

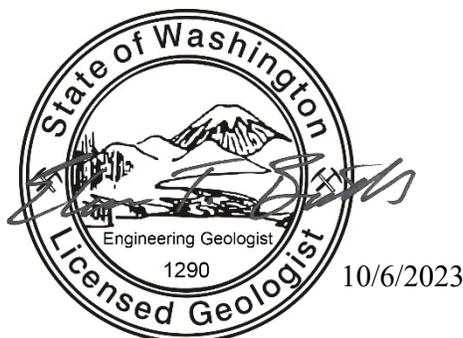
# MEMORANDUM

Project No.: 230234

October 6, 2023

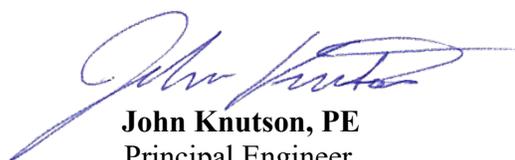
To: Chad Bala, Teanaway Ridge, LLC

From:



Elson T. Barnett

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Re: **Yakima River Campground Channel Migration Zone Preliminary Evaluation,  
Teanaway, Washington**

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## Introduction

Aspect Consulting, LLC (Aspect) has prepared this memorandum summarizing the results of a geomorphology assessment and Channel Migration Zone (CMZ) evaluation of a proposed camping area on Kittitas County (County) parcel number 346534 (Site) near Teanaway, Washington (Figure 1). The Site lies within the County-mapped CMZ along the left bank (north) side of the Yakima River and sits approximately 0.55 mile upstream of the confluence with the Teanaway River. Teanaway Ridge, LLC has requested a preliminary site-specific CMZ evaluation to address County comments in general accordance with CMZ delineation methodology described by Rapp and Abbe (2003) and Olson et al. (2014).

Kittitas County Code, Section 17A.02.290 defines a CMZ as an Erosion Hazard Area where a river or stream channel is likely to move laterally during the next 100 years, based on evidence of active stream channel movement over the past 100 years. The County's CMZ delineation extends north of the Site.

A brief portion of County code section 17A.06.050 is provided below for reference.

**17A.06.050 Erosion Hazard Area Standards.**

1. **Generally.** Alterations or development may be allowed within erosion hazard areas, provided that all responsible measures have been taken to minimize risks and other adverse effects with erosion hazards, and the amount and degree of the alteration are limited to minimum needed to accomplish the project purpose. Prior to approving a development or alteration in or adjacent to an erosion hazard area, a report will be prepared as defined in KCC 17A.06.100. Based on this information, the Director shall determine whether all the following standards are met.
  - a. The alteration or development includes all appropriate measures to eliminate or otherwise mitigate risks to health and safety;
  - b. The alteration or development includes best management practices to prevent, control and minimize erosion;
  - c. The alteration or development will not increase erosion potential;
  - d. The removal and disturbance of vegetation, clearing, or grading shall be limited to the area of the approved alteration or development;
  - e. The alteration or development will not increase surface water discharge or sedimentation to adjacent properties beyond predevelopment conditions, as documented in a geologically hazardous area risk assessment and/or geotechnical report;
  - f. The proposed alterations will not adversely impact other critical areas; and
  - g. Structures and improvements are designed to minimize alterations to the erosive soils and slopes.
  
2. **Channel Migration Zones.** If County maps or consultation by the Director with qualified professionals or agencies with expertise indicate that a potential channel migration zone hazard exists on or adjacent to a proposed development site, the applicant shall either:
  - a. Locate the proposed development outside of an already defined channel migration hazard area as indicated on the map; or
  - b. Submit a Channel Migration Zone Report, as described in [KCC 17A.06.100](#) prepared by a qualified geologist, or engineering geologist, or professional engineer, licensed in the state of Washington with experience in analyzing channel response in the fluvial systems of the Pacific Northwest.
  
3. **Permitted Alterations and Development in Channel Migration Zones.** The following alterations and development shall be allowed as specified below and previous sections:
  - a. **Surface Water Discharge.** Discharge of surface water, provided there are no other alternatives for discharge. The pipe shall be located on the surface of the ground and be properly anchored so that it will continue to

- function under erosion conditions and not create or contribute to adverse effects on downstream critical areas.
- b. Utility Lines. Utility lines, when no feasible location is available. Above-ground lines shall be anchored and/or designed so that it will not preclude or interfere with channel migration. Below ground lines shall be of sufficient depth as to not be affected by future channel migration.
  - c. Public Roads, Bridges, and Trails. Public roads, bridges, and trails when no feasible alternative alignment is available. Facilities shall be designed such that the roadway prism and/or bridge structure will not be susceptible to damage from active erosion.
  - d. Stream Bank Stabilization. Stream bank stabilization may be permitted subject to all of the standards listed in [KCC 17A.04.050](#).

## **Site Description and CMZ Evaluation**

The Site is an approximately 86.6-acre parcel south of the State Route (SR)10 highway. The southern portion of the Site is currently bifurcated by the Yakima River channel. The northern portion is developed with a residence, a shop building, a paved sport court, out-buildings and perimeter foundations, and Yakima River tributary channels.

We completed the geomorphic study and CMZ evaluation to delineate channel migration erosion-related risks at the Site. We evaluated channel behavior for an approximate reach area between river mile (RM) 176 upstream to RM 180 (Figure 2) bounded to the north by SR 970, which becomes SR 10, and to the south by areas of somewhat higher topographic relief toward Lower Peoh Point Road. The Yakima River through this area is generally characterized by single to multiple channel meander bend morphology.

### **Geomorphic Reconnaissance**

Aspect staff completed a fluvial geomorphic reconnaissance on June 30, 2023, to observe channel and bank conditions and adjacent slopes in the vicinity of the reach and within the Site. The flows along the Yakima River were a bit higher than ideal to observe bank conditions; however, we were able to observe higher flows where the channel could potentially overtop and migrate toward the Site, like at the East Cle Elum Boat launch access road approximately near RM 177.8. We observed areas of bank protection as shown on Figure 2 and areas south of the channel with significant topographic relief that limits channel migration locally. In general, the river banks are generally comprised of erodible alluvium with sand, silt, gravel, cobbles and boulders.

We observed a fluvial terrace slope west, south, and east of the developed northern portion of the Site. In general, the crest of the terrace slope is less than 8 feet vertically to the toe of the slope. The area surrounding the terrace slope includes tributary side channels that flow and eventually have a confluence with the Yakima River main stem just east of the Site.

We also observed indications of erosion and previous localized overflow from the east side of the lake may have locally occurred, suggesting some potential for avulsion if the channel ever reoccupied the lake.

### **Site Geology**

Geologic mapping shows the Site is underlain by Quaternary alluvial deposits (Qa) that generally consist of sorted combinations of silt, sand, and gravel. The material was deposited within stream beds and alluvial fans (Tabor et. al., 1982) in lower relief topographic areas. The reach of the Yakima River is bounded to the north and south by higher relief deposits of Pleistocene-age Quaternary Undifferentiated Drift (Qao(ld)) described as clastic sediment glacial deposits that includes alpine glacial till and outwash sands and gravels (Tabor et. al., 1982). We also reviewed a local well log from the Site that corroborates the geologic mapping and indicates the thickness of the alluvium extends to a depth of approximately 160 feet before a comparative migration-resistant sandstone is encountered.

### **Methodology**

Lateral channel migration risk for the Yakima River was evaluated by review of aerial photographs, General Land Office (GLO) maps from the United States Bureau of Land Management, publicly available Light Detection and Ranging (LiDAR) data from 2020, and nearby Washington State Department of Ecology (Ecology) well data. We used this as well as information from our field reconnaissance and analysis from Ecology's channel migration tool (2014) to estimate the CMZ.

To evaluate the Yakima River channel behavior in the reach, we reviewed GLO maps from 1880 and historical aerial photographs from 1954, 1994, 2005, and 2021 and digitized channel banks spanning a period of record of 141 years. The results of digitizing the various year's channel banks are provided on Figure 2. From our review of the aerial photographs, we noted that the apparent lake waterbody (Figure 2) that is west of the Site was not present in the 1954 aerial photograph and likely represents a former sand and gravel borrow pit.

The channel bank data was used along with LiDAR data to develop a historical migration zone (HMZ) that identifies current and past locations of the river banks (Figure 3). The HMZ represents areas where the channel has been located historically; it does not necessarily include areas where flooding has historically occurred. For example, the channel may have flooded north of SR 10, as interpreted from the 1954 aerial photographs; however, it is unlikely that the channel would migrate into this zone now because of existing highway and railway infrastructure and evidence of local bank hardening that restricts channel migration.

### **Lateral Migration Estimates**

Aspect used the collected data from our reconnaissance, LiDAR, and the digitized approximate channel centerline data from 1880, 1954, 1994, 2005, and 2021 to estimate annual lateral migration over the available period of record. The centerline data (Figure 4) was compiled into Ecology's analysis tool (2014) and run for estimates of annual migration. For each year digitized in a 2D setting, the tool provides an annual estimate for lateral migration estimates for a series of profiles numbered 1 through 32 as shown on Figure 4.

The tool results for each profile were reviewed and range from a low of less than 1 foot per year lateral migration at Profile 11 to a high just over 15 feet per year at Profiles 22 and 23, which are just slightly upstream of the Site (Figure 4).

We selected a rate of 15 feet per year of channel migration as it fits with an appropriate range of estimates for Profiles 21 through 24 to develop a CMZ. Profiles 21 through 24 are considered

reasonable to apply to the Site because of the nature of the meander bends and the ability of a meander bend to migrate downstream as it erodes alluvium.

### **CMZ Delineation**

Using the selected estimate of migration, Aspect applied a multiplier of 50 and 100 to the HMZ to show the potential for channel migration across the Site (Figure 4). The preliminary 100-year CMZ would be a potential CMZ in general accordance with the County code given the current conditions at the Site without any bank protection or bank protection upstream of the Site in the vicinity Profiles 21 through 24.

### **Conclusions**

Our preliminary CMZ delineation has identified areas within the Site that are within a 50- and 100-year CMZ, and include the following:

- An erosion-resistant bedrock unit that would limit channel migration is not present at the Site, based on review of the well log from the Site.
- Topographic relief and different geologic units south of the Site and Yakima River limit lateral migration south of the HMZ and likely increase the risk of migration to the north toward the Site.
- The terrace slopes at the northern portion of the Site do not include bank protection and are susceptible to lateral migration from the Yakima River.
- Lateral migration could potentially occur over a 50-year period for the portion the Site shown on Figure 4 (purple shading).
- Lateral migration could potentially occur over a 100-year period across the entire Site as shown on Figure 4 (orange shading).

### **References**

- Kittitas County (County), 2023, Kittitas County Code, Section 17A.02, Critical Areas definitions, accessed September 15, 2023, [https://www.co.kittitas.wa.us/boc/countycode/title17a.aspx#Chapter\\_17A.02](https://www.co.kittitas.wa.us/boc/countycode/title17a.aspx#Chapter_17A.02)
- Olson, P. L., Legg N. T., Abbe, T. B., Reinhart, M., and Radloff, J. R., 2014, A Methodology for Delineating Planning-Level Channel Migration Zones, Department of Ecology, Publication no. 14-06-025, July 2014. [1406025.pdf \(wa.gov\)](#)
- Rapp, C.F., and Abbe, T.B., 2003, A framework for delineating channel migration zones: Ecology Publication 03-06-027. <https://fortress.wa.gov/ecy/publications/summarypages/0306027.html>
- Tabor, R. W. R.B. Waite, R.B., Frizzell, V.A. Jr., Swanson, D.A., Byerly, G.R., and Bentley, R.D., 1982, Geologic map of the Wenatchee 1:100,000 quadrangle, central Washington, US Geological Survey, Miscellaneous Investigations Series Map I-1311

Washington State Department of Ecology (Ecology), 2014, The Channel Migration Toolbox: ArcGIS® Tools for Measuring Stream Channel Migration. Publication number 14-06-032, published October 2014.

U.S. Bureau of Land Management, Government Land Office Records, 2023 [Search - BLM GLO Records](#); accessed June 5, 2023.  
<https://glorerecords.blm.gov/search/default.aspx#searchTabIndex=0&searchByTypeIndex=1>

## **Limitations**

Work for this project was performed for Teaway Ridge, LLC (Client), and this report was prepared consistent with recognized standards of professionals in the same locality and involving similar conditions, at the time the work was performed. No other warranty, expressed or implied, is made by Aspect Consulting, LLC (Aspect).

Recommendations presented herein are based on our interpretation of site conditions, geotechnical engineering calculations, and judgment in accordance with our mutually agreed-upon scope of work. Our recommendations are unique and specific to the project, site, and Client. Application of this report for any purpose other than the project should be done only after consultation with Aspect.

Variations may exist between the soil and groundwater conditions reported and those actually underlying the site. The nature and extent of such soil variations may change over time and may not be evident before construction begins. If any soil conditions are encountered at the site that are different from those described in this report, Aspect should be notified immediately to review the applicability of our recommendations.

Risks are inherent with any site involving slopes and no recommendations, geologic analysis, or engineering design can assure slope stability. Our observations, findings, and opinions are a means to identify and reduce the inherent risks to the client.

It is the Client's responsibility to see that all parties to this project, including the designer, contractor, subcontractors, and agents, are made aware of this report in its entirety. At the time of this report, our analyses have not been finalized, and the recommendations presented herein are based on preliminary project information. If project developments result in changes from the preliminary project information, Aspect should be contacted to determine if our recommendations contained in this report should be revised and/or expanded upon.

The scope of work does not include services related to construction safety precautions. Site safety is typically the responsibility of the contractor, and our recommendations are not intended to direct the contractor's site safety methods, techniques, sequences, or procedures. The scope of our work also does not include the assessment of environmental characteristics, particularly those involving potentially hazardous substances in soil or groundwater.

All reports prepared by Aspect for the Client apply only to the services described in the Agreement(s) with the Client. Any use or reuse by any party other than the Client is at the sole risk

Teaway Ridge, LLC  
October 6, 2023

## MEMORANDUM

Project No.: 230234

of that party, and without liability to Aspect. Aspect's original files/reports shall govern in the event of any dispute regarding the content of electronic documents furnished to others.

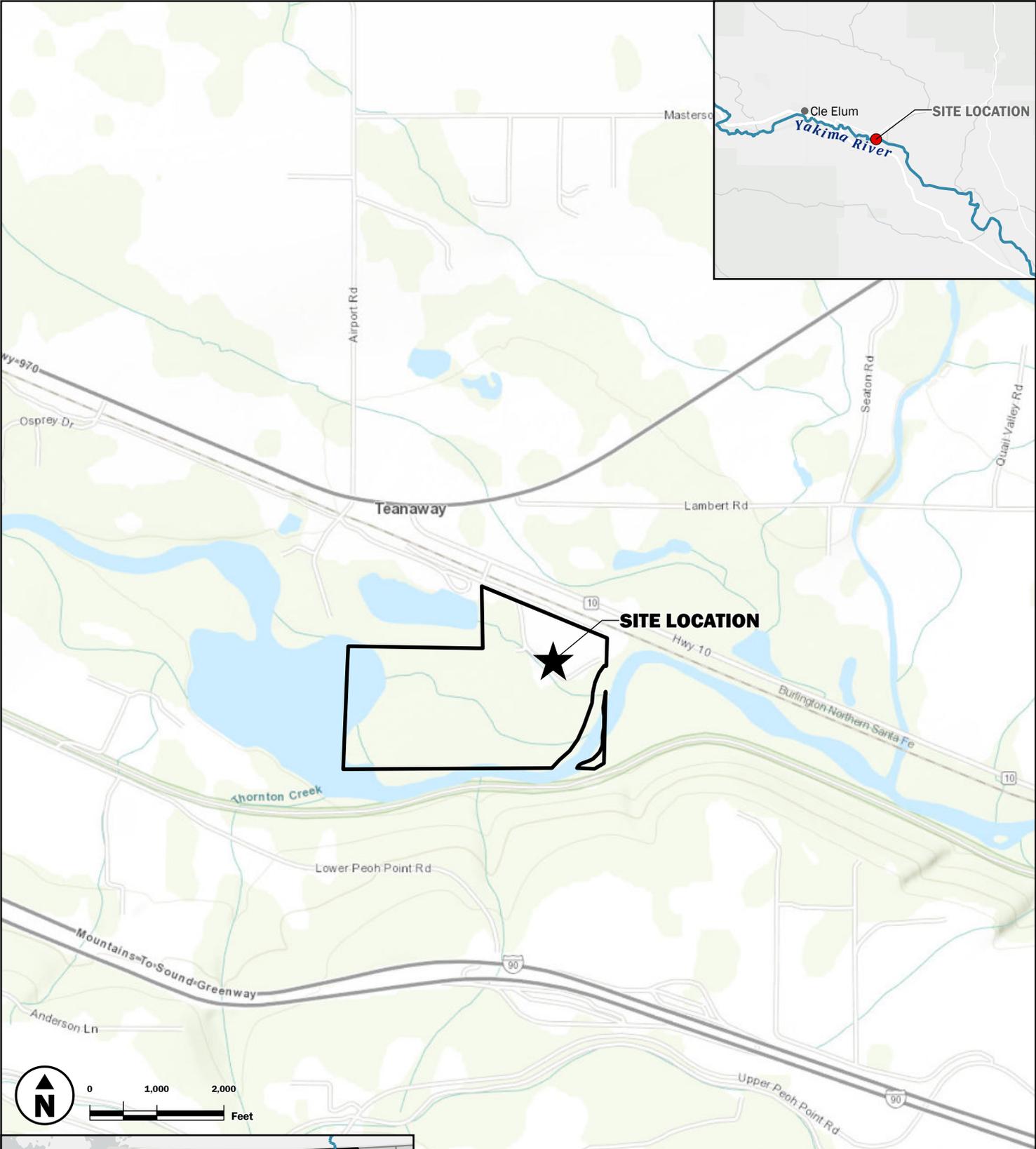
**Please refer to Appendix A titled "Report Limitations and Guidelines for Use" for additional information governing the use of this report.**

We appreciate the opportunity to perform these services. If you have any questions please call Chip Barnett, Senior Engineering Geologist, 206-413-5398.

Attachments: Figure 1 – Vicinity Map  
Figure 2 – Historic River Bank Edge  
Figure 3 – Historic Migration Zone  
Figure 4 – Channel Migration Zone  
Appendix A – Report Limitations and Guidelines for Use

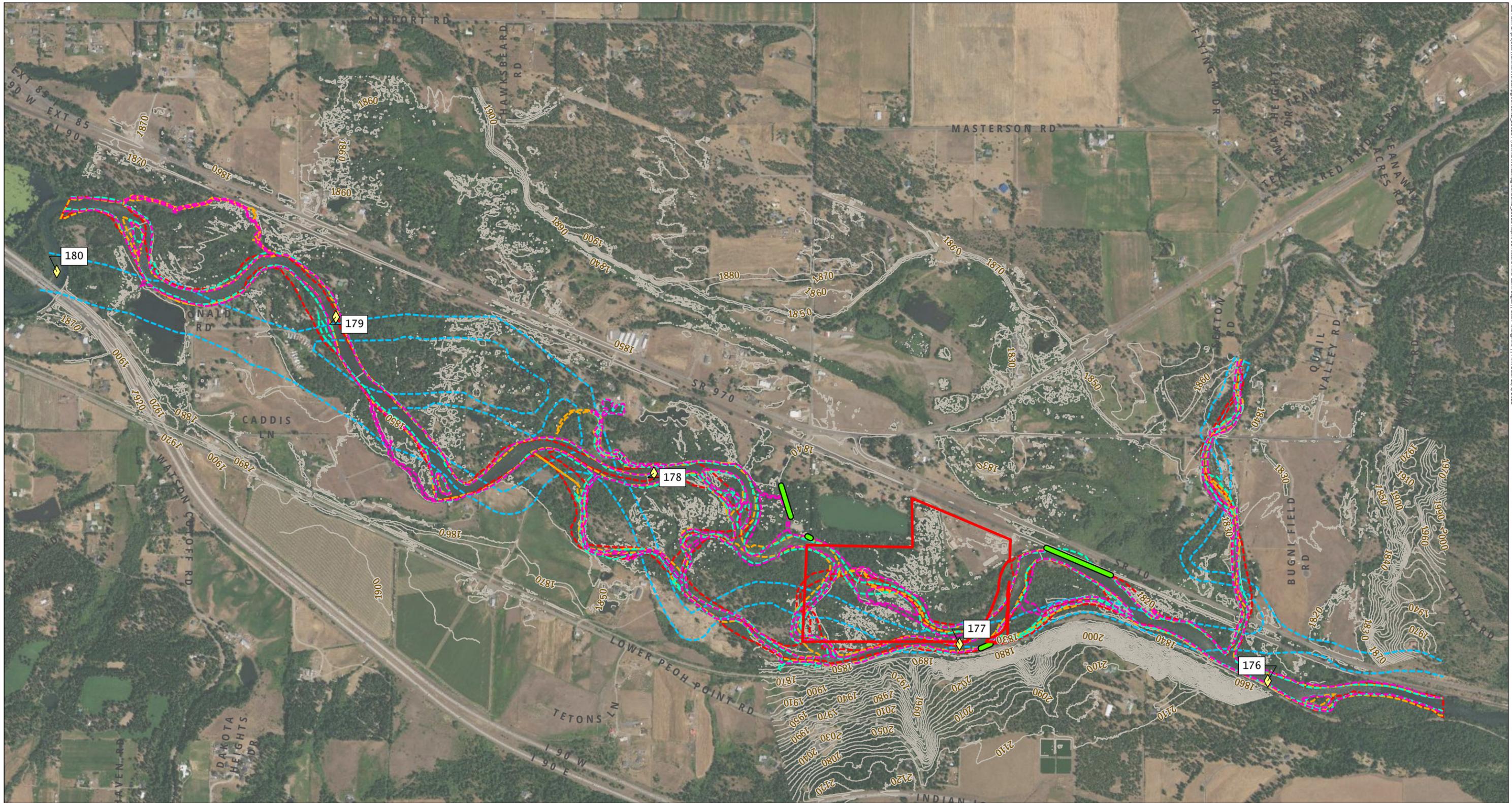
# FIGURES

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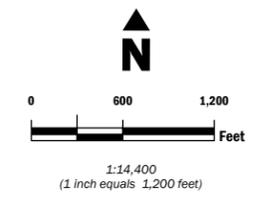


<p><b>Aspect</b> CONSULTING</p>		<p>OCT-2023</p>		<p>BY: CB / WBL</p>	<p>FIGURE NO. <b>1</b></p>
		<p>PROJECT NO. 230234</p>			

Data source credits: None | Basemap Service Layer Credits: County of Kittitas, WA State Parks GIS, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, County of Kittitas, Bureau of Land Management, Esri Canada, Esri, HERE, Garmin, INCREMENT P, USGS, METI/NASA, EPA, USDA, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA



- River Bank Edges**
- 2021 Bank Edge
  - 2005 Bank Edge
  - 1994 Bank Edge
  - 1954 Bank Edge
  - 1800 Bank Edge
- Legend:**
- Bank Protection
  - Site
  - ◆ River Miles
  - ~ 10ft Contour

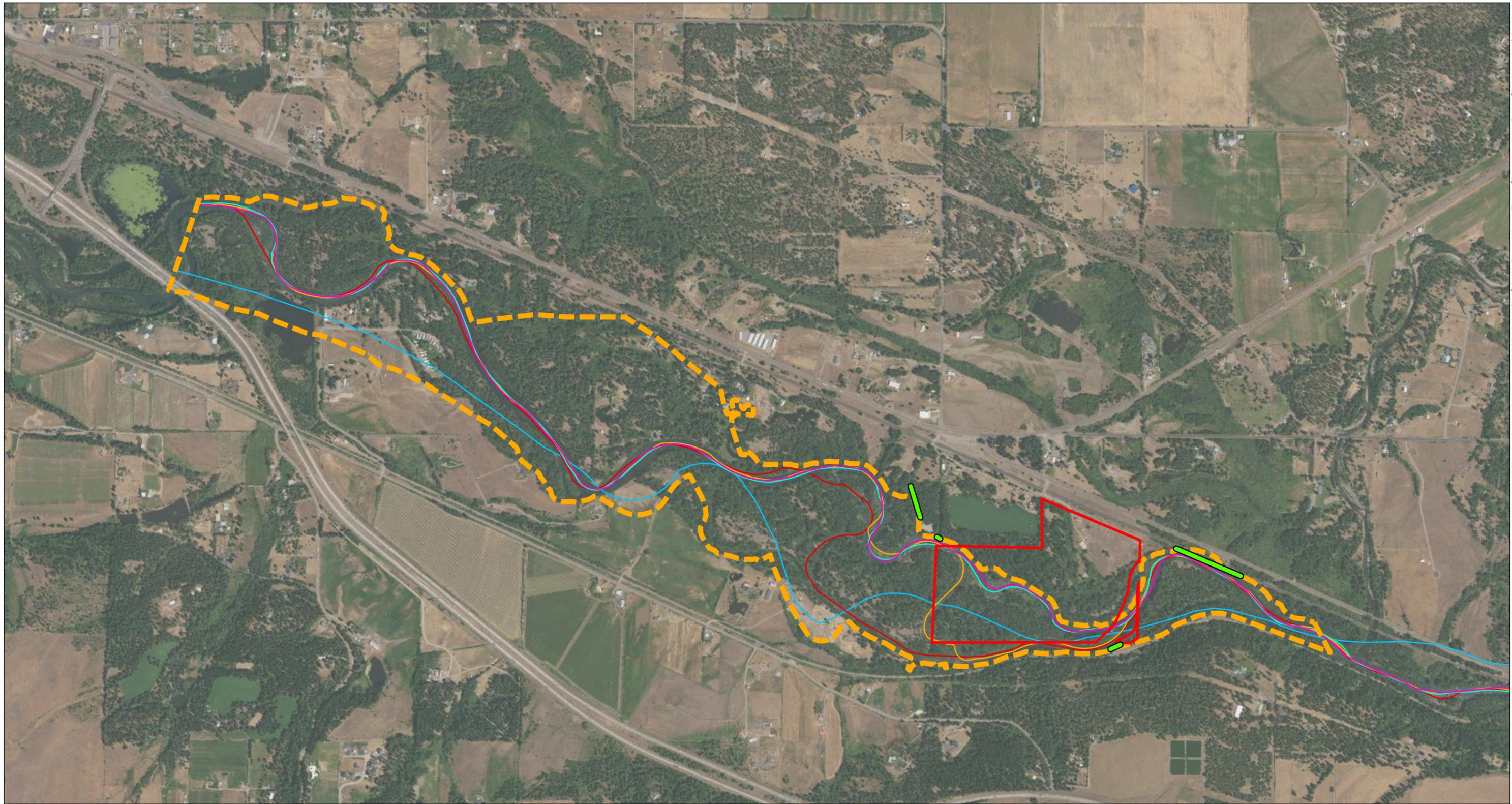


### Historic River Bank Edges

Yakima River Campground  
Teanaway, Washington

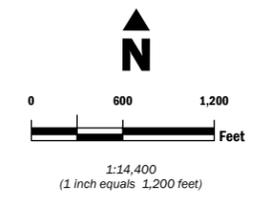
	OCT-2023	BY: CB / WBL	FIGURE NO. <b>2</b>
	<small>PROJECT NO.</small> 230234	<small>REVISED BY:</small> --- / ---	

Data source credits: None || Basemap Service Layer Credits: Hexagon, WaTech, Kittitas County GIS



- River Centerlines**
- 2021 River Centerline
  - 2005 River Centerline
  - 1994 River Centerline
  - 1954 River Centerline
  - 1880 River Centerline

- Site
- HMZ
- Bank Protection



**Historic Migration Zone**  
Yakima River Campground  
Teanaway, Washington

	OCT-2023	BY: CB / WBL	FIGURE NO. <b>3</b>
	<small>PROJECT NO.</small> 230234	<small>REVISED BY:</small> --- / ---	

Data source credits: None || Basemap Service Layer Credits: Hexagon, WaTech, Kittitas County GIS

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## **APPENDIX A**

### **Report Limitations and Guidelines for Use**

# REPORT LIMITATIONS AND GUIDELINES FOR USE

## This Report and Project-Specific Factors

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Aspect Consulting, LLC (Aspect) considered a number of unique, project-specific factors when establishing the Scope of Work for this project and report. You should not rely on this report if it was:

- Not prepared for you
- Not prepared for the specific purpose identified in the Agreement
- Not prepared for the specific real property assessed
- Completed before important changes occurred concerning the subject property, project or governmental regulatory actions

## Geoscience Interpretations

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The geoscience practices (geotechnical engineering, geology, and environmental science) require interpretation of spatial information that can make them less exact than other engineering and natural science disciplines. It is important to recognize this limitation in evaluating the content of the report. If you are unclear how these "Report Limitations and Use Guidelines" apply to your project or site, you should contact Aspect.

## Reliance Conditions for Third Parties

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This report was prepared for the exclusive use of the Client. No other party may rely on the product of our services unless we agree in advance to such reliance in writing. This is to provide our firm with reasonable protection against liability claims by third parties with whom there would otherwise be no contractual limitations. Within the limitations of scope, schedule, and budget, our services have been executed in accordance with our Agreement with the Client and recognized geoscience practices in the same locality and involving similar conditions at the time this report was prepared.

## Property Conditions Change Over Time

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This report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by events such as a change in property use or occupancy, or by natural events, such as floods, earthquakes, slope instability, or groundwater fluctuations. If any of the described events may have occurred following the issuance of the report, you should contact Aspect so that we may evaluate whether changed conditions affect the continued reliability or applicability of our conclusions and recommendations.

## **Discipline-Specific Reports Are Not Interchangeable**

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The equipment, techniques, and personnel used to perform a geotechnical or geologic study differ significantly from those used to perform an environmental study and vice versa. For that reason, a geotechnical engineering or geologic report does not usually address any environmental findings, conclusions, or recommendations (e.g., about the likelihood of encountering underground storage tanks or regulated contaminants). Similarly, environmental reports are not used to address geotechnical or geologic concerns regarding the subject property.

We appreciate the opportunity to perform these services. If you have any questions please contact the Aspect Project Manager for this project.