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August 12, 2019

To: Jim Chan, Division Director, King County Permitting Division, Department of Local Services (DLS)

VIA: Josh Baldi, Division Director, King County Water and Land Resources Division (WLRD), Department of Natural Resources and Parks (DNRP)
Steve Bleifuhs, Section Manager, King County River and Floodplain Management Section (RFMS), WLRD, DNRP

FM: Jeremy Bunn, LG, LEG, Geologist, RFMS, WLRD, DNRP

RE: Site Channel Migration Hazard Assessment, Parcel No. 3323069068, Scrivner Property

Introduction

King County Department of Local Services (DLS) has received a geotechnical report (Aspect 2018; "the Report") related to a proposed land development on a developed parcel (3323069068) shown in Figure 1. The Report provides new technical information and challenges the existing effective channel migration zone (CMZ) hazard mapping along this portion of the Cedar River (King County 2015). DLS requested that River and Floodplain Management Section (RFMS) staff review the Report with regard to the technical requirements set forth in the adopted 2018 Public Rule for the Designation, Classification and Mapping of Channel Migration Zones.

RFMS staff reviewed the Report, visited the parcel on May 16, 2019, and conducted additional analyses to check the Report's conclusions with respect to the CMZ mapping along this portion of the Cedar River. The Report review, site visit, and subsequent analyses conducted by RFMS

staff are summarized below, followed by conclusions and recommendations regarding the extents of the CMZ hazard areas in the immediate vicinity of the parcel.

Geotechnical Report Review

According to section 21-24-279A of the King County Channel Migration Public Rule (King County 2018):

> B. At the request of a property owner or on its own initiative, the department may reassess and adjust the boundary of a completed CMZ map within a smaller portion of the full CMZ study length and before the entire CMZ map is updated as follows:
>
> 1. A property owner may submit a critical area study to the department supporting the property owner's request for a site-specific reassessment of the CMZ boundary. The critical area study shall be conducted using channel migration mapping methods and criteria specified in Appendix A.

The channel migration hazard assessment (the Report) submitted on behalf of the property owner consists of a description of site conditions, a brief discussion of channel migration hazards, an assessment of erosion and landslide hazards, and conclusions and recommendations regarding the County's CMZ and associated slope stability hazards. Use of the King County CMZ Public Rule Appendix A methodology is implied by the Report's reference to and acceptance of King County's (2015) delineation of historical migration zones, avulsion hazard zones, reach-average lateral migration rates, and reach-average erosion setback distances. However, the Report does not itself apply the required methods and criteria as specified in Appendix A of the adopted 2018 Public Rule. The Report disputes the applicability of the reach-average erosion rates to the site on the basis of the presence in several test pits (Figure 2) of an excavation-resistant material, which was inferred to be highly erosion-resistant Renton Formation (Tertiary age) bedrock. The Report claims that this material constitutes the river banks at the site, and therefore that no erosion or geotechnical setback is appropriate.

Site Visit

Following initial review of the Report and recent aerial photographs of the site, RFMS staff conducted a site visit on May 16, 2019 to investigate the condition and erodibility of the assumed bedrock where it was exposed on the right bank of the river, at the south edge of the main portion of the site. We entered the Cedar River at the north (downstream) end of the parcel and walked upstream, observing the condition of the river bed and banks along the parcel's boundary. When we got to the location where the assumed bedrock was exposed, we took photographs of the river bank, used a laser rangefinder and hand-held GPS to approximately survey bank positions and the elevation of the contact between bank material layers (described below), and conducted erodibility testing of the exposed material.

The upper portion of the bank where the assumed bedrock is exposed consists of loose to medium-dense sand and gravel that we interpret as recent (Holocene) alluvium, below which a compacted and relatively competent fine-grained sediment is exposed in the lower river bank. This lower material comprises orange to tan-colored, compacted sand and silt, with visible bedding and intermittent thin gravel layers parallel to bedding planes (Figure 3). The material maintains sub-vertical to overhanging slopes over 10 feet in height, with 5 to 8-foot deep alcoves. Tree-bole diameter pockets were observed in the alcoves, including one with a tree still partially inserted in it, that were scoured into the bank by interaction of river flow and large

wood. At one location graffiti had been scraped into the surface of the material to a depth of approximately 1 inch. We conducted the Pocket Erodometer Test (PET) for erodibility (Briaud *et al.* 2011) in three locations along the base of the exposed material, the results of which placed it in the "medium erodibility" class.

Based on these observations and tests, we concluded that the material exposed on the lower portion of the river bank is likely to be compacted "older alluvium" as mapped and as described by Booth (1995). Given its elevation and extent, this is likely the same material as was encountered in the test pits and described as Renton Formation bedrock by Aspect. Regardless of its origins or proper name, however, the material exposed in the riverbank is not completely resistant to erosion by the river, but it is less erodible than the recent (Holocene) alluvium that overlies it.

Subsequent Analyses

According to the Channel Migration Public Rule Appendix A:

> IV.D.1.d. Where the Erosion Setback intersects an erodible landform that is more resistant to erosion than Holocene alluvium near the channel, the width of the portion of the Erosion Setback within the more resistant landform should be calculated using an appropriately lower channel migration rate. The resulting Erosion Setback width will be narrower than in Holocene alluvium (Figure A-3). The appropriately lower channel migration rate should be based on measurements taken in the same or a similar landform that the active channel encountered, within the same river channel reach, and during that part of the historical record of the study during which the active channel eroded that landform.

This condition applies to this site where the erosion-resistant material has been exposed by river action, and also where it is present at the level of the river but not currently exposed at the river's edge, as discovered in the test pits.

To determine the appropriate erosion rate for this location, RFMS staff used the 1936 to 2018 aerial photograph record to measure bank retreat distances and calculate erosion rates along two transects perpendicular to the river bank where the erosion-resistant material was exposed; one extending into the upper terrace and one into the lower terrace as shown in Figures 4 through 6. Results are presented in Figure 7. The erosion rates measured when the river was eroding into the upper terrace (with a greater thickness of erosion-resistant material) were lower than those measured when the river was eroding into the lower terrace. Based on bank retreat distances measured between 1936 and 2018, we calculated time-weighted average lateral migration rates and compared them with cumulative and interval rates for both upper and lower terraces (Figure 7). These methods for calculating lateral channel migration rates are consistent with Appendix A of the King County Channel Migration Public Rule (King County 2018).

The time-weighted average rate for the upper terrace was calculated to be 1 foot/year, and for the lower terrace 1.5 feet/year. Both rates are close to the cumulative rates at this location over the 81-year historical record, and therefore appropriate for use in determining 25 to 100-year erosion setback distances.

Recalculation of Erosion Setback and Addition of Geotechnical Setback

The extent of the revised erosion setback for the site was calculated using the time-weighted average lateral migration rates of 1 foot/year into the upper terrace and 1.5 feet/year into the lower terrace. The boundary of the erosion setback for lateral migration was set at the greater of the following two distances:

1. 50 years of lateral migration times the annual migration rate applied to the HMZ, or
2. 100 years of lateral migration times the annual migration rate, applied to the most recent (2018) active channel.

A geotechnical setback was applied to the outer edge of the erosion setback where it extended under a land surface greater than 20 feet in height above Ordinary High Water. The geotechnical setback was delineated at a 1H:1V slope measured from the predicted toe of slope after applying the erosion setback.

These methods for determining erosion and geotechnical setbacks are consistent with Appendix A of the King County Channel Migration Public Rule (King County 2018).

Proposed Revision of CMZ Hazard Area Boundary

RFMS staff generated proposed revised mapping of the CMZ hazard areas along this portion of the Cedar River to reflect our reassessment of the 2015 adopted CMZ mapping. This proposed mapping was produced using GIS shapefiles to reflect this reassessment per the Public Rule; it also incorporates an enhanced, site-specific understanding of the physical conditions and applies recalculated erosion and geotechnical setbacks to the area on the right bank of the Cedar River where we determined the erosion-resistant material to be present, based on test pit results (Aspect 2018), our site observations, and surface topography. The proposed revised portion of the CMZ extends from RM 12.2 to 12.6 along the right bank of the Cedar River (Figure 8).

Eight parcels would be affected by the proposed revision to the adopted 2015 Cedar River CMZ mapping and study. Table 1 lists the parcels and describes the mapping change for each individual parcel.

Table 1. Affected parcels

PIN	Description of Change
3323069010	CMZ extent slightly reduced. Severe CMZ reduced in width, moderate CMZ increased in width and extent in south 500 feet of parcel.
3323069014	Slight reduction in moderate CMZ width at north end of parcel.
3323069059	CMZ no longer extends onto parcel.
3323069063	CMZ no longer extends onto parcel.
3323069064	CMZ no longer extends onto parcel.
3323069066	CMZ extent substantially reduced. Severe no longer extends onto parcel, moderate CMZ reduced in width and extent in southwest corner of parcel.
3323069068	CMZ extent substantially reduced. Severe CMZ approximately 60 to 120 feet wide, moderate CMZ extent reduced to approximately 130 to 260 feet from riverward edge of parcel.
3323069084	Severe CMZ reduced in width at northwestern corner of parcel.

Summary and Conclusions

The Cedar River CMZ at parcel 3323069068 was reassessed by RFMS following submission of a channel migration hazard assessment (Aspect 2018) that disputes the extent of the existing CMZ hazard mapping and claims that a reduced CMZ width should be applied. The Aspect report advocates a narrower CMZ without an Erosion Setback, based on their discovery of excavation-resistant material at varying depths in a number of test pits across the parcel and at the riverbank on the southern edge of the main body of the parcel.

RFMS staff conducted independent site investigations and a review of the aerial photograph record, and determined that the submitted report's conclusion that the material is completely resistant to erosion is not warranted by site conditions or history. Therefore, a complete elimination of the Erosion Setback portion of the CMZ would be inappropriate. However, RFMS also determined that a revision of the existing effective CMZ mapping would be appropriate based upon incorporating a partial reduction of the erosion setback in light of site-specific information gained during site visit.

RFMS calculated erosion setback distances using new erosion rates for the observed erosion-resistant materials and generated proposed revisions to the extents of the Severe and Moderate CMZ hazard areas that include the Erosion Setback, Geotechnical Setback, and all requirements of the Public Rule accordingly.

Recommendation

In accordance with the procedures set forth in Section 21A-24-279A.B.3 of the King County Channel Migration Public Rule, the RFMS is recommending a revision to the effective Cedar River CMZ hazard area mapping in the vicinity of the Scrivner parcel. The revised mapping would also affect other adjacent parcels along the right bank of the Cedar River as listed in Table 1. RFMS is providing this memorandum and will transmit the appropriate digital version of the proposed revised mapping to DLS in support of DLS's adoption of this reassessment.

References

Aspect Consulting, LLC. 2018. Channel-Migration Hazard Assessment, Proposed Scrivner Residence.

Booth, D. 1995. Surficial Geologic Map of the Maple Valley Quadrangle, King County, Washington. US Geological Survey Map MF-2297. Scale 1:24,000.

Briaud, J.-L., H.-C. Chen, K.-A. Chang, S.J. Oh, S. Chen, J. Wang, Y. Li, K. Kwak, P. Nartjaho, R. Gudaralli, W. Wei, S. Pergu, Y.W. Cao, & F. Ting. 2011. Summary Report: The SRICOS-EFA Method. Texas A&M University.

King County. 2015. Cedar River channel migration study. Prepared by Terry Butler and Fred Lott. King County Department of Natural Resources and Parks, Water and Land Resources Division. Seattle, Washington.

King County. 2018. King County Channel Migration Public Rule. Chapter 21A-24, Rules and regulations of the Department of Permitting and Environmental Review and Department of Natural Resources and Parks. Critical Areas: Designation, Classification and Mapping of Channel Migration Zones. Amended July 13, 2018.

Figures

Figure 1. Location Map. Parcel No. 3323069068 is outlined in black.

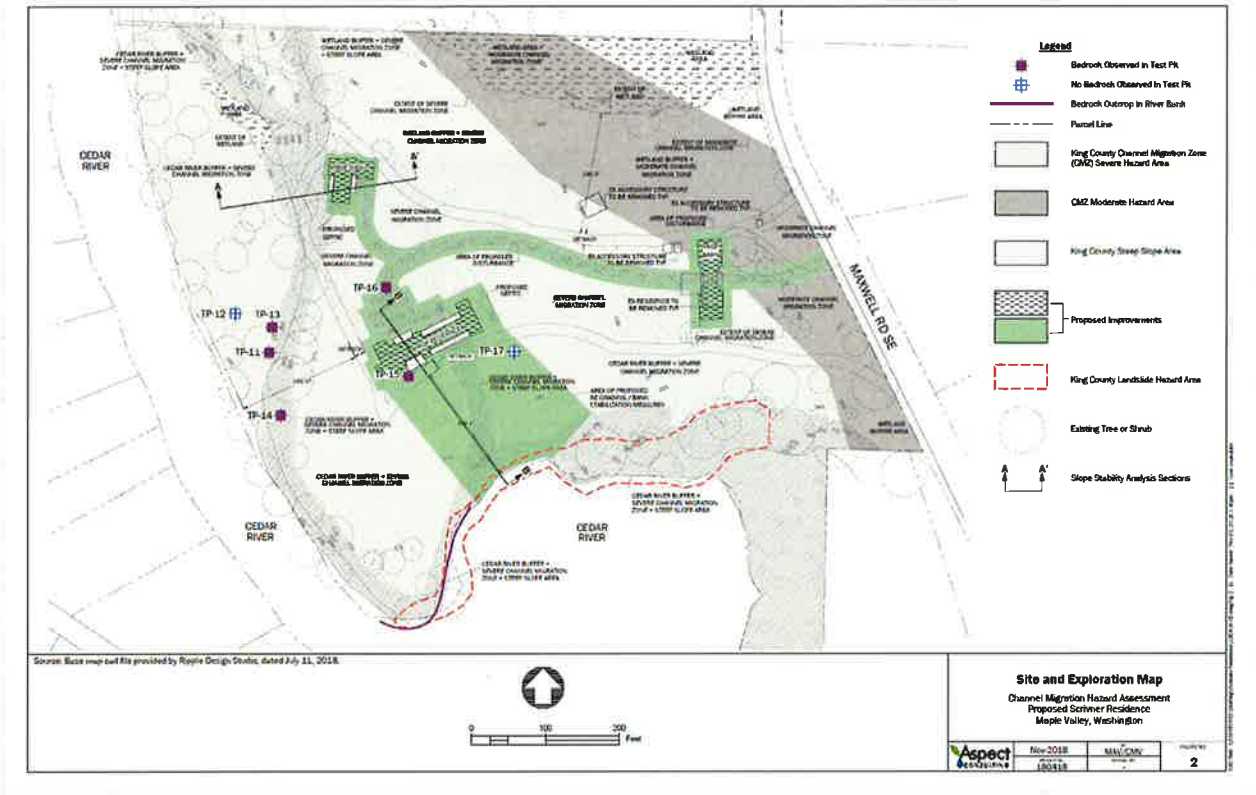

Figure 2. Site Map from geotechnical report (Aspect 2018). Test pits where Aspect identified bedrock are shown in purple.

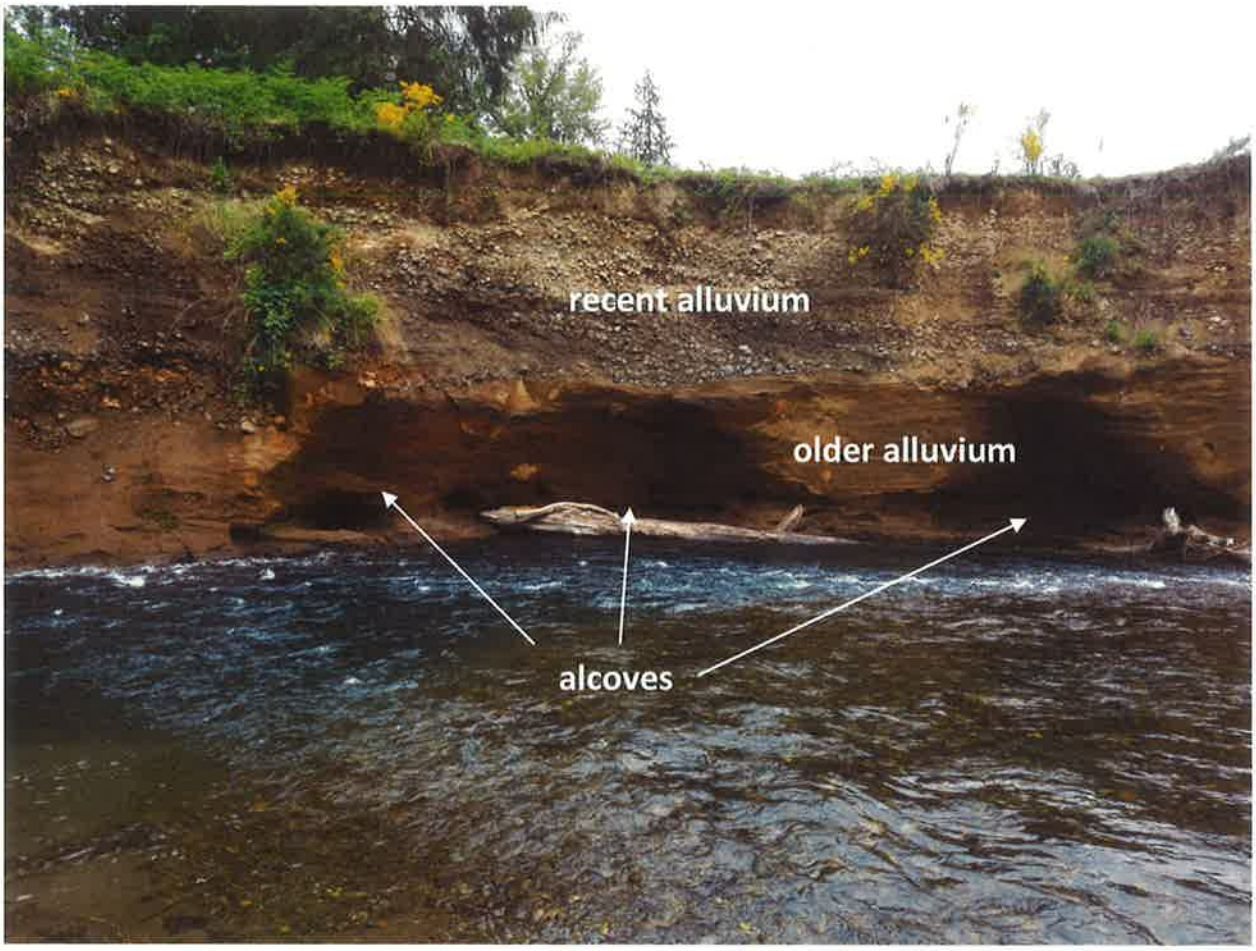

Figure 3. Exposure of layered alluvium along actively eroding river bank with tree-gouged alcoves. (Photo taken by RFMS on May 16, 2019).

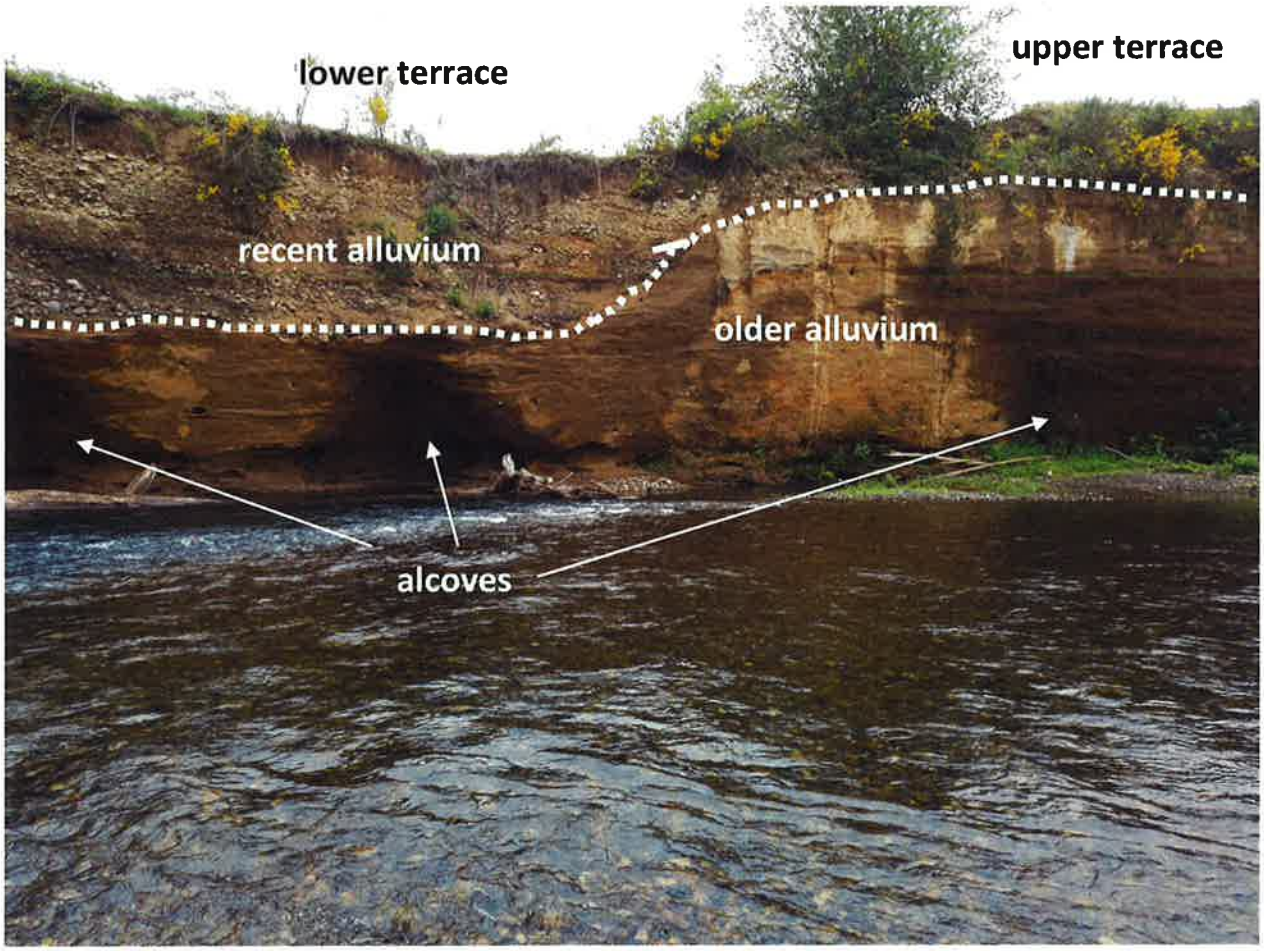

Figure 4. Elevation difference between upper and lower terraces echoes the shape of the contact between older and recent Holocene alluvium layers. (Photo taken by RFMS on May 16, 2019).

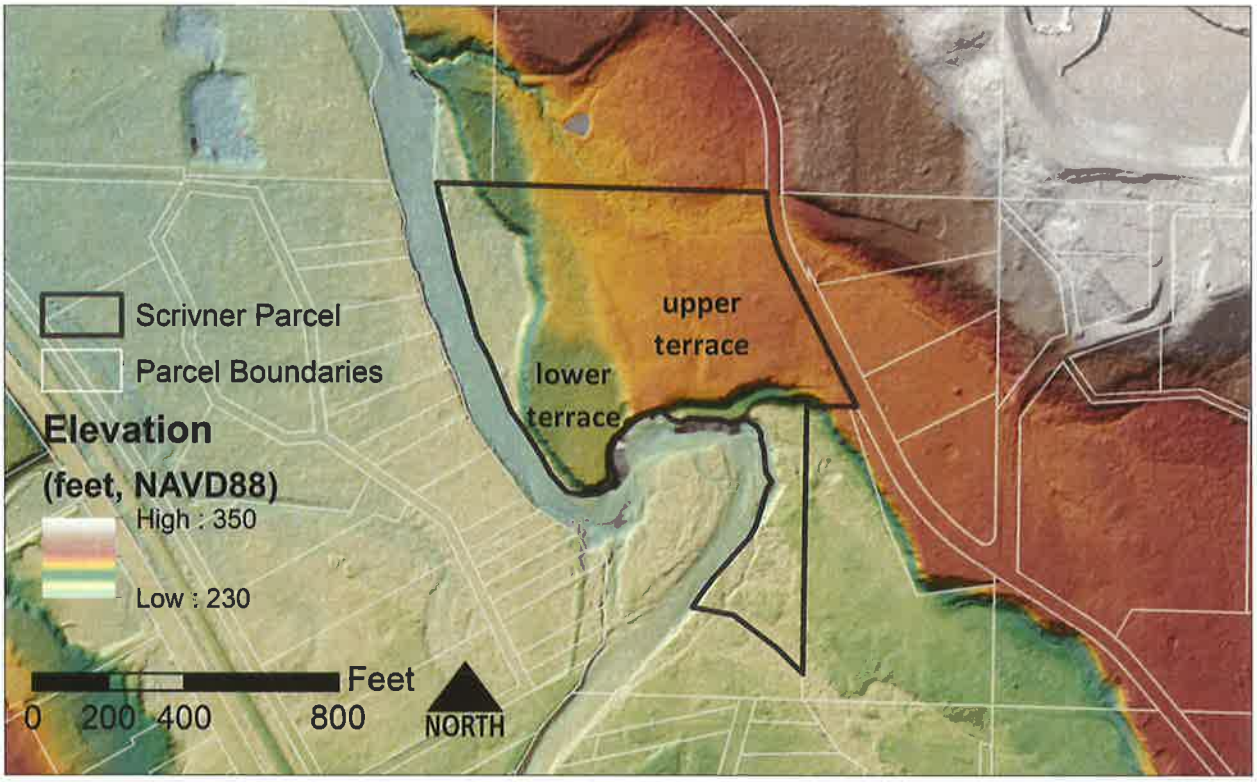

Figure 5: Location of upper and lower terraces. (LiDAR graphic generated by RFMS).

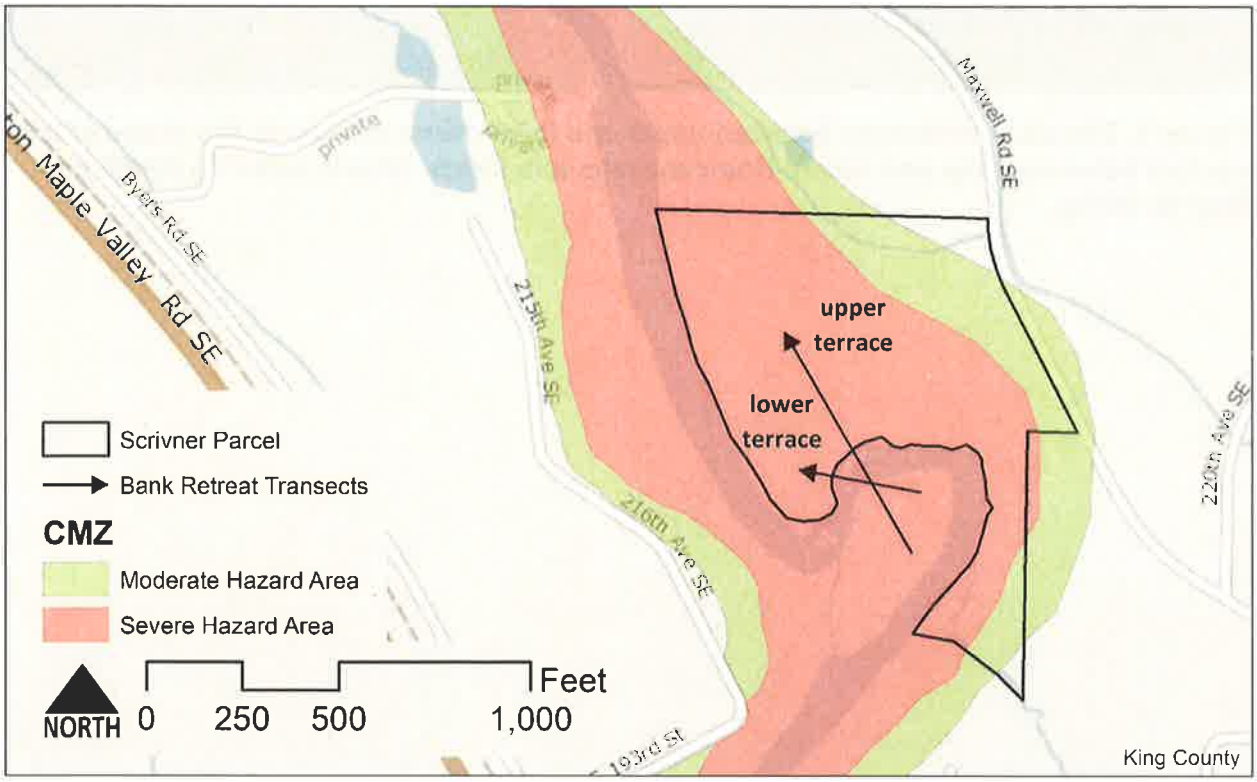

Figure 6. Location of transects used to calculate bank retreat distances and erosion rates. Graphic includes current effective CMZ Severe and Moderate hazard boundaries.

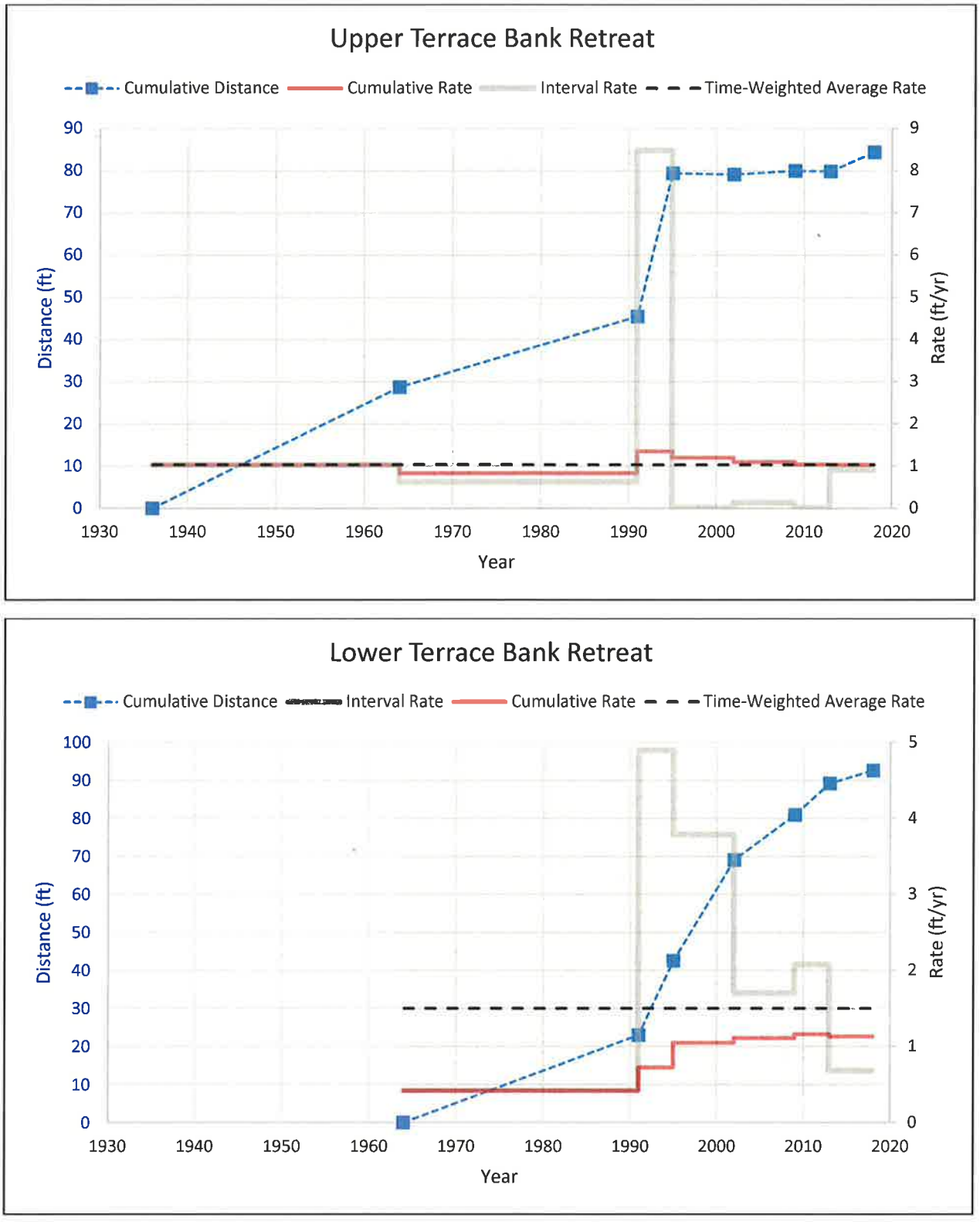

Figure 7. Upper and lower terrace bank retreat distances and erosion rates as calculated by RFMS.

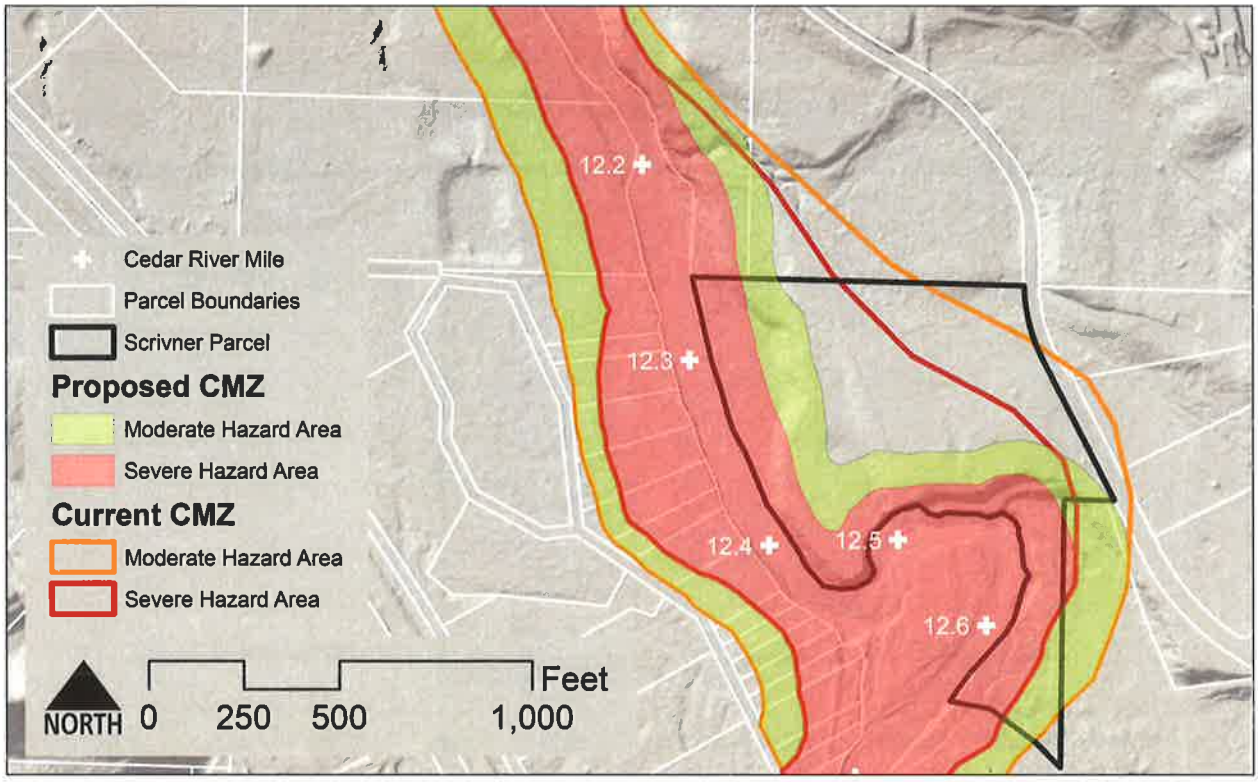

Figure 8. Comparison of currently effective CMZ mapping with the proposed revised hazard area boundaries.