Puget Sound Nearshore Habitat Conservation Calculator
User Guide

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Abbreviations

DSAYs  Discounted Service Acre Years
DSZ  Deeper Shore Zone
EFH  Essential Fish Habitat
ESA  Endangered Species Act
GIS  Geographic Information System
HAT  Highest Astronomical Tide
HEA  Habitat Equivalency Analysis
LSZ  Lower Shore Zone
MHHW  Mean Higher High Water
MLLW  Mean Lower Low Water
NHVM  Nearshore Habitat Values Model
NOAA  National Oceanographic and Atmospheric Administration
NRDA  Natural Resource Damage Assessments
OWS  Overwater Structures
PS  Puget Sound
SAV  Submerged Aquatic Vegetation
SSNP  Salish Sea Nearshore Programmatic
USACE  US Army Corps of Engineers
USFWS  US Fish and Wildlife Service
USZ  Upper Shore Zone
WDOE  Washing State Department of Ecology
WDFW  Washington Department of Fish and Wildlife
WDNR  Washing State Department of Natural Resources
Definitions

**Action Agency:** Federal Agency seeking ESA section 7 consultation with the National Marine Fisheries Service or US Fish and Wildlife Service.

**Conservation Credit (credit):** A unit of measure (e.g., a functional or areal measure or other suitable metric) representing a gain in ecological functions for Puget Sound Chinook and Hood Canal summer-run chum at a mitigation site. The measure of ecological functions is based on the resources restored, established, enhanced, or preserved. As part of Puget Sound Nearshore consultations, a credit is determined using the Conservation Calculator or other Services and Action Agency approved habitat quantification tool.

**Conservation Debit (debit):** A unit of measure (e.g., a functional or areal measure or other suitable metric) representing the loss in ecological functions at an impacted site. The measure of ecological functions is based on the resources impacted.

**Conservation Points:** Conservation Points are Discounted Service Acre Years multiplied by 100. This creates more intuitive outputs for small impacts.

**Discounted Service Acre Years (DSAYs):** Measure of change in habitat services provided over a specific duration of time to a set of target species within the Habitat Equivalency Analysis (HEA) methodology.

**Force Majeure:** Unexpected circumstances including accidents and extreme weather that may damage structures.

**Minor Maintenance:** Minor servicing of an existing structure that does not meaningfully prolong the life of the structure. For minor maintenance, a structure must remain the same size and within its current footprint. Minor Maintenance activities do not have to be entered into the Conservation Calculator. Further, minor maintenance includes the repair and replacement of previously mitigated elements during the first half of their design life.

**Repair:** Partial replacement, reconstruction, or rehabilitation of a structure that meaningfully extends the life of that structure.

**Replacements:** Reconstruction of an identical or highly similar structure in the same location as the structure being replaced.

**Service Area:** The service area is the geographic area in which conservation credits and debits can be traded to ultimately offset the loss of salmonid resource functions.

**Standalone Restoration:** A standalone restoration project restores or improves habitat functions without introducing new, or temporally extending, adverse effects aside from construction-related effects. Standalone restoration projects include removal of a structure that has adverse effects but does not include any replacement.
Introduction to the Conservation Calculator

What is the Puget Sound Nearshore Conservation Calculator?

NOAA and the US Fish and Wildlife Service (USFWS), collectively “the Services,” developed the Conservation Calculator as a user-accessible tool that simplifies the application of the Habitat Equivalency Analysis (HEA) and Nearshore Habitat Values Model (NHVM) (Figure 1). The goals of the Conservation Calculator are to:

- Quantify the habitat impacts relevant for Puget Sound (PS) Chinook salmon and Hood Canal summer-run chum from a proposed project and the habitat benefits from mitigation projects in terms of a common habitat metric.
- Allow the Services, Action Agencies, and project applicants to simultaneously and consistently apply both HEA and NHVM for proposed actions in the Puget Sound nearshore environment.
- Facilitate avoidance, minimization, and, where warranted or otherwise appropriate, no-net loss of nearshore habitat functions for PS Chinook salmon and Hood Canal summer-run chum by quantifying habitat impacts from proposed project actions (construction, repair, replacement, mitigation).

Figure 1. The Conservation Calculator is an interface for Habitat Equivalency Analysis (HEA) and the Nearshore Habitat Values Model (NHVM).

The Conservation Calculator is a user interface to the NHVM and HEA. It facilitates determination of conservation debits resulting from nearshore projects that decrease habitat...
function and **conservation credits** that are associated with projects that increase nearshore habitat function.

The Conservation Calculator allows the Services to assess habitat impacts and benefits in Puget Sound from several actions including:

1. Addition of new, replacement, and removal of overwater structures including piers, ramps, floats, house-boats, decks, piles, etc.
2. Removal of creosote
3. Addition of new, replacement, and removal of shoreline armoring
4. Addition of new, replacement, and removal of boat ramps, jetties, and rubble
5. Addition of new, and removal of riparian plantings
6. Addition of new submerged aquatic vegetation (SAV) plantings
7. Addition of forage fish spawning supplement/beach nourishment
8. Maintenance dredging

The Conservation Calculator is adaptable and allows the Services to make updates as new science or best available information becomes available. The Conservation Calculator also allows for expanding the types of analysis to account for the different types of nearshore development actions that could occur. (Note: These changes, if necessary, will be scheduled for predictable and regular updates. See below for specifics).

**Habitat Equivalency Analysis**

The **Habitat Equivalency Analysis (HEA)** methodology assesses impacts (net ecological loss) and benefits (net ecological gain) to the habitat. Ecological equivalency provides the basis of HEA as a concept that uses a common medium of exchange called **Discounted Service Acre Years (DSAYs)**. DSAYs express and assign a value to functional habitat loss and gain over a certain time period. Ecological equivalency is a service-to-service approach where the ecological habitat services relevant for a species or group of species impacted by an activity are fully offset by the services gained from a conservation activity. This is further explained in Ray (2008).

The NOAA Restoration Center developed HEA in cooperation with stakeholders and it has become a common method for Natural Resource Damage Assessments (NRDAs). NOAA’s Central and North Puget Sound area offices chose the HEA methodology for its Endangered Species Act (ESA) consultations and developed the NHVM and Conservation Calculator to facilitate the use of the HEA model. Not only has HEA been successfully used in multiple NRDA proceedings, it also addresses temporal impacts of the design life of nearshore structures.

The use of HEA requires several input parameters including nearshore habitat values (Figure 2). Habitat values characterize the functions and value of a specific habitat for the target species before and after an impact/restoration. A team of NOAA biologists developed a NHVM to aid in determining these habitat values specific to juvenile PS Chinook salmon and Hood Canal summer-run chum. The NHVM’s structure and values are specific to quantifying habitat conditions for the designated critical habitat of listed PS Chinook salmon and Hood Canal.
summer-run chum. The NHVM accounts for a range of habitat values (low to high depending on functionality and importance to the species). The NHVM design and values were derived from scientific literature and best available information, as required by the ESA. The resulting NHVM allows for consistent determination of habitat values across the Puget Sound nearshore through consideration of site-specific conditions.

![Habitat Equivalency Analysis Diagram]

**Habitat Equivalency Analysis: The Basics**

- **Size of affected area**
- **Time between impact and mitigation**
- **Discounting Factor: 3%**
- **Crediting/Discounting Factors e.g. connectivity, forage fish spawning areas**
- **Value of affected area before and after impact/mitigation**
- **Duration habitat will remain restored or degraded**
- **Duration till full function of habitat is reached e.g. mature forest**
- **Habitat Services in DSAYs**
- **Conservation Points**

*Figure 2. Components of Habitat Equivalency Analysis (HEA). Inputs include nearshore habitat values (pink) and additional parameters (navy). Outputs (orange) include DSAYs – conservation credits or debits – and Conservation Points. Conservation points are DSAYs multiplied by 100 which allow the user to work with more intuitive outputs for small impacts.*

**Nearshore Habitat Values Model**

The NHVM determines the habitat value, by ranking the existing conditions of physical and biological functions of salmonid critical habitat (50 CFR 226.212) for each of five elevation zones (Figure 3) in the subject habitat. The physical and biological functions for marine and estuarine critical habitat used for the NHVM include the unobstructed migratory corridor, cover and primary production, sediment quality and quantity, and water quality.
We split the marine/estuarine nearshore into five elevation zones based on their accessibility and function for the target species. The **Riparian Zone (RZ)** extends 130 feet landward from HAT. This is the area we found most relevant for supporting water quality and food provisioning for salmonids (see *Tab 3: RZ (Riparian Zone)* for more information). The **Upper Shore Zone (USZ)** extends between HAT and plus five Mean Lower Low Water (MLLW). The USZ is further split into **USZ 1** and **USZ 2** with the USZ 1 extending from HAT to Mean Higher High Water (MHHW). The duration and extent of tidal inundation in the USZ 1 is very limited and thus salmonid access, as well as sand lance and surf smelt spawning, is generally limited to the USZ 2. Based on the reduced extent, frequency, and duration of aquatic access for those species, we assigned the USZ 1 a lower maximum habitat value than the USZ 2 (Figure 4). The **Lower Shore Zone (LSZ)** extends from plus five MLLW to the deepest extent of submerged aquatic vegetation (SAV). All SAV is contained in the LSZ. The **Deeper Shore Zone (DSZ)** begins at minus 10 feet MLLW or the lowest limit of SAV growth. There is no defined limit end to the DSZ.

The five different shore zones provide different maximum habitat values for juvenile PS Chinook salmon and Hood Canal summer-run chum. Habitat values range from a minimum of 0 to a maximum of 1. The maximum habitat values that each zone can provide is based on the maximum possible contribution of habitat functions in that zone (Figure 4). For juvenile salmonids in the marine nearshore – a maximum habitat value of 1 – is an eelgrass meadow or other dense SAV providing food, cover, and an unobstructed migratory corridor. While the DSZ also provides migratory corridor function and forage (via primary production and drift in) for juvenile salmonids, it generally produces less forage than the LSZ as it does not contain SAV. While the riparian zone is not used directly by salmonids, it provides important functions for juvenile salmonids including provision of food via allochthonous\(^5\) input including insects. Corresponding maximum habitat values are shown in Figure 4.

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\(^5\) Allochthonous: Material that has been imported from outside of the system or considered area.
Figure 3. The Five Puget Sound Nearshore Zones. From highest to lowest elevation they are the Riparian Zone (RZ), Upper Shore Zone 1 (USZ 1), Upper Shore Zone 2 (USZ 2), Lower Shore Zone (LSZ), and Deeper Shore Zone (DSZ). Figure by Lee Corum, USFWS.
Figure 4. Maximum Habitat Values by Elevation. The corresponding nearshore zones are shown to the right. Values for each zone range from a minimum of 0 to a maximum of 1.

We mention these details to create an understanding about how some of the input requested for the Conservation Calculator is used. For example, to evaluate the cover and primary production in the LSZ, the NHVM uses presence and quality of SAV. For that evaluation, an assessment of the SAV condition via online resources or field surveys is needed.

**Application of this Tool**

The Conservation Calculator can be used to quantify habitat impacts for projects within marine and some estuarine environments of Puget Sound, including projects within the salt wedge of riverine systems. The Conservation Calculator is not appropriate for application in estuarine environments that do not fall within the shoreline descriptions outlined above (Figure 3), such as tidally influenced wetlands with backwater channels. Project elements upstream of documented salt wedges are also not suitable to be evaluated by this Conservation Calculator.

Conservation Calculator outputs are based on the evaluation of changes in physical and biological functions and their indicators relevant for PS Chinook salmon and Hood Canal summer-run chum productivity and abundance. The evaluation framework is dependent on the

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6 The salt wedge is defined as the area of intrusion of salt water into a tidal estuary in the form of a wedge along the bed of the estuary.
existing HEA model and the NHVM. The evaluation of project related changes is based on best available science, context-specific application of ecological processes, and best professional judgment. As with most other rapid assessment methods (Adamus, P, K. Verble 2020), field verification requires periodic process improvement.

If submitting a Conservation Calculator with a consultation request, ensure that the most current version of the Conservation Calculator and user guide is being utilized. The Conservation Calculator will be updated February 1st of every calendar year to incorporate applicable new science, monitoring results, additional modules, or other procedural, design, or usability improvements.

**Avoidance and Minimization**

NOAA strongly encourages applicants and consultants to evaluate nearshore projects with the Conservation Calculator prior to engaging in ESA consultation. Consider options for reducing conservation debits before project submission by (1) reducing the size of the structure, (2) incorporating hybrid or soft armoring for bulkheads, and/or (3) evaluating possible restoration on-site or on adjacent properties. On-site offsets, such as creosote removal, riparian plantings, or structure removal, may not be enough to reduce all debits associated with high impact projects.

**Best Management Practices for Structures Evaluated with the Conservation Calculator**

To reduce project impacts and associated debits, applicants should strive to minimize habitat impacts associated with their nearshore structures. Minimizing the project footprint to the greatest possible extent and avoiding areas with greater habitat value reduces the associated conservation debits.

In detail, best management practices (BMPs) to minimize impacts include:

1. Minimize the total size (area) of coverage or linear feet of the structure.
2. Reduce shoreline armoring (seawalls, bulkheads, abutments).
   a. Instead of a traditional “hard armoring” bulkheads (concrete, steel, rock), use soft-shore or hybrid armoring whenever possible. The Washington State Department of Fish and Wildlife (WDFW) Your Marine Waterfront guide is a valuable resource for minimizing your environmental impact. Soft or hybrid armoring is not entered into the Conservation Calculator, and therefore does not accrue debits!
   b. Relocate shoreline armoring as far landward as possible to reduce impacts to the USZ. Armoring landward of HAT does not incur debits for placement of armoring, but may incur small debits related to impacts to riparian vegetation.
   c. Slope rock bulkheads landward and incorporate native woody plantings.
d. Place vulnerable structures (like homes) as far landward of the shoreline as possible to reduce dependence on shoreline modification.

3. Minimize impacts to SAV.
   a. Delineate SAV for the project area within 25 feet of proposed structures. If SAV is found within that area, then delineate the entire property and choose a location for the structures that demonstrates the greatest avoidance and minimization of vegetation.
   b. Floating structures should never “ground out” on the substrate, and stoppers/pin piles/feet should hold the structure at least 12 inches above the substrate.
   c. If SAV is present within 25 feet of the proposed float, the bottom side of the float must be elevated at least 4 feet above the substrate at low tide to reduce prop scour impacts on SAV.

![Diagram of Proposed Float within 25 feet of SAV. Side-view. The bottom side of the float must be elevated at least 4 feet above the substrate at low tide.]

**Figure 5.** Proposed Float within 25 feet of SAV. Side-view. The bottom side of the float must be elevated at least 4 feet above the substrate at low tide.

d. We request SAV field surveys for most replacement projects. However, applicants should include a description of the SAV to the best of their ability using the following resources:
   i. Submit photographs of the LSZ taken at low tide between June 1 through October 1. An underwater camera (GoPro or equivalent) is ideal for photographing the LSZ area that is still underwater at low tide.
   ii. [Washington Marine Vegetation Atlas](https://www.wdfw.wa.gov) from the Washington State Department of Natural Resources (WDFW).
   iii. [Coastal Atlas](https://www.ecology.wa.gov) mapping tool from the Washington Department of Ecology (WDOE).
   iv. Old SAV surveys and SAV surveys from adjacent areas.

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7 NMFS accepts field surveys that follow the WDFW SAV interim survey guidelines.
In the absence of a description, survey, or photos that provides reasonable certainty of a vegetation condition rating as described in this User Guide, NMFS biologists will assign an SAV score based on available data.

If the project area is located in areas with dense SAV or native eelgrass (*Zostera marina*) and avoidance and minimization of impacts cannot be achieved with online resources, a field survey and delineation may be required to demonstrate how the project will avoid and minimize impacts.

4. Minimize impacts to forage fish spawning substrate by avoiding spawning areas, which can be found using WDFW’s [Forage Fish Spawning map](https://apps.ecology.wa.gov/coastalatlas/tools/Map.aspx). If this is not possible, construct 100% grated piers and ramps over spawning habitat and minimize the number of piles in the USZ.

5. Maximize light penetration
   a. Pier surfaces and ramps should be entirely grated with at least 60% open space.
   b. Floats should be grated to the maximum extent possible. To qualify as a grated float in the Conservation Calculator, floats must have 50% effective grating with 60% or more open space (Compliant with WAC 220-660-280).
   c. Install a mooring buoy in the DSZ rather than a boat lift in the LSZ.

6. Minimize impacts from piers
   a. Minimize the width of the pier. We recommend a pier width of 4 feet for residential structures, and as narrow as possible for commercial structures (ADA compliance may impact how wide the structure must be).
   b. Piers should be a straight line rather than finger, “L,” or “T” shaped.
   c. Do not construct additional structures on piers (i.e., buildings, planter boxes, slides, etc.). Solid structure areas must be entered in the Conservation Calculator as a solid pier, which has more habitat impacts than grated surfaces.
   d. Stairways should be open-frame construction and not solid structures (i.e., concrete). The width of stairway landings and steps should not exceed 4 feet for single-use and 6 feet for joint-use.

**User Requirements**

Use of the Conservation Calculator requires a moderate to substantial knowledge of nearshore ecology and coastal geology, and experience with field data collection methods including determining some tidal elevation. Field data that are necessary for use of the Conservation Calculator also include SAV surveys and forage fish surveys or appropriate use of existing information. Users will need to have experience with geographic information systems (GIS) or Google Earth, aerial photo interpretation, and/or field evaluation experience, depending on project type. Users will need to be able to interpret maps related to areas valuable for the target species including maps of natal estuaries, pocket estuaries, WDOE’s [Coastal Atlas map](https://apps.ecology.wa.gov/coastalatlas/tools/Map.aspx), and WDFW’s [Forage Fish Spawning map](https://apps.ecology.wa.gov/coastalatlas/tools/Map.aspx). WDOE’s [Coastal Atlas map](https://apps.ecology.wa.gov/coastalatlas/tools/Map.aspx) at https://apps.ecology.wa.gov/coastalatlas/tools/Map.aspx, and WDFW’s [Forage Fish Spawning map](https://apps.ecology.wa.gov/coastalatlas/tools/Map.aspx).

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8 Map layers are provided on NOAA web page and as hot links in the Conservation Calculator.
Resources on NOAA’s PS Nearshore web page at https://www.fisheries.noaa.gov/west-coast/habitat-conservation/puget-sound-nearshore-habitat-conservation-calculator, along with this user guide, provide information regarding the use of the Conservation Calculator. Further, pre-consultation technical assistance meetings can provide a venue for applicants and consultants to get help with more complicated projects. Email PSNearshoreConservation.WCR@noaa.gov for questions. NOAA will continue to provide training and technical assistance for use of the Conservation Calculator by adding training materials and updates to the PS Nearshore web page mentioned above.

Conservation Calculator as part of ESA Consultations in Puget Sound

The Conservation Calculator is a tool that can be used by agency staff, environmental consultants, non-profit and corporate staff, and project proponents. Users can download the Conservation Calculator and enter project specifications to determine credit and/or debits. Project specific Conservation Calculators are needed for most, if not all, Puget Sound nearshore projects. For example, no-net loss is required as part of the proposed action in the Salish Sea Nearshore Programmatic (SSNP) biological opinion. A tool to demonstrate no-net loss is the Conservation Calculator.

Conservation Calculator Process Improvements

The Services will apply new science, incorporate monitoring results, and process improvements to the Conservation Calculator, NHVM, and this user guide with thorough, regular and predictable updates.

Throughout the year, we encourage users to send improvement suggestions, new and relevant science, and potential bugs to PSNearshoreConservation.WCR@noaa.gov at NOAA and questions specific to USFWS species to (annelise_hill@fws.gov).

The Services plan to post any updates to the Conservation Calculator and user guide, if needed, on February 1st of every year. We document all updates and additions in a separate document, the Change Log, also available on our web page. In the event a more critical update would need to occur sooner, the Service will make every effort to update the website and user forums. Annual updates may include adjustments to credit factors, updates to maps related to the credit factors, and changes based on new science, policies, and feedback from applicants. Changes may also include improvements to the layout of the Conservation Calculator and user guide.

When a project specific Conservation Calculator is submitted as part of an ESA consultation initiation package, NMFS requests that applicants and their agent submit the most recent version
of the Conservation Calculator posted on NMFS’s web page. Once a project is initiated or for a programmatic implementation NMFS confirms that the project fits the programmatic, the project Conservation Calculator version is final and will stay with the project.

After the annual February Conservation Calculator update has been posted on PS Nearshore web page, applicants whose projects have not been initiated or whose programmatic implementation has not been confirmed by NMFS to fit a programmatic may amend their project file with a new Conservation Calculator using the updated February version.

**Conservation Calculator Training**

Materials from the January 2021 Conservation Calculator workshop are available on the PS Nearshore web page at https://www.fisheries.noaa.gov/west-coast/habitat-conservation/puget-sound-nearshore-habitat-conservation-calculator. We strongly encourage users to review this training before sending questions about calculator entry or requesting additional training. We plan to offer follow-up training. To receive updates regarding training, new material, updated versions of the Conservation Calculator and User Guide, sign up for our listserv on the PS Nearshore web page.

**Conservation Offsets**

*Applicant-accountable Credit Generation*

Conservation credits to offset impacts can be generated by engaging in **standalone restoration** actions. Applicant-generated conservation credits can be generated on the same site as a project causing debits or within the same service area. For example, an applicant may remove structures in the nearshore of the same service area of an impacting project to generate conservation credits to offset debits. The removal must be a standalone and separate action and cannot be integral to another project.\(^9\) Standalone applicant-accountable credit generation includes:

- Removal of individual creosote piles not associated with a structure
- Removal of an overwater structure (either containing creosote or not)
- Removal of a portion of a structure\(^10\)
- Removal of shoreline armoring (complete armoring, not a portion)
- Riparian plantings
- Beach nourishment

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\(^9\) Residual applicant-generated credits from a replacement project cannot be used as credits for a different debit project.

\(^10\) Partial structure removal is limited to distinct portions that can be removed as a standalone project without increasing the environmental risk associated with the remaining portion of the structure.
**Reporting for Applicant-responsive Credit Generation**

Creosote: After creosote removal and upland disposal, applicants must submit the disposal receipts and a picture of the dump truck on the scale to the Services. Disposal receipts need to contain actual weight of the total removed creosote.

**Removal Credits**

The Conservation Calculator is set up to determine credit for the removal of existing structures and creosote. For existing structures, we make the average estimate that at the time of permit application, the existing structure would remain in lawful and in a structurally sound and good condition for a period of 10 years. If structures are non-functioning, deteriorated and/or falling apart, or otherwise not in good condition as required by their permit, removal credit is generally not justified.

A request for an emergency authorization usually indicates that a structure has not been maintained in a good condition. Conservation credit for the removal of structures under an emergency authorization may apply only in very limited circumstances. Projects that received an emergency authorization from the US Army Corps of Engineers (USACE) may receive credits for the removal of the old/existing structures if the structure was in good condition at the time of permit application and dated pictures can be provided.

**Preservation of Existing Habitat**

Stay tuned for February 2023, we are working on this.

**Service Area**

To effectively offset impacts, credits must originate from within the same service area as debits. Service areas may vary depending on the credit provider and extend as far upriver as the maximum extent of saltwater intrusion in river mouths. See the [PS Nearshore web page](#) for links to conservation credit provider specific service area maps.

**General Information - Applicable to All Structure Entries**

*Replacements, Repairs, Minor Maintenance*

For the purposes of SSNP, replacements, repairs, and minor maintenance are part of individual activity categories. SSNP activity categories that cover repairs and replacement and require conservation offsets are “Shoreline modifications” and “Repair or replace an existing structure.” “Repair or replace an existing structure” includes: Aids to navigation; boat houses; covered boat houses; boat garages; breakwaters; commercial; industrial and residential piers; pier, ramp, and floats; float plane hangars; floating walkways; groins and jetties; house boats; boat ramps;
wharfs, port, industrial and marina facilities; dolphins, float storage units, debris booms. “Minor maintenance of an existing structure” is a separate SSNP activity category and includes: Pile resets, replacement of rubber strips, encapsulation of flotation material, replacement of fender piles that do not contribute to the structural integrity of the structure, capping of piles, replacement of flat stops, height extension of existing piles. Minor maintenance, which does not meaningfully extend the life of a structure, does not require conservation offsets.

For filling out the calculator, replacement means reconstruction of an identical or highly similar structure in the same location as the structure being replaced. In general, the structure that is being replaced has to be in the environment at the point of permit application for an installation to be considered a replacement. Further, to receive removal credit for the existing structure, the existing structure has to be in good condition. For more information on removal credits, review the Removal Credits section above.

For filling out the calculator, repair means to conduct partial reconstruction or rehabilitation of a structure that meaningfully extends the life of that structure. Repairs have impacts on critical habitat that are similar to the impacts of replacements. Like replacements, repairs extend the duration of an impact to the nearshore into the future. Such repairs include: Resurfacing boat ramps and encasing bulkheads. Most repairs have very similar or the same environmental effects as replacements. Thus, removal credits apply to most repairs even if the existing structure is not removed for the same reasons as discussed above in Removal Credits.

“Piece by Piece” approach for replacements and repairs: Only the element to be repaired or replaced is entered into the Conservation Calculator. For example, if X square feet of a boat ramp are proposed to be replaced, only those X square feet are entered into the Conservation Calculator.

In more detail, to quantify impacts from repairs and partial replacements:

1. Enter the footprint of the existing structure element that is proposed to be repaired or replaced into Entry Block III for Removal, Removal as Part of Replacements, and Repair. Structure elements to be repaired are generally eligible for removal credit.
2. Enter the footprint of the proposed replaced/repaired structure element (which should not exceed the existing footprint) in Entry Block II for Repair and Replacement. If partial replacements and repairs include design changes or improvements, like an increase in grating, those should also be reflected in Entry Block II.
3. “No Double Offsets” when replacing structurally overlapping elements. This mostly applies to overwater structures and is discussed in more detail in the section on Tab 4: Overwater Structures - Repair of Overwater Structures.

When filling out the Conservation Calculator, minor maintenance activities do not have to be entered. Minor maintenance means carrying out minor servicing at an existing structure that we have determined at this time does not meaningfully extend the life of the structure. Maintenance activities include pile resets, capping of piles, replacement of rubber strips, replacement of float stops, encapsulation of existing floatation material, height extension of existing piles, and replacement of fender piles that do not contribute to the structural integrity of the structure.
Further, for filling out the Conservation Calculator, minor maintenance includes the repair and replacement of previously mitigated elements during the first half of their design life. This includes unexpected damages caused by a force majeure, if it occurs during the first half of the structure’s design life. For these situations, the Conservation Calculator does not have to be used. If a structure or elements of a structure for which conservation offsets were previously provided must be repaired or replaced for any reason during the second half of their design life, it is considered a replacement and under SSNP conservation offsets apply.

**Entering Length and Width**

Entering floats, boat ramps, and jetties into the Conservation Calculator generally requires input of length and width parameters, rather than simply square footage. In addition to impacts related to square footage of structure, these structures have a physical buffer with added impacts factored into the final credits/debits (based on Ono et al. 2010). To correctly determine buffers, the longer side of the structure should be entered into the length field, regardless of orientation. Exceptions for overwater structures spanning several zones are discussed in the Tab 4: Overwater Structures section.

**Replacement vs. New**

If the area of a replacement structure exceeds the area of the existing structure, the difference is considered to be new/expanded structure. This determination is made by structure type and shore zone.

**Example** – If a replacement jetty is reduced in width but extended into the LSZ where there previously was no jetty, all area of the jetty in the LSZ is considered new/expanded.

**Example** – If a boat ramp is replaced with a jetty, the jetty is considered to be a new structure.

A detailed discussion and more examples of expanded overwater structures can be found in section Tab 4: Overwater Structures.

**Increased Credits for Removals with Site Protection**

The time horizon for credit determination associated with structure removal and no site protection on the property (e.g., a deed restriction or conservation easement) is 10 years. However, the Conservation Calculator is set up to credit removals of structure where site protections are in place for time horizons longer than 10 years. If proposing structure removals with site protections following the USACE regulations, Components of a Mitigation Plan (4) site protections instrument 33 CFR 332.4(c) §332.7(a); specific for nearshore structures, the USACE informs on deed restrictions associated with compensatory mitigation here. Contact the Services for help determining credits. If you would like an immediate estimate of increased credits based on a site protection, you may use Entry Block II, on the appropriate tab. Enter the dimensions of the structure to be removed as though you were installing a replacement structure; the resulting negative credits reflect the positive credits you would receive for a 40-year (design life for overwater structures and boat ramps) easement.
For shoreline armor removal the Services credit easements for a time of up to 50 years (limit based on sea level rise). Please contact Services via PSNearshoreConservation.WCR@noaa.gov for help with determining increased credits for armor removal with easements following USACE regulation.

Submerged Aquatic Vegetation

1. Submerged aquatic vegetation (SAV) density informs habitat values in the Conservation Calculator. SAV surveys provide site-specific information that is used in most tabs in the Conservation Calculator.

2. Use the WDFW Eelgrass/Macroalgae Habitat Interim Survey Guidelines to conduct SAV surveys and follow the USACE “Components of a Complete Eelgrass Delineation Report” for eelgrass delineations. If surveys are conducted outside of the SAV survey window (June 1st - October 1st), NOAA may increase the SAV rating in the Conservation Calculator to account for the likely underestimate of SAV coverage outside of the main growing season. This decision depends on additional site-specific information like site specific growth patterns, temperature regime of the area, and WDFW area habitat biologist input, as available.

3. When a survey shows that no macroalgae and only eelgrass is present, we also accept an Eelgrass Delineation Report based on the Components of a Complete Eelgrass Delineation Report developed by Dr. Deborah Shafer Nelson, U.S. Army Engineer Research and Development Center; Special Public Notice May 27, 2016.

4. SAV determinations should be based on the average SAV density in the footprint of the structure including a 25-foot buffer around the structure.

5. For the determination of the SAV category based on SAV density use Table 1, which is also displayed in the Conservation Calculator reference tab.

6. SAV category determinations for replacements: For most small size replacement projects, SAV information can be provided without a new survey by using a combination of older SAV surveys, SAV surveys from adjacent properties, pictures at extreme low tides, information from Washington State Department of Ecology’s (WDOE’s) Coastal Atlas map, or information from WDFW biologists.

7. Structure removals with SAV have two options:
   a. Enter the SAV category based on the average cover density as outlined above in number 4.
   b. Enter the SAV category based on the average cover density of the 25-foot buffer surrounding the structure. This option is appropriate if there is a distinct difference between SAV cover under an overwater structure and the area around it and it is likely that the SAV will reestablish after the structure removal.

8. Credit for the removal of unpermitted structures in the nearshore will be approved on a case-by-case basis.
### Delineation of Lower Shore Zone SAV Scenarios

<table>
<thead>
<tr>
<th>VEGETATION SCENARIO</th>
<th>Native Eelgrass and/or Kelp occurs within 25 feet of project area</th>
<th>Other SAV occurs within 25 feet of project area (no native eelgrass or kelp present)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 0</td>
<td>N/A</td>
<td>≤ 10%</td>
</tr>
<tr>
<td>Scenario 1</td>
<td>1-25% Combined SAV</td>
<td>11-25%</td>
</tr>
<tr>
<td>Scenario 2</td>
<td>26-69% Combined SAV</td>
<td>26-75%</td>
</tr>
<tr>
<td>Scenario 3</td>
<td>≥ 70% Combined SAV</td>
<td>&gt; 75%</td>
</tr>
</tbody>
</table>

### Delineation of Upper Shore Zone SAV Scenarios

<table>
<thead>
<tr>
<th>VEGETATION SCENARIO</th>
<th>Macro algae and saltmarsh vegetation (such as Salicornia sp. and Distichlis sp.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 0</td>
<td>Less than 5% of cover</td>
</tr>
<tr>
<td>Scenario 1</td>
<td>Between &gt;5% and &lt; 30% of cover</td>
</tr>
<tr>
<td>Scenario 2</td>
<td>Between &gt;30% and &lt;60% of cover</td>
</tr>
<tr>
<td>Scenario 3</td>
<td>Between &gt;30% and &lt;60% of cover</td>
</tr>
</tbody>
</table>

**Table 1. Delineation of Lower Shore Zone and Upper Shore Zone SAV scenarios (categories). SAV is defined as rooted vascular plants and attached macroalgae. Drift algae and Ulva spp. are not included when determining cover percentage unless Ulva spp. occurs in documented herring spawning areas.**

### Credit/Debit Factors

For habitat conditions that are especially important for Puget Sound Chinook and Hood Canal summer-run chum, the final credits or debits are multiplied by a factor. The Conservation Calculator only applies these credit/debit factors to aspects of the project that would affect the important habitat condition. Table 2 shows how the credit/debit factors apply to certain project elements.

1. Major Estuary Zones: A map of [Puget Sound Natal & Pocket Estuaries](https://www.psnearshore.org) is available on the PS Nearshore web page. We are using the historical extent of PS Chinook salmon natal river deltas plus a 5-mile buffer (as the fish swims), as per the PS Chinook Salmon Recovery Plan nearshore chapter (Redman et al. June 2005). For Hood Canal summer-run chum, we are using a 1-mile buffer around natal rivers and rivers where re-introduction was successful based on the first priority level for recovery actions of the Hood Canal summer-run chum recovery plan (Brewer et al. 2005).

2. Pocket Estuary or Embayment: See the [Puget Sound Natal & Pocket Estuaries map](https://www.psnearshore.org)

3. Feeder Bluff: We currently use the WDOE [Coastal Atlas map](https://www.wdowash.gov) with coastal landforms data layer to determine the location of feeder bluffs.

4. Forage Fish Spawning: We rely on WDFW’s [Forage Fish Spawning map](https://www.wdfw.wa.gov) and surveys to determine presence and extent of Pacific herring, Pacific sand lance and surf smelt. If questions arise for a specific location, USACE, USFWS, or NOAA staff will clarify presence in consultation with WDFW.
5. Shoreline armoring that is located within the same drift cell and updrift of forage fish spawning habitat. Use the WDOE Coastal Atlas map to determine drift direction.

While the GIS layer for “Major Estuary Zones” and “Pocket Estuary or Embayment” is depicted as a band (this is an artifact of how the GIS layer was created), these landscape-scale credit/debit factors apply to all zones and the entire structure. In other words, if any part of a structure overlaps or is waterward of location that is mapped as either “Major Estuary Zones” and/or “Pocket Estuary or Embayment,” this credit/debit factor applies to all parts of that structure not just the parts that are located on the band shown on the GIS layer; also see Table 2.
Table 2. Project-specific application of credit/debit factors. Credit/debit factors for water quality benefits related to creosote removal are 40% of full credit/debit factor because we expect creosote piles to be on site only for approximately 40 years of the 100-year assumed benefit period. After that they likely have broken off and are floating through Puget Sound.

**Duplication of Tabs**

The Overwater Structure, MDredging, Beach N, and SAV Planting tabs can be duplicated as many times as necessary in one Conservation Calculator workbook. This can be helpful for entering multiple structures on complex projects.

To duplicate one of these tabs, right click a tab on the bottom and click “Move or Copy.” Then select the tab to duplicate, check the box that reads “Create a Copy” on the bottom of the window, then press “Ok.”

The Conservation Calculator does not allow for duplication of ShorelStab or BoatR, Jetty tabs. For Excel experts, the Overwater Structures, MDredging, Beach N, and SAV Planting tabs work with lookup tables in the background, and the other tabs use the NHVM in the background. If an additional ShorelStab or BoatR, Jetty tab is needed for a complex project, please use and submit an additional Conservation Calculator workbook.
**Important:** Conservation credit/debit totals from duplicated tabs will not auto-populate in the summary tab, so the user should make a note about any added tabs and their resulting credit/debit outputs in the *ProjectD* tab. During consultation, NOAA project biologists will unlock and modify the *Summary* tab as needed.

**Hiding Tabs**

Tabs that are not in use can be hidden to make your calculator more user-friendly. Simply right click on the tab at the bottom and select “Hide.” To unhide tabs, right click on any existing tab, click “Unhide” and select the tab to unhide.

Advanced users: For visual ease only, we have hidden the NHVM and HEA calculation tabs. These tabs are the gears that build and populate the user-friendly Conservation Calculator you see. Using the “unhide” method described here will allow you to get into the Conservation Calculator mechanics if you wish to dig deeper.

**Puget Sound Conservation Calculator Tabs**

The Conservation Calculator consists of different entry worksheets/tabs for different types of actions. The worksheets are:

1. Summary
2. ProjectD: For recording project specific details
3. RZ: Riparian Zone
4. Overwater structures
5. ShorelStab: Shoreline stabilization
6. InputShorel
7. MDredging: Maintenance Dredging
9. BeachN: Beach Nourishment
10. SAV Planting
11. Ref.: References

The following sections describe different components of the Conservation Calculator and provide guidance for entering project information so that the outputs will be accurate and consistent.

**Tab 1: Summary**

A run-down of all impacts/benefits entered into the Conservation Calculator. This tab provides the total credits/debits consisting of the sum of all project elements.
Tab 2: ProjectD

The ProjectD tab is intended for recording project specific details relevant for filling out the Conservation Calculator. This is also the place to document your work and reference external sources you used to derive input values. For example, if you are using pictures at low tide to support your SAV category selection, add a note referencing the pictures and your conclusions or copy and paste the pictures into the ProjectD tab.

Tab 3: RZ (Riparian Zone)

Vegetation changes that occur within 130 feet of Highest Astronomical Tide (HAT) as part of a project are entered into the RZ tab. According to Brennan et al. (2009), various nearshore functions are supported by adjacent riparian habitat. They reviewed published literature, recommended buffers, and Forest Ecosystem Management Assessment Team (FEMAT) curves to evaluate each of these functions and propose different riparian buffer widths to maintain a minimum 80% effective function. NOAA considered the information provided in this review and designated the area within 40 meters above HAT as the riparian area for the Conservation Calculator. This width is focused on supporting shade, large woody debris recruitment, litter/organic matter inputs, water quality, and habitat function which we believe are the most impactful for aquatic ESA listed species in the region.

Square footage is entered in a before and after scenario in columns E and G. The key to entry is that the total square footage input into column E (before) must equal the total square footage in column G (after). Changes are represented in four categories (in Rows 14 through 17): Trees, Shrubs, Herbaceous Vegetation, and Impervious/Unvegetated. Entry represents the “changes” to the riparian from one habitat category to another.

Riparian categories are represented in the RZ tab with highest ecological value on top, descending to the lowest. Trees are on top, down to impervious surface/unvegetated on the bottom. A shift of square footage from impervious (in before column E) to trees (in after column G) would represent the most habitat benefit.

There may be locations in which woody vegetation growth extends below HAT, especially in areas with stabilized shorelines. In those locations, the area where woody vegetation is planted for mitigation may be entered in this tab, including any areas below HAT.

Riparian enhancements can be evaluated with the RZ tab/worksheet regardless of location as long as they are located within the same service area as the impact site.

Submit a planting plan, performance standards, proposed monitoring plans, and site protection if applicable with your consultation initiation package. You can find an example of a mitigation plan at: Components of a Mitigation Plan (4) site protections instrument; information on deed restrictions associated with compensatory mitigation here; and an example of a Mitigation Monitoring Report for riparian plantings can be found here.
**Overstory and Understory**
Ideally, native plantings should provide overstory and understory conditions. For overstory and understory arrangements, only the square footage of total area is entered into the Conservation Calculator – in other words, square footage cannot be “double counted” for two categories. Instead, enter the square footage as represented by the highest habitat value. For example, if trees are planted with native herbaceous vegetation below, enter only the square footage associated with the trees in the “After” column. Additional credit for shrubs or herbaceous vegetation under trees is not given.

**Entering Trees and Shrubs**
Enter trees and shrubs into the “After” column of the RZ tab as their full/mature crown size (area in square feet as seen from above), rather than the size when planted. The HEA model has time built into these categories and accounts for additional years needed for woody plants to reach their full size.

To find mature tree crown square footage, please use the Washington State University’s PNW Plants website.

1) On the PNW plants website, find the “Width” of the tree on the right hand “Plant Characteristics” box
2) Divide the width in half to obtain the radius of the tree crown
3) Use the formula for area of the circle $A = \pi r^2$ where $A$ is the area (the total crown square footage as seen from above), $\pi$ is pi (3.14159), and $r$ is the radius obtained in #2 above.

Note: Only use plants native to the area and appropriate for the weather and salt water conditions.

**Tab 4: Overwater Structures**
The Conservation Calculator allows for determining the impact of overwater structures (OWS) including simple piers, ramps, floats, and other structures that shade nearshore habitats. Entering measurements for typical piers, ramps, and floats into the calculator is straightforward, whereas entering measurements for more complex structures, like marinas and industrial structures, may require more explanation which is provided below.

**Simple Float Entry**
Enter the length and width of a simple float in the respective shore zone and grating category (solid or grated). Also see “Entering Length and Width” in the General Information section. Unlike piers and ramps, floats have associated buffers. In order to allow the Conservation Calculator to correctly determine the buffer area of the float, the length and width must be considered. Always enter the longer side of a float into the length field, regardless of orientation.

Example – For a replacement 8 feet by 30 feet 50% grated float with 70% open space in the LSZ, in the Overwater Structures tab, enter 30 in cell 57E, and 8 in cell 58E.
In order to be entered as a grated float, floats must have at least 50% functional grating, with a minimum of 60% open space (consistent with WAC 220-660-140).

Covered boat slips are entered into the nearshore Conservation Calculator as solid floats.

**Simple Floats with Length and Width Spanning Two or More Shore Zones**

If a float extends across more than one shore zone, the width entity must be adjusted to avoid double-counting a portion of the buffer. To do this:

1) Enter the float dimensions (L and W) for the portion of the float located in the more landward shore zone. Enter these zone-specific dimensions in the yellow entry cells for length and width.

2) For the adjoining waterward zone(s), enter only the length (in that zone) into the yellow entry field, **leaving the width at 0**. Then, manually enter the area (in square feet) for the applicable nearshore zone in the pink square footage box.

Example – For replacement of a grated float spanning the LSZ and DSZ, manually enter the float DSZ area located in the DSZ in the pink entry cell E63. Then enter the total DSZ length into the yellow entry cell E59, and enter 0 into E60.

Because other overwater structures, such as piers and ramps, do not have buffers, this modification is not needed for those structures extending across shore zones.

**Complex Floats**

Floats can have several “branches” or float components contributing to their overall shape. Enter T-shaped floats, L-shaped floats, comb-shaped floats, and other irregular-shaped floats into the Conservation Calculator as complex floats.

**Complex Floats with One Type of Decking**

Floats with decking that is entirely grated or entirely solid can be entered as a “complex float” following these two steps.

1) Enter the total length and the width at the widest point into the appropriate nearshore zone (LSZ, or DSZ) and grating category (solid or grated). This will allow for calculations of a simplified overall float buffer.

2) Determine the area of the complex float and manually enter the square footage directly into the appropriate pink nearshore zone’s cell. Letting the calculator determine the square footage for complex floats results in an overestimate of the total area, as it simply multiplies length by width.

---

11 The Conservation Calculator determines a buffer for floats based on length and width. If a float spans two zones, entering length and width for all zones would result in an additional buffer area based on the width at the zone break. The above outlined entry method ensures correct buffer determination in that no buffer area is assigned to the width at the end of a zone.

12 Most entry cells in the Conservation Calculator are yellow. This is one of the few cases where an area is manually entered into the pink float area cell.
Complex Floats with Solid Walkways and Grated Finger Slips

Some commercial and marina floats have a combination of solid and grated floats. Since there are different float types (solid and grated) within one structure, entry must be split between the solid and grated areas of the Conservation Calculator.

When a complex float structure has a solid center “walkway” and grated fingers, enter it in the Conservation Calculator in the following way:

1) Enter the solid main walkway as a simple solid float (as outlined above under Simple Float Entry: Enter the longest dimension in the length entry field and the shortest in the width entry field.)

   Example – For a replacement structure in the LSZ, enter length into cell E66 and width into E67.

2) Under grated float:
   a. Enter the widest width of the entire complex float minus the center walkway as the width (the length of the longest finger floats on both sides of the center
walkway, not including the center walkway. In Figure 8: W1+W2). Leave the length at 0.

b. Manually enter the total square footage of the grated finger floats directly into the pink square foot field.

Figure 7. Example Entries for a Replacement Complex Float with two types of decking (solid walkway and grated finger slips) in the LSZ.
Figure 8. Complex Float with Two Types of Decking (grated finger slips and a solid walkway) located entirely in either the LSZ or DSZ.

**Complex Floats Spanning Two or Three Shore Zones**

When complex floats extend across several nearshore zones (Figure 9), the float area as well as length and width entries for buffer calculations must be zone specific. To enter complex floats in more than one shore zone:

1) Enter the length of the complex float portion that exists in the most landward shore zone in the yellow entry field for its corresponding shore zone. Length, in this case, represents a portion of the longest dimension as it spans all shore zones.

2) Enter the maximum width of all the floats together (finger floats and walkways) in the yellow entry field for width in the most landward shore zone.

3) Manually enter the area of the float portion located in the most landward shore zone in the pink field for square footage.

4) For the adjoining waterward zone(s), enter the total zone-specific length into the yellow entry field for float length. Manually enter a width of 0.
5) Manually enter the area of the float located in each waterward shore zone into the respective pink field for square footage.

![Complex Float Across Shore Zones Diagram](image)

*Figure 9. Complex Float with One Type of Decking (either solid or grated) extending across Multiple Shore Zone.*

Conservation Calculator entry instructions for complex floats spanning two or three shore zones with both grated and solid decking combine the approaches outlined above under *Complex Floats with Solid Walkways and Grated Finger Slips* and *Complex Floats Spanning Two or Three Shore Zones*:

1) Enter the length of the complex float portion in the most landward shore zone in the yellow entry field for length of a *solid* float in its corresponding shore zone. Length, in this case, represents a portion of the longest dimension as it spans all shore zones, LSZ L1 in Figure 9.

2) Enter the longest width of *all* the floats together (e.g., finger floats and walkways) in the yellow entry field for width of a *grated* float in the most landward shore zone, LSZ W1 in Figure 8.

3) Enter 0 for the remaining landward shore zone dimension fields (solid float width and grated float length).

4) Manually enter the square footage of the solid portion of the float in the landward shore zone in the pink field for solid square footage. And manually enter the square footage of
the grated potion of the float in the landward shore zone in the pink field for grated square footage.

5) For the adjoining waterward zone(s), enter the total zone-specific length into the yellow entry field for the length of a solid float, DSZ L2 in Figure 9. Manually enter a width of 0. Manually enter the square footage for both the grated square footage and solid square footage for the total waterward shore zone of the float.

Replacement vs. New Overwater Structures

If the area of a replacement overwater structure is larger than the area of the removed structure (Figure 10), the difference is entered in the Conservation Calculator as new or expanded overwater coverage. The area entry for an expanded structure will be split between Entry Blocks I: New/Expanded area and Entry Blocks II: Replacement area and must be entered in the respective nearshore zone.

The Conservation Calculator determines impacts/benefits based on the affected area in each shore zone. Thus, the determination of what is new or expanded coverage is zone specific. Exception for legacy structures: Replacing floats in the USZ with same size floats in the LSZ can be entered as a replacement.

Finally, to enter a structure element as a replacement, it must be a “like structure.” Like structures are those that would be entered into the same structure category in the Conservation Calculator. For example, piers and ramps are like structures. Grated floats, solid floats and pontoons are also like structures.

Typically, the same square footage in the same zone can be minimally realigned. However, large shifts in location that cause increased habitat impacts should be entered as new structures (e.g., if a replacement pier is shifted 50 feet from its original location, and/or to an area with more SAV).

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13 The “New” category also applies to the ShoreStab and BoatR, Jetty tabs (Tabs 5 and 7 respectively). In these tabs it is a drop down “yes” or “no” selection, rather than a separate entry block.
14 New and replacement floats are usually not placed in the USZ where the water depth is insufficient to prevent the structure from grounding out on the substrate during normal low tides.
REPLACEMENT VS. NEW STRUCTURE IMPACTS

Entering Replacements with Expansions in the Calculator:

1. Confirm the total square footage of each like structure category to be removed within each shore zone. This is your maximum replacement square footage. Enter this in Entry Block III.
2. Enter the total square footage for the replacement structures in Entry Block II. This area must not exceed the values for zone specific areas entered above in Entry Block III.
3. Excess “replacement” structure square footage exceeding the removal square footage within a shore zone are considered expansions and must be placed in Entry Block I: New/Expanded. Enter zone specific expansions for each like structure in Entry Block I. Exception for legacy structures: Replacing floats in the USZ with same size floats in the LSZ can be entered as a replacement.

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15 New and replacement floats are usually not placed in the USZ where water depth is insufficient to prevent the structure from grounding out on substrate during normal low flow or low tide conditions.
We refer to area and square footage in the above section to focus on the concept of what is considered new/expanded area. To enter the area in the Conservation Calculator, this requires in most cases determining relevant length and width. As discussed with floats spanning different shore zones, the entry of float dimensions for expanded floats also has to consider the buffer area and is explained below.

**Example** – When removing a 5x10 foot solid float from the LSZ and installing a 5x5 foot grated float with a 3x3 foot solid mooring buoy in the LSZ:

- The total removal square footage in LSZ = 50 square feet. Enter 50 square feet solid float into the Removal Entry Block, along with the dimensions of the float.
- The total replacement square footage in LSZ = 25 + 9 = 34 square feet, which is less than the original 50 square feet. Therefore, both of these structures are entered in the Replace Entry Block. Even though the new float is grated (not solid) and the mooring buoy is “new,” the square footage from Remove is applied to the Replace section because the float and mooring buoy are “like structures.” The Replace structures are still entered as a 5x5 grated float and a 3x3 solid float in different entry boxes.

**Length and Width Entry for Expanded Floats**

This section covers directions for entering the length and width for replacement floats with expansions accounting for the buffer around floats. Enter the replaced square footage of the float with the actual Length and Width in Entry Block II. Enter the New/Expansion portion in Entry Block I, manually enter the square footage in the pink entry filed, enter the expanded length, and leave the width entry field at 0. This allows for the buffer area to match the new dimensions.

**Example** – For a 30x8 foot grated float being replaced with a 40x8 foot grated float in the LSZ (50% grated, > 60% open space) (Figure 11):

- In the Entry Block for replacement structures, enter 30 and 8 as the length and width respectively.
- In the Entry Block for new structures, enter 10 for the length of the “new/expanded” float, leave the width as 0, and enter 80 square feet as the area of the new/expanded float.
Figure 11. Example Visualization of Replacement Float: Above example where a 30x8 foot grated float is being replaced with a 40x8 foot grated float in the LSZ.

Mooring Buoys
In general, when a mooring buoy reduces or prevents ongoing adverse impacts, mooring buoys do not need to be entered into the Conservation Calculator. This applies in situations where vessels are currently moored in areas where they have adverse impacts and would without the placement of a new mooring buoy likely continue to be moored and have negative impacts. This includes situations where mooring buoys would re-direct vessel moorage away from areas where vessels ground out, or where vessels impact dense SAV (SAV score 2 or more), or areas with any kelp, or any eelgrass. In such cases, the applicant should provide information and evidence of ongoing adverse effects and their reduction based on the placement of the mooring buoys.

Otherwise, mooring buoys act similar to and should be entered into the Conservation Calculator as simple solid floats. Enter the length and width into the yellow entry fields.

The situations where mooring buoys should not be entered into the Conservation Calculator are limited to scenarios where the benefits from indirect effects of the mooring buoys\textsuperscript{16} that are

\textsuperscript{16} Benefits from placement of mooring buoys include redirecting shading associated with vessels away from areas with SAV to areas with less or no SAV and redirecting vessels from areas where they ground out and create sediment disturbance.
otherwise not considered in the Conservation Calculator outweigh the adverse effects from the placement of the mooring buoy. While adverse effects from boats on critical habitat need to be addressed in ESA Section 7 consultations, the Conservation Calculator currently does not assign debits from boats. If, however, unregulated adverse effects from boats exist, are ongoing, and would be reduced by the placement of mooring buoys, the mooring buoys do not have to be entered in the Conservation Calculator as impacting structures.

**Large Solid Decks/Piers**
Generally, elevated decks and piers have a smaller impact than floats because side lighting reduces the amount of shading. However, the wider a deck is, the less effective the side lighting compared to a long and narrow deck (e.g., a pier). In wide decks, much of the center of the deck is not affected by side lighting because light does not reach under the center of a wide deck (Figure 12).

To account for the dark center on wide decks, enter the deck area within 20 feet from the edge as a pier, and enter the remaining center deck area more than 20 feet from the edge as a float; enter the float area directly into the pink entry cell for solid floats.

![Figure 12. Conservation Calculator Entry for Large Solid Decks. Use two different entry zones: The orange center represents the area of a solid deck that is entered as a float due to the lack of light penetration from the sides. The 20 feet gray area is entered as an elevated solid deck. The blue gradient shows how the lighting dims towards the center underneath a large deck.](image)

**Houseboats and other 3-dimensional Overwater Structures**
Three-dimensional structures, including net sheds and houseboats, create a larger shadow than flat decks. To account for the larger shadow, add half of the square footage of the largest shade
producing vertical wall to the area of solid overwater coverage derived from the horizontal coverage (Figure 13).

1) Enter the length and width (Y and X in Figure 13 below) into the yellow entry fields for solid floats.
2) Manually enter the total shade producing area into the pink area entry field for the applicable nearshore zone. The total shade producing area is \( = X*Y + \frac{1}{2}(A*B) \).

![Diagram of a houseboat]

*Figure 13. Houseboats: Three-dimensional Overwater Structure. For Conservation Calculator entry, include height for determining the total shade producing area.*

**Boat Lifts**

Boat lifts are generally entered as solid or grated piers. If the boatlift is covered, the covered area between the pontoons should be entered as a solid pier. Uncovered boat lifts are entered as grated piers. Dimensions of boats (even if stored in the lift) are not entered into the Conservation Calculator. Piles associated with boat lifts are entered as piles.

Pontoons integrated within lifts that are permanently in contact with water should be entered as a complex float (see complex float entry above). Enter the longest length and width of both pontoons as the dimensions, then manually enter the pontoon area (Figure 14).
Repair and Replacement of Overwater Structures

Overlapping Structural Elements: Overwater structures contain overlapping structural elements like float tubes and decking. As debits/credits are based on area impacts, only the element with the largest area should be entered. Use the examples below to inform entries for similar situations.

1. Repairs to the float structural components, such as the frame and stringers: Enter 100% of the float square footage into the calculator (solid or grated surface as applicable) to determine impacts. If float tubes are replaced at the same time, no extra entry is required for float tubes (no double offsets).
2. If decking on a float is proposed to be replaced, enter the area of the decking unless:
   a. Within the last 20 years (first half the design life of a float) the frame and stringers, or decking have been replaced and conservation debits were provided for the entire float or proposed to be replaced element.
   b. Solid well-functioning decking is being replaced with grated decking (see below).

To quantify impacts from repairs and partial replacements with the Conservation Calculator:

1. Enter the footprint as determined using the principles above into Overwater Entry Block for Removal, Removal as Part of Replacements, and Repair.
2. Enter the footprint of the replaced/repaired structure element (proposed), in the Overwater Entry Block for Repair and Replacement. If the footprint of the replaced/repaired structure exceeds the footprint of the existing structure, you need to enter the expanded footprint as new/expanded area, see Figure 10.

Replacement of Well-Functioning Solid Decking with Fully Grated Decking for the Purpose of Reducing Shading

If well-functioning solid decking on overwater structures (floats, ramps, and piers) is proposed to be replaced with fully grated decking (defined as a minimum of 60% open space, in compliance
with WAC 220-660-140), the decking replacement does not have to be entered into the calculator if all of the following conditions are met:

1. The solid decking being replaced is in well-functioning condition with a remaining functional life of more than 10 years (dated photos of existing decking must be provided). If any solid surface on the overwater structure is proposed to be replaced with new solid surface decking, then this condition would not be met. In that case, both grated and solid replacement decking must be entered into the Conservation Calculator because the replacement of the solid surface with solid surface suggests the decking was approaching the end of its design life and needed to be replaced. For example, if solid decking is proposed to be replaced with decking that has a “grated, solid, grated” pattern and all decking is replaced, then all decking replacement and removal would be entered in the Conservation Calculator.

2. Decking replacement aims at reducing adverse effects from shading rather than extending the life of the structure. For example, state and local agencies or tribal entities often ask applicants to replace well-functioning solid decking with grated decking to reduce impacts. Such replacements would not have to be entered into the Conservation Calculator if conditions 1 and 3 in this description are also met.

3. No other structural replacements on the subject structure beyond decking are proposed. If other replacements or upgrades (like the replacement of piles, frame, stringers or float tubes) are proposed at time of the decking replacement, or within the 10 years following the decking replacement, all elements must be entered into the Conservation Calculator. The rationale is that the replacement of other elements at the same time or within 10 years suggests that at the time of decking replacement condition (#1 above) was not met and the structure, including the solid decking, had no more than 10 years of remaining functional life left.

If an applicant proposes to replace additional components of an overwater structure within ten years of replacing the solid decking, the evaluation of the later-proposed project would likely need to consider the long-term impacts of the previously replaced decking. In other words, the completed solid decking replacement will have to be entered into the Conservation Calculator along with the proposed project at the time of the later replacement.

Example – If the upgrade of an old float includes the replacement of solid decking with grated decking along with replacement of a float tube, then all elements are entered in the Conservation Calculator.

---

17 If the decking replacement is not entered into the Conservation Calculator, there will be no removal credit for the removal of the solid decking. This is based on the fact that the removal credit for solid decking with a remaining life of approximately 30 years is about equal to the placement of the same area of grated decking with a design life of 40 years.

18 Expected remaining life is more than 10 years.
Example – If a float that had its solid decking replaced under this provision and proposes nine years later to replace a different float element, the replaced decking has to be considered retroactively as the replacement of other float elements suggests that the float including the solid decking had less than 10 years of remaining life left and did not meet the conditions above.

**Piles**

This section outlines specifics regarding entering different types of piles into the *Overwater Structures* tab of the Conservation Calculator.

1) Structural piles excluding batter piles, or fender piles: (a) entering the number of piles to be placed, replaced or repaired and (b) entering the diameter of piles.

2) Multiple pile sizes: If different pile sizes are being installed, enter the average diameter of all the piles. A quick-use calculator provided in the *Overwater Structures* tab at row 129 allows for easy determination of the average pile diameter for each nearshore zone.

3) Batter piles and fender piles: Enter installation of new but not replacement piles. This is a simplified approach to account for the frequent replacement of non-structural piles intended to be hit by vessels.

4) Creosote removal: Residential creosote piles usually weigh ½ a ton or less rather than the 1 ton for industrial-sized, 70-ft-long piles. Use the tonnage estimator provided in the *Overwater Structures* tab at row 154 to determine the weight of creosote treated wood piles for known length and average diameter. Long wood piles often vary in diameter between top and bottom. Use average pile diameter for weight estimation.

5) Monitoring/Reporting of Creosote removal: After creosote removal and upland disposal, applicants must submit the disposal receipts and a picture of the dump truck on the scale to the Services. Disposal receipts need to contain actual weight of the total removed creosote. *Estimated credit calculations may require adjustment if the estimated creosote removal weight is greater or less than the actual disposed quantity.* The Services may use the average difference between estimated and actual creosote removal quantities over a year as an adjustment factor for the following year. In other words, if year one estimates were on average 8% higher than actual disposal quantities, then all estimated creosote removal quantities may be automatically discounted by 8% in year two.

6) Pile Repair: Pile repair (including adding sleeves/jackets) extends the life of a pile just like a replacement. Thus, enter the numbers of repaired piles including their increased diameter (example below) along with replaced piles. Removal credit applies to repairing piles.

   **Example** – Pile jacketing increases the diameter of piles. Enter the average pile diameter for partially jacketed piles and the number of to-be-repaired piles in Entry Block II: Repair and Replace of Overwater Structure Elements. Also enter the number of to-be-repaired piles and existing diameter of the old piles in Entry Block III: Removal. In terms of effects to habitat, repairs and replacements are similar and thus treated the same in the Conservation Calculator.
If creosote piles are repaired, enter only the weight of creosote treated wood that is proposed to be removed in the entry cell for "tons of creosote to be removed." If strut repair is proposed, usually the bottom section of the creosote pile remains in place.

**Crediting/Debiting Factors for OWS**
As described in the *General Information Applicable to Most Tabs: Credit/Debit Factors* section below, effects to habitat features that are especially important to Puget Sound Chinook and Hood Canal summer-run chum are multiplied by a factor. This gives more weight to the impact/credit of a proposed action on these especially important habitats. New in Conservation Calculator V 1.4, crediting/debiting factors can be entered in the ProjectD tab. They are applicable to the entire project. If a project consists of different locations that required application of different credit/debit factors, please fill out one Conservation Calculator per project location. We found that in Conservation Calculator V 1.3, applicants rarely used the separate entry blocks for credit/debit factors that allows for the installation of a new structure and the removal of an existing structure to be at different locations.

Floats in the DSZ in herring spawning and holding areas may have a herring factor applied depending on site conditions. The application of the herring spawning & holding factor to OWS in the DSZ is based on the consulting biologist’s and WDFW’s assessment of impacts related to the proximity of structure to holding and spawning areas, the size, type, and configuration of the proposed structure, and frequency and duration of use of the affected area.

**Tab 5: ShorelStab (Shoreline Stabilization)**

**Hard Armoring**
Shoreline armoring results in reducing the available nearshore habitat landward of hard armoring. Hard armoring cuts off access to the shallow nearshore area that is preferred early marine rearing habitat for juvenile PS Chinook salmon. This is called *intertidal encroachment* and is depicted in Figure 15. Intertidal encroachment encompasses the area between the toe of armoring and the HAT. Critical habitat for PS Chinook salmon is listed under the ESA up to the HAT (50 CFR 226.212). Hard shoreline armoring can also reduce the habitat quality waterward of the hard armoring via adverse effects. Such adverse effects include reducing wrack and large wood accumulation (and thus food availability for juvenile salmonids, also known as habitat provision), changing the wave regime (wave reflection), coarsening substrate, and lowering the beach profile (Figure 16) (Dethier et al. 2016a; Dethier et al. 2016b; Heerhartz et al. 2014; Heerhartz et al. 2016; Prosser et al. 2018). The Conservation Calculator evaluates these impacts to intertidal critical habitat for ESA-listed PS Chinook and Hood Canal summer-run chum salmon via an area based functional assessment. It evaluates the respective functional loss for the area of the intertidal encroachment and for a standard area waterward of armoring. Most functional loss occurs via intertidal encroachment.
Figure 15. Intertidal encroachment. Figure designed by Paul Cereghino.
The Conservation Calculator determines the area of intertidal encroachment considering the following three factors:

1. The length of the armoring
2. The location (elevation) of the toe of armoring relative to Mean Higher High Water (MHHW), and
3. The distance between MHHW and HAT

For the first factor, the length of armoring paralleling the shoreline should be taken from design plans. At times, armoring may wrap into the upland or encircle features jutting out into the intertidal. For such situations, the length relevant for the Conservation Calculator is the length parallel to the shoreline, only. Also see Figure 17.
The second factor, the elevation of the toe of armoring\textsuperscript{19} relative to MHHW, also is taken from design drawings. If no survey information is available to determine the elevation of the toe of hard armoring, follow the instructions in the \textit{Toe of Armoring Relative to MHHW} section on page 50 of this guide for approximating the toe elevation.

To determine the third piece of information necessary for calculating the affected area, the distance between MHHW and HAT, NOAA recently developed an approach. We document this approach in more detail in Cereghino et al. (2022) (NOAA White Paper \textit{in draft}). In short, NOAA developed tidal contour lines for the entire Puget Sound region outlining MHHW and HAT. We used NOAA tidal datum model outputs and a USGS high-resolution topobathymetric digital elevation model. These tidal contour lines provide site-specific elevations. Tidal contour lines are currently available on NOAA’s GIS server at https://noaa.maps.arcgis.com/home/item.html?id=69c1c16ba7c8473d890e9eaed9fc6d4f#visualize.

We used the horizontal distance between MHHW and HAT based on typical beach slopes rather than measuring site specific distances in the GIS layer. Reasons include that determining site-

\textsuperscript{19} The toe of a bulkhead, for the purpose of Conservation Calculator entry, is where the sand or other beach substrate naturally meets the bulkhead, not at the deepest portion of the bulkhead (extending below the beach grade).
specific horizontal distances between MHHW and HAT is subject to errors related to limited resolution (1 meter for recent USGS CoNED 2020 data), low confidence of the method at beaches with steep slopes, inter-annual beach profile variability, and finally that site-specific distances between MHHW and HAT cannot consistently be determined at hydromodified sites. To reduce errors, NOAA developed typical average beach slope values for unarmored beaches stratified by marine basin and beach type (Table 3). NOAA used the beach types described by MacLennan et al. 2017. In the Conservation Calculator, these typical beach slopes can then be used in combination with the site-specific elevations for MHHW and HAT taken from the GIS contour elevation lines to derive the site-specific distance between MHHW and HAT. NOAA documents the results from this approach in Table 5: InputShorel of the Conservation Calculator.

The formulaic expression of the horizontal distance between MHHW and HAT is:

\[
\text{Horizontal Distance (HAT - MHHW)} = \frac{\text{site specific: HAT elevation} - \text{MHHW elevation}}{\text{typical slope (taken from Table 3)}}.
\]

The horizontal distance between MHHW and HAT is determined by a Service biologist on the InputShorel tab. The result will be entered by a Service biologist in cell C32 of the ShorelStab tab.

<table>
<thead>
<tr>
<th>Typical Stratified Beach Slopes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basin/Service Area</td>
</tr>
<tr>
<td>Hood Canal</td>
</tr>
<tr>
<td>Hood Canal</td>
</tr>
<tr>
<td>Hood Canal</td>
</tr>
<tr>
<td>Hood Canal</td>
</tr>
<tr>
<td>North Puget Sound</td>
</tr>
<tr>
<td>North Puget Sound</td>
</tr>
<tr>
<td>North Puget Sound</td>
</tr>
</tbody>
</table>

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20 Hydromodified sites are sites where the beach profile has been altered by structures, for example existing bulkheads.
<table>
<thead>
<tr>
<th>Marine Basin</th>
<th>Beach Type</th>
<th>Slope</th>
<th>Degree</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Puget Sound</td>
<td>Transport</td>
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<td>79.9</td>
<td>38.6</td>
</tr>
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<td>Accretion</td>
<td>0.134</td>
<td>13.4</td>
<td>7.6</td>
</tr>
<tr>
<td>South Central Puget Sound</td>
<td>Feeder Bluff</td>
<td>0.316</td>
<td>31.6</td>
<td>17.5</td>
</tr>
<tr>
<td>South Central Puget Sound</td>
<td>FB Exceptional</td>
<td>0.26</td>
<td>26</td>
<td>14.6</td>
</tr>
<tr>
<td>South Central Puget Sound</td>
<td>Transport</td>
<td>0.295</td>
<td>29.5</td>
<td>16.4</td>
</tr>
<tr>
<td>Strait of Juan de Fuca</td>
<td>Accretion</td>
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<td>12.6</td>
<td>7.18</td>
</tr>
<tr>
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<td>26.2</td>
<td></td>
</tr>
</tbody>
</table>

Table 3. Typical stratified beach slopes by marine basin, beach type, and their slopes. This table is included in the ProjectID tab of the Conservation Calculator.

* What is a 25% slope? A 25% slope is simply a ratio of 25:100. In other words, the ground rises 2.5 inches every 10 inches of horizontal distance.

** How does percent slope relate to degrees? A 100% slope corresponds to 45 degrees. Convert the slope percentage to a ratio (slope (rise over run)) and look up the ratio in a tangent table.

Additional notes:
- See NOAA’s Nearshore Conservation Calculator webpage for basin/service areas map.
- For sites at hydromodified locations, use adjacent beach types.
- For sites with “no appreciable drift,” err on the side of the species and use the lowest slope value for that basin. Such sites (unless misclassified) often do not need armoring; instead, consider a hybrid approach.

**Soft and Hybrid Bank Stabilization**
Placement of soft or hybrid bank stabilization currently does not incur debits as it mostly allows aquatic access across the elements of stabilization. Replacing hard armoring with soft or hybrid approaches can result in conservation credits. Soft and hybrid armoring are defined below.
Soft Shoreline Treatments - Soft shore approaches allow for the following functions:

- Connectivity between terrestrial and aquatic habitats
- Natural fine sediment transport or accretion rates (i.e., does not coarsen the substrate)
- Does not inhibit sediment transport from upslope sources
- Retains native vegetation
- Supports forage fish spawning
- Does not increase erosion on the project beach or on adjacent properties
- Does not cause lowering of beach elevation
- Allows for woody debris and wrack to accumulate

Criteria for soft shore approaches:

1. No, or minimal, use of artificial structural elements
2. Incorporate beach nourishment (sand and small gravel)
3. Incorporate riparian plantings or allow for recruitment of native vegetation, including overhanging vegetation
4. Incorporate or allow for large wood recruitment, including allowances for small toe erosion protection where necessary, but where the wood does not act as a berm or a crib.
5. Large wood may be chained as part of the design.
6. Boulders may be incorporated into the design, but must not be used as a primary slope stabilizing element.
7. Degradable fabric and support filters may be used but must be designed and constructed to prevent surface exposure of the material through time.
8. Cannot not resemble a wall in any respect

Hybrid Shoreline Treatments – Hybrid shore approaches allow for the following functions:

- The hybrid method itself does not inhibit sediment transport from upslope sources (e.g., an adjacent road that is not part of the project may inhibit sediment transport that would not reflect on the hybrid technique).
- Retains native vegetation
- Supports forage fish spawning
- Does not increase erosion on the project beach or on adjacent properties
- Minimizes lowering of beach elevation
- Allows for woody debris and wrack to accumulate

Criteria for hybrid approaches:

1. Contains artificial structure that allows for some biological processes to occur (such as forage fish spawning), but inhibits some ecological processes from fully occurring (such
as suppressing some sediment transport, supply or accretion, but not fully ceasing the process as with hardened approaches).

2. Exposed rock, if used, must be discontinuously placed on the beach (i.e., not act as a berm or scour sediments)

3. For any individual project, a hybrid approach may not contain more than 30% of exposed rock as measured against the length of the project beach.

4. Buried rock may be used below grade where necessary to stabilize the toe of the slope, but must not form a wall or resemble rip rap, and must be covered with sand/small gravel mixes in such a way to minimize net erosion through time.

5. Incorporate beach nourishment (sand and small gravel) as needed to minimize lowering of beach grade and net erosion.

**Repair of Shoreline Armoring**

If shoreline armoring is repaired in place, treat it the same as a replacement:

1. Fill in the metrics for replacement armoring in Entry Block I: Armoring to be Installed
2. Click “yes” for replacement
3. Fill in the metrics of the armoring to be repaired in Entry Block II

If a shoreline armoring repair does not remove the old structure but places a replacement structure waterward of the existing armoring or encases the existing structure with material to extend the life of the structure, proceed as explained above. However, reflect the new impact footprint in the slope distance in Entry Block I: Armoring to be Installed.

Repairs involving creosote: When repairing structures that contain creosote, creosote removal credit applies only to removed quantities of creosote.

**COMMON QUESTION: When does removal of an existing bulkhead (BH) generate credit?**

1. As with all structures that are proposed to be removed, removal credit\textsuperscript{21} is tied to the structure being in good condition. For a bulkhead, that means the area landward of the structure is cut off from tides and aquatic access, preventing natural processes from occurring and aquatic use of that habitat.

2. Creosote bulkhead remnants that no longer function as a bulkhead anymore should be entered into the Conservation Calculator as creosote removal only. See Figure 18 and Figure 19 for examples of non-functioning bulkheads that would not be considered in good condition.

3. Concrete bulkhead remnants that no longer function as a bulkhead should be entered into the Conservation Calculator as rubble removal only.

\textsuperscript{21} For a standard remaining life of 10 years.
Figure 18. Removal Credits for Old Creosote Bulkhead: Removal credit applied for creosote, not for remnants of bulkhead. Picture by and with permission from Doris Small, WDFW.
Figure 19. Removal Credits for Non-Functional Shoreline Armoring that is not in good condition. Removal credits do not apply for horizontal pile stabilizer as there is no functioning bulkhead effect (like sediment retention behind the bulkhead or elimination of water exchange).

**Site Conditions Landward of Hard Armoring**

This section assesses the value of the riparian habitat rendered inaccessible to fish via armoring. The inputs in cells C5-C7 are used to determine the area weighted habitat value of the riparian habitat after installation (new or replacement) of armoring. If just one habitat type is present, it is sufficient to enter a 1 into the respective row. If there is a 50% split of the area between two habitat types, enter a 1 into each row for respective habitat types. For more complicated scenarios, enter respective Square Foot for each habitat type.

For armor installation, the conditions described need to match the *after* conditions in the *RZ* tab (column G) if any changes in the RZ are proposed. Evaluate habitat improvement/degradation through actions like tree or shrub plantings separately in the RZ spreadsheet/tab.

For standalone shoreline armor removal projects, describe the before RZ conditions in cells C5 through C6. Armor removal is also entered in the *RZ* tab as a change from before = armored to after = unarmored in Row 21. The reverse is also true.

**Toe of Armoring Relative to MHHW**

This entry is needed for *Tab 5: ShorelStab* cells C15, C16 and C30, C31.

Toe of Bulkheads: The toe of a bulkhead, for the purpose of entry into the Conservation Calculator, is where the sand or other beach substrate naturally meets the bulkhead, at grade. Often, we receive bulkhead replacement project packages where MHHW is not known or shown on a cross section of a bulkhead.
The following steps can be taken for bulkheads where the elevation of MHHW is not known or documented at the site:

1) If a beach survey is available: Use the beach survey to determine whether the toe of the armoring is located above or below MHHW (cell C 15 and C 30). Then determine how much the toe of armoring is located above or below MHHW (cell C 16 and C 31). If the distance between the toe of armoring and MHHW water varies along the armoring, calculate a length weighted average and document your determination in Tab 2: ProjectD.

2) If no beach survey is available: We realize that surveys are costly and noticed that many armor replacement projects do not provide information on the toe elevation. This is our currently best draft approach to determining the toe elevation absent a survey. We appreciate your feedback and improvement suggestions.

   a. Locate the nearest tidal station to the project in the NOAA Tides and Currents map. On the search bar, click “Advanced,” and under “Data Type” select “Datums.” On the map, click on the red location marker that is closest (by water) to your project site. The maker symbolizes a NOAA tidal station with tide predictions and datums. An information box for that station will open. In the information box click on the “Station Home” drop down menu in the upper right corner. This will bring you to the tidal station home page.

   b. On the top of the station home page, click on the “Tides/Water Levels” drop down and click on “Datums.” This will open a page showing tidal data for this station. Record the MHHW value shown towards the top of the elevations list. All data values are relative to the Mean Lower Low Water (MLLW). Note - some tidal stations do not have a “Datums” page. If this is the case, go back to the station map and locate the next closest tidal station.

   c. From there, go back up to the “Tides/Water Levels” drop down menu at the top of the page and click on “NOAA Tide Predictions.” This will open a page showing tidal predictions for the station. Using the chart’s date options, locate days when a high tide (either the high tide or higher high tide) is near (within 0.1 foot) of the MHHW value recorded in step b.

   i. You can click the blue button “plot calendar” on the bottom right to show an entire month of high and low tides.
ii. Hover your mouse over a high tide that is within 0.1 ft of the Datum MHHW value to find out the exact time that high tide will occur. Take a screenshot or your result.

iii. Alternatively, you can find a high tide within 0.1 ft of MHHW using the Data Listing below the graphic.

d. At the bulkhead site, take clear photographs within 10 minutes of the high tide time as determined above (where high tide is within 0.1 ft of the MHHW for the closest NOAA Tide Predictions station). Photos need to show:
   i. The water in relation to the bulkhead as viewed from multiple angles and along the entire existing bulkhead, at multiple photo locations.
   ii. Have a date, time, and GPS stamp. (Free smartphone apps can create this stamp see “Timestamp Camera Enterprise” for iPhone or android)
   iii. Include an object for scale reference (such as a 5-gallon bucket).
   iv. For armoring above MHHW: Lay out a tape measure from the water line landward to the bulkhead toe to determine the distance between the toe of armoring and the water. Take photos of the tape measure documenting this distance. If the distance between the toe and the waterline varies across the length, take several pictures and develop an area weighted average distance. Enter that distance in cell C 31 and/or C 16 depending on whether this is a replacement or new installation.
   v. For armoring below MHHW: Hold a tape measure showing the vertical distance between the toe of armoring and the water level. If you can’t find or see the toe of the armoring (this can be challenging with rip-rap) use a marker to mark where the water level was at high tide and take a picture with a date stamp showing the mark at high tide. At low tide, take a second picture identifying the vertical distance between the MHHW line and the toe of the bulkhead. Use the appropriate slope from Table 3 (Tab 6: InputShorel) to determine the horizontal distance between the toe of the armoring and MHHW. Enter that distance in cell C 31 and/or C 16 depending on whether this is a replacement or new installation.

e. We would greatly appreciate it if you can take the time and submit distance determinations from two separate days. We are still in the test phase for this method and are trying to evaluate possible variability between different dates.

f. Submit these photos in an email along with the NWS and WCRO project number and which tidal reference station was used to the NOAA project biologist or PSNearshoreConservation.WCR@noaa.gov.

g. A NOAA biologist will review the submitted information and will update the Nearshore Conservation Calculator (if applicable). The biologist may also request additional information.

Tab 6: InputShorel
This tab supports entries for Tab 5: ShorelStab. It is designed to determine the horizontal distances between MHHW and HAT and between MHHW and the toe of armoring in feet.

To determine the horizontal distance between MHHW and HAT:
1. Open NOAA’s Beach Slope Reference Line GIS layer located at: 
   https://noaa.maps.arcgis.com/home/item.html?id=69c1c16ba7c8473d890e9eaed9fc6d4f#visualize.
2. Locate your project site and click on the reference line to open the information box.
3. Copy the MHHW and HAT elevations in feet from the information box (see Figure 20) into cells B6 and C6 in the InputShorel tab.
4. Using the Marine Basin Name and Shoretype_Beach from the information box, go to the the InputShorel tab to find the appropriate slope value in column K of the Typical Stratified Beach Slopes table.
5. In the InputShorel tab, enter or link the slope value from column K into cell D6. You can either type the slope value directly into cell D6, or link cell D6 to the applicable beach slope cell. For example, for a Hood Canal Accretion beach type you would enter “=K3” into cell D6.
6. Sea level rise was determined for three distinct areas: The Strait of Juan de Fuca, North Puget Sound, and a combination of South Central Puget Sound, Whidbey, and Hood Canal marine basins. No additional entries are needed for inclusion of sea level rise.

The site appropriate horizontal distance between MHHW and HAT in feet is calculated and displayed in E6 on the InputShorel tab. It is automatically copied into cells C17 and C32 in the ShorelStab tab.

Figure 20. Beach Slope Reference Line Information Box.
**Horizontal Distances between MHHW and the toe of armoring** can be determined in row 15 for installation and row 19 for removal of armoring. The only needed entry is the vertical distance between MHHW and the toe of the bulkhead which is to be entered in the yellow entry cells B/C10 and B/C14. Site-specific typical beach slopes are automatically copied over from cell D6. The resulting horizontal distance between MHHW and the toe of armoring is automatically copied over into the ShoreStab tab.

**Sea Level Rise**
Climate Change will cause varying levels of sea level rise in Puget Sound. Sea level rise will cause bulkheads to cut off increasing areas of intertidal habitat from aquatic access. Sea level rise at sites with bulkheads means that the water level will move up on the bulkhead; MHHW and HAT will be higher on the beach while the toe of the BH remains in the same location. Effectively, sea level rise lowers the elevation of the toe of the armoring.

The Conservation Calculator includes the effect of average sea level rise for hard armoring for three distinct areas: the Strait of Juan de Fuca, the North Puget Sound marine basin, and the remaining three basins combined (*Tab 5: InputShorel rows 25 through 29*). We chose this breakout based on geographic distribution of basin average rise projections.

- We used a middle of the road (50% exceedance probability) for the sea level rise prediction scenario.
- We used a low Representative Concentrations Pathways (RCP 4.5) greenhouse gas scenario
- We used the sea level rise scenario for 2050 as that is commonly available. This, again, will provide a rather low estimate as it uses a time horizon below the design life of a bulkhead (50 years).
- Including sea level rise predictions for 2050 as though they would occur now provides a conservative estimate because in HEA habitat now is more valuable than habitat in 40 years.

**Fill Waterward of an Existing Bulkhead**
Replacement/addition of fill (like rip-rap, rocks, ecology blocks) waterward of an existing bulkhead should be entered into the Conservation Calculator as a jetty with dimensions equal to the birds-eye-view length and width (and/or square footage) of habitat covered by the fill.

However, depending on the site-specific scenario, the NOAA biologist will evaluate whether the amount and type of fill is functioning as a new bulkhead. In that case, the new fill may be entered as a bulkhead.

**Materials Added to the Toe of an Existing Bulkhead**
If new material, such as logs or concrete, is permanently affixed to the toe of an existing bulkhead (to prevent scour or otherwise protect an existing bulkhead), the footprint of that material is entered into the Conservation Calculator in the *BoatR, Jetty* tab as “concrete footings” (‘No’ in cell E10) in the Boat Ramp Installation block. Dimensions entered in the USZ are the birds-eye-view length and width of the attached materials.

Habitat logs with attached root-wads generally don’t have to be entered in the Conservation Calculator. You should discuss the site-specific function of habitat logs with one of the Service’s
project biologists. Depending on the site-specific scenario, the NOAA biologist will evaluate whether the amount and type of material anchored may function like a replacement bulkhead. If this is the case, materials anchored to the existing bulkhead toe may be entered as a replacement bulkhead.

**Staircases on Bulkheads**

Impacts to habitat caused by replaced or new solid-structure\(^{22}\) staircases are similar to the adjacent bulkhead because the stairs, themselves, also function as a bulkhead. Staircases that are in line with a bulkhead (i.e., not extending waterward) are simply added to the total linear feet of the bulkhead.

If stairs extend waterward of a bulkhead, either parallel or in another configuration, we expect additional adverse effects from the footprint of the stairs and landing. In that case, enter the entire bulkhead in the **ShorelStab** tab (if it is being replaced) and the length and width of the protruding stairs as a boat ramp in the **BoatR, Jetty** tab.

Stairs that are inset landward of the bulkhead eliminate slightly less habitat than the adjacent bulkhead. This may be accounted for in different ways. The stairs may be entered separately (in a new **ShorelStab** tab in a different calculator) as a bulkhead with a reduced horizontal beach slope distance. Alternatively, both the stairs and bulkhead can be entered as a single bulkhead, the total linear feet (bulkhead + stairs) is then entered with an averaged horizontal beach slope distance based on a weighted horizontal distance accounting for the stair inset.

**Example** – A concrete bulkhead of 50 feet (total) will be replaced. The horizontal beach slope distance from the bulkhead toe to MHHW, as determined in the **InputShorel** tab, is 8 and the horizontal distance from MHHW to HAT, also determined in **InputShorel** tab, is 15. The bulkhead has a 5-foot section with an inset stairway. The stairway is inset such that 3 feet of exposed beach exists from the bottom step out to the bulkhead wall. The bulkhead (sans stairs) may be entered separately as a 45 linear foot bulkhead with the site-specific horizontal distances (8 and 15). The 5-foot stairwell can then be entered in Calculator #2 as a 5 linear foot bulkhead with a reduced horizontal distance between the toe and MHHW (5 and 15). Or, the total wall (including stairs) can be entered as 50 linear feet with a weighted average of horizontal slope distances (between the toe and MHHW) between these pieces. \((5 \times 5) + (45 \times 8))/50 = 7.7\)

**Tab 7: MDredging (Maintenance Dredging)**

- The Conservation Calculator currently does not evaluate new dredging/deepening.
- The zone (LSZ or DSZ) is determined by the depth of the existing habitat, not the proposed dredge depth.
- The SAV scenario is usually 0 (zero) for maintenance dredging as very little to no SAV grows in areas frequently disturbed. While maintenance dredging could extend the

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\(^{22}\) Meaning water is not able to flow freely under the staircase. Solid structure staircases are typically rock or concrete, but may be wooden.
duration for which SAV cannot establish, it is usually too speculative to address what type of SAV might be present in the absence of dredging. However, if SAV establishes between dredging, the respective SAV rating should be entered as before condition. Further, if dredging clearly interrupts an eelgrass bed or SAV, then the SAV condition from the surrounding area should be used.

- Credit/debit factors apply to maintenance dredging.
- The Conservation Calculator considers impacts on SAV, sediment quality and forage, and the shallow water migratory corridor to last a combined average of three years. Thus, for multi-year dredge permits, impacts of dredging should be evaluated for every dredging event. This can be done via either summing up the dredged area over the multiple dredge events and entering that sum into the MDredging tab or duplicating the dredging tab and entering each dredging event in its own tab.

**Tab 8: BoatR, Jetty (Boat Ramps and Jetties)**
- Enter the SAV scenario as noted in the General Information section below and in the Reference tab of the calculator.
- Use this tab to calculate credit for removal of concrete, rubble and debris.
- Credit/debit factors do apply to boat ramp, jetty and rubble removal work.

**Marine Rails**
Marine rails resting on the sediment should be entered in the BoatR, Jetty tab. Enter the square footage of the solid metal rails as viewed from above (not the open space in between) as a boat ramp. If the square footage of the rail is unknown, use a default of 1 square foot for every 1 foot of length of the two parallel marine rails (based on measurements of terrestrial rails, see Figure 21). For example, if a marine rail system is 50 feet long and 8 feet wide, enter 50 in the length of the boat ramp to be removed field and 1 (2* 0.5 ft) in the width of the boat ramp to be removed. Enter the area of concrete footings and/or stub piles associated with the rails in the BoatR, Jetty tab under concrete footings.

Elevated rails should be entered in the Overwater Structures tab. Enter the length and width of elevated rails as a solid pier.

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23 The effects of removal of sediment and invertebrate prey usually extend over two years (Boese et al. 2009, Dethier and Schoch 2005; Jones and Stokes 1998; McCabe et al 1998). Maintenance dredging occurs at regular intervals; depending on the location every two to five years (pers. com Daniel Krenz, 2020). After dredging, the dredged area starts to silt back in and the habitat functions of the migratory corridor gradually increase. We chose a conservative impact duration for the reduction in migratory corridor function of four years. The average impact duration of three years used for the HEA analysis is based on these two time horizons.
Tab 9: Beach N (Beach Nourishment)
We usually rely on WDFW expertise in determining whether beach nourishment is appropriate for the project location. We welcome WDFW input on site-specific quantities and the technique of placement.

To ensure beach nourishment is ultimately beneficial for juvenile salmonids and will generate conservation credits, the following considerations need to be met:

- Placement of beach nourishment should follow considerations detailed in WDFW Marine Shoreline Design Guidelines (MSDG), 2014.
- Beach nourishment must demonstrate appropriate grain-size profile for target species and sediment supplementation rate according to estimated sediment erosion rates for sites and drift cell reaches.
- Dumping or disposal of non-native material, dredged material, or upland fill is excluded if it does not meet grain size and supplementation rate conditions.
- When placing material in areas known to have forage fish spawning, placement will adhere to timing windows protective of forage fish.
- Place beach nourishment within 9 linear feet of a bulkhead and at 6 inches depth for each foot of shoreline armoring. This recommendation results in 4.5 cubic feet per linear foot (pers. com WDFW).
- Beach nourishment may be piled up against armoring or spread out depending on agency biologists’ site-specific instructions.
Placement and anchoring of large woody material may be required to lengthen the retention of beach nourishment to meet the benefit period used in the Conservation Calculator.

Material has to be clean and suitable for nearshore habitat enhancement/restoration.

**Beware:**

- Site-specific recommendations will vary.
- Usually, we do not credit placement or beach nourishment in the “No Appreciable Drift” or “Accretion Shoreform” shore types, as shown in WDOE’s Coastal Atlas map.
- If the function of the application of beach nourishment appears to be stabilization of structure placement rather than addressing lack of substrate, the activity may not generate credits.

**Tab 10: SAV Planting**

To generate conservation credits for SAV planting, submit a planting plan, performance standards, a monitoring plan, and a site protection instrument where applicable with your consultation initiation package. You can find an example of a mitigation plan at: Components of a Mitigation Plan (4) site protections instrument; information on deed restrictions associated with compensatory mitigation here; and an example of a Mitigation Monitoring Report for riparian plantings can be found here.

**Tab 11: Reference**

The Reference tab provides background information including:

1) The cover categories for submerged aquatic vegetation and USZ vegetation;
2) The delineation of shore zones for the Riparian Zone, Upper Shore, Lower Shore, and Deep Shore Zones
3) Complex float length and width determination for overwater structure (OWS) tab.

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References


