# Alluvial Fan Hazard Areas

What are alluvial fan hazard areas?

Alluvial fans occur naturally along steam channels at the base of a slope. Their natural processes, such as debris flows or flooding, can be destructive. At the same time, alluvial fans are important places for habitat forming processes that support salmon, including transport and deposition of sediment and wood that contribute to habitat structure and complexity.
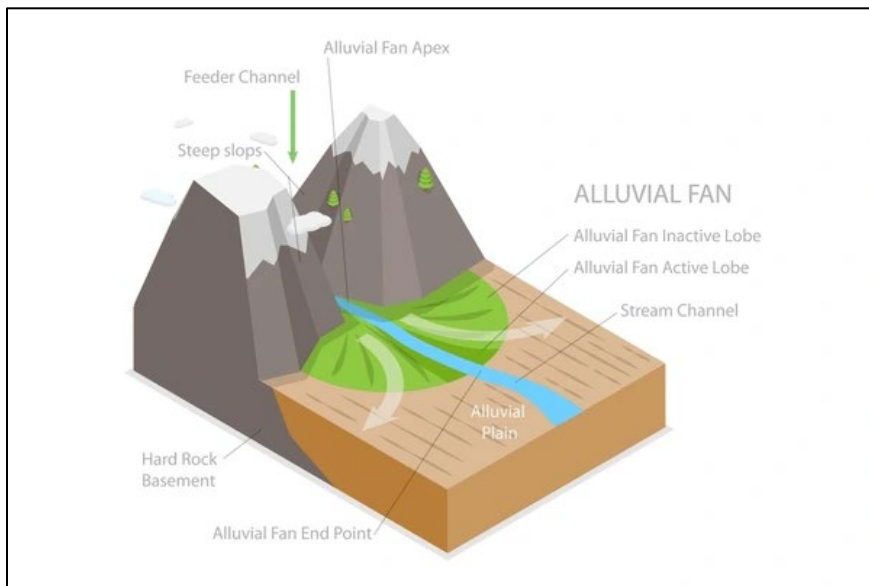
King County Code (KCC) defines an alluvial fan as a fan-shaped deposit of sediment and organic debris formed where a stream flows or has flowed out of an upland onto a flat plain or valley floor (see KCC 21A.06). The sediment is deposited due to a sudden change in sediment transport capacity, such as a significant change in slope or confinement.

Alluvial fans have been regulated in unincorporated King County as landslide hazard areas under 40 percent inclination, with a particular focus on debris flow risks. To more comprehensively address natural processes and ecological values on alluvial fans, some alluvial fans or portions of alluvial fans which are still episodically active are now classified as alluvial fan hazard areas.

Alluvial fan hazard areas are defined as "any area on an alluvial fan that is susceptible to natural hazards such as episodic inundation, sedimentation, and erosional impacts." (see KCC 21A.06)

The Department of Local Services, Permitting Division (Permitting) is responsible for determining the existence, location, and classification of critical areas including alluvial fan hazard areas during review of a permit application or Critical Area Designation. Permitting also determines if a permit application complies with the standards and regulations in KCC 21A.24.

How to determine the extents of an alluvial fan hazard area?

Many but not all alluvial fans are mapped on the King County iMap web page on the "Fans and Debris Flows" layer. This data is derived from the River Corridor Mapping project and is limited by the scope of the study. Some alluvial fans may be mapped under the overall landslide layer in iMap or shown on published geologic maps.

Without a geologic critical area report investigating the alluvial fan, or alternative data known to Permitting geological review, Permitting will classify all alluvial fans as alluvial fan hazard areas. To declassify the alluvial fan hazard area, Permitting will need to be provided with a specialized geological critical area report with sufficient data and analysis of hazards to conclude a fan or a portion of a fan is not susceptible to episodic inundation, sedimentation, and erosional impacts

To evaluate an alluvial fan hazard area, a geological critical area report should include:

a. Identification of active channels, historic channels, and relict channels visible in aerial photos and topographic data including LiDAR;

b. History of flooding, erosion, aggradation, or drainage problems and maintenance on the fan;

c. Discussion of existing conditions including subdividing the stream into reaches with similar geomorphology and habitat characteristics;

d. Stream gradient profile(s), typically extracted from LiDAR topographic data;

e. Subsurface explorations sufficient to characterize depositional processes;

f. Basin characteristics and upstream reach analysis;

g. Hydrology including precipitation and computed peak flow volumes for return intervals ranging from the 1- to 100-year event, including a bulking factor for flows with high sediment and debris concentrations;

h. Hydraulic modeling and sediment transport analysis to establish annual sediment delivery to the fan and the risk associated with a 100-year flood or debris flow event;

i. Evaluation of fan topography and channel avulsion potential based on geology, soils, gradient, hydrology, hydraulics, land use, sediment regime, large woody debris, and historical channel patterns;

In our experience, stream channels across many developed alluvial fans have been constrained to a single alignment for decades with periodic unpermitted maintenance. These conditions are inherently unstable. Streams on alluvial fans naturally deposit sediment that build up lobes of the fan with sediment, then abruptly change channel alignment, or avulse, to a topographically lower portion of the fan.

As a result, historic maintenance is not a justification to declassify a portion of an alluvial fan hazard area. However, if a future restoration project establishes a zone of natural alluvial fan function, include features such as roughened channels, alternative channels, and sedimentation or flood capacity, the project may effectively mitigate risks for another portion of the alluvial fan hazard area. Where such risks are demonstrably minimized, those portions of the alluvial fan hazard may be eligible for declassification.

What development standards apply to alluvial fan hazard areas?

Development proposals and alterations on sites containing alluvial fan hazard areas are subject to development standards given in KCC 21A.24.XXX.B. Those standards can be summarized as follows:

1. **A buffer may be required from all edges of an alluvial fan hazard area**. The buffer is the preferred regulatory tool to eliminate or minimize the risk of property damage or injury resulting from alluvial fan processes such as inundation, sedimentation, or erosion. Permitting is responsible for determining the width of the buffer, based on the data and recommendations given in a geological critical area report.

2. **A geological critical area report is required for development proposals on or within 50 feet of an alluvial fan**. Permitting geological review may exempt projects on sites within large, known less active alluvial fans in heavily developed areas.

3. **Alterations must minimize and not increase the risk of inundation, sedimentation, channel migration, or erosion on adjacent properties.**

4. **Removal of any vegetation from a landslide hazard area or associated buffer is generally prohibited**. Specific exceptions for allowed alterations to landslide hazard areas are given in KCC 21A.24.045.

5. **Disturbance to the ground surface and vegetation of the alluvial fan hazard area must be minimized**. Minimization follows the avoidance and mitigation sequence in KCC 21A.24.125.

6. **Alterations shall not increase the frequency or magnitude of sediment management activities or in-stream channel work**.

What alterations are allowed in alluvial fan hazard areas and buffers?

In general, existing development is allowed to remain within alluvial fan hazard areas. However, new modifications or improvements may not expand the footprint of existing structures or qualify as a substantial improvement as defined in KCC 21A.06.1270.

New development is generally restricted within alluvial fan hazard areas and buffers to avoid the hazardous nature of alluvial fan process and conserve habitat. However, exceptions for some specific types of development, or alterations, are listed by category in a table found in KCC

21A.24.045.C. These categories include allowances for certain projects involving structures, grading, utilities, roads, recreation, and agriculture.

Note that the stream which creates an alluvial fan hazard area also qualifies as an **aquatic area**. A width on either side of the aquatic area qualifies as **riparian area**. The extent of the alluvial fan hazard area is also regulated as riparian area, even if it extends beyond the standard riparian area width. Because of the hydrology and gradient of the alluvial fan, alluvial fan hazard areas are also frequently associated with **wetlands**. Because of the potential for upbasin landslides that result in debris flows, alluvial fans are regulated as **landslide hazard areas** under 40 percent inclination. Lastly, many valley floors where alluvial fans form are associated with **flood hazard areas** including floodplains and channel migration areas.

If an alteration is potentially allowable, specific conditions are given in KCC 21A.24.045.D. Each of the applicable conditions for each critical area present must be met in addition to the respective development standards, the avoidance and mitigation sequencing in KCC 21A.24.125, as well as any other applicable standards and regulations of KCC 21A.24.

Where can I find more information?

More information regarding critical areas is available on our website.
- Geological Critical Area Report Requirements
- Landslide Hazard Area guidance
- Ecological Critical Area Report Requirements

For most areas in unincorporated King County, the iMap GIS webpage contains a mapping layer of areas likely to qualify as steep slope hazard areas.

Visit our customer service page for contact information.

Recommended Pre-application Meeting

Because alluvial fan hazard areas require specialized geological critical area reports to delineate and are encumbered by many additional critical areas, projects within the vicinity of alluvial fans are almost always subject to complex regulatory requirements. During the preliminary design phase of a project or before any clearing or grading on site, we recommend applying for a **Voluntary Pre-Application Meeting** with Permitting staff. It's often valuable to present your conceptual development proposal and receive comments during the preliminary design phase to understand regulations that impact project design and feasibility. This information early in a project can avoid the time and expense of redesigns or infeasibility later in the permitting process. We recommend an applicant choose to submit a complete geological critical area report and ecological critical area report for feedback as part of the pre-application meeting. However, if unclear about report requirements, the pre-application meeting may also be used to learn more about report requirements before working

with geological and ecological professionals. For more information visit our website [Pre-application Meeting Information](#)