Vegetation Conservation: Mitigation Framework

The proposed approach to vegetation conservation in the City of Bellevue is designed to ensure a nexus and rough proportionality between impacts and required mitigation. The approach is based on a simplified version of Habitat Equivalency Analysis (HEA), which is used by the National Marine Fisheries Service's (NMFS) and U.S. Fish and Wildlife Service's (USFWS) to calculate mitigation credits and debits for listed species. The proposed approach incorporates the following inputs:

- Baseline level of shoreline ecological functions (value);
- Final level of shoreline ecological functions (value); and
- Area of impact and/or mitigation.

The proposed approach omits calculations that explicitly consider temporal factors used in the HEA analysis in order to simplify calculations and make the approach easily understandable and implementable by homeowners.

Both impacts and mitigation requirements are calculated based on a change in the type of land cover. The ecological value for each type of land cover is assigned within a range from 0 (no function) to 1 (maximum function). Values are assigned based on functions described in scientific literature (summarized in Table 1), as well as best professional judgment. The precise value of each type of land cover may be subject to debate; however, the relative values of different land cover types are fairly well established. Shoreline ecological functions and potential impacts to these functions from upland development are summarized in Table 1. A conceptual model supporting the valuation of different landcover types is provided in Figure 1.

Table 1. Shoreline vegetation functions and impacts from development.

Function	Characteristics	Area of interest	Impacts
Water quality	• Vegetative structure helps slow, infiltrate, and treat runoff [1–3] • Vegetative cover and root structure limits surface erosion and encourages infiltration [1,2]	Up to 30-100 feet from the water, depending on slope (and soils)	• Mown lawn grasses do not withstand overland flow conditions [1,3–5] • Chemical applications of fertilizer and pesticides can be transported into the lake[5–7] • Impervious surfaces concentrate and direct stormwater more rapidly to lake, thereby limiting infiltration and treatment capacity [2,8]
Fish habitat	• Vegetation that overhangs and drops into the shoreline provides physical structure preferred by juvenile Chinook salmon [9] • Secondarily, native shoreline vegetation provides insect foraging opportunities and organic detritus [10–12]	Immediately adjacent to the shoreline (primarily within 10 feet)	Hardscape (i.e. patios, structures), lawn, and maintained, ornamental plantings provide little if any habitat benefits.
Wildlife habitat	• Mature trees adjacent to the lake provide perches and nesting sites for raptors [13] • Native shrubs provide natural food source and structure for native wildlife [14,15]	Anywhere within shoreline jurisdiction	• Tree removal limits wildlife habitat [13,14,16] • Temporal losses from the removal of large trees are significant • Non-native vegetation does not support the diversity of native wildlife to the same extent as native plant communities [14–17]

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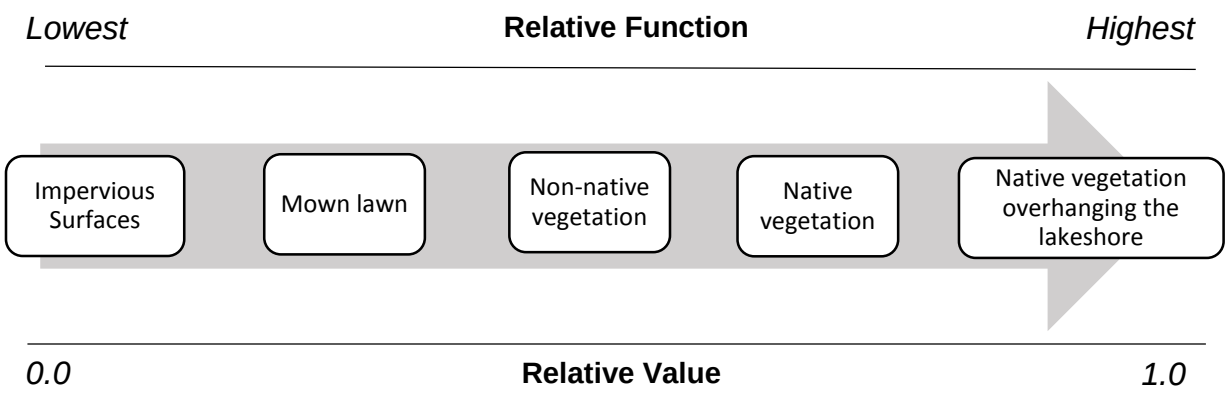


Figure 1. Conceptual model of the continuum of lakeshore landcover values

The location and type of mitigation required would be directly correlated with the location and type of impact. Table 2 summarizes how the location and type of impact corresponds with the type of mitigation planting that would be required.

Table 2. Impacts and mitigation options.

Location of impact	Mitigation Location
Zone 1: 0-25 feet from OHWM	Vegetation mitigation 0-25 feet from OHWM
Zone 2: 25-50 feet from OHWM	Vegetation mitigation 0-50 feet from OHWM
Significant tree impacts within vegetation conservation area	Replacement tree planting in vegetation conservation area
Significant tree impacts within shoreline jurisdiction (outside of vegetation conservation area)	Replacement tree planting in shoreline jurisdiction

Total impacts, or debits, are calculated by comparing the value of the proposed land cover with the value of the existing land cover, as follows:

*Debits = Sum of (change in land cover value*area) for all impact areas.*

The amount of the mitigation planting, or credits, must be greater than or equal to the total debits calculated above. Similar to the approach for debits, credits are calculated by comparing the value of the proposed land cover (mitigation planting) with the value of the existing land cover, as follows:

*Credits = Sum of (change in land cover value*area) for all mitigation areas.*

Table 3 identifies land cover values on a scale from 0 to 1 and the rationale used in assigning each value.

Table 3. Land cover values and summary of rationale.

Land cover type	Standard Value[1]	Rationale
Impervious surface	0.0	Impervious surfaces provide little to no habitat benefit and prevent infiltration of stormwater runoff. Where impervious surfaces are installed, they create a permanent area that lacks vegetative functions.
Mown lawn, bare ground, annuals, or pervious features	0.2	Mown lawn, bare ground, and pervious features allow for infiltration of runoff, but they provide little to no habitat benefits. Application of fertilizers and pesticides to lawns can be transported into the lake. Bare ground readily transports sediments via runoff.
Non-native vegetation[2]	0.4	Non-native vegetation provides habitat structure, and may provide food and nesting sites. Depending on the density, non-native vegetation may be effective at slowing and dispersing runoff. However, non-native vegetation does not support wildlife diversity, and fertilizers and pesticides applied to ornamental plantings may be transported directly to the lake.
Native vegetation[2] 25-50 feet from OHWM	0.6	Dense, native vegetation supports infiltration of runoff and diverse native species assemblages. Vegetation 25-50 feet from the OHWM is not expected to have a direct role in fish habitat structure, detritus, or invertebrate subsidies to the lake.
Native vegetation[2] 0-25 feet from OHWM	0.8	Dense, native vegetation supports infiltration of runoff and diverse native species assemblages. Vegetation 0-25 feet from the OHWM that does not overhang the shoreline may contribute to detritus and invertebrate subsidies to the lake, but is not expected to have a direct role on fish habitat structure.
Native overhanging vegetation 0-10 feet from OHWM	1.0	Complex in-water cover, which may be provided by native willows, dogwoods, and emergent vegetation overhanging or within the nearshore provides preferred shallow water habitat for juvenile Chinook salmon.

[1] Existing vegetation may not meet the species composition, cover, or density standards for mitigation planting. Existing vegetation with a minimum of 50% cover is included as a vegetation area.

[2] Significant trees are not included as non-native or native vegetation in this table. Mitigation ratios ranging from 1:1 to 3:1, depending on the size of the impacted tree, would be required for impacts to significant trees.

Replacement planting must meet standards for species composition, area coverage, and density in order to get credit for the "standard" value (Table 4).

Table 4. Minimum Shoreline Vegetation Standards for Mitigation Planting

Land cover type	Composition	Areal Coverage	Density	Noxious weeds	Size at Planting
Non-native vegetation	• Combination of trees, shrubs, and groundcover • Minimum combined tree and shrub coverage of 60 percent • If native species composition is less than 80 percent, the area is valued as non-native vegetation.	80 percent or greater by Year 5	Groundcover 3 feet on-center Shrubs: 6 feet on-center Trees:15 feet on-center	No more than 10 percent coverage	Groundcover: 1 gallon pot Shrubs: 2 gallon pot Trees: 5 gallon pot
Native vegetation	• 80 percent native species • Combination of trees, shrubs, and groundcover • Minimum combined tree and shrub coverage of 60 percent				
Native overhanging vegetation	• Any combination of native willows, red osier dogwood, and native emergent vegetation		In addition to above, live stakes may be used for willows and dogwood with an on-center density of 3 feet		

Enhancement of existing native or non-native vegetation that does not currently meet these standards can also generate mitigation credits. This approach is a means to provide landowners with the opportunity and incentive to maintain and improve existing conditions. The enhancement credit recognizes the more immediate functions that would result from maintaining and enhancing existing mature vegetation, compared to establishing newly vegetated areas. An "enhancement" credit would apply if an existing vegetated area was improved (i.e. via in-fill planting and/or removal of invasive vegetation) to meet the mitigation standards for composition, coverage at Year 5, and noxious weed cover. The enhancement credit would be calculated using an increase in land cover value of 0.1 for all qualifying areas. Where existing vegetation within the vegetation conservation area already meets the mitigation standards for composition, coverage at Year 5, and noxious weed cover, the landowner may elect to receive a "conservation" credit based on an increase in land cover value of 0.1 for all areas meeting the standard that are conserved, without conducting additional planting. Conservation and enhancement credits could only be applied for a single area once, and the maintenance standards for mitigation planting would apply to those conserved or enhanced areas once the credit was applied. Just as with replacement planting, the type of enhancement

or conservation credit must correspond with the type of impact, as shown in Table 2. Where enhancement or conservation credits apply, the credit calculation is amended as follows.

> *Credits = Sum of (change in land cover value*area) for all mitigation areas + Sum of (0.1*area) for all enhancement areas + Sum of (0.1*area) for all conservation areas.*

As a means to incentivize improvement in vegetative functions and eliminate a potential disincentive for immediate action, advance credits may be generated. These advance credits could be generated through any mitigation planting that is conducted prior to a vegetation impact. For each year that an advance credit matures prior to its use to offset a debit, its value would increase by 5 percent of the original value. The maximum appreciation of the value of an advance credit would be 100% of its original value. Or in other words, an advance credit would reach its maximum value 20 years after it is installed. The standards for maintenance of mitigation planting would apply to advance credits. Just as with replacement planting, the type of advance credit must correspond with the type of impact, as shown in Table 2.

Examples of Application of Vegetation Mitigation Approach

Example One: New patio

Project: Installation of 400 SF concrete patio adjacent to residential structure. Patio will replace mown lawn as well as ornamental shrubs. The entire patio falls within 30-50' from the shoreline.

Summary of impacts and mitigation: Debits are calculated separately for Zone 1 and Zone 2. In this example, all impacts fall within Zone 2. Two options for generating credits are shown below and in the figure.

Debit Table: Impacts

Impact Zone	Nature of Impact	Area (SF)	Land cover removed (Value)	Land cover installed (Value)	Total impact
Zone 1 (0-25 ft)	Loss of native or native overhanging vegetation AND/OR Increase in impervious surface	0	NA	NA	0
Zone 2 (25-50 ft)	Replace lawn and non-native vegetation with impervious structure	300	Mown lawn (0.2)	Impervious surface (0.0)	(300 SF)*(0.0 – 0.2)= **-60**
		100	Non-native vegetation (0.4)	Impervious surface (0.0)	(100 SF)*(0.0 – 0.4)= **-40**

Total Debit: -100

Credit Table: Mitigation Option A

Impact Zone	Mitigation planting option	Area (SF)	Land cover removed (Value)	Land cover installed (Value)	Total mitigation
Zone 2	Planting native overhanging vegetation in place of lawn in Zone 1	125	Mown lawn (0.2)	Native overhanging vegetation (1.0)	(125 SF)*(1.0 – 0.2) = **100**

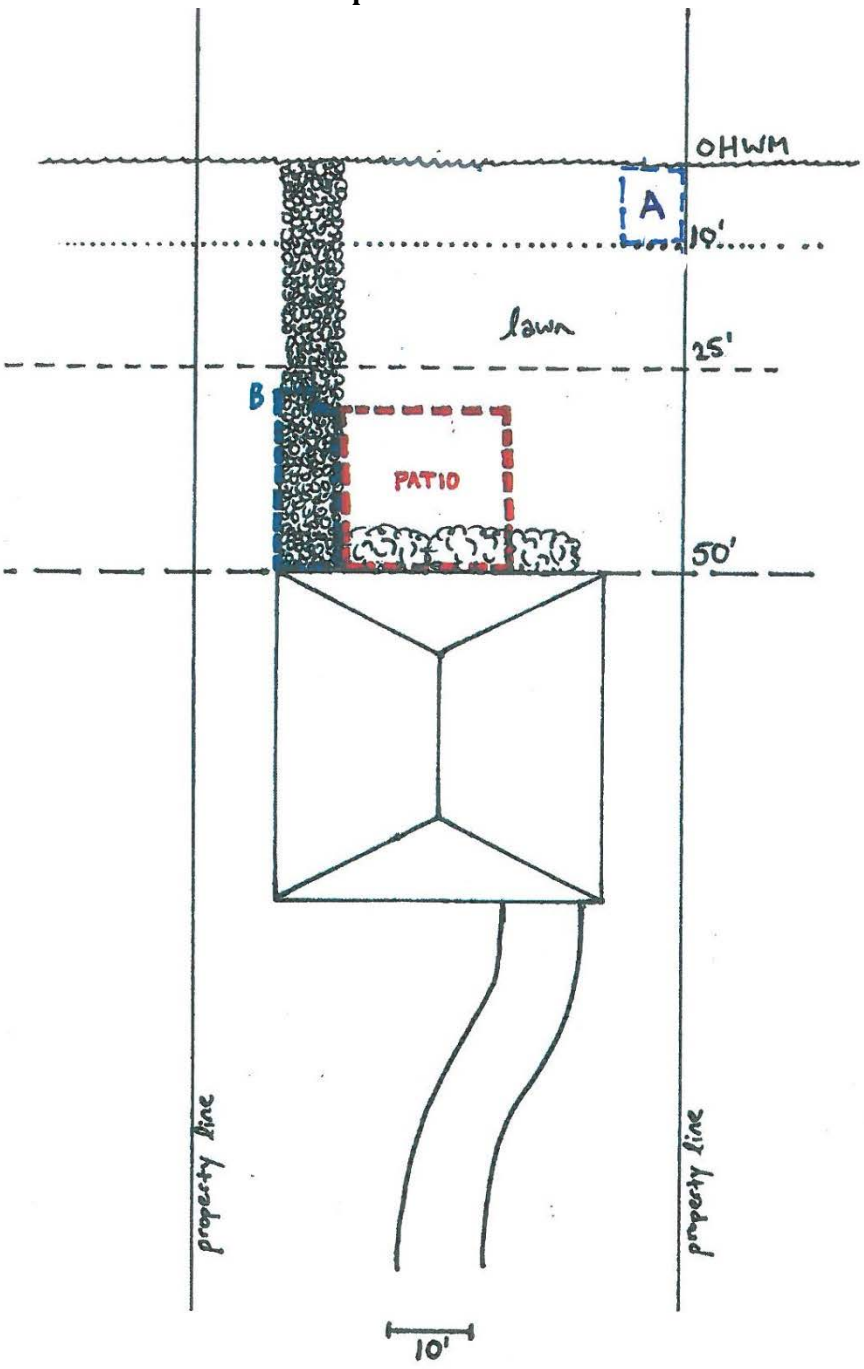
Total Credit Option A: 100

Credit Table: Mitigation Option B

Impact Zone	Mitigation planting option	Area (SF)	Land cover removed (Value)	Land cover installed (Value)	Total mitigation
Zone 2	Planting native vegetation in place of impervious path in Zone 2	167	Impervious surface (0.0)	Native vegetation (0.6)	(167 SF)*(0.6 – 0.0) = **100**

Total Credit Option B: 100

Example One: New Patio



Example Two: House expansion, partially over existing impervious surface

Project: Homeowner desires to expand residence waterward to 25 feet from the OHWM. Existing conditions within the setback include mown lawn, non-native vegetation, a concrete patio, and a concrete walkway.

Summary of impacts and mitigation: In this example, all impacts fall within Zone 2. No debit is calculated for expanding the structural footprint over the existing impervious surface. Two options for generating credits are shown below and in the figure.

Debit Table: Impacts

Impact Zone	Nature of Impact	Area (SF)	Land cover removed (Value)	Land cover installed (Value)	Total impact
Zone 1 (0-25 ft)					
Zone 2 (25-50 ft)	Increase in impervious surface	1,325	Mown lawn (0.2)	Impervious surface (0.0)	(1,325 SF)*(0.0 – 0.2) = **-265**
				Total Debit:	**-265**

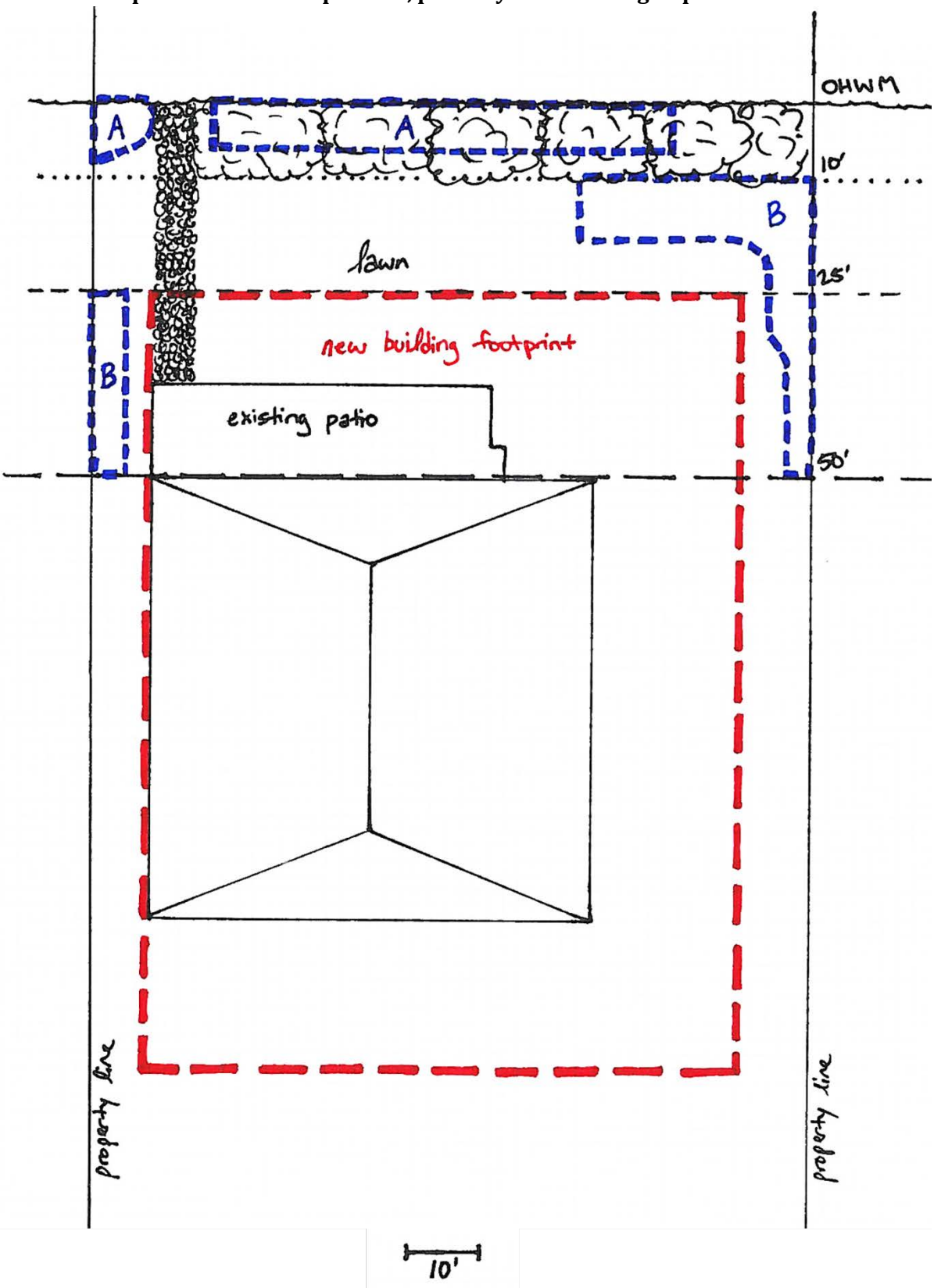
Credit Table: Mitigation Option A

Impact Zone	Mitigation planting option	Area (SF)	Land cover removed (Value)	Land cover installed (Value)	Total mitigation
Zone 2 (25-50 ft)	Planting native overhanging vegetation in place of lawn (Zone 1)	50	Mown lawn (0.2)	Native overhanging vegetation (1.0)	(50 SF)*(1.0 – 0..2) = **40**
Zone 2 (25-50 ft)	Planting native overhanging vegetation in place of non-native vegetation (Zone 1)	375	Non-native vegetation (0.4)	Native overhanging vegetation (1.0)	(375 SF)*(1.0-0.4) = **225**
				Total Credit Option A:	**265**

Credit Table: Mitigation Option B

Impact Zone	Mitigation planting option	Area (SF)	Land cover removed (Value)	Land cover installed (Value)	Total mitigation
Zone 2 (25-50 ft)	Planting native vegetation in Zone 1	300	Mown lawn (0.2)	Native vegetation (0.8)	(300 SF)*(0.8 – 0.2) = **180**
Zone 2 (25-50 ft)	Planting native vegetation in Zone 2	212	Mown lawn (0.2)	Native vegetation (0.6)	(442 SF)*(0.6 – 0.2) = **85**
				Total Credit Option B:	**265**

Example Two: House expansion, partially over existing impervious surface



Example Three: Use of Enhancement and Conservation Credits

Project: Homeowner desires to expand residence waterward to 25 feet from the OHWM. Existing conditions within the setback include native trees, shrubs, and groundcover. Native vegetation along the shoreline does not meet cover standards for mitigation planting; however, native vegetation along the western property line does meet these standards, and includes native trees, shrubs, and groundcover, with 90 percent areal coverage. Trees do not meet the definition of Significant trees.

Summary and estimate of total impacts: In this example, the homeowner uses enhancement and conservation credits to help offset debits. The homeowner will enhance the existing native vegetation along the shoreline with infill plantings. For areas meeting the native vegetation mitigation planting standards, the homeowner will receive a conservation credit. In order to increase the value of the existing native shoreline vegetation further, the homeowner will plant native red-twig dogwood at the property corners. Additionally, the homeowner will plant native vegetation in place of lawn so that the credits equal debits generated.

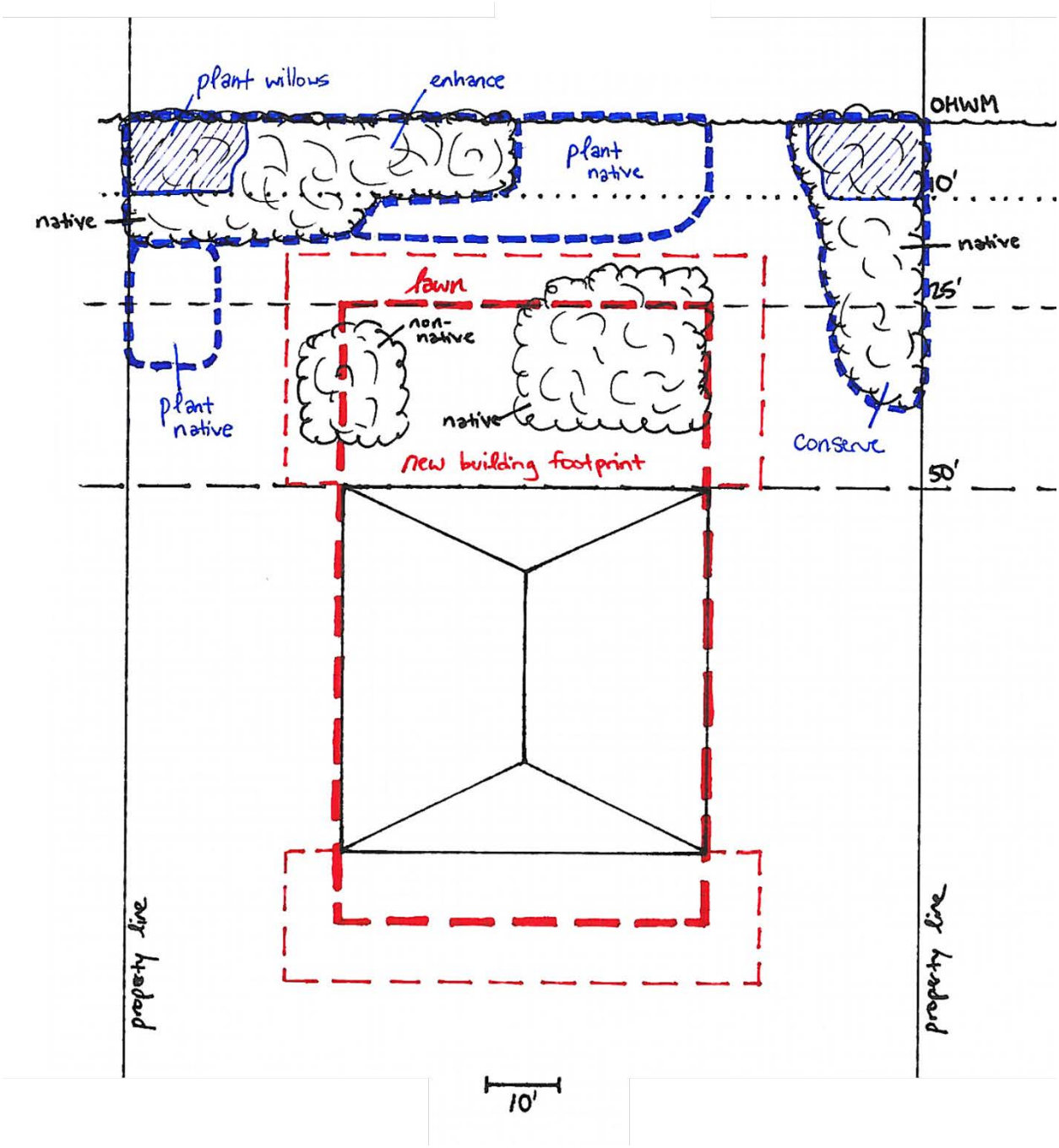
Debit Table: Impacts

Impact Zone	Nature of Impact	Impact Area (SF)	Land cover removed (Value)	Land cover installed (Value)	Total impact
Zone 1 (0-25 ft)	Area of native vegetation that will be replaced by lawn	100	Native shrub 0-25 ft (0.8)	Lawn (0.2)	(100 SF)*(0.2 – 0.8) = **-60**
Total Zone 1 Debits					**60**
Zone 2 (25-50 ft)	Replace non-native shrubs with impervious surface	125	Non-native shrubs (0.4)	Impervious surface (0.0)	(125 SF)*(0.0 – 0.4) = **-50**
	Replace native shrubs with impervious surface	440	Native shrub 25-50 ft (0.6)	Impervious surface (0.0)	(440 SF)*(0.0-0.6) = -**264**
	Replace non-native shrub with lawn	90	Non-native shrubs (0.4)	Lawn (0.2)	(90 SF)*(0.2-0.4) = **-18**
	Replace lawn and pervious area with impervious surface	725	Lawn/ bare ground (0.2)	Impervious surface (0.0)	(725)*(0.2-0.0) = **-145**
Total Zone 2 Debits					**477**
Debits from Zone 1 and 2 Combined					**537**
				Total Debits:	**537**

Credit Table: Mitigation Option

Impact Zone	Mitigation planting option	Mitigation Area (SF)	Land cover removed (Value)	Land cover installed (Value)	Total mitigation
Zone 1 (0-25 ft)	*Enhancement credit* for infill planting of native vegetation to meet cover and density standards	570	NA	NA	570 SF*0.1 enhancement = **57**
	Conservation credit for native vegetation 0-25 feet from OHWM	225	NA	NA	225 SF*0.1 conservation value = **22.5**
	Plant willows within existing native vegetation area (0-10 ft from OHWM)	300	Native vegetation (does not need to be removed) (0.8)	Native overhanging vegetation (1.0)	300 SF*(0.8-1.0) = **60**
	Replace bare ground with native vegetation 0-25 feet from OHWM	578	Bare ground (0.2)	Native vegetation (0.8)	578 SF*(0.8-0.2) = **347**
Total Credits from Zone 1					**386.5**
Zone 2 (25-50 ft)	*Conservation credit* for native vegetation 25-50 feet from OHWM	125	NA	NA	125 SF*0.1 enhancement = **12.5**
	Replace bare ground with native vegetation 25-50 feet from OHWM	95	Bare ground (0.2)	Native vegetation (0.6)	95 SF*(0.6-0.2) = **38**
Total Credits from Zone 2					**50.5**
Credits from Zone 1 and 2 Combined					**537**

Example Three: Use of Enhancement and Conservation Credits



Example Four: Use of Advance Credits

Project: Homeowner plants native vegetation along the shoreline in place of existing lawn. Five years later, the landowner applies the advance credits to debits generated from an addition to her house.

Summary and estimate of total impacts: After five years, the initial credit of 270 is valued at 351. The homeowner can use the advance credits when debits are generated.

Advance Mitigation

Impact Zone	Mitigation planting option	Mitigation Area (SF)	Land cover removed (Value)	Land cover installed (Value)	Total mitigation
Zone 1 (0-25 ft)	Plant native vegetation in place of lawn	450	0.2	0.8	450 SF*(0.8-0.2) = **270**
Total Credits from Zone 1					**270**
Zone 2 (25-50 ft)					
Total Credits from Zone 2					**0**
Credits from Zone 1 and 2 Combined					**270**

Advance Credit Maturation

Year After Planting	Credit at Start of Year	5% of initial value	Credit at End of Year
1	270	13.5	283.5
2	283.5	13.5	297
3	297	13.5	310.5
4	310.5	13.5	324
5	324	13.5	337.5

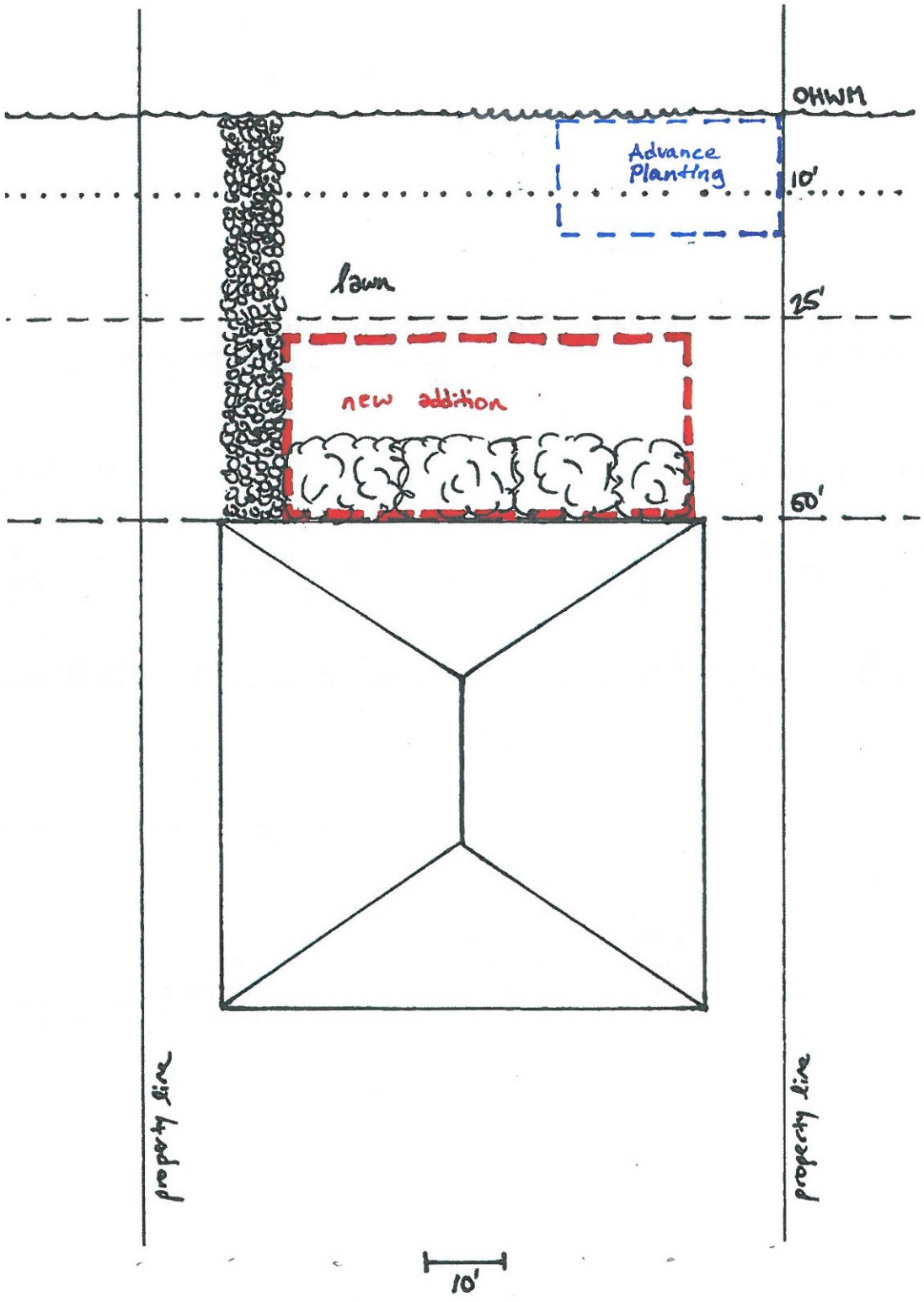
Total Debits at the End of Year 5: 337.5

Impacts Table

Impact Zone	Nature of Impact	Impact Area (SF)	Land cover removed (Value)	Land cover installed (Value)	Total impact
Zone 2 (25-50 ft)	Replace non-native shrubs with impervious surface	500	Non-native vegetation (0.4)	Impervious surface (0.0)	(500 SF)*(0.0 – 0.4) = -**200**
	Replace lawn with impervious surface	625	Mown lawn (0.2)	Impervious surface (0.0)	(625 SF)*(0.0 – 0.2) = -**125**

Total Debits: 325

Example Four: Use of Advance Credits



Example Five: Development in the Residential Canal Environment

Project: Homeowner desires to expand residence waterward to 25 feet from the OHWM. Existing conditions within the setback include mown lawn, non-native vegetation, a concrete patio, a pool, and a concrete walkway.

Summary and estimate of total impacts: No debit is calculated for expanding the structural footprint over the existing impervious surface or pool. Two options for generating credits are shown below and in the figure.

Debit Table: Impacts

Impact Zone	Nature of Impact	Impact Area (SF)	Land cover removed (Value)	Land cover installed (Value)	Total impact
Zone 1 (0-25 ft)	Replace non-native shrubs with lawn	76	Lawn (0.2)	Impervious surface (0.0)	(76 SF)*(0.0 – 0.2) = **-15**
Total Zone 1 Debits					**15**
Zone 2 (25-50 ft)	Replace non-native shrubs with impervious surface	254	Non-native shrubs (0.4)	Impervious surface (0.0)	(254 SF)*(0.0 – 0.4) = **-102**
	Replace lawn with impervious surface	570	Lawn (0.2)	Impervious surface (0.0)	(570 SF)*(0.0 – 0.2) = **-114**
Total Zone 2 Debits					**216**
				Total Debits:	**231**

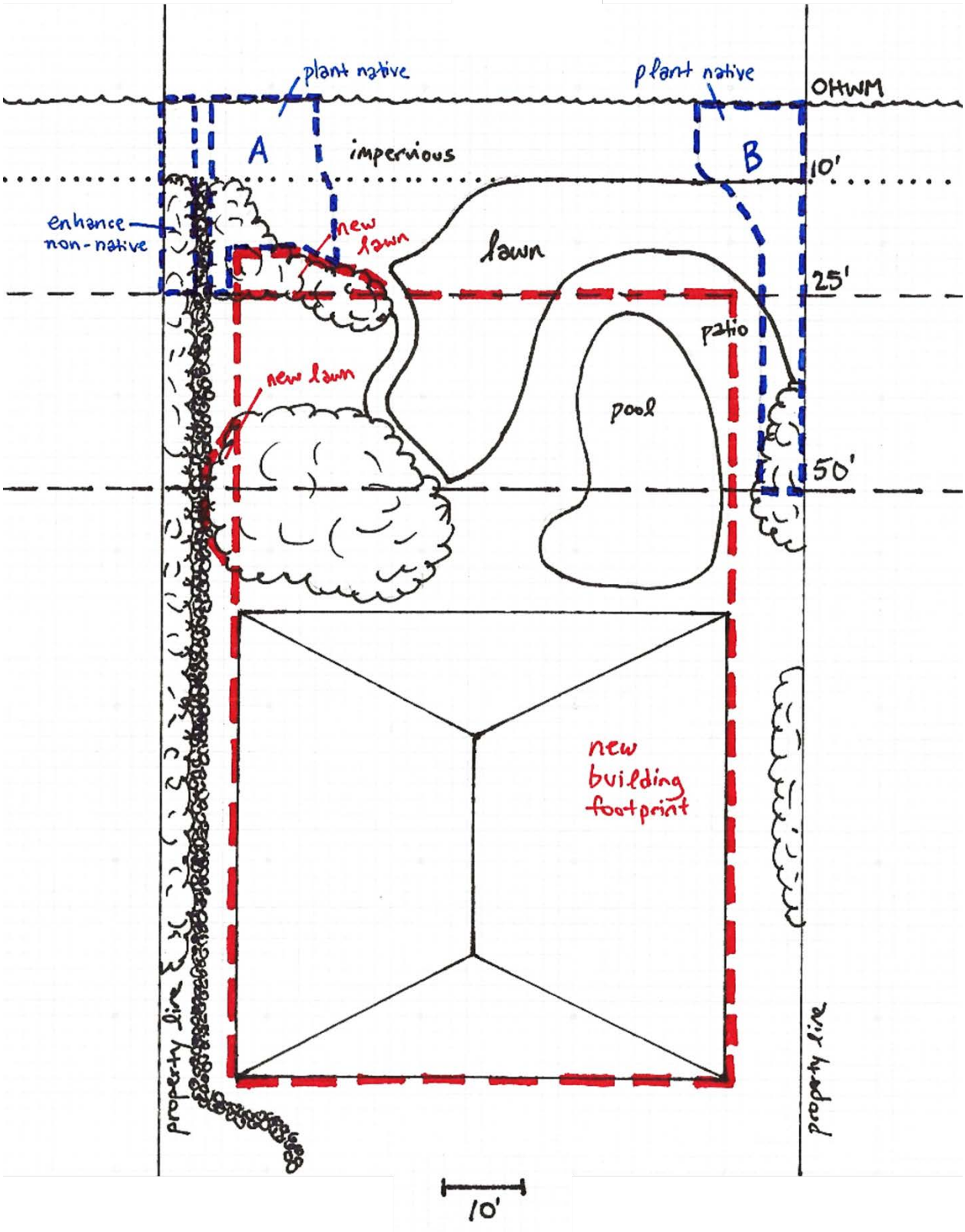
Credit Table: Mitigation Option A

Impact Zone	Mitigation planting option	Area (SF)	Land cover removed (Value)	Land cover installed (Value)	Total mitigation
Zone 1 (0-25 ft)	Plant native vegetation in place of impervious surface (Zone 1)	275	Impervious surface (0.0)	Native vegetation (0.8)	(270 SF)*(0.8 – 0.0) = **220**
Total Zone 1 Credits					**220**
Zone 2 (25-50 ft)	*Enhancement credit* for infill planting of native vegetation in non-native vegetation area to meet cover and density standards	145	NA	NA	145 SF & 0.1 enhancement = **14.5**
Total Zone 2 Credits					**14.5**
				Total Credit Option A:	**234.5**

Credit Table: Mitigation Option B

Impact Zone	Mitigation planting option	Area (SF)	Land cover removed (Value)	Land cover installed (Value)	Total mitigation
Zone 1 (0-25 ft)	Plant native vegetation in place of impervious surface (Zone 1)	140	Impervious surface (0.0)	Native vegetation (0.8)	(140 SF)*(0.8 – 0.0) = **112**
	Plant native vegetation in place of lawn (Zone 1)	106	Lawn (0.2)	Native vegetation (0.8)	(106 SF)*(0.8 – 0.2) = **64**
Total Zone 1 Credits					**176**
Zone 2 (25-50 ft)	Plant native vegetation in place of lawn (Zone 2)	42	Lawn (0.2)	Native vegetation (0.6)	(42 SF)*(0.6 – 0.2) = **17**
	Plant native vegetation in place of impervious surface (Zone 2)	44	Impervious surface (0.0)	Native vegetation (0.6)	(44 SF)*(0.6 – 0.0) = **26**
	Plant native vegetation in place of non-native vegetation (Zone 2)	72	Non-native vegetation (0.4)	Native vegetation (0.6)	(72 SF)*(0.6 – 0.4) = **14**
Total Zone 2 Credits					**57**
				Total Credit Option B:	**233**

Example Five: Development in the Residential Canal Environment



Example Six: Narrow lot with significant trees and native vegetation

Project: Homeowner desires to expand residence waterward. Existing conditions within the setback include native vegetation, three significant trees, and a pervious pathway. Two 12-inch diameter-at-breast-height (dbh) trees would be removed. Another 14-inch dbh tree would be removed from beyond 50 feet from the OHWM.

Summary and estimate of total impacts: Four trees would need to be planted to compensate for the loss of the two significant trees. These trees could be planted amidst existing native vegetation, although native vegetation within a 15-foot diameter of the tree would not qualify for conservation or enhancement credit. Replacement of significant trees is not required where the trunk is located outside of the vegetation conservation area, provided that the site landscape standards are met. If most of the remaining native vegetation within the vegetation conservation area is enhanced or maintained, the house could partially extend into the 50-foot vegetation conservation area.

Debit Table: Impacts

Impact Zone	Nature of Impact	Impact Area (SF)	Land cover removed (Value)	Land cover installed (Value)	Total impact
Zone 2 (25-50 ft)	Replace native vegetation with impervious surface	60	Native vegetation (0.4)	Impervious surface (0.0)	(60 SF)*(0.0 – 0.6) = **-36**
	Replace pervious path with impervious surface	50	Lawn (0.2)	Impervious surface (0.0)	(50 SF)*(0.0 – 0.2) = **-10**
Total Zone 2 Debits					**46**
				Total Debits:	**46**

Credit Table: Mitigation Option A

Impact Zone	Mitigation planting option	Area (SF)	Land cover removed (Value)	Land cover installed (Value)	Total mitigation
Zone 2 (25-50 ft)	*Enhancement/ Conservation credit* to meet cover, density, and composition standards	460	NA	NA	460 SF & 0.1 enhancement = **46**
Total Zone 2 Credits					**46**
				Total Credit Option A:	**46**

Example Six: Narrow lot with significant trees and native vegetation