WASHINGTON STATE DEPARTMENT OF ECOLOGY

Application for a 2015-2017 Floodplains by Design Project Grant

Submitted applications will be rated to create a ranked list in support of Ecology's FY 2015-2017 Floodplains by Design budget request.

Applications must be submitted electronically via email to Ecology by 5:00 pm, **September 8**, 2014. Send applications to:
Adam Sant at Adam.Sant@ecy.wa.gov
With the Subject line: 2015-2017 Floodplains by Design Project Grant Application
You will receive confirmation that your application has been received by close of business on September 15.
Applicants must use this form as provided. No alterations will be accepted.

Project Title **Lower Green River Levee Improvements and Habitat Restoration**

Organization/Jurisdiction Name: **King County Flood Control District**
Contact Name: **Lorin Reinelt**
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Legislative District(s): 11, 33
County: King
WRIA(s): 9
Congressional District(s): 9
Specific Project Location
Section: 02, 10, 11, 15 Township: 22N Range: 04E River Mile: 17 – 19.25
Latitude 47.380934 Longitude -122.234843 GPS coordinates, if available
Major Watershed Project is in: Green/Duwamish

Full project (or phase proposed herein) should be completed in 3-4 years.
Project Narrative and Budget are limited to 20 pages.

Scope of Work, Schedule, Maps and Photos can be in addition to those 20 pages.

1. **Short Description of Project (500 words or less)**
   Please describe the overall goals for this floodplain area that is the focus of your proposal. Include in the description all major components of the project or activity such as breaching a levee, constructing a new levee, restoring a specific number of acres of floodplain, wetland creation or fill, restoration planting, project design planning, public process, or any other appropriate major component. Please indicate if funding is being requested for a phase of a larger multi-year project.

The Lower Green River Levee Improvements and Habitat Restoration project has four main goals:

1) Improve flood protection and reduce flood risks to significant Lower Green River Valley economic assets by replacing 2.25 miles of levee and revetment with a flood containment system that meets current engineering design standards, sets back the levee where feasible, and achieves the Lower Green River level of protection goals established by the Green River SWIF.
2) Reconnect between 33 and 52 acres of historical floodplain that is currently isolated from the river by 1.4 miles of levee and road by setting the new levee back landward of the river in some locations.
3) Restore aquatic and riparian habitats with focus on the following:
   - Restore 17 to 22 acres of the reconnected floodplain to create off-channel rearing and refuge habitat for fish;
   - Restore the structure and diversity of riparian forest communities and reduce water temperatures by planting more than two miles of river shoreline with native trees and shrubs;
   - Install log clusters in the Green River mainstem and reconnected floodplain to create large, deep holding pools for migrating adult salmon and encourage formation of mainstem mid-channel bars to increase habitat complexity;
   - Construct shallow slow water alcoves in the mainstem to provide rearing and refuge habitat for fish.
4) Achieve multiple objectives:
   - Integrate the new levee, Russell Road, and reconnected floodplain with existing and enhanced parks, trails, and open space, thereby creating a unified landscape that offers opportunities for active and passive recreation while at the same time restoring aquatic and riparian habitats and providing flood protection;
   - Expand the City of Kent's Native Plant Nursery, in support of achieving volunteer site stewardship programming goals, as well as to provide native plants for City habitat restoration projects;
   - An interpretive center is planned by the City of Kent, but has yet to be designed or located, thereby enhancing environmental education and community engagement with the site.

The project is located on the Green River between S. 200th St and S. 231st Way, within the City of Kent (Figure 1). Project actions will take place along the length of the project area, with specific emphasis at three main sites: Sites A and B (Lower Russell Road levee) and Site C (Boeing levee). Site C is shovel-ready, with construction scheduled for 2015. Sites A and B are in the project planning and early design phase. King County held a conceptual design "charrette" in May 2014 to collect ideas and knowledge from interested parties such as the City of Kent (Public Works and Parks), the Muckleshoot Indian Tribe, WRIA 9, and regulatory agencies. Project partners will be consulted at regular intervals in the design

process. Concepts generated during the "charrette" have been used to identify several setback levee alignments and design alternatives, which are currently being evaluated.

2. **Flood hazard / risk reduction (*60 points*)**
   Describe your project and how it will reduce the magnitude or frequency of flood damages to people, structures or infrastructure. Projects will be evaluated on the significance of the flood hazard and the ability of the solution to address the hazard. Evidence of flood hazard reduction can be demonstrated via flood storage added (acre-feet), flood stage reduction [reduced BFE (base flood elevation)], conveyance increased (cubic ft/sec), sediment storage added or inputs reduced, number or value of structures and/or development rights removed from hazard area (# or areal extent), critical facilities removed from high hazard area, transportation and infrastructure facilities removed from high hazard areas, and other project-specific goals. Describe both upstream and downstream effects of your project.
   Answer question 2 here:

The Lower Green River Valley supports regionally significant economic assets, transportation infrastructure, and commercial/industrial and residential land uses within the floodplain; the valley contributes to over one eighth of Washington State's GDP. Flood risks along the Lower Green River are managed through regulated flows from Howard Hanson Dam at river mile 64.5, as well as over 50 levees and revetments that were not built to meet contemporary design standards and current flood protection goals. Primary flood risks within the Lower Green River include overtopping or breaching of levees and subsequent inundation of the residential, commercial, industrial, and agricultural lands within the floodplain. Expected annual damages from a right bank levee failure at the project sites, based on modeling of the current levee conditions, are estimated at $27 million in the Kent/Renton area (SWIF Current Conditions Report, 2014). Setting back the Lower Russell Road levee (Sites A and B) and raising the existing Boeing levee (Site C) will provide greater flood storage and conveyance capacity, and reduce long-term maintenance costs.

The Lower Green and Duwamish River levees and revetments provide bank protection and a flood containment system from the City of Auburn to the mouth of the Duwamish River where it empties into Puget Sound. The levees and revetments typically have over-steepened banks, areas with inadequate or deteriorating protection at the embankment toe, and incrementally slumping or sloughing riverbank slopes supporting constructed earthen levee berms. The historical levee reaches lack habitat features such as native riparian vegetation and instream wood accumulations. With flows confined to a narrow, leveed channel, the potential for flood scour of the riverbed is significant. Where this occurs, undermining and deterioration of the embankment toe have been observed. Such conditions stress the levee system, with the potential to increase the occurrence and magnitude of failures. As a result, many of these flood management structures have needed frequent maintenance. Nearly all of them have been identified for rehabilitation and reconstruction to structural design standards better suited to the levels of flood risk present.

The existing system of levee and revetments do not meet current engineering design standards. The system is prone to scour and slope instability, and overtopping, leaving the lower Green River valley and economic assets at risk.

A capital investment of $29.3 million will reduce flood risks to over $1.2 billion of property, not including contents (2013 King County Assessors Data for improved + unimproved value of the land protected by the levee), enhance aquatic and riparian habitat, and increase recreational activities (trail and park access and use). The project will increase conveyance capacity in this reach from 12,000 cfs to 18,800

cfs, and will result in approximately 28 industrial and commercial structures and approximately 2400 acres being less susceptible to flood hazards. This project is identified in the 2013 Flood Hazard Management Plan Update and Progress Report (King County, 2013), the WRIA 9 Salmon Habitat Plan: Making our Watershed Fit for a King (Project LG-10), and will be included in the 2015 Green River System Wide Improvement Framework (SWIF).

Flood Protection

At Sites A and B (Lower Russell Road levee), the existing flood containment system of levees and revetments will be removed and replaced to provide long-term flood protection and improve riparian and aquatic habitat. The new flood protection system will be set back from the existing alignment and designed to current engineering standards with the purpose of reducing flood risks to commercial and residential areas of Kent. At Site C (Boeing levee) the existing right bank levee will be raised to provide a higher level of protection, and riparian and aquatic habitat will be enhanced. Design expectations are to meet the 0.2% annual flood event (500-year recurrence interval) plus 3-feet of freeboard. Conveyance capacity will be increased from the current 12,000 cfs to 18,800 cfs, thereby greatly reducing the frequency of flooding.

The higher level of protection from the levee improvements will reduce the frequency of flooding from approximately the 140-year or larger (0.71% annual chance) flood event to the 500-year (0.2% annual chance) flood event. This will reduce the residual risk by a factor of three, and avoid hundreds of millions of dollars in future flood damages. The setback portion of levee at Site A will also require less frequent maintenance and repairs because it is substantially removed from the higher scour and erosion potential at the river's edge. The well vegetated river bank will also reduce bank erosion. Our project accounts for future changes to hydrology of the river system by designing for containment of 18,800 cfs, with three feet of freeboard, to address uncertainty in future flood flows. Our project will serve as a pilot to demonstrate how flood risk reduction goals can be achieved within a highly urbanized and constrained river corridor, in a manner that is mutually supportive of habitat restoration goals, public access (via passive and active recreational trails and open space provision), and protection of regionally significant economic assets and infrastructure.

3. **Floodplain ecosystem protection or restoration element (*60 points*)**
   Describe the ecological benefit of the project, its significance, and the ability of the solution to address the overall need in the project area or watershed. Examples include, but are not limited to, reconnecting floodplains, salmon recovery actions, habitat restoration, Channel Migration Zone protections, etc. Evidence of ecosystem benefits include floodplain (including estuary) habitat type (e.g., wetland, side channel, forest) and area restored (# acres), floodplain area protected from bank armoring (# of acres), floodplain area protected from development or other land use change (# acres), hardened bank removal or levee/riprap removal (linear feet), levee setbacks constructed (linear feet, # acres), new side channels or reconnection of old side channels (linear feet or storage volume), salmon species benefitted (# of listed, non-listed species). Secondary evidence includes culvert replaced to restore fish passage or increase conveyance, logjam and or wood structures installed, riparian area planted, and other project-specific goals.

Answer question 3 here:

Salmon habitat in the Lower Green River is degraded compared with historical conditions as a result of land use changes, floodplain development, and river management activities such as channel confinement by levees and revetments, flood control at Howard Hansen Dam, and diversion of the White River so that it no longer flows into the Green River. The highly engineered Lower Green River that resulted from these actions is characterized by confined, armored channels that lack the in-stream

geomorphic complexity and floodplain connection needed to create aquatic habitats that support healthy fish populations, including ESA-listed species such as Chinook salmon and steelhead (WRIA 9 Salmon Habitat Plan 2005).

The Lower Green River mainstem channel is physically isolated from its floodplain by a series of levees and revetments, and hydrologically isolated from the floodplain by both river bed incision and greatly reduced flood elevations. Shoreline and riparian areas lack mature trees, resulting in minimal shade and elevated water temperatures. Existing water temperatures and dissolved oxygen do not meet water quality standards, leading to adverse, sometimes lethal, affects to threatened species (Green River Temperature TMDL 2011). Lack of riparian trees and shrubs also reduces available food resources for juvenile salmonids.

The Green River supports populations of Chinook, coho, pink, and chum salmon, and steelhead, rainbow, and cutthroat trout; Chinook salmon and steelhead are listed as threatened under ESA. The river in the project area currently provides a migration corridor for adult and juvenile salmon and trout, as well as habitat for migratory birds and wildlife.

A limiting factors analysis completed by King County in 2000 as a precursor to the WRIA 9 Salmon Habitat Plan (2005) concluded that disconnection of the Lower Green River from its floodplains is one of the most significant factors impacting salmon. The Lower Green River also has a TMDL for water temperature, approved by EPA; the priority implementation strategy to address elevated water temperatures is to provide more shade and improve riparian areas (TMDL, 2011). The Lower Green River Levee Improvements and Habitat Restoration Project will help address the limiting factor and water temperature TMDL, thereby providing needed rearing and refuge habitat and improving water temperatures for threatened Chinook salmon and steelhead trout. The project is also identified as a priority project (Project LG-10) in the 2005 WRIA 9 Salmon Habitat Plan, and an early action in the Lower Green River System Wide Improvement Framework.

Sites A and B Habitat Restoration (Figure 2)

The project addresses the deficiencies described above by setting back the levee and restoring aquatic, floodplain, and riparian habitat. The levee will be set back as far as possible within site constraints to maximize opportunities for floodplain habitat. Restoration at Sites A and B includes the following elements:

- Seventeen to 22 acres of right bank floodplain along about 0.44 mile of the project corridor near RM 18 within Site A will be excavated to create off-channel habitat that is intended to be inundated for much of the winter and spring to provide rearing and refuge habitat for salmon and trout. The site will include side channels and secondary channels, large wood clusters, wetlands, and native plantings. Trails, river access, and river views will be included and integrated within the existing trail system along the river and in the adjacent Green River Natural Resource Area.
- Sixteen to 30 acres of additional historical right bank floodplain within Site A will be reconnected with the river by setting the levee back.
- Eleven to 33 acres near RM 19 at Site B will be reconnected to the river by breaching the existing road fill or placing a portion of the road on a trestle. This area is occupied by a depressional wetland that includes a seven-acre pond that will be reconnected to the river to provide rearing and refuge habitat for juvenile salmon and trout. A section of levee will be constructed along the northern boundary of Site B to protect existing houses; high ground is present along the western and southern boundaries of Site B.

- Engineered logjams will be placed in the main channel of the Green River to create holding pools for migrating adult salmon and, where suitable, encourage formation of mid-channel bars that will increase mainstem habitat complexity. Additional engineered logjams will be placed in reconnected off-channel and side channel habitats in Sites A and B, where suitable.
- Existing warehouses, totaling over $36 million in value, will remain on the right bank at the upstream end of the project corridor. About 0.4 mile of levee located in front of these warehouses will be set back to the maximum extent possible, allowing for a more stable bank slope, terracing, and riparian plantings.
- Most of the 1.4 miles of Site A shoreline will be planted with native trees and shrubs. The width of these riparian buffer plantings will vary from about 50 feet where the project is most constrained by existing development at the upstream end of Site A, to 150 feet near RM 18. Trees planted as part of the riparian buffer are intended to address elevated water temperatures and TMDL requirements on the Lower Green River, as well as provide other riparian functions such as wildlife habitat and aquatic food supplies. Effective shade and sun aspect studies indicate a high amount of shade benefit from trees planted along the right bank within the Site A project corridor.

Site C Habitat Restoration (Figure 3)

- Riparian buffer: 4.6 acres (about 35%, of Site C) will be planted with native trees, shrubs, and forbs to restore the riparian forest community. The average width of the riparian plantings will be 75 feet and as vegetation becomes established and matures over time it will provide substantial shade to the river. Two overlooks along 1.2 to 1.8 miles of secondary trails to be constructed within the restored riparian forest will provide intermittent and filtered visual connection to the river.
- Shallow slow-water alcoves (about 2.3 acres, or 17%, of Site C): two large, connected, shallow water alcoves designed to maximize edge and shallow water cover habitats at various flow levels will provide refuge habitat for juvenile salmon and trout. Topographic complexity associated with the alcoves and adjacent terraces will support riparian plantings intended to provide visual interest in addition to functional habitat. Part of the shallow water alcoves and terraced riparian zone will be visible from some locations along the secondary trail located landward of the alcoves.
- Water quality improvement: This project addresses water temperature conditions identified in the Green River Temperature TMDL (2011), approved by EPA. The priority implementation strategy is to provide more shade and improve riparian area.

Much land in the Lower Green River floodplain is developed. Salmon recovery in the highly developed lower watersheds of many Puget Sound rivers can be challenging because of existing land uses. This project area is one of the only remaining sites in the Lower Green River without major development, providing a unique opportunity for habitat restoration and what effective salmon recovery projects may look like when integrated with competing land-use priorities in a mostly developed landscape.

4. **Is your project in a Puget Sound Partnership Priority Floodplain?** ***(5 points)***
   (Deschutes, Dungeness, Duwamish/Green, Elwha, Hood Canal, Lake Washington, Lower Skagit, Nisqually, Nooksack, Puyallup, Sauk, Skokomish, Skykomish, Snohomish, Snoqualmie, Stillaguamish, Upper Skagit)
   Answer question 4 here: Yes: X – Duwamish/Green No

5. **Other benefits (*40 points*)**
   Describe how your project maintains or improves agricultural viability, water quality, public open space/recreation access, economic development, or other important local benefits or values, and does not conflict with other objectives of this program. Projects receive points based on the importance of the result produced, the ability of the solution to address the overall stakeholder need and the long-term improvement.
   a. Agricultural viability (evidence of agricultural benefits include reductions in flooding (acres), protection from development (acres), improvement of drainage infrastructure (acres), or other capital or non-capital benefits to agricultural productivity).
   b. Water quality improvement [e.g., through stormwater infrastructure upgrades, treatment of a TMDL or 303(d) issue, reduction in sediment, restoration of wetlands or riparian areas, implementation of related best management practices, etc.].
   c. Public access and recreation (e.g., through land acquisition, the development of trails or other recreational infrastructure, etc.)
   d. Other floodplain values or services of local importance.

Answer question 5 here:

Agriculture

The City of Kent native plant nursery, located on the right bank near RM 18.8 at Site A, will remain as an important part of the project corridor. The nursery provides plants for City habitat restoration projects and is one of the few remaining agricultural sites on this portion of the Lower Green River.

Water Quality Improvements

The priority implementation strategy identified in the Green River Temperature TMDL (2011), approved by EPA, is to provide more shade and improve riparian area. The Lower Green project promotes this strategy by planting more than two miles of river shoreline with native trees and shrubs. Planting widths will range from 50 feet in the more constrained upstream portion of Site A to over 150 feet in the excavated floodplain area at the downstream portion of Site A, and will have an average width of 75 feet at Site C, totaling up to 66 acres of planted shoreline. All of this planted area is located on the right bank of the river, where effective shade and sun aspect studies have shown tree plantings to have the most potential to provide shade to reduce solar radiation warming of the water (Muckleshoot Indian Tribe sun map, 2013, and Green River SWIF Aquatic, Floodplain, and Riparian Habitat Technical Memorandum (2014).

Public Access, Recreation, Stewardship, and Education

The City of Kent and King County have identified the Lower Green River and its shoreline as a local and regional recreational trail and public access priority. The proposed project will be integrated with Kent's current effort to develop a master plan for parks, trails, and open space within the project corridor. Recreational trails and open spaces will be incorporated into project elements throughout the project area to encourage passive recreation and foster increased public appreciation for the river ecosystem. Specific project elements include:

- Between 1.2 and 3.8 miles of trail will be integrated with the existing Green River Trail and trails in the Green River Natural Resource Area. These new trail segments will be isolated from road traffic and will include overlooks that provide views to the river and restored habitat features.
- The City of Kent's Van Doren's Park will maintain its current level of protection from flooding. The park will also be enhanced consistent with the City's parks and trails master planning effort currently underway.

- A Green River Natural Resource Area interpretive center planned by the City of Kent may include informative displays designed to educate the public about various project elements, including flood hazard reduction, habitat restoration, wildlife, and agriculture.

6. Cost-effectiveness (*20 points*)

a. Project will be judged on whether the budget is appropriate to the project scope, and designed for project success.
b. Describe how the project will be continued or maintained after the grant has been completed.
c. If project cannot be fully funded, explain how the project could be scaled downward.

Answer question 6 here: The current budget is estimated at $29.3 million, with a grant request of $4.9 million, and $24.4 million in primarily local (King County Flood Control District) and some federal (U.S. Army Corps of Engineers) match. The long-term maintenance of the project will be done by the KC FCD for the flood protection and habitat restoration portions of the project and the City of Kent for the recreational and agricultural components of the project.

If the project is not fully funded, some of the habitat and recreational elements of the project will not be completed at this time. All flood protection elements will be done regardless of the grant funding amount. Funding will help ensure that habitat elements are not delayed into an uncertain future or done as a separate project.

7. Long-term cost avoidance: (*30 points*)

a. Describe how your project minimizes or eliminates future costs for maintenance, operation, or emergency response. **(*15 points*)**

Answer 7.a. here:

These two levee setback and improvement projects, and associated habitat restoration and recreation elements, are designed to modern engineering standards and to reduce long-term maintenance costs. One of the three goals of the King County Flood Hazard Management Plan (2013) is "to reduce the long-term costs of flood hazard management." King County achieves this goal through designs that work with rather than against the river, reconnecting floodplains, and allowing more natural riverine processes where feasible to reduce the velocities and scour potential of peak flood flows.

An operations and maintenance (O&M) manual will be developed for both the Lower Russell and Boeing flood protection facilities, vegetation management (to control invasive vegetation, remove hazard trees, and ensure public safety), and recreational elements of the project.

In terms of emergency response, King County inspects all Lower Green River flood facilities when a Phase 3 flood warning threshold is reached on the Green River (9,000 cfs at Auburn).

b. Describe how your project accounts for expected future changes to hydrology, sediment regimes, or water supply resulting from other floodplain management efforts, land use changes, extreme weather events, or other causes. **(*15 points*)**

Answer 7.b. here:

This project is designed to accommodate peak flood flows up to the 500-year return interval (0.2 percent annual chance of occurrence). Three feet of freeboard is designed into the project to accommodate uncertainty and provide some factor of safety against future increase in peak flow, due to climate change, or in the event that more complete long-term records indicate larger estimates of the 500-year event.

Sediment is generally not an issue in the project reach because the river is downstream of the Howard Hanson Dam. In fact, the river bed is degrading slightly (1-2 feet over the past 25 years) due to reduction in the upstream sediment load. The greatest challenge associated with bed degradation is a slight oversteepening of the river embankments and toe erosion and scour.

In addition to flood control, the HHD and reservoir are also used as a water supply for the City of Tacoma and conservation flows to supplement Green River summer flows. There are no significant uses of the Green River for water supply downstream of Auburn.

Land uses changes in the Kent-Auburn valley have been significant over the past 50 years, as the valley has transitioned from largely agricultural to highly urban, including industrial, commercial, and residential land uses. However, because the Middle Green River basin is more lightly developed, and the Upper Green is entirely forested, significant increases in peak flows are not expected over time as a result of land use changes. The Upper Green River accounts for more than 50 percent of the watershed area tributary to the Lower Green and project sites.

8. Demonstration of need and support (*30 points*)

a. Describe how your project is consistent with the intent of existing floodplain management or habitat recovery plans or is specifically identified through existing plans or work programs. (Elements of the project may have been developed through more than one planning process. Please identify the planning process used for each major element if they are not from a common plan.) ***(15 points)***

Answer question 8.a. here:

- Site A of our project is identified as a priority project (Project LG-10) in the WRIA 9 Salmon Habitat Plan.
- The project is an early action project of the Green River System Wide Improvement Framework, employing the multi-objective goals approved for the SWIF
- The project will implement the primary strategy of the 2011 Green River TMDL for temperature, which is riparian planting.
- The project will coordinate with the City of Kent's master planning effort for parks, trails, and open space currently underway.
- Site B of the project is identified as an USACE Green/Duwamish River Basin Ecosystem Restoration Project.
- The Lower Russell and Boeing reaches (Sites A and C) of this project are identified in the King County Flood Hazard Management Plan (2006, 2013).

b. Describe which flood control authorities, Tribal Nations, local governments, lead entities, key stakeholders or decision-makers representing floodplain interests located within the river reach

or affected by the project have provided letters of support explicitly endorsing the project and its outcomes for their interests. ***(15 points)***

Answer question 8.b. here:

Letters of support are being provided by the WRIA 9 Salmon Recovery Lead Entity, King County, and others. Specific letters will be submitted no later than September 22.

9. Readiness to proceed and complete the proposed phase of the project (*25 points)*

Describe how your project is ready to proceed with the scope of work, and your capacity to complete the project successfully and maintain it over time, including your project schedule and deliverables. Describe your experience with similar projects. If your project is acquisition only, describe how you will complete floodplain restoration subsequent to the acquisition.

Answer question 9 here:

The Boeing Levee improvement and ecosystem restoration portion of the project is scheduled for construction in summer 2015. The 35% design for the levee improvement portion of the project will be completed in September 2014 and the 90% design in January 2015. The 60% design for the Ecosystem Restoration portion of the Boeing project will be completed in October and the 90% design in January 2015. The Boeing project has been prioritized by the City of Kent, the US Army Corps of Engineers, and the King County Flood Control District for construction in 2015.

The Lower Russell levee setback portion of the project is currently in the pre-design phase, with 30% plans expected in May 2015. The 90% design is projected for November 2015. Construction is funded for implementation in summer 2016.

The King County Flood Control District has prioritized both projects for implementation as early actions for the Green River SWIF. The assigned project manager for the Lower Russell project has a record of completing projects in a timely fashion. A consultant contract was initiated in August 2014 to perform design services for the project. A similar project, the Reddington setback levee along the Green River in Auburn ($17 million) was recently completed in 2013-14 by the same project manager. The King County Rivers managing engineer is also assigned to this project in an oversight role to ensure project delivery in a timely fashion.

Both projects are fully funded for the flood protection elements with $24.4 million committed and budgeted, but lack adequate funding for habitat restoration and recreation elements of the projects. Floodplain by Designs funding would help ensure more significant habitat restoration and recreation elements are fully included.

10. Pilot project and leverage opportunities *(25 points)*

a. If applicable, describe how your project could serve as a pilot effort or result in changes or results with broader impacts to the state. ***(10 points)***

Answer question 10.a. here:

This project represents a great opportunity for the state and Puget Sound Partnership to pilot multi-objective and fully integrated flood protection, habitat restoration, and recreation projects in Puget Sound floodplains in an urban area. It also represents an example of what is possible under the USACE national approach for System Wide

Improvement Frameworks. This project also addresses multiple federal mandates (Endangered Species Act, Clean Water Act), local priorities (flood protection and recreation), and balances economic, ecological, and community needs and priorities in the area.

b. If applicable, describe how your project leverages existing investments, such as SRFB, FCZDs, Dike Districts, TMDLs, WWRP, ESRP, NEP, and other funding sources. Evidence of this will be based on the amount and diversity of the leveraged funding sources. ***(10 points)***

Answer question 10.b. here:

As noted above, the project leverages existing investments from the King County Flood Control District, the USACE Ecosystem Restoration Program for the Green River, and the King County Conservation Futures Fund. This includes $20.4 million from the FCD and over $3 million from the USACE.

We are also exploring other funding opportunities, including SRFB/PSAR grants through WRIA 9 and the Washington state Recreation and Conservation Office grants.

c. If applicable, describe how your project addresses inequity or social justice issue by benefitting underserved communities. ***(5 points)***

Answer question 10.c. here:

The project is in an area used by many diverse communities in Kent and surrounding urban areas for recreation purposes, as well as regional trail users. The north portion of the Lower Russell project is also a KOA campground and RV park used heavily in the summer and year-round by lower or fixed-income residents.

11. **Budget** (add more tasks as needed).

Task	Amount Requested from Ecology*	Other Funding for Project** (20% of Total Cost)	Total Cost
Task 1 - Administration	**$0**	**$300,000**	**$300,000**
Task 2 - Project Design	**$0**	**$2,500,000**	**$2,500,000**
Task 3 - Acquisition	**$0**	**$3,700,000**	**$3,700,000**
Task 4 - Construction	**$4,900,000**	**$17,900,000**	**$22,800,000**
Total	**$4,900,000**	**$24,400,000**	**$29,300,000**

*Amount requested from Ecology under this grant program

**Other sources of funding dedicated to this project. Insert narrative below that details what the source of funding is and whether or not it has been received or applied for but not yet received. Match must be at least 20% of Total Project cost.

Narrative and/or Table of other funding sources for project, here:

Current funding sources include the King County Flood Control District that has committed $20.7 million for the two projects (Boeing and Lower Russell). This includes $1.7 million in match to the Boeing ERP project being constructed by the Corps of Engineers and $1.9 million to raise the Boeing levee to the desired Green River SWIF level of protection. The Boeing ERP project includes over $3 million in federal funding for design and construction of

the project. The Lower Russell levee setback project has commitment of KC FCD funding of $17.1 million for design, acquisition, and construction.

If it's not possible to fully fund this proposal, please describe a *phased* approach that would still significantly advance the effort:

If it's not possible to fund the entire proposal, some of the habitat and recreation elements of the project could possibly be phased in future years. The flood protection and levee containment elements need to be constructed as part of phase 1 or the entire project will not function for flood protection.

12. **SCOPE OF WORK:** Please attach a Scope of Work and schedule. If your proposal is a phase of a larger multi-year project, please place this proposal in the context of the overall project and provide preliminary cost projects to complete the project.

A schedule and Scope of Work for the Lower Russell Project and design work is attached at the end of the grant proposal (see pages 17 through 25).

13. **Maps:** Please attach at least two (2) maps to your application. The first map should be a vicinity map and the second should be a map of your project.

See attached maps (pages 14-16): (1) vicinity map showing 3 project site areas, (2) Lower Russell project site (Sites A and B), and (3) Boeing levee and ecosystem restoration project site (Site C).

14. **Planting Maintenance/Survival:** If your project includes plantings, please provide a description of how you will ensure plant survival and maintenance.

King County has extensive experience with planting of large project areas for restoration. Most recently, this includes the Reddington levee setback project in Auburn. We use onsite irrigation tanks and drip irrigation systems to ensure plant survival. We ensure a minimum of 80% of plants survive, following the first 3 years after construction.

We will also be developing an O&M manual for the project sites to guide long-term maintenance of levee, embankment, restoration and vegetation elements.

15. **Photos:** Photos are not required, but if you think they enhance our understanding of your application, please include them. We are particularly interested in *"before"* photos that can be matched with *"after"* photos.

16. **Executive order 05-05, Archaeological and Cultural Resources** (online at http://www.governor.wa.gov/office/execorders/eoarchive/eo_05-05.pdf) directs state agencies to review all capital construction projects for potential impacts to cultural resources to make sure that reasonable action is taken to avoid adverse impacts to these resources. If this grant program is funded by the 2015 Legislature, successful grant applicants will be required to submit additional information to Ecology to comply with this Executive Order.

Additional factors in ranking and award: This is a very new funding source. To ensure that projects

meet the objectives of the program, these additional factors will be considered in creating the proposed funding list:

- **Balance of project types:** Balance funding ready-to-proceed construction projects with funding pre-construction activities. This balance in project types is vital to ensuring success over time.
- **Geography:** There is strong interest in ensuring that projects in all areas of the state receive funding.
- **Advancing multi-benefit floodplain management:** It is important that the project list advance the principles and practical application of multi-benefit floodplain management.

Certification

I certify to the best of my knowledge that the information provided above is true and correct and that I am legally authorized to sign and submit this information on behalf of the organization applying for this grant.

Signature 9.8.14 Date

Marie Isaacson, Director, WRD Division

Printed name and Title

Kittitas County Flood Control District.

Name of Organization Applying for Grant

Figure 1. Site Map
Site C
Site A
Site B
S. 212th St
Green River Trail
Van Doren's Park
Green River Natural Resource Area
Green River
Native Plant Nursery
PSE Transmission Powerlines/Trail
Pedestrian Bridge
Russell Road
S. 231st Way
0
1,350
2,700
Feet
1 inch = 750 feet

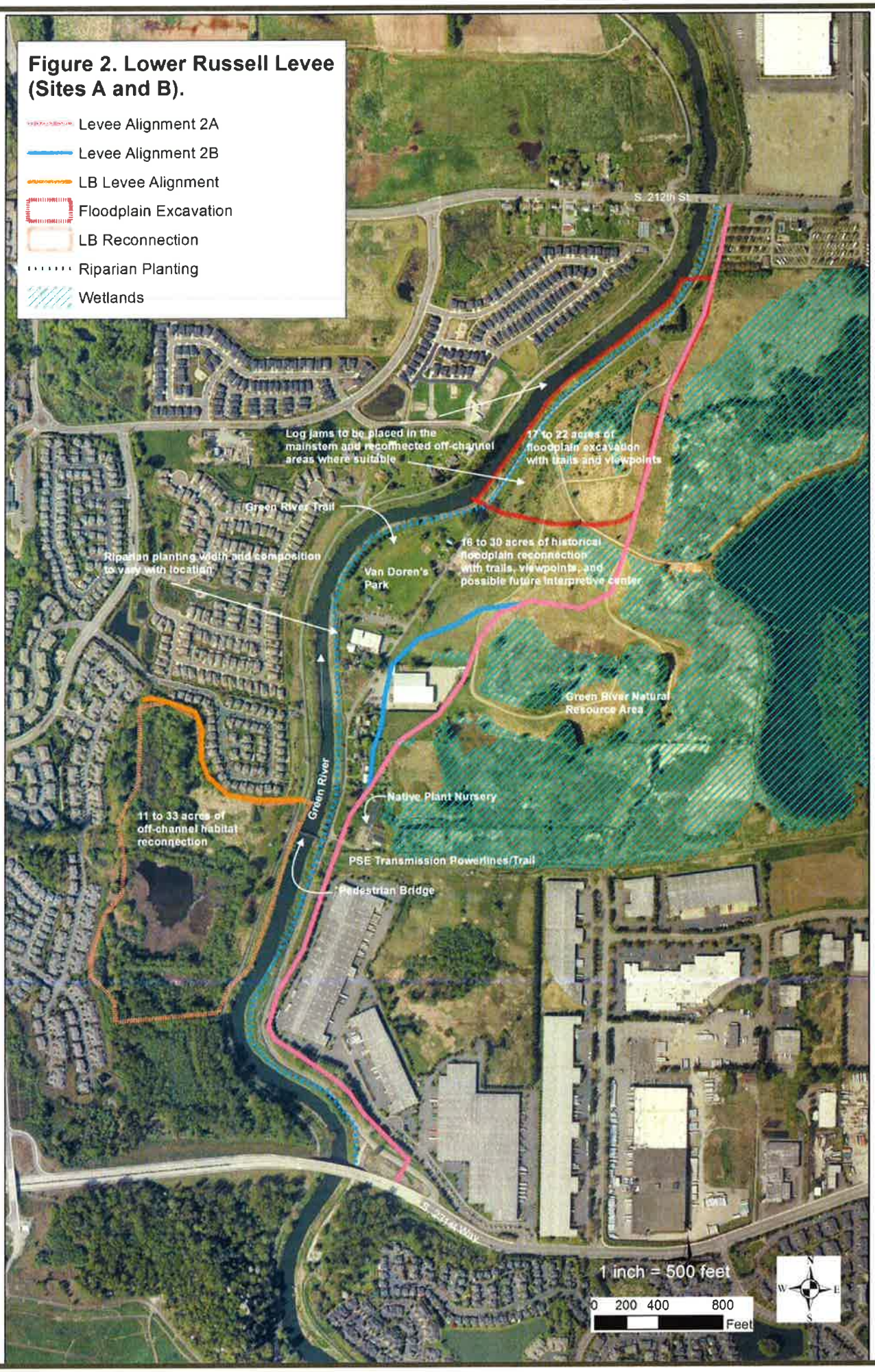
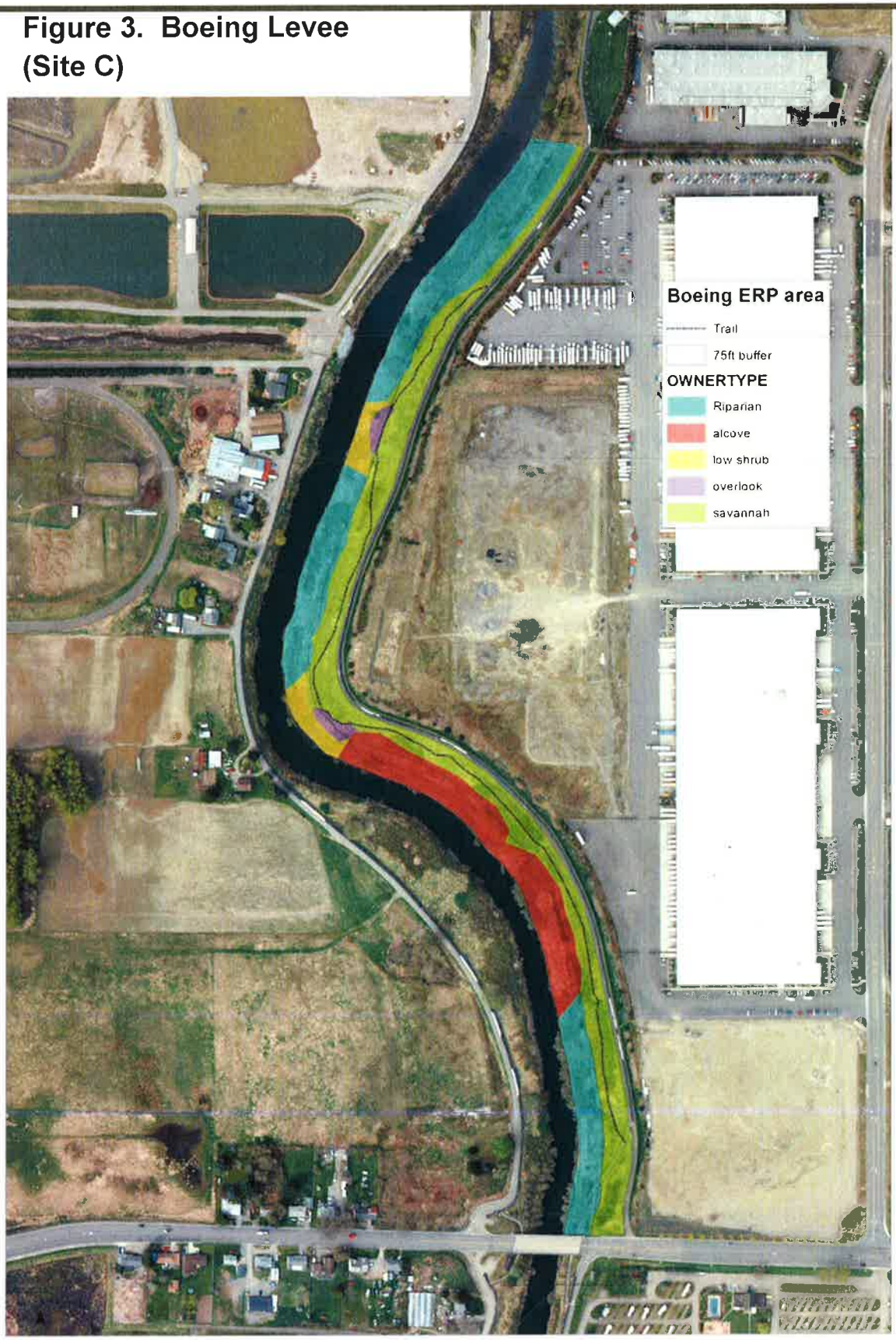
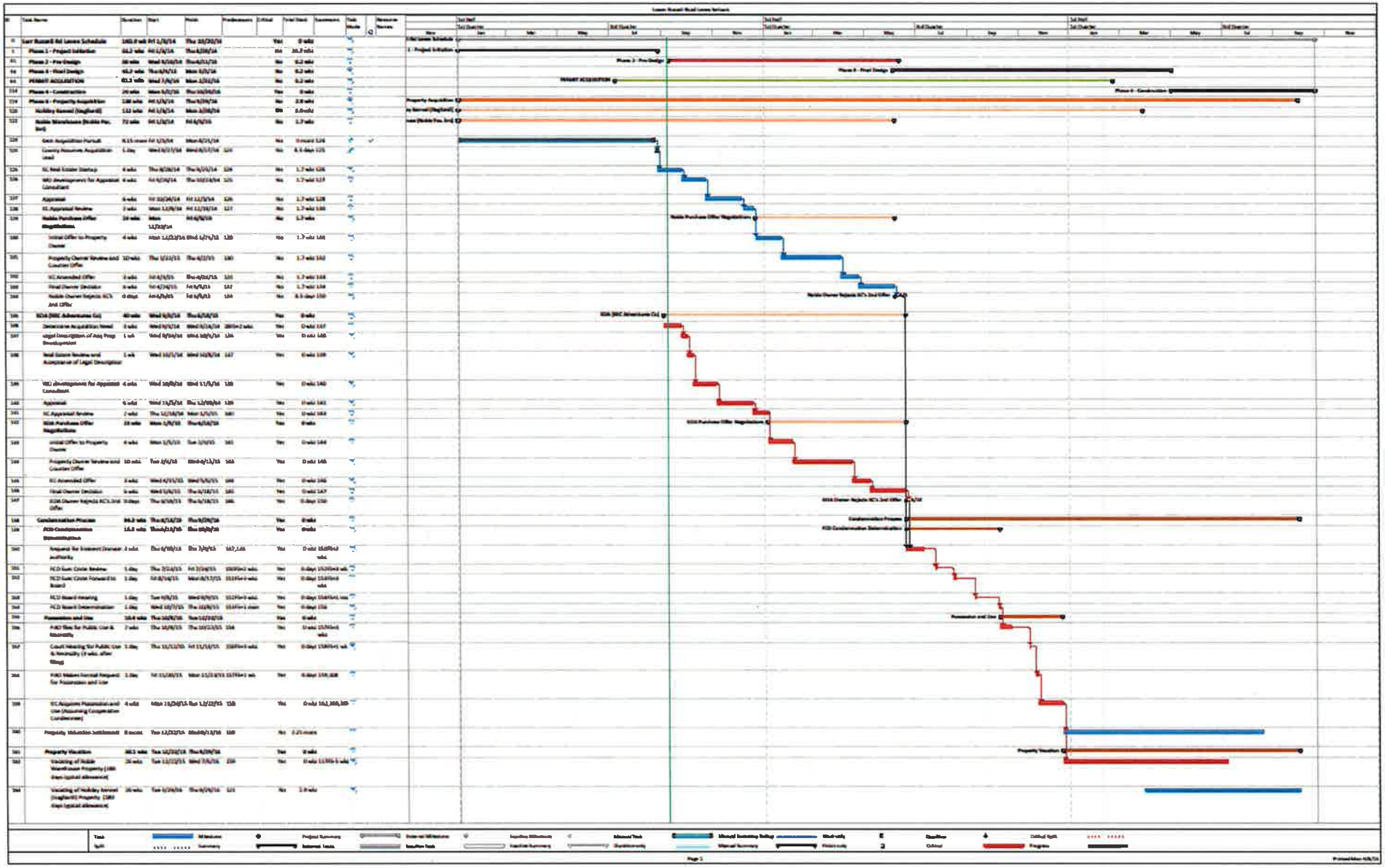


Figure 2. Lower Russell Levee (Sites A and B).
Levee Alignment 2A
Levee Alignment 2B
LB Levee Alignment
Floodplain Excavation
LB Reconnection
Riparian Planting
Wetlands
S. 212th St
Log jams to be placed in the mainstem and reconnected off-channel areas where suitable
17 to 22 acres of floodplain excavation with trails and viewpoints
Green River Trail
18 to 30 acres of historical floodplain reconnection with trails, viewpoints, and possible future interpretive center
Riparian planting width and composition to vary with location
Van Doren's Park
Green River Natural Resource Area
Green River
Native Plant Nursery
11 to 33 acres of off-channel habitat reconnection
PSE Transmission Powerlines/Trail
Pedestrian Bridge
1 inch = 500 feet
0 200 400 800
Feet
N
W
E
S

Figure 3. Boeing Levee (Site C)





SCOPE OF WORK

DESIGN SERVICES FOR THE LOWER RUSSELL ROAD LEVEE SETBACK PROJECT

GENERAL

The scope of work describes the tasks and work elements to provide Phase 1 preliminary design services for the replacement of the Lower Russell Road levee and revetment with a new flood protection system along the right (east) bank of the Green River between river mile 17.85 (S 212th St) and river mile 19.25 (Veterans Drive [formerly S. 231st St]/228th St) in the City of Kent. The project area is approximately 1.4 river miles in length.

The detailed schedule for Phase 1 is in Exhibit C Project Schedule.

The primary project goal is to replace the existing flood containment system of levee and revetments with a new flood protection system designed to current engineering standards and improve riparian and aquatic habitat. The project will improve flood protection for the residents and businesses of Kent, Tukwila, Renton and the Green River valley. Objectives in support of this goal include the following:

1. Design a system that minimizes long-term maintenance needs and associated costs.
2. Construct a flood protection system that balances policy directives regarding flood protection (e.g. scour protection, stability and vegetation maintenance), habitat restoration, and recreational use.
3. Increase the flow containment capacity of the flood protection system to the level to be defined in mid-2014 by the Green River Systemwide Improvement Framework (SWIF).
4. Set the new flood protection system back from the river, where feasible, to improve riverine and riparian processes, functions, and habitat.

Phase 1 work includes the evaluation and design of a new flood control system approach based on an analysis that includes the following elements:

- Russell Road relocation or realignment and traffic conveyance needs.
- Geomorphic assessment of future channel migration as the context for design of erosion-protection for the new flood protection system.
- Hydraulic assessment of pre and post project conditions based on US Army Corps 2012 design flood hydrographs.
- Ecological assessment of potential habitat benefits and risks associated with project elements of various design alternatives, as well as permit implications.
- Channel profile and scour evaluation.
- Erosion protection design informed by site specific issues and opportunities. Elements may include riprap revetment, engineered wood, bio-engineering, floodwalls, and rock barbs.

Work not part of Phase 1 and anticipated to be performed by others includes cultural resources investigation(s) and utility relocation design. Levee certification and FEMA accreditation is not a project deliverable. However, project deliverables will support anticipated certification efforts by the City of Kent.

SCOPE OF WORK

Phase 1 – Preliminary Design

Predesign includes the development of project alternatives, selection of a design flood protection system alignment and its preferred design component alternatives, and development of preferred design to at least 30% completion in order to establish a construction cost estimate. The level of accuracy of the construction cost estimate will focus on being within 15% of the actual construction costs to the extent the actual future construction contract reflects the 30% design. The County baselines the project scope, budget and schedule at the end of predesign. Project performance

compared to baseline is reported to the County Council. The Consultant shall furnish services and labor necessary to complete the following tasks.

Task 1: Project Management

The purpose of this task is organization, management and coordination of the services described in this Scope of Work. Project Management consists of managing the activities of the project team, including staff and subconsultant coordination. The Consultant will perform the following work:

1.01 Project Initiation

- A kickoff meeting that will initiate the project. The kickoff meeting agenda will include discussion of project approach, schedule and coordination issues. The meeting will include a review of stakeholder analysis matrix.
- Risk assessment meeting that will include identification of project delivery risks, qualitative risk analysis and resulting ranking of risks and ownership assignments for risk monitoring.
- Risk Response Planning: Following the risk assessment meeting the risk monitor owners (made up of the project team) will develop response plans and incorporate the plans into the project risk register. The Consultant will be responsible for monitoring risk directly under their control or associated with their work.

1.02 Project Management

- Keep the County advised on aspects of work under this contract and communicate with the County regarding progress and budget.
- Coordinate work with County staff and other County consultants and contractors.
- Setup and maintain project files.
- Develop, monitor and update, as needed, a project schedule.
- Monitor and update, as needed, the project risk register.
- Coordinate project team to verify work is performed in an integrated manner, producing deliverables of consistent quality that comply with the Contract.

Provide monthly progress reports to be submitted to the County by the 15th of each month. Each report will include a statement of consultant work completed during the reporting period, including:

- Estimated percent complete by task.
- Status of planned vs. actual expenditures.
- Status of scheduled progress vs. actual progress.
- Work scheduled for the next period.
- Summary of changes to the contract during the reporting period.

Meetings:

- One project risk assessment meeting with the County to identify potential risks to project success and response planning. Assume a meeting length of 2.5 hours on the same day as the kickoff meeting, held at the County's office in downtown Seattle. Meeting will be attended by the Project Manager and the Technical Leads for civil, hydraulics, geotechnical, ecologist and geomorphologist for the Project Team.
- Project Coordination Meeting: Coordinate and lead a general project coordination meeting with the County on an as needed basis during the course of the project. Assume one meeting of 2 hours duration. Develop agenda and summarize key elements of coordination meeting. Meeting will be attended by the Project Manager and the Technical Leads for civil, hydraulics, geotechnical,

ecologist and geomorphologist for the Project Team.

- Project Coordination Conference Calls: Coordinate and lead conference calls with the County on regular, as needed basis. Assume a total of 15 1-hour conference calls during the course of the project on a roughly bi-weekly basis. Develop agenda and summarize key elements of coordination calls. The Project Manager and the Technical Leads for civil, hydraulics, geotechnical, ecologist and geomorphologist will be the Project Team representatives on the calls.

Deliverables:

- Monthly progress report (10) submitted by the 15th of each month.
- Initial project schedule submitted prior to kickoff meeting and monthly schedule status updates including updated schedule in MS Project.
- Agendas and meeting notes associated with coordination meetings and conference calls.
- Initial Risk register submitted subsequent to the project risk assessment. Risk Register will be maintained and updated monthly.

Assumptions:

- Kick-off meeting agenda and minutes will be prepared by the County.
- Risk assessment meeting will be run by the County.
- Stakeholder matrix will be developed by the County.

Task 2: External Project Coordination

This task includes effort assisting the County in coordinating with external stakeholders. The Consultant will perform the following work:

2.01 Coordination with City of Kent: The project is entirely within the City of Kent and the City has multiple interests in the project area. Kent is also developing a master parks plan along the Green River corridor between Veterans Drive and S. 200th Street. Coordination efforts are expected to include discussions with Kent Parks and their landscape architect consultants on issues regarding parks, trail and recreational use and Kent Public Works regarding Russell Road and city owned utilities.

Assumptions:

- County will coordinate discussions with the City of Kent regarding project design considerations.

Task 3: Survey and Basemap Development

This task supplements the existing land survey of the project area with additional information and increases the accuracy of the topographic surface. The survey is intended to meet two primary needs:

1. Improve accuracy of digital topographic surface in areas where the existing surface accuracy is insufficient for measuring earthwork construction quantities. A minimum of one foot contour accuracy is required in these areas.
2. Provide additional information for planning, design, and permitting.

No additional bathymetric survey work for the project is anticipated. Work will include the following:

- Demarcate edge of vegetation (brush line, tree canopy edge). Locate tree stems for all trees with a diameter >= 4 inches, measured 4 feet above ground. Note in tree survey code whether conifer or deciduous tree.
- Identify and locate missing planimetric features and related information (e.g. pipe inverts and type).

- Perform field survey areas where obstructing vegetation reduced accuracy of aerial topographic survey(s).
- Integrate field survey work with existing digital files (land and bathymetric) and develop the project basemap and model surface using AutoCAD. Assume that the data prepared by others and provided by the County for use on this project is accurate and of appropriate quality. The Consultant is to inform the County's Project Representative if they determine that there are problems with the field survey information provided by others.
- Conduct a boundary review and prepare a legal description and exhibit for acquisition of a portion of the KOA (REC Adventures Company) property to support county acquisition of property necessary to construct the project. The extent of property acquisition need will be determined by the County after an initial cost benefit analysis.

The horizontal datum used will be: Washington State Plane Coordinate System, North Zone. The vertical datum used will be: NAVD1988. The topographic survey accuracy will comply with the United States National Map Accuracy Standard.

Any work restricting use of Green River Trail or Van Doren's Landing Park will be coordinated with the City of Kent. Site disturbances require immediate restoration to original condition. CAD standards used on this project will be consistent with the standards used by the County.

Deliverables:

- AutoCAD Civil 3D base map of specified survey area incorporating legacy Aerial, Hydrographic, and Terrestrial data with newly acquired Terrestrial data
  - Planimetric
  - Contours
  - Surface
- Digital Terrain Model (DTM) in LandXML format.

Assumptions:

- King County provided an AutoCAD drawing (LwrRusselProj_FldProtSysAlign_SurveyExt_062514 .dwg) delineating the outer extent of survey areas.
- King County will provide AutoCAD files of the existing base map and surface tin to be supplemented with the new survey data.
- King County will provide bathymetric survey files (GIS format) developed by the Muckleshoot Indian Tribe.
- King County will provide access to public and private properties needed for work to be performed within the project site.
- King County will provide title reports developed for Kent that include the KOA property.
- County will provide one set of consolidated comments for each review.

Task 4: Geotechnical Exploration and Laboratory Testing

The purpose of this task is to develop and implement a subsurface exploration, testing, and sampling plan to supplement existing information within the study area. The Consultant will perform the following work:

4.01 Conduct subsurface explorations, testing, and sampling

- Perform 6 Standard Penetration Test (SPT) in accordance with ASTM D1586 - Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils. Assumed Alignment 1 needs no new borings; 5 new borings along Alignment 2A; and 1 new boring along Alignment 2B in the short reach connecting Alignment 1 with Alignment 2A. None of these borings will be completed with monitoring wells to measure water levels for stability analyses.
- The SPT work will extend 40 feet in depth, or to the practical depth of the drilling equipment used.
- Provide a field representative on-site to observe the drilling, retrieve soil samples, and visually classify the samples in the field in accordance with classification methods of ASTM D2488 - Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). Soil samples collected from the boreholes will be placed in jars; transported to a geotechnical laboratory; and tested.
- At select locations, collect relatively undisturbed samples using Shelby tubes in general accordance with ASTM D1587 – Standard Practice for Thin-walled Tube Sampling of Soils for Geotechnical Purposes.
- The borings will be backfilled in accordance with Washington State Department of Ecology Water Resources Division requirements. Straw bales and/or silt fencing will be used at explorations near the river and wetlands, if needed.
- All exploration holes through asphalt will be patched with asphalt or concrete.
- Traffic control, if required, will consist of signage and cones only. Assumed no flaggers will be required.
- Locate all underground utilities in the test vicinity prior to drilling. Obtain all permits and file applicable notices with utility owners prior to drilling.
- Disturbances to Van Doren's Landing Park and/or the Green River Trail will be coordinated with the City of Kent a minimum of two weeks prior to the start of ground disturbing activity. Site disturbances will be restored to original condition upon completion of field exploratory work.

4.02 Conduct geotechnical laboratory tests in general accordance with US Army Corps of Engineers (USACE) EM 1110-2-1913 "Design and Construction of Levees" and appropriate ASTM International standards on the samples collected. Anticipated laboratory tests will include the following:

- 48 Water content determinations: (ASTM D2216 – Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass). Assumed each of the 6 new borings will be drilled 40 feet deep. Assumed collecting a sample every 5 feet for a total of 8 samples per boring hole and an overall total of 48 samples.
- 24 Grain size analyses: (ASTM D422 – Standard Test Method for Particle-Size Analysis of Soils). Assumed 4 gradation tests per new bore hole for an overall total of 24 gradation tests.
- 6 Atterberg limits: (ASTM D4318 – Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils). Assumed 1 Atterberg Limit test per new bore hole for an overall total of 6 Atterberg Limit tests.
- 3 Shear strength: (ASTM D4767 – Standard Test Method for Consolidated Undrained Triaxial Compression Test). Assumed 1 shear strength test on 50% of new bore holes for an overall total of 3 shear strength tests.

Contaminated soil is not anticipated at the project site. If encountered, proper disposal of contaminated soil may require environmental testing. Such testing and disposal if required would be address through a contract amendment.

Deliverables:

- Report on results of field exploration, in situ testing, and laboratory testing, including summary of findings.

Assumptions:

- King County will obtain right of way access to conduct the testing, provide ready access to the work locations, and will coordinate with local jurisdictions regarding public notification of field work.
- King County will provide a base map or GIS layers with existing utility types and locations.
- County will provide one set of consolidated comments for each review.

Task 5: Geotechnical/Hydrogeologic Analysis and Pre-Design

The purpose of this task is to provide geotechnical services to facilitate the project design and development of construction documents. Levee certification is not a project deliverable, but the project design is expected to be in accordance with FEMA's certification requirements, 44CFR65.10. The geotechnical evaluation and analysis will be in general accordance with the following USACE publications:

- EM 1110-2-1913 "Design and Construction of Levees"
- EM 1110-2-1902 "Slope Stability"
- EM 1110-2-2502 "Retaining and Flood Walls"
- ER 1110-2-1806 "Earthquake Design and Evaluation for Civil Works Projects"
- ETL 1110-2-569 "Design Guidance for Levee Underseepage"
- EC 1110-2-6067 "Engineering and Design: USACE Process for the National Flood Insurance Program (NFIP) Levee System Evaluation"

Scour depth assumptions for geotechnical considerations may differ from that used as basis for design of revetment toe protection. Levee design height, crest width, side slopes, scour depth, riverside scour slopes, and riverside scour distances to the levee toe will be selected collectively by the design team and King County. The design scour depth and distance from levee toe will be determined prior to geotechnical analysis, as part of Phase 1 work. Geotechnical field exploration and laboratory testing performed as part of the earlier study by the City of Kent will be used (or substantial portion of) as a basis for design. The Consultant's work will include the following subtasks for five (5) different apparent critical cross-sections:

5.01 Collect and review available geotechnical and geological information.

5.02 Steady state seepage analysis: Analysis will be conducted using the river's mean annual water level and mean flood season water level.

5.03 Static slope stability analysis: Analysis will be conducted using the river's mean annual water level and mean flood season water level.

5.04 Rapid drawdown analysis: Analysis will be conducted based on a drawdown to the river's mean annual water level and mean flood season water level.

5.05 Earthquake (seismic) stability analysis: Performed for the operational basis earthquake (OBE) based on guidance found in EC 1110-2-6067. Analysis will be conducted using the river's mean annual water level and mean flood season water level.

5.06 Prepare geotechnical design report based on geotechnical analysis performed above and flood protection system design recommendations.

5.07 Geotechnical Support for Transportation and Utility Infrastructure Design: Support will consist of synthesizing existing data to address design needs; coordinating with Civil/Transportation; completing limited geotechnical engineering analyses; and, producing a technical memo to document recommendations provided in the design.

5.08 Geotechnical Support for Scour Protection Design: Support will consist of synthesizing existing data to address design needs; coordinating with Hydraulic Engineer and Geomorphologist; completing limited geotechnical engineering analyses; and, producing a technical memo to document recommendations provided in the design.

5.09 Geotechnical Support for Habitat Restoration Features Design: Support will consist of synthesizing existing data to address design needs; coordinating with Ecologist and Civil Engineer; completing limited geotechnical engineering analyses; and, producing an internal technical memo to document recommendations provided in the design.

A draft of all technical memos and reports will be submitted to the County for review. Response to the County's review comments will be discussed with the County prior to finalizing the documents.

Deliverables:

- Geotechnical engineering report on engineering analysis and design recommendations. Draft report provided in electronic format only. Final report provided as two paper copies and in electronic (pdf) format.

Assumptions:

- County will provide one set of consolidated comments for each review.

Task 6: Structural Analysis and Pre-Design

The purpose of this task is to provide structural review, analysis and design of a floodwall as a design element in alternatives development, selection, and pre-design of selected alternative. The floodwall design will incorporate the following elements: maintenance access zone, levee/floodwall transitions; and wall foundation capable of protecting against scour. Floodwall design will be in general accordance with current engineering design standards including that found in the following USACE publications:

- EM 1110-2-2502 "Retaining and Flood Walls"
- EM 1110-2-2504 "Design of Sheet Pile Walls" (with consideration of ETL 1110-2-575)
- EC 1110-2-6066 "Design of I-Walls"

The Consultant's work includes the following subtasks:

6.01 Review existing subsurface exploration and laboratory testing data. Discuss findings with geotechnical team members

6.02 Develop a concept-level lateral earth pressure diagram and pullout capacity for floodwall tiebacks. Lateral earth pressures will be for static and seismic forces, and for cantilever tieback options, if necessary.

6.03 Perform structural assessment to develop up to two different floodwall cross-sections with construction cost estimate for each in support of Task 12 alternatives evaluation.

6.04 Develop 30% design of floodwall should selected alternative design include a floodwall component. The selected floodwall design alternative will be developed sufficiently such that a construction cost estimate can be developed with a focus on being within 15% of the actual construction costs to the extent the actual future construction contract reflects the 30% design.

Deliverables:

- Floodwall design elements and recommendations will be documented and included as a section in the Feasibility Report.

A draft of all technical memos and reports will be submitted to the County for review. Response to the County's review comments will be discussed with the County prior to finalizing the documents.

Assumptions:

- County will provide one set of consolidated comments for each review.

Task 7: Hydraulic Design

The purpose of this task is to complete hydraulic modeling to document existing baseline conditions, support the design of flood and scour protection features, provide input to the habitat evaluation, support the assessment of future geomorphic site evolution, and to evaluate compliance with floodplain management regulations. The Consultant will perform the following work:

7.01 Baseline Hydraulic Conditions.

The existing Green River HEC-RAS model developed for the FEMA FIS update and City of Kent CLOMR will be provided by the County. The model will be reviewed and additional geometric detail in the form of channel cross sections added within the project reach (212th Street to 228th Street). The original model was calibrated for the FEMA study which specifically focused on high flow events (9,000 to 12,000 cfs). This calibration will be reviewed and refined as needed to account for changes that may occur as a result of adding cross sections to the model within the project reach. The results will be compared to effective FEMA regulatory flood levels and any significant differences will be examined and explained. The resulting water surface profile will become the new regulatory flood profile to which the post project 1% annual chance water levels will have to be compared to determine project impacts.

The HEC-RAS model will also be used to evaluate low flow events (500 to 6000 cfs) and therefore, the Consultant will produce a second variation of the model that has slightly different model parameters. This will be done because variables such as Manning's "n" vary with discharge and stage. If reliable low flow calibration discharge/stage data are not available, the consultant will use engineering judgment and experience to assign appropriate model parameters. Once the low flow model is complete, it will be used to document existing low flow baseline hydraulic conditions. Specific discharges to be modeled will be determined in collaboration with the County. It is assumed that up to three low flow discharges will be analyzed. Figures and Tables will be created that document baseline water surface elevations, depths, and cross section average velocities.

The low flow HEC-RAS model will also be used to refine the OHW mark profile through the project reach so that it is hydrologically consistent. This will be done through an iterative process to identify a profile that provides a reasonable representation of the OHW water levels collected at specific points by the project team biologist. The OHW profile is needed to identify the elements of the project that will lie within the OHW boundary and therefore require additional regulatory review and approval.

All model runs will be steady state.

The modeling team will conduct a site visit to examine project reach conditions.

Methods and results of the hydraulic baseline modeling will be summarized and incorporated in to the Task 7 technical memorandum.

7.02. Hydraulic Design.

The HEC-RAS model will be used to evaluate the hydraulic performance of proposed design alternatives, to provide the hydraulic data needed to compute reach and site specific scour depths, and to prepare preliminary designs for scour protection features (e.g. rock revetments or groins).

The following assumptions are made regarding the number of HEC-RAS model runs that will be completed to support hydraulic design:

- Each alternative will be evaluated for up to three events – a low to moderate discharge, the 1% annual chance design event, and a higher design check flood. Up to three alternatives will be modeled for each event (9 runs).
- Up to six additional model runs will be made to refine project features (6 runs).

Methods and results of the hydraulic design modeling will be summarized and incorporated in to the Task 7 technical memorandum.

7.03 Habitat Hydraulics

It is anticipated that habitat features will be incorporated into the project. This may include floodplain benches with alcoves or side channels, LWD installations, and plantings. The HEC-RAS model will be used to the extent possible to support these efforts; however, it is recognized that the HEC-RAS model can not provide site specific two-dimensional hydraulic output and therefore, significant engineering judgment will be required to assess hydraulic conditions associated with proposed habitat features.

The following assumptions are made regarding the number of HEC-RAS model runs that will be completed to support the design of habitat elements:

- Up to six runs will be made to support the design of specific habitat elements.

Methods and results of the habitat hydraulic modeling will be summarized and incorporated in to the Task 7 technical memorandum.

7.04 Geomorphic / Project Site Evolution.

The purpose of this subtask is to estimate how the proposed system will evolve within the first 10 years following construction and secondly, how the system will evolve beyond 10 years after construction (i.e. 10-50 years). The team's hydraulic engineer will work with the lead geomorphologist, geotechnical engineer, and civil designer to estimate how the system may evolve over these time periods. Anticipated changes may include items such as vegetation growth, sediment deposition, lateral channel migration, and levee settlement. The team will define the expected changes, which will then be incorporated into the HEC-RAS model to determine how the changes will likely affect flood levels and cross section-average hydraulic conditions. The information will provide insight into whether additional design refinements are needed to prevent unintended hydraulic, scour, and habitat impacts. As noted in subtask 7.03, it is recognized that the HEC-RAS model can not provide site specific two-dimensional hydraulic output and therefore, significant engineering judgment will be required to estimate hydraulic conditions associated with the anticipated geomorphic site evolution assumptions.

The following assumptions are made regarding the number of HEC-RAS model runs that will be completed to evaluate evolutionary changes and impacts:

- Up to six runs will be made to evaluate expected project evolution.

Methods and results of the hydraulic modeling to support site evolution will be summarized and incorporated in to the Task 7 technical memorandum.

7.05 Regulatory Compliance (Zero-Rise).

Once a preliminary version of the preferred alternative has been identified, the HEC-RAS model will be modified to represent the proposed project. The analysis will need to demonstrate that the project will satisfy current floodplain development regulations (in particular Zero-Rise). Zero-Rise is defined as any increase in water surface elevation (0.005 ft. or greater) for the with-project 1% annual chance flood profile compared to existing conditions).

The following assumptions are made regarding the number of HEC-RAS model runs that will be completed:

- Up to two runs will be completed to evaluate regulatory compliance for the preliminary alternatives (one for each alternative).
- One run will be completed for the final preferred alternative.

Methods and results of the regulatory compliance modeling will be summarized and incorporated in to the Task 7 technical memorandum.

7.06 Hydraulic Design Memorandum.

At the conclusion of Task 7.05, a memorandum will be prepared that documents methods and results of Tasks 7.01 through 7.05.

It is assumed that FEMA flood insurance rate map updates (preparation of CLOMR and LOMR) is not a project deliverable and that existing topographic and bathymetric data provided by the County are reliable, accurate, and sufficient, such that no new survey data are required to create the HEC-RAS models. . The Consultant is to inform the County's Project Representative if they determine that there are problems with the topographic and bathymetric data information provided by the County.

Deliverables:

- Technical memorandum on hydraulic model files.

A draft of all technical memos and reports will be submitted to the County for review. Response to the County's review comments will be discussed with the County prior to finalizing the documents. Two hard copies and a PDF version of the draft and final reports will be submitted.

Assumptions:

- County will provide the flood frequency discharges for the Green River which have been established by the on-going Green River Systemwide Improvement Framework (SWIF) project.
- County will provide the design flow and freeboard requirements for the flood protection system as an outcome of the SWIF.
- County will provide one set of consolidated comments for each review.

Task 8: Integrated Scour Protection Design

The purpose of this task is to develop a scour protection system for the proposed project. The system is to protect critical project infrastructure, doing so in a manner that attempts to increase ecological function, and minimize long term operation and maintenance costs. The County anticipates that the final design will consist of a combination of treatments that allow an acceptable level of channel migration and other natural geomorphic processes to occur within defined limits. The following tasks will be completed by the Consultant to support scour protection design.

8.01 Geomorphic Response: Evaluate and determine the likely geomorphic response to the flood protection system alignments developed under Task 11.

- Review and apply existing analysis and data on river hydrology, hydraulics, and sediment transport, and aerial photographs to document the geomorphic context of the project including temporal trends.
- Conduct field inspection of the project reach to identify and map bank erosion, scour, and sediment deposition evidence of channel change processes for baseline conditions.
- Review and interpret results of the hydraulic modeling analysis of the alternatives and combine with field observations to identify locations susceptible to geomorphic change.
- Provide input to development of modeling scenarios for Task 7.04 and review modeling results of predicted geomorphic response to determine consistency with geomorphic context.
- Provide input to subtask 8.02 Scour Analysis by identifying the location and nature of anticipated geomorphic response processes to be quantified by the scour analysis. Review and validate scour analysis results for consistency with geomorphic context.

- Review and comment on proposed erosion protection alternatives developed and evaluated in subtask 8.03 with focus on anticipated interaction between proposed protection measures and geomorphic processes.
- Prepare technical memorandum summarizing geomorphic context, identifying locations and nature of anticipated geomorphic change, and documenting input to geomorphic change modeling, scour analysis, and evaluation of erosion protection alternatives.

8.02 Baseline Scour Assessment:

Assess the stability of the existing channel configuration to document baseline scour potential. The Consutlant's work will include the following:

- Obtain and review existing information on the extent and condition of existing scour protection revetments along the river banks.
- Obtain and review information on existing scour holes within the lower Green River.
- Conduct a site visit to examine conditions along both river banks during low flow conditions.
- Provide an assessment as to the general condition and reliability of the existing toe armor along both river banks.
- Provide an assessment as to the stability of the river's longitudinal profile based upon a review of existing data and reports.
- Estimate the general scour potential for the entire project reach for the design event.
- Examine scour potential at the 212th and 228th Street crossings.

  Note – Equations to be used to compute scour depth estimates will be selected in consultation with County staff.
- A written summary describing methods and results of the baseline scour and erosion assessment will be prepared and included in the Task 8 technical memorandum. It will include the scour calculations.

8.03 Scour Assessment for Proposed Project Conditions and the Identification and Evaluation of Scour Countermeasures:

Identify and develop concepts for scour countermeasures. A goal will be to identify cost-effective solutions that provide both protection and habitat benefits. Elements may include riprap revetment, engineered wood, bio-engineering, floodwalls, and rock barbs. Concept layouts will be developed which will identify treatment areas and list possible countermeasures types that are appropriate for each area. A meeting will be held with the County to review the countermeasure options and to select specific countermeasures to develop and evaluate for each area. The countermeasures will be designed and cost estimates developed to a level that will allow them to be compared so that in conjunction with the County a decision can be made as to which features to include in the preferred flood protection system developed under Task 12.

The following assumptions are made regarding the number of countermeasures that will be developed:

- It is assumed that four to six different countermeasure types may be considered.

A written summary describing methods and results will be prepared and included in the Task 8 technical memorandum.

8.04 Preliminary Design of Preferred Scour Countermeasures:

Develop preliminary design plans and a construction cost estimate for the preferred scour protection system. It will be developed sufficiently such that the cost estimate reflects anticipated actual construction cost with a focus on being within 15% of the actual construction costs to the extent the actual future construction contract reflects the 30% design.

A written summary describing the design effort will be prepared and included in the Task 8 technical memorandum.

8.05 Task 8 Technical Memorandum:

The written summaries prepared for each individual Task 8 task will be packaged into a single task memorandum.

Deliverables:

- Task 8 Technical Memorandum. A draft copy of the memorandum will be provided to the County for review. Response to the County's review comments will be discussed with the County prior to finalizing the documents. Two hard copies and a PDF version of the draft and final reports will be submitted.

A draft of all technical memos and reports will be submitted to the County for review. Response to the County's review comments will be discussed with the County prior to finalizing the documents.

Assumptions:

- County will provide one set of consolidated review comments for each review.

Task 9: Riparian and Aquatic Habitat Analysis

Existing information will be used to evaluate existing and forecasted post-project riparian and aquatic habitat in support of project alternatives analysis and permitting strategies. The Consultant's work will include the following subtasks:

9.01 Wetland Delineation and Report: Perform wetland delineation and classification supplementing work for the City of Kent by Shannon & Wilson in December 2012. The delineation will meet the Washington State and US Army Corps of Engineers criteria using the Supplement to the U.S. Army Corps of Engineers Wetlands Delineation Manual: Western Mountains, Valleys, and Coast Region (Environmental Laboratory 2010). Wetland functions will be assessed based on the Washington State Wetlands Rating System. Assume 8 hours of permitting support for one person for attendance at a field review meeting with agency staff.

The work includes mapping the ordinary high water mark (OHWM) for the Green River on both river banks. Final OHWM determination will reflect field investigation techniques and review of ground elevations to ensure OHWM determination is physically and hydrologically consistent.

A Global Positioning System (GPS) unit (horizontal accuracy of 0.1 meter or less) will be used to collect the location of the wetland delineation and OHWM flags for mapping. Use existing data to characterize present riparian and aquatic habitat within the project reach, including water quality (temperature and dissolved oxygen), large wood, vegetation, pools, slow water habitat, and fish use, with an emphasis on habitat for listed species. Conduct a visit to the site to verify and update information in existing reports and data sources.

9.02 Assess the potential impact to the two flood protection system alignments developed under Task 11. Two time periods will be considered in potential evaluation: within 10 years after construction and greater than 10 years (i.e. 10 to 50 years).

9.03 Identify Habitat Improvement Alternatives: Evaluate up to three (3) erosion protection alternatives developed under Task 8 and identify other measures (such as additional excavation to create more accessible floodplain) for both flood protection system alignments developed under Task 11 (i.e. up to 6 analysis scenarios) and their likely effects on habitat functions within the project area. Issues to be addressed with design alternatives include the following:

- Quantify the potential for increase in suitable salmonid habitat and the flood stage necessary for the newly created habitat (above OHWM) to be available.

- Describe the ability of the proposed design to minimize adverse impacts to sensitive areas (including riparian habitat and wetlands).
- Identify the regulatory implications (permit requirements) of the project and a description of appropriate minimization measures and performance standards.
- Characterize the capacity of the project to meet recommendations of relevant NMFS Biological Opinions, salmon recovery plans, independent third-party reviews of King County programs, and current peer-reviewed literature on effective restoration strategies.
- Develop cost estimates for each potential action. Costs will be developed sufficiently such that the cost estimate reflects anticipated actual construction cost with a focus on being within 15% of the actual construction costs to the extent the actual future construction contract reflects the 30% design.

Deliverables:

- Wetland delineation report describing findings.
- Memo describing existing and potential future habitat conditions of alternatives developed. The memo will also include for each alternative discussion on the consistency of design alternatives with regulations, recovery plans, third-party reviews, and peer-reviewed literature, and the permit implications of each design alternative.

A draft copy of all memorandums and reports will be provided to the County for review. Response to the County's review comments will be discussed with the County prior to finalizing the documents. Two hard copies and a PDF version of the draft and final reports will be submitted.

Assumptions:

- County will provide one set of consolidated comments for each review.
- County will provide or point to reports and or/data on existing habitat conditions. County will review data and determine if data gaps exist and whether the County can develop/provide additional information to fill data gaps.
- County will provide input on the identification of relevant NMFS Biological Opinions and independent third-party reviews.
- County will provide a copy of the wetlands delineation report prepared by Shannon & Wilson under work performed for the City of Kent and the associated AutoCAD boundary file.

Task 10: Russell Road Improvements

The existing road will be relocated where the existing levee is setback from the river. The purpose of this task is to develop and evaluate relocation alignments, cross-section, and pavement design. The evaluation of Russell Road will include consideration of traffic needs post property buyout; access needs of vehicles, pedestrians and bicyclists; shared use with recreational cycling; narrowing of the road width and elimination of the road between Van Dorens Park and 212th St; and, restrictions on traffic direction (e.g. one way vs. two way). The Consultant will perform the following work:

10.01 Review the existing condition and service provided by Russell Road. Assess changes in service need with adjacent property buyouts. Review intersections of Russell Road with 228th St and 212th Streets and assess need for 212th Street access improvements based on future Russell Road characteristics with concept layout figure(s). Designs of improvements to 228th Street or 212th Street are outside the scope of this sub-task.

10.02 Develop up to three alternative road alignments in conjunction with and to inform future flood protection system alignments developed under Task 11. It is assumed that the road alignment will be adjacent or on top of any levee and provide access to existing Van Doren's park. Develop up to three alternative road cross-

sections that may be applied to the three alternative road alignments. These may include a recreational component within the cross-sections. Provide recommendations where the alternative cross-sections may best be implemented along the alternative road alignments.

10.03 Develop design issues and cost estimates that are of sufficient detail for two alternative alignments and three alternative road cross-sections to allow for project alternative comparisons under Task 12. Alternative road cross-sections (all rural sections) are anticipated to take the form of the following:

- Two-lane road from 228th Street to Van Doren's park, with a sub alternative to extend the cross-section along the entire project length (228th St to 212th Street)
- A functional road/trail north from Van Doren's park to 212th Street (assumes above 2-lane road south of Van Doren's park). Possible cross-sections may include a one-lane road or a one-lane road with adjacent bike/pedestrian lane.
- Two-lane road section sub-alternative for cost estimating a wider road section for possible cost sharing with Kent.

10.04 Develop conceptual 30% design and associated cost of road improvements associated with selected preferred flood protection system alignment. Develop design cross-section(s) and pavement section of replacement road (assumed to have a rural section), including recreational trails. Pavement design will be developed in coordination with the County. The selected road design will be developed such that its cost estimate reflects anticipated actual construction cost with a focus on being within 15% of the actual construction costs to the extent the actual future construction contract reflects the conceptual 30% design.

- The conceptual 30% design rollplots will display information on 4 plots:Alignment, ROW, and Profile
- Existing Utilities and Proposed Relocated Utilities
- Proposed Drainage Design
- Proposed Paving and Channelization Design

Conceptual 30% design roadway typical sections will be provided in 11"x17" exhibits in addition to the 4 rollplots described above.

City of Kent Parks and its master plan will help inform park access needs and desired experience of park and trail users. Coordination efforts regarding parks, trail, and recreational use issues with Kent Parks, the City of Kent, and their landscape architect are outlined in Task 2.

Deliverables:

- Technical memorandum on Russell Road design alternatives considered and design recommendations.
- Conceptual 30% design rollplots, exhibits, and cost etimate.
- Conceptual figure of 212th Street access improvement needs.

A draft copy of all memorandums and reports will be provided to the County for review. Response to the County's review comments will be discussed with the County prior to finalizing the documents.

Assumptions:

- County will coordinate discussions with the City of Kent regarding roadway design. Determination of preferred alternative will be decided by the County with support from the design team and City of Kent.
- County will coordinate and provide necessary information regarding relocation of any utilities and drainage requirements associated with the relocation of Russell Road.

- County will provide one set of consolidated comments for each review.

Task 11: Flood Protection System Alignment Development and Levee Setback Design

The purpose of this task is to develop flood protection system alignments and integration of work under previous tasks in the presentation of alignment components (e.g. scour protection, habitat elements, etc.) with each flood protection system alignment based on project constraints, opportunities and objectives. The Consultant will perform the following work:

11.01 Develop the identified flood protection system alignments (Alignment #1 and #2) (with Alignment #2 having an "a" and "b" alternative – see Figure 1) in addition to a no action alternative. Alignments are to reflect site constraints and project goals and objectives.

11.02 Draft drawings and figures that convey the integration of team efforts under above tasks in development of alternative components for each flood protection system alignment (e.g. levees vs. floodwalls, geomorphic response, scour protection measures, riparian and aquatic habitat and park/recreation area users).

11.03 Evaluate the design issues and cost estimates for each significantly different flood protection system alignment to allow for project alternative comparisons.

11.04 Levee Setback Design: Develop 30% design and associated cost of levee improvements associated with the selected project flood protection system alignment. The cost estimate will be developed such that it reflects anticipated actual construction cost with a focus on being within 15% of the actual construction costs to the extent the actual future construction contract reflects the 30% design.

Deliverables:

- Maps, figures, typical cross-sections, itemized cost and material estimates.
- Electronic files (e.g. GIS, CAD, Excel) for each deliverable.

A draft copy of all memorandums and reports will be provided to the County for review. Response to the County's review comments will be discussed with the County prior to finalizing the documents.

Assumptions:

- County will provide one set of consolidated comments for each review.

Task 12: Alternatives Analysis and Feasibility Report

The purpose of this task is to conduct an alternatives analysis to identify, assess, and document project alternatives. A feasibility report will be prepared describing the selected project flood protection system (alignment and design elements) for achieving the desired level of flood risk reduction. The Consultant will perform the following work:

12.01 Project Alternatives Evaluation: Screen each flood protection system alignment developed under Task 11 and alternative components potentially making up each flood protection system alignment against project purpose, objectives, and performance requirements. Develop, in conjunction with the County, evaluation criteria and alternative comparison method. Evaluation criteria will include: 1) design complexity; 2) implementation cost; 3) constructability; 4) regulatory issues and constraints; 5) design resiliency and uncertainty; 6) project risk; 7) maintenance complexity and cost; 8) recreational elements (trails and parks); and 8) effect on aquatic and riparian habitat.

Alternatives development and analysis will include the following:

- Each flood protection system alignment alternative considered will have one or more sub-alternatives based on design component alternatives.

- Design component alternatives will separately address erosion protection, habitat, and other alternative evaluation criteria.
- Flood protection system alignment sub-alternatives will be separated to extent required to identify pros and cons of each and allow the County to select a project alternative.
- Work conducted under other tasks of Phase 1 will be managed with the purpose of providing meaningful information during alternatives analysis for the County to make an informed decision on a preferred alternative.

12.02 Feasibility Report: Prepare a report on the feasibility of the selected project alternative. The feasibility report is expected to reference heavily the content of technical memos of previous tasks. The Report will include the following:

- The report will be less than 200 pages and will be written for a general technical audience using information from the technical memorandums prepared under the previous tasks.
- Report will include figures of proposed project alignment and significant design elements.
- The report will include a cost summary and project schedule to include final design through construction completion in the body of the report, with a cost breakdown in the report appendix.
- Costs will be developed such that the cost estimate reflects anticipated actual construction cost with a focus on being within 15% of the actual construction costs to the extent the actual future construction contract reflects the 30% design.

The Phase 1 project schedule allows the County six (6) weeks to assess project alternatives and select the preferred project alternative following completion of the technical memorandum on alternatives comparison. The project schedule includes three (3) weeks for county staff to review the feasibility report and provide consolidated comments.

The alternative cost estimates listed in sections 8, 9, 10, and 11 will all be done together. A total of 3 separate estimates (Alignment #1; Alignment #2a; and Alignment #2b) with all the above sections combined into 3 separate alternatives will result in the 3 alternative estimates. In addition, cost for different scour protection approaches that may be applied to the same area (allowing the mix and matching of cost components) will be provided. Only 1 (one) 30% Design Development Estimate will need to be prepared.

Meetings:

- Four, 2-hour meetings to discuss task issues, to be scheduled as needed.

Deliverables:

- Technical memorandum on alternatives comparison.
- Feasibility Report.

A draft copy of all memorandums and reports will be provided to the County for review. Response to the County's review comments will be discussed with the County prior to finalizing the documents.

Assumptions:

- County will provide one set of consolidated comments for each review.