3. CAPITAL PROJECTS

The SWIF capital projects are being pursued to address levee concerns and deficiencies to ensure that the PL 84-99 levees along the Lower Green River remain eligible for PL 84-99 federal assistance. The King County Flood Control District provisionally approved a 500-year (18,800 cfs – measured at Auburn) plus three feet of freeboard flood protection goal for the six capital project areas included in the SWIF Capital Plan. All implementation costs estimates are based on a 2018 price level. Each capital project is aimed at improving the level of reliability of the levee and will also increase the level of performance with the increased design containment flow.

3.1. INTRODUCTION AND UPDATE

The capital projects summarized within this chapter are intended to address slope stability, seepage, erosion and other levee performance concerns identified by King County, the USACE or through studies intended to support levee certification efforts and which cannot be corrected through routine maintenance activities. These capital investments will also achieve level of protection from flooding goals provisionally approved by the District as well as achieve factors of safety to support future certification and FEMA accreditation. The USACE (EM 1110-2-1913 Design and Construction of levees) specifies a general standard for a levee side slope as flatter than or equal to slope of 2.0H:1V. Slope stability concerns, or over-steepened slopes (typically 1H:1V up to 1.7H: 1V), raise a levee performance concern. Many of the locations with identified slope stability concerns also have factors of safety values for rapid drawdown that are at or significantly below the minimum acceptable value of 1.0. The intent of the capital projects is to correct both the slope stability concerns to maintain eligibility and construct a levee or floodwall facility that results in an acceptable factor of safety to support future levee certification and FEMA accreditation. One capital project is located in the vicinity of Lower Russell Road, three capital projects are located along the Tukwila 205 levee, and two capital projects are located along the Horseshoe Bend levee. Project summaries and a location map are provided for each planned capital project.

3.2. LOWER RUSSELL

3.2.1. PROJECT OVERVIEW

Project Location
The Lower Russell capital project area is located on the right bank of the Lower Green River, between river mile 17.85 and river mile 19.25. The majority of the project area, river mile 18.25 to 19.23 is part of the existing PL 854-99 levee system. The segment from 17.85 to 18.25, referred to as Russell Road Lowest is not part of the current PL 84-99 levee system. The project area is located within the City of Kent.

Problem Identification
This PL 84-99 levee currently has an Unacceptable rating by the U.S. Army Corps of Engineer due to a slope deficiency at river mile 18.6. USACE PL 84-99 inspections also identified additional types of PL 84-99 deficiencies: encroachments, animal burrows, erosion, debris, and settling. A portion of the Lower
Russell levee was damaged in 1995/96 and repaired in 1997-98 in the vicinity of RM1s 17.9, 18.7, 18.9
and 19.2. In addition, there has been significant scour and damage to the levee toe and embankment at
RM 18.6 between 2012 and 2015. Major sloughing damage at this location initially occurred during a
2012 flood event. The 2013 USACE Levee Screening noted that:

“……The observed damage extends approximately 150 feet, but sloughing likely extends beyond
this area …..The riverward levee slope above the landward toe elevation is 2.5H:1V in the reach
but the slope below this elevation is between 1.5H:1V and 1H:1V. Erosion and sloughing below
the levee prism toe is significantly reducing the stability of the levee prism. Minor sloughing has
occurred over much of this levee and it is very likely that further sloughing will occur. The river is
significantly incised and further channel scour is expected during major flood events. This will
increase the likelihood of slope stability failure on the levee.”

The 2018 levee inspection report (April 30th, 2018) for Lower Russell noted the following items at this
location:

- **Slope Stability.** Major sloughing and slope stability failure of the riverward slope.
  Significantly reduces levee integrity. Evidence of further damages. Two stakes have slid
down the scarp. Eight feet from the edge of the crown to the top of the scarp.

- **Slope Stability.** Large slough upstream of the original (2012) one, the slough is about 30’
  wide and 10 feet from the levee crown.

Levee overtopping would be expected to occur at an elevation of 39.5 feet which corresponds to
approximately a 300-year event (USACE Levee Screening 2013).

**Site Context**

The existing PL 84-99 levee is located close to the river’s edge and protects commercial, industrial and
residential land uses in Kent, Renton and Tukwila. Van Doren’s Park, the Green River Natural Resources
Area and the Green River Regional Trail are located in this project area. Aquatic habitat in this project
area is degraded. Riparian habitat is marginal and consists predominantly of grasses, shrubs, and narrow
rows of trees. Approximately 82% of the project area’s shoreline is considered high priority for
increasing shade, per the Muckleshoot Tribe’s Solar Radiation Priorities Mapping Study (2013).

**Project Goals**

Achieve multiple objectives by integrating the new levee, 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.

- Improve flood protection by replacing and upgrading 1.4 miles of existing levee and revetment
  with a new flood containment system that meets current engineering design standards and is
  built to a 0.2 percent annual chance (a.k.a., a 500-year) flood event.

- Restore aquatic and riparian habitat for fish and wildlife, including species listed under the
  Endangered Species Act. The project is identified as a priority project in the 2005 WRIA 9 Salmon
  Habitat Plan.

- Complement existing parks, trails, and open space, thereby creating a unified landscape that
  offers opportunities for active and passive recreation while at the same time restoring habitat
  and providing flood protection.

- Reduce long-term maintenance costs.

**Proposed Project Description**
The proposed project includes replacement of the existing Lower Russell levee and revetment with a new flood containment system in the City of Kent along the east (right) bank of the Green River between river mile (RM) 17.85 (South 212st Street) and RM 19.25 (Veterans Drive/South 228th Street). The 1.4 mile-long levee improvement project includes construction of a new levee and floodwall that meet current engineering design standards and are designed to a 0.2% annual chance exceedance (500-year flood) event. Based on hydraulic modeling, the proposed levee and floodwall are approximately 4 to 6 feet higher than the height of the existing levee. The riverward slopes of the setback levee will have a grade of 3H:1V for increased slope stability. A floodwall is proposed to extend from Veteran’s Drive to the PSE corridor at RM 18.8 and then transition to a setback levee from RM 18.8 to S. 212th St (RM 17.85) (see Figure 3.1). The new levee includes a stable slope design that meets or exceeds factors of safety; vegetation and trees in accordance with the Draft SWIF Vegetation Plan; and scour counter measures to limit the likelihood of potential scour and erosion of the levee. The new levee is set back from the Green River to allow for riparian and aquatic habitat improvements, including reconnection of 40 acres of floodplain, creation of 16 acres of rearing and refuge habitat for juvenile salmon, vegetation to enhance and restore riparian function and increase shade to the river. Revegetation will include about 24 acres of riparian habitat and 1.4 acres of emergent wetlands. Riparian shoreline area available to plant large trees may range from 50-120 feet in width along the floodwall segment and 100-150 feet wide through the rest of the project area. The project also includes relocation of the existing Van Doren’s Park and enhancement of recreation opportunities including trails and replacement of a hand-carry boat launch.
Figure 3-1 Lower Russell Capital Project
3.2.2. ENVIRONMENTAL COORDINATION, COMPLIANCE AND TRIBAL CONSULTATION

3.2.2.1. ENVIRONMENTAL COORDINATION

Environmental coordination has been ongoing throughout the project development process. Several design workshops and public meetings were held to solicit input on project design. King County, on behalf of the Flood Control District has worked extensively with project stakeholders and partners including the City of Kent, Muckleshoot Indian Tribe Fisheries Division, and WRIA 9 to arrive at a project design that everyone can accept, although the need to accommodate conflicting land-use priorities has required all parties to make concessions. Coordination has been ongoing with these partners and stakeholders as the project progresses through permitting and final design.

- A habitat design work group was established during the alternatives analysis and continued through 90% design to inform development of key project components. Members of the work group included representatives from the City of Kent, WRIA 9, the Muckleshoot Indian Tribe and the King County and consultant project team. The work group met 12 times during the design phase between September 2015 and March 2018.
- Three public meetings were held at key milestone points in the project including: Initial project information meeting (Nov 18, 2014), identification of a preferred alternative (June 8th, 2015) and at 60 percent design completion (October 25th, 2017).

3.2.2.2. ENVIRONMENTAL COMPLIANCE

The following table summarizes federal, state and local environmental compliance, permits and approvals required for implementation. Environmental compliance and consultation with Tribes is ongoing. A SEPA Checklist was completed on October 24, 2017 and a SEPA Determination of Non-Significance was issued on October 25, 2017. The Clean Water Act Section 404 permit application was submitted to the Corps of Engineers in December 2017.

<table>
<thead>
<tr>
<th>Environmental Compliance</th>
<th>Issuing/Regulating Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean Water Act Section 404 Permit (Nationwide 27 (restoration), Nationwide 12 (bank armor), Nationwide 36 (boat ramp), Nationwide 33 (temporary construction access and dewatering)</td>
<td>US Army Corps of Engineers (USACE)</td>
</tr>
<tr>
<td>Endangered Species Act Section 7 Consultation</td>
<td>NOAA Fisheries and US Fish and Wildlife Service, Washington State Fish Passage and Restoration Programmatic BAs</td>
</tr>
<tr>
<td>Clean Water Act Section 401 Water Quality Certification (part of NW 27 permit)</td>
<td>WA Dept of Ecology</td>
</tr>
<tr>
<td>Coastal Zone Management Act (part of NW 27 permit)</td>
<td>WA Dept of Ecology</td>
</tr>
<tr>
<td>National Pollution Discharge (NPDES) Permit</td>
<td>WA Dept of Ecology</td>
</tr>
<tr>
<td>Permit/Approval</td>
<td>Approval Authority</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>Temporary Water Right Permit</td>
<td>WA Dept. of Ecology</td>
</tr>
<tr>
<td>National Historic Preservation Act Section 106</td>
<td>USACE/Tribes/WA Dept. of Archaeology &amp; Historic Preservation</td>
</tr>
<tr>
<td>SEPA (State Environmental Policy Act)</td>
<td>King County (lead agency)</td>
</tr>
<tr>
<td>Hydraulic Project Approval</td>
<td>WA Dept. of Fish &amp; Wildlife with Tribal review</td>
</tr>
<tr>
<td>Aquatic Use Authorization</td>
<td>WA Dept. of Natural Resources</td>
</tr>
<tr>
<td>Shoreline Management Act Compliance</td>
<td>City of Kent</td>
</tr>
<tr>
<td>Critical Areas compliance</td>
<td>City of Kent</td>
</tr>
<tr>
<td>Zoning Conditional Use Permit</td>
<td>City of Kent</td>
</tr>
<tr>
<td>Floodplain Development Permit</td>
<td>City of Kent</td>
</tr>
<tr>
<td>Shoreline Conditional Use Permit</td>
<td>City of Kent</td>
</tr>
<tr>
<td>Shoreline Substantial Development Permit</td>
<td>City of Kent</td>
</tr>
<tr>
<td>Civil Construction Permit (Includes Clearing/Grading)</td>
<td>City of Kent</td>
</tr>
<tr>
<td>Flood Hazard Certification</td>
<td>City of Kent</td>
</tr>
<tr>
<td>Right of Way Construction Permits</td>
<td>City of Kent</td>
</tr>
<tr>
<td>Demolition Permit</td>
<td>City of Kent</td>
</tr>
<tr>
<td>Seven Building permits (one each for floodwall, park restroom, viewing tower, picnic shelters [2], wiffle ball court backstop fence)</td>
<td>City of Kent</td>
</tr>
<tr>
<td>RCO Conversion</td>
<td>WA Recreation and Conservation Office</td>
</tr>
</tbody>
</table>

Federal environmental compliance and tribal consultation will be completed as part of Clean Water Act Section 404 permit review. A pre-application meeting was held with the USACE, Muckleshoot Tribe, WDFW, WDOE, and City of Kent in November 2017, and the permit application was submitted to the USACE in December 2017 (NWS-2017-0912). The application included proposed coverage under a Nationwide Permit 27 for restoration elements with coverage requests for lesser project elements under Nationwide Permit 12 for bank armor, Nationwide Permit 36 for a hand-carry boat launch ramp, and Nationwide Permit 33 for temporary construction access and dewatering. Tribal consultation will be through the Corps of Engineers permit process. In addition, King County will coordinate with the Muckleshoot Indian Tribe to maintain tribal treaty fishing access during and after construction.

Compliance with Section 7 of the Endangered Species Act (ESA) will be part of the Corps permit and is through the Fish Passage and Restoration Programmatic Biological Assessment (BA) II for the US Fish and Wildlife Service (USFWS) and the Fish Passage and Restoration Programmatic BA III for National Oceanic and Atmospheric Administration (NOAA Fisheries). The proposed effects determinations are
“May Affect, but Not Likely to Adversely Affect”. Washington State Section 401 Clean Water Act and Coastal Zone Management Act compliance will also be via the Corps permit.

Section 106 of the National Historic Preservation Act (NHPA) consultation and compliance will also be through Corps of Engineers permit process. Cultural Resource investigations are ongoing. Consultation with Tribes will include the Muckleshoot Indian Tribe, Snoqualmie, Stillaguamish, Suquamish and Tulalip tribes and possibly others.

3.2.3. IMPLEMENTATION SCHEDULE AND COSTS

The Lower Russell levee setback project is scheduled for construction in 2019-2020. The 60% design was completed in October 2017 and the 90% design in July 2018. The final (100%) design was completed in October 2018. Three properties were acquired to facilitate construction of the project, including the Noble warehouse and Holiday Kennel. The total project cost is estimated at $52 million (2018 price level).

3.3. TUKWILA 205

3.3.1. PROJECT AREA OVERVIEW

The Tukwila 205 levee is located on the left bank of the Lower Green River between RMs 12.45 and 16.72 within the City of Tukwila. The existing PL 84-99 levee is in close proximity to privately owned buildings, parking lots and other land uses, including: commercial/industrial, public facilities, religious facilities, and utilities. Recreational resources in the vicinity of the levee include the Green River Regional Trail. Aquatic habitat in this reach consists of glide, with a small segment of run habitat at RM 16.3. Riparian habitat consists predominantly of impervious surfaces, non-native shrubs, grass, and bare earth. There is less than 10% tree cover, concentrated in one patch adjacent to the pond/wetland at RM 13.9. The majority of the left bank is considered a high priority for achieving additional shading as it is a west bank with several southern exposures around bends. Table 3-1 provides the repair history for Tukwila.

<table>
<thead>
<tr>
<th>Facility Name</th>
<th>Flood Event that Caused Damage</th>
<th>Year Repair Completed</th>
<th>U/S River Mile (RM)</th>
<th>D/S River Mile (RM)</th>
<th>Length of Repair (feet)</th>
<th>Designed By</th>
<th>Built By</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tukwila 205-Van Worden</td>
<td>n/a</td>
<td>2005 a</td>
<td>13.02</td>
<td>13.02</td>
<td>75</td>
<td>City of Tukwila</td>
<td>King County</td>
</tr>
<tr>
<td>Tukwila 205-Van Warden</td>
<td>Nov 1990</td>
<td>1990</td>
<td>13.80</td>
<td>13.70</td>
<td>420</td>
<td>King County</td>
<td>King County</td>
</tr>
<tr>
<td>Christensen Rd.</td>
<td>Nov 1990</td>
<td>1992</td>
<td>14.21</td>
<td>14.15</td>
<td>210</td>
<td>King County</td>
<td>King County</td>
</tr>
<tr>
<td>Tukwila 205-Segale</td>
<td>Jan 2006</td>
<td>2008</td>
<td>15.10</td>
<td>14.90</td>
<td>1,055</td>
<td>USACE</td>
<td>USACE</td>
</tr>
</tbody>
</table>
### Corps of Engineers Levee Screening Risk Characterization (2018):

In May 2018, King County received the USACE approved risk characterization for the Tukwila system. An excerpt from the characterization is included below (USACE 2018):

**Risk Characterization: HIGH RISK.** The risk was determined to be high for this levee system based on a combination of the flood hazard frequency, the anticipated levee performance, and the potential consequences. The likelihood of a flood overtopping the levee presents an intolerable risk because of the anticipated high consequences from flooding. The levee served to prevent water from entering the floodplain during the project’s flood of record in 1996, but the levee sustained damage requiring repair and improvement. In its current condition, the levee is not anticipated to perform well during floods greater than previously experienced (e.g., greater than 12,400 cfs). During these large flood events, erosion of the already steep levee slopes could progress to levee failure. If the levee overtops or fails, multiple hundreds of millions of dollars in property damages could accrue with over 250 structures affected. With significant commercial business, the leveed area includes a transient daytime population that may be unaware of the flood risk and evacuation procedures. The loss of human life is possible. King County has a flood hazard management plan, flood warning program, flood patrol program, and public communication plan that all serve to reduce life safety risk (USACE 2018).
Three capital projects are proposed along the Tukwila 205 levee at Gaco-Segale, Ratolo, and Christensen Road to correct four PL 84-99 slope stability concerns. Planned capital projects along Tukwila 205 will also achieve factors of safety necessary to enable future certification and accreditation.

### 3.3.2. TUKWILA ENVIRONMENTAL COMPLIANCE CONSIDERATIONS.

Federal environmental compliance and tribal consultation will be conducted by the Corps of Engineers through the PL 94-99 program for the Segale-Green and Gaco Western project. King County on behalf of the Flood Control District and in accordance with the operation and maintenance agreement, will be responsible for state and local permits. The other two capital projects in this reach will involve alterations to the existing authorized Section 205 civil works project through and will comply with the Corps of Engineers Section 408 process (USACE EC 1165-2-220 Issued 10 September 2018). Federal environmental compliance and Tribal consultation will be met through the Section 408 process. King County, on behalf Flood Control District, will prepare necessary documentation to support this process and be responsible for mitigation or other measures necessary as part of environmental compliance. King County, on behalf of the Flood Control District will also be responsible for necessary state and local permits and environmental compliance. Environmental considerations that will be addressed as part of the 408 process for each capital project in this reach are summarized below.

Permitting of toe and scour protection along the reach will require both state WDFW hydraulic project approval (HPA) and USACE permits for in-water work. The Muckleshoot Tribe will also be consulted for their input on both permits. Several critical areas and listed fish species are present in the project area including wetlands, an osprey nest, and ESA-listed salmonids. Agencies and jurisdictions that are anticipated to be involved in permitting include the US Army Corps of Engineers, Washington State Department of Ecology, Washington Department of Fish and Wildlife, and the City of Tukwila.
Consultation with the US Fish and Wildlife Service and National Marine Fisheries Service will be required due to listed species and in-water work. In addition, the Muckleshoot Indian Tribe will be consulted by USACE and WDFW, prior to issuance of permits.

### 3.3.3. Segale-Green and Gaco Western (River Mile 15.55 to 15.88)

#### 3.3.3.1. Project Overview

**Project Location** The Tukwila 205 Segale-Green and Gaco-Western capital project area is located on the left bank, between RM 15.55 and 15.88 within the City of Tukwila.

**Problem Identification** Over-steepened levee side slopes, low factor of safety values and flood damages during 2015 contribute to heightened flood risk concerns along this reach of the Tukwila levee system. This levee segment has slope deficiencies which have been observed since 2010: River mile 15.7 (over-steepened slopes range from 1.25H to 1.33H:1V); RM 15.4 to 15.7 (over-steepened slopes that are approximately 1.4:1). The Tukwila certification study that is currently underway measured 1.33:1 slopes at RM 15.86 (X-section 10). This study also calculated a Factor of Safety value for rapid drawdown of 0.74 and steady state seepage of 0.88 at RM 15.86. These are below the minimum Factor of Safety of 1.0 from the USACE manual. Additionally, river bed scour in this reach between 1986 and 2011 showed erosion of 7 feet at RM 15.85 and 4.1 feet at RM 15.59 over 25 years. This indicates that the river is actively down cutting in the vicinity of the levee, leading to further over-steepening of the slopes. Flood damages to the levee during 2015 heightened concerns about this reach. Three high water events from the end of October through mid-December 2015 damaged the levee along approximately 600 LF between RMs 15.75 and 15.88. The riverward slope was scoured to an over-steepened slope of approximately 1H:1V, based on analysis by the USACE (Project Information Report GRN-01-16, USACE, 2016). The USACE concluded that in the damaged condition, the levee provides a 5-year level of protection (LOP). The USACE approved the damaged levee for a PL 84-99 repair in 2016.

**Site Context** The existing PL 84-99 levee is located close to the river’s edge and protects commercial/industrial land uses in Tukwila. Aquatic habitat in this project area is degraded. Riparian habitat is degraded and consists predominantly of grasses, and a narrow row of trees near RM 15.8. Approximately 30% of the project area’s shoreline is considered high priority for increasing shade, per the Muckleshoot Tribe’s Solar Radiation Priorities Mapping Study (2013).

**Proposed Project Description**

From fall 2016 to late 2017, the King County Flood Control District pursued acquisition of two properties to enable a levee setback. Unfortunately, in late December 2017, the acquisition of these properties proved unsuccessful. In January 2018, the Flood District informed the USACE to proceed with a repair using the existing levee easements. The Flood District also requested that the USACE include the Segale reach of the levee as a locally preferred alternative, to include the footprint of the proposed repair from the 2016 Interim SWIF.
The USACE is working with the Flood District to complete the design for this project. It may consist of a flood wall, a shoring wall, rock revetment and large wood placed riverward of the shoring wall. The flood wall is being designed to the 500-year LOP. Based on the 35% design project costs the project was paused to reassess alternative alignments and configurations. The basis of the project proposal is a 0.33 mile floodwall and is intended to minimize impacts to adjacent businesses while achieving an embankment design with acceptable factors of safety and necessary toe/scour protection. The constructed embankment slope is proposed to be a minimum 2:1 (and preferably 2.5:1) as measured from the levee crest to the estimated scour depth. The floodwall alignment (including embankment slope, factors of safety, and necessary real estate) will established during the design phase. Riparian revegetation will be included as part of the capital project design, although site constraints such as the proximity of the proposed floodwall to parking lots and buildings may affect levee slopes and will likely require planting of shrubs and smaller tree species. Based on hydraulic modeling, the proposed floodwall will be approximately 3 to 4 feet higher than the height of the existing levee.

3.3.3.2. IMPLEMENTATION COSTS & SCHEDULE

Cost Estimate Range
The estimated total project cost for the Segale-Green and Gaco Project is $15,500,000 - $18,600,000 with construction, design and permitting estimated to cost $14,900,000, and $600,000 - $3,700,000 in real estate costs. The low end of the total project cost estimate assumes acquisition of an easement for inspection and achieving minimum factors of safety while the high end includes acquisition of additional space to achieve more stable embankments and higher factors of safety.

Implementation Timing
The Segale-Green and Gaco-Western (RM 15.55-15.88) project is scheduled to be initiated in 2020 with preliminary design and acquisition; construction is planned for 2022-23.

3.3.4. RATOLO (RIVER MILES 14.6-14.75)

3.3.4.1. PROJECT OVERVIEW

Project Location The Tukwila 205 - Ratolo capital project area is located on the left bank, between RM 14.6 and 14.75. The project area is located within the City of Tukwila.
Problem Identification. This levee segment includes over-steepened slopes from 1.25H:1V for approximately 200-300 feet in vicinity of RM 14.6. The Tukwila Phase 1 certification study measured 1.64:1 slopes at RM 14.72 (cross-section 7). This study also calculated a Factor of Safety (FOS) value for rapid drawdown of 0.69 at RM 14.72. This is below the minimum FOS of 1.0 from the USACE manual. River bed scour in this reach between 1986 and 2011 is modest (approximately 1 foot), but there is one known deep scour hole downstream of RM 14.5.

Site Context The existing PL 84-99 levee is located close to the river’s edge and protects commercial/industrial land uses in Tukwila. Aquatic habitat in this project area is degraded. Riparian habitat is compromised and consists predominantly of grasses, shrubs, and a narrow row of trees near RM 14.7. Most of the project area’s shoreline is considered a moderate priority for establishing increased shade, per the Muckleshoot Tribe’s Solar Radiation Priorities Mapping Study (2013).

Proposed Project Description A 0.15 mile floodwall is proposed to minimize impacts to adjacent businesses while achieving an embankment design with acceptable factors of safety and necessary toe/scour protection. The embankment slope is proposed to achieve a minimum 2:1 (and preferably 2.5:1), as measured from the levee crest to the estimated scour depth. The floodwall alignment (including embankment slope, factors of safety, and necessary real estate) will be finalized during capital project design after the District initiates the project. Riparian revegetation will be included as part of the capital project design, although site constraints such as the proximity of the proposed floodwall to parking lots and buildings may affect levee slopes and will likely require planting of shrubs and smaller tree species. Based on hydraulic modeling, the proposed floodwall is approximately 3 to 4 feet higher than the height of the existing levee.

3.3.4.2. IMPLEMENTATION SCHEDULE AND COST

The Tukwila 205 - Ratolo (RM 14.6-14.75) project is scheduled to be initiated in 2022, with construction in 2024. The total estimated cost for the Ratolo Project is $7,100,000 - $8,400,000 with construction, design and permitting estimated to cost $6,700,000 and $400,000 - $1,700,000 estimated for real estate costs. The low end of the estimated project cost range assumes securing easements for inspection and minimum factors of safety while the high end results in additional space to achieve more stable embankments and higher factors of safety.
### 3.3.5. CHRISTENSEN ROAD

#### 3.3.5.1. PROJECT OVERVIEW

**Project Location.** The Tukwila 205-Christensen Road capital project area is located on the left bank, between RM 13.40 and 13.58 (Figure 3.4). The project area is located within the City of Tukwila.

**Problem Identification.** This levee segment includes over steepened slopes that range from 1.33 to 1.25H:1V for 1000 feet from RM 13.4 to 13.5. The 2018 levee inspection report indicates that steep slopes have been noted at several locations along the Tukwila levee since 2010. The preliminary Tukwila certification study measured 1.4:1 slopes at RM 13.53. This study also calculated a Factor of Safety (FOS) value for rapid drawdown of 0.7 at RM 13.53. This is below the minimum FOS of 1.0 for rapid drawdown from the USACE engineering manual (EM 1110-2-1913 Design and Construction of levees). River bed scour in this reach between 1986 and 2011 is modest (approximately 1.2 feet).

**Site Context.** The existing PL 84-99 levee is located close to the river’s edge and protects commercial and industrial land uses that are immediately adjacent to the levee. Aquatic habitat in this project area is degraded. Riparian habitat is compromised and consists predominantly of grasses. The entire project area shoreline is considered a moderate or high priority for increased shade, per the Muckleshoot Tribe’s Solar Radiation Priorities Mapping Study (2013).

**Proposed Project Description** A 0.18 mile long floodwall is proposed to minimize impacts to adjacent businesses while achieving an embankment design with acceptable factors of safety and necessary toe/scour protection. A minimum 2:1 (and preferably 2.5:1) embankment slope is proposed, as measured from the levee crest to the estimated scour depth. Details on the floodwall alignment (including embankment slope, factors of safety, and necessary real estate) will be worked out during the capital design phase after the District initiates the project. Riparian revegetation will be included as part of the capital project design, although site constraints such as the proximity of the proposed floodwall to parking lots and buildings may affect levee slopes and will likely require planting of shrubs and smaller tree species. Based on hydraulic modeling, the proposed floodwall is approximately three to four feet higher than the height of the existing levee.

#### 3.3.5.2. IMPLEMENTATION SCHEDULE AND COSTS

This project is scheduled for initiation in 2025 and construction in 2027. The estimated total cost for the Christensen Road project is $8,400,000 - $10,100,000 with construction, design and permitting.
estimated to cost $8,100,000 and $300,000 to $2,000,000 in real estate costs. The Tukwila 205 – Christensen Rd. (RM 13.4-13.58) project is scheduled to be initiated in 2025, with construction in 2027.

### 3.4. Horseshoe Bend Levee

#### 3.4.1. Project Area Overview

The Horseshoe Bend levee is located on the right bank of the Lower Green River between RM 24.25 and RM 26.1 within the City of Kent, with the Green River Trail traveling along the top of the levee for most of its length. There are multiple land uses in the area afforded protection by this levee system including industrial businesses, office parks, condominiums (Green River Estates, Holy Glen, and Riverfront Park), apartments (Park Place), and mobile home communities (Maple Lane, Horseshoe Acres, and Walnut Grove). The Green River Trail is along the top of the levee for most of the length of this system and there is also a municipal court. There are three bridges in the reach (78th Avenue South bridge at RM 24.25, railroad bridge at RM 24.08, and East Valley Highway South bridge at RM 25.23). This federal levee was raised and improved by the USACE in 1996. In 2012-13, the City of Kent constructed secondary containment structures (flood walls and berms) along portions of the levee, designed to contain 12,000 cfs plus three feet of freeboard, to advance the city’s certification and accreditation goals. Levee overtopping is expected to occur at flows exceeding 15,100 cubic feet per second (cfs). Portions of the existing Horseshoe Bend levee were damaged/repaired during the following years: 1991, 1994, 1996, 2003, 2006, and 2009, Table 3-2 summarizes these repairs. The most downstream project was not a levee repair project but instead involved repair of a City of Kent outfall pipe, for which King County performed the construction. The project between RM 25.50 and 25.60 involved filling of fourteen sinkholes on the crest and landward face of levee. The other repairs were embankment and/or toe repair projects. The toe repairs were constructed with a combination of riprap and LWD materials. Some of the projects involved minor setback of the levee crest.

<table>
<thead>
<tr>
<th>Segment</th>
<th>Flood Event that Caused Damage</th>
<th>Year Repair Completed</th>
<th>U/S River Mile (RM)</th>
<th>D/S River Mile (RM)</th>
<th>Length of Repair (feet)</th>
<th>Designed By</th>
<th>Built By</th>
</tr>
</thead>
<tbody>
<tr>
<td>McCoy</td>
<td>n/a</td>
<td>2003</td>
<td>24.31</td>
<td>24.30</td>
<td>50</td>
<td>City of Kent</td>
<td>King County</td>
</tr>
<tr>
<td>McCoy and Breda</td>
<td>Nov 1995 &amp; Feb 1996 floods</td>
<td>1996</td>
<td>24.80</td>
<td>24.40</td>
<td>1800</td>
<td>King County</td>
<td>USACE</td>
</tr>
<tr>
<td>Breda</td>
<td>n/a</td>
<td>2006</td>
<td>25.10</td>
<td>24.50</td>
<td>1800</td>
<td>King County</td>
<td>King County</td>
</tr>
<tr>
<td>Breda</td>
<td></td>
<td>2009</td>
<td>25.01</td>
<td>24.79</td>
<td>1040</td>
<td>USACE</td>
<td>USACE</td>
</tr>
<tr>
<td>Plemmons</td>
<td>Nov 1995 &amp; Feb</td>
<td>1996</td>
<td>25.60</td>
<td>25.00</td>
<td>200</td>
<td>King County</td>
<td>King County</td>
</tr>
</tbody>
</table>
Corps of Engineers Levee Risk Characterization (2018)

In May 2018, King County received the USACE approved risk characterization for the Horseshoe Bend levee system. An excerpt from the characterization is included below (USACE 2018):

*Risk Characterization: HIGH RISK. Considering the flood hazard, the anticipated levee performance, and the potential consequences the levee risk of this system is considered high. The likelihood of a flood overtopping the levee presents an intolerable risk because of the anticipated high consequences from flooding. The levee served to prevent water from entering the floodplain during past floods in 1996 and 2006, but the levee sustained damage requiring repair and improvement. In its current condition, the levee is not anticipated to perform well during floods greater than previously experienced (e.g., greater than 12,400 cfs). If inundation were to occur, property damages exceeding $100 million could accrue with over 300 structures affected. Limited evacuation routes are present and expected depths of flooding pose life safety hazards. King County has a flood hazard management plan, flood warning program, flood patrol program, and public communication plan that all serve to reduce life safety risk.*

Capital projects are proposed along two segments along the Horseshoe Bend levee (McCoy and Breda) at locations where there are slope stability concerns. The Breda reach has the lowest Factor of Safety rating (1.005) of the Horseshoe Bend levee, considered a “just-stable” condition in comparison to the minimum factor of safety of 1.0 from the USACE engineering manual.
3.4.2. **HORSESHOE BEND ENVIRONMENTAL COMPLIANCE CONSIDERATIONS.**

Capital projects in this reach will involve alterations to the existing authorized Section 205 civil works project through and will comply with the Corps of Engineers Section 408 process. Federal environmental compliance and Tribal consultation will be met through the Section 408 process. The City of Kent, on behalf of the Flood Control District, will prepare necessary documentation to support this process and be responsible for mitigation or other measures necessary as part of environmental compliance. The City of Kent will also ensure compliance with necessary state and local permits. Environmental considerations that will be addressed as part of the 408 process for each capital project in this reach are summarized below.

Any locations where toe and scour protection is needed will require both state WDFW hydraulic project approval (HPA) and USACE permits for in-water work. The Muckleshoot Tribe will also be consulted for their input on both permits. These are not anticipated to be needed at McCoy or Breda which are planned as setback projects. Other agencies and jurisdictions that are anticipated to be involved in permitting include the Washington State Department of Ecology, Washington Department of Fish and Wildlife, and the City of Kent. Consultation with the US Fish and Wildlife Service and National Marine
Fisheries Service will be required due to listed species and in-water work. In addition, the Muckleshoot Indian Tribe will be consulted by USACE and WDFW, prior to issuance of permits.

This reach is slightly over two miles long and aquatic habitat in the mainstem river includes riffles, runs, pools, and glides. This reach has more diverse and better quality habitat than in lower reaches of the river. This is a reach where salmon spawning occurs; Chinook salmon have been documented spawning from RM 24.5 and on upstream (WDFW 2014). Riparian habitat consists predominantly of impervious surfaces and non-native shrubs, with approximately equal cover of grasses and trees (16%). Approximately half of the right bank is considered high priority for increasing shading.

### 3.4.3. McCoy (River Mile 24.26-24.47)

#### 3.4.3.1. Project Overview

**Project Location** The McCoy capital project area is located on the right bank, between RM 24.26 and 24.47 within the City of Kent (Error! Reference source not found.).

**Problem Identification** This PL 84-99 levee segment is ‘Minimally Acceptable’. The segment includes over-steepened slopes from 1.3 to 1.7H:1V for 500 feet around RM 24.3. The City of Kent constructed a secondary containment levee in this reach, set back from the river’s edge, which is currently not part of the federal levee. The only remaining structure between the two levees is a Puget Sound Energy facility. The Horseshoe Bend Levee Certification Report calculated Factor of Safety (FOS) values for rapid drawdown of 1.08 and 1.55 at about RM 24.3 and RM 24.4, respectively. River bed scour in this reach between 1986 and 2011 is 2.7 feet at RM 24.24. River bed scour in this reach between 1986 and 2011 is 2.7 feet at RM 24.24.

**Site Context** The existing PL 84-99 levee is located close to the river’s edge and protects commercial and industrial land uses that are landward of the levee. Aquatic habitat in this project area is degraded. Riparian habitat is degraded and consists predominantly of grasses, shrubs, and trees. The entire project area shoreline is considered a high priority for achieving increased shade, per the Muckleshoot Tribe’s Solar Radiation Priorities Mapping Study (2013).

![Figure 3-7 McCoy: RM 24.26-24.47](image-url)
Alternatives
Two capital project alternatives are proposed for future evaluation:

- **Alternative One** – Submit a request to the USACE for a modification to the authorized Horseshoe Bend facility, from RM 24.26-24.47. The proposed project would result in a levee alignment that follows the City of Kent’s recently constructed secondary levee, that is currently set back from the Green River. This alternative would likely require relocation or floodproofing of the PSE facility that is located riverward of the new alignment.

- **Alternative Two** – If a Section 408 modification is not approved by the federal government, or proves to be infeasible, an in-place replacement of the existing riverward levee or a modestly setback levee should be constructed to achieve a 500-year level of protection, stable embankment and adequate toe/scour protection.

Proposed Project Description
The proposed capital project would be to include the setback levee alignment as part of the PL 84-99 levee system. Much of the existing technical material and information on the design and construction of the secondary levee is available from the City of Kent. Also, the real estate in this project area is owned by the City of Kent and King County Parks. The request to the Corps of Engineers will be to alter the Horseshoe Bend facility, from RM 24.26-24.47. The proposed project would result in a levee alignment that follows the City of Kent’s recently constructed secondary levee that is currently set back from the Green River.

**3.4.3.2. IMPLEMENTATION SCHEDULE AND COST**
Implementation timing for a Section 408 modification of the existing levee is estimated from 2018-2021. Estimated costs to prepare the documentation to support a Section 408 modifications are estimated at $400,000. This cost does not include addressing the PSE facility. Implementation costs of an in-place replacement are estimated at $5, 300,000.

**3.4.4. BREA (RIVER MILE 24.47 TO 24.7)**

**3.4.4.1. PROJECT OVERVIEW**
*Project Location* The Horseshoe Bend Breda capital project area is located on the right bank, between RM 24.47 and 24.7 within the City of Kent (Figure 3.7).
Problem Identification  The Breda portion of the Horseshoe Bend levee does not meet recommended structural engineering design standards. The existing levee system is vulnerable to undercutting scour due to narrow channel confinement, together with marginal stability resulting from over-steepened levee slopes and recent fill placement to achieve freeboard along the levee crest. Recent improvements were made to the downstream levee by the City of Kent (secondary containment levee from RM 24.3 to 24.47) and upstream by the USACE (2009 repair of launchable toe rock and embankment from RM 24.79-25.01). The Horseshoe Bend Levee Certification Report calculated a Factor of Safety (FOS) value for rapid drawdown of 1.005 at RM 24.57 (Section C). This is the lowest along the entire Horseshoe Bend levee and barely above the minimum FOS (1.0) from the USACE engineering manual. River bed scour in this reach between 1986 and 2011 was 3.7 feet at RM 24.59.

Site Context  The existing PL 84-99 levee is located close to the river’s edge and protects commercial and industrial land uses in Kent that are landward of the levee. Aquatic habitat in this project area is degraded. Riparian habitat is compromised and consists predominantly of grasses, shrubs, and trees. The entire project area shoreline is considered a high priority for achieving increased shade, per the Muckleshoot Tribe’s Solar Radiation Priorities Mapping Study (2013).

Proposed Project Description  A 0.23 mile long levee setback is proposed that would tie into two levee segments, upstream and downstream of the project area, that were recently completed by the USACE and City of Kent, respectively. The intent of the project is to construct a levee setback to achieve an embankment design with acceptable factors of safety and necessary toe/scour protection, while reducing erosive velocities and enabling enhanced riparian vegetation. A minimum embankment slope of 2.5:1 (and preferably 3:1) is proposed, from the levee crest to the estimated scour depth. Details on the setback levee alignment are proposed to be worked out during the capital project design process, after the District initiates the project. With a setback of the levee in this capital project location, it may be possible to construct a wider levee bench as illustrated in Chapter 5 (vegetation plan), to maximize riparian revegetation and achieve increased number of shade trees proximate to the river. Based on hydraulic modeling, the proposed levee is approximately 4 to 5 feet higher than the height of the existing levee. Because the levee is set back from the river, the facility will require lower long-term maintenance costs.

The proposed capital project will require additional easements or fee-simple land rights to provide for the raised and relocated levee structure. Because the Project involves major modifications to the federal levee here, this will require USACE approval prior to construction.
3.4.4.2. IMPLEMENTATION SCHEDULE AND COSTS

The Breda project was initiated in 2017 and is currently in the acquisition and planning phase. The project is expected to be constructed in 2020. A cost estimate for this project is $7,700,000 to $9,600,000. A breakdown of this estimate includes: $5,700,000 for construction, design and permitting and between 2,000,000 - $3,900,000 for real estate acquisition.
Page intentionally left blank