LOTT

CAPACITY REPORTS 2023

FLOWS & LOADINGS

I&I/FLOW MONITORING

CAPACITY ASSESSMENT

LOTT Clean Water Alliance
Annual Waste Load Assessment Report

May 11, 2023

Introduction

The information included in this report is intended to meet the annual reporting requirement for the LOTT Clean Water Alliance's National Pollutant Discharge Elimination System (NPDES) Permit No. WA0037061, issued on February 16, 2018. Pursuant to section S4. Facility Loadings, subsection B. Plans for Maintaining Adequate Capacity, the report includes the following:

- A discussion on compliance with permit effluent limitations for the year 2022.
- A comparison between the existing and design monthly average dry weather and wet weather flows, peak flows, biological oxygen demand (BOD), total suspended solids (TSS) loadings, and total nitrogen (TN), including a description of the percentage change in these parameters since the prior year.
- A statement of the present and design population equivalent, projected population growth rate, and the estimated date at which the design capacity is projected to be reached, according to the most restrictive parameters.

As established in LOTT's original long-range Wastewater Resource Management Plan, also known as the Highly Managed Plan, LOTT is continuously planning and evaluating system demands and requirements. Population projections published by the Thurston Regional Planning Council (TRPC) in 2018 and flow monitoring data collected in 2022 were used to update LOTT's flows and loadings projections.

Permit Compliance

During 2022, the Budd Inlet Treatment Plant (BITP) did not experience any permit violations for marine discharge to Budd Inlet.

The Budd Inlet Reclaimed Water Plant (outfall #005) experienced two violations for total coliform. One occurred on September 5, where an unchlorinated sample was mistakenly analyzed as Class A reclaimed water. The second occurred on December 1, when the plant had been off-line and the sample line wasn't adequately flushed before sampling.

Actual and Design Flows and Loadings Evaluation

Included in Table 1 is a comparison between the actual and design monthly average dry weather and wet weather flows, peak flows, influent Biological Oxygen Demand (BOD), Total

Suspended Solids (TSS), and Total Nitrogen (TN) loadings, with a description of the percentage change in these parameters since the previous year (2021).

Table 1. 2022 Budd Inlet Treatment Plant Influent Flows and Loadings

Parameter	Design	2022	% of Design	2021	% Increase
FLOWS (mgd)		(Current)		(Current)	2022 vs 2021
Annual Average	17	12.31	72.4%	12.36	0%
Maximum Monthly Average	28	18.67	66.7%	18.53	1%
Maximum Day	55	51.77	94.1%	45.05	15%
Wet Weather Monthly Average (Nov-Mar)*	22	14.38	65.4%	14.46	-1%
Dry Weather Monthly Average (Jun-Sept)*	15	10.17	67.8%	9.85	3%
Peak Hourly	64	64.58	100.9%	58.00	11%
BOD LOADING (lbs/day)					
Annual Average	31,400	26,272	83.7%	23,349	13%
Maximum Monthly Average	37,600	28,581	76.0%	27,607	4%
Daily Maximum	75,300	50,033	66.4%	38,722	29%
TSS LOADING (lbs/day)					
Annual Average	29,200	26,463	90.6%	24,268	9%
Maximum Monthly Average	35,100	28,034	79.9%	28,425	-1%
Daily Maximum	87,700	54,698	62.4%	44,934	22%
TN LOADING (lbs/day)					
Annual Average	5,350	2,662	49.8%	2,588	3%
Maximum Monthly Average	6,420	2,853	44.4%	2,843	0%
Daily Maximum	16,060	3,387	21.1%	3,693	-8%

Present and Historical Sewered Population

Sewered population, including both residential and employment population, is expressed in terms of Equivalent Residential Units (ERUs). One ERU is the amount of wastewater presumed to come from an average sewer-connected single-family household. Over the last 15 years, the LOTT service area has generally experienced steady growth in ERUs, with an annual average increase of approximately 1.73% per year (Table 2). It is suspected that the fluctuations in 2020 and 2021 are likely due to the COVID pandemic.

Table 2. 14-Year ERU Summary

Year	Lacey	Olympia	Tumwater	Total	% Increase
2008	18,497	24,522	8,441	51,460	2.45%
2009	19,092	24,333	8,622	52,047	1.14%
2010	19,463	24,220	8,819	52,501	0.87%
2011	20,376	24,452	9,131	53,958	2.78%
2012	20,372	24,324	9,464	54,161	0.38%
2013	20,837	25,193	9,885	55,914	3.24%
2014	21,400	25,616	9,620	56,635	1.29%
2015	21,895	26,502	10,391	58,716	3.67%
2016	22,545	26,295	10,738	59,578	1.47%
2017	23,139	27,150	10,761	61,049	2.47%
2018	23,760	27,452	10,979	62,191	1.84%
2019	24,407	27,354	10,876	62,637	0.72%
2020	24,589	26,281	10,751	61,621	-1.62%
2021	25,501	27,378	11,169	64,048	3.94%
2022	26,532	27,751	11,629	65,912	2.91%
			15-Year Average		**1.73%**

ERU allocations were developed based on flow monitoring data gathered by LOTT, population and employment densities provided by TRPC, and connections information obtained from the cities of Lacey, Olympia, and Tumwater (Table 3).

Table 3. Equivalent Residential Unit (ERU) Allocations

Jurisdiction	Residents/ERU	Employees/ERU
Lacey	2.42	7.06
Olympia	2.48	9.35
Tumwater	2.41	8.64
Weighted Average	2.45	8.42

Loading characteristics for both residential and employee populations were updated in 2022 based on BITP influent sampling data and calibrated with flow monitoring data and residential/employment densities (Table 4).

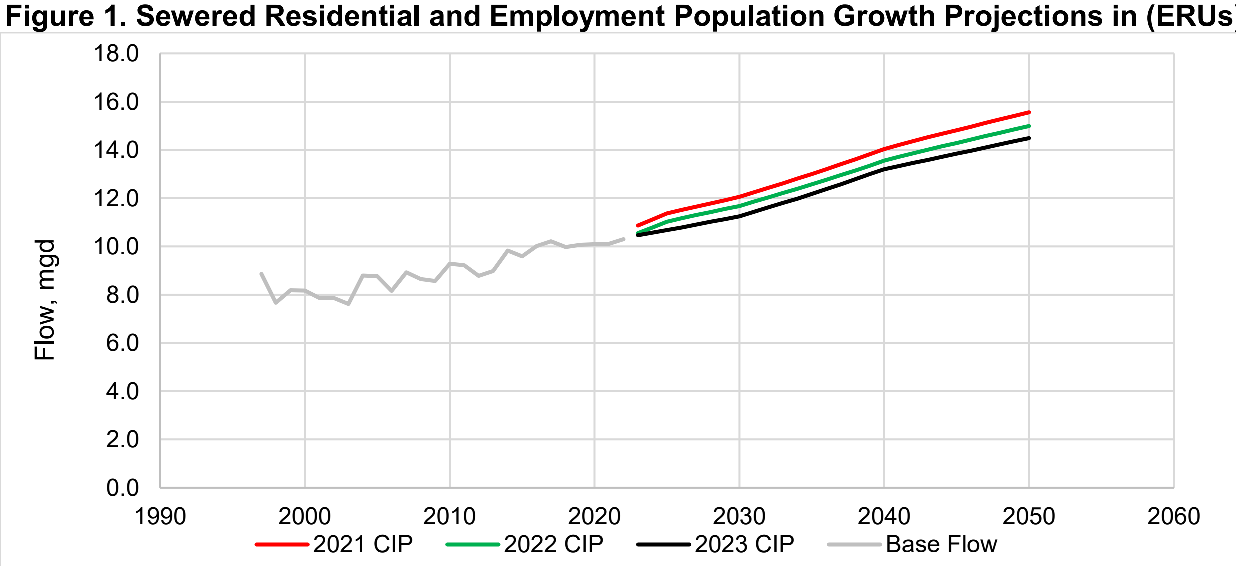
Table 4. Average Loading Generation Rate Profiles (lbs/person/day)

Residential		Employment	
BOD	TSS	BOD	TSS
0.113	0.120	0.113	0.120

Population Growth Projections

Data used for the development of the population growth projections included wastewater flow monitoring data, sewered and non-sewered population projections, existing sewer lines, estimated timelines for sewering of non-sewered areas within the overall Urban Growth Area (UGA), and the average drinking water consumption data from 2020 through 2022. Flow data was collected at BITP and at various flow monitoring locations throughout the collection system. Population projections were obtained from TRPC, in the form of projected residential and employment populations per parcel. The estimated sewering timelines, drinking water consumption data, and existing collection system piping information were obtained from each of the partner jurisdictions (Lacey, Olympia, and Tumwater).

Figure 1. Sewered Residential and Employment Population Growth Projections in (ERUs)



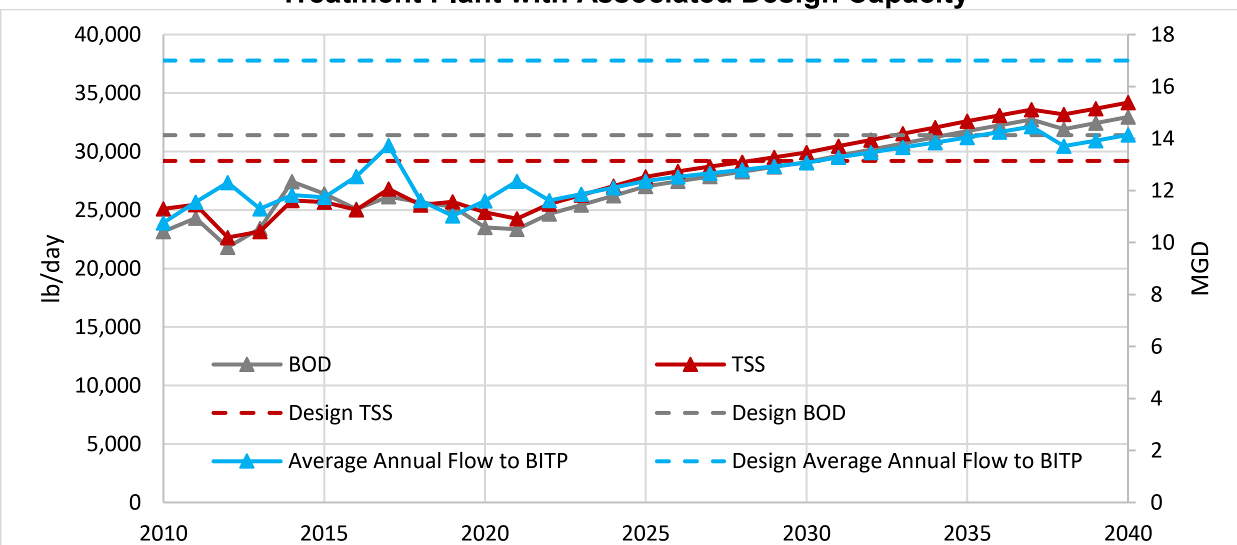
Capacity Assessment Analysis

Figure 2 illustrates the projected timeline for reaching the various annual average permit defined design criteria for BOD, TSS, and flow at the BITP based on the updated ERU projections and the associated loading rates for BOD and TSS.

Included is the planned expansion at the Martin Way Reclaimed Water Plant (MWRWP), which will relieve hydraulic flow and loading limitations to BITP. While on-line in 2022, the MWRWP diverted a daily average of 1.07 mgd of flow from BITP, approximately 8.7% of the total system flow. Reclaimed water produced at MWRWP will continue to be utilized at the Woodland Creek Groundwater Recharge Facility, operated by the cities of Lacey and Olympia. Expansion of the MWRWP to 3 mgd is currently anticipated for 2038, however this is closely tied to the rate at which septic conversions happen in the northeast Lacey area, as well as an increase in desire for reclaimed water.

Based on these projections, the current rated design capacity for BITP would be reached in the year 2029 for TSS. BOD and flow capacities would not be reached until after 2035.

Figure 2. Annual Average Projected Flows and Loadings at the Budd Inlet Treatment Plant with Associated Design Capacity



Changes from Last Year

Although the BITP is nearing its rated design loadings in terms of TSS, several major upgrades have been completed since the mid-1990s, when the original design capacities were established. These include a major renovation of the secondary clarifiers completed in 2008, the addition of new primary sedimentation basins in 2013, and upgrades to the centrate handling facility, providing the ability to more precisely meter centrate into the biological process. The Biological Process Improvements project, completed in 2023, will also increase the ability to manage loadings to BITP. In addition, LOTT finalized a master planning effort in 2023, which re-evaluated LOTT's capacity management strategy. Results of these efforts will be incorporated into future iterations of this report, as well as the associated capacity assessment report.

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2022 Flows and Loadings Report

May 2023

Prepared By:
Adam Klein and Hannah McLean, Brown & Caldwell
Tyle Zuchowski, LOTT Clean Water Alliance

PREFACE

The Flows and Loadings Report is one of three related documents that are part of the annual process to monitor and evaluate capacity in the entire LOTT system. The intent, under LOTT's Wastewater Resource Management Plan (also known as the Highly Managed Plan), is to assure that needed new capacity is brought on-line "just in time" to meet system needs. Capacity needs evaluated include wastewater treatment, Budd Inlet discharge, reclaimed water use/recharge, and conveyance capacity in the entire LOTT system. These three reports are prepared annually and are used to help identify capital projects for inclusion in the annual Capital Improvements Plan.

• **Flows and Loadings Report –** analyzes residential and employment population projections within the Urban Growth Boundary and estimates the impact on wastewater flows and loading within the LOTT wastewater system.

• **Inflow and Infiltration Report –** uses dry and wet weather sewer flow monitoring results to quantify the amount of unwanted surface (inflow) and subsurface (infiltration) water entering the sewer system and to prioritize sewer line rehabilitation projects.

• **Capacity Assessment Report –** uses flows and loadings data and inflow & infiltration evaluation results to analyze system components (i.e. conveyance, treatment, and discharge), determine when limitations will occur, and provide a timeline for new system components and upgrades.

As each report is published, it will be posted on LOTT's website – www.lottcleanwater.org.

Table of Contents

Executive Summary

In accordance with the Wastewater Resource Management Plan, also known as the "Highly Managed Plan", LOTT is continuously planning to ensure it maintains adequate operational capacity to meet community needs. The primary goal of the annual Flows and Loadings Report is to define the current and projected wastewater characteristics of the LOTT service area in terms of both wastewater flows and pollutant constituents (loads). The information in this report was used to develop the 2022 Capacity Assessment Report and the 2023-2024 Capital Improvements Plan.

The Thurston Regional Planning Council (TRPC) updates its population and employment projections every five years. The latest update was published in 2018. These projections were used to develop the flows and loadings included in this report. Additional data included flow monitoring data collected as part of LOTT's inflow and infiltration evaluation program, timelines for sewering of non-sewered areas provided by each of the jurisdictions (Lacey, Olympia, and Tumwater) and updated current sewered areas.

Both flow and load projections are slightly lower (3-10%) than in the previous year's report. The reduction reflects a five-year trend in reduced loadings. This is likely related to a slight reduction in the per capita wastewater generation rates, mostly due to a revision in the handling of so-called vacant parcels.

1. Introduction

1.1 Purpose

Accurate projections of future wastewater flows and loadings are essential in planning for new treatment capacity. In accordance with the Highly Managed Plan, LOTT is continuously monitoring and planning to assure that adequate new wastewater treatment capacity is available “just in time.” The primary goal of the annual Flows and Loadings Report is to define the current and projected wastewater characteristics of the LOTT service area in terms of both wastewater flows and pollutant constituents (loads). Flows and loadings projections cover the 27-year planning cycle (2023-2050) and will be used to evaluate the existing LOTT Capital Improvements Plan and develop recommendations for the timing of capacity related projects.

1.2 Data Elements

Data used for the development of this report included wastewater flow monitoring data, sewered and non-sewered population projections, existing sewer lines, estimated timelines for sewering of non-sewered areas within the overall Urban Growth Area (UGA), and 2017-2022 drinking water consumption data. Wastewater flow data was collected at the Budd Inlet Treatment Plant and at various flow monitoring locations throughout the collection system. Population projections, last updated in 2018, were obtained from the Thurston Regional Planning Council (TRPC) in the form of projected residential and employment populations per parcel. Estimated sewering timelines, drinking water consumption data, and existing collection system piping information were obtained from each of the partner jurisdictions (Lacey, Olympia, and Tumwater).

1.3 Modeling Software

To develop flow and loading projections, a multi-step process was used. Drinking water data from the cities was combined in Excel and uploaded to a map of the parcels in Thurston County in a geographic information system (GIS) database. The drinking water data was then allocated to its specific parcel which contained population data and projections provided by the TRPC. The combined drinking water and population data was grouped into sewer basins, exported, and manipulated in Excel to develop the flow and loading projections.

1.4 Changes from Previous Reports

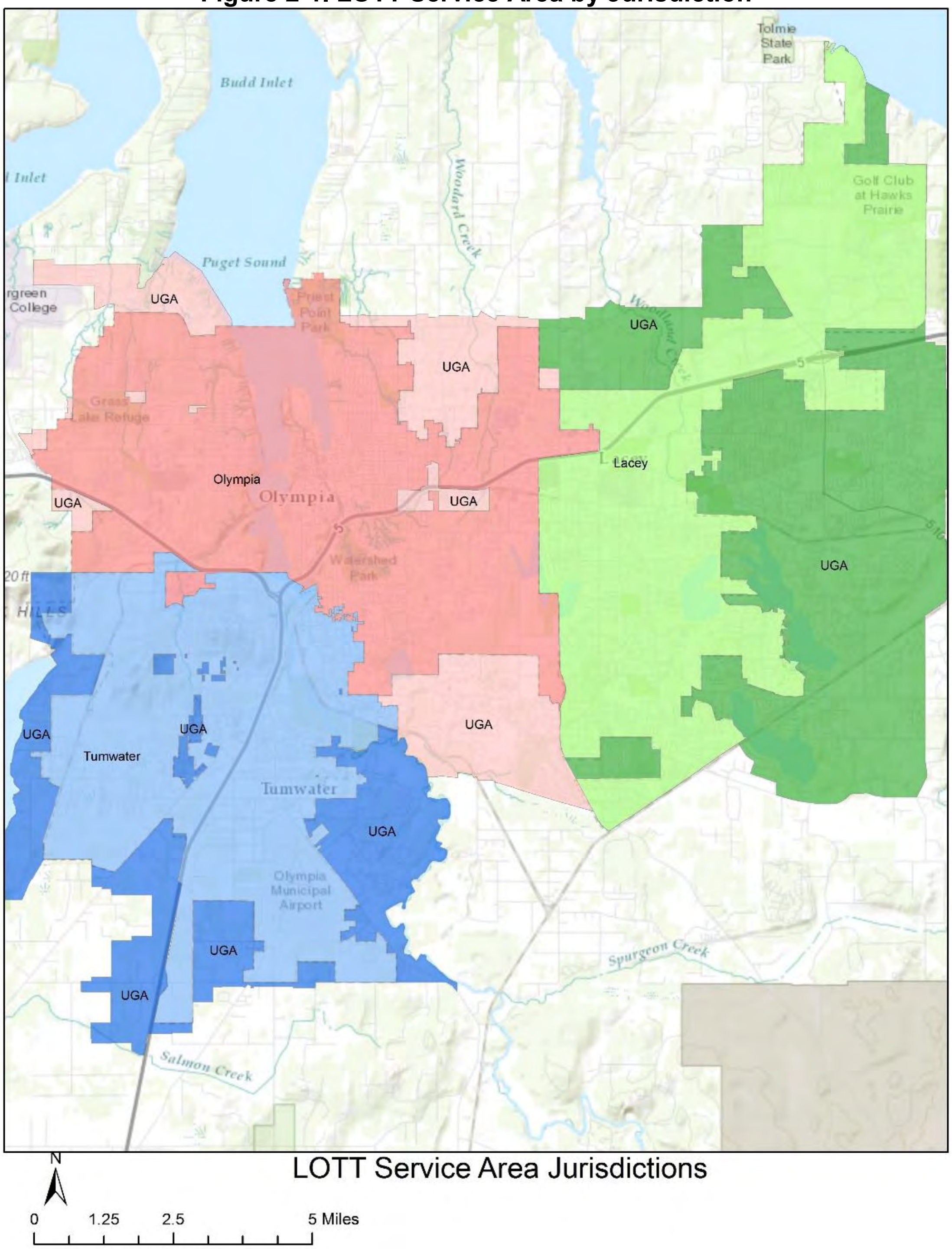
Changes from the 2022 Flows and Loadings Report include calibrating the wastewater flow generation rates based on updated drinking water consumption data from the cities of Olympia, Tumwater, and Lacey, flow monitoring data from 11 locations, updating the per capita wastewater load generation rates based on data collected at the Budd Inlet Treatment Plant and the Martin Way Reclaimed Water Plant, and updating the system-wide inflow and infiltration projections.

2. Study Area

2.1 Service Area

The LOTT service area includes the urban growth areas (UGAs) for the cities of Lacey, Olympia, and Tumwater. The current combined UGA encompasses approximately 52,276 acres, with a current residential population of 194,555 and an employment population of 104,641.

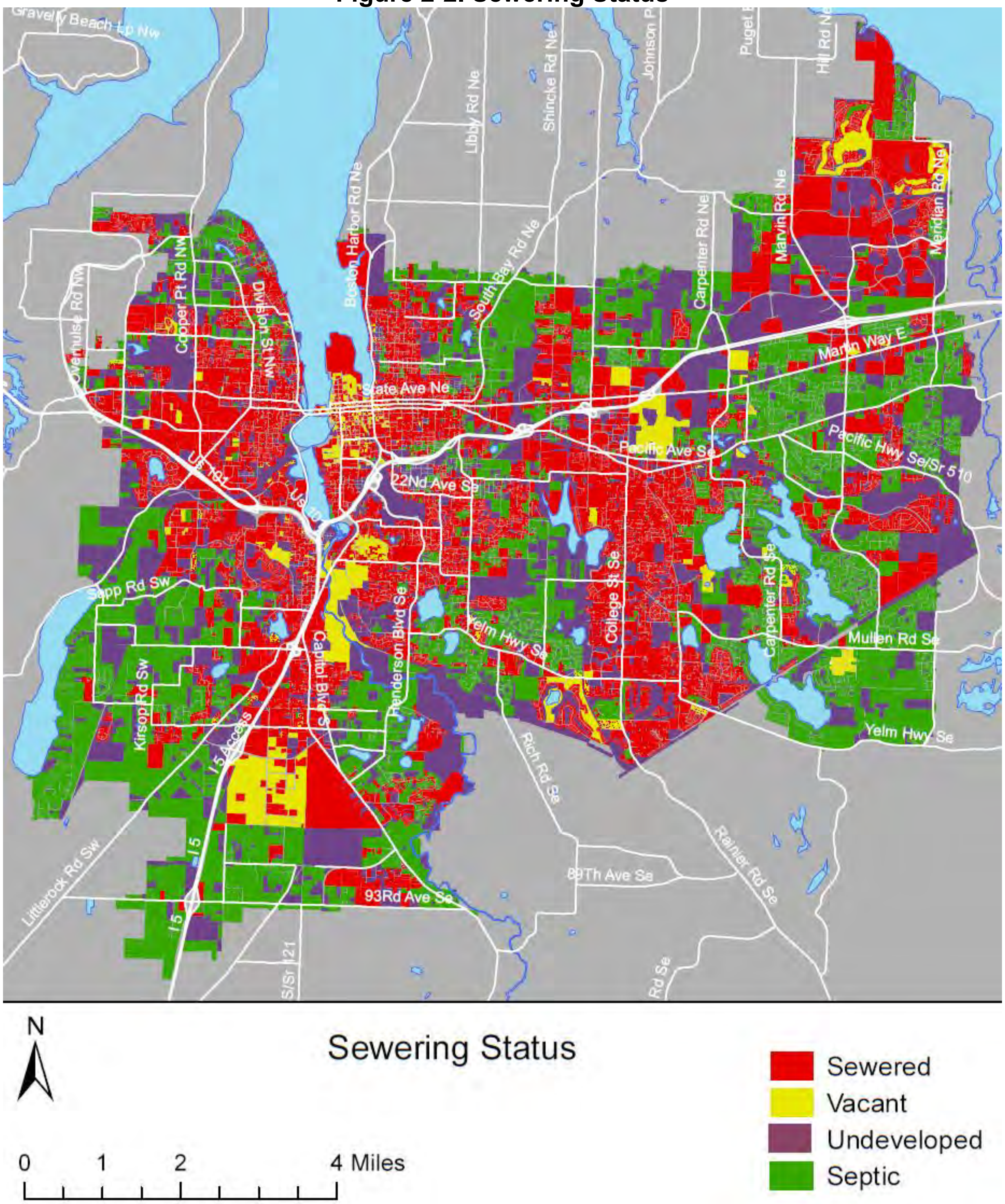
Figure 2-1. LOTT Service Area by Jurisdiction



2.2 Sewering Status

Within the LOTT service area, approximately 14,953 acres are sewered, serving a residential population of 122,633 and an employment population of 99,577. The currently sewered parcels, shown in red on Figure 2-2, indicate parcels which had drinking water consumption in the 2017-2022 period and were identified by LOTT's partners as active customers.

Figure 2-2. Sewering Status



The unsewered population within the service area has historically been divided into three categories. Vacant parcels are surrounded by sewered parcels but are currently designated as “unsewered” because they do not have any water consumption. Whether these are truly vacant, or just represent missing data in the water consumption database, these parcels are assumed to be connected, and are treated no differently from sewered parcels. There are 1,202 such parcels, representing a current population of 5,200.

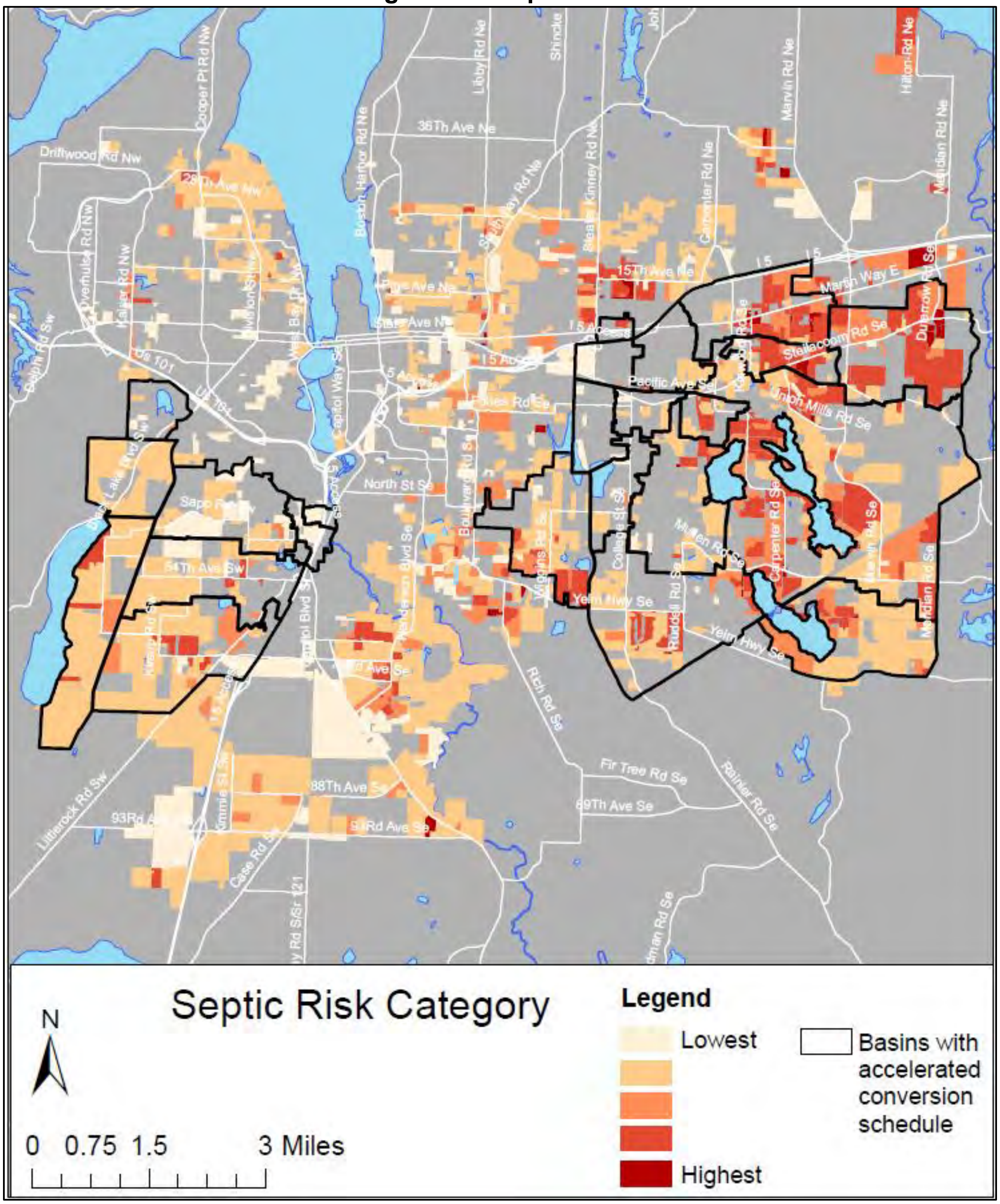
The second category are undeveloped parcels with no water consumption, and no known septic tank. This category (purple on Figure 2-2), includes 5,941 parcels, with a population of 11,100. In most instances, parcels with neither water consumption nor a septic tank would be assumed to be undeveloped, so the population of 11,100 is incongruous. It seems likely that, in places, TRPC allocated population regionally, without consideration of the status of individual parcels, leading to this disconnect. It is also likely that septic tanks have been undercounted, and a portion of these parcels are indeed on septic tanks. The latter point is borne out through inspection of satellite imagery, which shows development on many of these parcels.

The largest category of unsewered population are the parcels with known septic tanks, shown in green on Figure 2-2.

The latter two categories (purple and green parcels) are assumed to be sewered on a longer time frame, depending on location, proximity to the existing sewer system, and information obtained from the LOTT partners on future sewering efforts. In general, the undeveloped parcels are assumed to be connected earlier than the known septic tanks. Septic tank conversion has been prioritized in certain areas based on data generated by the Interjurisdictional Regional Septic Work Group. This data was obtained from the Thurston Geodata Center in the form of a GIS parcel file, which included an inventory of septic systems and associated risk scores based on environmental and health concerns. Basins with high environmental risk were projected to be connected earlier than those with lower risk. A map of the areas at risk is presented on Figure 2-3.

The 16,181 existing septic parcels represent a base flow of approximately 2.1 mgd. The current projection assumes sewering of 33% of those (5,266) by 2050, which would add a base flow of approximately 0.7 mgd to the system.

Figure 2-3. Septic Risk



The build out state, currently projected to occur in 2050 based on a linear regression analysis, is when all parcels within the UGA will have been developed. It should be noted that the build out state does not assume that all parcels will be connected to the sewer system by 2050. It is assumed that a certain percentage of new development within the UGA will include on-site septic systems, and that a certain percentage of existing septic system will remain in place. The development density is projected by TRPC based on the current zoning and the previous development density corresponding to that zoning.

3. Population and Employment Forecast

3.1 Projections

In 2018 TRPC published population projections in the form of a GIS parcel file which included projected residential population for the years 2018, 2020, 2025, 2030, 2035, and 2040. The build out residential population projections were updated in 2013. Employment projections, also from TRPC, were published in 2013. Employment projections included the years 2010 and 2035 and build out projections expected to occur in 2050 based on a linear regression analysis.

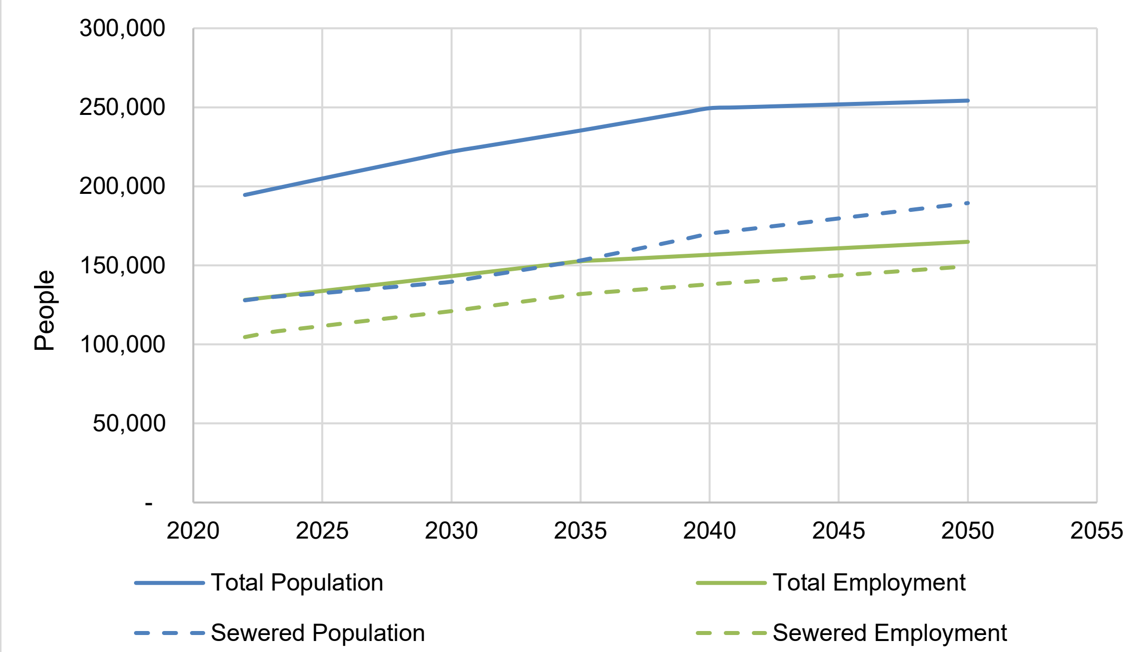
The future projections, shown in Table 3-1, were calculated through a linear extrapolation of the data provided by TRPC and the projected rate at which the sewered areas would expand, and septic tanks would be converted to sewer.

The residential and employment populations include all persons and employees within the UGA. The sewered residential population and sewered employment population include only those contained within the sewered areas. Future expansion of the sewered areas is accounted for in the projections throughout the forecast period. Figure 3-1 displays the projected population and employment forecasts for the planning period (2023-2050).

Table 3-1. Population and Employment Projections

Year	Residential Population	Employee Population	Sewered Residential Population	Sewered Employee Population
2023	198,025	130,036	129,907	107,724
2024	201,494	131,920	131,194	109,759
2025	204,964	133,803	132,426	111,647
2026	208,357	135,686	133,900	113,609
2027	211,751	137,569	135,314	115,496
2028	215,145	139,452	136,734	117,360
2029	218,538	141,335	138,170	119,210
2030	221,932	143,218	139,627	121,056
2031	224,608	145,101	142,456	123,295
2032	227,284	146,984	145,083	125,443
2033	229,961	148,867	147,719	127,585
2034	232,637	150,751	150,390	129,731
2035	235,313	152,634	153,108	131,886
2036	238,136	153,452	156,406	133,107
2037	240,959	154,270	159,747	134,333
2038	243,781	155,089	163,131	135,565
2039	246,604	155,907	166,562	136,804
2040	249,427	156,725	170,039	138,052
2041	249,908	157,544	171,968	139,145
2042	250,389	158,362	173,896	140,247
2043	250,870	159,180	175,825	141,358
2044	251,351	159,999	177,757	142,479
2045	251,832	160,817	179,690	143,610
2046	252,313	161,635	181,627	144,750
2047	252,794	162,454	183,568	145,900
2048	253,275	163,272	185,513	147,060
2049	253,756	164,090	187,463	148,230
2050	254,237	164,908	189,418	149,410
Full Sewering	254,237	164,908	254,237	164,908

Figure 3-1. Population and Employment Projections (2023-2050)



3.2 Equivalent Residential Units

For billing purposes, each customer connection to the sewered system is measured in terms of equivalent residential units (ERUs). One ERU is the amount of wastewater presumed to come from an average connected single-family household. For multi-family housing (apartments), each living unit is counted as 7/10 of an ERU. Commercial and industrial dischargers are billed on a volume basis using water consumption data, which is mathematically converted to ERUs.

Established in 1976 as part of the original LOTT Interlocal Agreement, LOTT has defined an ERU as 900 cubic feet of wastewater volume per month (224 gallons per day). Since that time, residential wastewater generation rates have decreased as a result of water conservation efforts. Estimates of current residents and employees per ERU are provided in Table 3-2.

Table 3-2. Jurisdiction ERU Summary 2022

Jurisdiction	Residents/ERU	Employees/ERU
Lacey	2.42	7.06
Olympia	2.48	9.35
Tumwater	2.41	8.64
Weighted Average	2.45	8.42

Table 3-3 displays the annual average number of ERUs for each of the jurisdictions over that last 25 years.

Table 3-3. ERU Totals 25-Year Comparison

Year	Lacey	Olympia	Tumwater	Total
1997	10,966	21,430	6,447	38,843
1998	11,363	21,860	6,845	40,068
1999	11,786	22,242	6,962	40,990
2000	13,356	22,398	6,625	42,379
2001	12,362	23,062	6,582	42,006
2002	13,493	23,142	6,667	43,302
2003	13,689	23,445	6,999	44,133
2004	14,206	23,552	7,161	44,919
2005	14,543	23,939	7,572	46,054
2006	15,326	24,575	7,808	47,709
2007	17,647	24,453	8,127	50,227
2008	18,497	24,522	8,441	51,460
2009	19,092	24,333	8,622	52,047
2010	19,463	24,220	8,819	52,502
2011	20,376	24,452	9,131	53,959
2012	20,372	24,324	9,464	54,160
2013	20,789	25,161	10,136	56,086
2014	21,000	25,100	9,600	55,700
2015	21,895	26,502	10,319	58,716
2016	22,545	26,295	10,706	59,546
2017	23,139	27,150	10,761	61,050
2018	23,760	27,452	10,979	62,191
2019	24,407	27,354	10,876	62,637
2020	25,000	28,000	11,000	64,000
2021	25,463	27,362	11,156	63,981
2022	26,532	27,751	11,629	65,912

3.3 New Connections

New connections to the system are billed a one-time connection fee, called a Capacity Development Charge (CDC). One CDC is assessed for each ERU connected to the system. Table 3-4 lists the number of CDCs collected over the last 25 years. Table 3-5 lists the projected new connections over the planning period.

Table 3-4. New Connections 25-Year Comparison

Year	Lacey	Olympia	Tumwater	Total
1997	533	381	109	1,023
1998	663	1,361	429	2,453
1999	1,062	882	214	2,159
2000	316	301	144	761
2001	498	306	164	968
2002	489	410	130	1,029
2003	541	296	273	1,110
2004	750	580	414	1,744
2005	942	392	368	1,702
2006	1,888	488	208	2,584
2007	1,129	219	400	1,748

Year	Lacey	Olympia	Tumwater	Total
2008	688	201	288	1,178
2009	510	247	119	875
2010	436	346	192	974
2011	462	429	176	1,066
2012	385	336	187	908
2013	384	399	187	970
2014	398	421	163	982
2015	667	332	142	1141
2016	986	642	243	1,871
2017	455	586	224	1,265
2018	905	266	155	1,326
2019	636	160	228	1,024
2020	593	646	124	1,363
2021	1,226	327	410	1,963
2022	1,069	389	473	1,931

Future connections are derived from the ERU forecasts in Table 3-3. These projections are summarized in Table 3-5.

Table 3-5. New Connection Projections Through the Year 2050

Year	Lacey	Olympia	Tumwater	Total
2023	357	596	239	1,192
2024	241	379	151	771
2025	229	359	143	730
2026	352	345	145	842
2027	316	346	145	807
2028	311	349	146	806
2029	310	354	148	811
2030	311	359	150	820
2031	699	454	283	1,435
2032	648	430	263	1,340
2033	649	431	264	1,343
2034	656	435	267	1,359
2035	666	441	272	1,379
2036	780	432	295	1,506
2037	787	435	302	1,524
2038	795	439	309	1,543
2039	804	443	316	1,563
2040	813	447	323	1,583
2041	511	212	207	931
2042	512	212	208	932
2043	512	212	209	933
2044	513	212	210	935
2045	514	212	212	938
2046	515	212	213	940
2047	517	212	214	943
2048	518	213	216	946
2049	519	213	217	949
2050	521	213	218	953

4. Flows and Loadings

4.1 Permit Requirements

The National Pollutant Discharge Elimination System (NPDES) permit number WA0037061 for the Budd Inlet Treatment Plant was issued by the Department of Ecology on February 16, 2018 and became effective on April 1, 2018. The compliance is based primarily on loadings of biological oxygen demand (BOD), total suspended solids (TSS), and total inorganic nitrogen (TIN), rather than flow. Table 4-1 lists the loadings-based permit limitations.

Table 4-1. NPDES Permit Limitations

	Summer (Jun–Sep)	Shoulder (Apr, May, Oct)	Winter (Nov–Mar)
BOD	7 mg/L 671 lb/d 85% removal	8 mg/L 900 lb/d 85% removal	30 mg/L 5,640 lb/d 85% removal
TSS		30 mg/L 5,265 lb/d 85% removal	
TIN	3 mg/L 288 lb/d	3 mg/L 338 lb/d	No limit
pH		6–9	
Fecal coliform bacteria		200/100 ml (monthly) 400/100 ml (weekly)	
Ammonia-N			26 mg/L (monthly) 36 mg/L (maximum day)
Additional limits for Fiddlehead Outfall			
Ammonia-N			22 mg/L (monthly) 31 mg/L (maximum day)
Total recoverable copper		6 µg/L (monthly) 7.5 µg/L (maximum day)	

µg/L = micrograms per liter

mg/L = milligrams per liter

ml = milliliter

TIN = total inorganic nitrogen

4.2 Drinking Water Analysis

For this report, drinking water consumption data from 2017 through February 2022 was collected from each of the jurisdictions. Drinking water consumption was reported monthly for each parcel. In order to determine the baseline drinking water consumption rate and minimize the effect of irrigation, only winter (November, December, January, and February) drinking water consumption data were used for sewered customers.

Consumption for each customer is based on an average of measured consumption in 2017-18, 2018-19, 2019-20, 2020-21, and 2021-22. Consumption for all the sewered customers averaged 8.37 mgd. Including flow from The Evergreen State College (TESC), the total base consumption was 8.55 mgd.

The water consumption data were calibrated against measured wastewater base flows to determine the wastewater generation rate. Base flow across the entire system, measured as the sum of the flows at the Budd Inlet Treatment Plant (BITP) and the

Martin Way Reclaimed Water Plant (MWRWP), is 10.3 mgd. The base wastewater flow was therefore 1.4 mgd higher than the total water consumption. Typically, wastewater base flows are expected to be lower than water consumption rates. Even during the winter, when irrigation uses are minimized, there are a number of water uses which don't show up in the wastewater flows. These include various types of cleaning, cooking, humidifying, plant watering, and other activities. The ratio of base wastewater flow to water consumption is typically 0.8 to 0.9. In this case, the base wastewater flow is 1.75 mgd higher than the water consumption.

Once the water consumption rates were calibrated against meter flow, the rates were divided by population and employment estimates to generate a set of wastewater generation rate profiles. Profiles were developed for 15 regions, with residential rates varying from 45 gallons per capita day (gpcd) in downtown Olympia to 71 gpcd in the Lacey and UGA septic areas. Employment rates varied from 11 gallons per employee day (gped) in parts of Lacey and the East Bay area to 41 gped in the residential part of east Olympia. Rates are summarized, by location, in Table 4-2.

Table 4-2. Wastewater Generation Rates by Drinking Water Basin

	Population		Drinking Water Consumption[1]			Adjusted Wastewater Generation Rate	
Basin	**Sewered Residents**	**Sewered Employment**	**Total gpd**	**Residential gpd**	**Employee gpd**	**Residential gpcd[2]**	**Employee gpcd[3]**
Lacey							
Active developments	31,774	7,978	1,761,398	1,595,593	165,805	50.2	20.8
Southeast Lacey	3,901	3,660	416,706	276,555	140,151	70.9	38.3
Other Lacey	18,607	13,790	1,021,895	864,963	156,933	46.5	11.4
Average						55.9	23.5
Olympia							
Downtown	5,800	23,956	558,080	262,522	295,558	45.3	12.3
STEP area	4,043	701	244,047	234,963	9,084	58.1	13.0
West Bay	8,067	2,848	520,154	463,653	56,500	57.5	19.8
East Bay	5,608	915	295,161	284,761	10,399	50.8	11.4
West residential areas	4,405	562	395,020	377,023	17,997	85.6	32.0
West commercial areas	9,297	13,217	849,369	577,767	271,602	62.1	20.5
East residential areas	11,103	3,265	715,922	580,542	135,380	52.3	41.5
East commercial areas	4,662	10,994	447,863	255,229	192,634	54.7	17.5
Average						58.3	21.0
Tumwater							
Tumwater Hill	3,003	1,039	169,033	152,926	16,107	50.9	15.5
Mottman	4,027	3,788	336,668	230,858	105,810	57.3	27.9
Commercial Core	5,576	8,948	417,196	301,882	115,314	54.1	12.9
Outlying	8,031	8,981	582,706	410,909	171,796	51.2	19.1
Average						53.4	18.9

[1] Raw data, only a portion of total parcels accounted for. Data not adjusted for sewer base flows.
[2] Gallons per capita per day
[3] Gallons per employee per day

The variance in drinking water consumption (and therefore, wastewater generation) between basins may be attributed to a number of contributing factors which include the predominant type of residential units in the basin (single-family, multi-family, senior housing, etc.), the predominant era of home construction, the average age of the residents, and the various commercial, industrial, or public-sector employers present in each basin.

On average, residential per capita usage increased by 2 gallons per person per day, and employment usage increased by 1 gallon per person per day.

4.3 Base Sanitary Flow

In order to accurately forecast flows based on population changes within the service area, a base sanitary flow (BSF) must be established to calibrate residential and employee wastewater generation rates. The BSF is defined as the minimum average flow generated in the entire collection system registered over a 7-day period in each year and is assumed to have little to no influence from inflow and infiltration.

Base sanitary flow is measured at the influent of the Budd Inlet Treatment Plant. Reclaimed water produced by the Martin Way Reclaimed Water Plant, which is diverted to the Hawks Prairie and Woodland Creek infiltration basins, is added to the flow measured at the BITP to ensure that flows of the entire system are accounted for. The BSFs, measured in million gallons per day (mgd), from 2001 to 2022 are provided in Table 4-3.

Table 4-3. Base Sanitary Flow in LOTT Service Area

Year	Base Sanitary Flow (mgd)[1]
2001	7.94
2002	7.92
2003	8.12
2004	8.79
2005	8.77
2006	8.50
2007	8.40
2008	8.68
2009	8.77
2010	9.29
2011	9.21
2012	8.77
2013	8.94
2014	9.22
2015	9.52
2016	10.06
2017	10.20
2018	10.96
2019	10.10
2020	10.09
2021	10.10
2022	10.30

[1]Equals the raw degritted sewage flow at the Budd Inlet Treatment Plant plus flow treated at the Martin Way Reclaimed Water Plant

The current NPDES permit requires that the LOTT Clean Water Alliance conduct an annual infiltration and inflow evaluation such that the entire collection system is evaluated once every seven years. LOTT currently has a total of 11 permanent flow monitors. This, along with flows recorded during previous years, allows for a more detailed analysis of each jurisdiction's base flows. The BSF for each of the jurisdictions is provided in Table 4-4.

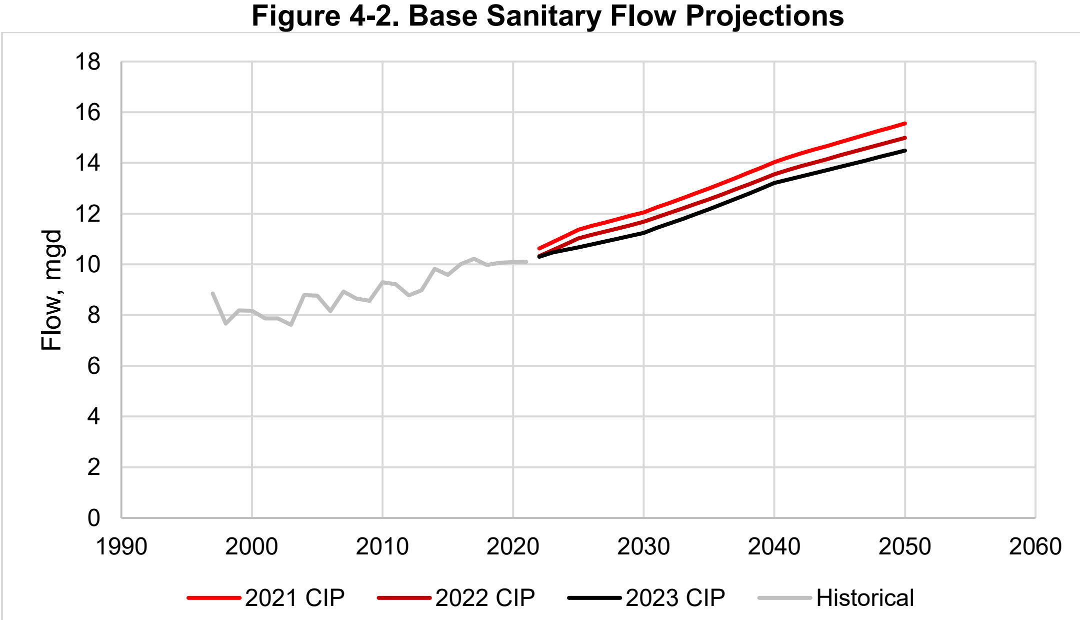
Table 4-4. Base Sanitary Flow by Jurisdiction (mgd)

Year	Lacey	Olympia	Tumwater	Point Sources (TESC[1], etc.)	Total
2006	2.63	4.31	1.73	0.05	8.27
2007	2.63	4.32	1.21	0.1	8.26
2008	2.94	4.02	1.14	0.48	8.58
2009	3.09	3.42	1.41	0.54	8.47
2010	3.14	3.56	1.19	0.45	8.34
2012 [2]	3.28	4.11	1.37	0.42	9.18
2013	3.10	4.14	1.23	0.41	8.88
2014	3.16	4.31	1.21	0.54	9.22
2015	3.18	4.25	1.54	0.53	9.52
2016	3.56	4.52	1.43	0.58	10.06
2017	3.75	4.34	1.52	0.58	10.20
2018	4.06	4.75	1.61	0.53	10.96
2019	3.20	3.69	1.44	1.77	10.10
2020	3.11	4.17	1.48	1.87	10.09
2021	3.10	3.69	1.44	1.87	10.10
2022	3.21	3.66	1.51	1.57	10.30

[1] The Evergreen State College (TESC), Mottman Industrial area, and artesian wells
[2] June 2011 – May 2012 Average

The large reduction in Olympia base flow and increase in point source base flow between 2018 and 2019 reflects the adjustment to suspected artesian inflow. Figure 4-2 presents the base sanitary flow projections and compares them with those published in the 2020 and 2021 LOTT Flows and Loadings Reports, as well as historical observations since 1997.

Figure 4-2. Base Sanitary Flow Projections



Base flow projections have decreased over the past two years. This is related to a slight reduction in the per capita wastewater generation rates, mostly due to a revision in the handling of so-called vacant parcels. In this report, parcels in sewered neighborhoods with no water data were assumed to be connected, and any population assigned to those parcels was assumed to be present. While water consumption totals did not change much from 2021 to 2022, there were more people assumed to be currently connected, therefore reducing the per capita rates. This reduction, and the effect on the projected base flow, was small – a change of only 3% by 2050.

4.4 Comparison with Historical Wastewater Generation Rates

Historically, wastewater generation rates were developed for each city based upon flow monitoring data. Beginning in 2007, drinking water consumption data has been obtained directly from each of the jurisdictions, enabling a more precise estimation of the wastewater generation rate profiles as shown in Table 4-2. These profiles have been organized into city-specific profiles for comparison with previous estimates. Table 4-5 summarizes the historical rate profiles, along with the corresponding values developed in this report.

Table 4-5. Wastewater Generation Rate Gallons Per Capita Per Day (gpcd)

Source	Lacey	Olympia	Tumwater	Employment
1995-2002 CIP	66	85	73	40
2003 CIP	64	81	69	39
Budd Inlet Master Plan (2004)	64	75	69	35
2005 CIP	68	62	65	35
2006 Flows and Loadings	71	64	61	34
2007 Flows and Loadings	69	67	74	22
2008 Flows and Loadings	62	66	82	26
2009 Flows and Loadings	66	67	73	20
2010 Flows and Loadings	66	69	69	25
2012 Flows and Loadings	63	67	66	18
2013 Flows and Loadings	66	75	72	20
2014 Flows and Loadings	57	64	58	19
2015 Flows and Loadings	58	58	51	23
2016 Flows and Loadings	57	64	80	24
2017 Flows and Loadings	58	70	61	25
2018 Flows and Loadings	53	63	57	29
2019 Flows and Loadings	60	69	59	33
2020 Flows and Loadings	61	56	58	22
2021 Flows and Loadings	57	54	58	21
2022 Flows and Loadings	56	58	53	21

These values are extrapolated from the values in Table 4-2 though they were not used in the model. They are presented for the sake of comparison to previous years' profiles. Per capita rates for all three cities were relatively unchanged since last year's report.

4.5 Flow Projections

Flow projections are calculated by multiplying the projected sewered populations by the wastewater generation rate. The per capita generation rates are basin specific. The projected sewered population projections are dependent on whether the parcel is currently sewered, on a septic system, or undeveloped. The model assumes that these generation rates are constant throughout the simulation period (2022-2050). Each year these wastewater generation rates will be recalibrated based on ongoing flow monitoring and population estimates.

The impact of inflow and infiltration on projected flows was modeled using the projected inflow and infiltration rates as documented in the 2022 Inflow & Infiltration and Flow Monitoring Report. Projections were developed for the following risk-based I&I scenarios: 1) annual average; 2) 10-year peak day; 3) 10-year peak hour; 4) 10-year peak month; 5) summer (June-September); 6) shoulder (April, May, and October); and 7) winter (November-March) time period flows. Flow projections are displayed in Figure 4-3 and listed in Table 4-6.

Figure 4-3. Flow Projections

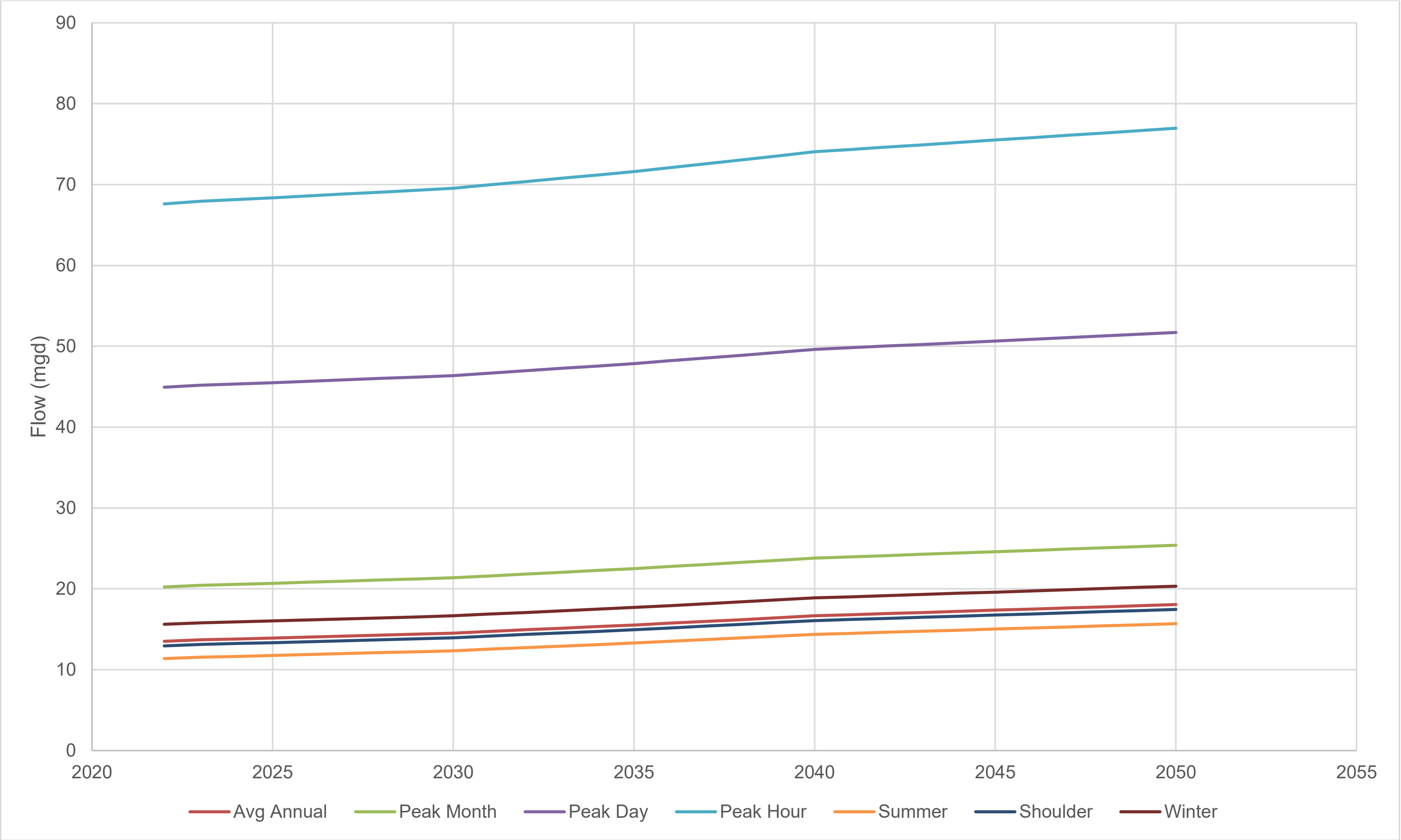


Table 4-6. Flow Projections (mgd)

Year	Base Sanitary Flow	Annual Average	Peak Month (10-year)	Peak Day (10-year)	Peak Hour (10-year)	Summer[1]	Shoulder[2]	Winter[3]
2023	10.47	13.69	20.43	45.18	67.94	11.54	13.12	15.80
2024	10.57	13.80	20.56	45.34	68.16	11.65	13.23	15.92
2025	10.67	13.91	20.68	45.50	68.36	11.76	13.34	16.03
2026	10.79	14.04	20.82	45.68	68.60	11.88	13.47	16.16
2027	10.90	14.16	20.96	45.85	68.84	11.99	13.59	16.29
2028	11.02	14.28	21.09	46.02	69.07	12.11	13.71	16.41
2029	11.13	14.40	21.23	46.20	69.30	12.23	13.83	16.54
2030	11.24	14.53	21.37	46.37	69.54	12.34	13.95	16.66
2031	11.44	14.74	21.60	46.68	69.97	12.54	14.16	16.88
2032	11.62	14.93	21.83	46.98	70.37	12.73	14.35	17.08
2033	11.80	15.13	22.05	47.27	70.77	12.92	14.55	17.29
2034	11.98	15.33	22.27	47.56	71.18	13.11	14.75	17.49
2035	12.17	15.53	22.50	47.86	71.60	13.30	14.95	17.70
2036	12.37	15.75	22.76	48.21	72.08	13.51	15.17	17.93
2037	12.58	15.98	23.01	48.55	72.56	13.72	15.39	18.16
2038	12.78	16.20	23.27	48.90	73.05	13.93	15.61	18.40
2039	12.99	16.43	23.54	49.25	73.55	14.15	15.84	18.64
2040	13.20	16.66	23.80	49.61	74.06	14.37	16.07	18.88
2041	13.33	16.80	23.96	49.82	74.34	14.50	16.21	19.02
2042	13.46	16.94	24.12	50.03	74.63	14.63	16.35	19.16
2043	13.59	17.08	24.28	50.24	74.92	14.76	16.48	19.31
2044	13.71	17.22	24.44	50.44	75.21	14.89	16.62	19.45
2045	13.84	17.36	24.59	50.65	75.50	15.03	16.76	19.60
2046	13.97	17.50	24.75	50.86	75.79	15.16	16.90	19.74
2047	14.10	17.64	24.91	51.07	76.09	15.29	17.04	19.89
2048	14.23	17.78	25.07	51.28	76.38	15.42	17.18	20.03
2049	14.36	17.92	25.23	51.50	76.67	15.56	17.32	20.18
2050	14.49	18.06	25.39	51.71	76.97	15.69	17.46	20.32
Full Sewering	19.73	23.68	31.65	59.67	87.65	21.07	23.04	26.11

1. June, July, August, and September
2. April, May, and October
3. November, December, January, February, and March

4.6 Loading Projections

Loading projections are updated each year based upon observed BOD and TSS loadings at the Budd Inlet Treatment Plant. In 2021, the average monthly BOD and TSS loads to the Budd Inlet Treatment Plant were 26,272 lbs/d and 24,463 lbs/d, respectively. Load removal at the Martin Way Reclaimed Water Plant is taken into account when estimating ERU generation rate profiles. In 2021, it is estimated that the Martin Way Plant removed approximately 2,011 lbs/d of BOD and 1,589 lbs/d of TSS.

Projected BOD and TSS loadings for this report are based on a correlation of loadings from 2003-2022, with the 2007 through 2022 values corrected to account for loadings removal at the Martin Way Reclaimed Water Plant. These values are broken down into blanket residential and employment generation rates based upon the latest population and employment projections. These rates are provided in Table 4-7.

Table 4-7. Wastewater Load Generation Rate Profiles (lbs per capita/employee day)

Residential		Employment	
BOD	TSS	BOD	TSS
0.113	0.120	0.113	0.120

Figure 4-4 displays the historical influent loading characteristics at the Budd Inlet Treatment Plant to include monthly averages for BOD and TSS. Loadings appear to have been declining slightly over the past few years, although the long-range trend continues

Figure 4-4. Historical Primary Influent Loads (Monthly Average)

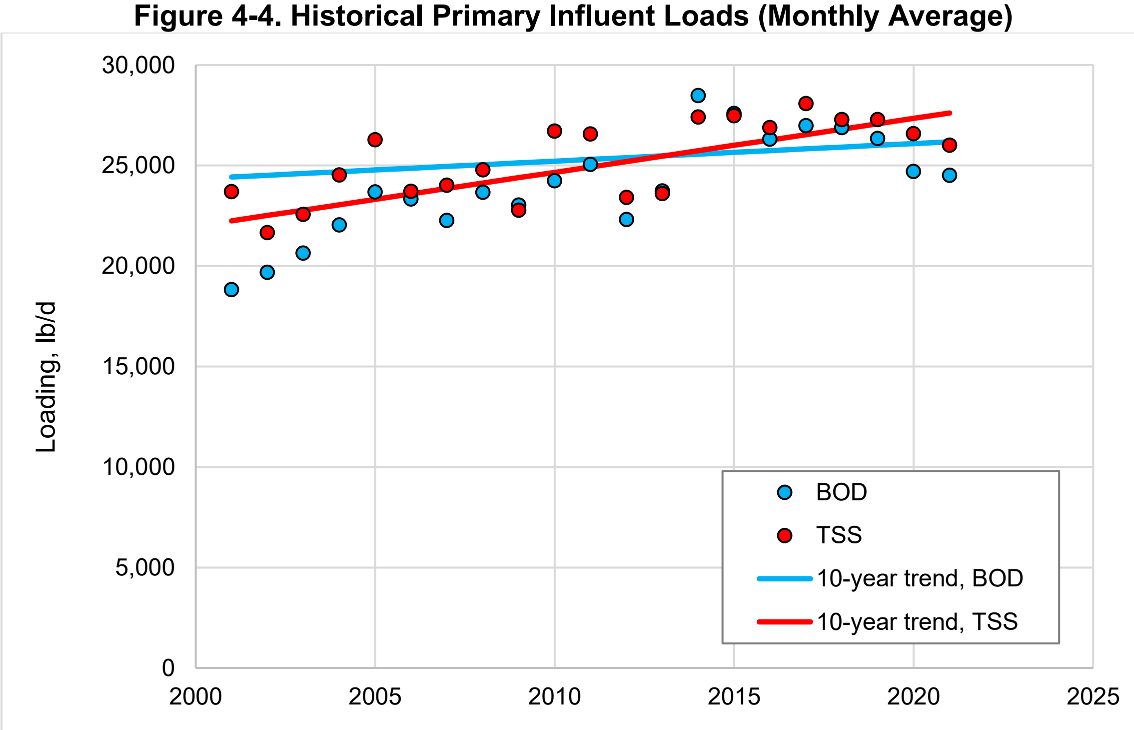


Figure 4-5 and Table 4-8 present the projected BOD and TSS loadings in the LOTT service area through 2050. These loading rates are calculated by multiplying the projected sewer populations by the per capita loading rates detailed in Table 4-7.

Figure 4-5. Projected Loadings

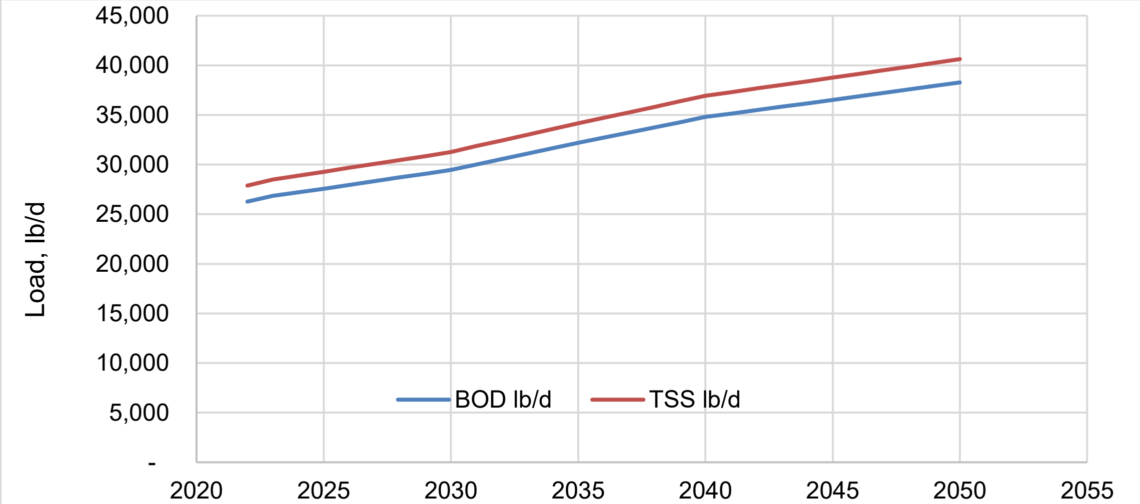


Table 4-8. Projected Loadings

Year	Average Day BOD (lbs/day)	Average Day TSS (lbs/day)
2023	26,841	28,489
2024	27,216	28,887
2025	27,569	29,262
2026	27,957	29,673
2027	28,330	30,069
2028	28,701	30,463
2029	29,072	30,857
2030	29,445	31,253
2031	30,017	31,860
2032	30,557	32,433
2033	31,097	33,006
2034	31,641	33,583
2035	32,191	34,167
2036	32,702	34,709
2037	33,217	35,257
2038	33,739	35,810
2039	34,266	36,370
2040	34,800	36,936
2041	35,141	37,299
2042	35,484	37,662
2043	35,827	38,027
2044	36,172	38,393
2045	36,518	38,760
2046	36,865	39,129
2047	37,215	39,499
2048	37,565	39,872
2049	37,918	40,246
2050	38,272	40,622
Full Sewering	47,344	50,251

5. Summary

Both flow and load projections are slightly lower (3-10%) than in the previous year's report. The reduction reflects a five-year trend in reduced loadings.

The information in this report was used to develop the 2022 Capacity Assessment Report and the 2024-2025 Capital Improvements Plan.

LOTT

CAPACITY REPORTS 2023

FLOWS & LOADINGS

I&I/FLOW MONITORING

CAPACITY ASSESSMENT

2022 Inflow & Infiltration and Flow Monitoring Report

(Data from April 2021 – December 2022)
May 2023

Prepared By:
Adam Klein and Hannah McLean, Brown & Caldwell
Tyle Zuchowski, LOTT Clean Water Alliance

Table of Contents

PREFACE

The Inflow & Infiltration and Flow Monitoring Report is one of three related documents that are part of the annual process to monitor and evaluate capacity in the entire LOTT system. The intent, under LOTT's Wastewater Resource Management Plan (also known as the Highly Managed Plan), is to assure that needed new capacity is brought on-line "just-in-time" to meet system needs. Capacity needs evaluated include wastewater treatment, Budd Inlet discharge, reclaimed water use/recharge, and conveyance capacity in the entire LOTT system. These three reports are prepared annually and are used to help identify capital projects for inclusion in the annual Capital Improvements Plan.

• **Flows and Loadings Report –** analyzes residential and employment population projections within the Urban Growth Boundary and estimates the impact on wastewater flows and loading within the LOTT wastewater system.

• **Inflow and Infiltration Report –** uses dry and wet weather sewer flow monitoring results to quantify the amount of unwanted surface (inflow) and subsurface (infiltration) water entering the sewer system and to prioritize sewer line rehabilitation projects.

• **Capacity Assessment Report –** uses flows and loadings data and inflow & infiltration evaluation results to analyze system components (i.e. conveyance, treatment, and discharge), determine when limitations will occur, and provide a timeline for new system components and upgrades.

As each report is published, it will be posted on LOTT's website – www.lottcleanwater.org.

1. Introduction

The LOTT Clean Water Alliance flow monitoring program was initiated in 2003. In accordance with National Pollutant Discharge Elimination System (NPDES) Permit WA0037061, an inflow and infiltration (I&I) evaluation for all sub-basins within the LOTT system is required such that the entire system is evaluated once every seven years. The purpose of this program is to ensure permit compliance, characterize flows within the collection system, identify areas of concern for I&I, and aid in the prioritization of rehabilitation projects to reduce I&I. The program is also intended to fulfill requirements of the Intergovernmental Contract for Inflow and Infiltration Management and New Capacity Planning, originally dated March 27, 1995, as presented in Exhibit J to the LOTT Interlocal Cooperation Act Agreement for Wastewater Management by the LOTT Wastewater Alliance. The report includes an overview of the LOTT I&I program as well as the results and analysis of the monitoring program for the 2021/2022 monitoring period. The monitoring program has been in place for eighteen years.

Brown and Caldwell provides data quality assurance and control and assists in annual I&I analyses. LOTT has contracted with SFE Global NW to install flow monitors throughout the system (Table 1-1) and collect monitoring data. For 2021/2022, flow monitors include seven permanent monitoring sites and four pump station monitors.

This report covers the monitoring year 2021 through December 2022. The report is arranged as follows:

- Section 2 provides an overview of the program, including a summary monitoring program, and an inventory and assessment of the flow monitoring sites, equipment, and technology.
- Section 3 presents the results of the inflow and infiltration analyses.
- Section 4 summarizes the data collected in the new program and provides recommendations for the flow monitoring program.

2. Overview

Inflow is defined as surface water entering the sewer via manholes, flooded sewer vents, illicitly connected storm drains, basement drains, and by means other than groundwater. Inflow is usually the result of rain and/or snowmelt events. *Infiltration* is defined as groundwater that enters the sewer, usually through leaky sewer pipe joints, manholes, and service connections.

2.1 Program History

When the program was instituted in 2003, information on system-wide I&I was limited. I&I modeling was conducted on flows recorded at the Budd Inlet Treatment Plant (BITP) and then allocated across the system based upon assumptions involving the age of the pipe and a subjective assessment of flows measured at pump stations. A major goal of this program was to more accurately define the spatial distribution of I&I. This would help LOTT with capacity planning for both its collection system, as well as its treatment system, which includes both the BITP and the Martin Way Reclaimed Water Plant.

Another goal of this program was to assess changes in I&I over time, allowing LOTT to identify areas of concern and advise LOTT's partner jurisdictions of areas to focus remediation efforts.

The first 15 years of this program featured rotating flow monitoring stations. Typically, a rotating flow monitoring station was set up for one calendar year, allowing for assessment of base flow during the summer, and I&I during the winter. As part of the program a total of 73 sites were monitored. Some of these sites were less useful than others in the sense that the data they provided were limited, either due to low flows, pump station impacts, or geometrical oddities which compromised the flow measurement. Others were monitored by LOTT partners for specific, short-term purposes. A total of 54 sites, plus the three LOTT pump stations and the Tumwater Hixon Street flow monitoring site are incorporated into LOTT's system-wide I&I model.

Starting in 2018, the program has shifted to monitoring 11 permanent locations. The rotating flow monitoring sites served their purpose and allowed for detailed allocation of I&I across the 88 sewer basins. Presently, a smaller number of permanent sites provide for long term tracking of I&I. Periodically, temporary monitoring will be performed at certain locations which have shown signs of deterioration over the course of the program, or where the permanent meters suggest that an upstream assessment is warranted.

Figure 2-1 shows the locations of the eleven current flow meters, and Figure 2-2 shows their connectivity. Table 2-1 lists the flow monitoring sites included in this program and the associated tributary sewer basins measured by each site.

Figure 2-1. Location of the Permanent Flow Monitoring Sites

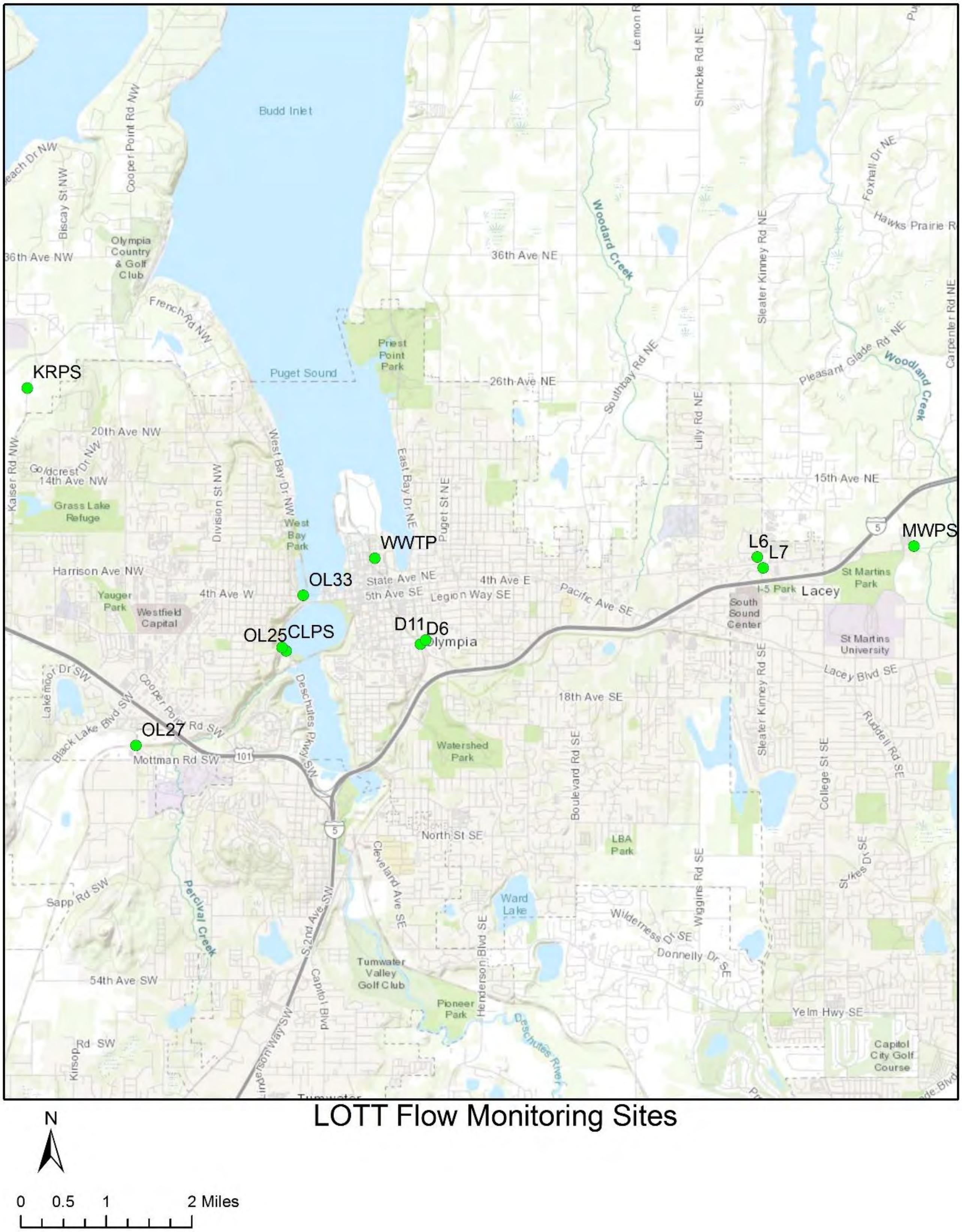
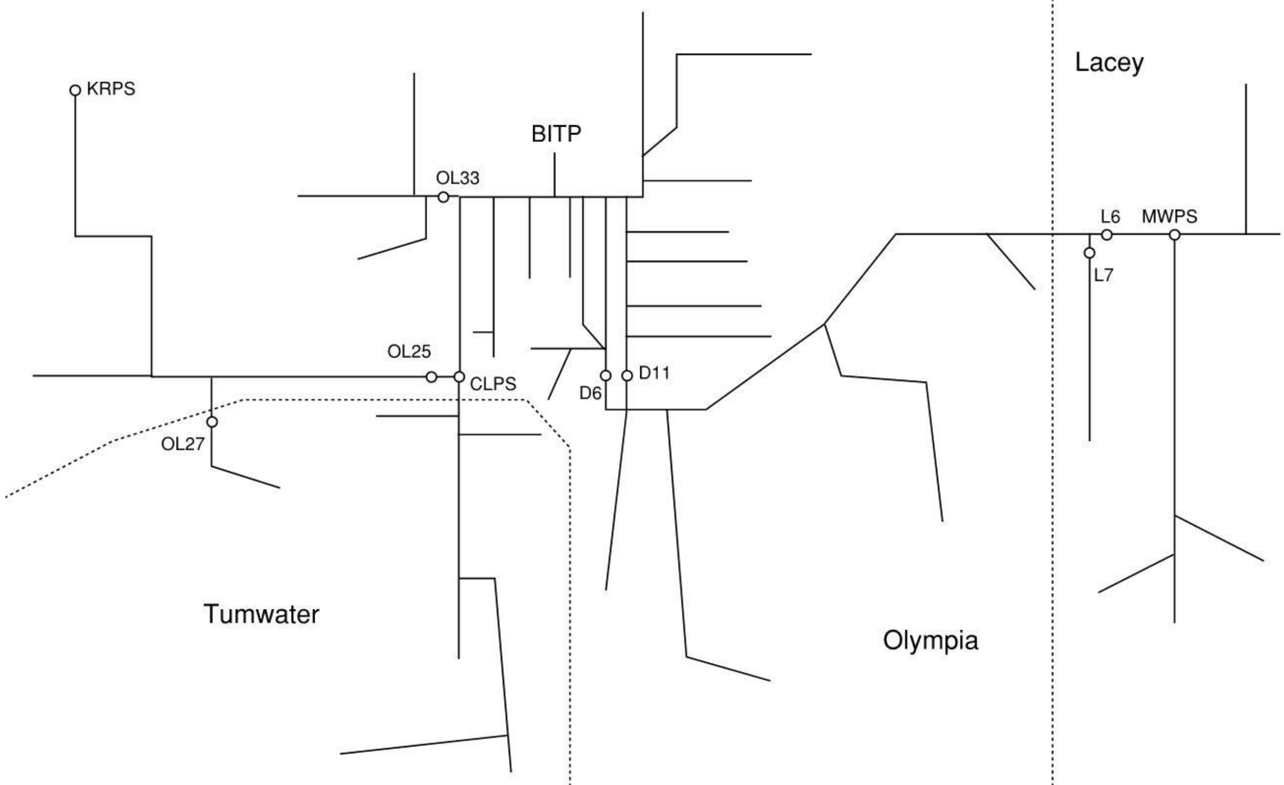


Figure 2-2. Connectivity of the LOTT Flow Monitoring Stations



Flows for each city were calculated using the seven permanent sites and four pump station sites as follows:

- Olympia = BITP – (OL27 + CLPS + L6 + L7) + OL25
- Tumwater = OL27 + CLPS – OL25
- Lacey = L6 + L7

Table 2-1. Flow Monitoring Sites, with Tributary Basins

Name	Manhole	Pipe Diameter	Location	Basins Served
OL25	MH70-246	30"	Private Drive off of Deschutes Parkway	54,55,57,58,64,65,66,67,68,69,70,71,TESC
OL33	SSMH9	24"	4th Avenue Bridge	56,59,60,61,62,63,
L6	MH70-200	30"	8468 Martin Way E. (Jack in the Box)	1,2,3,4,5,6,7,10,11,13,14,15,16,17
L7	MH70-205	24"	8503 Martin Way E. (Arco Station)	8,9,12
OL27	MH70-290	18"	Access Road East of Mottman Rd	69,70,71
D6	MH70-064	36"	1109 Plum St SE	These two pipelines are now connected, and combine to serve basins 1,2,3,4,5,6,7,8,9,10,11, 12,13,14,15,16,17,18,19,20,21,22,23,24,25,26, 27,28,42
D11	MH70-041	36"	Plum and Union Parking Lot	
MWPS			Martin Way Pump Station	1,2,3,4,5,6,7,10,11,13,15,16,17
CLPS			Capitol Lake Pump Station	54,57,58,64,65,66,67,68,69,71,72,73,74,75,76,78,79,80,81,82,83,85,86,TESC
KRPS			Kaiser Road Pump Station	54,TESC
WWTP			Budd Inlet Treatment Plant	1-22,24-54,56-69,71-76,78-83,85,86,TESC

2.2 Flow Measurement Methodology

The sewer flow monitoring sites installed by SFE Global consist of SFE Custom Compound Weirs or area-velocity meters. The SFE Weir is a variant of the V-notch type weir. Permanent flow monitoring sites feature a Lexan-bodied weir, while the rotating temporary sites contain weirs constructed of ¾-inch thick plywood. Flow was calculated by measuring the depth of water flowing over the weir, and then applying a rating curve, which was developed individually for each weir during installation and calibration. SFE Global maintains the sites on a monthly basis, during which time data is downloaded from on-site data logging equipment.

LOTT's Budd Inlet Treatment Plant (BITP) has both influent and effluent flow meters. The Martin Way Pump Station (MWPS) and Capitol Lake Pump Station (CLPS) have Doppler Ultrasonic, strap-on flow meters installed on the discharge piping. The Kaiser Road Pump Station (KRPS) monitors pump run-time, which is mathematically converted to gallons per minute (gpm) and ultimately to million gallons per day (mgd) ((GPM/60)*0.00144). These monitoring locations were integrated into the Budd Inlet Treatment Plant SCADA system in January 2005 and are now included in the I&I evaluation program.

2.3 Basin Summary

The 88 LOTT sewer basins were redefined as part of the 2014 Flows and Loadings Report based on sewer maps and basin realignments provided by the cities of Olympia, Lacey, and Tumwater. Seven basins are currently unsewered. Previously, of the sewered 81 basins, 27 were monitored with a single flow monitor located at a point downstream from all inputs into the basin, 32 were monitored by a flow monitor that gathers data from a group of several basins, and six were monitored individually with data gathered on the upstream and downstream ends of the basins, allowing for flow assessment by difference. I&I in the remaining basins was estimated through a system-wide regression model, which incorporated data from 58 temporary flow monitors and the four permanent flow monitors at the pump stations.

The current set of flow monitors is intended to track base flow and I&I in major interceptors. I&I in individual basins is estimated based on system connectivity and observations from the first 15 years of the flow monitoring program.

2.4 Flow Monitoring Site Summary

Table 2-2 lists attributes for the area served by each site monitored including the LOTT pump stations.

The equivalent residential units (ERU) values shown in Table 2-2 are based on 2021-2022 data and the inch-diameter-mile (IDM) values are based on 2021 data. IDM is a common way to express the relative size of a sewer system. It is calculated by multiplying the pipe length (in miles) by the pipe diameter (in inches).

Table 2-2. Flow Meter Basin Summary

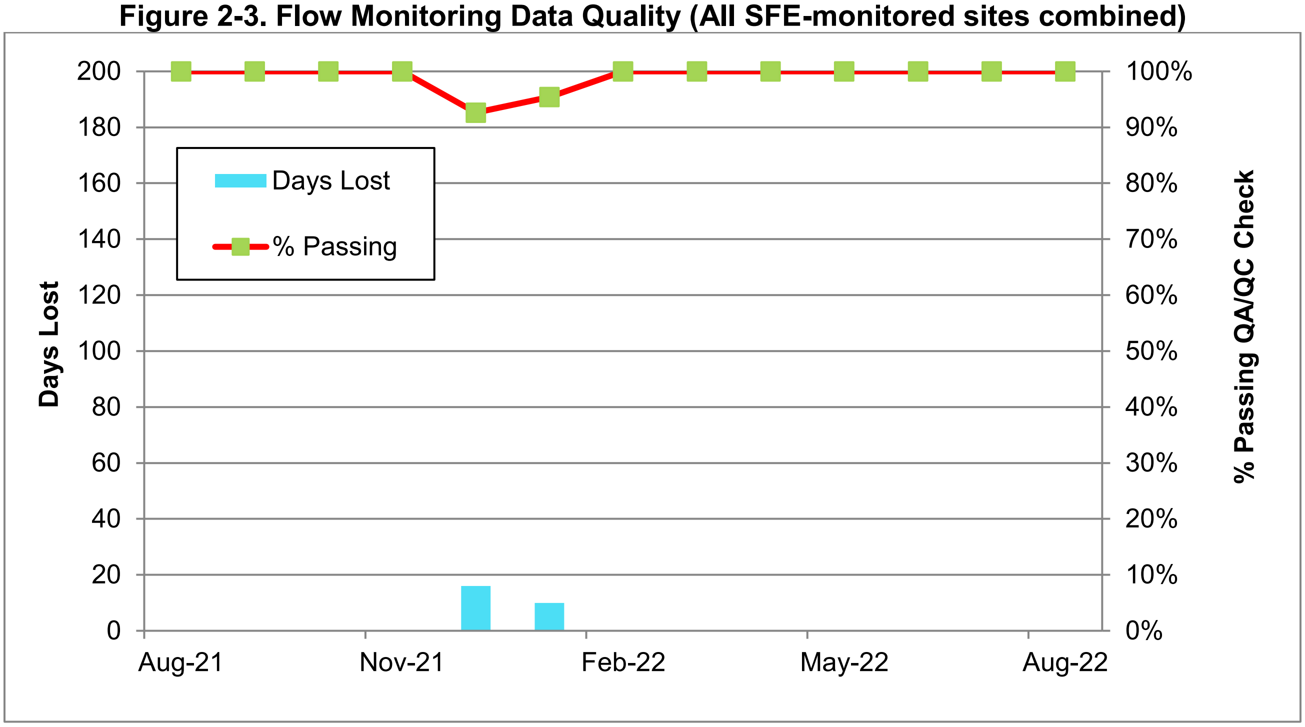
Flow Monitor	Sewered Residents	Sewered Employees	ERU[1]	IDM[2]	Acres	% Sewered
OL25	17,729	17,569	9,090	842	5,817	88%
OL33	8,067	2,848	3,549	269	1,475	84%
L6	47,319	18,041	22,081	1,870	19,315	58%
L7	6,964	7,386	3,919	243	1,141	88%
OL27	4,027	3,790	2,105	172	2,047	87%
D6 + D11	74,365	42,306	35,883	3,304	28,132	64%
MWPS	46,549	17,279	21,655	1,837	18,157	60%
CLPS	34,340	36,534	18,160	1,524	18,142	76%
KRPS	1,723	155	710	37	294	81%
WWTP	127,905	104,641	64,525	5,767	50,577	72%

1. ERU: Equivalent Residential Unit (see Flow and Loadings Report for more details)
2. IDM: Inch-diameter-mile of sewer pipe. The sum of each pipe segment of a particular diameter multiplied by its length (includes gravity and STEP sewers)

2.5 Flow Monitoring Data

SFE Global's contracted data quality objectives were met over 90% of the time during the 2021-2022 monitoring period. Figure 2-3 summarizes the flow monitoring reliability by showing the portion of flow data that was available and passed quality assurance checks each month.

Figure 2-3. Flow Monitoring Data Quality (All SFE-monitored sites combined)



2.6 Inflow and Infiltration Analysis

An I&I analysis was performed using the Capacity Assessment and Planning Environment (CAPE) modeling software, a wastewater forecasting and management tool provided by Brown and Caldwell. The record of observed flow data was plotted alongside a concurrent record of rainfall data. The model calculates flow based upon rainfall using a variety of hydrologic parameters. These parameters were calibrated until the model flows matched the observed flows over the period of record. Once calibrated, the model was applied to a long-term historical precipitation record (in this case, rainfall observed at the Olympia Regional Airport from 1955 to 2020). The long-term simulation produced risk-based estimates of the I&I flow over the full range of weather conditions contained in the historical rainfall record.

The CAPE calibration plot for the BITP is presented on Figure 2-4. This plot depicts flow monitored at the BITP (blue), rainfall (green), and modeled flow at the BITP (red). The model has been calibrated such that the modeled and observed flows match very closely.

Figure 2-4. BITP Model Calibration

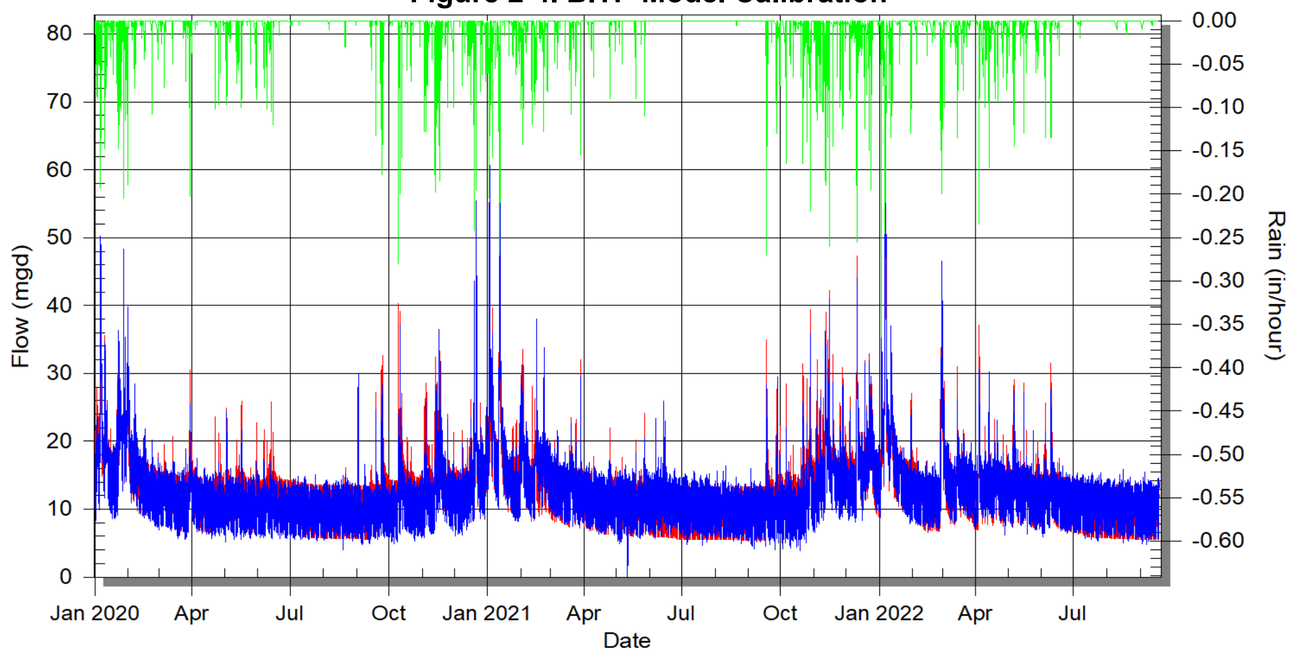
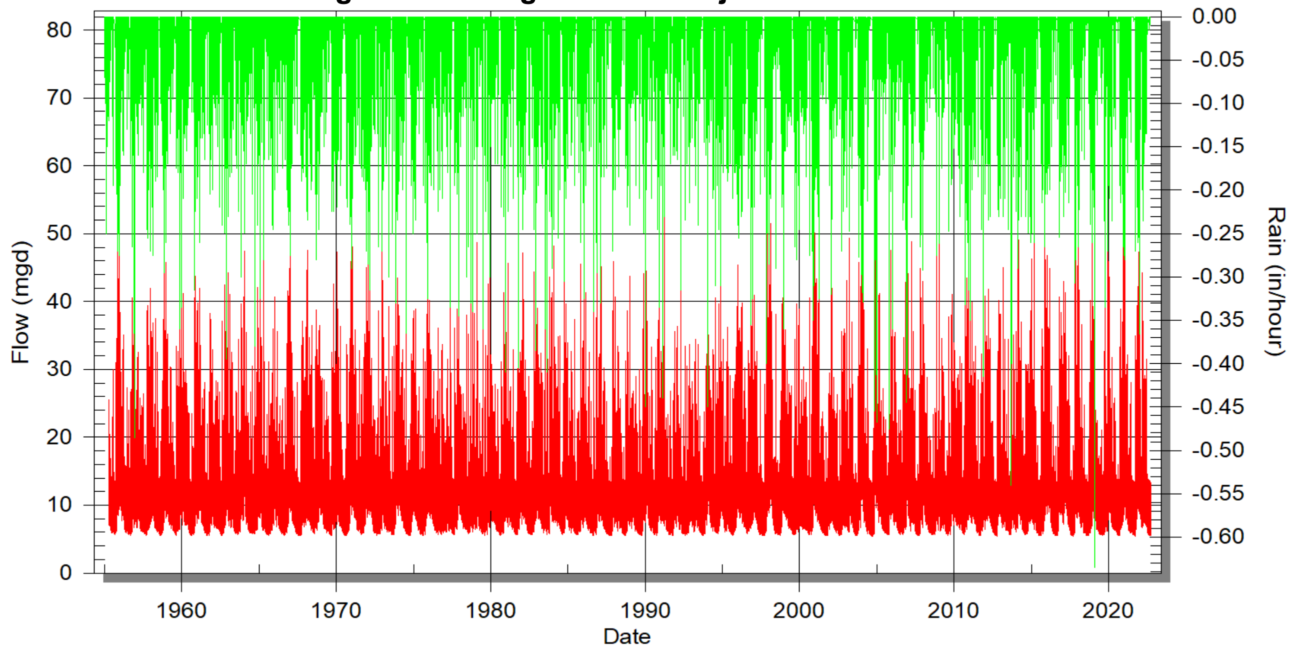


Figure 2-5 presents the model calibration from Figure 2-4 applied to the long-term precipitation record.

Figure 2-5. Long Term I&I Projection for the BITP



The calibration data in Figure 2-4 are used to calculate risk-based I&I estimates as shown in Figure 2.5. LOTT uses a 10-year return period as the basis of its peak flow projections. A 10-year peak flow carries a 10% risk of being surpassed in any given year.

The CAPE model was used to calculate risk-based I&I for each of the flow monitoring sites and combinations presented in Table 3-1. These data are presented and analyzed in the next section.

3. Flow Data Analysis

This section describes the results of the analysis conducted using the flow data collected during the 2021/2022 monitoring season.

3.1 Summary of I&I Statistics for All Flow Monitoring Sites

A summary of the I&I results for each of the flow monitoring sites is provided in Table 3-1. The estimates show the amount over the base sanitary flow resulting from inflow and infiltration.

Table 3-1. 2021-22 Flow Monitoring Sites Inflow and Infiltration Summary

Flow Monitor	Base Sanitary Flow (mgd)	Inflow and Infiltration (mgd)						
		Average Annual	10-year Peak Month	10-year Peak Day	10-year Peak Hour	Summer[1]	Shoulder[2]	Winter[3]
OL25	1.50	0.45	1.44	3.67	5.04	0.15	0.37	0.76
OL33	0.45	0.60	2.02	11.54	17.42	0.19	0.48	1.00
L6	2.60	0.23	0.63	2.05	4.49	0.09	0.20	0.37
L7	0.60	0.14	0.36	0.90	1.44	0.06	0.13	0.21
OL27	0.45	0.18	0.51	1.20	1.75	0.07	0.16	0.30
D6 + D11	5.00	0.25	0.64	3.57	6.20	0.10	0.22	0.38
MWPS	2.70	0.32	0.83	2.25	5.54	0.13	0.28	0.50
CLPS	2.65	0.81	2.38	6.45	8.14	0.28	0.68	1.32
KRPS	0.070	0.03	0.07	0.34	0.69	0.01	0.02	0.04
WWTP	10.30	3.21	9.94	34.63	57.31	1.08	2.65	5.32

1. Summer (June-September)
2. Shoulder (April, May, and October)
3. Winter (November-March)

3.2 Analysis of Inflow and Infiltration

There are a number of ways to assess the quality and integrity of the sewer system. Some of the most commonly used methods involve a calculation of I&I per inch-diameter-mile (IDM) of pipe, I&I per ERU, and the ratio of the peak hour flow to the base flow. The pipeline IDM calculations were updated in 2022 with geodata information received from the cities.

Statistics such as I&I per IDM are compared against benchmarks to determine the relative magnitude of I&I at each flow monitor, and within each sewer basin. The LOTT benchmarks were established in 2007, and represent the top 33rd percentile of I&I measures across all of the basins at that time. That is, two-thirds of the LOTT basins exhibited I&I parameters worse than these benchmarks in 2007.

Table 3-2. LOTT Sewer Basin I&I Benchmarks

Average Annual I&I per ERU	20	gpd/ERU
Peak Month I&I per ERU	50	gpd/ERU
Peak Day I&I per ERU	150	gpd/ERU
Peak Hour I&I per ERU	250	gpd/ ERU
Average Annual I&I per IDM	200	gpd/IDM
Peak Month I&I per IDM	500	gpd/IDM
Peak Day I&I per IDM	1,500	gpd/IDM
Peak Hour I&I per IDM	2,400	gpd/IDM
Peak Hour Flow to Base Flow Ratio	2.5	

I&I varies greatly between cities, and in different parts of the country. Arid locations often have very low levels of I&I, while areas near rivers may have very high I&I. There are relatively few nationwide or industry-standard benchmarks to offer a basis of comparison. EPA has established benchmarks for “excessive I&I”, at 1,500 gpd/IDM for dry weather flow, and 275 gpd/person for wet weather flow (given household sizes in the LOTT service area, the latter would equate to approximately 638 gpd/ERU). The LOTT benchmarks, intended to represent targets for a tight, relatively leak-proof system, are well below those levels.

Table 3-3 summarizes these statistics for each of the flow monitors.

Table 3-3. Summary of I&I Statistics

Flow Monitor	Annual Average I&I/ERU (gpd)	Peak Day I&I/ERU (gpd)	Peak Hour I&I/ERU (gpd)	Average Annual I&I/IDM (gpd)	Peak Day I&I/IDM (gpd)	Peak Hour I&I/IDM (gpd)	Peak Hour Flow/Base Flow (mgd)	Benchmark Ratio[1]
OL25	50	404	555	537	4,363	5,987	4.4	2.65
OL33	168	3,251	4,907	2,213	42,917	64,788	39.7	17.62
L6	10	93	203	123	1,098	2,401	2.7	0.74
L7	36	229	368	573	3,685	5,940	3.4	2.07
OL27	87	569	831	1,068	6,956	10,164	4.9	4.28
D6 + D11	7	100	173	75	1,081	1,876	2.2	0.58
MWPS	15	104	256	172	1,225	3,018	3.1	0.92
CLPS	44	355	448	529	4,232	5,341	4.1	2.38
KRPS	38	473	967	723	9,102	18,627	10.8	4.08
WWTP	50	537	888	557	6,006	9,938	6.6	3.30
Benchmark[2]	20	150	250	200	1,500	2,400	2.5	1.0

1. The benchmark ratio is the average value of seven ratios, corresponding to the first seven columns of the table (starting with average annual I&I/ERU and ending with the peak hour flow/base flow). The value in this table is divided by the benchmark. For example, the benchmark ratio at site OL25 is the average of the following values: {50/20; 404/150; 555/250; 537/200; 4,363/1,500; 5,987/2,400; 4.4/2.5} = 2.65.
2. I&I benchmarks established in the 2007 LOTT Inflow and Infiltration Report.

Table 3-4. Summary of I&I Statistics (Cities)

City	Annual Average I&I/ERU (gpd)	Peak Day I&I/ERU (gpd)	Peak Hour I&I/ERU (gpd)	Average Annual I&I/IDM (gpd)	Peak Day I&I/IDM (gpd)	Peak Hour I&I/IDM (gpd)	Peak Hour Flow/Base Flow (mgd)	Benchmark Ratio[1]
Olympia	84	1,013	1,701	823	9,897	16,616	9.5	5.6
Tumwater	48	355	434	630	4,652	5,676	4.0	2.5
Lacey	14	113	228	175	1,396	2,808	2.9	0.9
System	50	537	888	557	6,006	9,938	6.6	3.3
Benchmark	20	150	250	200	1,500	2,400	2.5	1.0

For existing pipe, the amount of I&I will vary widely depending on the age of pipe, local maintenance standards, and most importantly, the degree of sewer separation (i.e. whether downspouts are strictly disconnected or whether any sewer to storm pipe cross-connections exist) during the original design of the collection system. Benchmark values for the cities did not change from last year's analysis.

3.3 Site Assessments

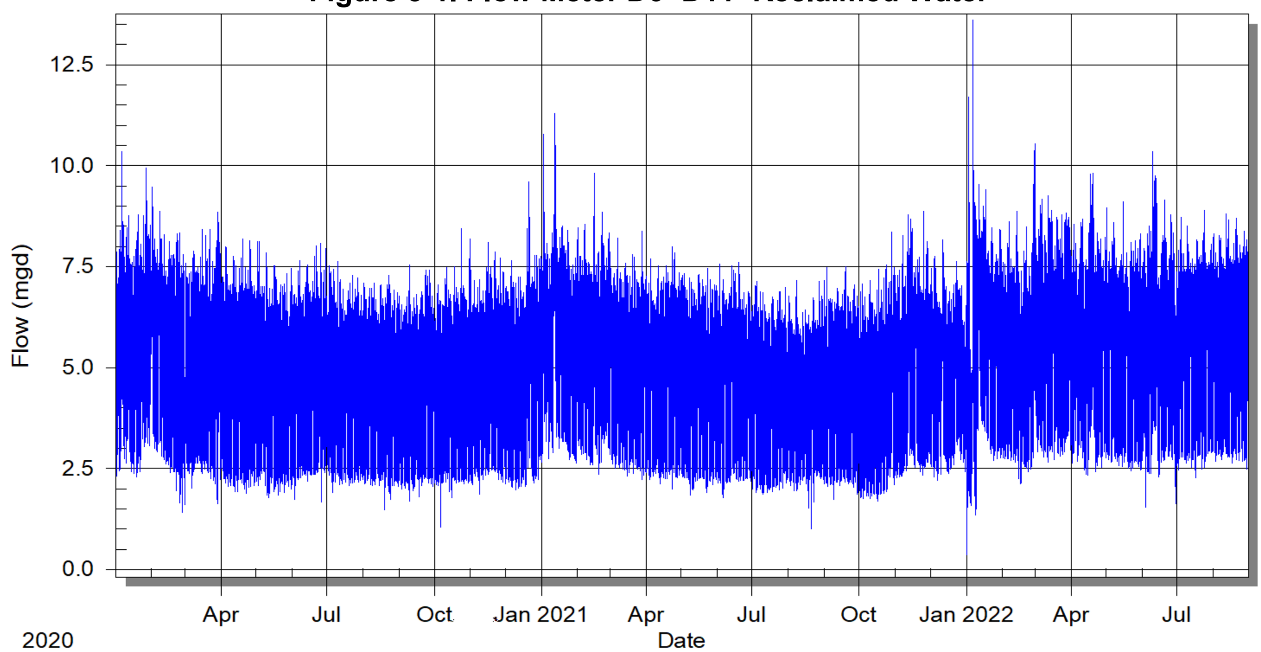
The following sections discuss the flow records and I&I model results at each site.

3.3.1 Sites D6 and D11

Flow from the Indian Creek Interceptor (all of Lacey and southeast Olympia) is mostly directed to the Cherry Street Interceptor, which is monitored at site D6. The Plum Street Interceptor is located nearby, conveying flow from Henderson Street and the North Avenue Basin in Southern Olympia. The Plum Street Interceptor is monitored at site D11. There is a 12" overflow connection which allows a small portion of flow from the Indian Creek Interceptor to flow into the Plum Street Interceptor. Because of this interconnection, flows from sites D6 and D11 cannot be considered separately.

Site D6 takes most of the flow, with a base flow averaging 3.4 mgd, compared to 0.65 mgd at site D11. Figure 3-1 shows the combined flow, plus the flow treated at the MWRWP, which comprised the full flow generated within the tributary basins.

Figure 3-1. Flow Meter D6+D11+Reclaimed Water



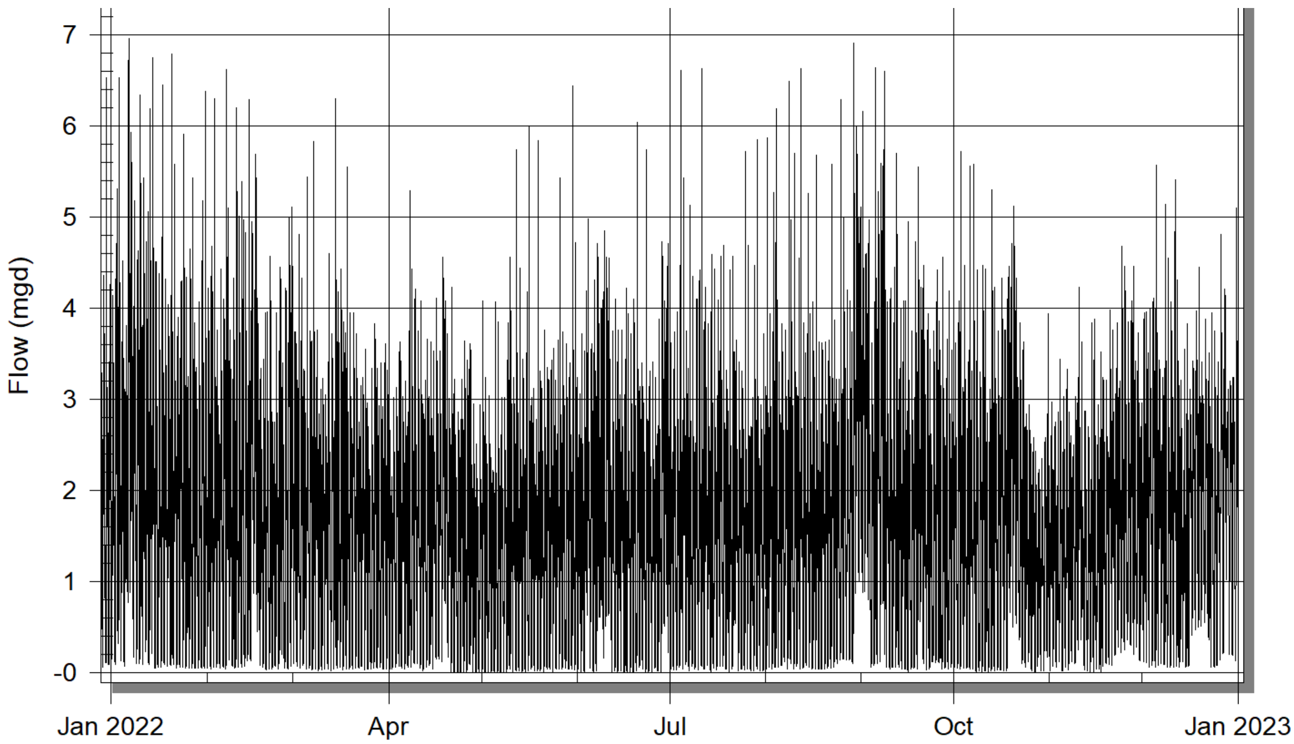
There is relatively little I&I in these basins, with an overall benchmark ratio of 0.58.

3.3.2 Site L6

The flow monitor at site L6 measures flows generated in east Lacey. This site's benchmark ratio is 0.7, indicating a tight sewer system with low I&I.

The flow record on Figure 3-3 features frequent spikes, much of which is related to weekend versus weekday peaking (weekend peak flows are 20-30 percent higher than weekday peak flows). Flow peaks are often rainfall-independent, and regular diurnal peaks are typically higher than rainfall-derived peaks.

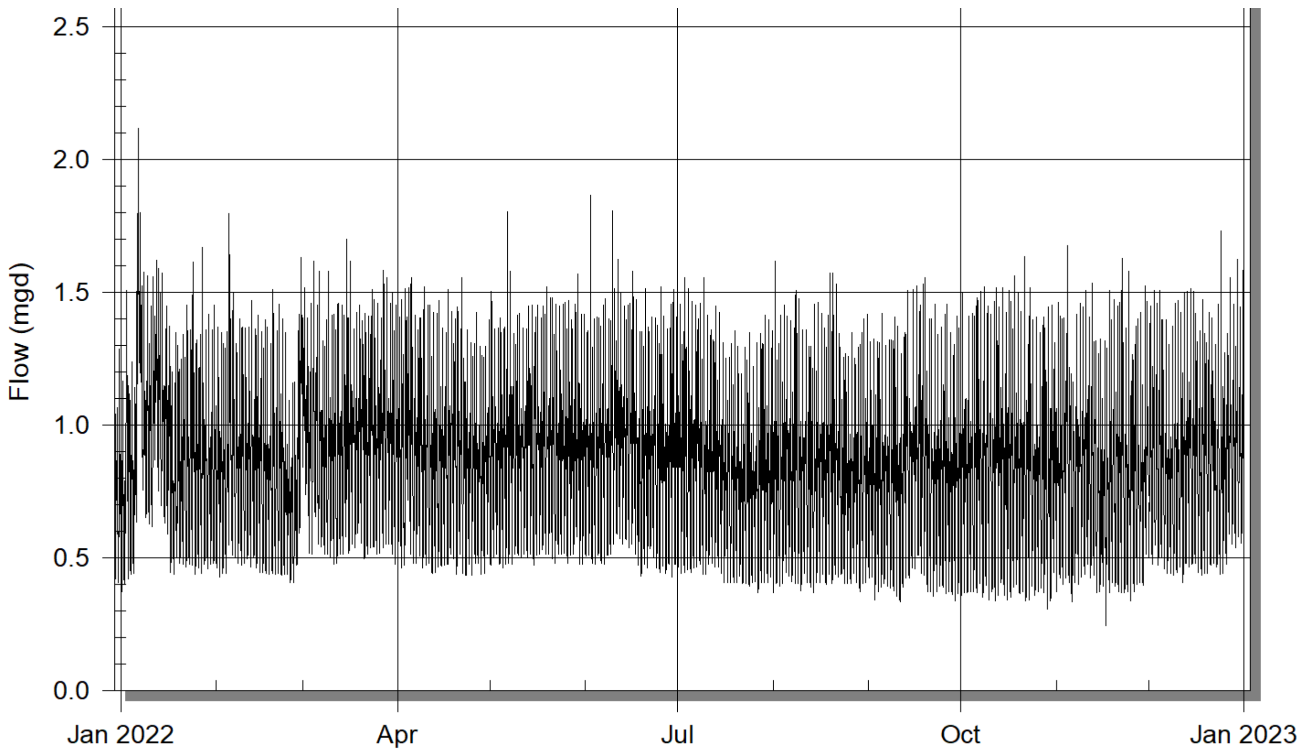
Figure 3-3. Flow Meter L6



3.3.3 Site L7

The flow monitor at site L7 measures flow generated in south Lacey. The benchmark ratio for this site is 2.1, higher than L6 but less than the overall system average of 3.3. The benchmark ratio for L7 did not change from last year. This area of Lacey exhibits a substantial amount of I&I, strongly correlated to precipitation.

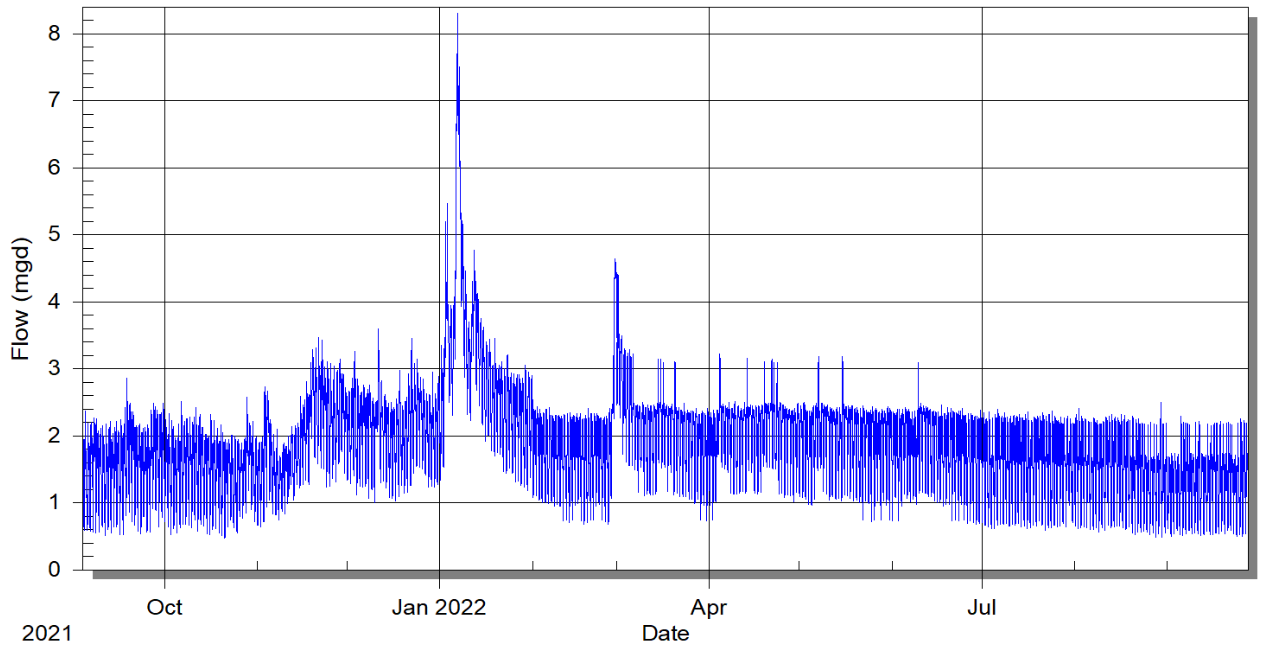
Figure 3-4. Flow Meter L7



3.3.4 Site OL25

Site OL25 monitors flow generated in west Olympia and northern Tumwater. The flow monitor is located on the Percival Creek Interceptor upstream of the Capitol Lake Pump Station. The benchmark ratio remained relatively unchanged at 2.6.

Figure 3-5. Flow Meter OL25

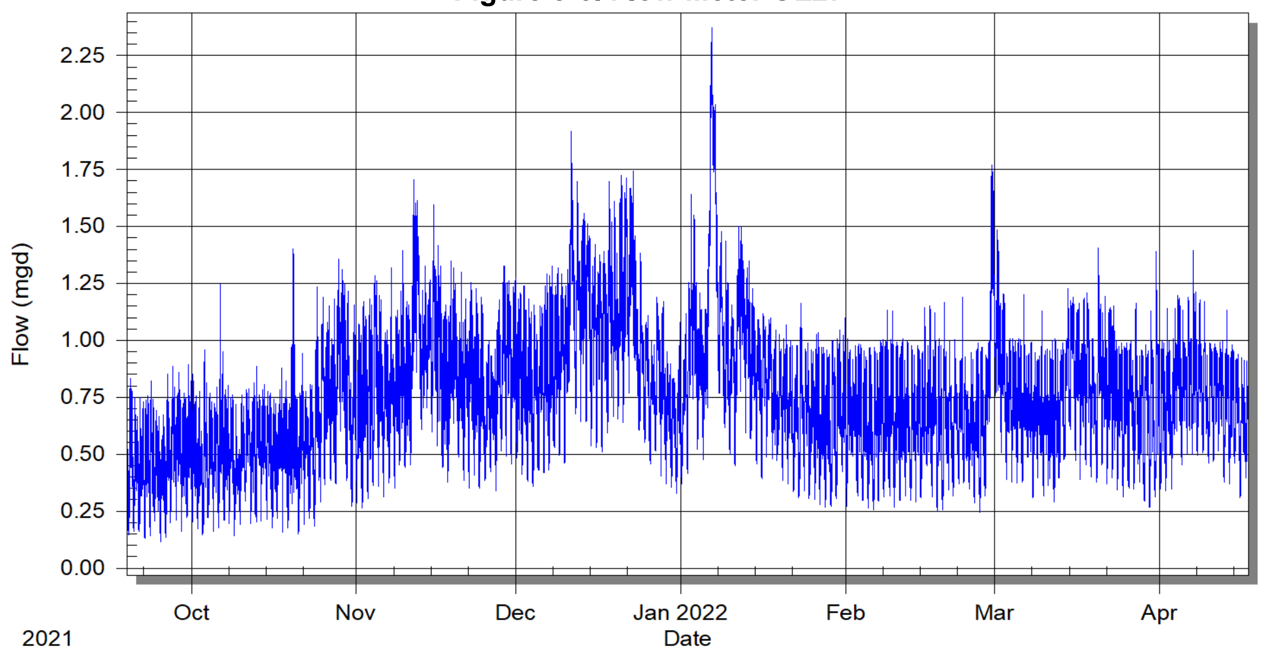


3.3.5 Site OL27

OL27 measures flow from Tumwater on the downstream end of the Mottman Road Interceptor. Site OL27's benchmark ratio increased slightly to 4.3. Given that this site monitors flow generated in the Mottman Industrial Zone, it is likely that some of what is being classified as I&I is actually point source flow from local industry. Seasonal contributions from South Puget Sound Community College also complicate the I&I calculation in this basin.

The flow pattern at this site is unusual, in that weekend flows are 10-20 percent lower than weekday flows. This reflects the commercial / industrial nature of the basin. I&I in this basin is rainfall-dependent, with little evidence of rainfall-independent peaking. Scatter related to the industrial flows makes this basin particularly difficult to model, however the January 2022 storm event resulted in a clear, rainfall-dependent peak flow of nearly 2.5 mgd.

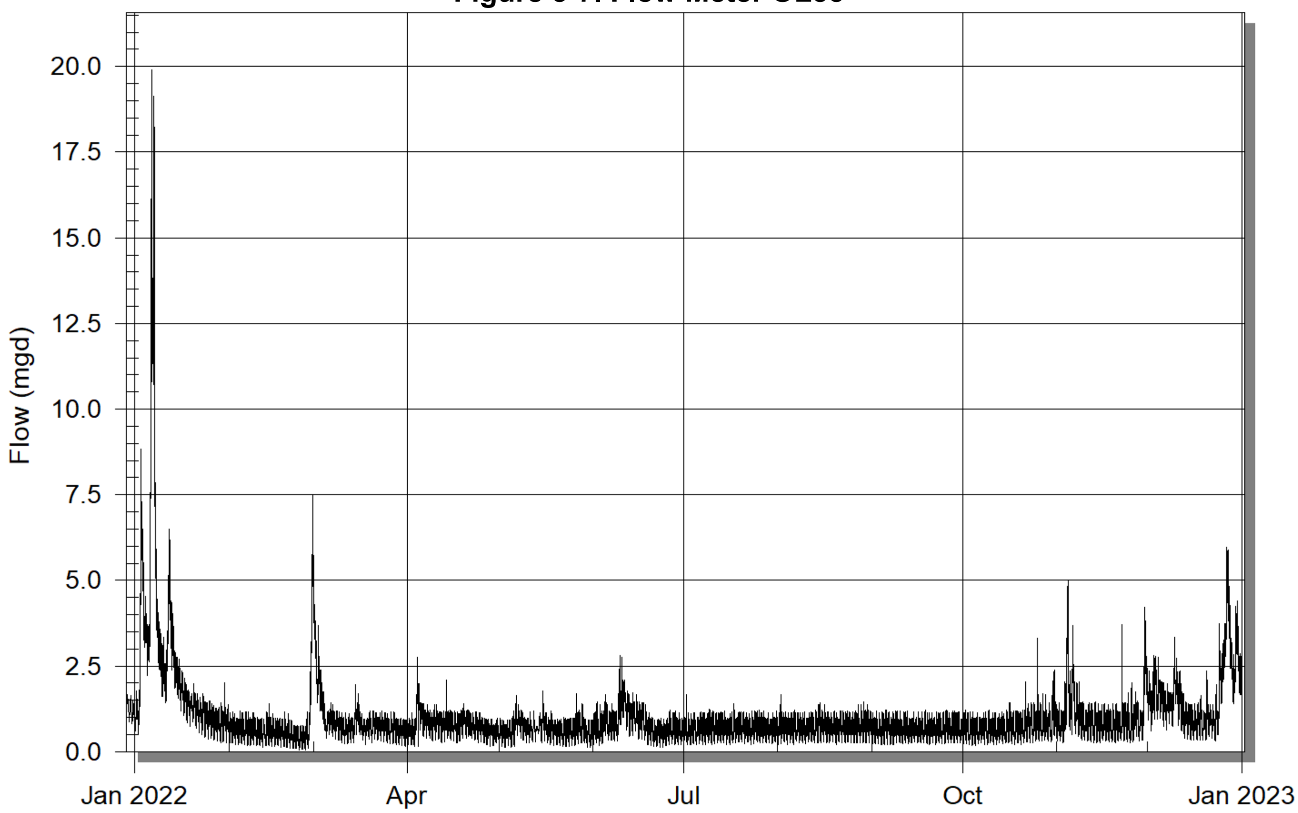
Figure 3-6. Flow Meter OL27



3.3.6 Site OL33

The OL33 flow meter is located at the 4th Avenue Bridge and measures flow from northwest Olympia. The benchmark ratio at this site was relatively unchanged from the previous year at 17.6. This site historically has recorded high levels of I&I related to older clay pipes on the West Side. Flow during the January, 2022 storm event peaked close to 20 mgd.

Figure 3-7. Flow Meter OL33



3.3.7 System-Wide

The system-wide I&I is largely a known quantity. Projections tend to vary slightly from year to year, which reflects some of the sensitivity of the model to variables such as groundwater which vary independently, or at least on a larger time scale, from I&I. In the big picture, system-wide I&I appears to be trending slightly upward, which is what one would expect as the service area expands and infrastructure ages. Figures 3-8 and 3-9 plot the system-wide I&I over the last 19 years.

Figure 3-8. System-wide I&I Trends

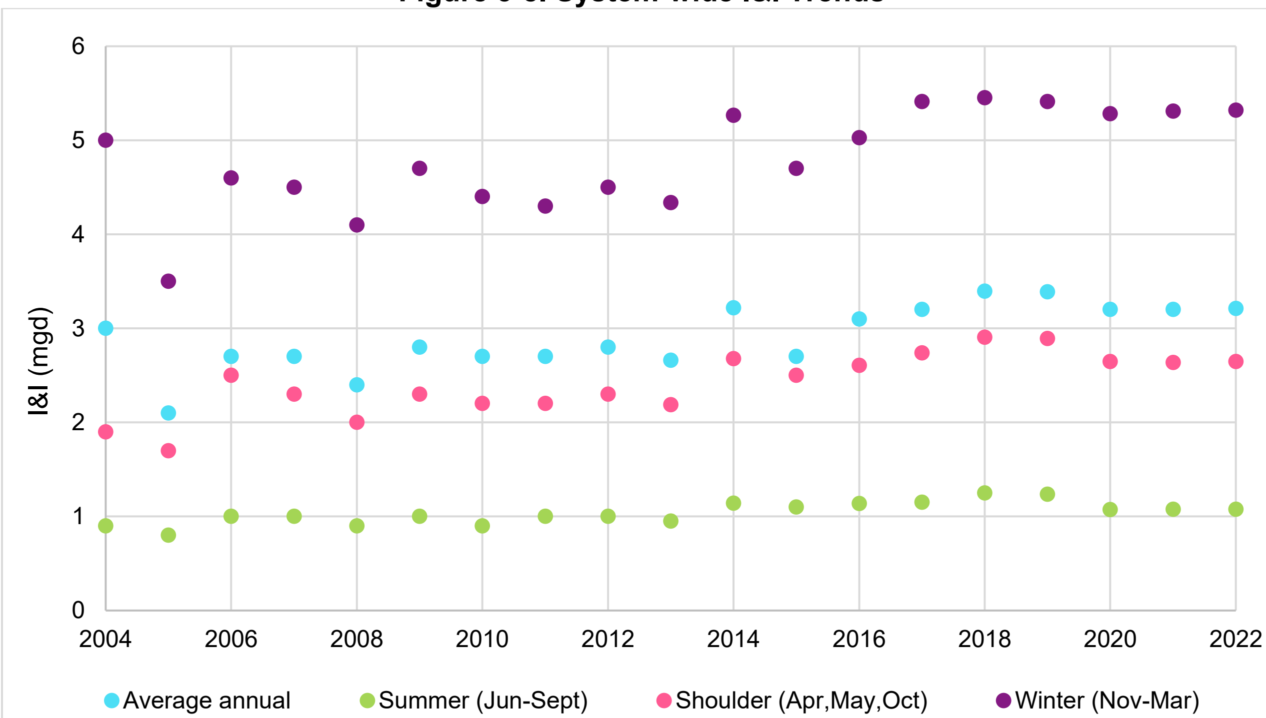
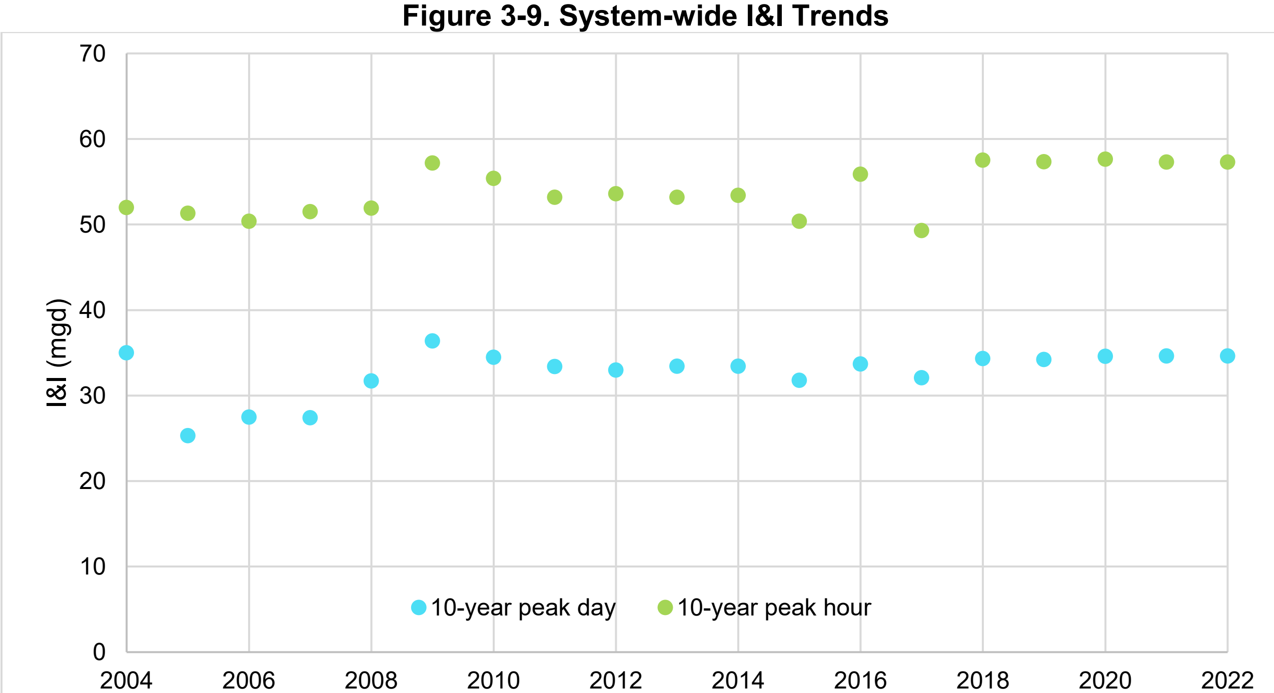


Figure 3-9. System-wide I&I Trends



3.3.8 Updated I&I Model

The previous 15 years of rotating flow meters established a breakdown of how much I&I each sewer basin contributed to the whole city. The current position of flow meters strategically measures flow from each city. Using the previous modeling efforts and I&I approximations, individual basin I&I can be estimated from the total city I&I. Inflow and infiltration estimates for each flow meter are translated to basin I&I estimates by first calculating the percentage of I&I each basin contributes to each city. This percentage is then applied to this year's flow measurements resulting in an estimate of I&I from each basin. Table 3-5 summarizes the basin I&I statistics.

Table 3-5. Basin I&I (gpd)

Basin	City	Location	Average Annual	Peak Month	Peak Day	Peak Hour	Summer (6,7,8,9)	Shoulder (4,5,10)	Winter (Nov-Mar)
1	L	Hawks Prairie	97,695	249,460	820,106	1,376,608	40,901	99,209	164,597
2	L	Meridian	17,498	55,593	166,833	320,942	9,668	21,441	32,113
3	L	Meadows	11,080	15,492	29,429	72,856	1,977	6,411	13,182
4	L	Lacey STEP	11,080	14,405	29,429	72,856	3,130	9,649	13,182
5	L	SE Corner	11,080	14,330	29,429	72,856	1,757	3,626	12,288
6	L	Horizon View	2,740	26,704	129,060	481,761	2,451	3,526	7,009
7	L	Ruddell	2,740	36,776	129,060	309,665	2,064	5,401	7,009
8	L	S Chambers Lake	15,019	66,359	226,951	497,443	3,976	9,886	26,203
9	L	N Chambers Lake	25,789	57,830	191,259	498,300	10,686	20,659	36,066
10	L	Lacey Blvd	13,925	42,891	246,378	540,024	4,791	11,083	21,640
11	L	Lacey Confluence	18,430	49,279	106,965	231,757	7,515	15,859	26,956
12	L	South Sound Center	85,277	235,655	450,297	718,832	33,117	67,370	133,569
13	L	St. Martins	11,080	15,619	29,429	72,856	4,283	9,584	13,182
14	L	Chinook	9,897	13,267	26,906	61,824	4,637	7,038	9,643
15	L	Britton Pkwy.	12,275	39,219	112,475	193,351	6,177	13,813	22,859
16	L	N Tanglewilde	12,275	26,834	112,475	180,079	3,802	6,630	22,859
17	L	S Tanglewilde	12,275	27,841	112,475	230,453	3,326	13,444	22,859
18	O	Motel 8	17,864	55,183	75,602	113,589	4,985	13,630	31,949
19	O	Lilly Rd.	17,864	55,183	75,602	113,589	4,985	13,630	31,949
20	O	South Bay Rd.	859	1,233	1,347	1,477	923	1,130	1,165
21	O	Fones	82,454	261,000	541,546	709,348	30,825	75,053	148,605
22	O	Boulevard	20,240	63,098	82,626	89,737	11,227	24,790	42,974
23	O	Wiggins	-	-	-	-	-	-	-
24	O	Indian Summer	8,704	19,919	98,569	179,936	4,375	8,616	15,254
25	O	South Boulevard	19,099	58,088	88,995	123,003	7,899	17,743	33,993
26	O	Henderson	8,704	33,514	98,569	150,099	3,182	8,196	15,254
27	O	North St.	27,486	87,106	360,906	677,975	10,285	24,700	48,748
28	O	Indian Creek	8,302	27,841	72,431	112,351	2,980	7,423	15,243

Basin	City	Location	Average Annual	Peak Month	Peak Day	Peak Hour	Summer (6,7,8,9)	Shoulder (4,5,10)	Winter (Nov-Mar)
29	O	SE Downtown	98,554	274,464	386,471	580,653	31,271	75,938	151,343
30	O	Priest Point	214,927	395,027	850,227	1,277,421	45,008	109,295	217,823
31	O	San Francisco	151,426	525,253	1,520,142	2,179,020	53,036	132,754	277,559
32	O	NE Downtown	7,837	41,584	420,014	2,055,585	2,557	3,780	14,954
33	O	Bigelow	28,008	81,233	221,654	313,420	11,832	26,378	47,738
34	O	Puget St.	5,961	17,843	154,276	313,331	1,793	4,107	8,198
35	O	Bigelow Springs	5,961	17,843	154,276	313,331	1,793	4,107	8,198
36	O	State Ave.	5,961	17,931	155,467	315,699	1,888	4,196	8,283
37	O	Lybarger	7,837	30,425	402,056	609,454	2,065	8,085	14,954
38	O	4th Ave. E	11,329	39,260	175,161	348,779	4,028	9,982	20,694
39	O	5th Ave. E	7,837	48,953	489,281	739,427	2,655	7,455	14,954
40	O	Pear	13,465	40,278	348,042	706,889	4,153	9,375	18,594
41	O	Plum	138,928	495,167	1,627,998	2,434,387	48,353	119,056	249,445
42	O	I-5 Interchange	6,945	25,452	141,677	421,109	2,623	7,376	15,363
43	O	Stevens Field	60,766	230,589	1,592,044	4,085,080	21,039	53,242	109,703
44	O	S Capitol 24th	14,188	43,827	260,335	599,715	3,110	23,453	27,982
45	O	S Capitol 22nd	8,075	60,644	451,256	1,324,163	888	5,011	17,260
46	O	S Capitol 17th	16,488	33,186	292,903	642,780	8,929	11,884	18,299
47	O	State Capitol	15,626	59,840	292,903	587,553	9,230	13,041	27,773
48	O	N Capitol Campus	15,722	50,043	266,519	347,009	3,511	9,360	26,096
49	O	State Offices	22,423	80,062	448,144	937,227	8,162	20,077	40,966
50	O	Central Downtown	100,094	333,272	1,728,359	3,780,732	37,011	89,276	178,561
51	O	Sylvester	126,604	431,492	2,817,149	5,028,119	49,507	117,507	228,866
52	O	Heritage Park	122,816	500,920	2,694,616	3,164,822	11,012	52,697	265,306
53	O	Port Peninsula	13,465	40,278	348,042	706,889	4,153	9,375	18,594
54	O	Cedrona	9,556	20,547	36,610	60,521	5,432	7,885	12,092
55	O	Westwood	-	-	-	-	-	-	-
56	O	Old Port	78,640	265,081	742,463	966,842	30,121	73,190	146,257
57	O	Cooper Point	57,618	184,077	302,280	424,079	9,267	47,366	106,280
58	O	Goldcrest	41,636	124,479	268,545	412,442	4,833	22,263	52,422
59	O	West Bay	16,531	62,944	139,800	210,042	3,145	12,510	33,764
60	O	West Side	52,061	167,666	705,160	1,059,466	15,076	55,560	72,671
61	O	Jefferson	238,565	855,178	2,468,334	3,157,011	98,031	221,809	415,593
62	O	Harrison	17,809	84,083	469,853	705,929	5,655	14,428	33,830
63	O	Decatur Woods	51,963	178,682	517,305	683,653	18,864	46,251	95,442
64	O	Grass Lake	38,570	44,948	148,506	223,123	5,121	12,436	24,785
65	O	West Olympia	2,729	7,595	13,295	24,538	1,115	2,076	4,143

Basin	City	Location	Average Annual	Peak Month	Peak Day	Peak Hour	Summer (6,7,8,9)	Shoulder (4,5,10)	Winter (Nov-Mar)
66	O	Capital Mall	36,777	144,948	420,464	507,866	7,612	27,618	54,118
67	O	Percival Creek	15,012	72,128	202,023	258,854	3,845	15,753	28,551
68	O	Ken Lake	106,958	349,377	767,241	810,842	40,460	94,111	195,731
69	O	Mottman	91,582	303,151	655,944	757,293	22,790	72,501	163,262
70	T	N Black Lake	-	-	-	-	-	-	-
71	T	Sapp	212,463	523,795	1,145,045	1,276,831	97,138	197,277	349,515
72	T	Tumwater Hill	124,042	362,522	1,118,328	1,273,950	38,971	100,895	196,799
73	T	E Street	7,991	22,605	57,757	60,968	2,873	6,245	13,791
74	T	H Street	6,426	20,155	47,682	59,585	2,466	4,931	11,195
75	T	Barnes Lake	17,089	52,942	117,403	149,641	6,320	14,046	27,278
76	T	NE Tumwater	32,314	86,096	207,824	310,601	11,112	27,234	49,596
77	T	Tumwater Valley	164	477	1,340	1,776	52	135	259
78	T	Southgate	92,182	232,836	726,344	1,034,811	31,179	79,397	137,687
79	T	Trosper	3,604	10,490	43,921	53,942	2,577	2,960	5,700
80	T	Littlerock	7,409	20,801	60,951	105,675	2,565	6,221	11,876
81	T	Tumwater City Hall	6,841	24,658	88,889	103,527	1,846	5,109	10,937
82	T	Trails End	6,841	24,658	88,889	103,527	1,846	5,109	10,937
83	T	Hwy 99	6,841	24,658	88,889	103,527	1,846	5,109	10,937
84	T	Airport	-	-	-	-	-	-	-
85	T	S Airport	6,841	24,658	88,889	103,527	1,846	5,109	10,937
86	T	Kimmie	6,841	24,658	88,889	103,527	1,846	5,109	10,937
87	T	Salmon Creek	-	-	-	-	-	-	-
88	T	Black Lake	-	-	-	-	-	-	-
TESC		The Evergreen State College	15,903	50,350	121,357	182,333	3,975	9,402	24,295

3.3.9 I&I Benchmarks and Basin Ranking

The intergovernmental agreement which established the LOTT I&I program includes a non-degradation clause. Based upon this clause, LOTT will annually evaluate I&I in each of its sewer basins. If the amount of I&I in a basin is found to be significantly increasing, LOTT and its partners will prioritize work in that basin to remedy the situation. In order to provide a measure which can be tracked on an annual basis, LOTT established its I&I benchmarks in 2007 (Table 3-2).

Each city served by LOTT is compared with the benchmark in each of the nine categories. A benchmark average is then calculated, which provides a representation of how each city compares to the benchmark. Table 3-6 compares the last three years of benchmarks for Olympia, Tumwater, Lacey, and the system as a whole.

Table 3-6. City Benchmarks

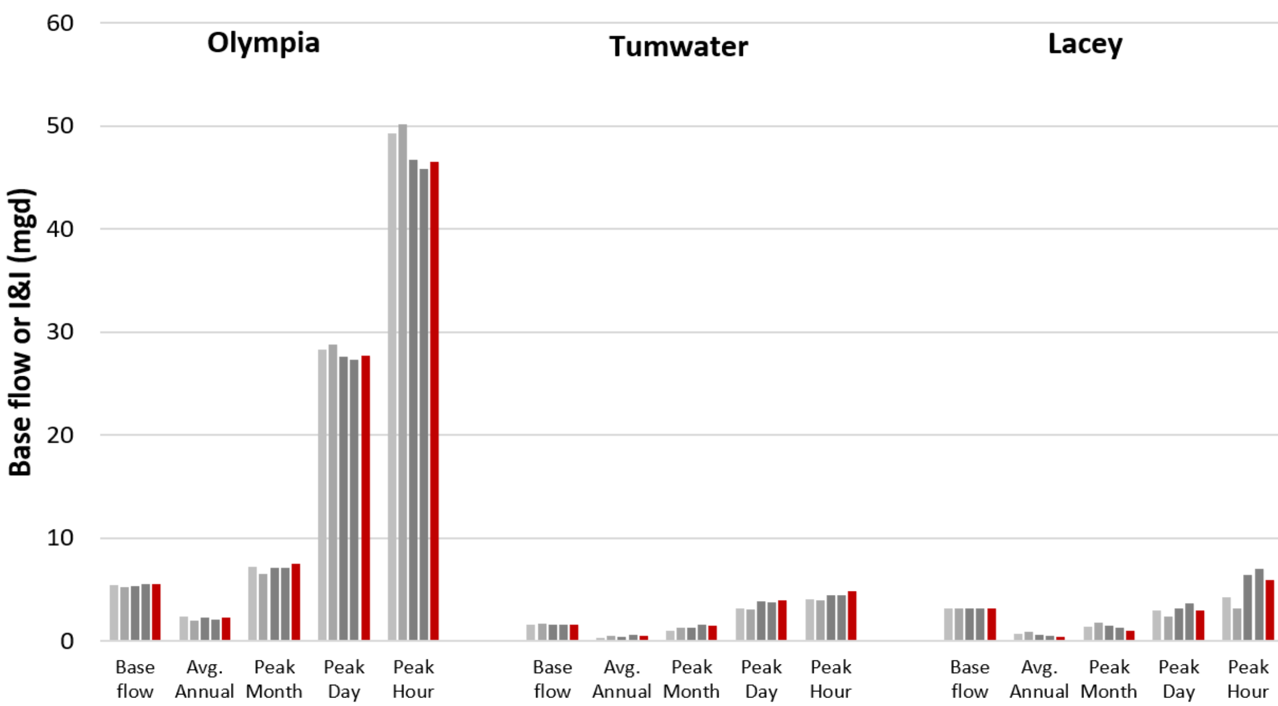
Flow Monitor	2015	2016	2017	2019	2020	2021	2022
Olympia	5.9	6.0	6.4	5.4	5.4	5.4	5.6
Tumwater	2.2	2.1	2.3	2.2	2.2	2.6	2.5
Lacey	0.9	1.0	1.2	1.1	1.1	1.1	0.9
System	3.5	3.5	3.8	3.3	3.3	3.3	3.3

Overall, the system benchmark ratio was 3.3, which is the same as the previous year's average. Overall, the benchmarks remained relatively unchanged since last year's analysis.

3.3.10 Comparison of base flow and I&I from 2021 to 2022

Figure 3-10 compares the city-wide flows and I&I projections.

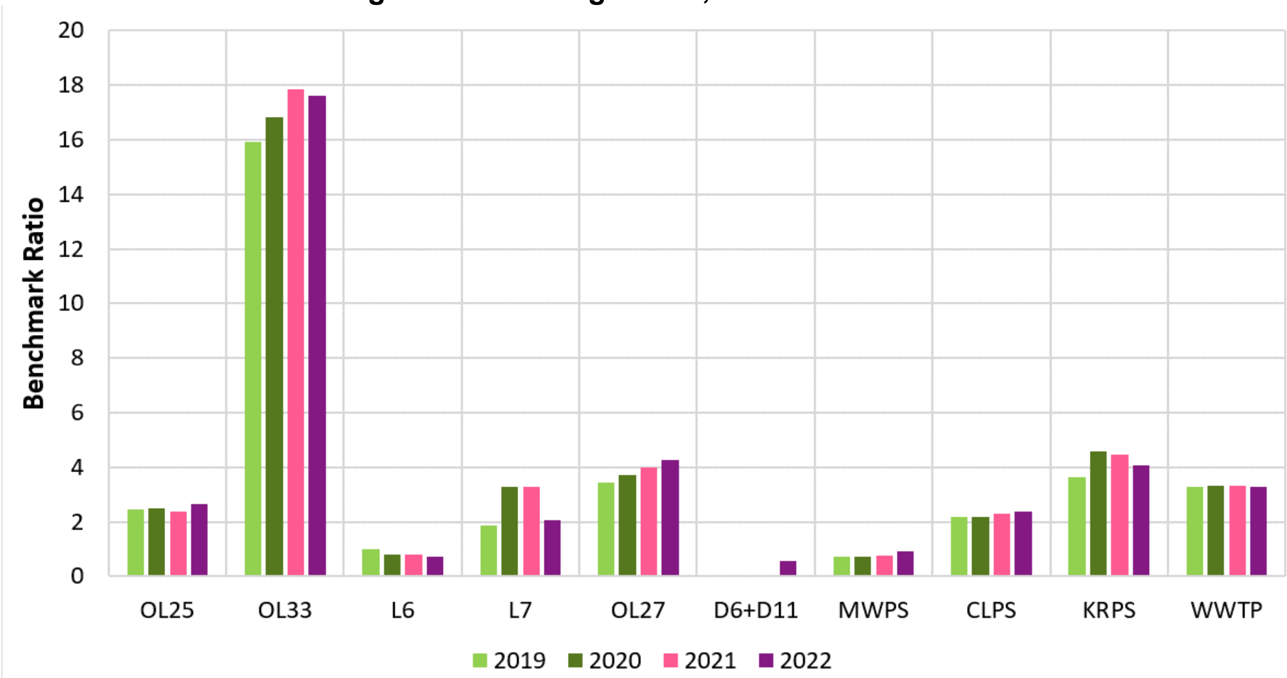
Figure 3-10. City-wide base flow and I&I comparison, 2021 to 2022



The year-to-year changes from city to city were relatively small. Total I&I recorded in the three cities remains stable.

Figure 3-11 presents the change in the I&I benchmark ratio between the 11 specifically monitored sites between 2019 and 2022.

Figure 3-11. Change in I&I, 2022 versus 2021



I&I benchmarks have remained stable at most sites. Overall, the 2022 analysis was very similar to 2021 indicating the amount of I&I is relatively stable. Trends of increased I&I at sites OL33 and OL27 will need to be monitored.

3.3.11 Analysis

This section provides analysis of flows at selected sites, particularly those which exhibited changes from previous reports, or those which experienced notable events.

MWPS

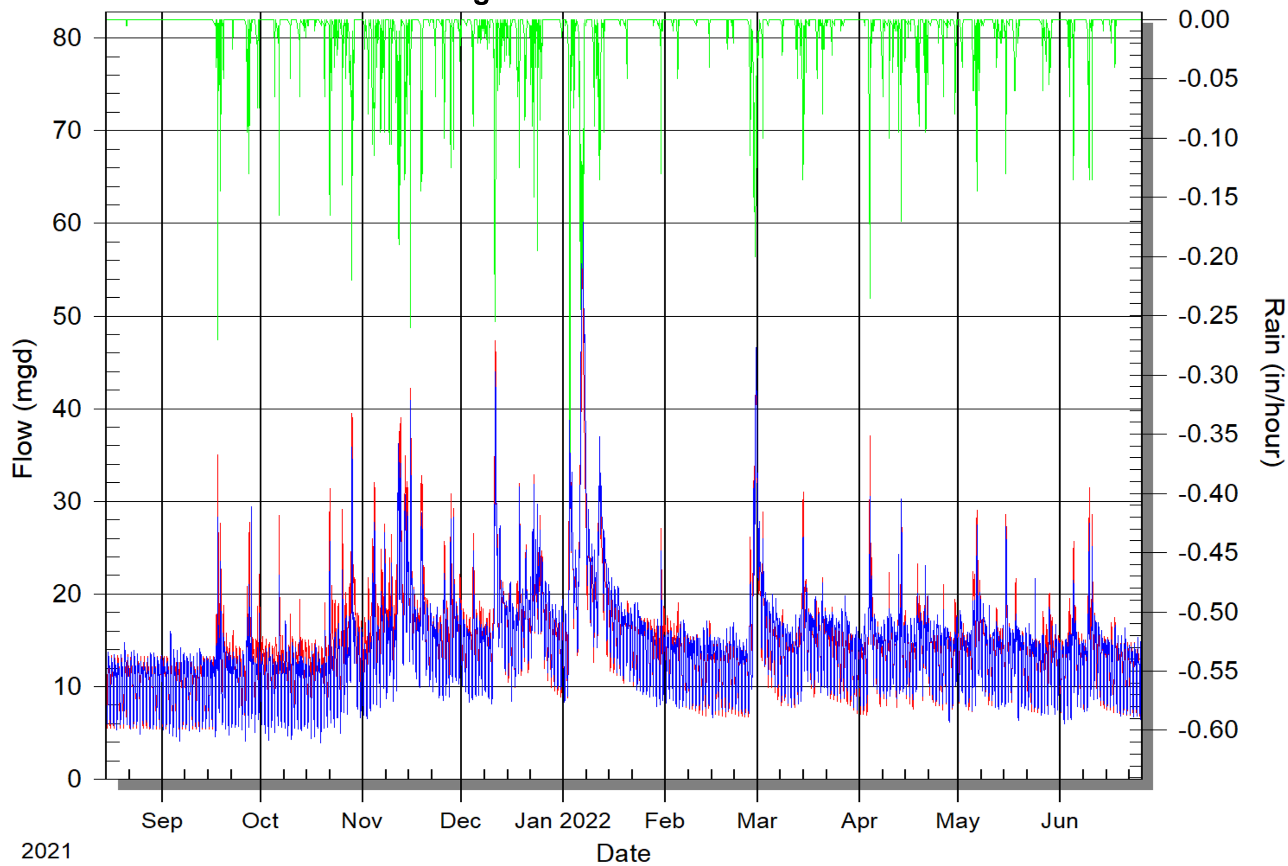
The 2020 I&I Report included an extensive analysis of I&I at the MWPS. The conclusion was that both rainfall-induced I&I and rainfall-independent peaking contribute to peak flows at this location. Rainfall-independent peaking is generally associated with operation of fill-and-draw lift stations, and the likelihood of multiple upstream pump stations pumping at the same time. An analysis of 10 years of historical data determined that the peak hour flow at the MWPS was approximately 6.3 mgd, as measured in both February 2019 and October 2015—periods with high rainfall totals.

Since that time, several more large flow events have been confirmed at the MWPS. These include a flow of 8.3 mgd on 1/23/22, and a flow of 6.2 mgd on 2/28/22. A peak hourly flow of 8.3 mgd is being used to project pump station flows into the future.

WWTP

The I&I pattern at the BITP tends not to vary much from year to year. The model fit remains very good. The model slightly underestimated the January 2022 event but overestimated some of the smaller peaks in late 2021 and the spring of 2022.

Figure 3-16. WWTP I&I Model



OL33

The peak hour I&I at site OL33 remained steady at close to 11 mgd, with a slight reduction in the benchmark ratio to 17.6. Peak flows of 20 mgd have been observed at this location. This site is challenging to model, as attempts to fit the largest peaks invariably cause the model to overestimate small peaks. This is corrected by calibrating the model to reflect more typical flows, and then manually adjusting the peaks.

4. Conclusions and Recommendations

1. I&I benchmarks in the three cities are very similar to those reported in last year's report.

2. While the trend of increasing I&I at site OL33 has stabilized, this should continue to be tracked, as this site represents a large portion of the total peak I&I generated in the system.

LOTT

CAPACITY REPORTS 2023

FLOWS & LOADINGS

I&I/FLOW MONITORING

CAPACITY ASSESSMENT

2022 Capacity Assessment Report

May 2023

Prepared by:
Adam Klein and Hannah McLean, Brown & Caldwell
Tyle Zuchowski, LOTT Clean Water Alliance

PREFACE

The Capacity Assessment Report is one of three related documents that are part of the annual process to monitor and evaluate capacity in the entire LOTT system. The intent, under LOTT's Wastewater Resource Management Plan (also known as the Highly Managed Plan), is to assure that needed new capacity is brought on-line "just in time" to meet system needs. Capacity needs evaluated include wastewater treatment, Budd Inlet discharge, reclaimed water use/recharge, and conveyance capacity in the entire LOTT system. These three reports are prepared annually and are used to help identify capital projects for inclusion in the annual Capital Improvements Plan.

Flows and Loadings Report – analyzes residential and employment population projections within the Urban Growth Area and estimates the impact on wastewater flows and loading within the LOTT wastewater system.

Inflow and Infiltration Report – uses dry and wet weather sewer flow monitoring results to quantify the amount of unwanted surface (inflow) and subsurface (infiltration) water entering the sewer system and to prioritize sewer line rehabilitation projects.

Capacity Assessment Report – uses flows and loadings data and inflow and infiltration evaluation results to analyze system components (i.e., conveyance, treatment, and discharge) to determine when limitations will occur, and provide a timeline for new system components and upgrades.

As each report is published, it will be posted on LOTT's website – www.lottcleanwater.org.

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Executive Summary

For the 2022 Capacity Assessment Report, updated flows and loadings projections, along with inflow and infiltration and flow monitoring data, were used to evaluate the current and projected capacity limitations within the LOTT system. The flow projections are slightly lower compared to previous years' reports and the loading projections are slightly higher. Overall, however, the changes are fairly small, with most projections are within 10-15% of the previous set of projections.

Much of the capacity discussion is centered on the Budd Inlet Treatment Plant's (BITP) National Pollutant Discharge Elimination System (NPDES) Permit, which limits discharge to a fixed load of biological oxygen demand (BOD) and total inorganic nitrogen (TIN) in pounds per day. The more the treatment plant can reduce its effluent concentration of BOD and TIN, the more flow it can discharge to Budd Inlet. Construction is complete for the Biological Process Improvements project, which is intended to improve LOTT's ability to consistently attain target effluent BOD and TIN levels.

Effective operational capacity equals the minimum combination of treatment, discharge, and conveyance capacity. Discharge capacity analysis considers two modeled flow projections – average flows and 10-year-return peak flows. All three seasonal conditions (summer, shoulder, and winter) were taken into account, with the summer and shoulder conditions being the most limiting. The first limitations are projected to occur as early as 2025, or as late as 2038. The range is due to the fact that although the newly renovated secondary process is performing well, it will be necessary to operate the system over several years to establish a firm understanding of performance levels. This report discusses how LOTT aims to meet capacity limitations.

Since the previous capacity assessment, LOTT has completed major planning initiatives that provide new updated information to consider as part of the overall system capacity analysis. Completion of the Reclaimed Water Infiltration Study in 2022 showed that the practice of using Class A reclaimed water for groundwater recharge is safe and responsible. That information and the associated cost/benefit analysis regarding future options for higher levels of treatment helped to inform the master planning effort, which was completed in early 2023. In addition, BITP hydraulic modeling and design progress for the future centrate handling facility upgrade offer insights and opportunities to manage capacity needs into the future.

Based on the 2050 Master Plan and updated projections, it is estimated that LOTT may need up to 10 million gallons a day (mgd) of additional discharge capacity by 2050. The plan identifies new opportunities to significantly expand capacity at the BITP through enhanced tertiary treatment. Capacity needs would also be met in part through expansion of reclaimed water production, reuse, and recharge at LOTT's existing reclaimed water facilities. These and other findings from the recently completed Master Plan will be incorporated into future iterations of the annual capacity assessment report.

1. Introduction

1.1 Purpose

In accordance with the Wastewater Resource Management Plan, LOTT is continuously monitoring system demands and planning for future capacity on a “just in time” basis. The primary purpose of this document is to evaluate system capacity requirements based on projected demands and identify and evaluate capital improvement projects to meet these requirements.

1.2 Current and Projected Flows and Loadings

For this report, county-wide population projections developed in 2018 by the Thurston Regional Planning Council (TRPC) were used. Updated projections are expected to be released in the fall of 2023. The projections include residential population estimates for the years 2018, 2020, 2025, 2030, 2035, and 2040. The 2022 Flow and Loadings report compiled these data along with drinking water consumption data from the past three years, and flow monitoring data to update the flows and loadings projections. LOTT’s service area includes the urban growth areas (UGAs) of Lacey, Olympia, and Tumwater.

Figure 1-1. LOTT Service Area by Jurisdiction

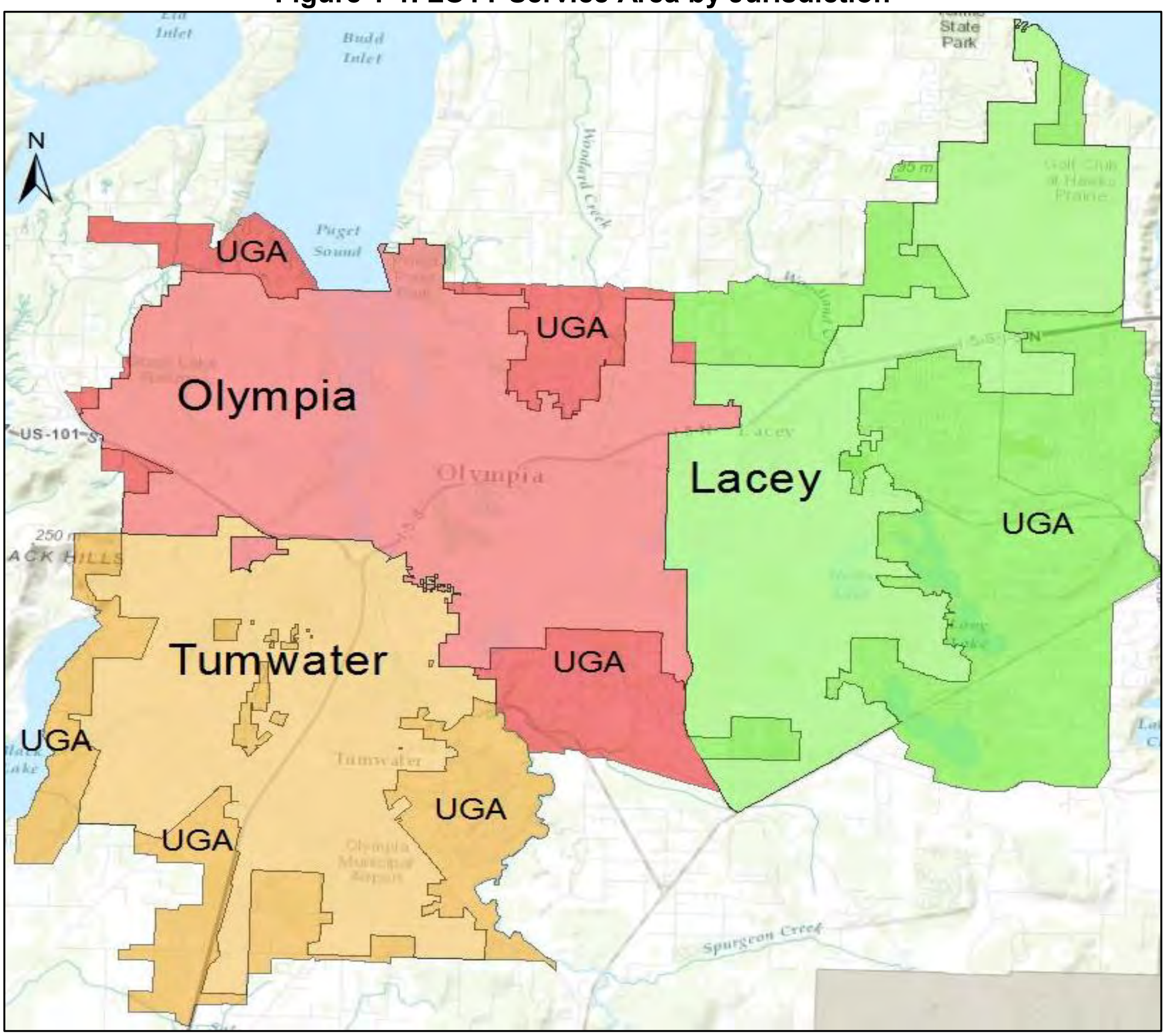


Figure 1-2 compares the projected base sanitary flows against projections from the past few years. The base sanitary flow is defined as the minimum average flow registered over a 7-day period in each year and is assumed to have little influence from inflow and infiltration. For additional details on per capita wastewater generation rates, refer to the 2021 Flows and Loadings Report.

Figure 1-2. Base Sanitary Flow Projection Comparison

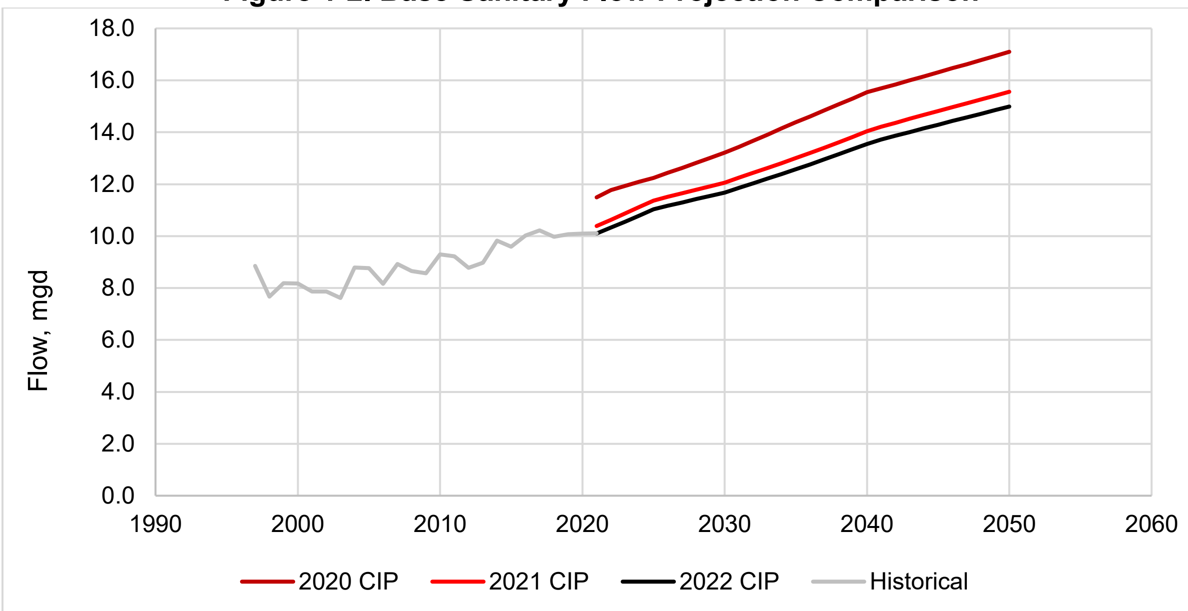


Figure 1-3 presents the projected biological oxygen demand (BOD) and total suspended solids (TSS) loadings in the LOTT service area through 2050. These loading rates are calculated by multiplying the projected sewer populations by the per capita loading rates.

Figure 1-3. Projected Loadings

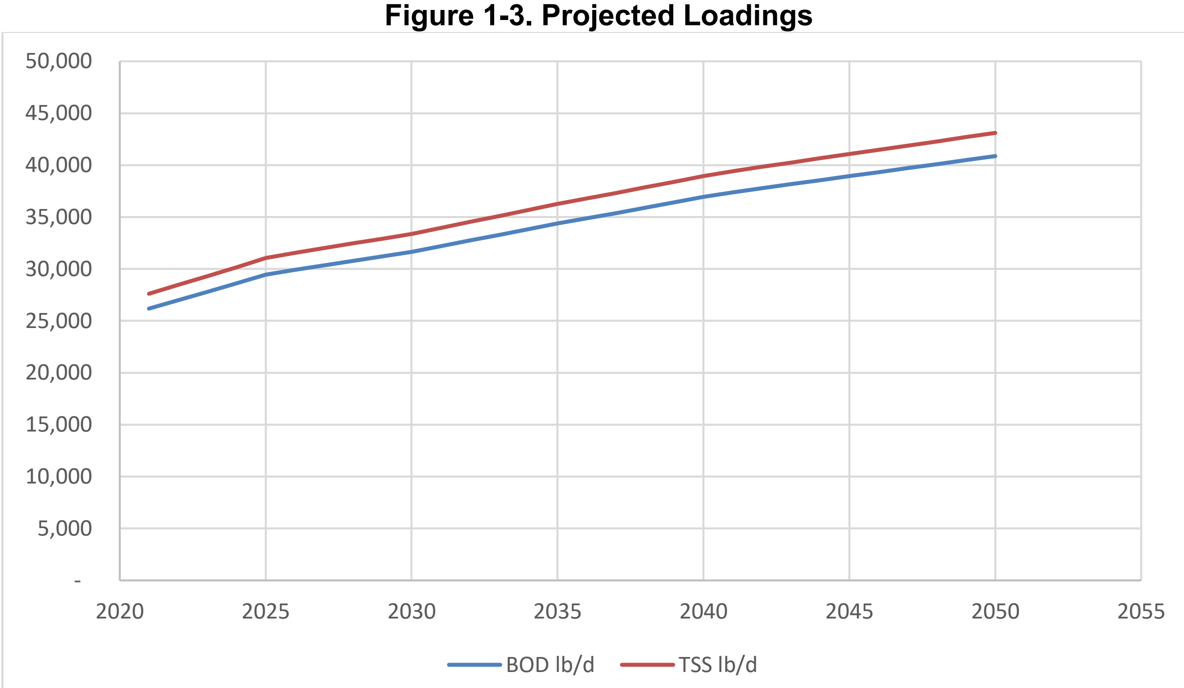


Table 1-1 lists the projected flows generated in the LOTT service area in millions of gallons per day (mgd). The summer and shoulder compliance periods represent the average monthly values. The 10-year peak values are based on the 10-year return period flows. In any given year, there would be a 10% chance of averaging the projected flow for each period.

Table 1-1. LOTT Service Area Projected Flows (mgd)

Year	Base Sanitary Flow	Annual Average	Peak Month (10-year)	Peak Day (10-year)	Peak Hour (10-year)	Summer[2]	Shoulder[1]	Winter[3]
2023	10.55	13.81	20.61	45.59	68.65	11.65	13.24	15.94
2024	10.79	14.06	20.90	45.95	69.15	11.89	13.49	16.20
2025	11.03	14.32	21.19	46.33	69.65	12.13	13.75	16.47
2026	11.17	14.48	21.36	46.55	69.96	12.28	13.90	16.63
2027	11.30	14.61	21.51	46.75	70.23	12.41	14.03	16.77
2028	11.42	14.75	21.67	46.95	70.50	12.54	14.17	16.91
2029	11.55	14.89	21.82	47.15	70.77	12.67	14.30	17.05
2030	11.68	15.02	21.98	47.35	71.05	12.80	14.44	17.19
2031	11.86	15.22	22.20	47.65	71.46	12.99	14.64	17.40
2032	12.04	15.41	22.42	47.93	71.84	13.17	14.83	17.60
2033	12.21	15.61	22.63	48.21	72.23	13.36	15.02	17.79
2034	12.39	15.80	22.85	48.50	72.63	13.54	15.21	17.99
2035	12.57	15.99	23.07	48.79	73.03	13.72	15.40	18.20
2036	12.76	16.20	23.31	49.11	73.48	13.92	15.61	18.41
2037	12.95	16.41	23.55	49.43	73.93	14.12	15.82	18.63
2038	13.15	16.63	23.80	49.76	74.40	14.32	16.03	18.85
2039	13.35	16.85	24.05	50.10	74.87	14.53	16.25	19.08
2040	13.55	17.07	24.31	50.44	75.35	14.74	16.47	19.31
2041	13.72	17.25	24.51	50.71	75.73	14.91	16.65	19.50
2042	13.86	17.41	24.69	50.95	76.07	15.06	16.81	19.66
2043	14.01	17.57	24.87	51.19	76.40	15.21	16.96	19.83
2044	14.15	17.72	25.05	51.42	76.72	15.36	17.11	19.99
2045	14.29	17.87	25.22	51.65	77.04	15.50	17.27	20.15
2046	14.43	18.03	25.40	51.88	77.36	15.65	17.42	20.30
2047	14.57	18.18	25.57	52.11	77.68	15.79	17.57	20.46
2048	14.71	18.33	25.74	52.34	78.00	15.93	17.72	20.62
2049	14.85	18.48	25.92	52.57	78.32	16.08	17.87	20.78
2050	14.99	18.64	26.09	52.80	78.63	16.22	18.02	20.93
Full Sewering	20.44	24.45	32.51	60.84	89.26	21.80	23.80	26.90

1. June, July, August, and September
2. April, May, and October
3. November, December, January, February, and March

1.3 Operational Capacity

LOTT considers three types of capacity when describing operational capacity – treatment capacity, discharge/use capacity, and conveyance capacity. Treatment capacity is defined as the amount of wastewater that can be treated within permit limitations. Discharge/use capacity is a combination of the amount of treated wastewater that can be discharged into the environment within permit limitations (i.e. Budd Inlet outfall), the amount of Class A reclaimed water that can be infiltrated into the ground (i.e. Hawks Prairie Ponds and Recharge Basins), and the amount of Class A reclaimed water that can be utilized for other beneficial uses (i.e. reclaimed water customers). Conveyance capacity represents the hydraulic capacity of both: 1) sewer lines to convey wastewater from the point of collection to the point of treatment; and 2) reclaimed water lines to convey Class A reclaimed water from the point of treatment to the point of discharge/use.

2. Budd Inlet Treatment Plant Capacity

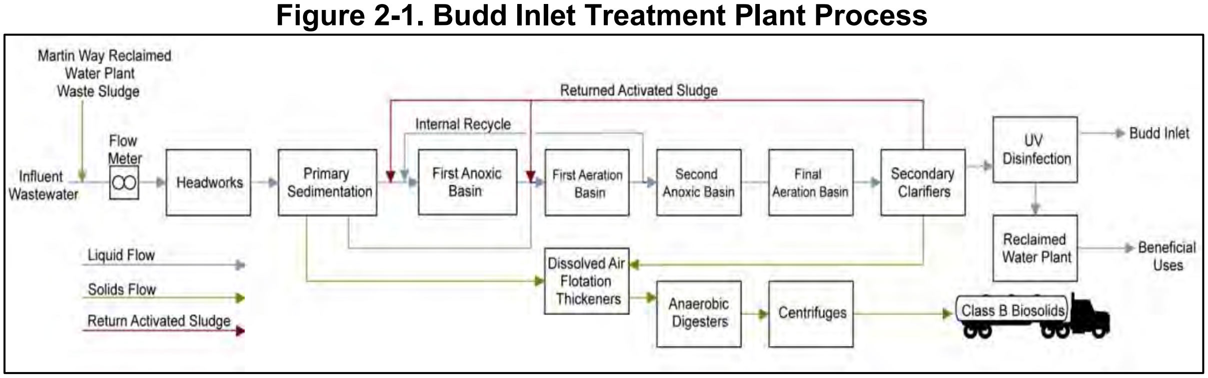
The rated capacity of the Budd Inlet Treatment Plant was established as part of the last major facility upgrade, which occurred in the mid-1990s. Although that rated capacity serves as the basis for this capacity assessment, it should be acknowledged that many systems have been upgraded since the mid-1990s and the plant capacity has likely increased. However, LOTT does not plan to request a re-rate of the plant until the Biological Process Improvements project has been completed and sufficient operational data has been collected.

The treatment capacity of the Budd Inlet Treatment Plant is also tied to the capacity of each individual system within the plant. These capacities are assessed annually based on updated flows and loadings projections. The following sections are included in the overview of each system unit:

- **System Profile** – General description of the system and its purpose.
- **System Schematic** – Schematic depicting the various components and flow paths.
- **Capacity Analysis** – Discussion of the various capacities as they relate to projected flows and loadings.
- **Completed and Planned Improvements** – List of completed and planned improvement projects.
- **Asset Management** – List of major equipment to include its capacity, date of last upgrade, and risk score (based on a score of 1 through 6, with 1 being the highest risk and 6 being the lowest).
- **Operations and Maintenance** – Description of the various activities associated with the operation and maintenance of the system and a review of historical costs. Costs are broken down into materials, labor, and contracted services. These historical costs are shown primarily to illustrate the improvements to LOTT's business practices in capturing costs through its computerized maintenance management system.

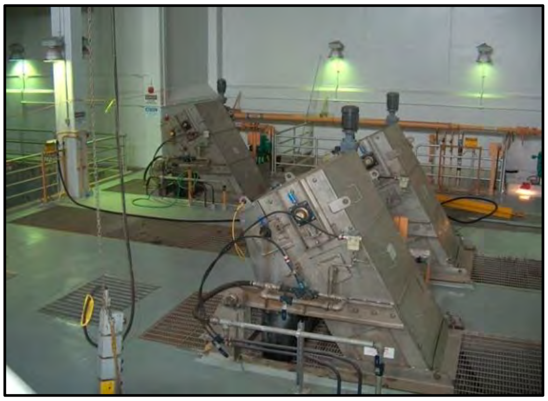
Figure 2-1 provides an overview of the Budd Inlet Treatment Plant and the various supporting systems.

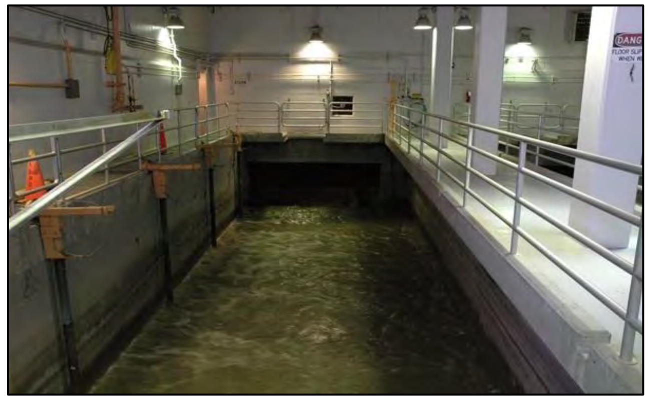
Figure 2-1. Budd Inlet Treatment Plant Process



2.1 Headworks

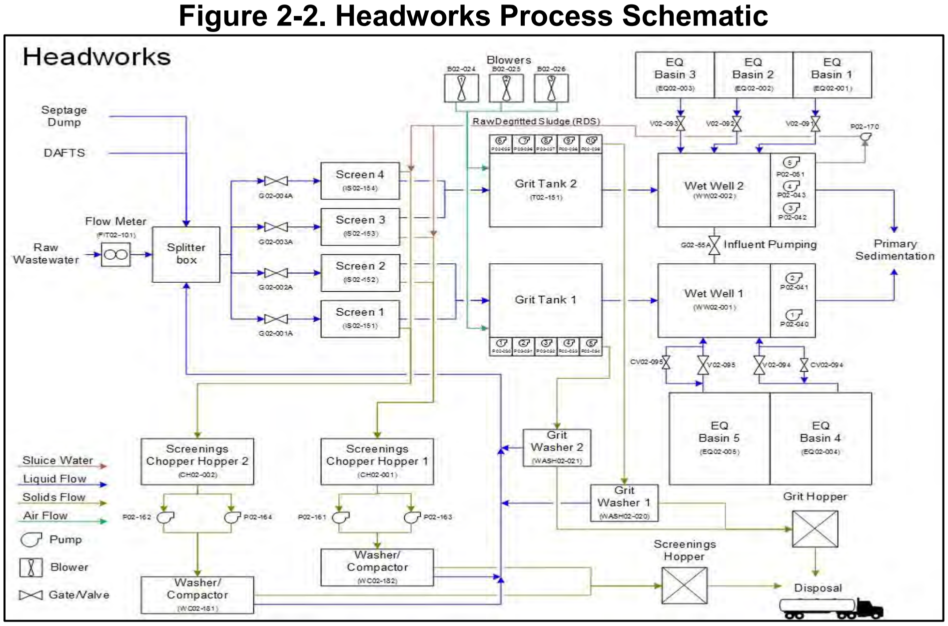
The headworks facility consists of preliminary treatment (screens and grit removal) and influent pumping. Flow enters the plant via a 60-inch plant influent pipe. A splitter box directs flow through four influent channels. Motor-operated sluice gates at the head of each channel control the flow to four mechanically cleaned screens that remove large debris from the influent wastewater. Screenings are conveyed to two screenings pits where chopper pumps convey ground-up screenings to two washer/compactor units. Dewatered screenings are collected and hauled to the Thurston County Waste and Recovery Center for disposal.





After screening, wastewater enters two aerated grit channels that remove large inorganic and organic particles. Grit collects in hoppers at the bottom of each tank and is removed by 10 grit pumps. Grit is conveyed to the grit screening/handling room where the grit is processed through two cyclone separators and grit washer/classifiers to remove organic material and return it to the process via the influent splitter box. Washed grit is stored in hoppers and then hauled to the Waste and Recovery Center for disposal. Liquid supernatant from the separator and classifier is recycled to the plant influent splitter box. Degritted sewage overflows from the grit tanks into two influent wet wells. Four variable speed 200-horsepower (hp) pumps provide the influent pumping capacity. The influent pumping system conveys raw degritted sewage to the primary sedimentation tanks.

Figure 2-2. Headworks Process Schematic



Five equalization basins (EQs) provide up to 2.5 million gallons of storage. As the water level rises in the wet wells during peak flows, the tanks fill in series as determined by elevation of the internal weirs. After the headworks upgrade of 2012, the addition of control valves on the lines to the north EQs allows the option of filling from the bottom of the wet wells rather than over the weirs. This change adds flexibility to flow pace during the summer months, reducing the impact of fluctuating flows on the biological treatment process.

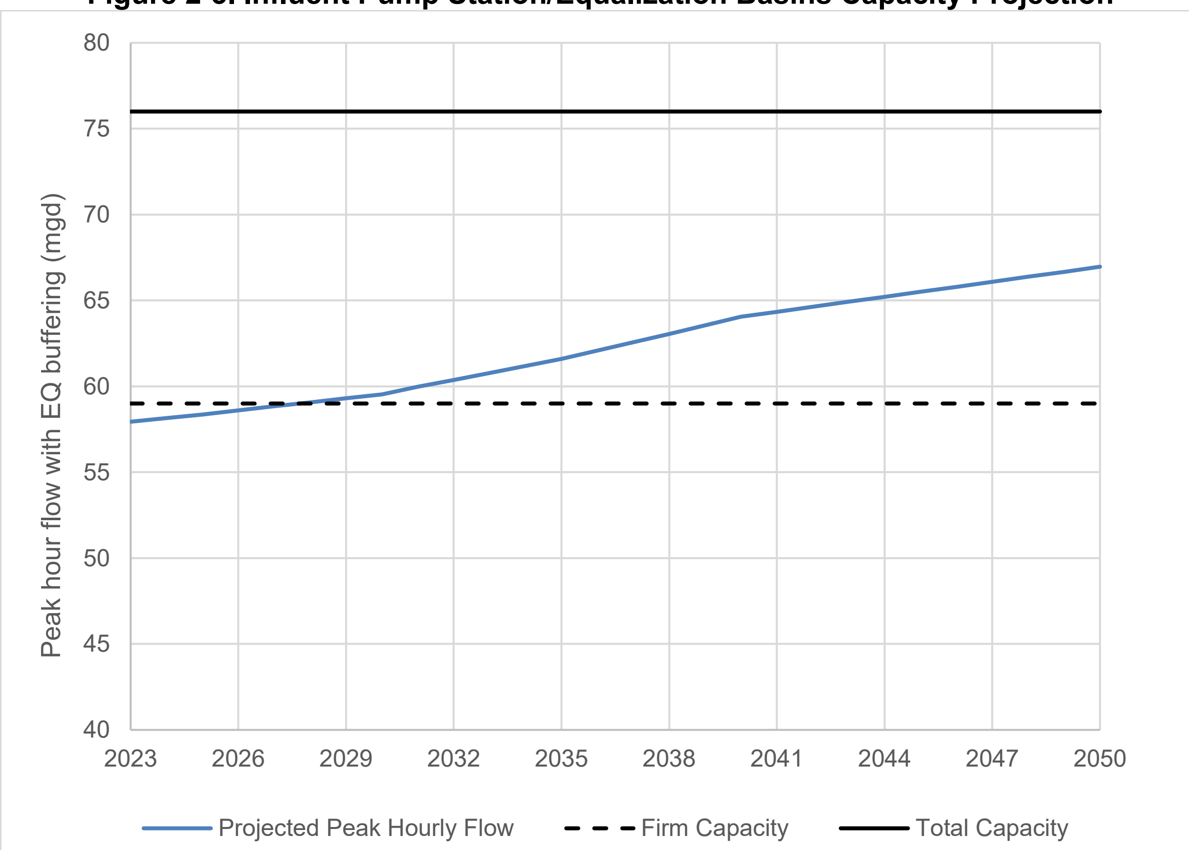
2.1.1 Capacity Analysis

Influent Pump Station/Equalization Basins

The influent pump station has a total capacity of 72 mgd, and a firm capacity (one pump out of service) of 55 mgd. A hydraulic analysis was conducted to determine the impact of the existing 2.5-million-gallon equalization basins on flow through the influent pump station. This analysis projected that the EQ basins could buffer approximately 10 mgd of peak hour flow, and the current equalized capacity of the influent pump station is approximately 82.9 mgd. The influent 60-inch sewer line begins to experience restrictions at flows between 60-70 mgd, and reaches a maximum capacity of 80-90 mgd depending on the pressure condition.

Figure 2-3 plots the peak hour influent flow against the estimated firm and total capacity of the influent pump station including the buffering capacity of the equalization basins. Peak hour flows are projected to reach 85% of the firm capacity within the next 10 years. LOTT is currently developing a comprehensive wet weather plan, which will include a pump station capacity expansion and ways to reduce hydraulic flows in the collection system near the BITP.

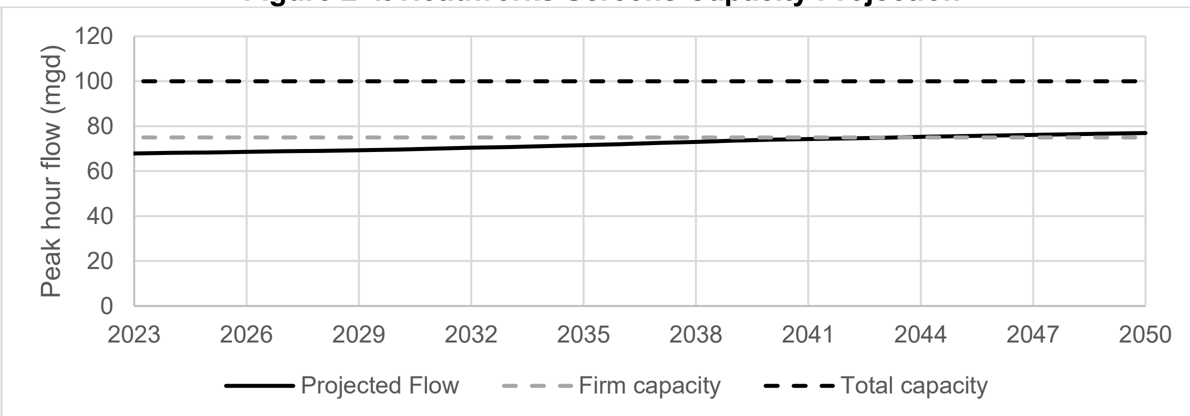
Figure 2-3. Influent Pump Station/Equalization Basins Capacity Projection



Headworks Screens

Each of the existing headworks screens has a rated peak hour influent flow capacity of 25 mgd. With four screens, the total capacity of the screening facility is 100 mgd and the firm capacity is 75 mgd. Figure 2-4 shows the existing firm and total screening capacities relative to the projected peak hour influent flow. Because the plant has the ability to bypass excessive peak flows around the screens, the screening system is evaluated based upon the total, rather than the firm capacity. No capacity-related projects are planned for the headworks screens.

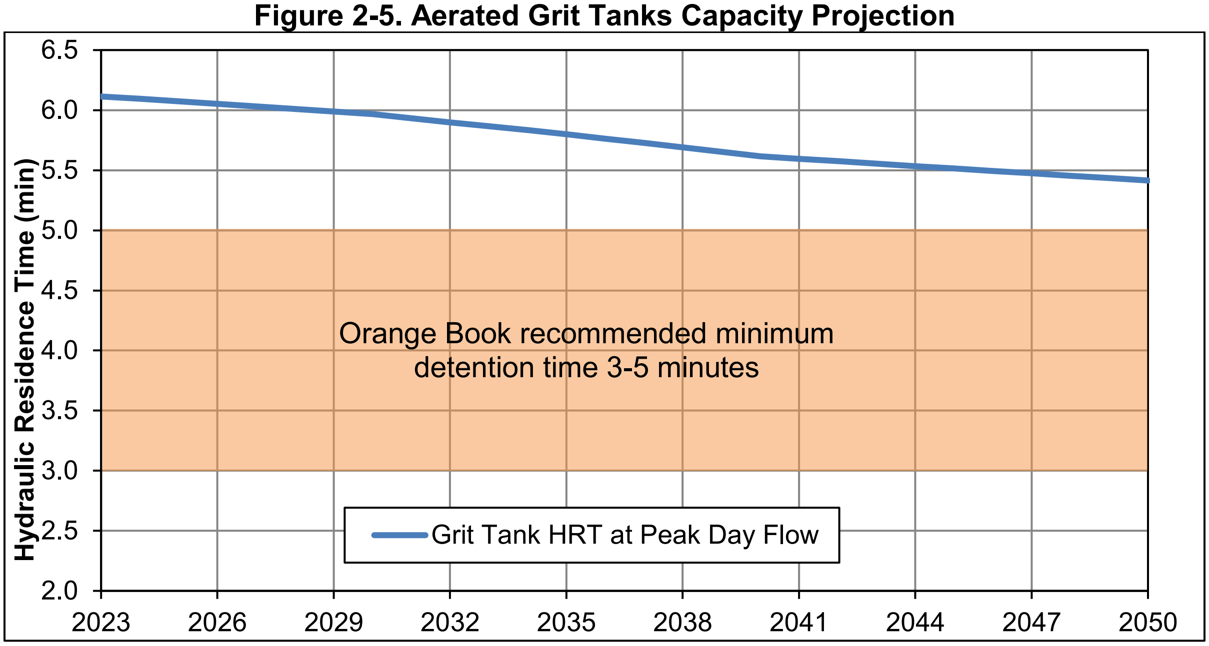
Figure 2-4. Headworks Screens Capacity Projection



Aerated Grit Tanks

The capacity of the aerated grit tanks is expressed relative to the hydraulic retention time (HRT) at peak day flow. Ecology's Orange Book recommends that aerated grit tanks be designed to maintain a minimum hydraulic retention time of three to five minutes in order to effectively remove grit during peak wet weather events. The retention time with both aerated grit tanks in service is projected to remain above this range through 2050. Therefore, no capacity-related projects are planned for the aerated grit tanks.

Figure 2-5. Aerated Grit Tanks Capacity Projection



Headworks System Capacity Summary

Table 2-1 provides a summary of the capacity analysis and assumptions for the headworks system. This includes the influent pump station and equalization basins, the headworks screens, and the aerated grit tanks.

Table 2-1. Headworks System Capacity Summary

					Condition		Utilization	
Unit Process	**Capacity Basis**	**Units**	**Redundancy Basis**	**Capacity**	**Current**	**2050**	**Current**	**2050**
Influent pump station	Peak hour flow with equalization	mgd	Total	82.9	65.8	74.7	79%	90%
Headworks screens	Peak hour flow	mgd	Total	100	65.8	74.7	66%	75%
Aerated grit tanks	Peak day HRT	min	Total	4	6.2	5.5	64%	73%

2.1.2 Completed and Planned Projects

Planned future capital projects include expanding the capacity of the influent pump station, currently planned for 2024. Additional flow equalization is not projected to be needed prior to 2050. However, given changing weather patterns and potential impacts related to climate change and sea level rise, LOTT maintains the flexibility to expand equalization capacity as needed. Completed and planned projects for the headworks system are listed in Table 2-2.

Table 2-2. Completed and Planned Project Summary

On-line	Name	Cost/Estimate	Status	Description
2013	Screenings Pumps	$270,513	Completed	Additional screening pumps to ensure process redundancy and reliability
2013	Grit Blower Replacement	$183,509	Completed	Two new grit channel blowers
2014	Headworks Improvements	$1,024,025	Completed	Includes replacement of the grit channel diffusers, influent wet well transfer gates, EQ valves, and basin and channel coatings
2016	Influent Screen #1 Refurbishment	$51,082	Completed	Included refurbishment of the #1 influent screen
2019	Influent Pump Station Valve and Piping Improvements	$548,222	Completed	Replace suction and discharge isolation gates, and check valves for four influent pumps
2020	Washington Street Property Improvements	$1,585,000	Completed	Demolish building, pave and fence site, and use for contractor staging
2022	Headworks Solids Handling Improvements	$400,000	Completed	Replaced grit washer/separators
2025	Influent Pumping Capacity Expansion	$4,800,000	Planning	Expand capacity to reduce risk of storm-related overflows
2028	Headworks and Solids Air Handling Improvements	$2,167,731	Planning	Improve ventilation and odor control at Headworks and Solids Handling Buildings

2.1.3 Asset Management

Major equipment includes the influent pumps, headworks screens, and associated screenings handling equipment, and the equipment associated with grit removal. This equipment is shown in Figure 2-2 and is summarized in Table 2-3.

Table 2-3. Existing Headworks Equipment

System	Count	Unit Capacity	Motor	Date of Last Upgrade	Risk Score (1-6)
Influent Pumps	4	18 mgd	200 hp	1994	3
Headworks Screens	4	25 mgd	2 hp	2016	2

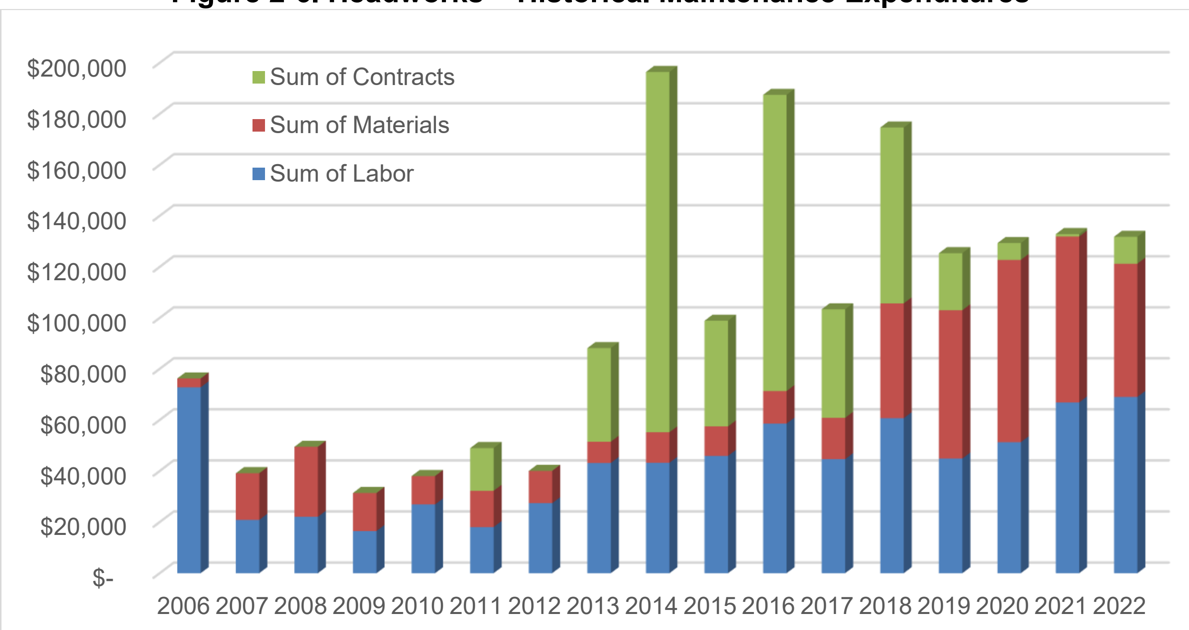
Screenings Pumps	2	200 gpm	20 hp	2012	2
Screenings Compactors	2	45 ft^3/hr	7.5 hp	2003	3
Grit Pumps	10	150 gpm	25 hp	1980	3
Grit Washer/Separator	2	1.5 ton/hr	0.5 hp	2022	1
Grit Chamber Blowers	3	263 cfm/11.6 psi	20 hp	2013	2

2.1.4 Operations and Maintenance

Headworks system operational costs include labor, energy, and disposal fees. Labor costs are associated with operations staffing requirements for the influent pump station, equalization basins, screens/screenings handling equipment, and the grit removal system. This also includes labor requirements for the collection, hauling, and disposal of dewatered screenings and grit. The major energy cost for the headworks system is the electrical power required for operation of the influent pumps, screens, and grit blowers.

Disposal costs have to do with the hauling and disposal of screenings and grit. Maintenance of the headworks system includes maintaining the major equipment, as well as associated instruments, gates, and piping systems. This may also include periodic draining and removal of any accumulated grit/sediment in the influent screen channels and grit tanks. Maintenance costs tracked in LOTT's computerized maintenance management system (CMMS) are shown in Figure 2-6.

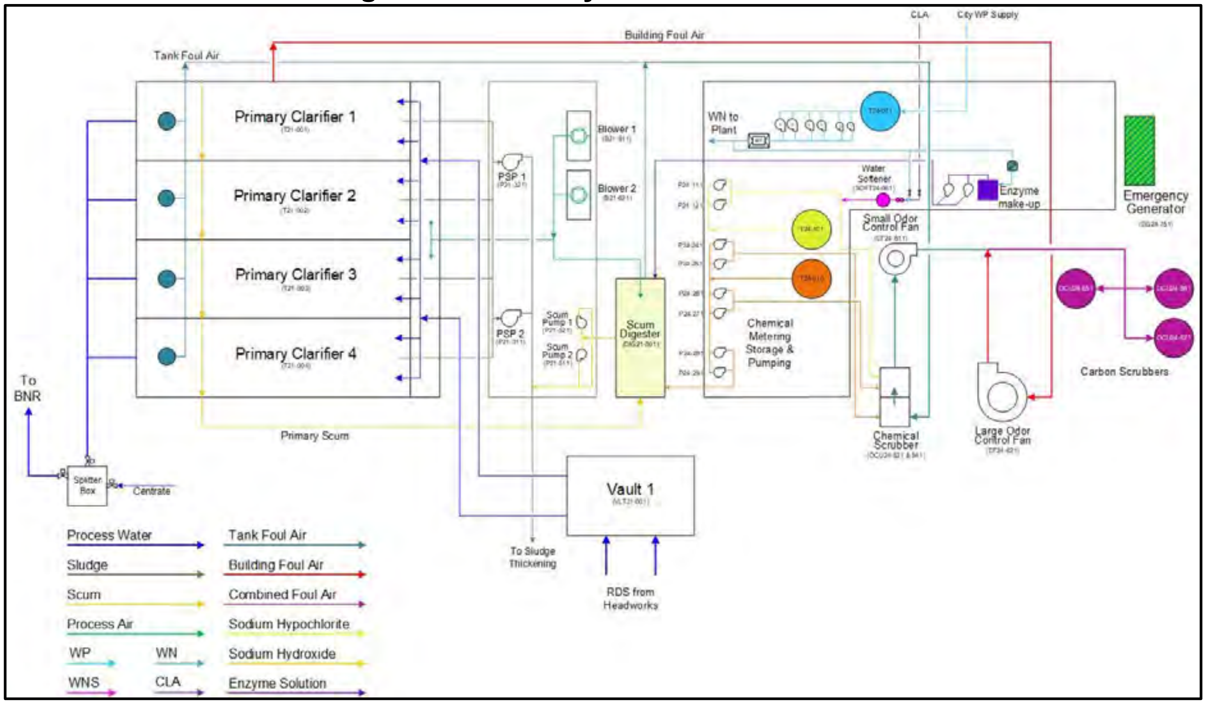
Figure 2-6. Headworks – Historical Maintenance Expenditures



2.2 Primary Treatment

The primary treatment process removes easily settleable material from the screened and degritted wastewater. The system includes two sets of primary clarifiers totaling four basins, brought into service in 2013. The primary treatment system includes magnetic flow meters, which provide an estimate of primary influent flow. This flow measurement is used to control influent gates and the pump speed for influent pumping, return activated sludge, waste activated sludge, and internal mixed liquor recycle pumping.

Figure 2-7. Primary Treatment Process



All of the primary clarifiers include scum collectors, surface return flight sludge collectors, and primary sludge pumps. Primary scum is sent to an aerated tank for pre-anaerobic digestion. Primary sludge removed from the primary sedimentation tanks is pumped to the dissolved air flotation thickeners.

Primary effluent is routed from the clarifiers to an effluent diversion structure. With completion of the biological process improvements project, flow from the diversion structure is now conveyed directly to the effluent channel of first anoxic basins under normal operation, bypassing the basins. Under emergency conditions, flow can be diverted to the first basins for flow equalization or can be sent via a 48-inch pipeline to either first aeration or the ultraviolet disinfection system.

The primary clarifiers include an odor control facility and chemical building, which have been sized to accommodate a potential primary sedimentation basins expansion. The primary odor control facility receives foul air from the primary clarifiers and treats it with a chemical (sodium hydroxide) scrubber, followed by a set of carbon scrubbers. The chemical building includes space and conduit for chemically enhanced primary treatment in the event that LOTT elects to augment solids removal in the future.

2.2.1 Capacity Analysis

The capacity of the primary treatment system may be defined as either hydraulic capacity or treatment capacity. The primary clarifiers can hydraulically pass up to 60 mgd of flow without flooding, though they are designed to treat flows up to 37.5 mgd. The latter condition corresponds to a surface overflow rate of 4,716 gpd/ft^2, with all four basins in service. While higher than Orange Book recommendations, eight years of operational data supports operation to this flow rate. At a high surface overflow rate (SOR), the performance of the primary clarifiers will degrade, and total suspended solids (TSS) and biochemical oxygen demand (BOD) removal rates will decrease. This will increase loadings to the secondary biological process and secondary clarifiers and will have a cascading effect on the capacity of downstream systems. The relationship between SOR and performance will be monitored, and the overall BITP capacity model is based upon that relationship.

Chemically enhanced primary treatment (CEPT) is another option to potentially improve the capacity of the existing primary clarifiers. Provisions for CEPT were included in the original design. Space in the chemical building was reserved for dosing pumps. A pad and secondary containment for chemical tanks was also included, as well as the necessary conduit and piping. LOTT conducted a pilot in the winter of 2020. While CEPT appears a viable option, the costs associated with chemical dosing were high, and LOTT has several other options available for wet weather treatment.

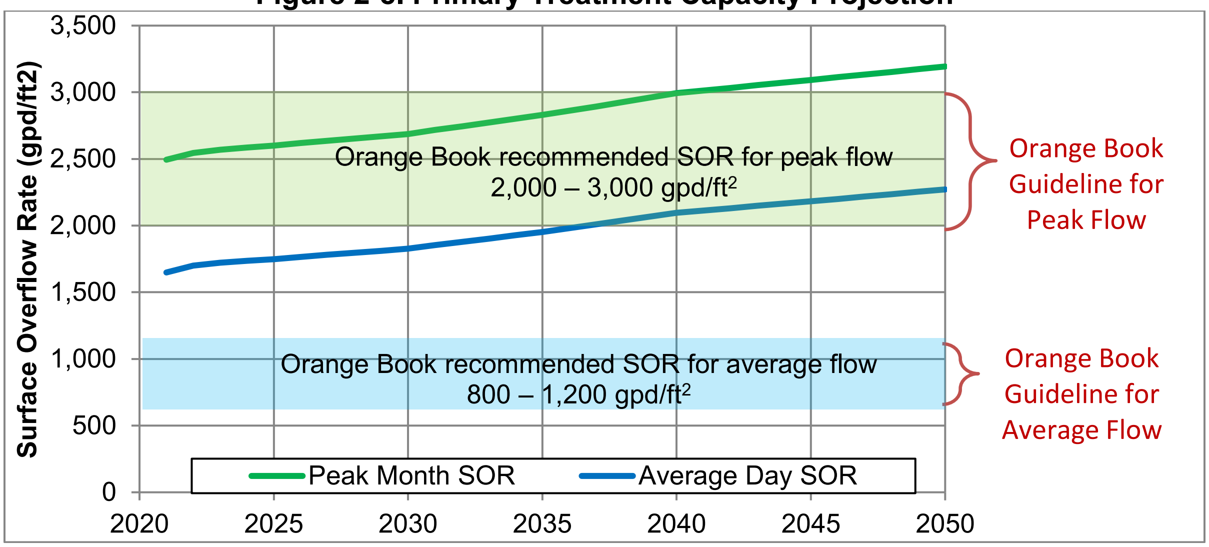
For the purpose of this capacity assessment, the capacity of the primary clarifier will be based on the Orange Book recommended peak overflow rate of 3,000 gpd/ft^2. This criterion will be applied to a maximum month flow condition, as single day exceedances of the criterion would not be expected to impact permit compliance. Table 2-4 includes a summary of the various capacity parameters assessed and the related assumptions.

Table 2-4. Primary Clarifiers Capacity Summary

					Condition		Utilization	
Unit Process	**Capacity Basis**	**Units**	**Redundancy Basis**	**Capacity**	**Current**	**2050**	**Current**	**2050**
Primary clarifiers	Peak month SOR	gpd/ft^2	Total	3,000	2,278	2,790	76%	93%

While the average day SORs are higher than Orange Book standards, the system has performed well since its construction. The average TSS removal rate in 2022 was 69.4%.

Figure 2-8. Primary Treatment Capacity Projection



2.2.2 Completed and Planned Projects

Construction of the primary clarifiers was completed in 2013 and included new odor control and chemical storage facilities sized to meet build out conditions. An in-kind expansion has been projected to cost between $30-50 million, depending on the scope and degree to which design details from the 2013 expansion are applied. Based on the performance of the existing primaries and the potential of supplementing wet weather flow management elsewhere, the second phase may not be needed. The upcoming Centrate Building

Rehabilitation project will include the retrofit of two of the four tanks to allow them to act as wet weather primary clarifiers, augmenting LOTT's overall primary treatment capacity.

Table 2-5. Primary Treatment Completed and Planned Project Summary

On-line	Name	Cost/Estimate	Status	Description
2010	Port of Olympia Land Purchase	$2,156,297	Completed	Purchased property to locate the new primaries
2013	Primary Sedimentation Basins	$58,957,736	Completed	Project added new primary clarifiers, odor control, and chemical feed and storage facilities
2025	Primary Sludge Pumping Capacity Expansion	$750,000	Planning	Project increase sludge pumping capacity
>2050	Primary Sedimentation Basins Phase II	$49,681,830	Future	Project adds new primary clarifiers, if needed

2.2.3 Asset Management

A variety of mechanical equipment is involved in the operation of the primary treatment system. Major equipment includes the influent flow meters, the chain and flight sludge and scum collectors, and the primary sludge pumps.

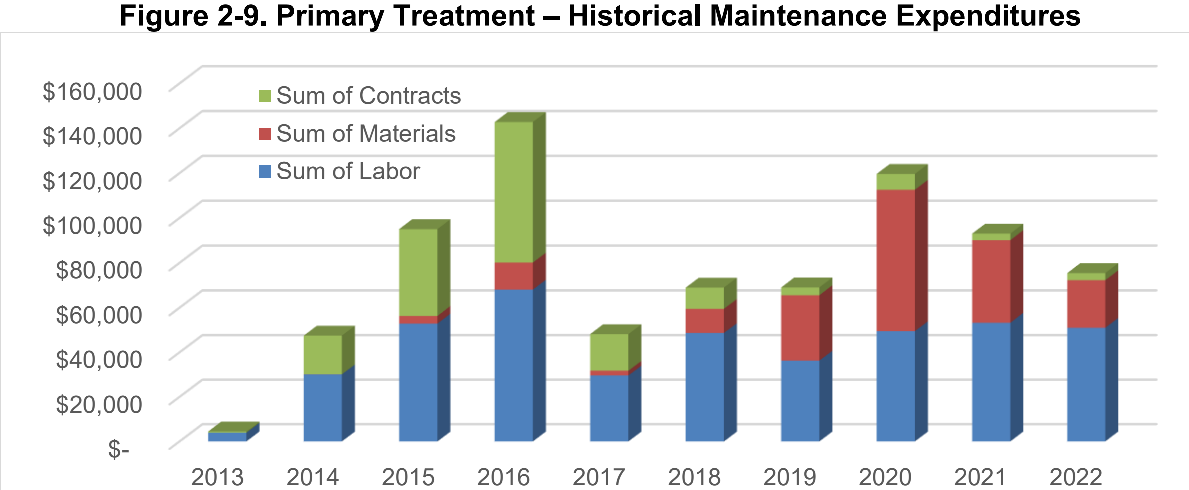
Table 2-6. Existing Primary Treatment Equipment

System	Count	Unit Capacity	Motor	Date of Last Upgrade	Risk Score (1-6)
Influent flow meters	2	NA	NA	2013	2
Clarifier chain and flight collectors	8	NA	0.5 hp	2013	2
Sludge pumps	2	230 gpm	15 hp	2013	4
Scum pumps	2	100 gpm	5 hp	2013	2

2.2.4 Operations and Maintenance

Primary treatment operational costs include labor and energy. Labor costs are associated with operations staffing requirements for the clarifiers, sludge pumps, and scum system. Energy costs are related to sludge pumping, operation of the chains and flights, and the odor control system fans. Chemical costs are associated with the odor control system. Maintenance of the primary treatment system includes maintaining the major equipment as well as associated instruments, gates, and piping systems.

Figure 2-9. Primary Treatment – Historical Maintenance Expenditures



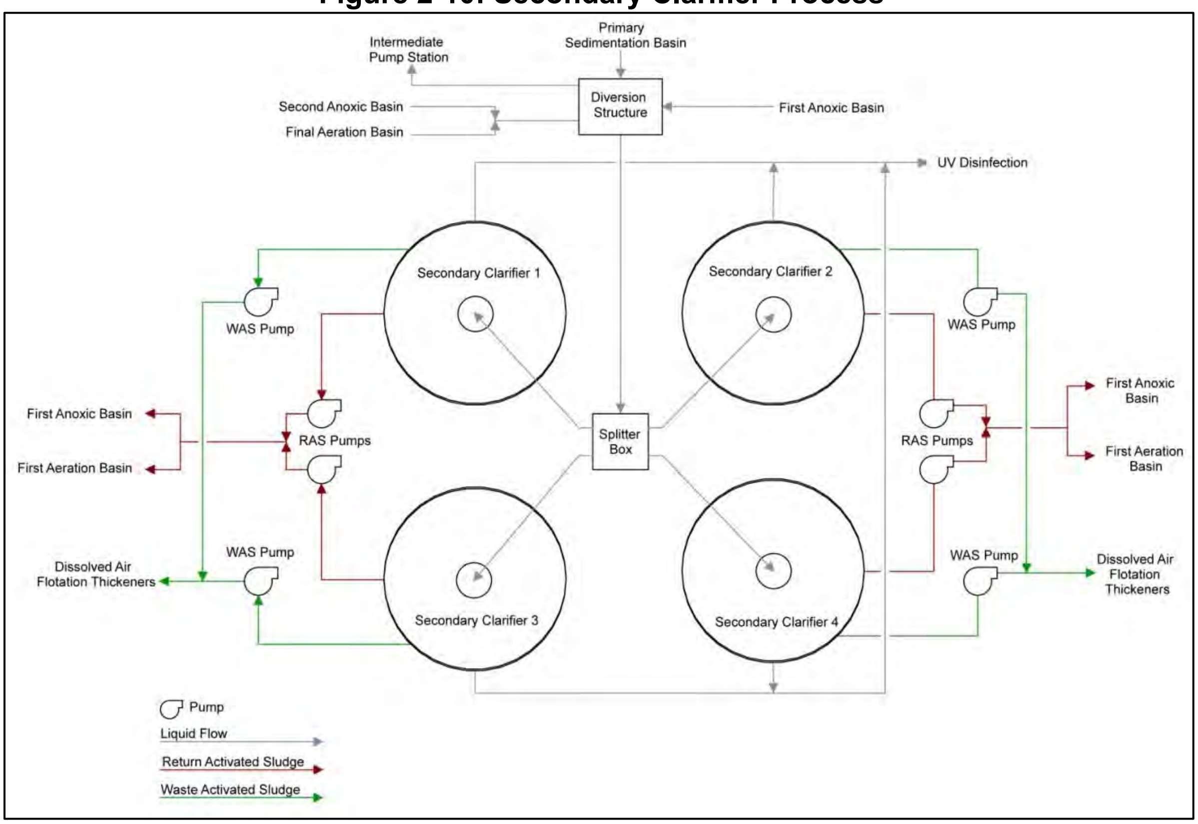
2.3 Secondary Clarifiers

The purpose of the secondary clarifiers is to retain the activated sludge bacteria within the secondary process and discharge clean effluent to the disinfection system. The clarifiers receive flow from the final aeration basin, and clarified effluent from the clarifiers flows to the ultraviolet disinfection system. There are four clarifiers at the plant with a diameter of 120 feet and a 14.5-foot side water depth. A project to upgrade the secondary clarifiers was completed in 2007. The project included the replacement of the clarifier mechanisms, and both the waste activated sludge (WAS) and return activated sludge (RAS) pumping systems.

Each clarifier is equipped with two RAS pumps and one WAS pump. Settled sludge is withdrawn from each clarifier through dedicated RAS pumps that are connected to a manifold of pipes located on the clarifier's rotating sludge collector rake arms.

A magnetic flow meter measures the flow from each pair of pumps. RAS is recycled back to the first aeration basin. The pumping rate is adjusted to maintain a blanket of settled sludge in the clarifier.

Figure 2-10: Secondary Clarifier Process

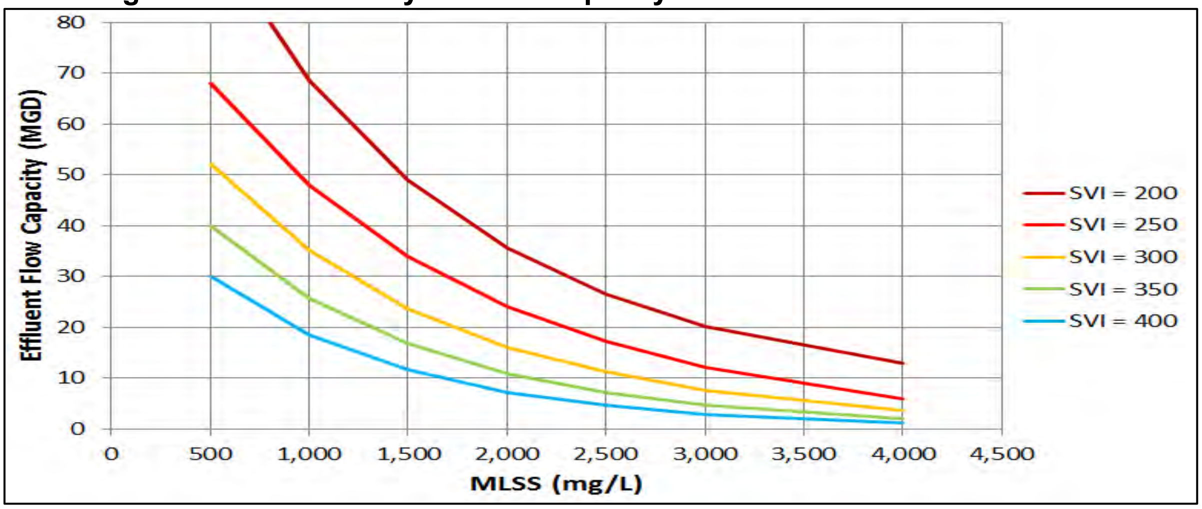


WAS is withdrawn from each RAS wet well and directed to the dissolved air flotation thickeners for solids processing. The WAS pumps are used to maintain the desired solids inventory in the system and the solids retention time in the secondary treatment process to allow the biological treatment process to operate correctly. The WAS pumps are operated continuously to even out the load to the dissolved air flotation thickeners.

2.3.1 Capacity Analysis

The capacity of the secondary clarifiers was established through stress testing and fluid dynamic modeling in late 2008. Unit capacity is a function of the mixed liquor suspended solids (MLSS) concentration in the aeration basins and the mixed liquor sludge volume index (SVI) (Figure 2-11). MLSS is a function of the BOD loading to the aeration basins and the total aeration basin volume. In addition, the BOD loading to the aeration basins is itself a function of both satellite plant diversion and primary sedimentation performance.

Figure 2-11. Secondary Clarifier Capacity as a Function of MLSS and SVI



As noted above, secondary clarifier capacity is a function of several factors and is linked to the influent flows and loads to the plant, primary sedimentation performance, and operation of the aeration basins as it relates to MLSS concentration. With the recent completion of the Biological Process Improvements project, it will likely take 3-5 years to develop enough operational data to assess the impact on mixed liquor settleability. The relationship between influent loadings, MLSS concentration, and clarifier capacity will need to be re-evaluated at that time.

Table 2-7 provides a summary of the capacity analysis and assumptions for the secondary clarifiers. Much of the table is currently undefined, though will be updated when sufficient operational data has been collected following the completion the Biological Process Improvements project. Based on the performance to date, secondary clarifier capacity is not projected to become limiting within the next 20 years.

Table 2-7. Secondary Clarifiers Simplified Capacity Summary

					Condition		Utilization	
Unit Process	**Capacity Basis**	**Units**	**Redundancy Basis**	**Capacity**	**Current**	**2050**	**Current**	**2050**
Clarifiers	Peak day loading rate	lb/d/ft^2	Total	TBD	11.4	20.1	TBD	TBD
RAS Pumps	Flow	mgd	Total	23	N/A	N/A	N/A	N/A
WAS Pumps	Flow	mgd	Total	3.5	N/A	N/A	N/A	N/A

2.3.2 Completed and Planned Projects

Secondary clarifier capacity will be reassessed after sufficient data is collected following the completion of the Biological Process Improvements project. Additional technologies to address potential future capacity limitations were identified as part of LOTT's master planning update for the footprint of the Budd Inlet Treatment Plant and will be further evaluated as necessary. In the worst-case scenario, two additional secondary clarifiers may be required by 2050.

Table 2-5. Secondary Clarifiers Completed and Planned Project Summary

On-line	Name	Cost/Estimate	Status	Description
2007	Clarifier upgrades	$6,075,037	Completed	Upgraded clarifier mechanisms, RAS and WAS Pumping
2028	Secondary Clarifier Refurbishment	$1,459,360	Future	Project provides for general system renewal
2050	Secondary Clarifier Expansion	$32,348,869	Future	Adds additional clarifiers, if needed

2.3.3 Asset Management

Major equipment involved in secondary clarifier operation includes secondary clarifier sludge collection mechanisms, RAS pumps, and WAS pumps.

Table 2-8. Existing Secondary Clarifiers Equipment

System	Count	Unit Capacity	Motor	Date of Last Upgrade	Risk Score (1-6)
Secondary Clarifier Mechanisms	4	120-ft diameter	N/A	2007	3
RAS Pumps	8	2,000 gpm	20 hp	2007	4
WAS Pumps	4	300 gpm	10 hp	2007	3

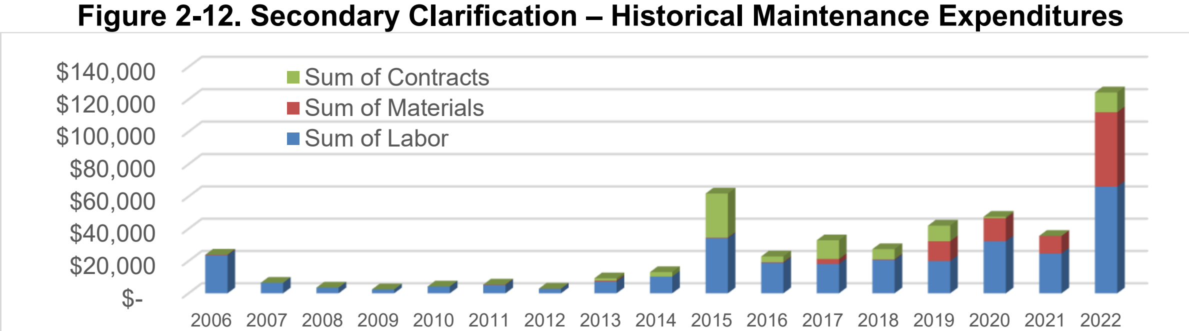
Maintenance costs include labor, materials, and contracted services captured in LOTT's CMMS are included in Figure 3-12.

2.3.4 Operations and Maintenance

Operational costs for the secondary clarifiers include labor and energy. Labor costs are associated with operations staffing requirements for the secondary clarifiers. Electrical energy is required to operate the secondary clarifier mechanisms and the RAS/WAS pumps.

Maintenance of the secondary clarifier system includes maintaining the major equipment, as well as associated instruments and piping systems.

Figure 2-12. Secondary Clarification – Historical Maintenance Expenditures



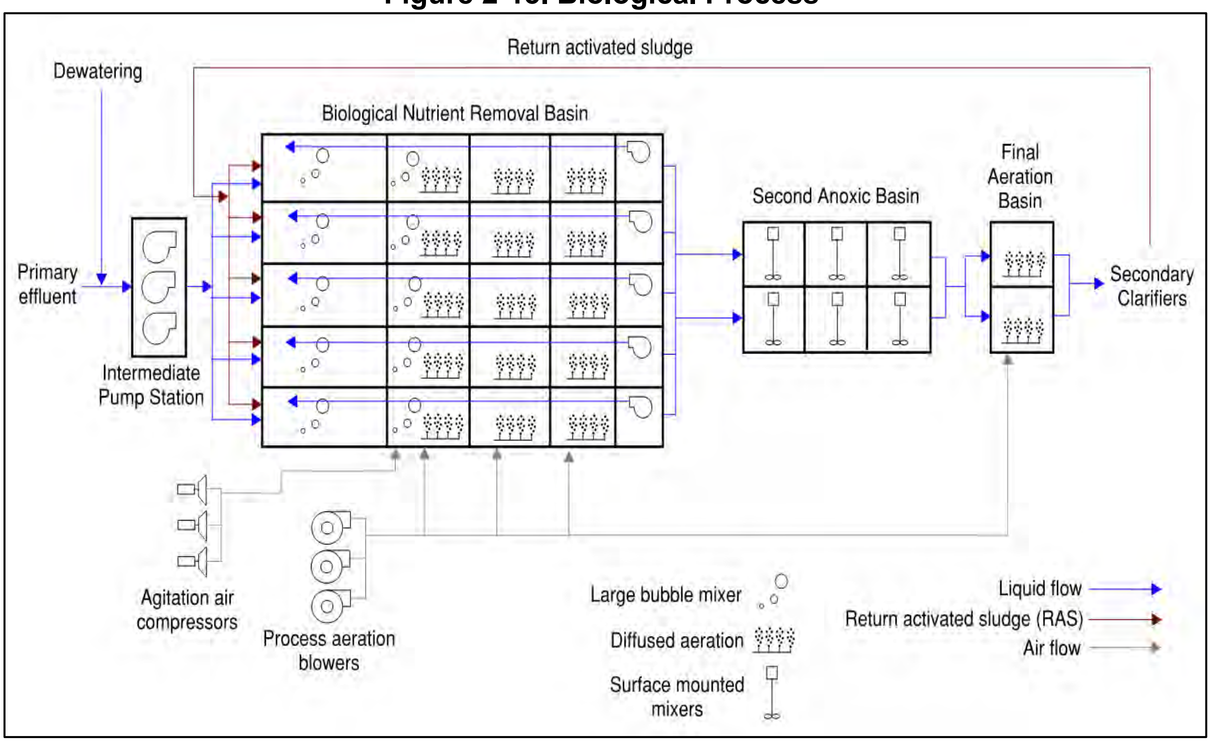
2.4 Biological Process

LOTT's biological nutrient removal system operates a modified four-stage Bardenpho process to optimize total inorganic nitrogen removal from the incoming wastewater. Effluent from the primary sedimentation tanks flows through a series of anoxic (low dissolved oxygen) and aeration (higher dissolved oxygen concentration) basins. Renovations to the process were completed in 2023.

Primary effluent, RAS, and an internal recycle stream are fed into an anoxic zone (stage 1) where nitrogen is removed from the wastewater (denitrification). The anoxic basins are mixed through large bubble displacement. Denitrified mixed liquor passes to a large aerated zone (stage 2), where BOD is removed, and where ammonia is converted to nitrate (nitrification). The nitrified mixed liquor is split – with one portion being pumped back to the anoxic zone for denitrification, and another portion flowing by gravity to a second anoxic basin.

The second anoxic and final aeration basins (stage 3 and 4) provide the final biological denitrification and nitrification steps prior to settling and disinfection. Stages 3 and 4 consist of two trains, each with four cells. The first three cells of each train serve as the second anoxic zone, and the fourth cell as the final aeration zone. In the anoxic cells, additional nitrate removal is achieved. In the final aeration cells the mixed liquor is aerated to further polish the mixed liquor prior to flowing to the secondary clarifiers.

Figure 2-13. Biological Process



2.4.1 Capacity Analysis

The secondary process tanks comprise 12.95 million gallons of anoxic and aerobic basin volume. While this process volume is sufficient to provide for BOD and TIN removal through build out, performance becomes increasingly tied to the mixed liquor suspended solids (MLSS) concentrations. The MLSS concentration is proportional to the BOD loading, which is projected to increase by approximately 200% by build out. The MLSS concentration is inversely proportional to the volume of the secondary process tanks.

The Biological Process Improvements project reconfigured the secondary process tanks to provide for improved control and efficiency. Key outcomes of the project include reduced energy use, a reduction in foam trapping, improved dissolved oxygen control, and improved mixed liquor settleability. Consolidation of the biological treatment process has also freed up valuable space on the plant site for additional future treatment processes. These positive outcomes are balanced against a reduction in process volume tied to the elimination of the existing first anoxic basin. The volume reduction could increase the projected MLSS concentration, which in turn increases downstream loading on the secondary clarifiers and reduces secondary clarifier capacity.

Table 2-9. Biological Process System Capacity Summary

					Condition		Utilization	
Unit Process	**Capacity Basis**	**Units**	**Redundancy Basis**	**Capacity**	**Current**	**2050**	**Current**	**2050**
Aeration basins	Capacity is driven by secondary clarifier solids loading							
Aeration blowers	Peak day air flow	scfm	Firm	16,400	14,457	21,132	88%	129%

The capacity of the aeration basins is linked to the secondary clarifiers via the relationship between MLSS concentration and solids loading. This relationship will need to be revisited once there is sufficient operational data with the new configuration. Blower capacity was increased, and space was provided for one additional blower, which would add 6,600 scfm to the firm capacity of the system.

2.4.2 Completed and Planned Projects

The Biological Process Improvements project was completed in the spring of 2023. The project reconfigured the biological treatment process and reduced the energy required to accomplish biological nutrient removal. The improvements included replacing oversized blowers and minimizing recycle pumping to reduce power consumption. The project also provided the opportunity to pilot test an alternative to methanol use for the secondary process.

Table 2-10. Completed and Planned Biological Process Projects

On-line	Name	Cost/Estimate	Status	Description
2011	Aeration Blower Upgrade	$344,264	Completed	Added Neuros high-speed turbo blower
2022	Biological Process Improvements	$35,902,102	In Progress	Upgrades aeration control, instrumentation, and process tank reconfiguration

2.4.3 Asset Management

A variety of mechanical equipment is involved in operation of the aeration basins. Major equipment includes second anoxic mixers, large bubble mixer compressors, intermediate and internal recycling pumps, and aeration blowers/diffusers.

Table 2-11. Existing Aeration Basins Equipment

System	Count	Unit Capacity	Motor	Date of Last Upgrade	Risk Score (1-6)
BNR Basin Large Bubble Mixer Compressor Assemblies	3	246 scfm	60 hp	2022	2
Second Anoxic Basin Mixers	6		15 hp	2010	2
Intermediate Pumps	2 4	17 mgd 33 mgd	75 hp 150 hp	1993 1993	3
Internal recycle pumps	10	12 mgd	18 hp	2023	1
Turbo Blowers	3	6,600 scfm	400 hp	2022	2

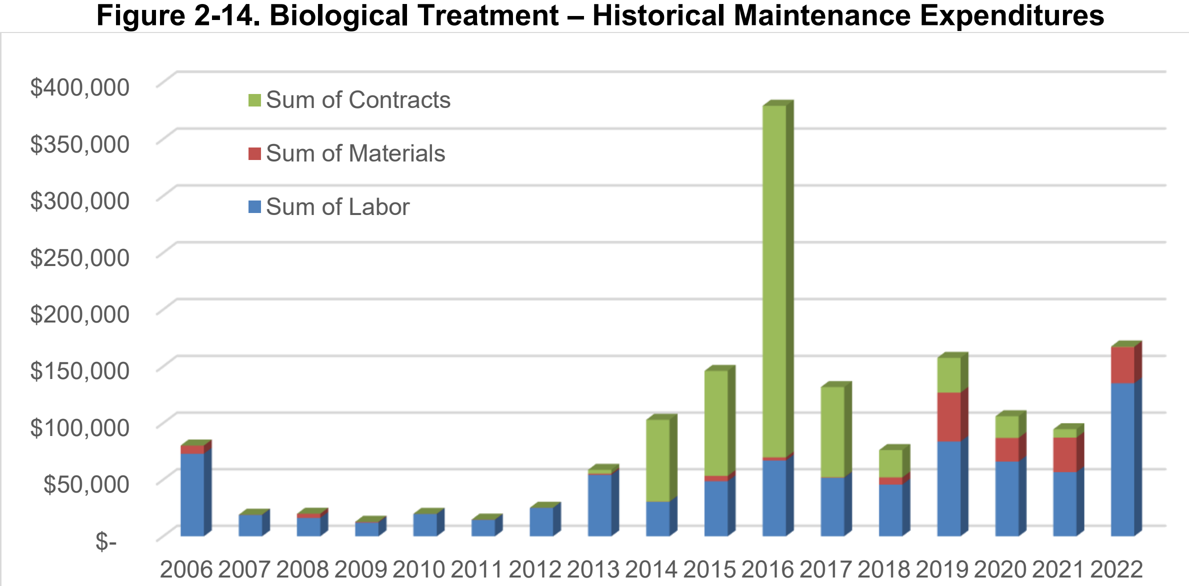
2.4.1 Operations and Maintenance

Aeration basin operational costs include labor, energy, and chemicals. Energy is primarily required for operation of the aeration blowers, recycle pumping, and operation of the anoxic and aeration basin mixers when in use.

Chemical costs include supplemental carbon to drive denitrification, and polyaluminum chloride (PAX) to reduce biological foaming. The plant typically uses methanol as a supplemental carbon source, and doses during the summer and shoulder permit seasons. PAX is typically dosed during the winter, to limit the growth of foaming filaments.

Maintenance of the aeration basins includes maintaining the major equipment, as well as associated instruments and piping systems. The aeration diffusers require periodic cleaning, which involves taking a basin out of service and manually cleaning the membranes.

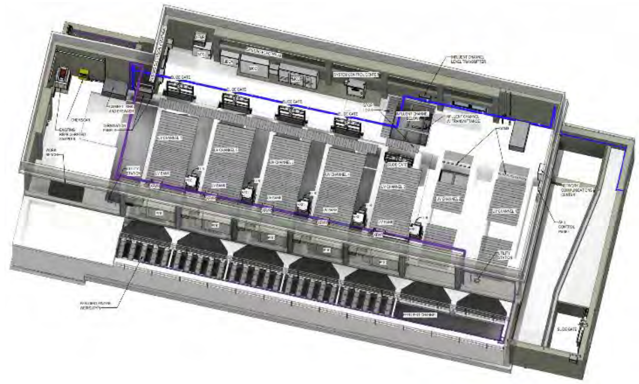
Figure 2-14. Biological Treatment – Historical Maintenance Expenditures



2.5 Ultraviolet Disinfection and Effluent Pumping

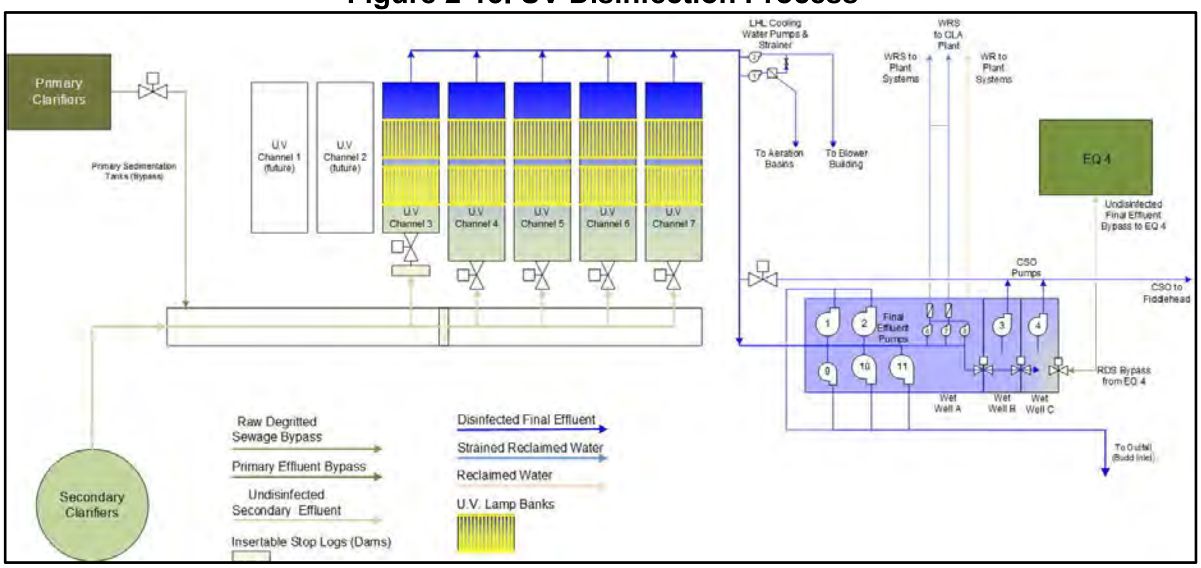
Ultraviolet Disinfection

The ultraviolet (UV) disinfection system is the final liquid stream processing step prior to discharge to Budd Inlet. The purpose of the system is to disinfect the effluent from the secondary clarifiers to satisfy NPDES permit requirements for fecal coliform counts in the final effluent.



A UV disinfection system exposes bacteria in the effluent to UV light by flowing past UV bulbs. The UV disinfection system consists of five channels equipped with 45-degree angled UV bulbs arranged in modules across the width of a channel. The spacing of the lamps in the channels provides sufficient UV radiation to ensure destruction of pathogenic microorganisms as effluent flows through the channel. The performance of the UV disinfection system is contingent on the successful performance of the secondary clarifiers, since high suspended solids will block the UV radiation and reduce the amount available for disinfection.

Figure 2-15. UV Disinfection Process



Effluent Pumping

The LOTT treatment plant has two 48-inch outfalls, the North Outfall and the Fiddlehead Outfall. Treated effluent is typically discharged to Budd Inlet out of the North Outfall that extends 953 feet off the shoreline near the north end of Washington Street. The final 250 feet of the outfall contains a diffuser section approximately 19 feet below the mean lower low water level (MLLW).

The effluent pump station for the North Outfall includes five pumps, three rated at 18 mgd and two rated at 12 mgd. The North Outfall is used for all plant flows up to 55 mgd at high tide and approximately 75 mgd at low tide. Most of the North Outfall was upgraded from 30- to 48-inch diameter in 1997. A portion of the pipeline, which crosses through a state-regulated dangerous waste site, could not be upgraded to 48-inch. The remaining 1,200 feet of 30-inch diameter pipe, which creates a flow bottleneck, is planned to be replaced in 2026.

Peak flows in excess of the North Outfall capacity can be discharged through the Fiddlehead Outfall, utilizing two pumps rated at 15 mgd each. In the event that the Fiddlehead Outfall is utilized, LOTT must notify the Department of Ecology that flow was diverted to this pipe.

2.5.1 Capacity Analysis

UV Disinfection

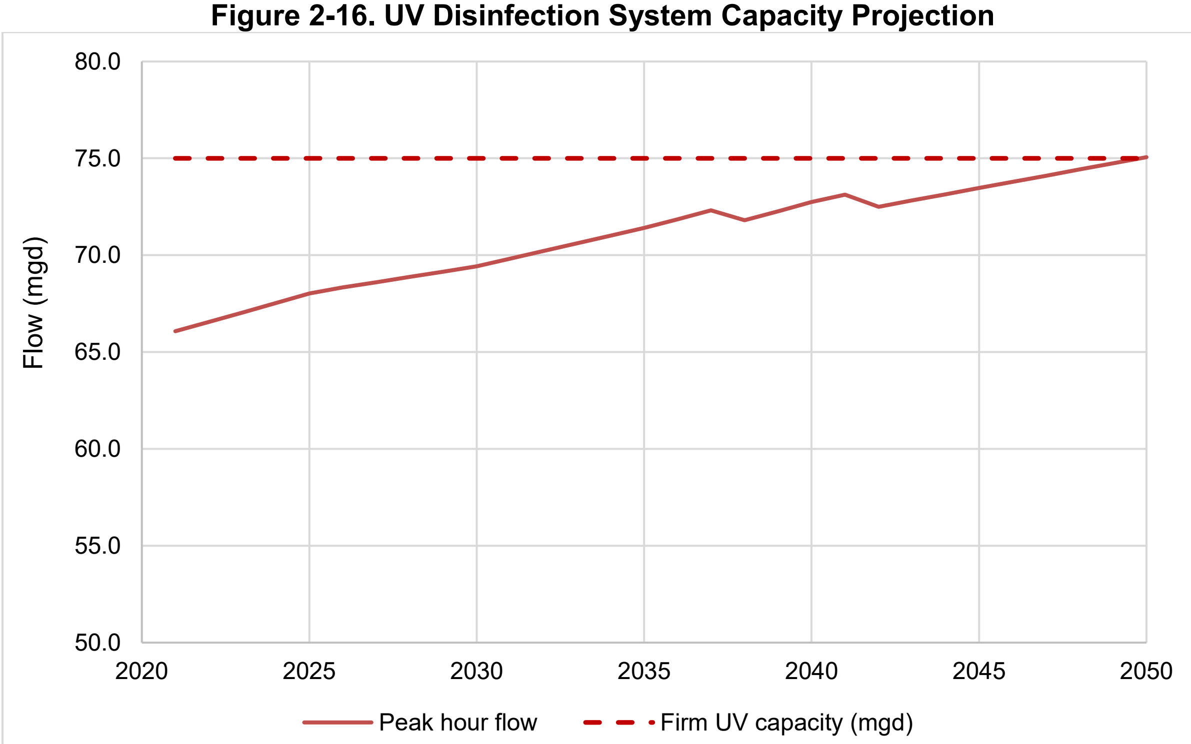
The UV disinfection system was installed in 2020. The system configuration includes UV lights installed at a 45-degree angle with deeper channels, thus increasing each channel's overall capacity. The system layout has four duty channels and one redundant channel, each with a treatment capacity of 18.5 mgd. Each channel contains two banks of UV lamps. Each bank contains 18 lamps, for a total of 180 lamps in the system. The design criteria was based on peak hourly flow and is included in Table 2.12.

Table 2.12 Trojan UV Signa™ Design Criteria

Parameter	Capacity
Peak Design Flow	75 mgd
Average Daily Flow	23.3 mgd
UV Transmission	63% minimum
Total Suspended Solids (TSS)	30 mg/l (30 Day Average, grab sample)
Minimum Dose	24 mJ/cm^2
Discharge Limit	200 Fecal Coliforms, 30 Day Geometric Mean

The UV system is not projected to reach its firm capacity until 2050. The system has capacity to expand in the future either by installing more or improved bulbs or adding another channel.

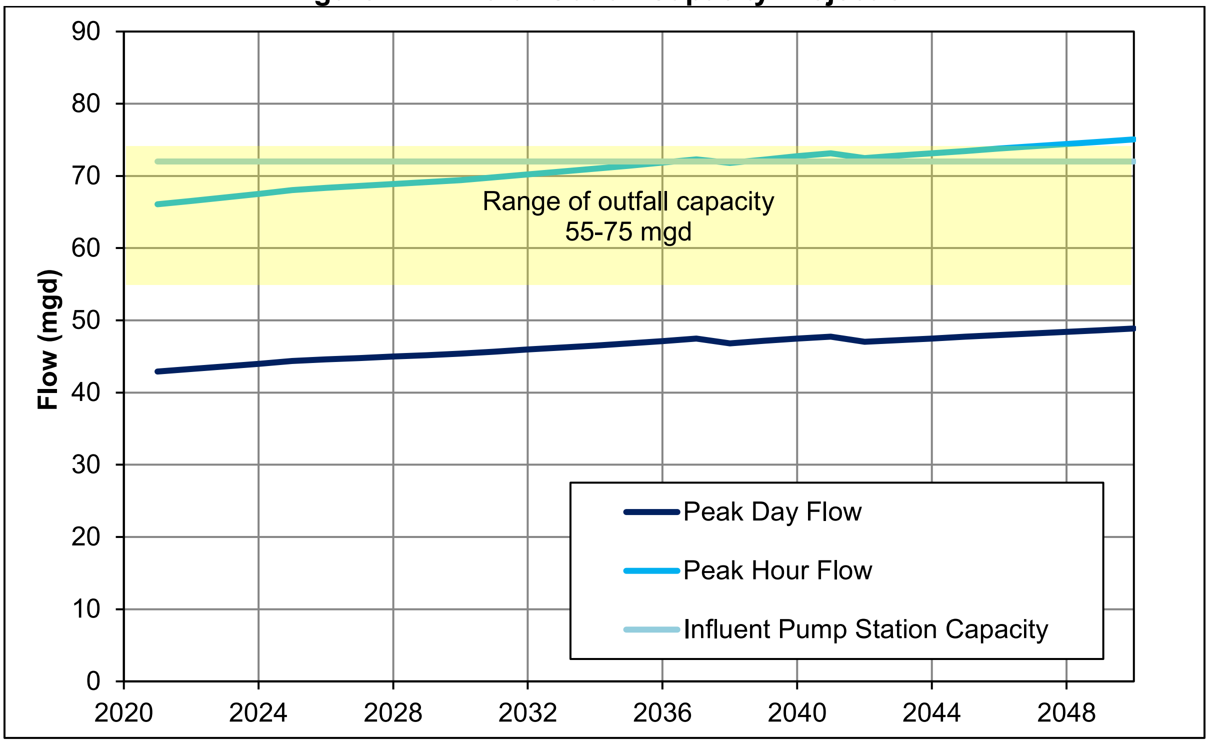
Figure 2-16. UV Disinfection System Capacity Projection



Effluent Pumping

There are four pumps discharging to the North Outfall, each with a nameplate capacity of 16.7 mgd at high tide. However, experience has suggested a real-world combined pumping capacity of 55 mgd at high tide, and pressure limitations in the outfall pipeline would limit flow increases above this level. Under normal tidal conditions, the outfall can pump up to 75 mgd. Two additional 15 mgd pumps can direct flow to the Fiddlehead Outfall under emergency circumstances, bringing the combined outfall capacity to 85 mgd. LOTT prefers to minimize use of the Fiddlehead Outfall as much as possible. Figure 2-17 shows the existing capacity of the North Outfall, not including Fiddlehead capacity, relative to the projected 10-year peak day flow.

Figure 2-17. North Outfall Capacity Projection



Currently, the North Outfall does not have capacity to discharge peak hour flows under high tide conditions. However, such conditions are rare, and the plant's influent flow equalization basins typically reduce peak hourly flow through the plant. Therefore, the plant has very rarely needed to discharge flow to the Fiddlehead Outfall. In addition, with the biological process improvements project, the first anoxic tanks are also now available for flow equalization.

A plan is currently being developed to increase the capacity of the North Outfall by replacing the 30-inch section of pipe, which is currently limiting pumping capacity, and by upgrading the existing pumps. After those improvements, the North Outfall will have the capacity to match the influent pump station under all tidal conditions. This project is currently planned for 2026.

UV Disinfection System and Outfalls Capacity Summary

Table 2-13 provides a summary of the capacity analysis and assumptions for the UV disinfection system and the North Outfall.

Table 2-13. UV Disinfection System and Outfalls Capacity Summary

					Condition		Utilization	
Unit Process	Capacity Basis	Units	Redundancy Basis	Capacity	Current	2050	Current	2050
UV Disinfection	Peak hour flow	mgd	Firm	75	62.2	77.0	88%	103%
North Outfall pumps	Peak hour flow	mgd	Firm	55	62.2	77.0	120%[1]	140%[1]
Fiddlehead Outfall pumps	Peak hour flow	mgd	Firm	30	N/A	N/A	N/A	N/A

1. Capacity rating is based on flow capacity at maximum tide conditions

2.5.2 Completed and Planned Projects

A list of planned projects is included in Table 2-14 below. The North Outfall Upgrade, planned for 2026, will address the current pressure limitations in the North Outfall pipeline and will help reduce future use of the Fiddlehead Outfall.

Table 2-14. Completed and Planned Projects

On-line	Name	Cost/Estimate	Status	Description
2013	Effluent Drive and Motor Control Centers Replacement	$1,692,754	Completed	Replaced effluent pump variable frequency drives and motor control centers
2020	Ultraviolet Disinfection Upgrades	$8,407,815	Completed	Upgrades 20-year-old TrojanUV3000™ system to new Trojan UV Signa™
2026	North Outfall Upgrade	$5,600,000	Planning	Remove existing bottleneck from outfall pipe run

2.5.3 Asset Management

A variety of mechanical equipment is involved in the operation of the UV disinfection system and the effluent pump station. Major equipment includes the UV disinfection system, North Outfall pumps, Fiddlehead Outfall pumps, and Budd Inlet Reclaimed Water Plant pumps.

Table 2-15. Existing UV Disinfection and Effluent Pumping Equipment

System	Count	Unit capacity	Motor	Date of last upgrade	Risk Score (1-6)
TrojanUV3000™ Disinfection System	6	11 mgd	N/A	2020	2
Effluent Pump Station Pumps – North Outfall	3 2	18 mgd 12 mgd	150 hp	1997 2001	3 3
Effluent Pump Station Pumps – Fiddlehead	2	15 mgd	125 hp	1980	3
Effluent Pump Station Pumps – Budd Inlet Reclaimed Water Plant	3	1 mgd	60 hp	2004	3

2.5.4 Operations and Maintenance

Operational costs for the UV disinfection system and outfalls include labor and energy. Labor costs are associated with operations staffing requirements for both systems. The major energy cost for the UV disinfection system is associated with the electrical energy needed to power the UV lamps. The outfalls also require electrical energy to operate the effluent pumps.

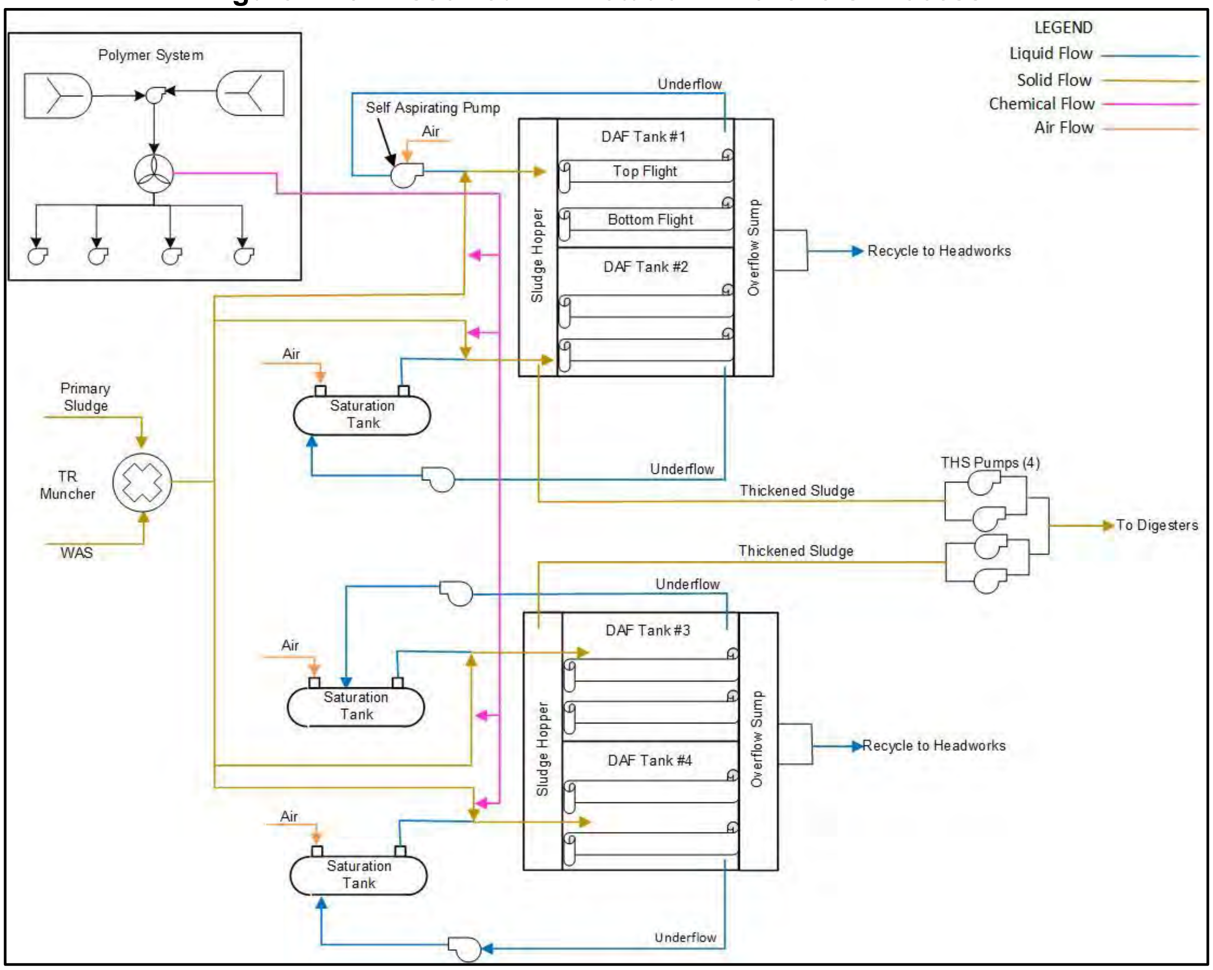
Maintenance of the UV disinfection system and outfalls includes maintaining the major equipment, as well as associated instruments, gates, and piping systems. Maintenance costs have increased in recent years due to the system approaching the end of its useful life.

Figure 2-18. UV Disinfection and Outfall – Historical Maintenance Expenditures

2.6 Sludge Thickening

The sludge thickening process removes excess water from the combined primary and waste activated sludge (WAS) flows prior to anaerobic digestion. The Budd Inlet Treatment Plant sludge thickening system consists of four rectangular dissolved air flotation thickener (DAFT) tanks. Polymer is used to enhance sludge thickening and performance of the DAFTs.

Figure 2-19. Dissolved Air Flotation Thickeners Process



Three of the DAFT tanks use a dedicated pressurization system to provide high-pressure air for flotation. A portion of the DAFT effluent is recycled to the pressurization tank, and the pressure is elevated to 40 pounds per square inch gauge (psig) using the plant's high-pressure service air. Pressurized flow from the tank passes through a pressure release valve, where it combines with the sludge and polymer feeds to the DAFT tanks. The decompressed air bubbles attach to the sludge and polymer particles float them to the surface. Skimmers collect the thickened sludge and push it to hoppers for transfer to the anaerobic digesters. Sludge that settles to the bottom of the DAFT tanks is drained back to headworks once each day. Overflow from the DAFTs drains back to headworks for re-processing with the plant influent flow. The fourth DAFT tank's air pressurization system is equipped with a self-aspirating pump. The new system saves energy and is easier to maintain. A project is currently in construction to replace the remaining three tanks with self-aspirating pumps and upgrade the bottom, top, and cross collectors.

2.6.1 Capacity Analysis

Common hoppers are shared between DAFT tanks 1 and 2 and tanks 3 and 4. The thickened sludge then combines in a common manifold and is carried to the digesters. The DAFT system was rated to a capacity of 29.7 pounds per square foot per day ($lb/ft^2/d$) in the 2006 Budd Inlet Treatment Plant Master Plan. However, the system has been operated at much higher loadings since that time. Historically, the system has been operated up to 60 $lb/ft^2/d$, although recently the system has struggled to perform under such loadings. A more conservative capacity estimate of 45 $lb/ft^2/d$ has been used to assess capacity needs for the sludge thickening system. Figure 2-20 depicts the firm and total capacity of the DAFT system. The system is projected to reach capacity in 2045.

Figure 2-20. Sludge Thickening Capacity Projection

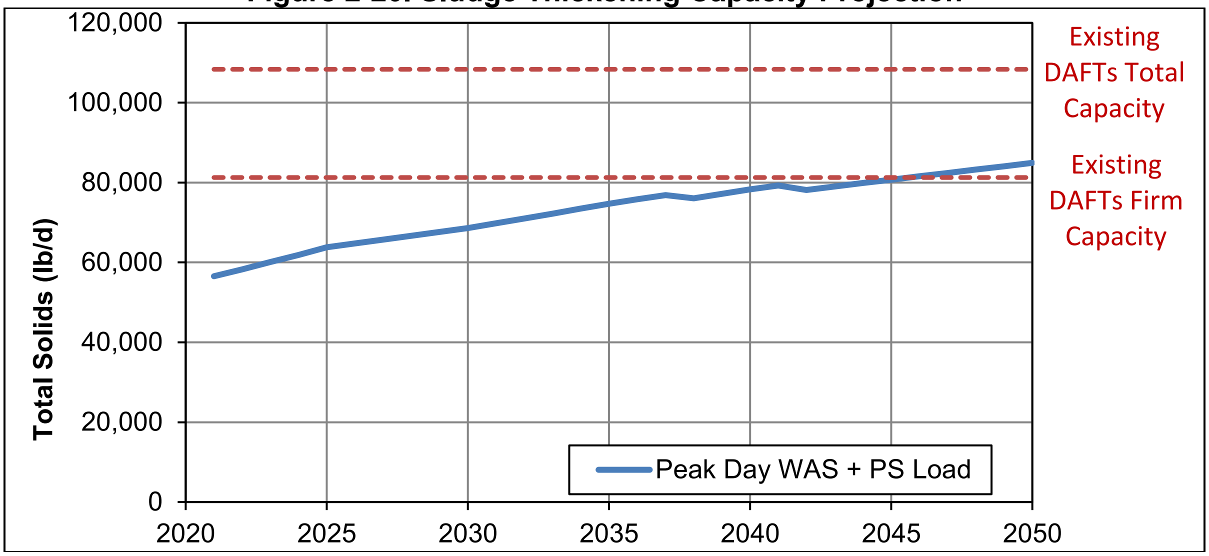


Table 2-16 provides a summary of the capacity analysis and assumptions for the sludge thickening system. Three DAFT units are projected to meet firm capacity needs through 2045. It is anticipated that capacity will be reassessed in the future once the system has been renovated or upgraded (planned for 2030).

Table 2-16. Sludge Thickening System Firm Capacity Summary

					Condition		Utilization	
Unit Process	**Capacity basis**	**Units**	**Redundancy Basis**	**Capacity**	**Current**	**2050**	**Current**	**2050**
DAF Thickening	Peak day solids load	$lb/d/ft^2$	Firm	45	31.3	47.0	70%	105%

2.6.2 Completed and Planned Projects

LOTT, with assistance from HDR Engineering, conducted a comprehensive evaluation of the DAFT system in 2016. Much of the equipment, originally installed in 1982, is reaching the end of its useful life. A project is currently in design upgrade the DAFT system to include the following:

- Replace the existing pressurization system in the remaining three DAFTs with self-aspirating pumps
- Replace bottom and top collectors in tanks 1, 2 and 3, and cross collectors in all tanks to include new drives and motors

Table 2-17. Completed and Planned Sludge Thickening Projects

On-line	Name	Cost/Estimate	Status	Description
2011	Thickening System Equipment Replacement	$372,196	Completed	Included the replacement of the sprocket, chains, collectors, and beaches for the top collectors for each of the 4 tanks
2012	DAFT Cover Replacement	$223,516	Completed	Replaced tank covers
2014	DAFT Polymer System Upgrade	$918,128	Completed	Added new polymer mixer and transfer pump and replaced metering pumps and associated controls and electrical
2015	DAFT Ventilation Fan Replacement	$42,764	Completed	DAFT ventilation fan replacement
2023	DAFT System and Thickened Sludge Pumping Upgrade	$7,858,896	Design	Includes upgrading the DAFT system with new bottom collectors, aspirating pumps, thickened sludge pumps, and process piping

2.6.1 Asset Management

For the existing DAFT system, there is a variety of mechanical equipment involved in sludge thickening operations. Major equipment includes the DAFT sludge collection flights, scum collection flights, as well as the thickened sludge pumps and pressurization system.

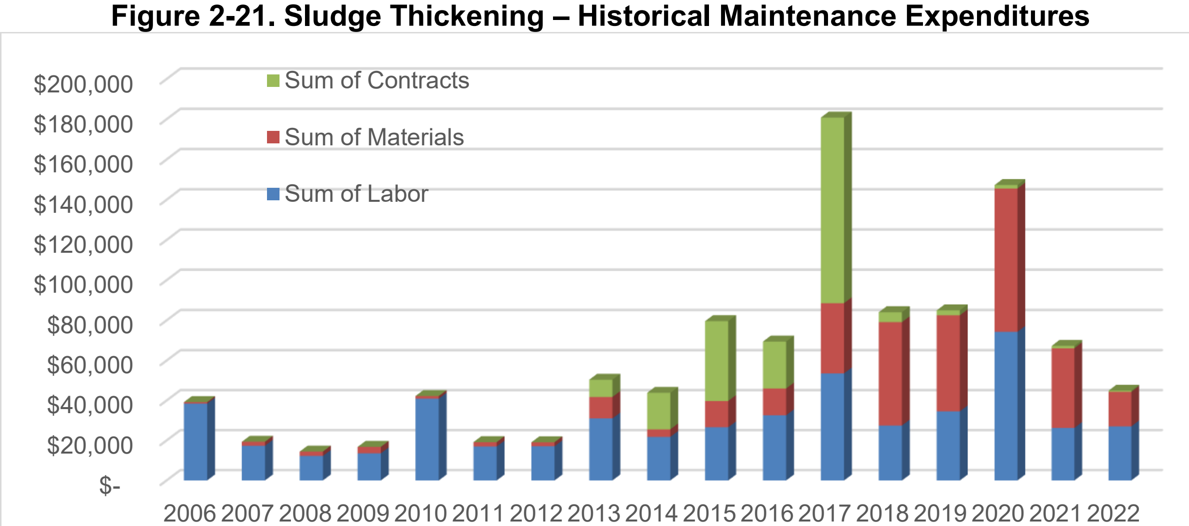
Table 2-18. Existing Sludge Thickening Equipment

System	Count	Unit capacity	Motor	Date of last upgrade	Risk Score (1-6)
Top Collectors	4	33 lb/ft^2-d	1.5 hp	2005	3
Bottom and Cross Collectors	4	33 lb/ft^2-d		1982	5
Pressurization System	4			1982	4
Polymer Metering Pumps	4	4 gpm	0.75	2014	2
Thickened Sludge Pumps	4	100 gpm	10 hp	2003	3

2.6.2 Operations and Maintenance

Sludge thickening operational costs includes labor, energy, and chemicals. Labor costs are associated with operations staffing requirements for the DAFTs and associated polymer supply system. Electrical energy is required to operate the DAFTs, polymer equipment, thickened sludge pumps, and odor control. Chemical costs are related to thickening polymer.

Figure 2-21. Sludge Thickening – Historical Maintenance Expenditures

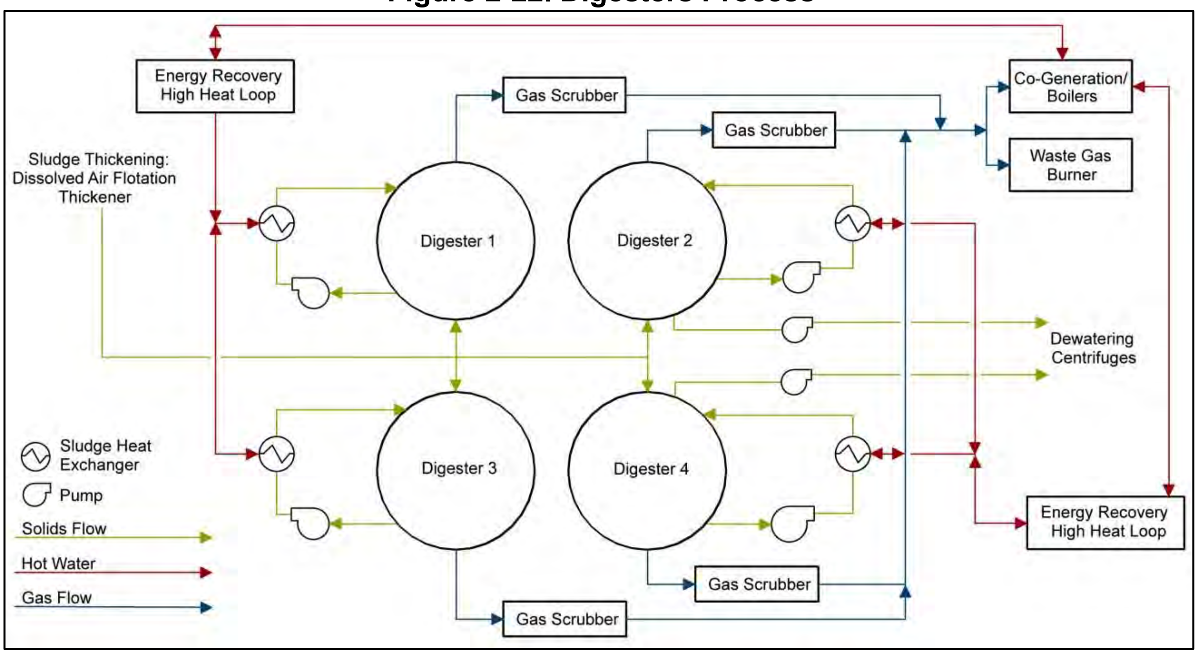


2.7 Digesters (Sludge Stabilization)

The anaerobic digesters biologically stabilize thickened sludge from the DAFTs by converting portions of the sludge to carbon dioxide, methane, and water. Following anaerobic digestion, the residual material (biosolids) is suitable for land application.

Anaerobic sludge digestion facilities include four 70-feet diameter, 30-feet deep concrete tanks with floating covers. Normal practice is to operate three digesters at a time, two being used for primary digestion, a third used for secondary digestion/solids holding, and the fourth digester being held in reserve.

Figure 2-22. Digesters Process



The anaerobic digester equipment building contains all process mechanical equipment needed to operate the digestion process. Thickened sludge is fed to the bottom of the digesters through the circulating sludge system in the center of the tank. Circulating sludge is withdrawn from each digester and pumped to sludge heat exchangers before being returned to the digesters to assist in keeping them completely mixed. The heat exchangers are used to maintain the temperature in the digester at 95° F, which is a permit requirement in order to meet Class B biosolids standards.

Methane gas from the digesters is the principal fuel for the high temperature heat loop system. Digested sludge is withdrawn from the bottom of the secondary digester and pumped to the solids dewatering centrifuges. Each digester is equipped with floating gasholder-type covers, which are supported by digester gas pressure. Each digester contains two separate gas-piping systems. The gas utilization system withdraws gas for use as fuel for the high temperature heat loop system. The second system uses digester gas to continuously mix the contents of the digester. A dedicated gas compressor recirculates digester gas through each digester.

Foul air from the anaerobic digester equipment building is collected and treated in the odor control system prior to release to the atmosphere.

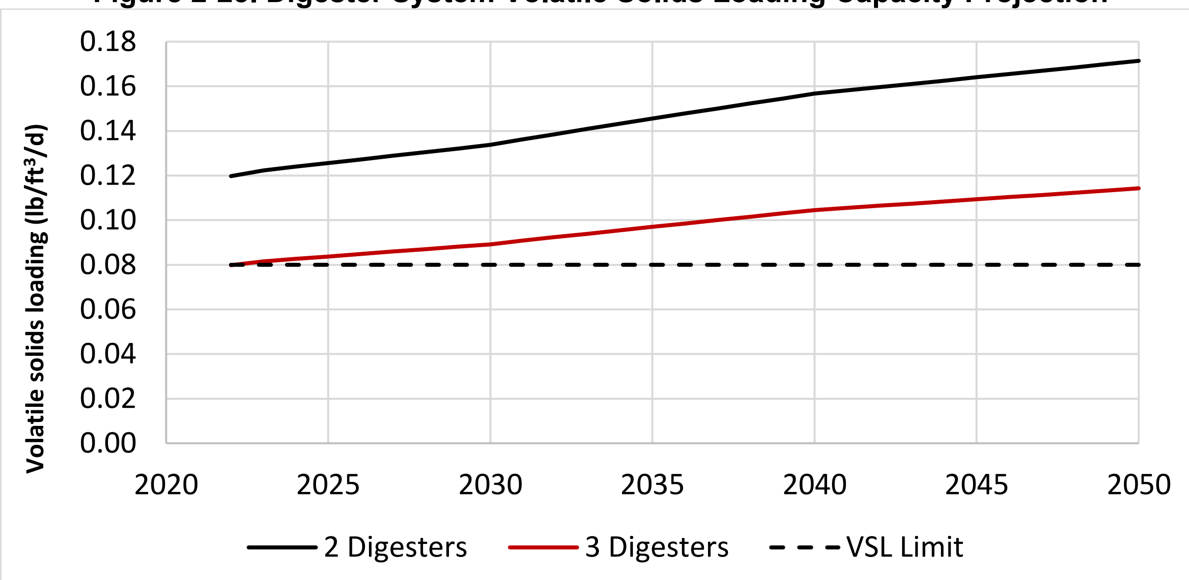
2.7.1 Capacity Analysis

Digester capacity is typically evaluated in terms of the hydraulic retention time and the volatile solids loading rate. The Environmental Protection Agency (EPA) biosolids rule requires a minimum detention time of 15 days. Historically, the plant has aimed to maintain an HRT of at least 25 days in order to allow stable operation. Most mesophilic digesters can operate at volatile solids loadings rate of 0.150 to 0.200 lb/ft^3/d. However, digesters with limited or inefficient mixing, such as the gas mixing employed at the plant, may have much lower loading capacities. Operations staff prefer to limit digester loading to 0.08 lb/ft^3/d.

Although the plant has four digesters, one unit is reserved for secondary digestion or solids holding, while another unit is reserved as a standby unit. This effectively limits primary digestion to two units.

Of the two capacity criteria, volatile solids loading is more critical. Figure 2-23 plots projected volatile solids loading for 2 and 3 primary digesters.

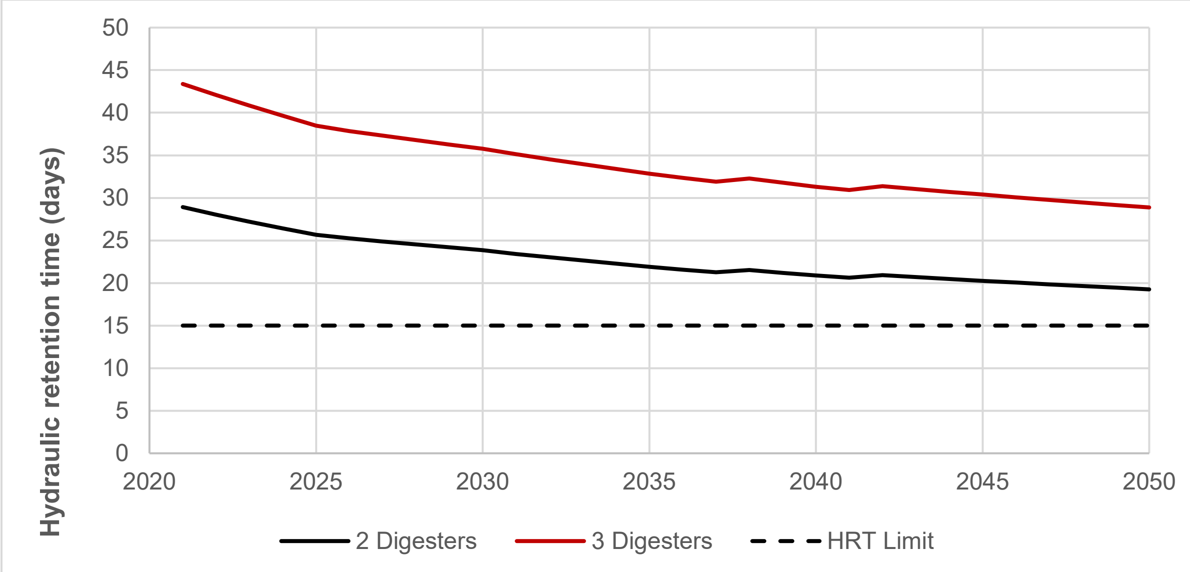
Figure 2-23. Digester System Volatile Solids Loading Capacity Projection



The system is currently operating at higher than preferred loading rate of 0.08 lb/ft^3/d with either two or three digesters in service. The more traditional planning guideline of 0.150 lb/ft^3/d would be reached in 2030 with two digesters in service.

Neither the two- or three-digester system is projected to come close to the regulatory limit of 15 days. However, the two-digester system would have an HRT of less than the preferred 25 days in 2025. Figure 2-24 plots the projected hydraulic retention time in the digester system.

Figure 2-24. Digester System Hydraulic Retention Time Projection



At the preferred operation condition, a hydraulic retention time of 25 days, the digester system is currently limited. To address these concerns, a project is currently underway to replace the existing gas mixers with linear motion mixers, install fixed covers, and implement a number of other modifications and equipment upgrades. In the long-term, capacity needs will be addressed by switching to thermophilic operation.

Table 2-19 below summarizes the digester loading projections and capacity.

Table 2-19. Digester System Capacity Summary

					Condition		Utilization	
Unit Process	Capacity Basis	Units	Redundancy Basis	Capacity	Current	2050	Current	2050
Anaerobic digestion	Peak 14-day volatile solids loading	$lb/ft^3/d$	2 digesters	0.08	0.11	0.17	143%	214%
Anaerobic digestion	Minimum 14-day hydraulic retention time	days	2 digesters	15	26.3	17.5	57%	86%

2.7.2 Completed and Planned Projects

A digester upgrade project is currently in design. This project will aim to increase loading capacity at least to the industry standard rate of 0.15 $lb/d/ft^3$. A future project to expand capacity is planned for 2045. A list of projects is included in Table 2-20.

Table 2-20. Completed and Planned Projects

On-line	Name	Cost/Estimate	Status	Description
2016	Digester Concrete Support Repair	$192,084	Complete	Repair degraded concrete supports
2018	Digester Building Drain Replacement	$286,580	Complete	Replace failing drain lines in the digester building
2023	Digester System Improvements Phase I	$3,012,057	Design	HVAC, air quality monitoring, and micro-aeration
2025	Digester System Improvements Phase II	$35,946,223	Design	Replace floating covers with fixed, new mixing, general asset replacement, and new waste gas burner
2045	Digestion Capacity Expansion	$4,428,593	Future	Thermophilic upgrades

2.7.3 Asset Management

A variety of mechanical equipment is involved in the operation of the digesters. Major equipment includes sludge transfer and recirculation pumps, gas circulating compressors, and sludge heat exchangers.

Table 2-21. Existing Digester Equipment

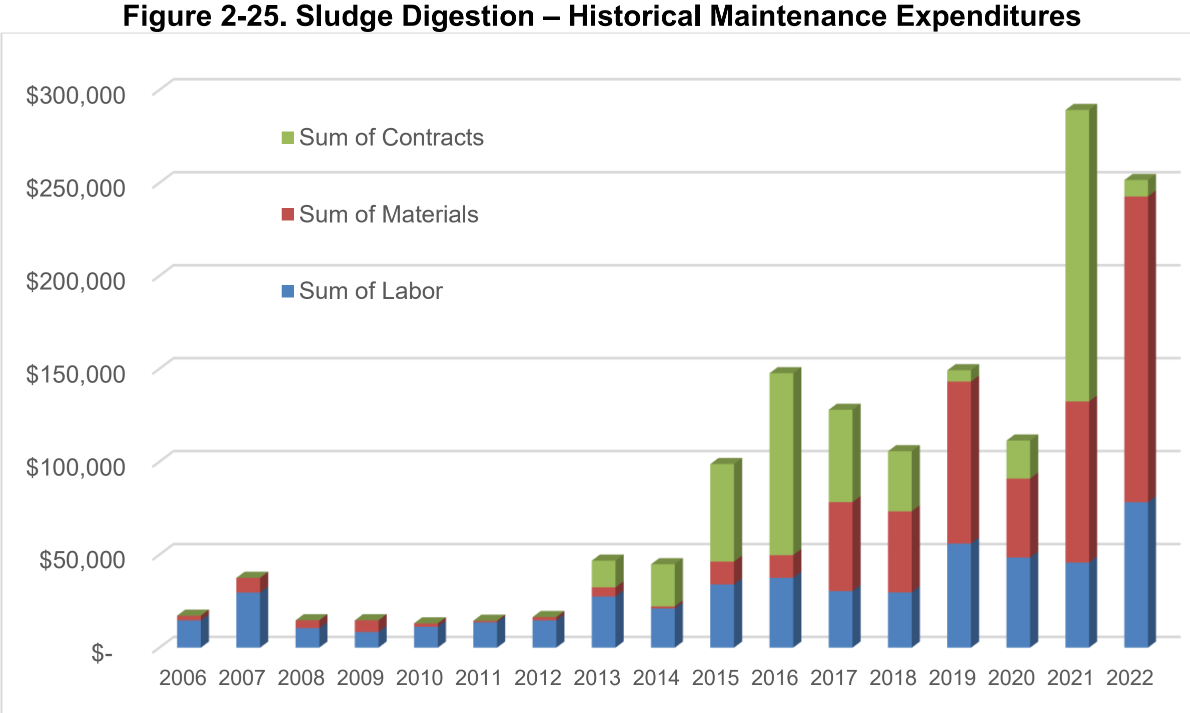
System	Count	Unit Capacity	Motor	Date of Last Upgrade	Risk Score (1-6)
Sludge Transfer Pumps	3	250 gpm	10 hp	1999	3
Sludge Recirculation Pumps	5	310 gpm	10 hp	2011	2
Gas Circulating Compressors	5	180 scfm at 25 psig	20 hp	2002	4
Sludge Heat Exchangers	5	1,500 mbtu/hr	N/A	2011	2
Waste Gas Flare	1		N/A	1998	4

2.7.4 Operations and Maintenance

Maintenance of the anaerobic digestion system includes maintaining the major equipment, as well as associated instruments and piping systems. The digester units themselves require periodic cleaning, which involves taking a unit out of service, pumping out the sludge, and removing grit and other debris that accumulates at the bottom. Such cleaning is required once every five years at a cost of $10,000 per event.

Digester operational costs include labor and energy. While energy to heat the digester is provided by the plant's cogeneration system, pumping and facility HVAC energy represents an annual cost.

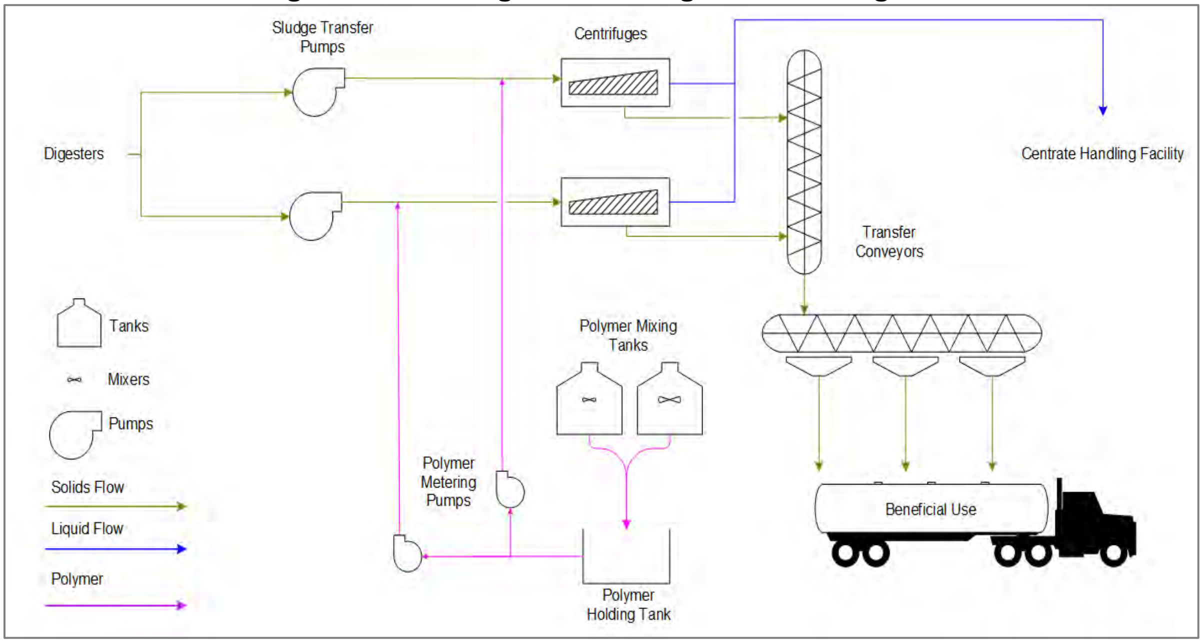
Figure 2-25. Sludge Digestion – Historical Maintenance Expenditures



2.8 Sludge Dewatering

The solids dewatering process removes excess moisture from anaerobically digested sludge (2-3% solids) to create biosolids (20-24% solids), thereby reducing land application hauling costs. Solids dewatering equipment consists of two centrifuges, dewatered sludge conveyance equipment, and loading facilities for sludge hauling trucks. All solids dewatering equipment is contained in the solids handling building.

Figure 2-26. Sludge Dewatering Process Diagram



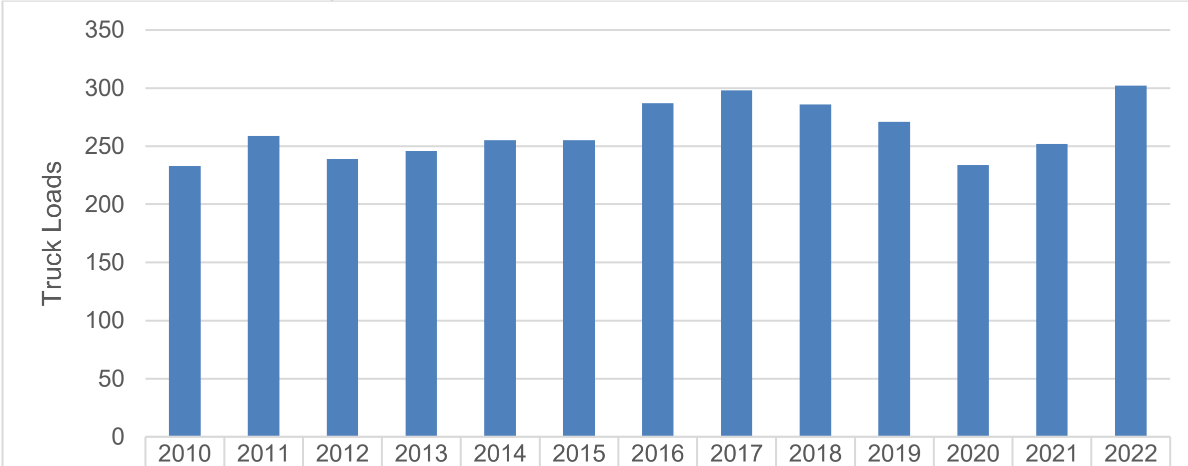
The 1979 facility was completely overhauled in 2018 to include two new Andritz D6LX centrifuges, each with a maximum capacity of 3,500 dry pounds per hour. It is assumed that the units will have a minimum 20-year life, at which time a new project will be initiated to upgrade the system. Firm capacity assumes one unit to remain as a standby to provide full redundancy.

The established level of service requires a truckload to be dewatered in no longer than 12 hours per day, 7 days per week (including centrifuge flushing). For optimum performance, the manufacturer's recommendation is to operate the centrifuges in an approximate range of 60-80% of the design capacity. The system will allow both centrifuges to run simultaneously if needed.

Polymer is added to improve dewatering performance. Dewatered biosolids are discharged from the centrifuges into a screw auger conveyor and transferred to the biosolids hauling trucks for land application. Effluent from the centrifuges (centrate) is drained to a centrate handling facility. Centrate is then metered into the secondary treatment process to control the ammonia loading.

Truck and trailer combination sets are alternatively used to transport biosolids to contracted land application sites in Eastern Washington. The trucks and trailers are all equipped with heavy-duty tarping systems and watertight tailgates to reduce odors and eliminate spillage. Depending on dewatering efficiency, 230 to 300 truckloads of biosolids are delivered for land application every year. The number of loads over the past thirteen years is shown in Figure 2-27.

Figure 2-27. Historical Biosolids Truckloads



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Loads	233	259	239	246	255	255	287	298	286	271	234	252	302

2.8.1 Capacity Analysis

With a single unit capacity of 3,500 lb/hr, the system can operate up to 20,000 lb/d for a 40-hour work week, or up to 42,000 lb/d when operated for an 84-hour work week (12 hours per day, 7 days a week). System capacity is projected on Figure 2-28.

Figure 2-28. Dewatering System Capacity Projection

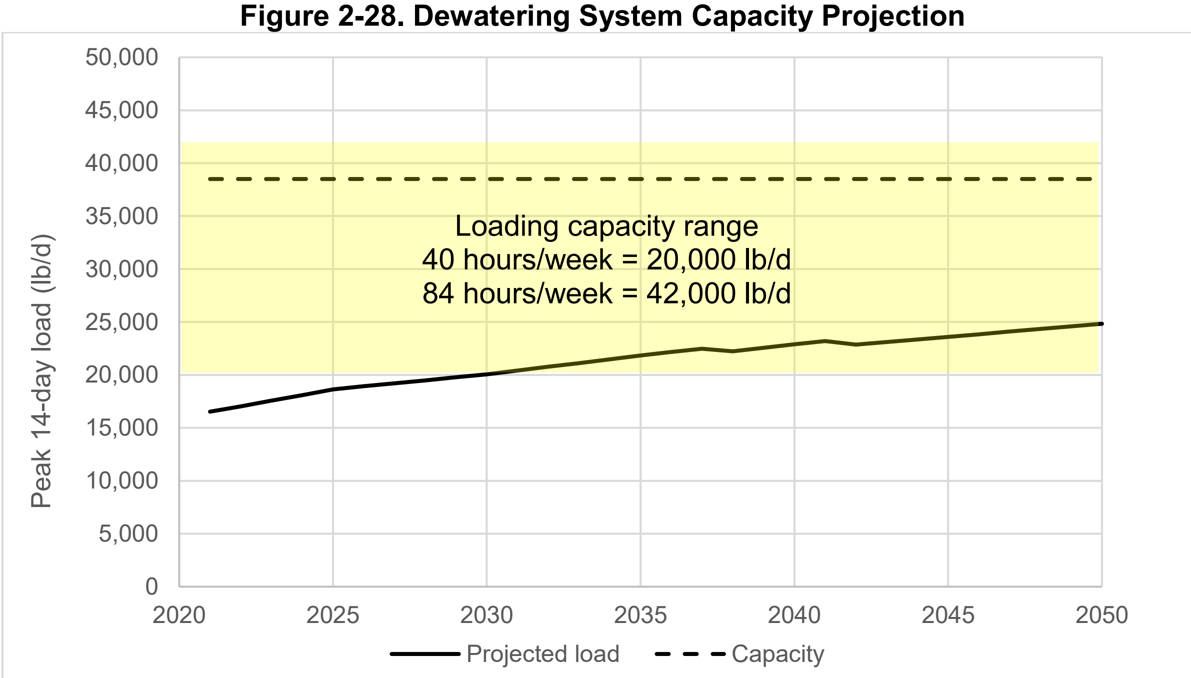


Table 2-22 below provides a summary of the capacity analysis and assumptions for the sludge dewatering system.

Table 2-22. Sludge Dewatering System Capacity Summary

					Condition		Utilization	
Unit Process	Capacity basis	Units	Redundancy Basis	Capacity	Current	2050	Current	2050
Dewatering	Peak 14-day solids loading	lb/hr	Firm	3,500	1,420	2,135	41%	61%

2.8.2 Completed and Planned Projects

Having just completed an overhaul of this system, no future projects are currently planned.

Table 2-23. Completed and Planned Sludge Dewatering Projects

On-line	Name	Cost/Estimate	Status	Description
2018	Sludge Dewatering System Upgrade	$12,972,813	Completed	Replace existing centrifuges and polymer addition system

2.8.3 Asset Management

A variety of mechanical equipment is involved in the operation of the sludge dewatering system. Major equipment includes the polymer system, sludge transfer pumps, centrifuges, and dewatered sludge conveyors. Table 2-24 lists the current equipment.

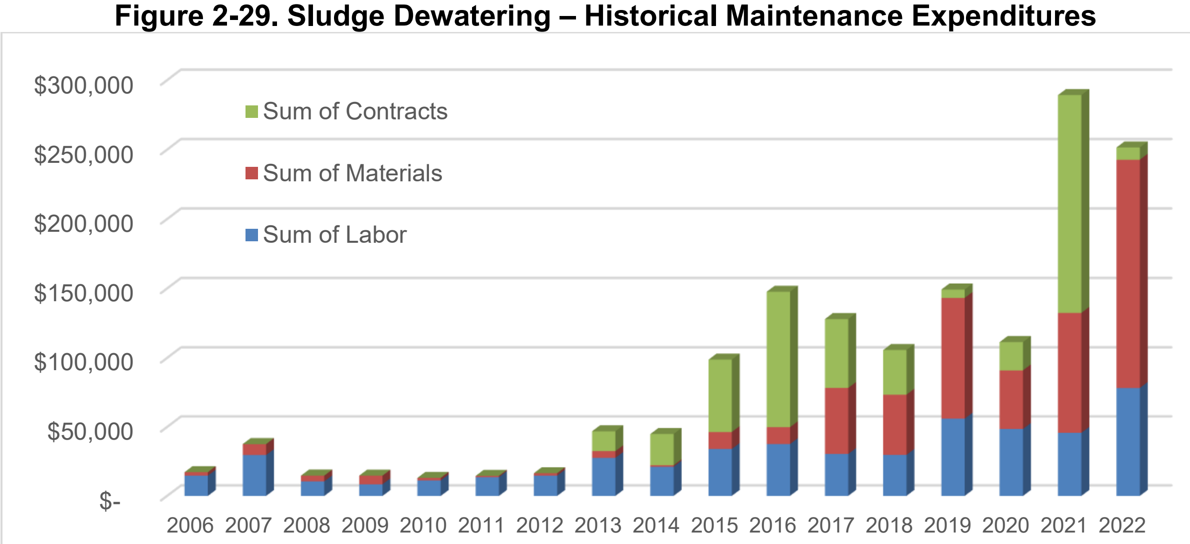
Table 2-24. Existing Sludge Dewatering Equipment

System	Count	Unit capacity	Motor	Date of last upgrade	Risk Score (1-6)
Centrifuges	2	3,500 lb-TS/hr	150 hp	2018	2
Polymer Feed Pumps	3	50 gpm	5 hp	2018	2
Dewatered Sludge Conveyors	1	variable	10 hp	2018	3

2.8.4 Operations and Maintenance

Sludge dewatering operational costs include labor, energy, chemicals, and disposal. Labor costs are associated with operations staffing requirements for the centrifuges and the associated polymer supply system. Detailed operations and maintenance labor costs are not available at this time. The centrifuges represent the main electrical energy consumer for the sludge dewatering system. Electrical energy is also required to pump the sludge from the digesters to the centrifuges, as well as for operation of the polymer equipment and dewatered sludge conveyance equipment. In addition, sludge dewatering requires chemicals to enhance performance. LOTT currently spends approximately $180,000 per year on dewatering polymer.

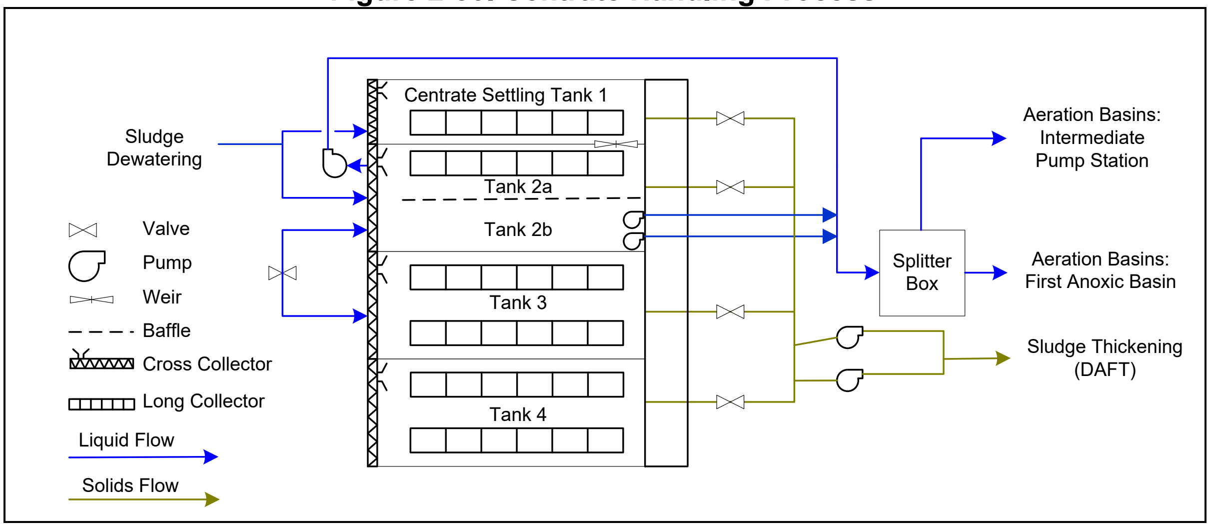
Figure 2-29. Sludge Dewatering – Historical Maintenance Expenditures



2.9 Centrate Management

The centrate handling process removes easily settleable material from the centrate and provides storage for equalizing the ammonia load sent to the biological treatment process. This process includes flow measurement, ammonia concentration monitoring, seven rectangular sedimentation tanks modified to provide settling and storage of centrate, two centrate discharge pumps, and two centrate sludge pumps as illustrated in Figure 2-30.

Figure 2-30. Centrate Handling Process



Centrate from the solids dewatering process enters the centrate handling facility through a 12-inch HDPE line. Centrate can be sent to either Centrate Tank 1 or 2a, though during normal operation, flow is directed to Tank 1, where any remaining solids are allowed to settle. Longitudinal collectors move the settled sludge to the sludge hoppers where it is pumped to the dissolved air flotation thickeners via two positive displacement, progressing cavity pumps.

Clarified centrate overflows from tank 1 to tank 2a via a weir at the north end and then flows south through tank 2a and back north through tank 2b. Centrate is metered into either the first aeration or first anoxic basins via the diversion structure via two self-priming centrifugal pumps.

2.9.1 Capacity Analysis

Capacity related to the centrate handling facility is dependent on a variety of factors to include solids dewatering (centrifuging) duration and performance, centrate dilution, and the amount and concentration of centrate that can be sent secondary treatment process due to performance issues or compliance periods (i.e. permit discharge limitations).

There are seven tanks, each with a volume of 100,000 gallons, totaling 700,000 gallons of storage capacity. The plant produces an average of 50,000 gallons per day of centrate, which is diluted up to a ratio of 3:1 to minimize struvite formation. Up to 270,000 gallons of diluted centrate may be sent to this system on a peak day. During normal operation, only tanks 1, 2a, and 2b are used.

2.9.2 Completed and Planned Projects

Design is underway for a project to rehabilitate the centrate handling building to include replacement of the roof and odor control systems, as well as seismic retrofits and electrical improvements. Construction is scheduled to begin in 2024. The project will also re-establish the ability to route raw degritted sludge (RDS) from headworks through tanks 3 and 4, allowing the facility to provide additional primary sedimentation treatment during peak wet weather events.

In addition, with the completion of the Biological Process Improvements project, the first anoxic tanks will no longer be needed for the biological process. In the near-term, the first anoxic basins will provide for wet weather flow equalization. Future uses of the basins identified through the master planning effort could include centrate treatment, which could be added in the decommissioned centrate storage basins, and one train of the former first anoxic basin. The estimated cost is $3.2 million and could be implemented in stages. This treatment would provide for bioaugmentation using the centrate treatment basins to incubate a highly efficient nitrifying population, which would seed the main biological treatment process and improve efficiency. The project is anticipated to result in more stable and resilient operation, and the improved efficiency may reduce solids loading to the secondary clarifiers, thereby extending the capacity of the secondary process.

Table 2-25. Completed and Planned Centrate Handling Projects

On-line	Name	Cost/Estimate	Status	Description
2009	Centrate Metering Pump	$30,000	Completed	Replace centrate metering pump
2017	Centrate Handling Improvements	$942,106	Completed	Upgrades the centrate pumping system to include adding two new pumps, instrumentation, and baffles
2024	Centrate Building Rehabilitation	$9,514,857	Design	Replace roof structure, odor control system, electrical upgrades, and add covers to the tanks
2027	Centrate Handling and Treatment	$3,200,000	Future	Install new centrate treatment system

2.9.3 Asset Management

Major equipment involved in centrate handling includes: centrate pumps, longitudinal collectors, cross collectors, an odor control system, and sludge withdrawal pumps, which are included in Figure 2-30 and summarized in Table 2-26 below.

Table 2-26. Existing Centrate Handling Equipment

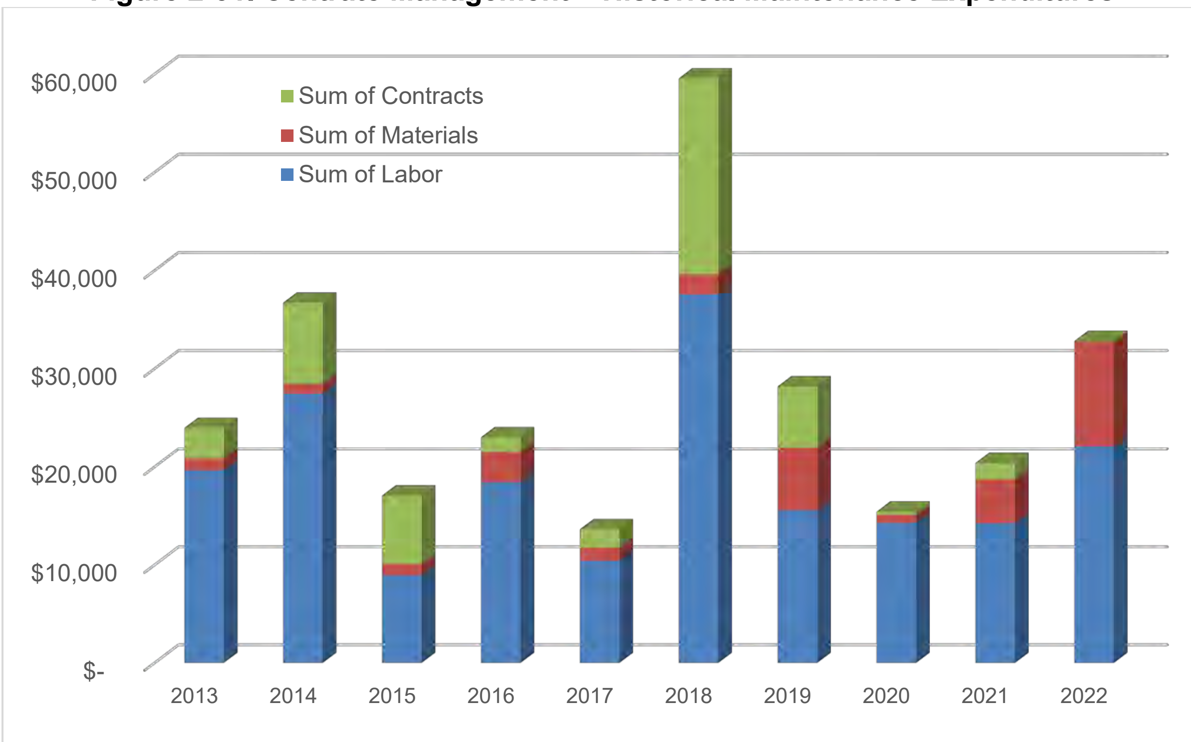
System	Count	Unit Capacity	Motor	Date of Last Upgrade	Risk Score (1-6)
Tanks	7	100,000 gal	NA	1955	3
Cross Collectors	6		0.5 hp	2017	2
Longitudinal Collectors	6		0.75 hp	2009	3
Centrate Pumps	2	130-425 gpm	10 hp	2017	2
Sludge Pumps	2	5-90 gpm	5 hp	2017	3

Maintenance costs to include labor, materials, and contracted services captured in LOTT’s CMMS are included in Figure 2-31.

2.9.4 Operations and Maintenance

Operational costs for the centrate handling facility include labor and energy. Labor costs are associated with operations staffing requirements for metering centrate to the secondary process. Electrical energy is required to operate the odor control fans, bottom flights, cross collectors, sludge pumps, and centrate metering pumps. Figure 2-31 includes the maintenance costs from the time it was operated solely for centrate management.

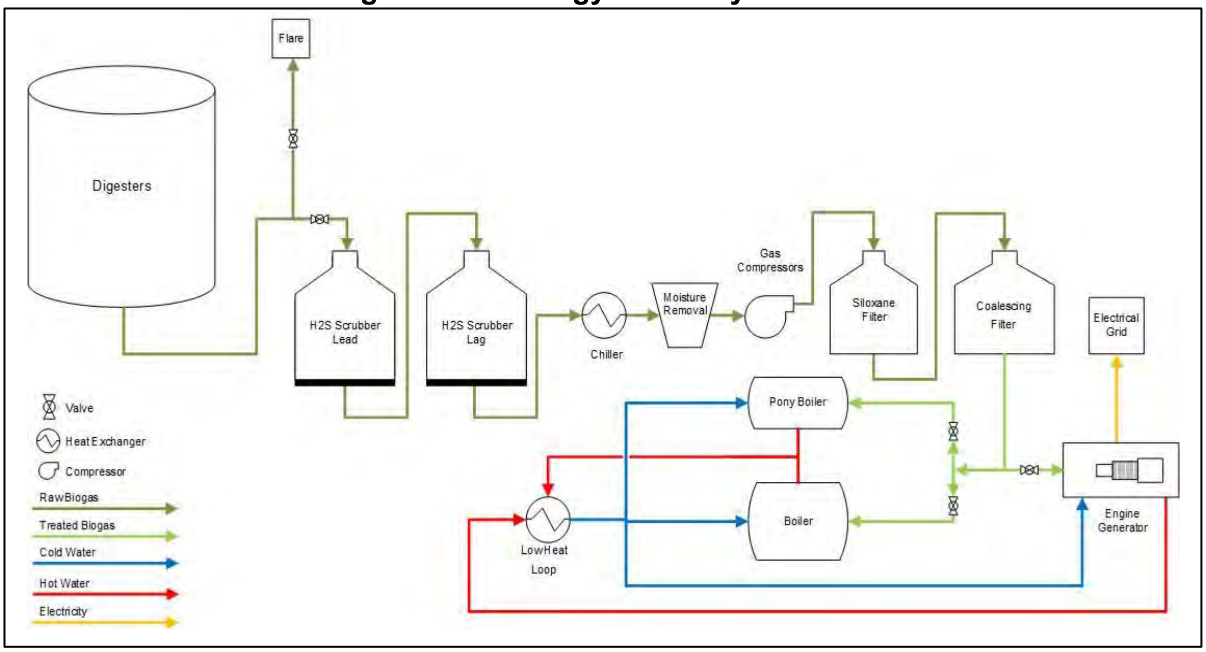
Figure 2-31. Centrate Management – Historical Maintenance Expenditures



2.10 Energy Recovery

The digestion process produces methane gas. LOTT utilizes this gas in an engine generator which produces electricity as well as heat. Additionally, two boilers are available to combust the methane gas to produce heat used to maintain the low heat loop. The system is illustrated in Figure 2-32.

Figure 2-32. Energy Recovery Process



Raw digester gas contains hydrogen sulfide and must be conditioned before it can be utilized by the engine generator or boilers. The gas conditioning system consist of two hydrogen sulfide (H_2S) scrubber tanks which use a media to strip off the H_2S. The gas then passes through a chiller to drop out the moisture. The gas is then reheated and sent through the siloxane scrubber. The scrubbed gas is then utilized in the engine generator or boilers to create electricity and heat.

2.10.1 Completed and Planned Projects

The original cogeneration project was completed in 2011 through a Puget Sound Energy (PSE) grant. A long block overhaul of the Jenbacher engine generator was completed in 2018. A project is underway to evaluate beneficial biogas utilization options for when the Jenbacher reaches the end of its useful life.

Table 2-25. Planned/Completed Energy Recovery Projects

On-line	Name	Cost/Estimate	Status	Description
2011	LEED Co-Generation	$3,002,636	Completed	Installed gas conditioning system and GE Jenbacher Engine Generator
2015	Boiler Upgrade Project	$2,205,675	Completed	Replaced 1980 boiler with two new boilers (one large and one small)
2018	Engine Generator Replacement	$401,299	Completed	Replace roof structure, odor control system, electrical upgrades, and add covers to the tanks
2027	Biogas Utilization Upgrades	$6,300,000	Planning	Select and implement preferred biogas utilization strategy anticipating engine generator end of life

2.10.2 Asset Management

Major equipment involved in the energy recovery system includes the GE Jenbacher Engine Generator, biogas boilers, natural gas boilers, H2S scrubber tanks, siloxane skid, gas compressors and chiller, which are included in figure 2-32 and summarized in table 2-26 below.

Table 2-26. Existing Energy Recovery Equipment

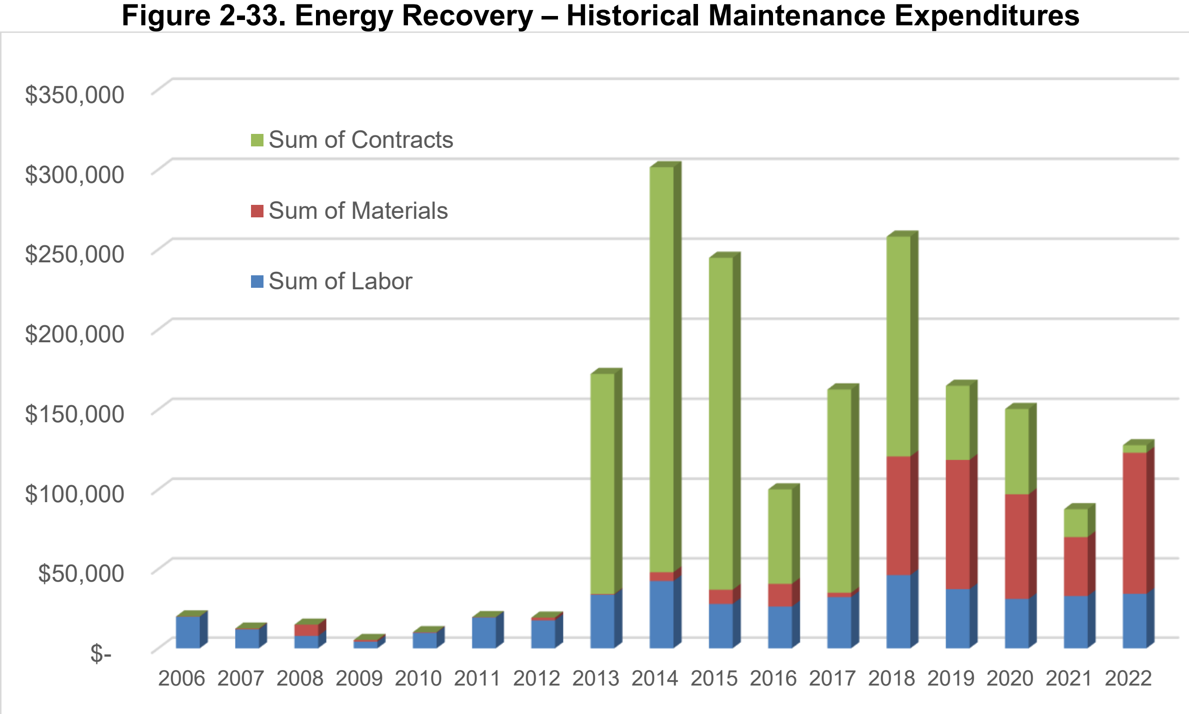
System	Count	Date of Last Upgrade	Risk Score (1-6)
GE Jenbacher Engine Generator	1	2018	3
Large biogas boiler	1	2015	2
Pony Boiler	1	2015	2
Natural Gas Boilers	2	2011	4
H_2S Scrubber Tanks	2	2011	3
Siloxane Scrubber Tanks	2	2011	3
Gas compressors	3	2011	4
Chiller	1	2018	3

Maintenance costs to include labor, materials, and contracted services captured in LOTT's CMMS are included in Figure 2-33.

2.10.3 Operations and Maintenance

Operational costs for the energy recovery system include labor, scrubbing media, and natural gas. Labor costs are associated with general operations and swapping of the gas conditioning system media. Natural gas is used to supplement heat when the biogas conditioning system is not available. Figure 2-33 includes the maintenance costs from the time it was operated solely for energy recovery.

Figure 2-33. Energy Recovery – Historical Maintenance Expenditures



2.11 Ongoing and Planned Projects Overview

As described in the previous sections, a number of projects are either planned or currently underway to address anticipated capacity limitations. The following highlights recent and upcoming large-scale projects. For more information regarding future planned projects, refer to the 2023-2024 Budget and Capital Improvements Plan and the 2050 Master Plan.

- The Biological Process Improvements project was completed in spring 2023 and optimized the biological treatment processes at the Budd Inlet Treatment Plant by reconfiguring the existing first aeration basins. It also reduced the energy required to accomplish nitrogen removal by replacing oversized blowers and minimizing recycle pumping. The new system is performing well, however several years of operation data will be necessary before establishing a firm understanding of performance levels. Capacity projections for the biological nutrient removal system and secondary clarifiers will be reassessed once performance levels for the new system are well established.

- Hydraulic limitations at the influent pump station will be addressed through an expansion project. The project is planned for 2025 and will reduce the 2050 risk of bypass to the Fiddlehead Outfall to less than once in ten years.

- A project to rehabilitate the Centrate Handling Facility is currently under design. Improvements will also include re-establishing the ability for the facility to accept flow from Headworks during high flow events, relieving primary sedimentation basin hydraulic capacity constraints.

- A Headworks and Solids Handling Building air handling project is planned to route odors to the South Scrubber and improve ventilation in the two buildings. This will include decommissioning of the North Scrubber.

- Projected limitations in the anaerobic digesters have resulted in a two-phase project. Phase 1 updated the air handling and life safety alarm systems. Phase 2, currently in design, will renovate the existing digesters with fixed covers, new mixers, and a new waste gas burner. These improvements are expected to eliminate existing volatile solids loading limitations and extend capacity another 20 years. Phase 2, currently planned for 2045, would further expand capacity through thermophilic operation.

- Capacity of the North Outfall is planned to be expanded in 2026 by removing an existing 36-inch bottleneck in the pipeline and allowing discharge of the full capacity of the influent pump station. This will bring the effluent pumping capacity up to 75 mgd at high-high tide.

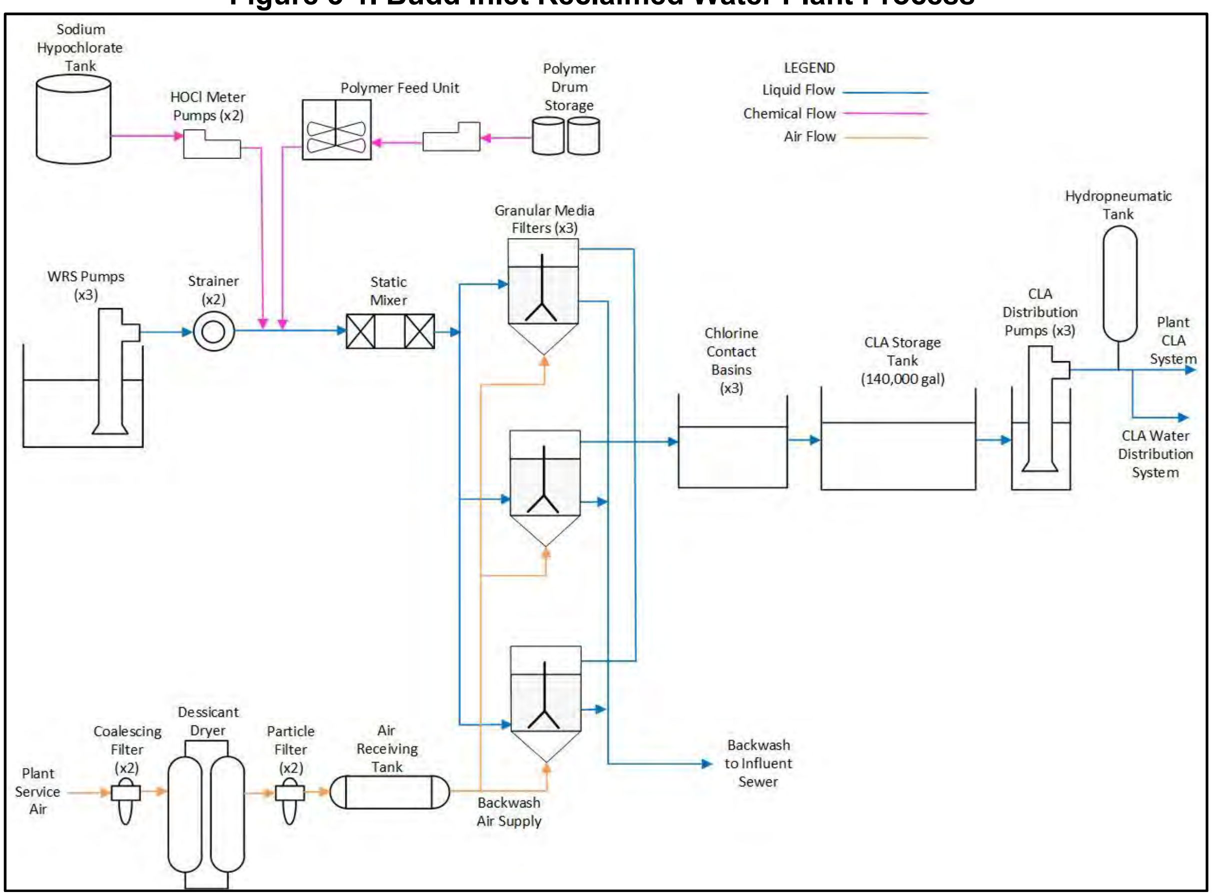
3. Reclaimed Water Production Capacity

Reclaimed water production capacity is an essential component of LOTT's overall treatment program. In response to community questions about residual chemicals from pharmaceuticals and personal care products, LOTT completed the multi-year Reclaimed Water Infiltration Study in 2022. The purpose of the study was to evaluate risks from infiltrating reclaimed water into groundwater because of chemicals that may remain in the water from products people use every day, and determine what can be done to reduce those risks. Study findings indicate that the practice of using Class A reclaimed water for groundwater recharge is safe and responsible. That information and the associated cost/benefit analysis regarding future options for higher levels of treatment helped to inform the master planning effort, which was completed in early 2023.

3.1 Budd Inlet Reclaimed Water Plant

The Budd Inlet Reclaimed Water Plant (BIRWP), commissioned in 2004, produces Class A reclaimed water using sand media and sodium hypochlorite to filter and disinfect secondary effluent. The facility is capable of treating up to a maximum of 1.5 mgd in the form of three bays of sand filters (0.5 mgd each). Some water is used for internal processes at the Budd Inlet Treatment Plant and the Capitol Lake Pump Station. The City of Olympia also has various customers in the downtown and Port Peninsula area that irrigate using reclaimed water. With the completion of the Tumwater Reclaimed Water Storage Tank in 2015, the City of Tumwater also uses reclaimed water to irrigate the Tumwater Valley Municipal Golf Course. Approximately 204.2 million gallons of reclaimed water were produced and put to beneficial use in 2022.

Figure 3-1. Budd Inlet Reclaimed Water Plant Process



Completed and Planned Projects

In 2015, HDR Engineering was contracted to update the 2010 Budd Inlet Reclaimed Water Plant Reclaimed Water Demand and Supply Analysis report. The update concluded that LOTT is currently able to meet the instantaneous demands of its existing customers. The report also identified potential future users of reclaimed water, which could include the Washington State Capitol Campus.

A project exists in the Capital Improvements Plan (CIP) to add 1.5 mgd of capacity to this system, allowing for up to 3 mgd of treatment. Master planning confirmed that, based on the LOTT partner jurisdiction estimates of future reclaimed water needs, expansion to 3 mgd is likely adequate to meet demand through the year 2070. While the expansion project is tentatively scheduled for 2040, timing may be driven by demand for the resource.

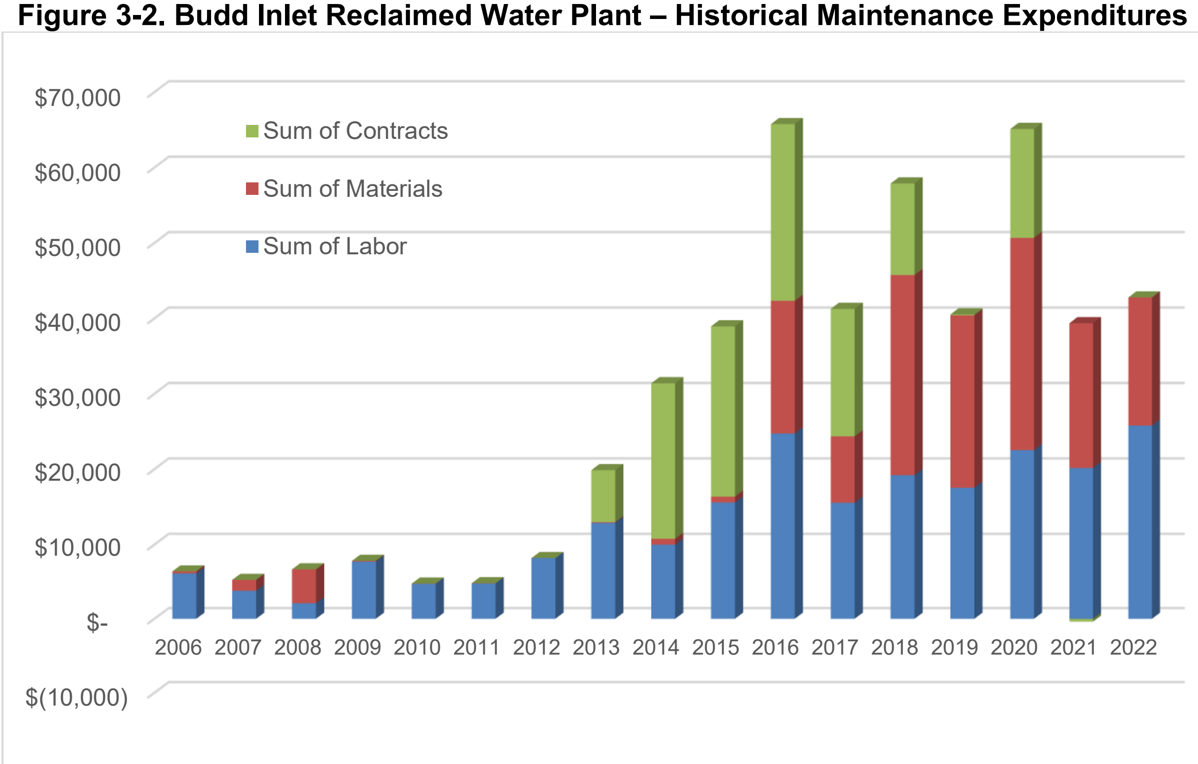
In 2015, a project was completed to replace deteriorating pipes, valves, seals, and flow meters, and upgrade the hypochlorite disinfection system.

Table 3-1. Completed and Planned Project Summary

On-line	Name	Cost/Estimate	Status	Description
2015	BIRWP Improvements	$425,990	Completed	Upgrades to the existing facility
TBD	BIRWP Expansion to 3 mgd	$4,750,000	Future	Add 1.5 mgd of capacity to existing facility with booster pump station expansion

Historical maintenance costs for the BIRWP are included in Figure 3-2.

Figure 3-2. Budd Inlet Reclaimed Water Plant – Historical Maintenance Expenditures

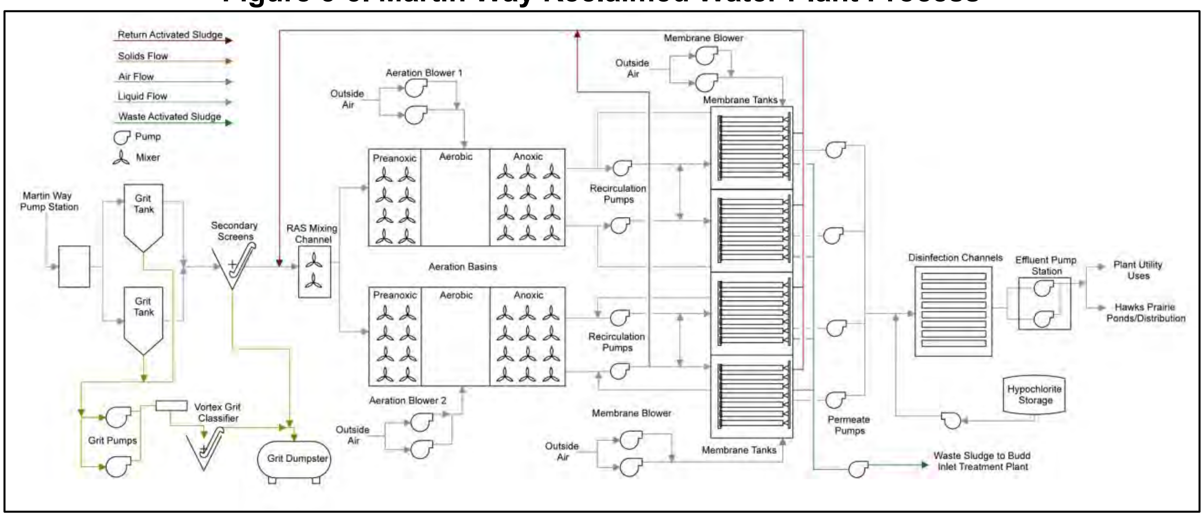


3.2 Martin Way Reclaimed Water Plant

The Martin Way Reclaimed Water Plant (MWRWP) is a membrane bioreactor, treating raw wastewater to Class A reclaimed water. The Martin Way Pump Station performs preliminary screening of the raw wastewater, which is pumped to the plant for treatment. The plant has a current treatment capacity of approximately 1.5 mgd, due to diurnal wastewater flow fluctuations and overall flow limitations in the portion of the collection system feeding the satellite facility. Reclaimed water produced at the plant is pumped to LOTT's Hawks Prairie Ponds and Recharge Basins for groundwater infiltration. Reclaimed water is also utilized at the Woodland Creek Groundwater Recharge Facility, a water rights mitigation project developed by the cities of Lacey and Olympia.

In 2022, the MWRWP produced 495 million gallons of reclaimed water, of which 317 million gallons was diverted to the Hawks Prairie Ponds, 73 million gallons to the Woodland Creek Groundwater Recharge Facility, and the remainder was used for internal processes at the Martin Way treatment plant and pump station.

Figure 3-3. Martin Way Reclaimed Water Plant Process



The MWRWP was designed to be expandable up to 5 mgd of treatment capacity with additional construction at the site. Process tanks for the third mgd of treatment capacity were included as part of the original construction project. Additional property adjacent to the site shown in Figure 3-4 was secured from the City of Lacey through a perpetual easement and provides enough space to expand the capacity to 8 mgd if needed.

The current plan is to expand the plant as soon as there are sufficient raw wastewater flows at the Martin Way Pump Station. Based on the updated flows and loadings projections this may not occur until 2038.

Flow availability is largely dependent on the septic conversion schedule for the City of Lacey. There are roughly 24,800 parcels within the service boundary of the Martin Way Pump Station, which feeds the MWRWP. Of those parcels, 12,700 are sewered, 9,400 have on-site septic systems, 700 are vacant, and 2,000 are undeveloped. In terms of flow, there is 2.2 mgd of base flow currently discharging to on-site septic systems within this basin. The current model projects that 3,600 septic parcels in this basin will be sewered by 2050 (38% of total). At that point, approximately 2 mgd of base flow will discharge to on-site systems. The City of Lacey assumes 2% a year will be connected to the system in their 2015 Sewer Comprehensive Plan update.

Figure 3-4. Martin Way Reclaimed Water Plant Expansion Easement

Table 3-2 lists the timing of flow availability to the MWRWP. These projections are based on the assumption that parcels with existing septic tanks in the Tanglewilde and Thompson Place areas will be 60-70% connected to sewer by 2050. Projections also include 500,000 gallons a day reserved as base flow in the system to ensure sufficient flow remains in the sewers to convey waste activated sludge from the reclaimed water plant to the Budd Inlet Treatment Plant.

Table 3-2. Flow Availability for the Martin Way Plant[1]

	Year	
Flow (mgd)	Without Flow Equalization	With Flow Equalization
1	Existing	Existing
2	Existing	Existing
3	2038	2034
4	>2050	2046
5	>2050	>2050
6	--	>2050

1. Allows for 500,000 gpd of base flow remaining in the system.

Production capacity at the MWRWP could potentially be increased with the addition of flow equalization capacity at the plant. Excess flow during the day could be sequestered for treatment at night, resulting in a relatively constant flow to the membranes. Flow equalization would therefore eliminate the constraint of overnight low flows. Figure 3-5 demonstrates the extreme amount of variability, as overnight flow reaches as low as 40% of the daily average.

Figure 3-6 depicts the base sanitary flow projection at the Martin Way Pump Station. Up to 5 mgd will be available at this location by 2050, with another 1 mgd added with full septic system conversion. Even during the summer, there is likely to be some component of inflow and infiltration, meaning that actual average daily flows should be slightly higher than those included in this evaluation.

Figure 3-5. Diurnal Flow at the Martin Way Pump Station

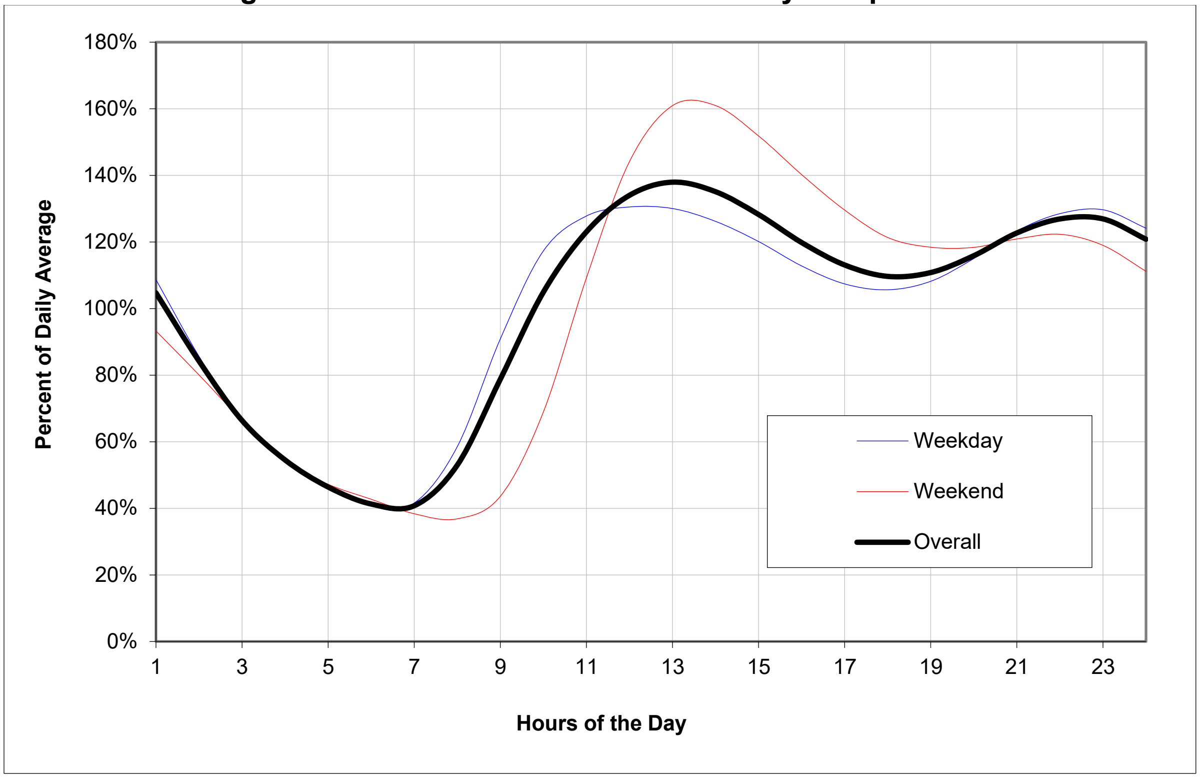
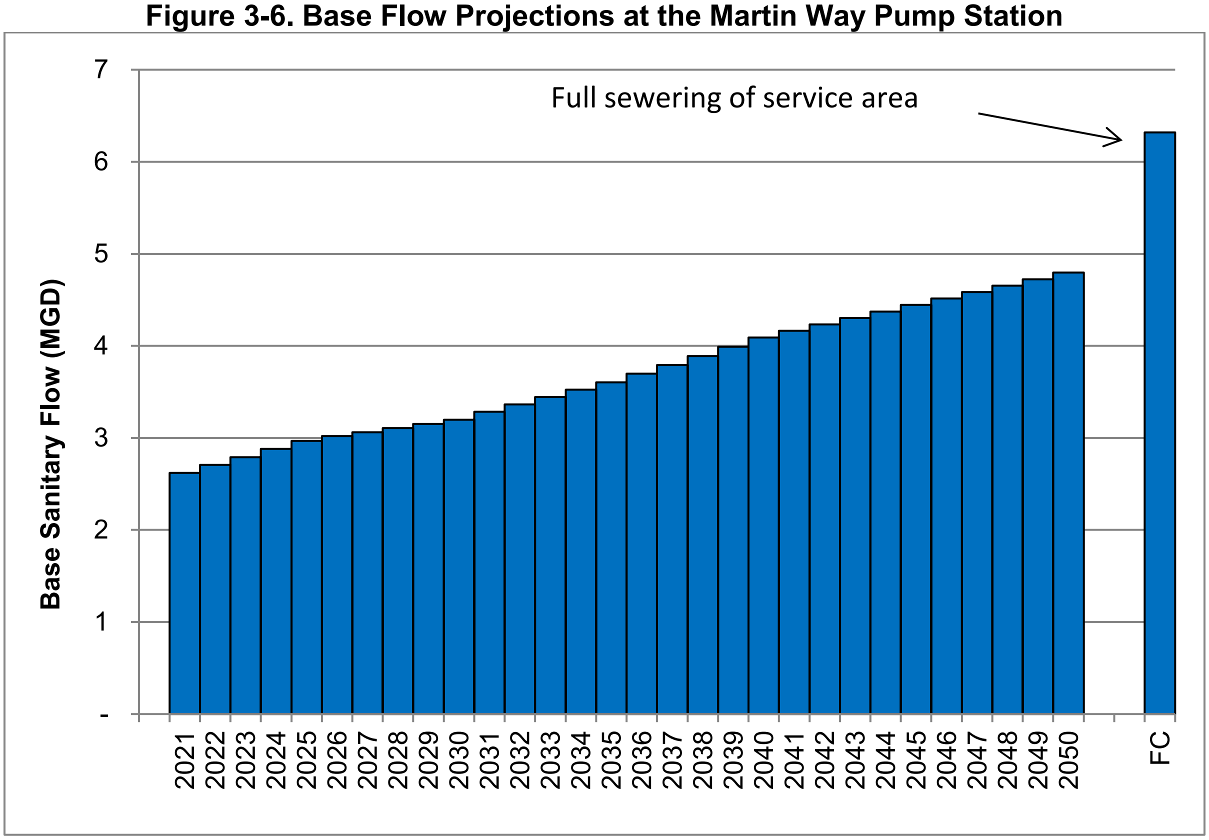


Figure 3-6. Base Flow Projections at the Martin Way Pump Station



Completed and Planned Projects

Consistent and reliable operation of the facility is increasingly important now that the Woodland Creek Groundwater Recharge Facility is on-line. Recently completed improvements at the Martin Way Reclaimed Water Plant include an additional blower and a redundant drum screen. Replacement of the membranes is scheduled for 2023. Additional anticipated improvements include replacement of aging process valves and equipment as well as the DeviceNet control system to improve process reliability and control, currently scheduled for 2027.

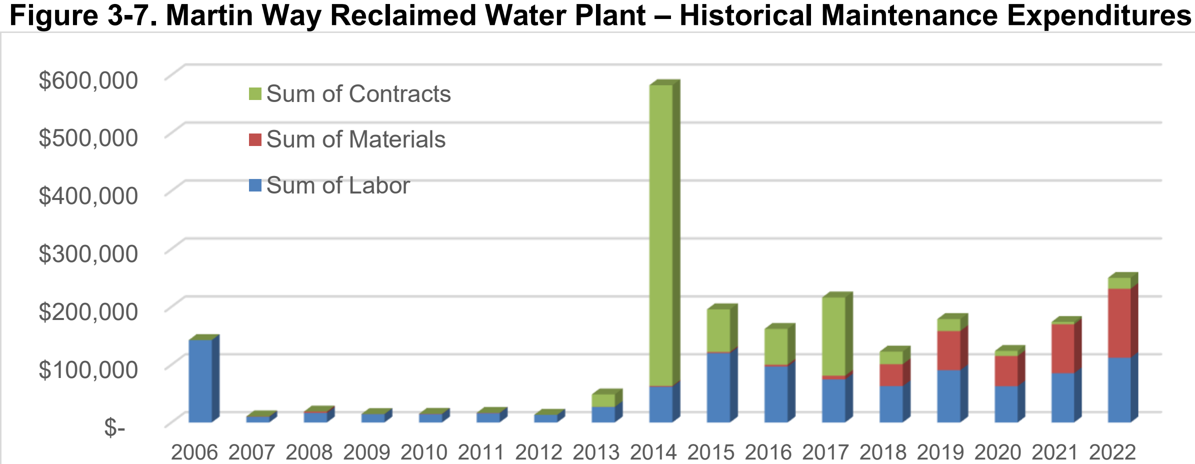
Expansion to the third mgd of treatment capacity is currently scheduled for 2038. Whether this expansion includes flow equalization has yet to be determined, and this decision may impact the timing of the project. Master planning included partner jurisdiction projections for future reclaimed water needs. These projections indicate that expansion to 3 mgd is likely sufficient to meet currently identified needs. A project to add the fourth and fifth mgd is included in the long-term CIP for planning purposes, however this expansion would likely be driven by reclaimed water demand or by changes to the regulatory environment.

Table 3-3. Completed and Planned Project Summary

On-line	Name	Cost/Estimate	Status	Description
2006	2 mgd Plant	$25,798,818	Complete	Original plant construction
2010	Huber Drum Screen	$720,000	Complete	Added secondary fine screens
2014	MWRWP Membrane Upgrade	$2,674297	Complete	Upgrades to the existing facility
2018	Waste Activated Sludge (WAS) Pump upgrades	$462,372	Complete	Replaced two WAS pumps and associated controls
2023	MWRWP Blower and Screen Upgrade	$946,910	Complete	Added blower and redundant drum screen
2023	MWRWP Membrane Filter Replacement	$915,955	Planning	Replace the membrane filters at the end of their service life
2027	MWRWP Improvements	$8,142,397	Planning	Replace process valves, DeviceNet and other aging equipment
2038	MWRWP 3rd mgd Equipment	$8,150,000	Future	Add equipment to bring facility capacity to 3 mgd.
TBD	Martin Way to Hawks Prairie Pipeline Expansion	$12,100,000	Future	Expand conveyance capacity
TBD	MWRWP 4th with EQ	$19,600,000	Future	Expand facility to 4 mgd with equalization
TBD	MWRWP 5th mgd with expansion	$29,900,000	Future	Expand facility to 5 mgd with expanded footprint for future

Historical maintenance costs are included in Figure 3-7.

Figure 3-7. Martin Way Reclaimed Water Plant – Historical Maintenance Expenditures



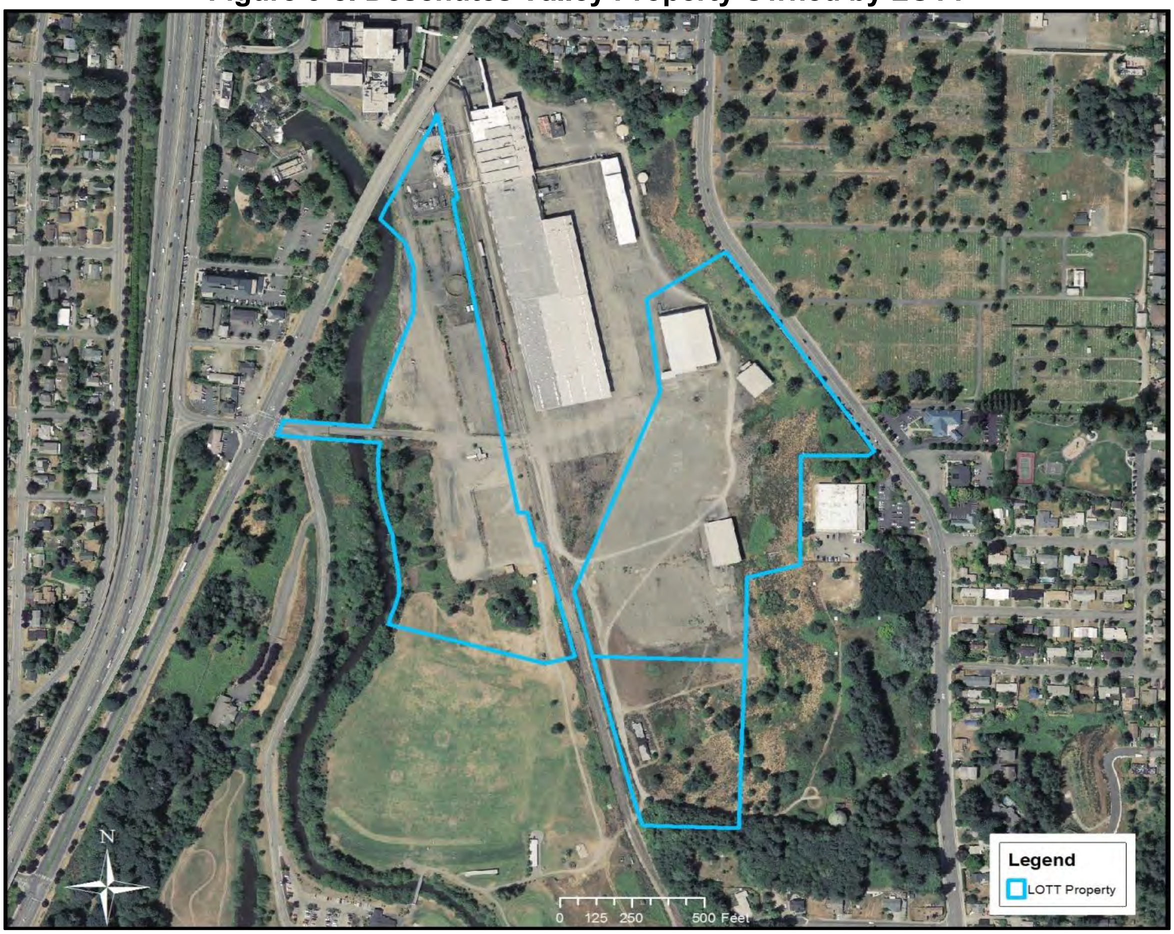
3.3 Mullen Road Reclaimed Water Plant

LOTT currently owns 5 acres near the intersection of College Street SE and Mullen Road SE in Lacey, purchased as a location for a potential future reclaimed water satellite plant. Based on the updated flows and loadings projections and master planning analysis, LOTT has confirmed that the Mullen Road Reclaimed Water Plant will not be needed.

3.4 Deschutes Valley Reclaimed Water Plant

LOTT owns approximately 45 acres of the former brewery property in the Deschutes River Valley as a location for a potential future reclaimed water plant (Figure 3-8). The facility was originally envisioned to draw raw sewage from Tumwater and portions of southeast Olympia or treat secondary effluent from the Budd Inlet Treatment Plant.

Figure 3-8. Deschutes Valley Property Owned by LOTT



A property planning effort was initiated in 2014 to guide the use and ultimate development of the property and initial site improvements were completed to remove several degraded structures. Further investment in site improvements was then suspended awaiting the completion of LOTT's 2050 Master Plan. Key findings from the master planning effort indicate that facilities at this site are not needed in the future. The plan identifies new opportunity to significantly expand capacity at the BITP through enhanced tertiary treatment as a more cost-effective capacity management strategy than investing in new satellite reclaimed water facilities.

4. Discharge Capacity

All of the flow generated within the LOTT system must ultimately be discharged or beneficially used. At the BITP, final effluent is discharged to Budd Inlet. Reclaimed water is reused at LOTT facilities and distributed to LOTT partner jurisdictions for beneficial reuse by a variety of users. Reclaimed water is also used to replenish groundwater at LOTT's Hawks Prairie Ponds and Recharge Basins and Lacey/Olympia's Woodland Creek Groundwater Recharge Facility.

The following analysis of discharge capacity does not fully integrate findings of the recently completed master planning effort, and does not account for reclaimed water purveyed to customers for reuse such as irrigation. It is also too soon to establish treatment performance levels of the recently completed Biological Process Improvements project at the BITP which will have a bearing on discharge capacity. Future iterations of the capacity assessment report will be revised to incorporate this new information.

4.1 Budd Inlet Outfall Permit Limitations

Based on LOTT's existing National Pollutant Discharge Elimination System (NPDES) Permit, discharge limitations to Budd Inlet are based on both concentration as well as loadings (pounds per day). Primary loading limitations include biological oxygen demand (BOD), total suspended solids (TSS), and total inorganic nitrogen (TIN). The existing permit was issued on February 16, 2018 with an expiration date of March 31, 2023. Table 4-1 lists the loadings-based permit limitations.

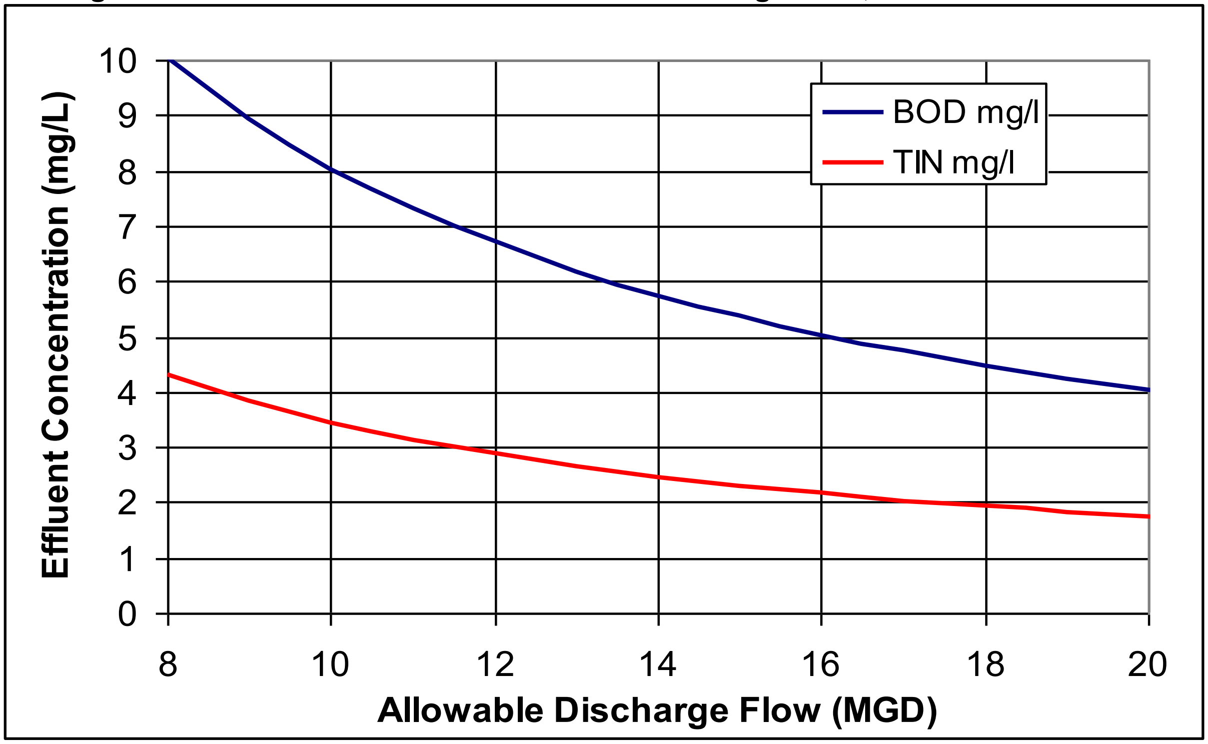
Table 4-1. Budd Inlet Treatment Plant NPDES Discharge Limits (lbs/d)

	Winter		**Shoulder**		**Summer**	
	(November-March)		(April, May, and October)		(June-September)	
Parameter	**Monthly**	**Weekly**	**Monthly**	**Weekly**	**Monthly**	**Weekly**
BOD (lbs/day)	5,640	8,460	900	1,350	671	1,006
TSS (lbs/day)	5,265	7,898	5,265	7,898	5,265	7,898
TIN	-	-	3 mg/L, 338 lbs/day		3 mg/L, 288 lbs/day	
Ammonia (as N)	26 mg/L	36 mg/L				

The amount of allowable flow to be discharged to Budd Inlet is based on the level to which the wastewater is treated. By treating wastewater to lower effluent concentrations of BOD and TIN, greater discharge capacity can be achieved.

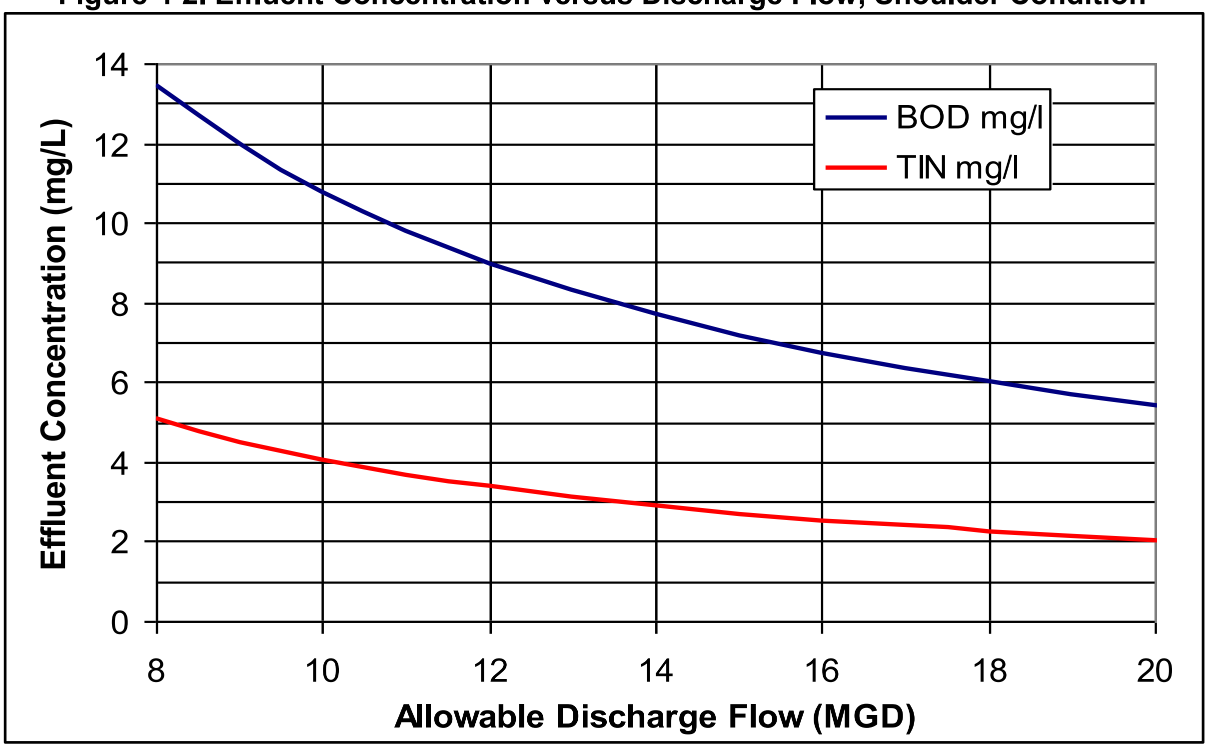
The two primary discharge limitations versus flow for the two seasonal conditions, summer and shoulder, are plotted in Figures 4-1 and 4-2.

Figure 4-1. Effluent Concentration versus Discharge Flow, Summer Condition



The allowable discharge is:
mgd = 671 lbs/d BOD ÷ x mg/L BOD ÷ 8.34 (based on BOD)
mgd = 288 lbs/d TIN ÷ x mg/L TIN÷ 8.34 (based on TIN)

Figure 4-2. Effluent Concentration versus Discharge Flow, Shoulder Condition



The allowable discharge is:
mgd = 900 lbs/d BOD ÷ x mg/L BOD ÷ 8.34 (based on BOD)
mgd = 338 lbs/d TIN ÷ x mg/L TIN÷ 8.34 (based on TIN)

4.2 Budd Inlet Treatment Plant Biological Process Improvements

LOTT recently completed a project to upgrade and reconfigure its secondary biological treatment system. Previously, the biological nutrient removal process required recirculation of treated water between two process areas in the plant. The project reconfigured the process resulting in reduced recycle-pumping rates, increased process control by adding additional instrumentation, and freeing up valuable space on the plant site for potential future treatment processes.

A better understanding of the effect on LOTT's treatment capacity will not be available until the project has been in operation for several years. However, based on the initial results, it is anticipated that the project will improve performance and efficiency.

The current NPDES permit is based on loadings (pounds per day) of biological oxygen demand (BOD) and nutrients in the form of total inorganic nitrogen (TIN). By increasing the efficiency of the treatment process (lowering the effluent loadings concentration), LOTT could potentially regain discharge capacity to Budd Inlet.

Table 4-2 summarizes the plant's current performance relative to its existing NPDES permit.

Table 4-2. Budd Inlet Treatment Plant Final Effluent Levels (mg/L)

Parameter/Season	NPDES Permit Limits	Average 2021	Maximum Month 2021
TIN (mg/L)			
Summer	3.0	2.10	2.96
Shoulder	3.0	2.08	2.48
BOD (mg/L)			
Summer	7.0	4.14	4.92
Shoulder	8.0	4.40	4.97
Winter	30	4.78	6.74
TSS (mg/L)			
Winter	30	8.49	13.18

In addition to the NPDES permit limitations, LOTT reserves 1.5 mgd of treatment capacity as an added measure of safety in measuring operational capacity. This serves two purposes: 1) allows for additional operational flexibility during peak flow events, minimizing the likelihood of a permit violation; and 2) protects the system from unanticipated rapid population growth and/or delays in the construction of new treatment capacity.

Figures 4-3 through 4-6 show the plant's BOD and TIN performance in terms of both concentration and loading for 2021. The plant has met BOD and TIN regulations throughout this period. While LOTT strives to perform at discharge levels well below those required by permit, it is important to note that:

- Operational conditions and performance vary considerably due to factors outside of LOTT's control, such as influent temperature, storm flows, or illicit discharges affecting the treatment process. Therefore, the existing buffer between permit limits and performance levels is necessary to ensure continued permit compliance.

- LOTT is responsible for management of wastewater from our partner jurisdictions, and they in turn are responsible for accommodating growth. By enhancing the performance of the Budd Inlet Treatment Plant, LOTT gains capacity in the system that will be necessary to responsibly manage community growth in the future.

Figure 4-3. Monthly Final Effluent BOD Compared to Permit

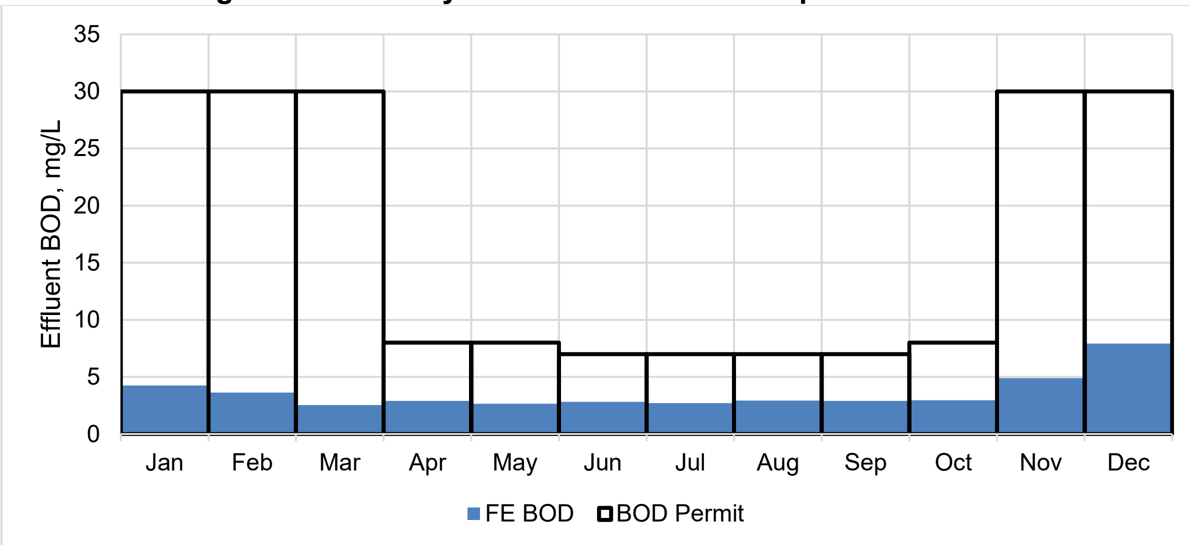


Figure 4-4. Monthly Final Effluent TIN Compared to Permit

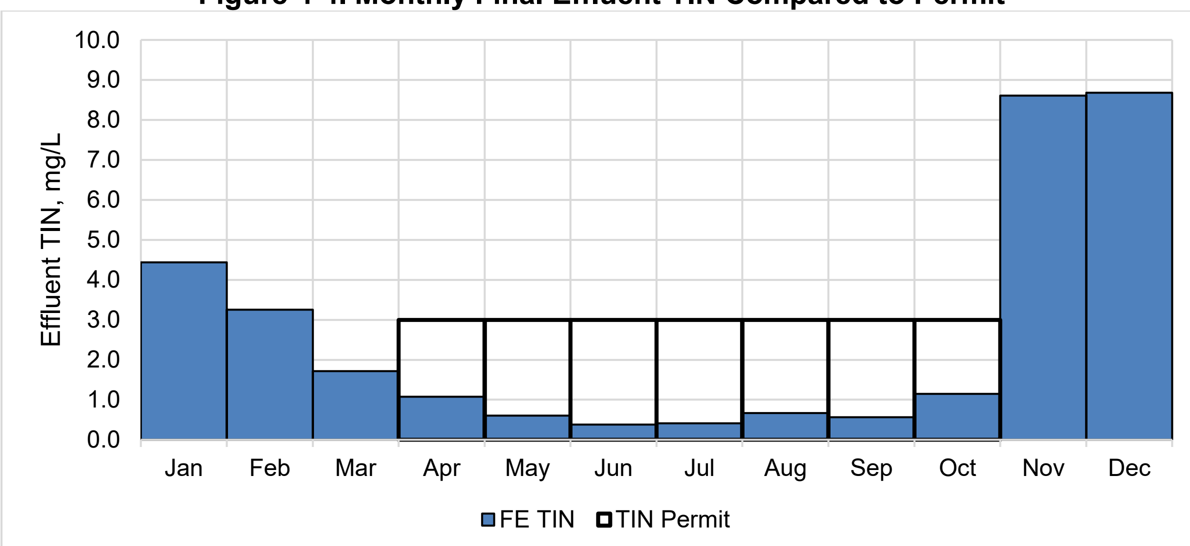


Figure 4-5. Monthly Final Effluent BOD Load Compared to Permit

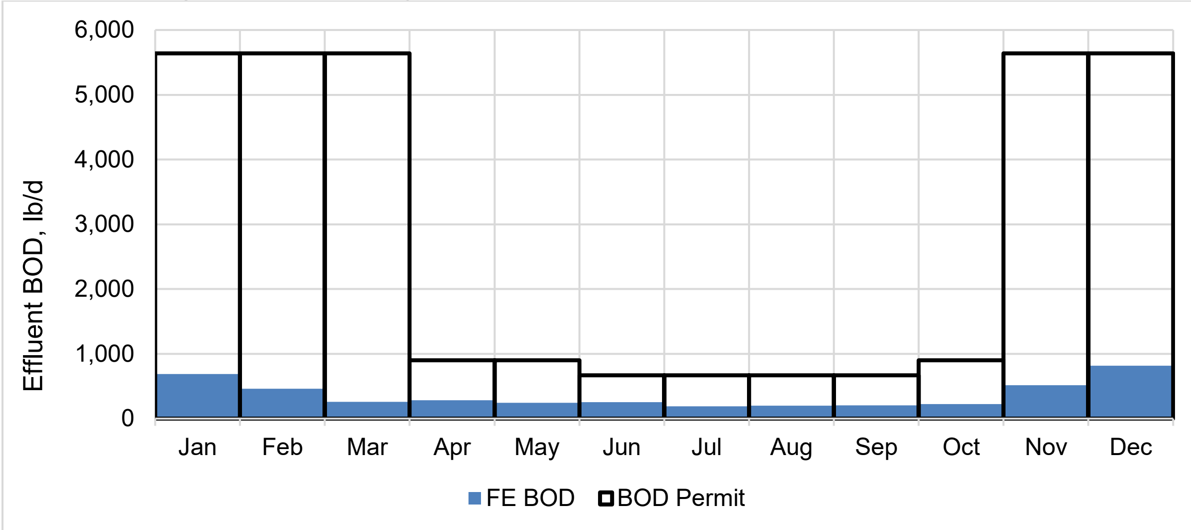
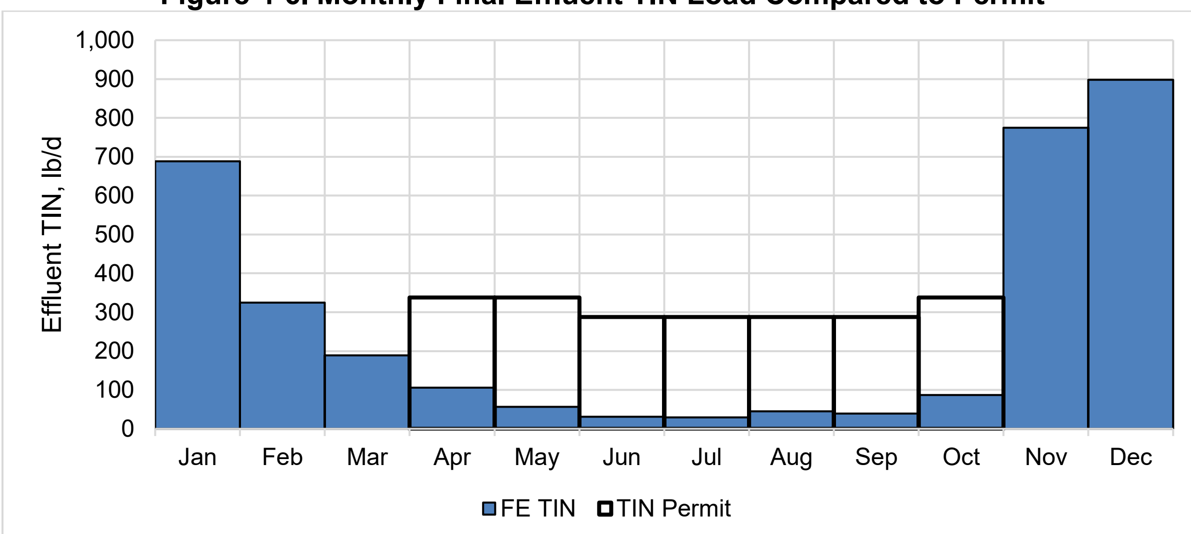


Figure 4-6. Monthly Final Effluent TIN Load Compared to Permit



4.3 Budd Inlet Treatment Plant Site Planning

LOTT recently completed a long-term master planning effort which was conducted in several phases. The first phase evaluated the Budd Inlet Treatment Plant footprint and updated the site plan, locating various treatment processes to meet future capacity needs. The site plan, presented in Figure 4-7, identifies the location of various facility needs through 2050.

The second phase of master planning considered LOTT's overall capacity management strategy, re-evaluating the reclaimed water production, distribution, and disposition program and other options for managing capacity long-term. This planning took into account that system capacity requirements have decreased, and that community use and demand for reclaimed water has increased since LOTT's original Wastewater Resource Management Plan (1999) and Budd Inlet Treatment Plant Master Plan (2006) were completed. In addition, new treatment technologies offer opportunity to further improve treatment performance at the Budd Inlet Treatment Plant and increase hydraulic discharge capacity.

Figure 4-7. Budd Inlet Treatment Plant Site Plan

4.4 Budd Inlet Discharge Capacity Analysis

Discharge capacity planning involves projecting a reasonable level of performance to allow compliance with the load-based BOD and TIN limits. Operation at the permitted concentrations would restrict the amount of discharge to Budd Inlet to 11.5 mgd in the summer (from Figures 4-1 and 4-2). In 2022, the average summer flow generated in the LOTT system was 11.17 mgd. However, Budd Inlet discharge was held below permit loadings as shown on Figures 4-5 and 4-6. This was due to three factors:

1. Reclaimed water production at the MWRWP and end uses in Lacey
2. Reclaimed water production at the BIRWP and end uses in Olympia and Tumwater
3. Effluent concentrations generally lower than permit regulation (Figures 4-3 and 4-4)

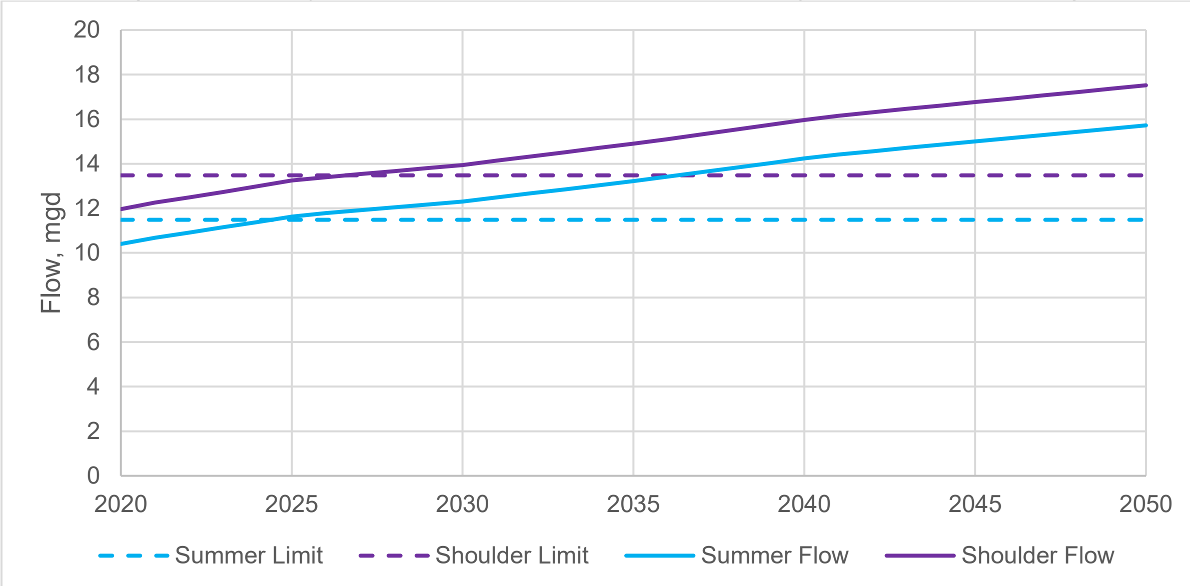
LOTT's approach to planning includes a number of assumptions – some conservative, some expedient. These assumptions include the following:

- A reserve of 1.5 mgd capacity is maintained, year-round.
- Credit for reclaimed water production is only applied where groundwater recharge is available, or where end uses are well documented.
- Performance assumptions which consider historical performance of the BITP, even though the biological process improvements project will likely improve performance consistency.

LOTT recently completed a master planning effort to determine the best way to manage discharge capacity. The plan considered a variety of alternatives, including expansion of Class A reclaimed water production and groundwater recharge. The plan identified new opportunities to significantly expand capacity at the BITP through enhanced tertiary treatment, effectively allowing for discharge of more effluent while remaining in compliance with loadings-based discharge permit requirements. These and other findings from the recently completed Master Plan have not been fully integrated into the following analysis, but will be incorporated into future iterations of the annual capacity assessment report.

This analysis considers when the first operational discharge limitation would occur during average flow conditions for each of the compliance periods. Figure 4-8 depicts the projected system-wide summer and shoulder season flow, plotted against the amount of discharge currently available in the system. This includes a maximum of 2 mgd of discharge at the Hawks Prairie Ponds and Recharge Basins, and 1.5 mgd of reserve capacity, and assumes performance at the existing NPDES concentration limits.

Figure 4-8. Projected Flows Compared to Currently Available Discharge

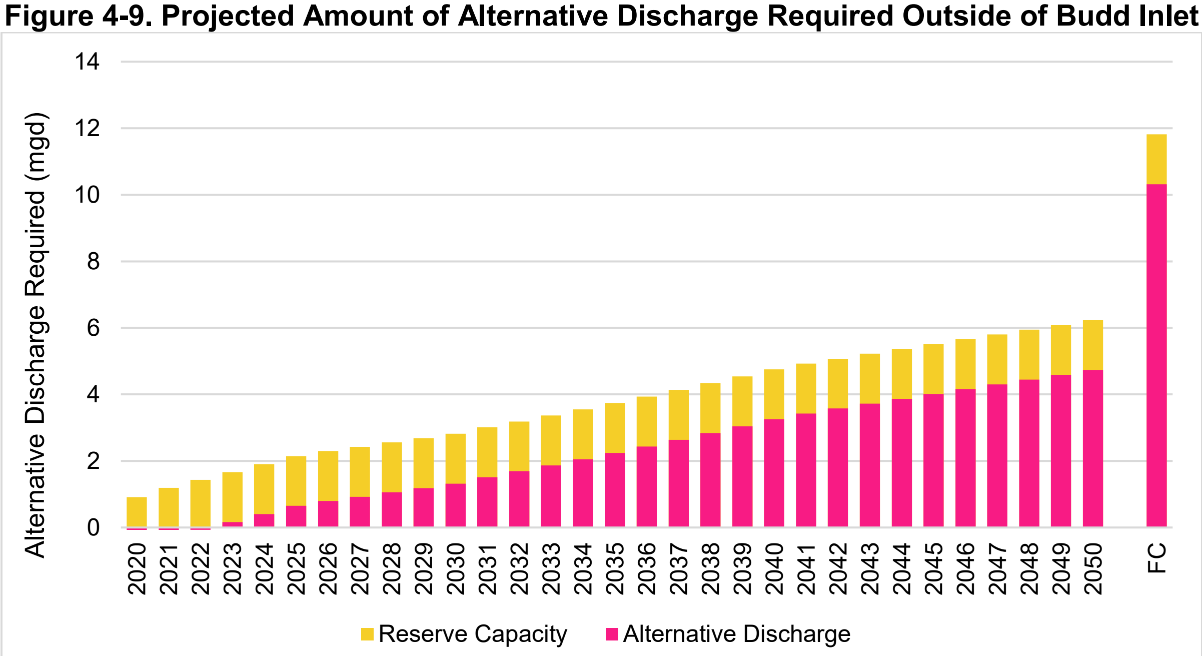


Note: assumes 2 mgd of discharge at Hawks Prairie Ponds and 1.5 mgd of reserve capacity, and operation at the NPDES concentration limits for BOD and TIN.

The figure shows that the system will become limited in 2023. This limitation is driven by the summer TIN regulation. The shoulder season limitation is projected to occur two years later, in 2026. While these limits appear to be rapidly approaching, LOTT has the ability to extend capacity by discharging at lower BOD and TIN concentrations.

For discharge planning, Figure 4-8 may be translated into a plot showing the amount of alternative discharge required, based on the assumptions listed above. This is plotted on Figure 4-9.

Figure 4-9. Projected Amount of Alternative Discharge Required Outside of Budd Inlet



Note: maintains 1.5 mgd of reserve capacity
Note: FC = full connection of all parcels within service area, with full septic conversion

This figure also shows the limitation arising in 2023 (allowing for 2 mgd of discharge at the Hawks Prairie Ponds) and estimates that a total of 7 mgd of discharge capacity will need to be in place by 2050, and up to 12 mgd for the full connection scenario. All of these projections represent a worst-case scenario, with the BITP operating at its NPDES concentration limits, and without any credit for operating below those limits.

4.5 Alternative Discharge Planning

Reclaimed water approaches to alternative discharge considered in this analysis include the following:

- Non-potable reuse (NPR), which includes consumption of reclaimed water by end users for irrigation or industrial uses.
- Environmental uses, which include streamflow or surface water augmentation and wetland enhancement.
- Indirect potable reuse (IPR), which includes groundwater recharge through soil percolation and direct injection to groundwater.
- Direct potable reuse (DPR), which involves discharge to a potable water distribution system.

Reclaimed water currently generated at the BIRWP and MWRWP is primarily used for irrigation, process water at LOTT facilities, and groundwater recharge.

In its capital program, LOTT includes tentative projects to generate up to 8.0 mgd of alternative discharge, which is more than the projected requirement by 2050 per Figure 4-9.

4.5.1 Reclaimed Water Treatment

Existing treatment facilities include the BIRWP and the MWRWP. These sites generate Class A reclaimed water, suitable for NPR, environmental uses, and groundwater recharge.

The BIRWP has a current treatment capacity of 1.5 mgd, which is sufficient to meet the demand of existing reclaimed water customers. Construction of the Tumwater Reclaimed Water Tank has allowed LOTT to meet instantaneous demands and allows for more reliable delivery to existing LOTT users. Community demand for reclaimed water in the area may drive expansion of the BIRWP. Potential users may include the Washington State Capitol Campus. In 2016, Gray and Osborne Consulting Engineers completed the Capitol Campus Reclaimed Water Assessment. The estimated cost was $2,427,000 to construct the necessary infrastructure to provide service to the campus.

The MWRWP treats raw sewage generated in Lacey. Reclaimed water from this facility is primarily used for groundwater recharge at LOTT's Hawks Prairie Ponds and Recharge Basins, and by the cities of Lacey and Olympia for water rights mitigation through their Woodland Creek Groundwater Recharge Facility. The plant is currently able to treat up to 2.0 mgd of reclaimed water, and the process basins are in place to expand capacity to 3.0 mgd with equipment installation. Further expansion to 5.0 mgd was included as part of the existing facility design. An easement on adjacent property could allow for expansion of the facility to 8.0 mgd if needed. Timing of expansion is limited by flow availability, with the third mgd not projected to become available until 2038. With influent flow equalization, this could be moved forward to 2031.

Table 4-3 summarizes previous assumptions about expansion of existing reclaimed water production facilities in the LOTT system.

Table 4-3. Reclaimed Water Production Sites

Facility	Product	Existing Capacity (mgd)	Potential Capacity in 2050 (mgd)	Potential Capacity beyond 2050 (mgd)	Next Steps
Budd Inlet Reclaimed Water Plant	Class A	1.5	3.0	5.0	Expand to 3 mgd (demand-driven)
Martin Way Reclaimed Water Plant	Class A	2.0	5.0	8.0	Expand to 3 mgd (2038)
Total		**3.5**	**8.0**	**13.0**	

4.5.2 Alternative Discharge Location

To ensure the capacity for adequate discharge, LOTT's original long-range plan assumed that LOTT would develop its own groundwater recharge locations. LOTT has purchased a number of properties as potential future infiltration sites. However, site suitability has been re-evaluated since the original estimates at time of purchase.

Overall discharge capacity is lower than previously estimated, and cost of conveyance continues to escalate. Master planning confirmed that expansion of infiltration at the existing Hawks Prairie site is a more cost-effective option than developing new infiltration facilities and associated conveyance lines. Master planning also identified new opportunities to manage future discharge capacity through enhanced treatment at the BITP, greatly reducing the need to invest in new infiltration facilities. Summary

Expansion of the BIRWP to 3.0 mgd and the MWRWP to 3.0 mgd will allow LOTT to generate 6.0 mgd of reclaimed water by 2038. This would provide more discharge capacity than strictly required per Figure 4-8.

5. Conveyance System Analysis

LOTT has instituted a program to inspect all of its collection system manholes and pipes on a regular schedule. This program keeps track of the condition of collection system assets and prioritizes projects to repair or replace pipes and manholes.

Conveyance system capacity is periodically assessed through dynamic sewer modeling. The following section summarizes the capacity analysis of the collection and conveyance systems conducted in 2022/2023. The projects listed at the end of this section involve capacity expansion and are separate from the repair and replacement projects developed as part of the LOTT's ongoing sewer inspection program.

5.1 Modeling Description

The LOTT sewer model includes all of the Olympia and Lacey pipes greater than 8-inch diameter, a number of key pipes of 8-inch diameter and smaller, and the Tumwater siphon pipeline running from Hixon Street into the LOTT Southern Connection. The model was designed to simulate a 10-year peak hour storm event and was run at 5-year time increments from 2025 through 2050, with an additional run with full connection of all septic tanks within the cities and UGAs. A summary of the model output as it relates to LOTT-owned pipe follows. Note that the model was run assuming flow diversion to the Martin Way Reclaimed Water Plant for all scenarios. The quantity of flow diversion starts with the current average diversion of 1.4 mgd, increasing to 1.9 mgd by 2050, and 2.0 mgd at full connection. This assumes no further increments of capacity are added at the MWRWP, and no flow equalization is added at the MWRWP.

5.2 Sewer Capacity Definition

The capacity of the collection system may be assessed in several ways. In this report, capacity is assessed using three measures:

1. Depth to flood. The most obvious measure of capacity is whether a pipeline is projected to flood. A conservative capacity trigger would be a water elevation which comes within 5 feet of manhole rim elevation at peak flows. Other communities have set capacity triggers anywhere from 1.5 to 7.0 feet of rim. The capacity trigger depends upon many factors, including the consequence of flooding (pipelines near sensitive areas may require a more conservative trigger), as well as the likelihood of secondary flooding (at what water elevation do nearby laterals begin to backflow).

2. Pipe filling or surcharge ratio. Pipe filling is defined as the energy grade level divided by the pipe diameter. A full pipe will have a pipe filling ratio of 1.0, meaning it is 100% surcharged. A pipe filling ratio of 2.0 means that the pipe is full, and there are x-inches of pressure in the pipe, where x is the pipe diameter. An 8-inch pipe with a pipe filling ratio of 3.0 will flood laterals 16 inches above the crown of the pipe. Pipe filling is a useful way to gauge the capacity of the sewer system, as surcharged pipes will act as bottlenecks, and will often result in a backwater effect upstream of the restriction. However, a pipe with a ratio of 2.0 or higher may be innocuous. For example, very deep pipes may carry a substantial surcharge, with little risk of flooding laterals due to the main's burial depth.

3. Pipe flow capacity. The capacity of a gravity sewer may be estimated by its diameter and slope. The model compares the projected flow in each pipe segment to its

theoretical capacity and reports the ratio. Pipes which are flowing at or above capacity act as bottlenecks, and cause flow to back up into upstream pipes.

The summaries in this section express capacity in terms of pipe filling, with additional discussion of capacity and depth-to-flood.

5.3 Existing Condition

Figure 5.1 presents a schematic of the existing system, as modeled. Pipes are colored by size, with pump stations shown as triangles. The model includes 22 pump stations, including the LOTT stations and a number of Olympia and Lacey stations. The model is mostly comprised of partner pipes, with the LOTT collection system forming the backbone.

Figure 5.1. Map of modeled sewer system

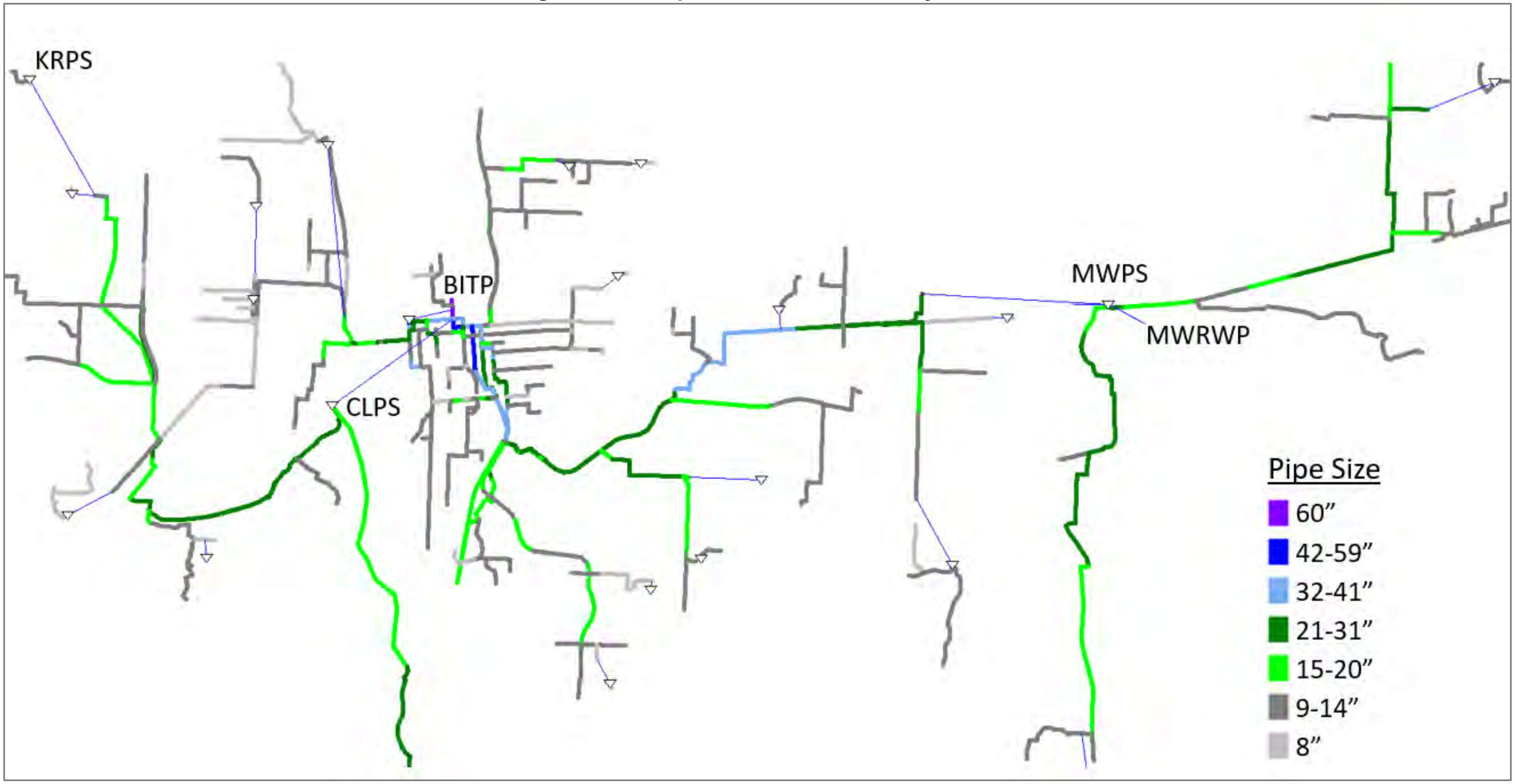
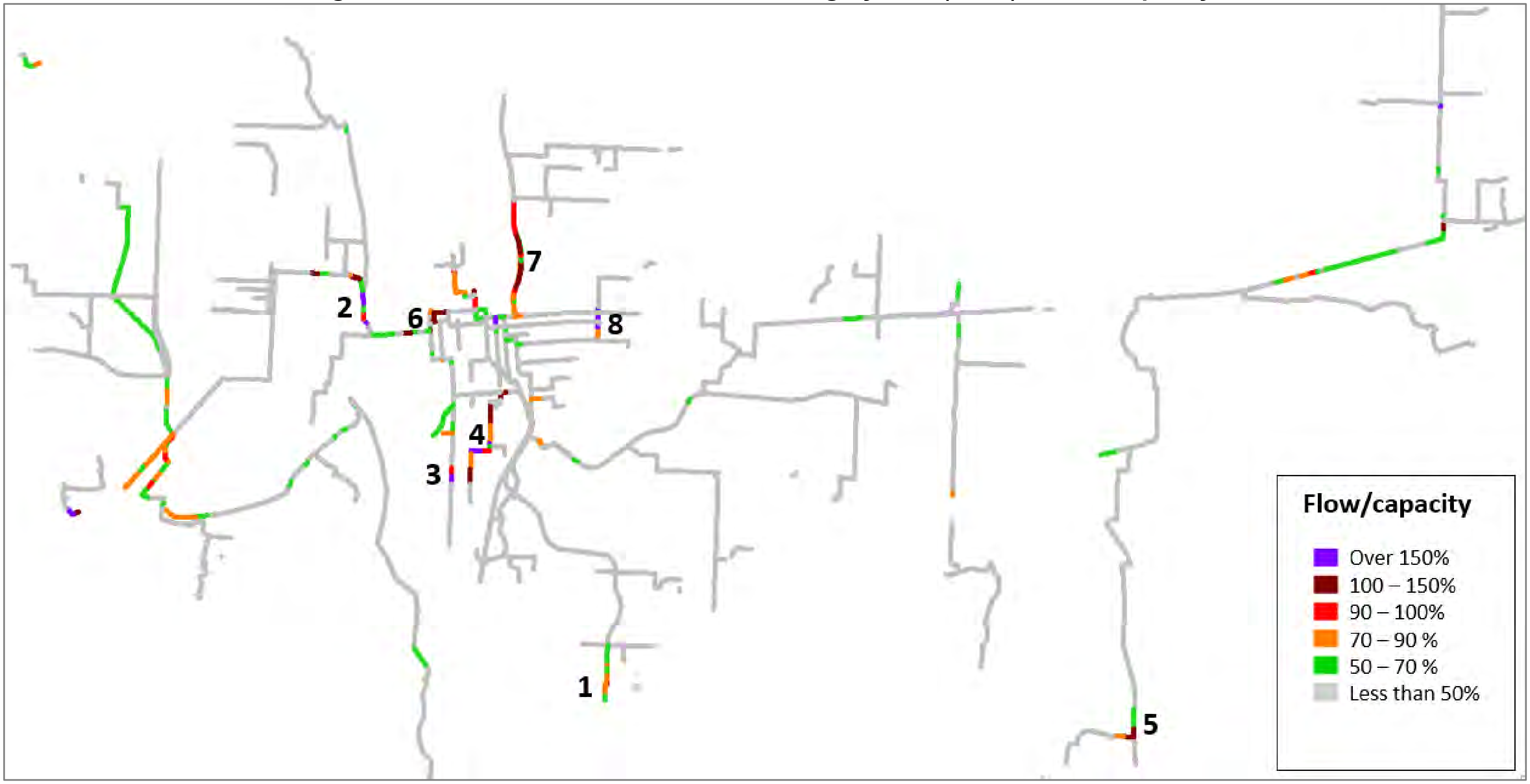


Figure 5.2 presents the current peak hour flow condition for the existing system. The figure is showing the peak hour flow divided by the theoretical capacity of each segment. The purpose of this figure is to summarize existing capacity limitations in the system. These limitations are currently restricting flow to downstream pipes, making it difficult to assess capacity of downstream segments.

Figure 5.2. 2023 Peak Hour Scenario Existing System (As-Is) – Flow Capacity



The as-is model simulates the current state of affairs as we know it in regard to flows and pipe sizes that are represented in the geodatabase (Figure 1). Major issues identified within the existing system include the following (numbering from Figure 2):

1. Bottlenecks in the 10” pipes at the southern end of the Henderson pipeline
2. Restrictions in several pipe sections along West Bay Drive
3. Restrictions in the 10” pipes along Capitol Way
4. Restrictions in the 10” pipes along Franklin and Jefferson Streets
5. Restrictions near the lift station outlet in south Lacey near Mullen Road
6. Restrictions in both of the pipelines coming across the 4th Avenue Bridge
7. Restrictions in both of the pipelines along East Bay Drive
8. Bottlenecks in the 12” pipe along Central Street

These issues are projected to cause flooding, or near-flooding conditions at several manholes. Flooding is projected at the 4th Avenue Bridge, West Bay Drive, as well as along Franklin Street. Near-flooding conditions are projected along East Bay Drive and Central Street. To date, flooding has been observed at only some of these locations. This may be related to sealed manholes, misallocation of I&I to certain locations, or the conservative nature of the sewer model.

Most of the major existing issues affect Olympia pipes. Olympia is aware of these limitations, and each jurisdiction is developing strategies to meet these capacity related issues.

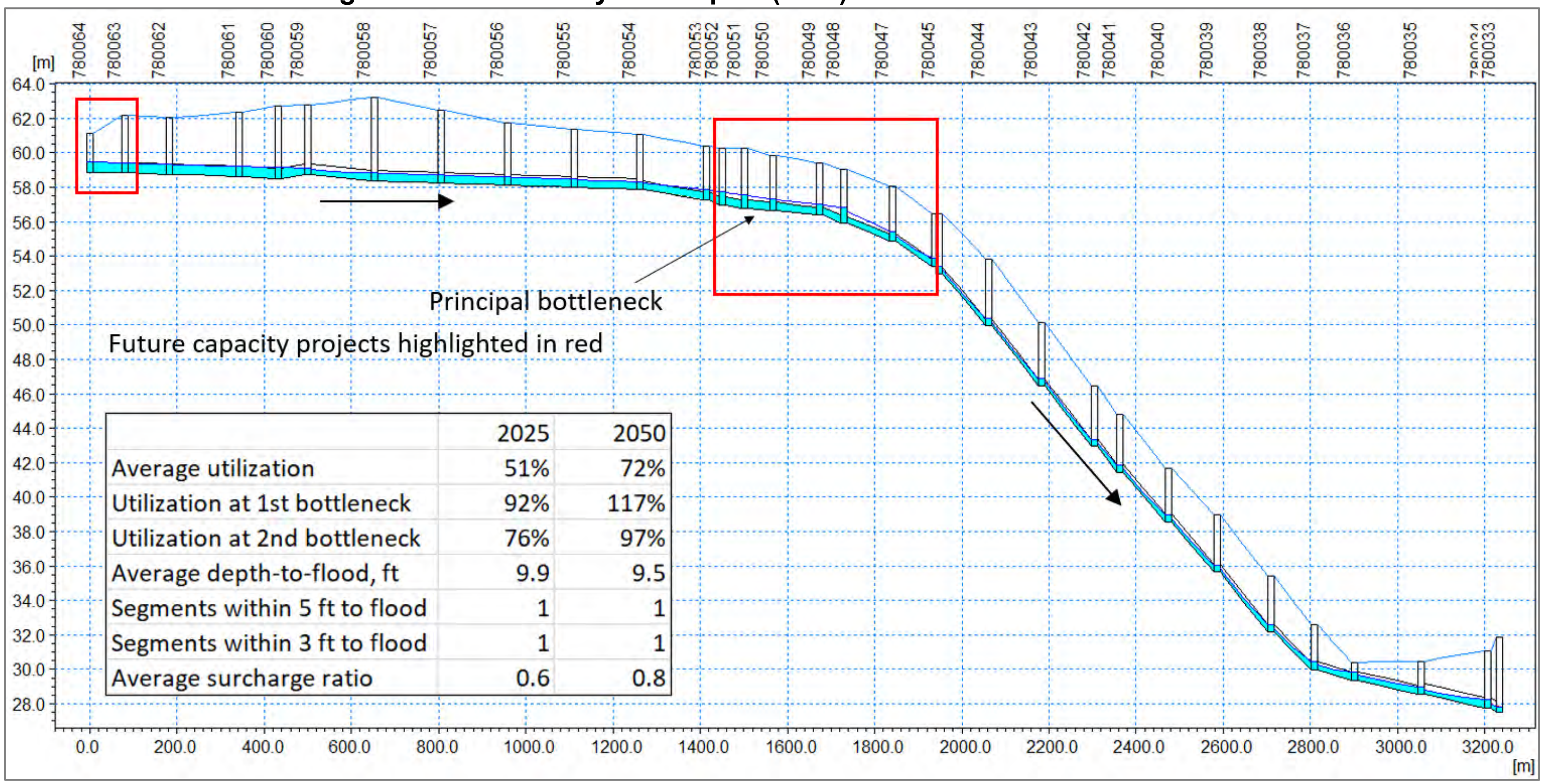
For the following scenarios, the bottlenecks causing surcharging in south and downtown Olympia and along West Bay Drive were removed to allow effective modeling of downstream pipes.

5.4 LOTT System Analysis

5.4.1 Martin Way Interceptor (East)

This interceptor consists of a relatively flat section of 24-inch pipe flowing into progressively steep portions of 18- and 15-inch pipe. The 15-inch pipe, particularly in a pair of less-steep upstream sections, acts as a flow bottleneck. Figure 5.3 presents the pipe profile, along with water depth at the 2050 peak hour condition, and other analytical information.

Figure 5.3. Martin Way Interceptor (East) 2050 Peak Hour Flow Profile



The pipe is deep for most of its length, and only a single manhole near the outlet poses a risk of flooding. The depth-to-flooding at manhole 780036 is within 2 ft by 2050.

The pipe projects to be fully surcharged for most of its length, although the amount of surcharging is low, and there appears to be little risk of flooding. The maximum amount of surcharging, taking place near the middle of the pipeline, is just under 1-foot of depth. That surcharge level is still 8 ft below ground level.

Overall, there does not appear to be any reason to increase capacity by 2050. The full connection scenario projects much more severe surcharging, with higher likelihood of lateral and/or basement flooding, as the surcharge level approaches within 5 feet of ground level for much of its length. A bottleneck replacement project would target 7 segments of pipe, mostly in the middle of the pipeline. This project will not be needed until after 2050.

This interceptor discharges into the MWPS. Peak flows reported at the MWPS have increased in recent years, which raises concern over whether those increases translate to increases at the MW Interceptor East segment. If so, the Interceptor may have significantly less capacity than modeled.

5.4.2 Martin Way Interceptor (West)

The Martin Way Interceptor (West) accepts flows from the MWPS Force Main, as well as from the Lacey interceptor running north along Sleater-Kinney Road. Flow splits between a northern and southern branch for the upstream portion of this pipeline—the north branch taking flow from the MWPS Force Main, and the southern branch taking flow from Lacey. Figures 5.4 and 5.5 present the profile of the interceptor in the 2050 peak hour flow condition.

Figure 5.4. Martin Way Interceptor (West), Including North Branch, 2050 Peak Hour Condition

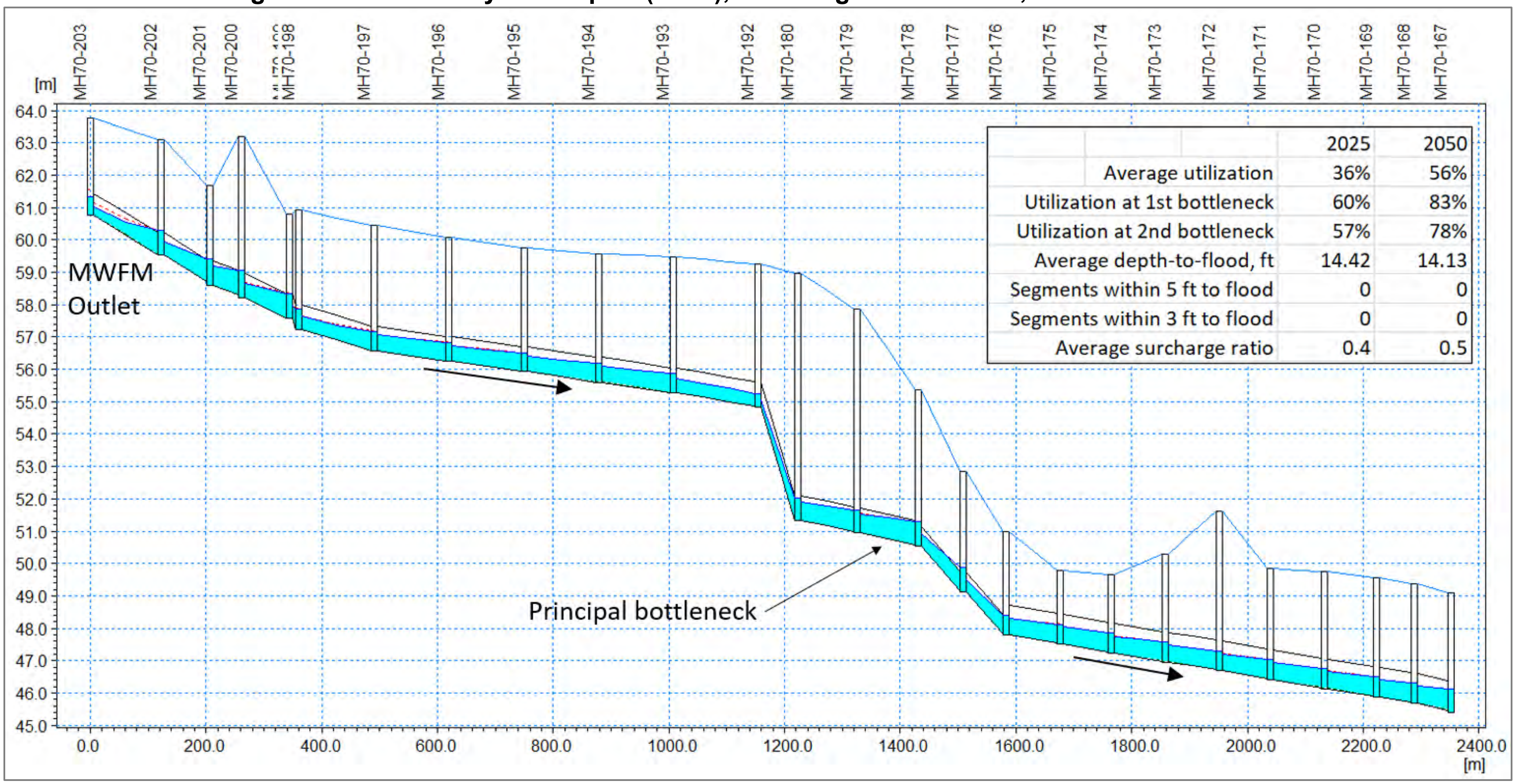
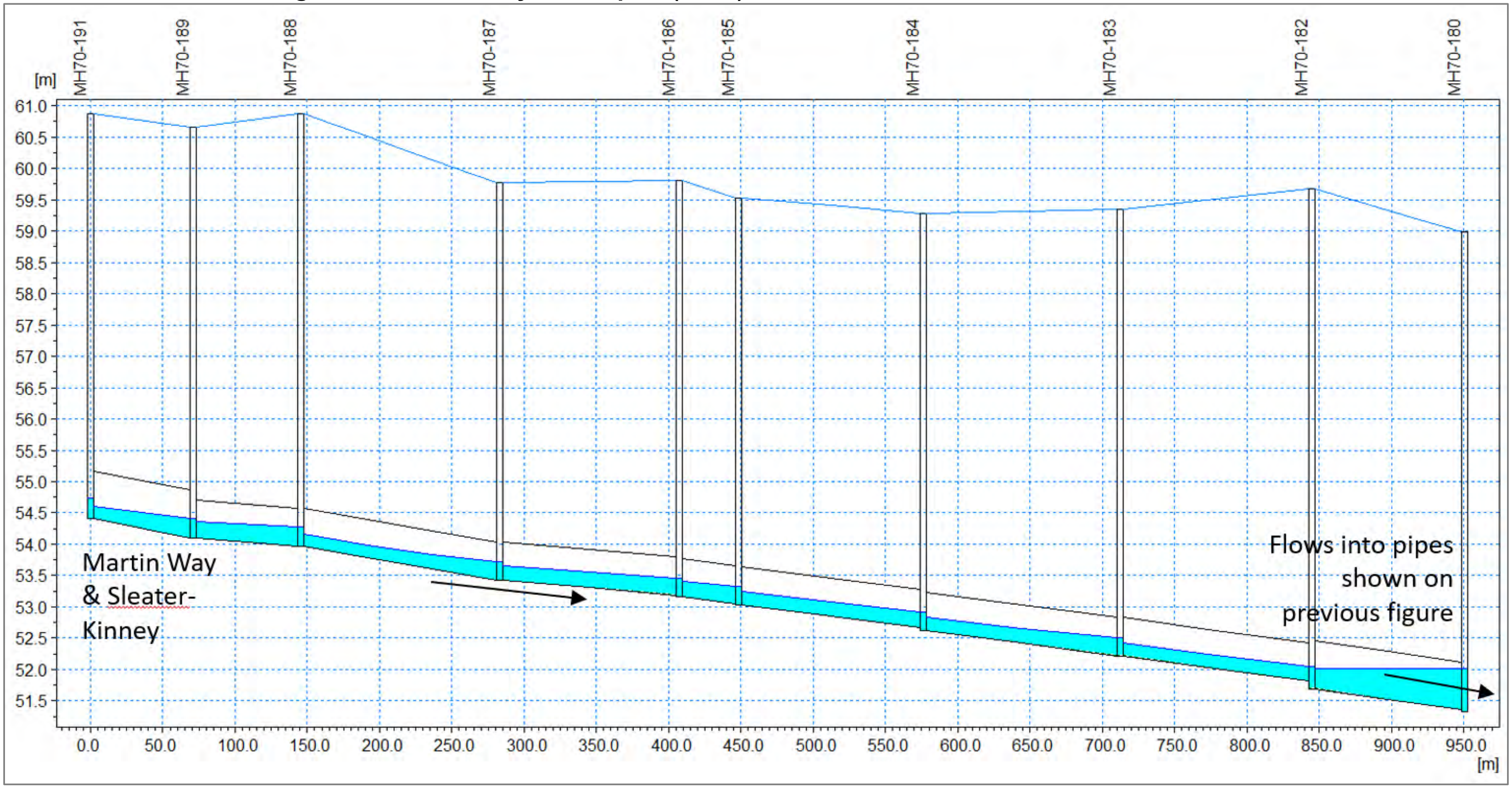


Figure 5.5. Martin Way Interceptor (West), South Branch, 2050 Peak Hour Condition



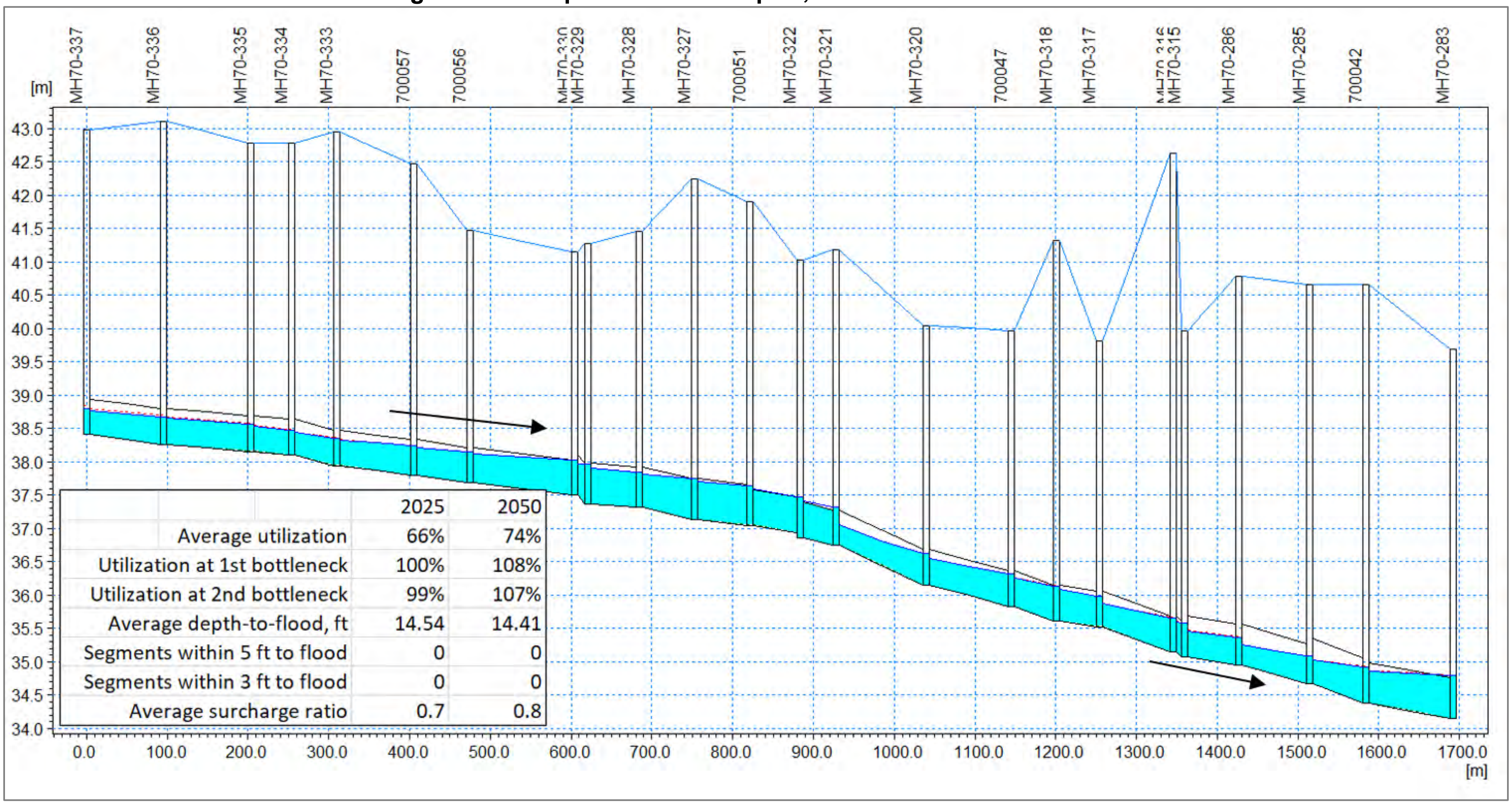
This pipeline poses a low risk of flooding, with no segments or manholes projected to fill within 5 feet of the ground elevation. No significant surcharging is projected to occur before 2050.

With full connection, a capacity restriction in the middle of the pipeline leads to some minor surcharging. No capacity-related projects are envisioned at this time.

5.4.3 Cooper Point Interceptor

The Cooper Point Interceptor is a deep pipeline, averaging over 10 feet of burial depth. Figure 5.6 presents its 2050 peak hour flow profile. The pipeline appears to be well-sized for 2050 flows, with only minor surcharging, and an average depth-to-flood of over 14 ft. There are no significant choke-points or shallow manholes. No capacity work is projected for this pipeline.

Figure 5.6. Cooper Point Interceptor, 2050 Peak Hour Condition

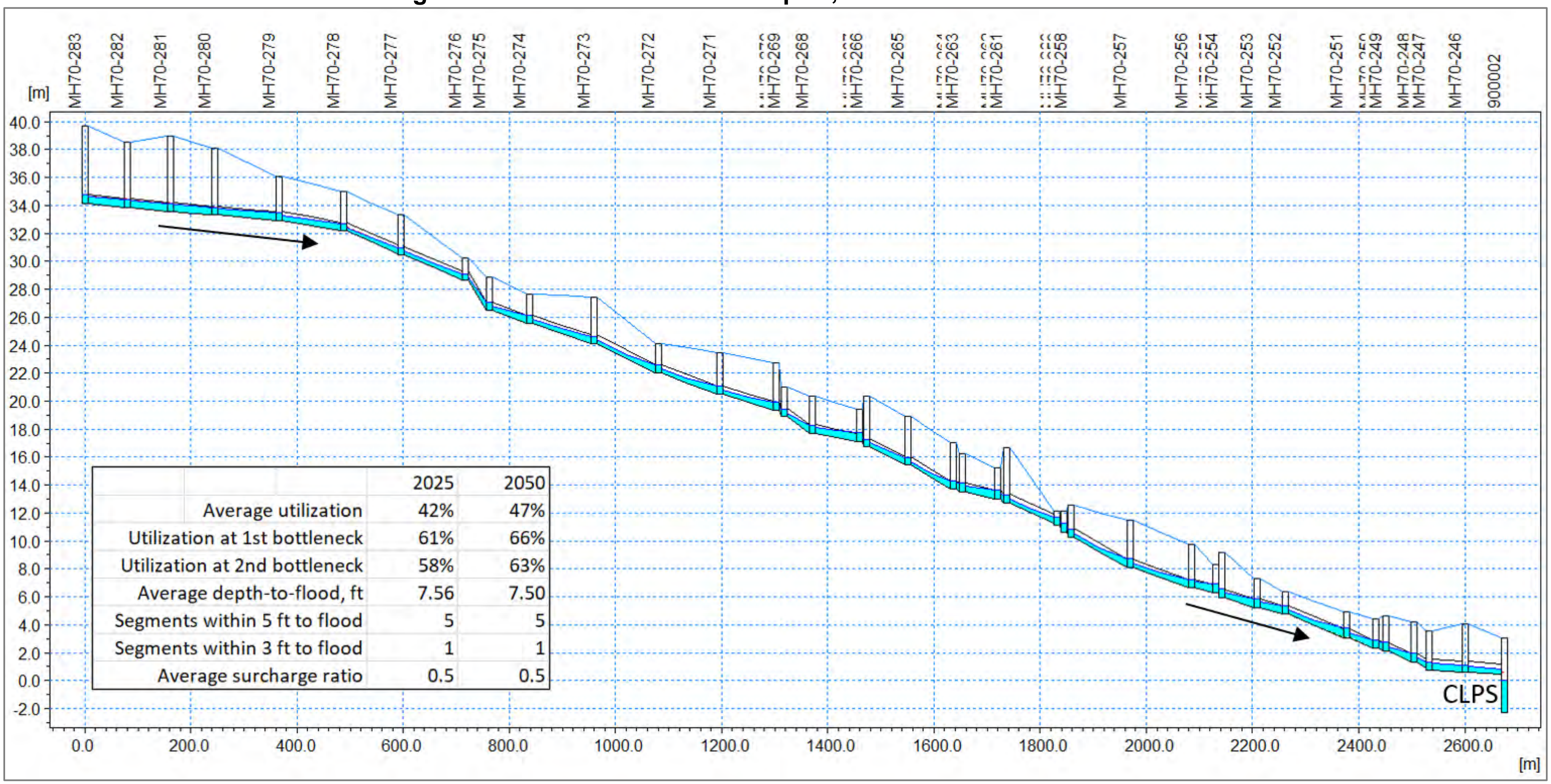


	2025	2050
Average utilization	66%	74%
Utilization at 1st bottleneck	100%	108%
Utilization at 2nd bottleneck	99%	107%
Average depth-to-flood, ft	14.54	14.41
Segments within 5 ft to flood	0	0
Segments within 3 ft to flood	0	0
Average surcharge ratio	0.7	0.8

5.4.4 Percival Creek Interceptor

The Percival Creek Interceptor is a long and comparatively steep pipeline, with areas under minimal cover. The 2050 peak hour profile is plotted on Figure 5.7. No capacity issues are observed in this pipeline. While the pipeline is shallow, it has ample capacity for projected flows. No capacity-related projects are planned for this pipeline.

Figure 5.7. Percival Creek Interceptor, 2050 Peak Hour Condition

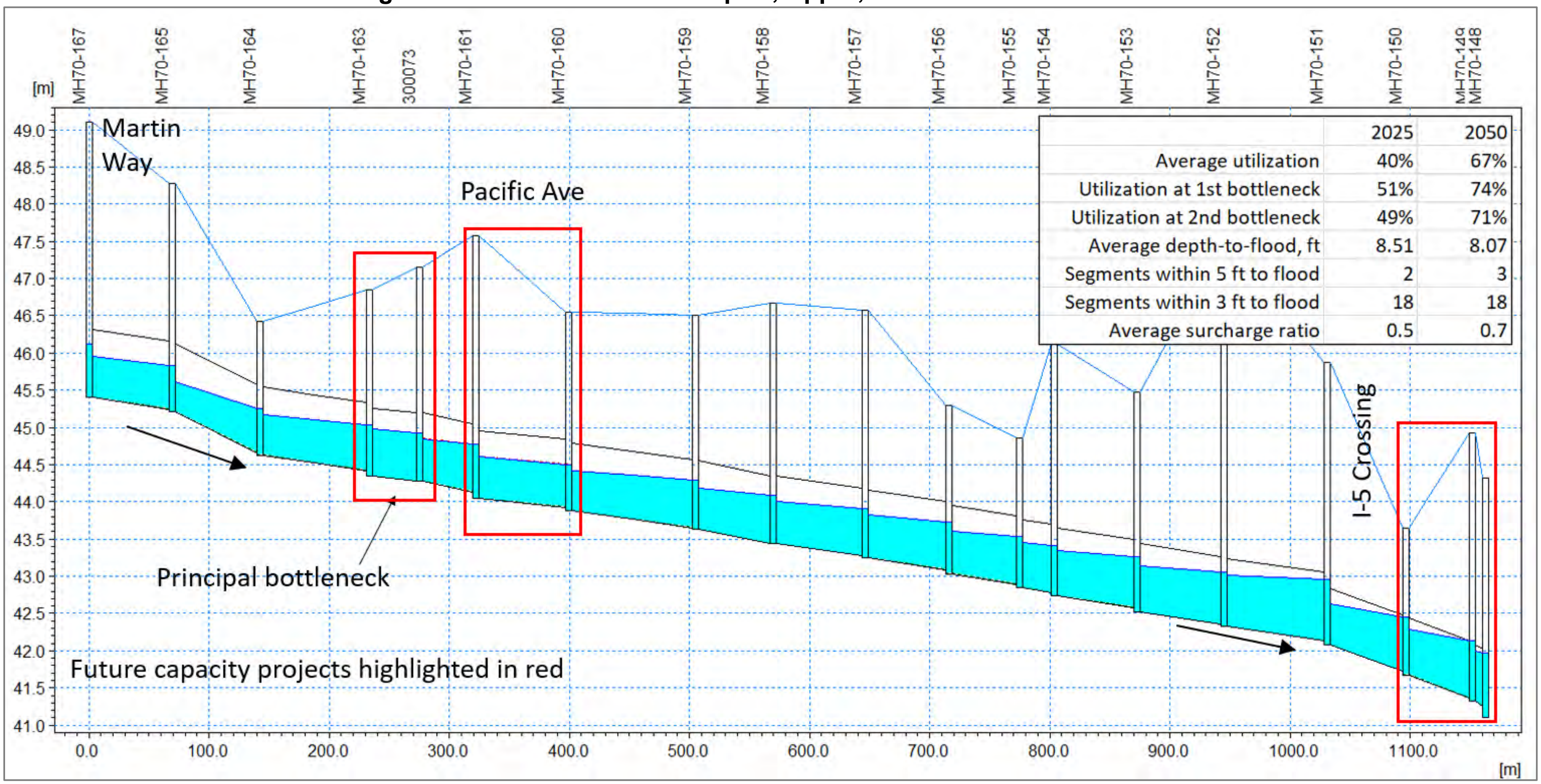


	2025	2050
Average utilization	42%	47%
Utilization at 1st bottleneck	61%	66%
Utilization at 2nd bottleneck	58%	63%
Average depth-to-flood, ft	7.56	7.50
Segments within 5 ft to flood	5	5
Segments within 3 ft to flood	1	1
Average surcharge ratio	0.5	0.5

5.4.5 Indian Creek Interceptor

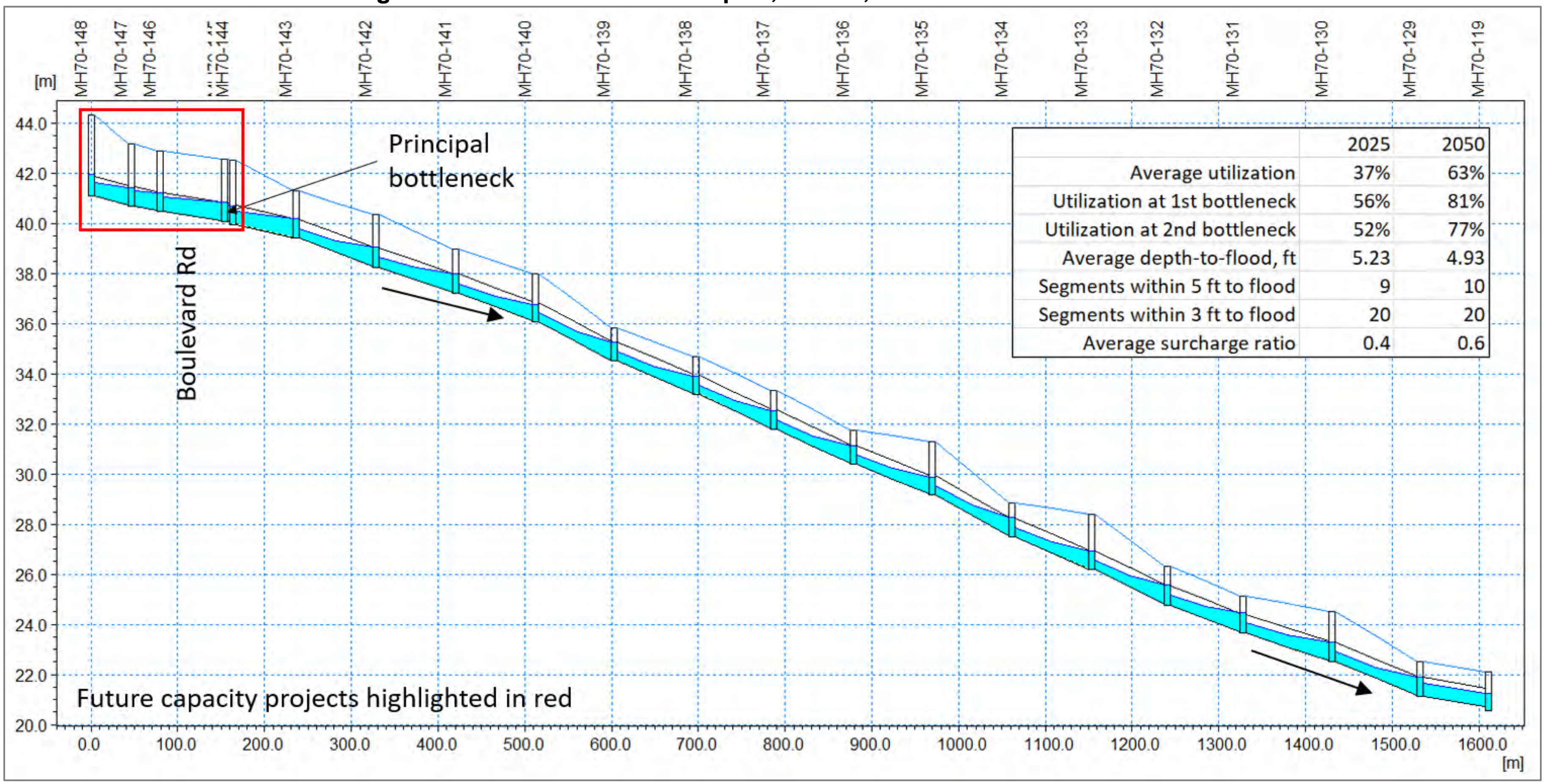
The Indian Creek Interceptor consists of three segments. The upstream segment of mostly 36-inch pipe runs from Martin Way down to I-5. The middle segment, more steeply-sloped, is mostly 30-inch pipe running along the Karen Fraser Woodland Trail. The final segment splits into two parallel pipes, travel through Watershed Park and cross back under I-5. Profiles of each segment at the 2050 peak hour flow condition are presented on Figures 5.8 to 5.11.

Figure 5.8. Indian Creek Interceptor, Upper, 2050 Peak Hour Condition



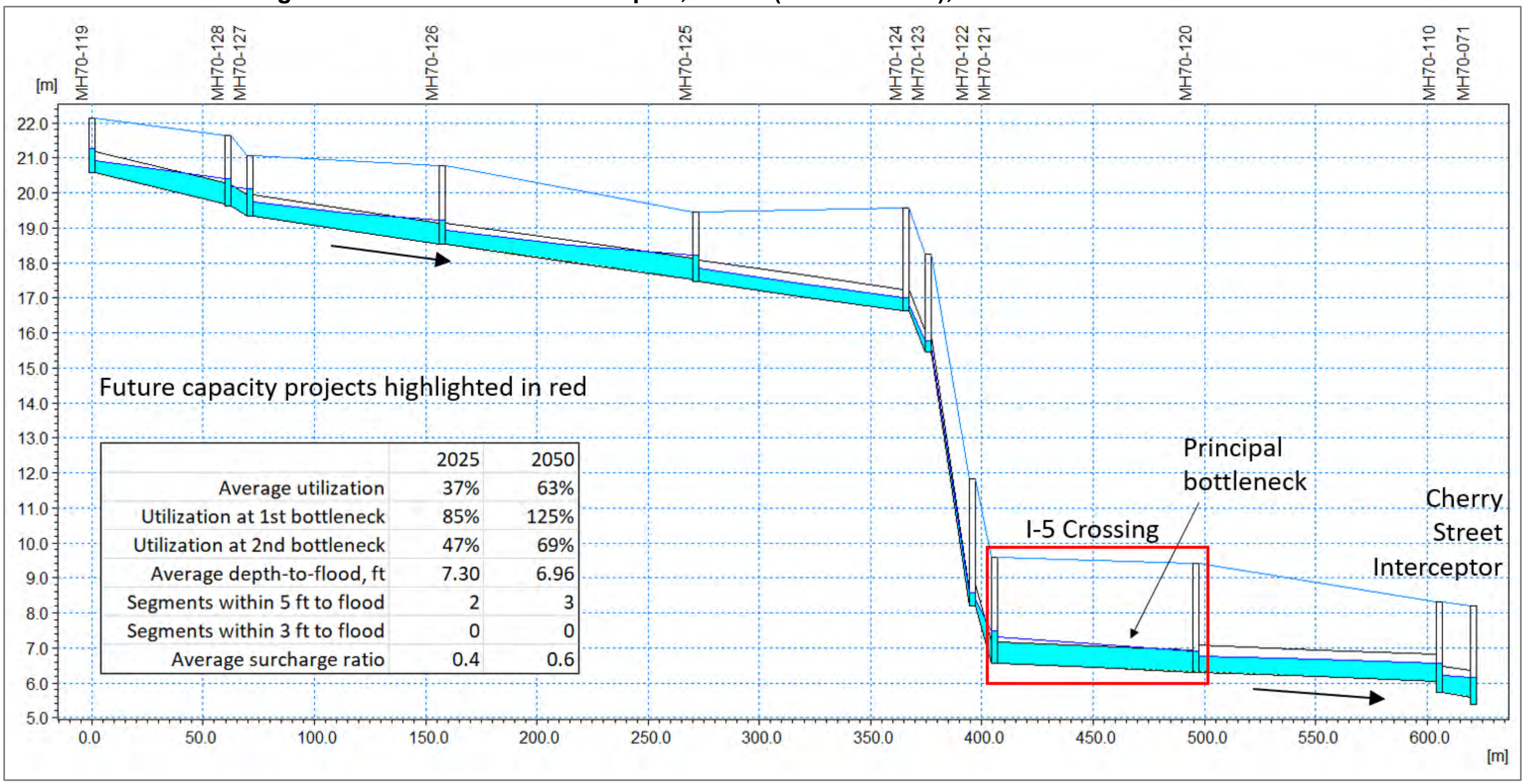
In the upper portion of the pipeline, a pair of bottlenecks limit flow to approximately 16-18 mgd. While this provides sufficient capacity for 2050, these restrictions are projected to result in surcharging and near-flood conditions for the full connection scenario. The shallow manhole MH70-164 is projected to come within 6-inches of flooding at full connection. A trio of bottleneck removal projects are planned for post-2050.

Figure 5.9. Indian Creek Interceptor, Middle, 2050 Peak Hour Condition



The middle section of the pipe is relatively steep, with most segments offering 25-35 mgd of flow capacity. Bottlenecks at the upstream end limit flow to 18-19 mgd, and a capacity project at that location would be required, after 2050, to accommodate full connection.

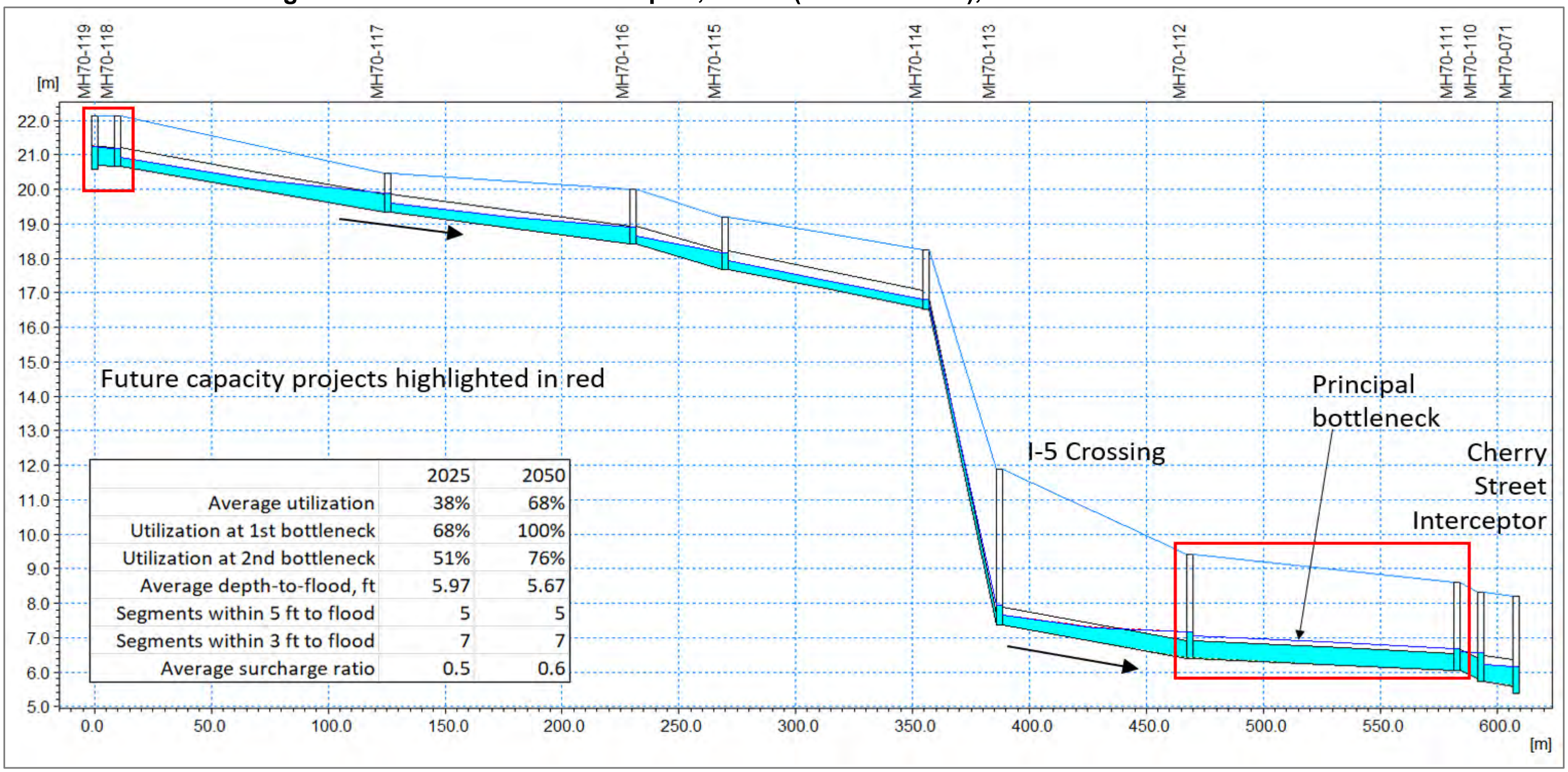
Figure 5.10. Indian Creek Interceptor, Lower (North Branch), 2050 Peak Hour Condition



	2025	2050
Average utilization	37%	63%
Utilization at 1st bottleneck	85%	125%
Utilization at 2nd bottleneck	47%	69%
Average depth-to-flood, ft	7.30	6.96
Segments within 5 ft to flood	2	3
Segments within 3 ft to flood	0	0
Average surcharge ratio	0.4	0.6

The interceptor splits into two parallel pipelines which cross I-5 before recombining at the Cherry Street Interceptor on Henderson Blvd. The northern branch has a flow restriction in the segment passing under I-5, which limits flow capacity to 7 mgd. This results in some moderate surcharging by 2050, and more major surcharging at full connection. This segment of pipe would need to be expanded to accommodate the full connection scenario. The other segment has a pair of flow restrictions. The first restriction is right after the split and MH70-119, with a small, flat segment of pipe limiting capacity to 7 mgd. The larger restriction is just downstream of the I-5 crossing, under the City of Olympia Maintenance Yard, where a relatively flat segment of pipe restricts flow to 5.6 mgd. These restrictions are not projected to be a problem before 2050, but would need to be corrected to accommodate full connection.

Figure 5.11. Indian Creek Interceptor, Lower (South Branch), 2050 Peak Hour Condition

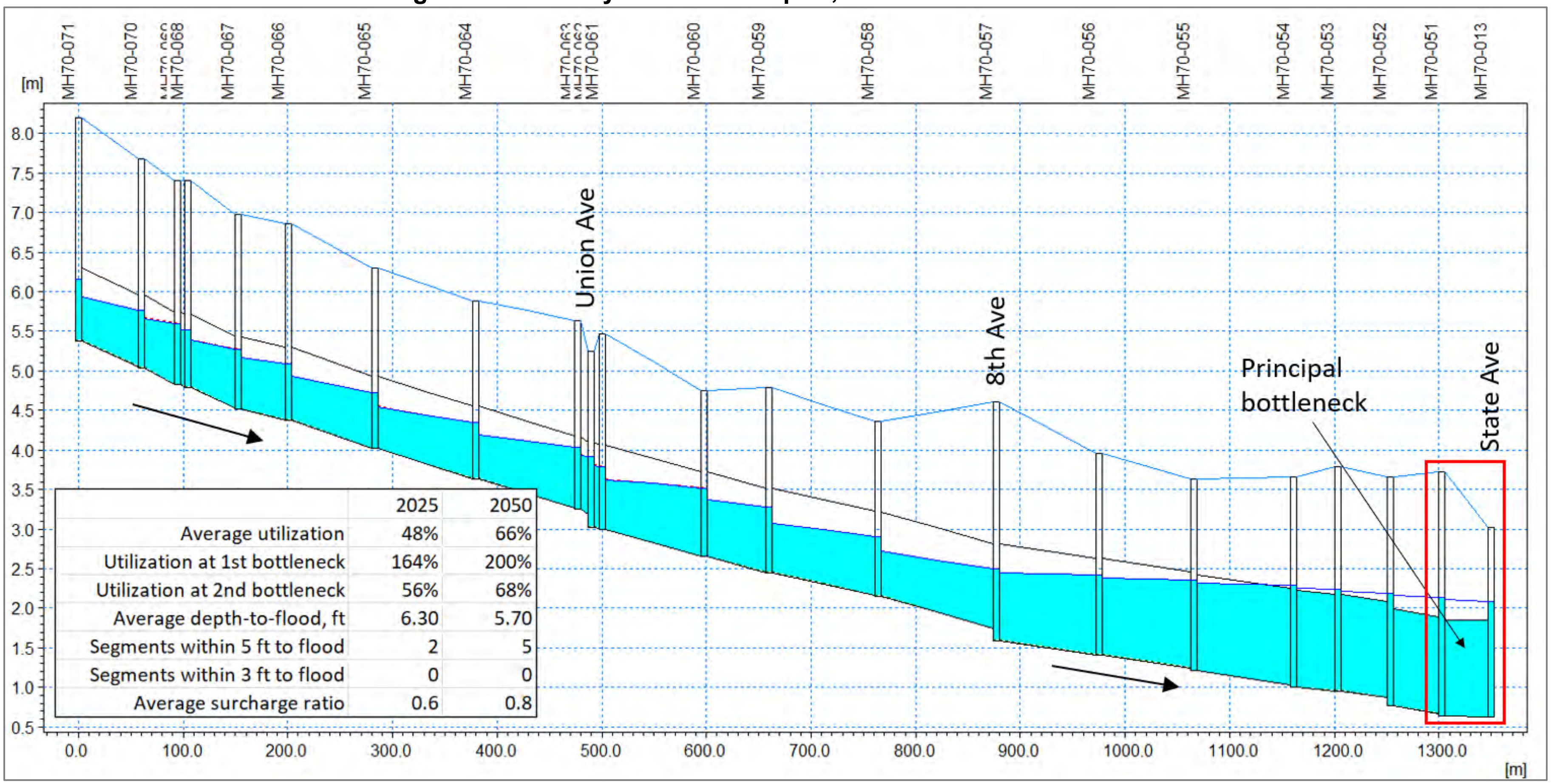


	2025	2050
Average utilization	38%	68%
Utilization at 1st bottleneck	68%	100%
Utilization at 2nd bottleneck	51%	76%
Average depth-to-flood, ft	5.97	5.67
Segments within 5 ft to flood	5	5
Segments within 3 ft to flood	7	7
Average surcharge ratio	0.5	0.6

5.4.6 Cherry Street Interceptor

The Cherry Street Interceptor takes most of the flow from the Indian Creek Interceptor and the Henderson Road Interceptor and picks up combined flows from the City of Olympia at Union Avenue. Figure 5.12 presents the 2050 peak hour profile. The interceptor has a capacity of 25-35 mgd for most of its run, with a major restriction at its outlet. That pipe limits flow capacity to 10.3 mgd and is already causing backups.

Figure 5.12. Cherry Street Interceptor, 2050 Peak Hour Condition

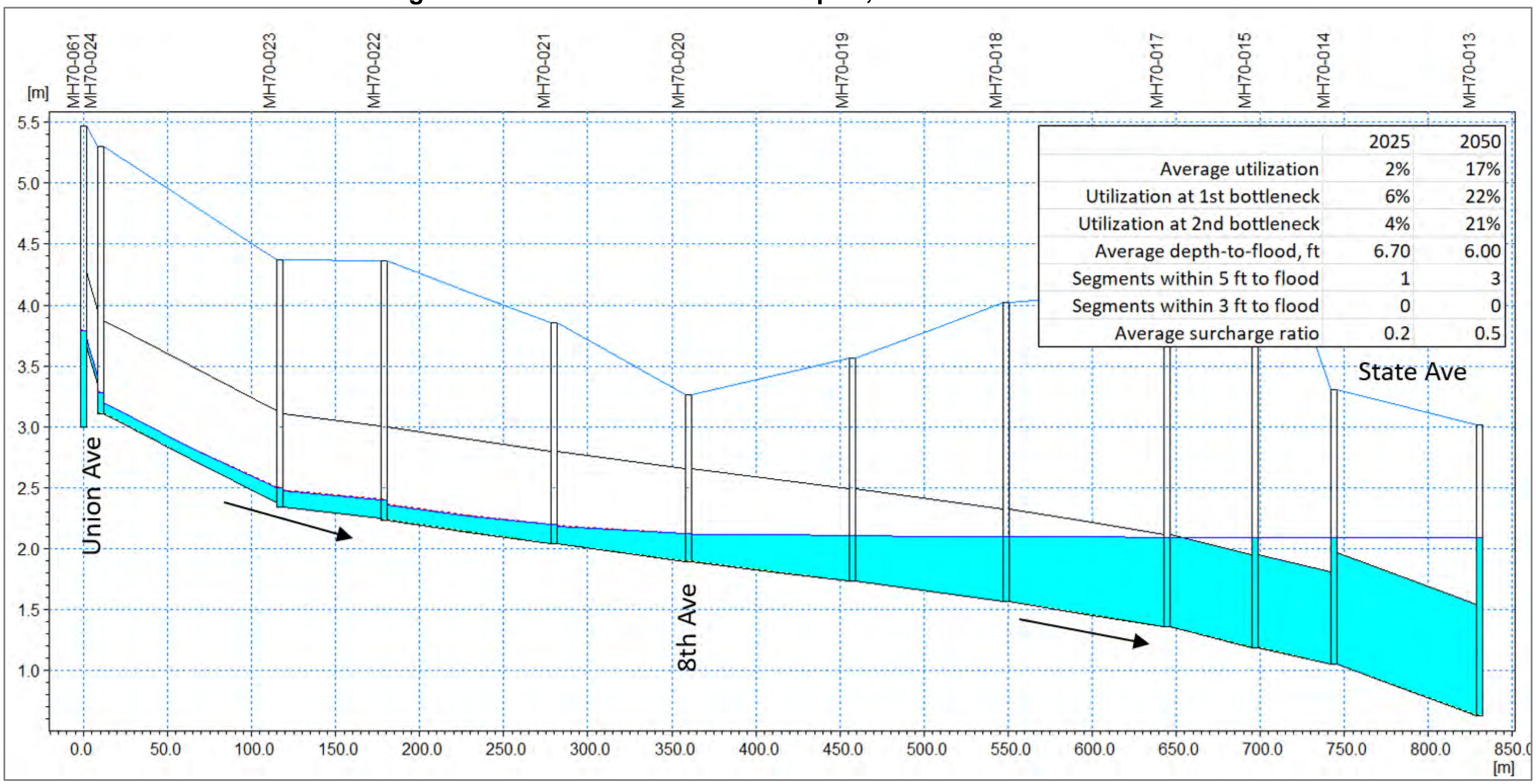


	2025	2050
Average utilization	48%	66%
Utilization at 1st bottleneck	164%	200%
Utilization at 2nd bottleneck	56%	68%
Average depth-to-flood, ft	6.30	5.70
Segments within 5 ft to flood	2	5
Segments within 3 ft to flood	0	0
Average surcharge ratio	0.6	0.8

5.4.7 Chestnut Street Interceptor

The Chestnut Street Interceptor takes overflows from the Cherry Street Interceptor at Union Avenue. Figure 5.13 presents the 2050 peak hour profile. The Chestnut Street Interceptor is under-utilized. Overflows at Union Street are rare, and most of the flow in this pipe is backwater caused by restrictions along State Avenue and Adams Street. There are no significant restrictions in the Chestnut Street Interceptor itself. Manhole MH70-020, at 8th Avenue, is subject to flooding due to its relatively low elevation. This manhole is projected to be within 3.8 ft of flooding by 2050, and within 2 ft of flooding under the full connection scenario.

Figure 5.13. Chestnut Street Interceptor, 2050 Peak Hour Condition

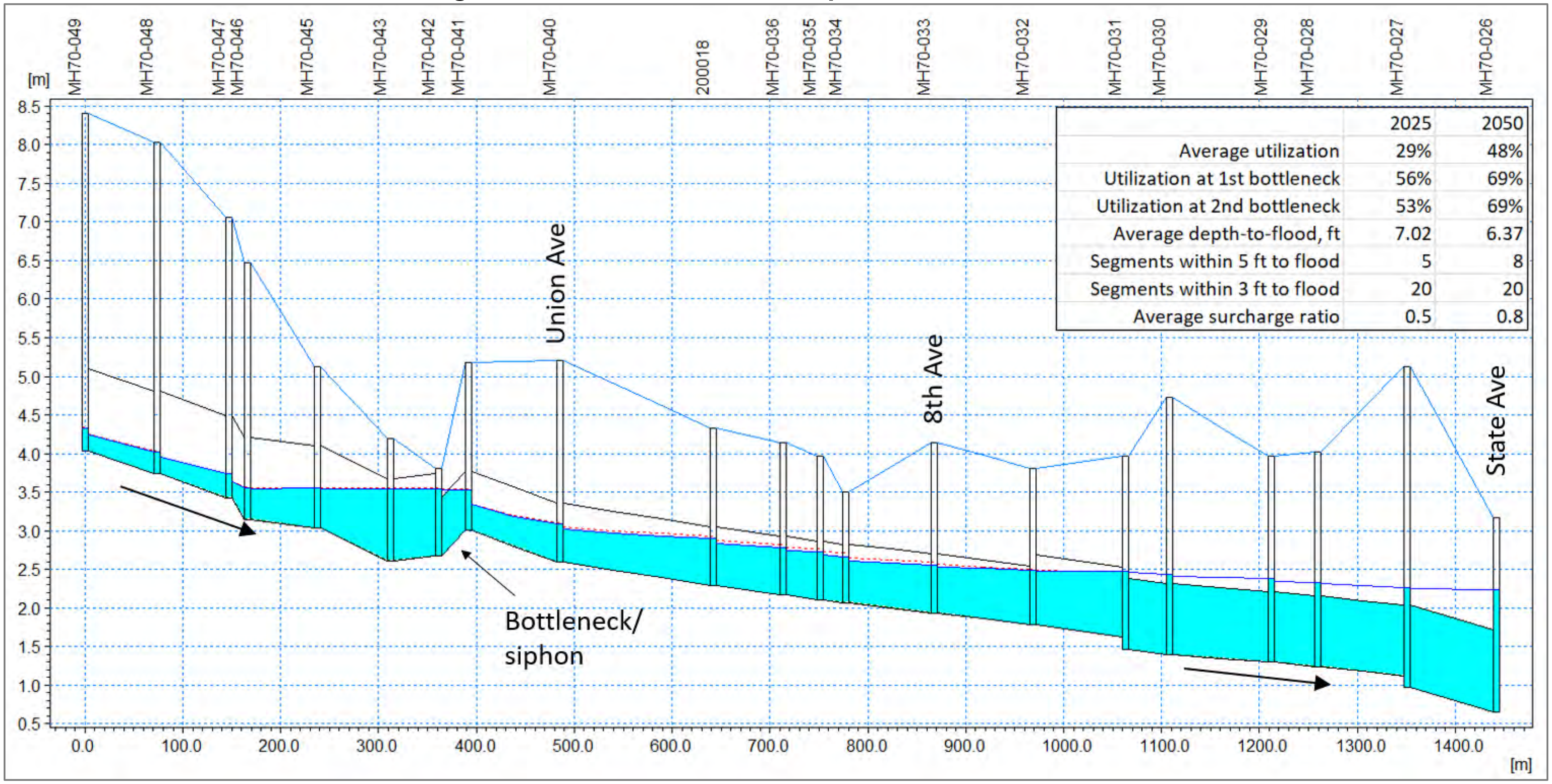


	2025	2050
Average utilization	2%	17%
Utilization at 1st bottleneck	6%	22%
Utilization at 2nd bottleneck	4%	21%
Average depth-to-flood, ft	6.70	6.00
Segments within 5 ft to flood	1	3
Segments within 3 ft to flood	0	0
Average surcharge ratio	0.2	0.5

5.4.8 Plum Street Interceptor

The Plum Street Interceptor takes flows from Tumwater and Olympia north of North Avenue. There is an overflow at its start, which allows a portion of flow from the Indian Creek Interceptor and Henderson Road to enter this pipeline. Figure 5.14 presents the 2050 peak hour profile. For most of its run, the Plum Street Interceptor has at least 10 mgd of capacity, which is sufficient both for 2050 projections, as well as for the full connection scenario. The pipeline is projected to fill up at its downstream end, due to restrictions in the State Avenue and Adams Street pipes. There is a section of upwards-sloping pipe from manhole MH70-043 to MH70-041which creates a small siphon at high flows. Manhole MH70-042 is at low elevation and will flood if not sealed.

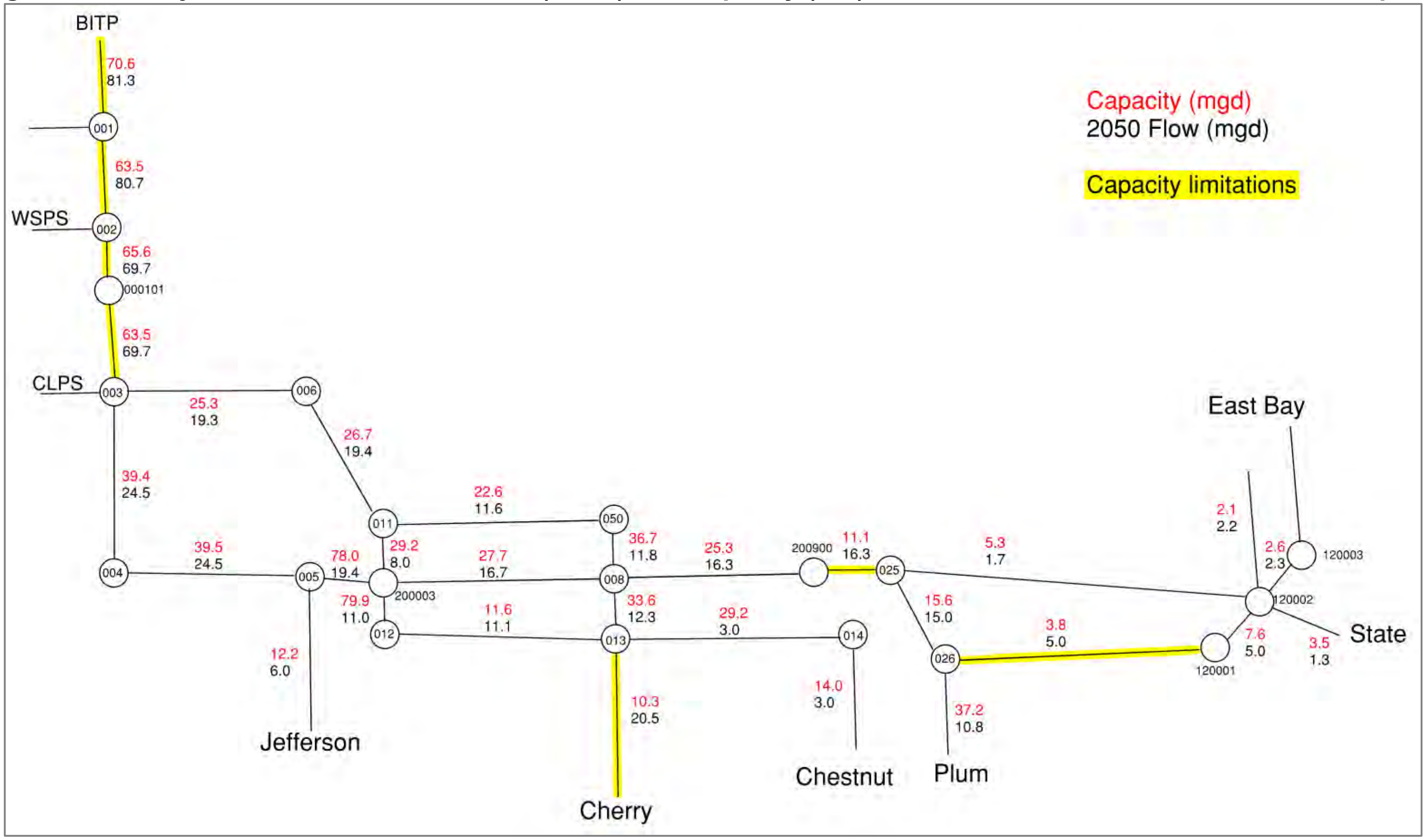
Figure 5.14. Plum Street Interceptor, 2050 Peak Hour Condition



5.4.9 State and Adams Street Interceptors

The State Street Interceptor receives flow from the Cherry, Chestnut, and Plum Street Interceptors. It also conveys flow from the two Olympia East Bay Interceptors, and State Avenue to the west. This interceptor turns north on Adams Street and conveys flow to the BITP. The Adams Street Interceptor also receives pressurized flow from the Capitol Lake Pump Station and the Water Street Pump Station. These interceptors are shown schematically on Figure 5.15. The figure shows the capacity of each pipeline, along with the 2050 peak hour flow.

Figure 5.15. Projected 2050 Peak Hour Flow (black) and Capacity (red), State Avenue and Adams Street Interceptors



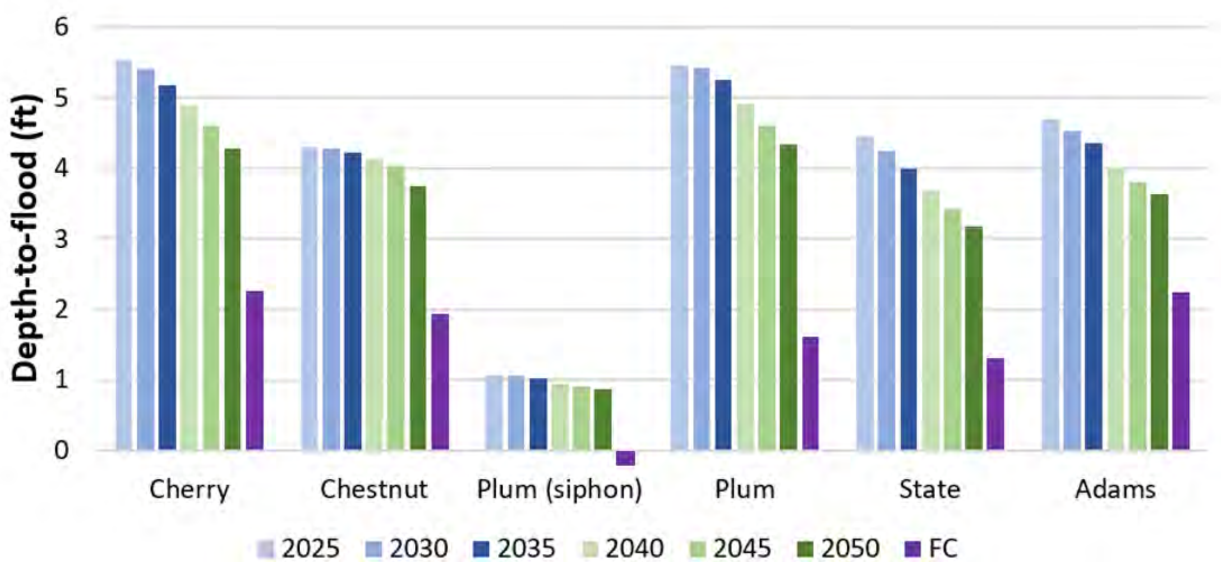
Major capacity restrictions are noted in seven pipes, highlighted in yellow on Figure 5.15:

- Cherry Street Interceptor manhole MH70-051 to MH70-013 (as shown above in Figure 12)
- State Street Interceptor manhole 120001 to MH70-026
- State Street Interceptor manhole MH70-025 to 200900
- Adams Street Interceptor from manhole MH70-003 to the BITP (4 pipes)

These restrictions are causing backwater effects into each of the three large LOTT interceptors (Cherry, Chestnut, and Plum). By 2050, this results in depth-to-flood of approximately three feet in several locations. That represents a loss of about 2-3 feet of freeboard in most cases. While it is possible that the increased surcharging may lead to lateral and/or basement flooding, it is not projected to cause ground-level overflows.

For the full connection scenario, the depth-to-flood decreases to 1-2 feet in most places, with flooding projected at the siphon in the Plum Street Interceptor as described in Figure 14. A depth-to-flood of 1-2 feet is very likely to cause lateral flooding, and many of the pipes will experience several feet of surcharge pressure. Figure 5.16 shows the minimum depth-to-flood for each of the major downtown interceptors from 2025 to 2050, and at full connection.

Figure 5.16. Minimum Depth-to-flood for Downtown Olympia Interceptors



FC = full connection of all septic tanks within cities and urban growth areas

There are two ways to alleviate flooding in these interceptors:

1. The first option is simply to relieve the bottlenecks identified above. Upsizing the seven pipes identified in Figure 5.16 will alleviate most of the issues noted above (flooding would still be observed at the Plum Street siphon at MH70-042, if the manhole is not properly sealed).

2. The second option would be to install a pump station in the region of the State Avenue and Adams Street pipes. The pump station would selectively remove flow

from the surcharged interceptors. Targeted bottleneck removal at Cherry Street and the two State Street Interceptors would likely still be necessary.

This does not appear to be necessary before 2050, although a detailed assessment on lateral impacts would need to be conducted to properly assess the implications.

5.5 Sewer System Modeling Summary

Key findings from the updated sewer modeling include the following:

- A number of pipes in Olympia and Lacey are either capacity-limited or projected to become capacity-limited in the near future. These pipes are currently acting as bottlenecks, and restricting flow to downstream pipes under peak flow conditions. These include:
  - Both of the large diameter pipes along the 4th Avenue Bridge
  - Piping along Madison Ave and West Bay Road
  - Piping along Central Street in downtown Olympia
  - Both of the pipelines along East Bay Road, but particularly the one originating on San Francisco Ave.
  - Piping along Franklin and Jefferson Streets
  - Piping along Central Street
- The LOTT interceptors appear to have sufficient capacity for flows projected through 2050. This is a change from previous modeling work, which projected several capacity needs in the 2030s and 2040s. This change is the result of conservation, which is reducing the per capita wastewater generation rate, and slower population growth projections.
- The most significant capacity restrictions are in the large diameter interceptors in downtown Olympia along State Avenue and Adams Street. Although no flooding is projected through 2050, it is unclear how increased surcharge levels will impact nearby laterals.
- Segments of the Indian Creek Interceptor may require expansion after 2050, as septic tanks are converted to sewer.
- The Martin Way Interceptor (East) will need to be monitored in upcoming years, to determine how much of the peak flow increased noted at MWPS is attributable to this interceptor. This may push capacity limitations in the interceptor ahead of 2050.

5.6 Pressure Mains

The capacity of LOTT pressurized force mains is summarized in Table 5.1. In most cases, capacity is based on a maximum pipe velocity of 7 ft/sec. The capacity of each force main was recently determined through hydraulic modeling.

Table 5.1. LOTT Force Main Capacity

Force Main	Size (in)	Capacity (mgd)	Current	2030	2040	2050
Martin Way Force Mmain[1]	18	9.2	75%	80%	99%	113%
Capitol Lake Force Main (south only)	24	14.5	78%	83%	95%	103%

Capitol Lake Force Main (south and north)	20+24	23.8	48%	50%	58%	63%
Southern Connection	22	14.5	33%	35%	40%	44%
Kaiser Road Force Main	10	2.1	48%	51%	51%	53%

1. Including satellite flow diversion increments for the Martin Way: existing (1.4 mgd), 2050 (1.9 mgd)

- The Martin Way Force Main would currently be at 91% capacity with no flow to MWRWP. With flow to MWRWP as planned, the force main will not reach 85% of capacity until 2034.

- The Capitol Lake Pump Station discharges into two force mains, a 24-inch pipeline that runs south of the lake, and a 20-inch pipeline that runs north of the lake. Using just the southern pipeline, the system would reach 85% capacity by 2031. With both force mains in use, the system is not projected to reach 85% capacity within the planning period.

- The Southern Connection is a double-barreled force main, which runs from Tumwater to the Capitol Lake Pump Station. The smaller 20-inch pipeline has been converted to a pipeline to convey reclaimed water from the Budd Inlet Treatment Plant to Tumwater. With only the 22-inch pipeline used for wastewater conveyance, the system is not projected to become limited within the planning period.

- The Kaiser Road Force Main is not projected to become limited at any point in the planning period.

5.7 Pump Stations

LOTT owns and operates three primary pump stations. Table 5-2 lists the current capacity of the LOTT pump stations in million gallons a day and the percentage of that capacity that will be reached in future years based on updated flow projections. The capacity listed is firm capacity, the capacity of the pump station with one of the largest units out of service.

Table 5-2. LOTT Pump Station Firm Capacity

Pump Station	Pumps	Total Capacity (mgd)	Current Flow (mgd)	2030	2040	2050	Full Connection
Martin Way Pump Station	4	9	93%	98%	123%	141%	191%
Capitol Lake Pump Station	5	24	47%	50%	57%	62%	78%
Kaiser Road Pump Station	3	2	51%	51%	51%	53%	58%

5.8 Required Capacity Improvements Projects

5.8.1 Martin Way Pump Station

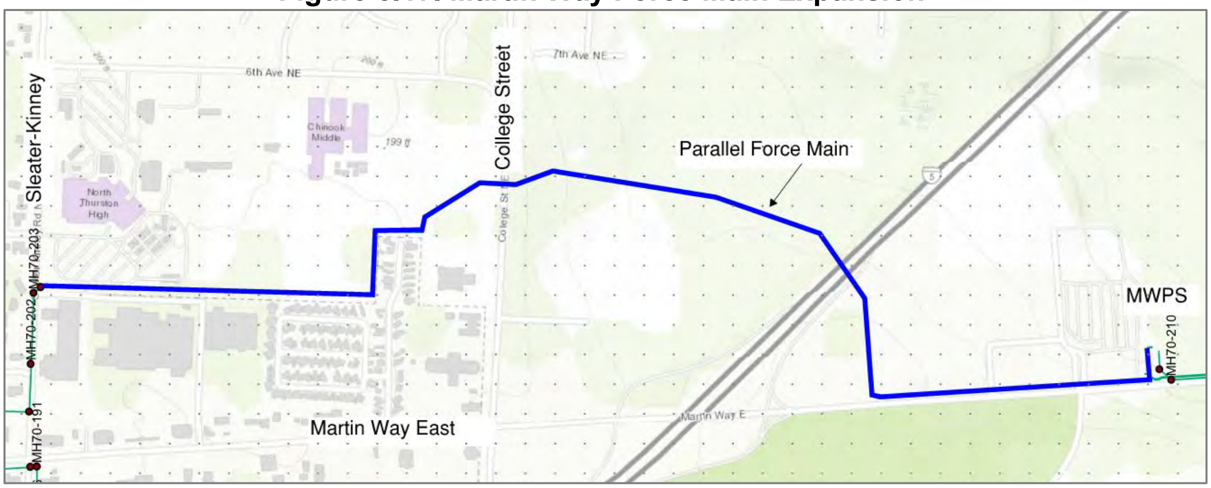
The Martin Way Pump Station currently sees peak flows around 8 mgd. This represents 93% of the station capacity, which includes 7.2 mgd of pumping to BITP and 1.8 mgd of pumping to the MWRWP. A pump station expansion would most likely involve swapping out the existing pumps and installing larger units. The pump station expansion depends on flow peaking in the influent sewers. The MWPS wet well has very limited storage capacity, so spikes in influent flow rate can quickly lead to flooding conditions. Influent peaking is related to precipitation, as well as to the influence of numerous upstream pump stations. Peak influent flows have increased over the past few years. A detailed assessment of 10 years of data in 2020 determined that the peak influent flow was approximately 6.3 mgd. Since that time, there have been verified peaks of 7.9 mgd, 6.2 mgd (twice), and an anomalous peak of

8.3 mgd. Planning for a pump station expansion is underway and will include flow monitoring of the two influent pipelines, an assessment of peaking related to upstream City of Lacey pump stations, and an evaluation of electrical and mechanical improvement alternatives.

5.8.2 Martin Way Force Main

Recent peak flow increases at the MWPS have pushed capacity limitations at this force main up to the mid-2030s. The force main is 7,700 feet along its current alignment, which includes one crossing of Interstate 5. A capacity increase would involve construction of a parallel force main (Figure 5.17). This expansion may happen concurrently with the MWPS expansion, in 2035.

Figure 5.17. Martin Way Force Main Expansion



5.8.3 Martin Way Interceptor (East)

While a portion of the Martin Way Interceptor (East) will be surcharged by 2050, the risk of flooding will remain low until after 2050. LOTT plans to install a parallel pipeline, running from Marvin Road to the Martin Way Pump Station (10,000 feet), in response to further development in western Lacey. The parallel pipeline will not become necessary until after 2050 timeframe, unless development and/or septic conversion in Lacey accelerates beyond the current projection. This pipeline is susceptible to same peaking issues discussed above for the MWPS, so flows in this pipeline should be periodically tracked with active flow monitoring.

5.9 Summary of Pipe Capacity Projects

The following table summarizes the sewer pipe capacity projects discussed in this section.

Table 5.3. Planned Pipe Capacity Projects

On-line	Name	Cost/Estimate	Status	Description
2028	Martin Way Pump Station	$4,500,000	Future	Relieves projected capacity limitations in the Percival Creek Interceptor
2035	Martin Way Force Main Expansion	$3,800,000	Future	Adds parallel force main to meet projected capacity limitations, though affected by pace at which the Martin Way Reclaimed Water Plant is expanded
post-2050	Martin Way Interceptor (East)	$11,600,000	Future	Increases capacity from Marvin to Carpenter

5.10 Reclaimed Water Conveyance Lines

Table 5-4 summarizes existing reclaimed water distribution pipes and their related capacities and Figure 5-18 maps the existing pipelines. The system includes a one million gallon Reclaimed Water Storage Tank to manage reclaimed water supply to the Tumwater Valley Golf Course and other end users in Olympia and Tumwater.

Table 5-4. Reclaimed Water Distribution Pipe Capacities

Reclaimed Water Main	Size (in)	Capacity (mgd)	Length (ft)	2020	2025	2030	2040	2050
Martin Way Reclaimed Water Plant to Hawks Prairie Ponds	14	4	16,600	2	2	2	3	5[1]
Budd Inlet Reclaimed Water Plant to Marathon Park	12	3.5	7,160	1.5	3	3	3	3
Marathon Park to Southern Connection A	20	10	230	1.5	3	3	3	3
Marathon Park to Southern Connection B	18	8	180	1.5	3	3	3	3
Marathon Park to Southern Connection C	20	10	8,900	1.5	3	3	3	3
Southern Connection to Deschutes Valley	18	8	1,110	1.5	3	3	3	3
Deschutes Valley to Tumwater Golf Course	20	10	5,110	1.5	3	3	3	3
Mullen Road	12	3	7,250	0	0	0	0	0

1. Capacity to be increased by adding an 18" pipeline

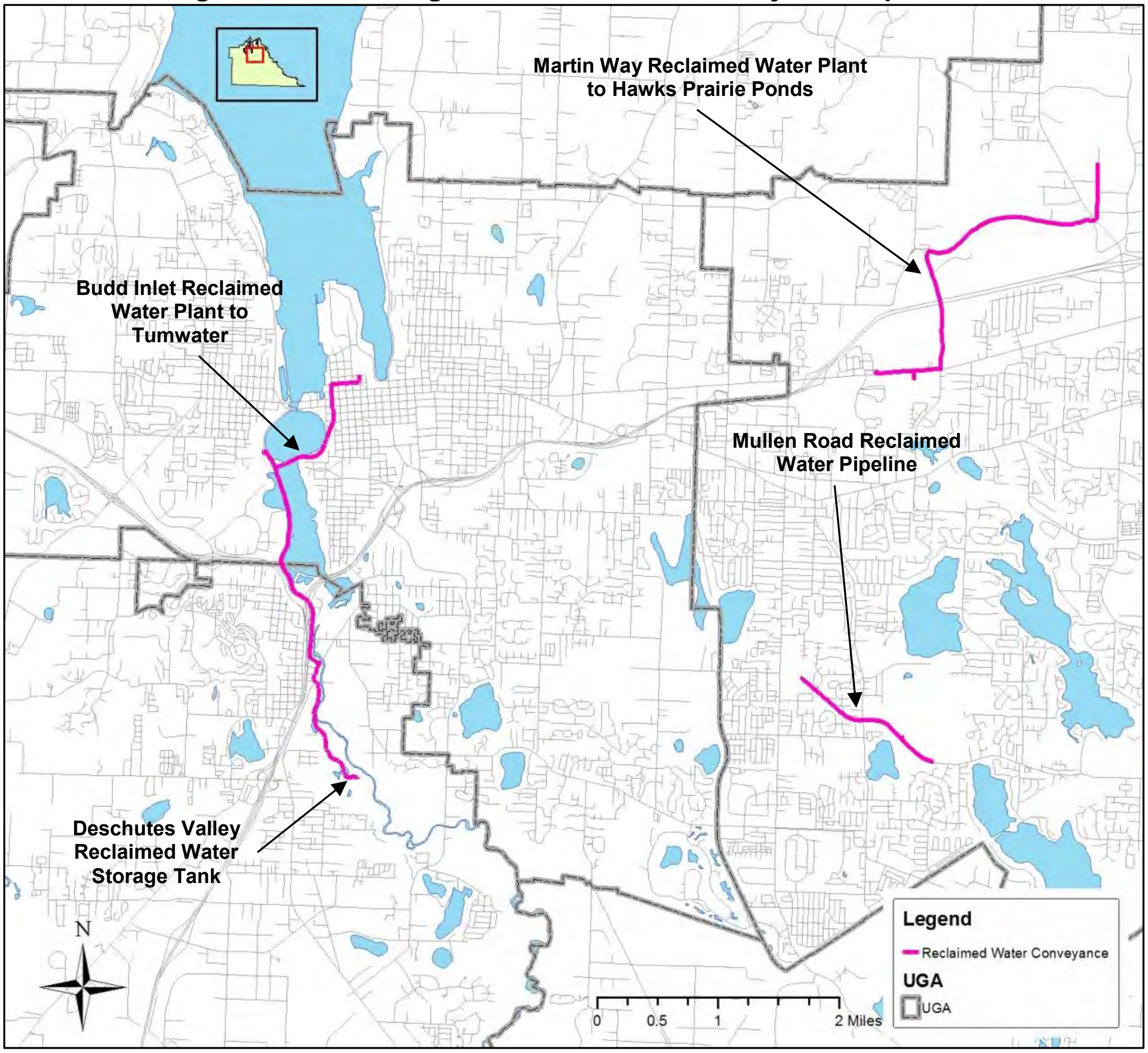
Planned Projects

A portion of the pipeline from the Tumwater Reclaimed Water Storage Tank to the planned Henderson North infiltration basins has been budgeted to enable collaboration with the City of Tumwater's project to extend their trail system to connect Pioneer Park.

Table 5-5. Planned Reclaimed Water Pipe Projects

On-line	Name	Cost/Estimate	Status	Description
2027	Tumwater Golf Course to Henderson North: Phase I	$924,000	Future	Constructs line to Pioneer Park in collaboration with City of Tumwater trail project
2039	Tumwater Golf Course to Henderson North: Phase II	$7,200,000	Future	Extends line from Pioneer Park to the Henderson North Groundwater Infiltration site
2046	Martin Way to Hawks Prairie Pipeline Expansion	$8,856,000	Future	Adds parallel force main to meet projected capacity limitations, though affected by pace at which the Martin Way Reclaimed Water Plant is expanded

Figure 5-18. Existing Reclaimed Water Conveyance Pipelines



6. Operational Capacity Analysis Summary

The projects identified in the 2023-2024 Capital Improvements Plan tie together process limitations at the Budd Inlet Treatment Plant, and capacity limitations related to treatment, discharge/use, and conveyance throughout the system. The list is based upon a number of key assumptions, many of which will have to be re-evaluated on an annual basis. In particular, the discharge capacity analysis will have to be re-assessed once performance levels associated with completion of the Biological Process Improvements project are established, and the target effluent TIN and BOD concentrations are finalized.

LOTT maintains 1.5 mgd of reserve discharge capacity to Budd Inlet in order to manage peak flows and potential delays in the construction of new capacity. LOTT will continue to evaluate and monitor the system requirements and adjust capital improvement projects accordingly to ensure operational capacities are met.

The capacity assessment outlined in this document, along with the 2023-2024 CIP, provide a review of capacity needs and how they can be met into the future. LOTT has also recently completed several major initiatives relevant to evaluation of overall system capacity, including the Reclaimed Water Infiltration Study, 2050 Master Plan, BITP hydraulic modeling, design progress for the future centrate handling facility upgrade, and completion of the Biological Process Improvements project. All these efforts offer insights and opportunities to manage capacity needs into the future. This new information will be incorporated into future iterations of the annual capacity assessment report.

Budget and Capital Improvements Plan

2023-2024

Table of Contents

Executive Summary

The LOTT Clean Water Alliance provides wastewater treatment and reclaimed water production services for the urban areas of Lacey, Olympia, and Tumwater in north Thurston County. LOTT's complex system of treatment and conveyance facilities represents one of our communities' largest regional investments, worth an estimated $1 billion.

LOTT operates its treatment facilities continuously to ensure that wastewater is properly treated and cleaned before it is released into the environment.

To sustain the communities' investment in the existing system and accommodate future service needs, LOTT operates under a continual cycle of planning, designing, and completing numerous capital projects. Many of these projects are large-scale, span multiple years, and require substantial investment. At the same time, LOTT must operate its treatment facilities 24 hours a day, 7 days a week, 365 days a year, to ensure that wastewater is properly treated and cleaned before it is released into the environment. To support all this, LOTT must carefully manage financial resources, planning ahead with a long-term view that provides flexibility to adjust to changing conditions, while minimizing impacts to ratepayers.

LOTT uses a six-year financial planning period, and 2023 and 2024 represent the last biennium of the current planning cycle.

This document outlines LOTT's two budgets for the 2023-2024 biennium – a Capital Budget and an Operating Budget. The Capital Budget includes costs to replace, upgrade, or rehabilitate existing facilities and to build new system capacity. These projects are described in the Capital Improvements Plan, also included in this document. The Operating Budget contains all the costs necessary to operate LOTT's facilities and provide related services. The following table shows a combined summary of both operating and capital revenues and expenses for 2023-2024.

Overall Budget Summary 2023-2024

REVENUE	2023-2024 Budget	2021-2022 Budget	Annual % Change
Wastewater Service Charge	$72,555,094	$64,268,294	6.4%
Capacity Development Charge	$16,010,795	$13,027,740	11.4%
Miscellaneous Revenue	$1,850,169	$1,344,218	18.8%
Net Revenue from Rates and Charges	**$90,416,058**	**$78,640,252**	**7.5%**
Debt Funding	$10,000,000	$21,500,000	(26.7%)
Use/(Saving) of Cash on Hand	$21,260,611	$11,760,156	40.4%
Total Resources	**$121,676,669**	**$111,900,408**	**4.4%**
EXPENSES	**2023-2024 Budget**	**2021-2022 Budget**	**Annual % Change**
Net Operating Expense	$32,423,273	$29,201,668	5.5%
Debt Service	$15,845,499	$18,596,994	(7.4%)
Capital Expense	$73,407,897	$64,101,746	7.3%
Total Expenses	**$121,676,669**	**$111,900,408**	**4.4%**

Capital Budget

Capital costs are based on LOTT's Capital Improvements Plan (CIP), which is reviewed and updated each biennium. The projects identified in the CIP are necessary to ensure LOTT sustains the existing wastewater treatment system and provides needed new system capacity. The CIP includes a detailed six-year plan through 2028 and a summary long-range plan for 2029 through 2035 and beyond. The Capital Budget includes costs for projects on the short-term CIP that LOTT expects to spend within the calendar years 2023 and 2024. It is up about 7.3% per year over the 2021-2022 Capital Budget due to inflation and several large-scale projects needed to upgrade portions of the Budd Inlet Treatment Plant.

Operating Budget

The Operating Budget includes three categories of expense – personnel, direct operating expense, and general expense. Overall operating expenses for 2023-2024 have increased approximately 5.5% per year over the previous Operating Budget.

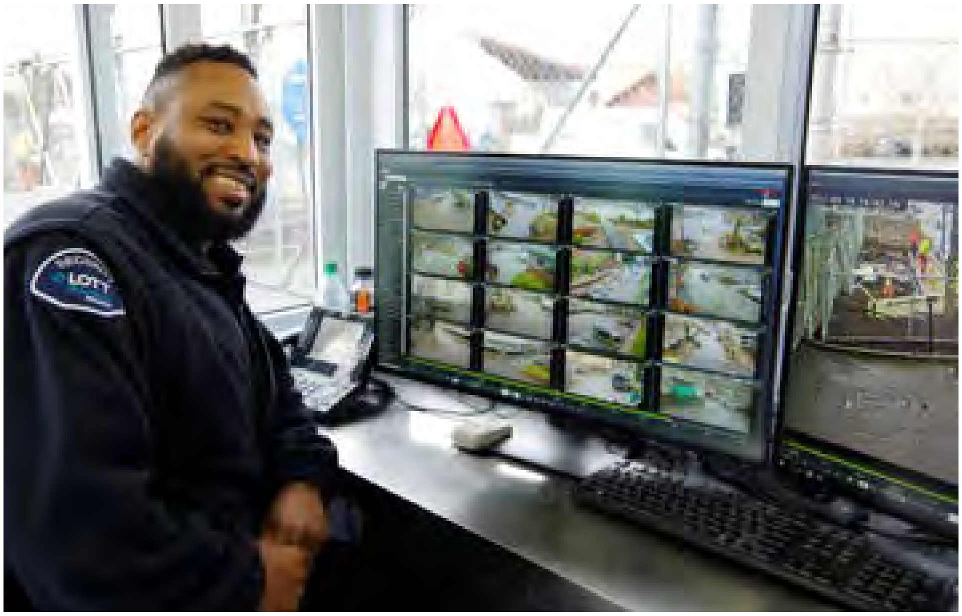
Rates

LOTT has two primary rates – a monthly rate for LOTT sewer service and a one-time connection fee. The monthly rate is called the Wastewater Service Charge (WSC). Revenue from the WSC is used to pay for costs of sustaining and operating the existing wastewater treatment system. The connection fee is referred to as the Capacity Development Charge (CDC). Revenue from the CDC pays for costs associated with building new system capacity to serve new customers.

- Wastewater Service Charge – The monthly rate in 2023 will be $44.80, increasing by $1.31 from the 2022 rate due to a 3% inflationary adjustment. The monthly rate in 2024 will be $46.14.
- Capacity Development Charge – The fee for new connections in 2023 will be $6,841.49, increasing from $6,610.13 in 2022 due to a 3% inflationary increase and a two-year 0.5% adjustment to account for costs associated with a pilot affordable housing support program. The charge in 2024 will be $7,080.94.
- Service Charges – LOTT also receives revenues such as disposal fees from waste haulers. Rates for disposal of septage, vactor, and similar non-septage wastes are automatically adjusted in conjunction with the Wastewater Service Charge.

Revenues

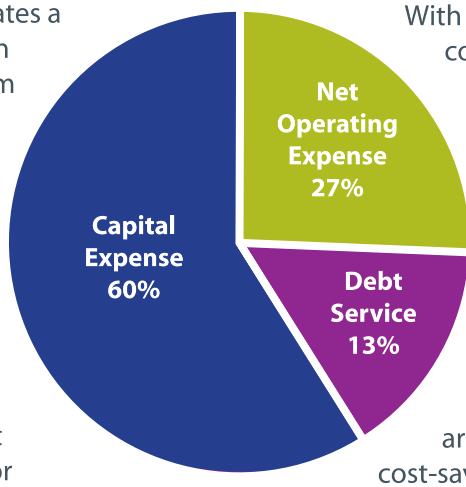
Throughout the past several budget cycles, monthly Wastewater Service Charge (WSC) revenues have seen stable growth as new customers are added to the system. Early in the COVID-19 pandemic, WSC revenue temporarily stalled, then returned to pre-pandemic levels by 2021. Growth in the number of Capacity Development Charge (CDC) connection fees has been higher than expected during the pandemic. Based on these factors, growth estimates have been readjusted to pre-pandemic levels.



The Operating Budget includes three categories of expense – personnel, direct operating expense, and general expense.

Financial Planning

Overview



The LOTT Clean Water Alliance operates a complex system of facilities worth an estimated $1 billion. The LOTT system includes the Budd Inlet Treatment Plant, Budd Inlet Reclaimed Water Plant, Martin Way Reclaimed Water Plant, Hawks Prairie Reclaimed Water Ponds and Recharge Basins, a reclaimed water storage tank, three major pump stations, 22 miles of sewer interceptor lines, and 11 miles of reclaimed water pipelines. Portions of the Budd Inlet Treatment Plant are over 60 years old, and major upgrades to the plant have been ongoing for the past several years.

To sustain the Budd Inlet Treatment Plant and other facilities, LOTT operates under a continual cycle of planning, designing, and completing numerous capital projects. Many of these projects are large-scale, span multiple years, and require substantial investment. LOTT revenue needs are driven primarily by the cost of this capital construction. Of the three cost centers shown in the chart, two – debt service and capital expense – exist to fund the total cost of capital construction. For 2023-2024, LOTT's combined infrastructure investment (debt service plus capital costs) represents 60% of total expense, with operating costs representing 27%.

With large-scale capital project commitments, the Board of Directors must consider budget decisions based on long-term financial planning. LOTT uses a customized finance planning tool to track anticipated expenses into the future, develop a capital finance plan that provides sufficient funds for capital projects, and balance the source of funds between rate income and borrowed dollars. Continual efforts are made to identify and implement cost-saving measures and minimize LOTT's debt, reducing costs to ratepayers from interest and other expenses associated with borrowing money. The results of this approach have been excellent. LOTT's service charge remains below the average for the region, and the percentage increase in rates is consistently below regional and national averages.

The Projected Budget Summary table on the following page shows anticipated expenses for each biennium in the current six-year planning period.

To sustain the Budd Inlet Treatment Plant and other facilities, LOTT operates under a continual cycle of planning, designing, and completing numerous capital projects.

Projected Budget Summary 2023-2028

REVENUE	2023-2024 Budget	2025-2026 Budget	2027-2028 Budget
Wastewater Service Charge	$72,555,094	$79,238,730	$86,509,519
Capacity Development Charge	$16,010,795	$14,450,401	$15,777,207
Miscellaneous Revenue	$1,850,169	$768,685	$623,826
Net Revenue from Rates and Charges	**$90,416,058**	**$94,457,815**	**$102,910,553**
Debt Funding	$10,000,000	$0	$0
Use/(Saving) of Cash on Hand	$21,260,611	$11,779,237	($2,397,279)
Total Resources	**$121,676,669**	**$106,237,053**	**$100,513,274**
EXPENSES	**2023-2024 Budget**	**2025-2026 Budget**	**2027-2028 Budget**
Net Operating Expense	$32,423,273	$37,046,237	$42,099,918
Debt Service	$15,845,499	$16,848,912	$13,878,928
	$73,407,897	$52,341,903	$44,534,427
Total Expenses	**$121,676,669**	**$106,237,053**	**$100,513,274**

LOTT's service charge remains below the average for the region, and the percentage increase in rates is consistently below regional and national averages.

Revenue, Rates, and Fee Summary

LOTT's primary sources of revenue are the monthly Wastewater Service Charge, and the Capacity Development Charge for new connections. LOTT also receives miscellaneous revenues from other sources.

Wastewater Service Charge

The Wastewater Service Charge (WSC) is used to pay most of the cost for repairs or upgrades to the existing wastewater treatment system, loan payments for system-related capital costs, and operating costs. The WSC is assessed based on the equivalent residential units (ERUs). The LOTT charge is included on the customers' utility bills, which are sent out by LOTT's partner cities. Each city also assesses a separate charge on utility bills for costs associated with maintaining their city-owned sewer collection systems.

Because 60% of LOTT's expenses are related to the capital budget, a 3% inflationary adjustment based on construction industry data is planned for the WSC and the CDC rates each year 2019-2024. The adjustment was established by the LOTT Board of Directors in 2012 as part of a comprehensive capital finance plan to ensure the utility keeps pace with escalating construction costs over time and is able to adequately fund LOTT's Capital Improvements Plan.

The adjustment was reviewed by the Board during the 2019-2024 strategic planning process, and again during the 2023-2024 budgeting process. The planned rate adjustment is necessary to keep up with inflation and rising construction costs. Large-scale capital improvements projects must be completed within the next few years to replace critical, aging infrastructure and ensure LOTT's continued ability to meet its mission. The original finance plan was designed specifically to keep rate adjustments modest and predictable, and avoid the need for dramatic, unforeseen rate increases. Inflation is currently higher than the 3% adjustment; however, LOTT's finance plan and steady approach to rate adjustments has allowed LOTT to weather the impact without the need to deviate from the planned adjustment. The Board will further evaluate the effects of inflation when setting rates for the 2025-2026 biennium.

WSC Adjustment – For 2023, the monthly charge will be $44.80, increasing by $1.31 from the 2022 rate. For 2024, the monthly charge will be $46.14.

Capacity Development Charge

The Capacity Development Charge (CDC), also described as a connection fee or hook-up fee, is used to build projects that add new capacity, such as satellite reclaimed water plants, larger sewer lines, and other projects that increase LOTT's ability to serve new customers. The CDC is assessed based on equivalent residential units.

CDC Adjustment – The fee for new connections in 2023 will be $6,841.49, and in 2024, will be $7,080.94. For each year, this reflects a 3.0% increase for inflation and a 0.5% adjustment to account for costs associated with a pilot affordable housing support program.

Miscellaneous Revenue

LOTT also earns interest on cash deposits and receives revenues from miscellaneous other sources such as disposal fees from waste haulers. Rates for disposal of septage, vactor, and similar non-septage wastes are automatically adjusted in conjunction with the Wastewater Service Charge.

Service Charge Adjustments – The adjusted rate for septage disposal will change to $18.48 per 100 gallons in 2023. The rate for vactor and similar non-septage disposal will change to $4.79 per 100 gallons. In 2024, the septage disposal rate is $19.03 per 100 gallons. The rate for 2024 vactor and similar non-septage disposal is $4.93 per 100 gallons.

Revenue Projections and Analysis

Throughout the past several budget cycles, monthly Wastewater Service Charge (WSC) revenues have seen stable growth as new customers are added to the system. Early in the COVID-19 pandemic, WSC revenue temporarily stalled, then returned to pre-pandemic levels by 2021. Growth in the number of Capacity Development Charge (CDC) connection fees has been higher than expected during the pandemic. Based on these factors, growth estimates have been readjusted to pre-pandemic levels.

Wastewater Rate Comparisons

The LOTT Clean Water Alliance is frequently asked about monthly service rates. Concern about the cost of wastewater services is often expressed by residents who are comparing the cost of wastewater and drinking water services, which can appear on the same utility bill, or by new residents to the community who have moved here from areas of the country with lower utility costs.

Wastewater treatment is, in general, an expensive business. LOTT treats an average of 12 million gallons of wastewater each day. The water must be treated to high standards to meet state permit requirements and be safely released into the environment. This requires a complex system of infrastructure – pipelines, pump stations, treatment plants, and related equipment – that must be up and running 24 hours a day, 7 days a week.

By contrast, drinking water services are considerably less expensive. This is due to the fact that our region enjoys a stable supply of high quality groundwater to meet drinking water needs. This water generally requires only minimal treatment. Rates for drinking water and for wastewater services can seem disproportionate, but are mainly due to the vast differences in the amount and complexity of treatment involved in each.

LOTT treats an average of 12 million gallons of wastewater each day.

Part of the cost of wastewater treatment comes from our communities' location along Puget Sound. The U.S. Environmental Protection Agency (EPA) requires states to comply with the federal Clean Water Act by identifying water bodies that do not meet water quality standards and developing action plans to bring those waters into compliance. Puget Sound, and more specifically Budd Inlet, are water quality impaired. The Washington State Department of Ecology has placed stringent requirements on LOTT to reduce the amount of nitrogen and biochemical oxygen demand discharged into Budd Inlet. LOTT was the first, and until recently, the only plant along Puget Sound that was required to treat wastewater to advanced secondary standards to remove nitrogen from the water. This high level of treatment adds technological complexity and cost to the operation of LOTT's main treatment facility.

LOTT is a recognized leader in wastewater treatment in the state. The Budd Inlet Treatment Plant remains one of the only treatment plants employing biological nutrient removal on Puget Sound. This advanced nitrogen removal technology is likely to be required of most major plants along Puget Sound in the future, potentially resulting in major rate increases for those communities. LOTT also operates an advanced membrane biological reactor system at the Martin Way Reclaimed Water Plant, which was one of the first membrane plants in the state producing Class A Reclaimed Water. This same technology is now being developed by several communities in our region to meet ever more stringent treatment requirements, and may require significant increases to their rates.

LOTT conducts an informal survey every two years to see how its residential rates compare with other communities. Some utilities, like LOTT, use a flat rate structure and others use a volume-based structure. To even out the different structures, all of the surveyed rates were compared assuming 700 cubic feet (or 5,236 gallons) per month for an equivalent residential unit. The current survey, conducted in 2022, shows that our monthly charges are lower than the average. Given LOTT's lower than average rates, and the advanced treatment already provided, LOTT ratepayers are receiving a high value for the investments they are making. LOTT strives to ensure its service charges are reasonable and affordable, and the rate survey indicates it is meeting that objective when compared to other utilities in the region.

Wastewater Rate Comparisons

	2022 Rate	2021 Rate	Percent Change	Flat or Volume	2022 Rank	2021 Rank
Thurston County (Tamoshan)	$144.86	$140.64	3.0%	F	1	1
City of Bonney Lake	$129.01	$121.11	6.5%	V	2	3
City of Tenino	$125.66	$125.66	0.0%	F	3	2
City of Shelton	$125.00	$120.20	4.0%	V	4	4
City of Seattle	$119.07	$116.69	2.0%	V	5	5
Thurston County (Boston Harbor)	$112.87	$109.58	3.0%	F	6	6
Thurston County (Olympic View)	$108.70	$105.53	3.0%	F	7	7
City of Chehalis (in city limits)	$98.50	$98.50	0.0%	V	8	8
City of Bellevue	$96.05	$81.88	17.3%	V	9	11
Thurston County (Grand Mound)	$94.91	$92.15	3.0%	F	10	9
City of Centralia (in city limits)	$87.33	$87.33	0.0%	V	11	10
City of Everett	$83.22	$80.90	2.9%	F	12	12
City of Yelm	$82.35	$78.28	5.2%	F	13	15
Average	**$81.47**	**$78.44**	**3.9%**			
City of Renton	$80.74	$78.49	2.9%	F	14	14
City of Snoqualmie	$80.57	$78.99	2.0%	F	15	13
City of Sumner	$76.26	$74.05	3.0%	V	16	16
City of Auburn	$75.26	$73.09	3.0%	F	17	17
City of Longview (in city limits)	$73.83	$73.07	1.0%	V	18	18
City of Bremerton (in city limits)	$72.23	$72.23	0.0%	V	19	19
City of Lacey	**$68.72**	**$65.27**	**5.3%**	**F**	**20**	**21**
City of Tacoma	$68.68	$68.27	0.6%	V	21	20
City of Olympia	**$66.97**	**$63.75**	**5.1%**	**F**	**22**	**23**
City of Kelso	$66.37	$64.44	3.0%	F	23	22
City of Puyallup	$65.43	$61.81	5.9%	V	24	25
City of Tumwater	**$64.13**	**$61.92**	**3.6%**	**F**	**25**	**24**
City of Orting	$60.63	$56.66	7.0%	F	26	26
City of Aberdeen	$60.00	$53.00	13.2%	F	27	28
Pierce County Sewer	$57.34	$53.89	6.4%	F	28	27
City of Mount Vernon	$54.71	$52.35	4.5%	V	29	29
City of Edmonds	$50.53	$48.12	5.0%	F	30	30
City of Bellingham (in city limits)	$49.10	$46.68	5.2%	F	31	31
Lakehaven Sewer District	$46.46	$42.01	10.6%	V	32	32
City of Vancouver	$43.12	$41.86	3.0%	V	33	33

Cost Allocation

Operating costs are paid out of Wastewater Service Charge (WSC) revenue; capital projects and debt service are paid from both WSC and Capacity Development Charge (CDC) revenues. The allocation between these funds depends on the type of project involved, as specified by the Interlocal Cooperation Act Agreement for Wastewater Management.

The primary purpose of the CDC is to pay for new capacity in the system and to ensure that growth pays for growth. This was one of the guiding principles in the development of the interlocal agreement. The LOTT Board determined that the costs assigned to the CDC should reflect the full spectrum of construction, interest on debt, costs for staff, and related ancillary costs to support new capacity development. Because LOTT strategically develops new capacity as it is needed, the utility invests significant staff time and other resources in ongoing activities, such as planning, engineering, land acquisition, permit acquisition, public involvement, and other project-related activities.

It is important to recognize that the CDC is adjusted over the life of the Capital Improvements Plan (CIP) and is not used for short-term revenue adjustments. When conditions require short-term revenue adjustments for capital projects, the WSC must be raised to meet costs as required by the interlocal agreement. Over time, the two funds are reviewed to ensure that system costs and new capacity costs are applied to the appropriate projects. The estimated costs and revenues are balanced over the life of the CIP, and the Board of Directors reviews these costs each biennium to determine if adjustments are needed.

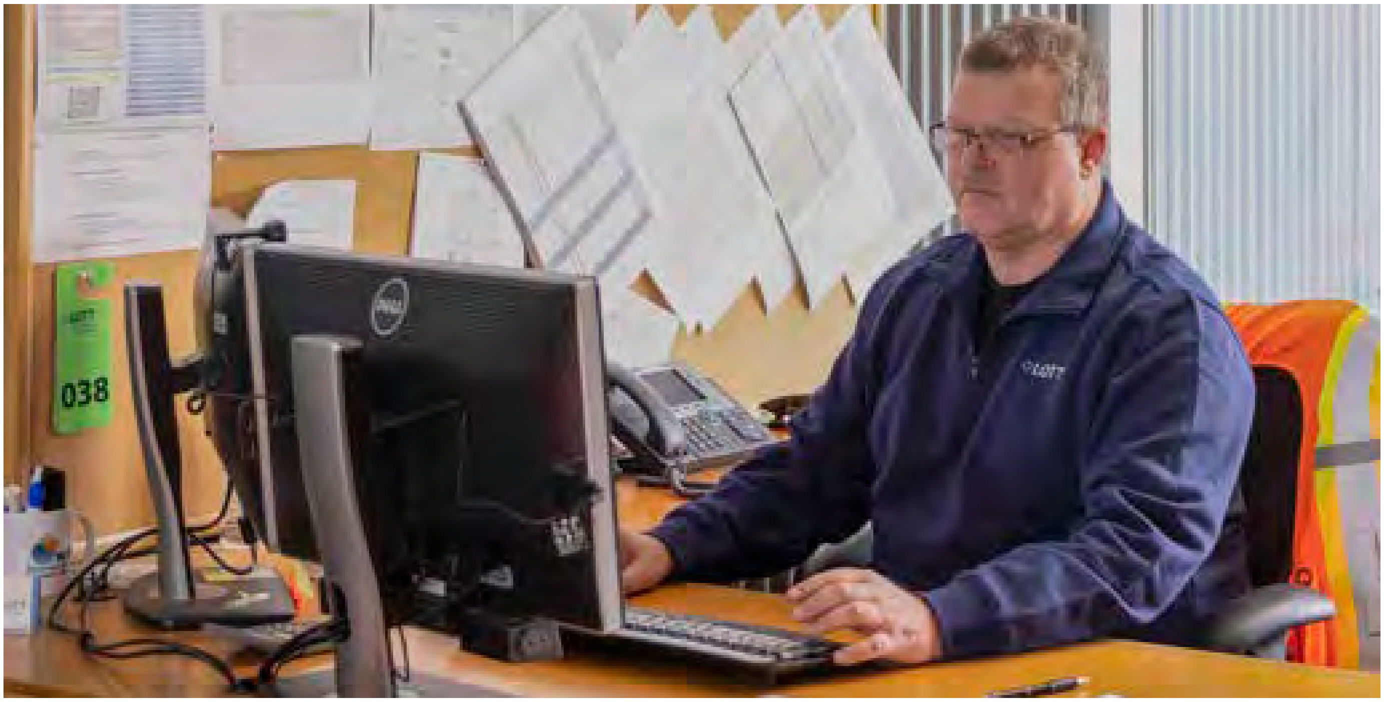
LOTT is currently conducting a cost of service analysis to update the basic unit of measurement (the equivalent residential unit or ERU), and to review the cost centers and cost allocations employed in LOTT's accounting practices. LOTT's partner communities are using more reclaimed water than ever before, and have high interest in using more water than LOTT currently produces. As a result, future Capital Improvements Plans may include projects that are demand-driven, rather than strictly capacity-driven, and adjustments in LOTT's cost allocations may be needed to accommodate this "new" type of project. Results of the cost of service analysis will be integrated into future budgets and CIPs.

Emergency Reserves

One of LOTT's Board-directed goals is to maintain six months of operating expenses and additional reserves for emergency capital expenditure. These amounts are separate from, and in addition to, reserves required by debt covenants. For 2023 and 2024 emergency reserves will include:

- $3 million for emergency capital expenditures
- $9.5 million (approximately) in emergency operating reserves

The primary purpose of the CDC is to pay for new capacity in the system and to ensure that growth pays for growth.



LOTT actively manages projects and programs to identify efficiencies and cost-savings, minimize expenses, and limit the need to increase rates.

Cost Control

LOTT operates under a set of core values that includes managing financial resources in a responsible, sound, economical, and equitable manner. Toward that goal, LOTT actively manages projects and programs to identify efficiencies and cost-savings, minimize expenses, and limit the need to increase rates. Cost control takes vigilance and effort, and is an integral aspect of how LOTT does business. LOTT cannot prevent the rising cost of supplies and labor, but makes every effort to minimize capital and operational costs through a variety of efforts, including:

- Asset Management – The Asset Management Program inventories LOTT's equipment, processes, and systems to proactively identify and schedule needed repairs and replacements. This program protects LOTT's assets and extends their useful life.
- Debt Management – In 2021, revenue bonds originally issued in 2011, along with three State Revolving Fund loans, were refinanced. This action is expected to result in approximately $3.5 million in savings and has effectively brought interest rates on remaining debt to less than 2%.
- Business Case Evaluation – Value engineering by a team of technical staff ensures that each project is designed and built efficiently and effectively. Projects are scheduled over time, and rearranged on the CIP, so as not to exceed available financial and staffing resources.
- Energy Reduction Efforts – LOTT completes a comprehensive greenhouse gas emissions (GHG) inventory each year to track energy reduction progress over time. This work will also help Thurston Regional Planning Council and Thurston Climate Action Team track progress toward community-wide GHG reduction goals. Upcoming, large-scale capital projects, such as the Biological Process Improvements and Digester System Improvements, are designed for energy efficiency, and are anticipated to reduce overall energy use at the Budd Inlet Treatment Plant by over 20% once completed. LOTT also completes smaller-scale energy-efficiency projects, many of which are identified by staff through LOTT's employee incentive program to generate energy-saving ideas.
- Human Resource Management – LOTT strives to make the most of staffing levels, realigning workloads and resources to create efficiencies. Investment in a proactive knowledge management program is helping create training tools and succession plans to effectively prepare future employees with the specialized technical knowledge needed in this industry.

Capital Improvements Planning

LOTT operates under a National Pollution Discharge Elimination System (NPDES) permit that is issued by the Washington State Department of Ecology for the U.S. Environmental Protection Agency (EPA). LOTT must meet all permit requirements, as well as expectations of federal and state agencies regarding responsible utility management. The EPA has developed the Capacity, Management, Operation, and Maintenance Performance Program Plan, requiring wastewater utilities to demonstrate that they have a comprehensive, long-term plan for maintaining existing utility infrastructure and meeting future system needs. LOTT meets that expectation through development of an organizational Strategic Plan every six years, and through continual review and adjustment of the Capital Improvements Plan (CIP). The CIP, prepared each biennium, is submitted to the Department of Ecology, along with a three-part Capacity Report, as part of permit requirements.

Continuous planning is key to this process and allows LOTT to sustain existing infrastructure and build new infrastructure to meet projected future capacity needs. One of the first steps in planning capital improvements is gathering information about the condition of existing infrastructure, repair and replacement needs, current system capacity, and needs for additional capacity in the future. Data gathered includes:

- Asset management data, such as system condition, criticality, and useful life
- Population forecasts from the Thurston Regional Planning Council
- Recently added sewer pipelines
- Anticipated septic tank conversions to the sewer system
- Flow monitoring results
- Planned development

The asset management data is used to identify and prioritize projects necessary to sustain existing treatment, conveyance, and discharge equipment and facilities. Portions of LOTT's main treatment facility, the Budd Inlet Treatment Plant, are over 60 years old. The plant involves a complex maze of piping and thousands of assets that must be maintained properly to keep the plant running. Asset management is a proactive approach to sustaining the plant and LOTT's other infrastructure, allowing the utility to keep ahead of needed maintenance and avoid unexpected, and potentially catastrophic, system failures.

Capacity-related data is modeled in a geographic information system (GIS) to develop population growth forecasts and predict associated wastewater flows and loadings spatially throughout the system. This information is used to develop a three-part Capacity Report, which helps identify and prioritize capital projects for inclusion in the CIP. Based on this report, LOTT identifies needs within the system and develops projects to meet those needs.

All this information funnels into the CIP, which lists projects anticipated over the short- and long-term.

Capacity Report

LOTT's Capacity Report is updated annually, and is available on LOTT's website at www.lottcleanwater.org. The report contains three sections:

Flows and Loadings Report analyzes residential and employment population projections within the urban growth area, and estimates the impact on wastewater flows and loadings in the LOTT wastewater system.

Inflow & Infiltration and Flow Monitoring Report uses dry and wet weather sewer flow monitoring results to quantify the amount of unwanted surface stormwater (inflow) and subsurface groundwater (infiltration) entering the sewer system, and prioritizes sewer line rehabilitation projects.

Capacity Assessment Report analyzes system components to determine when limitations will occur and provides a timeline for new and upgraded system components.

Capital Project Categories

LOTT's Capital Improvements Plan is built around four major project categories. Understanding these categories, and the types of projects within them, provides a general understanding as to how they are funded. Each individual project is assessed regarding the proportion of existing system/new capacity benefits, and is funded through a combination of WSC/CDC funds that reflects that proportion.

System Upgrades

System Upgrade projects include improvements to existing facilities. Upgrades are necessary to replace outdated equipment, improve efficiency, and in some cases, to meet higher water quality standards. One of the public values guiding LOTT's operations is to maximize use of existing facilities before building new ones. These projects are funded primarily from monthly rates.

New Capacity

New Capacity projects are those that provide new facilities to serve added wastewater flows. Under the Wastewater Resource Management Plan, also known as the Highly Managed Plan, LOTT is continuously planning for new system capacity, to be built "just in time" to ensure that future demands are met. For this purpose, LOTT considers three types of capacity when describing its overall operational capacity – treatment capacity, discharge and use capacity, and conveyance capacity. New capacity projects are funded primarily from new connection fees.

Asset Management (Repair, Rehabilitation, and Replacement)

When systems or equipment reach the point where repairs are no longer cost-effective, they can be rehabilitated (overhauled) to a usable condition or they can be replaced. These projects are funded primarily from monthly rates.

Support Services and Projects

Support Services and Projects provide planning information and services that support projects in all categories. They include the ongoing flow monitoring and flow reduction programs, property acquisition, and special studies and projects that support LOTT's long-range Wastewater Resource Management Plan. Engineering and staff costs allied with the Capital Improvements Plan are also included in this category. These projects are funded primarily from monthly rates.

CIP Overview and Organization

The Capital Improvements Plan (CIP) represents all major capital projects in the foreseeable future. It is revised each biennium based on updated capacity reports, asset management evaluations, and other changing conditions.

The CIP is divided into two sections – short-term and long-term. Each section is summarized in a table.

- 2023-2028 CIP – This six-year CIP groups projects by category. It includes a Capital Budget column showing anticipated spending for 2023 and 2024 for each project. Following the table, a project summary page is provided for each project in the short-term plan.
- 2029-2035 and beyond – The longer-range table divides projects by operational systems, based on asset management life-cycle investments needed to meet the expected build-out condition of the entire Lacey-Olympia-Tumwater service area.

Capital Budget and Short-Term CIP Summary

	2023-2024 Budget	2023-2028 CIP
System Upgrades	$43,854,111	$79,265,161
New Capacity	$5,554,643	$15,431,414
Asset Management	$4,126,131	$22,651,451
Support Services and Projects	$19,873,012	$53,668,539
Total	**$73,407,897**	**$171,016,566**

Capital Budget and Capital Improvements Plan

2023-2024 Capital Budget / 2023-2028 Capital Improvements Plan

Summary Page		Year Start	Year Complete	2023-2024 Expenditure	2023-2028 CIP
	System Upgrade Projects			**$43,854,111**	**$79,265,161**
	Budd Inlet Treatment Plant			**$39,305,456**	**$64,631,407**
16	Biological Process Improvements	2021	2023	$2,795,050	$2,795,050
17	Sludge Thickening System Improvements	2022	2024	$6,994,658	$6,994,658
18	Digester System Improvements II	2023	2025	$20,810,971	$35,946,223
19	Odor Control Upgrades	2026	2028	$0	$2,279,898
20	Centrate Building Rehabilitation	2023	2025	$8,491,754	$9,514,857
21	Biogas Utilization Upgrades	2025	2027	$213,022	$7,100,720
	Conveyance				
22	Martin Way Pump Station Improvements	2026	2028	$0	$895,771
23	Martin Way Pump Station Emergency Power Upgrades	2027	2028	$0	$1,198,911
24	Collection System Management Program	2008	Ongoing	$410,873	$1,446,820
25	Collection System Piping Rehabilitation II	2023	2023	$1,388,582	$1,388,582
26	Force Main Air Valve Replacement	2023	2023	$1,523,818	$1,523,818
	Martin Way Reclaimed Water Plant				
27	Reclaimed Water Plant Improvements	2023	2026	$141,928	$7,096,398
28	Membrane Filter Replacement	2023	2023	$1,083,454	$1,083,454
	New Capacity Projects			**$5,554,643**	**$15,431,414**
29	Reclaimed Water Capacity Development	2004	Ongoing	$150,000	$808,026
30	Influent Pump Station Capacity Expansion	2023	2024	$5,009,749	$5,009,749
31	North Outfall Upgrade	2024	2026	$394,894	$6,581,565
32	Centrate Treatment	2026	2027	$0	$3,032,074
	Asset Management Projects			**$4,126,131**	**$22,651,451**
33	General Equipment Repair and Replacement (LERF)	2009	Ongoing	$1,465,464	$4,397,267
34	Instrumentation and Controls Replacement	2012	Ongoing	$657,077	$1,605,256
35	Intermediate Pump Station Improvements	2027	2028	$0	$6,092,743
36	Substation and Switchgear A/B Replacement	2023	2024	$943,017	$943,017
37	Treatment Plant Emergency Power Improvements	2025	2026	$0	$6,974,882
38	Building 8 Electrical Upgrades	2026	2027	$0	$1,105,092
39	Capitol Lake Pump Station Improvements	2023	2024	$389,623	$389,623
40	Facility Roof Repair and Replacement	2016	Ongoing	$670,950	$1,143,572

2023-2024 Capital Budget / 2023-2028 Capital Improvements Plan *(continued)*

Summary Page		Year Start	Year Complete	2023-2024 Expenditure	2023-2028 CIP
	Support Services and Projects			**$19,873,012**	**$53,668,539**
41	Annual Miscellaneous Professional Services	2006	Ongoing	$1,440,966	$4,591,507
42	Engineering Project Support	2006	Ongoing	$4,319,467	$13,617,120
43	Facilities Project Support	2006	Ongoing	$2,550,862	$8,041,594
44	Administrative Project Support	2006	Ongoing	$3,175,651	$10,011,239
45	Flow Monitoring Program	2006	Ongoing	$364,131	$1,160,270
46	Flow Reduction Programs	1997	2024	$260,000	$260,000
47	WET Center Exhibit Updates	2011	Ongoing	$60,000	$485,400
48	Miscellaneous Small Projects	2006	Ongoing	$1,936,442	$5,237,109
49	Occupied Space and Facilities Improvements	2019	Ongoing	$230,000	$531,640
50	Information Technology Upgrades	2014	Ongoing	$1,029,500	$2,150,596
51	Water Quality and Habitat Improvement	2006	2024	$350,000	$1,082,338
52	Septic Conversion Incentive Program	2017	2024	$480,000	$960,000
53	Energy Efficiency and Consumption Reduction Program	2014	Ongoing	$425,994	$1,357,390
54	Public Health Emergency Support Program	2018	2024	$150,000	$150,000
55	Affordable Housing Support Pilot Program	2023	2024	$1,000,000	$1,000,000
56	Sea Level Rise Response	2017	Ongoing	$100,000	$300,000
57	Property Acquisition	2001	Ongoing	$2,000,000	$2,000,000
	Total			**$73,407,897**	**$171,016,566**

The Digester System Improvements project includes refurbishment of aging components associated with the sludge digestion system.

Biological Process Improvements

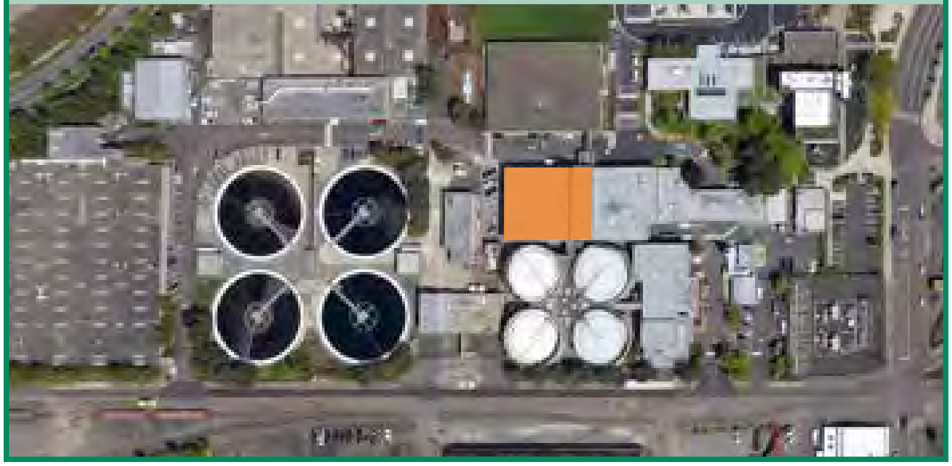
Project Type	System Upgrade
Location	Budd Inlet Treatment Plant
Description	This project involves optimizing the current biological treatment process by reconfiguring the first aeration basins, and reducing the energy required for biological nutrient removal. The improvements include replacing oversized blowers and minimizing recycle pumping. The project also includes optimizing methanol addition to the secondary process.
Background	The first aeration basins were installed in 1994 and were originally sized to meet the anticipated demands of the former brewery in Tumwater. Much of the equipment is reaching the end of its useful life.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2021	2023	$2,795,050	$2,795,050

Sludge Thickening System Improvements

Project Type	System Upgrade
Location	Budd Inlet Treatment Plant
Description	This is phase two of the effort to upgrade the dissolved air flotation thickener (DAFT) system. This project includes installation of new bottom sludge collectors, aspirating pumps, thickened sludge pumps, and process piping.
Background	The DAFT system is used to thicken primary and waste sludge before it is pumped into the digesters. The DAFTs were constructed in the early 1980s and much of the associated equipment is approaching the end of its useful life.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2022	2024	$6,994,658	$6,994,658



Digester System Improvements II

Project Type	System Upgrade
Location	Budd Inlet Treatment Plant
Description	The project includes refurbishment of aging components associated with the sludge digestion system. Improvements include replacement of the digesters' floating covers with fixed covers, upgrades to the sludge mixing system, replacement and relocation of the emergency waste gas burner, and replacement of aging mechanical equipment and the carbon addition system for the biological process.
Background	The digesters were constructed in 1982 and much of the associated equipment is reaching the end of its useful life. There are four digesters, with three in-service and one off-line at any one time. This project will follow a rotational schedule to complete upgrades to one digester at a time.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2023	2025	$20,810,971	$35,946,223

Odor Control Upgrades

Project Type	System Upgrade
Location	Budd Inlet Treatment Plant
Description	This project includes improvements to the headworks, solids, and maintenance building air handling systems as well as modifications to consolidate foul air flows to the south odor scrubber.
Background	The north odor scrubber equipment was originally installed in the early 1980s as part of the construction for the Budd Inlet Treatment Plant secondary upgrade, and is reaching the end of its useful life.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2026	2028	$0	$2,279,898

Centrate Building Rehabilitation

Project Type	System Upgrade
Location	Budd Inlet Treatment Plant
Description	Phase two of the centrate management system upgrade includes replacement of the roof, refurbishment of the interior steel beams and columns, seismic retrofits, odor control system replacement, and electrical upgrades.
Background	Centrate is the liquid removed during the solids dewatering process. With the addition of new primary sedimentation basins in 2017, use of the original basins was converted to storage and management of centrate, which is high in ammonia. This is the second phase of work to repurpose the basins and better manage centrate loading to the secondary treatment process.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2023	2025	$8,491,754	$9,514,857

Biogas Utilization Upgrades

Project Type	System Upgrade
Location	Budd Inlet Treatment Plant
Description	This project will evaluate biogas utilization options, which could include replacement of the existing engine generator or an alternative system to optimize the use of biogas as a resource. The evaluation will incorporate operational data following the digester system improvements, which are anticipated to increase gas production.
Background	The Jenbacher engine generator was originally installed in 2010 as part of a Puget Sound Energy grant. The engine was overhauled in 2018 and has a normal service life of seven years at which time it must be overhauled.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2025	2027	$213,022	$7,100,720

Martin Way Pump Station Improvements

Project Type	System Upgrade – Conveyance
Location	Martin Way Pump Station
Description	The Martin Way Pump Station is projected to reach 85% of its capacity by the year 2050. This project replaces aging equipment and increases pumping capacity to meet projected flows.
Background	The Martin Way Pump Station conveys flows from Lacey to the Budd Inlet Treatment Plant. It also sends raw wastewater to the Martin Way Reclaimed Water Plant. The pump station was originally constructed in 1991. Some of the equipment is reaching the end of its useful life and needs to be replaced.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2026	2028	$0	$895,771

Martin Way Pump Station Emergency Power Upgrades

Project Type	System Upgrade – Conveyance
Location	Systemwide
Description	This project replaces the standby emergency generator at the Martin Way Pump Station. This critical piece of equipment keeps pumps running during interruptions to electrical service to prevent overflow of raw wastewater into surrounding areas, including nearby wetlands.
Background	The standby emergency generator at the Martin Way Pump Station was originally installed in 1991 and is reaching the end of its serviceable life.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2027	2028	$0	$1,198,911

Collection System Management Program

Project Type	System Upgrade – Conveyance
Location	Systemwide
Description	This includes the ongoing monitoring and rehabilitation of sewer lines and manholes within the LOTT collection system. It ensures federal compliance with capacity management, operations, and maintenance standards and is an integral part of LOTT's Asset Management Program. Annual activities include closed circuit televised inspection and condition assessment, which is used to develop plans for needed repairs and replacements.
Background	LOTT currently owns and maintains approximately 22 miles of gravity sewer lines, 8 miles of force mains, and 325 manholes. The collection system management program provides an efficient and systematic approach to inspection, maintenance, repair, and replacement of LOTT's collection system assets.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2008	Ongoing	$410,873	$1,446,820

Collection System Piping Rehabilitation II

Project Type	System Upgrade – Conveyance
Location	Collection System
Description	This is the second of two collection system rehabilitation projects, which includes interceptor pipeline segments along Cooper Point Road North, Mottman Road, Henderson Boulevard, Plum Street, and Eastside Street.
Background	In 2017, LOTT completed a comprehensive condition assessment of the collection system including manholes and sewer interceptors. This project was identified as part of a prioritized investment plan to ensure reliability of the collection system.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2023	2023	$1,388,582	$1,388,582

Force Main Air Valve Replacement

Project Type	System Upgrade – Conveyance
Location	Collection System
Description	The project replaces approximately 50 force main valves that are in poor condition, and includes repairs and modification to some of the vaults to prevent flooding.
Background	Air vacuum release and inlet valves are necessary to protect pressurized pipe systems. As a result of LOTT's recent comprehensive condition assessment effort, a number of needed improvements were identified.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2023	2023	$1,523,818	$1,523,818

Reclaimed Water Plant Improvements

Project Type	System Upgrade
Location	Martin Way Reclaimed Water Plant
Description	This project involves a number of improvements to the treatment plant to replace aging infrastructure and improve operational reliability. Improvements include valve replacement, additional blower capacity, improvements to automation, and upgrades to the electrical and control systems.
Background	Since the Martin Way Reclaimed Water Plant first came on-line in 2006, a number of operational challenges have been identified. Also, reclaimed water demand in the system has increased significantly, making continuous and reliable operation increasingly important. This project will address some of the operational limitations of this facility.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2023	2026	$141,928	$7,096,398

Membrane Filter Replacement

Project Type	System Upgrade
Location	Martin Way Reclaimed Water Plant
Description	This project involves the scheduled periodic replacement of the membrane filters at the Martin Way Reclaimed Water Plant.
Background	The Martin Way Reclaimed Water Plant uses membrane bioreactor technology to produce Class A Reclaimed Water. The membrane filters were last replaced in 2013. Based on the manufacturer's recommendation, the estimated useful life of the membranes is 7 to 10 years.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2023	2023	$1,083,454	$1,083,454

Reclaimed Water Capacity Development

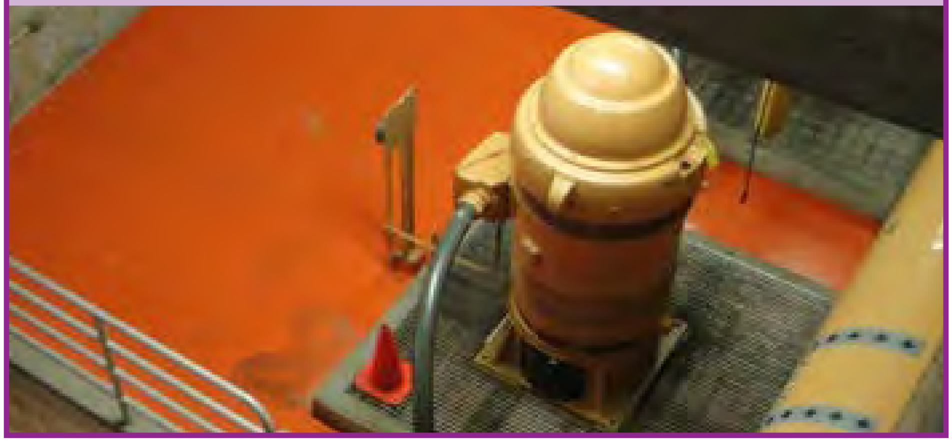
Project Type	New Capacity
Location	Systemwide
Description	This effort includes site assessment and planning associated with expansion of LOTT's reclaimed water system. This could include evaluations of treatment technologies, conveyance routes, reuse opportunities, and site assessments for potential groundwater recharge sites. It also includes design and construction of a reclaimed water pipeline from LOTT's reclaimed water storage tank in Tumwater to Pioneer Park, as a route to reach future recharge or use sites.
Background	LOTT has purchased a number of properties as potential sites for future recharge of reclaimed water produced at the Budd Inlet Treatment Plant. As LOTT adjusts long-range management plans, assessment of alternative sites and reuse opportunities may be needed.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2004	Ongoing	$150,000	$808,026

Influent Pump Station Capacity Expansion

Project Type	New Capacity
Location	Budd Inlet Treatment Plant
Description	All the flow entering the Budd Inlet Treatment Plant must be lifted and pumped to the primary sedimentation basins. The influent pump station consists of four 200 horsepower pumps, each capable of pumping 18 million gallons per day. This project replaces the pumps with new pumps, increasing reliability, redundancy, and hydraulic capacity.
Background	Replacement of the influent pumps, originally installed in 1994, will improve pumping capacity to better manage high flow events associated with more frequent and intense rain events.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2023	2024	$5,009,749	$5,009,749



North Outfall Upgrade

Project Type	New Capacity
Location	Budd Inlet Treatment Plant
Description	This project upgrades a 1,250-foot section of north outfall pipeline from 30-inch to 48-inch diameter pipe to increase hydraulic pumping capacity. The pipeline runs north from the treatment plant, through the Port of Olympia log yard and Cascade Pole site, to the northernmost point of the Port peninsula.
Background	The original 30-inch diameter north outfall pipeline was constructed in 1952. In 1992 the outfall was replaced with a 48-inch pipeline, with the exception of a section running through the contaminated soils of the Cascade Pole site. That section is a hydraulic bottleneck, limiting outfall capacity. This project will resolve the bottleneck and improve LOTT's ability to manage high flow events.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2024	2026	$394,894	$6,581,565

Centrate Treatment

Project Type	New Capacity
Location	Budd Inlet Treatment Plant
Description	This project adds a dedicated centrate sidestream treatment system to reduce nitrogen loading to the main treatment system. The centrate treatment system will utilize existing tanks freed up by the Biological Process Improvements project.
Background	Centrate, the byproduct of the sludge dewatering process, has a high concentration of ammonia and represents approximately 20% of the nitrogen load to the treatment process. The addition of this sidestream treatment system will increase capacity and potentially delay the need for further nutrient removal upgrades.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2026	2027	$0	$3,032,074

General Equipment Repair and Replacement

Project Type	Asset Management
Location	Systemwide
Description	This provides funding for miscellaneous small repair and replacement projects.
Background	In 1987 LOTT established the LOTT Equipment Replacement Fund (LERF) to set aside funds for equipment replacement. These funds pay for small projects identified through LOTT's Asset Management Program.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2009	Ongoing	$1,465,464	$4,397,267

Instrumentation and Controls Replacement

Project Type	Asset Management
Location	Systemwide
Description	This line item provides funding for instrumentation and controls replacements and upgrades.
Background	The control system receives input from a number of controls and instuments, many of which are reaching the end of their useful lives and need to be replaced.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2012	Ongoing	$657,077	$1,605,256

Intermediate Pump Station Improvements

Project Type	Asset Management
Location	Budd Inlet Treatment Plant
Description	The intermediate pump station is responsible for recirculating flow to support the biological nutrient treatment process. This project includes replacing aging and inefficient equipment in the intermediate pump station and second anoxic basins.
Background	Completion of the Biological Process Improvements project will significantly reduce the need for recirculation pumping, resulting in substantial energy savings. Because of reduced pumping requirements, pump station equipment no longer matches pumping capacity needs.

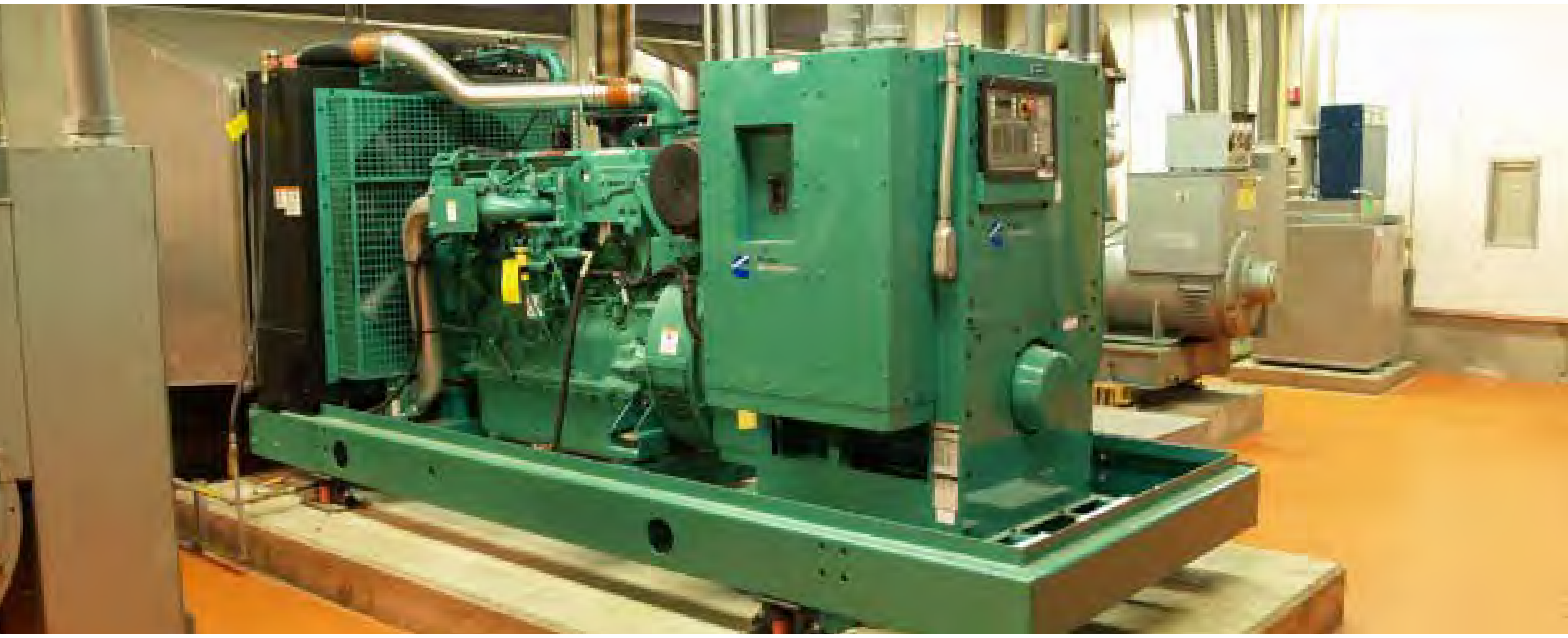
Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2027	2028	$0	$6,092,743

Substation and Switchgear A/B Replacement

Project Type	Asset Management
Location	Budd Inlet Treatment Plant
Description	This project will replace substation and switchgear A/B. This equipment provides critical utility power to headworks, influent pumping, and the Budd Inlet Reclaimed Water Plant. Temporary power will be required to maintain service during construction, supplied through a combination of portable and plant generators.
Background	The substation and switchgear A/B was installed in 1980 and is reaching the end of its useful life.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2023	2024	$943,017	$943,017

Treatment Plant Emergency Power Improvements



Project Type	Asset Management
Location	Budd Inlet Treatment Plant
Description	Emergency standby generators currently serve only select equipment when utility power is interrupted, including the combined sewer overflow pumps, ultraviolet disinfection system, and some electrical controls. Replacement of this aging equipment provides an opportunity to expand back-up power to additional treatment processes and improve redundancy.
Background	The existing standby generators were installed in 1982 and are in need of replacement.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2025	2026	$0	$6,974,882

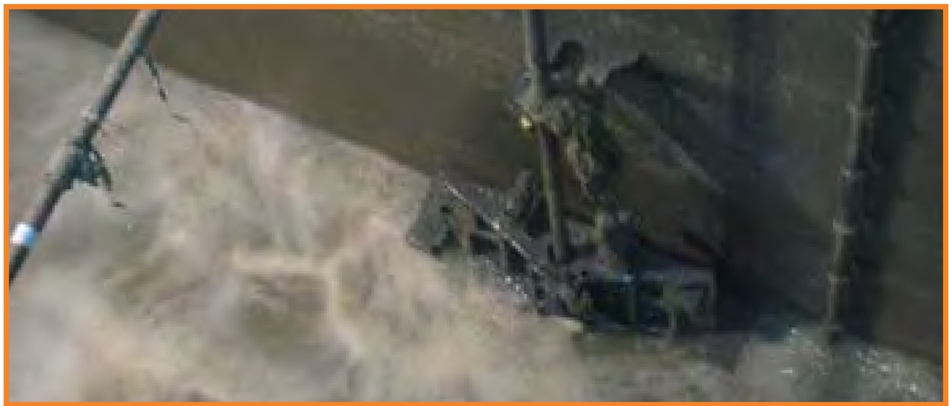
Building 8 Electrical Upgrades

Project Type	Asset Management
Location	Budd Inlet Treatment Plant
Description	This project replaces aging motor control centers located in Building 8 that provide power to equipment in the anoxic basins, portions of the secondary clarifiers, and other aspects of the treatment process.
Background	The motor control centers were originally installed in the early 1980s and are reaching the end of their useful life.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2026	2027	$0	$1,105,092

Capitol Lake Pump Station Improvements

Project Type	Asset Management
Location	Capitol Lake Pump Station
Description	Coatings of wet wells protect the concrete from degradation caused by the presence of hydrogen sulfide. This project involves replacing the coatings in the Capitol Lake Pump Station wet wells, which have begun to fail, creating the risk of wet well deterioration and pump blockages.
Background	Wet well coatings were installed at the Capitol Lake Pump Station in 1999, however, moisture from groundwater intrusion prevented proper adhesion. New wet well coatings will increase the lifespan of the concrete and reduce the risk of system failure during high flow situations.



Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2023	2024	$389,623	$389,623

Facility Roof Repair and Replacement

Project Type	Asset Management
Location	Systemwide
Description	This includes repair and replacement of facility roofs at the Budd Inlet Treatment Plant and offsite facilities.
Background	As part of LOTT's Asset Management Program, a maintenance and monitoring program was established to maximize the life of the existing roofs and ultimately plan for their replacement. A number of roofing systems at the plant and pump stations are reaching the end of their useful lives and need to be replaced in the coming years.

Start	Complete	2023-2025 Expenditure	2023-2028 CIP
2016	Ongoing	$670,950	$1,143,572

Annual Miscellaneous Professional Services

Project Type	Support Services and Projects
Location	Systemwide
Description	This provides funding for various engineering and professional consulting services associated with unexpected small projects identified during the biennium, including projects associated with emergency situations.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2006	Ongoing	$1,440,966	$4,591,507

Engineering Project Support

Project Type	Support Services and Projects
Location	Systemwide
Description	Engineering staff provide support for current and future projects. Services include facility planning, permitting, engineering design, construction management, and documentation.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2006	Ongoing	$4,319,467	$13,617,120

Facilities Project Support

Project Type	Support Services and Projects
Location	Systemwide
Description	Staff from Operations, Maintenance, Control Systems, and Environmental Compliance Divisions provide support for capital projects. Services include participation on project teams, design review, construction support, equipment and process commissioning, and integration into LOTT's asset management system.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2006	Ongoing	$2,550,862	$8,041,594

Administrative Project Support

Project Type	Support Services and Projects
Location	Systemwide
Description	Staff from the Finance and Environmental Planning & Communication Divisions provide a variety of support for capital projects. Services include environmental evaluations, public notification, participation on project teams, contracting and bid support, accounting, and financing. This line item also includes a portion of LOTT's general expenses related to capital projects.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2006	Ongoing	$3,175,651	$10,011,239

Flow Monitoring Program

Project Type	Support Services and Projects
Location	Systemwide
Description	This provides funding for the collection and analysis of flow monitoring data to support the development of the annual three-part Capacity Report (Flows and Loadings, Inflow & Infiltration and Flow Monitoring, and Capacity Assessment). Annual costs include the monthly data collection fees, and annual calibration, relocation, and maintenance of flow meters.
Background	As part of LOTT's National Pollutant Discharge Elimination System (NPDES) permit, LOTT is required to monitor its sewer collection basins so that each is assessed within a seven-year period.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2006	Ongoing	$364,131	$1,160,270

Flow Reduction Programs

Project Type	Support Services and Projects
Location	Regional
Description	This line item funds efforts related to the regional Water Conservation Program, implemented in collaboration with LOTT's partner water utilities.
Background	To help maximize capacity at the Budd Inlet Treatment Plant, LOTT encourages and facilitates water conservation. Through this program LOTT provides incentives for residential and commercial projects that cost-effectively reduce water use and wastewater flows.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
1997	2024	$260,000	$260,000

WET Center Exhibit Updates

Project Type	Support Services and Projects
Location	Regional Services Center
Description	The WET Science Center serves as the heart of LOTT's education and outreach program. Exhibits and other features of the WET Science Center are updated occasionally to ensure they reflect relevant, up-to-date information and hold community interest.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2011	Ongoing	$60,000	$485,400

Miscellaneous Small Projects

Project Type	Support Services and Projects
Location	Systemwide
Description	This line item provides funding for unidentified small projects that arise during the biennium.
Background	Small-scale projects that fall into this category include collection and conveyance system improvements, small construction projects, and engineering analysis and design. This also includes funding for projects authorized through LOTT's Public Art Policy, which was approved by the Board of Directors in July 2008 to incorporate public art in large-scale, publicly accessible capital projects.

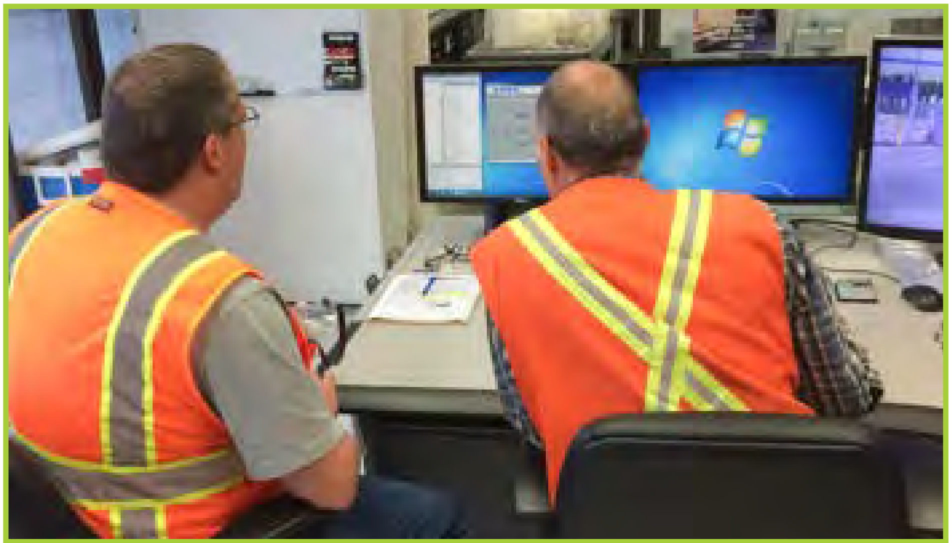
Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2006	Ongoing	$1,936,442	$5,237,109

Project Type	Support Services and Projects
Location	Systemwide
Description	This provides funding for the continued maintenance, refurbishment, and expansion of LOTT-owned occupied spaces such as offices and workrooms. It also includes funding for security improvements for LOTT facilities.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2019	Ongoing	$230,000	$531,640

Information Technology Upgrades

Project Type	Support Services and Projects
Location	Systemwide
Description	This funds information system upgrades to include network servers, routers, switches, desktop computers, security, fire protection, and video surveillance systems. It also supports the continued development of LOTT's electronic operation and maintenance (O&M) manual system, which is a permit requirement.
Background	As technology continues to advance, LOTT must keep pace and continue to upgrade and maintain its information technology infrastructure.



Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2014	Ongoing	$1,029,500	$2,150,596

Water Quality and Habitat Improvement

Project Type	Support Services and Projects
Location	Regional
Description	LOTT funds ongoing efforts to identify and support water quality and habitat improvement projects. Some of these projects result from collaborative efforts with the Squaxin Island Tribe and other local organizations.
Background	Projects that protect or enhance the water quality or habitat of local surface waters or groundwater have benefit in terms of improving these vital shared resources. They also help protect the receiving waters where LOTT discharges water treated at the Budd Inlet Treatment Plant or infiltrates reclaimed water to groundwater.

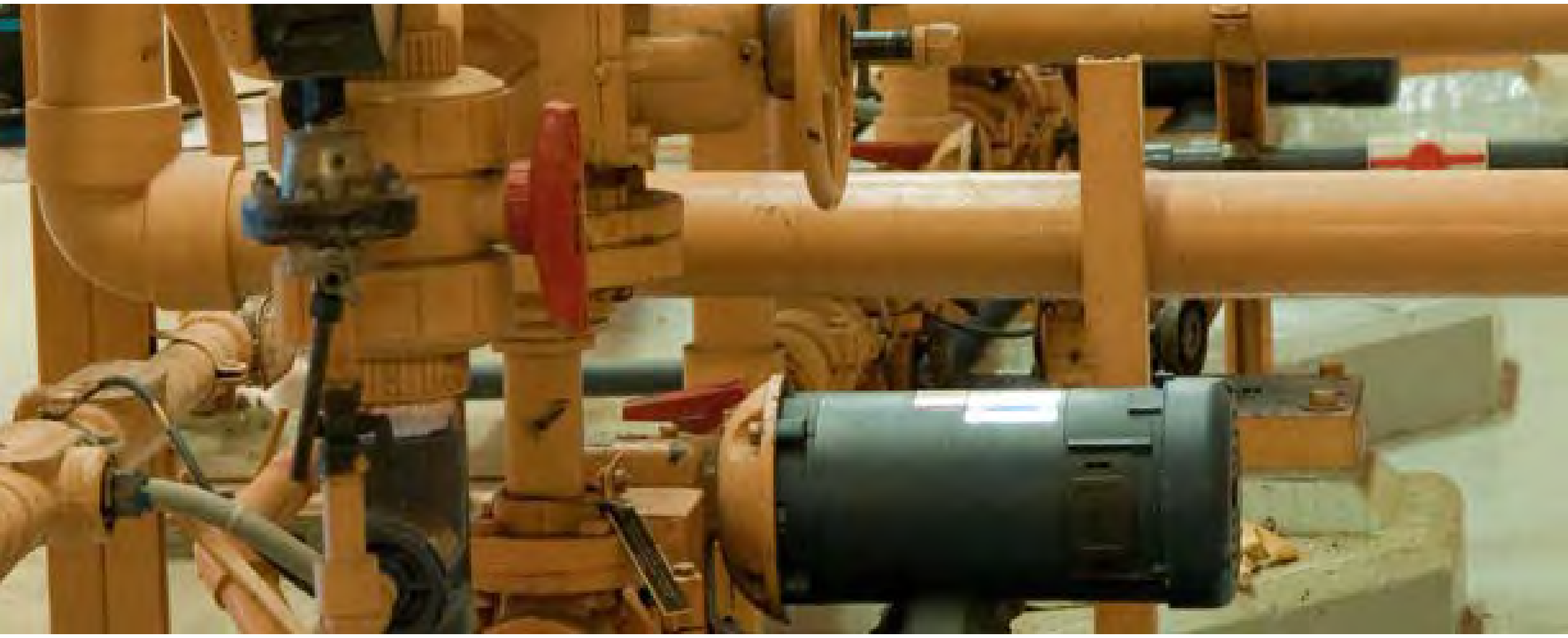
Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2006	2024	$350,000	$1,082,338

Septic Conversion Incentive Program

Project Type	Support Services and Projects
Location	Regional
Description	This program incentivizes conversion from urban septic systems to sewer service through rebates for a portion of LOTT's connection fees.
Background	Connecting properties served by onsite septic systems to the public sewer system helps protect LOTT's receiving waters by ensuring a higher level of treatment than can be provided by septic systems.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2017	2024	$480,000	$960,000

Energy Efficiency and Consumption Reduction Program



Project Type	Support Services and Projects
Location	Systemwide
Description	This line item provides funding for energy conservation efforts. A team of LOTT staff nominate, evaluate, and prioritize projects for implementation. Anticipated projects include replacing old and inefficient motors throughout LOTT facilities.
Background	Through the Energy Efficiency and Consumption Reduction Program, funds previously used to purchase green power from Puget Sound Energy are being used for internal energy conservation projects.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2014	Ongoing	$425,994	$1,357,390

Public Health Emergency Support Program

Project Type	Support Services and Projects
Location	Regional
Description	This program provides grants to LOTT's partner jurisdictions for efforts to improve management of human waste associated with homelessness. An example of an eligible project is the purchase of equipment, such as portable toilet and shower trailers, for use in managed camping areas.
Background	The homeless crisis has resulted in a significant increase in human waste along streets, sidewalks, and other outdoor areas. This poses a risk to public health and the environment, as runoff can carry bacteria and nutrients into storm drains and nearby surface waters. Projects that protect or enhance the quality of local surface waters help protect LOTT's receiving waters – Budd Inlet.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2018	2024	$150,000	$150,000

Affordable Housing Support Pilot Program

Project Type	Support Services and Projects
Location	Regional
Description	This pilot program is designed to encourage development of affordable housing within LOTT's service area through a partial rebate of LOTT's connection fee.
Background	An increased supply of affordable housing is a regional goal shared by the LOTT partner justifications. This is a two-year pilot program to measure the efficacy of reducing costs to foster development of low income housing and to assess potential impacts to utility revenue.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2023	2024	$1,000,000	$1,000,000

Sea Level Rise Response

Project Type	Support Services and Projects
Location	Budd Inlet Treatment Plant
Description	This line item provides funding for continued sea level rise response efforts, including joint projects with the City of Olympia and Port of Olympia. Near-term joint actions identified in the Sea Level Rise Response Plan include data gathering efforts such as installation of a tide gauge, monitoring of subsidence, and study of groundwater intrusion.
Background	LOTT, the City of Olympia, and the Port of Olympia completed a joint planning effort in 2019 to create the Olympia Sea Level Rise Response Plan. The plan provides a comprehensive list of short-term, mid-term, and long-term strategies for minimizing and preventing flooding to downtown Olympia and protecting LOTT's Budd Inlet Treatment Plant from rising sea levels.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2017	Ongoing	$100,000	$300,000

Property Acquisition

Project Type	Support Services and Projects
Location	Systemwide
Description	This line item provides funding for purchase of property to meet future infrastructure and system needs, including property adjacent to the Budd Inlet Treatment Plant along Washington Street.
Background	As capacity needs and regulatory requirements change over time, additional properties may be needed to expand existing facilities and to build new treatment, conveyance, and discharge facilities.

Start	Complete	2023-2024 Expenditure	2023-2028 CIP
2001	Ongoing	$2,000,000	$2,000,000

Long-Range Planning

The long-range Capital Improvements Plan (CIP) represents major capital projects projected to occur within the 2029-2035 timeframe and those that are anticipated beyond that period. This table is based on LOTT's current understanding of system needs well into the future. However, the plan is refined each biennium based on new information, including updated capacity reports, asset management evaluations, and other data. Revisions also occur due to changing conditions that result from recently completed planning efforts such as LOTT's Reclaimed Water Infiltration Study and the state-level Budd Inlet Total Maximum Daily Load (TMDL) Study, and regional plans related to climate change and urban septic system conversion. This long-range CIP has been revised based on the first phase of a master planning effort to consider system upgrades that will be necessary at the Budd Inlet Treatment Plant over the next 30 years. Additional revisions are expected following completion of the second phase of master planning and public engagement in late 2022. The long-range plan is continually adjusted, shifting projects in time, based on the most current information.

Long-Range Capital Improvements Plan

System Life-Cycle Investments	2029-2035	Beyond 2035	Project Cost
Headworks			
Headworks Solids Handling Improvements		✓	$16,232,200
Wet Weather Flow Capacity Expansion		✓	$54,261,214
Primary Sedimentation			
Chemically Enhanced Primary Treatment	✓		$911,641
Primary Sedimentation Basins Phase 2		✓	$49,681,830
Secondary Clarifiers			
Secondary Clarifier Refurbishment	✓		$1,459,360
Secondary Clarifier Expansion		✓	$32,348,869
Tertiary Treatment Facility Phase 1	✓		$7,144,067
UV Disinfection			
UV Disinfection System Replacement		✓	$12,195,479
Budd Inlet Reclaimed Water Plant			
Budd Inlet Reclaimed Water Plant Expansion		✓	$9,525,358
Sludge Thickening			
Sludge Thickening System Upgrade	✓		$4,323,423

Long-Range Capital Improvements Plan *(continued)*

System Life-Cycle Investments	2029-2035	Beyond 2035	Project Cost
Sludge Digestion			
Digestion Capacity Expansion		✓	$7,163,317
Sludge Dewatering and Disposal			
Sludge Dewatering System Upgrade		✓	$17,264,576
Struvite Precipitation	✓		$9,167,310
Odor Control			
South Odor Scrubber Upgrade	✓		$2,094,200
Electrical and Controls			
Substation and Switchgear E/F Replacement	✓		$3,437,048
Substation and Switchgear C/D Replacement	✓		$3,608,088
BITP Control System Upgrades		✓	$903,056
Collection			
Percival Creek/Mottman Road Interceptor		✓	$6,871,100
Martin Way Parallel Force Main	✓		$3,033,176
Henderson/Indian Creek Improvements		✓	$3,462,328
East Corridor Upgrade (Marvin to Carpenter)		✓	$9,913,687
Indian Creek Interceptor Improvements		✓	$14,280,415
Martin Way Reclaimed Water Plant			
Membrane Replacement	✓		$2,371,796
Martin Way Reclaimed Water Plant 3rd mgd	✓		$30,730,745
Martin Way Reclaimed Water Plant 4th and 5th mgd		✓	$46,725,632
Hawks Prairie Ponds			
Martin Way to Hawks Prairie Pipeline Expansion		✓	$15,207,016
Reclaimed Water Capacity Expansion (Based on second phase of master planning effort)			
Treatment/Production Facilities Expansion			TBD
Conveyance System			TBD
Infiltration/Recharge/Augmentation Projects			TBD

Operating Budget

2023-2024 Operating Budget

The Operating Budget for 2023-2024 was the subject of multiple work sessions with the Board of Directors during 2022. It includes three categories of expense – personnel, direct operating expense, and general expense. Budgeted amounts for each category are shown in the table. The overall 2023-2024 Operating Budget has increased approximately 5.5% per year over the previous budget.

Operating Expense Summary 2023-2024

	2022-2023 Budget	2021-2022 Budget	Annual % Change	Biennial $ Change
Personnel	$20,441,036	$18,176,021	6.2%	$2,265,014
Direct Operating Expense	$9,919,674	$9,280,930	3.4%	$638,744
General Expense	$2,062,563	$1,744,717	9.1%	$317,847
Total Operations Expense	**$32,423,273**	**$29,201,668**	**5.5%**	**$3,221,605**

Personnel

This category includes all staffing and related benefit costs. LOTT's staffing level for 2023-2024 includes a total of 87.75 full-time equivalent (FTE) positions. Two new FTEs and conversion of one temporary position to FTE status are included in the total. Increases in healthcare and scheduled cost of living adjustments contribute the majority of the increase in this biennium's personnel budget.

Direct Operating Expense

This accounts for all the non-personnel costs associated with the wastewater treatment process and production of reclaimed water. It includes items such as operating supplies, utilities, chemicals, and tools. This category increased by 3.4% per year, largely due to an increase in property insurance and chemical costs.

General Expense

General Expense, the smallest of the three categories, includes all other necessary expenses that are not directly related to operations. This includes items such as training, professional services, and other overhead costs. Total expenses in this category have increased 9.1% per year in comparison to the 2021-2022 budget due to increased costs for security services. Additional contract security services are being employed in response to an uptick in security incidents over the last few years.

Direct Operating Expense accounts for all the non-personnel costs associated with the wastewater treatment process, such as operating supplies, utilities, chemicals, and tools.

Our Commitment

The LOTT Clean Water Alliance is committed to meeting our communities' needs for wastewater treatment and reclaimed water production services, and doing so in a fiscally responsible, sound, and equitable manner. Protecting our communities' investment in LOTT's regional infrastructure and meeting future needs for new treatment capacity requires effective operations, continuous planning, and completion of large-scale capital projects. While the cost of these needs is substantial, LOTT has managed to minimize impacts to ratepayers, while keeping the utility financially sound.

The LOTT Clean Water Alliance is committed to meeting our communities' needs for wastewater treatment and reclaimed water production services, and doing so in a fiscally responsible, sound, and equitable manner.

LOTT Clean Water Alliance

500 Adams Street NE, Olympia, WA 98501
(360) 664-2333 • www.lottcleanwater.org