King County Department of Natural Resources and Parks Water and Land Resources Division 2019-2020 Flood Season Report

May 1, 2020

KING COUNTY FLOOD CONTROL DISTRICT

King County

Department of Natural Resources and Parks
Water and Land Resources Division
River and Floodplain Management Section
201 South Jackson Street, Suite 600
Seattle, WA 98104
http://www.kingcounty.gov/wlr

Alternate Formats Available
206-477-4727 TTY Relay: 711

Table of Contents

Appendices

Tables

Figures

I. INTRODUCTION

The 2019-2020 flood season began during Flood Awareness Month with the Snoqualmie River reaching Phase 4 (severe flooding) on October 21, 2019. This early season flooding occurred in advance of the annual flood preparedness outreach campaign. Available records for the Snoqualmie River near Carnation gage indicate this was the highest flow to occur during the month of October since 1934. The flood coincided with fall harvest season, having a negative impact on the economic viability of at least some commercial agriculture in the valley.

A total of seven flood events occurred in King County during the 2019-2020 season, above the average of 5.4 over the past 10 years. Monthly rainfall totals were far greater than average throughout the region in December, January and February. SeaTac Airport had 28 days of measurable precipitation in January, tying the highest number on record.

Established in 1960, the Flood Warning Center is the center of operations for the Flood Warning Program during flood events. The flood emergency director activates the Flood Warning Center whenever one or more rivers reach Phase 2 of the four-phase flow-based flood warning alert system. At Phase 3 or greater, or at the flood emergency director's discretion, Flood Patrol teams are sent out to monitor flood protection infrastructure and investigate potential flood risks.

On January 31, 2020, the Flood Warning Center opened as an atmospheric river arrived in the area bringing heavy and sustained rain. The Tolt River reached the highest flow in over five years and other rivers overflowed their banks causing widespread road closures. The more significant impact was that dams on some of King County's major rivers captured large volumes of water that are typically slowly released over several days to make room for the next storm. The next atmospheric river arrived without enough time to allow for sufficient release of water from several of these dams.

The Flood Warning Center opened again on February 5, 2020, just three days after closing from the previous flood event. Early forecasts indicated major flooding would occur throughout Western Washington. The combination of prolonged rainy conditions, high river flows, saturated soils and elevated pools behind dams caused some areas in King County to experience the most severe flooding in decades. By the end of the storm, flooding and landslides had caused severe damage to public and private property, displaced hundreds of people from their homes, and disrupted the lives of people throughout the region. Despite the severity and dangerous nature of the storm, no lives were lost due to flooding. Based on a post flood assessment of Flood Warning Center Operations, this report includes a number of recommend process improvements.

Table 1. Peak River Gage Data

River	Peak Phase	Site Number	USGS gage location	Date of peak	Provisional Peak flow or stage	Time elapsed since higher peak	Recurrence Interval
South Fork Skykomish	3	12131500	at Skykomish	2/1/2020	20,400 cfs	N/A	N/A
Skykomish		12134500	near Gold Bar	2/1/2020	74,300 cfs	4 years	~8.2
Snoqualmie	4	N/A	Sum of the forks	10/22/2019	45,680 cfs	11 years	N/A
Snoqualmie		12144500	near Snoqualmie	10/22/2019	46,900 cfs	4 years	~5.1
Snoqualmie		12149000	near Carnation	2/7/2020	39,200 cfs	4 years	~3
Raging		12145500	near Fall City	2/6/2020	3,280 cfs	4 years	~8
Tolt River	4	12148500	near Carnation	2/1/2020	9,740 cfs	11 years	~9
Issaquah Creek	4	12120600	near Hobart	2/6/2020	9.53 ft	24 years	~12
Cedar	4	12117500	near Landsburg	2/7/2020	7,590 cfs	11 years	~35
Cedar		12119000	at Renton	2/8/2020	9,620 cfs	29 years	~48
Green	3	12113000	near Auburn	2/7/2020	11,400 cfs	14 years	~6
White	2	12099200	above Boise Creek at Buckley	2/13/2020	6,240 cfs	4 years	~1.5

cfs = cubic feet per second
Phase indicates typical severity of flooding: Phase 4-Severe; Phase 3-Moderate; Phase 2-Minor; Phase 1-None

Post flood recovery activities began ramping up as the Flood Warning Center was closing on February 11, 2020. The River and Floodplain Management Section (RFMS) performed Preliminary Damage Assessments (PDA) of river facilities in accordance with the joint FEMA-State process for identifying damages to public facilities. The King County Office of Emergency Management (OEM) coordinated the collection of PDAs from all impacted divisions in the County. On February 19, 2020, RFMS provided OEM with documentation of over $8 million in damages to 31 river facilities. Since then, many more facilities have been identified that may be eligible for funding through the FEMA Public Assistance program. King County submitted over $27 million in damages and associated costs to Washington State Emergency Management Division (EMD). EMD coordinated with Governor Inslee to request a Presidential Major Disaster Declaration. On April 23, 2020, a Presidential Major Disaster was declared for King County and 14 other Counties in Washington. The declaration includes Public Assistance (PA) Program funding for all categories, including debris removal, emergency protective measures,

and permanent repair/replacement of disaster-damaged facilities. With this declaration, hazard mitigation grant funding is also available; however, Individual Assistance (IA) Program funding was declined. This is King County's 13th Presidential Major Disaster Declaration related to flooding since 1990. RFMS also requested Rehabilitation Assistance from the U.S. Army Corps of Engineers (USACE) under Public Law (PL) 84-99 for the repair of three levee systems damaged by high flows during the January 30 to February 10, 2020, flood events.

As of the transmittal of this report, RFMS teams have inspected 373 of the 511 river facilities maintained by King County. Damage assessments completed to date are summarized in the body of this report and outlined in detailed in Appendix B. King County is complying with Centers for Disease Control and Public Health Seattle and King County COVID-19 guidance for physical distancing, including using separate vehicles and adhering to safe distancing on vessels. These modified practices have caused delay in some inspection work, and remaining inspections will be completed over the spring and summer.

This report is intended to provide an overview of the river conditions, impacts, damages, actions taken, lessons learned, planned near-term actions, proposed long-term actions, and recommendations associated with the 2019-2020 food season with an emphasis on the February 5-11, 2020, flood. Findings in this report will help to inform the upcoming update to the King County Flood Hazard Management Plan.

This report is provided by King County in its role as service provider to the District. Implementation of any of the flood response actions and recommendations described in this report that require changes to adopted Flood District budget, work plan, or policy are subject to authorization by the District's Board of Supervisors.

II. SNOQUALMIE RIVER BASIN

A. Impacts

The Snoqualmie River and tributary basins were impacted by all seven of the flood events during the 2019-2020 flood season. The October 2019 flood event resulted in the loss of livestock, crops and equipment in the lower Snoqualmie River valley. A survey done by the Snoqualmie Valley Preservation Association reported flood damages on 26 farms. The February 5-11, 2020, flood resulted in Phase 3 flood conditions on the Snoqualmie River and Tolt River. This flooding was preceded by an even larger flood event on February 1, 2020, on the Snoqualmie, Tolt, and South Fork Skykomish rivers.

Due to the persistent rainfall and saturated antecedent conditions, the February 5-11, 2020, flood resulted in more severe lowland inundation and road closures than previous floods at similar

river levels. Concerns related to the potential for significant regional road closures led Eastside Fire and Rescue to request support from the Washington National Guard, which provided a high clearance vehicle to the City of Carnation. The Guard did not participate in any rescue activities but was on site and on call for 24-hours. Road closures included NE Tolt Hill Road, NE 124th Street, West Snoqualmie River Road NE, and State Route 203 between Fall City and Carnation. Fall City, Carnation, and Duvall remained accessible throughout the flood.

- Flood facility damages included significant bank erosion and slumping that threaten sole access roads at the Dutchman, Stossel Right Bank and Joy revetments. Flood facility impacts are detailed in Appendix B.

The significant seasonal precipitation and high antecedent soil moisture conditions also contributed to landslide prone conditions. Landslides were widespread in the Snoqualmie River basin during the February 5-11, 2020, flood. These conditions, combined with erosive flood flows on the Raging River, led to a landslide at river mile (RM) 7.14 that threatened a private residence and led to its evacuation and designation as uninhabitable.

Figure 1. Landsliding and bank erosion along the Raging River.

B. Potential Mitigation Actions

Priority repairs to damaged facilities are summarized in Appendix B.

III. CEDAR RIVER

A. Impacts

Flows in the Cedar River during the February 5-11, 2020, flood were similar in magnitude to the 2009 flood (9,620 cfs at Renton on February 8, which is approximately a 2 percent annual chance flood or 50-year recurrence interval), but remained above Phase 4 for twice the duration (4 versus 2 days over 5,000 cfs) compared to the 2009 flood (Figure 2). Longer durations of Phase 4 high velocity erosive flows caused extensive flooding and flood-related damage throughout the Cedar River valley below Landsburg. The February 2020 flood caused the Cedar River to avulse (a rapid change in the course of a river alignment) at two locations. The loss of a portion of the Riverbend Lower Revetment at RM 6.85 allowed the river to avulse through Cavanaugh Pond and damage the upstream end of the Cedar River Trail (CRT) Site 2 Revetment. The second avulsion on the Cedar River occurred near RM 16.48 in the Dorre Don neighborhood, where the main flow of the river occupied a left floodplain side channel that could potentially increase bank erosion. Heavy rainfall triggered several landslides throughout the valley that led to temporary road closures, including State Route 169 (SR 169) and closure of the Cedar River Trail within the City of Renton.

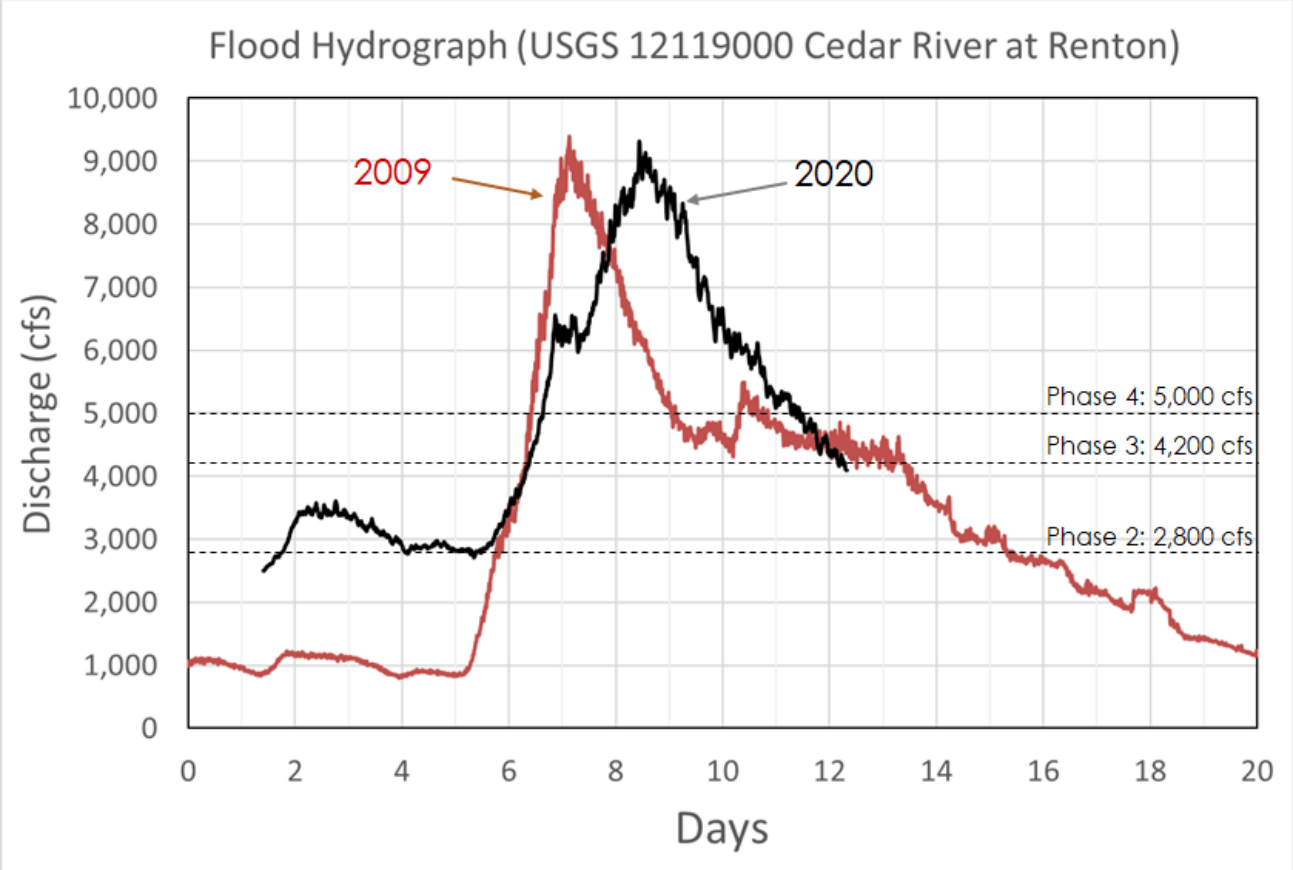

Figure 2. Flood Hydrograph for Cedar River at Renton (2009 vs. 2020).

Overview of impacts in the Cedar River Basin during the flood:

- Damages to 31 river facilities ranging from complete loss to small areas of eroded rock facing.
- Flooding of homes and roadways.
- Two emergency actions authorized by the Flood Control District.
- Flooding and closure of SR 169 west of Cedar Grove Road due to poor stormwater conveyance through a blocked culvert under SR 169 and the Cedar River Trail.
- Channel migration and bank erosion recruited hundreds of trees, some of which remain in the channel to create valuable habitat for salmonids and safety concerns for river recreational users.

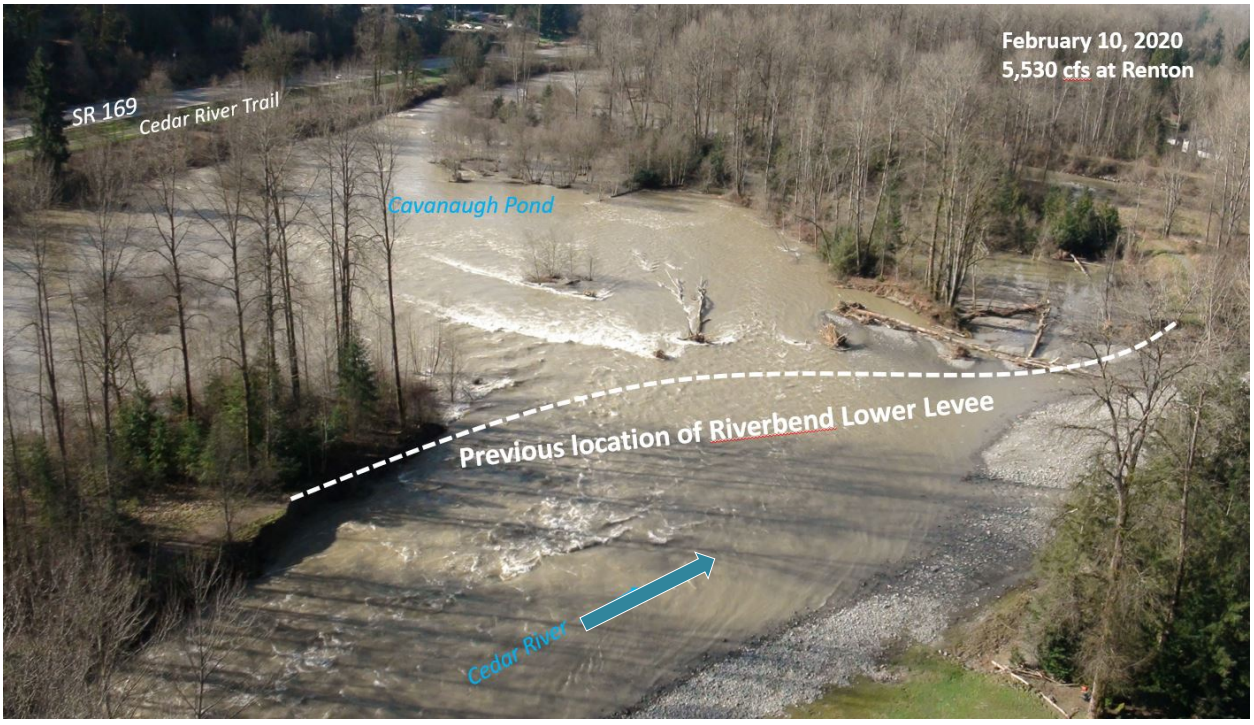

Figure 3. Cedar River avulsion through Riverbend Lower revetment and Cavanaugh Pond.

B. Mitigation Actions

- Emergency action completed in February to repair and extend the CRT 2 Revetment at the Cavanaugh Pond avulsion to protect the Cedar River Trail and buried regional fiber optic line.
- Emergency action during the flood event to place temporary super sacks upstream of the Byers Curve Levee to reduce neighborhood impacts and flooding of a sole-access road.
- Emergency action during the flood event at the site of the SR 169 flooding to deploy pumps, clean out the clogged culvert, and install additional culverts under the Cedar River Trail.

C. Potential Mitigation Actions

- Implement the design and permitting of repairs to facilities deemed to be high risk (Appendix B).
- Consider re-prioritization of the Byers Road Neighborhood Improvement Study and Project, currently in the medium term of the Cedar CIS (projects L and M) and include in the 2021 budget request.
- Modify the Herzman Levee Setback CIP to address the nearby avulsion and damage to adjacent facilities (Camp Freeman).
- Conduct a hazard and risk assessment at the site of the Dorre Don avulsion, and re-prioritize the Dorre Don Neighborhood Improvement feasibility study currently in the medium term (2023-2026) of the Cedar CIS (project P), in the 2021 budget request.
- Evaluate sandbag distribution program expansion near Maple Valley (see page 16).

IV. ISSAQUAH CREEK

A. Impacts

Extensive flooding occurred in the Issaquah Creek Basin resulting in road closures, flooding of homes and businesses, landslides, and damage to many King County levees and revetments throughout the basin. A Phase 4 flood warning was issued for Issaquah Creek; the highest stage (height) at the Hobart gage since 1996.

Overview of impacts during the flood:

- Damages to sixteen river facilities (see Appendix B).
- Flooding in the downtown core of Issaquah, which experienced the worst flood conditions since 2009.
- Road damages and closures:
  - Issaquah-Hobart Road was closed for several days in both directions to repair flood damage.
  - Newport Way SW from Front Street S to Wildwood Boulevard SW was closed due to flooding.
  - Newport Way NW from NW Oakcrest Drive to State Route 900 closed for approximately a week due to the threat of landslides.
  - State Route 900 from NW Talus Drive to SE May Valley Road closed.
  - Water over Sycamore Drive SE resulted in limited access to the Sycamore neighborhood.
  - A tree fell across State Route 18 hitting a car (no injuries) and blocking eastbound lanes near Issaquah-Hobart Road. All lanes reopened after a few hours.
- Three landslides occurred between RM 7.55 and 10.4, ranging from low to high risk; the high-risk landslide resulted in a yellow-tagged home with restricted access.
- Over 200 people evacuated per the City of Issaquah's direction from three apartment complexes in Issaquah.

- Damages to homes, vehicles, septic and well systems. Examples include:
  - Residential property with downed trees directed overbank flow into the house, flooded the crawlspace, and put the wellhead at risk.
  - Residential property: erosion of revetment flooded the home and outbuildings.

B. Potential Mitigation Actions

Prioritized repairs to damaged facilities are summarized in Appendix B.

V. SAMMAMISH RIVER AND LAKE SAMMAMISH

A. Impacts

The February 5-11, 2020, flood resulted in the highest recorded level on Lake Sammamish (elev. 31.2 feet) since construction of the Sammamish River flood project in 1965. Flood impacts along the Sammamish River, while minor during the February event, were more noticeable in Redmond and diminished downstream. Whereas flows in Bothell began to recede days after the peak precipitation, flooding along the river in Redmond and in Marymoor Park persisted for nearly a week due to sustained inputs from Bear Creek that inhibited and delayed outflows from the lake.

Overview of impacts in the Sammamish River Basin during the February 5-11, 2020, flood:

- High lake levels exacerbated by wind-generated waves eroded shoreline and residents reported damaged docks along Lake Sammamish.
- Culverts received sediment loading and erosion to the bank at some outfall locations, particularly in the City of Redmond.
- Sediment benches in the river channel accumulated additional fine-grained sediment, mainly within the Agricultural Production District (APD) and extending into the City of Kenmore.
- Flapgates at several locations appear to be stuck open due to corrosion of the hinge mechanisms that may have contributed to road flooding. Additional investigation is needed to determine ownership and maintenance history.
- Backwater flooding into stormwater facilities in February closed sections of roads for a few days in the City of Redmond.
- Within the City of Redmond, flooding along the Sammamish River in December came close to closing sections of the Sammamish River Trail. Flooding in February resulted in closure of several sections of the trail.
- Erosion near the abutment of the NE 175th Street bridge and a leaning pier under the NE 145th Street bridge. Both bridges are part of State Route 202 and are within Washington State Department of Transportation (WSDOT) right of way.
- Bulging of a retaining wall at NE 124th Street along the Sammamish River Trail.

- Potential seepage and slumping concerns in the APD due to caving of mammal burrows in the river facility.
- Sediment deposition in the APD and at the confluence with major tributaries such as Little Bear Creek may have decreased conveyance capacity in the mainstem.
- Erosion beneath non-conforming and encroaching bank material at two mobile home parks in Bothell and Kenmore.

B. Mitigation Actions

- Refer culvert maintenance needs to local jurisdictions for cleanout, coordinate review of any proposed repairs that may impact the bed or banks of the river.
- Flood patrols were dispatched for the December and February 2020 flood events to track water surface elevations at the Lake and River over time.

C. Potential Mitigation Actions

- Potential mitigation actions may be considered as part of the Sammamish Capital Investment Strategy currently in development.

VI. GREEN RIVER

A. Impacts

The Green River experienced sustained high flows with a peak flow at the Auburn gage that was the highest in over 14 years. On February 7, 2020, the U.S. Geological Service (USGS) Auburn gage reported a peak flow of 12,200 cfs considered flood Phase 4. The USGS later revised the peak flow data to 11,400 cfs, considered flood Phase 3. The combined effect of the two back-to-back floods beginning on January 31 led Howard Hanson Dam reservoir to reach the highest pool elevation since 2009. During the February 5-11, 2020, flood, USACE rapidly lowered outflows from Howard Hanson Dam based on an incorrect forecast of local inflows downstream from the dam. Outflows were again increased after the error was detected. The long duration of high flows and rapid drawdown of water between the two peak flows by the USACE dam operations may have contributed to damages to river facilities. RFMS did not observe damages to private property.

Seepage was observed through the Desimone levee on the right bank of the Green River at several locations between RM 14.8 and 15.2 in Tukwila (Figure 4); boils developed at the landward toe at RM 15.1. In addition, there was significant damage to the Tukwila Trail revetment on the left bank at RM 10.88 and the Fort Dent levee on the right bank at RM 11.0.

Figure 4. Seepage through Desimone Levee in Tukwila.

B. Mitigation Actions and Potential Mitigation Actions

After the February 5-11, 2020, flood, the Green River basin team staff inspected all facilities in the lower Green River reach, downstream from State Route 18. The team also visited known vulnerable facilities in the middle Green River reach. The team's recommendations are categorized in order of damage extent and failure consequence in 34 damage locations (see Appendix B). Out of the 34 damage locations, 29 are considered not severe enough to be priority and therefore "enhanced monitoring" is recommended at these segments.

The most important issue the team observed was at the Desimone levee, RM 14.8-15.2. The February 5-11, 2020, flood resulted in seepage boils on the landward toe and water seepage through the levee to nearby properties. The observed evidence suggests that water seeped through the levee prism in at least three locations. The team proposed a levee condition analysis study. In April the King County Flood Control District approved a study contract with an on-call consultant and provided funding through the emergency contingency fund. The study is expected to provide a wide range of information that will assist in providing recommendations to the District.

A cooperation agreement between the USACE and King County was signed for a potential emergency repair at Desimone Levee during the flood season. In addition, USACE is undertaking the production of a Project Information Report (PIR) to determine if this damage would qualify for a repair through the PL 84-99 levee rehabilitation program. Two viable approaches to reducing Desimone Levee flood risk are anticipated. The PL 84-99 levee rehabilitation program will likely repair only the damaged areas. The other alternative will likely involve a larger effort to repair or replace the entire reach.

Near-term repairs are proposed at Tukwila Trail Revetment RM 10.88 and Fort Dent levee at RM 11.0. The Tukwila Trail Revetment segment adjacent to the new damages was repaired last summer. The area immediately upstream of the repair developed a new slump during the February 5-11, 2020, flood. The repaired section performed well. The Fort Dent levee slump is 6-8 feet away from an active trail posing a significant risk. This project may require a setback to create a more stable slope, which would require acquiring property from the City of Tukwila, Starfire Soccer complex.

VII. WHITE RIVER

A. Impacts

Minor flooding occurred along the White and Greenwater rivers during the February 5-11, 2020, flood. While the White River only reached Phase 2, the pool elevation behind Mud Mountain Dam was the highest since 1996. In an effort to minimize downstream flood impacts, sustained dam releases of approximately 6,000 cfs (Phase 2) continued for over a week after other rivers in the County had begun receding. River spotters with the USACE patrolled the Lower White River and provided real-time updates to the Flood Warning Center and White River Basin team that proved to be valuable in the absence of County flood patrols.

Overview of impacts during the flood:

- Greenwater Upper Revetment overtopped threatening access and at least two residential structures in the neighborhood. Residents placed sandbags to protect homes. Post-flood inspections observed diminished rock facing on the revetment.

- 3rd Ave SE in front of Pacific Park in the City of Pacific was closed due to water on the roadway.
- Minor damages to river facilities were observed at eight locations on the White River in the cities of Auburn and Pacific. Enhanced monitoring of these damage sites is recommended (see Appendix B).

B. Potential Mitigation Actions

Near-term repairs are planned for the super sack barrier at the A-Street Trailer Court Revetment (RM 6.40), which has been subject to vandalism and was recently opened up to allow access to the river for the removal of wood from the A Street Bridge pier by the City of Auburn. These actions have diminished the flood protection function of the super sacks. Furthermore, preliminary hydraulic modeling indicates that the super sacks may not provide flood protection for a Phase 3 event. Prior to and after the February 5-11, 2020, flood RFMS met with the cities of Pacific and Auburn and recommended replacing the super sacks with a HESCO barrier extending farther upstream to provide more robust, temporary flood protection until a permanent flood-risk reduction solution is implemented at this location.

VIII. FLOOD WARNING PROGRAM

Operations

The Flood Warning Program has several components including Flood Monitoring, Flood Patrol and Sandbag Distribution. Flood Monitoring consists of operating the Flood Warning Center to gather, analyze and distribute information to assist people in making critical health, safety and economic decisions before, during and after flood events. The Flood Warning Center was open for 144 continuous hours from February 5-11, 2020, the longest opening since 2009. Typical for a major flood event, there was a tremendous demand for flood warning information. Over 1,000 phone calls were made to the Flood Warning Center. The vast majority of callers asked about one or more of these topics: river forecasts, expected flood impacts, dam operations, road closures and sandbag availability. Many more people were able to obtain information using a variety of King County flood warning services. The Flood Warning App was accessed a record 24,500 times from February 6-7, 2020, and 15 separate Flood Alert messages were sent to thousands of subscribers. Response to this season's floods also highlighted problems with internal and external information sharing and operations as well as potential solutions as described in the Recommendations section.

Flood Patrol crews inspected critical river facilities continuously for six days with two person crews working 12-hour shifts. Flood Patrol crews are dispatched when any major river rises above Phase 3 thresholds or sent to other areas of the County based on conditions. During

powerful winter storms, one or two rivers typically exceed Phase 3; however, in the February 2020 flood five river systems exceeded Phase 3. To meet the increased need for flood patrol crews, other WLRD staff were recruited from outside the established flood patrol roster. A total of 37 staff worked to fill 50 shifts during the event. The crews identified damages to many river facilities throughout the flood event. Information about damages was shared with basin technical staff to assist in evaluating whether emergency repairs were necessary. Observed damages information was the basis for additional inspections and included in the Preliminary Damage Assessments.

The King County Flood Control District provides funding to partner agencies to operate sandbag distribution sites. Twelve of these sandbag distribution sites were open during the February 5-11, 2020, flood in locations throughout King County including four operated by King County RSD at their shop sites. The City of Issaquah also funds and operates a sandbag distribution site intended for their residents, businesses and property owners. As expected, there was high demand for sandbags during the flood. King County RSD briefly ran out of sandbags at the Black Diamond site but quickly replenished the stock. Due to flooded roads throughout the County, many people encountered longer driving times that expected to access the sandbag materials.

A. Recommendations

The recommendations described in this section reflect a wide range of actions to improve flood warning services to the public. Many of the recommendations are operational changes that are expected to allow staff to work in a more efficient and effective manner. Others involve scoping or implementing expanded flood warning services. All recommendations are interrelated and should be prioritized and managed using a LEAN process to ensure flood warning services are delivered as efficiently and effectively as possible. Many of the actions recommended in this section comprise a significant body of work that is not included in the 2020 work program and staff allocation model. Should the Flood Control District wish to proceed with these recommendations using RFMS staff, other operating programs and capital projects may have to be deferred or scaled back to accommodate the work.

Evaluate expanding the flood warning system to include Lake Sammamish and the Sammamish River: The Flood Warning Center received a high volume of calls from concerned Lake Sammamish residents. Staff were able to answer many of the questions related to historical data and current conditions: however, there is no available forecast data for Lake Sammamish elevations or Sammamish River flows. Possible added services include: Sammamish River and tributary gage data to the Flood Warning website and App, flood patrol services and a patrol book for the Sammamish River, and continuous forecast modeling of the lake elevation and river flow. This scoping effort could examine the options, costs and anticipated benefits of providing

advanced flood warning capabilities to anyone that may be impacted by high lake levels or flooding in these areas. This scoping effort would be coordinated with the County's existing lake monitoring program.

Flood Level Viewer feasibility analysis: The Cedar River Flood Level Viewer is an interactive web-based mapping application that shows inundation areas and flood depths at various modeled high flow conditions. It allows the public to understand potential flood risk and take action to become more resilient and less vulnerable to flooding. During the February 2020 flood, this tool proved to be effective in communicating risk to the public, particularly since it had been over 11 years since the Cedar River had a higher peak flow. The displayed inundation areas and depths on the Cedar River Flood Level Viewer were similar to conditions that occurred during the February 2020 flood at comparable flows.

The analysis would determine the feasibility of producing similar Flood Level Viewers on other major rivers using existing information and models already available to the public such as those used for FEMA's flood insurance rate map studies and reports.

Evaluate adding gaging in the lower Snoqualmie Valley: This effort would evaluate further implementation of the recommendations (shown below) from the "Snoqualmie River Hydrologic Study, Evaluation of Flooding Trends and Current Conditions" report prepared for King County by Watershed Science & Engineering and Herrera Environmental Consultants in 2018. Since the time of these recommendations, the Snoqualmie Valley Preservation Alliance (SVPA) has implemented a gage data collection and transmission system. This proposal is intended to evaluate the expansion of that system.

- Expand the amount of web-based real-time detailed information available to the public for flood levels and flow rates. Increasing access to detailed information would help ensure that farms, residents, and businesses can be safer during floods.
- Develop a distributed data collection program that expands and institutionalizes the web-based social network that exists. Landowners could be an important resource in implementing the program. This effort could be developed and implemented cooperatively by Snoqualmie Valley Preservation Alliance (SVPA), the King County River and Floodplain Management Section, and the King County Flood Control District.
- Collect, store, and share flood-related data for analysis over time. Data should include high water marks, photos, and flood observations.

Planning for remote Flood Warning Program operations: On the heels of the 2019-2020 flood season, our world found itself in the midst of a global pandemic. Responding to COVID-19 and related stay at home orders made it clear that King County should prepare for the need to be able to operate the Flood Warning Center remotely, whether due to another pandemic, or other catastrophic situation. Preparation would also be needed for the Flood Patrols crews to operate

safety in many different circumstances. This proposal is to develop an emergency response plan for all elements of Flood Warning Program operations.

Use of Microsoft Teams (Teams) by Flood Warning Program Staff: Teams is a collaboration tool that provides remote and dispersed staff with the ability to work together and share information via a common space. There is no additional cost to use Teams and it is already available to all King County staff as part of the standard software and services package provided by the Department of King County Information Technology. During flood events, the timely sharing of critical information is always challenging between Flood Monitoring and Flood Patrol staff, incoming and outgoing staff, Basin technical staff and management. A Teams flood warning workspace could be setup and customized to facilitate communication and collaboration. The tool could be used to coordinate staff availability and scheduling which has been a persistent challenge and assist with remote operations. Use of Teams could begin at the start of the next flood season in October 2020 after thorough testing, training and documentation.

Develop and implement Issaquah Creek Flood Patrol operational plan: Flood Patrol crews are dispatched to major rivers when they rise above Phase 3 thresholds. However, Patrols have not consistently operated on Issaquah Creek. Facilities can be evaluated to determine which should be inspected during floods to provide early detection of potentially hazardous conditions. Flood Patrol instructions, routes, maps and training materials could be developed. Flood Patrols could operate on Issaquah Creek anytime Phase 3 or higher conditions occur starting in October 2020.

New Flood Patrol Books: Flood Patrol crews and Technical staff rely on custom laminated map books that show aerial imagery, flood facilities and inspection information. Patrol books have never been produced for Issaquah Creek but are needed to be able to operate Flood Patrols and perform facility inspections. A new Issaquah Flood Patrol Book may be able to be completed prior to the next flood season in October 2020. The February 5-11, 2020, flood significantly changed the landscape making the existing Cedar River Patrol book less relevant. An updated Cedar Flood Patrol Book could be completed prior to the 2021-2022 flood season after new aerial imagery is available.

Addition of images to the Flood Photo Viewer dataset: The Flood Photo Viewer is a collection of hundreds of oblique images of past flood events taken via helicopter that have been geo-referenced and included in the King County iMap tool. The web-based mapping application allows users to see images of past floods based on the geographic location. This tool provides visual context of the impacts of floods for specific areas dating back to 1946. It can be helpful in preparing and responding to floods. During the February 5-11, 2020, flood, thousands of photos were taken during several helicopter tours. RFMS could select, geo-reference and add images to the Flood Photo Viewer dataset prior to the start of the next flood season in October 2020.

Implement Substantial Damage Assessments and Property Owner Outreach: As part of King County's participation in the National Flood Insurance Program (NFIP), the County is responsible for making substantial damage assessments on flooded homes, businesses, and other buildings located in the floodplain. Any buildings with damage totaling more than 50 percent of their pre-damaged value, are required to be brought into compliance with current flood code. The NFIP expects proactive outreach about this requirement to minimize the possibility of residual health hazards or of flood repairs being completed without compliance with flood code. Assessments are led by the permitting agency. Substantial damage assessment program typically include the following elements: (1) immediate post-flood assessments of flooded structures, (2) letters to property owners informing them of the substantial damage estimates, and (3) outreach to floodplain residents about resources toward flood recovery. Substantial damage requirements should be a key piece of the ongoing floodplain management work sessions to improve coordination between RFMS and DLS-Permitting Division. For future flood events, trained staff and template outreach letters can support consistent and timely communications with residents in flood hazard areas.

Evaluate Flood Phase thresholds and descriptions: This season's flood events provide an opportunity to assess the impacts of rivers at a variety of river flows and adjust Phase thresholds and descriptions accordingly. For instance, the Tolt River reached Phase 4 but severe flooding did not occur which indicates that the flow threshold is set too low. Any proposed changes should be coordinated with partner agencies. If any Flood Phase is changed, the information will need to be communicated in brochures, web sites, Flood Warning App, Flood Alerts and other materials. This effort could be completed prior to the next flood season in October 2020.

Evaluate expanded use of Flood Alerts: The Flood Alert System is an automated notification system that sends pre-defined alert messages to registered users via phone, email or text message when upward flood phase changes occur or during flood related emergencies. The Cedar River Council has requested that the Flood Warning Program provide additional notifications related to dam releases by Seattle Public Utilities during flood events. RMFS could evaluate the specific conditions throughout the County that would warrant additional notifications and determine if pre-defined messages can adequately communicate the requested information. Expanded use of the Flood Alerts was implemented following the 2009 damage to Howard Hanson Dam to provide additional notification services to people living or working in areas along the Green River that were at a higher risk of flooding.

Evaluate expansion of Sandbag distribution program: The sandbag distribution program provides Residents in some areas of the Cedar River floodplain between Renton and Landsburg found it difficult to obtain sandbags during the February 5-11, 2020, flood and several neighborhoods were completely inaccessible due to inundated roads. It is possible that there are other areas in the County that have similar challenges obtaining sandbags. RFMS could evaluate expanding the sandbag distribution in many areas of the County, including reaching out Community Emergency Response Teams and exploring service provision contracts.

Flood App push notification capability: The King County Flood Warning App has been continuously improved since its launch in 2012. The Flood Warning Program has received several requests to increase alerting capabilities. One possible option is to add functionality to the app that would allow users to customize alerting settings. An app user could select a river gage, specify a specific flow, and receive a sound or visual notification when the river gage reaches that threshold. One drawback is the App would provide automated notifications based on unverified gage data unlike King County Flood Alerts that are only sent after staff review. The USGS offers a free WaterAlert notification service that provides unverified gage notifications. The proposed App feature could provide another notification option.

IX. STRUCTURAL REPAIRS, NON-STRUCTURAL MITIGATION AND NEXT STEPS RECOMMENDATIONS: POST-FLOOD RESPONSE ACTIONS

A. Post-Flood Home Buyout Inquiries

Following the February 5-11, 2020, flood, WLRD and Emergency Management have been contacted by landowners who were isolated by fast flowing flood waters, suffered flood damage to their homes, or have had to evacuate their homes due to channel-migration induced landslide threat. In a flood event briefing to the Council's Local Services Committee, WLRD committed to maintain and share a list of landowners who have requested buyout assistance since the flood event. This list was provided to the District and Councilmembers in March. At the time of this report, the District has authorized WLRD to prepare an appraisal for the first home on the list, which has experienced repetitive flood insurance losses; funding needed to complete this acquisition is identified in the draft mid-year budget materials. Since the transmittal of the original list, one additional landowner on the Cedar River at the site of the Byers Curve emergency sandbag placement has expressed interest in being considered for buyout. The updated list is attached as Appendix A.

B. Post-Flood Inspections and Recommended Responses

Once flood flows receded sufficiently for inspections, RFMS teams inspected 373 of the 511 river facilities maintained by King County. At the time of this report post-flood inspections have not been completed on the Middle Green River and on sections of the Snoqualmie River due to a reduced pace of field work as staff modify practices to ensure compliance with COVID-19 safety guidance (e.g., maintaining physical distancing in vehicles and vessels used for facility inspection). These inspections are anticipated to continue into the summer of 2020.

Post-flood inspection teams documented 136 problem sites for further evaluation. The District's adopted flood risk policies from the 2006 Flood Hazard Management Plan and the flood risk criteria contained in Appendix K of the 2013 Flood Hazard Management Plan Update were used to evaluate the risk at each problem site. Basin teams provided an initial screening of each site using the criteria to evaluate consequence, severity, and urgency, as well as an initial categorization of the most appropriate response. Multi-disciplinary workshops were convened to ensure clear and consistent understanding of the problem site, application of the criteria, and the most appropriate category for post-flood response actions. The results of these workshops is included in Appendix B, a summary of the results with a description of each category of response action is provided in Table 1 below. The mid-year budget revision includes additional budget authority necessary to complete the Category A project in 2020, and to initiate capital planning work in category B, C, and E4. For sites in category E2, additional budget is requested where necessary to expand the existing capital project scope.

Table 2. Recommended Post-Flood Response Actions.

Category	Description	#	Notes and examples
A	Complete repair in 2020	1	<u>Green River</u> • The Tukwila Revetment site on the Green River, damages observed upstream and downstream of the 2019 repair site. Repairs can be completed in 2020 using the existing permit.
B	Initiate in 2020, complete repair in 2021-2022	7	<u>Cedar River:</u> • CRT2 (Zone D) on the Cedar River immediately downstream of the emergency repair completed in February 2020. • Belmondo and Brodell revetments on the Cedar River where SR 169, the fiber optic cable, and the regional trail are at risk. <u>Green River</u> • Fort Dent Park in Tukwila; two sites that would be completed as one project. <u>Issaquah Creek</u> • Sole access road at risk (Irwin revetment). • Residential structures at risk (Jerome revetment).
C	Assessment to determine whether a project is needed as part of 2021-2026 CIP	6	Site characterization and risk assessment at the following locations: <u>Cedar River</u> • Assess risk in the Dorre Don neighborhood where the river has avulsed into a new channel (RM 16.5). This may result in recommending rescheduling the medium-term project planned for this area in the Cedar Capital Investment Strategy (CIS). • Assess risk at engineering log jam (ELJ6) in the Cedar Rapids reach.

Category	Description	#	Notes and examples
			• Assess risk to SR 169, the fiber optic cable and the regional trail at the CRT 5 and CRT5B revetments. The CRT 5B site also includes the Williams NW pipeline. <u>Issaquah Creek</u> • Assess potential risk to sole access roadways serving 30 homes (SE 156th at the Momb revetment) and 70 homes (Bayless revetment in the Sycamore neighborhood of the City of Issaquah).
D	Monitor	77	Monitor - no capital action needed here. Follow up monitoring during routine low flow inspections and future post-flood inspections.
E1	Requesting policy direction regarding potential landowner outreach	10	Locations where acquisition has previously been identified as a risk reduction strategy, either through the District's capital investment strategies or through the "Current Flood and Channel Migration Hazard List." Before recommending investments in capital repairs at these sites, requesting policy direction from the District on whether landowner outreach should be initiated under Section 8.6.4 of the District's acquisition policy.
E2	Incorporate into existing CIP project	9	Additional scope and schedule, implemented by RFMS: • Add Camp Freeman, Buck's Curve, and Herzman damage sites to existing Herzman project, shift construction from 2021 to 2022. Additional scope, implemented by others: • Riverbend Lower added to Riverbend project managed by ERES, construction anticipated in 2021 or 2022. Incorporate into existing work, no change to budget anticipated: • Stuck River Drive (White), Jan Road and CRT7 (Cedar), Holberg (Tolt), and Circle River Ranch (Snoqualmie).
E3	New Capital Investment Strategy	12	Recommendations developed through CIS on Sammamish (underway in 2020) and White (recommended for 2021) rivers.
E4	New / Initiate CIP projects	4	Solutions are more complex than a repair and will take more than 2 years; recommend initiating new capital construction project in mid-2020. The four projects are Taylor-Crowall on the Cedar; and Dutchman, Stossel Right Bank and Joy on Snoqualmie.
E5	Corps Emergency Assistance Plan	3	Coordinate with USACE through Emergency Assistance Plans on the Green River at the Briscoe and McCoy levees, as well as 2 sites on the Desimone levee. Separate capital projects may be established to implement recommendations in the 2021-2026 CIP.
E6	Minor maintenance action	1	Minor maintenance action through the operating budget at the Elkington mitigation site on the Cedar River.

Category	Description	#	Notes and examples
F	FCD policy direction	4	Policy question for FCD: Problem site is not associated with existing public flood protection infrastructure. Examples include: • Riverbank erosion that threatens a residential structure evacuated during the flood event on Issaquah Creek, landowner is interested in selling or stabilizing riverbank (Appendix B). • Riverbank erosion that threatens regional trails on the Cedar and Snoqualmie rivers. Cedar River site is in the City of Renton; coordination with the City has occurred. • Landslide site along Issaquah Creek in the Four Creeks neighborhood; landowner is working with DLS and geotechnical consultant to assess risk to the structure.
Totals		**136**	

Along with the evaluation of problem sites that warrant action in 2020, RFMS also identified actions that could potentially be accomplished by other partners (e.g., King County Roads Services Division, WLRD's Ecological Restoration and Engineering Services Unit, or consultants), and assumed that the new project team authorized in the 2020 Flood District budget would be hired and provide capital program capacity by the end of September 2020. At the time of transmittal, Roads Services Division had no additional capacity in their 2021-2022 work program, but may add some sites as back-up projects should staff capacity become available.

The February 2020 flood response effort and recommended programmatic and project actions are significant. Should the District wish to implement any of these actions beginning in 2020, options to adequately resource work program additions or adjust project phasing would be developed for the District's consideration.

RFMS also recommends that the 2021 budget process reconsider revisions to the schedule of the Cedar CIS as a result of changing flood risk in the Byer's Bend and Dorre Don neighborhoods.

Appendices

Appendix A: Post-Flood Landowner Property Acquisition Inquiries

Appendix B: 2020 Facility Damage

#	Parcel Number	River	Type of mapped hazard	Part of Capital Investment Strategy? (Tolt, Cedar, MF and SF Snoq only)	Consistent with a project on the CIP already	CIP project name	FEMA Insurance Repetitive Loss?	Urgency (e.g. red tag, isolated)	Acquisition Policy: Imminent Risk?	Acquisition Policy: Section 7 Mapped Flood Hazard?	Notes	Estimated Cost
1	3223069089	Cedar	Floodway, CMZ	Y	Y	WLFL7 CEDAR RES FLOOD MITIGATION	Y (RL number: 0077513)	Access cut off; isolated (Byers Rd and 184th).	Y	Y	Home flooded 2-3 feet above finished floor elevation, garage and truck flooded, sole access cut off.	$627,000
2	5111400177	Cedar	Floodplain	Y	Y	WLFL7 CDR PRE-CONST STRTGC ACQ	N		Y	Y	Basement flooded. Wants to sell. Damage reported to OEM. Part of Byers future project area under CIS. Included in Cedar Pre-Construction Acquisition project.	$590,000
3	1461400005	Cedar	Floodway/ Floodplain, CMZ	N	Y	WLFL7 CEDAR RES FLOOD MITIGATION	N	Evacuated during flood.	Y	Y	Evacuated during flood. In floodway. Home is in moderate CMZ, right at transition to severe. This moderate risk is why it was not included in the CIS as part of the Residential Flood Mitigation project list. Multiple outbuildings are in severe CMZ. The District could consider this to be consistent with the Residential Flood Mitigation project.	$595,000
4	3223069040	Cedar	Floodway/ Floodplain	N	Y	WLFL7 CEDAR RES FLOOD MITIGATION	N	Access cut off; isolated floodwaters (Byers Rd and driveway).	Y	Y	House and outbuildings surrounded by floodwater. Basement and outbuildings flooded. House in floodplain, much of property also in floodway. Not included under CIS due to moderate risk; the District could consider this to be consistent with the Residential Flood Mitigation project.	$650,000
10	5111400168	Cedar	Floodway/ Floodplain, CMZ	Y	Y	WLFL7 CDR PRE-CONST STRTGC ACQ	U	Home is uninhabitable. Tenants evacuated.	Y	Y	Overbank flows flooded house and cut-off neighborhood sole access road. King County crews deployed to place supersacks along bank in emergency action. Heating and electric systems destroyed. Subflooring flooded and finished floor saturated. Foundation sunk by several inches - internal doors don't close. Tenants forced to evacuate. Septic system damage is unknown at this time.	$486,100

#	Parcel Number	River	Type of mapped hazard	Part of Capital Investment Strategy? (Tolt, Cedar, MF and SF Snoq only)	Consistent with a project on the CIP already	CIP project name	FEMA Insurance Repetitive Loss?	Urgency (e.g. red tag, isolated)	Acquisition Policy: Imminent Risk?	Acquisition Policy: Section 7 Mapped Flood Hazard?	Notes	Estimated Cost
5	1425079022	Tolt	Landslide / Floodplain	N	Y	WLFL3 TOLT R NATURAL AREA ACQ	N	Evacuated, not red-tagged.	Y	N	Structures below landslide hazard area, evidence of ground cracking. Family has evacuated, staying with friends. Parcel is split by Tolt River Rd. West side with structures in landslide area; east side without structures has floodplain area. Since the home itself is not in a mapped hazard area it was not included in CIS. However, this structure is in the Tolt Natural Area project area; the District could choose to include it as part of this project.	$580,000
6	1023069031	Issaquah	Floodplain	N/A	N	N/A	N	Isolated by floodwaters surrounding home. Elderly family member was evacuated with help from RFMS staff. Not red tagged.	Y	Y	Wood in creek shifted channel towards home causing flooding. Lost 10 feet of riverbank due to flood; river is 19 feet from home. Crawlspace flooded and home surrounded, floodwaters just below first floor elevation.	$859,000
7	1023079036	Raging	Adjacent to CMZ, adjacent to landslide	N/A	N	N/A	N	Red tag and evacuated.	Y	Y	Slope failure likely resulting from channel migration, home in danger of falling in river. In 2017 home was 70 feet from edge, now it is 17 feet away. Red tagged 2/12/20.	$710,000
8	3221079180	Unnamed closed depression pond	Unmapped. Likely floodplain.	N	N	N/A	N	Family has evacuated and currently homeless. House is unsuitable for occupancy.	Y	N	8-inches of floodwater had been inside the manufactured home. Significant damage to electrical, floors and walls. Majority of structure is in mapped wetland.	$414,600
9	7349700070	SF Skykomish	Severe CMZ and floodway	N	Y	WLFL0 SF SKYKMSH REP LOSS MIT	N	Bank erosion has undercut deck; possible home foundation cracks.	Y	Y	Elderly homeowner is in the hospital with serious health concerns. Family may take emergency measures to stabilize bank if homeowner choses to return home (terminal illness).	$436,000
											Estimated Cost:	**$5,947,700**

Category*	River	Facility Name (or Problem Site RM)	Location (RM = River Mile)	Description of Damage	Summary of Flood Risk Evaluation	Planning Level Cost Estimate	Preliminary Damage Assessment Submitted? (Y/N)
A	Green	Tukwila Trail	RM 10.88 (Left Bank)	50 feet of erosion upstream of 2019 repair project, and 150 feet of erosion downstream of the 2019 repair project.	Facilities include the Green River Trail, approximately 20 commercial facilities and Interurban Ave South in vicinity of damage area. Bank erosion with very steep slopes increases vulnerability to the trail and adjacent industrial businesses.	$ 300,000	Y
B	Cedar	Belmondo	RM 10.3 (Left Bank)	Erosion and scour have resulted in loss of toe and bank rock, oversteepened and undercut banks, and localized bank erosion (scallop). Damage is observed along approximately 50 feet of facility, near the upstream end.	Critical facilities (Utilities, CRT, SR 169). Regional impact extents. Potential human injury from sudden change in conditions. Generally exposed bank - damage likely to occur next major high-flow event.	$ 100,000	N
B	Cedar	Brodell	RM 3.4 (Right Bank)	Oversteepened downstream from houses, and generally overall. Facility is a mixture of riprap, concrete pieces, and in places concrete slabs laid against the bank. Approximately 10-foot tension crack observed near furthest downstream home where a slab has slid down into the river. Additional minor damage upstream of facility. Downstream portion of facility observed to be oversteepened, with undercut banks (approximately 200 feet in length).	Residential land use and critical facilities (Utilities, CRT, SR 169). Regional impact extents. Potential human injury from sudden change in conditions. Damage may occur next flood season/likelihood increasing.	$ 500,000	N
B	Cedar	Cedar River Trail Site 2 (CRT 2 Zone D)	RM 6.5 (Left Bank)	Erosion and scour have resulted in loss of toe rock and general oversteepening of bank, along approximately 100 feet of upstream end of facility.	Critical facilities (Utilities, CRT, SR 169). Regional impact extents. Potential human injury from sudden change in conditions. Damage may occur next flood season/likelihood increasing.	$ 193,000	Y
B	Green	Fort Dent	RM 11 (Right Bank)	Pavement erosion along levee/revetment at fence and cracking of trails along a 78-foot segment. Cracking for approximately 28 feet, 5 feet wide and 10-12 deep.	Damage increases vulnerability of the heavily used regional Green River trail and regional soccer complex (Starfire) and Tukwila Park. Erosion increases vulnerability to trail and soccer fields.	$ 100,000	Y
B	Green	Fort Dent	RM 11.2 (Right Bank)	This is a location that had approximately 38 feet of erosion prior to flood event. Total eroded area is now approximately 127 feet in length, 16 feet wide and 11 feet deep.	Damage increases vulnerability of the heavily used regional Green River trail and regional soccer complex (Starfire) and Tukwila Park. Erosion increases vulnerability to trail and soccer fields.	$ 400,000	Y
B	Issaquah Creek	Irwin R	RM 7.77 - 7.74	Irwin R revetment damage - 5 feet of scour at downstream end of revetment facility with rock missing near a private driveway bridge (sole access) and near a major arterial, Issaquah Hobart Rd.	Further damage to the facility could cut off the sole access to one resident (via a private road and bridge over the creek).	$ 75,000	Y

Category*	River	Facility Name (or Problem Site RM)	Location (RM = River Mile)	Description of Damage	Summary of Flood Risk Evaluation	Planning Level Cost Estimate	Preliminary Damage Assessment Submitted? (Y/N)
B	Issaquah Creek	Jerome	RM 5.63 - 5.69	Jerome revetment damage - 70 feet of erosion of the left bank revetment facility.	The Jerome Revetment protects three private residences in the City of Issaquah. Erosion of the revetment could result in loss of property and damage to private utilities. Loss of bank in front of middle property. 70 linear feet (LF) of erosion.	$ 140,000	N
C	Cedar	Cedar Rapids Right (ELJ 6)	RM 7.4 (Right Bank)	Erosion and scour have resulted in loss of upper ballast, dislodging of key logs, shearing of piles, and damage to hardware connections, to an Engineered Log Jam (ELJ #6), within the Cedar Rapids reach.	Undeveloped land in floodplain; recreational risk. Potential human injury from sudden change in conditions. Structure severely damage and vulnerable - damage likely to occur next major high-flow event.	$ 186,000	Y
C	Cedar	Cedar River Trail Site 5B (CRT 5B)	RM 9.9 (Left Bank)	Erosion and scour have resulted in loss of toe and bank rock, oversteepened and undercut banks. Scour has undermined numerous large trees, likely to fall into the channel likely resulting in further damage of the bank. Damage is observed along approximately 50 feet of facility, near the downstream end.	Critical facilities (Utilities: Williams NW pipeline and fiberoptic line, regional trail, SR 169). Potential human injury from sudden change in conditions. Damage may occur next flood season/likelihood increasing.	$ 100,000	N
C	Cedar	Cedar River Trail Site 5 (CRT 5)	RM 9.4 (Left Bank)	Erosion and scour have resulted in loss of toe and bank rock, oversteepened and undercut banks (some portions cantilevered). Scour has undermined numerous large trees, likely to fall into the channel likely resulting in further damage of the bank. Damage is observed along approximately 350 feet of facility, near the upstream end.	Critical facilities (Utilities, CRT, SR 169). Regional impact extents. Potential human injury from sudden change in conditions. Damage may occur next flood season/likelihood increasing.	$ 300,000	N
C	Cedar	RM 16.5	RM 16.5 (Left Bank)	The main channel has avulsed into the previous left floodplain, leading to erosion of the channel bank, adjacent to 231st Pl SE.	Residential land use and critical facilities (231st Pl SE, utilities). Moderate impact extents (structures, roads). Potential human injury from sudden change in conditions. Damage may occur next flood season/likelihood increasing.	$ 50,000	N
C	Issaquah Creek	Momb	RM 10.39 - 10.47	Momb revetment damage - 30 feet of erosion and 25 feet of slumped bank at the upstream end of the revetment facility. Undercutting may have cut into SE 156 St (a sole access road) bed prism. There is also a landslide immediately downstream of the facility on the same left bank that may pose a risk of channel migration to residential properties on the Right Bank.	Damage to the SE 156th St. road next flood season could cut off the sole access to a community of about 30 homes. More erosion at the downstream end of the facility may further destabilize the steep slope of the landslide and threaten downstream homeowners.	$ 110,000	Y

Category*	River	Facility Name (or Problem Site RM)	Location (RM = River Mile)	Description of Damage	Summary of Flood Risk Evaluation	Planning Level Cost Estimate	Preliminary Damage Assessment Submitted? (Y/N)
C	Issaquah Creek	Bayless	RM 5.19-5.21	Bayless revetment damage - 125 feet of erosion of the right bank revetment facility.	The Bayless Revetment protects a sole access bridge to a residential community (about 70 homes) in the City of Issaquah. The facility was flanked and/or overtopped during the flood resulting in flooding of the low lying Sycamore neighborhood in the City of Issaquah behind the revetment. Continued erosion may result in damage to the bridge and ongoing flooding to the neighborhood.	$ 250,000	N
D	Cedar	Young	RM 16.9 (Right Bank)	Erosion and scour of 80-100 LF of middle and upper bank near the middle portion of the facility.	Does not immediately endanger homes or infrastructure, but could lead to further deterioration of the facility. Facility is located on the outside cutbank at the downstream end of a meander bend.	$ 200,000	N
D	Cedar	Orchard Grove Levee	RM 17.6 (Right Bank)	Erosion and scour have resulted in loss of toe and bank rock and general oversteepening of bank, along approximately 100 feet of upstream end of facility.	Levee damage compromises facility integrity, increasing its vulnerability to further scour and potential failure. Failure of this facility could leading to impacts to people and property, behind the levee, along SE 238th St.	$ 196,000	Y
D	Cedar	Dorre Don Upper	RM 16.6 -16.7 (Right Bank)	Erosion and scour have resulted in loss of toe rock and general oversteepening of bank, in various section of the revetment, totaling approximately 65 feet in total. Additionally, bank erosion has resulted in the loss of face rock from the upper bank, along the length noted above.	Revetment damage compromises facility integrity, increasing its vulnerability to further scour and potential failure. Failure of this facility could lead to impacts to people and property, behind the revetment.	$ 130,000	N
D	Cedar	Cedar River Trail Site 6 (CRT 6)	RM 11.0 - 11.3 (Left Bank)	Erosion and scour have resulted in loss of toe and bank rock, oversteepened and undercut banks (some portions vertical). Scour has undermined numerous large trees, likely to fall into the channel likely resulting in further damage of the bank. Damage is observed along two locations, totaling approximately 200 feet.	Critical facilities (Utilities, CRT, SR 169). Regional impact extents. Potential human injury from sudden change in conditions. Damage may occur next flood season/likelihood increasing.	$ 400,000	N
D	Cedar	Rawson	RM 12.5 (Right Bank)	Erosion and scour have resulted in loss of toe rock and general oversteepening of bank, and localized bank erosion (scallop). Damage is observed along approximately 50 feet of facility, near the upstream end.	Revetment damage compromises facility integrity, increasing its vulnerability to further scour and potential failure. Failure of this facility could result in impacts property, behind the revetment.	$ 100,000	N
D	Cedar	Getchman Levee	RM 13.7 -13.9 (Right Bank)	Erosion and scour have resulted in loss of toe rock and general oversteepening of bank, and localized bank erosion (scallop). Damage is observed along approximately 250 feet of facility.	Levee damage compromises facility integrity, increasing its vulnerability to further scour and potential failure. Failure of this facility could result in impacts to property, behind the levee.	$ 500,000	N

Category*	River	Facility Name (or Problem Site RM)	Location (RM = River Mile)	Description of Damage	Summary of Flood Risk Evaluation	Planning Level Cost Estimate	Preliminary Damage Assessment Submitted? (Y/N)
D	Cedar	Royal Arch	RM 14.1 (Left Bank)	Erosion and scour have resulted in loss of toe rock, localized upper bank erosion, and general oversteepening of bank. Damage is observed along approximately 700 feet of facility, near the upstream end.	Levee damage compromises facility integrity, increasing its vulnerability to further scour and potential failure. Failure of this facility could result in impacts to property, behind the levee.	$ 1,400,000	N
D	Cedar	Arcadia-Nobel	RM 18.9 (Left Bank)	Damaged or missing toe rock at upstream end for approximately 30 LF.	Minor damage does not appear to present immediate threat to facility or homes.	$ -	N
D	Cedar	Maplewood Golf Course	RM 4.31 - 4.25 (Right Bank)	Between golf path bridge and SR169 bridge approximately 70 feet of bank rock is missing, with erosion and oversteepening. Upstream of facility and golf bridge approximately 200 feet of bank erosion.	Critical facilities (SR 169). Regional impact extents. Potential human injury from sudden change in conditions. Damage will eventually occur, but risk is not increasing rapidly.	$ 140,000	N
D	Cedar	Upper Elliott Park	RM 4.8 - 4.9 (Left Bank)	Significant bank erosion Upstream of facility resulting in damage to upstream end of facility and access. Culvert blocked (for Renton mitigation project). Risk of losing access. Renton wants to modify project to resolve fish access.	Access to the facility could be cut off by continued erosion. Facility is immediately downstream of 2001 Nisqually landslide site with high sediment storage and movement, abundant large wood.	$ -	N
D	Cedar	Brassfield	RM 7.1 -7.3 (Right Bank)	Erosion and scour have resulted in loss of toe rock and general oversteepening of bank, in various section of the revetment, totaling approximately 325 feet in total. A large cottonwood has been eroded from the bank, leaving a large localized scallop along the bankline.	Residential land use. Localized impact extents. Moderate flood or erosion damage, unlikely long-term impact. Damage may occur next flood season/likelihood increasing.	$ 650,000	Y
D	Green	Gateway Lowest	RM 6.55 (Left Bank)	Rocks eroded at downstream end of bridge along trail. Approximately 19 feet long, 6 feet wide and 3 feet deep.	Increased vulnerability of paved trail and businesses.	$ 38,000	Y
D	Green	Gateway Lowest	RM 6.79 (Left Bank)	Cracking along trail in three locations over a 35-foot segment of the trail. Erosion at one location, approximately 5 feet long and 5 feet wide to a depth of 1 foot.	Increased vulnerability of paved trail and businesses.	$ 10,000	Y
D	Green	Gateway Lowest	RM 6.8 (Left Bank)	Erosion area upstream of outfall over a 24-foot segment of trail. Approximately 6 feet long, 6 feet wide and 2 feet deep.	Increased vulnerability of paved trail and businesses.	$ 12,000	Y
D	Green	Gateway Lowest	RM 6.81 (Left Bank)	Erosion at trail (next to wood stairs), approximately 8 feet in length, 5 feet wide and 1.5 foot deep.	Increased vulnerability of paved trail and businesses.	$ 16,000	Y

Category*	River	Facility Name (or Problem Site RM)	Location (RM = River Mile)	Description of Damage	Summary of Flood Risk Evaluation	Planning Level Cost Estimate	Preliminary Damage Assessment Submitted? (Y/N)
D	Green	NA	RM 7.3 4030 S 117th Pl 98168. Across from Duwamish Park and 42nd Ave S levee.	Approximately 50 feet of bank erosion, 20 feet wide and 30 feet deep.	Bank erosion increases vulnerability of several single family homes.	$ 100,000	Y
D	Green	Fort Dent	RM 11.4 (Right Bank)	Landward side of trail there is approximately 7 feet of trail that has failed/sunk about 1-foot wide and 3 feet deep.	Erosion increases vulnerability to trail and soccer fields. Could be related and combined with other Ft. Dent damage areas	$ 14,000	Y
D	Green	Best Western/Nedel's	RM 12.55 (Right Bank)	Sloughing on bank near new hotel. Approximately 100 feet from building.	Increased vulnerability of hotel business.	$ -	N
D	Green	Nelson	RM 13.2 (Right Bank)	Near vertical slope. Close to W. Valley Hwy SR 181.	Increased vulnerability of W Valley Hwy.	$ -	N
D	Green	N.C. Machinery	RM 13.6 (Right Bank)	Erosion at upstream end of NC Machinery.	Increased vulnerability of businesses.	$ -	N
D	Green	Tukwila 205-Segale	RM 15.05 (Left Bank)	Eroded bank, Corps staff were not concerned about this eroded area because this is the location of the 2008 U.S. Army Corps of Engineers (USACE) repair project.	Increased vulnerability of businesses.	$ -	N
D	Green	Tukwila 205-Segale	RM 15.15 (Left Bank)	Hole in the top of levee; appears to be boring hole from previous levee projects.	Increased vulnerability of businesses.	$ -	N
D	Green	Dykstra	RM 30.55 (Left Bank)	Erosion along approximately 16 feet of the riverward toe/bench, approximately 7 feet wide and 3+ feet in depth.	This is an identified low area. Erosion increases vulnerability to single family homes.	$ 32,000	Y
D	Green	Tukwila 205-Van Warden	RM 12.55 (Left Bank)	RM 12.55 Two cracks noted, looks newer 8 feet wide on 10-foot trail, 1" length (M)	Increased vulnerability of trail and hotel business.	$ -	N
D	Green	Stoneway Upper	RM 19.8 (Left Bank)	No damage; trash observed and flagged for maintenance.	Increased vulnerability of Frager Road.	$ -	N
D	Green	Maddox	RM 21.05 (Right Bank)	Several potholes (3+) on Frager Rd S.	Increased vulnerability of Frager Road.	$ -	N
D	Green	P,D & J #2	RM 22.1 (Left Bank)	Some minor sloughing noted.	Increased vulnerability of Frager Road.	$ -	N
D	Green	Frager Road Upper	RM 22.45 (Left Bank)	Sloughing from RM 22.45-22.55. Bank sloughing, toe rock in place.	Increased vulnerability of Frager Road.	$ -	N
D	Green	Milwaukee #1	RM 24 (Right Bank)	Just downstream of bridge, RM 24, shallow slumping not into prism.	Increased vulnerability of paved trail and Foster Park.	$ -	N
D	Green	Reddington	RM 29.29 (Left Bank)	50 feet x 20 feet x 10 feet bank erosion.	Part of PL 84-99 levee system providing flood risk reduction to large residential areas in Auburn. Increased vulnerability of paved trail.	$ -	N

Category*	River	Facility Name (or Problem Site RM)	Location (RM = River Mile)	Description of Damage	Summary of Flood Risk Evaluation	Planning Level Cost Estimate	Preliminary Damage Assessment Submitted? (Y/N)
D	Green	Dykstra	RM 29.9 (Left Bank)	Rilling on top of levee; may be from burrowing animal.	Increased vulnerability to multi family homes.	$ -	N
D	Green	Dykstra	RM 30.7 (Left Bank)	Potential for debris to block pipe outlet.	Increased vulnerability of single family homes.	$ -	N
D	Green	Hamakami	RM 35.65 (Right Bank)	Existing bank erosion.	Increased vulnerability of agricultural land.	$ -	N
D	Green	Lone's	RM 37.5 (Right Bank)	Additional erosion at site of Lones levee setback project.	Increased vulnerability of agricultural land.	$ -	N
D	Green	Fenster	RM 31.97 (Left Bank)	Monitor erosion near trail near RM 31.97 and the anchored wood in the thalweg.	Increased vulnerability of ELJ being released downstream.	$ -	N
D	Green	O' Connell	RM 17.35 (Left Bank)	Bank slump that may compromise the slope stability for the road's guardrail and possibly the toe of the revetment.	Increased vulnerability of agricultural land and Frager Rd S.	$ -	N
D	Green	Foster Lower	RM 9.79 (Left Bank)	Partial log spanner with erosion at rootball.	Increased vulnerability of golf course.	$ -	N
D	Green	Kent Airport	RM 24 (Left Bank)	At RM 24 there is an approximately 100-foot-long slump. Uncertain whether the slump affected the revetment toe.	Increased vulnerability of trail and warehouses.	$ -	N
D	Greenwater	Greenwater Lower	RM 0.46 - 0.50	Damage at upstream end of facility (15 feet x 15 feet) near creek confluence. Damage at downstream end of facility also 15 feet x 15 feet.	Facility protects private residences on the right bank, and the right bank abutments of the sole access bridge.	$ 60,000	N
D	Issaquah Creek	Irwin L	RM 7.70 - 7.60	Irwin L revetment damage - 15 feet of rock was eroded along upstream end of revetment on private property.	Continued erosion of the left bank may impact the landowner's buildings that lie behind the revetment.	$ 30,000	Y
D	Issaquah Creek	Roath	RM 5.53 - 5.55	Roath revetment damage - 25 feet' of erosion of the left bank revetment facility in two locations.	The Roath Revetment protects a residential community. Long-term channel migration could result in slope failure that may impact homes in the vicinity.	$ 100,000	Y
D	Issaquah Creek	Issaquah-Hobart Bank Repair	RM 7.84	Flood flows eroded 90 feet of bank and threatened Issaquah-Hobart Rd. KC Roads repaired the bank with a rock revetment. There continues to be debris in the channel. There is 5 feet of bank erosion immediately upstream of the repair revetment.	While immediate risks are low to Issaquah-Hobart Rd, there is a threat of continued erosion upstream of the repaired revetment.	$ -	N
D	Issaquah Creek	North of East Fork	RM 3.06 - 3.08	North of East Fork revetment damage - 120 feet of erosion of the right bank revetment facility.	The North of East Fork Revetment protects a City of Issaquah Parks storage and fleet yard. Continued erosion of the steep slope could result in slope failure that may impact parking lot in the vicinity.	$ 240,000	N

Category*	River	Facility Name (or Problem Site RM)	Location (RM = River Mile)	Description of Damage	Summary of Flood Risk Evaluation	Planning Level Cost Estimate	Preliminary Damage Assessment Submitted? (Y/N)
D	Issaquah Creek	Issaquah-Hobart Blocked Culvert	RM 7.5	A tributary creek that flows through a box culvert under Issaquah-Hobart Rd. was blocked by debris. KC Roads crews removed much of the debris, but there remains very little conveyance in the culvert.	During flood flows, another blocked culvert could flood Issaquah-Hobart Rd.	$ -	N
D	Issaquah Creek	Issaquah Cr. Gage L DS	RM 11.79 - 11.82	Issaquah Creek gage L DS revetment damage - Rock from the revetment has fallen into creek at the upstream end of the facility between the facility and 252nd Ave. SE bridge where the gage station is located. There is 4 feet of bank exposed on the left bank bridge abutment.	The area of erosion is minor and does not appear to be threatening the bridge.	$ 8,000	Y
D	Issaquah Creek (Holder Creek Trib)	Urlich R	RM 0.82 - 0.90	Urlich R (Holder Creek) Revetment Damage - The 300-foot length of the revetment has been eroded and the Creek has flooded nearby private property (a house, tree farm, and farm buildings).	If not repaired, the Creek may continue to migrate toward home, outbuildings and bridge abutment.	$ 600,000	Y
D	Issaquah Creek (Holder Creek Trib)	Urlich L US	RM 0.87 - 0.92	Urlich L US (Holder Creek) Revetment Damage - The 5-foot length of the revetment has been eroded at the upstream end.	Small risk to bank.	$ 10,000	Y
D	Issaquah Creek (Holder Creek Trib)	SR 18 US	RM 1.1 - 1.21	SR 18 US (Holder Creek) Levee Damage - Erosion on Issaquah-Hobart Rd on left bank. Downed trees directing flow into the right bank. 20-foot long section of erosion under road prism.	If not repaired, Issaquah-Hobart Rd SE could be impacted by lane closure or complete closure.	$ 40,000	Y
D	Issaquah Creek (Holder Creek Trib)	SR 18 DS	RM 1.08 - 1.12	SR 18 DS (Holder Creek) Levee Damage - Downstream of levee facility, the left bank is eroded under and downstream of the SR 18 onramp left bank bridge abutment. There is 2 feet of erosion under abutment, and another 12 feet of eroded rock from the facility on the bank.	If not repaired, scour under the abutment could severely damage the SR 18 highway onramp bridge.	$ 28,000	Y
D	Raging	Upstream Brg on RB	RM 7.9	Potential flanking of downstream end of facility immediately downstream of bridge. Large pocket of missing bank protection.	Potential Risk to bridge on Upper Preston Road SE. Bridge is sole access to multiple residential properties.	$ 50,000	N
D	Raging	312th	RM 4.47	Immediately upstream of facility, or at upstream end of the facility, the 30-foot-high embankment is near vertical; with a clay lens appearing to stabilize the toe. No face rock or toe rock observed.	Erosion is located on the unprotected river bank upstream of the 312th revetment. Further bank erosion could threaten 312th Pl SE. Roadway is primary access to approximately three (3) residential properties. Embankment is in Severe CMZ.	$ -	N

Category*	River	Facility Name (or Problem Site RM)	Location (RM = River Mile)	Description of Damage	Summary of Flood Risk Evaluation	Planning Level Cost Estimate	Preliminary Damage Assessment Submitted? (Y/N)
D	Raging	Mouth to Bridge LB	RM 0.3	Intermittent toe rock and face rock observed between RM 0.0 and RM 0.3. However, no bank erosion was observed. This damage was originally documented in May and Sept. 2019.	Levee protects residential and commercial properties in Fall City.	$ -	N
D	Raging	Bridge to Bridge RB	RM 1	Approximately 200 LF of levee has sporadic toe rock; bank appears stable however.	Residential structures in vicinity of observations are set well back from river and outside of floodplain and relict channels.	$ -	N
D	Raging	Georgeff	RM 5.7	At downstream end, undercutting of upper bank near top of slope. Toe rock and face rock on lower bank still appear intact.	Property at risk is King County property owned in fee.	$ -	N
D	Raging	Hursch	RM 5.05	Approximately 100 LF of facility is missing toe protection.	Property at risk is King County property owned in fee.	$ -	N
D	Raging	Mouth to Bridge RB	RM 0.1	Scalloped bank; total loss of armoring; no face rock or toe rock observed.	Property at risk is King County property owned in fee. Mouth to Bridge Right considered for Levee Setback in this location.	$ -	N
D	Snoqualmie	Pump Station	RM 40.35	Erosion of embankment upstream of revetment that leads to Meadowbrook bridge.	Erosion is located on the unprotected river bank upstream of the Pump Station revetment. Erosion threatens City of Snoqualmie (COS) sewer line. COS planning to relocate sewer line in summer 2020; coordinate to ensure relocation is as far from the riverbank as possible. Continued embankment erosion will damage upstream end of Pump Station facility. Ongoing damage to Pump Station facility could threaten COS Pump Station.	$ -	N
D	Snoqualmie	Cherry Creek	RM 6.07	Total loss of bank for approximately 100 feet; adjacent land is Farmland Preservation Program (FPP) and appears to be active farming.	Adjacent land is FPP and appears to be active farming.	$ -	N
D	Snoqualmie	S. Wallace #2	RM 12.5	Bank sloughing over a length of approximately 100 feet, width of 5 feet and depth of 20 feet; no apparent toe or face rock.	Adjacent to FPP farmland but damage looks like it is adjacent to Adair Creek outlet.	$ -	N
D	Snoqualmie	S. Wallace #3	RM 12.9	Upper bank sloughing over a length of 100 feet. This damage which is 10 feet deep and 10 feet wide appears to be caused by a recently fallen tree; low bank intact.	Adjacent to FPP farmland.	$ -	N
D	Snoqualmie	S. Wallace #6	RM 14.1	There is a total of approximately 500 feet of damage in two locations in downstream end (300 feet) and middle (200 feet); lower bank is sloughing off, no face rock and intermittent toe rock, upper bank looks stable.	Adjacent to FPP farmland.	$ -	N

Category*	River	Facility Name (or Problem Site RM)	Location (RM = River Mile)	Description of Damage	Summary of Flood Risk Evaluation	Planning Level Cost Estimate	Preliminary Damage Assessment Submitted? (Y/N)
D	Snoqualmie	Sinnema Lower	RM 18.1	Bank scallop removed all face rock and rip rap for two 80-foot scallops.	Adjacent to non-FPP farmland.	$ -	N
D	Snoqualmie	Sinnema Quaale Lower	RM 18.5	Significant scallop; sandy soil and will continue to erode and flank remaining facility. Downstream end of the damage has some rock but it is sloughing off.	Adjacent to non-FPP farmland.	$ -	N
D	Snoqualmie	Little Friskie Revet	RM 19.4	Bank scallop in middle of facility; no toe or face rock, will continue to erode.	Adjacent to non-FPP farmland.	$ -	N
D	Snoqualmie	Robertson Upper	RM 28.15	Bank slumping in two locations (75 feet each for a total 150 feet).	Adjacent to non-FPP farmland.	$ -	N
D	Snoqualmie	Sinnema Quaale Upper	RM 17.74	Upper bank slump over a length of approximately 250 feet.	Erosion is located on the unprotected river bank between two sections of Sinnema Quaale Upper (SQU) facility, just downstream of retaining wall and 2015/16 repair site and upstream of the downstream section of Sinnema Quaale Upper. Near Hwy 203.	$ -	N
D	Snoqualmie	SE 19th Way	RM 31.5	Erosion to approximately 75 feet of unprotected embankment between facilities. Scour threatens large cottonwood that is at risk of falling into river.	Erosion is located on the unprotected river bank downstream of the SE 19th Way Revetment Repair. Continued erosion could threaten SE 19th Way, which is a localized sole access road as well as the upstream end of the downstream revetment (Sletten US).	$ -	N
D	Tolt	Frew	RM 0.62	Just upstream from culvert that drains ponds near pond berm. Some unraveling of rocks at top of facility. LWD/trees may have contributed to minor damage. This damage was originally documented in May 2019.	Significant erosion to Frew facility could pose at least low to moderate severity risk to SR 203.	$ -	N
D	Tolt	Remlinger	RM 1.13	Just upstream of Trail Bridge at 2018 repair site. Face rock on upper portion is missing; toe rock intact. Could start to unravel if high flood flows.	0	$ -	N
D	White	Oravetz School	RM 6.39 - 6.69	Low point and ponded water behind revetment in 2 locations at RM 6.5 & 6.56. The RM 6.5 may be a stormwater issue (two stormdrains and clear water there).	Overtopping and flooding behind the revetment may impact the preschool-high schools that are located in this vicinity.	$ 40,000	N

Category*	River	Facility Name (or Problem Site RM)	Location (RM = River Mile)	Description of Damage	Summary of Flood Risk Evaluation	Planning Level Cost Estimate	Preliminary Damage Assessment Submitted? (Y/N)
D	White	Valley Wall	RM 7.99 - 8.68	Landslides found upslope of the facility. The largest is approximately 15 feet wide by 30 feet tall. Tree roots with scour along facility. Bank is undercut, some sections missing toe rock, roots exposed. Fallen trees along top of bank between RM 8.2 and 8.6. At RM 8.6 tree fell from upper bank and took rock with it.	Erosion or undercutting of toe of the hillslope may exacerbate landslide potential and threaten private residences on the top of the bluff between RM 8.6 - 8.4.	$ 60,000	N
D	White	Auburn Wall	RM 7.99 - 8.30	Landslide of unknown age at upstream end of revetment. Slide appears to have no impact on the facility or river at this time.	Further erosion of the slope may cause erosion of the facility.	$ -	N
D	White	Countyline	RM 5.00 - 6.20	BR 84 wood structure continues to lose ballast material. All wood members appear in place.	In sufficient flood flows, the wood structure may lose wood members. Even if the structure is compromised, there is another buried structure and levee to protect areas landward of the levee.	$ 40,000	N
D	White	Countyline Upper	RM 6.10 - 6.38	Minor additional slumping at top of peninsula at toe of coir lifts in 2 spots.	Erosion of this facility could result in the loss of the revetment which helps limit the amount of flow into the Countyline reach.	$ 20,000	N
D	White	Game Farm Wilderness Park	RM 8.22 - 8.65	Around RM 8.3 three 10- to 15-foot scallops along bank. Section of toe rock missing at RM 8.35.	Loss of the facility comes with a relatively low risk. Facility protects undeveloped public lands.	$ 90,000	N
D	White	Segale-White	RM 6.97 - 7.65	At RM 7.4 risk of trees falling in and unstable rocks/concrete. At RM 7.2 fresh sloughing and missing riprap.	Low risk from damage to the facility. Facility protects a private access road and undeveloped private property.	$ 100,000	N
D	White	Trans-Canada	RM 8.65 - 9.37	Around RM 9.15 no toe rock was observed. At RM 8.9 about 30 LF of slumping - possibly old damage.	Low risk from damage to the facility. Facility protects undeveloped private property.	$ 120,000	N
E1	Cedar	Dorre Don Lower	RM 16.3 -16.6 (Right Bank)	Erosion and scour have resulted in loss of toe rock and general oversteepening of bank, along approximately 283 feet of upstream end of facility. Large scallop observed in location of frequent overtopping of levee, leading to inundation of the primary access road through the neighborhood (Lower Dorre Don Way SE). Multiple parcels in Dorre Don neighborhood mapped as hazard properties.	Residential land use and critical facilities (Lower Dorre Don Way SE). Moderate impact extents (structures, roads). Moderate flood or erosion damage, unlikely long-term impact. Damage may occur next flood season/likelihood increasing.	$ 566,000	Y
E1	Cedar	Bain Road	RM 15.0 (Left Bank)	Erosion and scour have resulted in loss of toe rock and general oversteepening of bank, and localized bank erosion (scallop). Damage is observed along approximately 200 feet of facility, near the upstream end. Three parcels mapped as potential hazard properties.	Residential land use and critical facilities (SE Bain Rd). Localized impact extents. Moderate flood or erosion damage, unlikely long-term impact. Damage may occur next flood season/likelihood increasing.	$ 400,000	N

Category*	River	Facility Name (or Problem Site RM)	Location (RM = River Mile)	Description of Damage	Summary of Flood Risk Evaluation	Planning Level Cost Estimate	Preliminary Damage Assessment Submitted? (Y/N)
E1	Cedar	Banchero Barnes	RM 15.8 (Right Bank)	Erosion and scour have resulted in loss of toe rock and general oversteepening of bank, in various section of the revetment, totaling approximately 207 feet in total. Additionally, bank erosion has resulted in the loss of face rock from the upper bank, along the length noted above. Two parcels are in Doris Creek/Rafter Park project area and mapped as hazard properties.	Residential land use and critical facilities (SE 225th St). Localized impact extents. Moderate flood or erosion damage, unlikely long-term impact. Damage may occur next flood season/likelihood increasing.	$ 415,000	N
E1	Cedar	Coleman-Lotto	RM 15.6 - 15.7 (Left Bank)	Entire facility is damaged or missing. Significant bank retreat. About 30-40 feet of bank erosion. One parcel mapped as hazard property.	Primary home is set back at least 100 feet. A secondary home is under construction downstream from the facility, but could be at risk from potential channel avulsion that would occupy small tributary/side channel. Damage area is on outside of meander bend cutbank downstream of Dorre Don avulsion - expect channel migration and widening to result in continued bank recession.	$ -	N
E1	Cedar	McDonald	RM 11.6 -11.7 (Left Bank)	Erosion and scour have resulted in loss of toe rock and general oversteepening of bank, along approximately 235 feet of upstream end of facility. Gouging of top of levee and upper bank and dislodging of bank rock, due to wood racking, also observed within these extents. One parcel mapped as hazard property.	Residential land use and critical facilities (SE 184th St). Moderate impact extents (structures, roads). Potential human injury from sudden change in conditions. Generally exposed bank - damage likely to occur next major high-flow event.	$ 470,000	Y
E1	Cedar	RM 11.7	RM 11.7 (Left Bank)	Erosion resulted in loss of approximately 60 feet of left floodplain (private property). Multiple parcels in the Byers Bend neighborhood project area mapped as potential hazard property.	Residential land use and critical facilities (SE 184th St). Moderate impact extents (structures, roads). Potential human injury from sudden change in conditions. Generally exposed bank - damage likely to occur next major high-flow event.	$ -	N
E1	Cedar	RM 12.9	RM 12.9 (Left Bank)	Failure of sandbag levee resulted in damage to private flood protection facilities, approximately 300 feet upstream of the Byers Curve Levee, ultimately leading to structure and roadway damages, within the Byers Road Neighborhood. Multiple parcels in the Byers Bend neighborhood project area mapped as potential hazard property.	Residential land use and critical facilities (Byers Rd SE). Moderate impact extents (structures, roads). Potential human injury from sudden change in conditions. Temporary flood protection measure in place - damage likely to occur next major high-flow event. Two landowners in potential project area have expressed interest in a buyout.	$ -	N
E1	Cedar	Erickson	RM 4.2 (Right Bank)	Upstream of facility the bank is eroded to near vertical, extending upstream to trail/highway bridge.	Residential land use. Localized impact extents. Moderate flood or erosion damage, unlikely long-term impact. Generally exposed bank - damage likely to occur next major high-flow event.	$ 900,000	N

Category*	River	Facility Name (or Problem Site RM)	Location (RM = River Mile)	Description of Damage	Summary of Flood Risk Evaluation	Planning Level Cost Estimate	Preliminary Damage Assessment Submitted? (Y/N)
E1	Greenwater	Greenwater Upper	RM 0.56 - 0.68	Facility overtopped and flanked. Where flow returned to channel facility appears to have lost material (15 feet long x 15 feet wide). 135 LF in middle of facility has diminished rock facing. 20-25 parcels identified as potential hazard properties.	Facilities protect a series of private residences from flooding.	$ 300,000	N
E1	Middle Fork Snoqualmie	Mason Thorson Ells	RM 1.9	Face rock launched and upper bank eroded over approximately 50 LF of the downstream end of the facility. Two parcels on mapped hazard list at this location. CIS project area and authorized capital project includes 18 parcels.	Missing rock compromises levee integrity, increasing its vulnerability to further scour. Further damage to downstream end of the facility could increase risk to downstream residences (1 property in close proximity, 2 properties that could potentially be impacted by changing flood flow patterns).	$ 251,101	Y
E1	Middle Fork Snoqualmie	Mason Thorson Extension	RM 1.45	Displacement of face rock for approximately 50 feet. Also erosion at upstream end of facility that could evolve to damage upstream end of facility. One parcel on mapped hazard list at this location. CIS project area and authorized capital project includes 18 parcels.	Facility primarily protects single residential property. Continued erosion upstream of facility could impact vehicle access to residence.	$ -	N
E2	Cedar	Camp Freeman	RM 6.2 - 6.3 (Right Bank)	Erosion and scour have resulted in loss of toe and bank rock, oversteepened and undercut banks, and localized bank erosion likely due to tree recruitment. Damage is observed along approximately 390 feet of facility.	Critical facilities (SE Jones Rd). Regional impact extents. Potential human injury from sudden change in conditions. Generally exposed bank - damage likely to occur next major high-flow event.	$ 780,000	N
E2	Cedar	Bucks Curve	RM 6.1 - 6.2 (Right Bank)	Erosion and scour have resulted in loss of toe and bank rock, oversteepened and undercut banks. Damage is observed along approximately 230 feet of facility.	Critical facilities (SE Jones Rd). Regional impact extents. Potential human injury from sudden change in conditions. Damage may occur next flood season/likelihood increasing.	$ 460,000	N
E2	Cedar	Cedar River Trail Site 7 (CRT 7)	RM 13.1 (Left Bank)	Erosion and scour have resulted in loss of toe and bank rock, oversteepened and undercut banks (some portions cantilevered). Scour has undermined numerous large trees, likely to fall into the channel likely resulting in further damage of the bank. Damage is observed along approximately 300 feet of facility, near the upstream end.	Critical facilities (CRT, SR 169). Regional impact extents. Potential human injury from sudden change in conditions. Damage may occur next flood season/likelihood increasing.	$ 600,000	N
E2	Cedar	Jan Road Levee	RM 13.2 -13.3 (Right Bank)	Erosion and scour have resulted in loss of toe rock and general oversteepening of bank, in various section of the levee, totaling approximately 950 feet. Additionally, bank erosion and scarring on the top of the facility has resulted in the loss of face rock from the upper bank, along the length noted above.	Residential land use and critical facilities (197th Pl SE). Moderate impact extents (structures, roads). Potential human injury from sudden change in conditions. Damage may occur next flood season/likelihood increasing.	$ 1,904,000	N

Category*	River	Facility Name (or Problem Site RM)	Location (RM = River Mile)	Description of Damage	Summary of Flood Risk Evaluation	Planning Level Cost Estimate	Preliminary Damage Assessment Submitted? (Y/N)
E2	Cedar	Riverbend Lower	RM 6.7 -7.1 (Left Bank)	Portion of facility directly upstream of avulsion site experiencing continued erosion and scour, resulting in loss of toe and bank rock and general oversteepening of bank. Condition likely to continue in near term due to head cutting, as the profile of the channel adjusts. Oversteepening condition most pronounced in downstream approximately 450 feet of remaining facility - however, loss of toe and bank rock exists for approximately 900 feet, upstream of the avulsion site.	Undeveloped land in floodway and CMZ. Regional impacts outside of damage (Utilities, CRT, SR 169). Potential human injury from sudden change in conditions. Damage may occur next flood season/likelihood increasing.	$ 2,508,000	Y
E2	Cedar	Herzman	RM 6.7 (Right Bank)	Erosion and scour have resulted in loss of toe rock and general oversteepening of bank, and localized bank erosion (scallops). Damage is observed near the upstream end of the facility, total approximately 100 feet.	Levee damage compromises facility integrity, increasing its vulnerability to further scour and potential failure. Failure of this facility could result in impacts to people and property, behind the levee.	$ 200,000	N
E2	South Fork Snoqualmie	Circle River Ranch	RM 1.5	Scour and erosion damage to upstream 50 feet of the revetment.	The facility protects four right bank property owners from channel migration.	Funded at $4,969,013 in 2020 6-year CIP.	N
E2	Tolt	Holberg	RM 1.8	Toe rock displacement along approximately 130 feet of the levee.	The facility protects right bank property owners from channel migration and flood inundation.	Funded at $500,000 in 2020 6-year CIP.	N
E2	White	Stuck River Drive	RM 7.65 - 8.14	Additional damage to existing repair site at RM 7.845. At RM 7.75 section is missing toe rock.	Damage at the facility may affect Stuck River Dr. if left unattended.	$ -	N
E3	Sammamish	Reach 3 - NE 175th to Pedestrian Bridge (SAMM_4)	RM 4.75 - 4.80	Toe failure under mature tree.	If tree fails or erosion continues will create a substantial scour hole in the revetment adjacent to the Sammamish River trail between the two 2018 Sammamish Bank Repairs site.	$ 150,000	N
E3	Sammamish	Reaches 5 and 6 - Marymoor Park to Trib 102 (SAMM_FLPGT1,2,3)	RM 11.25 - 13.5	Severe corrosion on three large flap gates, some jammed with rock or frozen open; NE 95th St, Redmond Way Bridge, Redmond Town Center stormwater pond outlet.	Backwatering of river flow into core downtown Redmond business centers. Redmond has indicated existing capacity issues with stormwater system.	TBD	N
E3	Sammamish	Reaches 5 and 6 - Marymoor Park to Trib 102 (SAMM_CLV3,4,5)	RM 11.25 - 13.5	Four urban drainage culverts with substantial sediment or erosion around them; near NE 90th St, Upstream of Redmond Way Bridge (need to GPS), just upstream of 520 bridge abutment, just upstream of Marymoor Park Bridge.	Lack of drainage during storm events from core downtown Redmond business centers. Redmond has indicated existing capacity issues with stormwater system.	TBD	N
E3	Sammamish	Reach 2 - 102nd to Wayne GC (SAMM_1)	RM 3.12 - 3.26	Substantial erosion at construction area in Park at Bothell Landing.	Loss of public parkland.	TBD	N

Category*	River	Facility Name (or Problem Site RM)	Location (RM = River Mile)	Description of Damage	Summary of Flood Risk Evaluation	Planning Level Cost Estimate	Preliminary Damage Assessment Submitted? (Y/N)
E3	Sammamish	Reach 2 - Pedestrian Bridge to 102nd Ave NE (SAMM_2)	RM 3.53 - 3.70	Several sections of over-steepened eroding bank in the trailer park. Non-conforming structures undermined.	Several trailers are at or near top of bank with significant erosion immediately below. Face rock is missing or frequently displaced by non-conforming structures. Soils are generally stable and flows low, however another large event could cause slope failure putting homes and people at risk.	TBD	N
E3	Sammamish	Reach 3 - NE 175th to Pedestrian Bridge (SAMM_3)	RM 4.29 - 4.50	Oversteepened eroding bank below trailer park. Across from outlet of North Creek.	Non-conforming bank structures such as docks and stairs show erosion below structures.	TBD	N
E3	Sammamish	Reach 3 - NE 175th to Pedestrian Bridge (SAMM_5)	RM 5.55	Substantial rill erosion adjacent to NE 175th Bridge pier. Appears to be related to failed upstream adjacent drainage swale. Minor rilling noted in fall inspection has grown substantially in the most recent flood event.	Damage to bridge pier on a major arterial road. It appears adjacent parcel may be source. Unclear if from Lazy Deuces business lot or from the Woodinville right of way parcel.	TBD	N
E3	Sammamish	Reach 3 - Gold Creek to Woodin Creek (SAMM_CLV1,2)	RM 7 - 7.5	Erosion under and some physical damage to several culverts in this reach.	If these right bank culverts fail they will cause drainage issues for farmland in the Sammamish Agricultural Production District (APD) or athletic fields.	TBD	N
E3	Sammamish	Reach 3 - NE 145th to Gold Creek (SAMM_6)	RM 7.45	Scour around 145th St bridge pier. Pier appears to be leaning. Some wracking wood material on upstream piers. Pier is older and undersized, several skinny piers adjacent to one another, buried depth unknown.	Damage to major arterial roadway.	TBD	N
E3	Sammamish	Reach 4 - NE 124th to NE 145th (APD) (SAMM_7)	RM 7.52 - 8.82	Significant rilling, erosion, and bank caving. Cavernous mammal burrows observed in fall inspection appear to have caved throughout. Needs geological inspection to determine porosity of the revetment in the APD.	Loss of rare farmland in unincorporated King County between two growing cities, Redmond and Woodinville.	$ 100,000	N
E3	Sammamish	Reach 4 - NE 124th to NE 145th (APD) (SAMM_7)	RM - 9.00	Ecology block floodwall is bulging out and safety railing pulling up from concrete foundation.	Failure would create a severe safety hazard on a highly used commuter and recreational bike trail.	TBD	N
E3	White	A-Street Trailer Court	RM 6.40 - 6.97	Recent hydraulic modeling is showing almost 800 cfs overtopping the existing supersacks during a 100 year flood that results in flooding of residential areas of Auburn, Algona and Pacific.	While CIP projects are underway downstream, overtopping at this location floods flooding in areas thought to be protected by supersacks. The long-term success of downstream projects relies on addressing flooding at this location.	TBD	N

Category*	River	Facility Name (or Problem Site RM)	Location (RM = River Mile)	Description of Damage	Summary of Flood Risk Evaluation	Planning Level Cost Estimate	Preliminary Damage Assessment Submitted? (Y/N)
E4	Cedar	Tabor-Crowall	RM 2.8 (Right Bank)	Entire facility is oversteepened. Varying amounts of rock protection on toe and face combined with areas of exposed soil.	Critical facilities (Utilities, CRT, SR 169). Regional impact extents. Potential human injury from sudden change in conditions. Generally exposed bank along 200 feet - damage likely to occur next major high-flow event.	$ 400,000	N
E4	Snoqualmie	Dutchman Road	RM 8.1	Bank eroded over a length of 200 feet in close proximity to West Snoqualmie River Road NE.	Erosion threatens West Snoqualmie River Road NE which provides the sole access to residences and business on the west side of the Snoqualmie Valley downstream of Duvall. Continued erosion of the revetment could severely limit access to the downstream property owners during or following a flood event.	Funded at $748,593 in 2020 6-year CIP.	N
E4	Snoqualmie	Stossel Brg RB	RM 21.8	Bank eroded over a length of 80 feet, width of 10 feet and depth of 12 feet just upstream of 2018 repair; no rock is visible in this damaged section. Damage extends to log structure in 2018 repair.	Adjacent land use in King County road serving as sole access to 2 commercial structures. Rapid erosion of embankment could result in changes of inundation patterns, potentially endangering residents. Agricultural land is not FPP.	$ 3,370,000	N
E4	Snoqualmie	Joy	RM 8.9 -9.0	Three separate damage locations were identified along this 860 LF-long King County owned and maintained river revetment. Each damage location is characterized as having significant slumping of the riverbank that has created near vertical bank conditions. The length of the damage locations range from 26 LF to 64 LF. Rock bank armoring and toe protection are notably absent at all five of these locations.	Adjacent property is private road serving as sole access to residential and commercial structures. Agricultural land is not FPP.	$ 3,720,000	N
E5	Green	Briscoe School	RM 16.9 (Right Bank)	Ponded water at landward toe slope, indication of potential seepage pathways. Approximately 250 feet in length, 10 feet wide and 0.5 feet in depth. Included in PL 84-99 request to the Corps.	Seepage pathway through/under levee increases vulnerability to the levee and large commercial areas in Kent, Tukwila and Renton.	$ 500,000	Y
E5	Green	Desimone	RM 14.9 (Right Bank)	Seepage, ponding and sediment at landward toe of the levee across approximately 250 feet. Included in PL 84-99 request to the Corps.	Critical levee system, failure would result in inundation of large portions of commercial and industrial areas of Tukwila, Kent and Renton and highly used transportation infrastructure. Seepage pathway through/under levee increases vulnerability to the levee and large commercial areas in Kent, Tukwila and Renton.	TBD	Y

Category*	River	Facility Name (or Problem Site RM)	Location (RM = River Mile)	Description of Damage	Summary of Flood Risk Evaluation	Planning Level Cost Estimate	Preliminary Damage Assessment Submitted? (Y/N)
E5	Green	Desimone	RM 15 - 15.2 (Right Bank)	A dozen or more boils located on landward toe of the levee, indication of potential seepage pathways along approximately a 500-foot section of the levee. No past levee improvements made in this area. Included in PL 84-99 request to the Corps.	Critical levee system, failure would result in inundation of large portions of commercial and industrial areas of Tukwila, Kent and Renton and multiple highly used roadways. Seepage pathway through/under levee increases vulnerability to the levee and large commercial areas in Kent, Tukwila and Renton.	TBD	Y
E5	Green	Mccoy	RM 24.3 (Left Bank)	RM 24.35 – 150-foot cracking noted along riverward levee crest in vicinity of PSE sub-station. Included in PL 84-99 request to the Corps. (Existing FCD project at this site managed by the City of Kent).	Part of Horseshoe Bend levee system providing flood risk reduction to significant commercial areas in Kent. Increased vulnerability of businesses.	TBD	N
E6	Cedar	Elkinton Mitigation	RM 16.3 (Right Bank)	Chained logs have dislodged from lower bank.	Undeveloped land in floodway and CMZ. Regional impacts extents (recreational hazard). Potential human injury from sudden change in conditions. Structure connections damaged and vulnerable - damage likely to occur next major high-flow event.	$ 50,000	N
F	Cedar	RM 2.2	RM 2.2 (Left Bank)	Scour and erosion resulted in significant loss of bank material and vegetation, resulting in general oversteepening of the bank.	Regionally important, developed recreational land (CRT). Regional impact extents. Potential human injury from sudden change in conditions. Generally exposed bank - damage likely to occur next major high-flow event.	$ 900,000	N
F	Issaquah Creek	Four Creeks Neighborhood Landslide	RM 9.15	A landslide on the right bank bluff downed several large trees spanning the creek and onto the left bank neighbor's property.	Stability of the vertical bluff on the right bank is uncertain. The home owner is working with DLS and a geotechnical firm to assess risk to their home. There is a sole access bridge (229th Dr SE) 200 feet downstream of the slide serving about 8 residences, but does not appear to be at risk at this time.	TBD	N
F	Issaquah Creek	Bank erosion and residential flooding	RM 7.25	During the flood, downed trees directed overbank flow into the home; home was isolated by floodwaters and residents evacuated during flood. Structure is in a mapped floodway. There is a large scour hole in front of the house. Creek is now 19 feet from the home; wellhead on top of riverbank appears to be undermined.	The homeowner is examining their options for bank repair, setting their house back, or selling their property. Their property is surrounded by KC parks property on 3 sides. In their current location, the home continues to be vulnerable to frequent flooding.	TBD	N
F	Snoqualmie	Snoqualmie Valley Trail	19.17	Further site investigation needed to assess damages.	Ongoing erosion may threaten Snoqualmie Valley Trail and AT&T regional fiber optic line located in trail.	TBD	N