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# **Regional Needs Assessment**

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## **Conveyance System Improvement Program**

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**King County**

Department of  
Natural Resources and Parks  
**Wastewater Treatment Division**

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# Introduction

This report was prepared as a part of the 2017 Conveyance System Improvement (CSI) Program plan update, undertaken by the King County Wastewater Treatment Division. It describes the process and results of the effort to identify where additional capacity will be needed through 2060 in the portion of King County’s conveyance system served by separated sewers.

This chapter gives background on the peak flow standard and the hydrologic and hydraulic models used in the analysis, followed by an overview of the needs assessment process. For more information on the flow standard and other planning assumptions, see Updated Planning Assumptions for Wastewater Flow Forecasting.

## 1.1 Peak Flow Standard

King County adopted a 20-year peak flow capacity standard for regional conveyance facilities in the separated portion of the service area in order to prevent sanitary sewer overflows (KCC 28.86.060).<sup>1</sup>To meet this standard, facilities must have capacity to convey peak flows of a magnitude that can be expected on an average of once every 20 years (20-year return interval). This return interval corresponds to a 5 percent chance that such flows or higher would occur in any given year and a 63 percent chance that such flows would occur in any 20-year period.

For the design of pump stations in the separated system, a five-year peak flow is used to set the firm pumping capacity (all pumps except the largest pump are operating).

## 1.2 Flow Models Used

To estimate current flows, simulate future flows, and determine when and where the 20-year peak flow standard will be exceeded, WTD uses the MOUSE (MOdeling of Urban SEwers) flow modelling software produced by Danish Hydraulics Institute. This software was selected because it allows the County and local agencies to share modeling data, analyses, and results. Both the MOUSE RDII hydrologic model and the MOUSE HD hydraulic model are used.

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<sup>1</sup> The federal Clean Water Act prohibits discharge of pollutants other than where allowed by National Pollutant Discharge Elimination System (NPDES) permits.

## 1.3 Overview of the Needs Assessment Process

Peak wastewater flows are used to identify capacity needs in the separated portion of the regional conveyance system. Peak flows consist of base flow (wastewater) plus infiltration and inflow (I/I).<sup>2</sup> Base flow is primarily a function of how many households and businesses are connected to the sewer system. I/I is primarily a function of the extent of sewers in the developed area served by the wastewater system and on the system's response to rainfall and groundwater conditions.

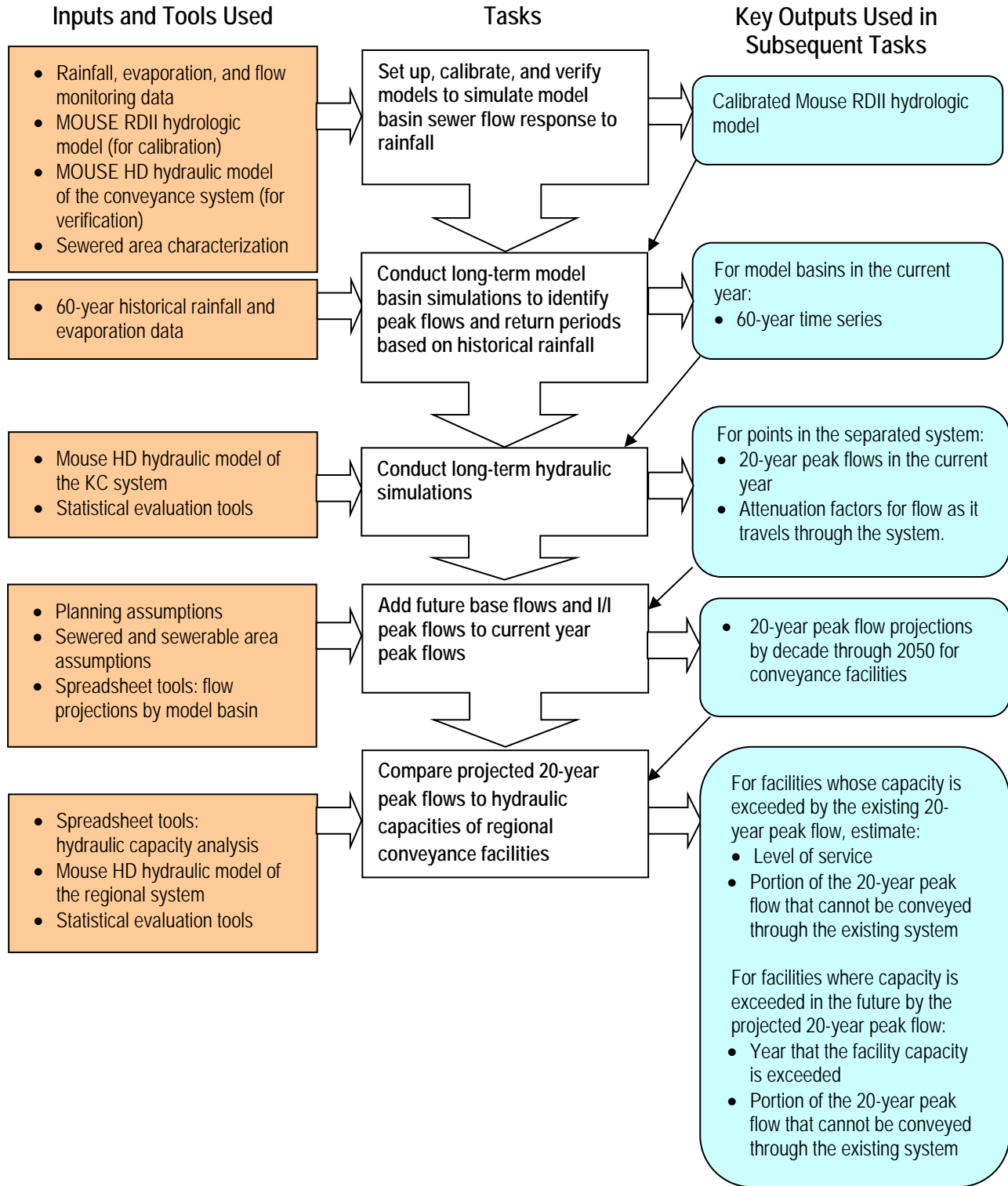
The process for identifying capacity needs consists of three main steps:

1. **Estimate current flows.** The MOUSE model was developed and calibrated to measured flows in the separated portion of the regional conveyance system. This calibrated model is used to simulate the base wastewater flow and hydrologic responses throughout a long-term simulation to estimate the current 20-year peak flow condition. The simulation establishes a baseline that represents how the system currently performs under peak flow conditions. The year that flow monitoring data was collected and used for model calibration serves as the current, or baseline, condition for estimating peak flow conditions. The baseline year for this effort is 2010.
2. **Estimate future peak flows.** Peak flows are estimated by decade through 2060 for the regional conveyance system using sewer area, population, and employment projections.
3. **Determine capacity exceedance and level of service.** Capacity constraints are identified based on when 20-yr peak flows exceed the capacity of existing regional conveyance facilities:
  - a. For facilities whose current capacity is exceeded, their level of service and the portion of the 20-year peak flow they cannot convey are estimated.
  - b. For facilities where capacity will be exceeded in the future, the year that the capacity is exceeded and the portion of the 20-year peak flow that cannot be conveyed through the existing system are identified.

Figure 1-1 illustrates this process, and Chapters 2 through 4 describe each step in more detail.

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<sup>2</sup> I/I is excess water that enters sewer pipes from groundwater and stormwater. In general, the peak flow is comprised of 30–40 percent base flow and 60–70 percent I/I.



**Figure 1-1. Process and Inputs for Identifying Capacity Needs in King County’s Separated Conveyance System**





# Estimating Current Flows

This chapter describes the methodology used for estimating current (2010) peak flows in King County's separated sewer system. It also describes the data that was used in the analysis.

## 2.1 Methodology

The method for estimating current peak flows consisted of the following tasks:

- **Obtain Input Data.** The following data were entered into the MOUSE RDII hydrologic model: basin boundary and sewer/unsewered area, rainfall, evaporation, and sewer flow monitoring data.
- **Calibrate Hydrologic Model.** Using the data, the MOUSE RDII hydrologic model was calibrated to simulate flow response to rainfall in each model basin for the calibration period. Model calibration involved matching dry-weather flow patterns first. Then model parameters were adjusted until a good match between measured flow and modeled flow was achieved for several rainfall events and groundwater conditions (different seasons).
- **Verify Model Accuracy.** To verify model accuracy, modeled flows (both base flow and I/I) for individual basins were grouped and input into the MOUSE HD hydraulic model to compare the modeled flows with measured flows at places where meters collected data from several basins. Where discrepancies were noted, the area was evaluated to determine if the model needed adjustment or if flow monitoring needed some correction.
- **Conduct Long-Term Simulations.** Once good calibrations were achieved (model results closely approximated metered data), peak flows were identified for each basin by performing long-term historical simulations using a 60-year extended time series of hourly precipitation and monthly evaporation.
- **Estimate Current Year Peak Flows.** After the long-term simulations were run, peak flows identified from the long-term simulation were ranked in order of intensity and plotted using basic statistical methods to determine the magnitude of flow that occurred on average every 20 years.

## 2.2 Input Data for the Hydrologic Model

### 2.2.1 Model Basin Delineation

Model basins were delineated to help quantify flow contributed by local sewer systems to various portions of the King County conveyance system. A number of data sources, including sewer comprehensive plans, GIS databases, aerial photographs, and available maps of local sewers, were used to determine the area tributary to each modeling flow meter. Because the

model basins are used for projecting future flows, the boundaries of the basins encompass the future basin limit through 2060, not just the currently sewered area. King County GIS parcel coverage served as the basis for geographically defining basin boundaries. Local agency representatives were consulted to verify information and establish eventual boundaries within the local service area.

Model basins in the separated part of the service area, as delineated during the 2009–2011 flow monitoring effort (see below), are shown in Figure 2-1. The average basin size is 1,164 acres.

### 2.2.2 Service Area Classification in the Separated System

Various sources of information, including sewer comprehensive plans, local sewer maps, aerial photography (2010), and parcel data, were used to determine boundaries and classifications of sewered and unsewered areas in the separated sewer area. Sewered areas were input to the MOUSE RDII hydrologic model and were also used in quantifying I/I in terms of gallons per acre per day (gpad). Unsewered areas were divided into two categories—potentially sewerable and not sewerable. The potentially sewerable areas were key in estimating how much new sewered area will be contributing to future flows.

### 2.2.3 Flow Monitoring Data

Extensive flow monitoring of the separated system is performed every 10 years. The data from each of these decennial flow monitoring (DFM) efforts is used to update the calibration of the basin models. The updated calibration becomes the basis for the “current year,” which is the year the monitoring occurs.

The most recent DFM began in 2009. A total of 235 flow meters were installed. Flow data was collected over two wet seasons from September 2009 through mid-2011.<sup>3</sup>

### 2.2.4 Rainfall Data

Rainfall data was used to calibrate the hydrologic model and establish storm flow patterns in order to identify peak flows and their return intervals. King County’s 72 rainfall gauges throughout the service area provided data for calibrating the MOUSE model. The nearest gauge was used; data from other nearby gauges were checked if the sewer flow response appeared inconsistent with the rain gauge data.

To predict the 20-year peak flow, a 60-year rainfall record was used as a reasonable approximation of future rainfall frequency and intensity. The 60-year record is an extended time series (ETS) based on Seattle-Tacoma (Sea-Tac) International Airport precipitation records.<sup>4</sup> The

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<sup>3</sup> King County Wastewater Treatment Division. 2012. Decennial Flow Monitoring Project Report.

<sup>4</sup> MGS Engineering Consultants, Inc. 2002. Extended Precipitation Time-Series for Continuous Hydrological in Western Washington. Prepared for Washington State Department of Transportation.  
[http://www.mgsengr.com/downloads/ExtendedTimeSeriesReport\\_WSDOT.pdf](http://www.mgsengr.com/downloads/ExtendedTimeSeriesReport_WSDOT.pdf). King County’s rationale for use of

ETS is based on the longest continuous record of rainfall data for the area. For modeling, it was assumed that the ETS represents future rainfall patterns likely to occur in the service area. Such a record is valuable because of the strong influence that antecedent conditions have on I/I entering a pipe. The most effective way to simulate antecedent conditions is to use a model simulation that relies on an actual series of measured rainfall.

One of the primary features of the ETS rain data is that it contains scaled rainfall datasets based on zones of mean annual precipitation (MAP Zones), which allows the model to account for locations with no long-term rainfall record that have greater rainfall than Sea-Tac.

### 2.2.5 Evaporation Data

Monthly evaporation data obtained from the Washington State University Experimental Field Station in Puyallup was used as model input for hydrologic model calibration. This site is the closest location with a long-term evaporation record and, because evaporation does not vary greatly in the Puget Sound lowlands, is deemed to be a good source of evaporation data.

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this time series is described here: <http://your.kingcounty.gov/dnrp/library/wastewater/ii/NeedsAssess/report-docs/AppA2.pdf>.

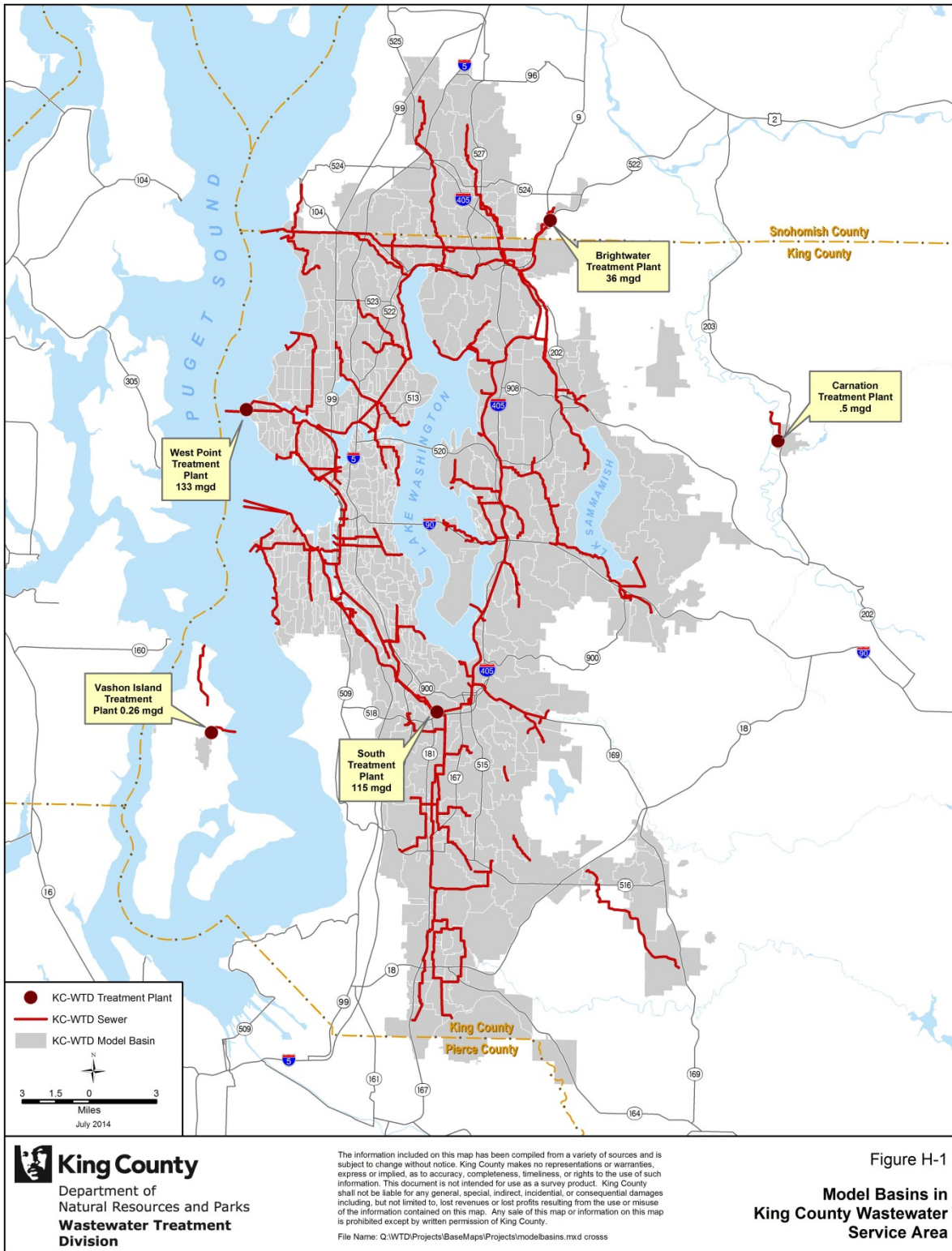


Figure -2-1. KC-WTD Modeling Basins in Separated Portion of Service Area

# Estimating Future Peak Flows

The following approach was used to project 20-year peak flows in 10-year increments through 2060 and assess capacity over time for each basin in the separated system.<sup>5</sup>

- Projected population and employment for the basin were multiplied by the expected water use rates to calculate the expected average wastewater flow. The base wastewater flow during storm events was estimated as 1.35 times the average wastewater flow.
- The new construction I/I assumption—2,000 gpad with 7 percent degradation per decade—was applied to additional land that is expected to be sewerred.
- The degradation I/I assumption—an increase from the previous 10-year increment by 7 percent—was applied for sewerred areas.
- The future peak 20-year I/I was added to the base wastewater flow.
- Flows were attenuated as they were conveyed downstream to reflect the difference in response times between basins. The attenuation factors were derived using the MOUSE HD hydraulic model simulations.

The 20-year peak flows for each basin were placed into an Excel spreadsheet containing all the King County pipe segments in the separated system. The resulting peak flows are the 20-year peak flows associated with each King County pipe segment.

## 3.1 Initial Hydraulic Capacity Analysis

The Excel spreadsheet was used to compare existing capacities with projected 20-year peak flows by decade to determine the capacity of gravity pipes, force mains, and pump stations:

- Capacity for gravity pipes was assessed by grouping adjacent pipes into hydraulically representative pipe reaches, consisting of trunk lines of contiguous pipes of a common diameter located between major connections. The use of pipe reaches to assess capacity allows for local surcharging (water above the crown of the pipe) in individual pipes as long as the overall pipe reach is not surcharged. Pipe reach capacity was calculated from Manning's equation for pipes flowing full under steady, uniform flow conditions. For use in this equation, a representative gradient was derived as the vertical difference between the upstream and downstream inverts of the pipe section divided by the sum of the individual pipe lengths in the pipe section.

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<sup>5</sup> For more detail, see [Updated Planning Assumptions for Wastewater Flow Forecasting](#).

- Force main capacities were calculated as the product of the cross sectional area for a pipe flowing full and a maximum velocity of 10 feet per second (fps).
- Specifications for peak pump station capacities are documented in the 1999 WTD offsite facilities publication.<sup>6</sup> Updated pump station capacities based on subsequent testing and analyses were used where available.

## 3.2 Supplemental Hydraulic Modeling

The MOUSE HD hydraulic model was used to model all trunks identified as having a capacity constraint, either currently or at some point in the future, to refine the initial conveyance capacity estimate. This modeling evaluated local head losses at pipe bends, expansions and contractions, and parallel pipe bifurcations and convergences, as well as hydraulically complex facilities such as inverted siphons, low-head crossings, and drop structures. It provided information on pipe sections with varying slopes and the extent of surcharging in each reach. In some cases, a minimal amount of surcharging may provide enough capacity to accommodate the saturation peak flow. Figures 3-1 and 3-2 show a pipe profile without and with surcharging.

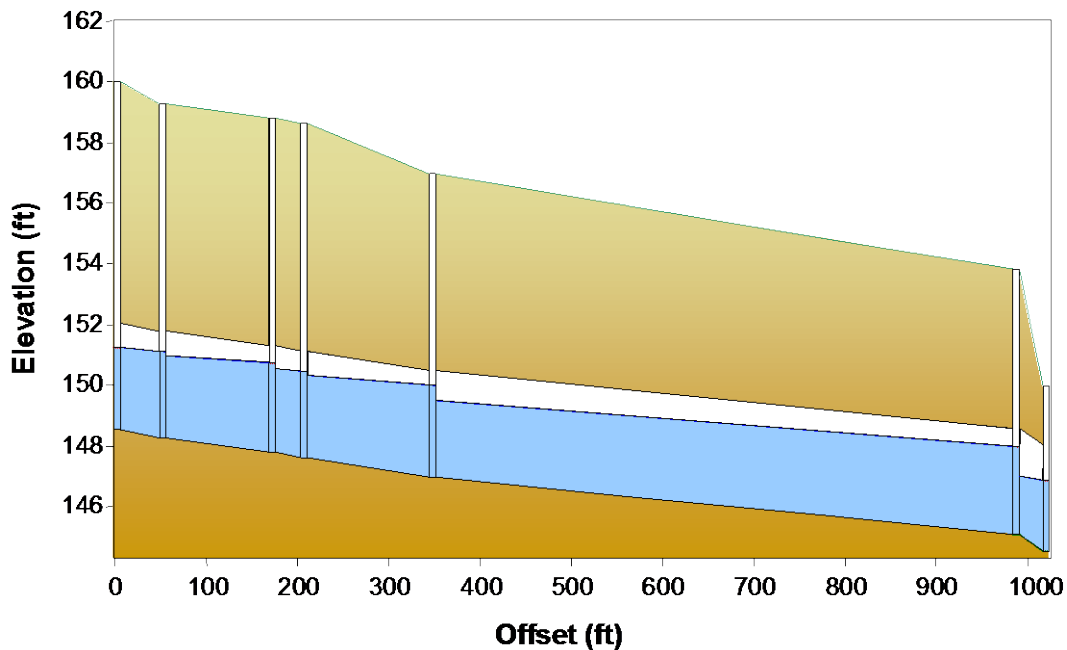


Figure 3-1. MOUSE Profile Without Surcharging

<sup>6</sup> The offsite facilities brochure (last revised 1999) is available online at <http://www.kingcounty.gov/environment/wtd/About/System/OffsiteFac.aspx>.

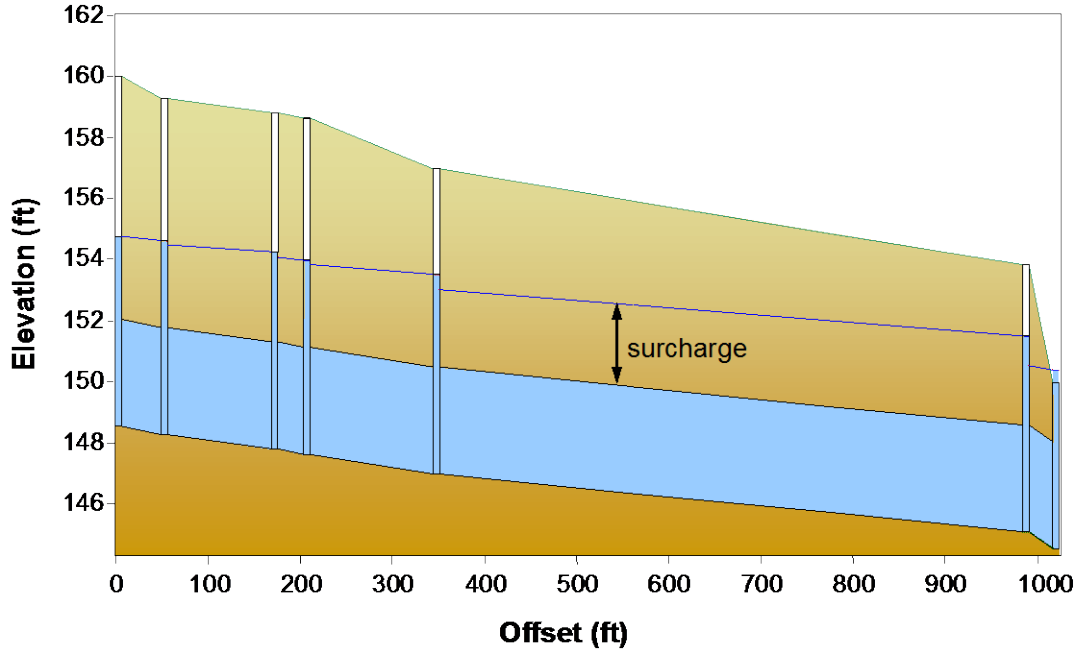


Figure 3-2. MOUSE Pipe Profile with Surcharging





## Chapter 4

# Determining Capacity Exceedance and Level of Service

This chapter describes the methodology used to determine if and when pipeline capacity will be exceeded.

Available capacity was compared to projected 20-year peak flow demand by decade through 2060 to determine whether pipeline capacity is or will be exceeded. The year when demand will exceed capacity was determined by linearly interpolating between projected flows at the start and end of the decade (Figure 4-1).

If the projected flow in 2060 exceeds capacity by less than 5 percent, then no new facility is required. It was assumed that this exceedance will be addressed by limited surcharging and that the pipe can accommodate greater than 15-year peak flows without surcharging (Figure 4-2).

For facilities that cannot convey a 20-year peak flow without surcharging and/or overflowing under current conditions (“pre-2010”), the level of service (LOS) the facility provides was determined. LOS is defined as the return interval of peak flow that can be conveyed through the facility without significant surcharging (for gravity pipes). It was estimated by plotting the peak flow vs. return interval, comparing the resulting curve with the facility’s capacity, and identifying the return interval that corresponds to the facility’s capacity (Figure 4-3).

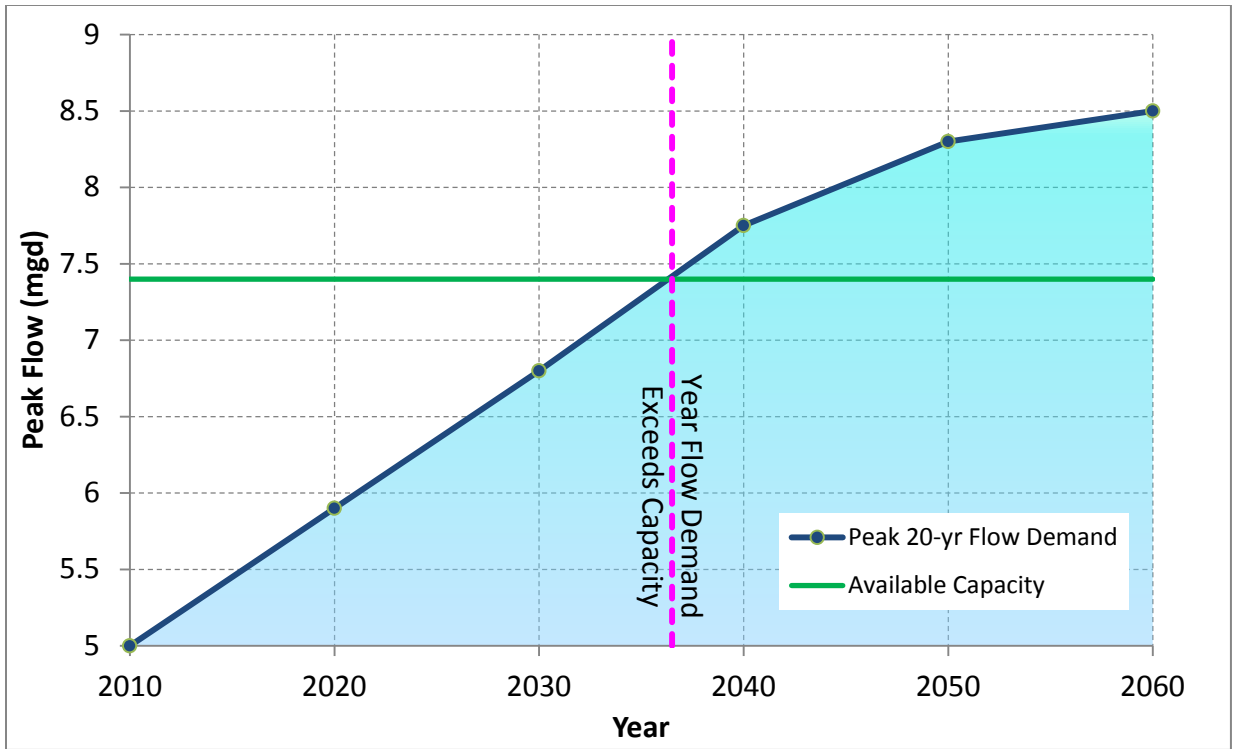


Figure 4-1. Determination of Exceedance and Year Exceeded

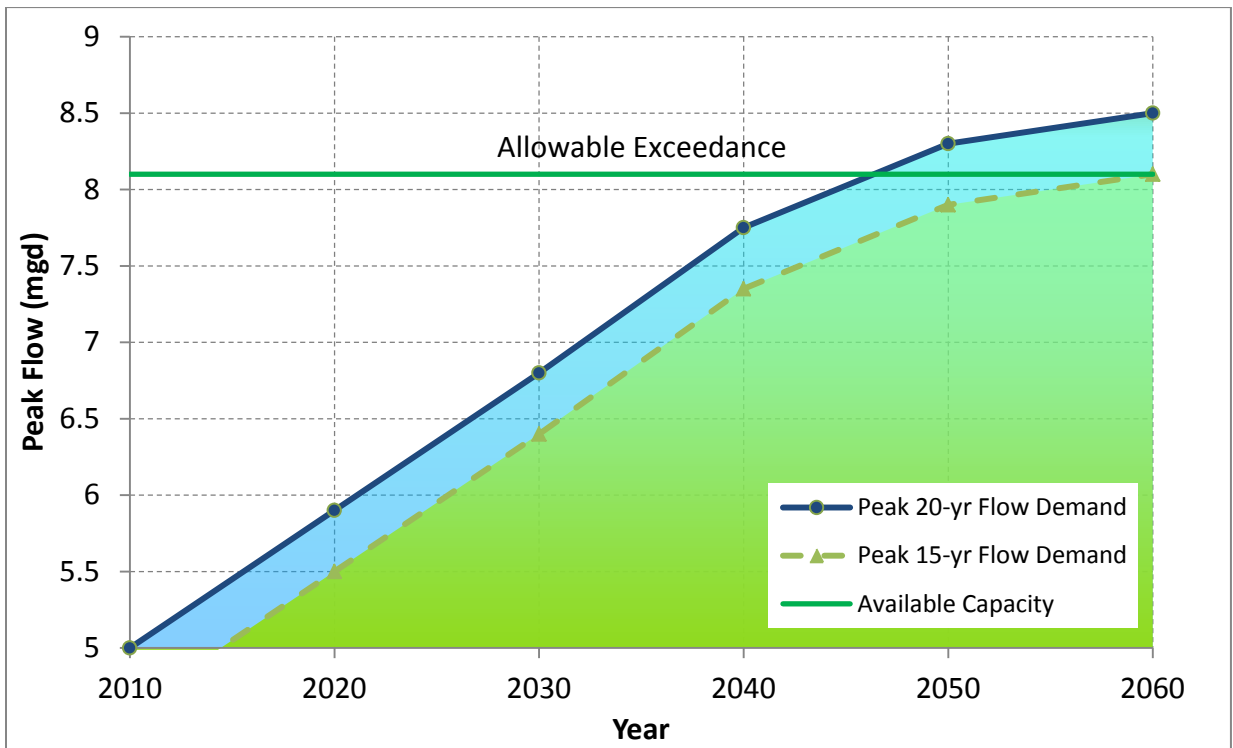


Figure 4-2. Allowable Exceedance at 2060 Saturation Flow Demand

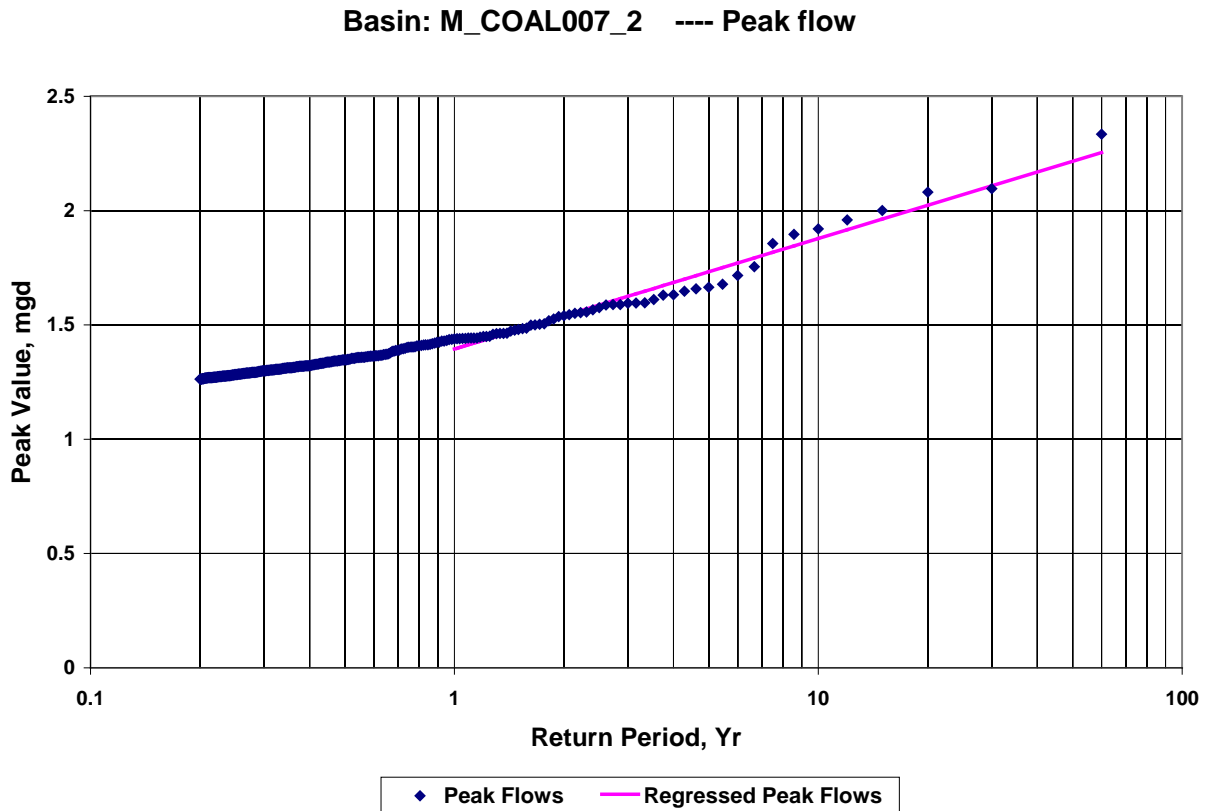


Figure 4-3. Assigning Return Intervals to Simulated Peak Flows



# Identified Capacity Needs

This chapter presents and discusses the 2010–2060 conveyance capacity needs identified through the procedures described in the preceding chapters. It first summarizes the needs for King County’s wastewater service area and then describes the needs for each CSI planning area.

## 5.1 Service Area Capacity Needs

Figure 5-1 shows the locations of identified pre-2010 to 2060 conveyance capacity needs, including pipelines and pump stations, and CSI projects in progress to address some of these needs. Table 5-1 lists the needs in the order of the decade that the 20-year peak flow is or will be exceeded (earliest decade first) and by estimated LOS for facilities whose capacity was exceeded before 2010 (lowest LOS first). It was assumed that the LOS for facilities where capacity was not exceeded before 2010 is greater than 20 (meets the 20-year peak flow standard).

Table 5-1 also indicates whether or not a need had been identified in the 2007 CSI plan update. Because of improved flow monitoring data that includes larger storms, some facilities shown as exceeding the standard before 2010 may not have been identified in the 2007 plan update.

The needs identification process found that the capacities of 77 conveyance facilities are below or will fall below the standard sometime in the 50-year planning period. Over half of the facilities (40) currently do not meet the standard. These facilities, especially those with an LOS of less than 10, will be the focus of the process to identify and prioritize CSI projects that increase their capacity to meet the standard. The breakdown of these facilities according to their LOS is as follows:

- 16 facilities have an LOS below 5, which means there is a one in five chance that an overflow will occur in any given year. CSI projects are under way to address eight of these needs. One of the 16 needs was not identified in the 2007 CSI plan update.
- 13 facilities have an LOS of 5–10. Projects are under way to address two of these needs. Three of the needs were not identified in the 2007 CSI plan update.
- 11 facilities have an LOS of 10–20. No projects are in progress to address these needs. Two of the needs were not identified in the 2007 CSI plan update.

The South Green River–Kent planning area has the most facilities (five) with current capacities below the 20-year peak standard, an LOS of less than 10, and no CSI projects in progress to address the needs. The Northeast Lake Washington planning area has four such facilities. More detail on each planning area follows, starting with areas in the north and moving southward.

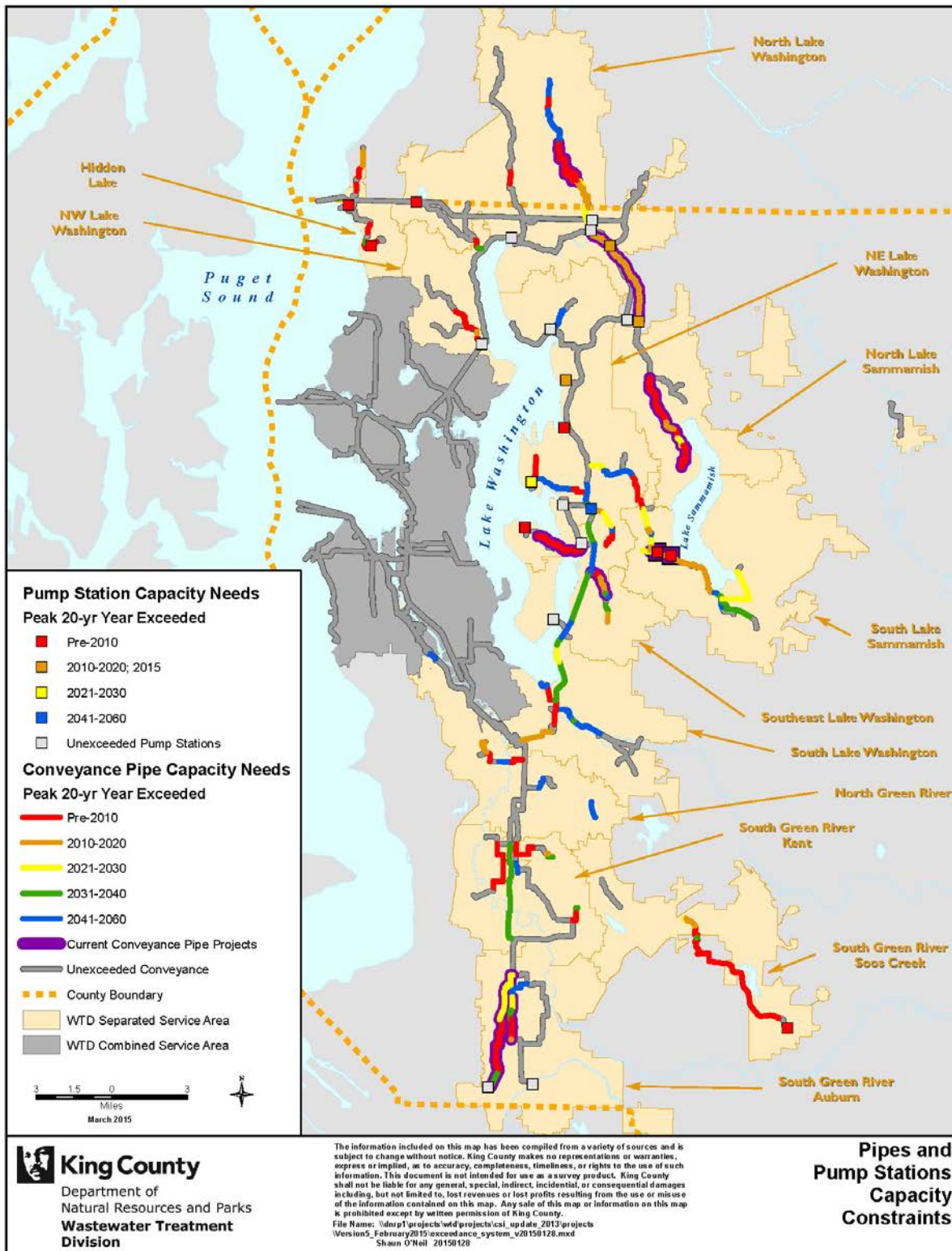


Figure 5-1. Locations of Identified Conveyance Capacity Needs in Separated Sewer Service Area

**Table 5-1. Identified Conveyance System Capacity Needs Organized by Decade Exceeded and Estimated Level of Service**

Need	CSI Planning Area	Decade Capacity Exceeded	Estimated Level of Service in 2010	Identified in 2007 CSI Update	Capital Project in Progress to Address Need
Medina Trunk	NE Lake Washington	pre-2010	<5	Yes	Not in 6-year CIP
Auburn-West Interceptor	South Green River/Auburn	pre-2010	<5	Yes	Kent – Auburn Conveyance System Improvements Project Phase B
Auburn-West Valley Interceptor	South Green River/Auburn	pre-2010	<5	Yes	Kent – Auburn Conveyance System Improvements Project Phase B
Algona-Pacific Trunk	South Green River/Auburn	pre-2010	<5	Yes	Kent – Auburn Conveyance System Improvements Project Phase B
Richmond Beach Pump Station	Hidden Lake	pre-2010	<5	Yes	Not in 6-year CIP
Thornton Creek Trunk	NW Lake Washington	pre-2010	<5	Yes	Not in 6-year CIP
Richmond Beach-Edmonds Interceptor	Hidden Lake	pre-2010	<5	Yes	Not in 6-year CIP
Tukwila Freeway Crossing	North Green River	pre-2010	<5	No	Not in 6-year CIP
Kent-Cascade Relief Interceptor	South Green River/Kent	pre-2010	<5	Yes	Not in 6-year CIP
Enatai Interceptor	NE Lake Washington	pre-2010	<5	Yes	North Mercer and Enatai Sewer Upgrades
North Mercer Island Interceptor	NE Lake Washington	pre-2010	<5	Yes	North Mercer and Enatai Sewer Upgrades
Garrison Creek Interceptor	South Green River/Kent	pre-2010	<5	Yes	Not in 6-year CIP
Coal Creek Trunk	SE Lake Washington	pre-2010	<5	Yes	Coal Creek Siphon and Trunk Parallel
Heathfield Pump Station/Force Mains	South Lake Sammamish	pre-2010	<5	Yes	Sunset and Heathfield Pump Station and Force Main Upgrades
Sunset Pump Station/Force Mains	South Lake Sammamish	pre-2010	<5	Yes	Sunset and Heathfield Pump Station and Force Main Upgrades
ULID #1 Contract #4 – Kent	South Green River/Kent	pre-2010	<5	Yes	Not in 6-year CIP
Lake Hills Trunk	North Lake Sammamish	pre-2010	5-10	Yes	Lake Hills Trunk and NW Lake Sammamish Sewer Upgrade
Boeing Creek Trunk	Hidden Lake	pre-2010	5-10	Yes	Not in 6-year CIP
Lake Ballinger Pump Station	North Lake Washington	pre-2010	5-10	No	Not in 6-year CIP
NW Lake Sammamish Interceptor	North Lake Sammamish	pre-2010	5-10	Yes	Lake Hills Trunk and NW Lake Sammamish Sewer Upgrade
North Creek Trunk Extension–North	North Lake Washington	pre-2010	5-10	Yes	Not in 6-year CIP
North Creek Trunk Extension–Middle	North Lake Washington	pre-2010	<5	Yes	North Creek Interceptor
North Creek Trunk Extension–South	North Lake Washington	pre-2010	5-10	Yes	Not in 6-year CIP

Need	CSI Planning Area	Decade Capacity Exceeded	Estimated Level of Service in 2010	Identified in 2007 CSI Update	Capital Project in Progress to Address Need
ULID #1 Contract #5 – Kent	South Green River/Kent	pre-2010	5-10	Yes	Not in 6-year CIP
Medina Siphon	NE Lake Washington	pre-2010	5-10	No	Not in 6-year CIP
Yarrow Bay Pump Station	NE Lake Washington	pre-2010	5-10	No	Not in 6-year CIP
Black Diamond Pump Station	South Green River/Soos	pre-2010	5-10	Yes	Not in 6-year CIP
ULID 250 – Kent	South Green River/Kent	pre-2010	5-10	Yes	Not in 6-year CIP
Factoria Trunk	NE Lake Washington	pre-2010	5-10	Yes	Not in 6-year CIP
Tukwila Interceptor	North Green River	pre-2010	10-20	Yes	Not in 6-year CIP
Hidden Lake Pump Station	Hidden Lake	pre-2010	10-20	Yes	Not in 6-year CIP
Black Diamond Trunk	South Green River/Soos	pre-2010	10-20	Yes	Not in 6-year CIP
Hidden Lake Force Main	Hidden Lake	pre-2010	10-20	Yes	Not in 6-year CIP
North Lake City Trunk	NW Lake Washington	pre-2010	10-20	Yes	Not in 6-year CIP
Swamp Creek Trunk Extension	North Lake Washington	pre-2010	10-20	Yes	Not in 6-year CIP
Lake Hills Interceptor	NE Lake Washington	pre-2010	10-20	Yes	Not in 6-year CIP
North Mercer Pump Station	NE Lake Washington	pre-2010	10-20	No	Not in 6-year CIP
Eastside Interceptor Section 1	South Lake Washington	pre-2010	10-20	Yes	Not in 6-year CIP
McAleer Trunk	North Lake Washington	pre-2010	10-20	No	Not in 6-year CIP
Bryn Mawr Trunk	South Lake Washington	pre-2010	10-20	Yes	Not in 6-year CIP
Issaquah Interceptor Section 1	South Lake Sammamish	2011–2020	>20	Yes	Not in 6-year CIP
Lakeland Hills Trunk	South Green River/Auburn	2011–2020	>20	Yes	Not in 6-year CIP
Kirkland Pump Station	NE Lake Washington	2011–2020	>20	Yes	Not in 6-year CIP
Eastgate Trunk	South Lake Sammamish	2011–2020	>20	Yes	Not in 6-year CIP
Cedar River Interceptor Section 2	South Lake Washington	2011–2020	>20	No	Not in 6-year CIP
Sammamish Valley Interceptor	North Lake Washington	2011–2020	>20	Yes	North Lake Sammamish Diversion
Woodinville Pump Station	North Lake Washington	2011–2020	>20	Yes	North Lake Sammamish Diversion
Bothell-Woodinville Interceptor	North Lake Washington	2011–2020	>20	Yes	North Lake Sammamish Diversion
Hollywood Pump Station	North Lake Washington	2011–2020	>20	Yes	North Lake Sammamish Diversion
North Creek Trunk	North Lake Washington	2021–2030	>20	Yes	North Creek Interceptor



Need	CSI Planning Area	Decade Capacity Exceeded	Estimated Level of Service in 2010	Identified in 2007 CSI Update	Capital Project in Progress to Address Need
SE Lake Sammamish Interceptor	South Lake Sammamish	2021–2030	>20	Yes	Not in 6-year CIP
West Valley Interceptor	South Green River/Auburn	2021–2030	>20	Yes	Kent – Auburn Conveyance System Improvements Project
Eastside Interceptor Section 3	South Lake Washington	2021–2030	>20	Yes	Not in 6-year CIP
Medina Pump Station	NE Lake Washington	2021–2030	>20	No	Not in 6-year CIP
Eastside Interceptor Section 2	South Lake Washington	2031–2040	>20	Yes	Not in 6-year CIP
Auburn Interceptor Section 3	South Green River/Kent	2031–2040	>20	Yes	Not in 6-year CIP
Eastside Interceptor Section 11	NE Lake Washington	2031–2040	>20	No	Not in 6-year CIP
Issaquah Interceptor Section 2	South Lake Sammamish	2031–2040	>20	Yes	Not in 6-year CIP
Yarrow Bay Force Main	NE Lake Washington	2031–2040	>20	No	Not in 6-year CIP
Eastside Interceptor Sections 5, 6, & 7	SE Lake Washington	2031–2040	>20	No	Not in 6-year CIP
Eastside Interceptor Section 10	NE Lake Washington	2031–2040	>20	No	Not in 6-year CIP
Eastside Interceptor Section 9	NE Lake Washington	2031–2040	>20	No	Not in 6-year CIP
Issaquah Creek Interceptor	South Lake Sammamish	2031–2040	>20	Yes	Not in 6-year CIP
Eastside Interceptor Section 4	SE Lake Washington	2031–2040	>20	Yes	Not in 6-year CIP
Auburn Interceptor Section 1	South Green River/Kent	2031–2040	>20	Yes	Not in 6-year CIP
Auburn Interceptor Section 2	South Green River/Kent	2031–2040	>20	Yes	Not in 6-year CIP
Rainier Vista Interceptor	North Green River	2041–2050	>20	No	Not in 6-year CIP
Medina Force Main	NE Lake Washington	2041–2050	>20	Yes	Not in 6-year CIP
South Renton Trunk	North Green River	2041–2050	>20	Yes	Not in 6-year CIP
Wilburton Pump Station	NE Lake Washington	2041–2050	>20	Yes	Not in 6-year CIP
Cedar River Interceptor Section 1	South Lake Washington	2041–2050	>20	No	Not in 6-year CIP
South 277th Interceptor	South Green River/Kent	2041–2050	>20	No	Not in 6-year CIP
North Soos Creek Trunk	North Green River	2051–2060	>20	No	Not in 6-year CIP
Juanita Creek Trunk	NE Lake Washington	2051–2060	>20	No	Not in 6-year CIP
Eastside Interceptor Section 8	NE Lake Washington	2051–2060	>20	No	Not in 6-year CIP
Eastside Interceptor Section 12	NE Lake Washington	2051–2060	>20	No	Not in 6-year CIP

## 5.2 North Lake Washington Planning Area

Table 5-2 lists the identified capacity needs for conveyance facilities in the North Lake Washington planning area, and Figure 5-2 shows their locations. Five facilities currently do not meet the 20-year peak flow standard and do not have CSI projects under way to address the needs. The capacity constraint for two of these facilities—Lake Ballinger Pump Station and McAleer Trunk—were not identified in the 2007 CSI plan update. The Lake Ballinger Pump Station and the North Creek Trunk Extension (north and south) have an LOS of less than 10.

The North Creek Interceptor project, expected to be substantially completed in 2017, will increase the capacity of the middle section of the North Creek Trunk Extension (LOS of less than 5) and the North Creek Trunk (expected to exceed capacity in 2021–2030). The North Lake Sammamish Flow Diversion project, scheduled for completion in 2019, will address the needs of four other facilities whose capacity is estimated to be exceeded in 2011–2020.

**Table 5-2. Identified Conveyance Capacity Needs in North Lake Washington Planning Area**

Need	Identified in 2007 CSI Update	Decade Capacity Exceeded	Estimated Level of Service in 2010	Capital Project in Progress to Address Need
Lake Ballinger Pump Station	No	pre-2010	5-10	Not in 6-year CIP
North Creek Trunk Extension—North	Yes	pre-2010	5-10	Not in 6-year CIP
North Creek Trunk Extension—Middle	Yes	pre-2010	<5	North Creek Interceptor
North Creek Trunk Extension—South	Yes	pre-2010	5-10	Not in 6-year CIP
Swamp Creek Trunk Extension	Yes	pre-2010	10-20	Not in 6-year CIP
McAleer Trunk	No	pre-2010	10-20	Not in 6-year CIP
Sammamish Valley Interceptor	Yes	2011–2020	>20	North Lake Sammamish Flow Diversion
Woodinville Pump Station	Yes	2011–2020	>20	North Lake Sammamish Flow Diversion
Bothell-Woodinville Interceptor	Yes	2011–2020	>20	North Lake Sammamish Flow Diversion
Hollywood Pump Station	Yes	2011–2020	>20	North Lake Sammamish Diversion
North Creek Trunk	Yes	2021–2030	>20	North Creek Interceptor

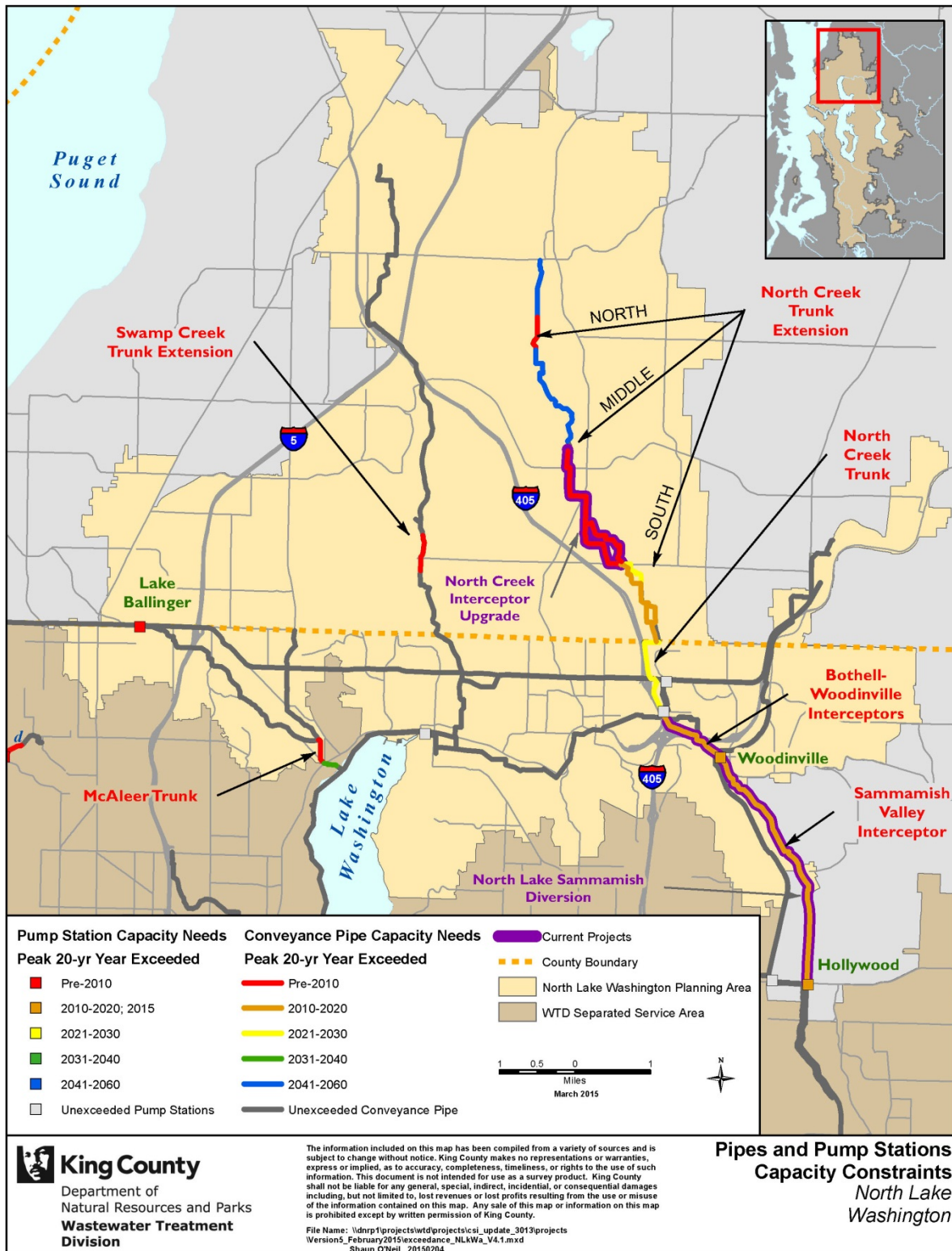


Figure 5-2. Locations of Identified Conveyance Capacity Needs in North Lake Washington Planning Area

## 5.3 Hidden Lake Planning Area

Table 5-3 shows the identified capacity needs for conveyance facilities in the Hidden Lake planning area, and Figure 5-3 shows their locations. Three facilities currently do not meet the 20-year peak flow standard, have an LOS of less than 10, and do not have CSI projects under way to address the needs. Two of the facilities have an LOS of less than 5: Richmond Beach Pump Station and Richmond Beach–Edmonds Interceptor. The two other identified needs, with an LOS of 10–20, also do not currently meet the standard and do not have projects under way.

**Table 5-3. Identified Conveyance Capacity Needs in Hidden Lake Planning Area**

<b>Need</b>	<b>Identified in 2007 CSI Update</b>	<b>Decade Capacity Exceeded</b>	<b>Estimated Level of Service in 2010</b>	<b>Capital Project in Progress to Address Need</b>
Richmond Beach Pump Station	Yes	pre-2010	<5	Not in 6-year CIP
Richmond Beach-Edmonds Interceptor	Yes	pre-2010	<5	Not in 6-year CIP
Boeing Creek Trunk	Yes	pre-2010	5-10	Not in 6-year CIP
Hidden Lake Pump Station	Yes	pre-2010	10-20	Not in 6-year CIP
Hidden Lake Force Main	Yes	pre-2010	10-20	Not in 6-year CIP

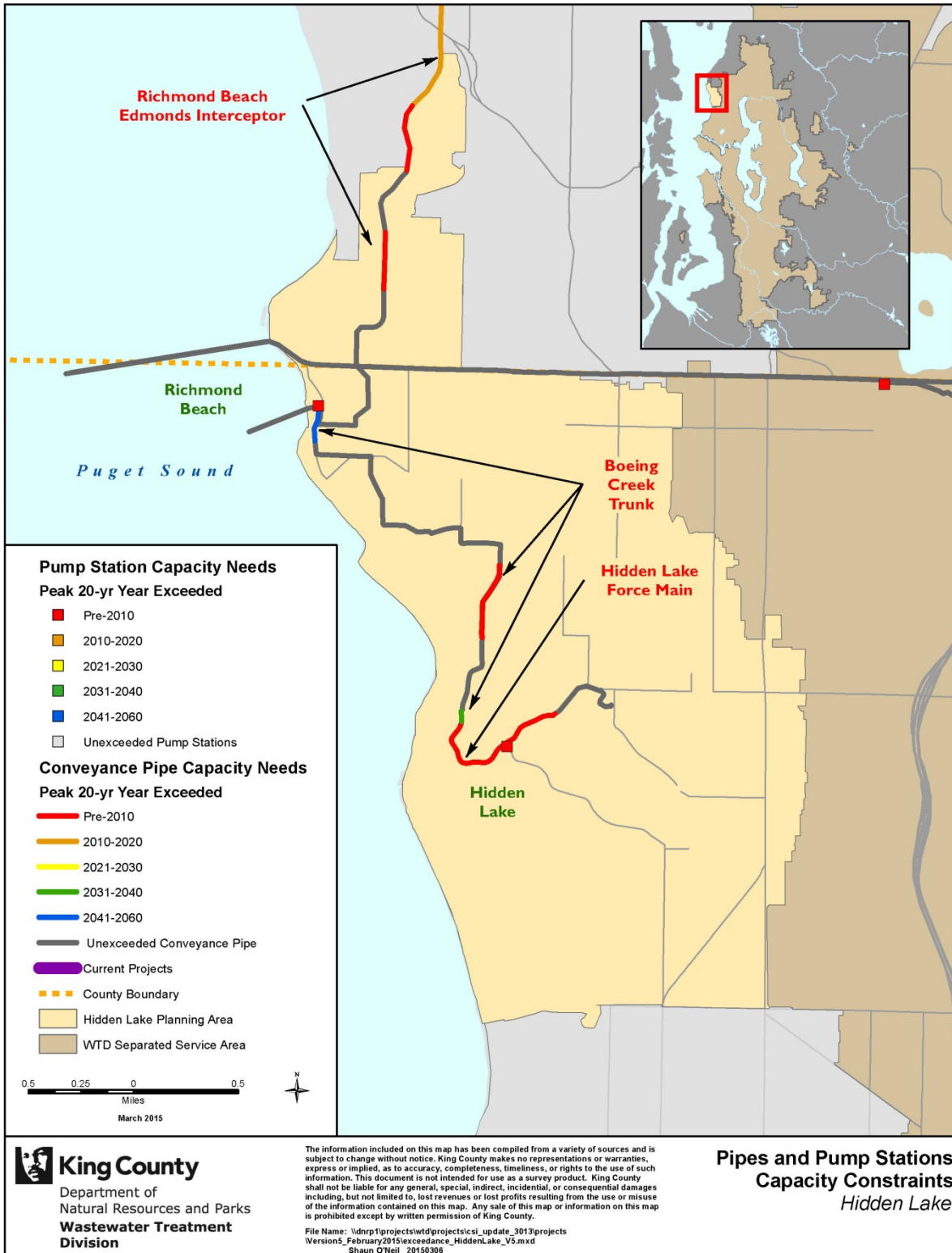


Figure 5-3. Locations of Identified Conveyance Capacity Needs in Hidden Lake Planning Area

## 5.4 Northwest Lake Washington Planning Area

Table 5-4 shows the identified capacity needs for conveyance facilities in the Northwest Lake Washington planning area, and Figure 5-4 shows their locations. Two facilities currently do not meet the 20-year peak flow standard, one with an LOS of less than 5 and one with an LOS of 10–20, and do not have CSI projects under way to address the needs.

**Table 5-4. Identified Conveyance Capacity Needs in Northwest Lake Washington Planning Area**

<b>Need</b>	<b>Identified in 2007 CSI Update</b>	<b>Decade Capacity Exceeded</b>	<b>Estimated Level of Service in 2010</b>	<b>Capital Project in Progress to Address Need</b>
Thornton Creek Trunk	Yes	pre-2010	<5	Not in 6-year CIP
North Lake City Trunk	Yes	pre-2010	10-20	Not in 6-year CIP

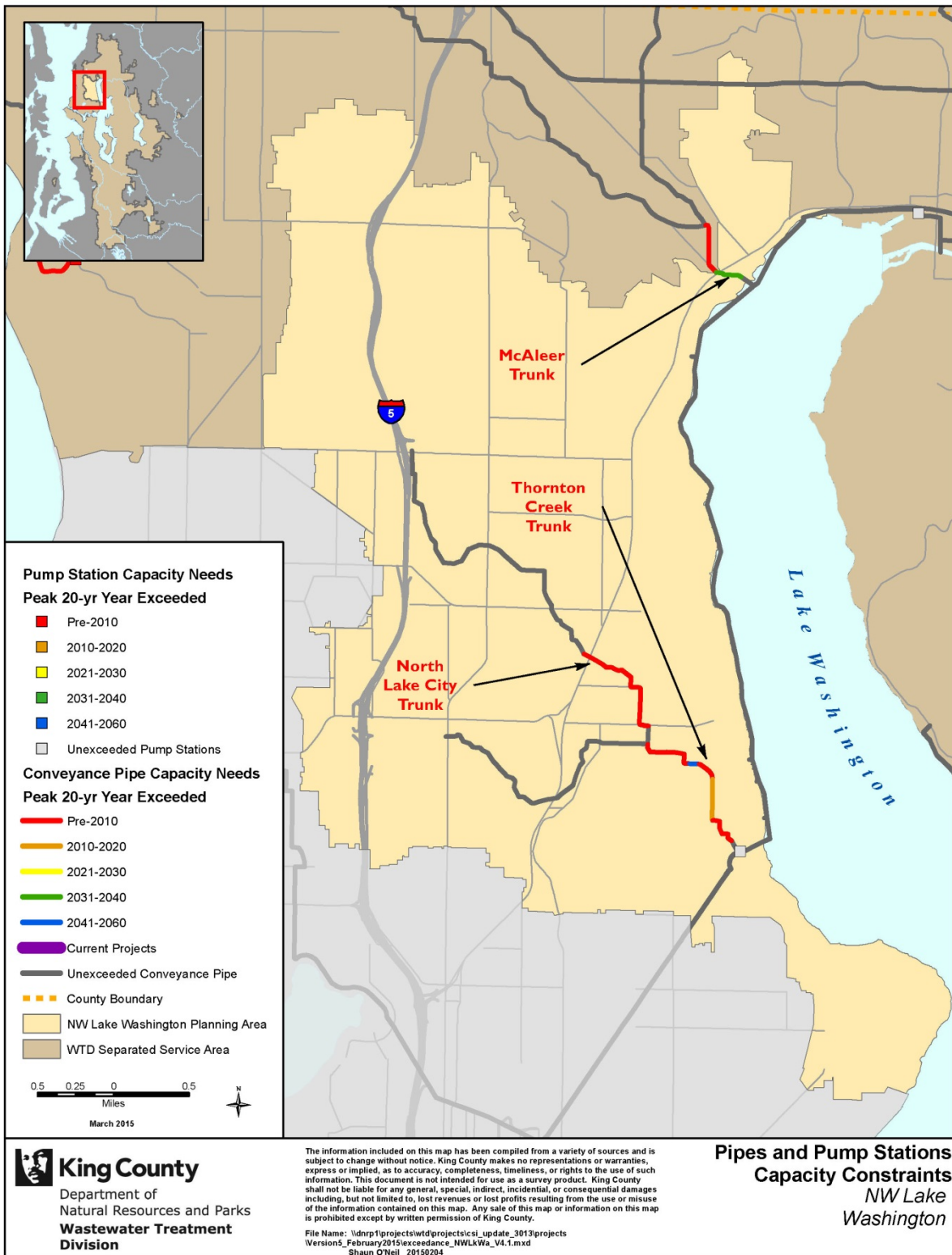


Figure 5-4. Locations of Identified Conveyance Capacity Needs in Northwest Lake Washington Planning Area



## 5.5 Northeast Lake Washington Planning Area

Table 5-5 shows the identified capacity needs for conveyance facilities in the Northeast Lake Washington planning area, and Figure 5-5 shows their locations. Six facilities currently do not meet the 20-year peak flow standard and do not have CSI projects under way to address the needs. Three of the facilities have an LOS of 5–10 and one has an LOS of less than 5. The North Mercer and Enatai Sewer Upgrades project is in progress to increase the capacity of two other facilities that have an estimated LOS of less than 5. The project is scheduled to be substantially complete by the end of 2022.

The capacity needs for three of the facilities that currently do not meet the standard—Medina Siphon, Yarrow Bay Pump Station, and North Mercer Pump Station—were not identified in the 2007 CSI plan update. The capacity of the remaining 11 facilities identified will fall short of the standard sometime between 2011 and 2060. No projects are under way to increase their capacity.

**Table 5-5. Identified Conveyance Capacity Needs in Northeast Lake Washington Planning Area**

<b>Need</b>	<b>Identified in 2007 CSI Update</b>	<b>Decade Capacity Exceeded</b>	<b>Estimated Level of Service in 2010</b>	<b>Capital Project in Progress to Address Need</b>
Medina Trunk	Yes	pre-2010	<5	Not in 6-year CIP
Enatai Interceptor	Yes	pre-2010	<5	North Mercer and Enatai Sewer Upgrades
North Mercer Island Interceptor	Yes	pre-2010	<5	North Mercer and Enatai Sewer Upgrades
Medina Siphon	No	pre-2010	5-10	Not in 6-year CIP
Yarrow Bay Pump Station	No	pre-2010	5-10	Not in 6-year CIP
Factoria Trunk	Yes	pre-2010	5-10	Not in 6-year CIP
Lake Hills Interceptor	Yes	pre-2010	10-20	Not in 6-year CIP
North Mercer Pump Station	No	pre-2010	10-20	Not in 6-year CIP
Kirkland Pump Station	Yes	2011–2030	>20	Not in 6-year CIP
Medina Pump Station	No	2021–2030	>20	Not in 6-year CIP
Eastside Interceptor Section 11	No	2031–2040	>20	Not in 6-year CIP
Yarrow Bay Force Main	No	2031–2040	>20	Not in 6-year CIP
Eastside Interceptor Section 10	No	2031–2040	>20	Not in 6-year CIP
Eastside Interceptor Section 9	No	2031–2040	>20	Not in 6-year CIP
Medina Force Main	Yes	2041–2050	>20	Not in 6-year CIP
Wilburton Pump Station	Yes	2041–2050	>20	Not in 6-year CIP



Juanita Creek Trunk	No	2051-2060	>20	Not in 6-year CIP
Eastside Interceptor Section 8	No	2051-2060	>20	Not in 6-year CIP
Eastside Interceptor Section 12	No	2051-2060	>20	Not in 6-year CIP

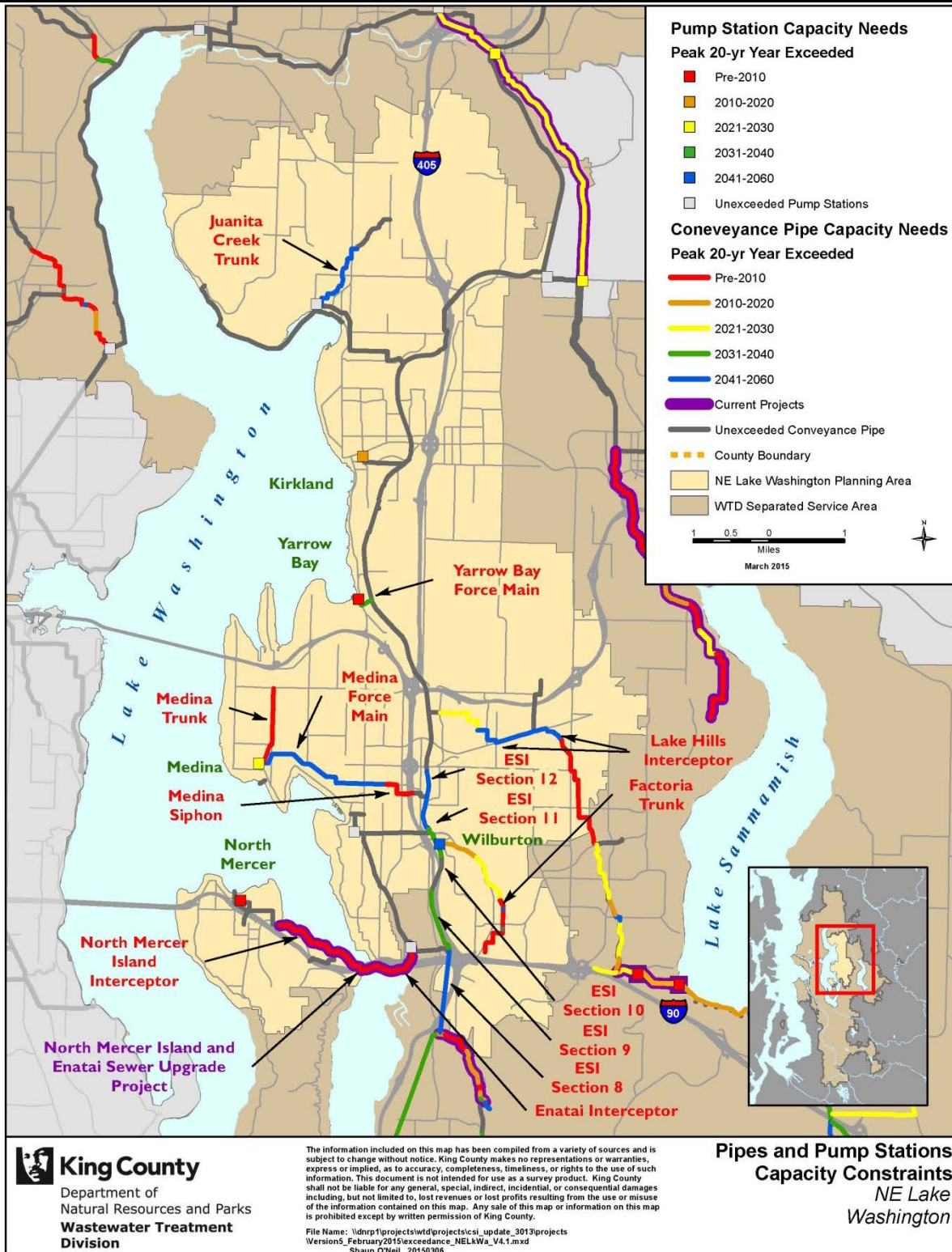


Figure 5-5. Locations of Identified Conveyance Capacity Needs in Northeast Lake Washington Planning Area

## 5.6 North Lake Sammamish Planning Area

Table 5-6 shows the identified capacity needs for conveyance facilities in the North Lake Sammamish planning area, and Figure 5-6 shows their locations. Two facilities currently do not meet the 20-year peak flow standard. Both have an LOS of 5–10. The Lakes Hill Trunk and NW Lake Sammamish Sewer Upgrade project is under way to address these needs. The project is scheduled to be substantially complete by end of 2021.

**Table 5-6. Identified Conveyance Capacity Needs in North Lake Sammamish Planning Area**

<b>Need</b>	<b>Identified in 2007 CSI Update</b>	<b>Decade Capacity Exceeded</b>	<b>Estimated Level of Service in 2010</b>	<b>Capital Project in Progress to Address Need</b>
Lake Hills Trunk	Yes	pre-2010	5-10	Lakes Hill Trunk and NW Lake Sammamish Sewer Upgrade
NW Lake Sammamish Interceptor	Yes	pre-2010	5-10	Lakes Hill Trunk and NW Lake Sammamish Sewer Upgrade

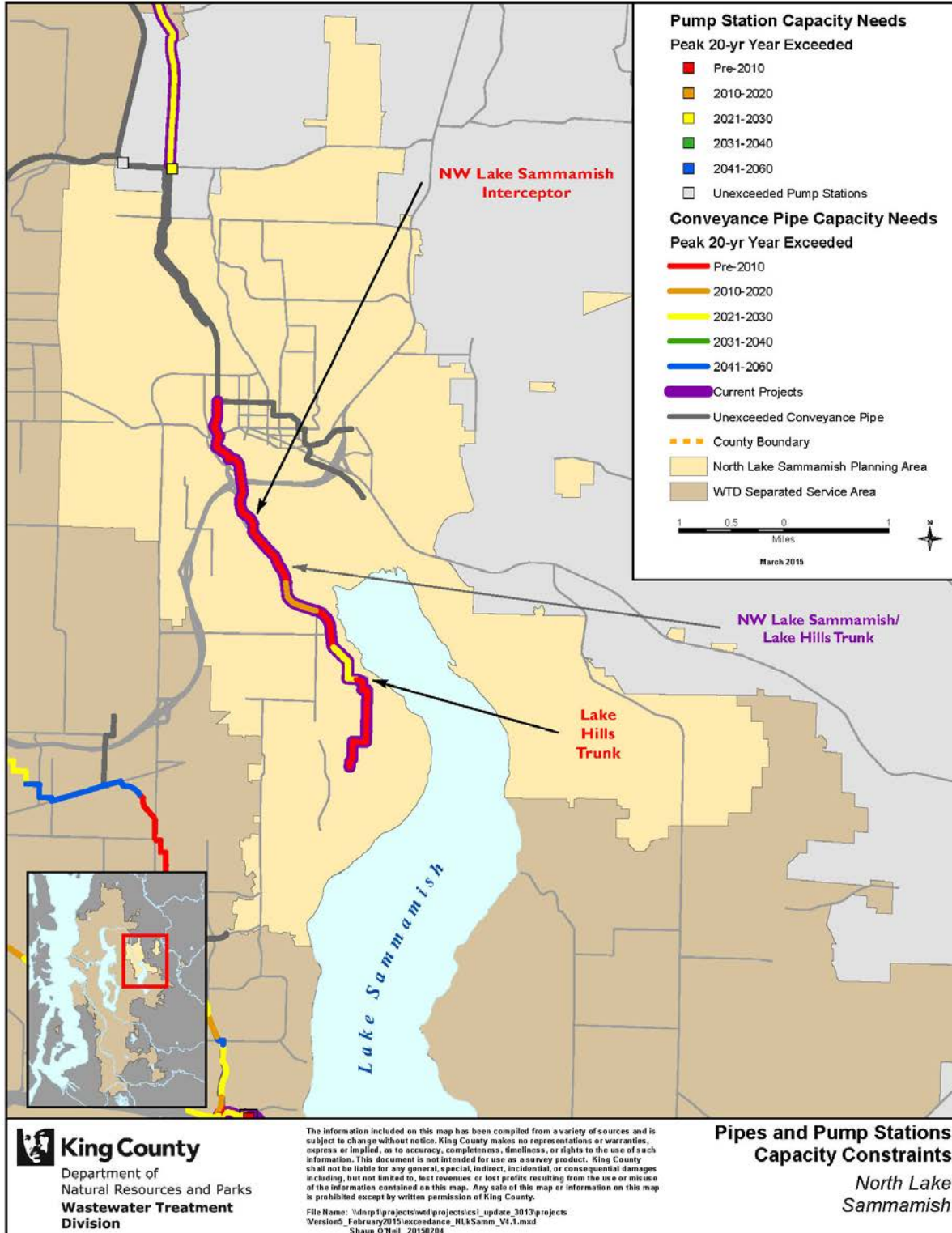


Figure 5-6. Locations of Identified Conveyance Capacity Needs in North Lake Sammamish Planning Area

## 5.7 Southeast Lake Washington Planning Area

Table 5-7 shows the identified capacity needs for conveyance facilities in the Southeast Lake Washington planning area, and Figure 5-7 shows their locations. One facility, with an LOS of less than 5, currently does not meet the 20-year peak flow standard. The Coal Creek Siphon and Trunk Parallel project will begin in 2015 to address this need.

The capacity of the other two identified facilities will fall short of the standard in 2031–2040. No CSI projects are needed at this time to increase their capacity. One of the capacity needs, Eastside Interceptor Sections 5, 6, and 7, was not identified in the 2007 CSI plan update.

**Table 5-7. Identified Conveyance Capacity Needs in Southeast Lake Washington Planning Area**

<b>Need</b>	<b>Identified in 2007 CSI Update</b>	<b>Decade Capacity Exceeded</b>	<b>Estimated Level of Service in 2010</b>	<b>Capital Project in Progress to Address Need</b>
Coal Creek Trunk	Yes	pre-2010	<5	Coal Creek Siphon and Trunk Parallel
Eastside Interceptor Sections 5, 6 & 7	No	2031–2040	>20	Not in 6-year CIP
Eastside Interceptor Section 4	Yes	2031–2040	>20	Not in 6-year CIP



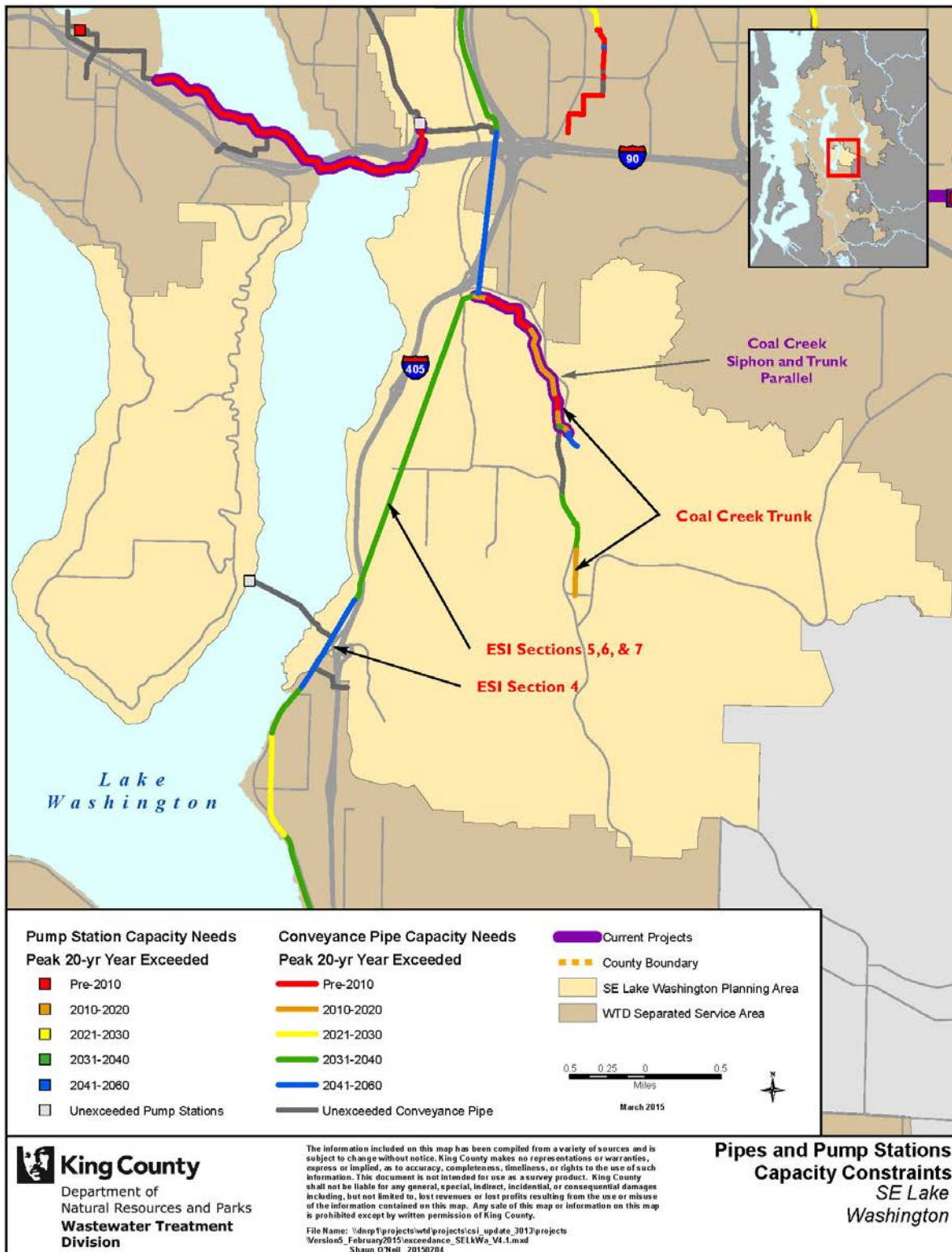


Figure 5-7. Locations of Identified Conveyance Capacity Needs in Southeast Lake Washington Planning Area

## 5.8 South Lake Sammamish Planning Area

Table 5-8 shows the identified capacity needs for conveyance facilities in the South Lake Sammamish planning area, and Figure 5-8 shows their locations. Two facilities currently do not meet the 20-year peak flow standard and have an LOS of less than 5. The Sunset and Heathfield Pump Station and Force Main Upgrades project is in progress to increase the capacity of these two facilities. The project is scheduled to be substantially complete in 2020.

The capacity of two other facilities will fall short of the standard sometime between 2011 and 2020. Four other facilities were identified as needing additional capacity between 2021 and 2040.

**Table 5-8. Identified Conveyance Capacity Needs in South Lake Sammamish Planning Area**

<b>Need</b>	<b>Identified in 2007 CSI Update</b>	<b>Decade Capacity Exceeded</b>	<b>Estimated Level of Service in 2010</b>	<b>Capital Project in Progress to Address Need</b>
Heathfield Pump Station/Force Mains	Yes	pre-2010	<5	Sunset and Heathfield Pump Station and Force Main Upgrades
Sunset Pump Station/Force Mains	Yes	pre-2010	<5	Sunset and Heathfield Pump Station and Force Main Upgrades
Issaquah Interceptor Section 1	Yes	2011–2020	>20	Not in 6-year CIP
Eastgate Trunk	Yes	2011–2020	>20	Not in 6-year CIP
SE Lake Sammamish Interceptor	Yes	2021–2030	>20	Not in 6-year CIP
Issaquah Interceptor Section 2	Yes	2031–2040	>20	Not in 6-year CIP
Issaquah Creek Interceptor	Yes	2031–2040	>20	Not in 6-year CIP

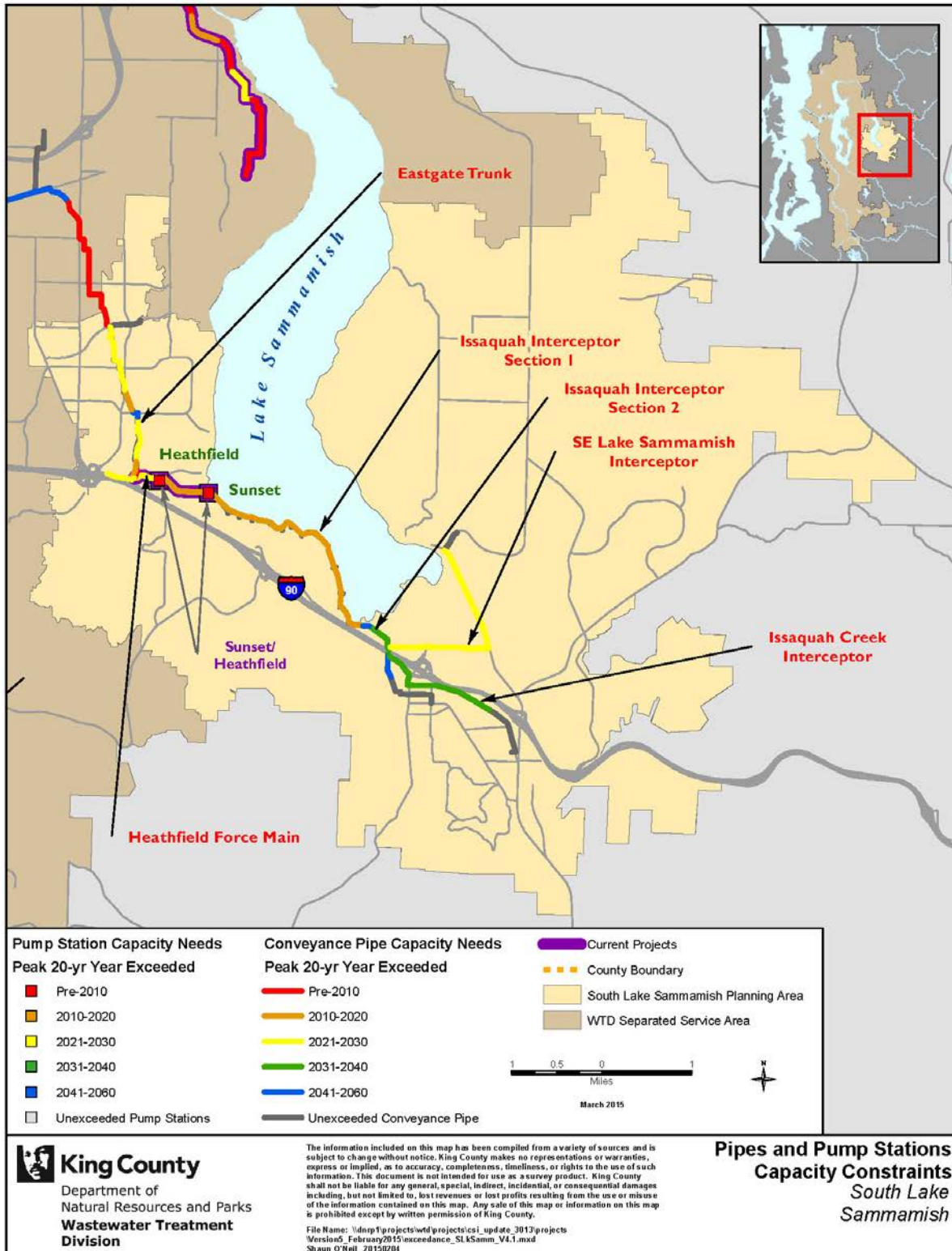


Figure 5-8. Locations of Identified Conveyance Capacity Needs in South Lake Sammamish Planning Area

## 5.9 South Lake Washington Planning Area

Table 5-9 shows the identified capacity needs for conveyance facilities in the South Lake Washington planning area, and Figure 5-9 shows their locations. Two facilities currently do not meet the 20-year peak flow standard and do not have CSI projects under way to address the needs. Both facilities have an LOS of 10–20.

The capacity of one other facility is expected to fall below the standard sometime between 2011 and 2020. Three other facilities were identified as needing additional capacity between 2021 and 2050.

**Table 5-9. Identified Conveyance Capacity Needs in South Lake Washington Planning Area**

<b>Need</b>	<b>Identified in 2007 CSI Update</b>	<b>Decade Capacity Exceeded</b>	<b>Estimated Level of Service in 2010</b>	<b>Capital Project in Progress to Address Need</b>
Eastside Interceptor Section 1	Yes	pre-2010	10-20	Not in 6-year CIP
Bryn Mawr Trunk	Yes	pre-2010	10-20	Not in 6-year CIP
Cedar River Interceptor Section 2	No	2011–2020	>20	Not in 6-year CIP
Eastside Interceptor Section 3	Yes	2021–2030	>20	Not in 6-year CIP
Eastside Interceptor Section 2	Yes	2031–2040	>20	Not in 6-year CIP
Cedar River Interceptor Section 1	No	2041–2050	>20	Not in 6-year CIP



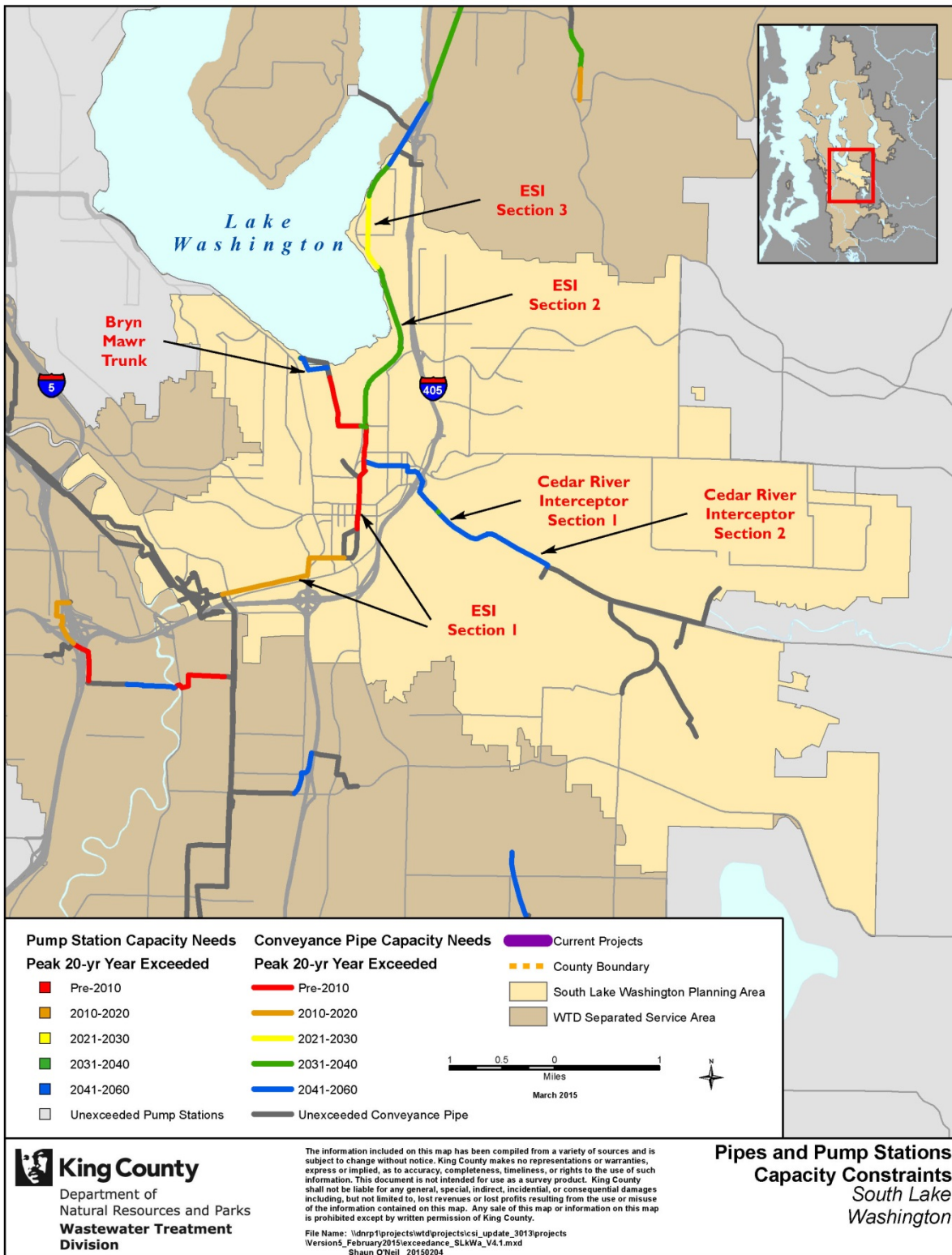


Figure 5-9. Locations of Identified Conveyance Capacity Needs in South Lake Washington Planning Area

## 5.10 North Green River Planning Area

Table 5-10 shows the identified capacity needs for conveyance facilities in the North Green River planning area, and Figure 5-10 shows their locations. Two facilities currently do not meet the 20-year peak flow standard and do not have CSI projects under way to address the needs. One facility—the Tukwila Freeway Crossing—has an LOS of less than 5, and its capacity need was not identified in the 2007 CSI plan update. The other facility has an LOS of 10–20.

Three other facilities will need additional capacity sometime between 2041 and 2060.

**Table 5-10. Identified Conveyance Capacity Needs in North Green River Planning Area**

<b>Need</b>	<b>Identified in 2007 CSI Update</b>	<b>Decade Capacity Exceeded</b>	<b>Estimated Level of Service in 2010</b>	<b>Capital Project in Progress to Address Need</b>
Tukwila Freeway Crossing	No	pre-2010	<5	Not in 6-year CIP
Tukwila Interceptor	Yes	pre-2010	10-20	Not in 6-year CIP
South Renton Trunk	Yes	2041–2050	>20	Not in 6-year CIP
Rainier Vista Interceptor	No	2041–2050	>20	Not in 6-year CIP
North Soos Creek Trunk	No	2051–2060	>20	Not in 6-year CIP

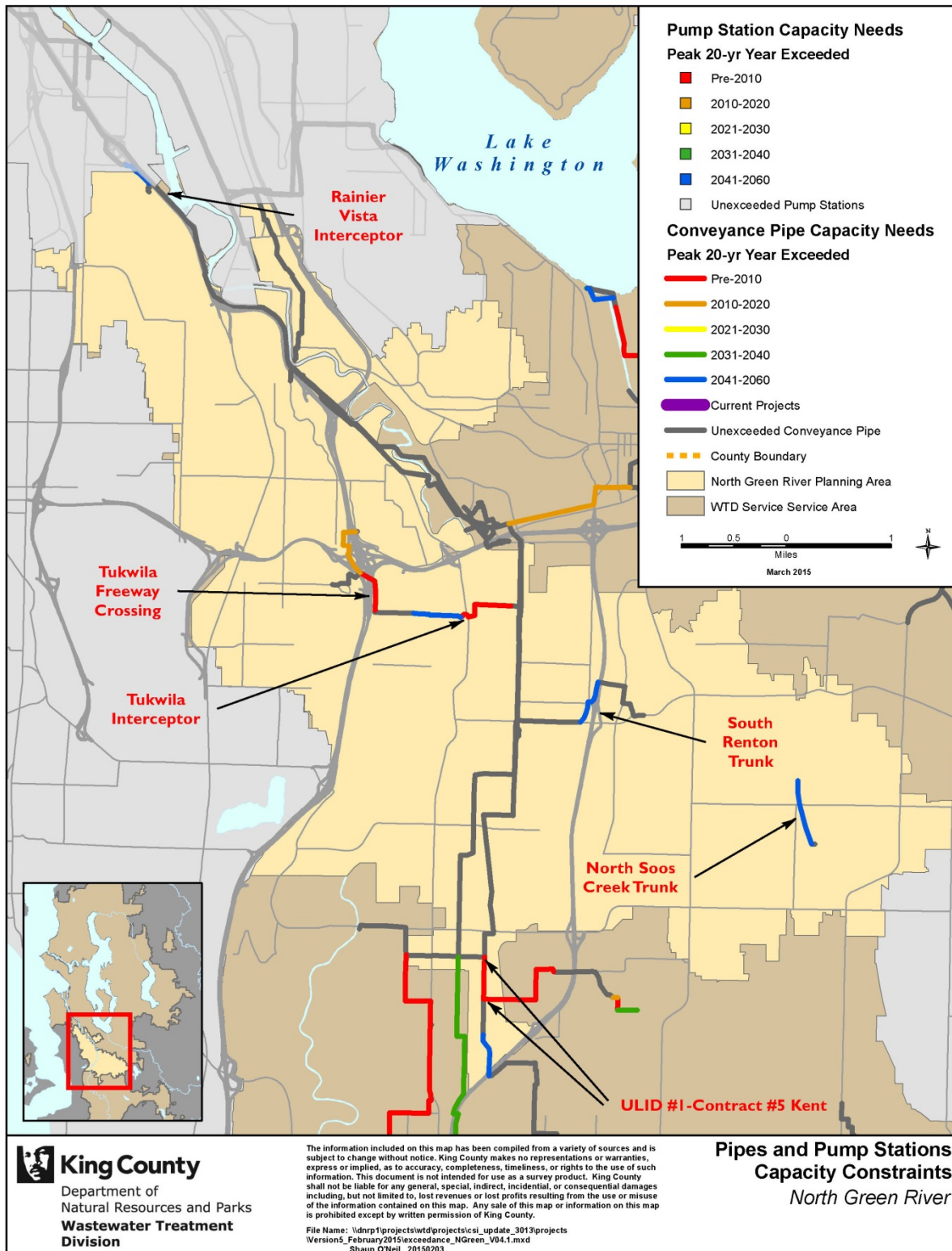


Figure 5-10. Locations of Identified Conveyance Capacity Needs in North Green River Planning Area

## 5.11 South Green River–Kent Planning Area

Table 5-11 shows the identified capacity needs for conveyance facilities in the South Green River–Kent planning area, and Figure 5-11 shows their locations. Five facilities currently do not meet the 20-year peak flow standard and do not have CSI projects under way to address the needs. Three have an LOS of less than 5, and two have an LOS of 5–10.

Four other facilities will need additional capacity sometime between 2031 and 2050.

**Table 5-11. Identified Conveyance Capacity Needs in South Green River–Kent Planning Area**

<b>Need</b>	<b>Identified in 2007 CSI Update</b>	<b>Decade Capacity Exceeded</b>	<b>Estimated Level of Service in 2010</b>	<b>Capital Project in Progress to Address Need</b>
Kent-Cascade Relief Interceptor	Yes	pre-2010	<5	Not in 6-year CIP
Garrison Creek Interceptor	Yes	pre-2010	<5	Not in 6-year CIP
ULID #1 Contract #4 – Kent	Yes	pre-2010	<5	Not in 6-year CIP
ULID #1 Contract #5 – Kent	Yes	pre-2010	5-10	Not in 6-year CIP
ULID 250 – Kent	Yes	pre-2010	5-10	Not in 6-year CIP
Auburn Interceptor Section 3	Yes	2031–2040	>20	Not in 6-year CIP
Auburn Interceptor Section 1	Yes	2031–2040	>20	Not in 6-year CIP
Auburn Interceptor Section 2	Yes	2031–2040	>20	Not in 6-year CIP
South 277th Interceptor	No	2041–2050	>20	Not in 6-year CIP

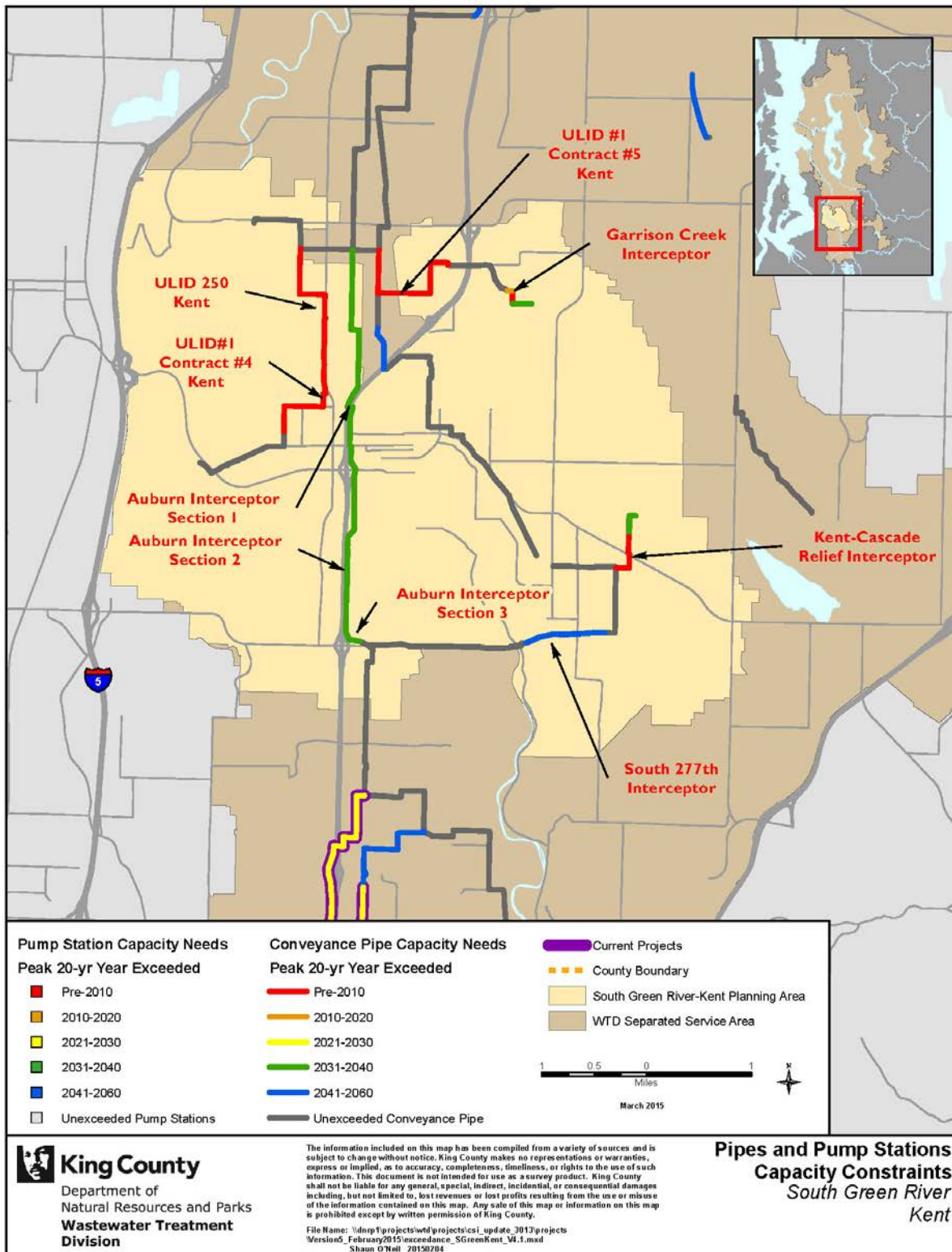


Figure 5-11. Locations of Identified Conveyance Capacity Needs in South Green River-Kent Planning Area



## 5.12 South Green River–Soos Creek Planning Area

Table 5-12 shows the identified capacity needs for conveyance facilities in the South Green River–Soos Creek planning area, and Figure 5-12 shows their locations. Two facilities currently do not meet the 20-year peak flow standard and do not have CSI projects under way to address the needs. One facility has an LOS of 5–10; the other facility has an LOS of 10–20.

**Table 5-12. Identified Conveyance Capacity Needs in South Green River–Soos Creek Planning Area**

<b>Need</b>	<b>Identified in 2007 CSI Update</b>	<b>Decade Capacity Exceeded</b>	<b>Estimated Level of Service in 2010</b>	<b>Capital Project in Progress to Address Need</b>
Black Diamond Pump Station	Yes	pre-2010	5-10	Not in 6-year CIP
Black Diamond Trunk	Yes	pre-2010	10-20	Not in 6-year CIP

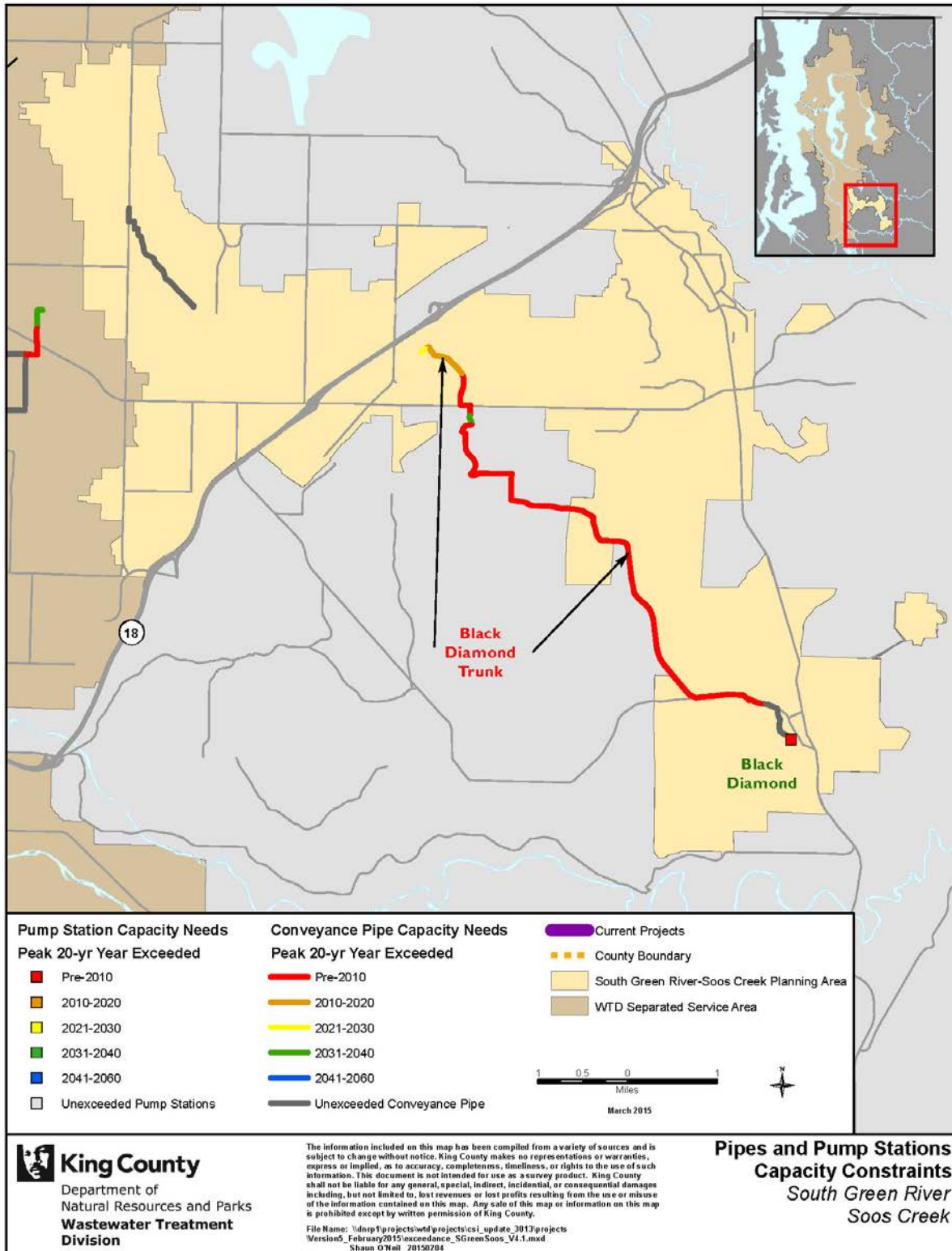


Figure 5-12. Locations of Identified Conveyance Capacity Needs in South Green River–Soos Creek Planning Area

## 5.13 South Green River–Auburn Planning Area

Table 5-13 shows the identified capacity needs for conveyance facilities in the South Green River–Auburn planning area, and Figure 5-13 shows their locations. Three facilities currently do not meet the 20-year peak flow standard and have an LOS of less than 5. Phase B of the Kent–Auburn Conveyance Improvements project is addressing these capacity needs and those of the West Valley Interceptor, estimated to need additional capacity in 2021–2030. The project is scheduled to be substantially complete in late 2018.

One other facility has been identified as needing additional capacity by 2020.

**Table 5-13. Identified Conveyance Capacity Needs in South Green River–Auburn Planning Area**

<b>Need</b>	<b>Identified in 2007 CSI Update</b>	<b>Decade Capacity Exceeded</b>	<b>Estimated Level of Service in 2010</b>	<b>Capital Project in Progress to Address Need</b>
Auburn-West Interceptor	Yes	pre-2010	<5	Kent – Auburn Conveyance Improvements Project Phase B
Auburn-West Valley Interceptor	Yes	pre-2010	<5	Kent – Auburn Conveyance Improvements Project Phase B
Algona-Pacific Trunk	Yes	pre-2010	<5	Kent – Auburn Conveyance Improvements Project Phase B
Lakeland Hills Trunk	Yes	2011–2020	>20	Not in 6-year CIP
West Valley Interceptor	Yes	2021–2030	>20	Kent – Auburn Conveyance Improvements Project Phase B



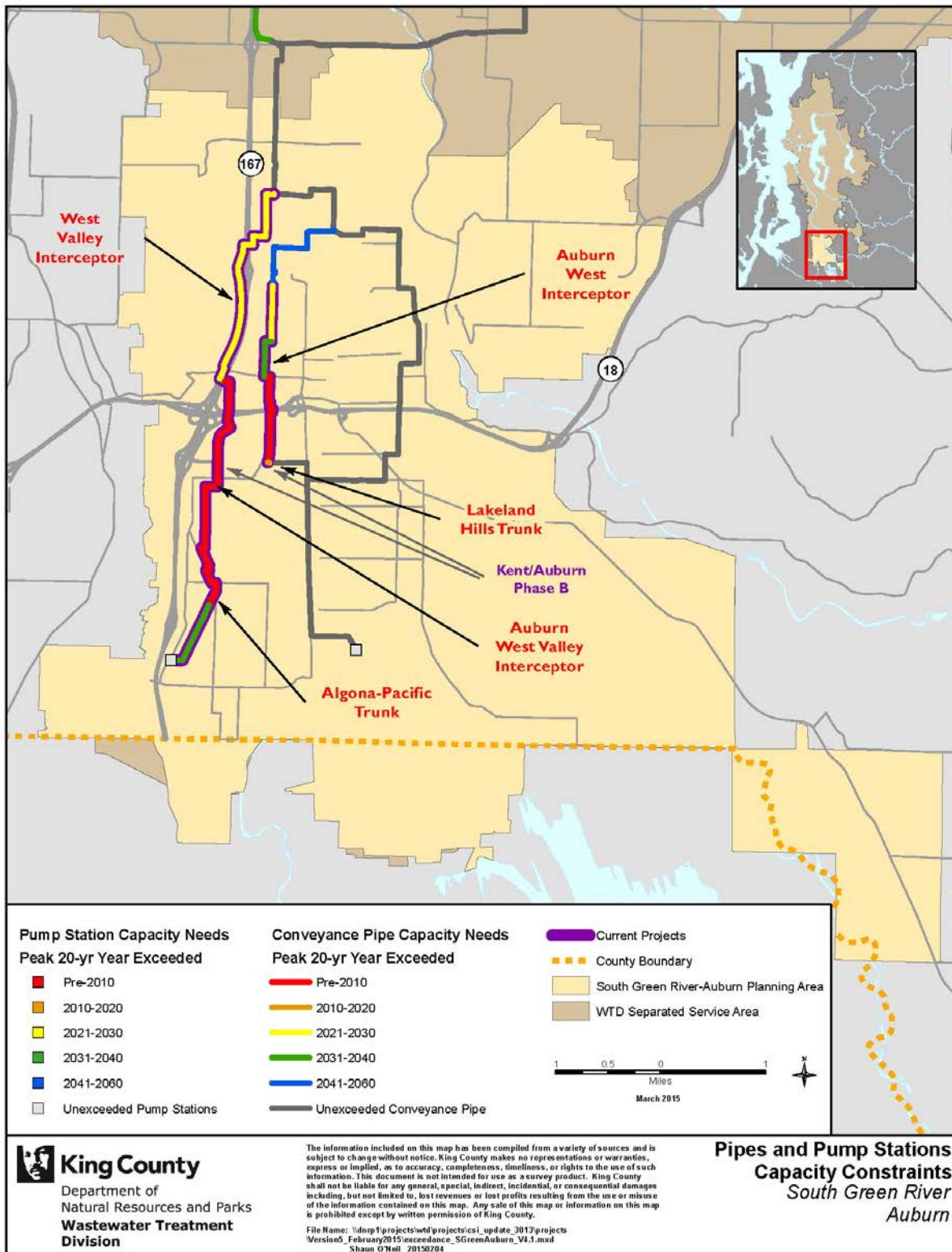


Figure 5-13. Locations of Identified Conveyance Capacity Needs in South Green River–Auburn Planning Area