CHAPTER 3
DESCRIPTION AND COMPARISON OF SERVICE STRATEGIES AND SERVICE STRATEGY OPTIONS

This chapter describes the four service strategies and compares their potential environmental impacts. It also discusses how the service strategy options considered in the RWSP could affect these impacts. In addition, it briefly summarizes alternatives considered in the early stages of the planning process, but later eliminated from further consideration. For comparison purposes this summary includes the "no action" alternative (i.e., constructing no new facilities, undertaking no new programs). Brief cost comparisons are also provided at the end of the chapter. Detailed cost information is provided in the Draft Financing Plan.

DESCRIPTION OF SERVICE STRATEGIES

This section describes the four service strategies that form the core of the RWSP. Elements common to all service strategies are presented first, followed by descriptions of the individual service strategies. Each service strategy description begins with a short list of key defining features. Then system components are described, including the facilities needed to convey and treat wastewater and reduce the volume of combined sewer overflows. A summary of major components grouped by strategy is provided in Table 3-1.

Elements Common to All Strategies

Ongoing Projects

King County is currently in the process of planning, designing, and constructing several projects called for in previous comprehensive plan updates. These include the current expansion at the East Treatment Plant, as well as conveyance capacity improvements such as the North Creek diversion, the South Interceptor parallel, the Mill Creek relief sewer, and the Swamp Creek Interceptor extension. These treatment and conveyance improvements are needed to handle increasing wastewater volumes from the basins they serve, regardless of what service strategy the Council adopts. These projects have had or will have project-level environmental review.

Common Facilities and Programs

Several new facilities are proposed under all of the service strategies. These include expansion of the East Treatment Plant, parallel pipelines to sections of the Eastside and Bothell-Woodinville interceptors and a new 20-million gallon tank to store effluent entering the transfer system from the East Treatment Plant. These facilities are included in the list of capital facilities provided for each service strategy in this chapter. In addition, a number of capacity improvements to trunk sewers are proposed throughout the County's wastewater system over the next 30 to 40 years. These improvements are listed in more detail in Appendix E. All service strategies also include an inflow and

infiltration

[***INSERT TABLE 3-1]

(I/I) component that ranges between a very aggressive level and a maintenance level. The level of I/I control, as well as the timing required to achieve it, is included under each service strategy. The potential environmental impacts of these common proposed facilities are addressed in discussions of impacts common to all elements of the service strategies, provided in Chapter 5.

Biosolids Management

All of the service strategies assume that King County will continue to emphasize recycling of biosolids. Biosolids processing currently includes digesters and dewatering facilities at each treatment plant. Each service strategy describes the number of new digesters that would be needed and when they would need to come on-line.

King County will continue to maintain a high quality biosolids product, consider new technologies, and participate in regional collaboration and research.

Potential for Water Reuse

The use of reclaimed water to supplement water supply is of interest to a number of community members and local elected officials. While present costs for providing reclaimed water generally exceed those for development of a new potable supply, some reuse service proposals are economically viable and are being implemented, with several others potentially viable in the near-term. Examples of potential applications of reclaimed water include wastewater treatment plant process water, landscape irrigation, and industrial heating and cooling.

Both the East and West Treatment Plants have recently added reclamation facilities to produce Class A reclaimed water under the Washington State reuse standards. If an additional treatment plant were added to the regional system (the North Treatment Plant described in SS 2 and SS 3), it would be designed to include reuse production facilities. Reclaimed water produced at the treatment plants is available for landscape irrigation and as process water within the treatment plants, where water of less than potable quality is acceptable.

Service Strategy 1

Service Strategy 1 splits the northern flows between the two existing treatment plants, first expanding the East Treatment Plant (by 2010), then the West Treatment Plant (by 2020). Initially sending the flow to the East Treatment Plant requires expansion of the North Creek Pump Station near Bothell (in 2000), and constructing a parallel pipeline to the Kenmore Interceptor (by 2010) to send a portion of the northern flow to the West Treatment Plant. Sending additional flow to the East Treatment Plant in later years requires constructing a parallel pipeline along two-thirds of the Eastside Interceptor (ESI) by 2035, and the addition of storage for the Effluent Transfer System, which transports treated effluent to the outfall in Puget Sound, off Duwamish Head. See the Figure 3-1 for a graphic representation of the elements comprising SS1. The defining features of this strategy are presented in Table 3-2.

Table 3-2. Defining Features of Service Strategy 1
Maintain the existing two-treatment-plant system (West and East Treatment Plants).
Expand the East Treatment Plant capacity by 2010, with subsequent expansions required at the East and West Treatment Plants.
Parallel the Kenmore Interceptor by 2010.
Parallel two-thirds of the ESI by 2035 to carry flows to the East Treatment Plant.
Include a full-scale I&I reduction program.
Store CSOs along the Lake Union Ship Canal in large, underground storage tanks, and convey them to the West Treatment Plant after peak flows subside.
Store CSOs south of the Lake Union Ship Canal on-site and/or provide treatment at CSO locations.
Produce Class B Biosolids using anaerobic digestion at both plants pending analysis of other technologies.
Produce Class A reclaimed water at both treatment plants.

Wastewater Treatment and Conveyance

East Service Area. To accommodate the expected increase in flow, the East Treatment Plant would be enlarged from 115 to 154 mgd by 2010. Long-term capacity needs in the East Service Area would be met by subsequent expansions of the East Treatment Plant in 2030 and 2040 to an ultimate capacity of 235 mgd. The expansions of the East Treatment Plant would serve growth in south Snohomish and north King Counties, the Eastside, and the southern portion of the service area from Renton south to Auburn.

The need for additional conveyance capacity would be met by adding a third leg to the existing Effluent Transfer System outfall off Duwamish Head by 2000 and constructing 20 million gallons of storage at the East Treatment Plant site by 2015. If I/I reduction goals were not fully met, further expansion of Effluent Transfer System capacity would be necessary.

To accommodate the additional growth-related flow in the East Service Area, approximately 20 million gallons of storage would be needed along the Eastside Interceptor and it would be necessary to construct parallel pipes to portions of the Eastside Interceptor after 2030. Five million gallons of storage would be constructed by 2005 in the northern portion of the East Service Area to provide sufficient capacity to avoid overflows from the Eastside Interceptor and the Kenmore Interceptor through 2010.

West Service Area. Long-term treatment capacity needs in the West Service Area would be met by expanding the West Treatment Plant to its maximum capacity of 159 mgd in 2020.

Increased flows in the northern portion of the West Service Area would require that the Kenmore Pump Station be upgraded by 2010 in preparation for the parallel of the entire length of the Kenmore Interceptor by 2010.

In 2015, flows from south Snohomish and north King Counties would be transferred back to the West Service Area to coincide with the West Treatment Plant expansion, freeing up capacity at the East Treatment Plant to accommodate growth in the south and east. To minimize conveyance expansions, an I/I reduction program in local sewer systems would target 30 percent reduction of peak I/I by 2010.

Combined Sewer Overflows

The size and timing of construction of most of the CSO control facilities must be integrated with the service strategy conveyance system. For example, paralleling the Kenmore Interceptor eventually brings more flows to the West Treatment Plant, increasing the volume of CSOs along the way. To accommodate higher flows, CSO control facilities along the Lake Washington Ship Canal must be larger than if the Kenmore Interceptor was not paralleled and must be in place in time to offset any increase in overflows.

Proposed CSO projects include storage tanks and on-site treatment, as well as rooftop disconnection and implementing side-sewer repair programs in certain basins. The disconnection and repair programs would be most useful in reducing CSO volume at North Beach, Southwest Alaska, Southwest Murray, and Southwest Barton streets. These programs would also be helpful (but to a lesser extent) for South Magnolia and the CSOs located along Alki Beach in West Seattle. On a broader scale, these programs could be used to increase the effectiveness of the Martin Luther King, Jr. Way and Henderson CSO projects to completely eliminate CSOs at this location.

Some CSO projects may either be constructed directly to the state-mandated one-event-per-year control level, or phased to four events per year with additional capacity added at a later date to reach the one-event-per-year level. Additional improvements would be required at the West Treatment Plant for the additional CSOs conveyed there. These improvements should be on-line by 2017. See Table 3-3 for details.

I/I Program

The I/I reduction program for Service Strategy 1 would target all basins in the separated system for reduction activities. The program would investigate sources of I/I by using flow monitoring, smoke testing, video inspection, and existing component agency knowledge and focus on correcting problems with the projects that are most cost-effective to implement. The program would reduce inflow sources by disconnecting roof drains, sealing manhole covers, and removing storm drain cross connections. Infiltration would be reduced by lining or grouting mains, side sewers, and manholes. The program would also coordinate and improve local agency efforts to upgrade new sewer construction standards and practices. In addition, King County would work with local agencies to implement maintenance practices and construction techniques designed to ensure that newer systems contribute as little I/I as possible.

Table 3-3. Proposed CSO Projects for Service Strategy 1			
		CSO Control Date	
CSO Location	Project Description	4 Events per year	1 Event per year
North Beach	Storage tank and pump station enlargement		2009
Ballard	1.0-mg storage tank (40% King County)		2033
11th Ave. NW	2.0-mg storage tank		2034
University/Montlake	4.6-mg storage tank	2012	
University/Montlake Upgrade	7.4-mg additional storage		2039
Harbor	Conveyance		1998
Denny Way/Dexter	14.5-ft tunnel treatment facility		2006
Martin Luther King Jr. Way	6.2-mg storage		2006
Norfolk	0.8-mg storage		2007
Henderson	1.3-mg storage tank		2007
SW Alaska	0.7-mg storage tank		2008
Chelan	4.0-mg storage tank		2025
Connecticut	2.1-mg storage/treatment tank		2028
King Street	Conveyance to Connecticut treatment		2029
West Michigan	Conveyance enlargement		2030
Terminal 115	0.5-mg storage tank		2030
3rd Avenue West	5.0-mg storage tank	2033	
3rd Avenue West Upgrade	2.0-mg additional storage		2043
South Magnolia	0.9-mg storage tank	2008	
South Magnolia Upgrade	0.4-mg additional storage		2022
Murray	0.2-mg storage	2009	
Murray Upgrade	0.6-mg additional storage		2023
Barton	Pump station enlargement	2009	
Barton Upgrade	Pump station upgrade		2023
Lander	1.0-mg storage/treatment @ Hanford	2019	
Lander Upgrade	0.5-mg addition @ Hanford		2040
Hanford #2	3.0-mg storage/treatment tank	2015	
Hanford Upgrade	0.3-mg additional storage/treatment		2039
Hanford@Rainier	0.6-mg storage tank		2029
Brandon	0.4-mg storage/treatment tank	2022	
Brandon Upgrade	0.4-mg additional storage/treatment		2041
Michigan	1.1-mg storage/treatment tank	2021	
Michigan Upgrade	1.1-mg additional storage/treatment		2041
8th Avenue South	0.8-mg storage tank	2030	
8th Avenue South Upgrade	0.2-mg additional storage		2042
West Point Improvements	Primary and/or secondary enhancements		2017

Since inflow reduction is typically more cost-effective than infiltration reduction, it is likely that some level of inflow reduction would occur in all targeted basins. Infiltration reduction is targeted primarily for the north-end McAleer-Lyon basin tributary to the Kenmore Interceptor and the southern basins containing Eastside Interceptor Section l, the Cedar River Trunk, and the South Interceptor.

Achieving a target peak flow reduction of 30 percent would affect conveyance lines throughout the system. The size of future parallels to most of the Eastside Interceptor would be reduced, and the need for much of the costly capacity expansion of the Effluent Transfer System would be avoided. The service strategy description assumes that 30 percent I/I reduction will be achieved. Many of the smaller trunks and interceptor improvements, including parallels to the Issaquah Interceptor and Eastgate Trunk, would be either delayed or eliminated.

The total net present value of this program is estimated at $155 million (including both King County and local agency funding), with most spent by 2010. Since most I/I enters through the local systems, the component agencies would probably fund 30 to 40 percent of these costs, as was the case for two I/I reduction pilot projects completed with the cities of Kent and Issaquah.

If I/I control efforts were not effective, conveyance system capacity would have to be increased sooner, and the size of future parallel pipelines would be increased. The Effluent Transfer System capacity would have to be increased as well. This could add significant costs to this strategy. Service Strategy Option 4G addresses the implications of not (or of unsuccessfully) implementing I/I Control (see Chapter 12).

Biosolids

Under this strategy, the West Treatment Plant will need two digesters in addition to the six already in operation. The first will be needed by 2009, and the second by 2029. The East Treatment Plant will need two digesters in addition to the four already in operation. The first will be needed by 2009, and the second by 2029.

Schedule for Implementation

Table 3-4 lists the facility improvements necessary to accommodate current population and employment projections under SS1. The timing for facilities required before 2010 is more certain than for projects required after 2010.

Service Strategy 2

Service Strategy 2 splits the northern flows between the West Treatment Plant and a new treatment plant in north King or south Snohomish County. The flows are first sent to the West Treatment Plant. Until a new plant is constructed, therefore, all northern flows are conveyed through the Kenmore Interceptor, requiring it to be paralleled by 2003. The West Treatment Plant would be expanded by 2010, and the first phase of the new North Treatment Plant would be constructed by 2018. The East Treatment Plant would be expanded to 154 mgd in 2023 and to 172 mgd in 2042. Proposed expansions and new facilities proposed for SS2 are shown in Figure 3-2. The defining features of this strategy are presented in Table 3-5.

Table 3-4. Service Strategy 1
List of Capital Facilities (by year required on-line)

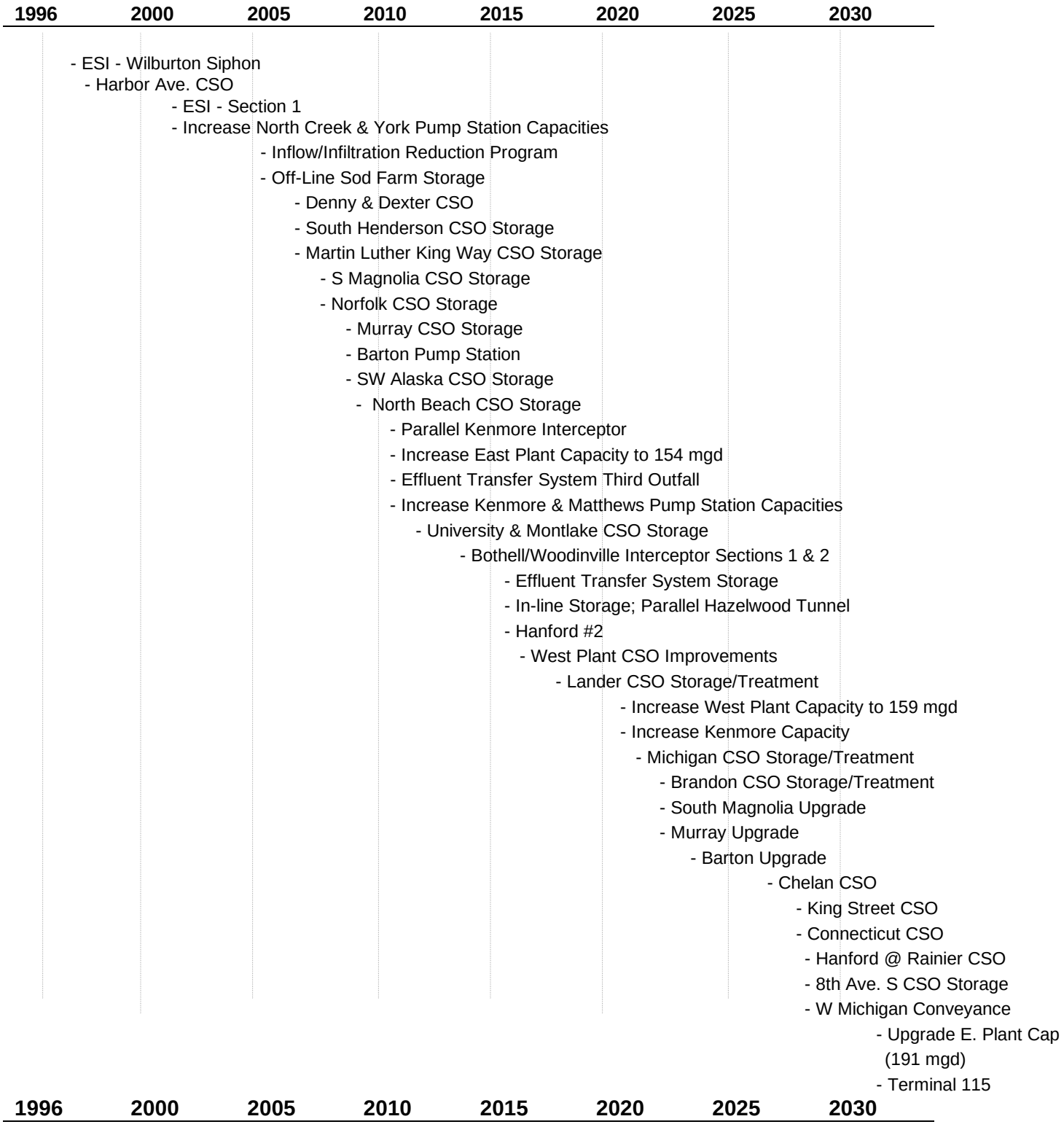


Table 3-5. Defining Features of Service Strategy 2
Create a three-treatment-plant system (comprised of West Treatment Plant, the East Treatment Plant, and a new North Treatment Plant).
Expand the capacity at the West Treatment Plant to 159 mgd by 2010.
Construct a new North Treatment Plant in north King or south Snohomish County by 2018.
Expand the East and North Treatment Plants by 2023 and 2032, respectively.
Parallel the Kenmore Interceptor by 2003.
Construct a conveyance system to carry influent to the North Treatment Plant and an outfall from the North Treatment Plant to Puget Sound by 2018.
Include a small-scale I&I reduction program.
Store CSOs along the Lake Union Ship Canal in large underground storage tanks for conveyance to the West Treatment Plant after peak flows subside.
Store CSOs south of the Lake Union Ship Canal on-site and/or provide treatment at CSO locations.
Produce Class B biosolids by using anaerobic digestion at all three plants pending analysis of other technologies.
Produce Class A reclaimed water at all three plants.

Wastewater Treatment and Conveyance

East Service Area. Long-term treatment capacity needs in the East Service Area would be met by expanding the East Treatment Plant to 154 mgd by 2023 and 172 mgd by 2042. The expansions of the East Treatment Plant would serve growth on the Eastside and southern service area from Renton south to Auburn.

The need for additional conveyance capacity would be met by adding a third leg to the existing Effluent Transfer System outfall off Duwamish Head by the year 2000, and constructing 20 million gallons of storage at the treatment plant site by 2015.

West Service Area. Treatment capacity in the West Service Area would first be increased by expanding the West Treatment Plant in 2010 from 133 to 159 mgd. Expansion at the West Treatment Plant would serve growth in the western portion of north King and south Snohomish Counties.

To accommodate the additional flow going to the West Treatment Plant, the Kenmore Interceptor would have to be paralleled by 2003. This would require upgrades to the Kenmore, York, and Matthews Beach Park pump stations.

North Service Area. Long-term treatment capacity needs in the North Service Area would be met by constructing a new 35-mgd North Treatment Plant and marine outfall by 2018, and expanding the plant to 65 mgd by 2032. The northeastern portion of the

West Service Area, including parts of south Snohomish County, would eventually be served by the new North Treatment Plant, along with the area north of Lake Sammamish.

New influent and effluent conveyance systems would be constructed for the North Treatment Plant. Part of the increased flow in the northern portion of the West Service Area would be sent to the plant. To transfer this flow, a tunnel would be constructed from the Kenmore Pump Station to the plant, along with a new pump station. Flows that could not be accommodated in the existing Bothell-Woodinville Interceptor would be conveyed to the Kenmore Pump Station with 20,000 feet of forcemain from the North Creek Pump Station. Finally, modifications to the York Pump Station in Redmond would also transfer some East Service Area flows to the North Creek Pump Station to be conveyed to the Kenmore Pump Station and then to the North Treatment Plant.

By sending a portion of the East Service Area flows to the new North Treatment Plant, sufficient capacity would remain in the Eastside Interceptor and the East Treatment Plant Effluent Transfer System to prevent the need for major capacity upgrades. This excess capacity would also reduce the scope of the I/I reduction program from a systemwide program to one that targeted localized problems.

If the new North Treatment Plant were located some distance from Puget Sound, a new effluent pipeline extending from the plant west to Puget Sound would have to be constructed by 2018. Conversely, if the plant were located near the Sound, an influent pipeline would have to be constructed to the plant from the Kenmore area by that year. A new effluent outfall would be constructed in either case.

Combined Sewer Overflows

SS2 is identical to SS1, both in total cost and the implementation schedule of CSO projects. The size and timing of construction of most of the CSO control facilities must be integrated with the service strategy conveyance system. For example, paralleling the Kenmore Interceptor eventually brings more flows to the West Treatment Plant, increasing the volume of CSO along the way. To accommodate higher overflows, CSO control facilities along the Lake Union Ship Canal must be larger than if the Kenmore Interceptor were not paralleled, and must be in place in time to offset any increase in overflows.

CSO projects include storage tanks and on-site treatment, as well as rooftop disconnection and side-sewer repair programs in certain basins. The disconnection and repair programs would be most useful in reducing CSO volume at North Beach, Southwest Alaska, Murray, and Barton. These programs would also be helpful, but to a lesser extent, for South Magnolia and the CSOs located along Alki Beach in West Seattle. On a broader scale, these programs could be used to increase the effectiveness of Martin Luther King, Jr. Way and Henderson projects to completely eliminate CSOs at this location.

Some CSO projects may be constructed either directly to the state-mandated one-event-per-year control level or phased to four events per year, with additional capacity being added at a later date to reach the one-event-per-year level. Additional improvements will have to be undertaken at the West Treatment Plant to treat additional CSOs conveyed to

the treatment plant. These improvements should be on-line by 2017. A complete list of proposed improvements is presented in Table 3-6.

I/I Program

The proposed I/I program for SS2 would be smaller than for SS1, as there would be fewer economic benefits. While the scale of the program would be reduced, the type of activities would remain the same. The program would investigate for sources of I/I using flow monitoring, smoke testing, video inspection, and existing agency knowledge. It would reduce inflow sources by disconnecting roof drains, sealing manhole covers, and removing storm drain cross connections. Infiltration would be reduced by lining or grouting mains, side sewers, and manholes. The program would also coordinate and improve local agency efforts to upgrade new sewer construction standards and practices.

The King County facilities affected under this program would be primarily the Issaquah Interceptor, Eastgate Trunk, Lake Hills Interceptor, and Bryn Mawr Siphon. Some of the smaller trunks and interceptors in the southern portion of the East Service Area may also be affected, pending more detailed investigation.

The total net present value of this program is estimated at $23 million (including both King County and local agency funding), with most spent by 2010. Since most I/I enters through the local systems, the component agencies would probably fund 30 to 40 percent of these costs, as was the case for two I/I reduction pilot projects completed with the cities of Kent and Issaquah.

Biosolids

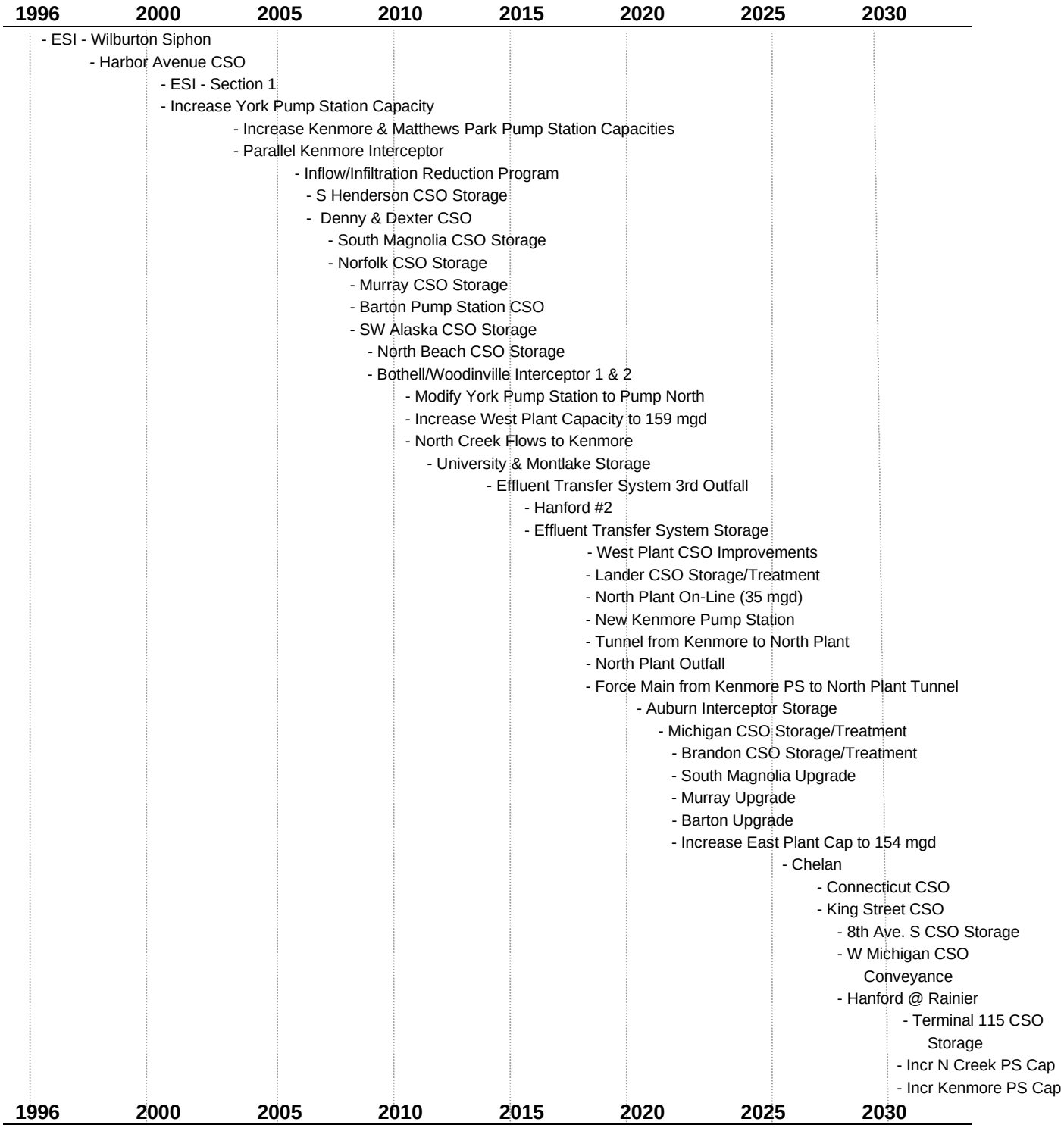
Under this strategy, the West Treatment Plant will need two additional digesters by the year 2009. The East Treatment Plant will also need two digesters: one by 2019, and the second by 2029. The North Treatment Plant will need three digesters by the year 2019.

Schedule for Implementation

Table 3-7 lists the facility improvements necessary to accommodate current population and employment projections. The timing for facilities required before 2010 is more certain than for projects required after 2010.

Table 3-6. Proposed CSO Projects for Service Strategy 2			
		CSO Control Date	
CSO Location	Project Description	4 Events per year	1 Event per year
North Beach	Storage tank and pump station enlargement		2009
Ballard	1.0-mg storage tank (40% King County)		2033
11th Ave. NW	2.0-mg storage tank		2034
University/Montlake	4.6-mg storage tank	2012	
University/Montlake Upgrade	7.4-mg additional storage		2039
Harbor	Conveyance		1998
Denny Way/Dexter	14.5-ft tunnel treatment facility		2006
Martin Luther King Jr. Way	6.2-mg storage		2006
Norfolk	0.8-mg storage		2007
Henderson	1.3-mg storage tank		2007
SW Alaska	0.7-mg storage tank		2008
Chelan	4.0-mg storage tank		2025
Connecticut	2.1-mg storage/treatment tank		2028
King Street	Conveyance to Connecticut treatment		2029
West Michigan	Conveyance enlargement		2030
Terminal 115	0.5-mg storage tank		2030
3rd Avenue West	5.0-mg storage tank	2033	
3rd Avenue West Upgrade	2.0-mg additional storage		2043
South Magnolia	0.9-mg storage tank	2008	
South Magnolia Upgrade	0.4-mg additional storage		2022
Murray	0.2-mg storage	2009	
Murray Upgrade	0.6-mg additional storage		2023
Barton	Pump station enlargement	2009	
Barton Upgrade	Pump station upgrade		2023
Lander	1.0-mg storage/treatment @ Hanford	2019	
Lander Upgrade	0.5-mg addition @ Hanford		2040
Hanford #2	3.0-mg storage/treatment tank	2015	
Hanford Upgrade	0.3-mg addition		2039
Hanford@Rainier	0.6-mg storage tank		2029
Brandon	0.4-mg storage/treatment tank	2022	
Brandon Upgrade	0.4-mg additional storage/treatment		2041
Michigan	1.1-mg storage/treatment tank	2021	
Michigan Upgrade	1.1-mg additional storage/treatment		2041
8th Avenue South	0.8-mg storage tank	2030	
8th Avenue South Upgrade	0.2-mg additional storage		2042
West Point Improvements	Primary and/or secondary enhancements		2017

Table 3-7. Service Strategy 2
List of Capital Facilities (by year required on-line)



Service Strategy 3

Service Strategy 3 treats all flows from the northern portion of the West Service Area at a new treatment plant in north King or south Snohomish County. The first phase of construction would be completed by 2010. This would eliminate the need to expand the West Treatment Plant or parallel the Kenmore Interceptor. The East Treatment Plant would eventually be expanded to handle the increased flows in the southern and eastern portions of the system. Proposed expansions and new facilities included in Service Strategy 3 are shown in Figure 3-3. The defining features of this strategy are presented in Table 3-8.

Table 3-8. Defining Features of Service Strategy 3

Create a three-treatment-plant system (West Treatment Plant, East Treatment Plant, and new North Treatment Plant).
Construct a new North Treatment Plant to accommodate 35 mgd by 2010.
Expand both the East and the North Treatment Plants by 2020 and 2030, respectively; no expansion is required at the West Treatment Plant.
Construct a conveyance system to carry influent to the new North Treatment Plant and an outfall from this plant to Puget Sound by 2010.
Initiate a smaller scale I&I reduction program.
Store CSOs along the Lake Union Ship Canal in underground storage tanks for conveyance to the West Treatment Plant after peak flows subside.
Store CSOs south of the Lake Union Ship Canal on-site and/or provide treatment at CSO locations.
Produce Class B biosolids by using anaerobic digestion at all three plants pending analysis of other technologies.
Produce Class A reclaimed water at all three plants.

Wastewater Treatment and Conveyance

East Service Area. Long-term treatment capacity needs in the East Service Area would be met by expanding capacity at the East Treatment Plant to 154 mgd by 2020 and to 172 mgd by 2040. Expansions of the East Treatment Plant would serve growth on the Eastside and the southern portion of the East Service Area from Renton south to Auburn.

Additional capacity requirements for the Effluent Transfer System from the East Treatment Plant would be met by adding a third leg to the existing outfall at Duwamish Head in 2004 and constructing a 20-million-gallon, off-line storage tank in 2007.

West Service Area. The West Treatment Plant would not be expanded under this service strategy, and there would be no parallel of the Kenmore Interceptor.

North Service Area. Treatment capacity would be increased by constructing a new 35-mgd North Treatment Plant by 2010. Longer-term capacity needs would be met by expanding the North Treatment Plant to 55 mgd by 2020 and to 89 mgd by 2030. The North Treatment Plant would serve north King and south Snohomish Counties, along

with the area north of Lake Sammamish. Transferring these flows to the North Treatment Plant would make available sufficient capacity at the West Treatment Plant at its present size to treat projected flows on the west side.

New influent and effluent conveyance systems would be constructed for the North Treatment Plant. Part of the increased flow in the northern portion of the West Service Area would be sent to the plant. To transfer this flow, a tunnel would be constructed from the Kenmore Pump Station to the plant, along with a new pump station. Flows that could not be accommodated in the existing Bothell-Woodinville Interceptor would be conveyed to the Kenmore Pump Station with 20,000 feet of the force main from the North Creek Pump Station. Finally, modifications to the York Pump Station in Redmond would also transfer some East Service Area flows to the North Creek Pump Station to be conveyed to the Kenmore Pump Station and then to the North Treatment Plant.

By sending a portion of the East Service Area flows to the new North Treatment Plant, enough capacity would remain in the Eastside Interceptor and East Treatment Plant Effluent Transfer System to prevent major capacity upgrades. This excess capacity would also reduce the scope of the I/I reduction program from a systemwide program to one that targeted localized problems.

If the new North Treatment Plant were located some distance from Puget Sound, a new effluent pipeline extending from the plant west to Puget Sound would have to be constructed by 2018. Conversely, if the plant were located near the Sound, an influent pipeline would have to be constructed to the plant from the Kenmore area by that year. A new effluent outfall would be constructed in either case.

Combined Sewer Overflows

Without a parallel Kenmore Interceptor bringing more flows south into Seattle, CSO volumes north of the Lake Union Ship Canal would be smaller than under SS1 and SS2. This would allow for smaller CSO control facilities.

CSO projects include storage tanks and on-site treatment, as well as rooftop disconnection and side-sewer repair programs in certain basins. The disconnection and repair programs would be most useful in reducing CSO volume at North Beach, and Southwest Alaska, Murray, and Barton streets. These programs would be helpful (but to a lesser extent) for South Magnolia and the CSOs located along Alki Beach in West Seattle. On a broader scale, these programs could be used to increase the effectiveness of Martin Luther King, Jr. Way and the Henderson projects to completely eliminate CSOs at this location.

Some CSO projects may be constructed either directly to the one-event-per-year control level, or phased to four events per year with additional capacity being added at a later date to reach the one-event-per-year level. Additional improvements would be required at the West Treatment Plant for additional CSOs conveyed there. These improvements should be on-line by 2017. A complete list of proposed improvements is presented in Table 3-9.

Table 3-9. Proposed CSO Projects for Service Strategy 3			
		CSO Control Date	
CSO Location	Project Description	4 Events per year	1 Event per year
North Beach	Storage tank and pump station enlargement		2009
Ballard	1.0-mg storage tank (40% King County)		2031
11th Ave. NW	2.0-mg storage tank		2033
University/Montlake	2.6-mg storage tank	2012	
University/Montlake Upgrade	4.9-mg additional storage		2036
Harbor	Conveyance		1998
Denny Way/Dexter	14.5-ft tunnel treatment facility		2006
Martin Luther King Jr. Way	6.2-mg storage		2006
Norfolk	0.8-mg storage		2007
Henderson	1.3-mg storage tank		2007
SW Alaska	0.7-mg storage tank		2008
Chelan	4.0-mg storage tank		2024
Connecticut	2.1-mg storage/treatment tank		2027
King Street	Conveyance to Connecticut treatment		2028
West Michigan	Conveyance enlargement		2029
Terminal 115	0.5-mg storage tank		2029
3rd Avenue West	3.5-mg storage tank	2033	
3rd Avenue West Upgrade	1.5-mg additional storage		2040
South Magnolia	0.9-mg storage tank	2008	
South Magnolia Upgrade	0.4-mg additional storage		2021
Murray	0.2-mg storage	2009	
Murray Upgrade	0.6-mg additional storage		2022
Barton	Pump station enlargement	2009	
Barton Upgrade	Pump station upgrade		2022
Lander	1.0-mg storage/treatment @ Hanford	2018	
Lander Upgrade	0.5-mg addition @ Hanford		2037
Hanford #2	3.0 mg storage/treatment tank	2014	
Hanford Upgrade	0.3-mg addition		2036
Hanford@Rainier	0.6-mg storage tank		2028
Brandon	0.4-mg storage/treatment tank	2021	
Brandon Upgrade	0.4-mg additional storage/treatment		2038
Michigan	1.1-mg storage/treatment tank	2020	
Michigan Upgrade	1.1-mg additional storage/treatment		2038
8th Avenue South	0.8-mg storage tank	2029	
8th Avenue South Upgrade	0.2-mg additional storage		2039
West Point Improvements	Primary and/or secondary enhancements		2016

I/I Program

The proposed I/I program for SS3 is essentially the same as for SS2.

Biosolids

Under this strategy, both the East and West Treatment Plants will need one additional digester by the year 2009. The North Treatment Plant will need four digesters: two by 2009, one by 2019, and one by 2029.

Schedule for Implementation

Table 3-10 lists the facility improvements necessary to accommodate current population and employment projections. The timing for facilities required before 2010 is more certain than for projects required after 2010.

Service Strategy 4

Service Strategy 4 splits the northern flows between the two existing treatment plants, as in SS1. However, flows that exceed the capacity of the existing Kenmore and Eastside Interceptors are conveyed south through a new deep tunnel underneath the City of Seattle. Eventually, the tunnel would be operated to optimize efficiency by routing variable flows to the East and West Treatment Plants. The tunnel eliminates the need to parallel the Kenmore and Eastside Interceptors and provides storage capacity for CSOs. The West Treatment Plant would be expanded to 159 mgd by 2010. The East Treatment Plant would first be expanded to 154 mgd in 2020, with successive expansions to an ultimate capacity of 235 mgd in 2040. The facilities proposed for SS4 are shown in Figure 3-4. The defining features of this strategy are presented in Table 3-11.

Table 3-10. Service Strategy 3
List of Capital Facilities (by year required on-line)

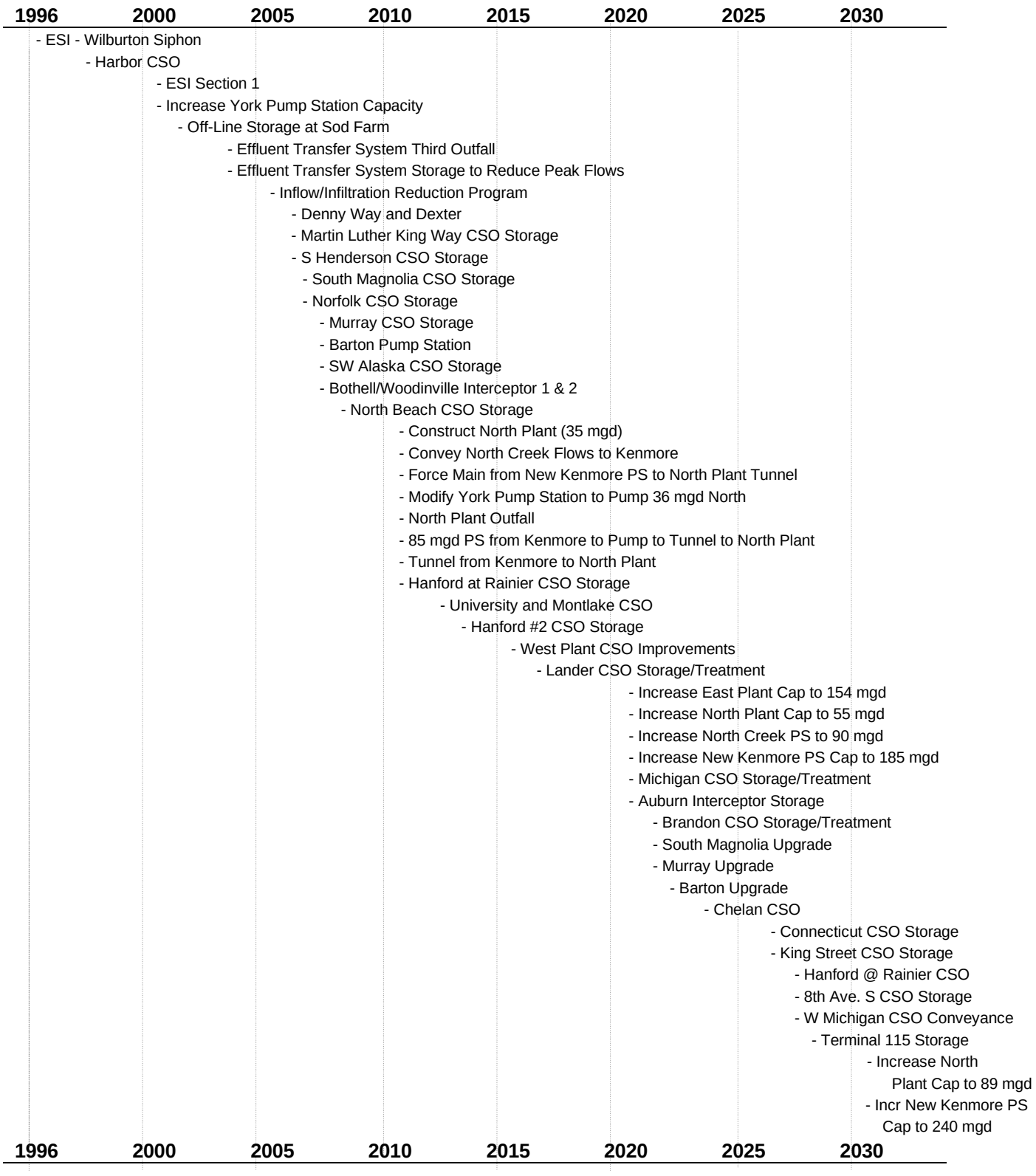


Table 3-11. Defining Features of Service Strategy 4
Maintain the existing two-treatment-plant system (West and East Treatment Plants).
Expand the treatment capacity at the West Treatment Plant by 2010.
Expand the treatment capacity at East Treatment Plant in 2020, 2030, and 2040.
Construct an 18-mile-long deep tunnel in phases from the Kenmore Pump Station to the Duwamish Pump Station for wastewater conveyance and CSO storage.
Include a full-scale I&I reduction program.
Produce Class B biosolids by using anaerobic digestion at both plants pending analysis of other technologies.
Produce Class A reclaimed water at both treatment plants.

Wastewater Treatment and Conveyance

East Service Area. Long-term treatment capacity needs would be met by expanding capacity at the East Treatment Plant to 154 mgd by 2020, to 191 mgd by 2030, and to 235 mgd by 2040.

The need for additional capacity in the Effluent Transfer System would be met in the long term by reducing peak flows through I/I control, adding 20 million gallons of storage, and by storing excess flows in the deep tunnel.

West Service Area. For treatment of wastewater flows from the West Service Area, this strategy assumes that the West Treatment Plant would be expanded to its maximum capacity of 159 mgd by 2010 and that no new plants would be constructed.

Increased flows in the northern portion of the West Service Area would be conveyed to the West Treatment Plant through an 18-foot-diameter, deep tunnel, constructed mainly under street rights-of-way from the Kenmore Pump Station to Westlake Avenue in Seattle. The northern tunnel would be built in two phases, with the first phase (Kenmore to Thornton Creek) completed by 2005 and the second phase (Thornton Creek to Westlake Avenue) completed by 2010. The northern tunnel would connect to a central, 24-foot-diameter deep tunnel to the Duwamish Pump Station to provide storage of stormwater flows (CSOs and I/I) in the system. To transfer flows from the tunnel to the West Treatment Plant, an 80-mgd pump station would be constructed near Third Avenue West.

Construction of the deep tunnel increases system capacity in several ways. First, it conveys north King and south Snohomish County flows to coincide with the expansion at the West Treatment Plant. In 2020, the tunnel would connect to the East Treatment Plant by a force main, allowing flows to be transferred to the East Treatment Plant west of Lake Washington, eliminating the need to parallel the Eastside Interceptor. Capacity requirements for the Effluent Transfer System would be met by temporarily storing peak flows in the tunnel until they could be treated and discharged at either the East or the West Treatment Plants. To minimize the size of the tunnel, an I/I reduction program would target a 30 percent reduction of peak I/I. Without the 30 percent peak I/I reduction, the force main connecting the Duwamish Pump Station to the East Plant

would have to be replaced with another section of deep tunnel to provide necessary storage capacity.

Combined Sewer Overflows

Under SS4, most CSOs north and south of the Lake Union Ship Canal are stored in the series of connecting tunnels and treated at the West Treatment Plant. Due to the construction of the deep tunnel, only those overflows along the Alki beaches in West Seattle can be reasonably phased to control CSOs to four events each year as the interim step, with one event each year at a later date. CSOs at Ballard, North Beach, Magnolia, and Chelan would be controlled via off-line storage tanks.

In addition, treatment plant improvements would be instituted by 2040 to accommodate additional loadings at the West Treatment Plant resulting from CSOs conveyed to the plant after storage. A complete list of proposed improvements is presented in Table 3-12 below.

I/I Program

The I/I reduction program for SS4 is the same as for SS1.

Biosolids

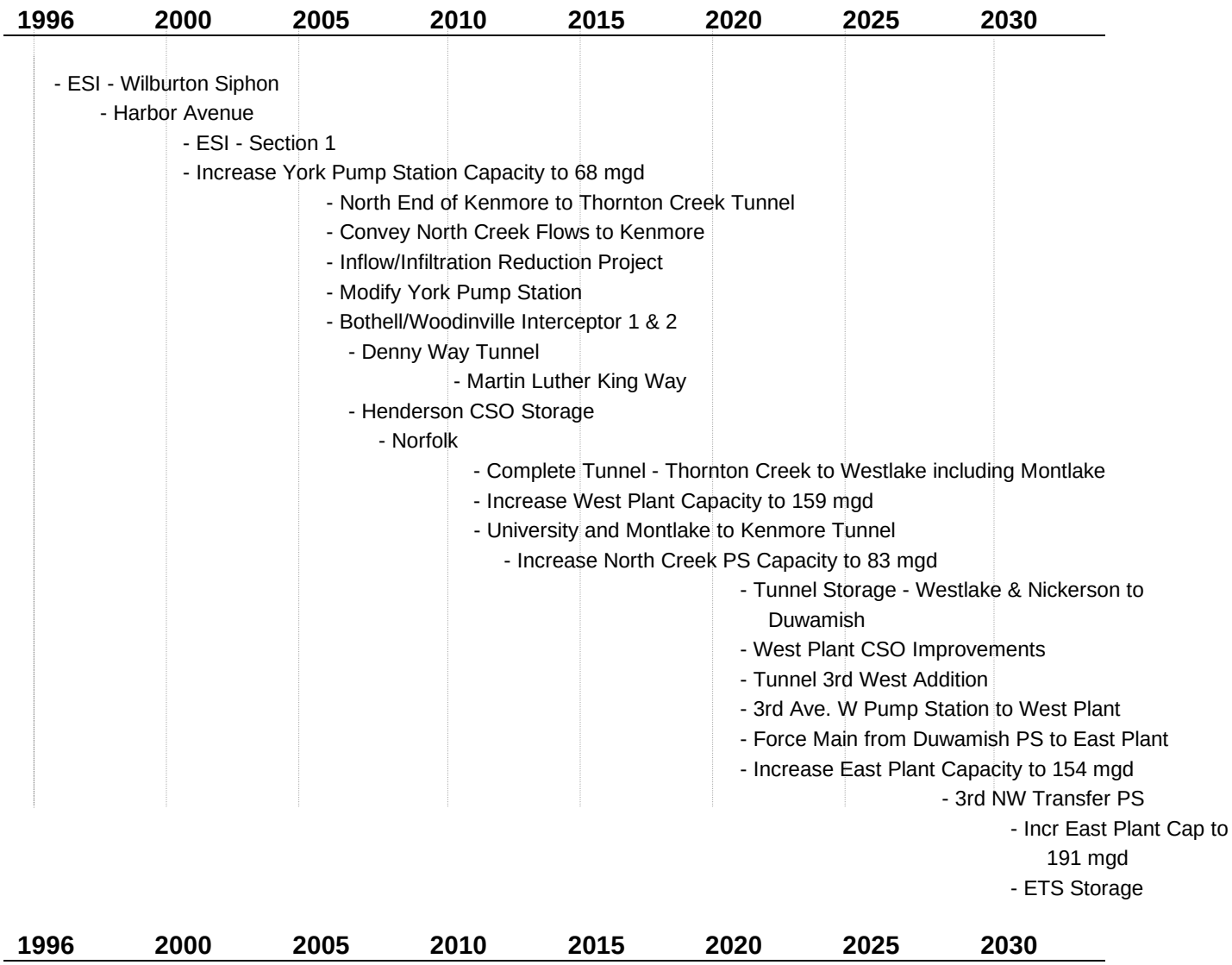
Under Service Strategy 4, the West Treatment Plant will require two additional digesters: one by 2009 and one by 2019. The East Treatment Plant will require two additional digesters under this strategy.

Schedule for Implementation

Table 3-13 lists the facility improvements necessary to accommodate current population and employment projections. The timing for facilities required before 2010 is more certain than for projects required after 2010.

Table 3-12. Proposed CSO Projects for Service Strategy 4			
		CSO Control Date	
CSO Location	Project Description	4 Events per year	1 Event per year
North Beach	Storage tank and pump station enlargement		2032
Ballard	1.0-mg storage tank (40% King County)		2033
11th Ave. NW	2.0-mg storage tank		2034
University/Montlake	Increase Kenmore tunnel diameter		2010
Harbor	Conveyance		1998
Denny Way	18-ft tunnel with drop structure		2006
Martin Luther King Jr. Way	6.2-mg storage		2006
Norfolk	0.8-mg storage		2007
Henderson	1.3-mg storage tank		2007
SW Alaska	0.7-mg storage tank		2031
Chelan	4.0-mg storage tank		2036
3rd Avenue West	3rd W tunnel audit and pump station		2020
Connecticut	Drop structure to deep tunnel		2020
King Street	Drop structure to deep tunnel		2020
Lander	Drop structure to deep tunnel		2020
Hanford #2	Drop structure to deep tunnel		2020
West Michigan	Conveyance enlargement		2041
Terminal 115	0.5-mg storage tank		2042
South Magnolia	0.9-mg storage tank	2031	
South Magnolia Upgrade	0.4-mg additional storage		2042
Murray	0.2-mg storage	2032	
Murray Upgrade	0.6-mg additional storage		2043
Barton	Pump station enlargement	2032	
Barton Upgrade	Pump station upgrade		2043
Michigan/Brandon	84-inch conveyance to deep tunnel		2041
8th Avenue South	1.0-mg storage tank		2041
West Point Improvements	Primary and/or secondary enhancements		2020

Table 3-13. Service Strategy 4
List of Capital Facilities (by year required on-line)



COMPARISON OF SERVICE STRATEGY IMPACTS

Table 3-14 provides a comparison of the potential environmental impacts of the four service strategies. These impacts are described in greater detail in Chapters 5 through 8, and 11 of this document.

Water Quality Comparison

While the collection, treatment, and discharge of wastewater affects many elements of the environment, a key environmental issue is the potential impact of each service strategy on the region's water quality. For this reason, an overview of the water quality issues raised by the RWSP and a comparison of water quality impacts by service strategy is presented below.

Wastewater

Each of the four service strategies proposes to discharge all treated wastewater into the offshore marine environment via submerged outfall pipelines. The total volume of treated wastewater is assumed to be the same for all four strategies. While total volumes of treated wastewater would increase over current conditions because of anticipated population growth in the region, discharged effluent would meet water quality standards for all service strategies.

For effluent discharge, the water quality differences among the four service strategies are related primarily to the different locations of the submerged outfalls.

All existing and proposed outfalls are located in Puget Sound. How the effluent is dispersed after leaving the outfalls, and the resulting impacts on water quality, will depend on tidal and current influences and the location and depth of the outfalls.

Differences in water density occur within the Sound such that, in general, the upper layer of relatively less dense water tends to circulate northward, while the lower layer of denser, more saline water slowly moves southward. Other factors being equal, northward dispersion of the effluent is generally preferable, as it promotes more rapid flushing of the effluent from Puget Sound.

Outfalls for the two existing plants are located about two miles west of Duwamish Head (East Treatment Plant) and off West Point (West Treatment Plant). The outfall off Duwamish Head is located at about 600 feet of depth, in the denser lower water layer. The West Point outfall is located at a depth of approximately 240 feet, permitting effluent from the West Treatment Plant to enter the upper water layer and flow northward most of the year.

The four service strategies propose different combinations and discharge volumes from the system's outfalls. SS1 and SS4 would discharge effluent from locations off both Duwamish Head and West Point . SS 2 and SS3 would add a new, more northerly outfall associated with a North End Plant to the other two outfall locations. The new outfall would be located further north than the West Point outfall and would in general be considered a desirable location from a water quality perspective if it is placed to direct the effluent into the upper water layer. The complexity of the flow layering in this area of the Sound will require additional study to determine the best location for the new north outfall.

Preliminary Review of Current and Hydrographic Conditions (Ebbesmeyer, 1994) provides a more detailed discussion of these issues (included as Appendix G).

Pollutant loadings are predicted to increase under all four service strategies compared to existing conditions. This occurs as a direct result of increasing regional population. Pollutants that are discharged in treated effluent include nitrogen, lead, PAHs, fecal coliform, and total suspended solids (TSS). While the total volume of treated wastewater is assumed to be the same for all service strategies, loadings associated with the system's individual outfalls vary by alternative; these differences are discussed below.

Although there are minor variations (due primarily to differences in the volume of CSO flows directed to the treatment plants), in general the differences in pollutant loadings at the outfall locations are proportional to the capacities of the wastewater treatment plants that discharge to them. For the outfall off Duwamish Head, for example, capacity at the East Plant would ultimately reach 235 mgd for SS1 and SS4, while SS2 and SS3 include a 172-mgd East Plant. Pollutant loadings from the Duwamish Head outfall discharge are thus predicted to be greater under SS1 and SS4 when the plant is operating at full capacity. Under all service strategies, effluent discharges would meet water quality standards and permit discharge limits.

For the outfall off West Point serving the West Plant, SS3 includes a plant capacity of 133 mgd, while SS1, SS2, and SS4 include a 159-mgd West Plant. Loadings from this outfall would thus be greater for SS1, SS2, and SS4 than for SS3. Under all service strategies, discharges would meet water quality standards and permit discharge limits. The plant and its discharge would also meet shoreline permit and Settlement Agreement requirements for all service strategies.

The new outfall serving the North Plant would be needed for SS2 and SS3. Because SS3 includes an 89-mgd plant, pollutant loadings from the north outfall would be greater for SS3 than for SS2 and its 65-mgd treatment plant. Under both service strategies, effluent discharges would meet water quality standards and permit discharge limits.

Figure 3-5 provides a comparison of outfall discharge volumes that illustrates the above discussion.

Combined Sewer Overflows

In addition to the discharge of treated effluent, direct discharge of CSOs occurs during heavy rains to the Duwamish River, the Lake Washington Ship Canal, and Elliott Bay. Each service strategy includes a CSO control program that would reduce the discharge of CSOs to once per year per CSO outfall. To minimize rate impacts, the full CSO program would be completed by 2043 (2040 for SS3).

In general, the four service strategies offer similar beneficial water quality impacts from the CSO program. All substantially reduce pollutant loadings compared to existing conditions. Figure 3-6 illustrates the estimated reductions in loadings for total suspended solids, one of the pollutants of concern in CSO discharges. The figure is representative of the pattern expected for reductions in other pollutants contained in CSOs as well; these include nitrogen, lead, PAH, and fecal coliform. As the bar chart indicates, loadings to all four near-shore waters (Duwamish River/Waterway, Elliott Bay, Puget Sound off West Seattle, and the Lake Washington Ship Canal) would decrease under all service strategies compared to existing conditions. Reductions would be particularly dramatic in the Duwamish, Elliott Bay, and the Ship Canal.

As indicated in Figure 3-6, SS4 would provide somewhat greater water quality benefits in the Duwamish River and Elliott Bay than the other three service strategies. This is because SS4's deep tunnel would store more CSO volume for ultimate treatment at the West or East Treatment Plants, and rely on fewer individual CSO outfall locations in the Duwamish or Elliott Bay. While pollutant loadings would be somewhat higher from the West Point and Duwamish Head outfalls as a result, net water quality impacts of SS4's

CSO program are projected to be somewhat more beneficial than those of the other service strategies for two reasons. First, CSO flows directed to the West or East Treatment Plants would be discharged into the offshore marine environment rather than the nearshore environment, as they would be for the other service strategies. Second, most CSO flows would also receive full secondary treatment prior to discharge. For very high flows associated with more severe storms, portions of the CSO flow that exceed the plants' secondary treatment capacity would receive primary treatment, similar to the treatment that would occur at CSO discharge locations for SS1, 2, and 3.

SUMMARY OF MITIGATION MEASURES

Table 3-15 summarizes the mitigation measures for the four service strategies.

TABLE 3-15
SUMMARY OF MITIGATION MEASURES

Element of the Environment	Mitigation Measures
Earth	**Construction** • In areas of suspected contaminated soils, testing would be conducted to determine the extent of contamination before construction. • Contaminated soils from excavations would be disposed of in compliance with all applicable local, state and federal regulations. Where contaminated soils and groundwater are found together, dewatering systems would be implemented to avoid discharging contaminated groundwater or letting soils leach to receiving surface waters. **Operations** • Adherence to state regulations and guidelines for the production and application of reclaimed water will ensure that potential adverse impacts to earth resources are minimal. • Biosolids are regulated by federal (part 503), state and local agencies. The 503 regulations limit the amount of biosolids that can be land applied in addition to limiting the level of constituents in the product.
Air	**Construction** To minimize blowing dust, implement best management practices such as watering exposed soil areas, covering soil stockpiles and minimizing areas of earth disturbed at any one time. **Operations** • King County will continue to seek practical technologies that will prevent odors from escaping wastewater facilities. • Using Class A biosolids would reduce odors from applied biosolids. • Avoid direct exposure of humans to reclaimed water by irrigating at night or in temporarily restricted areas. Integrate signage, training and appropriate operations and maintenance procedures for equipment into health and safety program.
Water Resources	**Construction** • Include best management practices for erosion control in construction

Element of the Environment	Mitigation Measures
	specifications to minimize sedimentation of water bodies. **Operations** • Select wastewater discharge outfall sites with strong currents and favorable circulation patterns that most rapidly move pollutants northward out of Puget Sound. Research indicates that the upper water layer best provides these conditions. Outfall locations that meet these criteria would reduce long-term operational impacts. • Infiltration and inflow control projects in flood-prone areas would include studies of local groundwater and surface water drainage patterns to avoid exacerbating local flooding and wet basements. • King County's Industrial Waste/Source Control Pretreatment Program reduces the levels of contaminants entering the sewer system and enhances both biosolids and reclaimed water products. • At biosolids application sites, use agronomic rates to maximize crop uptake of nutrients, maintain moderate pH and monitor for soil contaminant concentrations. Maintain buffers from surface water bodies. Adhere to federal, state and local regulations and permits. • Monitor reclaimed water quality. For dual distribution systems, incorporate safeguards to prevent cross connections between potable and reclaimed water. Adhere to state standards and guidelines.
Biological Resources	**Construction** • Routes would be selected to avoid sensitive riparian and wetland areas wherever possible. • Pipeline alignments would be designed to minimize destruction of existing vegetation and wildlife habitat. These resources would be restored after construction. • Construction in streams and nearshore areas would not occur during designated fishery closure periods. • Outfall alignments would be designed to minimize impacts to sensitive intertidal communities wherever possible. • During construction, King County staff and contractors would coordinate with Muckleshoot and Suquamish Tribes to reduce the potential for disruption of tribal fishing operations. • Wetland mitigation plans would be developed for wetland areas disturbed during construction. • King County would work with resource agencies to develop specific site restoration methods for affected sensitive areas. **Operations** • Mitigation measures to protect ecological health include monitoring the quality of reclaimed water to ensure that it consistently meets the Class A standard. • If high levels of mineral salts and inorganic compounds are known to be present in the reclaimed water, plant materials can be selected that are proven to be tolerant of these conditions. • Applying biosolids to the soil as an amendment improves tilth and increases plant productivity.

Element of the Environment	Mitigation Measures
Energy	**Construction** All equipment used during construction would meet applicable energy efficiency standards. **Operation** • Methane and other gases produced at treatment plants could be captured and sold to power companies or used to generate power to reduce demand on suppliers.
Environmental Health	**Construction** • Construction noise would be controlled wherever possible to avoid adversely impacting sensitive receptors such as residential neighborhoods and schools. **Operation** • Use appropriate procedures for handling chemicals and petroleum products during facility operation. • The State of Washington Water Reclamation and Reuse Interim Standards protect public health by requiring a specific level of water quality and treatment corresponding to each beneficial use of reclaimed water. King County's adherence to these standards produces the highest quality effluent designated by the state, Class A. • Potential risks to public health from use of reclaimed water can be reduced even further through the following measures: Irrigation could occur at night when public exposure is likely to be low; public education (e.g., posting of signs); environmental monitoring (e.g. soil and water sampling); appropriate irrigation design and operation (e.g., providing for emergency shut-off of the irrigation system in the event of a pipe rupture) and; implementation of appropriate irrigation system maintenance procedures. • The 503 Regulations for biosolids application specify strict "ceiling concentrations" on the amounts of these metals that are allowable in biosolids. King County's biosolids are well below this level. • Proper application of biosolids and adherence to permit and operations plan requirements protect public health such that no significant adverse impacts are likely to occur from biosolids applications.
Land & Shoreline Use	**Construction** • Refer to mitigation measures discussed under air, noise, aesthetics and transportation. **Operations** • To site new treatment facilities (i.e. plant, pipelines), high priority would be given to sites where such facilities would be compatible with surrounding uses.
Recreation	**Construction** • Where short periods of temporary construction impacts are expected at recreational facilities, construction could be scheduled to avoid the periods of highest recreational use. • Where trail use is disrupted, King County would provide a safe detour around the construction area wherever possible.

Element of the Environment	Mitigation Measures
Aesthetics	**Operations** • To make treatment facilities more compatible, measures such as landscaped buffers and architectural treatment would be used in design.
Transportation	**Construction** • Traffic plans would be developed to ensure continued circulation and access during construction. • Open trench segments would be covered to allow residents and service vehicles to access driveways and loading areas. • Temporary measures would be implemented along trails to separate pedestrians and bicyclists from vehicles.
Cultural Resources	**Construction** • Presence of known cultural resources would be taken into account when designing facilities and cultural resources will be avoided wherever possible. • If cultural resources are encountered during construction, construction would cease and a professional archaeologist will be consulted.

POTENTIAL IMPACTS OF SERVICE STRATEGY OPTIONS

Table 3-16 discusses how the service strategy options considered in the RWSP could affect the potential environmental impacts of the service strategies. For each option the table discusses potential impacts on water resources, biological resources, environmental health and land use. More detailed discussions of the impacts of the service strategy options are provided in Chapter 12 of this DEIS. More detailed discussions of the options themselves are provided in Chapter 4 of the RWSP. This table addresses only operating impacts. A programmatic discussion of construction impacts is presented in Chapter 11.

It should be noted that wherever a service strategy option could result in increased pollution, the potential environmental impacts of this pollution would be evaluated before the option would be implemented.

TABLE 3-16
EFFECTS OF SERVICE STRATEGY OPTIONS ON SERVICE STRATEGIES

Service Strategy Option	Effects
4A **Re-define Secondary Treatment (East and North Plants only)**	**Water** Advanced primary treatment would result in higher soluble biological oxygen demand (BOD) levels in discharged effluent and higher levels of bacteria if disinfection with chlorine were eliminated. Enhanced primary treatment using sand filtration technology could result in lower total suspended solids (TSS) and better organism removal (beneficial impact).

Service Strategy Option	Effects
	Biological Resources Potential impacts to marine biota resulting from discharge of lower quality effluent if it reduces receiving water quality.
	Environmental Health Potential adverse health effects from consumption of large quantities of marine animals if advanced primary treatment resulted in degraded water quality. Potential adverse health effects from contact with water receiving higher pollutant loadings. Reduced potential for exposure to chlorine if chlorine use is reduced.
	Land Use Positive land use impact resulting from smaller treatment plant "footprints".
4B **Re-rate Plant Capacities**	**Water** Higher BOD and TSS levels could reduce water quality. Increased risk of plant malfunctions leading to more potential adverse impacts to water quality.
	Biological Resources Potential for reduced water quality could adversely impact marine biota.
	Environmental Health Potential adverse health effects from contact with water receiving higher pollutant loadings from treatment plant discharges.
	Land Use Positive land use impact resulting from smaller treatment plant "footprints".
4C **Build in Smaller Increments**	**Water** Potential for adverse water quality impacts from increased sewer system overflows or treatment plant overloads if unexpectedly rapid population growth exceeded wastewater treatment and conveyance facility capacities before new facilities could be brought into service.
	Biological Resources If water quality reduced, biological resources could be adversely affected.
	Environmental Health Potential adverse health effects from consumption of large quantities of marine or freshwater animals if water quality reduced. Potential adverse health effects from contact with water receiving higher pollutant loadings from treatment plant discharges or from contact with wastewater or other polluted water if sewer overflows occurred.
	Land Use None
4D **Decrease Conveyance Design Standard (5-year size, 5-year overflow)**	**Water** Increased potential for overflows in separated sewer systems could adversely affect quality of surface and ground waters at and near overflow locations.
	Biological Resources If water quality reduced, biological resources could be adversely affected.

Service Strategy Option	Effects
	Environmental Health Potential adverse health effects from consumption of large quantities of freshwater animals if water quality reduced. Potential adverse health effects if well water contaminated. Potential adverse health effects from contact with wastewater or with other polluted water if sewer overflows occurred.
	Land Use Somewhat smaller regional wastewater facilities needed, resulting in smaller "footprints."
4E **Decrease Conveyance Design Standard (20-year size, 5 year overflow)**	**Water** Same as for 4D but once new facilities constructed potential for subsequent adverse impacts would be less.
	Biological Resources Same as for Water.
	Environmental Health Same as for Water.
	Land Use None
4F **Discharge to the Duwamish**	**Water** Discharges would increase pollutant loadings to the river, which would potentially create modest adverse water quality impacts. Most discharges would occur during high river flow periods, which would dilute effluent. Greatest potential for adverse impacts would occur from strong early fall storms, which can cause peak plant flows prior to significant increases in the flows in the river (less dilution). Low risk of this occurrence. Long-term implications of the implementation of this option on water are being studied (Water Quality Assessment).
	Biological Resources Risk of adverse impacts to biological resources commensurate with extent of water quality degradation described in Water section above. Long-term implications of the implementation of this option on aquatic habitat are being studied (Water Quality Assessment).
	Environmental Health Potential for human contact with effluent discharge during or shortly after storm events is low. Risk of adverse impacts to human health is commensurate with extent of water quality degradation. Long-term implications of the implementation of this option on environmental health are being studied (Water Quality Assessment).
	Land Use None
4G **No I/I Program**	**Water** None if adequate wastewater treatment and conveyance systems are brought into service in time to prevent treatment plant overloads or conveyance system overflows as wastewater system flows increase.
	Biological Resources Same as for Water.
	Environmental Health Same as for Water
	Land Use Somewhat larger regional wastewater facilities needed, resulting in larger "footprints."

Service Strategy Option	Effects
4H **Reduce CSO Control Goal**	**Water** Ultimate pollutant discharge levels from CSOs would be greater than now targeted under current Ecology regulations. Long-term implications of these greater discharges on water are being studied (Water Quality Assessment).
	Biological Resources Ultimate pollutant discharge levels from CSOs would be greater than now targeted under current Ecology regulations. Long-term implications of these greater discharges on aquatic habitat are being studied (Water Quality Assessment).
	Environmental Health Ultimate pollutant discharge levels from CSOs would be greater than now targeted under current Ecology regulations. Long-term implications of these greater discharges on environmental health are being studied (Water Quality Assessment).
	Land Use CSO facilities could be somewhat smaller, resulting in smaller "footprints."
4I **Alternative Biosolids Technologies**	**Water** None if regulatory requirements and best management practices adhered to.
	Biological Resources Same as Water.
	Environmental Health Same as Water.
	Land Use Would require additional land for biosolids processing facilities. Could emit more odors, depending upon technology chosen.
4J **Discharge at Hiram Chittenden Locks**	**Water** By replacing water otherwise released through the locks, would make Lake Washington water available for water supply (if withdrawals permitted by regulators) or help conserve existing upstream water supply. This enhancement of water supply would thereby help avoid or delay development of new water supplies (and the associated adverse water quality impacts). Could also allow for more flexible and efficient management of upstream flows for water quality beneficial uses. Additional outflow would facilitate containment of saltwater intrusion into the Ship Canal and Lake Union. Possible reduction in water quality in the vicinity and downstream of effluent discharge. Possible improvement in water quality because water that would otherwise have received secondary treatment at West Plant would be given advanced treatment before being discharged at the locks.
	Biological Resources Could help preserve existing streamflows for upstream fish and wildlife. Might also facilitate salmon passage through the locks. Conversely, might impede migration by introducing water with unfamiliar "smell" (further study needed). Possible adverse impacts of increased pollutants on biological resources in vicinity of discharge.
	Environmental Health None
	Land Use Advanced wastewater treatment plant would be needed near discharge point.

Service Strategy Option	Effects
4K **Discharge to Lake Washington/Sammamish**	**Water** By adding to Lake Washington basin waters, would make Lake Washington water available for water supply (if withdrawals permitted by regulators) or help conserve existing upstream water supply. This enhancement of water supply would thereby help avoid or delay development of new water supplies (and the associated adverse water quality impacts). Could also allow for more flexible and efficient management of upstream flows for water quality beneficial uses. Potential additional outflow would facilitate containment of saltwater intrusion into the Ship Canal and Lake Union. Freshwater discharge would increase pollutant loadings to the Lake Washington drainage basin. Unknown environmental impacts resulting from discharge of excess reclaimed water into groundwater or Lake Washington drainage basin.
	Biological Resources Could help preserve existing streamflows for upstream fish and wildlife. Possible adverse impacts of increased pollutants on biological resources in vicinity of discharge (further study required). Freshwater discharge would increase pollutant loadings to the Lake Washington drainage basin. Unknown effects to freshwater biota resulting from discharge of excess reclaimed water into Lake Washington drainage basin.
	Environmental Health Freshwater discharge would increase pollutant loadings to the Lake Washington drainage basin. Unknown impacts to environmental health resulting from discharge of excess reclaimed water into groundwater or Lake Washington drainage basin.
	Land Use Two sites converted to wastewater treatment use instead of one. May prompt changes in some land uses in the vicinity of the satellite plants due to the availability of reclaimed water.
4L **North Treatment Plant Discharge to Lake Washington (Service Strategies 2 and 3 only)**	**Water** Would delay potential water quality impacts of new secondary treated effluent discharge into Puget Sound. By adding to Lake Washington basin waters, would make Lake Washington water available for water supply (if withdrawals permitted by regulators) or help conserve existing upstream water supply. Would thereby help avoid or delay development of new water supplies (and the associated adverse water quality impacts). Could also allow for more flexible and efficient management of upstream flows for water quality beneficial uses. Potential additional outflow would facilitate containment of saltwater intrusion into the Ship Canal and Lake Union. Freshwater discharge would increase pollutant loadings to the Lake

Service Strategy Option	Effects
	Washington drainage basin. Unknown environmental impacts resulting from discharge of excess reclaimed water into groundwater or Lake Washington drainage basin.
	Biological Resources Could help preserve existing streamflows for upstream fish and wildlife. Possible adverse impacts of increased pollutants on biological resources in vicinity of discharge (further study required). Freshwater discharge would increase pollutant loadings to the Lake Washington drainage basin. Unknown effects to freshwater biota resulting from discharge of excess reclaimed water into Lake Washington drainage basin.
	Environmental Health Freshwater discharge would increase pollutant loadings to the Lake Washington drainage basin. Unknown impacts to environmental health resulting from discharge of excess reclaimed water into groundwater or Lake Washington drainage basin.
	Land Use Could alter some land uses in the vicinity of the plant due to the availability of reclaimed water.
4M **Implement Pollutant Source Trading**	**Water** Could maximize benefits to water quality by carrying out most effective programs/projects first. Would be difficult to accurately identify tradeoffs on "apples-to-apples" basis and thus identify which are most effective projects.
	Biological Resources Similar to Water
	Environmental Health Similar to Water
	Land Use Unknown
4N **Offer Siting Incentives**	**Water** Unknown
	Biological Resources Unknown
	Environmental Health Unknown
	Land Use Incentives could include measures that would have beneficial impacts on local land uses.

SUMMARY OF STRATEGIES CONSIDERED AND ELIMINATED FROM FURTHER CONSIDERATION

During the facility planning process, a number of other strategies for providing waste-water services were evaluated. Some of these strategies involved different environmental impacts than those retained for evaluation in the RWSP and this DEIS. Most of these strategies involved substantial drawbacks compared to those retained (i.e., higher cost, environmental impacts, or risks associated with implementation). The strategies eliminated from consideration due to these drawbacks are described in this section.

Eastside Advanced Wastewater Treatment Plant

This strategy would involve construction of a large advanced wastewater treatment plant east of Lake Washington. This plant would give wastewater advanced treatment (beyond secondary treatment) and would discharge directly to Lake Washington. This strategy was eliminated from consideration for cost and technical feasibility reasons.

Under Service Strategy Option 4K, two advanced wastewater treatment plants would be built near Issaquah and Woodinville. The two plants would each be smaller than the single large plant discussed above. This would enable them to be sited near potential customers for reclaimed water, both because of their relatively small footprint and because they would not have to be located at the lower end of a drainage basin to receive enough flow to operate efficiently (as the larger plant would). They also would not require the more extensive and costly conveyance facilities associated with the large plant. Option 4K is discussed in Chapter 12 of this document and in Chapter 4 of the RWSP.

Interbay Treatment Plant

This strategy proposed construction of a new 72-mgd-capacity treatment plant in the Interbay area. This plant would draw flow from the Elliott Bay Interceptor, which carries all wastewater from the southern part of the West Service Area to the West Treatment Plant. It was eliminated from further consideration because it was more costly than expanding the existing two treatment plants or building a North Treatment Plant, and it offered no overriding benefits.

Strategies Involving Both North End and Duwamish Plants

These strategies proposed constructing both a North End plant and a Duwamish area plant. Different options were explored for sizing of the new plants and the existing plants in the system. These strategies were eliminated from consideration because the two-new-plant concept would provide no advantage over the one-new-plant concept or expanding/ maximizing existing plants, and would be much more costly.

Placement of All Capacity Increases at East Treatment Plant

Two strategies would have placed all capacity increases at the East Treatment Plant. Under these strategies no new treatment plants would be built, and the West Treatment Plant would remain at its current 133 mgd capacity. The East Treatment Plant would be expanded in stages to an ultimate capacity of 261 mgd. One strategy would involve transferring northern service area flows to the East Treatment Plant via the Eastside Interceptor, or transferring some flows from the West Treatment Plant's southern service area to the East Treatment Plant. These strategies were eliminated for technical and cost considerations, including loss of system flexibility and need for much more extensive conveyance improvements to and from the East Treatment Plant.

Placement of All Capacity Increases at North Treatment Plant

One strategy would have placed all capacity increases at a North Treatment Plant. Both the East and West Treatment Plants would remain at their current capacities. The North

Plant would be expanded in stages to an ultimate capacity of 146 mgd. This strategy would involve construction of a new force main roughly paralleling I-405 from I-90 to Bothell to carry flows from the surrounding area to the new plant. Additional conveyance facilities would be constructed to bring flows from the northern part of the West and North Service Areas to the plant. This strategy was eliminated because of insufficient lead time to bring a North Treatment Plant into service before one of the existing treatment plants would have to be expanded and because it would involve substantial new conveyance on the Eastside, thus failing to meet one of the main objectives of the North Treatment Plant strategies.

Expansion of West and East Treatment Plants; Transfer of West Treatment Plant Southern Service Area Flows to East Treatment Plant

This strategy is similar to SS1 in that no new treatment plants would be built. The West Treatment Plant would be expanded to 159 mgd, and the East Treatment Plant would be expanded to 235 mgd. This strategy would differ in that a flow transfer from the West Service Area would convey flows to the East Treatment Plant via a new pipeline from the Duwamish industrial area to the East Treatment Plant. It was eliminated from consideration because it did not offer any advantages over Service Strategy 1 and was not as cost-efficient.

Construction of New Duwamish Treatment Plant; Expansion of East Treatment Plant

Two other strategies considered would involve construction of a new treatment plant in the Duwamish area to accommodate the West Treatment Plant's southern service area flows, thus eliminating the need to expand that plant. The East Treatment Plant would also be expanded. The strategies differed in the size of the Duwamish plant and the amount of expansion of the East Treatment Plant. A new parallel to the Kenmore Interceptor would still be needed to convey more North Service Area flows to the West Treatment Plant. These strategies were eliminated because they did not offer cost benefits in terms of reduced conveyance needs and thus were not cost-effective.

Alternatives to Building Additional Wastewater Facilities

During early planning, the RWSP evaluated approaches that could reduce the need for building new facilities. Out of these, several have been carried forward as integral parts of the service strategies (e.g., I/I control) or options that could be implemented to alter the strategies (e.g., changing the design standard for sizing conveyance pipes).

Following is a list of the demand management approaches that have been set aside and are not being carried forward as parts of the strategies or options.

- Maximize use of on-site sewage systems for new development (e.g., composting toilets, septic tanks).
- Restrict or slow growth.
- Provide no wastewater treatment service to utilities outside King County

- Separate gray water from toilet water in a parallel plumbing/treatment/recycling system.
- Eliminate home and commercial garbage grinders as sources of wastewater solids.
- Build separate stormwater systems in parts of Seattle now served by combined sewers (service strategies propose to store and treat CSOs instead).
- In areas served by combined sewers, increase stormwater detention requirements.

Reasons for setting these measures aside include the following:

- Savings in infrastructure are outweighed by costs of implementation.
- Costs from the wastewater system are transferred to other governmental agencies, with no apparent benefit to the public.
- Measures would violate the adopted King County and other agency comprehensive plans.
- Measures would require changes to State health regulations due to potential for adverse public health impacts.

No-Action Alternative

Under the no-action alternative, no new facilities would be constructed and existing facilities would not be expanded. This alternative is discussed for comparison purposes only. It could not be implemented because the region's growing population will generate progressively larger amounts of wastewater and King County is legally required to treat this wastewater. King County is also legally required to reduce its CSO discharges. Consequences of the no-action alternative could include:

- Increased potential for sewage overflows into streets, homes, and businesses during heavy rain storms, threatening public health, degrading water quality and resulting in violation of government regulations.
- Closures of public swimming beaches and decertification of shellfish harvesting areas.
- Degradation of receiving water aesthetics and beneficial uses.
- Regulatory fines and enforcement orders for non-compliance with permit discharge limits.
- Regulatory sanctions such as building moratoria and bans on sewer hook-ups in designated growth areas.
- Liability for not fulfilling contractual obligations to receive wastewater flows from cities and sewer districts.

Additionally, under the State Growth Management Act, the adequacy of the King County Comprehensive Plan could be challenged if the capital facilities element, of which the RWSP will be a part, failed to support the adopted vision and land use in the plan by not accommodating the projected growth or providing an adequate level of service within the Urban Growth Area.

The impact comparison table, Table 3-14, compares impacts of No Action to the service strategies.

COST COMPARISONS

Tables 3-17 and 3-18 compare the costs of the service strategies. Table 3-17 compares overall capital, operating, and maintenance costs. Table 3-18 compares the rate impacts of the service strategies. A more detailed discussion of costs is provided in the financial plan that accompanies the RWSP.

Table 3-17. Service Strategy Cost Comparison Capital, Operating, and Maintenance (in $ millions, 1997 net present value)

Service Strategy	Cumulative Costs, present through	
	2030	2050
1	876	1244
2	1128	1366
3	1235	1457
4	1398	1621

Reference: RWSP Financing Plan, May1997.

Table 3-18. Comparison of Levelized (average) Monthly Rate Impacts,[a] 1997 to 2030 (in 1997 dollars)

Rates	Service Strategy:			
	1	2	3	4
Current	19.10	19.10	19.10	19.10
Average, 1997-2030	17.59	18.40	19.10	19.74
Maximum	19.60	19.60	21.45	21.57
Minimum	14.71	16.77	16.47	17.33

[a]Dollars/month for a single-family residence.

Reference: RWSP Financing Plan, May 1997