

Habitat Evaluation Procedures Web Map and Habitat Unit Calculator User Guide

The City of Seattle is required to ensure that no net loss of ecological functions occurs through shoreline development. The City must ensure that the ecological functions impacted by development are mitigated by the gain in ecological functions through habitat improvements. To establish a standardized procedure for determining the impacts of and providing mitigation for a standard set of development activities that occur within the City's Shoreline District, the City has developed a Habitat Evaluation Procedures (HEP) Program.

This User Guide is a resource for Seattle Department of Construction and Inspections (SDCI) shoreline permit applicants to refer to while mapping their project and completing the Habitat Unit (HU) Calculator form through the HEP Web Map application to determine their mitigation requirements. For a definition of terms used in this document, please see Appendix A. For additional background regarding the HEP Program, please see Appendix B.

HEP Web Map User Interface

There are multiple tools to be aware of within the HEP Web Map application. The items below are identified with corresponding numbers in Figure 1:

1. Use the search bar to search for and zoom to a parcel or address.
2. Use the "Add Data" button to add your own spatial data that contains your plans with project specific information regarding your proposal to the map interface. File types that can be uploaded are zipped shapefiles, CSV, KML, GeoJSON, GPX, hosted ArcGIS Online layers, and compatible URLs.
3. Click the "HEP Habitat Unit Calculator" button to open the HU Calculator form, which is used to calculate HU change from pre-project to post-project conditions.
4. Click the sidebar tab to collapse the sidebar and enlarge the map interface.
5. Click the Layers menu icon to toggle on and off layers as needed.
6. Click the Legend icon to view the legend for layers that are currently toggled on in the map interface.
7. Use the Draw tool to create and measure polygons for calculating HUs.

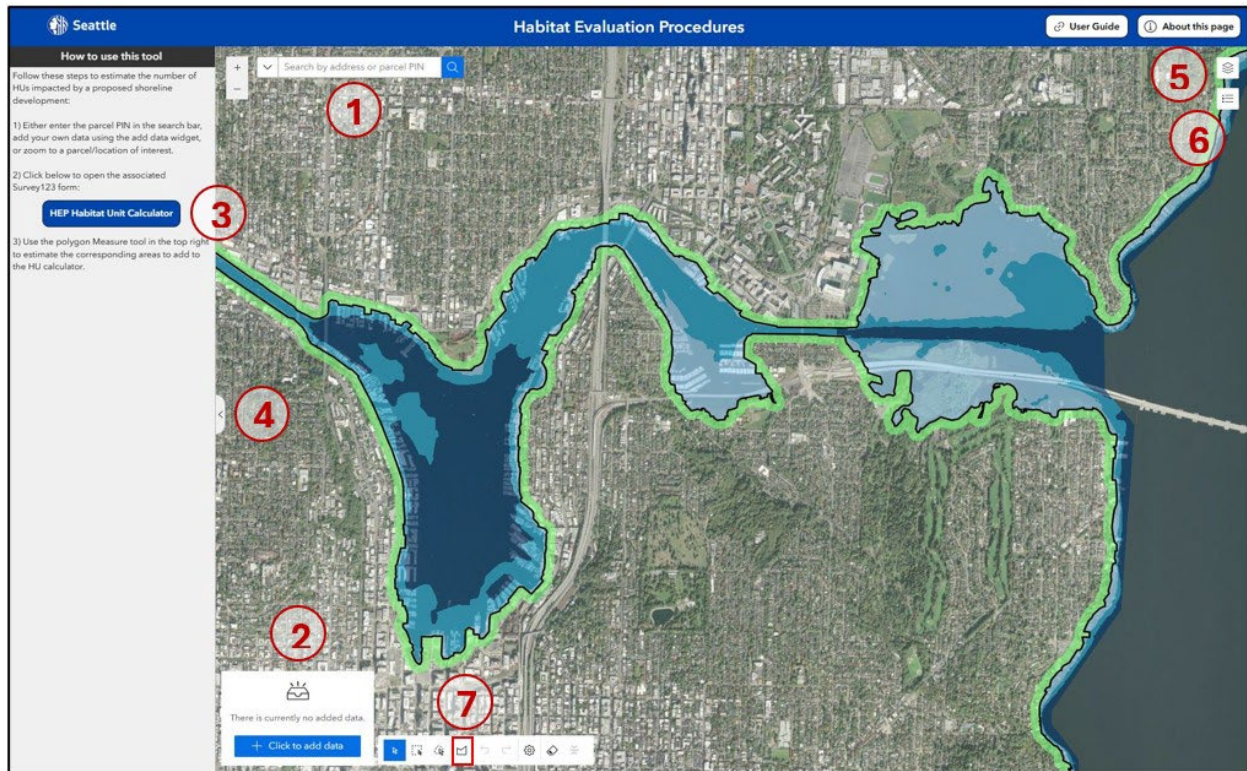


Figure 1: Web Map User Interface. Use this figure as a guide for locating the tools and features of the Web Map.

Using the HEP Web Map

To start the process of calculating HUs for your project, use the search bar to locate your parcel or address, then load your data into the web map using the “Add Data” button. If you do not have spatial data available (i.e., your plan is not available in a format that can be uploaded into the web map), you will need to use your project plans and dimensions to draw the project extent on the web map, a process described in more detail in the next section. After adding your data, click “Done” and the map will automatically zoom to the location of your data. Once you have located your project area, click the “HEP Habitat Unit Calculator” button to open the HU Calculator form.

Using the HU Calculator: Calculating Pre-Project Condition HUs

After opening the HU Calculator form, fill in your name, email, and project number, if available. Select the region your project falls within (Lake Washington, Lake Union/Ship Canal, or Lower Duwamish/Puget Sound). If your project happens to span two regions, you will need to complete a separate HU Calculator submission for each region. If you are unsure which region your project is within, there are two methods to determine the appropriate region. Toggle on the “Habitat Evaluation Procedures Regions” layer in the Layers menu and click on the overlapping region (dark black outline) to view the region

name in the pop-up. Alternatively, the associated region can be found in the title of the pop-up for the HEP Zones layer (Figure 2). The first group of questions will pertain to pre-project (existing) habitat conditions within your project extent.

HEP Region: Lake Washington

HEP ID: LW1352

Shoreline Zone: Shallow Aquatic

Shoreline Condition: Riprap/Bulkhead

Substrate: Cobble (2.5 to 10 in)

Submerged Aquatic Vegetation: No SAV

Riparian Zone Condition: Aquatic Zone

Proximity Zone: No

Overwater Structure (OWS) Class: No OWS

OWS Height: Not Applicable

Does the OWS extend into the Deep Aquatic Zone? No

Which region does your project fall within?
If your project happens to fall within two regions, please complete a separate form for the area falling within each region.

Lake Washington

Lake Washington Form

Lake Washington HEP Zone Entries (1)

What is the square footage of your project overlapping this HEP Zone?

50

Select the Shoreline Zone:

Shallow Aquatic

Select the Shoreline Condition:

Riprap/Bulkhead

Select the Substrate:

Cobble

Select the Submerged Aquatic Vegetation:

No SAV (Absent)

Is this area within a Proximity Zone of significance?

No

If applicable, select the height of the overwater structure:

No overwater structure

Does any part of the overall project include an overwater structure that extends into the Deep Aquatic Zone?

No

Figure 2: HEP Zone pop-up example with the information used to complete the HU Calculator form.

Back in the Web Map, use the Draw tool to define the full extent of your project. To accomplish this, draw a polygon for the portion of each unique HEP Zone overlapping your project. Figure 3 illustrates an example scenario where four polygons would need to be drawn to define the full project extent. To draw a polygon, select the polygon Draw tool, toggle on the “Show area measurement” button, and select square feet from the “Unit” drop-down menu (Figure 4). Click to add new vertices (i.e., the points used to draw lines that create the polygon outline) and double click to finish a polygon. Click the gear/settings icon to enable different layers for snapping (i.e., automatically guiding vertex placement to align with a reference layer, such as the HEP Zones layer).

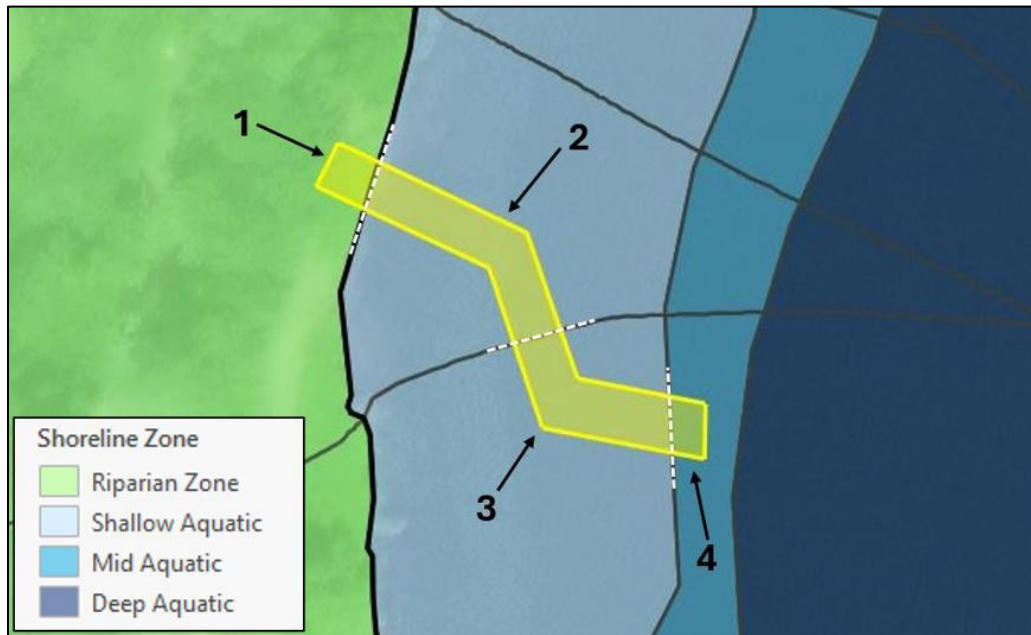


Figure 3: Sample project extent (in yellow) overlapping four HEP Zones. The four zones overlapped by the example project are identified with numbers 1-4. The project extent overlaps one riparian HEP Zone, two shallow aquatic HEP Zones, and one mid aquatic HEP Zone. Dashed white lines illustrate how the project extent should be divided into four smaller polygons based on where it overlaps the HEP Zones.

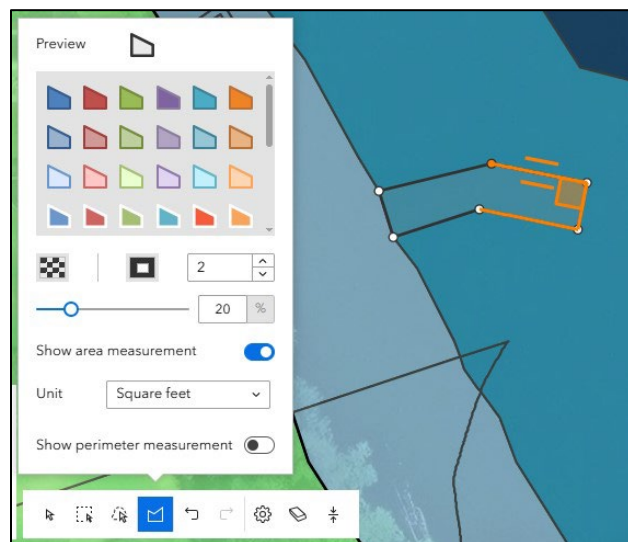


Figure 4: Draw tool user interface - toggle on the "Show area measurement" option and select square feet as the unit. This screenshot shows a polygon being created using the Draw tool, with vertices in white.

All information required to complete the HU Calculator form for the pre-project habitat conditions can be found in the pop-up panel for the HEP Zones within the HEP Web Map (Figure 2). To view the pop-up information, you may need to click the polygon Draw tool again to deactivate the Draw tool.

Alternatively, if you have field-verified data that doesn't align with the habitat conditions in the HEP Zones dataset, use your field-verified data to fill out the habitat condition questions where possible. Table 1 summarizes which information must be obtained from the HEP Web Map, and which information can be overridden based on field-verified data. If field-verified data are used to fill out any habitat conditions, use the last two pre-project questions to describe any differences from the HEP Zone dataset and provide supporting photos. Figure 2 provides a visualization of how information from the HEP Zone pop-up in the HEP Web Map should be used to populate the HU Calculator form. After completing entries for all HEP Zones, you can toggle through each entry as needed to review the breakdown of each zone's habitat condition attributes and HUs. The HU values are automatically calculated using subject matter expert-defined weighting factors. For more details about how weighting factors were developed, please see Appendix B.

Table 1: Summary of how to populate data in HU Calculator.

Metric	Only use data from HEP Web Map	Use field-verified data if available, otherwise use HEP Web Map
Shoreline Zone	✓	
Proximity Zone	✓	
OWS Height		✓
OWS in Deep Aquatic Zone	✓	
Shoreline Condition		✓
Riparian Zone Condition		✓
Substrate		✓
SAV		✓
Slope		✓

OWS = over water structure

SAV – submerged aquatic vegetation

In the HU Calculator form, after filling out the form for the first HEP Zone, use the + button to repeat this process for each additional HEP Zone overlapped by your project extent (Figure 5). For instance, the sample project extent shown in Figure 3 in yellow overlaps four

HEP Zones. Therefore, four separate entries would be required in order to capture the habitat conditions specific to each HEP Zone. You will eventually need to repeat this process for anticipated post-project conditions.



Figure 5: Adding new entries within the HU Calculator for additional HEP Zones overlapped by the project extent.

Using the HU Calculator: Estimating Post-Project Condition Habitat Units

The second group of questions in the HU Calculator form pertains specifically to post-project conditions. Use a similar process to fill out the habitat condition attributes for post-project conditions. The only differences will be changing the shapes of individual HEP Zone entries (if necessary) and changing habitat condition attributes based on shoreline development or restoration design elements. A HEP Zone from the pre-project conditions may be split into two or more smaller HEP Zones for post-project conditions if the project is altering one or more habitat condition attributes for only a portion of the HEP Zone. For example, the sample project extent in Figure 6 only has two HEP Zone entries for pre-project conditions, but four for post-project conditions. This could occur if one portion of the project has moderate impacts on existing habitat conditions (e.g., tree removal), while another portion poses significant changes to existing conditions (e.g., riprap/bulkhead construction).

You can create as many HEP Zones as necessary for post-project conditions as long as the total area assessed for post-project conditions matches the total area for pre-project conditions. As specified in Table 1, the only attributes that must be populated using the HEP Zone layer in the web application, and which must remain the same between pre- and post-project conditions for a given location are the Shoreline Zone and the Proximity Zone, as these are location-based attributes which cannot be altered by development or restoration actions.

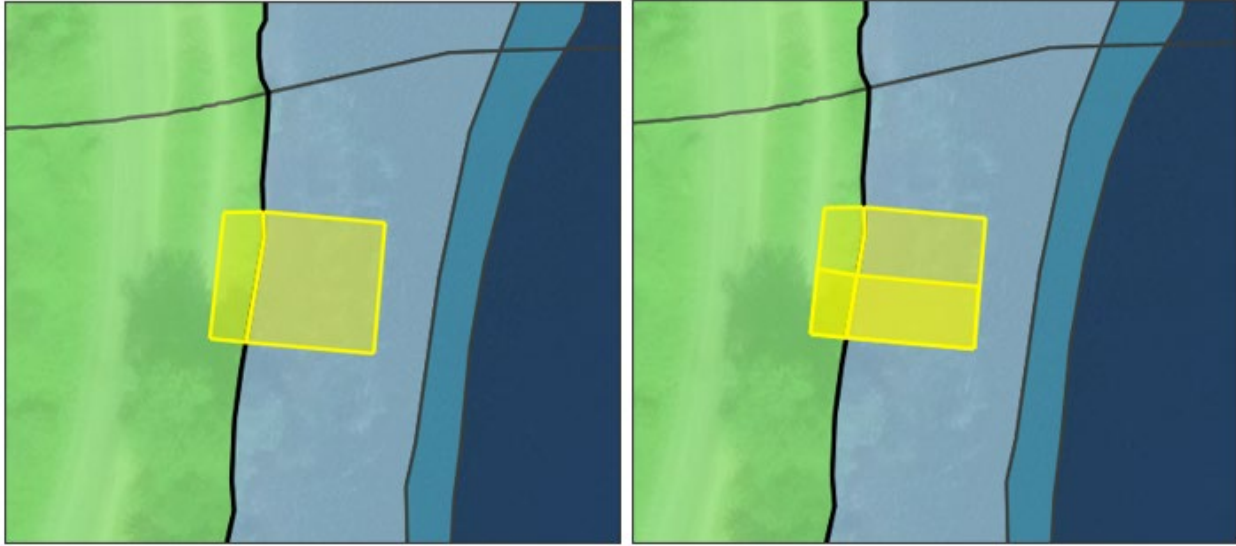


Figure 6: Example of differences between pre-project (left) and post-project (right) HEP Web Map drawings for a given project extent.

Review the Results and Quality Control

After filling out all pre-project and post-project entries, review the total HUs and square footages for pre-project and post-project conditions at the bottom of the HU Calculator form (Figure 7). Change in HUs and square footage is also provided at the bottom of the form. Ensure that the total area does not change between pre-project and post-project conditions. This is especially important if using field-verified areas and habitat conditions. In other words, use the identical project extent/boundary for both the pre- and post-project condition HU calculations. There may be a different number of entries depending on project elements, but the total area should remain unchanged. The final step is to click “Submit” at the bottom of the HU Calculator form. This step is critical as submission of the form allows the City to have record of the information input into the form. See Figure 7 for a screenshot of example auto-calculated values and the “Submit” button.

If you have any questions, comments, or concerns about the methodology or HEP Web Map/HU Calculator functionality, please contact Margaret Glowacki (Margaret.Glowacki@seattle.gov).

Pre-Project Total Habitat Units: 168.6

Pre-Project Total Area (square feet): 1124

Post-Project Total Habitat Units: 8.43

Post-Project Total Area (square feet): 1124

Change in Habitat Units: -160.17

Change in Total Area (square feet): 0 

Figure 7: Example of HU Calculator form that provides summary data for HUs and square footage

APPENDIX A – DEFINITION OF TERMS

Habitat Evaluation Procedures (HEP): a standardized procedure for determining the impacts of and providing mitigation for a standard set of development activities that occur within the City’s Shoreline District.

HEP Web Map: The map-centric application used to view HEP Zones, access the HU Calculator, and draw/measure polygons to be used in the HU Calculator.

HEP Zone: A polygon within one of the three HEP Zone layers (Lake Washington, Lake Union/Ship Canal, Lower Duwamish/Puget Sound) that spatially represents a unique set of habitat conditions.

Habitat Unit (HU): a standardized unit of measurement used to document the quality and quantity of habitat for selected species, developed by the U.S. Fish and Wildlife Service.

HU Calculator: a form created using Esri’s Survey123 software that calculates the change in HUs from pre- to post-project conditions based on a user’s inputs for habitat condition metrics.

Spatial Data: Data that contains information relating to physical location and shape and can be shown geographically

Vertex/vertices: point/points that when connected form a polygon.

APPENDIX B – HABITAT EVALUATION PROCEDURES BACKGROUND

This appendix describes the Habitat Suitability Index (HSI) models that are used in developing the Habitat Evaluation Procedures (HEP) program developed for the City of Seattle (City) shoreline using examples from the marine shoreline model.

State and local law, in order to ensure no net loss of ecological functions during shoreline development, require that habitat lost during development be mitigated by the creation of equal habitat through habitat restoration. This is termed mitigation and occurs through the local permitting process.

The City has developed a Habitat Evaluation Procedures (HEP) program to establish a standardized procedure for determining impacts and mitigation for a standard set of development activities that occur within the City within the Shoreline Jurisdiction. The Shoreline Jurisdiction includes the area landward 200-ft of the shoreline and the areas that are in and over the water. Additionally, payment for a fee-in-lieu of mitigation will be a part of this program.

The standardized procedure for determining impacts and providing mitigation is habitat units based on a method developed by the US Fish and Wildlife Service (USFWS) to document the quality and quantity of available habitat for selected wildlife species (USFWS 1980). This results in a scientifically defensible delineation and quantification of habitat units that can be used to balance shoreline development impacts with mitigation project values.

HEP provides the ability to document the quality and quantity of available habitat for selected wildlife species and allows comparison of the relative values of a given site over time and/or the relative values of other areas. HEP is based on the assumption that the value of habitat to a given species can be described by an HSI, which ranges in value from 0.0 to 1.0, representing unsuitable to optimal habitat quality, respectively. Any habitat model that can be transformed to this range is potentially applicable. The index value is multiplied by a given area of available habitat to obtain habitat units that can be used for comparative purposes (e.g., the loss from shoreline development, relative to the gains from habitat mitigation).

The City's HEP program is evaluating shoreline ecological function through the lens of habitat requirements for juvenile Chinook salmon (City of Seattle 2006). Developing a framework based on one species allows for consistency in measuring impacts and establishing equivalency between different types of shoreline impacts. The City's shoreline provides habitat to a variety of other aquatic and terrestrial species which are impacted by

many of the same shoreline processes that impact Chinook salmon; a focus on Chinook salmon will support habitat conditions for many other shoreline species.

Chinook salmon are the focus because of their protected status under the Endangered Species Act (ESA). Juvenile Chinook salmon have similar marine nearshore habitat requirements to those of juvenile summer chum salmon and bull trout, which are also ESA listed. These species are dependent on regional nearshore and marine resources for rearing as outmigrants (Chinook and chum) and as resident sub-adults or adults (Chinook and bull trout) (Redman et al. 2005).

A panel of subject matter experts provided knowledge and insight into the primary uses and functions of the City of Seattle (City) marine and freshwater shorelines by juvenile Chinook salmon. This information was used to develop HSI models representative of the City's shoreline areas with respect to ecological services for Chinook salmon as part of the City's HEP program. The experts consulted included Kurt Fresh (NOAA), Roger Tabor and Mark Celedonia (USFWS), Aaron Bosworth (WDFW), Kollin Higgins (King County), Lauren Urgenson and Scott Stolnack (WRIA 8), Jason Toft and Jeff Cordell (University of Washington), Matt Luxon, Jenny Love, Ron Gouguet, and Abby Hawley (Windward), Paul Schlenger (ESA), Paul DeVries (R2 Resources), Ed Connor, Julie Hall, Michelle Koehler, Ben Perkowski and Maggie Glowacki (City of Seattle).

The resulting model will be used to evaluate the City's shoreline on a landscape scale using readily available GIS data and individual shoreline development or habitat enhancement projects on a project-specific scale using site drawings. Habitat features (e.g., riparian vegetation) are assigned associated habitat values over their areal extent on the landscape, be it project or landscape scale.

Geographic Scope

Habitat units and costs were developed for four subareas of the City's shoreline environment: the Duwamish River, the Puget Sound Shoreline including Shilshole Bay, Lake Union and the Ship Canal, and Lake Washington.

Model structure

The model was applied to shoreline segments extending from -15 ft MLLW (or as far waterward as shoreline development is expected to extend) to 200 ft landward of the ordinary high water (OHW) line. On a project-specific scale, portions of this area unaffected by the project were not included in the evaluation.

Each segment of the shoreline was divided into depth zones. For the Puget Sound and Duwamish River subareas, these depth zones consisted of intertidal and subtidal zones.

For Lake Union and Lake Washington subareas, these depth zones consisted of shallow, mid, and deep aquatic zones. The riparian zone was assessed separately, with a generally lower weighting factor since it only indirectly influences juvenile Chinook habitat. An HSI for each depth zone was calculated separately and was weighted based on relative importance to juvenile Chinook salmon, as determined by the subject matter experts (see example for the Puget Sound subarea in Table 1).

Table 1. Relative weighting factors for Duwamish and Puget Sound subarea shoreline zones

Shoreline Zone	Elevation	Duwamish	Puget Sound
Riparian	OHW to 200 ft inland	0.20	0.30
Intertidal	-4 ft MLLW to OHW	0.55	0.40
Subtidal	-15 ft MLLW to -4 ft MLLW	0.25	0.30

A suite of metrics relating to habitat suitability were each classified using values from 0 to 1 corresponding to unsuitable to optimal habitat value, respectively. Table 2 shows an example of weightings for the substrate metric for the Puget Sound subarea.

Table 2. Substrate suitability index for the Puget Sound subarea

Habitat Condition	Habitat Value
Silt/sand/gravel	1.0
Cobble/boulder	0.3
Concrete, anthropogenic debris, compacted sediments, pilings	0.1

Within each depth zone, each relevant metric was also assigned a weight from 0 to 1 relative to its importance to Chinook habitat with all weights summing to 1. The zone-specific HSI score was calculated as the importance-weighted sum over all metrics. Table 3 shows an example of how metrics were weighted for the shallow aquatic depth zone for Lake Washington.

Table 3. Metric weightings within the Lake Washington subarea

Metric	Metric Weight
Shoreline Condition	0.5
Substrate Composition	0.3
Submerged Aquatic Vegetation	0.2

Habitat units associated with any given metric are calculated as the product of the area (in square feet), habitat value, metric weight, and depth zone weighting factor. Losses or gains in habitat units resulting from shoreline development or habitat enhancement projects are calculated as the change in habitat units over all metrics prior to (baseline) and post-project.

Habitat Suitability Metrics

The HSI model is constructed to be as simple as possible with few metrics and each metric having few possible values (1.0 = optimal habitat, 0.5 or lower = intermediate quality habitat, 0.1 = poor quality habitat, and 0 = unsuitable habitat). The metrics listed below were included in at least one of the four subareas:

- Bank/shoreline condition
- Riparian vegetation
- Bed slope
- Substrate composition
- Submerged aquatic vegetation

Additionally, modifiers were applied as multipliers to the total HSI calculation:

- Overwater structures
- Proximity to Cedar River (Lake Washington only)

For detailed information regarding the development of the HEP model for the City of Seattle's four geographic subareas see the following reports:

Puget Sound and Duwamish River HEP (Windward 2016)

Lake Union and the Ship Canal Updated HEP (ESA 2022)

Lake Washington HEP (ESA 2023)

References

- City of Seattle. 2010. Shoreline characterization report. City of Seattle, Seattle, WA.
- City of Seattle. 2006. Shoreline alternative mitigation plan. City of Seattle, Seattle, WA.
- ESA. 2022. Lake Union and the Ship Canal Updated HEP Final.
- ESA. 2023. Lake Washington HEP Final.
- NOAA, USFWS. 2012. Supplement to the draft Lower Duwamish River NRDA programmatic restoration plan & programmatic environmental impact statement. Appendix D: Habitat valuation in the Lower Duwamish River and determination of time to sustained function. National Oceanic and Atmospheric Administration and US Fish and Wildlife Service.
- Redman S, Myers D, Averill D. 2005. Regional nearshore and marine aspects of salmon recovery in Puget Sound. Puget Sound Action Team.
- USFWS. 1980. Habitat evaluation procedures (HEP). ESM 102. US Fish and Wildlife Service, Division of Ecological Services, Washington, DC.
- Windward. 2016. Puget Sound and Duwamish River HEP Final.