Review and Recommendations on Regulations for Geologically Hazardous Areas

Section 1. Most significant Best Available Science (BAS) documents. Following are the BAS documents that most influenced the recommendations associated with geologically hazardous areas:

Burns, S. 2007. *Prevention Is the Best Medicine: Doing Site Evaluations to Prevent Geological Hazard Catastrophes* Geotimes (February 2007). Downloaded on September 30, 2010 from: http://www.geotimes.org/feb07/feature_prevention.html

Canning, D.J. and H. Shipman. 1995. Coastal erosion management studies in Puget Sound, Washington: Executive summary. Coastal Erosion Management Studies, Volume I. Department of Ecology, Olympia, WA.

Gray, D. and Sotir, R.B. Sotir. 1996. Biotechnical and Soil Bioengineering Slope Stabilization: a Practical Guide for Erosion Control. John Wiley and Sons.

Johannessen, J. and A. MacLennan. 2007. Beaches and Bluffs of Puget Sound. Puget Sound Nearshore Partnership Report No. 2007-04. Published by Seattle District, U.S. Army Corps of Engineers, Seattle, Washington. Available at www.pugetsoundnearshore.org.

Manashe, E. 1993. Vegetation Management: A Guide for Puget Sound Bluff Property Owners. Shorelands and Coastal Zone Management Program, Washington Department of Ecology, Olympia. Publication 93-31.

Ritter D., et al. 1978. Process Geomorphology. (Third Edition.) Wm. C. Brown Publishers. Dubuque, IA.

San Juan County/Town of Friday Harbor Department of Emergency Management (SJC/FH DEM). 2010. Information accessed from the Internet at: http://joomla.sanjuandem.net/

Shipman, H. 2004. "Coastal Bluffs and Sea Cliffs on Puget Sound, Washington" in Monty A. Hampton and Gary B. Griggs, Editors Formation, Evolution, and Stability of Coastal Cliffs–Status and Trends (U.S. Geological Survey Professional Paper 1693: 2004).

Shipman, H. 2010. The geomorphic setting of Puget Sound: Implications for shoreline erosion and the impacts of erosion control structures, in Shipman, H., Dethier, M.N., Gelfenbaum, G., Fresh, K.L., and Dinicola, R.S., eds., 2010, Puget Sound Shorelines and the Impacts of Armoring- Proceedings of a State of the Science Workshop, May 2009: U.S. Geological Survey Scientific Investigations Report 2010-5254, p. 19-34.

Section 2. Review and recommendations on regulations.

The existing regulatory provisions for Geologically Hazardous Areas are generally consistent with the model code and the minimum State requirements associated with these areas. One area of apparent inconsistency is the lack of protection measures for areas where people and property are at risk due to tsunami or soil liquefaction associated with earthquakes (both are considered seismic hazards). Options for addressing these and other issues are presented below, with staff recommended options shown in bold.

Geologically Hazardous Areas: Most Relevant Laws, Regulations and Policies	Existing Local Regulations (items in bold are of concern)	Analysis of Existing Regulations	Options for Addressing Problems (items in bold are recommended)
RCW 36.70A.060, 170, and 172 (general requirements to consider the BAS, protect the functions & values of Critical Areas, and give special consideration to conservation and protection of anadromous fisheries. **WAC 365-190-120** **Geologically hazardous areas.** (1) Geologically hazardous areas. Geologically hazardous areas include areas susceptible to erosion, sliding, earthquake, or other geological events. They pose a threat to the health and safety of citizens when incompatible commercial, residential, or industrial development is sited in areas of significant hazard. (2) **Some geological hazards can be reduced or mitigated by engineering, design, or modified construction or mining practices so that risks to public health and safety are minimized. When technology cannot reduce risks to acceptable**	**18.30.120 Geologically hazardous areas.** **A. Classification.** Geologically hazardous areas are classified in three categories according **to the probability of hazardous geologic activity occurring**. In all cases, a slope is delineated by establishing its toe and top and measured by averaging the inclination over at least 20 feet of vertical relief. In the absence of a topographic field survey of the subject property, the administrator shall use the United States Coast and Geodetic Survey 7.5 Minute Series	**1. Classification.** In addition to categorizing geologically hazardous areas according to the probability of their occurrence, the consequences to people and property could be added as a consideration. Also, the vertical relief requirement for the evaluation of slopes could be reduced from 20 feet to 10 feet, in order to provide a more accurate determination of slope for the many properties with a shorter vertical rise. This is consistent with the State Example Code (WSDCTED 2003) and with the professional opinion of Brendan Cowan, Director of the San Juan County – Friday Harbor Department of Emergency Management (2009). **2. Classification - Additional Category 1 areas.** The existing code does not include several types of landslide hazard areas and seismic hazard areas that the State regulations say need to be included at a minimum. Some of these (soil liquefaction and tsunami hazard zones) have not yet been mapped in San Juan County, but may be mapped in the near future. To meet the minimum standards of the WAC it appears these need to be	**1. Classification.** Option A. Retain existing code language. **Option B. Add "consequences to people and property" as factors that are considered in application of the regulations, and consider changing "20 feet" to "10 feet".** **2. Classification - Additional Category 1 areas.** **Option A: Include under Category 1 all landslide hazard and seismic hazard areas listed in the WAC 365-190-120.**

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levels, building in geologically hazardous areas must be avoided. The distinction between avoidance and compensatory mitigation should be considered by counties and cities that do not currently classify geological hazards, as they develop their classification scheme. (3) Areas that are susceptible to one or more of the following types of hazards shall be classified as a geologically hazardous area: (a) Erosion hazard; (b) Landslide hazard; (c) Seismic hazard; or (d) Areas subject to other geological events such as coal mine hazards and volcanic hazards including: Mass wasting, debris flows, rock falls, and differential settlement. (4) Counties and cities should assess the risks and classify geologically hazardous areas as either: (a) Known or suspected risk; (b) No known risk; or (c) Risk unknown - data are not available to determine the presence or absence of risk. (5) Erosion hazard areas include areas likely to become unstable, such as bluffs, steep slopes, and areas with unconsolidated soils. Erosion hazard areas may also include coastal erosion areas: This	Topographic Quadrangle Maps to determine slopes. 1. **Category I**. a. Areas designated in the Washington Department of Ecology Coastal Zone Atlas as U (Unstable), UB (Unstable Bluff), URS (Unstable Recent Slide), or UOS (Unstable Old Slide) and other areas identified by site-specific geologic reports. b. Areas with slopes of greater than 50 percent and with a vertical relief of 20 feet or more, except areas of exposed, unfractured bedrock. If any portion of a slope meets this definition, the slope or some larger portion may be designated a landslide hazard area. 2. **Category II.** a. Erosion hazard areas characterized by soils	included. **3. Classification - Erosion hazard areas.** Need to verify or change the names of these soil types to be consistent with the new soil survey (or refer generally to soils identified by the USDA as having a severe risk of soil erosion). **4. Protection Standards – Category II - Report.** Regarding the report mentioned in Section 18.30.120.B.2, the code language should include review and approval by the administrator prior to the determination to waive or modify the requirements set forth in subsections (B)(2)(a-c) (the current language just requires receipt of the report). This is the first step in ensuring that high quality information is submitted with development proposals in geohazard areas, and that the conclusions reached in the reports are founded on adequate technical information. Regarding the type of report, the current language does not require a geotechnical report in order to have the Category II requirements modified or waived, except when further modifying previously altered slopes in order to enhance stability (see Section 18.30.120.B.2.b). The absence of a requirement for geotechnical reports for development in Category II areas has important implications. Section 18.30.120.B.2 (a-c) (“*Protection Standards, Category II*”) requires that the County determine if the protection standards have been satisfied; however, this cannot always be determined without the	**3. Classification - Erosion hazard areas.** Option A. Retain existing references to soil types that are an erosion hazard after confirming that they remain the same in the current soil survey. **Option B. Option A plus add any new soils identified in the current soil survey as having a severe risk of erosion.** Option C. Rather than listing specific soil types, include a general reference to soils identified by the USDA as having a severe risk of soil erosion. **4. Protection Standards – Category II - Report.** Option A. Retain existing code language.

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information can be found in the Washington state coastal atlas available from the department of ecology. Counties and cities may consult with the United States Department of Agriculture Natural Resources Conservation Service for data to help identify erosion hazard areas. (6) Landslide hazard areas include areas subject to landslides based on a combination of geologic, topographic, and hydrologic factors. They include any areas susceptible to landslide because of any combination of bedrock, soil, slope (gradient), slope aspect, structure, hydrology, or other factors, and include, at a minimum, the following: (a) Areas of historic failures, such as: (i) Those areas delineated by the United States Department of Agriculture Natural Resources Conservation Service as having a significant limitation for building site development; (ii) Those coastal areas mapped as class u (unstable), uos (unstable old slides), and urs (unstable recent slides) in the department of ecology Washington coastal atlas; or (iii) Areas designated as quaternary slumps, earthflows, mudflows, lahars, or landslides on maps published by the United States Geological Survey or Washington department of natural resources.	identified in the USDA San Juan County Soil Survey as having severe water erosion hazards: **i. The Pickett Soil portion within the Pickett-Rock Outcrop Complex;** **A. (PrD-only where slope exceeds 15 percent);** **B. (PrE);** **ii. The Roche Soil portion within the Roche-Rock Outcrop Complex, 30 to 70 percent slopes (RxE); or** **iii. Roche gravelly loam, 8 to 15 percent slopes (RgC).** b. Any area with all three of the following characteristics: i. Slopes in excess of 15 percent; ii. Soil having layers of moderate or faster permeability (0.8 inches	information that would be found in a geotechnical report. For example, this information would be necessary in determining the least "hazard-prone portion of the site" so that it can be avoided as is required by the Code. **5. Protection Standards – Category II – Setbacks and/or Vegetative Buffers.** In San Juan County, the geology is varied and dramatic. Radically different geologic conditions can exist even within a single parcel, such as a portion of the shoreline in an erodible bluff and the remainder showing bedrock. This makes the application of standard, uniform setbacks for all properties inappropriate. (Note that, while SJCC 18.30.120.A.1.b excepts areas of "exposed, unfractured bedrock" from designation as Category I hazards, this only applies if the entire slope is so characterized.) Uniform setback requirements could prove inadequate for the areas of a property where there is a geologic hazard, due to the changes in geologic conditions across a property. Alternatively, uniform setbacks could over-protect in those areas of a property where stable, more erosion-resistant bedrock exists. The varied geologic conditions present throughout the County make it appropriate to require geotechnical reports for the development of all areas designated Category II (rather than leaving them largely discretionary, as in the current code). **6. Protection Standards - Category III.** The existing code language does not recognize that construction occurring	**Option B. Require a "geotechnical" report for Category II geohazards.** **5. Protection Standards – Category II – Setbacks and/or Vegetative Buffers.** Option A. Retain existing code language. **Option B. Require that appropriate setbacks and buffers to protect structures in Cat. II geohazard areas be addressed as part of a geotechnical report prepared by a qualified professional.** **6. Protection Standards – Category III.** Option A: Retain existing code language with update of term Uniform Building Code to International Building and Residential Codes.

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(b) Areas with all three of the following characteristics: (i) Slopes steeper than fifteen percent; (ii) Hillsides intersecting geologic contacts with a relatively permeable sediment overlying a relatively impermeable sediment or bedrock; and (iii) Springs or groundwater seepage. (c) Areas that have shown movement during the holocene epoch (from ten thousand years ago to the present) or which are underlain or covered by mass wastage debris of this epoch; (d) Slopes that are parallel or subparallel to planes of weakness (such as bedding planes, joint systems, and fault planes) in subsurface materials; (e) Slopes having gradients steeper than eighty percent subject to rockfall during seismic shaking; (f) Areas potentially unstable as a result of rapid stream incision, stream bank erosion, and undercutting by wave action, including stream channel migration zones; (g) Areas that show evidence of, or are at risk from snow avalanches; (h) Areas located in a canyon or on an active	per hour or greater) overlying layers having very slow or slower permeability (0.20 inches per hour or less); and iii. Evidence of groundwater seepage to the surface. c. Areas directly underlain or affected by mine workings including steep and unstable slopes created by open mines. Mine hazard areas are based upon the identification of active or historic mining activity and site-specific information regarding topography and geology provided by the applicant as needed. 3. **Category III.** San Juan County in its entirety is located within Seismic Zone 3 in accordance with the Uniform	under the County's owner/ builder exemption are not required to conform to the provisions of the International Building and International Residential Codes. **7. Protection Standards – Review Area.** The State Example Code recommends that the geotechnical report define the project's impact area as the area including the proposed activity as well as all designated Geologically Hazardous Areas that are either within 200 feet of the project area or having the potential to be affected by the proposal. Because geologic hazards do not observe manmade property boundaries, the purpose of this language is to allow a large enough view in the geotechnical report for to identify any offsite threats to the subject property. Such offsite threats could exacerbate the geologic conditions on the subject property or reduce the efficacy of mitigation measures that would otherwise be adequate. The language referring to potential off-site impacts is consistent with two concepts found throughout the Best Available Science for geologic hazards: that some hazards can naturally extend beyond property lines and that the actions of one landowner can have serious impacts on nearby properties (due to changes to the hydrology of an area, etc.). Although many geologic features extend beyond property lines, not all pose the same level of (or any) risk. For example, a certain hazard-designated soil type may cover a great many miles of shoreline but not translate any impacts from one development to another. Alternatively, two or three	**Option B: Amend existing code language to except buildings constructed under the County's owner/ builder exemption.** **7. Protection Standards – Review Area.** Option A: Retain existing code language. **Option B. Modify code to extend area to be analyzed in the geotechnical evaluation and report to include all geohazard areas and all potentially affected areas within 200 feet of the proposed development.** **8. Protection Standards – Concentrated Discharge of Runoff.** Option A. Retain existing code language.

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alluvial fan, presently or potentially subject to inundation by debris flows or catastrophic flooding; and (i) Any area with a slope of forty percent or steeper and with a vertical relief of ten or more feet except areas composed of bedrock. A slope is delineated by establishing its toe and top and measured by averaging the inclination over at least ten feet of vertical relief. (7) Seismic hazard areas must include areas subject to severe risk of damage as a result of earthquake induced ground shaking, slope failure, settlement or subsidence, soil liquefaction, surface faulting, or tsunamis. Settlement and soil liquefaction conditions occur in areas underlain by cohesionless soils of low density, typically in association with a shallow groundwater table. One indicator of potential for future earthquake damage is a record of earthquake damage in the past. Ground shaking is the primary cause of earthquake damage in Washington, and ground settlement may occur with shaking. The strength of ground shaking is primarily affected by: (a) The magnitude of an earthquake; (b) The distance from the source of an earthquake; (c) The type or thickness of geologic materials at	Building Code. **B. Protection Standards.** 1. **Category I.** a. The following shall be prohibited: i. Structures where the primary occupancy is public assembly, including but not limited to schools, churches, day care centers, hospitals and other medical facilities; and ii. Facilities for emergency response and public safety. b. Applications for development other than in subsection (B)(1)(a) of this section shall be accompanied by a geotechnical report, which is approved by the County and prepared in accordance with subsection (C) of this section, below, and	properties may unknowingly be located within the same basin of permeable soil layers underlain by less permeable ones, potentially linking their impacts together. These variables are best addressed in the geotechnical report. **8. Protection Standards – Concentrated Discharge of Runoff.** The Stormwater Management Manual for Western Washington recommends that a Storm Water Pollution Prevention Plan (which is typically only required if a project exceeds a certain amount of surface disturbance) be required for any project where concentrated runoff water is discharged within 50 feet of a "geologically unstable area," and that the plan be reviewed and approved by a geotechnical engineer (see BMP 5.10) (Ecology, 2005). This is consistent with the hydrology alteration concepts presented in the Best Available Science. **9. Protection Standards – Bulkheads.** The potential for shoreline armoring to gradually cause the loss of protective spits and other land barriers can lead to significant hazards to life and safety. The geology, topography, bathymetry and sediment transport mechanisms associated with each property and each armoring project- are unique and cannot be adequately addressed by uniform, standard regulations. The existing code does not address these safety hazards that can be caused by shoreline armoring. The addition of a	**Option B. Modify existing language to require that a stormwater pollution prevention plan, approved by a qualified geologic professional, be required whenever concentrated runoff will be disposed of within 50 feet of a landslide or erosion geohazard area.** **9. Protection Standards – Bulkheads.** Option A. Do not include additional language to identify and prevent potential property damage associated with some bulkheads in some locations. **Option B. Add a requirement for geotechnical review in conjunction with proposed shoreline bulkheads to identify potential negative impacts to nearby property and to provide mitigation options. Where feasible, identify biotechnical**

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the surface; and (d) The type of subsurface geologic structure. (8) Other geological hazard areas: (a) Volcanic hazard areas must include areas subject to pyroclastic flows, lava flows, debris avalanche, or inundation by debris flows, lahars, mudflows, or related flooding resulting from volcanic activity. (b) Mine hazard areas are those areas underlain by, adjacent to, or affected by mine workings such as adits, gangways, tunnels, drifts, or air shafts. Factors which should be considered include: Proximity to development, depth from ground surface to the mine working, and geologic material. **County Comprehensive Plan Goals and Policies.** Goal 1: Protect the functions and values of Critical Areas, giving special consideration to anadromous (migratory) fish. Goal 2: Allow for use of property to the greatest extent possible while protecting Critical Area functions and values. Goal 3: Establish Critical Area requirements that are balanced and related to impacts.	which demonstrates that: i. The slope is less than 80 percent; and ii. There is no hazard or the hazard will be mitigated with appropriate conditions. The geotechnical report shall specify adequate development conditions to ensure this. 2. **Category II. The administrator may, with discretion or upon receipt of a report from a qualified professional, waive or approve modifications to the requirements set forth in subsections (B)(2)(a – c) of this section.** a. Development shall be located in accordance with the following: i. Structures and improvements shall be sited, designed, and constructed to	requirement for a geotechnical review of proposed shoreline bulkheads to identify and mitigate any potential negative impacts to adjacent lands would help prevent this situation. Also, in this section there is no mention of biotechnical engineering techniques that might provide necessary shoreline stabilization with fewer off site impacts. **10. Protection Standards – Tsunami Waves.** There are three potential causes of tsunami waves that could affect San Juan County shorelines: a large Cascadia subduction zone earthquake, a large earthquake along the nearby Devils Mountain or South Whidbey Island faults (which would affect the southern part of the County), or an underwater landslide in the Fraser River delta (which would affect the northern part of the County). The County currently does not have a detailed tsunami hazard map, but it is anticipated that WA DNR will complete one within the next two to three years. It is estimated that the height of a tsunami wave resulting from a large Cascadia subduction earthquake would be approximately 10 feet (20 feet at the head of narrow inlets). The character of the wave would likely be similar to a rising tide occurring over several minutes. Tsunami waves occurring due to either a nearby earthquake or an underwater landslide could however, produce more hazardous and damaging waves, with little advance warning.	**engineering techniques as a preferred alternative over rock, concrete, or steel stabilization.** **10. Protection Standards – Tsunami Waves.** Option A. Postpone adoption of standards for increased elevation, floodproofing and/or setback of structures located in tsunami hazard zones until after these areas are mapped by the Dept. of Natural Resources. Until maps have been completed provide shoreline property owners who are preparing building plans with information on the risks associated with tsunami waves. **Option B. For the habitable portion of structures along marine shorelines, establish a 10 foot minimum elevation requirement (measured from the ordinary high water**

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Goal 4: Establish funding mechanisms to support Critical Area protection programs including funding for voluntary measures such as education, technical assistance, and cost share programs. Policies (2.5.B.1–11): 1. In conformance with the Washington Growth Management Act, in designating and protecting critical areas establish regulations that protect Critical Areas based on consideration of the best available science. 2. Adopt policies and regulations that, as of the effective date of implementing ordinances, are designed to protect functions and values of critical areas. 3. In addition to regulations, develop voluntary and incentive-based programs to protect the overall functions and values of Critical Areas and other natural resources. Voluntary actions may include education, technical assistance, water conservation, stewardship programs, implementation of best management practices, and restoration activities. One purpose of these programs is to mitigate impacts resulting from authorized exemptions and exceptions. 4. The impacts of land use and development	minimize cut and fill and to retain as much of the natural topographic character of the slope as possible; and ii. Structures and improvements shall be located to avoid the most hazard-prone portion of the site and to preserve vegetation necessary to prevent soil erosion. b. Where previous human activity has significantly modified natural topography, the County may allow further modification of such slopes if a geotechnical report, prepared in accordance with subsection (C) of this section demonstrates that such activity will result in improved slope stability. c. Cleared or graded	Properties at greatest risk are those that are low-lying with no topographic barriers, particularly if located at the head of a long, narrow inlet, and those located in the northern and southern areas of the County that would be affected by locally caused tsunami waves. Due to the differing character of tsunami waves that might affect the County, it may be appropriate to develop two levels of standards, a general standard applying to all low lying coastal areas in the County, and additional standards for low lying areas in inlets and in the northern and southern areas of the County where there is a risk to people and property from a damaging tsunami wave occurring with very little warning. WAC 365-190-120(2) provides the following to guide protection of people and property from tsunami hazards: "Some geological hazards can be reduced or mitigated by engineering, design, or modified construction or mining practices so that risks to public health and safety are minimized. When technology cannot reduce risks to acceptable levels, building in geologically hazardous areas must be avoided." **11. Protection Standards – Areas at risk of earthquake damage due to soil liquefaction**. Little information appears to be available on areas that may be subject to soil liquefaction during a large earthquake. Maps identifying any areas need to be developed, and options for minimizing risks to structures need to be explored prior to making any associated code changes.	**mark) or if feasible, allow for floodproofing if capable of withstanding tsunami waves associated with a Cascadia subduction zone earthquake. (This could be adopted in the flood hazard ordinance rather than the Critical Area ordinance). In addition, identify areas at risk of higher and/or more damaging waves and consider additional protection measures for these areas.** **11. Protection Standards – Areas at risk of earthquake damage due to soil liquefaction**. **Option A. Develop maps identifying any areas at risk of soil liquefaction during large earthquakes, and identify options for minimizing risks to structures prior to determining how to best address this geologic hazard.**

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preferably will be managed and mitigated on site. 5. When developing Critical Area regulations, consider the positive effect of all State, Federal and local environmental protection programs. 6. To the extent possible, adopt protection standards that vary based on site characteristics. 7. Encourage the installation of water catchment systems. 8. Implement applicable provisions of adopted Salmon Recovery and Marine Area Stewardship Plans, giving special consideration to anadromous fish. 9. Monitor and enforce permit requirements and Best Management Practices designed to protect Critical Areas. 10. Control or eradicate invasive and/or noxious weeds in conformance with RCW 17.10. 11. Any regulation created pursuant to these policies should include provisions for reasonable use exceptions and nonconforming uses. **a. Geologically Hazardous Areas**	areas must be restored and protected until replacement plantings are established and maintained unless occupied by structures or other impervious surfaces to avoid soil erosion and to stabilize slopes. Temporary erosion and drainage controls may be required unless permanent restoration and protection are timed to ensure slope stability in the wet season. 3. **Category III. Development activities are required to conform to the applicable provisions of the Uniform Building Code which contains structural safeguards to reduce the risks from seismic activity.** **C. Geotechnical Reports.**	**12. Geotechnical Reports.** The existing code provisions outlining the contents of geotechnical reports, and the qualifications for the professionals that prepare them generally appear to be adequate. The identification of geological hazards is a complex technical undertaking often involving the interplay of variables that are not immediately apparent to the lay person or even educated professionals from other fields of study. The State Example Code recommends that the qualified professional be either "an engineer or geologist…with experience analyzing geologic, hydrologic, and ground water flow systems." Further, the professional should serve as an impartial technical expert; this speaks to the consultant's ability to remain neutral in the presentation of scientific findings and committed to a professional code of ethics. The best available mechanism by which to ensure this level of analysis is by relying on the State's existing licensing program for professional engineers, which verifies the experience and education of the engineer, extensively tests his or her technical aptitude, and involves adherence to a code of ethics. Additional detail on the contents of geotechnical reports could be outlined in the code, and local experts could be consulted regarding both the qualifications of those preparing the reports, and recommendations for what should be included in the reports.	**12. Geotechnical Reports.** **Option A. Discuss with local geologic professionals, whether any additional detail is needed on either the contents of geotechnical reports or the qualifications of those who should prepare the reports. Consider adopting any recommendations that are developed.** **13. Enhancing Existing Geohazard Maps.** Option A. Do not take steps to enhance existing geohazard maps. **Option B. Use the County LiDAR technology to identify or confirm the presence of landslide hazards, and include this information on the maps used in the application of the regulations for geohazard areas. In**

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Goal: To protect the public health, safety and welfare from threats resulting from incompatible commercial, residential, institutional or industrial development being sited in geologically hazardous areas. Policies: i. Designate geologically hazardous areas in accordance with WAC 365-190-080(4). ii. Designate and classify areas on which development should be prohibited, restricted, or otherwise controlled because of danger from geological hazards based on the level of hazard or risk. iii. Require that significant geological impacts resulting from development are either mitigated or avoided within geologically hazardous areas. iv. Avoid locating essential public facilities such as hospitals and emergency response operations in geologically hazardous areas.	**If a geotechnical report is required in accordance with this section, it shall include investigation, testing, analysis, and recommendations and shall be prepared and signed by an engineer with relevant geotechnical education and experience, licensed to practice in the state of Washington. The engineer shall certify that the project as conditioned or otherwise will pose no unreasonable threat to persons or property either on- or off-site and that the project will not decrease slope stability.**	**13. Enhancing Existing Geohazard Maps.** The Washington State Department of Ecology *"Washington State Coastal Atlas"* is the only available county-wide source of information for identifying Category I geologic hazards. However, the county has recently obtained Light Detection and Ranging (commonly referred to as "LiDAR") topographical maps, which can be used to accurately identify less-obvious areas of historic mass ground movement, which are generally designated as Category I hazards. This mapping resource should be used to identify or confirm the presence of landslide hazards for use in applying this section of the code. Further, the County's mapping resources could be improved incrementally by updating hazard maps with information provided in required geotechnical reports. **14. Protection Standards – Planning for climate change and sea level rise.** Currently the building and land use regulations do not require that new structures be sited to allow for increased storm intensity and sea level rise. Since this will occur over decades, it should not be an immediate public health and safety hazard and the issue may be more appropriately handled under the Frequently Flooded and Fish and Wildlife Habitat Conservation Area sections of the code.	**addition, update hazard maps with the information provided in required geotechnical reports (e.g. require that geotechnical reports be submitted in an electronic format that is compatible with the County's Geographic Information System.** **14. Protection Standards – Planning for climate change and sea level rise.** **Option A: Do not include regulations related to climate change and sea level rise in the Geohazard section of the code (address this issue under the provisions for Frequently Flooded Areas and Fish and Wildlife Habitat Conservation Areas).**