

Testimony on King County's 2004 Proposed Critical Areas Ordinance:

by

Dr. Robert N. Crittenden

Crittenden Biometrical
274 Sturdevant Road, Sequim WA 98382
360 582-9550

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Executive Summary

The proposed ordinances on clearing, grading, and stormwater would remove from use more than half of the total land area of rural King County and restrict the use of the remaining area. Even if those restrictions were removed from the proposed ordinance its proposed buffers would still remove a substantial area. However, the studies upon which the clearing grading and stormwater ordinances are based lack scientific validity and fail to meet the standards for Best Available Science; likewise, relatively few studies on buffers are both scientifically valid and applicable to the Puget Sound Region. I, therefore, recommend against the adoption of these proposed ordinances.

A few of the defects in the supporting studies are listed below:

1. The overall context and scientific framework of the Best Available Science underlying the Critical Areas Code update is based on the principles of conservation biology. Those principles include two which show that conservation biology is not science:
 - A) Conservation biology assumes complexity as an initial hypothesis, in violation of Occum's Razor and
 - B) Studies in conservation biology are mission oriented, instead of being value-free.
2. A key study identified as providing the scientific basis for these ordinances is by Booth, in 2000. It is not directly applicable to current conditions in King County, because its data were collected from a

- watershed which did not have detention ponds.
3. The modeling study establishing its applicability is unavailable for examination.
 4. That study was "modeling" but was presented as "expert opinion," thus avoiding the necessity of exposing it to review, but also making it and Booth's study, which rests upon it, fail the standards of Best Available Science.
 5. The conclusions about the relative roles of deforestation and impervious surfaces are unsupported, because Booth was unable to separate the impacts of these two factors. He relied on the above mentioned modeling study and others to reach his conclusions. Unfortunately, their validity remains unknown because they are unavailable for examination.
 6. Two earlier studies cited by Booth, in 2000, are also inapplicable, because they are based on the same data set from the watershed which did not have detention ponds.
 7. Those two studies also did not adequately describe their modeling methods to be repeatable or to allow their evaluation. That component of their papers was a hydraulic model which they used for similar purposes as the model discussed above in items 3, 4, and 5.
 8. Many of the studies identified as supporting the clear, grading and stormwater ordinances are weak in statistics and quantitative analysis. For this reason they fail to demonstrate that their conclusions achieve an acceptable error-rate and also fail to meet the standards for Best Available Science.
 9. The suggested thresholds for clearing and impervious surface are based on observed correlation's, but correlation does not prove causation. Thus, the conclusions do not follow logically from the results, failing the standards for Best Available Science.
 10. Although several thousand studies have been done on buffers, worldwide, most of them are inapplicable to the Puget Sound region, as its soils are of glacial origin and it has a temperate marine climate. That makes it relatively unique.
 11. In addition, a surprisingly high proportion of buffer studies are not scientifically valid.
 12. After the inapplicable or invalid studies are removed, few remain.
 13. Many of the studies supporting the proposed buffers are weak in statistics and quantitative analysis.
 14. The County's Best Available Science review cites several correlational studies supporting their buffers. But, correlation does not prove causation.
 15. A related problem is that data on salmonid abundance is often drawn from periods during which they were declining for reasons not related to the availability of freshwater habitat. Consequently, based on data from these periods, significant positive or negative correlations, significant regressions, and so on... can be found between salmonid abundance and urban growth. But, these results are misleading.
 16. There is no consensus in the literature regarding single buffer widths for particular functions or to accommodate multiple functions.
 17. The GMA does not mandate the restoration of habitat, only its protection and preservation. Thus, buffers are not necessarily required.
 18. Agricultural pollution is probably most effectively controlled through the use of best management practices, specific to the particular application, instead of buffers.
 19. Prohibiting a specific list of egregious agricultural practices, which pose an unusually high risk of pollution, has been remarkably effective in Skagit County.
 20. I present the case for narrow buffers based on the reviews by Desbonette et al, Chris May, and DOE.
 21. A US Judge ruled, in 2004, that it is better to restrict the use of chemicals near the water than to use buffers.
 22. Contrary to the statement in the County's BAS review that, no studies show that no buffers are needed, I give examples of seven studies which show this.
 23. The proposed ordinances do not allow for engineering or other alternative solutions.
 24. The ordinances can not be justified by a desire to "save the salmon" as the salmon crisis was caused by ocean conditions not habitat. Also, some runs are current being kept at low numbers, by WDFW, for legitimate management reasons.
 25. The proposed ordinances place a disproportionate burden on rural property owners.

Introduction

My testimony focuses on the proposed buffers and requirement that a minimum of 65% of the land area of parcels in rural King County be in native vegetation and a maximum of 10% be impervious surface.

The County's review of Best Available Science states that the primary purpose of these regulations is to protect the functions and values of critical areas.

Best Available Science:

Ordinances which affect critical areas are required to consider best available science (BAS), but that is not much different from the requirements which apply to ordinances controlling other areas, as the State's BAS requirement is essentially their interpretation of the Federal due process requirement that all laws, rules, ordinances and their applications be reasonable.

"Reason" and "science" are approximately equivalent, for that which is truly supported by reason will be scientifically valid. Thus, scientific validity becomes the central issue when we consider the studies which provide the basis for the County's proposed ordinances.

However, the State uses Best Available Science, instead. The State's standards for BAS are published in the Washington Administrative Code, WAC 365-900 through 925 and are, also, summarized in Appendix A of Volume I of the County's Best Available Science document.

BAS has six criteria:

1. The study must have passed independent peer review;
2. Its methods must be valid and adequately described for the study to be repeated;
3. Its results must have passed appropriate statistical tests and quantitative analysis;
4. Its conclusions and inferences must follow logically from the results;
5. It must be in its proper context; and
6. It must cite the relevant scientific literature.

The standards for Best Available Science differ depending upon the type of study. The highest standards apply to research and modeling. They must pass all six of the criteria. These standards are approximately equivalent to the conventional guidelines for peer review provided by respected scientific journals.¹

¹ One difference between Science and Best Available Science, is that BAS allows a government employee, based on his or her position and experience, or a person with only a master's degree or professional license to pose as a "scientist," whereas full membership as a peer of the scientific community traditionally requires a Ph.D. and selection to be a referee for a scientific journal is based on the individual's publication record. --- The definition of a "scientist" in BAS probably reflects the definition of an "expert witness," as defined in the Rules of Evidence, ER 702. That is not necessarily inappropriate, as the context of Best Available Science is often the legal context, when laws and ordinances are challenged in court, instead of the scientific context.

The criterion for Best Available Science that appropriate statistical tests be conducted, establishes the traditional scientific error rate, of 0.05%, as the "acceptable error rate"² in the context of the due process requirement. Thus, when Best Available Science is required, passing the statistical tests demonstrates that, in the State's opinion, an acceptable error rate has been achieved .

But, the criteria for Best Available Science for other types of studies, than research and modeling, have lower standards. In particular, "expert opinion" is only required to meet the fourth, fifth, and sixth criteria. Therefore, for expert opinion, as well as for those other types of studies for which lower standards apply, "Best Available Science," does not necessarily guarantee scientific validity, nor does it guarantee that the study provides reasonable support or achieves an acceptable error-rate.

Fortunately, in most of the studies which are examined here are research or modeling and, therefore, BAS and scientific validity are approximately equivalent.

Overall Context and Scientific Framework:

The overall context and scientific framework of the County's review of Best Available Science are described in their Chapters 1 and 2. They rest upon the ideas of conservation biology enunciated by Noss and Cooperrider, in 1994,³ and Noss et al., in 1996.⁴ But, the principles of conservation biology include two which directly violate the long-established principles of scientific methodology:

1) Conservation Biology Violates Occum's Razor: Their principle that ecosystems are complicated beyond human understanding, and that their highly complex nature should be adopted as the working hypothesis, directly contradicts Occum's Razor, that the simplest hypothesis should be adopted as the working hypothesis until proven otherwise. The simplest hypothesis, is that simple direct effects should be accounted for first, before interactions and more complex processes are considered.

There is a large body of successful ecological research demonstrating the effectiveness of this traditional scientific approach, whereas only a few successes support the alternative approach taken in conservation biology.

The statement of this principle from conservation biology, can be found on page 330 of Noss and Cooperrider's book. It is a quotation from Frank Egler, in 1977: "Ecosystems are not only more complex than we think, but more complex than we can think."

The relevance of this principle to the body of Best Available Science underlying the proposed ordinances became clear, in 2000, when it was identified by Dr. Chris May. He was one of the reviewers of the County's report on Best Available Science, he was one of the contributors to the studies it is based on; and he received his doctorate from the department of Civil Engineering of the University of Washington, which is where most of the central studies cited in the County's review of Best Available Science originated.

² Laws, rules and ordinances are not required to be error-free, they only have to achieve an acceptable error-rate, so that they do not err too often.

³ Noss, R.F. and A. Y. Cooperrider 1994. Saving Nature's Legacy: Protecting and Restoring Biodiversity. Island Press, Washington D.C. 416 pages.

⁴ Noss, R.F., M.A. O'Connell and D.D. Murphy, 1997. The Science of Conservation Planning: Habitat Conservation under the Endangered Species Act. Island Press, Washington D.C.

Dr. May explicitly recognized this principle as one of the central principles of conservation biology, in his study of a system of proposed salmonid refuges for Kitsap County.⁵ That study was done concurrent with King County's Best Available Science document. However, his study for Kitsap County was rejected by their Planning Commission, partly, because it rested upon that principle.

2) Research in Conservation Biology is Mission-Oriented: A second principle which Noss and Cooperrider enunciated was that, "Conservation biology ... is not value-free science. Rather it is mission-oriented." That can be found on page 89 of their book. They go on to say that the first step is to set goals and, only afterwards, are studies conducted. They serve the purpose of achieving those goals.

The principle, that conservation biology is mission-oriented, directly recognizes the non-scientific nature of conservation biology. It should serve as a warning to carefully examine the studies presented in King County's review of Best Available Science.

It should also alert the County Commissioners to the possibility that the County's employees may have goals and a goal-setting process independent of the County Council. If that is the case, hopefully, the County Council will establish control over that process so that they will determine the goals which the County's ordinances serve.

3) Furthermore, In Conservation Biology, People are Regarded as Being Part of the Ecosystem: Conservation biology is an approach to ecosystem management. As people are included as part of the ecosystem,⁶ conservation biology includes the management of people. Dr. May's, 2000, Salmonid Refugia Report for Kitsap County illustrates how the principles of ecosystem management can be applied to molding public opinion and, thus, controlling peoples' behavior.

Validity and Applicability of Studies:

There appears to be at least 3000 to 4000 studies of buffers and their related issues, worldwide. However, the vast majority of these studies are either scientifically invalid or inapplicable to the Puget Sound Region. King County's review of Best Available Science did a good job in limiting the studies they cited to ones which are applicable, but some of the key studies have flawed science.

I examined about 100 studies, at random, from the documents which were assembled for the court case by the two sides for or against the narrow agricultural buffers originally required by Skagit County. More than half of those studies suffered from some problem in their scientific methodology. ---- The most prevalent flaw was probably their failure to control for other variables, such as slope or soil type, which would be expected to influence the effectiveness of the buffers. Probably the second most common mistake was their failure to do the statistical tests necessary to establish the scientific validity of their results. A

⁵ May, Chris and Kitsap County, 2000. *Kitsap Peninsula Salmonid Refugia Study*. available online at Kitsap County's website. The review of it, which resulted in its being rejected, is available at the Kitsap Alliance of Property Owners' Website. There is also a recent update of the Refugia Study and a corresponding review of it.

⁶ This is stated on page 2-2 of the Best Available Science Vol. I., although they say, "imbedded in" instead of "part of."

few studies even did the statistical tests, showed that their results were not significant but, nevertheless, drew conclusions from them. Good sampling designs which had adequate replicates, randomization, and controls were the exception rather than the rule and serious mistakes in statistical methods were not uncommon. The vast majority of these studies are "gray literature": That is, they were the reports of consulting companies, government agencies, or were published in minor or obscure journals, engineering journals,⁷ symposia, or as chapters in books. These types of publications often do not receive independent review by peers of the scientific community. Nevertheless, a few of the flawed studies were published in respected scientific journals.

After eliminating the studies which were not scientifically valid, almost all of those which remained were inapplicable to the Puget Sound Region. --- This area is relatively unique, as it has soils of glacial origin and it is in a littoral zone with a prevailing onshore wind, which gives it a temperate marine climate with a dry season in the Summer. The only similar regions may be Western Scotland, Southern Norway and Denmark.

This climatic zone is delimited on the East by the Cascades. The prevailing onshore wind keeps temperatures mild, the air humid, and also results in a dry period usually from August through October. This climatic region, may or may not be considered to include the Frazer Valley, as the cold air from the Canadian interior will flow down it, at times during most winters; but, the Northern limit of this region is certainly not further north than the mountains along the North side of that valley, as they divide the Arctic air mass of the Canadian Interior from the marine air mass of the Lower Canadian Mainland. Much of the coastal regions of Vancouver Island are included in this climatic region, but along the coast north of there, the conditions tend to be colder.

In addition, the Puget Sound Region has soils of glacial origin. The glaciers of the last Ice Age extended as far South as Olympia. They left behind them sediments mostly composed of either gravel and cobble or of the silts and clays which precipitate from glacial milk. All of these materials were very well washed by the ice-melt during the glacial periods. That removed much of their soluble minerals and changed their soil chemistry. The result is that this region has a type of soil in terms of porosity and chemistry which is only found in a band around the Earth, at approximately the limit of the glaciers of the Ice Age.

Thus, having both a glacial origin and a temperate marine climate, makes this region is fairly unique. It extends roughly from Olympia to Vancouver BC and from the Pacific Ocean to the crest of the Cascades. Studies done in Western Scotland, Southern Norway or Denmark may also be applicable to this region, but the applicability of other studies needs to be demonstrated before they are applied.

King County's Review of Best Available Science clearly tried to limit the studies it cites to ones which are from this region, when such studies were available. However, some of the key studies they cite are not scientifically valid. I point out some of these in the following sections.

⁷ Science and engineering are different disciplines. The purpose of science is the discovery of new concepts and the demonstration of their validity, whereas engineering focuses on the application of proven concepts. Consequently, engineers traditionally were not trained in the rigorous methods of scientific proof, but in the use or creation of "standard methods," instead. Thus, although engineering and science journals are similar, they often do not have precisely the same standards. Consequently, when considering an engineering study as if it were science, one must pay particular attention to whether they satisfied the standards of scientific methodology. They must demonstrate that they have done so, as review by their peers would not necessarily have rigorously examined that issue. Nevertheless, it is a good practice to also apply that rule to science articles, as many mistakes slip by the referees.

Criticism of the Studies Supporting the Proposed Clearing, Grading, and Stormwater Ordinances:

Volume 1 of King County's review of Best Available Science contains an essay by Dr. Booth,⁸ which they say reviews the studies which support their clearing, grading, and stormwater ordinances.

That study and some of the studies it cites, fail to meet the standards for Best Available Science nor are they scientifically valid. A few of their defects are as follows:

1. **Not directly applicable:** Booth's 2000 article is based on a study of a watershed in which ponds for the detention and infusion of stormwater were not used, at that time. Consequently, a large part of the runoff from roads, parking lots, roofs and other impervious surfaces was probably conveyed, by storm drains, directly to the streams and rivers, where it made an immediate and substantial contribution to peak flows. As these practices are now avoided in King County, the author's conclusions about the relationship between urbanization and peak flows are not directly applicable to current conditions in King County.
2. **The model establishing its applicability is unavailable for examination:** He attempted to bridge this critical gap in his reasoning, by relying on a modeling study by David Harley, in 2000. However, that study was cited only as "written communication." Evidently, it was not a peer-reviewed published work. Nor, is it available for examination. Consequently, its validity remains unknown. For this reason, this critical gap in Booth's logical argument remains unbridged and his paper, fails to demonstrate that his conclusions follow logically from his results. For this reason, among others, Booth's paper fails to meet the standards both of Best Available Science and scientific validity.
3. **That study was "modeling" but was presented as "expert opinion":** In essence, Booth presented the conclusions of Hartley's research as "expert opinion," whereas, his study was research involving modeling. ... Expert opinion has the lowest standards in BAS; whereas modeling and research must meet all the criteria and, thus, have the highest standards. Thus, as it is presented, Hartley's study does not meet the standards for Best Available Science. It also clearly fails to establish its scientific validity. Furthermore, Booth's presentation of Hartley's conclusions did not even meet the criteria for "expert opinion," as only the conclusion of his study was given, without showing that it follows from the results, nor did he establish the context or cite references.
4. **The result of the unrepresented model appears unlikely:** In Chris May's Ph.D. Dissertation, he states that approximately 65% of the impervious surface in rural King County is roads and parking lots. As roads and parking lots are often traditionally ditched to drain directly into streams and rivers, whereas other impervious surfaces, such as roofs or driveways rarely are, roads and parking lots must be contributing disproportionately to increasing peak flows in streams and rivers. They may account for roughly 80% or 90% of the problem. Therefore, the expected conclusion, which one would anticipate from that model, would be that the problem of increased peak flows in streams and rivers can not be resolved unless quick runoff from roads and parking lots is substantially reduced. However, they gave the result, that the problem of increased peak flows in streams and rivers can not be resolved unless the problem of quick runoff from other impervious surfaces is substantially reduced. However, as they may contribute only roughly 10% or 20% of the problem, it is doubtful whether one could even observe the beneficial effects of reducing that source of quick runoff.
5. **The conclusions about the relative roles of deforestation and impervious surfaces are unsupported:** Similarly, Booth's study recognized that both deforestation and the creation of impervious surfaces, are results of urbanization. He clearly showed their interrelationship in his figure 12. But, he was unable to separate the impacts of these two factors. Therefore, he relied on the modeling

⁸ Booth, D.B. 2000. Forest cover, impervious-surface area, and the mitigation of urbanization impacts in King County, Washington. Appendix in, *Best Available Science*, Vol. 1. 18 pages.

studies by David Hartley and others to reach his conclusions. Unfortunately, the validity of these studies remains unknown. This is another critical gap in logic, causing his study to fail the standards for Best Available Science.

6. **Two earlier studies Booth cites are also inapplicable for the same reason:** Booth's paper is largely a recapitulation of a symposium talk presented by Booth and Jackson, in 1994, and an article, in 1977, by those same authors.⁹ They are both subject to the first criticism, presented above, that as the watershed studied did not have detention ponds, their results are not applicable to current conditions in King County.
7. **Those two studies also did not adequately describe their modeling methods:** That talk and paper also had a modeling component, in which the authors examined the expected runoff at various levels of urban development. But, they did not describe that model adequately nor their parameter values and methods of analysis, to repeat the modeling exercise. Consequently, it is not possible to evaluate the validity of their results which were based on that model. Thus, their talk and paper fail several of the criteria of Best Available Science.
8. **Observed correlation's do not prove causation:** The County's review of Best Available Science, in speaking of the 10% threshold, recognizes that it came from a correlation found by Booth, in 2000, but they state that,¹⁰ "not all correlative studies are in agreement with these findings." However, instead of doubting the validity of those findings, they use that weakness as a justification for adding the 65% threshold on clearing. But, that threshold also came from the same observed correlation's from the same studies and suffer from the same weaknesses. Furthermore, those studies were weak on statistical tests and quantitative analysis. In addition, observed correlation's do not prove causation. The most common cause of this problem with observed correlation's is the so-called "underspecification bias"¹¹ and Booth's study is seriously underspecified. Likewise, the study by They and May, in 1997, showing the impact of a 10% threshold on impervious surface, is inconclusive as it is based on observed correlation's.
9. **At least one of the reviewers of the County's BAS document was not independent:** In particular, Dr. Chris May is listed as a reviewer, but one of the studies in the section he reviewed was his own dissertation, while many of the other studies in that section were done by individuals from the same department at the University of Washington. --- Independent review is necessary to assure impartial evaluation, for, even if there is no deliberate bias, individuals who have worked or studied closely together are likely to share one narrow viewpoint. ---- The details of the histories of the other experts listed in the County's Best Available Science document, are unknown to me, but this one obviously inappropriate reviewer, raises a concern over the possibility that the County's documents may have had other non-independence of reviewers as well.

In conclusion, overall, their studies which provide the basis for the clearing, grading, and storm water ordinance, and which also pervade the rest of King County's CAO update, contain enough errors, gaps, and omissions that they do not meet the standards of Best Available Science nor are they scientifically valid.

Criticism of the Studies supporting the Proposed Buffers:

⁹ Booth, D.B. and C.J. Jackson 1996. Urbanization of aquatic systems --- degradation thresholds, stormwater detention, and the limits of mitigation. *Waster Resources Research*, 33: 1077-1090.

¹⁰ *Best Available Science*. Vol. II page 4-8.

¹¹ Underspecification bias arises when, there are other variables which were not observed but which have a causal relationship to the variable of concern. If they are correlated to the observed variables, the observed variables would have a correlation with the variable of concern, even though there is no causal relationship between them. --- This bias is discussed in most good textbooks on regression methods.

1. **Chris May's dissertation is not applicable to King County due to a sampling problem:** Dr. Chris May's dissertation¹² bears upon both the proposed buffers and the clearing, grading and stormwater ordinance. It involved a study of selected streams in Western Washington. However, because they were selected rather than being chosen at random, the results of his study apply only to the particular streams he selected, rather than to all streams in Western Washington. --- Had he selected them at random from some population of streams, for example, from all streams in King County, then, his results would have applied to that population of streams. But, he did not do that. Consequently, his results apply only to the specific streams he studied. --- The risk inherent to the methodology he used, is that his results may incorporate a bias due to the streams he selected not being representative of streams in King County. I do not know whether this methodological error was done deliberately or through naivety, but preselection of the subjects of a study may provide a means for biasing the results, so that they become "mission oriented," that is, so that they serve a predetermined goal, instead than being value-free science.
2. **Another technical problem with Dr. May's dissertation:** Dr. May used stepwise regression to develop relationships among the various variables he considered, but he said that he did all his tests at $\alpha=0.05$. He should have decreased the alpha-level to compensate for multiple comparisons. What he did violates well-known standard methods for stepwise regression. The risk in what he did is that some of the relationships he identified may not be statistically significant, but may be due solely to random variation. It is, in fact, relatively likely that this occurred. Fortunately, the main contribution of his dissertation was not the relationships he developed, but in its extensive literature review, which undoubtedly helped to lay the intellectual foundation for the programs in the Center for Urban Water Resources Management, at the Department of Civil Engineering of the University of Washington. ---- That is a relatively new program which is entering a field which, until now, has traditionally been part of aquatic biology.
3. **The studies are weak in statistics and quantitative analysis:** It would appear that statistics is not one of Dr. May's strengths nor, judging from the various studies I have examined from the University of Washington's Department of Civil Engineering, is it one of their's, either, and the studies supporting the grading, clearing, and stormwater ordinances are mostly their work. --- Their studies are generally empirical or descriptive; they contain few statistical tests and often contain errors in statistical methodology; their models are simple and determinate or non-stochastic; and they do not calculate the propagated errors, to establish whether their predictions are meaningful, nor do they do sensitivity analysis to examine the impacts of structural changes in their models. --- The standards for Best Available Science, require studies which have research and modeling to have statistical tests and quantitative analysis. In their absence, it is difficult, at best, to ascertain whether their results have any predictive accuracy. This defect, alone, invalidates their studies, for without these statistical tests and analysis, there is no demonstration that they show anything at all. Thus, they not only fail the standards of Best Available Science, but they have also failed to demonstrate that their conclusions achieve on an acceptable error-rate.
4. **Observed correlation's do not prove causation:** The County's Best Available Science review cites several correlational studies supporting their buffers. A few examples are the study by Pess et al., in 2002, which observed a correlation between Coho abundance and land use; May et al., in 1997, found a correlation between the coho/cutthroat ration and urbanization's impacts; and Moscript and Montgomery, in 1998, found a correlation between salmonid abundance and peak discharges.
5. **Salmonid Abundance Declined for other Reasons:** A related problem is that data on salmonid abundance is often drawn from periods during which they were declining for reasons not related to the availability of freshwater habitat. In particular, their two most recent periods of decline are now

¹² May, C.W. 1996. *Assessment of Cumulative Effects of Urbanization on Small Streams in Puget Sound Lowland Ecoregion: Implications for Salmonid Resource Management*. Ph.D. dissertation, University of Washington, Seattle, Washington, Department of Civil Engineering. 383 pages.

considered, by most scientists, to have been caused by ocean conditions and secondarily by hatchery problems.

Although the preservation of freshwater habitat and the maintenance of streams is a legitimate government objective, it should be remembered that, as Robert Lohn, the Director of the National Atmospheric and Oceanic Administration (NOAA), pointed out, "Most scientists, today, believe that the salmon crisis was caused by ocean conditions, not by habitat."

However, this conclusion should also occur to any good observer, as the size of the salmon runs, throughout the Northwest, declined and subsequently largely recovered not only in degraded streams, but also in pristine ones. --- It is generally believed that a number of factors contributed to the decline of the salmon runs, but that stream habitat was only a minor contributor.

Thus, the decline in salmon abundance during this period was not caused by problems with terrestrial habitat, but these were also periods of urban growth. Consequently, based on these data from these periods, significant positive or negative correlation's, significant regressions, and so on... can be found between salmonid abundance and urban growth or between salmonid abundance and any other variable which is related to urban growth. Thus, salmonids provide entirely misleading data when they are used as ecological indicators. This objection eliminates many of the studies cited in section 7.2.3 of the County's Review of Best Available Science. In particular, the substance of its subsection entitled, "Salmonids as Ecological Indicators and Keystone Species", is cast into doubt.

1. **No Consensus on Buffers:** I generally agree with the statement on page 7-22 of the County's Best Available Science Review that, "There is no consensus in the literature regarding single buffer widths for particular functions or to accommodate multiple functions." --- Skagit County found between 800 and 900 studies supporting their narrow agricultural buffers, but the parties who challenged their ordinance found two or three times that number of studies supporting wide buffers. The Growth Management Hearings Board, however, found this evidence inconclusive. The problem, as discussed above, was that very few of the studies were both valid and applicable.
2. **There is No Mandate for Buffers in the GMA:** After two tries, Skagit County abandoned trying to set agricultural buffer widths. They then, required no buffers whatsoever, but established a sampling program to assure that there no further degradation of habitat occurred. Their position was that the GMA did not mandate the restoration of habitat, only its protection and preservation. This ordinance was challenged, but their ordinance and interpretation of the GMA was upheld by the Growth Management Hearings Board. Their ruling was appealed, but it was upheld by the Court of Appeals. Thus, this is now established in case law.
3. **BMP's are a better way to control agricultural pollution:** Agriculture is already required to follow best management practices. They are generally effective and have the advantage of being specific to the particular application. For that reason they will usually be more effective than a one-size fits all buffer.
4. **Prohibiting a list of egregious agricultural practices is also effective:** Skagit County also prohibits a list of specific egregious agricultural practices, such as feedlots draining into streams, dairy barns hosed out into streams, and so on... A planner from that County proudly told me that this has been far more effective than they expected and that, since they adopted this ordinance early this year, they have had only two or three complaints about agricultural pollution, whereas, they previously received many each month. --- This approach appears to have been very effective.
5. **Fairly narrow grassy buffers remove most pollution from nutrients and sediments:** Having looked at much of the literature, it appears that grass provides one of the best vegetated buffers for removing dissolved nutrients and suspended sediment. Many studies have show that a large proportion of these types of pollutants are removed by grassy buffers even as narrow as 6 to 12 feet in width. Sixteen to Thirty foot (5-10 meters) grassy buffers are most often recommended as the standard.
6. **Buffers are ineffective at removing certain types of chemicals.** Buffers of 300 feet (100 meters) or more do poorly at removing certain types of herbicides and pesticides. The use of these types of

chemicals should be restricted instead of relying on buffers.

7. **The case for narrow vegetated buffers drawn from the reviews presented by Desbonnet et al.,¹³ Chris May, and the Washington Department of Ecology's (DOE) draft report on buffers.** These are some of the more widely cited reviews of buffers:

- ⑩ 78% of the vegetated buffer widths cited by Desbonnet et al, support buffers of 100 feet or less for pollutant removal resulting from heavy agricultural use.
- ⑩ Desbonnet shows (in his figure 8) that the first thirty feet are the most effective in pollutant removal in heavy agricultural uses, and that beyond 100 feet there is virtually no increase in function.
- ⑩ Desbonnet concluded that, "In general, the greater than 50% removal standard can be met with vegetated buffers about 5 meters (16 feet) wide."
- ⑩ In another place he stated that, "A multiple use vegetated buffer of 5 meters (16 feet) could be considered a reasonable minimum buffer-width standard"
- ⑩ 92% of temperature studies examined by Desbonnet found adequate microclimate control with buffers less than 100 feet wide. Chris May reached the same conclusion.
- ⑩ 62% of studies cited by Chris May for fine sediment removal had buffers of 100 feet or less.
- ⑩ May also found that a buffer of 9 meters (29 feet) was 98% effective on an 11% slope.
- ⑩ 88% of studies cited by Chris May for animal waste removal had buffers of 100 feet or less.
- ⑩ May found that a 4.6 meter (15 feet) buffer was 98% effective at animal waste removal at an 7% slope.
- ⑩ 52% of studies cited by Chris May for wildlife habitat had buffers of 100 feet or less.
- ⑩ In DOE's synthesis, the studies cited show effective sediment removal with buffers of 100 feet or less.
- ⑩ DOE's summary on sediment control was that 30 foot buffers gave 85% removal.
- ⑩ DOE's synthesis found 85% removal of sediment in the first 30 feet of buffer.
- ⑩ In DOE's synthesis, 88% of the studies they cite showed effective removal of nutrients from animal waste by buffers of 100 feet or less.
- ⑩ In DOE's synthesis, 66% of the studies cited showed that fecal coliform was effectively removed by buffers from 13 to 100 feet in width.
- ⑩ in DOE's synthesis, they found that a 16 foot vegetated buffer provided 50% or greater sediment and nutrient removal and that a 100 foot buffer provided only 70% or better removal of sediments and pollutants.
- ⑩ The majority of studies cited by DOE show that buffers of 16 feet or less are very effective in buffering low intensity residential uses.
- ⑩ DOE states, "Castelle and Johnson (2000) note that the apparent effectiveness of small buffers in removing toxics is due to the absorption of many toxics to sediment particles. When vegetated buffers are effective as filtering sediments, they will also be effective at filtering those toxics and nutrients adhered to

¹³ Desbonnet, Alan, et al. 1994. Vegetated buffers in the coastal One, a summary review and bibliography. Coastal Resources Center Technical Report No. 2064. Narragansett, RI University of Rhode Island Graduate School of Oceanography.

them."

1. **A US Judge ruled, in 2004, that it is better to restrict the use of chemicals near the water than to use buffers:** In January 2004, US District Judge John Coughenour signed an order prohibiting the use of certain pesticides and herbicides within 64 feet of a stream or river which contained salmon listed as threatened or endangered. He had considered the Best Available Science, and had the benefit of expert witnesses from numerous State and Federal agencies and scientists from the public and private sectors. He concluded that it was not necessary to prohibit uses, such as agriculture and residential use, but only to ban chemicals within 64 feet of the water.
2. **Some studies show that no buffers are needed:** The County's Review of Best Available Science goes on to state that, "However, neither does the literature indicate that buffers are not needed." Some examples of studies which show that no buffers are needed, buffers are ineffective, or fish do better when there are no buffers, are:
 - ⑩ Bisson, Peter A. and James R. Sedell, 1984. "Salmonid populations in streams in clearcut vs. old-growth forests in Western Washington." In Meehan, William R. et al. eds. *Fish and wildlife relationships in old-growth forests*, proceedings of a symposium, April 1982. American Institute of Fishery Research Biologists.
 - ⑩ Hall, James D. and Richard L. Lantz., 1969. "Effects of logging on the habitat of coho salmon and cutthroat trout in coastal streams. In: Northcote, T.G. ed. *Symposium on salmon and trout streams*. H. R. MacMillan Lectures in Fisheries, a symposium held by the University of British Columbia, in 1968. Vancouver: Institute of Fisheries, UBC.
 - ⑩ Meehan, William R. 1996. *Influence of riparian canopy on macro-invertebrate composition and food habits of juvenile salmonids in several Oregon streams*. Portland: US Forest Service, PNW Research Paper 496.
 - ⑩ Rafael, Martin G. Peter A. Bisson, Larence L. C. Jones, and Alex D. Foster, 2002. *Congruent Management of Multiple Resources*, Proceedings from the Wood Compatibility Initiative Workshop. Two papers in PNW Station GTR 563, 2002
 - ⑩ O'Connell, M.A. J.G. Hallett, and S.D. West 2000. *Effectiveness of riparian management zones in providing habitat for wildlife*. University of Washington and Washington DNR Timber Fish and Wildlife Report. TFW-LWAGI-00-001 459 p.
 - ⑩ Reynolds, William Gene, and Heidi, 2003. *State of the Lakes Report*. Everett: Snohomish County Public Works Department.
 - ⑩ Ward, Fruce R., Donald J.F. McCubbing, and Patrick A Slaney, 2003. "Evaluation of the addition of inorganic nutrients and stream habitat structure in the Keogh River watershed for steelhead trout and coho salmon." In Stockner, John G. ed. *Nutrients in salmonid ecosystems: sustaining production and biodiversity*. Proceedings of the 2001 Nutrient Conference, Eugene. Bethesda American Fisheries Society.

In fairness, I must add that this is gray literature and some of it is from other regions. But, it does demonstrate that there is a literature supporting the idea that no buffers are needed.

Other Criticisms:

The ordinances do not allow engineering or other solutions: When an engineering or other alternative is possible in many cases. The County should embrace such alternatives to take the fullest advantage of the public's energy, creativity and ingenuity. Furthermore, they should go beyond merely passively allowing this, but sponsor the development of such solutions and they should also be pursuing some of them, themselves. Several obvious possibilities include the following:

- ⑩ Rainbarrels or other suitable ways for storing water captured off impervious surfaces;
- ⑩ Off-channel storage ponds, with their associated drainage ditches, curtain screens, or other structures to capture water from peak flows and convey it to the ponds;
- ⑩ Flood by-pass channels;
- ⑩ Organic or other land management methods which increase the soil's ability to hold water.
- ⑩ The use of desirable or useful non-native plants which are good at retaining water in the soil, as an alternative to native vegetation;
- ⑩ and so on.....

In the first two of the above items, the County should also be actively pressuring the legislature to change the water law to allow the Department of Ecology to issue the associated water rights, so that the captured stormwater can be put to a beneficial use.

The salmon crisis was not caused by the loss of freshwater habitat: As discussed above, most scientists agree that the salmon crisis was not caused by the degradation of terrestrial habitat.

The salmon crisis is now over and the abundance of most stocks has recovered to record run sizes.

But some stocks are being deliberately kept at low numbers for management purposes. --- In the public hearing on Washington State's hatchery plan, in Hadlock, during 2004, the representatives of the Washington Department of Fisheries and the National Marine Fisheries stated that they were keeping selected salmon runs at low levels, until they had gathered enough data to obtain statistical significance in fitting on their spawner-recruit curves. That is an appropriate management decision which will be beneficial in the long-run, but the depressed condition of those runs should not be used to justify ordinances to protect the environment.

For these reasons, ordinances to preserve stream habitat can not be motivated, as being necessary to "save the salmon." King County's documents do not often invoke that justification, but in the few places they do, it should be removed as it reduces the credibility of their case.

The proposed ordinances would place a disproportionate burden upon the rural property owners. If an equal burden, of up to 65% of the property value, were placed on the urban property owners, a great deal might be accomplished towards alleviating the impacts of stormwater runoff from those areas and it should be remembered that the most severe impacts are occurring in the urban areas.

The County's argument for not applying the regulations equally is that: ¹⁴

King County's proposed thresholds however do not apply to urban areas, (nor can it because of historical development). As such , this may represent a departure from BAS in those watersheds and basins where such application is still possible and beneficial."

Their statement contains several errors:

- ⑩ The thresholds only apply to new development. Therefore, if they were equally applied to urban areas they would only regulate new development.
- ⑩ They would not apply to areas where no further development is possible;

¹⁴ *Best Available Science*, Volume II, page 4-8

- ⑩ except that they would probably be later extended to regulate redevelopment, whenever there is a change in use;
- ⑩ There are still many urban areas in King County which are not fully developed , where the ordinances would still be applicable;
- ⑩ There are still streams in urban areas which are not severely impacted stream and need protection;
- ⑩ The application of the ordinances to urban areas would move those areas towards "urban forest." --- As illustrated by Carmel, California, urban forest is achievable through land use regulations;
- ⑩ The proposed ordinances for clearing, grading, and stormwater are not based on Best Available Science;
- ⑩ Thus, application of the regulations to urban areas would be possible and beneficial (if they are applicable and beneficial in rural areas, which has yet to be demonstrated).

Undue Financial Burden: By preventing the use of 65% of the rural land in King County and placing additional restrictions on the use of the remaining 35%, the proposed ordinances place an undue financial burden on the rural property owners.

Conclusion

The proposed buffers and the clearing, grading, and stormwater ordinances would remove from use more than half of the total land area of rural King County and restrict the use of the remaining area, but many of the key studies upon which they are based lack scientific validity and fail to meet the standards for Best Available Science. I, therefore, recommend against their adoption.

However, I have, at various places in this document made suggestions of what I think will be better or more effective approaches.

Dr. Robert N. Crittenden
October 17, 2004