Puget Sound Nearshore "Conservation Calculator" User Guide

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Version 1.0

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Background Material for the Conservation Calculator

What is the Puget Sound Nearshore "Conservation Calculator"?

This "conservation calculator" is a user-friendly tool that simplifies the complex application of the Habitat Equivalency Analysis (HEA) and Nearshore Habitat Values Model (NHVM). The goal of the conservation calculator is to quantify the habitat impacts from a proposed re-development/development projects and the habitat benefits from restoration projects in terms of a common habitat currency.

The HEA methodology assesses impacts and benefits to habitat. Ecological equivalency that forms the basis of HEA is a concept that uses a common currency (DSAYs, Figure 1) to express and assign a value to functional habitat loss and gain. Ecological equivalency is a service-to-service approach where the ecological services for a species or group of species impacted by an activity are fully offset by the services gained from a conservation activity.

HEA was developed by the NOAA Restoration Center in cooperation with stakeholders and has become a common method for Natural Resource Damage Assessments (NRDA). The National Marine Fisheries Service (NMFS) chose the HEA methodology for its ESA consultation and developed the Nearshore Habitat Values Model (NHVM) and conservation calculator to facilitate its use. The reasons for using HEA include that it adopts and requires a high standard of scientific input and rigor and as well as the fact that this method has withstood multiple legal challenges that can occur during NRDA proceedings.

The use of HEA requires several input parameters including habitat values (Figure 1). A team of NMFS biologists developed a Nearshore Habitat Values Model (NHVM) to aid in determining these habitat values specific to the Puget Sound. The NHVM's structure and values are specific to quantifying habitat conditions for the designated critical habitat of listed Puget Sound Chinook and Hood Canal summer run chum. The NHVM design and values were derived from scientific literature and best available information as required by the ESA. The NHVM accounts for a range of habitat values (low to high depending on functionality and importance to the species). It allows for consistent determination of habitat values across the Puget Sound nearshore through consideration of site specific conditions.

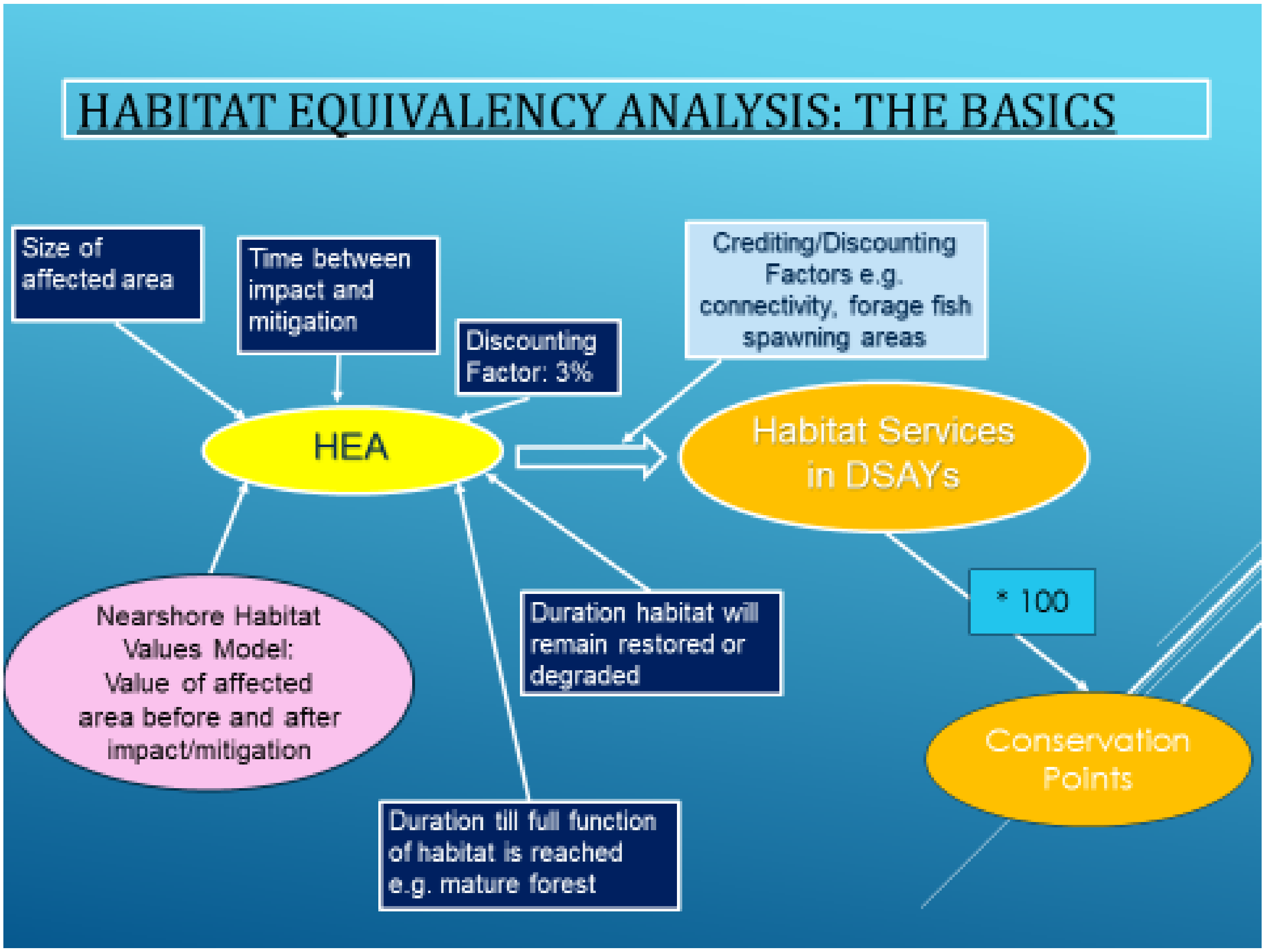
For Endangered Species Act (ESA) consultations, the NMFS and United States Fish and Wildlife Service (USFWS, collectively "the Services") developed the user friendly conservation calculator which is an easy interface to the HEA and the NHVM. The conservation calculator facilitates the HEA and the NHVM quantification of changes in nearshore habitat function (Figure 2). It determines debits resulting from projects that decrease habitat function and credits which are associated with increases in nearshore habitat function. The conservation calculator allows users to assess how credits from project modification and restoration actions can offset debits resulting from the maintenance, replacement, expansion, or new construction of nearshore structures.

The Puget Sound conservation calculator allows the Services to assess habitat impacts/benefits from several actions including:

- Addition of new, replacement, and removal of overwater structures including: piers, ramps, floats, house-boats, decks, and piles.
- Removal of creosote.
- Addition of new, replacement, and removal of shoreline armoring.
- Addition of new, replacement, and removal of boat ramps, jetties, and rubble.
- Addition of new, and removal of riparian plantings.
- Addition of forage fish spawning supplement/beach nourishment.

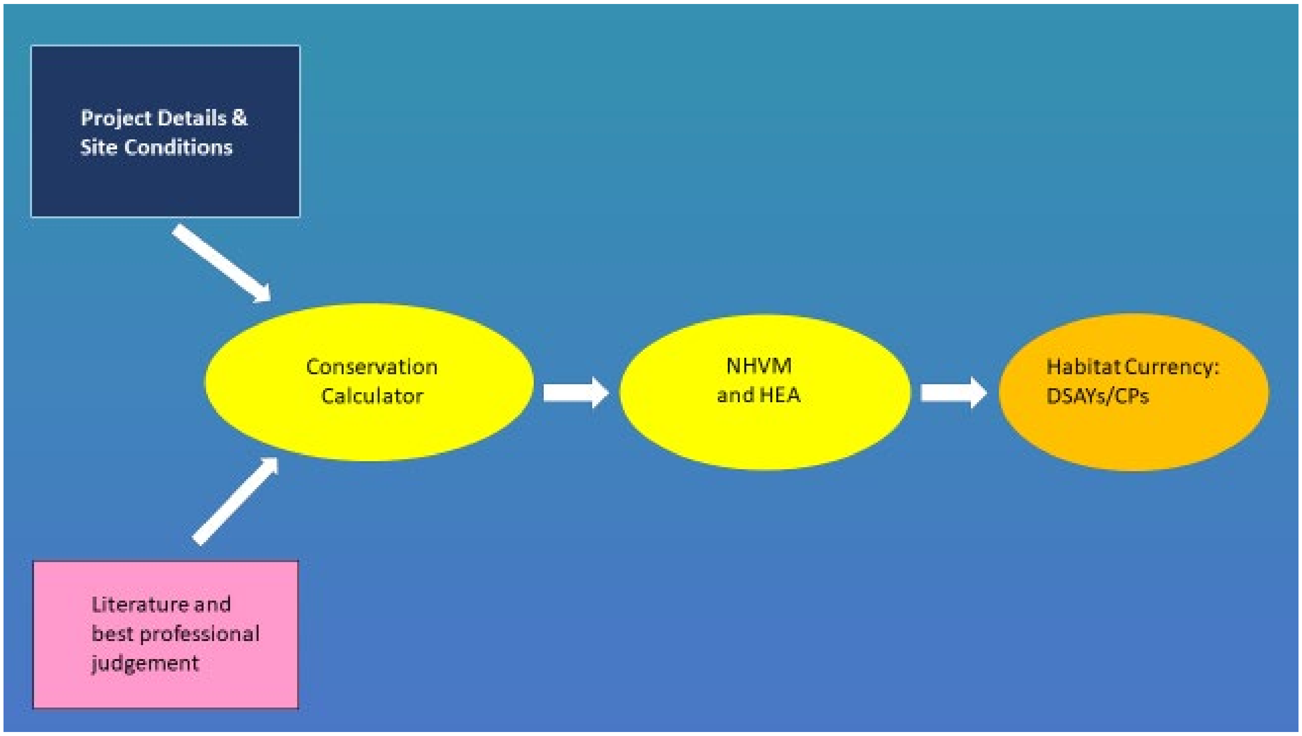
The NHVM and conservation calculator are adaptable and allow for updates. The Services will update as new science or best available information becomes available. The NHVM and conservation calculator also allow for expanding the types of analysis to account for the different types of nearshore develop actions that could occur. Note: these changes, if necessary, will be scheduled for predictable and regular updates (see below for more specifics on this).

Figure 1: Habitat Equivalency Analysis



DSAYs: Discounted Service Acre Years – common habitat currency

Figure 2: The Conservation Calculator, an easy interface for HEA and the NHVM



Calculator User Requirements

The conservation calculator is a tool that can be used by agency staff, environmental consultants, non-profit and corporate staff, and occasionally project proponents. Users may download the conservation calculator and enter project specifications in the conservation calculator to determine credit/debit outputs. These outputs can be submitted as part of the Endangered Species Act consultation package. The complete project-specific calculator outputs, together with a project description has to be part of the consultation initiation requests submitted to the Services from the respective Federal action agencies.

Use of this calculator requires a moderate to substantial knowledge of nearshore ecology and coastal geology, and experience with field data collection methods, including determining Mean Lower Low Water, Highest Astronomical Tide, and beach slope. Field data that are necessary for use of the conservation calculator also include Submerged Aquatic Vegetation (SAV) surveys and forage fish surveys or use of existing information on forage fish spawning. Users will need to have experience with geographic information system (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 especially valuable areas for the target species including maps of natal estuaries[3] and their buffers, pocket estuaries[3], WA coastal atlas, and the WDFW forage fish spawning maps. In addition, the user must have access to the internet and Microsoft Excel 2007 or later.

[3] Map layers are provided on NMFS web page

The conservation calculator is largely an entry mask to the NHVM and HEA (Figure 2) that will suffice for assessing most nearshore projects. Pre-application meetings can provide a venue for applicants and consultants to get help with more complicated projects. NMFS will provide training and technical assistance for use of the conservation calculator and NHV model.

Conservation Calculator Continuous Process Improvements

The Services will apply continuous process improvements to the conservation calculator, NHVM, and this user guide with thorough regular and predictable updates. The continuous process improvement outlined here will facilitate incorporation of monitoring results and new science as well as improvements in the usability of the calculator.

Throughout the year, we encourage users to send improvement suggestions, new and relevant science, and potential bugs to (Stephanie.Ehinger@noaa.gov, Lisa.Abernathy@noaa.gov, and Mary.Bhuthimethee@noaa.gov) at NMFS and (Lee_Corum@fws.gov) at USFWS.

During 2021, NMFS expects expanded and broader use and application of this tool. As such, we may, if applicable, update the conservation calculator and user guide on a quarterly basis, to accommodate user feedback. After that the Services will post regular updates to the conservation calculator and user guide in February of every year. In the event a more critical update would need to occur sooner, the Service 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 calculator and user guide.

In general, when a project specific conservation calculator is used as part of an ESA consultation we recommend that projects proponents and or their designated agent use the latest version of the calculator for their project. Conservation calculators submitted by project proponents to Federal Action Agency's for the purpose of ESA consultations that older than 30 days (from the date of application submittal to the Federal Action Agency) may require an updated calculation at the time of ESA consultation.

Conservation Calculator Training

The Services will schedule remote and public trainings for early 2021. Watch our web page for details. Follow-up training will be held on an annual basis.

Conservation Credits

Sources and Use of Conservation Credits

Conservation credits can be generated by engaging in restoration actions. Those conservation credits can be used anywhere within the same marine basin or natal estuary. Applicant-generated conservation credits can be generated on the same site as a project causing debits or within the same marine basin or natal estuary. An applicant may remove structures in the nearshore of the same marine basin or natal estuary to generate conservation credits for a new or replacement project. Such removal for credit must be a standalone and separate action and cannot be integral to another project. Standalone mitigation includes removal of individual creosote piles not associated with a structure, the removal of a structure, the removal of a portion of a structure[4], riparian plantings, and beach nourishment. Residual applicant-generated credits cannot be used as off-site credits for a different debit project. To split the credits from removal of a structure between different users, the applicant needs to have a conservation banking agreement or similar instrument in place with the Services. Conservation credits can also be bought from approved providers.

Advance Conservation Offsets

Advance credits are credits resulting from restoration actions that were performed by an applicant prior to an impact and the resulting habitat benefits are realized before the credits are used to offset debits. Use of advance credits must meet the following criteria:

1) Advanced credits cannot be transferred to a different user. The individual or entity generating the credits is the only individual or entity that can use them.
2) While the NMFS will set up a spreadsheet to track advance mitigation, it is ultimately the applicant's responsibility to track the credits.
3) We cannot guarantee that the amount of credits will remain the same at the time of use compared with when the advance mitigation was constructed.

Conservation Calculator User Guide

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The NHVM calculator consists of different entry worksheets/tabs for different groups of actions. The first worksheet is a summary of all impacts/benefits. Impact/benefit entry worksheets are:

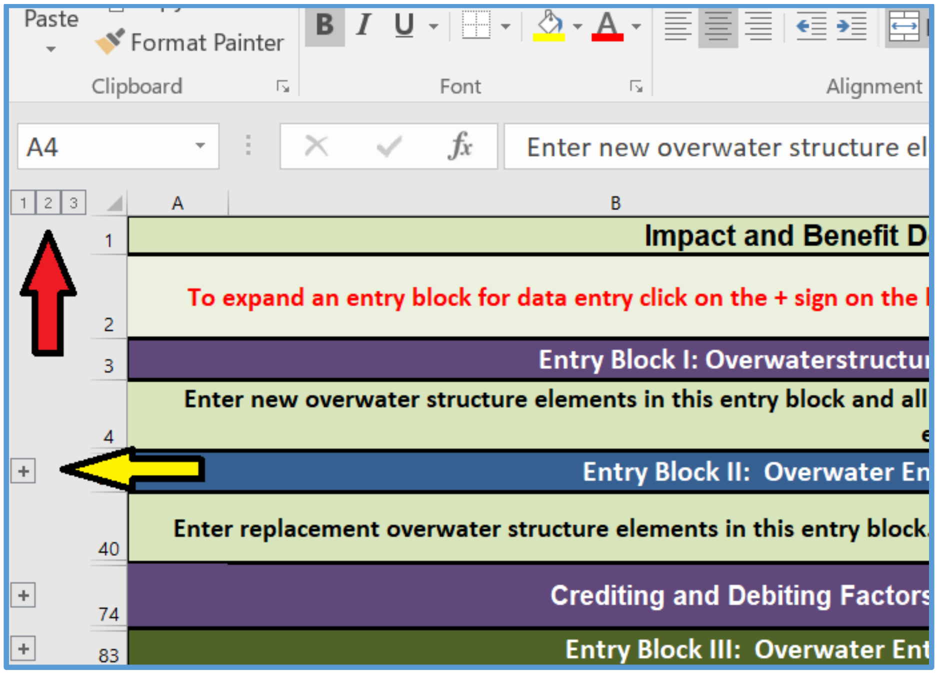
1. Summary
2. Overwater structures
3. ShorelStab: Shoreline stabilization
4. MDredging: Maintenance Dredging
5. BoatR, Jetty: Boat ramps, Jetties, Rubble
6. BeachN: Beach Nourishment
7. RZ: Riparian Zone
8. Ref.: References

Some groups of actions within tabs are quite extensive. Each worksheet/tab is divided into different Entry Block sections that can be collapsed for the user's ease[5]. Click on the small '+' in the left pane next to each entry block (Fig. 1, yellow arrow) to expand the individual block above the '+'. Clicking the 2 (Fig. 3, red arrow) will expand all entry blocks. Clicking 1 closes all entry blocks.

[4] 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.

[5] We have not been able to get this feature to work after locking formula cells and are working on addressing this issue.

Figure 3. Expanding and collapsing entry block sections.



General Information Applicable to most Tabs

1. References: The Reference Tab provides background information including:
    a. The cover categories for submerged aquatic vegetation and USZ vegetation;
    b. The delineation of shore zones for the Riparian Zone, Upper Shore, Lower Shore, and Deep Shore Zones;
    c. Complex float length and width determination for overwater structure (OWS) tab.
2. Submerged aquatic vegetation (SAV) surveys. Use the WDFW "Eelgrass/Macroalgae Habitat Interim Survey Guidelines" to provide SAV maps and data.
3. When a survey shows that no macroalgae and only eelgrass is present, we also accept an Eelgrass Delineation Report based on "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 category determinations (Figure 4) for the calculator should use the average SAV density in the footprint of the structure including a 25 foot buffer around the structure.
5. SAV category determinations for replacements: For most small size replacement projects, the 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, using the DNR Coastal atlas, and information from WDFW biologists. If none of these provide any information, use SAV 1 as a default.
6. SAV with structure removals: In most cases, determining the likelihood of re-establishment of SAV after structure removal is difficult. To err on the conservative side, the calculator assumes

the same SAV scenario for before and after structure removal. However, if there is strong evidence that "but for the OWS there would be SAV", contact the Services in pre-consultation to request adjusting the calculator to reflect SAV re-establishment.

7. The calculator is set up to determine credit for the removal of existing structures in the context of removals and replacements. We make the average assumption that at the time of permit application, the existing structure would remain in lawful and structurally sound condition for a period of 10 years. If structures are in non-functioning condition, in other words deteriorated and/or falling apart, removal credit is generally not justified.
8. If a structure is repaired rather than replaced, no removal would occur and generally no removal credit should be included. This would be a replacement with no removal. Examples include splicing or adding a sleeve to existing piles and placing a bulkhead waterward of an existing bulkhead.
9. If there is no site protection (e.g., like a deed restriction) associated with the removal, the default and maximum time horizon for credit determination is 10 years. For removals with site protections longer than 10 years, contact the Services for help on determining credits.
10. Credit for the removal of unpermitted structures in the nearshore will be approved on a case by case basis.

Figure 4: SAV Categories

Table 1: Delineation of LSZ Submerged Aquatic Vegetation Scenarios		
VEGETATION SCENARIO	***Native Eelgrass and/or Kelp occurs within 25 feet of project area***	***Other SAV occurs within 25 feet of project area (no native eelgrass or kelp present)***
Scenario 0	N/A	≤ 10%
Scenario 1	1-25% Combined SAV	11-25%
Scenario 2	26-69% Combined SAV	26-75%
Scenario 3	≥ 70% Combined SAV	> 75%

*SAV is defined as rooted vascular plants and attached macroalgae. Drift algae and Ulva spp. are not included when determining cover percentage except where Ulva spp. occurs in documented herring spawning areas.

Credit Factors

For especially important or rare habitat conditions, the final credits or debits are multiplied by a credit factor. The conservation calculator applies these credit factors only to aspects of the project that would affect the important habitat condition. The credit factors are described below. Figure 5 shows how the credit factors apply to certain project elements.

1. Major Estuary Zones: This map is available on NMFS's web page. We are using the historical extent of Chinook natal river deltas plus a 5 mile buffer (as the fish swims), as per the Puget Sound Chinook 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 chum recovery plan (Brewer et al. 2005).

2. Pocket Estuary: This map is available on NMFS's web page.
3. Feeder Bluff: We currently use the Department of Ecology Coastal Atlas coastal landforms data layer to determine the location of feeder bluffs.
4. Forage Fish Spawning: We rely on WDFW forage fish spawning surveys and maps to determine presence and extent of Pacific herring, Pacific sand lance and surf smelt. If questions arise for specific location, COE, USFWS, or NMFS 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 Department of Ecology Coastal Atlas to determine drift direction.

Figure 5: Project Specific Application of Credit Factors

Nearshore Impact	Major Estuary Zone	Pocket Beach	Feeder Bluff	Sand lance or surf smelt spawning	Updrift of FF spawning within same drift cell	Herring spawning
Shoreline armoring	XX	XX	XX	XX	XX	In rare cases
Piers and ramps	XX	XX				
Piles depending on zone	XX	XX	XX	XX		XX
Floats (USZ)	XX	XX		XX	In rare cases	
Floats (LSZ)	XX	XX				XX
Floats (DZ)	XX	XX				depends
Creosote Piles WQ benefit[1]	X	X		X		X
Boat ramps & Jetties (USZ)	XX	XX	XX	XX	In rare cases	
Boat ramps & Jetties (LSZ)	XX	XX				XX
Boat ramps & Jetties (DZ)	XX	XX				
Beach Nourishment	XX	XX		XX	XX	
Riparian	XX	XX	XX	XX		

[1] Credit factors for water quality benefits related to creosote removal are 40% of full credit 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.

Conservation Calculator worksheets

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

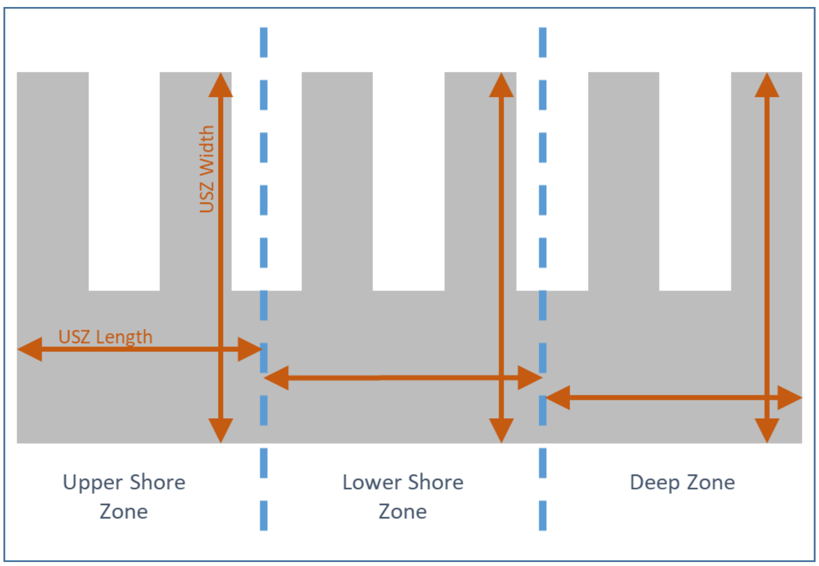
Overwater Structures

The most ubiquitous overwater structures in Puget Sound are residential pier, ramp, and float structures, but the Conservation Calculator can also be used to determine the impact of other structures that shade nearshore habitats. Entering measurements for typical piers, ramps, and floats into the Calculator should be relatively straightforward, but entering measurements for other structures, including marinas and industrial structures, may require more explanation which is provided below.

Complex floats

Most marinas have floats with multiple slips, which we categorize as complex floats here. For each nearshore zone, enter the sum of the length of each float and the average width of the floats (Figure 6) in the appropriate calculator cells. The average width and total length is used in the background of the calculator to determine buffers around floats. Enter the square footage of the structure directly into the appropriate nearshore zone's cell. Letting the calculator determine the square footage for complex floats would result in an over estimate as it simply multiplies length by width.

Figure 6. Calculating area of complex floats.

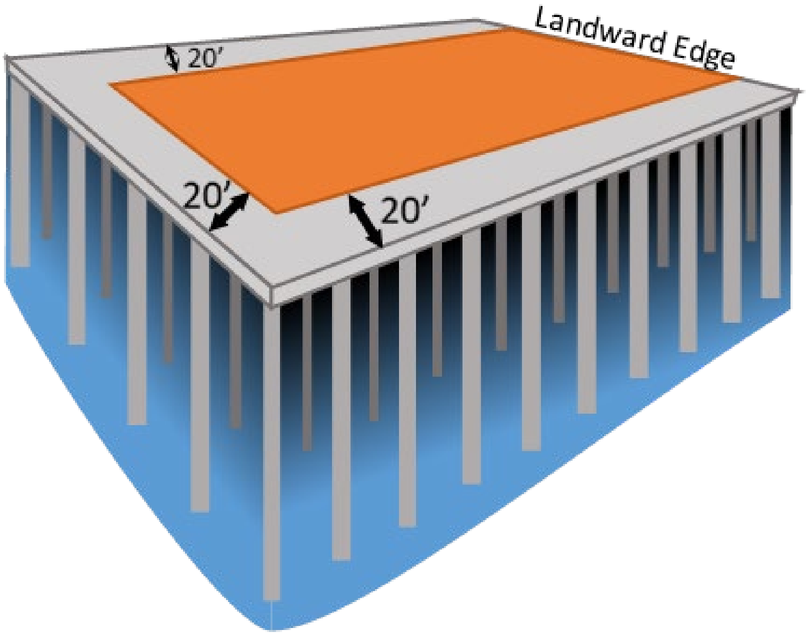


Large decks

Generally, elevated decks have a smaller impact than floats because side lighting reduces the amount of shading. However, the wider a deck is, the less effective is 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 7.).

To account for the dark center on wide decks, enter the deck area within 20 feet from the edge as pier, and enter the deck area more than 20 feet from the edge as a float.

Figure 7. Two different Conservation Calculator Entry Zones in Large Decks



Lighting underneath a large deck. The orange center represents the area of a wide solid deck that is treated similar to a float due to the lack of light penetration from the open sides. The 20 feet gray areas are treated as elevated solid deck.

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, enter half of the square footage of the largest shade producing vertical wall as solid overwater coverage in addition to the square footage derived from the horizontal coverage as shown on plan sheets.

Piles

Since piles are used to support overwater structures in many ways, below are a few tips for entering pile information into the Overwater Structures tab of the Conservation Calculator.

a) Structural pile replacement or repair (not batter piles, or fender piles) on industrial-sized structures. Input in calculator: a) number of piles to be replaced or repaired; b) the area of decking supported by the ‘to be replaced’ or ‘to be repaired piles’. Meaning, if 50 percent of pier/dock piles are proposed to be replaced or repaired, enter 50% of the square footage of the pier/dock that they support, too. Exception: If the elevated overwater structure has been mitigated for at installation or the previous replacement for a duration that includes the design life of the proposed pile replacement/repair.

b) Multiple pile sizes: If different pile sizes are being installed, enter the average diameter of all the piles into the conservation calculator. A quick-use calculator provided at row 129 allows for easy determination of the average pile diameter for each nearshore zone.

c) 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 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.

d) Monitoring of Creosote removal: After creosote removal and upland disposal, applicants need to submit the disposal receipts to the Services. Disposal receipts need to contain actual weight of the total removed creosote. Additional credits may be required if the estimated creosote removal weight is greater 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. Meaning, if in year 1 estimates were on average 8% higher than actual disposal quantities, in year 2 all estimated creosote removal quantities will be automatically discounted by 8%.

e) Pile Repair: Pile repair, including adding sleeves, extends the life of a pile just like a replacement. Thus, enter numbers of repaired piles along with replaced piles. No removal credit applies to repairing piles. If creosote piles are repaired, enter only that 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.

f) Temporary Construction Impacts: The calculator, NHVM, and underlying HEA are currently only used to quantify mid to long term habitat impacts. Construction impacts are generally not being quantified. However, if large construction projects work with temporary habitat impacts that persist longer than a year, short-term impacts for elements like template piles can be assessed. We currently will do this on a case-by-case basis depending on the size of the temporary construction impacts. In future versions of the calculator, we may add a spreadsheet/tab to assess impacts from construction related overwater structures.

Crediting and Debiting Factors for OWS

As described in the 'Credit Factors' section above, effects to especially important or rare habitat features are multiplied by a factor to give more weight to the impact/credit of a proposed action. Crediting and debiting factors for OWS to be installed, at row 74, are being applied to both replacement and new structures. Crediting and debiting factors for OWS to be removed are located in row 119. Having two separate entry blocks allows for the installation of a new structure and the removal of an existing structure to be at different locations.

Floats in the DZ in herring spawning & holding areas may have herring factor applied.

Shoreline Stabilization

Soft and Hybrid Armoring

Placement of soft or hybrid armoring currently does not incur debits.

Soft and hybrid armoring are defined as:

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 approaches:

a. No or minimal use of artificial structural elements
b. Incorporate beach nourishment (sand and small gravel)
c. Incorporate riparian plantings or allows for recruitment of native vegetation, including overhanging vegetation
d. Incorporates or allows 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.
e. Large wood may be chained as part of the design.
f. Boulders may be incorporated into the design, but must not be used as a primary slope stabilizing element.
g. Degradable fabric and support filters may be used but must be designed and constructed to prevent surface exposure of the material through time.
h. 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:

a. Contains artificial structure that allows for some biological processes to occur (such as forage fish spawning), but inhibits some ecological processes to fully occur (such as suppressing some sediment transport, supply or accretion, but not fully ceasing the process as with hardened approaches.
b. Exposed rock, if used, must be discontinuously placed on the beach (i.e., not act as a berm or scour sediments)
c. 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.

i. 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.

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

Replacing hard armoring with soft or hybrid approaches can be credited with conservation credits.

Highest Astronomical Tide

Critical Habitat for Puget Sound Chinook is listed up to the Highest Astronomical Tide (HAT). HAT can be determined using NOAA datums (https://tidesandcurrents.noaa.gov/datums.html?id=9447130). Actions below HAT, including placement of shoreline armoring, likely impact critical habitat and their impact is quantified in the calculator. Further, actions in the riparian zone landward of HAT, including removal and planting of trees, impact functions within the CH. These impacts are quantified in the RZ worksheet/tab.

Armoring Repair Landward of Existing Armoring

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 , fill in metrics for replacement armoring and click “yes” for replacement. In such a case, no credit applies for any removal. Leave the section for the ‘to be removed structure’ empty.

Site Conditions Landward of Hard Armoring up to HAT

This section assesses the value of the habitat rendered inaccessible to fish via armoring. The inputs in cells C5-C7 are used to determine percentage of each habitat type behind armoring and below HAT. 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 SqFt. Evaluate habitat improvement/degradation through actions like tree or shrub plantings separately in the RZ spreadsheet/tab.

Slope Distance

“ShorelStab” tab. Cells B16 and B31

The slope distance between the MHHW line and the toe of the shoreline armoring is measured along the substrate/beach surface, see Figure 8 below. It should be approximated using the plan sheets using one of the methods outlined below.

a) If shoreline armoring is located below/waterward of MHHW, extrapolate the beach slope through the armoring and measure the slope distance. If armoring is located above MHHW, measure the slope distance between the MHHW line and the armoring directly on the plan sheets. Use a ruler to follow beach slope line and follow it out until it meets the MHHW line. Measure this line from the toe to MHHW. Use the drawing’s scale to convert the ruler measurement to feet (e.g., 0.25 inches = 1 foot).

b) If extrapolating on the plan sheets lands you off the page, determine the slope distance via a smaller triangle first: The slope distance (beach surface) and the vertical distance (rise) and the horizontal distance (run) can be measured for a smaller triangle. Then the slope equation can be rearranged to provide the equation for calculating the horizontal distance for the larger triangle.

Using the provided profile drawing, measure the rise and run of a shorter distance (smaller triangle) to calculate the slope.

Slope = rise b / run b

Use this calculated slope and the rise *nb* (the change in vertical elevation from the plansheets between the toe and MHHW) to calculate the run *na*.

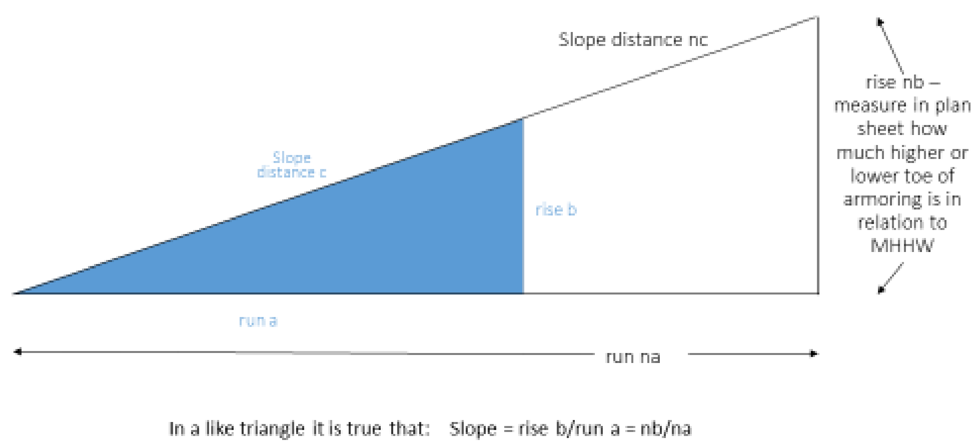
Run na = rise nb / slope

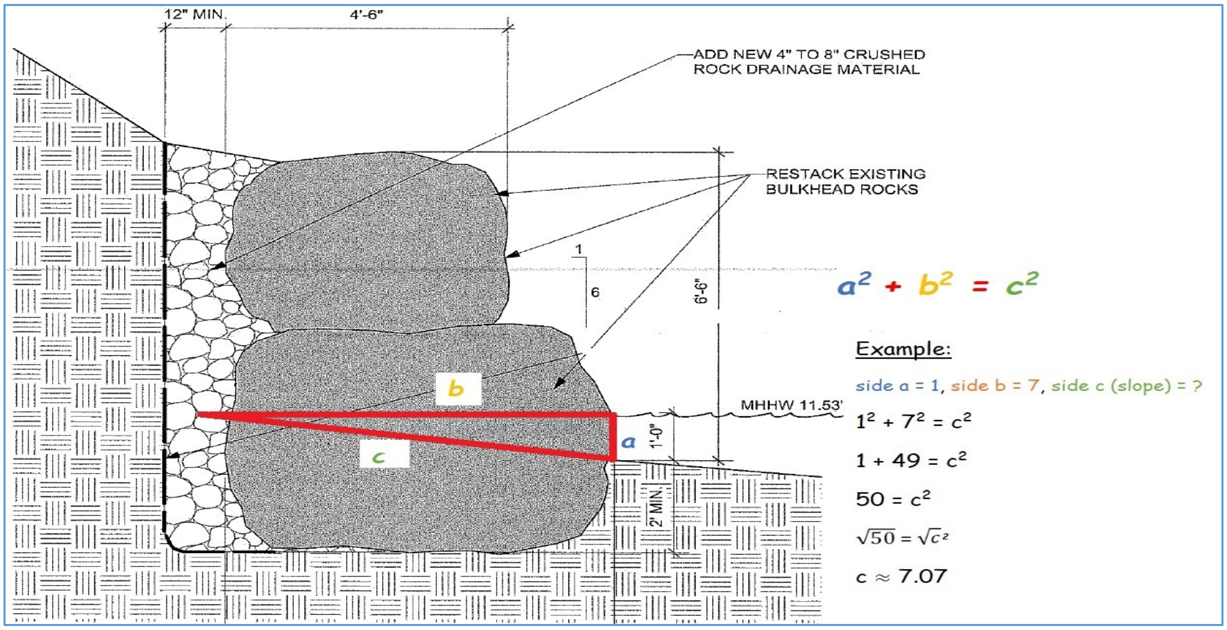
Now you can determine the slope distance using

$a^2 + b^2 = c^2$, where c = slope distance.

$$slope\ distance\ nc = \sqrt{(a^2 + b^2)}$$

Figure 8. Determining slope distance between MHHW and the toe of the shoreline armoring.





c) If no beach profile is available, use best fitting numbers from the Table 1, below, as the slope distance for each vertical feet that the armoring is located below or above MHHW. We determined slope distances and vertical elevation differences between MHHW and HAT for four different beaches in Puget Sound. If no other data are available, we use these data to approximate the slope distance per vertical foot elevation distance below or above MHHW.
We realize that stratifying data by beach type and below and above MHHW would provide more accurate estimates and are working on developing such refinements.

d) If the elevation for HAT is not available for the subject site extrapolate using the two closest NOAA tidal station or similar method. The calculator uses 25 ft slope distance as the default for the slope distance between MHHW and HAT (Table 1). This is the average over the four profiles NMFS used. This slope distance should be updated where data are available.

Table 1. Estimated slope distance per 1 foot vertical elevation, using 4 different beaches in Puget Sound.

Location	Beach Type	Source Profile	Slope Distance MHHW to HAT	Slope distance per 1 ft vertical elevation
Kilisut Harbor	Bluff Backed Beach	Provided by Cardno Entrix, Dan Elephant	39 ft	26 ft
Sakelum Pt Whidbey Island, Saratoga Passage	Barrier Beach	WDFW Shoreline Design Guidance Appendix A BN-23	22 ft	9 ft
East Eld Inlet	Bluff Backed Beach	WDFW Shoreline Design Guidance Appendix A LW 11	20 ft	10 ft
West Lummi Peninsula	Bluff Backed Beach	WDFW Shoreline Design Guidance Appendix A RE 4	20 ft	9 ft
Average			25 ft	14 ft

Detailed spreadsheet “Slope Dist MHHW HAT”

Maintenance Dredging

- The zone (LSZ or DZ) is determined by the depth of the existing habitat, not the proposed dredge depth.
- SAV scenario: The SAV scenario is usually 0 for maintenance dredging as very little to no SAV grows in areas frequently disturbed. While maintenance dredging could extend the 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 factors apply.

Boat ramps and Jetties

Enter SAV scenario as noted above and in the reference tab of the calculator. Use this tab to receive credit for removal of concrete, rubble and debris. Credit factors apply.

Beach Nourishment

Beach nourishment may not be appropriate in every location. We usually defer to WDFW expertise in determining whether beach nourishment is appropriate, the specific quantities, and the technique of placement for specific projects. A common recommendation from WDFW is to place beach nourishment within a distance of 9 lineal feet out from the bulkhead at 6 inches depth for each foot of shoreline armoring. That comes out to 4.5 cubic feet per linear foot (pers.com WDFW). However, site specific recommendations may vary. Depending on WDFW observations and site-specific conditions, beach nourishment may be piled up against armoring or spread out.

Depending on site conditions and WDFW, NMFS, or USFWS recommendations, 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 calculator.

Usually, we don't credit placement or beach nourishment in shoretype 0.

Credit factors apply.

Riparian Zone

The Riparian Zone encompasses the area within 40 meters (131 feet) of HAT. 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. In the 'Habitat Evaluation' section of the tab, the square foot area in Column E should equal the same amount in Column G because they represent a 'before' and 'after' scenario of the proposed action. Credit factors apply.

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. We took into account the information provided in this review and designate 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.

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

References

Brennan, J. S., Culverwell H., Gregg R., and G. P. 2009. Protection of Marine Riparian Functions in Puget Sound, WA. Washington Departement of Fish and Wildlife, WDFW 08-1185.

Brewer, S., J. Watson, D. Christensen, and R. Brocksmith. 2005. Hood Canal and Eastern Strait of Juan de Fuca SUmmer Chum Salmon Recovery Plan.

Redman, S., D. Myers, and D. Averill. June 2005. Regional Nearshore and Marine Aspects of Salmon Recovery in Puget Sound. Pages 246 *in*.