

# Appendix C

Desktop Geotechnical Review Memorandum



February 26, 2024

Mr. Mark Brower, PE  
KPFf Consulting Engineers  
421 W. Riverside Avenue, Suite 524  
Spokane, WA 99201

RE: DESKTOP GEOTECHNICAL REVIEW (REV. 0); COLUMBIA RIVER CROSSING STUDY, CHELAN / DOUGLAS COUNTIES, WASHINGTON

Dear Mr. Brower;

Shannon & Wilson prepared this Desktop Geotechnical Review (DGR) report for the Columbia River Crossing (CRC) Study, Chelan and Douglas Counties, Washington. The purpose of this report is to present the site geology; available subsurface information and geologic hazard mapping; anticipated subsurface conditions; and preliminary engineering recommendations for the alternative CRC alignments.

## SCOPE AND AUTHORIZATION

To prepare this report, Shannon & Wilson:

- Reviewed the Request for Proposals issued by the Chelan-Douglas Transportation Council (CDTC) on December 15, 2022;
- Discussed the project preliminary nature and geotechnical services with Mr. Mark Brower, PE, of KPFf Consulting Engineers (KPFf) in preparation of our scope of services;
- Obtained and reviewed readily available geological and geotechnical engineering information;
- Reviewed mapped geologic hazards of the area;
- Developed conceptual subsurface conditions based on the geologic and geotechnical information review; and
- Provided preliminary assessment of potential foundations.

We completed the scope of services described in this DGR report in accordance with our May 26, 2023, executed agreement with KPFf. Shannon & Wilson prepared this DGR for use by KPFf and the CDTC for the CRC Study. Do not use or rely upon this report for other locations or purposes without the written consent of Shannon & Wilson.

## BACKGROUND

Within the Wenatchee metropolitan area (Wenatchee and East Wenatchee), the Columbia River flows north to south, dividing Wenatchee and East Wenatchee, then at the south end, turns to the east and back to the south before encountering the Rock Island Dam. Within this area, there are two existing east-west vehicle crossings, as listed below and shown on the enclosed Study Area Map:

- The **George Sellar Bridge (State Route [SR] 285)** directly connects Wenatchee and East Wenatchee near the south end.
- The **Odabashian Bridge (US 2/97)** crossing connects the north end of Wenatchee and East Wenatchee.

Other non-vehicular crossings within the project segment of the Columbia River include:

- The Old Wenatchee (Pedestrian) Bridge about ½-mile north of the SR 285 Sellar Bridge, and
- An active rail crossing about ¾ miles (straight-line distance) northwest of the Rock Island Dam.

A third vehicle crossing has been discussed in the Wenatchee Valley. The intent of the CDTC's Study is to apply concept-level planning, environmental, and engineering analyses to understand the magnitude of the costs, benefits, and impacts at up to four alternative river crossings which could be further evaluated for selection of a preferred alternative.

The CDTC provided three alternative crossing locations for the Study, and a fourth alternative has been selected by the KPF team in conjunction with the CDTC (see the enclosed Study Area Map). The alternative CRC alignments consist of:

1. **Downtown Connection** - a non-highway bridge connecting downtown Wenatchee and downtown East Wenatchee.
2. **SR 285 Expansion** - a capacity expansion of the existing SR 285 Sellar Bridge with an emphasis on SR 285-to-SR 28 connectivity for the highway system.
3. **Mid-Valley Crossing** - An arterial connection between the community of Malaga (on the west, Chelan County side) and East Wenatchee (on the east, Douglas County side) supporting emerging development and access to Pangborn Airport.
4. **Malaga / Rock Island Industrial Area Crossing** - a new connection at the southeast corner of the metro area between the Malaga industrial area and SR 28 south of Rock

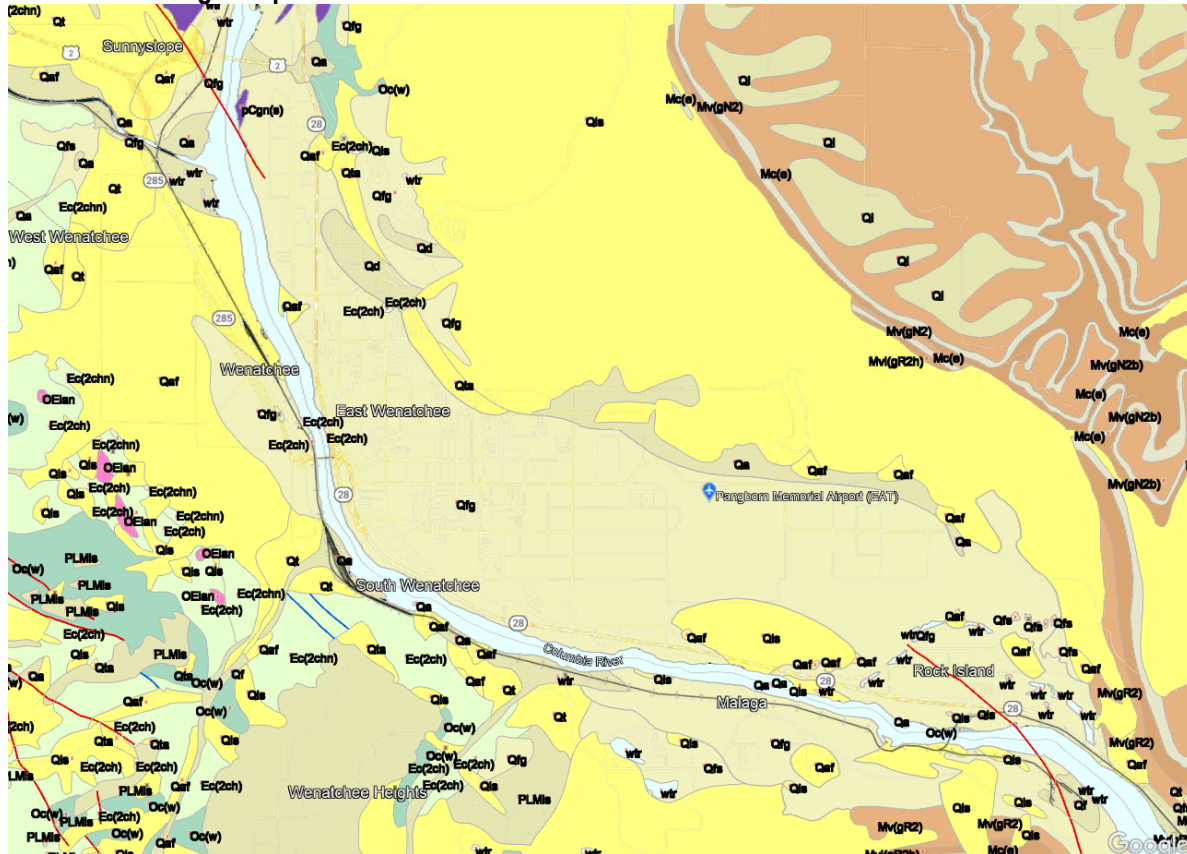
Island, improving mobility for freight, commuters, and connectivity to Grant County and Interstate 90 (to the east) via SR 28.

## GEOLOGY AND GEOLOGIC HAZARDS

### Local Geology

According to *The Geology of the Wenatchee and Monitor Quadrangles, Chelan and Douglas Counties*, (Gresens, 1983)<sup>1</sup>, as shown in Exhibit 1 below, the geologic units that underlie the Columbia River and its shorelines from the north end of the project extending to Rock Island Dam include:

**Exhibit 1: Geologic Map**



<sup>1</sup> Gresens, R.L., 1983, *Geology of the Wenatchee and Monitor Quadrangles, Chelan and Douglas Counties*: Washington State Department of Natural Resources, Division of Geology and Earth Resources, scale 1:24,000.

- **Manmade Fill and Modified Land (Qf)** – Mapped predominantly at the Alcoa Wenatchee Works plant.
- **Alluvium Deposits (Qa)** - relatively small areas mapped at the deltas of the Wenatchee River and other drainages into the Columbia River.
- **Alluvial Fan Deposits (Qaf)** – typically consisting of sandy gravel to gravelly sand with varying quantities of cobbles to boulders and silts. Mapped north of the Alcoa Wenatchee Works plant on the Douglas County shoreline.
- **Landslide Deposits, Undifferentiated (Qls)** – typically consisting of poorly sorted bouldery gravel to bouldery mud; most exhibit hummocky surfaces and bulbous toes. Present in localized areas on the Douglas County side across from Malaga and in Chelan County near the existing rail crossing east of Malaga.
- **Oligocene Continental Sedimentary Deposits, Wenatchee formation Oc(w)** – Present in a relatively small area on the Douglas County shoreline at the existing rail crossing east of Malaga.
- **Swakane Biotite Gneiss (pCgn(s))** – a localized area on the Douglas County shoreline south of the existing US 2 / 97 crossing.
- **Outburst Flood Deposits, Gravel (Qfg)** – typically consisting of sandy coarse gravel with varying quantities of cobbles to boulders.
- **Grande Ronde Basalt (Mv(gR2)) of the Columbia River Basalt Group (CRBG)** – mapped in Douglas County north and south of the Rock Island Dam.

Based on our local experience, we anticipate groundwater along the alternative CRC alignments coincides closely with the Columbia River surface elevation.

## Geologic Hazards

Shannon & Wilson reviewed potential geologic hazards along the Columbia River through the project segment and nearby areas (less than about ½-mile radius of the project segment) based on the Washington State Department of Natural Resources (DNR) information portal<sup>2</sup> and our local experience. We summarize our geologic hazards review below.

- **Earthquake Shaking Hazard** - Low to moderate expected, which translates to a primary Seismic Design Category (SDC) (shaking hazard combined with anticipated subsurface

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<sup>2</sup> Washington State Department of Natural Resources (DNR), 2022, Geologic Information Portal, Interactive Map, accessed July 2023 from DNR website at: <https://geologyportal.dnr.wa.gov/2d-view>

- conditions) of C with localized areas mapped along the Columbia River shoreline of SDC B.
- **Liquefaction Hazard** – Primarily low to moderate (Qfg and Qls deposits) with localized areas of very low to low (e.g., Qaf, Qt, bedrock), moderate to high (e.g., Qa), and high (e.g., Qf).
  - **Landslide Hazard** – Primarily low with areas of moderate to high within the Qls deposits (pre-historic to historic landslides). The Qls deposits in the area are known to become increasingly unstable with heavy precipitation events and/or increasing groundwater levels.
  - **Volcanic Hazard** – None mapped at any of the alternative locations.

In our opinion, the potential for earthquake-induced ground surface rupture is low at the four alternative alignments as the nearest potentially active faults are the:

- **Spencer Canyon fault** – southwest-to-northeast trending about 13 miles north of downtown Wenatchee;
- **Kittitas Valley faults** - east-to-west trending about 23 miles southwest of the project alignment from the Malaga area; and
- **Umtanum Ridge Structures** - northwest-to-southeast trending with inferred faults mapped about 39 miles southwest of the Rock Island dam.

Based on our local experience, the potential for flash flooding also exists within the major drainages of the area, including, but not limited to the approximately north-south trending Squilchuck Creek and Stemilt Creek drainages. Flash floods exiting the drainage systems at the Columbia River pose erosion risks along the Columbia River shoreline and could impact nearby structures due to hydraulic forces on foundations and/or columns.

## PRELIMINARY CONCLUSIONS AND RECOMMENDATIONS

Based on the geology and geologic hazards discussion above, in our opinion, a new CRC alignment is feasible at the four alternative alignments. Within the scope of the geology and geotechnical discussion above, the primary differentiating factor between the alternative alignments are the mapped geologic units and likely subsurface conditions. However, based on our experience within these geologic units and with other bridge projects, structure foundations would be designed to extend through potentially lesser competent soils (e.g., alluvial fans, etc.) into competent geologic units such as Qfg flood gravels or CRBG bedrock.

Based on our experience, deep foundations would likely be utilized at most pier locations with potential spread footings at abutments in very dense soils and/or bedrock. Drilled shafts can be designed to resist seismic design forces; downdrag from liquefaction-induced seismic consolidation of fill; and other support considerations. Within bedrock and dense to very dense bearing conditions, shallow foundations may be utilized, permitting the excavation can be completed in the dry.

## Design Phase Geotechnical Explorations and Engineering

A geotechnical exploration program should be completed for the selected alignment(s) to develop site-specific geotechnical design and construction recommendations. The exploration program should include subsurface explorations (e.g., borings, test pits, and potentially others) for the proposed structure(s), pavements, utility alignments, and other potential items that require geotechnical input.

### LIMITATIONS

Within the limitations of the scope, schedule, and budget, the analyses, conclusions, and preliminary recommendations presented in this DGR report were prepared in accordance with generally accepted professional geotechnical engineering principles and practices at the time when it was produced. We make no other warranty, either express or implied.

The analyses, conclusions, and preliminary recommendations are based on our understanding of the project, as described in this report and on limited geological and geotechnical information from other projects. Project-specific subsurface explorations have not been completed to date for the proposed project. Shannon & Wilson will provide more detailed geotechnical recommendations, as requested, in a design phase geotechnical engineering report.

This report was prepared for KPF and the CDTC for the exclusive use of providing preliminary geotechnical engineering recommendations and considerations for the prospective CRC alignments. It should not be made available for use by others or for purposes other than those described in the report. Unanticipated soil conditions are commonly encountered and cannot be fully determined by merely taking soil samples from explorations. Such unexpected conditions frequently require that additional expenditures be made to attain properly constructed projects.

The scope of our services did not include assessment or evaluation regarding the presence or absence of hazardous or toxic materials in the surface and subsurface environment. We

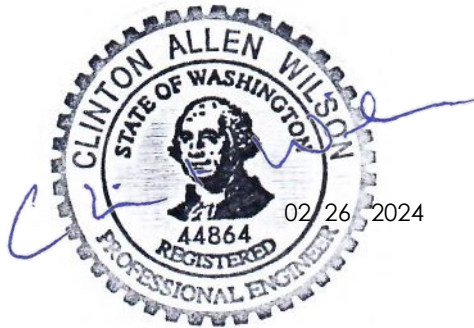


would be pleased to provide you a scope for these services at your request, should these services become necessary.

Shannon & Wilson prepared "Important Information About Your Geotechnical Report" to assist the design and permitting teams, and others who might read this report, in understanding the use and limitations of our work.

Sincerely,

SHANNON & WILSON



Clinton A. Wilson, P.E.  
Senior Associate

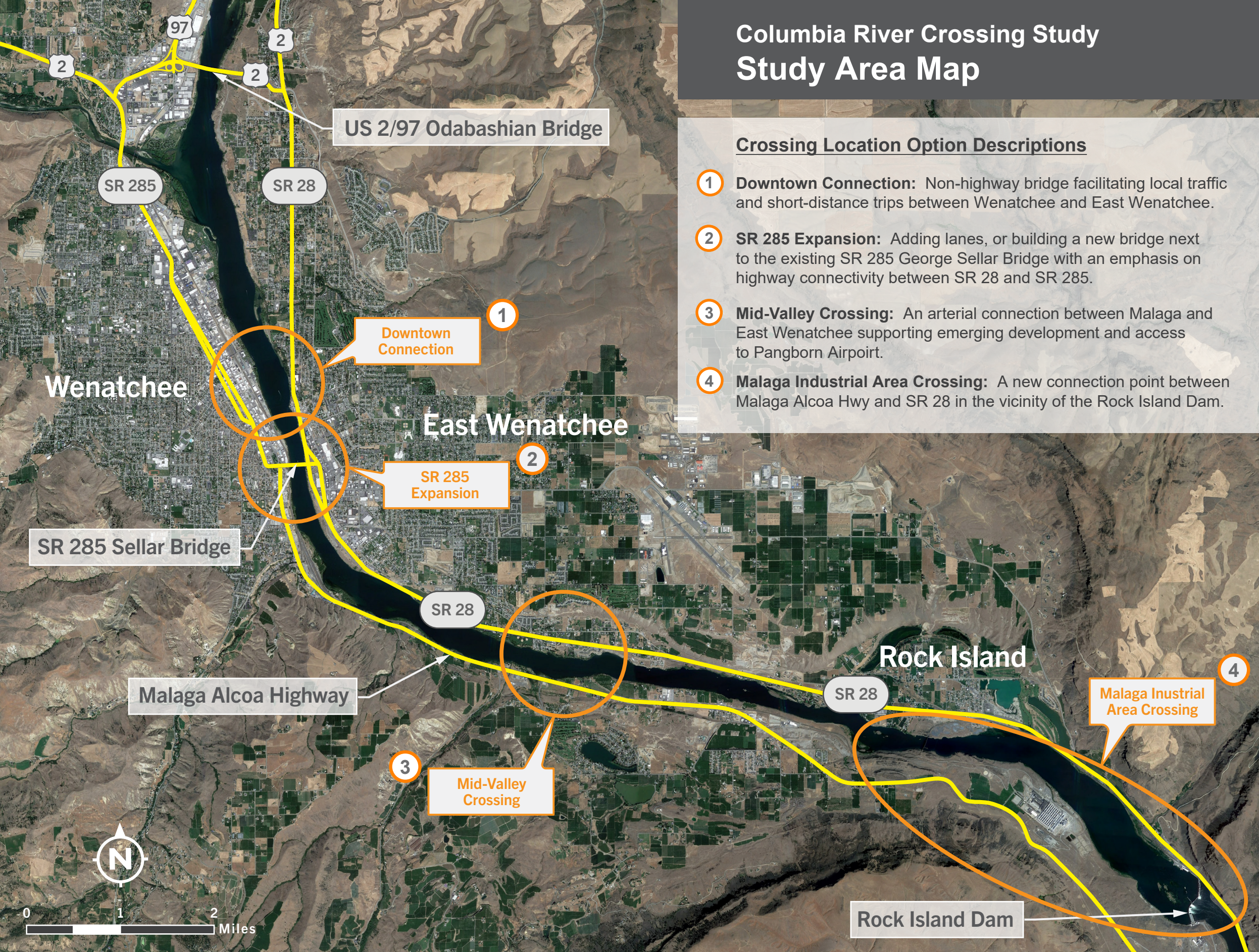
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Enc. Study Area Map (provided by KPFF)  
Important Information About Your Geotechnical Report

# Columbia River Crossing Study Study Area Map

## Crossing Location Option Descriptions

- 1 Downtown Connection:** Non-highway bridge facilitating local traffic and short-distance trips between Wenatchee and East Wenatchee.
- 2 SR 285 Expansion:** Adding lanes, or building a new bridge next to the existing SR 285 George Sellar Bridge with an emphasis on highway connectivity between SR 28 and SR 285.
- 3 Mid-Valley Crossing:** An arterial connection between Malaga and East Wenatchee supporting emerging development and access to Pangborn Airport.
- 4 Malaga Industrial Area Crossing:** A new connection point between Malaga Alcoa Hwy and SR 28 in the vicinity of the Rock Island Dam.



## Important Information About Your Geotechnical Report

### CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

### THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors that were considered in the development of the report have changed.

### SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events and should be consulted to determine if additional tests are necessary.

### MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to

help reduce their impacts. Retaining your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

#### A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary, because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

#### THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

#### BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

#### READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports, and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

**The preceding paragraphs are based on information provided by the GBA, Silver Spring, Maryland**