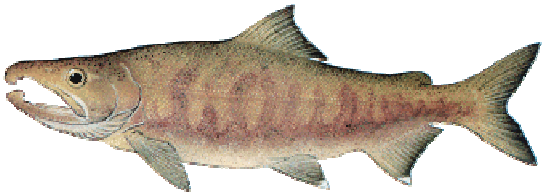
A SUMMARY OF

Best Available Science Review

Kitsap County Critical Areas



December 2004

Kitsap County
Department of Community Development

Table of Contents

Purpose

The purpose of this report is to describe the process undertaken by Kitsap County to consider Best Available Science (BAS) as part of the 2004 updates to the Critical Areas Ordinance (CAO), Title 19 Kitsap County Code. Further, this report summarizes the primary sources of BAS taken into account and describes those measures that give special consideration to the conservation and protection of anadromous fisheries.

Background

Counties planning under The Growth Management Act of 1990 (Revised Code of Washington (RCW) 36.70A) are required to designate critical areas (RCW 36.70A.170) and develop policies and regulations to protect:

- Wetlands,
- Aquifer recharge areas,
- Frequently flooded areas,
- Geologically hazardous areas, and
- Fish and wildlife habitat conservation areas.

(definition of critical areas per the Growth Management Act (GMA) [RCW 36.70A.030(5)])

These requirements are based on the legislature's finding that "…uncoordinated and unplanned growth, together with a lack of common goals expressing the public's interest in the conservation and the wise use of our lands, pose a threat to the environment, sustainable economic development, and the health, safety, and high quality of life enjoyed by residents of this state" (RCW 36.70A.110).

It is further recognized in the minimum guidelines for counties and cities designating critical areas (Washington Administrative Code (WAC) 365-190-020) that:

> "Sprawl and the unwise development of natural resource lands or areas susceptible to natural hazards may lead to inefficient use of limited public resources, jeopardize environmental resource functions and values, subject persons and property to unsafe conditions, and affect the perceived quality of life. It is more costly to remedy the loss of natural resource lands or critical areas than to conserve and protect them from loss or degradation. The inherent economic, social, and cultural values of natural resource lands and critical areas should be considered in the development of strategies designed to conserve and protect lands."

In 1998, the Act was amended to include the following section:

> "In designating and protecting critical areas under this chapter, counties and cities shall include the best available science in developing policies and development regulations to protect the functions and values of critical areas. In addition,

> counties and cities shall give special consideration to conservation or protection measures necessary to preserve or enhance anadromous fisheries. RCW 36.70A.172(1) (emphasis added)."

In order to comply with this statutory requirement of the GMA, cities and counties must include a consideration of "best available science" (BAS) in the development of critical areas policies and critical areas ordinances. Special consideration must also be given to measures that preserve or enhance anadromous fisheries, which includes salmon, steelhead and cutthroat trout.

WAC BAS Criteria

To assist cities and counties in identifying and including BAS in revising their policies and regulations the Washington State Department of Community Trade and Economic Development (CTED) promulgated BAS rules (WAC 365-195-900 through 365-195-925) in 2000. These rules are briefly explained, below:

1. **Criteria for determining which information is the "best available science,"** WAC 365-195-905. *Explained in Table 1, below*.
2. **Criteria for obtaining the BAS,** WAC 365-195-910. A*ccessing and obtaining technical assistance, publications and guidance documents from state and federal resource agencies; and, acquiring and compiling scientific information that meets best available science through county efforts and expertise.*
3. **Criteria for including the BAS in developing policies and development regulations,** WAC 365-195-915. *Documenting that what is adopted to protect critical areas functions and values is linked to relevant sources of best available science; and, procedurally showing that BAS is included in the granting of administrative variances and exemptions*.
4. **Criteria for addressing inadequate scientific information,** WAC 365-195-920. *This criteria addresses those cases where there is an absence of valid scientific information or incomplete scientific information relating to a county's or city's critical areas.*
5. **Criteria for demonstrating "special consideration" has been given to conservation or protection measures necessary to preserve or enhance anadromous fisheries.** WAC 365-195-925. *Counties and cities must include the "best available science" when developing policies and development regulations to protect the functions and values of critical areas, and counties and cities must give "special consideration" to conservation or protection measures necessary to preserve or enhance anadromous fisheries. These measures relate to spawning and incubation, rearing and migration, access, estuary and near shore marine habitat quality, and maintenance of salmon prey species.*

Table 1. Criteria for determining what constitutes best available science

Source[(a)]	***Peer Review***	***Methods***	***Logical conclusions & Reasonable references***	***Quantitative Analysis***	***Context***	***References***
Research	X	X	X	X	X	X
Monitoring		X	X	Y	X	X
Inventory		X	X	Y	X	X
Survey		X	X	Y	X	X
Modeling	X	X	X	X	X	X
Assessment		X	X		X	X
Synthesis	X	X	X		X	X
Expert Opinion			X		X	X

X = characteristic must be present for information derived to be considered scientifically valid and reliable
Y = presence of characteristic strengthens scientific validity and reliability of information derived, but is not essential to ensure scientific validity and reliability

(a) ***Characteristics of a valid scientific process (WAC 365-195-905).***

1. ***Peer review.*** *The information has been critically reviewed by other persons who are qualified scientific experts in that scientific discipline. The criticism of the peer reviewers has been addressed by the proponents of the information. Publication in a refereed scientific journal usually indicates that the information has been appropriately peer-reviewed.*

2. ***Methods.*** *The methods that were used to obtain the information are clearly stated and able to be replicated. The methods are standardized in the pertinent scientific discipline or, if not, the methods have been appropriately peer-reviewed to assure their reliability and validity.*

3. ***Logical conclusions and reasonable inferences.*** *The conclusions presented are based on reasonable assumptions supported by other studies and consistent with the general theory underlying the assumptions. The conclusions are logically and reasonably derived from the assumptions and supported by the data presented. Any gaps in information and inconsistencies with other pertinent scientific information are adequately explained.*

4. ***Quantitative analysis.*** *The data have been analyzed using appropriate statistical or quantitative methods.*

5. ***Context.*** *The information is placed in proper context. The assumptions, analytical techniques, data, and conclusions are appropriately framed with respect to the prevailing body of pertinent scientific knowledge.*

6. ***References.*** *The assumptions, analytical techniques, and conclusions are well referenced with citations to relevant, credible literature and other pertinent existing information.*

Kitsap County Goals and Policies on Critical Areas

Kitsap County's Comprehensive Plan and Countywide Planning Policies (CPPs) contain goals and policies that recognize the need to designate and protect critical areas. The GMA prescribes that comprehensive plans be a "generalized coordinated land use policy statement that contain maps and descriptive text covering growth management objectives, principles and standards." The CPPs are statements used for establishing a county-wide framework from which the comprehensive plans are developed and adopted. These documents officially guide Kitsap County's vision of its future; providing a framework for managing growth and for protecting critical areas as mandated by the GMA. Below is summarized some of the key policies on critical area protection contained in these planning documents:

Countywide Planning Policies (Ordinance No. 312-2003 and 327-2004)

- Element A: Urban Growth Areas - Direct growth to designated urban areas to benefit critical areas, open space, resource protection.

- Element D: Open Space, Resource Protection and Critical Areas – Preserve and enhance the natural environment, wildlife habitat and critical areas; encourage the use of environmentally sensitive development practices; coordinate and maintain a regional best available science database.

Kitsap County Comprehensive Plan Goals (Ordinance No.311-2003)

- Land Use Goal #20: Protect Kitsap County's natural systems and ecologically sensitive areas.

- Natural Systems Goal #5, #14, #25: Develop a critical areas ordinance and development regulations that protect surface and groundwater resources including fish and wildlife habitats and wetlands; evaluate potential impacts to water quality and quantity during the development review process; identify, protect, enhance and restore aquatic habitat areas and other important habitats.

Kitsap County Comprehensive Plan Policies

- Land Use Policy LU-2: Development should recognize the presence of critical areas including streams, wetlands, fish and wildlife habitat, geologically hazardous areas, flood-prone areas and aquifer recharge areas.

- Natural Systems Policy NS-26: Kitsap County shall safeguard water resources.
- Natural Systems Policy NS-33: The county shall require native vegetation buffers along streams and wetlands.
- Natural Systems Policy NS-34: Kitsap County shall strive to achieve no net loss of wetland functions and acreage in the following manner – avoid direct impacts to wetlands and (wetland) buffers, and mitigate impacts through creation, restoration or enhancement of wetlands or buffers.
- Natural Systems Policy NS-66: To protect fish and wildlife habitat, Kitsap County requires vegetative buffers along streams, lakes, ponds, wetlands and marine shorelines – larger or enhanced buffers may be required to adequately protect priority fish and wildlife species.
- Open Space Policy OS-8: Minimum sizes for buffers and wildlife corridors shall be established based upon consideration of best available science on the known needs of particular wildlife. Where feasible, open space corridors shall include vegetative buffers and riparian zones.

The BAS Process

Kitsap County relied primarily on existing scientific information determined by other local, state and federal natural resource agencies to meet the BAS criteria [WAC 365-195-905(2)].

Review of BAS for local applicability to Kitsap County was assisted by a Technical Review Committee, convened by the County and composed of representatives from local, state and natural resource agencies, tribes, and various community stakeholder groups. Committee members were guided by a duty and purpose statement that emphasized "…assisting the county in determining what BAS is appropriate to consider" in updating the County's CAO. Representatives from community stakeholder groups who wished to participate as committee members were likewise encouraged to fit a set of "desirable characteristics" including the "…ability to communicate, work well with others" and to have some level of subject matter familiarity in critical areas. A complete list of Technical Review Committee representatives and the committee's purpose statement can be found on the Kitsap County website, www.kitsapgov.com/nr/cao/cao_bas/trc/TRC%20Members.pdf .

The committee held 10 meetings beginning in November, 2003 and concluding in March, 2004. The committee considered the applicable, relevant scientific information related to Kitsap County's designated critical areas: wetlands, frequently flooded areas, geologically hazardous areas, fish and wildlife habitat conservation areas, and critical aquifer recharge areas. All committee members were invited to submit additional relevant information, such as local inventories, monitoring studies, etc. Committee meeting agendas, meeting notes and materials are available for review at the Kitsap County website (www.kitsapgov.com/nr/cao/cao_bas/default.htm).

The committee discussed each critical area, focusing on their functions and values and on other factors related to local applicability of BAS. The committee spent time and effort evaluating BAS information and reviewing a number of options related to the protection of critical areas. Some of the options included: improving information databases and monitoring of critical areas, adjusting protective buffer widths around sensitive wetlands and fish and wildlife habitat, and protection of channel migration zones in existing flood control programs. At the conclusion of the committee meetings, a summary of recommendations was compiled that the County could consider in revising the existing ordinance.

The committee was not a consensus-making body but a representative group that actively reviewed and discussed BAS and options for revising the CAO. The proposed revisions to the CAO are based on the range of BAS considered and do not represent agreement by committee members on BAS or on the relative merits of specific options.

Additional scientific information, submitted to Kitsap County for consideration in the CAO revision subsequent to the committee meetings, was accepted and evaluated for eligibility, applicability and utility as BAS. This post-committee review was conducted by the Natural Resources Division and Environmental Review staff of the Department of Community Development (DCD). The complete archive of materials considered by Kitsap County is available for review at the Kitsap County DCD, 614 Division St., MS-36, Port Orchard, WA 98366, (360) 337-4966.

This BAS report provides a synthesis of BAS review that was considered in the proposed revisions to Kitsap County's CAO. Each type of critical area is discussed in terms of the BAS considered and to the specific critical area's functions and values. This report takes into account the numerous factors that influence the development and revisions to the CAO, for example: recent scientific studies applicable to Kitsap County; new and revised state and federal legislation; and existing and proposed local conservation, land use and development programs. Some scientific and technical information, while relevant and recent was not available to the BAS process in a timely manner, including draft environmental guidance documents, mapping efforts and monitoring studies.

General Critical Area Functions and Values

Kitsap County occupies a unique portion of the State of Washington, directly between the urban areas of Seattle and Tacoma and the wilderness of the Olympic Mountains. It is bounded by the Hood Canal on the west, Puget Sound on the east, and Mason and Pierce Counties to the south. It comprises a total land mass of 393 square miles. Kitsap County ranks 36th in size among Washington counties. The current population of Kitsap County is estimated at 230,000 and it is the second most densely populated county in the state.

The functions of critical areas are driven by the interaction of physical, chemical and biological processes that occur in and around resource areas. Examples of physical process include the presence of water (standing, stored, flowing or flooding); soil and sediment accumulation, erosion, or movement (landslides); and wind and weathering. Chemical processes include the uptake, release and general movement of chemical compounds in a natural system or the cycling of chemical contaminants. Biological processes are the progression of vegetation and reproductive cycles of fish and wildlife. The overall function of critical areas is dependent on the magnitude and rate of these processes. These functions of critical areas that provide benefit to the human environment include improving and maintaining water quality, retaining floodwaters and sediment and sustaining habitat for fish and wildlife species.

It is important to note that a specific ecosystem, such as a wetland, may not support all the potential functions of that ecosystem type. Kitsap County uses the Washington State Wetlands Rating System to define the resource. For instance, a category I wetland supports more potential wetland ecosystem functions than does a category IV wetland. In addition two ecosystems with a common ranking may support completely different functions due to location within a watershed, physical characteristics of a site or other factors.

It is repeated throughout the sources of BAS that site-specific measures are the most effective way to protect the functions of critical areas. A case-by-case approach, however, to critical area protection requires a commitment of substantial human and financial resources and is not currently feasible. Because the resources to identify and assess site specific critical area functions are not available to Kitsap County, revisions to the CAO will rely upon more uniform development standards, based on the BAS, for most critical areas. This provides a basis from which to develop more site-specific management options.

The values associated with critical areas are more difficult to quantify or rank due to their foundation in societal perceptions, which may change over time. Critical area values include the protection of property, public safety, aesthetics, wildlife or nature viewing, or the provision of recreational opportunities. An example of how these values may differ for a particular area might be related to public access to an area and valuation by a community due to accessibility and enjoyment of a critical area. The economic value of these resources is difficult to ascertain as they are not typically bought and sold in an open market.

Best Available Science (BAS) Review for Each Critical Area:

Wetlands

Kitsap County uses the federal regulatory definition of wetlands, endorsed by the State of Washington and derived from the US Fish and Wildlife Service wetland classification methodology. Specifically, this definition of wetlands is: "areas that are inundated or saturated to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Kitsap County provides further wetlands definition:

> *"Wetlands generally include, but are not limited to swamps, marshes, estuaries, bogs, and ponds less than 20 acres, including their submerged aquatic beds and similar areas. Wetlands do not include those artificial wetlands intentionally created from non wetland sites, including, but not limited to, irrigation and drainage ditches, grass-lined swales, canals, storm water 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 include those artificial wetlands intentionally created from non wetland areas to mitigate the conversion of wetlands."*

Principle Sources of BAS for Wetlands

Kitsap County's BAS review for wetlands drew extensively from the following documents:

- DRAFT Freshwater Wetlands in Washington State Volume 1: A Synthesis of the Science– Department of Ecology, August 2004 (this document , despite being draft, contains a large quantity of scientific studies useful in this discussion of BAS)

- Washington State Department of Ecology Wetlands Rating System (August 2004)

Functions and Values of Wetlands

Not all wetlands perform the same functions, nor do similar wetlands provide the same functions at the same level of performance. Wetland functions, however, are best evaluated within the context of the landscape in which they exist (WA Dept of Ecology, Aug 2003). What follows is a list of wetland functions from *Freshwater Wetlands in Washington State Volume I: A Synthesis of the Science* (Dept. of Ecology, Aug. 2003). This list provides the framework for this BAS discussion on wetland functions for riverine, depressional and lacustrine (lake) wetlands.

1. *Functions associated with water quality improvement*

- *Trapping, removal and/or uptake of nutrients*
- *Trapping, removal and/or uptake of metals and toxic organics*
- *Trapping and removal of sediment*

2. *Functions associated with habitat*

- *Habitat for plant communities*
- *Invertebrate species habitat*
- *Fish (resident and anadromous) habitat*
- *Mammal habitat*
- *Bird habitat*
- *Reptile and amphibian habitat*
- *General habitat*
- *Primary (plants, microorganisms) production*

3. *Functions associated with water quantity (hydrology)*

- *Reduction in peak flows*
- *Decrease in downstream erosion*
- *Maintenance of low flows to streams during dry season*
- *Ground water and aquifer recharge*

Wetlands Protection Mechanisms Driven By BAS

As stated earlier, the Kitsap County review of BAS is based in large part on existing information, scientific literature and analyses conducted by other local, state, and federal agencies and private non-profit groups. The compendium of scientific wetland references in the August 2004 DRAFT "*Freshwater Wetlands in Washington State, Volume I: A Synthesis of the Science*" published by Washington State Department of Ecology (DOE) was the primary BAS source considered for wetlands. This publication discusses at length the recent, available scientific literature on wetland functions relative to water quality, hydrology and habitat and, provides a detailed discussion on buffers, buffer widths, mitigation scenarios, replacement ratios and the relationship of wetland buffers to protecting wetland functions. Reproduced from the DOE publication are two tables (below) that present a summary of the research on wetland functions and buffer widths that establish the range for updating the wetlands section in the CAO.

A summary of pollutant removal effectiveness and wildlife habitat value of vegetated buffers according to buffer width (Desbonnet et al. 1994).

Buffer Width in Feet (m)	***Pollutant Removal Effectiveness***	***Wildlife Habitat Value***
16 feet (5 m)	Approximately 50% or greater sediment and pollutant removal	Poor habitat value; useful for temporary activities of wildlife
32 feet (10 m)	Approximately 60% or greater sediment and pollutant removal	Minimally protects stream habitat; poor habitat value; useful for temporary activities of wildlife
49 feet (15 m)	Greater than 60% sediment and pollutant removal	Minimal general wildlife and avian habitat value
66 feet (20 m)	Greater than 70% sediment and pollutant removal	Minimal wildlife habitat value; some value as avian habitat
98 feet (30 m)	Approximately 70% or greater sediment and pollutant removal	May have use as a wildlife travel corridor as well as general avian habitat
164 feet (50 m)	Approximately 75% or greater sediment and pollutant removal	Minimal general wildlife habitat value
246 feet (75 m)	Approximately 80% or greater sediment and pollutant removal	Fair to good general wildlife and avian habitat value
328 feet (100 m)	Approximately 80% or greater sediment and pollutant removal	Good general wildlife habitat value; may protect significant wildlife habitat
656 feet (200 m)	Approximately 90% or greater sediment and pollutant removal	Excellent general wildlife value; likely to support a diverse community
1,968 feet (600 m)	Approximately 99% or greater sediment and pollutant removal	Excellent general wildlife value; supports a diverse community; protection of significant species

The ranges of wetland buffer widths for providing a particular wetland function is dependent on site-specific factors. The DOE volume noted several criteria that should be considered in the actual determination of buffer widths. These include wetland size, type, level of functions and intensity of adjacent land use. Effective buffer widths, the DOE volume continues, should be based on those criteria and range from 25-75 feet for wetlands with minimal habitat functions to 150 to 300 feet for wetlands with high habitat functions. DOE further provides a summary of all wetland buffer literature in the following table.

Summary of recommendations for wetland buffer dimensions from the literature.

Author(s)	Date	Minimum Buffer	Maximum Buffer	Comments
Castelle et al.	1994	25 feet (8 m)	98 feet (30 m)	"Adequate under most circumstances"
Desbonnet et al.	1994	49 feet (15 m) 98 (30 m)	98 feet (30 m) 164 feet (50 m)	Low-intensity land uses (agriculture, recreation, and low density residential) High-density residential housing and commercial/industrial
Fischer	2000	98 feet (30 m)	328 feet (100 m)	Larger buffer for reptiles, amphibians, birds and mammals
Groffman et al.	1991a	197 feet (60 m)	328 feet (100 m)	For most wildlife needs
Howard and Allen	1989	197 feet (60 m)		For most wildlife needs
McMillan	2000	25 feet (8 m)	350 feet (107 m)	Case by case, using a rating system and the intensity of proposed or existing land use
Norman	1996	164 feet (50 m)		To protect wetland functions; more may be required to protect more "sensitive wildlife species"

One specific discussion contained in the DOE volume reflects how Kitsap County envisions wetlands protection and impact mitigation:

> "….an approach (is recommended) to determining buffers that attempts to balance predictability with flexibility by setting standard buffer widths that can be altered on a case-by-case basis to adapt to site specific factors….The (current) fixed minimum-width approach enjoys the virtue of simplicity in application, but has the potential for providing either not enough or too much protection…Many of the functions that buffers provide are directly related to physical characteristics…and (are) therefore informed by site specific information…(A) case-by-case argument could be made for establishing buffer widths."

When proposed development projects involve regulated wetlands, Kitsap County relies on the Washington State Wetlands Rating System, developed and published by the Washington DOE to assess current wetland functions. The wetland rating system provides a scientific basis for rapid assessment when rigorous, site-specific, scientific study is not feasible. The Rating System reveals important information on the potential and on the opportunity for selected wetland sites to provide specific functions (i.e., hydrologic, water quality, habitat). When used in combination with BAS-supported data the wetland rating system establishes a comprehensive basis for sound and effective decision making regarding wetland protection – whether it involves setting suitable buffer widths, avoiding impacts and/or determining mitigation ratios,. Kitsap

County plans to adopt the new Washington State Wetlands Rating system as it becomes finalized, field-tested and is locally validated.

Fish & Wildlife Habitat Conservation Areas

Kitsap County fish and wildlife habitat areas are generally associated with the hundreds of miles of streams and saltwater shorelines, numerous lakes and large forested areas. A variety of fish and wildlife species use these areas during all or portions of their lives. Species supported by these areas include aquatic and terrestrial organisms, such as salmon, shellfish, kelp, eelgrass, large and small mammals, birds, amphibians, reptiles and a wide diversity of invertebrate animals.

The CAO categorizes fish and wildlife habitat conservation areas as:

- **Streams** that meet criteria of the Washington Department of Natural Resources (DNR) water typing system (WAC 222-16-030).
  - **Type S** (formerly Type 1)– "Shorelines of the State," which includes segments of streams with flows greater than 20 cubic feet per second, lakes greater than 20 acres and saltwater shorelines. Type S waters provide fish habitat.
  - **Type F** (formerly Type 2 and 3)– streams that do not meet Type S criteria for size or flow, but which also contain fish habitat.
  - **Type Np** (formerly Type 4)– year-round flowing streams that do not contain fish possibly due to natural passage barriers, such as a waterfall, or due to insufficient water flow.
  - **Type Ns** (formerly Type 5)– seasonal or intermittent streams that do not contain fish.

- **Saltwater shorelines and lakes with surface areas of 20 acres or greater**. Shorelines include commercial and recreational shellfish areas, kelp and eelgrass beds, and forage fish (e.g. smelt, sand lance, herring) spawning areas.

- **Lakes and ponds less than 20 acres** that meet criteria of the DNR water typing system (WAC 222-16-030) for Type F, Np and Ns waters.

- **Class I Fish and Wildlife Conservation Areas**, which include habitat areas for species listed as endangered, threatened or sensitive by federal or state agencies; areas targeted for preservation by federal, state and/or local government that provide fish and wildlife benefits; areas that contain habitats and species of local importance.

- **Class II Fish and Wildlife Conservation Areas**, which includes habitats for state listed candidate and monitored species and/or habitats that include attributes such as comparatively high wildlife density, high wildlife species richness, significant wildlife breeding habitat, seasonal ranges or movement corridors of limited availability and/or high vulnerability.

Principle Sources of BAS for Fish and Wildlife Habitat Conservation Areas

Kitsap County's BAS review for fish and wildlife habitat conservation areas drew extensively from the following documents:

Knutson, K. L. and Naef, V. L. 1997. Management recommendations for Washington's priority habitats: Riparian. Washington Department of Fish and Wildlife. 181 pp.

May, C.W. 2003. Stream-Riparian Ecosystems In the Puget Sound Lowland Eco-Region: A Review of Best Available Science. Watershed Ecology LLC. 78 pp.

Functions and Values of Riparian Vegetation

1. *Producing and delivering woody debris to streams*
    - *Provides habitat structure – places to hide from predators, prey and competitors, areas to escape high flows, etc.*
    - *Nutrient cycling by trapping organic materials*
    - *Channel forming processes*
    - *Regulates sediment flow in non-fish streams downstream to fish-bearing streams*
2. *Shoreline protection and habitat formation*
    - *Riparian vegetation resists erosion yet is flexible enough to allow for channel meandering that forms and maintains salmon habitat features.*
    - *Vegetation provides cover and concealment from predators and competitors for aquatic species*
3. *Removal of sediments and dissolved chemicals from water (pollution filtration)*
    - *Uptake of dissolved chemicals in surface run-off or floodwaters*
    - *Filtration (removal) of sediments from run-off and floodwaters*
4. *Moderating water temperature*
    - *Stable temperatures -- summer cooling & winter insulation*
5. *Providing favorable microclimate*
    - *Elements of microclimate include humidity, air temperature, soil temperature, wind speed, solar radiation*
    - *Plant growth and diversity, nutrient cycling, plant succession*
6. *Providing habitat for terrestrial animals*
    - *Predators, such as otters and birds, put beneficial selective pressure on fish populations*
    - *Terrestrial animals modify habitat for aquatic species by altering vegetation, digging side channels and creating ponds*
    - *Animals recycle nutrients in aquatic ecosystems*
7. *Providing proper nutrient sources for aquatic life*

- *Riparian vegetation, as well as associated insects, provide the major food source for small streams.*

Fish and Wildlife Habitat Protection Mechanisms Driven By BAS

Fish and wildlife habitat conservation areas are protected primarily for their ecological significance. In addition, these areas make a considerable contribution to the quality of life for Kitsap County residents through their support of recreational activities, educational opportunities and their intrinsic aesthetic value.

Several technical reports summarize the results found in the literature on riparian functions and present recommendations for ranges of buffer widths to retain specific functions. Following are excerpts from technical reports that summarize the scientific literature on buffer widths directly related to riparian function(s). The following tables display the ranges of stream buffer widths that support ranges of functions and values.

Summary of riparian buffer widths needed to maintain riparian functions reported in the literature. (Modified from Knutson and Naef 1997)

Habitat Function	Buffer Width in feet (meters)
Water temperature control	35 – 151 (11 – 46)
Large woody debris	100 – 180 (30 – 55)
Filter sediments	100 – 300 (30 – 91)
Filter pollution	13 – 600 (4 – 183)
Erosion Control	100 – 125 (30 – 38)
Microclimate influence	200 – 525 (61 – 160)
Wildlife habitat	75 –312 (23 – 95)

Riparian functions and buffer widths. (Modified from FEMAT (1993) as cited in King County 2004)

Function	Number of SPTH*	Equivalent Based on SPTH of 150 ft.**
Sediment Removal/Erosion Control	0.5 – 1.0	75 - 150 ft.
LWD Recruitment	1	150 ft.
Shade	.75	112 ft.
Wildlife Habitat	---	98 – 600 ft.
Microclimate Protection	Up to 3	Up to 450 ft.

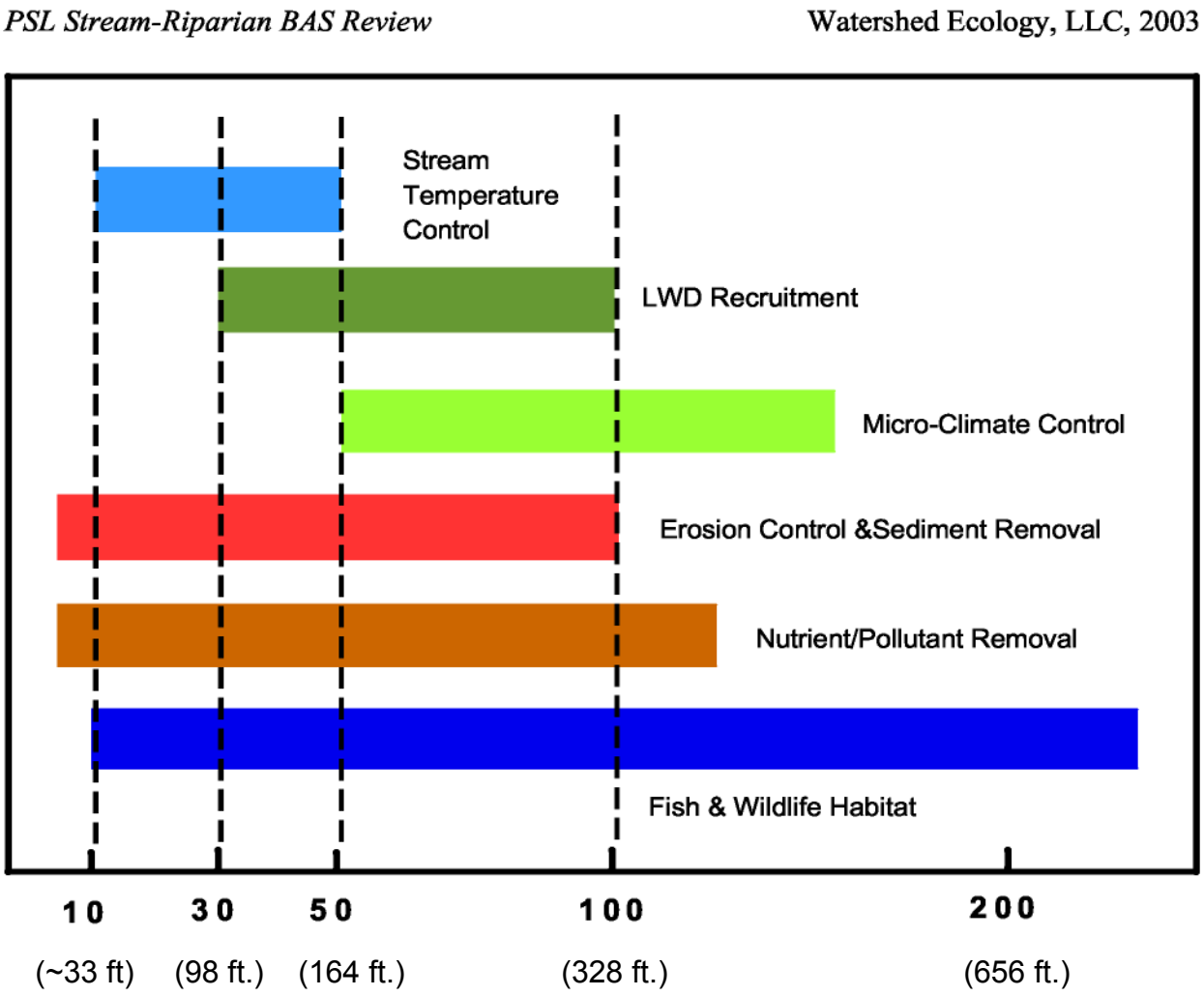
* *Site Potential Tree Height (SPTH): the maximum height a tree will reach given soils, geology and other site conditions. Streamside forests profoundly influence habitat structure and food resources of stream systems for lateral distances exceeding a tree height for many functions. Tree height distance away from the stream is a meaningful indicator of an area that is crucial for providing aquatic habitat components (FEMAT, 1993).*

***SPTH for Kitsap County: ~ Range: 115 ft. – 195 ft. in 150 years; Avg. = ~150 ft.*

Recommended riparian management zones (RMZ) for streams. (Modified from May, 2003)

Function	Buffer Width Range	Minimum Recommended	Notes on Function
Sediment Removal/Erosion Control	26-600 ft.	98 ft.	For 80% sediment removal
Pollutant Removal	13-860 ft.	98 ft.	For 80% nutrient removal
LWD Recruitment	33-328 ft.	~163 ft.	1 SPTH based on long-term natural levels
Water Temperature Regulation	36-141 ft.	98 ft.	Based on adequate shade
Wildlife Habitat	33-656 ft.	328 ft.	Coverage not inclusive
Microclimate Protection	148-656 ft.	328 ft.	Optimum long term support

This table displays a range stream buffer widths (RMZ) in streams with and without an active channel migration zone (CMZ) . This literature further notes that RMZ widths and the functions provided by them should take into account site-specific information such as ecosystem structure and function, surrounding land use activities, presence of steep slopes, active flood plains and/or contiguous wetlands. This is why a range of effective stream buffer widths is given in the table above and displayed graphically in the following chart.



RMZ Width (m) on both sides of the Stream CMZ

Summary of riparian buffer width ranges from current scientific research. The range of effective buffers for each riparian function is shown. Dashed lines at 10, 30, and 50 meters show the most frequently required buffer widths from regional jurisdictions. Dashed line at 100 meters shows recommended minimum buffer width to achieve natural ecological levels for all riparian functions.

The scientific literature contains recommendations on stream buffer widths that will support all ecosystem functions fully. Knutson and Naef (1997) considered these multiple functions in developing the Washington Department of Fish and Wildlife (WDFW) recommendations for fully functional riparian and aquatic ecosystems. WDFW buffer recommendations by stream types are presented in the next table.

Standard recommended Riparian Habitat Area (RHA) widths for areas with typed and non-typed streams. If the 100-year floodplain exceeds these widths, the RHA width should extend to the outer edge of the 100-year floodplain. (Modified from Knutson and Naef 1997)

Stream Type (Revised Water Type)	Recommended RHA widths in feet (meters)
Type 1 and 2 streams; or Shorelines of the State, Shorelines of Statewide Significance (Type S)	250 (76)
Type 3 streams; or other perennial or fish bearing streams 1.5-6.1 m (5-20 ft) wide (Type F)	200 (61)
Type 3 streams; or other perennial or fish bearing streams <1.5 m (5 ft) wide (Type F)	150 (46)
Type 4 and 5 streams; or intermittent streams and washes with low mass wasting potential (Type Np & Ns)	150 (46)
Type 4 and 5 streams; or intermittent streams and washes with high mass wasting potential (Type Np & Ns)	225 (69)

Channel Migration Zone Protection Mechanisms Driven By BAS

Rivers and streams are energetic, dynamic ecosystems and under natural conditions their channels can be expected to move back and forth across an area due to floods, droughts, landslides and other disturbances (Naiman, et al., 1992 as cited in Bolton and Shellberg, 2001). This channel movement across or even beyond the extent of the floodplain is an important process that supports the functions of streams listed above. The area of movement is called the channel migration zone (CZM) and is defined by WAC 176-26-020(6).

The CMZ for most Kitsap County streams are either nonexistent due to local topography and the natural confinement of channels in steep sloped ravines or because of bank hardening (rip-rap, bulkheads, etc.) associated with existing development. To protect the functions of stream corridors in rural areas, outside of Urban Growth Areas, where an intact CMZ is identified, the width of the buffers shall be measured from the edges of the CMZ.

Lakes and Ponds Protection Mechanisms Driven By BAS

There is considerably less scientific literature examining the functions of riparian areas associated with lakes and ponds. King County (2004) found that the prescription of buffers along lakes and ponds was primarily related to water quality protection, and was based on an examination of functions associated with buffers along streams and wetlands.

While some functional aspects listed above for stream riparian areas apply in a similar fashion to riparian areas around lakes and ponds, there are some notable exceptions. One exception is the role of riparian vegetation in the regulation of water temperature. King County notes that the air temperature and the temperature of tributaries drive water temperatures in lakes rather than microclimate factors associated with riparian forests along streams.

Another function that differs between streams and lakes is the role of woody debris. While its presence adds habitat structure and is an important source of organic material in both ecosystems, in the lower energy environment of Kitsap County lakes and ponds, the sedimentation control and channel forming functions are not significant. The lower energy environment also allows wood to remain in place longer providing habitat structure, likely necessitating a more modest rate of supply than higher energy stream systems (most of which have a deficit of large woody debris).

For functions such as bank stabilization, water quality protection, wildlife habitat, and nutrient source, riparian vegetation around lakes and ponds are likely similar to streams.

Marine Shorelines Protection Mechanisms Driven By BAS

As in the case of lakes and ponds, the functions associated with marine riparian areas are a mix of similarities and contrasts to riverine riparian areas. Also similar to lakes and ponds is the scarcity of scientific data examining the marine-riparian interactions (Levings and Jamieson, 2001). There are a number of studies that do support the establishment of riparian buffers, although they do not identify specific widths based on direct scientific evidence. For example Brennan et al. (2004) identify terrestrial insects as a significant prey item for juvenile salmonids rearing along nearshore areas in King County, but the study did not examine the distance back from the shoreline from where these insects were derived. Similarly, Pentilla (2001) examined the effects of riparian shading on the egg survival of forage fish, but doesn't provide guidance on a threshold extent of riparian vegetation needed for summer egg survival.

Class I & II Fish and Wildlife Habitat Conservation Areas - Protection Mechanisms Driven By BAS

The protection of Class I and II Fish and Wildlife Habitat Conservation Areas is provided in the CAO on a site specific basis through the development of habitat management plans (HMPs). HMPs are required for all new development proposed within 200 feet of designated Class I areas. Guidance for development of these plans is provided by the Washington State Department of Fish and Wildlife, *Priority Habitat and Species Management Recommendations*. HMPs are required to consider measures to protect the habitat and consider the effects of land use intensity, buffers, setbacks, impervious surfaces, erosion control and the retention of natural vegetation.

HMPs may be required if proposed new development occurs within the ranges or habitat elements of Class I areas. Similarly, for major new development in Class II areas, HMPs may be required. In either instance, the development of an HMP is determined through the SEPA/critical area review for proposals.

Geologically Hazardous Areas

Geologically hazardous areas are regulated under the Kitsap County CAO primarily to safeguard property and to minimize human health and safety risks. In 1999 Kitsap County conducted a comprehensive review of this section of the CAO using local experts including the Washington Department of Fish and Wildlife, the Suquamish Tribe and Myers Biodynamics, a local geological consulting firm.

Principle Sources of BAS for Geologically Hazardous Areas

Applicability of BAS for geologically hazardous areas in the CAO address the information used to identify these areas. Geologically hazardous areas are those areas designated in the Washington Department of Ecology Coastal Zone Atlas (1979) and the Quaternary geology and stratigraphy of Kitsap County (Deeter, 1979) as land that has had recent or historic landslide activity and/or has unstable slope conditions. In addition, soil classifications published by the Natural Resource Conservation Service (map 1980, tables updated 2002) are used to determine highly or potentially highly erodible soils and soils subject to liquefaction during seismic events. This soil survey explains in great detail each soil's suitability for agricultural, residential, sanitary facility, recreational, woodland wildlife habitat, and other land uses.

Functions of Geologically Hazardous Areas

The unconsolidated geology of the Kitsap peninsula is the product of our glacially dominated past. Advancing glaciers gouged out new landscape features; deep pits and steep canyons eventually flooded with meltwaters. Kitsap's lakes and stream valleys as well as the Puget Sound and Hood Canal, are the spectacular products of this glacial energy. As a result, high shoreline bluffs and steep ravines following its stream corridors characterize Kitsap County's topography.

Topography influences the suitability of land for development. For example, steep slopes are typically unstable in nature, are costly to develop, and in certain areas, are not suitable for development. Geologically hazardous areas are those areas that, because of their susceptibility to erosion, landslides, debris or mud flows, or other geologic events, are generally not suited for commercial, residential, or industrial development.

Soil suitability for structural support and stability are also important factors in determining the potential for development. Load-bearing capacity of soil, hydric properties, erosion potential, and characteristics with respect to shrink-swell all play a significant role in development of land. In particular, hydric properties indicate the existence of wetlands, and signal the potential for other environmental concerns.

Geologically Hazardous Areas Protection Mechanisms Driven By BAS

Development standards were updated by local experts as part of the 1999 review of the geologically hazardous area section of the CAO and are based on the protection of life, safety and property. Site-specific considerations may be considered for a development in a geologically hazardous area through the preparation of geotechnical or geologic report prepared by a geotechnical engineer or licensed geologist.

Frequently Flooded Areas

Flood hazard areas are those areas that are at risk of being inundated by a 100-year flood or, more specifically, subject to a one percent or greater chance of flooding in any given year. Federal Emergency Management Agency (FEMA) provides Kitsap County flood hazard mapping through its 1980 Flood Insurance Rate Maps. These maps have been incorporated into the county's Geographical Information System (GIS) maps which depict overall Building Limitations including other inventoried and mapped critical areas. When land use applications potentially affect a known flood hazard area, these maps provide an excellent indication for additional site evaluation should a limitation such as a flood hazard exist.

The first Kitsap County flood protection ordinance was enacted in 1980 and was subsequently adopted by reference into the county's 1994 Critical Areas Ordinance (CAO).

In 2003, the Washington Department of Ecology and FEMA conducted a community assistance review of Kitsap County's flood protection ordinance. The review found that the 1980 ordinance needed to be updated to meet current FEMA flood insurance program requirements. Due to the importance of keeping flood insurance rates reasonable in Kitsap County, revisions to the flood protection ordinance were undertaken separate and in advance of the CAO update. Using the Ecology/FEMA model flood ordinance for guidance, the 1980 ordinance was revised. FEMA indicated that the revised ordinance complied with the minimum standards of the National Flood Insurance Program and in October 2003, the Kitsap County Board of County Commissioners adopted the revised Flood Ordinance (codified at Title 15 Kitsap County Code).

Principle Sources of BAS for Frequently Flooded Areas

Kitsap County's BAS review for frequently flooded areas drew extensively from the following documents:

Kitsap County .Title 15 Flood Hazard Areas; Kitsap County Code. September 2003. Kitsap County, WA.

WA Office of Community Development . Citations of Recommended Sources of Best Available Science.2003.

Functions of Frequently Flooded Areas

Flood hazard areas of Kitsap County are confined to the lower reaches of streams and to low-lying shoreline areas. The County does not possess broad, far-reaching floodplains associated with large river systems nor do the County's streams contain large volumes of mountain snow melt.

Floodplains and low-lying riparian areas can possess channel migration zones (CMZs) which support and supply benefits to anadromous and resident fisheries. In Kitsap County, unlike other Puget Sound jurisdictions, CMZs are infrequent or have been diminished over time by development. The scientific literature discusses the riverine processes that occur within CMZs such as bank erosion, gravel and wood recruitment and unconstrained formation of natural channel morphology - all of which provide direct and indirect benefits to salmon habitat. Those streams with significant CMZs tend to occur within large ravines in West Kitsap County or near the mouths of larger streams classified as "shorelines of the state (Type S)."

Floodplains and stream reaches that have historically supported CMZs are the subject of a new round of countywide mapping using Light Distancing and Radar Mapping (LiDAR). With the advanced identification of CMZs, stream-associated flood zones would appropriately receive further review to determine measures to sufficiently protect anadromous fisheries.

Frequently Flooded Areas Protection Mechanism Driven By BAS

The County does carryout a cooperative program to identify, plan and manage flood hazard areas. Flood Hazard Management Plans are prepared usually in response to a known or historical flooding problem area and provide long term guidance for flood prevention and management. Special consideration is given to adopting flood control measures that preserve or enhance existing fisheries, wildlife and other natural uses of a riparian corridor.

Flood ordinance standards apply to any development proposed in flood hazard areas. In some cases, a "Flood Elevation Certificate" is required in order to certify the elevation of a proposed structure relative to the 100-year flood zone. Completed by a licensed land surveyor, these forms serve as a site-specific inventory to determine whether a proposed structure or activity occurs in a flood hazard area and, if that structure is elevated to an appropriate level above the floodplain.

The recent updating and compliance review of Title 15 Kitsap County Flood Hazard Areas ordinance is adopted by reference in the CAO along with provisions to give special consideration to anadromous fisheries in the implementation of Title 15.

Critical Aquifer Recharge Areas

Groundwater is the single most significant source of potable water in Kitsap County, representing approximately 80% of available water supplies with the primary use being residential (WRIA 15 Planning Unit, 2002). While an estimated 70-80% of the landmass recharges aquifers, *critical* recharge areas are regulated in the CAO to protect the recharge areas most vulnerable to contamination and that represent the greatest risk to sources of potable water.

Principle Sources of BAS for Critical Aquifer Recharge Areas

There are two elements to identifying "critical aquifer recharge areas" (CARAs). The first element is to identify and map areas that are most susceptible to contamination. The second element is to prioritize and categorize the susceptible areas with the highest priority going to those areas where contamination would have the most sever consequences for the most people.

Kitsap County is currently participating in the development of a watershed management plan that will call for additional data gathering and analysis to inform efforts to refine CARA protection in the future. The watershed plan will also likely call for greatly enhanced efforts to monitor and manage groundwater quantity. Through this effort, Kitsap County is collaborating with a groundwater working group of local hydrologists and groundwater experts from the Kitsap County Health District, Kitsap Public Utility District, and the Port Gamble S'Klallam Tribe to refine CARA protections as additional information becomes available through the WRIA 15 planning process and surface geology mapping projects.

Functions of CARAs

The risk of aquifer contamination depends on how easily water passes through the soil and surface geology to groundwater, referred to as "hydrologic susceptibility," and the amount, chemical composition and handling of a contaminant, known as the "contaminant loading potential." "Vulnerability" is the consideration of these two conditions, which represents the risk a particular aquifer could become contaminated by potential sources of contaminants (Washington Department of Community, Trade and Economic Development, 2003). At this time, there has been no study to determine Kitsap County aquifer's vulnerability. In cases such as this, the Washington Department of Ecology (2000) suggests that the determination of susceptibility for an aquifer provides a conservative approach which provides a worst case scenario for contamination movement to groundwater.

Based on susceptibility studies in Washington, Oregon and Idaho, three factors generally dominate any determination (Washington Department of Ecology, 2000)

1. The overall permeability of the soil and underlying geologic material.
2. The depth to water in unconfined conditions.

3. The amount of recharge available (precipitation or irrigation).

CARA Protection Mechanism Driven By BAS

Kitsap County is proposing to use the first two factors listed above in the identification and management of CARAs. Due to the complex hydrogeology and/or insufficient data, potential errors in recharge estimates make the recharge factors unreliable for a number of sub-areas (Kitsap Public Utility District, 1997). Efforts currently underway in the groundwater working group include evaluation of information that will hopefully yield more accuracy in recharge estimates in the near future.

The use of wellhead protection area boundaries that have been derived using analytical or numerical modeling techniques provide valid susceptibility (Washington Department of Ecology, 2000). Determinations of wellhead protection areas are based on the "time of travel," or the time it takes a particle of water to travel from its source to the wellbore. For example, a five-year time of travel represents the distance a water particle would travel in five years.

Kitsap County is proposing to establish two categories of CARAs.

Category I CARAs are those areas with a high potential for certain land use activities to adversely affect groundwater. These CARAs are those areas inside the five or ten-year time of travel around Group A water systems as calculated using methods accepted by and in accordance with the Washington State Well Head Protection Program. Criteria for the increase time of travel include the depth of the aquifer, permeability of soils and the absence of an impermeable protective layer.

Kitsap County is also proposing to adopt "regionally significant recharge areas" for inclusion as Category I CARAs. These areas represent areas of special circumstances. Currently only the "Hansville Aquifer Recharge Areas" is proposed for this designation, but additional areas could be adopted in the future based on additional studies, monitoring or data analyses that meet criteria for BAS.

Category II CARAs are the recharge areas for current or potential potable water supplies and are vulnerable to contamination based on certain types of land use activities. These areas include locations with highly permeable soils (Group A Hydrologic Soils) identified in the Kitsap County soil survey (Natural Resource Conservation Service, 1980); areas above shallow principal aquifers which are not separated by impermeable protective layers; and those areas with high concentrations of Group B water system wells and private domestic wells.

References

References - Wetlands

Cowardin, L., F. Golet, V. Carter and E. LaRoe. 1979. Classification of Wetlands and Deepwater Habitat of the United States. U.S. Fish and Wildlife Service, FWS/OBS 79/31. 103pp.

Natural Resource Conservation Service. 1980. Soil Survey of Kitsap County Area, Washington. U.S. Department of Agriculture.

U.S. Army Corps of Engineers. 1987. Corps of Engineers Wetland Delineation Manual. U.S. Department of Defense, 133 pp.

U.S. Fish and Wildlife Service, 1980. National Wetland Inventory Maps.

Washington Department of Ecology. August 1993 Wetland Rating System for Western Washington, Second Edition. Publication Number 93-74.

Washington Department of Ecology , US Army Corps of Engineers Seattle District, US Environmental Protection Agency. 2004. Guidance on Wetlands Mitigation in Washington State Parts I and II. Ecology Publication 04-06-013b.

Washington Dept. of Ecology. 2003. Freshwater Wetlands in Washington State. Volume I Ecology Publication 03-06-016.

References – Fish and Wildlife Habitat Conservation Areas:

Bolton, S. and J. Shellberg. 2001. Ecological issues in floodplains and riparian corridors. White paper prepared for the Washington Department of Fish and Wildlife, Washington Department of Ecology and Washington Department of Transportation. University of Washington, Center for Streamside Studies. 145 pp.

Brennan, S.J., K.F. Higgins, J.R. Cordell, and V.A. Stamatiou. 2004. Juvenile Salmon Composition, Timing, Distribution and Diet in Marine Nearshore Waters of Central Puget Sound in 2001-2002. King County Department of Natural Resources and Parks. Seattle, WA. 164 pp.

Forest Ecosystem Management Assessment Team (FEMAT). 1993. Forest Ecosystem Management: An Ecological, Economic and Social Assessment: Report of the Forest Ecosystem Management Assessment Team. 793-071 US Govt. Printing Office. 1366 pp.

King County. 2004. Best Available Science. Volume I: A Review of Science Literature. King County Executive Report. Critical Areas, Stormwater, and Clearing and Grading Ordinances.

Knutson, K. L. and Naef, V. L. 1997. Management recommendations for Washington's priority habitats: Riparian. Washington Department of Fish and Wildlife. 181 pp.

Levings, C and G. Jamieson. 2001. Marine and Estuarine Habitats and Their Role in Coastal Ecosystems, Pacific Region. Research Document 2001/190, Canadian Science Advisory Secretariat. Fisheries and Ocean Canada. 40 pp.

May, C.W. 2003. Stream-Riparian Ecosystems In the Puget Sound Lowland Eco-Region: A Review of Best Available Science. Watershed Ecology LLC. 78 pp.

May, C.W. and G. Peterson. 2003. Kitsap Salmonid Refugia Report.

Pentilla, D.E. 2001. Effects of shading upland vegetation on egg survival for summer spawning surf smelt on upper intertidal beaches in Puget Sound. In Proc. Puget Sound Research 2001.

References – Geologically Hazardous Areas:

Deeter, J.D. 1979. Quaternary geology and stratigraphy of Kitsap County, Washington. Western Washington University, Master of Science thesis. 175 pp., 2 plates.

Natural Resource Conservation Service. 1980. Soil Survey of Kitsap County Area, Washington. U.S. Department of Agriculture. (http://www.or.nrcs.usda.gov/pnw_soil/wa_reports.html)

Washington Department of Ecology. 1979. Coastal Zone Atlas. Vol. 10. (http://www.ecy.wa.gov/programs/sea/femaweb/kitsap.htm)

References – Frequently Flooded Areas

Kitsap County .Title 15 Flood Hazard Areas; Kitsap County Code. September 2003. Kitsap County, WA.

WA Office of Community Development . Citations of Recommended Sources of Best Available Science.2003.

King County. BAS Review 2002 Chapter 3 Flood Hazard Areas.

Pierce County . Chapter 18E.70 Pierce County Code. Pierce County, WA.

Pierce County. Revision of Pierce County Critical Areas Ordinance. April, 2003.

References – Critical Aquifer Recharge Areas:

Kitsap Public Utility District. 1997. Kitsap County Initial Basin Assessment. DOE Open File Technical Report #97-04, Poulsbo, WA.

Natural Resource Conservation Service. 1980. Soil Survey of Kitsap County Area, Washington. U.S. Department of Agriculture. (http://www.or.nrcs.usda.gov/pnw_soil/wa_reports.html)

Washington Department of Ecology. 2000. Guidance Document for the Establishment of Critical Aquifer Recharge Area Ordinances. Publication # 97-30, Ver. 4. Olympia, WA. 41 pp.

Washington Department of Community, Trade, and Economic Development. 2003. Critical Areas Assistance Handbook: Protecting Critical Areas Within the Framework of the Washington Growth Management Act. Olympia, WA. 81 pp.

WRIA 15 Planning Unit. 2002. Kitsap Basin (WRIA 15) Watershed Planning: Level 1 Assessment. Port Orchard, WA.