Best Available Science

Wetlands

Prepared for the City of Sammamish

by AMEC Environment & Infrastructure, Inc.

Introduction

This Best Available Science Review describes information relative to protecting wetlands as a Critical Area within the City of Sammamish (City). The review includes an overview of wetland regulations, new wetland science, and wetland issues throughout the Puget Sound region, conditions unique to the City, relevance of federal and state policy changes to the existing City regulations, and a list of recommended actions for the City's Environmentally Critical Areas Code for wetlands. The previous review and update to the City's Environmentally Critical Area Code was conducted in 2005. Therefore, this review focuses on changes in wetland science, regulation, and policy since the City's 2005 Critical Areas Code update.

As a result of the relative maturity of wetland science that has been used to provide wetlands protection, the major focus of recent publications (within the past seven years) has been primarily ways to adequately address wetland mitigation (compensation), with some attention to protection of isolated wetlands, provision of buffers, and implementation of density allowances for development.

In addition to a general review, searches were conducted of peer reviewed scientific literature to address specific issues identified by the City as "known topics," including:

- Ecological function of small, isolated wetlands;
- Functional effects of filling small, isolated wetlands;
- Potential effects of filling low-functioning, human modified wetlands; and
- Effects of trails in wetland buffers for assessing placement of trails within buffers.

Wetlands: Functions, Classifications, and Protective Measures

Wetlands are regulated and protected by law under Sections 404 and 401 of the Federal Water Pollution Control Act, commonly called the Clean Water Act, which is enforced in the State of Washington by the U.S. Army Corps of Engineers (USACE) and the Washington State Department of Ecology (Ecology). Wetlands are locally regulated by the City of Sammamish under the Environmentally Critical Areas Code. Wetlands are defined by the State of Washington and the USACE as,

> "those areas that are inundated or saturated, by surface or ground water, at a frequency and duration sufficient to support, and under normal conditions do support, a prevalence of vegetation typically adapted for life in saturated soil" (USACE, 2010).

Wetlands

The City of Sammamish definition of wetlands is consistent with the federal and state definition of wetlands, and Section 21A.15.1415 of the City Code further emphasizes that wetlands, "generally include swamps, marshes, bogs, and similar areas."

Wetlands are identified and delineated in landscapes following the guidance contained in the federal 1987 *Wetland Delineation Manual* (Environmental Laboratory, 1987). In 2010, the USACE developed a series of regional supplements, including a supplement for western mountains and valleys, which includes the Puget Sound Area (USACE, 2010). In response to the supplement's publication and to maintain consistency between the state and federal approaches to wetland identification and boundary delineation, Ecology repealed WAC 173-22-080 (the *Washington State Wetland Identification and Delineation Manual*, 1997), and adopted a revision of WAC 173-22-035, which provides that wetland identification and boundary delineations should follow the currently approved federal manual and applicable supplement. The changes became effective March 14, 2011.

The USACE *Interim Regional Supplement for Western Mountains, Valleys, and Coast Region* (USACE, 2010) differs from the Ecology Manual (Ecology, 1997) only as follows:

- Revised data form is provided;
- A new rapid test for hydrophytic vegetation as a confirmation of hydrophytic vegetation in areas where all vegetation community dominants are obligate and Facultative wetland species;
- New information for using hydric soil indicators; and
- Revised definition of "growing season."

Wetlands provide ecological functions in watersheds. They aid in floodwater storage and retention, groundwater discharge and recharge, and protecting and improving water quality. Species of plants and wildlife are dependant for some or all of their life history stages. Some wetlands provide habitat for federal and state threatened, endangered and sensitive plant and animal species, as well as provide habitats for non-Endangered Species Act protected invertebrates, amphibians, birds, and mammals. Wetlands also provide values to communities such as recreation, open space, and other aesthetic functions.

Wetlands are classified by landscape position, hydrologic characteristics, and other biological characteristics. There are currently three classification systems commonly employed for wetlands in Washington:

- **Cowardin Classification** (Cowardin, et al. 1979) - Wetlands are classified based on vegetation community composition (e.g., forested, scrub-shrub, emergent, or open water) and fresh water (palustrine, lacustrine) or saltwater dependent (estuarine).
- **Hydrogeomorphic Classification** (Brinson, 1993): Wetlands are classed based on landscape and hydrologic settings (i.e., riverine, slope, depressional).
- **Functional Classification** (Hruby, 2004) – Rates wetlands according to estimated levels of wetland functions, such as ability to provide water quality improvement, for example.

The City of Sammamish has adopted Ecology's functional classification (Hruby 2004) for evaluating and regulating wetlands. The City uses this system to establish wetland buffers and

mitigation ratios as described later in this memorandum. This classification method was developed using methods and approaches considered best available science (Hruby 2004).

Wetland Protection

The federal Clean Water Act protects navigable waters, and other waters of the U.S., including wetlands (Water Pollution Control Act of 1972, 33 U.S.C. § 1251 et seq. 2002). The 2006 Rapanos Supreme Court decision reviewed the jurisdiction of the Clean Water Act relative to wetlands specifically, and held that through the enforcement of the Clean Water Act, U.S. Environmental Protection Agency (U.S. EPA) and USACE maintain jurisdiction over Traditional Navigable Waters (TNWs), any wetland adjacent to or abutting TNWs, non-navigable tributaries of TNWs that are relatively permanent, and wetlands that abut such tributaries. For those wetlands associated with non-navigable tributaries that are not relatively permanent, the agencies have jurisdiction where wetlands are found to have a significant nexus to a TNW. The nexus can be biological or hydrologic. For wetlands not meeting these criteria or not to having a significant nexus, the U.S. EPA and USACE do not have jurisdiction.

Two state laws, the State Water Pollution Control Act and the Shoreline Management Act, give Ecology the authority to regulate wetlands. Ecology also uses the State Environmental Policy Act (SEPA) process to identify potential wetland-related concerns early in the permitting process. Some types of wetlands are regulated by state and local governments but not by the federal government. The most common type is isolated wetlands. Isolated wetlands generally have no surface water connections to other aquatic resources, as discussed later in this memo.

Wetlands are regulated by the City of Sammamish under the City's Environmentally Critical Areas regulations (SMC 21A.50). Specific wetland protective measures adopted by the City, as well as most jurisdictions in Puget Sound, include avoidance of negative effects, provision of wetland buffers; and where minimized, unavoidable impacts occur, providing compensation for those impacts. These protective measures are described below.

Buffers

Buffers are vegetated areas adjacent to an aquatic resource that can reduce, through various physical, chemical, and/or biological processes, impacts to the resource from adjacent land uses. Buffers sometimes can provide terrestrial habitats necessary for wildlife that also use wetlands to meet their life-history needs. The primary purpose of buffers is to protect and maintain the wide variety of functions provided by wetlands (or other aquatic areas). The physical characteristics of buffers—slope, soil, vegetation communities, and width—determine how well buffers reduce the adverse effects of development.

Mitigation

When a change in land use has the potential to adversely affect a wetland, regulatory agencies require the applicant to conduct wetland mitigation, as part of a national "no net loss" policy toward protecting wetlands. "No net loss of wetland functions and values" is a federal and state policy goal that emerged in 1989 and has been a mainstay of land use regulations since then (NRC, 2001). To date, the no net loss policy has been interpreted to mean that wetlands should be conserved wherever possible, and that wetlands converted to other uses must be offset

through compensatory mitigation to provide the same functions and values that have been lost (NRC, 2001).

As described in the 1990 Memorandum of Agreement between the U.S. EPA and the USACE (U.S. EPA and USACE, 1990), the mitigation sequence is a three-step sequence that helps guide decisions and to determine the type and level of mitigation required under Clean Water Act Section 404/401 Regulations. The Washington State Environmental Policy Act (SEPA) (Chapter 43-21C RCW), administered by Ecology (also requires that a sequence of actions be taken for proposals that will impact wetlands (mitigation sequence). The following are the steps in the mitigation sequence according to the implementing rules of SEPA (Chapter 197-11-768 WAC):

- Avoiding the impact altogether by not taking a certain action or parts of an action;
- Minimizing impacts by limiting the degree or magnitude of the impacts;
- Rectifying the impact by repairing, rehabilitating, or restoring the affected environment;
- Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action;
- Compensating for the impact by replacing, enhancing, or providing substitute resources or environments; and/or
- Monitoring the impact and taking appropriate corrective measures.

If, through mitigation sequencing, it is determined that compensatory mitigation is necessary, an applicant has several alternatives for how to approach compensation. The alternatives, reviewed and described by Ecology, et al. (2006), are as follows:

- Restoration: Re-establishment of wetland conditions where they formerly, but no longer, exist.
- Creation: Establishment of wetland conditions in a location where wetland conditions previously did not exist or that has not been a wetland within the last 100-200 years.
- Enhancement/Exchange: Modifying a specific structural feature of an existing degraded wetland to improve one or more functions based on management objectives.
- Preservation: Protection of an existing and well-functioning wetland from perspective future development threats.
- Mixed compensatory mitigation: Involves more than one of the listed types of compensatory mitigation.
- Wetland mitigation banking: Allows applicants to compensate for wetland loss by purchasing credits from a bank that is commissioned to restore, create, enhance, or preserve wetland areas in providing compensatory mitigation for authorized impacts to wetlands.
- In-lieu fee programs: Allows applicants to compensate for wetland losses by paying a fee to a third party, such as a government agency or conservation organization where the fee is used to ensure wetland protection, creation, enhancement of wetlands.

As a result of failure of many previous mitigation projects, Ecology and some Washington jurisdictions are encouraging the use of mitigation banks and in-lieu fee programs because these can offer greater assurance for mitigation success to both the applicant and the jurisdiction.

Puget Sound-Wide Issues

The following provides a review of wetland Critical Areas regulations in the City of Sammamish and selected neighboring peer jurisdictions (City of Bellevue, City of Issaquah, City of Redmond, and King County). Specific topics addressed include:

- an assessment of best available science as related to the City of Sammamish's existing wetland regulations;
- a description of any new best available science and implications to Sammamish's wetland regulations;
- a targeted discussion of known topics of interest identified by the City; and
- analysis of peer jurisdiction regulations as related to targeted regulatory topic areas.

Wetland Buffers

Buffer Width

Buffers are currently the most common and widespread method employed to provide physical protection to wetlands from adjacent land uses (NRC, 2001). Buffers are vegetated areas adjacent to wetlands that through various physical, chemical, and/or biological processes reduce impacts from adjacent land uses (Sheldon, et al. 2005).

Studies have been conducted over the last twenty years on buffer functions and the buffer widths needed for protection of natural resources, such as wetlands. Based on the literature cited in *Synthesis of the Science* (Sheldon, et al. 2005), wetland buffers widths should be determined based on:

- The type of wetland and the functions the wetland provides;
- Adjacent land uses; and
- Physical and biological characteristics of the buffer itself.

The general guidance is that to provide effective wetland protection, buffer widths should range from:

- 25 to 50 feet wide for wetlands that have minimal levels of habitat functions and are adjacent to low-intensity land uses (e.g., a passive-use park);
- 75 to 150 feet wide for wetlands with moderate habitat functions and are adjacent to moderate or high-intensity land uses (e.g., an active-use park or residential development);
- 150 feet to 300 feet or greater for wetlands with high habitat functions, regardless of the adjacent land use intensity (Sheldon, et al. 2005).

In general, studies recommend a wider buffer to preserve wildlife function than to screen adjacent disturbance, to remove toxins and nutrients, or to control sediments. Recommended buffer widths for specific ecological functions are described Table 1 and information provided based on studies cited in Ecology's review (Sheldon, et al. 2005).

As shown in Table 1, buffers as narrow as 25-50 feet may improve water quality functions, whereas buffers of at least 100 feet are required for improving wildlife function, although most studies agree that buffers ranging from 200-300 feet are required to provide protective habitats for many wildlife species that use Puget Sound wetlands (Castelle, et al. 1992).

Table 2 provides a comparison of buffer widths required by King County, the City of Bellevue, the City of Redmond, and the City of Issaquah. The required buffer widths in the City of Sammamish are consistent or slightly lower than those of nearby jurisdictions but are within the range suggested by Best Available Science.

Table 1. Recommended buffer widths to preserve wetland function based on studies cited in Sheldon, et al. 2005

Function	Recommended buffer width (feet)	Effectiveness of buffer width	References
Sediment Control	5-10	60% removal of sediments, especially larger sediments (sands)	Desbonnet, et al. 1994, Noramn, 1996
	11-50	Removal of all but the finest particles (silts and sands)	Desbonnet, et al. 1994
	51-100	70-80% removal	Lynch, et al., 1985
	100-200	90-95% removal	Wong and McCuen, 1982
Nutrient Removal	10-20	50-60% removal of nitrogen with use of vegetated filter	Dilaha,1993
	21-30	70-80% removal of nitrogen and phosphorous with use of vegetated filter	Desbonnet, et al. 1994, Dillaha, 1993
	31-65	47-99% removal of nitrogen	Patty, et al. 1997
Pathogen control	15	Reduction in fecal coliform bacteria levels	Doyle, et al. 1977
	100-115	Removal of 60% fecal coliform bacteria	Grismer, 1981
Wildlife habitat	50-100	Variable buffer widths based on adjacent land uses can provide adequate buffer	Desbonnet, et al. 1994
	100-200	Adequate for most habitat needs, including most breeding birds and mammals	Chase, et al. 1995
	200-300	Range for all species noted in study	Castelle, et al. 1992
	1,000+	Buffer needed to include all bird richness in Puget Sound lowland wetlands, highest small mammal richness, and salamanders	Richter and Azous, 2001, Semlitsch, 1998
Screening adjacent disturbance	50-100	Adequate for low intensity land use	Cooke, 1992
	101-150	High density residential housing and commercial/industrial (most effective with steep slopes and dense shrubs)	Shisler, et al. 1987

Wetland buffers in the City of Sammamish are currently prescribed based on the wetland rating (e.g., Category I, II, III, IV Wetlands), with wider buffers for areas with high habitat value (SMC 21A.50.890). However, the existing code does not account for anticipated or existing adjacent land use intensity, a choice that was made by the City to simplify the code given that land uses in Sammamish are primarily residential.

The maximum buffer width in the City for Category I wetlands with high habitat functions is 215 feet. Assuming the buffer is well vegetated, this width provides room for a variety of wildlife functions, such as providing shelter and forage, and is within the recommended guidance provided by Ecology (see Table 2).

Table 2. Review of Wetland Buffer Widths for Five Puget Sound Jurisdictions

Wetland Rating[1]	Habitat Value / Description[2]	Ecology Guidance (ft)[3]	Recommended Buffer Width Per Municipality (ft)				
			Bellevue	Issaquah	Redmond[4]	King County[5]	Sammamish
Category I	bogs and natural heritage wetlands	150-300+	190	190	150-300[5]	215	215
Category I	Habitat score high		225	225	150-300[5]	225	200
Category I	Habitat score med		110	150	75-150	150	150
Category I	Habitat score low		75	100	50-100	150	125
Category I	All others		75	75	50-100	125	125
Category II	Habitat score high	75-300	225	225	150-300	200	150
Category II	Habitat score med		110	150	75-150	125	100
Category II	Habitat score low		75	100	50-100	100	75
Category III	Habitat score med	40-150	40	75	75-150	125	75
Category III	All others		60	50	40-80	75	50
Category IV over 2500 sf	All others	25-50	40	40	25-50	50	50

1 Based on Wetland Rating System for Western Washington (Hruby 2004)

2 Based on Wetland Rating Score (Hruby 2004). Each jurisdiction varied slightly in defining high/medium/low habitat function so exact values are not shown. For exact values, refer to the Critical Area codes.

3 Sheldon 2005.

4 For the City of Redmond, a range of buffer widths is provided because the required buffer is assigned based on proposed land use intensity

5 King County provides separate guidance for wetlands within and beyond the Urban Growth Boundary. The values shown are for wetlands within the Urban Growth Boundary. Wetland systems within the King County Urban Growth Boundary contain characteristics more similar to the City of Sammamish than wetlands outside of the Urban Growth Boundary.

Buffer Reduction

Most of the reviewed Critical Areas regulations had provisions that allow for the reduction or alteration of wetland buffers under certain conditions. For jurisdictions reviewed, buffer reductions were allowed where a buffer has been previously established and is permanently recorded. For example, the Sammamish Environmentally Critical Areas Code allows for a buffer to remain as it was previously established, as long as it is at least 50 percent of the currently required buffer (SMC 21A.50.290). Bellevue and Issaquah codes provide similar allowances.

The City of Sammamish Code also allows for buffer reductions of up to a maximum of 50 percent of the standard buffer width, after mitigation sequencing requirements are met, if some or all of the following best management practices or mitigation measures listed below are also provided in the site development (SMC 21A.50.290(8)):

- Installation of stormwater bio-filtration/infiltration mechanisms supplemental to existing storm drainage and water quality requirements;

- Removal of existing impervious surfaces;
- Removal of invasive non-native vegetation;
- Install stormwater controls;
- Install pervious driveway materials as an alternative to new impervious surfaces;
- Restoration of on-site buffers, or off-site buffers within the same sub-basin of the impacted wetland; and
- Removal of significant refuse or sources of toxic materials.

The City of Redmond, Issaquah, Bellevue, and King County also allow for buffer reductions, with provisions similar to those described above for the City of Sammamish. Provisions written into other Critical Areas ordinances that the City of Sammamish may wish to consider include the following:

- An undisturbed vegetated corridor (100-ft wide) is preserved between wetlands with moderate to high habitat function and other priority habitats (Redmond Zoning Code 21.64.030.5.a.i.A), within or in addition to the required buffer;
- Reduction of required buffer width based on existing condition of the buffer. Specifically, if existing buffer conditions are degraded such that more than 40 percent of the buffer is covered by non-native/invasive plant species, tree or shrub vegetation covers less than 25 percent of the total buffer area, or the wetland buffer has slopes of less than 25 percent (Issaquah Municipal Code 18.10.640). Such language should be carefully crafted to avoid creating an incentive for a code compliance situation.

These provisions are not required by best available science, but are consistent with protection of the general habitat functions performed by wetland buffers described in the previous section.

Modification of Man-made Wetlands

All of the reviewed local jurisdiction regulations allow for the modification of entirely man-made wetlands. The definition of wetlands regulated by the State of Washington excludes:

> …artificial wetlands intentionally created from non-wetland sites, including, but not limited to, irrigation and drainage ditches, grass-lined swales, canals, detention facilities, wastewater treatment facilities, farm ponds, and landscape amenities, or those wetlands created after July 1, 1990, that were unintentionally created as a result of the construction of a road, street, or highway. Wetlands may include those artificial wetlands intentionally created from non-wetland areas to mitigate the conversion of wetlands… (Revised Code of Washington [RCW] 36.70A.035).

The term “non-wetland” means an area where wetland characteristics are lacking, i.e., an upland area (Ecology 2010, Sammamish Critical Areas Code). Wetlands intentionally created where wetlands would not occur under normal circumstances are not defined as wetlands unless the wetlands are created as mitigation to compensate for wetland impacts.

Stormwater ponds constructed in previous non-wetland areas are an example of such a situation where the stormwater pond would not be regulated as a wetland. In addition, Section 21A.15.1314 of the Sammamish Municipal Code exempts regulation of some wetlands created upslope of roads constructed after 1990.

Occasionally, wetlands are unintentionally created. Such wetlands may or may not be regulated depending on how the wetland was formed and whether or not the created wetland would occur under normal circumstances. Making this determination can be complicated and may require historical reviews, field investigations, and hydrologic studies.

If someone intentionally creates a new water feature, such as a ditch or pond, in an area that was already wetland, the new water feature is regulated under state law as a wetland (Ecology 2010). These areas are known as man-modified wetlands. Alteration or filling these wetlands without permits, would result in a "net-loss" of wetland area and wetland function, and would be considered a violation of federal, state, and local wetland regulations.

Definitions of wetland and non-wetland in the City of Sammamish code are consistent with best available science.

Reasonable Use Exceptions

Most of the peer jurisdiction Critical Areas Codes reviewed for this report had provisions for reasonable use of a property that is otherwise 100 percent encumbered by Critical Areas and/or associated buffers. For example, the City of Sammamish code may allow alterations to Critical Areas, including wetlands, if there is no reasonable use with less impact to the Critical Area that would allow for reasonable use of the property, and assuming that mitigation is provided under an approved mitigation plan (SMC 21A.50.070). The City of Bellevue and City of Redmond provide a similar allowance.

The King County code includes additional provisions that the proposed development must also be outside of any Shoreline Management area, and that any proposed dwelling units must not be more than 5,000 square feet or 10 percent of the parcel, whichever is greater.

There is no new BAS that would indicate changes to the existing code language might be considered at this time.

Zoning Tools

The City of Sammamish Zoning Code (21A.25.030) requires, to the extent possible, that all subdivisions and short subdivisions in the R-1 zone be clustered away from critical areas or the axis of designated corridors, such as urban separators or the wildlife habitat network. More provisions for how subdivisions and developments should be managed in terms of density are provided for the Wetland Management Area—Special District Overlay as described later in this document under Unique Conditions in Sammamish.

The reviewed peer jurisdiction codes provided development density to be transferred from an encumbered area of a property to an unencumbered area on the same property. Both the City of Issaquah and the City of Bellevue's codes provide an alternative development density calculation to manage density of a property and protect Critical Areas.

For example, in Bellevue, the maximum density allowed for a property in the Critical Areas Overlay District is termed a "development factor," which is calculated based on the code designation within the buildable area, the number of dwelling units per acre, and on the area of critical areas and critical areas buffer. Essentially, the density is moved into an upland, or non-buffer portion, of a given property. A similar density calculation is used in the City of Issaquah to sub-divide a property into a Critical Areas lot and a developable lot, and allows development even if the resulting developable lot is smaller than the minimum lot size that would be allowed. The City of Sammamish provides a similar provision to cluster development and protect wetlands in the Wetland Management Area (SMC 21A.50.322).

The existing code specific to the Wetland Management Area, which encourages development away from wetlands, is consistent with current best available science. In general, zoning tools may have effects beyond the Critical Areas Code, and may require changes in other areas of the City's code and comprehensive plan.

Isolated Wetlands

Wetlands that do not have a continuous surface connection to traditional navigable waters (are "isolated") may still be regulated by the USACE under the Clean Water Act. A determination of whether a wetland qualifies for federal regulation is typically made by the USACE. If the USACE determines that the wetland does not qualify for federal regulation, the wetland is still typically regulated by Ecology and the local jurisdiction. Ecology requires that, to fill an isolated wetland, an applicant must obtain authorization from Ecology through an administrative order. To obtain an administrative order, Ecology has developed a worksheet that evaluates the size of the wetland, distance to nearest waterway, presence within floodplain, Cowardin classification, proposed wetland impacts, and reviews wetland delineation reports, the proposed project plans, any mitigation plan, and any other relevant information (Ecology, 2011).

The level of wetland functions do not always scale with the wetland area or the wetlands hydrologic connection. In other words, larger, hydrologically connected wetlands do not always demonstrate greater functioning capability than smaller or hydrologically isolated wetlands. There are instances where small wetlands provide levels of functions in the landscape that are important beyond what would be anticipated if only size were taken into account. The best example of this might be for pothole or vernal pool wetland, where these generally smaller, isolated systems provide ecosystem functions that would not occur in the landscape otherwise. For example, in some landscapes these types of small, seasonal wetlands provide the only location with the appropriate habitat conditions for amphibian breeding.

The codes of jurisdictions reviewed provide exemptions for small, isolated wetlands (approximately 2,500 square feet or less) from Critical Areas regulations; although the exemption ranged from no regulation of small isolated wetlands by the jurisdiction (Bellevue, Redmond, and Issaquah) to requiring compensation for impacts (Sammamish, King County). The size of exempt wetlands ranges from 250 to 2,500 square feet, depending on the jurisdiction. Table 3 provides a comparison of small, isolated wetland exemptions by jurisdiction, and a brief description of compensation required. It is suggested that any application to fill small, isolated wetlands be reviewed in regards to the wetland's function in a watershed-based context.

Table 3. Summary of Wetland Exemptions of Nearby Jurisdictions and Compensation Required

Jurisdiction	Isolated Wetland Exemption	Compensation Required
Sammamish	1,000 square feet	Cumulative impacts must be mitigated pursuant to an approved mitigation plan
Bellevue	Category IV wetlands under 2,500 sf are not designated Critical Areas	None
Redmond	Category IV wetlands less than 250 sf are not regulated	None
Issaquah	Category IV wetlands under 2,500 sf are not designated Critical Areas	None
King County	2,500 square feet	Relocation of wetlands

Compensation

Recent state policies recommend that mitigation (compensation) be based on a watershed approach for demonstrated unavoidable impacts to wetlands (Hruby, et al. 2009). Since the City last updated its wetland regulations in 2005, the Ecology has issued guidance (2009) for using a watershed-based approach for wetland mitigation (Hruby, et al. 2009) that encourages the following measures when selecting a mitigation site:

- Locate mitigation in areas that will enhance or protect ecological processes within the watershed (or hydrologic unit);
- Determine where critical processes have been altered within the watershed to prioritize areas for protecting and restoring processes and related functions;
- Select on-site mitigation when the wetland functions at the site are important to the ecological processes of the entire watershed and opportunities for improving functions on-site have a high likelihood of being successful and sustainable; and
- Allow for options that may result in wetlands of different types (e.g., different hydrogeomorphic classes) or provide different functions than those being impacted.

At this time, all of the peer jurisdictions' codes reviewed allow compensation for impacts to wetlands. However, the jurisdictions, including Sammamish, do not reflect the most recent Ecology guidance for using a watershed-based approach for wetland mitigation. This is an aspect of the Sammamish code that may be appropriate to update, within the context of Sammamish-specific regional conditions.

Watershed Based Mitigation Alternatives

Because of the newly emphasized focus on a watershed-based approach to wetland mitigation (compensation), regulatory provisions and avenues for wetland mitigation banking and in-lieu fee wetland mitigation programs have been further established since the City's 2005 wetland regulatory update. In 2009, Ecology adopted a wetland banking rule.

In a federal rule published in April 2008 (USACE and U.S. EPA 2008), the USACE and the U.S. EPA define in-lieu fee programs as follows:

> A program involving the restoration, establishment, enhancement, and/or preservation of aquatic resources through funds paid to a governmental or non-profit natural resources management entity to satisfy compensatory mitigation

> requirements. Similar to a mitigation bank, an in-lieu fee program sells compensatory mitigation credits to permittees whose obligation to provide compensatory mitigation is then transferred to the in-lieu program sponsor.

On March 12, 2012, an in-lieu fee program led by King County was certified by the USACE. The program is designed to satisfy mitigation obligations for a wide variety of permit types, including federal, state, and local permits. The King County in-lieu fee Program, called the *Mitigation Reserves Program*, could be used for wetland mitigation in limited circumstances where mitigation sequencing has been demonstrated and wetland impacts cannot be avoided. Through a purchase of credits from the *Mitigation Reserves Program,* the applicant would satisfy their mitigation requirements and have no further involvement in providing the compensation (King County, et al. 2011). King County would then allocate the funds to a mitigation site from a predefined roster; the sites may be held publicly or privately and would be chosen based on watershed priorities.

The King County *Mitigation Reserves Program* is available throughout unincorporated King County. According to the King County website, the Program may be available to project proponents working within incorporated cities if the City code allows it, and if the City and County have an agreement in place (King County, 2012). City staff has been working with King County to investigate opportunities for making this program available for use within the City. Other western Washington jurisdictions, such as Mount Vernon and Whatcom County, have explored and implemented similar programs.

Mitigation Ratios

Each of the codes reviewed recommended similar mitigation ratios based on the ecological function of the impacted wetland. Ecology, the City of Redmond and King County recommended specific ratios based on the proposed type of mitigation (re-establishment, restoration, enhancement, or a combination of creation/enhancement). King County also recommends different ratios for temporary as opposed to permanent impacts.

Each of the codes reviewed provide provisions for both increasing and decreasing mitigation ratios. Standard provisions for both increasing and decreasing mitigation are based on the quality of the wetland impacted and likelihood of success of the mitigation measures. The King County code specifies that a wetland mitigation ratio may be decreased if the wetland impacted is characterized with several hydrogeomorphic classes, and the proposed impact is proposed within an area of lower value than the entire wetland. To qualify for a mitigation ratio reduction in any of the municipalities, justification must be provided by a qualified wetland scientist.

Several of the codes reviewed provide provisions for buffer mitigation as well as wetland mitigation ratios. Specifically, both King County and the City of Bellevue require a one-to-one ratio for wetland buffer mitigation. The City of Sammamish does not designate a specific mitigation ratio for wetland buffers.

Mitigation Credit and Debit calculations

In early 2012, Ecology adopted an approach for estimating the functions lost when a wetland is altered, and to estimate the gain in functions that may result from mitigation (Hruby, 2011).

The credit-debit method is based on the *Washington State Wetland Rating System for Western Washington* (Hruby, 2004) and estimates the type and area of compensation to be provided based on functions of the wetland being altered (debits), and the amount compensation action

will create (credits). Under the guidance, a mitigation proposal would be deemed adequate when the "credit" score for the mitigation project is higher than the "debit" score for the impacted wetland (Hruby, 2011).

Unique Conditions in Sammamish

This section provides an overview of documented wetland conditions in Sammamish, and describes conditions that may call for non-standard approaches in Sammamish including:

- Small and isolated wetlands;
- Bogs;
- Man-modified wetlands;
- Permitted Alterations such as public access trails; and
- The Wetland Overlay District.

Wetland Conditions in the City of Sammamish

The City of Sammamish completed a 2006 field inventory of approximate wetland locations in the City's Town Center area (Figure 1) and has reviewed known wetlands as part of shoreline inventory efforts for the Shoreline Master Program Update (2007). Otherwise, the City primarily relies on the older 1990 King County wetland inventory for information about the approximate location and characteristics of some of the known wetlands in the City (Figure 2).

Bogs

The City of Sammamish has ten wetlands that have been mapped to include bog ecosystems and two additional bogs are located outside of the City limits but within the City's urban growth boundaries. The U.S. EPA describes bogs as "spongy peat deposits, acidic waters, and a floor covered by a thick carpet of sphagnum moss. Bogs are unique communities that require hundreds, if not thousands, of years to form naturally," (U.S. EPA 2012).

Bogs provide a variety of functions including moderating flood pulses, controlling downstream flows through controlled water release, acting as carbon and nutrient sinks, and providing for specific bog vegetation communities and associated habitat (Kulzer, et al. 2001). Recently, bogs have been recognized for their role in regulating global climate by storing large amounts of carbon in peat deposits and due to their extensive area in northern latitudes. Bogs are among the most sensitive type of Puget Sound lowland wetlands to alteration of water chemistry and require special water quality management to avoid losses of their relatively rare communities (Horner, et al. 1997).

When a bog is part of a greater wetland system, ecologically the entire system functions together. As a result, the *Wetland Rating System for Western Washington* rates any wetland unit that includes a bog component as a Category I wetland (Hruby, 2004).

Wetlands

The City of Sammamish *Shoreline Inventory and Characterization Report* conducted in conjunction with the Shoreline Master Program Update (ESA Adolfson, 2007) describes

wetlands associated with the East Lake Sammamish Basin, and the individual sub-basins that make up the East Lake Sammamish Basin within the Sammamish City Limits. Parts of Sammamish also drain into the Evans Creek basin and the Patterson Creek sub-basin of the Snoqualmie River, but these areas were not included in the 2007 inventory.

The East Lake Sammamish Basin includes six sub-basins with four primary stream systems and many wetlands and small hillside drainages. The more than 40 inventoried wetlands within the basin provide habitat for fish and wildlife, recreational opportunities, and aesthetic enjoyment for basin residents (King County, 1994). As of 1994, nine of the forty wetlands were classified as "unique and outstanding," which would likely correlate to Category I or II wetlands using the Ecology guidance. Many of the wetlands within the basin have been impacted by development including roads and stormwater runoff (King County, 1994).

The Inglewood sub-basin and the Thompson sub-basin are both well-studied systems that lie within the East Lake Sammamish Basin. In the Inglewood sub-basin, numerous wetlands on the plateau form the headwaters for tributaries that converge into George Davis Creek. George Davis Creek drains these wetlands into Lake Sammamish (Entranco, 2005). In the Thompson sub-basin, several large depressional wetlands drain to Lake Sammamish. Some of the wetlands in the Thompson sub-basin are degraded due to residential development, while others are in good condition (City of Sammamish, 2011). Opportunities for restoration of wetlands in the Thomson sub-basin are described in the Thompson Sub-Basin Plan (City of Sammamish, 2011).

It is important to note that the City of Sammamish, like nearly all local governments, maintains a limited inventory of wetlands, and that it is presumed that many more wetlands occur within the City limits than is shown on existing City wetland inventory maps. At this time, the most thorough wetland inventory within the City of Sammamish is the 1990 King County Wetlands Inventory (interactive mapping tool available online at http://www5.kingcounty.gov/iMAP/viewer.htm?mapset=wria), which is known to be incomplete and boundaries and stream connections are not always accurate. As defined in Sammamish Municipal Code 21A.15.942, applicants should hire a qualified professional to evaluate site conditions in conjunction with development plans.

The City of Sammamish is unusual in that restoration opportunities are prevalent within the City's Urban Growth Boundary. As mentioned previously, specific restoration opportunities are identified in the Thompson Sub-Basin Plan, and other opportunities have been identified by City staff. These restoration opportunities could potentially be used by applicants for designing mitigation sites to compensate for unavoidable impacts to wetlands.

Isolated Wetlands

Isolated wetlands in the City of Sammamish may occur naturally, or may have resulted from habitat fragmentation due to adjacent development. Some isolated wetlands may provide important ecological functions, whereas others may not (Smelitsch and Bodie, 1998; Smith, et al. 2011; NRCS, 2006). The current Sammamish Environmentally Critical Areas Code indicates that isolated wetlands less than 1,000 square feet *may b*e exempt if the City determines that the cumulative impacts do not unduly counteract the purposes of this chapter, and if impacts are mitigated pursuant to an approved mitigation plan. The existing provisions in the Code are consistent with best available science, as the code requires professional review of proposals to

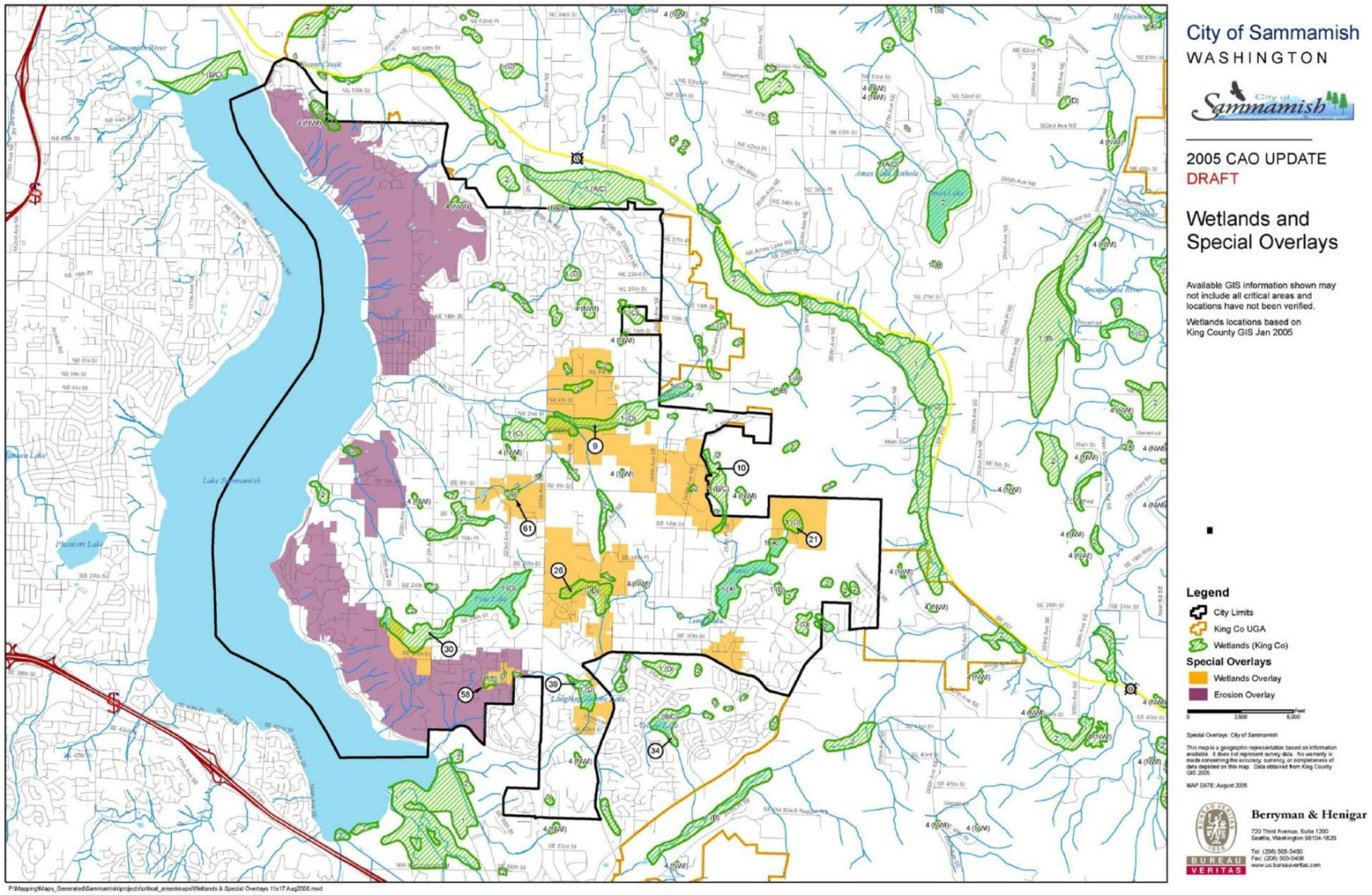

Figure 1. Field Inventory of Approximate Wetland Locations, 2006

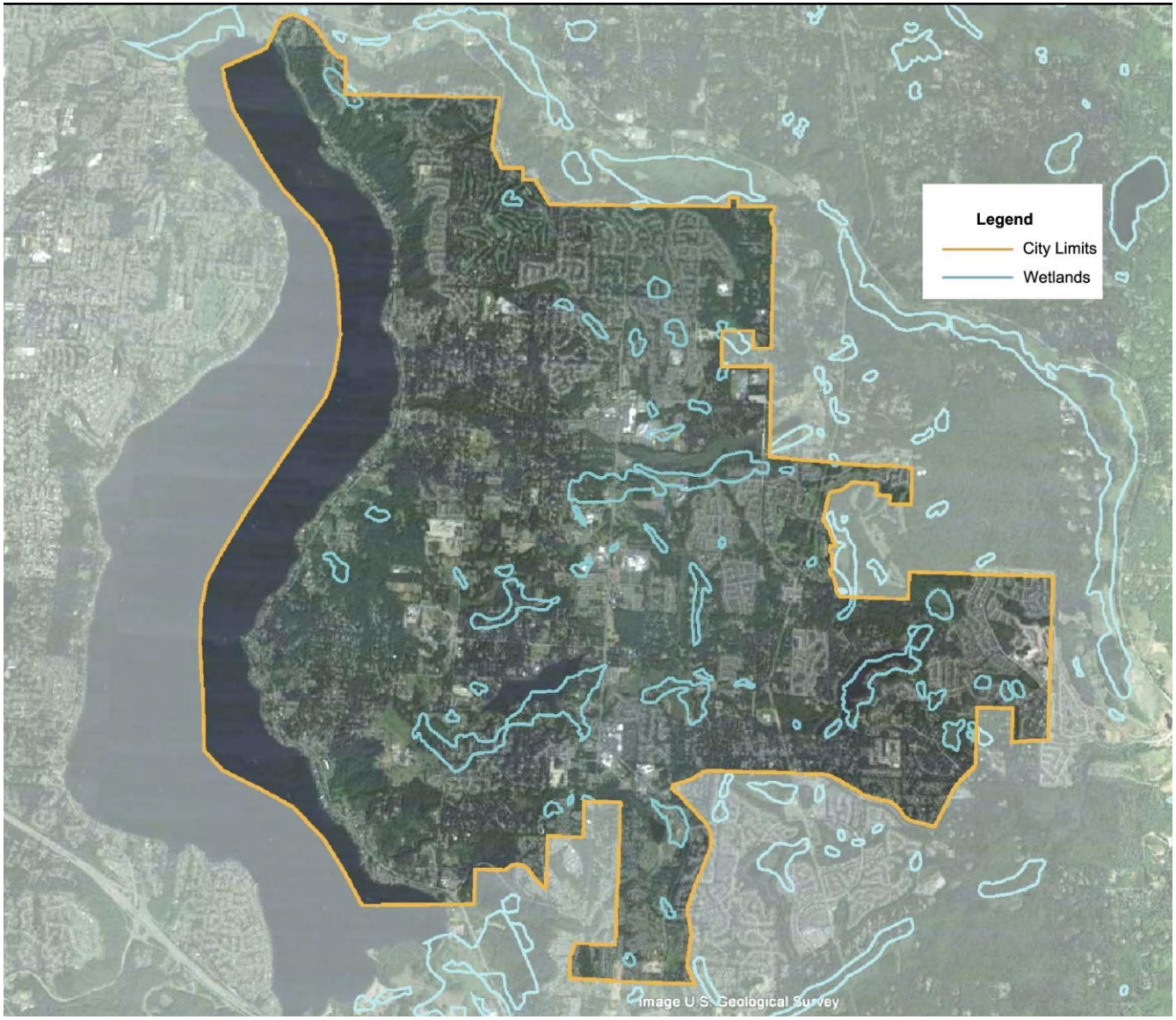

Figure 2. King County wetland inventory, 1990

fill small, isolated wetlands with an allowance for exemption from Critical Areas requirements if shown justified.

Permitted Alterations: Public Access

The City of Sammamish identified several known issues that should be addressed in this Best Available Science Review. One of these is the suitability of public access and trails within wetland buffers. As a developed suburban area, Sammamish must balance public access with preservation of wetland areas. For example, a key aspect of the Sammamish Town Center Plan is to provide, "open space, environmental quality, trails, and access with an extensive trail system for pedestrians and bicycles." The Town Center Plan notes that trail construction is a critical aspect of the plan to connect physically the Town Center area. The anticipated trail system includes soft surface nature trails along wetland buffers, as well as multi-use trails connecting developments (Makers Architecture and Urban Design, 2008).

Wetland Management Area—Special Overlay District

As described previously, the City of Sammamish is unique in the region in that wetlands with bog components are mapped within the City's urban growth boundaries. According to the Sammamish Critical Areas Code, Wetland Management Areas were designed to protect "unique and outstanding wetlands," such as the bogs and other high-functioning wetlands in the City.

The Wetland Management Area provides additional protection to these wetlands by limiting impervious surfaces, clustering developments away from wetlands, preserving forested vegetation, and limiting clearing and grading to the dry season. The overall objective is to treat the wetlands within a Wetland Management Area as a systems integral with the landscape, and to prevent adjacent development from resulting in geographic and/or hydrologic isolation.

In the wetlands literature, it is documented that creation of such management areas allows development to be planned around wetlands, potentially minimizing impacts (Milder, et al., 2008). Milder, et al. (2008) described four different types of conservation development techniques: conservation buyer projects, conservation and limited development projects, conservation subdivisions, and conservation oriented planned development projects. The Sammamish Wetland Management Area overlay district integrates these development techniques to provide general guidance to allow development with a conservation emphasis.

The Sammamish Wetland Management Area overlay district includes several wetland systems that, ideally, would be connected by corridors that should be preserved to prevent habitat fragmentation. An analysis of the Wetland Management Area as an effective regulatory tool is provided in the next section.

Implications for Existing City Regulations

This section describes the applicability of the issues described above to the existing City of Sammamish Environmentally Critical Areas Code. Subheadings in this section coincide with the specific Code heading. Recommended changes to the Critical Areas Code are summarized in Table 5.

Critical Area Reviews and Studies

Regulation of buffers can extend beyond individual property boundaries, and therefore, critical areas studies must sometimes extend beyond property boundaries. The widest required buffer is the distance recommended to extend studies beyond the property boundary. Investigations beyond property boundaries may be conducted using aerial photos and existing wetland data (NWI Inventory, King County Inventory, etc.) if access is not granted by adjacent property owners.

To maintain consistency with state and federal wetland delineation methods, the City of Sammamish should adopt the latest federal wetland delineation manual and its supplements for use in delineating wetlands in the City. This is not expected to change the outcome of wetland delineation efforts within the City, as the latest federal delineation manual is largely the same as the state manual currently referenced in Sammamish's regulations (SMC 21A.15.1415).

Mitigation

This section includes a description of in-lieu fee alternatives to mitigation and mitigation ratios. The City should consider revising this code section to emphasize a watershed approach to wetland mitigation. Following state and federal recommendations, other jurisdictions, such as Mount Vernon, Whatcom County, and King County currently are providing mitigation alternatives such as in-lieu fee programs for mitigating for demonstrated unavoidable and minimized wetland impacts, and where there are no appropriate mitigation opportunities on-site that better meet the community's resource protection goals. Development of a similar approach in Sammamish could provide some additional tools for addressing wetland mitigation needs and direct efforts to areas of the watershed where compensatory actions may make be the most effective.

City staff should continue existing efforts to coordinate with King County on the location and scope of Sammamish Service Area mitigation sites within the County's *Mitigation Reserves program* and which would provide the best benefit for the Sammamish community and its watersheds.

This section of the code should be revised to reflect current best available science, emphasizing a watershed approach to mitigation and a more specific approach to mitigation ratios as described previously. The following recommendations for revised mitigation ratios assume the use of permittee-directed mitigation.

Mitigation ratios should be revised to be specific to the type or category of wetland impacted, the type of mitigation offered, and whether the impacts are considered temporary or permanent in character. Incorporating more specifics and greater alternatives into the Code will allow landowners to evaluate alternatives more clearly and potentially provides greater protection and restoration of resources.

The City of Redmond's mitigation ratios (Table 4) follow this principle, and are suggested as guidance. Best available science would generally suggest larger ratios than the 1:1 used by Redmond for restoration and creation of wetlands, given the uncertainty of success and the time lag required for new wetlands to perform functions similar to established ones (e.g., the time needed for vegetation to mature).

Table 4. Alternative mitigation ratios based on type of mitigation offered and type of wetland (City of Redmond)

Wetland Category and Type	Creation or Re-establishment	Rehabilitation (Restoration)	Restoration or Creation *and* Enhancement	Enhancement Only
Category I Forested	6:1	12:1	1:1 R/C and 10:1 E	24:1
Category I based on Score	4:1	8:1	1:1 R/C and 6:1 E	16:1
Category II	3:1	8:1	1:1 R/C and 4:1 E	12:1
Category III	2:1	4:1	1:1 R/C and 2:1 E	8:1
Category IV	1.5:1	3:1	1:1 R/C and 2:1 E	6:1

Development Standards

This section of the Critical Areas Code includes recommended buffer widths as well as allowances for increased and decreased buffers, buffer averaging, and allowable modifications of buffers.

In addition, the City of Sammamish may consider buffer reduction options similar to the City of Redmond and Issaquah providing the following wildlife values are preserved or existing conditions are met:

- An undisturbed vegetated corridor (100-ft wide) is preserved;
- Existing buffer conditions are degraded such that more than 40 percent of the buffer is covered by non-native/invasive plant species;
- Tree or shrub vegetation covers less than 25 percent of the total buffer area; or,
- The wetland buffer has slopes of less than 25 percent.

Any application for a buffer reduction or modification should be evaluated on a case-by-case basis and be justified by a qualified professional using Best Available Science to preserve and enhance wildlife function. For example, for a site with existing low quality buffer areas, adjacent to additional low quality buffer areas with limited potential for restoration, a smaller buffer may be justifiable due to limited potential habitat. However, in a parcel where buffer function is low, but adjacent buffer function is high, it may be suggested that the buffer be restored, and the buffer width not be reduced.

Permitted Alterations

The SMC 21A.50.300 currently allows for public and private trails in wetland buffers, including viewing platforms and associated access trails. The concept of a zoned buffer has been used in riparian areas and forestry management (May, 2003; Welsch, 1991), where various levels of development are allowed within each zone. This zoned buffer approach was developed based on the understanding that the portion of the buffer nearest the resource offers the greatest potential function (May 2003). As a result, the ability of the buffer to provide beneficial functions and values begin to decrease as distance from the wetland increases (refer to Table 2). By dividing the buffer into two or three zones, it may be possible to preserve wetland function while still allowing for human use near the wetland. Following this concept, a trail in the outermost

zone would have the least impact, whereas a trail in the innermost zone would have the greatest potential impact.

A review of the scientific literature did not provide any guidance on the effects of trails within wetland buffers. The literature focused primarily on the effects of trail use on wildlife. In general, increasing levels of pedestrians tend to reduce species richness and overall abundance of birds (Fernandez-Juricic, 2000) and potentially other wildlife.

No changes to the existing alterations regulations are recommended based on best available science.

Limited Exemption: Isolated Wetlands

The current Critical Areas Code allows for alteration of isolated wetlands less than 1,000 square feet. Due to the potential ecological functions of small isolated wetlands, best available science indicates that no wetland should be completely exempt from review or regulation. As described previously, there is scientific evidence to suggest that small, isolated wetlands may potentially provide functions equivalent to larger, non-isolated wetlands. Alternatively, the NRCS documented that small isolated wetlands may limit wildlife dispersal, preventing wildlife from accessing their required habitat.

As a result, where existing isolated wetlands occur, a review should be conducted to identify the functions that the wetland provides to determine how the isolated wetland should be managed for ecological function of the watershed as a whole. The NRCS suggested that, for isolated wetlands, mitigation should be encouraged off-site to improve the overall function of the watershed (NRCS, 2006), where fill is allowed and/or merited following mitigation sequencing as described previously.

As described previously, the existing code is consistent with Best Available Science, in that it allows review of isolated wetlands less than 1,000 square feet, and the potential to exempt small, isolated wetlands from Critical Areas requirements if scientifically justified. There is no Best Available Science to suggest an amendment to the Sammamish Critical Areas Code at this time.

Wetland Management Area

The U.S. EPA encourages the use of flexible zoning techniques for avoiding impacts to wetlands. Flexible zoning, such as the use of “net density” in the City of Sammamish, and the density calculators used by Bellevue and Issaquah, enable local government to analyze the effects of the development proposal on a parcel and, based on site-specific analysis, to avoid and minimize impacts to wetlands and buffers (WWF, 1992).

The approach taken by the Wetland Management Area of clustering development away from wetlands, and applying “net density,” is consistent with Best Available Science. Whereas other jurisdictions (particularly Issaquah and Bellevue) take different approaches for calculating density for encumbered properties or wetlands areas, the approach outlined in the current Sammamish Critical Areas Code is consistent with Best Available Science. No changes are recommended at this time.

The Wetland Management Area of the Code indicates that the vegetation standards detailed in the Wetland Management Area do not apply to the Town Center Area, but does not provide any justification.

Table 5. Recommended Changes to the Sammamish Environmentally Critical Areas Code

Recommended code change	Best Available Science	Professional Experience
Adopt the latest federal delineation manual and its supplements should be used to delineate wetlands in the state.	To maintain consistency with State and Federal guidance.	
Specify that Critical Areas studies must include the area to 215-feet beyond the project area boundary. If site access cannot be granted, investigation may be limited to available information and aerial photographs.		To determine the existence and provide protection for buffers and adjacent wetlands, the study area should include the widest buffer width.
Address code requirements to emphasize a watershed approach for the establishment of wetland mitigation (compensation), and de-emphasize "in-kind" and "on-site" mitigation approach.	Ecology, et al. 2006; Hruby, et al. 2009, King County 2011, City of Mount Vernon 2008	
Revise buffer width requirements to include evaluations of proposed land use intensity and existing buffer function and condition.	Sheldon, et al. 2005	Redmond and King County Critical Areas Codes
Revise mitigation ratios in the code to be dependent on the kind of mitigation proposed (creation, enhancement, preservation, etc.).		City of Redmond Critical Areas Code
Provide additional guidance (both allowances and limitations) concerning small isolated wetlands. Potentially require a review/justification of wetland functions for small, isolated wetland by a qualified professional as suggested in text.	Sheldon, et al. 2005, Comer, et al. 2005, Smelitsch and Bodie, 1998, Smith, et al. 2011	
Provide justification for excluding the Sammamish Town Center Area from the vegetation standards in the wetland management area.		There is no Best Available Science basis for excluding the Town Center from the vegetation standards in the wetland management area.
Provide additional guidance for mitigation impacts to wetland buffers. Other jurisdictions recommend a 1:1 mitigation ratio.	City of Bellevue and King County Critical Areas Codes	

Potential Research or Monitoring

As described earlier, the City should continue existing efforts to evaluate the appropriateness of using an in-lieu fee mitigation program, like King County's, for use as one of the available wetland mitigation tools when demonstrated unavoidable and minimized wetland impacts cannot be effectively mitigated on site.

The City should also conduct one or more focused basin-level planning studies to evaluate existing functions and likely future development patterns, with the goal of developing a basin-specific prioritized list of watershed functional needs (e.g., flood storage, habitat corridors, etc.), while also identifying potential locations where such functions could be (re)established or preserved. Many of the relevant basins are located entirely within the City's jurisdiction, and some of the baseline work needed for this type of effort has already been performed. Expanding

on these existing efforts could support evaluations of watershed-level mitigation approaches. The results of this study could also provide the baseline for a list of potential receiving sites for any in-lieu fee mitigation program the City developed or in which the City would chose to participate.

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