King County

INSTREAM PROJECT DESIGN CHECKLIST

For Design and Construction of Flood and Erosion Protection Facilities and Habitat Restoration Projects that May Include Large Wood Placement or Natural Wood Recruitment

Project Name: Reinig Road Revetment Repair Project Manager: Craig Garric/Stella Torres

River/River Mile/Bank: Snoqualmie River/ RM 41.75 – 41.84/ Right Bank Date April 5, 2019

Check one or both:

☒ Project includes placement of large wood elements

☒ Project may influence the recruitment, mobility and accumulation of natural large wood.

Note: If the project is comprised of emergency work, then fill out and file this form within 30 days of completion of emergency work.

I. Project Background and Preliminary Design (30-40 Percent) Information

(Provide general information at a conceptual level)

1. Describe the overall river management context, strategy and objectives for the river reach. Refer to pertinent plans, policies or documents pertaining to flood hazards, salmon recovery, etc.

River management approaches in this river reach are informed by several plans and related documents that provide context for flood hazard management, salmon recovery, and agriculture.

- This project is consistent with the alternatives for managing King County's flood protection facilities in the adopted 2006 King County Flood Hazard Management Plan (updated in 2013).

- The Snohomish River Basin Salmon Conservation Plan (2005) provides a snapshot of the salmon recovery strategy for sub-basins of the Snoqualmie River above Snoqualmie Falls on pages 11-81-84. The highest ecological recovery need for this area is preserving habitat for hydrologic and sediment processes.

2. Describe the goals and objectives of the project and its relative importance to the success of DNRP program goals and mandates. Identify funding source(s) and describe any applicable requirements or constraints.

Goal: The goal of the project is to address damages to the Reinig Road revetment in order to continue providing flood protection to King County's Reinig Road, private properties, Puget Sound Energy's power transmission lines and the City of Snoqualmie's Canyon Springs water main. The Reinig Road revetment is a 2,795 foot long rock riprap facility that was constructed in the late 1960s in the wake of the 1959 flood – generally considered to be the flood of record in the Upper Snoqualmie Basin – to stabilize areas along the road that were at risk to flood damage. Geomorphic change and ongoing erosion have severely damaged several large sections of the revetment within an approximately 775-foot length of the revetment.

After completing an alternatives analysis and considering risks, opportunities and constraints, the King County River and Floodplain Management Section project team recommended rebuilding the 775 foot long damaged section and installing several bank log and rock deflector structures anchored with steel piles. The purpose of the deflector structures are to shift the highest flow velocities away from the riverbank and toward the center of the river channel in this highly dynamic and geomorphically complex area. Construction of this alternative has been approved by the King County Flood Control District.

Objectives:

- Address significant damage to the Reinig Road Revetment by rebuilding the damaged section and installing a series of flow deflector structures (see 30% design drawings).
- Reduce channel migration and erosion risk to Reinig Road, the City of Snoqualmie's Canyon Springs water main, Puget Sound Energy power infrastructure, private and public properties.
- Conduct repair to minimize long-term maintenance needs and associated costs.
- Enhance aquatic and riparian habitat

Funding: The project is funded by the King County Flood Control District.

Constraints: Primary constraints on project implementation include:

- The Project will need to demonstrate no rise in the base flood elevation (100-year recurrence interval) water surface elevations to meet Federal Emergency Management Agency (FEMA) floodplain regulations.
- The project must be in compliance with all federal, state, and local permit requirements.
- In-channel elements of the project must be constructed between July 1st and October 31st.

3. **Describe the existing (and historic, if relevant) site and reach conditions, including structural features, channel form, and the presence of naturally-deposited large wood. Describe known utilization by salmonids and any important or unique biological or ecological attributes**.

The project site is located within the Three Forks Natural Area along the Snoqualmie River, and is situated on the right (north) riverbank adjacent to Reinig Road and directly opposite the confluence with the South Fork Snoqualmie River. The 20 to 25-foot high riverbank is quite steep (greater than 1.5H:1V) within the project limits. Missing Riprap in the damaged sections has resulted in 6 to 12-foot high nearly vertical eroded banks.

This river reach is highly dynamic and rapidly evolving, resulting in significant changes to the channel shape including significantly increasing width, shifting gravel bars and primary flow paths, and large, varying quantities and configurations of naturally recruited large wood. An examination of historic aerial photos (1942 – 2017), historic and modern maps and LiDAR imagery provide strong evidence that this area of the upper Snoqualmie River valley has a long history of ongoing river channel changes. While the infrastructure and utilities along the (north) bank of the river are protected by the Reinig Road Revetment, the left bank and adjacent floodplain is undeveloped, in a natural condition and subject to natural river processes. Due to these rapidly changing channel conditions and a lack of man-made protections, the left bank of the river is actively retreating into the adjacent floodplain forest of large cottonwood and big-leaf maple trees. Consequently, many of these large trees have and continue to fall into the river channel adjacent to and upstream of the project site.

The Snoqualmie River channel forms the jurisdictional boundary between the City of Snoqualmie and unincorporated King County. The project site is located on the north side of the channel in unincorporated King County on a narrow strip of property between Reinig Road and the river channel that is owned by King County Parks Department. Reinig Road itself is a King County owned public right-of-way, which includes utility easements for PSE (overhead power lines) and the City of Snoqualmie (buried water main). The properties north of Reinig Road are in private ownership. The South Fork and mainstem Snoqualmie River channels are waters of the state under Washington DNR management. The property across the river opposite the project site, downstream of the South Fork Snoqualmie River is the Three Forks Natural Area owned by City of Snoqualmie and upstream of the South Fork confluence is owned by Puget Sound Energy.

The project site is located above Snoqualmie Falls where anadromous (migratory sea-run) salmon and trout are not present. Several species of resident trout are documented above the Falls, including coastal cutthroat trout (*Oncorhynchus clarki, clarki*), rainbow trout (*O. mykiss*), westslope cutthroat trout (*O. clarki lewisi*), hybrid or unidentified Pacific trout *Oncorhynchus* species (Onxx), eastern brook trout (*Salvelinus fontinalis*) and mountain whitefish (*Prosopium williamsoni*).

4. Describe what is known about adjacent land uses and the type, frequency, and seasonality of recreational uses in the project area. Are there nearby trail corridors, schools or parks? What is the source(s) of your information?

The surrounding properties in the general vicinity of the project site are predominantly low density rural residential parcels with a mix of pasture and forest. The project site is situated on parcels owned by King County Parks which are part of the Three Forks Natural area. On the shoulder of Reinig Road adjacent to the project site there is a vehicle pullout that supports passive recreation. An informal user-created footpath down the riverbank provides access to the right bank of the Snoqualmie River. The vehicle pullout also serves as a destination for the City of North Bend based Twin Peaks

Tour. The pullout is a popular stop for visitors on the tour to take pictures of Mt. Si, enjoy scenery and access the river during summer low flow.

The Three Forks Natural Area serves recreational activities including fly-fishing, floating and general river access. A King County River Recreation Study (2013) reported that fewer than 2 percent of all floaters observed in the Snoqualmie River system were observed collectively in the Snoqualmie River main stem above Snoqualmie Falls, Middle Fork and South Fork.

5. If the project includes wood placement, describe the conceptual design of large wood elements of the project, including, if known at this stage in the design, the amount, size, location, orientation, elevation, anchoring techniques, and type of interaction with the river and stream at a range of flows.

The project will consist of two primary components; rebuilding approximately 775 lineal feet of the Reinig Road Revetment. Riverward of the rebuilt revetment, four flow deflector structures will be constructed of rock and large wood (logs). The rebuilt revetment will not include wood, but instead be a combination of riprap along the lower bank, and geogrids layers and native vegetation along the upper bank.

The four flow deflectors will be spaced at approximately 150-foot intervals along the toe of the riverbank. The purpose of the flow deflectors are to shift high flow velocities away from the riverbank and toward the center of the river channel. The flow deflectors are designed to accommodate changing channel hydraulics and channel geometry in this highly dynamic area. They are designed to overtop at flows exceeding the ordinary high water (OWH) elevation. Due to the use of large wood in their construction, the flow deflectors will also provide habitat benefits and on-site mitigation to offset the project's aquatic impacts.

Each of the four flow deflector structures will share the same design. The flow deflectors will have a triangular "wedge" shape measuring approximately 70-feet along the bank and protruding approximately 40-feet into the channel. A foundation of riprap will be placed to prevent undermining scour. Each flow deflector will have four layers of logs, with alternating layers angled upstream and downstream. A total of approximately two dozen logs will be included in each flow deflector, the majority with rootwads attached. Log lengths will range between 20 to 50-feet, with diameters between 24 to 30-inches. The logs will be anchored with chain to nine steel H-piles driven into the river bottom. Additionally, large ballast boulders will be chained to the logs for added stability and to counteract buoyancy. The top the flow deflector structure will be roughly level at the OWH elevation.

In addition to the large wood incorporated into the flow deflector structures, trees removed during construction will be placed along the river bank in the gaps between and downstream of the flow deflector structures to enhance habitat and provide mitigation for construction impacts to aquatic habitat. The river velocities in these spaces will be minimal due to the design of the flow deflector structures. The trees placed in these gaps will likely be unanchored.

6. If the project includes wood placement, what is the intended structural, ecological or hydraulic function of the placed wood? What role does the placed wood have in meeting the project's goals and objectives? Is the project intended to recruit or trap additional large wood that may be floating in the river?

Structural function:
In conjunction with the rebuilt revetment, the structural function of the wood flow deflectors is to provide long-term protection to SE Reinig Road, PSE powerlines, City of Snoqualmie's water main and public and private properties by shifting the most erosive river velocities away from the riverbank.

Hydraulic functions:
The wood structures are designed to shift the highest flow velocities away from the riverbank and toward the center of the river channel in this highly dynamic and geomorphically complex area. In addition, they are designed to accommodate changing channel hydraulics and channel geometry in this highly dynamic area. They are designed to overtop at flows exceeding the ordinary high water (OWH) elevation.

Ecological functions:
The placed wood will provide several ecological functions such as increasing the structural complexity of riverine habitat. The wood structures will also promote scour pool creation, gravel sorting and areas of reduced flow velocity. Lastly, the structures will increase shading and refuge for wildlife and fish.

7. Is the project likely to affect the recruitment, mobility or accumulation of natural large wood, e.g., by encouraging wood deposition on or near the site or promoting bank erosion that may cause tree toppling? Describe expected site evolution and its potential effects on natural wood dynamics.

Current patterns and magnitudes of large wood recruitment, mobility and accumulation are not expected to measurably change as a result of the project. As previously described, the project site is located within a very dynamic reach of the river with existing, very high volumes of large wood and active retreat of the left bank into a forested floodplain. Consistent with existing conditions, natural large wood from both adjacent and upstream sources may accumulate periodically at the site during high flows, including on or between the flow deflector structures. It is anticipated that naturally recruited large wood will be transitory and eventually be transported downstream during subsequent high flow events.

8. Describe how public safety considerations have been incorporated into the preliminary project design. For placed wood, address each of the considerations:

a. Type, frequency, and seasonality of recreational use;

The Three Forks area serves recreational activities including fly-fishing, floating and general river access. A King County River Recreation Study (2013) reported that fewer than 2 percent of all floaters observed in the Snoqualmie River system were observed collectively in the Snoqualmie River main stem above Snoqualmie Falls, Middle Fork and South Fork. The Three Forks Natural Area was one of the observation sites in the 2013 study and is located on the right bank of the Mainstem Snoqualmie River at RM 42.2, less than half a river mile upstream of the project site. The Three Forks Natural Area observation sites included a side channel and a main channel. The side channel had a moderate volume of recreational user (mostly swimmers), but these users were stationary and did not travel beyond the side channel. The main channel was fast, cobbled and shallow. Recreational tubers in the main channel generally put in and took out in the same 50-meter stretch and would walk up the mid-channel sand bar between runs. The people and dogs that swam and floated in the main channel generally struggled against the current, which was speculated as the reason the area did not receive much through-floating traffic.

b. *Wood location, positioning, and anchoring techniques*:

The four flow deflector structures have been shaped, sized and spaced to collectively redirect flows away from the right (north) river bank. Approaching flows will encounter the upstream face of the flow deflectors at an angle rather than straight-on. While the flow deflectors will not be impermeable, the relatively dense placement of logs, boulders, river gravels and slash will minimize velocities through the structures and in-turn minimize potential "straining" effects. Therefore both the configuration and the internal structure of each deflector will help reduce the risk of potential straining of recreational river users. Following is a more detailed description of the design of the deflector structures:

Each flow deflector structure will be embedded along the bank using four layers of logs to create a "wedge" shape pointing into the channel. The first layer of logs will be placed below summer water levels on a deep layer of riprap excavated into the river bed. Each log will be chained to driven steel H-piles for stability, and large ballast boulders will be chained to each log to counteract buoyancy during construction. The rootwads will be oriented along the upstream face of the structure. The spaces between the logs will be backfilled with river alluvium, creating a level platform for the next layer. The second layer will be arrayed between the piles and perpendicular to the first layer, with the rootwads facing downstream and chained to the H-piles. The third layer of logs will be installed in the same manner as the second but perpendicular to the second layer, with root wads oriented upstream and topped with a layer of smaller logs and slash. The fourth layer will be placed parallel to the second later. These logs will not have root wads but will have ballast boulders attached to counteract buoyancy of the entire complex of logs during high flow events. Additionally, they will be chained securely to steel piles to ensure the complex remains in place during high flows.

In addition to the flow deflector structures, non-structural, unanchored trees salvaged during construction will be placed in low velocity areas between and downstream of the deflector structures riverward of the revetment. These trees will provide additional habitat benefit and are intended to mimic natural process as the site evolves by being recruited into the river much in the same way they would naturally. However, their placement in the low velocity zone between and downstream of the flow deflector structures will minimize risk to recreational river users.

c. *Maximizing achievement of project goals and objectives while minimizing potential public safety risks*

Several features of the log deflector structures help minimize risk to public safety while optimizing the flood protection goals of the project:

- The deflectors are located in an area that experiences minimal in-water recreational use, likely in large part due to the already significant accumulation of naturally recruited large wood.
- During summer low flow periods when in-water recreation may be occurring upstream of the project site, flow depths and velocities through the project reach are modest.
- The upstream face of the deflectors are angled downstream to more easily deflect flows away from the riverbank. This angle also reduces the risk of recreational river users impinging on the structures.
- The relatively dense construction of the deflectors reduces flow velocities through the structures, and thus reduces "straining" risk to recreational river users.
- The configuration of the deflectors will create low velocity zones between the structures.
- A combination of steel H-piles and ballast boulders will stabilize the structures.

d. Use of established and recognized engineering, geological, and ecological expertise:

The project design team consists Professional civil engineers, geotechnical engineers, geologists, geomorphologists and ecologists experienced in designing, permitting and constructing flood protection and habitat enhancement structures in riverine environments. The methods used to design this project are consistent with best professional practices.

9. Has the project been reviewed and approved by a Licensed Professional Civil Engineer? Please list other licensed technical staff who have reviewed and provided input on the design (e.g., Licensed Geologist and Licensed Engineering Geologist). Specify the Engineer of Record for the design and any other Licensed Professionals who have sealed their portion of the design plans. Were all reviews and approvals completed?

Licensed Professional Civil Engineers that are integral to project design include King County Project Manager and Engineer Craig Garric, King County Lead Designer and Engineer Mark Beggs, King County Supervising Engineer Mark Ruebel, and Pile Design Consultant Team Project Manager Henry Hasselton (Aspect Consulting). The Engineer of Record is Mark Ruebel, King County, and Mark Beggs, will stamp the final design. Additional key contributors to the project design include King County licensed geologists Judi Radloff and Jeremy Bunn, and King County Professional Civil Engineers Alan Corwin and Doug Walters.

10. Has the project been reviewed and approved by a King County Professional Ecologist (e.g., person with an advanced degree in aquatic and/or biological sciences from an accredited university or equivalent level of experience) if ecological benefits are an intended project objective, to evaluate the consistency of the design with project goals, existing environmental policies and regulations, and expected or known permit conditions? Specify the Reviewing Ecologist for the project. Was this review and approval completed? What is the anticipated schedule for completing project milestones (30-40% design, final design, major construction/earthmoving) and for soliciting public input)?

Tom Bloxton, an ecologist on the Capital Strike team within the River and Floodplain Management Section, is the lead ecologist for the project team. Tom has reviewed and approved the 30% design. Tom is also the project lead for preparing permit documents and coordinating with permitting agencies. The anticipated completion of 30-40% design is April 2019. Final design is expected to be completed by October of 2019 and SEPA public notice for the project is expected between May and June of 2019. Major construction will begin in July of 2020 and last through September of 2020.

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Project Manager Date

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Supervising Engineer, Project Supervisor or Unit Manager Date

II. Pre-Construction Information (70% or 100% design with permits) *These questions relate to the designed and permitted project. Information should include input resulting from permit review process, SEPA, boater safety meetings and any other stakeholders.*

11. **Have any answers provided in Section I at the Preliminary Design Phase changed in the interim? If so, provide the new answers and the rationale for the change.**

12. **What regulatory review or permits are required for the project (e.g. HPA, Clearing and Grading permit, COE permits)? List any conditions or requirements included in the permit approvals relevant to placement of large wood in the project.**

13. **What specific actions or project elements were employed to address public safety in the final, permit-approved design?**

14. **Describe how the project team solicited public input on the preliminary design. Describe the input received from the public and how, if appropriate, the project team has responded to this input.**

15. **Describe any additional design modifications or mitigating actions that were or will be taken in response to the public comments.**

16. **Will further educational or informational materials be made available to the public to heighten awareness of the project (e.g., public meeting, press release, informational website, or temporary or permanent signage posted in the vicinity of the project)? If so, explain.**

17. **If the project is expected to influence the recruitment, mobility or accumulation of natural wood, has a Public Safety Management Plan been completed?**

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Project Manager Date

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Supervising Engineer, Project Supervisor or Unit Manager Date

III. Post-Construction Actions or Project Modifications

- Have any answers provided in Sections I and II at the Preliminary design and Pre-Construction phases changed in the interim? If so, provide the new answers and the rationale for the change.

- Briefly describe the scope and timing of post-construction monitoring and inspection activities planned for the project as they relate to large wood. If a Public Safety Management Plan or Monitoring Plan has been developed for the project, you may simply reference and attach that document.

- If post construction monitoring or inspections result in modifications to the project, please describe the action taken and the rationale and consistency with the Public Safety Management Plan, if applicable.

Project Manager Date

Supervising Engineer, Project Supervisor or Unit Manager Date