

Advisory Group Meeting #8 Briefing Document

Introduction

This briefing document provides Advisory Group members with the background information needed to engage in discussions at the December 10, 2020 Clean Water Plan Advisory Group Meeting. The objectives for the meeting are to:

- Learn about recent and upcoming regional engagement and communications activities.
- Review emergent thinking on Clean Water Plan strategy alternatives and obtain Advisory Group member input on the opportunities and choices WTD should highlight through the strategies and how to engage decision makers and community members about these opportunities/choices.
- Provide a granular understanding of how King County is scoping and analyzing actions by reviewing details for two example actions and solicit feedback on potential ways to show summary comparison performance data for the actions.

For a graphical representation of the planning process, and its relationship to the Advisory Group meeting topics, visit Attachment A: Clean Water Plan Activities & Advisory Group Meeting Topics. As discussed at Meetings 6 & 7, the Clean Water Plan alternative investments exploration process will include two steps: first, an evaluation of potential actions and, second, an evaluation of alternative strategies. This briefing packet includes an overview of the Clean Water Plan Strategy Alternatives first with a second section on the Action Analysis.

Clean Water Plan Strategy Alternatives

King County is faced with unprecedented regional water quality investment needs requiring billions of dollars over the decades ahead. The magnitude of these investments, combined with complexity arising from multiple factors influencing the region's water quality future, including climate change, socio-economic inequities, current and future regulations, aging infrastructure, and population growth, has driven King County to explore alternative strategies to investing in the regional wastewater system and water quality to meet the needs.

As a reminder, the overall objective of exploring the strategies is to determine:

What is the most appropriate path to ensure we direct the right public investments to the right actions at the right time for the best water quality outcomes?

The Clean Water Plan Team (Team) has been advancing the Clean Water Plan planning process and has nearly completed draft conceptual description, analysis, and evaluation of approximately 35 different actions that represent specific water quality investment programs within seven decision areas (see Attachment B for list of Decision Areas and associated Actions – these have not changed since last presented to the Advisory Group). The actions reflect the variety of ways King County could pursue

protecting and restoring water quality and maintaining/improving system health through investing in renewing aging water quality protection infrastructure, wastewater treatment, wet weather management, wastewater conveyance system, recovery of resources from wastewater, legacy pollution, and pollution source control. Acknowledging that these actions or a subset of them represent investments that will occur as a collective, and in order to understand the full picture of outcomes and impacts any collection of actions will have, the planning process will next assemble different sets of actions into alternative strategies.

The strategy formulation and analysis phase of the planning process will explore alternative approaches the County could follow. The strategies, by design, will explore alternative outcomes - they will display the nature of the choices needing to be made and the value (or not) of pursuing a given approach. The results of the strategy formulation and analysis, including consultation with interested and impacted parties throughout the region, will inform the foundation of the Plan's ultimate Preferred Strategy. The Preferred Strategy will outline near-term (up to 10 years) and programmatically guide long-term (10 to 40 years) investments for the regional wastewater system.

Each strategy will represent a distinct and separate, complete approach to investing in the regional wastewater system and water quality. These strategies will be data-based depictions of future water quality investment approaches. Each strategy will reveal the interconnections among its component actions, as well as an understanding of the benefits, challenges, and policy implications. The **data-based strategies and evaluation of them will provide the basis for an outcomes-based, regional conversation**. The conversation will lay out the policy and other choices for the region and decision makers to foster a robust discussion on making regional water quality investments. Ultimately, **the strategies provide a platform to explore the choices and opportunities the Region has and the related outcomes and consequences to help determine the components of a preferred approach**.

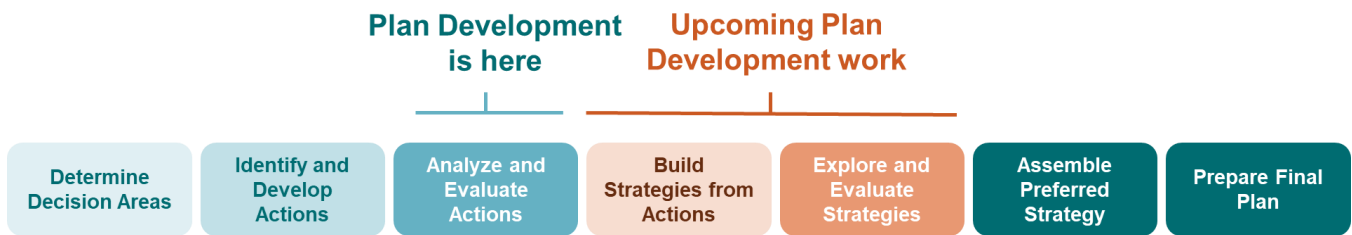
Strategy Formulation and Analysis Progression Overview

Formulating and analyzing strategies in an exploratory environment will reflect an intentional, transparent, and inclusive process to enhance understanding for and garner input from the regional community and decision makers. The strategies collectively 'paint the whole picture' showing the span of potential investments and outcomes for the Region. **Each strategy will characterize potential issues or conditions. These issues or conditions are intended to help clearly illustrate the choices that need to be made and scale of the potential benefits and impacts. Each strategy will have a well-defined purpose and will be subjected to the same objective analysis rigor to enable a thorough and thoughtful regional dialogue**. The Team anticipates four to five separate strategies will be needed to accomplish this objective.

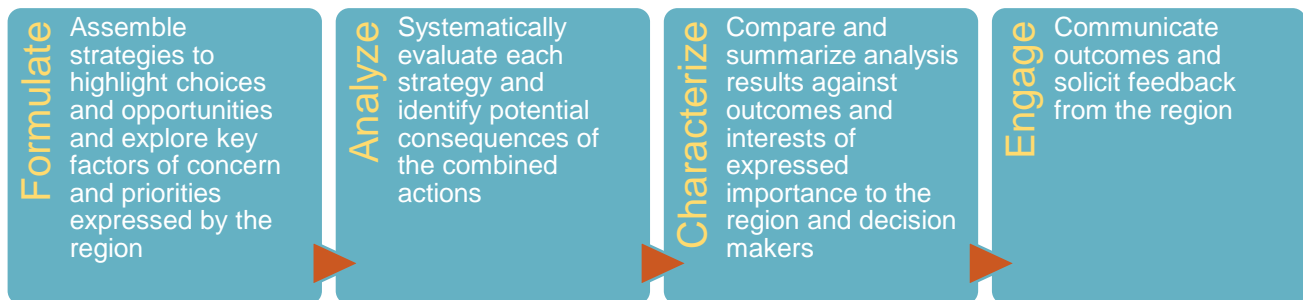
The Clean Water Plan Team expects the strategy exploration process to have similarities to the action evaluation process, but not be identical, since strategy exploration will allow for a more comprehensive, systemwide understanding of outcomes, such as distributional equity, programmatic financial resource requirements, and the overall timing, magnitude, and location of water quality improvements. Assembling the strategies will take into consideration: the results of the action analysis; community input related to regional priorities and values; the SEPA scoping comments; critical King County system requirements; current and anticipated regulations and obligations; and other related regional planning and program efforts. Attachments C and D provide an indication of the different types of analysis

undertaken and performance outcomes considered at the action characterization, strategy evaluation, and preferred strategy selection phases of Plan development.

As illustrated in the flow diagram below, the Team is currently completing the ‘Analyze and Evaluate Actions’ step and getting ready for the ‘Build Strategies from Actions’ and ‘Explore and Evaluate Strategies’ steps. How the strategies are assembled will determine what conditions are more easily explored and how comparisons between different water quality investment approaches can be effectively made. The results of the strategy analysis and the input received through regional engagement will provide the Team (and County decision makers) with performance information and requirements, along with the perspectives and strong preferences of regional constituencies to inform assembling of a Preferred Strategy.



The Team is preparing to begin building and evaluating the strategies, where each strategy advances through a purposeful sequence of four activities as shown below. Through these activities, a better understanding of the key choices and opportunities facing the region can be developed and presented for regional discussion. These four activities are designed to also facilitate analysis and comparisons by the Team as well as support decision making.



Formulate

Formulating each strategy will largely affect what information is developed and how choices and opportunities will be portrayed. Each strategy will have a clear purpose and include the following:

- Explain **what** the strategy is intended to do, including outcomes evaluated for and conditions that may be constrained.
- Outline **why** this strategy is needed to compare outcomes and delineate regional choices. Describe the premise and what types of conditions are likely to be explored through analysis.
- Describe generally what **types of outcomes** are hoped to be shown through the strategy analysis and characterization. Describe expected outcomes and/or how the results may be used to help characterize or explain choices.
- Summarize potential **policy areas** that may need to be addressed if implemented.
- Depict the **types of actions** likely to be included.

Much of the input received during the Clean Water Plan effort has highlighted the need to explore potential water quality and financial outcomes. To accomplish this, the Plan will form between four and five strategies **based primarily on water quality and cost constructs (see Table 1) and then analyze them based on other important considerations (e.g., equity and social justice) for the region.**

Analyze

The strategies are primarily formulated to test and reveal specific water quality and financial outcomes (e.g., cost and affordability). Table 1 below summarizes current Team thinking on how each strategy will be analyzed against evaluation criteria, including the community priorities (conditions/issues and factors). The top section identifies five conditions/issues which will undergo data driven analysis to show the resulting outcomes. The lower section identifies three factors, which will be subject to more of a narrative comparison to illustrate what items King County needs to manage and/or adapt to implement the strategy.

Table 1. Working List of Strategy Analysis Considerations

| Condition / Issue | Outcome Analysis |
|---------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Water Quality | Serves as basis for formulating strategies and is also analyzed for each strategy. Outcomes determined through multiple methods (e.g., WQBE, SEPA, etc.) to determine how the outcomes compare across strategies. |
| Financial (Cost, Affordability) | Serves as basis for formulating strategies and is also analyzed for each strategy. Outcomes determined through multiple methods (e.g., rate models) to determine how the outcomes compare across strategies. |
| Community | Analyze span of social impacts and Equity and Social Justice (ESJ) factors. Outcomes described through measures of the built environment and ESJ metrics. Possible methods include land use index, vegetation distribution and pollution by region (under the category healthy built and natural environment) and living wage gap (under the category job training and jobs). |
| System Health | Analyze to identify system capability to sustain levels of service. For example, net asset age over time, projected unplanned failures, etc. |
| Sustainability | Analyze to identify the amount of product recycling, greenhouse gas (GHG) emissions, and energy recovery. |
| Factors for comparative assessment against existing conditions only | |
| Flexibility | Assessment describing the ability to adapt system configuration to accommodate different performance demands in the future. |
| Authorizing Environment | Identify the potential interagency dependencies required to fully implement the strategy. Compare alignment with existing policy and current authority |

| | |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| and Partnerships | to manage / influence desired outcomes. Identify potential areas for partnerships or institutional change. |
| Legal / Regulatory | Assess consistency with existing and reasonably anticipated legal and regulatory environment. Compliance conditions or legal obligation imposed or determined to establish a comparison. |

Characterize

As analysis results are revealed, they will be objectively compared and characterized through multiple means to help satisfy exploratory, statutory, and communication purposes of the Clean Water Plan. The outcomes from strategy formulation and analysis will be described, at a minimum, through:

- Strategies Characterization – A document that presents the investments that would be made in the regional wastewater system and water quality under each strategy.
 - Water quality, financial (cost, affordability, rate impacts), and other outcomes of each approach
 - Policy considerations across approaches, including comparison to existing policies
 - Legal, governance, and regulatory implementation considerations across approaches
- Draft Programmatic EIS (SEPA) – WAC 197-11 compliant document comparing outcomes across environmental and social categories.

These documents will be used to solicit feedback and more fully understand the issues, conditions, and priorities of most concern to the region. Ultimately, the strategy evaluation and subsequent regional discussion will inform the assembling of a Preferred Strategy for King County. The Preferred Strategy will be reflected in Final Plan documents, including a document presented to Department of Ecology for approval that is consistent with WAC 173-240 that outlines general sewer plan completeness.

Engage

The Team will engage the region in conversation about the strategies. The focus of this engagement will be to increase regional understanding of the potential approaches and associated outcomes, as well as to more fully understand the issues, conditions, and priorities of most interest to the region. It is anticipated that this engagement will be anchored by the release of and public comment on the Programmatic Draft Environmental Impact Statement (DEIS), but also include both focused and broad engagement with the regional community and decision makers to support robust and informed participation. Ultimately, the dialogue will assist decision makers understand preferences for the choices to be made and opportunities to pursue, ultimately influencing the development of the Preferred Strategy.

Assembling Clean Water Plan Strategies

Regional engagement efforts, including the Clean Water Plan Advisory Group, community-based organization (CBO) partnerships, Tribal consultations, and general public engagement, have identified several priorities for the Plan to address. These priorities also connect back to key regional constituencies and interested/impacted parties that have and can be anticipated to pay close attention to the strategies considered, how they are analyzed and characterized, and the water quality and system health performance they deliver. In response, the strategies need to highlight the options the

region has for addressing these priorities and any choices the region will need to make on the path to formulating a single, preferred strategy. The key priorities include:

- Avoid sewer system failures (has implications for how asset management and conveyance capacity are addressed by different strategies)
- Ensure benefits and impacts are experienced equitably (has implications for the type, location, and duration of performance provided by different strategies)
- Keep rates affordable within the context of a growing region (has implications for the range of total and annual costs explored through the strategies)
- Prepare for and fight climate change (has implications for the performance range of climate mitigation outcomes across, in particular, wastewater treatment, wet weather management, and resource recovery actions and climate adaptation associated with asset management)
- Protect and restore our rivers, lakes, and Puget Sound, protect public health, and support healthy habitats for fish and wildlife (all three of which have implications for the range of pollutant parameters and related performance addressed through the strategies)
- Prioritize the best water quality investments (has implications for how cost effectiveness of actions is considered in assembling the strategies)

Additionally, at the September 9 Clean Water Plan Advisory Group meeting, members provided the following feedback relative to the formulation of strategy alternatives.

- Include how the regulatory and legal drivers are influencing the process and their relationship to individual actions.
- Look to present information on the synergies among actions within a particular strategy and how those synergies impact cost and local communities.
- Look to simultaneously address nitrogen removal and upgrades/replacements that will improve the reliability of, in particular, the West Point treatment plant.
- Examine cost impacts over a number of different timeframes and avoid only examining low cost in the short term. Often, low cost in the short term can be seen as a valid driver while long term cost may be a more important consideration.
- Proceed with a mindset that, while wastewater currently may be thought of as “waste,” in the future it may be seen as a valuable resource.
- Have a values system not just based on monetary considerations, but also an approach that considers the value of resources in and out (e.g., energy, water, land, air) and the use of those resources.
- Look for a cross-jurisdictional approach and seek to meet with cities, counties, and the state - other jurisdictions in the region are innovative, and this sets up the opportunity for learning from each other.
- Seek solutions that can work in tandem with more unconventional approaches, such as biological processes, distribution of potable water, and water reuse for industrial processes, to reduce reliance on current potable water supplies.

With these considerations in mind, and within the context of the Clean Water Plan Team’s intent that the alternative strategies will reveal for the region a range of clean water choices and opportunities, the Team has identified the following six major areas of choice to consider as part of assembling the alternative strategies.

Major Areas of Choice for the Alternative Strategies

Water Quality: range of choices from maintaining historical focus on point source control and maintaining current programs related to sediment management through exploring approaches that

blend measures to address additional/alternative pollution sources and pathways (e.g., stormwater, source control) and examining proactively (in advance of regulatory requirements) moving to advanced wastewater treatment consistent with water quality improvement opportunities identified through action analysis. *Regional Priorities Supported by These Choices: Protect and restore our rivers, lakes, and Puget Sound; protect public health; support healthy habitats for fish and wildlife.*

Wastewater System Reliability and Resiliency (system health): range of choices from maintaining current regional wastewater system asset management investment level and current conveyance capacity level of service through decreasing or increasing these levels with associated changes to risk of system failures such as sewer overflows. *Regional Priority Supported by These Choices: Avoid sewer system failures.*

Wastewater System Sustainability: range of choices from maintaining current resource recovery and climate mitigation efforts (e.g., net zero carbon emissions, Class B biosolids recycling) through enhanced resource recovery and climate mitigation efforts (e.g., net energy positive, Class A biosolids products). *Regional Priority Supported by These Choices: Prepare for and fight climate change.*

Regulatory Approach: range of choices from addressing current and reasonably foreseeable regulatory requirements through conventional means (e.g., single source discharge permits) through tailoring compliance with requirements (e.g., King County manages nitrogen reduction as a whole across regional treatment plants) to enable best value investments to the extent action analysis indicates an opportunity exists. These choices are interdependent with, in particular, water quality choices. *Regional Priority Supported by These Choices: Prioritize the best water quality investments.*

Financial Approach: range of choices from maintaining current County program funding policies and practices (e.g., maintain current percentage mix of capital investment paid in cash and bonds, rate increases generally following inflation, occasional rate increases above inflation) through adapting funding and financing policies and practices consistent with level of investment needed for actions/investments prescribed in each strategy. *Regional Priority Supported by These Choices: Keep rates affordable within the context of a growing region.*

Clean Water Plan Scope: range of choices from centering on and maintaining King County's historical role in regional water quality (point source wastewater focus) through evolving consistent with water quality improvement opportunities identified through action analysis (e.g., pursue near-term stormwater investments). Collaboration and partnerships would need to evolve consistent with implementation requirements. *Regional Priority Supported by These Choices: Increase collaboration between agencies.*

Finally, within the context of these major areas of choice and taking into account the feedback received during the September 9 Advisory Group meeting, the Team has identified the following features for inclusion in each strategy:

- Represent a “complete package” of investments (programs, projects, and policies) designed to address the full range of the decision areas - the strategies will provide different cohesive approaches for water quality and regional wastewater system improvements.
- Distinctive from each other to provide for an effective exploration of alternatives as well as clearly tee up the choices, challenges, and opportunities the region has for advancing water quality and regional wastewater system performance.

- Take into account existing and anticipated future obligations (e.g., regulations).
- Reveal the water quality performance anticipated (including type, magnitude, location, and timing) as well as broader ecosystem and sustainability benefits to the extent supported by available data and methods.
- Indicate the contribution each strategy can make to addressing Equity and Social Justice determinants.
- Present the programmatic financial resource needs, over what time period, to support the strategy.
- Identify the enabling environment considerations for implementing the strategy (e.g., enhanced regional collaboration, alterations to current policy, etc.).

Meeting 8 Discussion on Strategies

At the December 10 Clean Water Plan Advisory Group meeting, the Team would like to engage Advisory Group members in a discussion related to the major choice areas, with a particular emphasis on how best to assemble strategies to provide regional interested and impacted parties with a clear sense of the choices and opportunities the region has as it contemplates its clean water future. The Team would also like to discuss how to best ensure the strategies speak effectively to the regional priorities recognizing that tensions can exist among the priorities depending on the make up any individual strategy.

Action Analysis: An Overview of the Action Description Sheets

This briefing for Advisory Group Meeting 8 includes two Action Description Sheets (ADSs) as attachments: **Attachment E: Medium Planned Investment Levels for Asset Risk Management and Resiliency Program** and **Attachment F: King County WTD Manages Nitrogen Reduction as a Whole Across Regional Treatment Plants**. Since these are technical database worksheets, this document provides a high-level guide to navigating and understanding key parts of the ADS. By providing a glimpse “under the hood” at the detailed actions analysis with these examples, King County hopes Advisory Group members will become more familiar with the type of information the County is assembling for the Clean Water Plan actions. **Please note that the selection of these two actions as examples for discussion purposes does not reflect any particular preference the County has for these actions at this time.**

Purpose of the Action Description Sheets

As described in previous Advisory Group meetings, the County is considering approximately 35 actions across seven decision areas. The purpose of an ADS is to collect and store information about each action in a comprehensive and standardized way so they can be characterized consistently to aid in the grouping of actions into strategies. Each ADS serves as a database worksheet of information on the action including the scope and scale of the action, key considerations and assumptions, and analytic

results characterizing potential impacts (e.g., changes in pollutant loadings, total and decadal cost). If you think of a strategy like a meal and actions as the dishes in that meal, then the ADS is like the recipe and nutrition analysis for each dish in the meal.

ADSs are living documents that function as Clean Water Plan Team working documents to memorialize and store the Team's work. As living documents, they will continue to evolve as strategies are developed, reflecting progression of concepts and analysis throughout the planning process.

ADS Organization and Contents

The ADS contain four sections. The first two sections describe what is in the action and how it was developed, and the second two sections outline what potential benefits and impacts the action could have for the region based on initial analysis. The ADS sections include:

FIGURE 1: ACTION DESCRIPTION SHEETS

Coversheet: The first 2-3 pages of the ADS contain brief descriptions of the action and key contextual information including the decision area, status quo for the decision area, drivers for the action, relevant pollutant pathways, and whether the action could affect King County policies. The decision area status quo will be the same for all actions in a specific decision area (e.g., the same for all asset management actions).

Part 1: Description and Overview: Part 1 of the ADS describes the details of the action and outlines how the Clean Water Plan team developed it. This section contains the following:

- **Overview/Summary** – A narrative summary of the action and its programmatic components; this expands on the brief descriptions in the coversheet.
- **Major Assumptions** – Assumptions that are foundational to the framing of and basis for the action.
- **Key Components** – Description of the components of the action, including both programmatic components and any projects that are part of the action; this is the next level of detail in the description of the action (e.g., in the nitrogen reduction ADS, the overview/summary describes the concept of managing nitrogen across the regional treatment plants and that the County would need to modify treatment plants, but the key components section details the specific changes needed, including technology, treatment process, and staffing requirements, based on the major assumptions).
- **Regulatory Considerations** – How the action fits in the current or anticipated future regulatory landscape.
- **Partnerships** – Opportunities or needs for partnership and collaboration.
- **Potential Benefits** – Potential high-level benefits to implementation independent of the analysis and evaluation categories.
- **Potential Drawbacks** – Potential high-level drawbacks to implementation independent of the analysis and evaluation categories.
- **Potential Implementation Challenges and Risks** – Potential challenges and risks related to cost, schedule, coordination, support, or other implementation issues.

- **Equity and Social Justice Opportunities** – How pro-equity and social justice opportunities can be integrated into the action and any potential unintended adverse equity outcomes.
- **Duration and Timeline** – Timeline for the initiation and implementation of the action.
- **Triggers** – Activities that may trigger initiation, delay, or cancelation of the action.
- **References** – List of key sources used for developing the action.
- **Figures** – Maps, figures, or schematics that help to visually illustrate components of the action, as needed.

Part 2: Analysis: Part 2 outlines the estimated changes to water quality pollutant loadings, costs and revenues, and energy use and greenhouse gas emissions. This section contains raw data to support the evaluation of water quality, financial, and sustainability outcomes for actions, and the Evaluation Results in Part 3 starts to interpret what that means for important public health and ecological endpoints.

Part 3: Evaluation Results: Part 3 summarizes what is known about the expected potential benefits and adverse impacts to key outcomes for the Clean Water Plan, in the following categories:

- **Water quality** – narrative description of the potential of pollutant removals to impact human health (recreational contact; edible fish and shellfish) and aquatic health, the timing of water quality outcomes, and a discussion of water quality related equity outcomes.
- **Cost analysis** – analysis of pollutant load removed per dollar, and a summary of the sensitivities of the cost analysis outcomes.
- **Sustainability** – narrative descriptions, supported by the metrics in Part 2, of impacts to operational energy use, greenhouse gas emissions, resource consumption/recovery potential, ecosystem services, and sustainability-related equity outcomes.
- **Management and Operations** – narrative descriptions of impacts to public health exposure, resiliency/redundancy, legal/liability/regulatory risks, public confidence, and risk-related equity outcomes.
- **Community** – narrative descriptions of impacts of construction, economic impacts, impacts to community vibrancy, and community-related equity outcomes.

Highlighting in Advisory Group Action Description Sheets

Two ADSs are included with the Advisory Group briefing materials to illustrate the type of information King County is assembling for Clean Water Plan actions. **Highlighted text** is intended to assist Advisory Group members by focusing on:

- key aspects of the actions that have material relevance for performance results
- important “so what” findings illustrating the types of choices that the actions present

Figure 2 shows a highlighted section of the ADS for medium planned investment level for asset management.

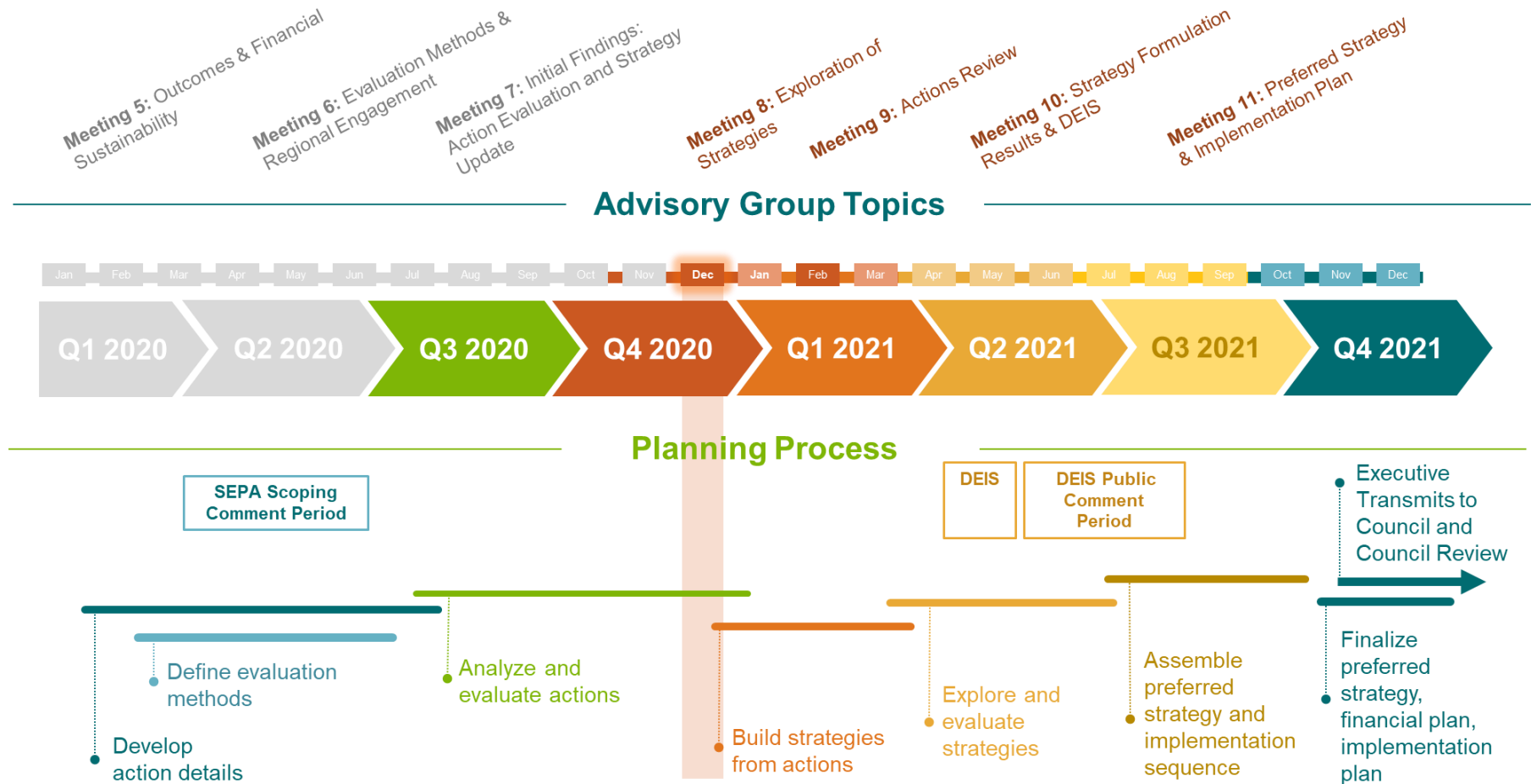
| Treatment plants and wet weather facilities, Action 3 | |
|-------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Name | King County WTD manages nitrogen reduction as a whole across regional treatment plants |
| Short Description | <p>Program description: Implement treatment upgrade and capacity program across King County WTD secondary treatment plants using a “bubble” permit strategy to achieve an overall 13 mg/L annual average target (providing a similar load reduction as an individual plant 8 mg/L seasonal target).</p> <p>Project description: Complete solids and liquids treatment capacity expansion to accommodate population growth at the same time as treatment level improvements. Treatment level improvements include upgrades to existing wastewater treatment plants with nitrogen removal to 13 mg/L year-round (providing a similar load reduction as an individual plant 8 mg/L seasonal target). Nitrogen removal at West Point would be modest, using sidestream treatment only. South Plant and Brightwater would each be upgraded to achieve nitrogen removal to 3 mg/L year-round. South Plant and West Point will be upgraded by the early 2030s, while Brightwater will be upgraded the following decade.</p> <p>King County policy description*: Modify existing treatment policies to reflect guidance and direction on higher level of treatment at secondary treatment plants, including activities such as bubble permitting for nitrogen.</p> <p>Update existing treatment policies to reflect additional level of treatment.</p> <p><i>*policy analysis will be completed following action evaluation and will be documented separately</i></p> |

FIGURE 2: HIGHLIGHTED ACTION DESCRIPTION SHEET

Meeting 8 Discussion

At the Advisory Group meeting on December 10, the Clean Water Plan team will review highlights of the two example Action Description Sheets, **Medium Planned Investment Levels for Asset Risk Management and Resiliency Program** and the **King County WTD Manages Nitrogen Reduction as a Whole Across Regional Treatment Plants**. The asset management ADS highlights one of the options the region can consider related to overall system health and reliability, while the nitrogen reduction action is one of the options for how the County could address an important water quality challenge depending on future regulatory requirements. Both have implications for water quality performance and funding needs. We are not seeking discussion of the details or findings of these particular actions, although the Team will be happy to answer any questions Advisory Group members have. Instead, consistent with using the two ADS as examples of the type of information and analysis that will be available for each of the 35 actions, we would like to engage Advisory Group members in discussion about which of the types of information presented in the ADS are of most interest to members, and how can the Team compile results across the 35 actions to best support regional dialog, including presentation of action analysis results at the now scheduled February 4th Advisory Group meeting.

Attachment A: Clean Water Plan Activities & Advisory Group Meeting Topics



Attachment B: Clean Water Plan Actions for Exploration

Decision Area: Wastewater Treatment

Actions for Exploration:

- Status Quo Treatment
- Nutrients – Individual Discharge Permits
- Nutrients – Managed as Whole Across Regional Treatment Plants
- Nutrient Trading – Multiple Source Discharge Management
- Advanced Treatment for Treatment Plants
- Decentralized Satellite Treatment Plants
- Building Scale Decentralized Treatment
- Decentralized Combined CSO/Wastewater Treatment
- Status Quo Onsite Septic System Program
- Expanded Onsite Septic System Program

Decision Area: Wet Weather Management

Actions for Exploration:

- Status Quo CSO Program
- Modified Approaches to CSO Control
- Expanded Stormwater Treatment at Existing Facilities
- Stormwater Treatment at New Facilities
- Stormwater Retrofit Fund – Regional Collaboration

Decision Area: Pollution Source Control/ Product Stewardship

Actions for Exploration:

- Status Quo Source Control Program
- Expanded Pollution Elimination and Control Focus

- State/Federal Requirements Source Control Approach

Decision Area: Asset Management, Resiliency, and Redundancy

Actions for Exploration:

- Run to Failure Asset Management
- Low Level Asset Management Investment
- Medium Level Asset Management Investment
- High Level Asset Management Investment
- Adaptive Sea Level Rise

Decision Area: Resource Recovery

Actions for Exploration:

- Status Quo Biosolids and Energy Program
- Enhanced Biosolids and Energy Program

Decision Area: Wastewater Conveyance

Actions for Exploration:

- Status Quo Conveyance
- 5-year Conveyance Level of Service
- Inflow and Infiltration – Point of Sale Inspections
- Inflow and Infiltration – Peak Flow Standards
- Smart Utility – Data Driven, Real Time Control

Decision Area: Legacy Pollution

Actions for Exploration:

- Status Quo Sediment Management
- Far Reaching Legacy Pollution Program

Attachment C: Evaluation of Actions and Strategies – Water Quality Analysis

| Plan Development Steps | Actions | Strategies | Preferred Strategy |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Activities | <u>For each program:</u> <ul style="list-style-type: none"> Pollutant load reductions (nitrogen, phosphorus, TSS, Copper, Zinc, PCBs, PAHs, PBDEs, Fecal coliform) Relative impact to receiving waters and impairments Identify potential connections to endpoints | <u>For each strategy:</u> <ul style="list-style-type: none"> Pollutant load reductions Relative impact to receiving waters and impairments Impacts (positive and negative) on endpoints (swimming, edible fish, shellfish harvesting, chinook salmon, Orca, aquatic health) | <u>For preferred strategy:</u> <ul style="list-style-type: none"> TBD Pollutant load Receiving water impacts Endpoint impacts |
| Example Tools | <ul style="list-style-type: none"> Pollutant loading models Pollutant removal worksheets | <ul style="list-style-type: none"> Water Quality Benefits Evaluation (WQBE) Causal Models | <ul style="list-style-type: none"> Sensitivity analysis |

Attachment D: Evaluation of Actions and Strategies – Financial Evaluation

| Plan Development Steps | Actions | Strategies | Preferred Strategy |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | <u>For each program:</u> <ul style="list-style-type: none"> • Capital cost estimates • O/M cost estimates | <u>For each strategy:</u> <p><i>Financial capability assessment</i></p> <ul style="list-style-type: none"> • Rate projections • Capacity charge projections • Bond funding requirements <p><i>Household affordability assessment</i></p> <ul style="list-style-type: none"> • Household burden • Number hours worked at minimum wage <p><i>Community affordability assessment</i></p> <ul style="list-style-type: none"> • Burden on other public services | <u>Financial Plan:</u> <p>Define funding needs and sources for implementation</p> <ul style="list-style-type: none"> • Rate • Capacity charge • Debt management • Measures to address household affordability |
| Activities | | | |
| Example Tools | <ul style="list-style-type: none"> • Historic cost information • Cost estimating worksheets | <ul style="list-style-type: none"> • Financial capability assessment tool | <ul style="list-style-type: none"> • Financial capability assessment tool • Sensitivity analysis |

NOTE: Action Description Sheets are internal living document worksheets used as a database to collect and store information about actions in a comprehensive and consistent way. As living documents, they will continue to evolve, reflecting progression of concepts throughout the planning process.

Attachment E: Action Description Sheet: Asset Management, Resiliency, and Redundancy, Action 2

Asset management, resiliency, and redundancy, Action 2

| Name | Medium Planned Investment Levels for Asset Risk Management and Resiliency Program to Maintain Current Risk Level |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Short Descriptions | <p>Program description: Asset management approach and invest level that leads to infrastructure maintenance and renewal at a level to maintain current risk of spills and discharges caused by structural and maintenance failures. Under this approach maintenance and renewal following these guidelines:</p> <ul style="list-style-type: none"> Planned renewal investments at 1.7% to 1.9% of total system value. Amount of time to replace equivalent of total system value through planned investment is approximately 50 to 60 years with some asset types being replaced multiple times over the planning horizon (i.e., mechanical, electrical, instrumentation). Annual maintenance spending approximately 0.10% of total system value. Maintenance practices result in approximately 70% of maintenance dollars spent proactively, and 30% of maintenance dollars spent on break-in work. Backlog of deferred renewal to correct system deterioration will remain at the current level of \$2.2 billion. Spending on unplanned renewal will be required and will be in addition to planned investment spending. Failures resulting in overflows and discharges are projected to average 6.5 million gallons (MG) of untreated wastewater spilling annually. <p>Deterioration will remain unchanged from 2020 levels.</p> <p>Project description: Infrastructure projects include replacement of all mechanical, electrical, and instrumentation assets in the King County Wastewater Treatment Division's (WTD's) wastewater system at least once, and in some cases multiple times, over the Clean Water Plan (Plan) horizon. Approximately 25% of the value of structural assets and 35% of the value of civil assets will be replaced over the Plan horizon through planned investments. Other projects include all seismic retrofits of vulnerable facilities over the first 25 years of the Plan. Projects will be completed on all assets including wastewater treatment plants, pump stations, conveyance pipes, buildings, etc.</p> <p>A wastewater system post-earthquake reconstruction plan for non-critical assets would be developed, incorporating economic, equity, and social justice considerations, and would be in place within 10 years of implementation of this program to proactively prepare for and enable an efficient recovery in the aftermath of a seismic event. Return to service would be achieved establishing emergency procurement channels prior to an earthquake, partnerships and agreements with other utilities, some from regions unlikely to be affected by an earthquake, to provide staff and resources, response plans, etc.</p> |

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King County Develop asset management policies that state the rationale for a medium level of investment in infrastructure renewal and maintenance policy and provide guidance for directing capital and operation and maintenance (O&M) spending based on risk.
description*: **Policy analysis will be completed following action evaluation and will be documented separately.*

Decision Area
Primary decision area

Secondary decision area(s)

- ☐ Treatment Plants and Wet Weather Facilities
☐ Combined Sewer Overflows and Stormwater
☐ Pollution Source Control/Product Stewardship
☒ **Asset Management/Resiliency/Redundancy**

- ☐ Resource Recovery
☐ Legacy Pollution
☐ Wastewater Conveyance System
☐ Financial Strategies

Decision Area Status Quo

The nature of King County's evolving asset management program and aging infrastructure prevent definition of a current long-term status quo direction.

Drivers

A medium asset management approach and investment level in system reliability is driven by the following factors:

- Significant investment is needed to address known condition reliability issues to maintain the current system backlog of renewal and prevent further deterioration.
System performance becomes a higher priority than other infrastructure spending drivers, such as capacity to accommodate growth and regulatory requirements.
- There is a strong desire to mitigate risk of failure during a seismic event quickly (within 25 years).
- The public and other stakeholders desire a quick response and recovery following a seismic event.

Potential Pollutant Pathways

- ☒ POTWs
☒ CSOs
☒ SSOs

- ☐ Stormwater
☐ Contaminated sediment
☐ Direct source

Relevant Existing Policies

Policy language update needed:
☒ Likely ☐ Possible ☐ Unlikely

PART 1: DESCRIPTION AND OVERVIEW

Overview/Summary

To convey and treat regional wastewater, WTD maintains extensive infrastructure: conveyance pipelines, force mains, pump stations, treatment facilities, and structures. For system performance to be maintained, infrastructure must be regularly inspected and repaired, and periodically refurbished or replaced. Typically, as infrastructure ages and/or runtime increases, the risk of these assets failing

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increases. Failures can lead to service interruptions and discharges and spills of untreated wastewater into receiving waters. Similarly, acute events, such as an earthquake, can also result in infrastructure failure.

Spending on prevention and avoidance of failures is a priority over other competing capital needs. Under this action, any deterioration will be halted, though the existing backlog of renewal needs will stay the same. Current rates of spills and discharges is expected to stay the same, and large failure events will be avoided over the Plan horizon. Some unplanned rehabilitation and replacement will occur; amounts will increase over time.

Asset management spending will focus on proactive renewal of assets that are deteriorating; capital renewal of failed infrastructure; and inspection, maintenance, and repair of assets. This work is conducted by numerous work groups at WTD, including the asset management program, maintenance crews at the treatment plants and off-site, inspection and maintenance crews for conveyance assets, and capital delivery.

Facilities (non-conveyance assets) in the regional wastewater system are brought up to current earthquake building codes within the first 25 years of the Plan. Currently approximately \$84 million in seismic improvements are identified at 17 facilities.

Major Assumptions

- Most assets will be replaced as soon as condition is compromised to the point that the asset does not function as designed and additional maintenance is required.
- Total system replacement value of \$14.5 billion to \$21.4 billion based on estimated replacement values for treatment facilities, pump stations, combined sewer overflow (CSO) facilities, and pipelines.
- Unplanned spending will have an added cost premium three times greater than planned spending.
- The last 5 years of maintenance costs are representative of current maintenance spending levels; maintenance spending will not increase beyond current levels except for inflation.
- Pipelines currently rated at Conditions 4 and 5 (worst condition) will be remediated during the planning horizon.
- All mechanical, electrical, and instrumentation assets at treatment plants and pump stations will be replaced within the planning horizon (i.e., next 40 years).
- The \$84 million in seismic retrofit costs are spread evenly over the first 25 years of the planning horizon.
- All new infrastructure will be built to current seismic code (and so does not contribute to future retrofit costs).
- Shorter equipment life expectancy due to saltwater intrusion at coastal infrastructure sites is not included because of the limited number of assets that would be impacted compared to the total system. Renewal forecast needs models may be updated in the future to account for sensitivities to saltwater intrusion.

Key Components

The asset management program is an existing WTD program. A medium investment risk management approach expands on this existing program. It involves the following key components:

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- Emergency corrective maintenance, rehabilitation, and replacement as needed with goal to minimize this program component
- Increased maintenance program planning
- Increased routine inspection
- Increased routine preventive maintenance
- Increased condition assessment
- Increased planned rehabilitation and replacement
- Greater asset data collection and management
- Long-range renewal forecasting and planning

This action requires 9 full-time equivalents (FTEs) in program administration in the first 6 years of the Plan horizon. These staff will carry out tasks related to the following topics to direct asset management funds:

- Condition assessment and asset information gathering protocols
- Emergency response plan development
- Maintenance planning
- Program management
- Renewal planning
- Risk-based decision-making processes
- Technology support

Regulatory Considerations

Under National Pollutant Discharge Elimination System (NPDES) requirement Code of Federal Regulations (CFR) Title 40 Section 122.41(e) Proper operation and maintenance, which states:

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar system which are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

Additionally, federally mandated minimum controls for combined sewer systems include conditions specifically related to effective operations and maintenance for system performance; these are listed in the West Point Treatment Plant NPDES permit.

Finally, regulatory limits on CSOs are in place. Any sanitary sewer overflows (SSOs) (both separated system and dry weather overflows in the combined system) are prohibited and can result in fines by the Washington State Department of Ecology. The causes of such overflows are varied, and can include structural or maintenance failures, which are typically addressed through asset management programs.

Partnerships/Collaboration

N/A

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Benefits

The increased condition monitoring and inspection required to support this action improves the quality and availability of information for decision making, which supports better planning, cash flow predictions, and rate impact assessments.

Additionally, improvements to conveyance pipe condition may reduce infiltration and inflow (I/I), improving system capacity. Proper maintenance of conveyance pipes and appropriate abandonment of old and inactive outfalls may reduce sediment buildup, which contributes to legacy pollution.

This action also includes more planned work than unplanned work; unplanned work can cost significantly more than planned work. This means that more work can be done for the same amount of money.

Drawbacks

A medium investment level may require the diversion of funds and resources from other system needs. Unplanned work will come at a cost premium that can be three times or greater than work that is planned.

**Implementation
Challenges and Risks**

To maintain current risk levels, funding and maintenance must be directed to the highest-risk assets. Focusing asset management portfolio Capital Improvement Program (CIP) investments on the most critical assets requiring remediation poses a challenge to implementation because it requires an understanding of the effectiveness of the renewal needs identification in place as well as the effectiveness of renewal planning, packaging and project prioritization, and maintenance decision making. Significant coordination is required between operations and maintenance, planning, engineering, and finance functions to deliver an asset management program.

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Equity and Social Justice Opportunities

Asset management can be used to promote equity and social justice by using spatial overlay of distributed overflow locations as well as critical infrastructure and the condition/seismic vulnerability of that infrastructure. Knowledge of the spatial location of these items can help inform decision making and prioritization inspection, maintenance, and renewal by looking at the equity issues of implementation. For example, distributed infrastructure in poor condition has a greater likelihood of failing. When located in communities of color this can cause greater adverse impacts in these communities. A policy that assigns a higher consequence of failure and/or factors equity into inspection, maintenance, and renewal decision making could reduce the risk of impacts to these communities. For example, if WTD establishes a criticality rating for pipelines, location within a priority community could be a factor that denotes a pipeline as more critical. Similarly, emergency response and recovery planning could take into account the resiliency of communities and their ability to endure and recover from a natural disaster when establishing response priorities, placing emergency response equipment, etc.

The billion-dollar investment into asset management will create several job opportunities. Spreading this investment into capital facilities maintenance, repair, and construction to King County residents and businesses using established County procurement practices can greatly reduce inequities in the county.

Duration and Timeline

Asset management activities are ongoing and will occur every year throughout the planning horizon.

Table 1. Timeline for Investment

| Investment Type | Percentage of Capital Spending | | | |
|--------------------------------------|--------------------------------|-----------|-----------|-----------|
| | 2021–2030 | 2031–2040 | 2041–2050 | 2051–2060 |
| Planned | 24.2% | 23.7% | 24.6% | 25.6% |
| Unplanned | 0.1% | 0.1% | 0.1% | 0.1% |
| Cost premium (unplanned work) | 0.2% | 0.2% | 0.2% | 0.2% |
| Seismic retrofits | 0.3% | 0.3% | 0.2% | 0.0% |
| Total | 24.8% | 24.3% | 25.0% | 25.9% |

Remaining backlog at the end of the planning horizon is approximately \$2.2 billion.

Maintenance spending is assumed to be constant year-to-year.

The following factors will influence spending rates over time:

- Opportunistic projects that take advantage of other Division's work or conditions to perform renewal
- Planning to smooth financial impacts to ratepayers

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- Other capital work addressing capacity and compliance, which may offer opportunity to perform addition renewal and seismic retrofits

Triggers

Triggers that may lead to the interruption of planned asset management activities include:

- An unpredicted failure event that triggers a renewal action, significant maintenance work, etc.
- An unforeseen financial expenditure in another area of the capital program that leads to delays in asset management projects
- Reductions or interruptions to staff availability due to hiring difficulties or externalities (e.g., COVID pandemic)

Triggers that may speed up implementation include:

- Increased public attention to failures or a high-profile failure event
- Changes to regulations that create new requirements for asset management

REFERENCES

1. AM_Reports_01172020.xlsx: Preventive-Corrective maintenance ratio data; Sewer pipeline data; BI-Cycle equipment data
2. Sewer Rate Simplified Model 12.2019: Long term financial forecast for portfolios; 2019–2024 budgeted CIP projects; Assumptions
3. Table of SSOs and Discharges from 2009 through 2018
4. Sewer Pipeline Replacement Unit Costs: Developed by HDR
5. April 2012 Ratepayer Report
6. April 2016 Ratepayer Report
7. Recommendations to Enhance the Resiliency and Recovery of King County's Regional Wastewater Treatment Facilities – Final Resiliency Recommendations (2018)
8. Department of Ecology New Release Nov. 6, 2019 - King County fined for sewer overflow violations
9. WTD SAMP Workplan Dashboard (as of March 23, 2020)

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LOCATION MAP/SCHEMATIC/INFOGRAPHIC

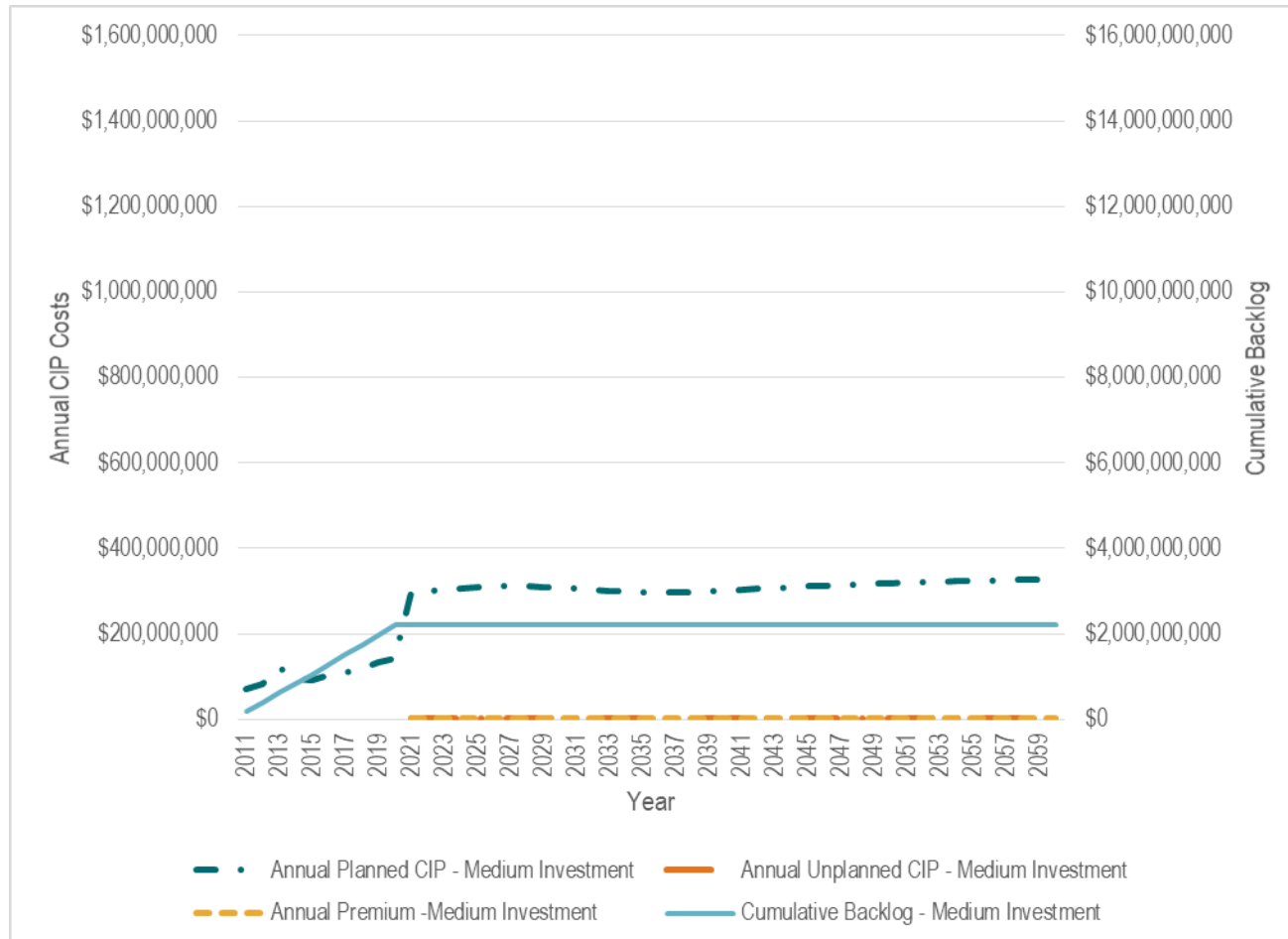


Figure 3. Renewal Investment Spending: Planned, Unplanned, Cost Premium, and Backlog

Unplanned and cost premium spending is approximately \$3.9 million per year.

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PART 2: ANALYSIS

WATER QUALITY

Because Action 2 assumes current spill and discharge volumes will remain the same, there will be no changes to loads.

| Parameter | Total Pollutant Load Reduction | Receiving Water Body (may be more than one) |
|-----------------------------------------|--------------------------------|---------------------------------------------|
| Total nitrogen | 0 lb | N/A |
| Total phosphorus | 0 lb | N/A |
| Total/dissolved copper | 0 lb | N/A |
| Total/dissolve zinc | 0 lb | N/A |
| Total suspended solids (TSS) | 0 lb | N/A |
| Polychlorinated biphenyls (PCBs) | 0 lb | N/A |
| Polybrominated diphenyl ethers (PBDEs) | 0 lb | N/A |
| Polycyclic aromatic hydrocarbons (PAHs) | 0 lb | N/A |
| Fecal coliform | 0 CFU | N/A |
| Flow reduction | 0 MG/yr | |
| CEC reduction | None | |

COST

| | 2020s | 2030s | 2040s | 2050s | Total *Note, rounding impacts totals |
|-------------------------------------------------------|----------------------------------------------|---------------------------------|---------------------------------|---------------------------------|-----------------------------------------|
| Total capital cost (accuracy range: 50%/+300%) | N/A | N/A | N/A | N/A | N/A |
| Total O&M and administrative costs | \$181,000,000 | \$180,000,000 | \$180,000,000 | \$180,000,000 | \$720,000,000 |
| R&R cost | Planned CIP: \$1,553,000,000-\$9,315,000,000 | \$1,519,000,000-\$9,114,000,000 | \$1,566,000,000-\$9,393,000,000 | \$1,623,000,000-\$9,738,000,000 | \$6,260,000,000-\$37,560,000,000 |

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| | | | | | |
|-----------------------------------------------|---------------------------------------------------------|---------------------------------|---------------------------------|---------------------------------|----------------------------------|
| (accuracy range - 50%/+300%) | Unplanned + cost premium: \$20,000,000-\$117,000,000 | \$20,000,000-\$117,000,000 | \$20,000,000-\$117,000,000 | \$20,000,000-\$117,000,000 | \$78,000,000-\$468,000,000 |
| | Total: \$1,527,000,000-\$9,432,000,000 | \$1,539,000,000-\$9,231,000,000 | \$1,585,000,000-\$9,510,000,000 | \$1,643,000,000-\$9,855,000,000 | \$6,338,000,000-\$38,028,000,000 |
| Total revenues (accuracy range: 50%/+300%) | N/A | N/A | N/A | N/A | N/A |
| Avoided costs | N/A | N/A | N/A | N/A | N/A |
| External costs to the region | N/A | N/A | N/A | N/A | N/A |

All values shown in 2020 dollars.

SUSTAINABILITY

| | |
|--------------------------|-----|
| Greenhouse gas emissions | N/A |
| Electricity use | N/A |
| Natural gas use | N/A |
| Vehicle fuel use | N/A |

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PART 3: EVALUATION RESULTS

WATER QUALITY OUTCOMES

Endpoint connections to be evaluated:

Impacts to human and aquatic health endpoints will be determined during strategy analysis using WQBE and other tools. Pollutants that have a connection to and are inputs to endpoint analysis are noted below.

| | |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Human health: Recreation | <p>Pollutants considered under this action that are inputs to human health: recreation endpoint analysis:</p> <ul style="list-style-type: none"> Fecal coliform <p>Receiving waterbody affected:</p> <ul style="list-style-type: none"> Multiple, with Puget Sound being the majority <p>Endpoint impacts from nutrients would not be affected by this action.</p> |
| Human health: Edible fish and shellfish | <p>Pollutants considered under this action that are inputs to human health: edible fish and shellfish endpoint analysis:</p> <ul style="list-style-type: none"> Fecal coliform <p>Receiving waterbody affected:</p> <ul style="list-style-type: none"> Multiple, with Puget Sound being the majority <p>Endpoint impacts from PCBs and PBDEs would not be affected by this action.</p> |
| Aquatic health | Aquatic health endpoint impacts would not be affected by this action. |
| Timing for water quality outcomes | TBD |
| Water quality outcomes summary | |
| TBD | |
| Water quality–related equity outcomes | |
| Geographic distribution of services (e.g., location of infrastructure, target outreach locations) | Based on historical spill and discharge patterns 46% of spills by volumes occur in the distributed system; this type of spill has the greatest likelihood of impacting priority communities. |
| Geographic impact of services (e.g., water bodies, neighborhoods) | Based on historical spill and discharge patterns, the majority of spills and discharges impact Puget Sound (54%), followed by the Duwamish Waterway and Elliott Bay (28%). Those populations that use the Duwamish Waterway and its associated end points are therefore likely to be impacted more than users of other water bodies. |
| Gaps of service and impact for communities of color, low-income populations, and limited English-speaking residents (e.g., greater rates of overflows in certain neighborhoods due to infrastructure age and rates of repair) | This action will invest more in maintenance and renewal of all infrastructure, including distributed infrastructure. It is anticipated that locations will maintain current distribution, which suggests continued impacts to the Duwamish Waterway; however, overall spill volumes will not grow from today's averages. |
| Indirect impact of WTD to priority populations (e.g., job opportunities, economic opportunities) | Water quality outcomes may impact job opportunities or economic opportunities temporarily when an overflow or discharge occurs, because this can shut down local fishing and shellfish harvesting. However, large spills, which have the greatest impact, will be avoided in Action 2. |

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| | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Interaction with WTD services in different ways (e.g., subsistence fishing vs. recreation; odor/noise control associated with different types of infrastructure) | Impacts to different end points and water uses are expected to be proportional across end points. |
| Magnification of WTD impacts/choices (some communities are better equipped to absorb adversity; conversely benefits may accrue differently for communities of color, lower socio-economic communities) | Priority communities may be less equipped to abandon or substitute water bodies or human health/ecological end points impacted by increasing wastewater overflows and discharges than other communities that may be able to use other, less polluted water bodies. Additionally, in the event of failure, because of either deteriorating infrastructure or a seismic event, how response is prioritized could magnify or reduce the impact of such an event. |

COST ANALYSIS

| | |
|--------------------------------------------------------------------------|-----|
| Nitrogen benefit/cost ratio (lb removed/dollar) | TBD |
| <Insert other pollutant of focus> benefit/cost ratio (lb removed/dollar) | TBD |
| <Insert other pollutant of focus> benefit/cost ratio (lb removed/dollar) | TBD |
| Cost outcomes TBD | |

CO-BENEFITS AND IMPACTS

| | | |
|----------------|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sustainability | Operational energy use | N/A: operational energy use for this action is below the threshold of 1% of WTD's total energy use. |
| | Greenhouse gas emissions | Direct (scope 1) greenhouse gas emissions for this action are below the threshold of 1% of WTD's total greenhouse gas emissions. Scope 3 emissions consist primarily of materials required for the rehabilitation and replacement of structural and civil assets, and the disposal of materials from replaced assets. |
| | Resource consumption/ recovery potential | Resource consumption consists of non-renewable/virgin materials for structural, civil, mechanical, electrical, and instrumentation assets. This includes everything from concrete to steel to electrical conduits, etc. Many assets will require multiple replacements. This action will not recover any resources. |

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| | | |
|----------------------------------|-----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Management and operations | Ecosystem services | This action replaces assets “in-kind,” so existing ecosystem services will be preserved. |
| | Sustainability-related equity outcomes | Because investment in maintenance and renewal will be distributed throughout the system based on infrastructure age and condition, sustainability outcomes related to construction are also expected to be distributed based on age and condition. |
| | Public health exposure | This action maintains the risk of public health exposure to untreated wastewater by investing at a rate that maintains deterioration at current levels. The number of spills and discharges that do occur will remain unchanged though the risk of a large spill will be unlikely over the Plan horizon. |
| | Resiliency/ redundancy | <p>This action will increase resiliency to seismic hazards within the next 25 years by retrofitting critical infrastructure. Overall system performance will be maintained. Because more proactive inspection work will be performed and additional resources will be available for training and other preparedness activities, system resiliency and ability to respond will increase.</p> <p>This action will not create redundancies as it replaces assets “in-kind.”</p> |
| | Legal/liability/ regulatory | <p>This action does not change WTD’s legal/regulatory risk for permit compliance because the risk of spills and discharges (resulting in permit violations) remains the same. The risk of a “major” failure is low.</p> <p>WTD is liable for spills and discharges that lead to property damage, regulatory fines, etc. when those discharges are caused by structural and maintenance failures.</p> |
| | Reputational | Because spills and discharges will continue, WTD’s reputation will remain unchanged. However, because more maintenance, rehabilitation, and replacement will occur proactively and WTD’s ability to respond to events that do occur will improve, costs will decrease and WTD’s role as steward of the public’s infrastructure may be improved. |

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| | | |
|------------------|----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | Management and operations-related equity outcomes | This action does not reduce or increase the risk of public health exposure to untreated wastewater in priority communities. Overall, system resiliency and performance will be maintained over time. Those communities least able to respond to service disruptions or timely responses to and corrections of failures will be impacted the most. Priority communities may have less knowledge or receive less communication about what to do when a spill event occurs. This may also increase distrust of utility services in these communities. |
| Community | Impacts of construction | <p>Impacts of construction will occur when major rehabilitation or replacement is conducted, particularly in the distributed (conveyance and off-site) system, and will include traffic interruptions and noise. This may lead to disruptions to businesses, community gatherings, etc. These impacts will be temporary.</p> <p>Interruptions to communities surrounding treatment plants comprise the potential for increased truck traffic.</p> <p>Nearly all interruptions will be planned, the community will be given notice, and efforts can be made to minimize impacts.</p> |
| | Economic impacts | This action replaces assets “in-kind,” so existing economic opportunities will be preserved. |
| | Community vibrancy | This action replaces assets “in-kind,” so existing community amenities will be preserved. Interruptions to wastewater conveyance services that create temporary impacts to community functionality and quality of life can be easily managed. |
| | Community-related equity outcomes | Activities with community impacts such as construction, spill response, and service interruptions will be distributed through the system. Because most activities in the community will be planned, priority communities will have time to prepare. Because these activities will replace services “in-kind,” any existing inequities will be preserved. If using the County’s existing procurement processes, economic opportunities through construction will be preserved. |

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Attachment F: Action Description Sheet: Treatment Plants and Wet Weather Facilities, Action 3

Treatment plants and wet weather facilities, Action 3

| | | |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Name | King County WTD manages nitrogen reduction as a whole across regional treatment plants | |
| Short Description | Program description: | Implement treatment upgrade and capacity program across King County WTD secondary treatment plants using a “bubble” permit strategy to achieve an overall 13 mg/L annual average target (providing a similar load reduction as an individual plant 8 mg/L seasonal target). |
| | Project description: | Complete solids and liquids treatment capacity expansion to accommodate population growth at the same time as treatment level improvements. Treatment level improvements include upgrades to existing wastewater treatment plants with nitrogen removal to 13 mg/L year-round (providing a similar load reduction as an individual plant 8 mg/L seasonal target). Nitrogen removal at West Point would be modest, using sidestream treatment only. South Plant and Brightwater would each be upgraded to achieve nitrogen removal to 3 mg/L year-round. South Plant and West Point will be upgraded by the early 2030s, while Brightwater will be upgraded the following decade. |
| | King County policy description*: | Modify existing treatment policies to reflect guidance and direction on higher level of treatment at secondary treatment plants, including activities such as bubble permitting for nitrogen. Update existing treatment policies to reflect additional level of treatment. <i>*policy analysis will be completed following action evaluation and will be documented separately</i> |
| Decision Area | <input checked="" type="checkbox"/> Treatment Plants and Wet Weather Facilities <input type="checkbox"/> Combined Sewer Overflows and Stormwater <input type="checkbox"/> Pollution Source Control/Product Stewardship <input type="checkbox"/> Resource Recovery <input type="checkbox"/> Legacy Pollution <input type="checkbox"/> Wastewater Conveyance System | |

King County Wastewater Treatment Division

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| | | |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| | <input type="checkbox"/> Asset Management/Resiliency/Redundancy | <input type="checkbox"/> Financial Strategies |
| Decision Area Status Quo | The status quo action assumes existing levels of treatment currently provided at each of King County's WTD secondary treatment plants will be maintained, and the facilities will be expanded to provide additional solids and liquids stream treatment capacity to meet population growth requirements throughout the planning horizon. Capital investments will be made to accommodate additional growth only; no additional investments will be made to provide a higher quality effluent than currently produced. | |
| Drivers | <p>This action is driven by potential regulatory changes, specifically Ecology implementing a nitrogen limit in future upcoming permits.</p> <p>As of spring 2020, anticipated regulatory changes include Ecology issuing a regional general permit with a concentration-based nitrogen limit in late 2021 or early 2022. Permit cycles are typically 5 years; it is anticipated that the first permit cycle will allow for facility planning to incorporate nitrogen removal requirements, while the second cycle will build on the first and allow for project implementation. This results in an overall 10-year planning and implementation cycle for nutrient removal at regional wastewater treatment plants, including King County plants (i.e., requirements for all 67 point-source facilities that discharge to Puget Sound to meet nitrogen removal requirements in the early 2030s)</p> | |
| Potential Pollutant Pathways | <input checked="" type="checkbox"/> POTWs <input type="checkbox"/> CSOs <input type="checkbox"/> SSOs | <input type="checkbox"/> Stormwater <input type="checkbox"/> Contaminated sediment <input type="checkbox"/> Direct source |
| Relevant Existing Policies | <p>Policy language update needed: <input type="checkbox"/> Likely <input checked="" type="checkbox"/> Possible <input type="checkbox"/> Unlikely</p> <p>Supporting existing WTD policy code sections include:</p> <ul style="list-style-type: none"> 28.86.050 Treatment plant policies (TPP) 28.86.180.1 Implementation, Treatment capacity | |

King County Wastewater Treatment Division

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PART 1: DESCRIPTION AND OVERVIEW

Overview/Summary

This action includes upgrades to the King County's Wastewater Treatment Division (WTD) regional wastewater system to meet more stringent nitrogen removal regulations anticipated within the region. Instead of meeting individual nitrogen removal permit conditions at each of the regional treatment facilities, this action assumes the use of a "bubble" permit concept. A "bubble" permit would allow for intra-plant nitrogen credit trading between each of WTD's regional treatment facilities, such that an overall nitrogen removal condition is met. This concept would allow the County to selectively invest in nitrogen removal upgrades at sites that more readily have the space and/or existing infrastructure to enable lower nitrogen effluent conditions to be met. Nitrogen removal upgrades will be implemented at each of the County's regional treatment facilities (i.e., West Point, South Plant, and Brightwater). However, both South Plant and Brightwater will meet a lower effluent target of 3 mg/L so that West Point will be able to meet a higher effluent target within the existing space-constrained site and without significant disruptive construction impacts. West Point nitrogen removal will be accomplished through sidestream treatment only. In addition to any facility upgrades needed to meet nitrogen removal requirements, capital investments will also be made to expand liquid and solids stream treatment capacity to accommodate population growth through the planning horizon.

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Major Assumptions

Major assumptions include the following:

- Regulatory framework allows for management of nitrogen reduction as a whole across regional facilities.
- Brightwater and South Plant will achieve an effluent total inorganic nitrogen concentration (TIN) of 3 mg/L or less year-round. West Point will implement sidestream nitrogen treatment only. This will result in an equivalent effluent TIN concentration of approximately 13 mg/L or less year round, and a total nitrogen reduction (pounds of nitrogen per year) similar to that as an overall 8 mg/L seasonal (April-October) condition.
- Nitrogen removal upgrades are not assumed as part of this action at the Carnation treatment facility. Carnation does not discharge to Puget Sound and, consequently, is not one of the potential permittees considered by Ecology for nitrogen removal upgrades.
- Nitrogen removal upgrades are not considered as part of this action at Vashon treatment facility. The contribution of flow from Vashon relative to the regional treatment facilities is small (i.e., less than 0.2% of WTD's overall treatment facility rated capacity). The water quality and cost impacts from nitrogen removal upgrades at Vashon are assumed to be negligible as compared to the large regional facility upgrade requirements.
- Timeline and cost considerations described in this action are based on results from the 2019 Treatment Plant Flow and Loadings Study and the 2020 Nitrogen Removal Study.
- South Plant will be converted to an MBR facility to allow for additional plant expansion to provide treatment capacity throughout the 2060 planning horizon.
- Solids process expansion needs identified to address capacity constraints due to growth are assumed to be adequate to represent the capacity needs with the inclusion of nitrogen removal.
- Each of the facilities that currently produce a recycled water source (i.e., South Plant, Brightwater, and Carnation) will continue to do so, but the capacity of these systems will not be expanded throughout the planning horizon.

Conceptual site plans of each regional treatment facility with additional unit processes for nitrogen removal and facility expansion requirements are shown in Figure 1 (South Plant), Figure 2 (Brightwater), and Figure 3 (West Point).

Key Components

This action requires significant new capital investments at WTD's regional treatment plants to meet both capacity expansion needs and nitrogen removal requirements. The following components were derived from the 2019 Treatment Plant Flow and Loadings Study and the 2020 Nitrogen Removal Study.

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The unit processes assumed to be required to implement nitrogen removal upgrades to enable a bubble permitting scenario include:

- South Plant → new primary effluent pump station and fine screening facility, 6 additional aeration basins, existing aeration basin reconfigurations to four-stage modified Bardenpho (4SMB), 54 new membrane bioreactor (MBR) basins, new membrane feed pump station and electrical building, new supplemental alkalinity and methanol systems, and new sidestream annamox system.
- Brightwater → 3 additional aeration basins, 2 additional membrane cassettes installed in existing membrane basins 9 and 10, 6 additional membrane basins, 1 additional primary clarifier/aerated grit tank, 1 additional odor control train, new supplemental methanol system, and new sidestream annamox system.
- West Point → new sidestream annamox system.

In addition to these improvements, further upgrades will be needed to address capacity limitations. **Some of the upgrades would be required regardless of whether nitrogen removal is implemented (and are also described in the status quo action) while others would be needed to maintain nitrogen removal capacity throughout the planning period.** The additional process units needed to meet capacity needs include:

- South Plant → 1 additional aeration basin, 12 additional membrane basins, expansion of effluent transfer system by adding one additional peaking pump, 1 additional aerated grit tank, and 1 additional digester.
- Brightwater → 1 new aerated grit tank/primary clarifier train, 5 additional aeration basins, 5 additional membrane basins, one additional centrifuge, one additional gravity belt thickener, and 1 additional digester. The existing site will need to be reconfigured to accommodate the additional aeration basins. There is currently space for the additional membrane basins (4 basins are planned for, and the 5th basin would require reconfiguration of existing roadwork to accommodate).
- West Point → digester intensification project (i.e., conversion from mesophilic to thermophilic digestion), 2 additional aeration basins. It is assumed there is space available on the existing site for these additional basins, but implementation will be challenging due to proximity to the edge of the site.

The number of additional FTEs associated with nitrogen removal upgrades at each facility are as follows:

- South Plant → 4.5 FTEs
- Brightwater → 2.25 FTEs
- West Point → 0.5 FTE

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| | <p>An additional 0.5 FTE is assumed to be added each decade at each facility to accommodate the additional unit processes required for capacity expansion.</p> <p>Community engagement will be required during the planning and construction of the nitrogen removal upgrades.</p> |
| Regulatory Considerations | <p>The regulatory driver for this action is Ecology implementing a nitrogen limit in future upcoming permits. If Ecology does not implement a nitrogen limit, then the regulatory driver is removed.</p> <p>This action represents an alternative methodology to individual plant permits for meeting the anticipated general permit nitrogen removal requirements. As such, additional coordination with Ecology will be required to develop an approach for nitrogen removal credit accounting between WTD's facilities that is amenable to all parties.</p> |
| Partnerships/Collaboration | <p>The implementation of a treatment upgrade and expansion program that leverages a bubble permitting framework will require the collaboration of many different parties during the development of a trading framework. The following entities will likely be involved during the negotiation process:</p> <ul style="list-style-type: none">• Washington State Department of Ecology• Other permittees with multiple discharges that also may want to leverage a bubble permitting approach (e.g., Kitsap County, City of Tacoma)• Local environmental groups <p>Current partnerships with recycled water users would be maintained throughout the planning period.</p> |
| Benefits | <p>By implementation of the bubble permit, this action offsets the need for extensive nitrogen removal upgrades at the West Point facility. By implementing side-stream treatment only, there is space within the existing site to provide treatment throughout the planning horizon. This approach mitigates the need for extensive upgrades at West Point as well as the need for a 4th regional treatment facility within the planning horizon.</p> <p>Conversion of South Plant to an MBR facility will result in more site space available for other potential uses throughout the planning horizon, including future plant expansion, expansion of recycled water systems, and advanced resource recovery options.</p> |

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| | Other benefits associated with Clean Water Plan evaluation criteria (e.g., water quality, sustainability, risk, community) are provided in Parts 2 and 3. |
| Drawbacks | <p>Nitrogen removal upgrades at Brightwater result in less site space available for other potential uses, as the Brightwater site will be close to fully developed with this action. As a result, future capacity needs in the Brightwater service area could require the siting of an additional (4th) regional treatment plant.</p> <p>Other drawbacks associated with Clean Water Plan evaluation criteria (e.g., water quality, sustainability, risk, community) are provided in Parts 2 and 3.</p> |
| Potential Implementation Challenges and Risks | <p>Potential implementation challenges and risks include, but are not limited to:</p> <ul style="list-style-type: none">• Specific effluent nitrogen limits have not been determined by Ecology. Higher or lower effluent nitrogen limits than assumed here would impact the needed upgrades and ability to meet an overall nutrient effluent limit.• Implementation of nitrogen removal upgrades within the prescribed timeline will require a very aggressive planning, design and construction schedule. There is a risk that this implementation timeline will not be able to be met.• If actual flow and loads increase more quickly than the projections used, the timing of capacity expansions may need to be accelerated. In cases where capacity needs are being addressed in conjunction with nitrogen removal improvements, this may cause either the nitrogen removal project as a whole to be accelerated or lead to the implementation of back-to-back capital projects at one or more treatment plant.• Similarly, if Ecology delays the implementation of regulatory requirements for nitrogen removal, there would be instances where a portion of the nitrogen removal improvement projects described here are still needed in the timeline below (to meet capacity needs), even if the overall nitrogen removal improvement projects are delayed.• Additional study is required to confirm the scope of the capacity expansion projects identified herein. In particular, the number of membrane basins required to provide adequate capacity at Brightwater throughout the planning horizon is contingent upon future filterability performance. Should performance improve, then less membrane basins may need to be constructed. Likewise, additional study of the Effluent Transfer system at South Plant is required to determine if the existing ETS pipeline has sufficient capacity to provide service throughout the planning horizon. If capacity is shown to be insufficient, the system will need to be either expanded or replaced and will significantly increase the capital costs associated with this action. |

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| | <ul style="list-style-type: none"> Implementation of capacity expansion projects at West Point will be challenging. The construction of the two additional aeration basins will likely require water staging via barge and temporary dock, archeological services during excavation, site mitigation, and compensation per tribal agreements for potential impact to fishing and shellfish harvests. Solids system capacity requirements at South Plant and Brightwater could be higher than those for the status quo treatment action, likely due to supplemental carbon addition. Further evaluation of the solids system expansion requirements and timeline for implementation should be conducted. |
| Equity and Social Justice Opportunities | With upgrades primarily located within existing facility footprints, opportunities for ESJ augmentation could be focused on the process for implementing the upgrades (e.g., opportunities for community input and employment opportunities). |
| Duration and Timeline | <p>A treatment upgrade and expansion program using a “bubble” permit framework to achieve nitrogen removal will be initiated should a nitrogen removal general permit be issued in the 2020s. A conceptual timeline for implementation follows:</p> <ul style="list-style-type: none"> 2020s: South Plant will initiate project planning immediately after issuance of the general permit. South Plant will target full nitrogen removal to 3 mg/L year-round for current plant rated capacity (144 max month MGD). Planning, design, and construction will occur over a 10-year period, with nitrogen removal upgrades online by the early 2030s. West Point will target the implementation of sidestream nitrogen removal only during this timeframe. Concurrent to facility planning/design activities, an accounting framework that enables tracking of nitrogen removal credits between WTD’s regional facilities will be negotiated. This framework will be collaboratively developed in partnership with Ecology. 2030s: Brightwater will initiate project planning at the beginning of the decade. Both capacity expansion and nitrogen removal upgrades to 3 mg/L year-round target will be initiated. Planning, design, and construction will occur over a 10-year period, with capacity expansion and nitrogen removal upgrades online by the early 2040s. In addition, planning and design activities for South Plant’s expansion requirements will begin by the mid-2030s to allow for implementation by 2043. 2040s: Construction activities for South Plant expansion requirements will be complete by the early 2040s. 2050s: No major activities are anticipated during this period. |

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For all nitrogen removal upgrades and facility expansion, ongoing operational and maintenance activities will be required for the life of the installed facilities.

Triggers

The regulatory trigger for this action is the anticipated requirements for nitrogen removal. If Ecology does not implement these requirements, then the regulatory trigger is removed. King County may still elect to implement the components described in this action, but would do so without a regulatory obligation.

Capacity expansion projects as defined in this action are initiated to meet population and growth requirements based on projections. If actual flow and loads vary from the projections, the timing of expansions may need to be accelerated (for earlier than anticipated growth) or could be delayed (for slower growth than anticipated).

Specific effluent nitrogen limits have not been determined by Ecology. Higher or lower effluent nitrogen limits than assumed here would impact the needed upgrades and ability to meet an overall nutrient effluent limit

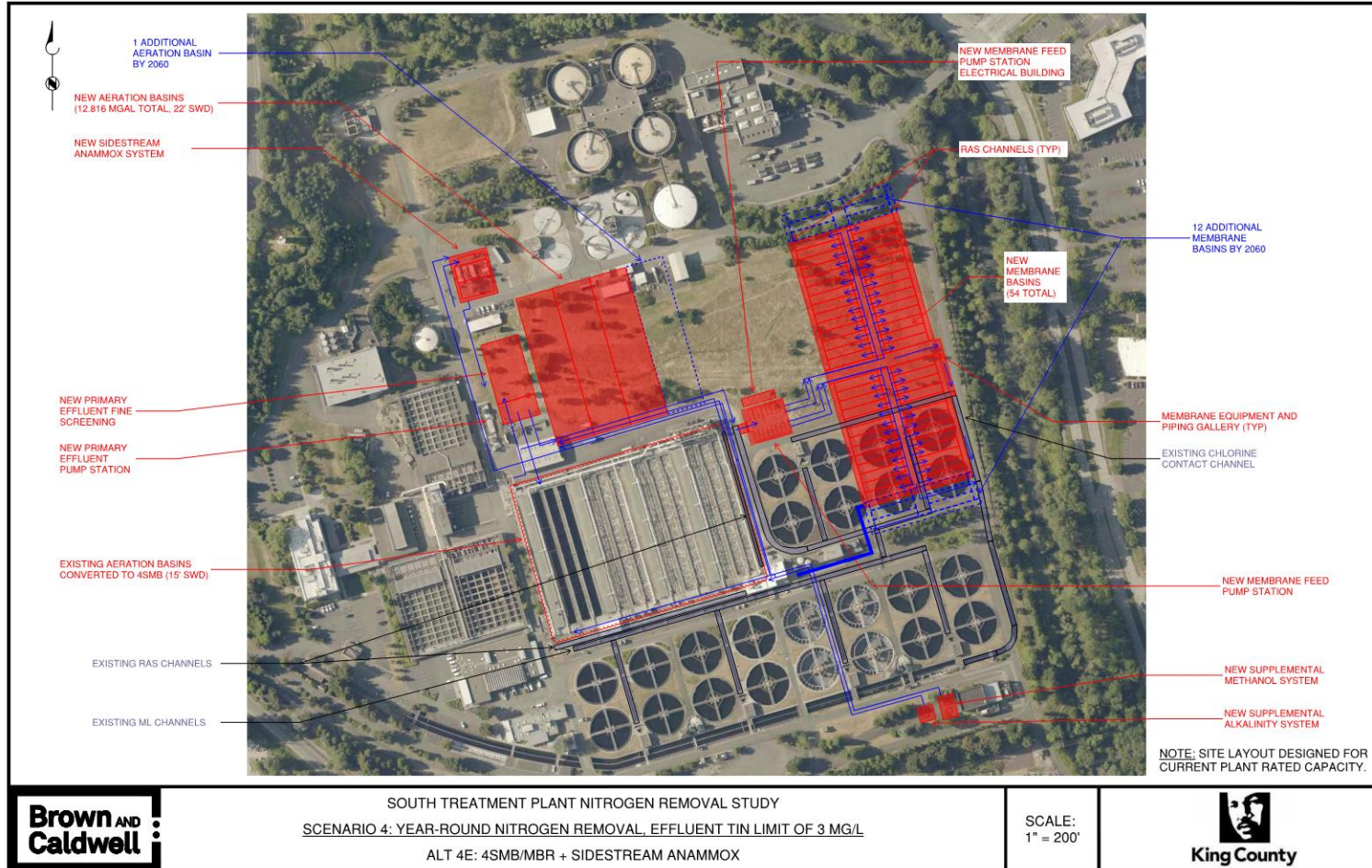
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 11. *Nitrogen Removal Study Summary Report- DRAFT*, Prepared for King County Department of Natural Resources and Parks Water Treatment Division, Pending.
 12. *West Point Treatment Plant Peak Flow and Wasteload Projections 2010-2060 TM*, King County Department of Natural Resources and Parks Water Treatment Division, December 2018
 13. *South Treatment Plant Peak Flow and Wasteload Projections 2010-2060 TM*, King County Department of Natural Resources and Parks Water Treatment Division, January 2019
 14. *Brightwater Treatment Plant Peak Flow and Wasteload Projections 2010-2060 TM*, King County Department of Natural Resources and Parks Water Treatment Division, January 2019
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LOCATION MAP/SCHEMATIC/INFOGRAPHIC

Figure 1.



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PART 2: ANALYSIS

WATER QUALITY

Pollutant load reductions relative to: treated wastewater

| Parameter | Total Pollutant Load Reduction | Receiving water body |
|-----------------------------------------|-------------------------------------------------------|----------------------|
| Total nitrogen | 272,000,000-352,000,000 lbs | Puget Sound |
| Total phosphorus | (9,000,000)-(11,000,000) lbs | Puget Sound |
| Total/dissolved copper | (24,000)-(31,000) lbs | Puget Sound |
| Total/dissolved zinc | (94,000)-(121,000) lbs | Puget Sound |
| Total suspended solids (TSS) | 20,000,000-26,000,000 lbs | Puget Sound |
| Polychlorinated biphenyls (PCBs) | 3-4 lbs | Puget Sound |
| Polybrominated diphenyl ethers (PBDEs) | 36-46 lbs | Puget Sound |
| Polycyclic aromatic hydrocarbons (PAHs) | (1,400)-(1,800) lbs | Puget Sound |
| Fecal coliform | (1.11x10 ¹⁵)-(1.43x10 ¹⁵) CFU | Puget Sound |
| Flow reduction | None | |
| CEC reduction | Negligible | |

COST

| | 2020s | 2030s | 2040s | 2050s | Total |
|-------------------------------------------------------------------|-----------------------------|---------------------------------|-------------------------------|-------------------------------|-----------------------------------------|
| Total project cost (accuracy range -50%/+300%) | \$120,000,000-\$720,000,000 | \$1,250,000,000-\$7,500,000,000 | \$380,000,000-\$2,280,000,000 | \$0 | \$1,750,000,000-\$10,500,000,000 |
| Annual O&M and admin costs (accuracy range -50%/+300%) | \$29,000,000-\$174,000,000 | \$35,000,000-\$210,000,000 | \$40,000,000-\$237,000,000 | \$42,000,000-\$249,000,000 | \$145,000,000-\$870,000,000* |
| R&R cost (accuracy range -50%/+300%) | -- | -- | \$36,000,000-\$213,000,000 | \$745,000,000-\$4,470,000,000 | \$781,000,000-\$4,683,000,000 |
| Annual revenues (accuracy range -50%/+300%) | N/A | N/A | N/A | N/A | N/A |
| Avoided costs (accuracy range -50%/+300%) | N/A | N/A | N/A | N/A | N/A |
| External costs to the region (accuracy range -50%/+300%) | N/A | N/A | N/A | N/A | N/A |

*average over planning horizon
All costs presented as 2020 dollars

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SUSTAINABILITY

| | |
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| Annual greenhouse gas emissions | TBD MT CO ₂ e |
| Annual electricity use | 260,000,000 kWh/yr average over planning horizon |
| Annual natural gas use | 690,000 therms/yr average over planning horizon |
| Annual vehicle fuel use | Hauling costs associated with biosolids program captured in Resource Recovery Actions; usage from plant operations assumed negligible |

EQUITY AND SOCIAL JUSTICE

TBD

PART 3: EVALUATION RESULTS

WATER QUALITY OUTCOMES

Endpoint connections to be evaluated:

Impacts to human and aquatic health endpoints will be determined during strategy analysis using WQBE and other tools. Pollutants that have a connection to and are inputs to endpoint analysis are noted below.

Note: King County, in partnership with Ecology and the scientific community, continue to evaluate the uncertainty of realized environmental benefits to Puget Sound by reducing nitrogen from wastewater effluent.

| | |
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| Human health: Recreation | <p>Pollutant reductions from this action that are inputs to human health: recreation endpoint analysis:</p> <ul style="list-style-type: none"> • Marine nitrogen <p>Receiving waterbody affected:</p> <ul style="list-style-type: none"> • Puget Sound <p>Endpoint impacts from freshwater phosphorus and fecal coliform would not be affected by this action.</p> |
| Human health: Edible fish and shellfish | <p>Pollutant reductions from this action that are inputs to human health: edible fish and shellfish endpoint analysis:</p> <ul style="list-style-type: none"> • PBDEs <p>Receiving waterbody affected:</p> <ul style="list-style-type: none"> • Puget Sound <p>Endpoint impacts from PCBs and fecal coliform would not be affected by this action.</p> |
| Aquatic health | <p>Pollutant reductions from this action that are inputs to aquatic health endpoint analysis:</p> |

King County Wastewater Treatment Division

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| | <ul style="list-style-type: none"> • Marine nitrogen • TSS • PBDEs Receiving Waterbody affected: <ul style="list-style-type: none"> • Puget Sound |
| Timing for water quality outcomes | TBD |
| Water quality outcomes summary TBD | |
| Water quality related equity outcomes | |
| Geographic distribution of services (e.g., location of infrastructure, target outreach locations) | TBD |
| Geographic impact of services (e.g. water bodies, neighborhoods) | TBD |
| Gaps of service and impact for communities of color, low-income populations, and limited English-speaking residents (e.g. greater rates of overflows in certain neighborhoods due to infrastructure age and rates of repair) | TBD |
| Indirect impact of WTD to priority populations (e.g. job opportunities, economic opportunities) | TBD |
| Interaction with WTD services in different ways (e.g. subsistence fishing vs. recreation; odor/noise control associated with different types of infrastructure) | TBD |
| Magnification of WTD impacts/choices (some communities are better equipped to absorb adversity; conversely benefits may accrue differently for communities of color, lower socio-economic communities) | TBD |
| COST ANALYSIS | |
| Nitrogen benefit/cost ratio (lb removed/dollar) | 0.09 |
| TSS benefit/cost ratio (lb removed/dollar) | 0.01 |
| PBDEs benefit/cost ratio (lb removed/dollar) | 14×10^{-9} |

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Cost outcomes
TBD

CO-BENEFITS AND IMPACTS

| | | |
|---------------------------|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sustainability | Operational energy use | Operational energy use will increase as wastewater flows and loads increase. In addition, operational energy use will significantly increase when nitrogen removal upgrades come online. |
| | Greenhouse gas emissions | Greenhouse gas emissions will increase as wastewater flows and loads increase. In addition, greenhouse gas emissions will increase with the addition of nitrogen removal processes due to the increase in nitrous oxide emissions. With respect to indirect emissions, this action significantly increases chemical usage. |
| | Resource consumption / recovery potential | This action maintains the existing reclaimed water program; this program is assumed to not be expanded beyond current production volumes. |
| | Ecosystem services | Given that this action provides plant upgrades within existing facility footprints, the opportunities to impact ecosystem services are minimal. |
| | Sustainability related equity outcomes | TBD |
| Management and operations | Public health exposure | This action describes projects at WTD regional facilities to provide additional levels of treatment and capacity expansion over the planning horizon. Replacement of assets not identified in this action are described in the Asset Management actions. |
| | Resiliency / redundancy | With the implementation of a significant amount of new infrastructure, this action has the opportunity to increase reliability/reduce risk of catastrophic failure for WTD's treatment services. |

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| | Legal / liability / regulatory | This action exceeds current regulatory performance requirements but is intended to be representative of the anticipated future regulations for the region. This action requires additional coordination to negotiate a trading framework. In addition, based on the precedent set by the 1991 West Point Settlement Agreement, any major construction activities on the West Point site will likely have major permitting challenges and will require extensive stakeholder coordination. |
| | Public confidence | Because all capacity and nitrogen removal projects described within this action are occurring within existing regional facility sites, there are minimal public interaction and partnership opportunities. |
| | Risk related equity outcomes | TBD |
| Community | Impacts of construction | Construction projects would be confined to the treatment plant sites. However, construction would temporarily impact local communities due to construction traffic, noise, and, in the instance of West Point, public park closures. |
| | Economic impacts | This action has minimal economic impact, but creates several operational jobs at the regional facilities over the planning horizon. |
| | Community vibrancy | Given the use of existing plant sites, this action does not significantly increase opportunities to interact with the public, create green space, or contribute to social development. |
| | Community related equity outcomes | TBD |

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