring was permitted and 2.3 miles per year of replacement armoring was permitted.[42] These figures do not include unpermitted structures, which can exceed those constructed with permits. For example, in the Green/Duwamish River Watershed (Water Resources Inventory Area 9), permitted structures comprised only 38 percent of the all the armoring physically surveyed in 2012 and 2013.[43] Residential parcels make up 57 percent of Puget Sound shorelines and 48 percent of these are armored. In some areas armoring is even more prevalent: more than 50 percent of the residential parcels are armored in King, Kitsap, Pierce, Snohomish, Mason, and Thurston counties. Overall, 26 percent of residential parcels are in forage fish spawning grounds and 58 percent of those are armored.[44]

**Effects of Modifications to the Nearshore**

Along with physical loss of habitat, the impacts of nearshore modification include the loss of functions such as filtration of pollutants, floodwater absorption, shading, sediment sources, and nutrient inputs as well as water quality degradation, including increased turbidity. The greatest impacts to the nearshore are from shoreline armoring; roads and artificial fill are also significant, and these stressors often occur together or with other modifications.[45] Shoreline armoring generally reduces the sediment available for transport by disconnecting the sediment source, e.g. a feeder bluff, from the drift cell, potentially causing loss of beach width and height as transport of material outpaces supply. This can occur at the site of the structure or down the drift cell. Structures in the intertidal zone change the hydrodynamics of the waves washing up on the beach. Hard structures reflect waves without dissipating their energy the way a natural beach would, especially if vegetation is present. This energy can lower the beach, make it steeper, and wash away fine sediments. Dikes and fill reduce estuarine wetlands and other habitat for salmon, forage fish, and eelgrass.

When the physical processes are altered, there is also a shift in the biological communities. The number and types of invertebrates, including shellfish, can change; forage fish lose spawning areas; and juvenile salmon and forage fish lose the feeding grounds that they use as they migrate along the shore.[46] Native shellfish and eelgrass have specific substrate requirements

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[42] Johannessen, J., A. MacLennan, A. Blue, J. Waggoner, S. Williams, W. Gerstel, R. Barnard, R. Carman, and H. Shipman. 2014. Marine Shoreline Design Guidelines. Washington Department of Fish and Wildlife, Olympia, Washington.

[43] King County. 2014. The WRIA 9 Marine Shoreline Monitoring and Compliance Pilot Project. Prepared by Kollin Higgins, Water and Land Resources Division for the WRIA 9 Watershed Ecosystem Forum.

[44] Puget Sound Marine and Nearshore Grant Program. 2014 Shore Friendly Final Report. Prepared by Colehour + Cohen, Applied Research Northwest, Social Marketing Services, Futurewise, and Coastal Geologic Services for Washington Department of Fish and Wildlife and Wash. Department of Natural Resources. http://wdfw.wa.gov/grants/ps_marine_nearshore/files/final_report.pdf

[45] Fresh, K., M. Dethier, C. Simenstad, M. Logsdon, H. Shipman, C. Tanner, T. Leschine, T. Mumford, G. Gelfenbaum, R. Shuman, J. Newton. 2011. Implications of Observed Anthropogenic Changes to the Nearshore Ecosystems in Puget Sound. Prepared for the Puget Sound Nearshore Ecosystem Restoration Project. Technical Report 2011-03.

[46] Shipman, H., Dethier, M. N., Gelfenbaum, G., Fresh, K. L. and Dinicola, R. S. (*Eds.*). 2010. Puget Sound Shorelines and the Impacts of Armoring-- Proceedings of a State of the Science Workshop, May 2009. U.S. Geological Survey, Scientific Investigations Report 2010-5254.

and altered geomorphic processes can leave shellfish beds[47] and eelgrass meadows with material that is too coarse or with too much clay exposed. Shoreline armoring can also physically bury forage fish spawning beaches when structures are placed in or too close to the intertidal zone. When shoreline development removes vegetation, the loss of shading and organic material inputs can increase forage fish egg mortality.[48] Surf smelt, for example, use about 10 percent of Puget Sound shorelines for spawning and many bulkheads are built in forage fish spawning habitat, threatening their reproductive capacity.[49] The effects of nearshore modification cascade through the Puget Sound food web. The consequences can be seen in the population declines of a variety of species that depend on these ecosystems, from shellfish, herring, and salmon to orcas, great blue heron, and eelgrass. The loss of nearshore habitat also reduces areas available for sport fishing, bird watching, and other outdoor recreation opportunities that the people of this region have come to enjoy.

**Enabling shoreline development and modification**

The changes that Puget Sound shorelines have seen as a result of modifications to the marine nearshore have far reaching ecological impacts. Despite the documented environmental consequences briefly mentioned and cited here, the loss of habitat quantity and quality is a problem that continues to persist despite the region's concerted recovery efforts. This is a problem that requires adequate analysis and response in order better understand, for example, why habitat loss and degradation continues to outpace restoration, as well as forcing us to consider regulatory changes that can and ought to be made in order to better ensure that salmon recovery and Puget Sound restoration efforts are being realized.[50]

In efforts to respond to this negative trend, particularly as it relates to nearshore concerns, the Puget Sound Partnership 2014/2015 Action Agenda has identified recovery targets for the nearshore. While recovery will require a suite of complementary actions, one of the specified targets named in this strategy calls for the removal of shoreline armoring at a rate greater than its installation. However, the reality that we are facing today loudly shows us that restoration is not keeping pace with destruction of habitat. Recent studies continue to illustrate that our efforts in the nearshore are not being as effective as they ought to be. This has been further exemplified in Washington Department of Fish and Wildlife's (WDFW) survey of shoreline armoring Hydraulic Project Approvals (HPAs). In a survey of HPAs issued by WDFW in Puget Sound between January 2005 and December 2010 the data recorded the installation of 6.5 miles of new armor and 14.45 miles of replacement armor. This starkly contrasts with data from

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[47] *See e.g.,* Dethier, M.N. 2006. Native Shellfish in Nearshore Ecosystems of Puget Sound. Puget Sound Nearshore Partnership Report No. 2006-04. Published by Seattle District, U.S. Army Corps of Engineers, Seattle, Washington.

[48] Penttila, D. 2007. Marine forage fishes in Puget Sound. PSNERP Tech. Rep. 2007-03, Pub. by USACOE, Seattle Dist.

[49] Penttila, D. 2007. Marine forage fishes in Puget Sound. PSNERP Tech. Rep. 2007-03, Pub. by USACOE, Seattle Dist.

[50] Ongoing habitat loss in Puget Sound as noted in reports such as Western Washington Treaty Tribes' "Treaty Rights at Risk white paper" (2011), available at: http://nwifc.org/w/wp-content/uploads/downloads/2011/08/whitepaper628finalpdf.pdf, *see also* NMFS, Puget Sound Chinook Salmon Recovery Plan – 2011 Implementation Status Assessment Final Report, 2011, at 6.

that same time period that shows only 0.61 miles of armor were removed.[51] More recent studies have suggested a less dramatic rate of new armoring, but those studies were limited in their geographic scope and types of shoreline modification. [52] They have, however, corroborated that the bulk of permitted shoreline armoring activities continue to be repair and replacement. This demonstrates that the lifecycle of aging armoring in Puget Sound will present continual opportunities to address previous habitat modifications or simply perpetuate old harms.

In sum, there is ample technical justification that supports, if not demands, that the Seattle District no longer authorize the use of NWP 13 in the Salish Sea. In addition, we firmly believe that the use of NWP 13 in western Washington lakes, rivers, and streams should also be heavily curtailed. As the following discussion demonstrates, freshwater bank armoring also results in significant (i.e., more than minimal) cumulative effects.

**Cumulative Impacts of Bank Stabilization in Freshwater Systems**

The impacts of bank stabilization in freshwater environments are complex. The following Figure was excerpted from a report commissioned by the United States Department of Transportation regarding the cumulative impacts of bank stabilization on freshwater systems[53]. It provides a means of expressing the relationships and impacts accruing from freshwater bank stabilization.

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[51] Carman, R., B. Benson, T. Quinn, T. and D. Price. 2011. Trends in Shoreline Armoring in Puget Sound 2005-2010. Salish Sea Ecosystem Conference, Vancouver, B.C.

[52] Shoreline Permitting Through TACT (Spring 2015) (TACT is an acronym for: Trouble-Shooting, Action Planning, Course Correction, and Tracking and Monitoring).

[53] Sargeant, S.L., Miller, M.C., May, C.W., Thom, R.M. Battelle Marine Sciences Laboratory, Shoreline Armoring Research Program, Phase II – Conceptual Model Development for Bank Stabilization in Freshwater Systems, Prepared for WA Dept. of Transportation (June 2004) at 35.

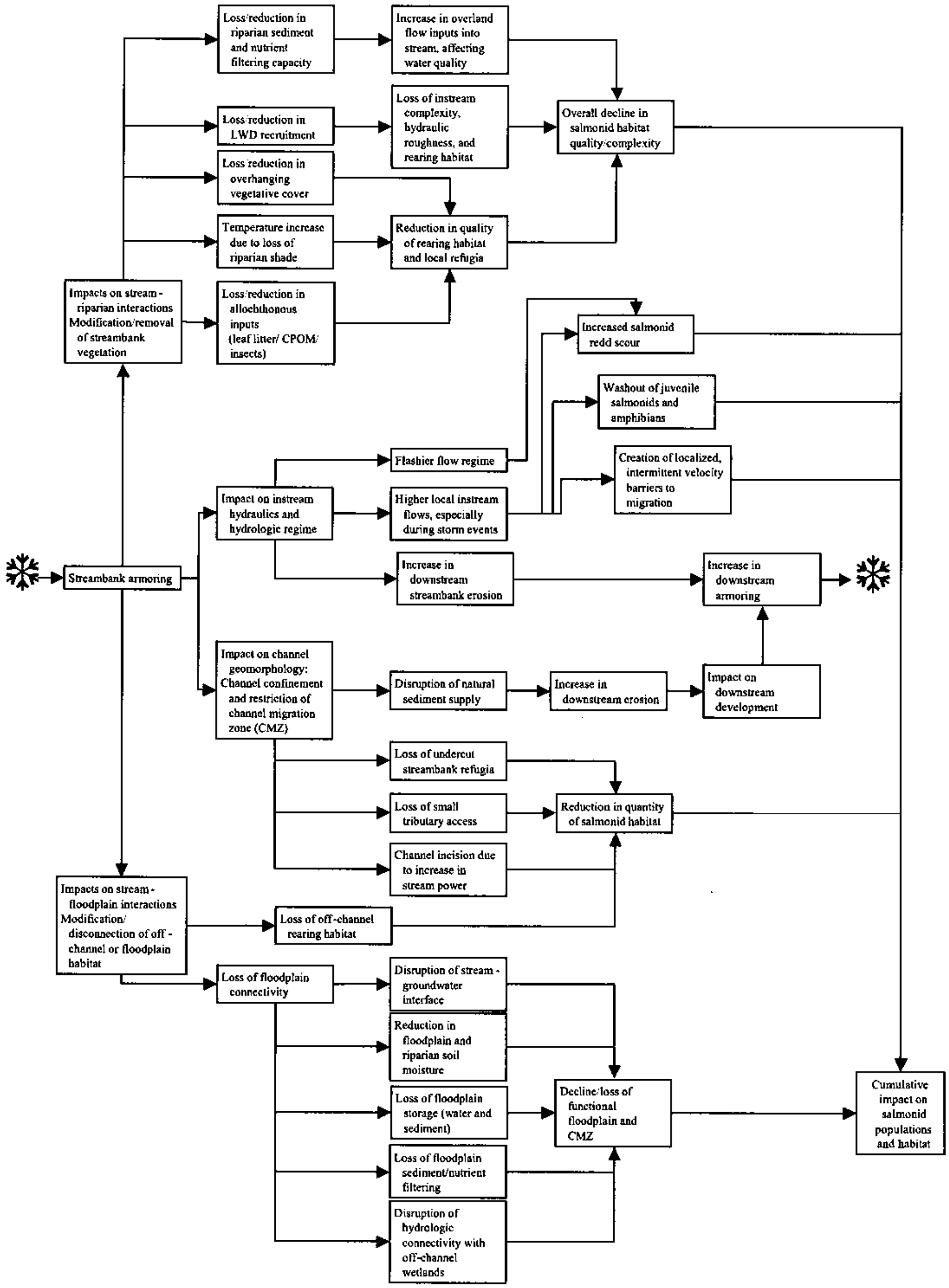


**Figure 12.** Conceptual model indicating streambank armoring connections to cumulative impacts on salmonid populations and habitat.

This model is useful in considering the impacts that are caused/maintained by levee repair projects. Following is a general description of the impacts of freshwater bank stabilization in the context of a recent Corps of Engineers levee riprapping project along the Pilchuck River within the Snohomish watershed in Puget Sound.[54] It documents the significant reduction in use of habitat, where banks are armored, by ESA-listed – and treaty-reserved – salmon.

> Beamer and Henderson (1998) showed that subyearling juvenile Chinook salmon use natural banks (i.e., banks with riparian cover, large woody debris, and backwaters) at a density five times greater than riprap banks. Bank stabilization such as the riprap repair proposed in this project reduces the quality of edge habitat and the density of juvenile salmonids that rear near banks. A planting plan will be implemented as part of this action, which minimizes that impact. As the vegetation matures detrital inputs and shading will increase, improving the edge habitat over time. Beamer and Henderson (1998) reported a reduction in juvenile rearing density of 5 to 10 times between natural forested banks and riprapped banks. Beechie et al. (2006) suggested that modified banks lacked backwater areas, and pools created by eddies. Fish species have much lower densities and diversity in riprap areas than in natural areas (Bolton and Shellberg 2001). More fish species were found in areas with natural banks due to the greater diversity of habitat in these areas. Peters et al. (1998) compared seasonal fish densities in Washington at sites with various bank stabilization structures. They surveyed typical bank stabilization methods and found that 496 of 667 projects used riprap or riprap with deflectors. Only 29 projects used bioengineering or large woody debris. Of all project types (riprap, riprap with large woody debris, rock deflectors, rock deflectors with large woody debris), only sites stabilized with large woody debris consistently had higher fish densities in spring, summer, and winter than the control sites without any stabilization structures (Peters et al., 1998). Riprap sites consistently had lower densities than control sites. At all sites, fish densities were generally positively correlated with increasing surface of large woody debris and increasing amounts of overhead riparian cover within 30 cm of the water surface. Replacement of bank armor to maintain the existing system of flood control will perpetuate a lowered ability of the action area to support rearing fish, and hold both abundance and productivity of the affected populations stable at suboptimum levels.
>
> The effects of streambank alteration are not limited to the wetted stream channel and extend beyond the construction site. Connectivity longitudinally (up and downstream), laterally (floodplain and uplands) and vertically (groundwater, hyporheic, and phreatic) is a major feature of stream corridors (Stanford and Ward 1992). Lack of floodplain connectivity and access to flood refugia also impairs juvenile fish growth and survival during flood conditions (Sommer et al 2001, Sommer et al 2004, Jeffres 2008).

[54] *See* Lord Hill Levee Biop at 19-21.

The third pathway is the preclusion of habitat forming processes that occur through erosion and deposition. Habitat complexity is the key factor related to success of species during and after floods (Pearsons et al., 1992; Letcher and Terrick 1998; Bischoff and Wolter, 2001; Schwartz and Herricks 2005). These complex habitat features are formed and maintained by the same flood events, which may form new pools, floodplains, and gravel bars (Bischoff and Wolter 2001). Following floods, complex reaches lost proportionately fewer fish, had higher fish diversities, and had higher fish assemblage than simple reaches (Pearsons et al., 1992). Juvenile fish are particularly vulnerable to strong flows associated with floods because of their limited swimming ability and small size (Pearsons et al., 1992). Valuable habitat used by juveniles during floods includes inundated floodplain which serves as a nursery (Bischoff and Wolter 2001). The loss of floodplain directly reduces the complexity of watercourse reaches and permanently removes valuable rearing and holding areas during floods. The loss results in an increase in fish washed downstream and a reduced ability to recolonize following the flood. Channeling and diking isolates floodplains, thereby reducing the amount of channel habitat available for juvenile salmonids. Hayman et al. (1996) demonstrated that natural and unaltered floodplains have twice the amount of channel habitat than isolated floodplains. Assuming a direct correlation to the amount of habitat available, unaltered floodplains may support up to twice the amount of salmonids as riprapped or altered floodplains. Maintaining the levee system ensures that those features which contribute to salmonid survival and recovery will not be restored in the action area.

Typically, changes due to human activities in the channel migration zone result in a reduction in habitat diversity, which affects the numbers and kinds of animals that can be sustained. As the physical habitat changes, stresses are placed on individual plants and animals. These stresses, depending on the tolerance of the species and individual, may limit growth, abundance, reproduction, and survival. Biologically important parameters that change following channel activities include water temperature, turbidity, flow velocity, variable water depths, hydrologic regime, a decrease or change in vegetation, changes in storage of organic matter and sediment, and changes in the size and stability of channel substrate (Bolton and Shellberg 2001). These changes can decrease habitat connectivity and the exchange of energy and matter between habitats. The direction of change varies by site and circumstance. Within this action area, fish response to the proposed action will be a continued suppression of habitat carrying capacity, limiting the growth and survival of individuals among the two populations from both species.

Unfortunately, the impacts described above are not unique, but have occurred in rivers and streams throughout much of western Washington. Bank armoring, levee construction and repair, floodplain fill/development resulting in excessive levels of impervious surfaces, and construction and maintenance of transportation networks along streams have resulted in significant impacts on salmon habitat in western Washington. These impacts, and the mechanisms by which they occur, are documented in NMFS' biological opinion on FEMA's National Flood Insurance Program in Puget Sound.

The effects of hydromodification stemming from floodplain development include increased flood stages, increased flood damage, increased volume of instream flows, increased velocity of instream flows, and associated erosion and sedimentation.[55] Flood volumes increase as there is more runoff from developing watersheds. If development encroaches into floodplains, the water has to go somewhere. If floodwaters cannot be attenuated and stored in the floodplain, they are passed downstream, further increasing flood levels downstream. As floodplain development increases, there is increased risk of induced flood damage to existing structures and natural habitat in or near the floodplain.[56] The response of flood districts or diking districts has often been to channelize the river to increase the velocity, which 'gets rid of' the water more quickly but also leads to the loss of storage in the floodplain. In some cases, this has led to the increased severity of downstream flooding."[57]

When stream flows increase without a corresponding increase in the cross-sectional flow area, or when this cross-sectional flow area is narrowed by floodplain development, flow velocities increase. Increased velocity often occurs when levees are installed. The impact of these increased velocities include increased erosion and often additional downstream damage.[58] Increased flow velocities also destabilize spawning gravels and scour out redds killing both eggs and alevins. Rearing juveniles will be stressed by the high flows, turbidity, and debris, and will be flushed downstream because shallow flood fringe refugia are often not available in a system channelized by levees and/or armored banks.[59]

Development in adjacent floodplains and channel confinement, due to filling or levees, leads to increased erosion and sedimentation.[60] In response to the threat of increased erosion, bank stabilization projects proliferate.[61]

> These projects are generally measured for site-specific performance, but their impacts on channel geomorphology are often overlooked. In some cases this has led to the creation of instabilities, causing channel down-cutting and bank erosion. In many cases channels have been "bank protected" with little consideration of how the channel will

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[55] *See* NMFS, Endangered Species Act Section 7 Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation Regarding Implementation of the National Flood Insurance Program in the State of Washington – Puget Sound Region (September 22, 2008) (NMFS Tracking No.: 2006-0472) at 124-127 (hereinafter "FEMA NFIP Biop").
[56] *Id.* at 125.
[57] *Id.* at 126.
[58] *Id.*
[59] *Id.*
[60] Spence, B. C., G. A. Lomnicky, R. M. Hughes, and R. P. Novitzki. 1996. An ecosystem approach to salmonid conservation. Funded jointly by the EPA, U.S. Fish and Wildlife Service, and National Marine Fisheries Service. TR-4501-96-6057. Man Tech Environmental Research Services Corp., Corvallis, OR. at §6.4.8 (Effects of Urbanization on Physical Habitat).
[61] FEMA NFIP Biop at 127.

respond. Often streams and rivers respond with accelerated erosion of other sections of the channel or floodplain to compensate for the loss of sediment supply from the protected reach.[62]

Bank stabilization structures, including levees, riprap, walls, etc., along with maintenance of these same structures, cannot occur [legally] without a Corps of Engineers Section 404 permit. As noted above, bank stabilization projects create impacts downstream thereby increasing the demand for bank stabilization projects in a self-propagating cycle. In the meantime, as documented in the various sources cited above, channelization and disconnection of the floodplain result in flow velocities and loss of refugia that have dramatically reduced salmon habitat productivity.

In the FEMA NFIP Biop, NMFS stated that "[f]loodplain connectivity and channel function in almost all habitat areas evaluated for this analysis have been identified as limiting species productivity."[63] The areas and populations specifically mentioned in the FEMA NFIP Biop where floodplain connectivity and function must be restored are: Chinook in the Lower White, lower Puyallup, and lower Carbon watersheds;[64] Nooksack River Chinook;[65] Dungeness River Chinook;[66] Skagit River Chinook;[67] and Hood Canal Summer Chum watersheds.[68] Continued incremental degradation of floodplain connectivity and channel function through streamlined permitting of both new bank stabilization projects and repair of existing projects is not consistent with either recovering salmon or meeting federal obligations to Indian tribes. Requiring individual permitting of both new projects and repair/maintenance of existing projects will trigger the alternatives analysis needed to begin thorough consideration of floodplain and channel management that both protects treaty-reserved rights and stops and better addresses flood risk reduction.

**Maintenance and repair of bank stabilization and other structures, including culverts, reinvigorate the original harm caused by the projects by removing the opportunity to reduce impacts or restore habitat.**

Maintenance and repair and even replacement of bank stabilization structures, and other structures, are often treated as being "no impact" events. The stated rationale is that since maintenance, repair, or replacement merely maintains the continued existence of a structure or impact that was already there, there is no new impact and therefore there is no need for mitigation or even close examination. This logic is flawed for at least the following reasons.

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[62] *Id.*

[63] *Id.* at 132. NMFS' analysis of the impacts of the NFIP focused on ten salmon populations it found representative of the salmon and steelhead populations found throughout Puget Sound. *Id.* at 61.

[64] *Id.* at 133. Additional watersheds mentioned as important to protect and restore include: South Prairie Creek, Boise Creek, Greenwater River, Huckleberry Creek, and the Clearwater River. *Id.*

[65] *Id.* at 133-134.

[66] *Id.* at 134-135.

[67] *Id.* at 135.

[68] Id. at 135-136.

First, repairing or replacing a structure that adversely affects or prolongs habitat impacts causes harm to future generations of salmon that would not have occurred but for that repair or replacement. Neither levees nor armored shorelines are permanent. They are subject to the constant working of nature's forces and, in the absence of repair and replacement, would soon be washed away. Many of the forces that these structures seek to fight against are the same forces that create and maintain good fish habitat.

Second, NMFS and the Corps of Engineers have already recognized that repair and replacement are not no-impact events. For example, the Corps and NMFS agree that repairs and replacements of overwater structures in Lake Washington could not merely repair and replace the existing structure. Instead, repaired/replaced structures are required to incorporate structural changes to make them less harmful to salmon habitat. Thus, the letter of concurrence between the Corps and NMFS calls for limits on the square footage of structures, their width, the length they can extend into Lake Washington, prohibits skirting, requires the use of grating to allow passage of light, prohibits structures over shallow water habitat, restricts the use of treated wood,[69] and requires habitat enhancement to compensate for unavoidable habitat effects. The enhancement includes retention or planting of a 10 foot buffer of native vegetation along the entire shoreline of the project.[70] While one can debate whether these requirements are adequate to commensurately contribute to the recovery of ESA-listed species, the principle is clear. Requests for permits to repair or replace Corps-permitted structures create an opportunity to either maintain impacts or to reduce them.

Another example where NMFS and, arguably, the Corps have recognized that repairs result in new impacts is the Lord Hill Levee Biop mentioned previously. It states that: "Replacement of bank armor to maintain the existing system of flood control will perpetuate a lowered ability of the action area to support rearing fish, and hold both abundance and productivity of the affected populations stable at suboptimum levels."[71] Shortly thereafter, it adds that "[m]aintaining the levee system ensures that those features which contribute to salmonid

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[69] We support restrictions on the use of treated wood for in-water structures. We recommend adoption of language such as the following: "No treated wood may be used as part of the decking, piling, or other components of any in-water structures such as docks, wharves, piers, marinas, rafts, shipyards and terminals. Treated wood may only be used for above water structural framing and may not be used as decking, piling or for any other uses. During maintenance that involves replacement of treated wood, existing treated wood must be replaced with alternative materials such as untreated wood, steel, concrete, or recycled plastic, or encased in a manner that prevents metals, hydrocarbons and other toxins from leaching out."

[70] *See* NMFS, Endangered Species Act Section 7 Informal Consultation and Magnuson-Stevens Fishery Conservation Management Act Essential Fish Habitat Consultation for Proposed Programmatic Consultation in the Lake Washington Basin (September 24, 2013) (NMFS Tracking No.: 2010/04978) at 3-4. *See also id.* at 7: (noting that repairing and replacing existing piers would extend the adverse effects of the piers by 20-30 years or more. Compensatory mitigation is necessary to offset the adverse cumulative effects).

[71] *See* Lord Hill Levee Biop at 20. The statement that affected populations are at "suboptimum levels" is a significant understatement. According to the Biop, the affected Chinook populations will remain at roughly 3.4% and 5.7% of historical abundance. Both populations are at or below 10% of their recovery target. *Id.* at 24.

survival and recovery will not be restored in the action area."[72] Finally, NMFS notes that "[w]ithin this action area, fish response to the proposed action will be a continued suppression of habitat carrying capacity, limiting the growth and survival of individuals among the two populations from both species."[73] In short, repairing/maintaining bank stabilization structures perpetuates a status quo that will, at a minimum, maintain current depressed fish populations or, as one of many relatively small bank armor repairs considered and found individually insignificant, cumulatively contribute to thwarting salmon recovery and meeting treaty obligations.[74]

Repair and replacement projects are key opportunities to reduce the impacts of the environmental baseline (such as the Lake Washington overwater structure concurrence letter), to actually implement recovery actions, and to minimize or eliminate further degradation. There are many more requests for repair and replacement bank armor than there are for new bank armor.[75] As noted by the Corps in a previous attempt to partially assess cumulative impacts, the rate of new shoreline armor, has been significantly less than replacement armor, and both of these dwarf the removal of these structures.

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[72] *Id.* at 20-21.

[73] *Id.* at 21.

[74] This is also true to of fish-blocking culverts. Allowing maintenance of blocking culverts perpetuates both the loss of habitat productivity and the concomitant loss of fish available for harvest.

[75] *See* Shoreline Permitting Through TACT (Spring 2015) (TACT is an acronym for: Trouble-Shooting, Action Planning, Course Correction, and Tracking and Monitoring). The TACT[75] report, prepared by WDFW and Kitsap and San Juan counties, found that during the timeframes of their analyses (2007-2012 for Kitsap County and 2006-2013 for San Juan County) there were significantly more armor repair or replacement projects implemented than new armoring projects. During the Kitsap County five-year analysis period, 56 of the total 66 bulkhead projects were for repair or replacement. Of these 56 projects, 20 were for repairs, while 36 were for replacement. *Id.* at Appendix A, Kitsap County Troubleshooting Report at 3. Only 9 new bulkheads were installed (four of which were classified as "soft-shell" or "hybrid" structures). While not as heavily weighted towards repair/replacement as Kitsap County, the data from San Juan County show that 45 of 75 bulkhead projects were for repair or replacement projects, while 30 of the 75 projects were new bulkheads. TACT Report at 5 (Table 1). The TACT report did not distinguish between which projects were repair and which were replacement.

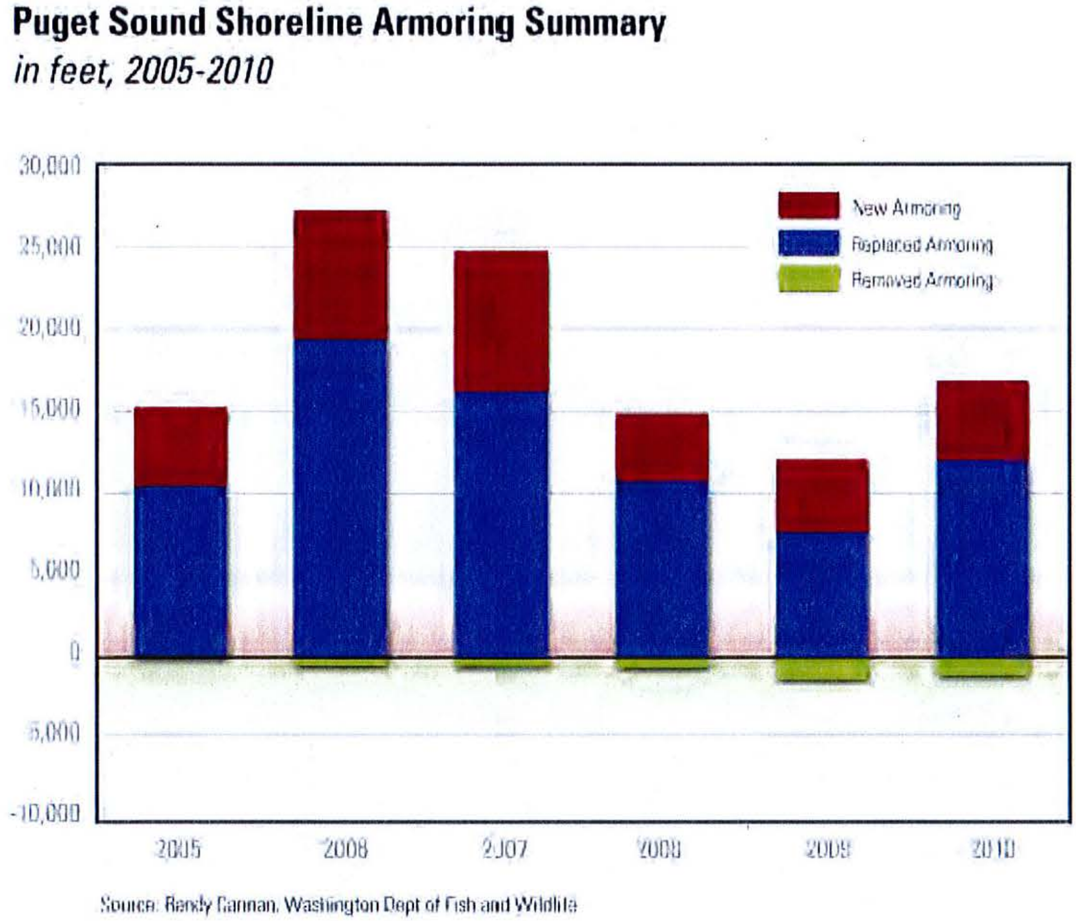


**Figure 3-5 Trend of bankline armoring for all of Puget Sound.**[76]

It would squander a vital opportunity for salmon recovery to grant permission for the perpetuation of numerous existing structures, while only requiring that new projects incorporate the latest science and standards for compensatory mitigation and minimizing impacts. Permitting of repair and replacement projects needs to carefully consider whether the need for repairs or replacement creates an opportunity to reduce or eliminate conditions that are harmful to salmon. Permits for Installation and/or perpetuation of hard armor, in both marine and freshwaters draining into the Salish Sea, should be the most difficult permits to get. The Corps should incentivize the use of less harmful or "softer" approaches. The current best available science for marine shoreline stabilization in the Salish Sea is reflected in the Marine Shoreline Design Guidelines.[77] This is currently the best guidance for design of shoreline

[76] This figure was copied from the Corps of Engineers, Cumulative Effects Analysis of the Eastern Shore of Puget Sound (February 7, 2014) Figure 3-5 at page 3-8. The Corps extracted it from another document (Carman et al. 2011). A less blurry version may be found there.

[77] Johannessen, J., A. MacLennan, A. Blue, J. Waggoner, S. Williams, W. Gerstel, R. Barnard, R. Carman, and H. Shipman, 2014. Marine Shoreline Design Guidelines. Washington Department of Fish and Wildlife, Olympia, Washington.

stabilization that, short of avoidance, causes the least harm to nearshore habitat. Moreover, there is significant opportunity to eventually make existing structures less harmful. Around 46% of residential shoreline parcels in Puget Sound are armored even though the erosion potential they face ranges from none to moderate.[78] With the passage of time, these armored parcels will need maintenance, repair, and eventually replacement. The Corps has the authority to require hard armor to be replaced with more natural, "softer" approaches to bank stabilization that maximize habitat function, while addressing stabilization at the site.[79] These armored shoreline parcels represent a vital habitat restoration opportunity that the Corps has both the authority and the obligation to implement. Improving existing degraded shoreline habitat conditions (and reducing the extent of armored freshwater banks) will be essential to assuring recovery of ESA-listed salmon habitat[80] and meeting the tribes' treaty-secured rights to take fish. Moreover, perfunctory approval of maintenance projects not only solidifies existing harms, but also can cause further degradation (e.g., waterward movement of bank armor or removal of mature riparian vegetation).

**The impacts of continued use of NWPs to authorize both new and/or existing bank stabilization projects will be exacerbated by the effects of climate change.**

Observed climate trends in the Pacific Northwest include warmer air temperatures, loss of glacier area, reduced snowpack, changes to timing and magnitude of stream flows, increased water temperatures, rising sea levels, and altered marine chemistry. Projections for the 21st century point to continued warming in air temperatures, changes to precipitation timing, changes to annual streamflow patterns, increased water temperatures, rising sea levels, and altered marine chemistry.

[78] *See* Shore Friendly Final Report (2014) at 11 (discussing Category 2 landowners), report prepared for the Washington Departments of Fish and Wildlife and Natural Resources, by Colehour + Cohen, Applied Research Northwest, Social Marketing Services, Futurewise and Coastal Geologic Services.

[79] NWP 3 (repairs) could be regionally conditioned in a manner similar to the approach that the Seattle District used with the 2012 Regional General Condition 4 where it required permittees to, among other things, demonstrate "the least environmentally damaging practicable bank protection methods." Unfortunately, we are not acquainted with any data regarding how effective this RGC was. In addition, this RGC would potentially allow for the use of a considerable amount of rock, thereby largely undermining the potential habitat benefits. (RGC 4(f) allows the use of rock if its "incorporates elements beneficial to fish." We do not know how that would be done nor have we seen any data indicating the level of success if this RGC. Again, with respect to marine shoreline repairs, the Marine Shoreline Design Guidelines appear to provide the best existing guidance.

[80] Almost 10 years ago, the Puget Sound Technical Recovery Team found "that protecting existing habitat and the ecological processes that create it is the most important action needed in the short-term to increase the certainty of achieving plan outcomes. Protection must occur in <u>both urban and rural areas</u> if we are to ensure the long-term persistence of salmon in Puget Sound." *See* NMFS, Puget Sound Chinook Salmon Recovery Plan, Volume 1, (January 19, 2007) at 354 (emphasis added). *See also id.*at 353: "Puget Sound is like a large water bucket, full of habitat and life. Habitat losses are the holes in the bucket, and many small holes can eventually drain it. Restoration is the process of plugging the holes while protection is to prevent new holes from being formed, allowing the bucket to fill once again through natural processes." The Corps' NWP program needs to stop being a program that keeps punching holes in Puget Sound.

Loss of snowpack and mountain glaciers poses a threat to salmon populations since they need adequate amounts of cool, clean water to survive. By the 2080s, the number of locations with summer stream temperatures in excess of 67°F, which is stressful to salmon, will increase by 16 percent.[81] In the winter, higher than normal peak flows can scour salmon eggs from the stream gravel.[82] Additionally, receding glaciers and more precipitation falling as rain introduces more sediment into rivers.[83] This excess sediment in streams increases salmon egg mortality and reduces ecosystem productivity.[84]

Of course, climate change is not the only driver of winter peak flows and associated scour. As discussed in previous sections, increased floodplain fill and impervious surfaces deliver more water faster to stream networks.[85] These higher peak flows trigger more bank erosion (along with the substrate scour which is harmful to salmon) and increase the demand for bank armoring to prevent bank erosion. These armored banks trigger increased flow velocities as more water must travel through a channel that cannot expand. In turn, these higher peak flows move downstream at higher velocities and increase the erosional forces at work downstream thereby triggering additional demand for bank armor to halt erosion and prevent flooding.[86] On the one hand, everyone wants to protect their property from erosion and flooding. On the other hand, as everyone seeks to protect their property from erosion and flooding, the water has to go somewhere and so it moves downstream more rapidly and with greater volume, to the detriment of downstream interests and salmon. Excessive streambank armoring has contributed significantly to the degradation of salmon habitat and contributed to the listing of

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[81] Mantua, N, I. Tohver, and A. Hamlet (2010) Climate change impacts on streamflow extremes and summertime stream temperature and their possible consequences for freshwater salmon habitat in Washington State. Climatic Change 102:187-223.

[82] Montgomery, D.R., J.M. Buffington, N.P. Peterson, D. Schuett-Hames, and T.P. Quinn (1996) Streambed scour, egg burial depths and the influence of salmonid spawning on bed surface mobility and embryo survival. Canada Journal of Fisheries and Aquatic Sciences 53: 1061-1070.

[83] Czuba, J.A., C.R. Czuba, , C.S. Magirl, F.D. Voss (2010) Channel-conveyance capacity, channel change, and sediment transport in the lower Puyallup, White, and Carbon Rivers, western Washington: U.S. Geological Survey Scientific Investigations Report 2010-5240.

[84] Nooksack Indian Tribe, U.S. Environmental Protection Agency, and Tetra Tech. 2016. Qualitative Assessment: Evaluating the Impacts of Climate Change on Endangered Species Act Recovery Actions for the South Fork Nooksack River, WA. EPA Region 10 Climate Change and TMDL Pilot. In cooperation with Washington Department of Ecology and NOAA Fisheries.

[85] *See e.g.,* Center for Watershed Protection Research Monograph No. 1, Impacts of Impervious Cover on Aquatic Systems (March 2003) (hereinafter "Center for Watershed Protection 2003") at 47 citing Booth (1991) who found that streams in Puget Sound lowlands begin developing unstable stream banks once impervious cover reached 10%).

[86] *See* FEMA NFIP Biop at 94: "Confinement of the channel eliminates off channel flood storage and off channel habitat relied on by juvenile salmonids for refuge from high flows. Confinement disconnects the side channels, oxbows, and off-channel areas that store floodwaters and provide refuge for juvenile salmon during floods. Reducing floodplain flood storage capacity increases flood velocities and peak flows in the stream channel and exacerbates downstream erosion and scour (Task Force on the Natural and Beneficial Functions of the Floodplain 2002)." *See also* Conceptual Model indicating streambank armoring connections to cumulative impacts on salmonid populations and habitat.

Puget Sound Chinook salmon.[87] The tribes' 2016 State of Our Watersheds report documents significant impacts – if not severe impacts – from armored banks in numerous watersheds.[88] Even without climate change, many Puget Sound watersheds suffer from excessive peak flows and channel scour due to excessive development and associated bank stabilization. By increasing peak flows, climate change will make these impacts worse. All the more reason why freshwater bank armoring needs to be brought under control in a way that protects salmon habitat and does not perpetuate the vicious cycle of development, bank armoring, development, and bank armoring.

**Impervious Surfaces**

Impervious surfaces are an important indicator of cumulative effects that call out for dramatic changes in how the Corps implements its NWP program in Puget Sound.[89] As noted by NMFS in its biological opinion on the 2012 NWP program, "[t]he amount of impervious surface cover in a watershed is a reliable indicator of a suite of phenomena that influence a watershed's hydrology."[90] The Corps appears to agree that impervious cover is an important indicator because it has chosen to monitor impervious cover as an indicator of some of the impacts of implementation of its NWP program.[91]

Impervious cover is defined as "a hard surface area which either prevents or retards the entry of water into the soil. Common impervious surfaces include roof tops, walkways, patios, driveways, parking lots or storage areas, concrete or asphalt paving, gravel roads, packed earthen materials, and oiled surfaces."[92] Impervious cover affects the volume and timing of

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[87] *See e.g.*, 65 Fed. Reg. 42422, 42450-51 (July 10, 2000) (Chinook 4(d) Rule Response to Comments) ("NMFS believes altering and hardening stream banks, removing riparian vegetation, constricting channels and floodplains, and regulating flows are primary causes of anadromous fish declines."); *see also* 63 Fed. Reg. 11482, 11494 (March 9, 1998) (proposed Chinook listings) ("The Puget Sound salmon Stock Review Group (PFMC) provided an extensive review of habitat conditions for several of the stocks in this ESU. They concluded that reductions in habitat capacity and quality have contributed to escapement problems for Puget Sound Chinook salmon, citing evidence of curtailment of tributary and mainstem habitat due to dams, and losses of slough and side-channel habitat due to diking, dredging, and hydromodificaiton.").

[88] *See e.g.*, 2016 State of Our Watersheds at 47 (Dungeness); 68-69 (Morse Creek floodplain impairment); 101-102, 104, 109,(Green); *see also id.* at 113 (map of modified banks along Cedar, White, Green Puyallup, Sammamish rivers, and Issaquah Creek); *id.* at 164-165, 167, 169 (Puyallup, including map of Puyallup basin levees); 140 (need to restore Nooksack River channel migration zone); 209 (map of Skagit levees); 260, 263-264 (documenting disconnection of Stillaguamish floodplain and estuary by dikes, levees, and bank armor); 288 (55% of Skagit County shorelines already armored – potential to have 83% of Skagit County shorelines armored under full build out of current zoning); 291 (map of lower Skagit River basin levees and armor); 301 (loss of Snohomish estuarine and side-channel habitat); 320-321, 327 (Skagit floodplain disconnection and stream blockages).

[89] It's important to recognize that impervious surfaces/cover is not the sole indicator of cumulative effects. Bank and shoreline armoring have resulted in adverse cumulative effects, in the absence of excessive levels of impervious cover, for example, in various parts of Hood Canal and in the Skagit basin. *See e.g.*, 2016 State of Our Watersheds at 153, 156-158 (Port Gamble Tribe); *see also* Comments of Upper Skagit Tribe regarding Seattle District Regional Conditions (August 19, 2016) (discussing bank armoring impacts in middle Skagit River).

[90] 2012 NWP Biop at 270 (citing Center for Watershed Protection 2003).

[91] The Corps has agreed to incorporate consideration of impervious cover into its proposed action. *Id.* at 66-68.

[92] *Id.* at 269.

runoff, facilitates the introduction of toxic chemicals into runoff, results in increased bank erosion and instability, and causes decline in the amount of large woody debris and pools (both of which are important for salmon habitat).[93]

In discussing the significance of impervious cover, NMFS cites research and analysis indicating that diversity of fish and invertebrates begin to change or decline in association with varying amounts of watershed impervious surface cover. NMFS points to a study by Wang et al. (2003), which found that impervious cover from 6-11% caused major changes in diversity of fish fauna in cold water streams and that many species fell out of the fish fauna when impervious cover exceeded 11%.[94] Additionally, NMFS points out a regional study done by May et al. (1997) that looked at the impacts of urbanization on small streams in Puget Sound. As summarized by NMFS, May et al. (1997) found that: "As the area of total impervious surface cover increased, habitat attributes that are important for salmon, such as pools and the presence of woody debris, declined along with the benthic index of biotic integrity, and the ration of Coho salmon to cutthroat trout. When the area of total impervious surface cover exceeded 5%, this latter ratio declined substantially suggesting that Coho salmon were being competitively excluded by the trout in these streams."[95] NMFS notes later that "most relevant studies in the scientific literature demonstrate measurable changes in the hydrology of rivers and streams and a significant degradation in biological integrity when the area of total impervious surface cover was between 2 and 12%. However, there is a high degree of variability in these responses among watersheds."[96]

NMFS then takes the unsupported step of deciding that, regardless of existing impervious surface levels, the Corps can continue to increase impervious cover in a watershed above baseline impervious cover for that watershed by another 1% as a surrogate metric that would "alert the Corps that a problem may be approaching, and would allow them the opportunity to take action before significant impacts occur."[97] The Commission does not accept this approach because it fails to take into consideration existing levels of impervious cover which may already be causing significant impacts, in violation of federal obligations for the protection of salmon.

An additional problem with the incremental increase approach outlined in the 2012 NWP biop is that it masks the likely impacts to salmon and water quality by expanding the size of the watershed over which the impacts are measured. NMFS and the Corps call for measuring a 1% increase in impervious cover over a USGS 10-digit hydrologic unit (HUC-10) watershed.[98] The mean average area of HUC-10 watersheds found in western Washington is around 166 square miles. In contrast, the impervious cover data for Puget Sound streams showing significant

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[93] *Id.* at 270. *See also* Center for Watershed Protection (2003) at 14-15 (impacts on stormwater quality); 25-37 (impacts on runoff volume, peak flows, and base flows); 40-54 (physical/channel impacts); 47 (impacts on bank stability); 55-91 (various chemicals).
[94] *Id.* at 270.
[95] *See* 2012 NWP Biop at 270.
[96] *Id.* at 343.
[97] *Id.*
[98] *Id.* at 343-344.

impacts to coho when impervious cover reaches 5% or more is based on watersheds ranging in size from 1 square mile to 34 square miles.[99] The impacts in smaller watersheds can be masked if averaged out over a much larger watershed.[100]

As discussed above and in the stormwater section of these comments, coho salmon have already been experiencing unsustainable levels of mortality due to runoff from impervious cover in Puget Sound.[101] Existing levels of impervious cover are already too much. Rather than continuing to allow incremental increases of impervious cover caused and/or facilitated by the Corps' NWP program, the Commission recommends revoking NWPs that cause or facilitate any increases in impervious cover in USGS 12-digit hydrologic unit (HUC-12) watersheds[102] that have 5% or more impervious cover.[103] In turn, we recommend expanding proposed regional general condition (RGC) 4 (Commencement Bay)[104] to include those HUC-12 watersheds draining into the Salish Sea and its tributaries, Grays Harbor, and the Chehalis basin where impervious cover is 5% or greater.[105]

We note that proposed RGC 4 does not include NWP 3 (repairs). As discussed previously in these comments, repairs, maintenance, and replacement can and do prolong, if not re-inflict, the impacts associated with the original action. As discussed previously, in many cases, there are opportunities to lessen, if not eliminate, the impacts associated with the original action, if the appropriate opportunities and incentives were provided. Due to the already extensive amount of bank armor in marine and freshwater areas of western Washington, requests to repair or replace existing armor are much more numerous than requests to install new armor.

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[99] *See* May, C. Rl Horner, J.r. Karr, B. Mar and E. Welch. 1997. Effects of urbanization on small streams in the Puget Sound ecoregion. Watershed Protection Techniques 2:483-494. *C.f.*, 2012 NWP Biop at 270 (NMFS cites to May et al. 1997 but fails to note the watershed scale on which analysis and conclusions of May et al. 1997 are based).

[100] *See* Appendix A (Maps of Impervious Cover in HUC-10 watersheds and HUC-12 watersheds in the Boldt case area.

[101] *See* Spromberg, J.A. Baldwin, D.H., Damm, S.E., McIntyre, J.K., Huff, M., Sloan, C.A., Anulacion, B.F., Davis, J.W., and Scholz, N.L. Coho salmon spawner mortality in western US urban watersheds: bioinfiltration prevents lethal stormwater impacts, Journal of Applied Ecology, 2016, 53, 398-407. For information on the dramatic reduction in returning coho this year, *see* Pacific Fishery Management Council. 2016. *Preseason Report I: Stock Abundance Analysis and Environmental Assessment Part 1 for 2016 Ocean Salmon Fishery Regulations.* (Document prepared for the Council and its advisory entities.) Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 101, Portland, Oregon 97220-1384 at pages 58-59.

[102] *See* Appendix A. HUC-12 watersheds have an average area of 33 square miles. While still larger than the watersheds assessed by May et al. 1997, the HUC-12 watershed is the finest level of detail currently in use in western Washington by the federal watershed (HUC) designation system. Use of the HUC-12 will be more consistent with the science and will avoid diluting impervious cover impacts as much as using HUC-10 watersheds would.

[103] This recommendation is supported by the analysis in May et al. 1997. In addition to better protecting coho, it will better protect other salmon species.

[104] This RGC provides that the following NWPs may not be used to authorize activities located in the mapped Commencement Bay area: NWPs 12 utility line activities); NWP 13 (bank stabilization); NWP 14 (linear transportation projects); NWP 23 (approved categorical exclusions); NWP 29 (residential developments); NWP 39 commercial and institutional developments); NWP 40 (agricultural activities); NWP 41 (reshaping drainage ditches); NWP 42 (recreational facilities); and NWP 43 (stormwater and wastewater management facilities).

[105] *See* Appendix A (maps of impervious cover in HUC-12 watersheds along with table of HUC-12 watersheds).

The real opportunities to protect salmon habitat and to begin to provide the productivity that salmon will need to survive and eventually meet the tribes' treaty-reserved rights will come from ameliorating many of these past impacts. At a minimum, re-infliction and aggravation of past harms through maintenance projects that are not carefully designed to minimize fisheries projects must be avoided.

All applicants for NWP 3 projects within the Boldt case area should be required to submit a preconstruction notification (PCN) containing all the information required by general condition (GC) 32 (preconstruction notification) and RGC 1 (preconstruction notification) along with an estimate of how long the proposed repair will prolong the life of the structure or project, date and description of previous repairs or replacements, and evidence that the applicant has communicated with the affected tribe(s) and the WA Dept. of Fish and Wildlife regarding whether the repair or replacement is occurring in an area proposed for modification under a salmon habitat improvement plan.

**Stormwater Impacts**

Storm water is the runoff generated when precipitation from rain and snowmelt events flows over land or impervious surfaces without percolating into the ground. Storm water is often considered a nuisance because it mobilizes pollutants such as motor oil and trash and often flows directly to water bodies and is thus a major source of pollution to rivers, lakes, and seas. NWP 43 addresses permitting of stormwater management facilities, including associated detention and retention basins, low impact development bio-retention facilities, vegetative filter strips, grass swales, etc. Stormwater is a source of significant impacts to salmon. As noted in the NFIP Biop:

> Recent occurrences of pre-spawn mortality (PSM) in coho salmon have heightened our concern with stormwater quality....adult coho salmon, which enter small urban streams following fall storm events, are acutely sensitive to non-point source stormwater runoff containing pollutants that typically originate from urban and residential land use activities....a growing body of science...suggests it is likely that other salmonids, including listed salmonids, experience sub-lethal impacts from pollutants found in stormwater.[106]

Subsequent research has been done exposing healthy coho spawners to undiluted highway runoff. One study found that untreated highway runoff collected during nine different storm events was lethal to coho salmon relative to unexposed controls.[107] The authors noted further that wild coho populations cannot continue to sustain the high rates of morality that are now

[106] FEMA NFIP Biop at 98. *See also id.* at 98-99 (floodplain development increases pollution loading from stormwater and stormwater pollution contaminates sediments affecting salmonids).

[107] *See* Spromberg, J.A. Baldwin, D.H., Damm, S.E., McIntyre, J.K., Huff, M., Sloan, C.A., Anulacion, B.F., Davis, J.W., and Scholz, N.L. Coho salmon spawner mortality in western US urban watersheds: bioinfiltration prevents lethal stormwater impacts, Journal of Applied Ecology, 2016, 53, 398-407.

occurring in urban spawning habitats.[108] By definition, these are significant impacts. A morsel of good news is that these impacts can be alleviated by treating stormwater via soil infiltration prior to discharge into streams.[109] NWP 43 permitting needs to require treatment of stormwater via soil infiltration as a permit condition.

**Recommended changes to RGCs**

In addition to any changes recommended in our comments above, we also recommend the following changes to the Seattle District's proposed regional general conditions and regional specific conditions.

1) Preconstruction Notification (PCNs) – To better protect treaty rights, PCNs should be required for all projects that occur within the Boldt case area. Along with the information already required, PCNs should require information regarding how long the proposed project is expected to last. If the project is a repair or replacement, the applicant should provide proof that the project had been permitted previously, along with date and description of previous repairs or replacements, and evidence that the applicant has communicated with the affected tribe(s) and the WA Dept. of Fish and Wildlife regarding whether the proposed project, or repair or replacement, is occurring in an area proposed for modification under a salmon habitat improvement plan. Additionally, with respect to mitigation, if not all impacts of the proposed action are avoided, then a compensatory mitigation plan should be provided. Mitigation for temporal impacts is important. Also, there is no such thing as a repair or replacement that is zero impact. A repair or replacement prolongs the impacts of the original project and must be mitigated.

2) Aquatic Resources Requiring Special Protection – It is inconsistent with the Seattle District's obligation to protect these aquatic resources to authorize impacts via NWP 3.

3) New Bank Stabilization in Tidal Waters of the Salish Sea – As discussed above, the Commission supports the Seattle District's decision to not authorize bank stabilization by NWP in tidal waters. Also, for the reasons discussed above, we do not support the District's decision to allow repair or replacement of shoreline armor via NWP because streamlined permitting should not be used to re-inflict harm on nearshore resources that have already suffered very significant cumulative impacts from the Corps' NWP program. In addition, new bank stabilization activities in freshwater tributaries of the Salish Sea should not be authorized by NWP. More than minimal cumulative impacts have already occurred.

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[108] *Id.*
[109] *Id.*

4) Commencement Bay – As discussed above, we recommend expanding proposed regional general condition (RGC) 4 (Commencement Bay) to include those HUC-12 watersheds draining into the Salish Sea and its tributaries, Grays Harbor, and the Chehalis basin where impervious cover is 5% or greater.[110]

5) Bank Stabilization – As discussed above, this RGC should not apply anywhere in the Salish Sea or its freshwater tributaries. To the extent that it is used in tributaries along the Washington coast, it needs to be used carefully. For example, although one might think that the Hoh River has been largely untouched by bank stabilization, channel migration has been significantly constrained. As it stands now, 10% of the lower 37 miles of the Hoh have been armored.[111] We note that this proposed RGC has removed the need for repair or replacement bank stabilization projects to provide information justifying the need for repair along with other important site, design, and habitat condition parameters. This is a major step backwards and cannot be reconciled with current fish habitat conditions and the impacts that the Corps' bank stabilization permitting has caused.

6) Crossings of Waters of the United States – The Commission emphasizes that the Ninth Circuit has recently affirmed the District Court's delineation of clear standards for crossings of the waters of the United States. Accordingly, the Corps is duty-bound to require that project proponents adhere to the standards enunciated in *United States v. Washington*, 20 F. Supp. 3d 986 (2013), and associated orders. Our proposed language for water-crossings will be submitted by the Muckleshoot Tribe via separate letter.

7) Stream Loss – We agree that no activity should result in the loss of perennial stream beds. With respect to ephemeral and intermittent streams, given their influence on downstream water quality and channel conditions, it does not appear that any further loss of these channels is justified, unless it is part of a restoration project.

8) Mitigation – PCNs should be required for any wetland loss. The Corps' no net loss policy has not worked as promised. Allowing 1000 square feet of loss before even having to provide a PCN is not a recipe for achieving no net loss. While the Corps may argue that the Clean Water Act allows it to use streamlined permitting for activities that only have minimal impacts, that is true only so long as those impacts don't cumulatively amount to significant impacts. As discussed above, Corps permitting has resulted in cumulatively significant impacts. Further losses must be mitigated. As discussed in the NWIFC's comments to the Corps of Engineers regarding the proposed 2017 NWPs, the best available data indicates that the mitigation required by the Corps has not been sufficient to compensate for the impacts allowed.[112] As summarized by NMFS:

[110] *See* Appendix A (maps of impervious cover in HUC-12 watersheds along with table of HUC-12 watersheds).
[111] *See* 2016 State of the Watersheds at 36 (Hoh River riprap).
[112] *See* NWIFC Comments to Corps HQ regarding Proposal to Reissue NWPs (August 1, 2016) at 9-10.

> Based on the data available, there has historically been a relatively low rate of compliance with the requirement to provide compensatory mitigation and only a small percentage of compensatory mitigation projects replaced the hydrologic, chemical and ecological functions of the wetlands they were designed to replace.[113]

Given its poor track record, the Corps cannot justify continuing to use one-to-one mitigation ratios or its paltry level of project review (5% of all NWP verifications within the most recent fiscal year; 5% of active permittee-responsible mitigation sites each fiscal year).[114] The Corps' mitigation program cries out for review and the tribes would like to be involved.

**Comments Regarding Specific Regional Conditions**

In addition to any changes recommended in our comments above, we also request that you consider the following comments regarding the Seattle District's proposed specific regional conditions:

3) Maintenance – PCNs should be required for all maintenance projects occurring within the Boldt case area. As discussed above, many maintenance projects serve to prolong adverse impacts that instead could be remediated. PCNs are necessary to assure that both the applicant and the Corps (and affected tribes) have the opportunity to look at projects to see if modifications are feasible that better support protection and recovery of salmon. Maintenance and minor repairs of bank stabilization projects (no more than 20% of the structure is being worked on and no change in the structure footprint) that use rock, riprap, or some other form of hard armor need to provide PCNs and include all the information called for in Regional General Condition 5 (bank stabilization). Rehabilitation and replacement projects that call for replacing hard armor with more hard armor need to go through individual permitting, not streamlined permitting. As discussed above, there are a large number of shoreline landowners with armored banks located in areas with low to moderate erosion potential.[115] The Corps should explore how it could use a NWP to streamline permitting for landowners who are willing to remove bank armor and use "softer" approaches.[116]

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[113] *Id.* at 9, quoting 2012 NWP Biop at 282.

[114] *Id.* at 9, citing 2012 NWP Biop at 349.

[115] *See* Shore Friendly Final Report (2014) at 11 (discussing Category 2 landowners), report prepared for the Washington Departments of Fish and Wildlife and Natural Resources, by Colehour + Cohen, Applied Research Northwest, Social Marketing Services, Futurewise and Coastal Geologic Services.

[116] By "softer" approaches, we mean using the Marine Shoreline Design Guidelines (for inland marine areas): Johannessen, J., A. MacLennan, A. Blue, J. Waggoner, S. Williams, W. Gerstel, R. Barnard, R. Carman, and H. Shipman, 2014. Marine Shoreline Design Guidelines. Washington Department of Fish and Wildlife, Olympia, Washington. For freshwater areas, we recommend using and the Integrated Streambank Protection Guidelines: Cramer, M., K. Bates, D. Miller, K. Boyd, L. Fotherby, P. Skidmore, and T. Hoitsma. 2003. *Integrated Streambank Protection Guidelines*. Co-published by the Washington departments of Fish & Wildlife, Ecology, and Transportation. Olympia, Washington. 435 pp.

10) Mooring Buoys – The Seattle District should require permittees to have an individual permit to install mooring buoys in the Boldt case area. These should not be approved without the consent of any affected tribe. The individual permit allows for the use of the alternatives analysis process, which looks at a suite of alternatives if the applicant has docks, marinas, or other options nearby. Should individual permits not be mandatory, we strongly support the Seattle District requiring PCNs and requiring all permit applicants to provide inventory information, including photographs, regarding the number of mooring buoys within the local area. The size of the area to be examined for existing mooring buoys will depend upon the unique circumstances of the area where the applicant seeks to place a mooring buoy. Management of mooring buoys is more complicated than it sounds. For example, the 2010 Mystery Bay Management Plan in Mystery Bay resulted in failed management and improper regulation of mooring buoys. This failure resulted in the closure of shellfish beds for which the S'Klallam tribes possess treaty reserved rights to fish.[117] According to the National Shellfish Sanitation Program, there are strict sanitation standards for areas where shellfish are grown. The NSSP definition of a marina is any water area with a structure (docks, basin, floating docks, etc.) which is used for docking or otherwise mooring vessels; and is constructed to provide temporary or permanent docking space for more than ten boats. The FDA has stated, "any area which has buoy moorage for at least 10 boats is also considered a marina" under their marina definition.[118] When an area surpasses the marina threshold, the surrounding waters cannot be considered safe for shellfish harvesting. In interpreting the National Shellfish Sanitation Program (NSSP) guide marina definition the DOH uses the one boat per acre as a screening tool to count boats toward the marina threshold. The density threshold may need to be decreased in water bodies that have poor dilution characteristics (like a shallow enclosed embayment).[119] In sum, the Corps should include sideboards so that these thresholds cannot be reached for areas not already identified by the WA Dept. of Health.

Obviously, NWP 10 should not be used in WDOH areas that are already closed. Additionally, NWP 10 must not be used to put additional areas at risk. We recommend that all permit applicants adhere to the following conditions:

A) There must an inventory and map of all buoys and docks within the waterway.
B) The proposed mooring buoy must be situated such that there is no more than one buoy per acre.

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[117] State of Washington Governor's Office for Regulatory Innovation and Assistance (2010). Mystery Bay Management Plan (2010) at 1 (accessed August 11, 2016 at: http://www.oria.wa.gov/Portals/_oria/VersionedDocuments/Mystery_Bay_Documents/Mystery_Bay_Management_Plan.pdf).
[118] *Id.* at 1.
[119] *Id.*

C) NWP may not be used to authorize a buoy in a waterway where there are nine or more existing buoys or docks.
D) Due to the site-specific issues with locating mooring buoys, it is difficult to identify a blanket rule for buoy location that will ensure no interference with the various treaty fisheries that may occur. This underscores the necessity of consulting with affected tribes regarding buoy location. Tribal consent must be obtained prior to the installation of any buoy.
E) Should any new buoy installed not meet all of the above conditions, the buoy should be removed at the owner's expense.

13) Bank Stabilization – As discussed in these comments, we support revocation of this permit for use in both tidal waters of the Salish Sea AND in freshwaters draining into the Salish Sea.

14) Linear Transportation Projects – PCNs should be submitted for all such projects whether in fresh water or tidal waters.

19) Minor Dredging – Too often, minor dredging is used as a substitute for good land and bank management. As noted in 2016 State of Our Watersheds, the rivers draining into the Salish Sea have already suffered from extensive impacts.[120] Dredging of pool/riffle complexes, salmonid spawning or rearing habitat, and vegetated shallows should be subject to individual permitting.

29) Residential Developments -- We support the proposed specific condition with the caveat that NWP 29 only be available for use in HUC-12 watersheds where impervious cover is less than 5%.

31) Maintenance of Existing Flood Control Facilities -- We recommend that the Seattle District revoke NWP 39 in the following watersheds: Dungeness, Morse Creek, Green, Cedar, White, Puyallup, Sammamish, Nooksack, Skagit, Stillaguamish, and Snohomish rivers and Issaquah Creek.[121] Individual permitting of maintenance plans for flood control facilities would provide a means by affected tribes and flood control entities could better reach agreements about how such facilities could be managed to better protect fish habitat.

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[120] *See e.g.*, 2016 State of Our Watersheds at 170 (Puyallup); 209 (Sauk-Suiattle); 291 (Swinomish).

[121] For information regarding impacts of levee systems on salmon habitat, see 2016 State of Our Watersheds at 47 (Dungeness); 68-69 (Morse Creek floodplain impairment); 101-102, 104, 109, (Green); *see also id.* at 113 (map of modified banks along Cedar, White, Green Puyallup, Sammamish rivers, and Issaquah Creek); *id.* at 164-165, 167, 169 (Puyallup, including map of Puyallup basin levees); 140 (need to restore Nooksack River channel migration zone); 209 (map of Skagit levees); 260, 263-264 (documenting disconnection of Stillaguamish floodplain and estuary by dikes, levees, and bank armor); 288 (55% of Skagit County shorelines already armored – potential to have 83% of Skagit County shorelines armored under full build out of current zoning); 291 (map of lower Skagit River basin levees and armor); 301 (loss of Snohomish estuarine and side-channel habitat); 320-321, 327 (Skagit floodplain disconnection and stream blockages).

39) Commercial and Institutional Developments -- We support the proposed specific condition with the caveat that NWP 39 only be available for use in HUC-12 watersheds where impervious cover is less than 5%.

43) Stormwater Management Facilities -- We support the proposed specific condition with the caveat that NWP 43 only be available for use in HUC-12 watersheds where impervious cover is less than 5%. This condition should also be modified to include a requirement that stormwater be treated so that it is no longer lethal to coho and other salmonids.[122]

44) Mining Activities – The Seattle District should revoke this permit. Mining activities harm fish in watersheds like the Nooksack.

52) Water-based Renewable Energy Generation Pilot Projects – The Commission submitted comments to the Corps regarding this NWP on August 1, 2016. Those comments apply here, as well and we incorporate them by reference.

Proposed NWP B Living Shorelines – We support the Seattle District's proposal to revoke this permit for use in the Salish Sea. We also believe that this proposed permit is inappropriate for use on the Washington coast and in freshwater habitats in the Seattle District, as well. The comments submitted by the Commission to the Corps on August 1, 2016 also apply here.

**Conclusion**

Thank you again for this opportunity to provide comments. We think that an appropriate next step would be a meeting between Corps of Engineers staff and concerned tribal staff (and NWIFC staff) to clarify and explore avenues for addressing these comments.

Sincerely,

Justin R. Parker

Justin Parker
Executive Director

cc: NWIFC Commissioners

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[122] We note that the Corps has authority to condition general permits to require treatment of stormwater. *See e.g., Sierra Club v. Corps of Engineers*, 508 F.3d 1332, 1336 (11th Cir. 2007). *See also* Spromberg, J.A. Baldwin, D.H., Damm, S.E., McIntyre, J.K., Huff, M., Sloan, C.A., Anulacion, B.F., Davis, J.W., and Scholz, N.L. Coho salmon spawner mortality in western US urban watersheds: bioinfiltration prevents lethal stormwater impacts, Journal of Applied Ecology, 2016, 53, 398-407 (feasibility of treatment to protect coho).

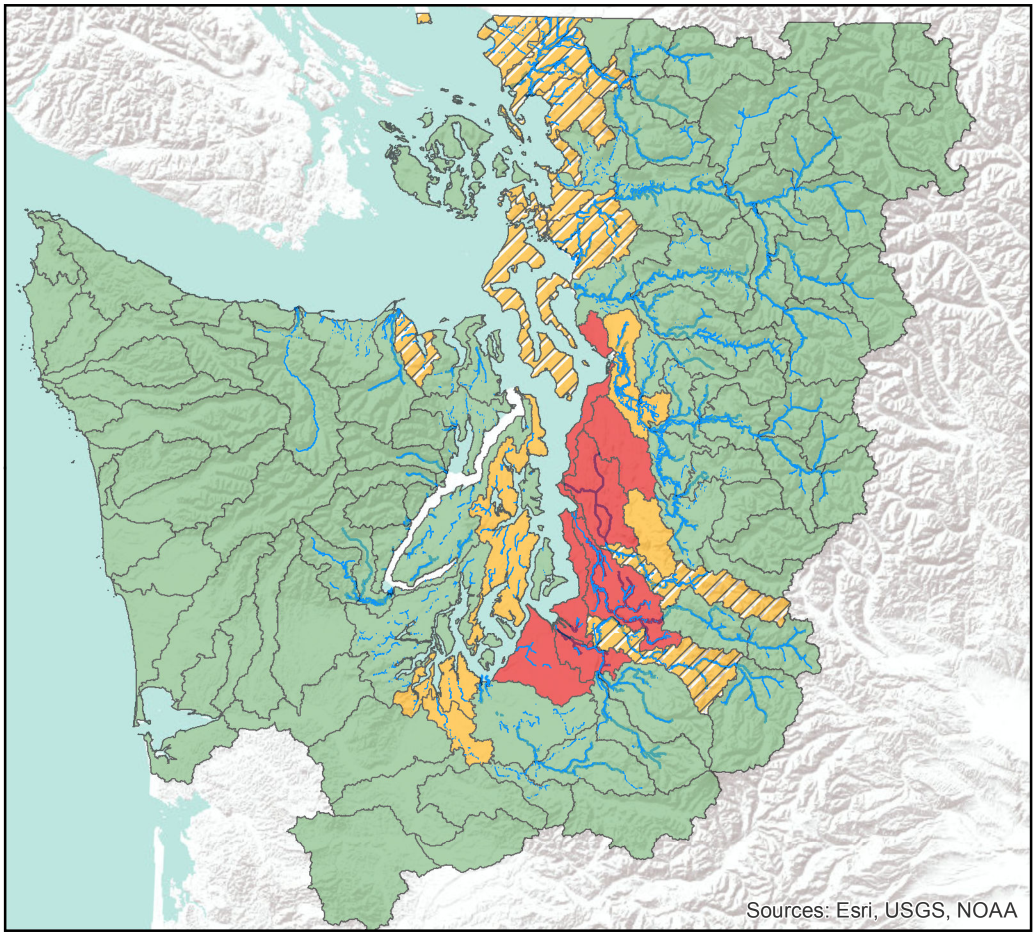
# 10-field HUC (HUC-10) watersheds contributing to NOAA Fisheries Critical Fish Habitat for ESA listed species in the Case Area

**NOAA Fisheries**
**ESA Critical Fish Habitat**

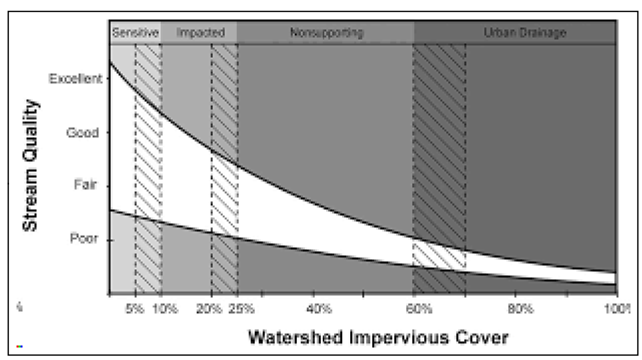
**The Reformulated Impervious Cover Model**

**Percent Impervious Cover 2011**

- 0 to 5% (Sensitive)
- 5 to 10% (Transition to Impacted)
- 10 to 20% (Impacted)
- 20 to 25% (Transition to Nonsupporting)
- 25 to 60% (Nonsupporting)
- 60 to 70% (Transition to Urban Drainages)
- 70 to 100% (Urban Drainages)



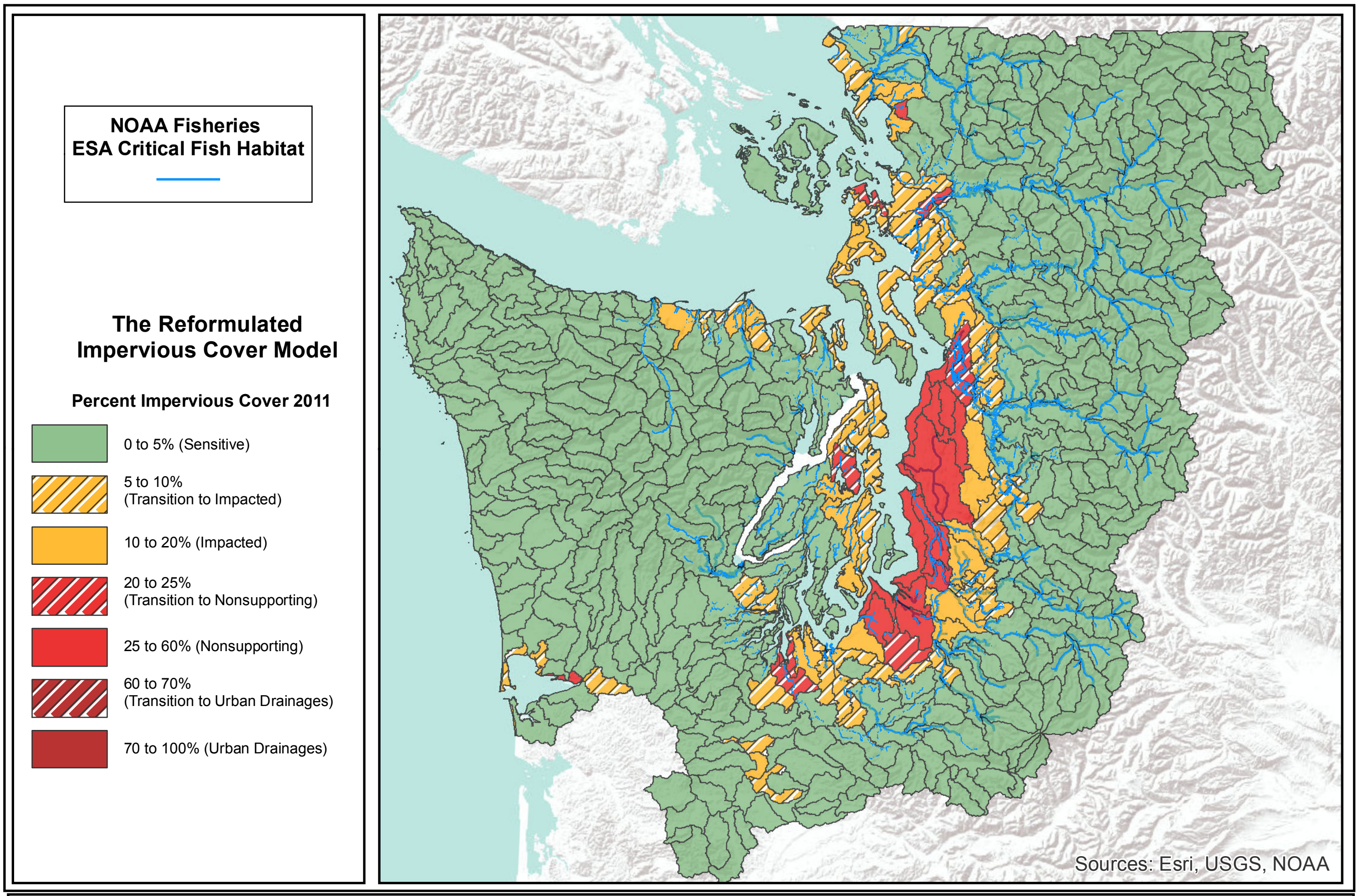

## Description of the Reformulated Impervious Cover Model



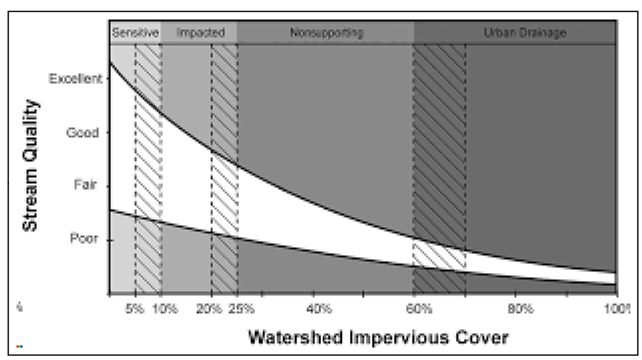

The Impervious Cover Model (ICM) was created by the Center for Watershed Protection as a rapid watershed planning tool, and is based on the premise that the quality of urban streams can be predicated on the basis of percent impervious surface in their contributing watershed (Scheuler 1994; CWP 1998; Scheuler Et al. 2009). In 2009, a meta-analysis of 65 new research studies using the ICM was performed, and results found 69% of peer reviewed papers generally support the original ICM, and revealed ways to improve or reformulate the ICM (Scheuler Et al. 2009).

The Reformulated ICM has three key components, first, the impervious cover (IC)/ stream quality relationship is expressed as a "cone" that is widest as low levels of IC and that narrows at high levels of IC. Second, the cone is widest for watershed IC less than 10%, this illustrates the area of greatest variability in stream conditions related to IC, and it also shows that streams with watershed IC less than 10% are not necessarily in "excellent" or "good" condition, any amount of IC can have an impact on stream quality. Lastly, transitions happen through bands representing a range of IC values, instead of at fixed threshold lines representing a single IC value. This better reflects the variability of watershed IC impacts to streams (Schueler Et al. 2009). The Reformulated ICM is used by the NOAA Coastal Change Analysis Program (CCAP) to characterize and symbolize impervious surface cover for unique watersheds (https://coast.noaa.gov/data/digitalcoast/pdf/water-quality-indicator.pdf).

# 12-field HUC (HUC-12) watersheds contributing to NOAA Fisheries Critical Fish Habitat for ESA listed species in the Case Area




## Description of the Reformulated Impervious Cover Model

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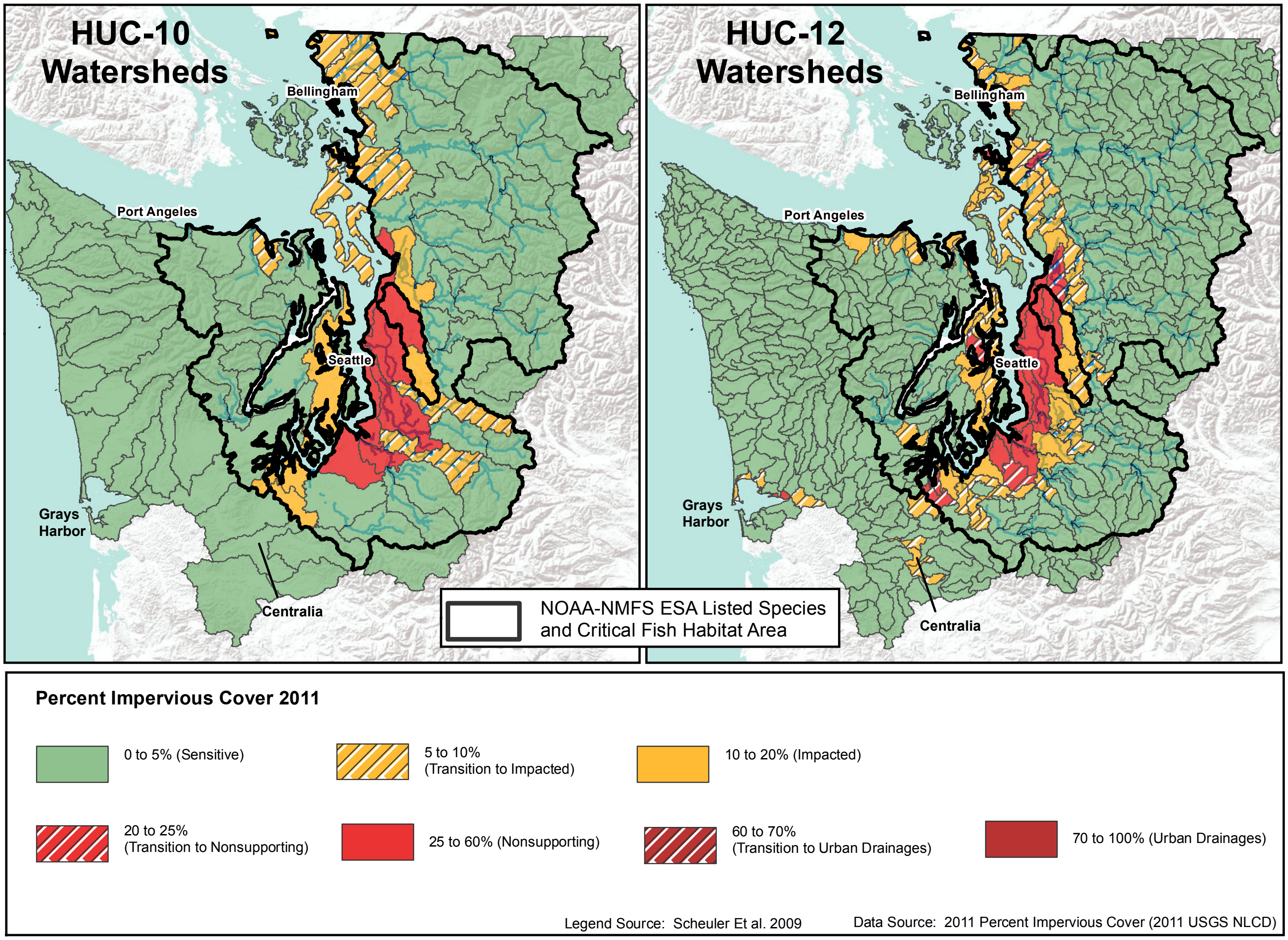
The Reformulated ICM has three key components, first, the impervious cover (IC)/ stream quality relationship is expressed as a "cone" that is widest as low levels of IC and that narrows at high levels of IC. Second, the cone is widest for watershed IC less than 10%, this illustrates the area of greatest variability in stream conditions related to IC, and it also shows that streams with watershed IC less than 10% are not necessarily in "excellent" or "good" condition, any amount of IC can have an impact on stream quality. Lastly, transitions happen through bands representing a range of IC values, instead of at fixed threshold lines representing a single IC value. This better reflects the variability of watershed IC impacts to streams (Schueler Et al. 2009). The Reformulated ICM is used by the NOAA Coastal Change Analysis Program (CCAP) to characterize and symbolize impervious surface cover for unique watersheds (https://coast.noaa.gov/data/digitalcoast/pdf/water-quality-indicator.pdf).

# Assessing the accumulated impacts of impervious cover: 10th-field HUC (HUC-10) watersheds v. 12th-field HUC (HUC-12) watersheds

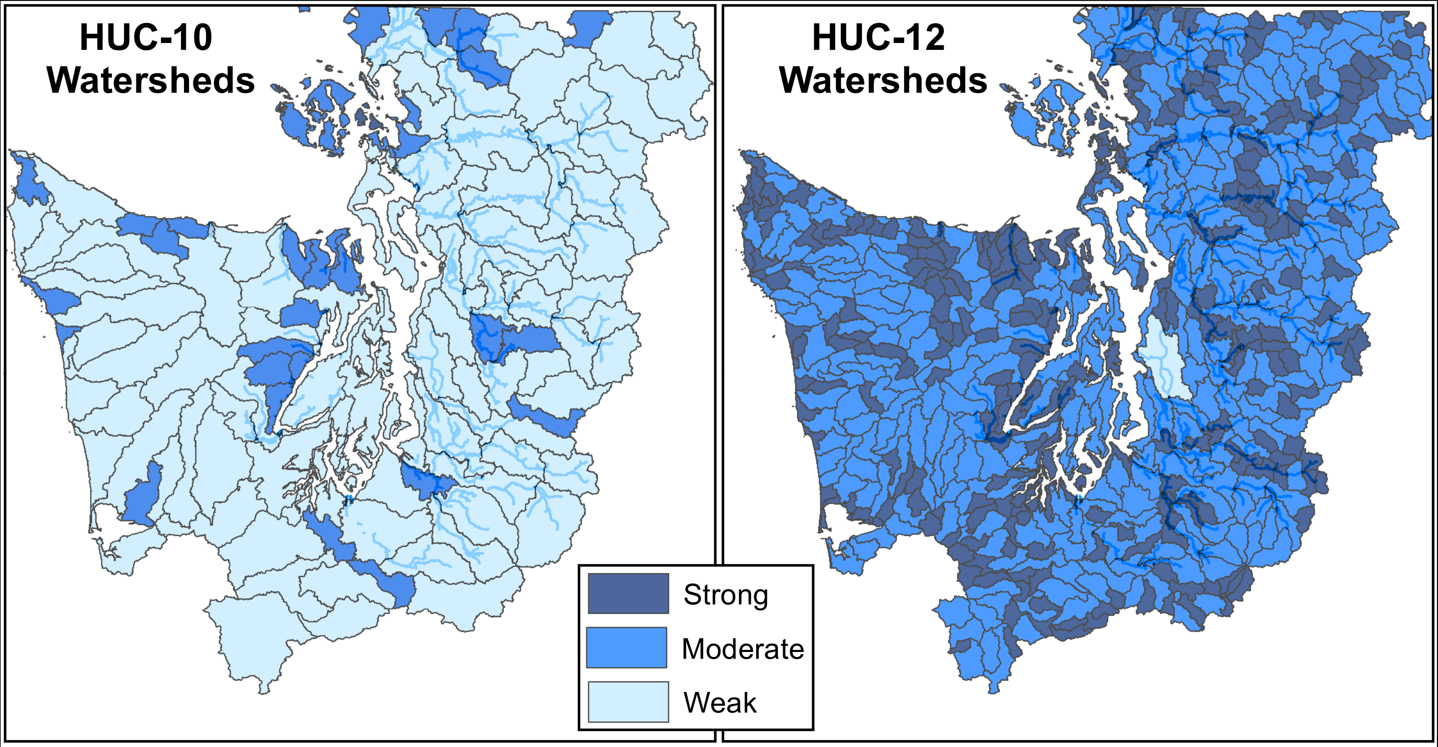



There are 115 HUC-10 watersheds in the case area and nested within those are 561 HUC-12 watersheds. The mean average area for a case area HUC-10 watershed is 161 Square Miles, and the mean average area for a case area HUC-12 watershed is 33 Square Miles. The greatest present impacts from impervious cover extend from the coastline of the Puget Sound, the eastside of the Hood Canal north to the Strait of Juan de Fuca, around the north of Grays Harbor, and along I-5 around Chehalis. Because of larger average area of the HUC-10 watersheds when compared to the HUC-12 watersheds, the impervious cover impacts around Grays Harbor and Chehalis along I-5 are muted. It is at the HUC-12 scale that those present impacts are evident.

As part of the 2012 NOAA-NMFS Biologic Opinion of the US Army Corps of Engineers (Corps) Nationwid Permit, if Corps Natiowide permitted activities result an increase of 1% or more impervious cover from the baseline impervious cover within a HUC-10 waterhseds that have listed species and Critical Fish Habitat, the Corps will consider that information (with other pertinent information) when making its ESA Section 7 effect determinations. Within the case area, 70 HUC-10 watersheds and 324 HUC-12 watersheds have listed species and critical fish habitat.

Using the 70 HUC-10 watersheds to determine impervious cover accumulation beyond baseline conditions, a mean average of 0.056 Square Miles of impervious cover per watershed would have to be added at the HUC-10 watershed scale before that information needed to be considered in its ESA Section 7 effect dertimination. If the Corps were to use the 324 HUC-12 watersheds to determine impervious cover accumulation beyond baseline condition, a mean average of 0.016 Square Miles of impervious cover would have to be added at the HUC-12 watershed scale before that information needed to be considered in its ESA Section 7 effects dertimination.

# Watershed Size and the Relative Influence of Impervious Cover Comparing HUC-10 to HUC-12 Watersheds within the Case Area




HUC-10 Watersheds within the Case Area

The mean average HUC-10 watershed is 161 Square Miles. Impervious cover has a relatively "weak" influence on watershed condition at that scale.

1 of 115 HUC-10 watersheds in the Case Area are within the "sub-watershed" scale between 0.5 and30 Square Miles. Impervious cover has a relatively "strong" influence on watershed condition at that scale.

27 of 115 HUC-10 watersheds in the Case Area are within the "watershed" scale between 30 and100 Square Miles. Impervious cover has a relatively "moderate" influence on watershed condition at that scale.

87 of 115 HUC-10 watersheds in the Case Area are within the "sub-basin" scale between 100 and1,000 Square Miles. Impervious cover has a relatively "weak" influence on watershed condition at that scale.

HUC-12 Watersheds within the Case Area

The mean average HUC-12 watershed is 33 Square Miles. Impervious cover has a relatively "moderate" influence on watershed condition at that scale.

258 of 561 HUC-12 watersheds in the Case Area are within the "sub-watershed" scale between 0.5 and 30 Square Miles. Impervious cover has a relatively "strong" influence on watershed condition at that scale.

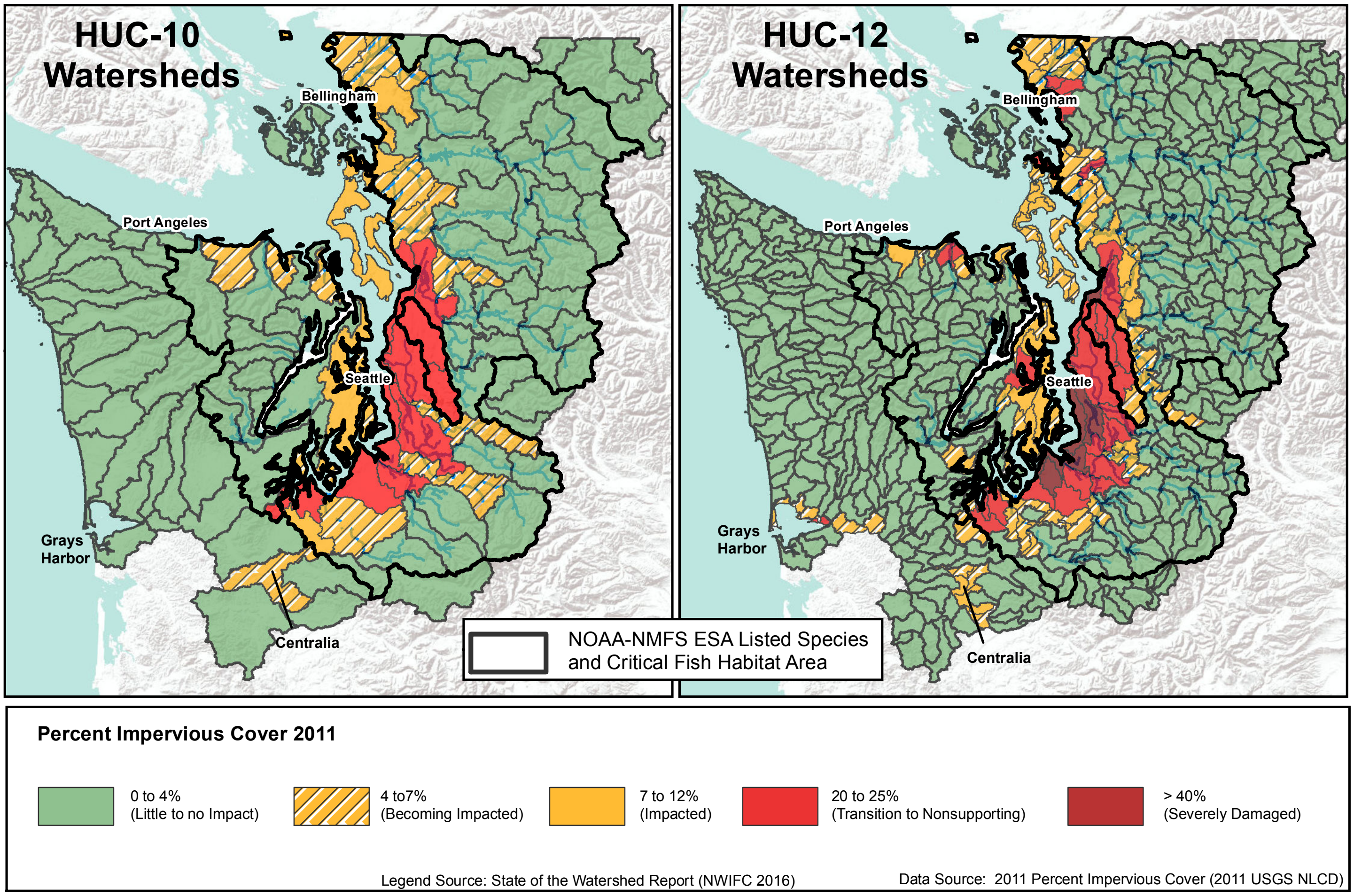
302 of 561 HUC-12 watersheds in the Case Area are within the "sub-basin" scale between 30 and 100 Square Miles. Impervious cover has a relatively "moderate" influence on watershed condition at that scale.

1 of 561 HUC-12 watersheds in the Case Area are within the "watershed" scale between 100 and 1,000 Square Miles. Impervious cover has a relatively "weak" influence on watershed condition at that scale.

| Watershed Management Unit | Typical Area of Feature ($mi^2$) | Relative Influence of Impervious Cover | Sample Management Measure |
|---|---|---|---|
| Catchment | 0.05 – 0.5 | Very strong | Stormwater management and site design |
| Subwatershed | 0.5 – 30 | Strong | Stream classification and management |
| Watershed | 30 – 100 | Moderate | Watershed based zoning |
| Sub-Basin | 100 – 1,000 | Weak | Basin planning |
| Basin | 1,000 – 10,000 | Very Weak | Basin planning |

Table Source: Zielinski 2002, Coleman Et al. 2005

# 2016 State of the Watershed Report categories for assessing the accumulated impacts of impervious cover: 10th-field HUC (HUC-10) watersheds v. 12th-field HUC (HUC-12) watersheds




The State of the Watershed (SOW) Report's use of 7 to 12% impervious surface as “impacted” originated with the impervious indicator for the Tulalip Tribes chapter in the 2012 State of the Watershed report. While developing that indicator SSHIAP reviewed the Snohomish River Salmon Conservation Plan (Snohomish Basin Salmon Recovery Forum 2005).

The Recovery Plan to that number based on a review of The ManTech Report: An Ecosystem Approach to Salmonid Conservation ( Spence et al. 1996) That document was fully funded by NOAA Fisheries and appears to be a foundation document used in NOAA –NMFS West Coast Region Salmon Recovery planning to set habitat targets for recovery. In that document a range of impervious surface impacts to aquatic habitat were reviewed. Based on the review of impacts, 7 to 12% total impervious area of a watershed was shown to impact aquatic habitat.

Finally, for the State of the Watershed report we show a range of conditions for impervious surface in an attempt to reflect a progressive pattern of decline, and not simply a single measure of imperviousness where things go from “no impact” to “degraded”. This is a point made in Booth Et al. 2002.

By creating separate categories for impervious surface we are attempting to illustrate the point made by Booth et al. 2002 The categories preceding "Impacted (7-12%)" and the categories following "Impacted" are to illustrate the progressive decline of aquatic health with the increase in watershed impervious cover.

Table 1. Case area HUC-10 watersheds that exceed 5% impervious cover based on 2011 NLCD layer.

| HUC-10 Watersheds by WRIA (centroid inside of WRIA boundaries) | ESA Critical Fish Habitat | Watershed Area (SqMi) | Watershed Percent Impervious Cover (IC) | Watershed IC (SqMi) | Additional watershed IC that would be equivalent to a 1% increase |
|---|---|---|---|---|---|
| *WRIA 1* | | *428.93* | *7.11%* | *28.55* | *0.29* |
| California Creek-Frontal Semiahmoo Bay | Yes | 94.37 | 6.84% | 6.46 | 0.06 |
| Nooksack River-Frontal Bellingham Bay | Yes | 214.99 | 5.00% | 10.76 | 0.11 |
| Whatcom Creek-Frontal Bellingham Bay | Yes | 119.56 | 9.48% | 11.33 | 0.11 |
| *WRIA 3* | | *265.97* | *7.18%* | *18.47* | *0.18* |
| Skagit River-Frontal Skagit Bay | Yes | 176.96 | 6.47% | 11.44 | 0.11 |
| Telegraph Slough-Frontal Padilla Bay | Yes | 89.01 | 7.90% | 7.03 | 0.07 |
| *WRIA 6* | | *236.25* | *7.27%* | *17.16* | *0.17* |
| Whidbey Island | No | 236.25 | 7.27% | 17.16 | 0.17 |
| *WRIA 7* | | *154.54* | *16.11%* | *24.90* | *0.25* |
| Quilceda Creek-Frontal Possession Sound | Yes | 154.54 | 16.11% | 24.90 | 0.25 |
| *WRIA 8* | | *606.89* | *18.87%* | *115.95* | *1.16* |
| Lake Sammamish | No | 100.91 | 12.08% | 12.19 | 0.12 |
| Middle Sammamish River | No | 141.63 | 26.28% | 37.23 | 0.37 |
| Cedar River | Yes | 186.28 | 5.03% | 9.38 | 0.09 |
| Lower Sammamish River | Yes | 178.06 | 32.10% | 57.16 | 0.57 |
| *WRIA 9* | | *385.34* | *29.86%* | *113.21* | *1.13* |
| Lower Green River | Yes | 212.92 | 25.32% | 53.91 | 0.54 |
| Lunds Gulch-Frontal Puget Sound | Yes | 172.42 | 34.39% | 59.30 | 0.59 |
| *WRIA 10* | | *280.59* | *17.04%* | *34.27* | *0.34* |
| Lower Puyallup River | Yes | 76.68 | 27.68% | 21.22 | 0.21 |

| | | | | | |
|---|---|---|---|---|---|
| Lower White River | Yes | 203.91 | 6.40% | 13.05 | 0.13 |
| *WRIA 12* | | *166.03* | *32.03%* | *53.18* | *0.53* |
| Chambers Creek-Frontal Puget Sound | Yes | 166.03 | 32.03% | 53.18 | 0.53 |
| *WRIA 13* | | *188.52* | *12.49%* | *23.70* | *0.24* |
| Lower Deschutes River | Yes | 80.92 | 11.92% | 9.65 | 0.10 |
| McLane Creek-Frontal Puget Sound | Yes | 107.60 | 13.06% | 14.05 | 0.14 |
| *WRIA 15* | | *288.40* | *10.52%* | *30.34* | *0.30* |
| Ollala Valley-Frontal Puget Sound | Yes | 288.40 | 10.52% | 30.34 | 0.30 |
| *WRIA 17* | | *68.05* | *6.68%* | *4.55* | *0.05* |
| Jimmycomelately Creek-Frontal Sequim Bay | Yes | 68.05 | 6.68% | 4.55 | 0.05 |

Table 2. Case Area HUC-10 watersheds that are potentially at risk because they are adjacent to watersheds with impervious cover >= 5%.

| HUC-10 Watersheds by WRIA (centroid inside of WRIA boundaries) | ESA Critical Fish Habitat | Watershed Area (SqMi) | Watershed Percent Impervious Cover (IC) | Watershed IC (SqMi) | Additional watershed IC that would be equivalent to a 1% increase |
|---|---|---|---|---|---|
| *WRIA 1* | | *450.45* | *1.03%* | *3.75* | *0.04* |
| Sumas River | No | 69.24 | 2.45% | 1.70 | 0.02 |
| Lower North Fork Nooksack River | Yes | 95.92 | 0.83% | 0.80 | 0.01 |
| Middle Fork Nooksack River | Yes | 99.51 | 0.33% | 0.32 | 0.00 |
| South Fork Nooksack River | Yes | 185.79 | 0.50% | 0.93 | 0.01 |
| *WRIA 3* | | *138.28* | *1.90%* | *3.31* | *0.03* |
| Lummi Island-Guemes Island | Yes | 22.55 | 1.17% | 0.26 | 0.00 |
| Samish River | Yes | 115.74 | 2.63% | 3.04 | 0.03 |
| *WRIA 4* | | *276.12* | *1.05%* | *2.90* | *0.03* |
| Finney Creek-Skagit River | Yes | 276.12 | 1.05% | 2.90 | 0.03 |

| | | | | | |
|---|---|---|---|---|---|
| *WRIA 5* | | *163.90* | *4.27%* | *7.00* | *0.07* |
| Stillaguamish River-Frontal Port Susan | Yes | 163.90 | 4.27% | 7.00 | 0.07 |
| *WRIA 7* | | *563.74* | *3.32%* | *19.01* | *0.19* |
| South Fork Snoqualmie River | No | 86.53 | 2.88% | 2.49 | 0.02 |
| Lower Snoqualmie River | Yes | 94.13 | 3.60% | 3.39 | 0.03 |
| Pilchuck River | Yes | 137.20 | 4.76% | 6.53 | 0.07 |
| Upper Snoqualmie River | Yes | 141.30 | 2.76% | 3.90 | 0.04 |
| Woods Creek-Skykomish River | Yes | 104.58 | 2.58% | 2.70 | 0.03 |
| *WRIA 9* | | *272.69* | *0.73%* | *1.98* | *0.02* |
| Middle Green River | Yes | 137.40 | 0.86% | 1.18 | 0.01 |
| Upper Green River | Yes | 135.29 | 0.59% | 0.80 | 0.01 |
| *WRIA 10* | | *704.00* | *1.20%* | *7.82* | *0.08* |
| Carbon River | Yes | 228.94 | 1.55% | 3.56 | 0.04 |
| Upper Puyallup River | Yes | 183.08 | 1.60% | 2.93 | 0.03 |
| Upper White River | Yes | 291.98 | 0.45% | 1.33 | 0.01 |
| *WRIA 11* | | *281.78* | *4.68%* | *13.20* | *0.13* |
| Lower Nisqually River-Frontal Puget Sound | Yes | 281.78 | 4.68% | 13.20 | 0.13 |
| *WRIA 13* | | *89.77* | *1.25%* | *1.12* | *0.01* |
| Upper Deschutes River | Yes | 89.77 | 1.25% | 1.12 | 0.01 |
| *WRIA 14* | | *337.49* | *2.41%* | *8.13* | *0.08* |
| Goldsborough Creek-Frontal Puget Sound | Yes | 337.49 | 2.41% | 8.13 | 0.08 |
| *WRIA 15* | | *245.88* | *2.48%* | *6.10* | *0.06* |
| Tahuya River-Frontal Hood Canal | Yes | 245.88 | 2.48% | 6.10 | 0.06 |
| *WRIA 17* | | *81.22* | *2.33%* | *1.90* | *0.02* |
| Snow Creek-Frontal Discovery Bay | Yes | 81.22 | 2.33% | 1.90 | 0.02 |
| *WRIA 18* | | *198.57* | *1.52%* | *3.02* | *0.03* |
| Dungeness River | Yes | 198.57 | 1.52% | 3.02 | 0.03 |
| *WRIA 23* | | *703.39* | *2.36%* | *15.95* | *0.16* |
| Black River-Chehalis River | No | 315.50 | 1.61% | 5.09 | 0.05 |
| Independence Creek-Chehalis River | No | 203.18 | 4.13% | 8.39 | 0.08 |
| Skookumchuck River | No | 184.70 | 1.33% | 2.46 | 0.02 |

Table 3. Case Area HUC-10 watersheds not adjacent to watersheds with impervious cover >= 5%, but that are potentially at risk because they have watershed impervious cover > 4%.

| HUC-10 Watersheds by WRIA (centroid inside of WRIA boundaries) | ESA Critical Fish Habitat | Watershed Area (SqMi) | Watershed Percent Impervious Cover (IC) | Watershed IC (SqMi) | Additional watershed IC that would be equivalent to a 1% increase |
|---|---|---|---|---|---|
| *WRIA 15* | | *104.76* | 4.43% | *4.64* | *0.05* |
| Anderson Island-Hartstene Island | Yes | 104.76 | 4.43% | 4.64 | 0.05 |
| *WRIA 17* | | *80.25* | 4.27% | *3.43* | *0.03* |
| Chimacum Creek-Frontal Port Ludlow | Yes | 80.25 | 4.27% | 3.43 | 0.03 |
| *WRIA 18* | | *161.71* | 4.56% | *7.37* | *0.07* |
| Morse Creek-Frontal Port Angeles Harbor | Yes | 161.71 | 4.56% | 7.37 | 0.07 |

Table 1. Case area HUC-12 watersheds that exceed 5% impervious cover based on 2011 NLCD layer.

| HUC-12 Watersheds by WRIA (centroid inside of WRIA boundaries) | ESA Critical Fish Habitat | Watershed Area (SqMi) | Watershed Percent Impervious Cover (IC) | Watershed IC (SqMi) | Additional watershed IC that would be equivalent to a 1% increase |
|---|---|---|---|---|---|
| *WRIA 1* | | *153.18* | *13.88%* | *18.18* | *0.18* |
| Chuckanut Creek-Frontal Bellingham Bay | Yes | 18.70 | 12.44% | 2.33 | 0.02 |
| Fishtrap Creek | Yes | 15.77 | 9.04% | 1.43 | 0.01 |
| Lower Whatcom Creek | Yes | 8.89 | 30.81% | 2.74 | 0.03 |
| Nooksack River-Frontal Bellingham Bay | Yes | 33.73 | 5.48% | 1.85 | 0.02 |
| Silver Creek | Yes | 15.24 | 12.84% | 1.96 | 0.02 |
| Squalicum Creek-Frontal Bellingham Bay | Yes | 27.96 | 17.27% | 4.83 | 0.05 |
| Terrell Creek-Frontal Birch Bay | Yes | 32.88 | 9.28% | 3.05 | 0.03 |
| *WRIA 3* | | *260.87* | *10.30%* | *21.10* | *0.21* |
| Fidalgo Island-Frontal Padilla Bay | No | 17.13 | 22.05% | 3.78 | 0.04 |
| Fidalgo Island-Frontal Similk Bay | No | 27.44 | 6.85% | 1.88 | 0.02 |
| Joe Leary Slough-Frontal Padilla Bay | Yes | 44.46 | 6.35% | 2.82 | 0.03 |
| Lower Samish River | Yes | 31.30 | 5.04% | 1.58 | 0.02 |
| Nookachamps Creek | Yes | 34.28 | 5.75% | 1.97 | 0.02 |
| Skagit Delta-Frontal Skagit Bay | Yes | 83.26 | 5.10% | 4.24 | 0.04 |
| Skagit River | Yes | 23.00 | 21.00% | 4.83 | 0.05 |
| *WRIA 5* | | *88.03* | *6.63%* | *5.81* | *0.06* |
| Armstrong Creek-Stillaguamish River | Yes | 42.56 | 7.47% | 3.18 | 0.03 |
| Stillaguamish River-Frontal Port Susan | Yes | 45.48 | 5.78% | 2.63 | 0.03 |
| *WRIA 6* | | *138.69* | *9.25%* | *12.21* | *0.12* |
| Camano Island | No | 39.16 | 6.12% | 2.40 | 0.02 |
| Whidbey Island-Frontal Saratoga Passage | No | 60.98 | 9.27% | 5.65 | 0.06 |
| Whidbey Island-Frontal Skagit Bay | No | 20.22 | 10.43% | 2.11 | 0.02 |
| Whidbey Island-Frontal Strait of Juan De Fuca | No | 18.34 | 11.18% | 2.05 | 0.02 |
| *WRIA 7* | | *297.83* | *15.00%* | *39.75* | *0.40* |
| Evans Creek-Snohomish River | Yes | 16.72 | 7.48% | 1.25 | 0.01 |
| French Creek | Yes | 28.63 | 9.96% | 2.85 | 0.03 |

| | | | | | |
|---|---|---|---|---|---|
| Little Pilchuck River | Yes | 33.62 | 9.12% | 3.06 | 0.03 |
| Lower Pilchuck River | Yes | 38.25 | 7.05% | 2.70 | 0.03 |
| Patterson Creek-Snoqualmie River | Yes | 57.69 | 5.24% | 3.02 | 0.03 |
| Powder Mill Gulch-Frontal Possession Sound | Yes | 13.74 | 44.15% | 6.07 | 0.06 |
| Quilceda Creek | Yes | 38.09 | 16.71% | 6.37 | 0.06 |
| Snohomish River-Frontal Possession Sound | Yes | 71.10 | 20.30% | 14.43 | 0.14 |
| *WRIA 8* | | *499.70* | *25.78%* | *130.23* | *1.30* |
| Bear Creek | No | 47.11 | 13.87% | 6.53 | 0.07 |
| Bear Creek-Sammamish River | No | 41.05 | 26.37% | 10.82 | 0.11 |
| Headwaters Sammamish River | No | 56.36 | 6.82% | 3.84 | 0.04 |
| Lake Sammamish-Sammamish River | No | 44.55 | 18.73% | 8.34 | 0.08 |
| North Creek | No | 28.78 | 35.22% | 10.14 | 0.10 |
| Swamp Creek | No | 24.70 | 39.40% | 9.73 | 0.10 |
| Lake Washington-Sammamish River | Yes | 178.06 | 32.10% | 57.16 | 0.57 |
| Madsen Creek-Cedar River | Yes | 38.84 | 19.72% | 7.66 | 0.08 |
| Shell Creek-Frontal Puget Sound | Yes | 40.26 | 39.75% | 16.00 | 0.16 |
| *WRIA 9* | | *265.91* | *26.99%* | *76.06* | *0.76* |
| Big Soos Creek | Yes | 51.19 | 19.87% | 10.17 | 0.10 |
| Green River | Yes | 61.75 | 47.81% | 29.53 | 0.30 |
| Mill Creek-Green River | Yes | 24.38 | 37.87% | 9.23 | 0.09 |
| Miller Creek-Frontal East Passage | Yes | 52.99 | 41.80% | 22.15 | 0.22 |
| Newaukum Creek-Green River | Yes | 54.04 | 5.66% | 3.06 | 0.03 |
| Ravensdale Creek | Yes | 21.56 | 8.90% | 1.92 | 0.02 |
| *WRIA 10* | | *207.69* | *22.94%* | *48.02* | *0.48* |
| Fennel Creek-Puyallup River | Yes | 26.97 | 19.06% | 5.14 | 0.05 |
| Fiske Creek-Puyallup River | Yes | 27.78 | 6.52% | 1.81 | 0.02 |
| Hylebos Creek-Frontal Commencement Bay | Yes | 34.09 | 40.66% | 13.86 | 0.14 |
| Puyallup River | Yes | 49.71 | 32.35% | 16.08 | 0.16 |
| White River | Yes | 69.14 | 16.08% | 11.12 | 0.11 |
| *WRIA 11* | | *153.88* | *6.20%* | *9.60* | *0.10* |
| McAllister Creek | Yes | 30.30 | 6.78% | 2.05 | 0.02 |
| Muck Creek | Yes | 42.18 | 5.87% | 2.48 | 0.02 |
| Nisqually River-Frontal Puget Sound | Yes | 59.61 | 6.40% | 3.81 | 0.04 |
| Yelm Creek | Yes | 21.78 | 5.74% | 1.25 | 0.01 |

| | | | | | |
|---|---|---|---|---|---|
| *WRIA 12* | | *166.03* | *34.53%* | *53.18* | *0.53* |
| Chambers Creek | Yes | 42.33 | 45.17% | 19.12 | 0.19 |
| City of Tacoma-Frontal Commencement Bay | Yes | 22.99 | 48.29% | 11.10 | 0.11 |
| Clover Creek | Yes | 59.87 | 24.80% | 14.85 | 0.15 |
| Sequalitchew Creek-Frontal Cormorant Passage | Yes | 40.85 | 19.86% | 8.11 | 0.08 |
| *WRIA 13* | | *108.37* | *18.18%* | *21.21* | *0.21* |
| City of Beachcrest-Frontal Nisqually Reach | Yes | 10.37 | 9.68% | 1.00 | 0.01 |
| Deschutes River-Capitol Lake | Yes | 38.16 | 22.77% | 8.69 | 0.09 |
| Ellis Creek-Frontal Budd Inlet | Yes | 17.05 | 22.22% | 3.79 | 0.04 |
| Woodland Creek-Frontal Henderson Inlet | Yes | 42.79 | 18.06% | 7.73 | 0.08 |
| *WRIA 14* | | *52.01* | *5.07%* | *2.64* | *0.03* |
| Cranberry Creek-Frontal Oakland Bay | Yes | 52.01 | 5.07% | 2.64 | 0.03 |
| *WRIA 15* | | *320.02* | *10.94%* | *33.13* | *0.33* |
| Bainbridge Island | Yes | 27.30 | 8.05% | 2.20 | 0.02 |
| Barker Creek-Frontal Dyes Inlet | Yes | 35.75 | 21.40% | 7.65 | 0.08 |
| Big Valley-Frontal Puget Sound | Yes | 59.75 | 7.30% | 4.36 | 0.04 |
| Blackjack Creek-Frontal Port Orchard | Yes | 36.53 | 10.65% | 3.89 | 0.04 |
| Burley Creek-Frontal Carr Inlet | Yes | 42.71 | 10.28% | 4.39 | 0.04 |
| Chico Creek-Frontal Sinclair Inlet | Yes | 24.09 | 15.48% | 3.73 | 0.04 |
| Curley Creek-Frontal Colvos Passage | Yes | 51.32 | 8.94% | 4.59 | 0.05 |
| Port Gamble-Frontal Hood Canal | Yes | 42.56 | 5.46% | 2.32 | 0.02 |
| *WRIA 17* | | *69.41* | *6.69%* | *4.68* | *0.05* |
| Beckett Point-Frontal Discovery Bay | Yes | 21.29 | 5.56% | 1.18 | 0.01 |
| Johnson Creek-Frontal Sequim Bay | Yes | 23.24 | 6.98% | 1.62 | 0.02 |
| Marrowstone Island-Frontal Port Townsend | Yes | 24.88 | 7.53% | 1.87 | 0.02 |
| *WRIA 18* | | *98.97* | *12.17%* | *11.57* | *0.12* |
| Bagley Creek-Frontal Strait of Juan De Fuca | Yes | 19.93 | 6.21% | 1.24 | 0.01 |
| Cassalery Creek-Frontal Strait of Juan De Fuca | Yes | 14.18 | 18.46% | 2.62 | 0.03 |
| Ennis Creek-Frontal Port Angeles Harbor | Yes | 43.11 | 11.70% | 5.04 | 0.05 |
| Lower Dungeness River | Yes | 21.76 | 12.30% | 2.68 | 0.03 |
| *WRIA 22* | | *71.93* | *13.81%* | *6.40* | *0.06* |
| Chenois Creek-Frontal North Bay | No | 28.35 | 6.68% | 1.89 | 0.02 |
| City of Grayland-Frontal Pacific Ocean | No | 2.06 | 12.04% | 0.25 | 0.00 |
| Elliot Slough-Chehalis River | No | 33.53 | 5.23% | 1.75 | 0.02 |

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|---|---|---|---|---|---|
| Fry Creek-Frontal Grays Harbor | No | 7.99 | 31.32% | 2.50 | 0.03 |
| *WRIA 23* | | *117.52* | *7.69%* | *8.49* | *0.08* |
| Dillenbaugh Creek-Chehalis River | No | 33.13 | 9.87% | 3.27 | 0.03 |
| Prairie Creek-Chehalis River | No | 20.80 | 5.40% | 1.12 | 0.01 |
| Scammon Creek-Shehalis River | No | 16.13 | 10.39% | 1.68 | 0.02 |
| Upper Black River | No | 47.46 | 5.10% | 2.42 | 0.02 |

Table 2. Case Area HUC-12 watersheds that are potentially at risk because they are adjacent to watersheds with impervious cover >= 5%.

| HUC-12 Watersheds by WRIA (centroid inside of WRIA boundaries) | ESA Critical Fish Habitat | Watershed Area (SqMi) | Watershed Percent Impervious Cover (IC) | Watershed IC (SqMi) | Additional watershed IC that would be equivalent to a 1% increase |
|---|---|---|---|---|---|
| *WRIA 1* | | *306.46* | *3.37%* | *10.40* | *0.10* |
| Johnson Creek | No | 18.82 | 4.72% | 0.89 | 0.01 |
| Anderson Creek-Nooksack River | No | 46.22 | 1.53% | 0.71 | 0.01 |
| Dakota Creek-Frontal Drayton Harbor | Yes | 52.93 | 4.22% | 2.23 | 0.02 |
| Oyster Creek-Frontal Samish Bay | Yes | 27.42 | 1.57% | 0.43 | 0.00 |
| Tenmile Creek | Yes | 35.87 | 4.63% | 1.66 | 0.02 |
| Upper Whatcom Creek | Yes | 57.04 | 2.32% | 1.32 | 0.01 |
| Wiser Lake Creek-Nooksack River | Yes | 68.17 | 4.63% | 3.16 | 0.03 |
| *WRIA 3* | | *169.01* | *1.68%* | *2.72* | *0.03* |
| East Fork Nookachamps Creek | Yes | 36.42 | 1.09% | 0.40 | 0.00 |
| Friday Creek | Yes | 36.91 | 2.38% | 0.88 | 0.01 |
| Hansen Creek | Yes | 72.81 | 1.41% | 1.03 | 0.01 |
| Middle Samish River | Yes | 22.87 | 1.85% | 0.42 | 0.00 |
| *WRIA 5* | | *193.09* | *1.91%* | *3.03* | *0.03* |
| Lower Pilchuck Creek | Yes | 30.50 | 2.94% | 0.90 | 0.01 |
| Lower South Fork Stillaguamish River | Yes | 24.00 | 4.11% | 0.99 | 0.01 |
| Middle South Fork Stillaguamish River | Yes | 47.14 | 0.74% | 0.35 | 0.00 |
| Rock Creek-North Fork Stillaguamish River | Yes | 46.08 | 1.09% | 0.50 | 0.01 |
| Upper Pilchuck Creek | Yes | 45.36 | 0.66% | 0.30 | 0.00 |

| | | | | | |
|---|---|---|---|---|---|
| *WRIA 6* | | *70.12* | *4.25%* | *3.08* | *0.03* |
| Whidbey Island-Frontal Admiralty Inlet | No | 54.32 | 4.50% | 2.44 | 0.02 |
| Whidbey Island-Frontal Possession Sound | No | 15.80 | 4.01% | 0.63 | 0.01 |
| *WRIA 7* | | *474.96* | *2.20%* | *10.91* | *0.11* |
| Lower Middle Fork Snoqualmie River | No | 47.63 | 0.64% | 0.30 | 0.00 |
| Lower South Fork Snoqualmie River | No | 40.90 | 4.46% | 1.82 | 0.02 |
| Tate Creek-North Fork Snoqualmie River | No | 18.55 | 0.97% | 0.18 | 0.00 |
| Elwell Creek-Skykomish River | Yes | 48.20 | 2.24% | 1.08 | 0.01 |
| Griffin Creek | Yes | 17.01 | 0.45% | 0.08 | 0.00 |
| Harris Creek-Snoqualmie River | Yes | 37.23 | 4.59% | 1.71 | 0.02 |
| Raging River | Yes | 34.27 | 0.80% | 0.27 | 0.00 |
| Ricci Creek-Snoqualmie River | Yes | 28.78 | 4.18% | 1.20 | 0.01 |
| Stossel Creek-Tolt River | Yes | 17.02 | 0.74% | 0.13 | 0.00 |
| Tokul Creek | Yes | 32.34 | 1.63% | 0.53 | 0.01 |
| Tulalip Creek-Frontal Possession Sound | Yes | 31.34 | 3.89% | 1.22 | 0.01 |
| Upper Pilchuc River | Yes | 65.33 | 1.17% | 0.77 | 0.01 |
| Woods Creek | Yes | 56.38 | 2.87% | 1.62 | 0.02 |
| *WRIA 8* | | *35.26* | *2.33%* | *0.77* | *0.01* |
| Rock Creek | Yes | 14.56 | 3.27% | 0.48 | 0.00 |
| Rock Creek-Cedar River | Yes | 20.70 | 1.40% | 0.29 | 0.00 |
| *WRIA 9* | | *36.16* | *1.40%* | *0.51* | *0.01* |
| Coal Creek-Green River | Yes | 36.16 | 1.40% | 0.51 | 0.01 |
| *WRIA 10* | | *242.84* | *2.03%* | *5.11* | *0.05* |
| Boise Creek-White River | Yes | 54.95 | 2.44% | 1.34 | 0.01 |
| Kapowsin Creek | Yes | 28.12 | 1.85% | 0.52 | 0.01 |
| Kings Creek-Puyallup River | Yes | 35.66 | 0.69% | 0.25 | 0.00 |
| Lower Carbon River | Yes | 28.55 | 3.35% | 0.96 | 0.01 |
| South Prairie Creek | Yes | 61.91 | 2.62% | 1.62 | 0.02 |
| Voight Creek | Yes | 33.64 | 1.24% | 0.42 | 0.00 |
| *WRIA 11* | | *127.90* | *2.39%* | *3.60* | *0.04* |
| Clear Creek | Yes | 20.13 | 0.47% | 0.09 | 0.00 |
| Lacamas Creek | Yes | 16.78 | 1.68% | 0.28 | 0.00 |
| Murray Creek-Nisqually River | Yes | 54.76 | 2.90% | 1.59 | 0.02 |
| South Creek | Yes | 36.23 | 4.52% | 1.64 | 0.02 |

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|---|---|---|---|---|---|
| *WRIA 13* | | *123.16* | *2.83%* | *2.81* | *0.03* |
| Beatty Creek-Frontal Eld Inlet | Yes | 21.47 | 4.88% | 1.05 | 0.01 |
| Lake Lawrence-Deschutes River | Yes | 58.94 | 1.37% | 0.81 | 0.01 |
| Spurgeon Creek-Deschutes River | Yes | 42.75 | 2.24% | 0.96 | 0.01 |
| *WRIA 14* | | *174.83* | *2.09%* | *3.61* | *0.04* |
| Schneider Creek-Frontal Totten Inlet | No | 19.20 | 2.55% | 0.49 | 0.00 |
| Deer Creek | Yes | 16.10 | 1.29% | 0.21 | 0.00 |
| Goldsborough Creek | Yes | 59.48 | 2.17% | 1.29 | 0.01 |
| Jones Creek-Frontal Case Inlet | Yes | 17.80 | 3.01% | 0.54 | 0.01 |
| Mill Creek | Yes | 29.62 | 1.95% | 0.58 | 0.01 |
| Sherwood Creek | Yes | 32.62 | 1.57% | 0.51 | 0.01 |
| *WRIA 15* | | *220.29* | *2.68%* | *5.20* | *0.05* |
| Key Peninsula-Frontal Carr Inlet | No | 38.24 | 4.52% | 1.73 | 0.02 |
| Big Beef Creek-Frontal Hood Canal | Yes | 48.91 | 2.41% | 1.18 | 0.01 |
| Key Peninsula-Frontal Case Inlet | Yes | 60.58 | 1.57% | 0.95 | 0.01 |
| Tahuya River | Yes | 49.34 | 0.78% | 0.39 | 0.00 |
| Union River | Yes | 23.21 | 4.10% | 0.95 | 0.01 |
| *WRIA 16* | | *24.10* | *1.14%* | *0.27* | *0.00* |
| Skokomish River-Frontal Hood Canal | Yes | 24.10 | 1.14% | 0.27 | 0.00 |
| *WRIA 17* | | *124.68* | *1.70%* | *2.06* | *0.02* |
| Chimacum Creek | Yes | 37.43 | 2.88% | 1.08 | 0.01 |
| Chimacum Valley-Frontal Port Ludlow | Yes | 17.94 | 2.66% | 0.48 | 0.00 |
| Jimmycomelately Creek | Yes | 19.17 | 0.33% | 0.06 | 0.00 |
| Salmon Creek-Frontal Discovery Bay | Yes | 38.68 | 0.50% | 0.19 | 0.00 |
| Town of Blyn-Frontal Sequim Bay | Yes | 11.46 | 2.13% | 0.24 | 0.00 |
| *WRIA 18* | | *160.57* | *1.09%* | *1.57* | *0.02* |
| Lake Aldwell-Elwha River | Yes | 9.86 | 1.57% | 0.15 | 0.00 |
| Little River | Yes | 22.87 | 0.10% | 0.02 | 0.00 |
| McDonald Creek | Yes | 22.47 | 1.75% | 0.39 | 0.00 |
| Middle Dungeness River | Yes | 29.17 | 1.03% | 0.30 | 0.00 |
| Morse Creek | Yes | 57.06 | 0.78% | 0.44 | 0.00 |
| Siebert Creek | Yes | 19.15 | 1.32% | 0.25 | 0.00 |
| *WRIA 21* | | *17.71* | *2.83%* | *0.50* | *0.01* |
| Connor Creek-Frontal Pacific Ocean | No | 17.71 | 2.83% | 0.50 | 0.01 |

| | | | | | |
|---|---|---|---|---|---|
| *WRIA 22* | | *302.40* | *2.13%* | *5.52* | *0.06* |
| East Fork Hoquiam River | No | 40.52 | 0.52% | 0.21 | 0.00 |
| Elk River-Frontal South Bay | No | 51.12 | 2.22% | 1.14 | 0.01 |
| Hoquiam River | No | 15.35 | 4.41% | 0.68 | 0.01 |
| Lower Humptulips River | No | 40.50 | 0.71% | 0.29 | 0.00 |
| Lower Wishkah River | No | 19.42 | 2.57% | 0.50 | 0.00 |
| Lower Wynoochee River | No | 40.64 | 1.25% | 0.51 | 0.01 |
| Metcalf Slough-Chehalis River | No | 25.29 | 4.35% | 1.10 | 0.01 |
| Newskah Creek-Frontal Grays Harbor | No | 34.67 | 2.61% | 0.91 | 0.01 |
| West Fork Hoquiam River | No | 34.88 | 0.55% | 0.19 | 0.00 |
| *WRIA 23* | | *398.93* | *2.11%* | *7.71* | *0.08* |
| Beaver Creek | No | 26.88 | 2.66% | 0.72 | 0.01 |
| Bunker Creek | No | 36.22 | 0.42% | 0.15 | 0.00 |
| City of Newaukum-Newaukum River | No | 21.53 | 4.73% | 1.02 | 0.01 |
| Davis Creek-Chehalis River | No | 22.61 | 1.52% | 0.34 | 0.00 |
| Hanaford Creek | No | 58.31 | 1.03% | 0.60 | 0.01 |
| Independence Creek | No | 25.80 | 0.50% | 0.13 | 0.00 |
| Lincoln Creek | No | 43.42 | 0.53% | 0.23 | 0.00 |
| Lower Black River | No | 34.04 | 2.45% | 0.83 | 0.01 |
| Lower Skookumchuck River | No | 23.04 | 4.96% | 1.14 | 0.01 |
| Mill Creek-Chehalis River | No | 25.41 | 2.02% | 0.51 | 0.01 |
| Salzer Creek | No | 24.04 | 3.19% | 0.77 | 0.01 |
| Scatter Creek | No | 39.86 | 3.00% | 1.20 | 0.01 |
| Waddell Creek | No | 17.78 | 0.40% | 0.07 | 0.00 |

Table 3. Case Area HUC-12 watersheds not adjacent to watersheds with impervious cover >= 5%, but that are potentially at risk because they have watershed impervious cover > 4%.

| HUC-12 Watersheds by WRIA (centroid inside of WRIA boundaries) | ESA Critical Fish Habitat | Watershed Area (SqMi) | Watershed Percent Impervious Cover (IC) | Watershed IC (SqMi) | Additional watershed IC that would be equivalent to a 1% increase |
|---|---|---|---|---|---|
| *WRIA 15* | | *36.73* | *4.16%* | *1.53* | *0.02* |
| Vashon Island | Yes | 36.73 | 4.16% | 1.53 | 0.02 |