

While we acknowledge Oaks Bottom Wildlife Refuge provides the region with ecosystem services, it is a natural area purchased and managed by public dollars for the express purpose of protecting and maintaining those services. What possible role or place could ecosystem service credits and debits have in this scenario? There are at least two possibilities:

1. Citizens wishing to contribute additional funding to assist the landowner's (the City of Portland) existing ongoing efforts toward conducting the necessary management tasks necessary to maintain and improve optimal performance of the Refuge's ecosystem services, could voluntarily purchase credits from the City and be assured the money received from their purchases would be solely dedicated to this Refuge. It is important to note this additional revenue would be required to supplement the existing management budget and not in any way be allowed to displace or replace any part of that budget. Transparent accounting would be necessary to assure that is the case.
2. City related development projects that impair or displace ecosystem services in other areas of the lower Willamette River (both regulated and nonregulated) watershed, could off-set or mitigate<sup>1</sup> the resulting debits by purchasing credits from the Oaks Bottom Wildlife Refuge with the important caveat that those credits must result from efforts above and beyond that which would normally be funded (e.g., additional new land purchases, enhancements, and / or restoration work) in the existing budget for the Oaks Bottom Wildlife Refuge management plan. Transparent accounting would be necessary to assure that is the case.

#### Development Acres

This is the amount of acreage of a given natural resource type (e.g., frequent emergent wetland, wet-grass prairie, vernal pool, snowy plover breeding habitat, etc.) that will be converted to alternative uses (e.g., housing sub-divisions, shopping malls, highway interchanges, etc).

#### Mitigation Acres

This is the amount of acreage of a given parcel of land (often degraded farmland or open space) that will be converted to alternative uses (e.g., frequent emergent wetland, wet-grass prairie, vernal pool, snowy plover breeding habitat, etc.) to off-set the loss of the same or similar resources somewhere else.

#### Development Multiplier

This is an assigned number often representing the relative importance of a particular resource type. Resources assigned high importance values are assumed to require a proportionally greater number of acres to compensate for their loss. Factors that can affect the assignment of resource value include but are not limited to: 1) scarcity in the landscape relative to historical extent, 2) time periods required to reach a fully functioning condition, 3) importance to focal concerns (e.g., imperiled species, watershed TMDLs, aesthetic and recreational opportunity, 4) the relative capability of a habitat unit to provide life-cycle requirements for a species, etc.). The acreage of a given development site multiplied by its assigned

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<sup>1</sup> Avoidance, minimization, onsite reduction and rectification should all be employed to the fullest extent practicable before any amount of compensatory mitigation is considered.

development multiplier equals the amount of debit accrued by the development action and the amount of credit needed from the mitigation site to off-set the debit. If the development site is equal to 10-acres and the Development Multiplier is 2, then the number of debits is 20 ( $10 \times 2$ ).

### Mitigation Divider

This is an assigned number often representing the relative likelihood of mitigation success depending on the compensatory mitigation method(s) employed. Methods that have a low track record of failure are generally assigned low mitigation dividers and those with a demonstrated high risk of failure are typically given higher mitigation dividers. Also compensatory mitigation methods that result in 100% loss of resource acreage are often assigned higher mitigation dividers. The acreage of a given mitigation site divided by its assigned mitigation divider equals the amount of credit available at that mitigation site. If the mitigation site is equal to 10-acres and the mitigation divider is 2, then the number of credits available is 5 ( $10 / 2$ ).

### Price Per Credit

The "price per credit" is generally a free-market determined decision often based on the sale prices of credits in the general area being "serviced" by a mitigation site. Factors such as the monetary cost of producing a credit (e.g., costs of land acquisition, site-preparation, maintenance, long-term endowments, etc.) combined with the prices of credits from competing mitigation providers have a relatively large influence on the price a credit is sold for. These prices tend to vary temporally and spatially depending on such factors as supply and demand, the strength of the economy, and proximity to major metropolitan areas.

### Lab Calculation Sequence

Variables:

Debit = transDbt, Credit = transCrdt, Development Acres = transDevAc, Mitigation Acres = transMitAc, Multiplier = transMult, Divider = transDivd, Net Credit = transNetCrdt, Credit Value = transCrdtVal, Price Per Credit = transPPCrdt

Formulas:

$\text{transDbt} = \text{transDevAc} \times \text{transMult}$ ;  $\text{transCrdt} = \text{transMitAc} / \text{transDivd}$ ;

$\text{transNetCrdt} = \text{transCrdt} - \text{transDbt}$ ;  $\text{transCrdtVal} = \text{transPPCrdt} \times \text{transNetCrdt}$ ;

Example (2-acre development site; 40-acre mitigation site; \$75,000 price per credit):

$4 = 2 \times 2$ ;  $20 = 40 / 2$ ;

$16 = 20 - 4$ ;  $\$1,200,000 = \$75,000 \times 16$

Lab Assignment:

Using the same development site acres, mitigation site acres, and price per credit in the example above, run the calculation at least 6 times with varying multipliers and dividers. Then consider the following questions:

From the perspective of financial gain and / or reduction of loss,

Which runs most benefited the developer?

Which runs most benefited the mitigation provider?

From the perspective of ecosystem services,

Which runs most benefited the natural resource agencies with missions to maximize ecosystem services?

Write a brief paragraph summarizing your findings. Also, feel free to discuss any variables you would add, change, or subtract to improve insight and ultimately inform applications of ecosystem services based credit debit transactions.