City of Wilsonville
Wastewater Treatment Plant Master Plan

EXECUTIVE SUMMARY

DRAFT | July 2022

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Abbreviations

AA	average annual
AAF	average annual flow
ABF	average base flow
ADWF	average dry-weather flow
AWWF	average wet weather flow
BCR	biochemical reactor
BOD_5	biochemical oxygen demand
Carollo	Carollo Engineers, Inc.
CIP	Capital Improvement Plan
City	the City of Wilsonville
$CBOD_5$	five-day carbonaceous biochemical oxygen demand
CSZ	Cascadia Seismic Zone
DBO	Design-Build-Operate
DEQ	Department of Environmental Quality
DMR	Discharge Monitoring Reports
ETL	excess thermal load
gpd/sf	gallons per day per square foot
HMI	human-machine interface
Jacobs	Jacobs Engineering Group Inc.
kcal/day	kilocalories per day
lbs	pounds
MBR	membrane bioreactor
mg/L	milligrams per liter
mgd	million gallons per day
MGI	Northwest Geotech, Inc.
ml	milliliter
MLSS	mixed liquor suspended solids
MM	maximum month
MMDWF	maximum month dry weather flow
MMWWF	maximum month wet weather flow
MW	maximum week
MWDWF	maximum month dry weather flow
MWWWF	maximum week wet weather flow
NH_3	ammonia
No.	number
NPDES	National Pollutant Discharge Elimination System
OSSC	Oregon Structural Specialty Code

PD	peak day
PDDWF	peak day dry weather flow
PDWWF	peak day wet weather flow
PHF	peak hour flow
ppd	pounds per day
PSU PRC	Portland State University Population Research Center
R/C	residential/commercial
SPA	State Point Analysis
SRT	solids residence time
the Plan	Master Plan
TMDL	total maximum daily loads
TP	total phosphorous
TS	total solids
TSS	total suspended solids
TWAS	thickened waste activated sludge
UGB	urban growth boundary
UV	ultraviolet
WWTP	wastewater treatment plant

EXECUTIVE SUMMARY

This new City of Wilsonville (City) Wastewater Treatment Plant (WWTP) Master Plan (the Plan) has been developed to satisfy requirements associated with the State of Oregon Department of Environmental Quality (DEQ) guidance document entitled "Preparing Wastewater Planning Documents and Environmental Reports for Public Utilities." To accommodate future flows and loads, projections were developed based on population projections and referencing WWTP historical data and DEQ wet weather project methodologies. Similarly, to accommodate future water quality regulations, the Plan is adaptive and considers potential future regulatory changes.

The City prepared the Plan with the goal of developing a capital plan that identifies improvements required through the planning period (today through 2045) to comply with requirements of the WWTP National Pollutant Discharge Elimination System (NPDES) permit and potential future regulatory requirements, while accommodating growth identified in the City of Wilsonville Comprehensive Plan (October 2018, updated June 2020 - the 2018 Comprehensive Plan). These improvements are designed to provide the best value to the City's ratepayers by maximizing the use of existing infrastructure and improving system operation while continuing to protect water quality and human health and supporting economic development, consistent with goals and policies contained in the 2018 Comprehensive Plan and 2021-2023 City Council Goals.

The City's WWTP was originally built in 1971 and discharges treated effluent to the Willamette River. The WWTP underwent major upgrades in 2014 to expand the average dry weather capacity to four million gallons per day (mgd) to accommodate the City's continued growth. The WWTP processes include headworks screening and grit removal facilities, aeration basins, stabilization basins, secondary clarifiers, biosolids processing, cloth filtration, and disinfection processes. Additionally, the City contracts with Jacobs for operation of the wastewater treatment plant, located at 9275 Southwest Tauchman Road.

This Plan identifies improvements taking into consideration:

- The age and condition of existing process equipment and structures,
- Growth in demand for sewer service due to increased population and economic development over the planning period,
- Potential changes to water quality regulations impacting process needs in order to meet effluent limitations and discharge prohibitions imposed by the Oregon Department of Environmental Quality (DEQ),
- City of Wilsonville Wastewater Collection System Master Plan (2014, MSA), and

- Consistency with the 2018 Comprehensive Plan and City Council 2021-2023 Goals 5, 6 and 7:
  - Goal 5: Align infrastructure plans with sustainable financing sources.
  - Goal 6: Engage the community to support emergency preparedness and resiliency.
  - Goal 7: Protect Wilsonville's environment and increase access to sustainable lifestyle choices.

ES.1 Planning Area Characteristics

Chapter 1 summarizes the City's wastewater service area characteristics relevant to assessing WWTP facility needs. The planning area considered by this Plan is consistent with the City's 2014 Collection System Master Plan and 2018 Comprehensive Plan including the urban growth boundary (UGB), which is currently the limit of City sewer service as shown in Figure ES 1.

The northern portion of the City of Wilsonville is located within Washington County, and the majority of the City lies in the southwestern part of Clackamas County.

The City sits within the jurisdictional boundaries of Metro, the regional government for the Portland metropolitan area. By state law, Metro is responsible for establishing the Portland metropolitan area's UGB, which includes Wilsonville. Land uses and densities inside the UGB require urban services such as police and fire protection, roads, schools, and water and sewer systems. A figure of the City's existing land use is presented in Chapter 1. Also presented in Chapter 1 are the City's physical characteristics, water resources, and population and employment information, which are all significant factors in planning for wastewater conveyance and treatment facilities.

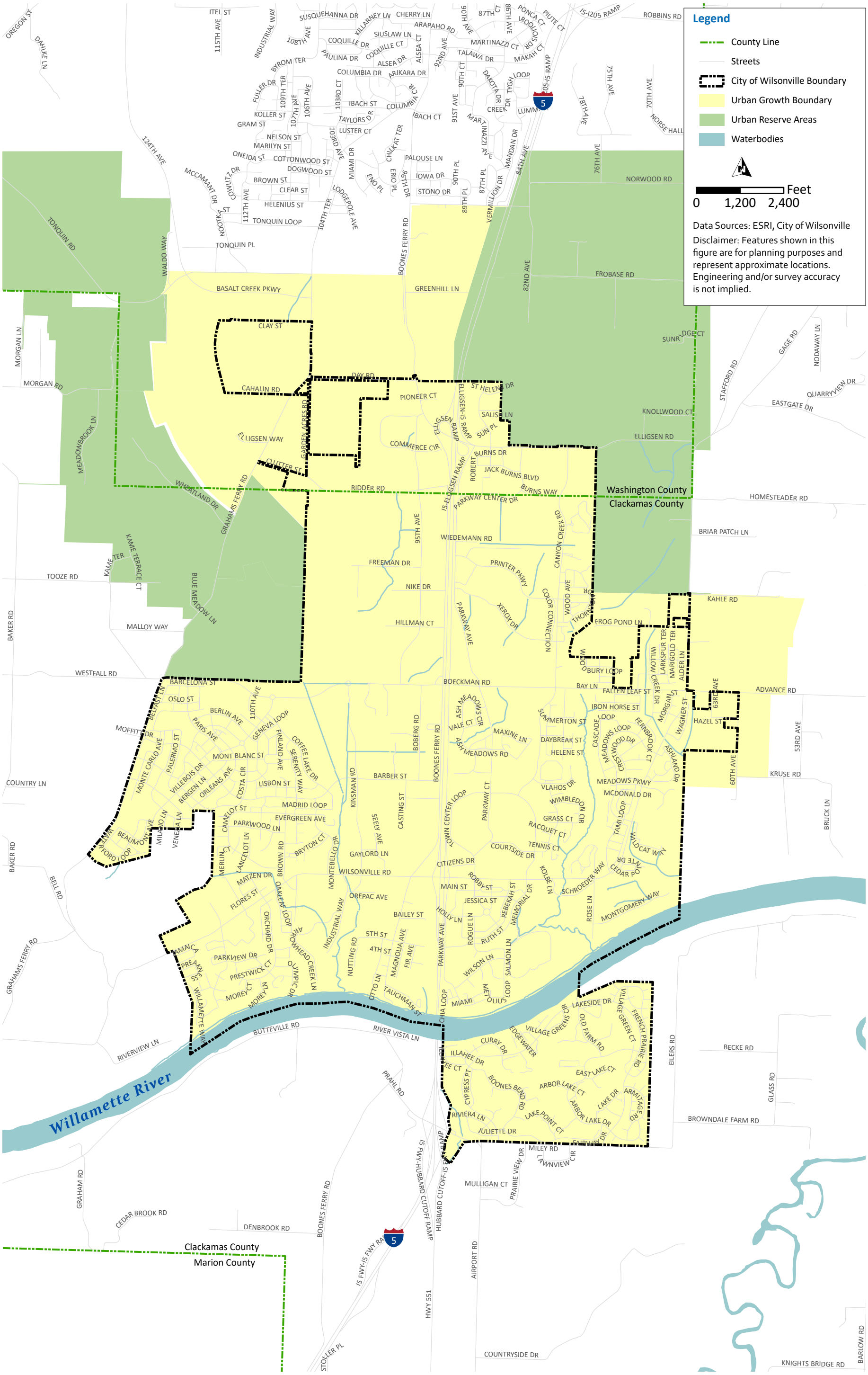

Figure ES.1 Planning Area

The Portland State University Population Research Center (PSU PRC) publishes annual estimates of populations for the previous year for cities in Oregon while Metro develops population projections for the future within the Portland metropolitan area, including Wilsonville. The PSU PRC estimated the City's population as 27,186 in 2021. Metro estimates the City's population to reach 30,566 people by 2045.

For establishing a per capita basis for flow and load projections for the Plan, certified PSU PRC historical population estimates were used for 2015 through 2019. Metro's future population forecasts were used for 2020 through 2045. Figure ES.2 shows the historical population and future growth predicted for the City. Figure ES.2 also identifies growth projections developed to allow the City to assess capital requirements possibly resulting from more aggressive growth than projected by Metro. Analysis of possible growth scenarios is described in greater detail in Chapter 4.

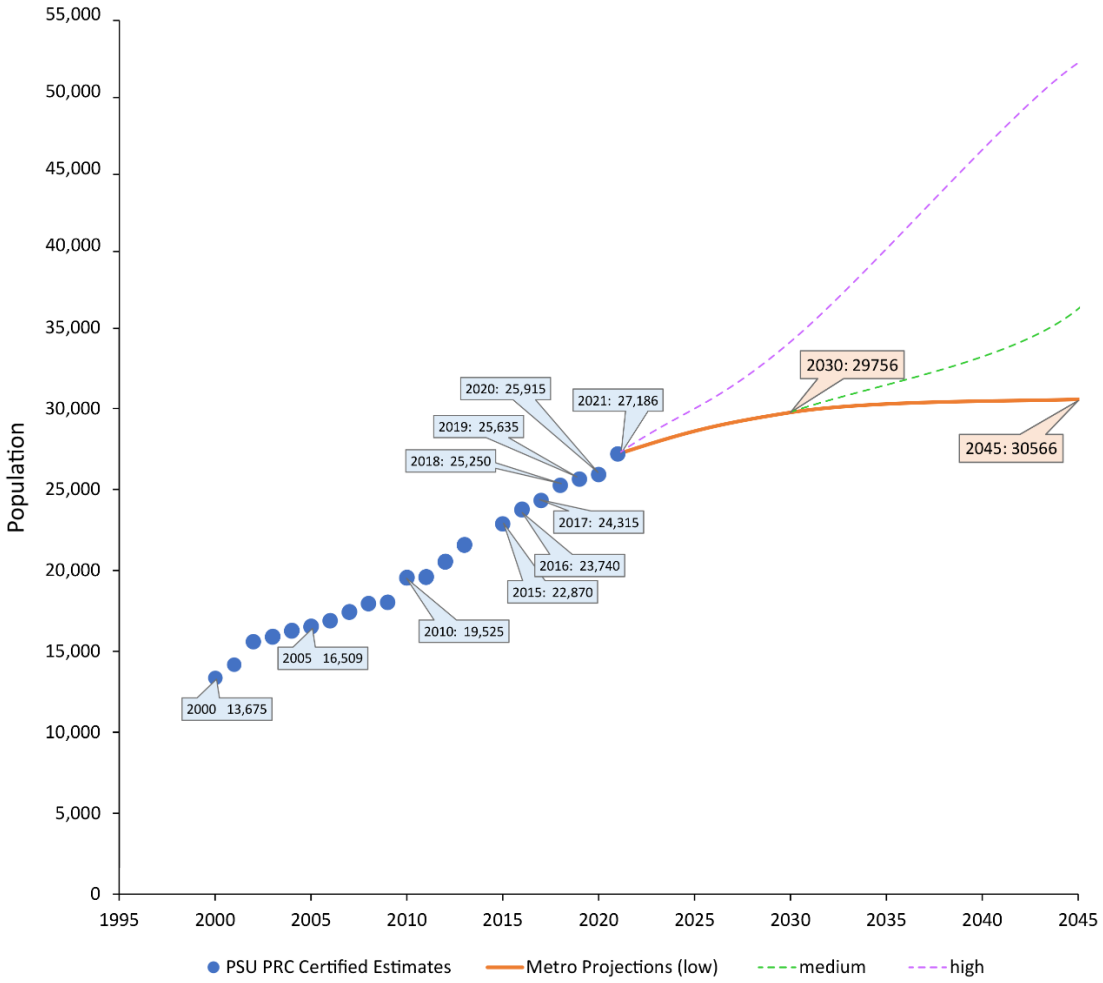

Figure ES.2 Historical Population and Expected Growth for the City of Wilsonville

ES.2 WWTP Condition Assessment

Carollo Engineers, Inc. (Carollo) reviewed prior condition assessments performed by others, conducted geotechnical investigations and performed seismic assessments at the WWTP in the course of Plan development.

In 2019, Jacobs Engineering Group Inc. (Jacobs) and Brown and Caldwell both completed condition assessments at the City's WWTP. A total of 322 major assets (per Jacobs' report), including process and mechanical equipment, motors and drives, control panels, generators, instrumentation, and structures, were examined for a variety of conditions that may signify their need for maintenance or replacement. Chapter 2 presents a summary of critical assets that require short term rehabilitation or replacement, as well as a list of assets that are less critical to operations, or have minor condition issues, but may be included in a short-term improvements project or a task order for Jacobs operations personnel. Table ES.1 displays the condition driven rehabilitation or replacement projects from Chapter 2 that were included in the recommended Capital Improvement Plan (CIP) in Chapter 7.

Table ES.1 CIP Condition Driven Replacement Projects

Asset	Description
Trojan UV 4000 System	While only used as a backup to the Ozonia UV system, the Trojan system's HMI has errors that prevent it from showing the status of the lamps in module 3. Since it is used infrequently, the system's condition is largely unknown. After review of the 2019 condition assessment reports and discussion with the City and Jacobs staff, it was concluded that the UV 4000 unit must be replaced.
Secondary Clarifiers No. 1 and No. 2	Ovivo completed a field review of the plant's secondary clarifiers No. 1 and No. 2 in April 2022. Although both units were operational, repairs were identified to improve the operation of the clarifiers. The recommended repairs include drive controls for both units, new skimmers for both units, squeegees for both tanks rake arms, EDI chains, one motor and reducer assembly, one skimmer arm assembly, and new secondary clarifier mechanisms.(1)

Notes:
(1) The detailed Ovivo Field Service Report is included in Appendix X.
Abbreviations: HMI - human-machine interface; No. - number; UV - ultraviolet.

ES.3 Seismic Analysis

In 2021, Carollo performed a seismic evaluation and analysis of the City's WWTP as part of the overall plant condition assessment. Because the WWTP was substantially upgraded and expanded in 2014, most of its infrastructure is designed in accordance with the 2010 Oregon Structural Specialty Code (OSSC) and follows modern seismic design and detailing. During Tier 1 evaluations, Carollo identified potential deficiencies and areas for additional investigation. A Tier 1 seismic analysis is an initial evaluation performed to identify any potential deficiencies, whether structural or non-structural, in a building based on the performance of other similar buildings in past earthquakes. Subsequent to the Tier 1 analysis, a more detailed seismic

evaluation of five older and potentially seismically vulnerable structures on the WWTP site was conducted. Those structures receiving a more detailed evaluation included the following:

- Operations Building.
- Process Gallery.
- Workshop.
- Aeration Basins and Stabilization Basins.
- Sludge Storage Basins and Biofilter.

The five potentially vulnerable structures were compared against an S-4 Limited Safety structural performance level and N-B Position Retention non-structural performance level for an M9.0 Cascadia Seismic Zone (CSZ) earthquake. The M9.0 CSZ is reflective of a catastrophic natural disaster event that has an estimated 35 percent likelihood of occurring within the next 50 years. Following the Tier 1 evaluation, Carollo began Tier 2 evaluations for a select number of identified deficiencies. Although none of the structures showed significant irregularities, the team did identify seismic deficiencies. The recommended seismic retrofits are included in the CIP for this Plan.

Prior to the 2021 seismic evaluation, Carollo's subconsultant, Northwest Geotech, Inc. (NGI), completed a seismic response and geologic hazards assessment of the City's WWTP. Through past and present site investigations and engineering analyses, NGI determined that the native soils beneath the site's granular pit backfill have low risk of liquefaction and its slopes do not pose undue risk. NGI concluded that the WWTP's primary site hazard is the differential settlement that may be caused by soil piping (development of subsurface air-filled voids), which raises the risk of sinkholes forming beneath structures and pipelines. Soil piping usually develops in unsaturated soils when a water source percolates into the ground. While the site is mostly paved and stormwater is being collected, there may be areas where infiltration is occurring next to structures or below pipelines. Recommended actions from NGI to mitigate the risk of soil piping are presented in Chapter 2.

ES.4 Wastewater Flow and Load Projections

Chapter 3 of the Plan evaluates the historical and projected wastewater flows and loads generated in the City of Wilsonville's service area. The load projections include total suspended solids (TSS), biochemical oxygen demand (BOD_5), ammonia (NH_3), and total phosphorous (TP) loads.

Service area, residential population, industrial contribution, and rainfall records were all considered in the flow and load projection analyses. Facility planning involves estimating rates of growth in wastewater generation within the service area which are unlikely to align precisely with the actual growth observed. During the planning period, City staff will need to assess service area growth at regular intervals and revisit the analysis presented in this Plan. A determination will need to be made whether projected flows and loads (which drive assessments of unit process capacity) are aligned with calendar projections presented in this plan and consider if conclusions presented regarding capacity and timing of recommended improvements remain valid. If not, adjustments to the plan will need to be undertaken to ensure sufficient capacity remains available to serve anticipated growth.

Analysis of flow projections were completed through two different methods: (1) analysis of historical plant records and (2) DEQ Guidelines for Making Wet-Weather and Peak Flow Projections for Sewage Treatment in Western Oregon, which is referred to as the DEQ methodology in this Plan. Since there is no DEQ methodology for load analysis, all projections were developed based on historical plant records. Figure ES.3 summarizes the measured and projected maximum month, peak day and peak hour flows. The projections for the remaining flow elements can be found in Chapter 3.

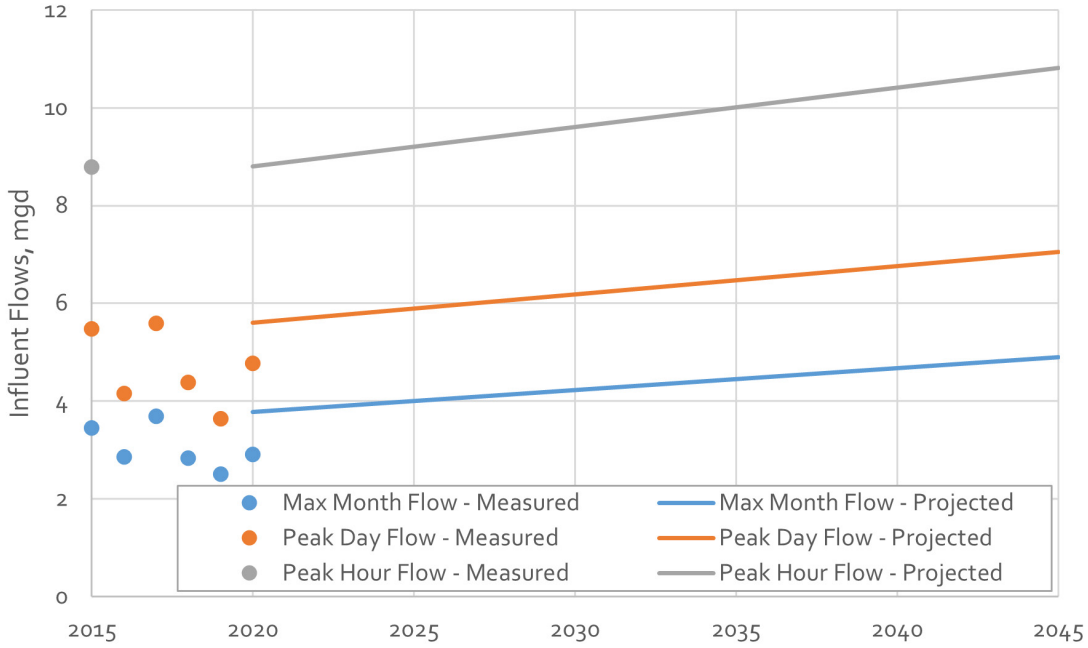

Figure ES.3 Flow Projection Summary

Load projections were calculated for influent TSS, BOD_5, NH_3, and TP. Figure ES.4 summarizes the measured and projected influent maximum month BOD and TSS loads. The projections for the remaining load elements can be found in Chapter 3.

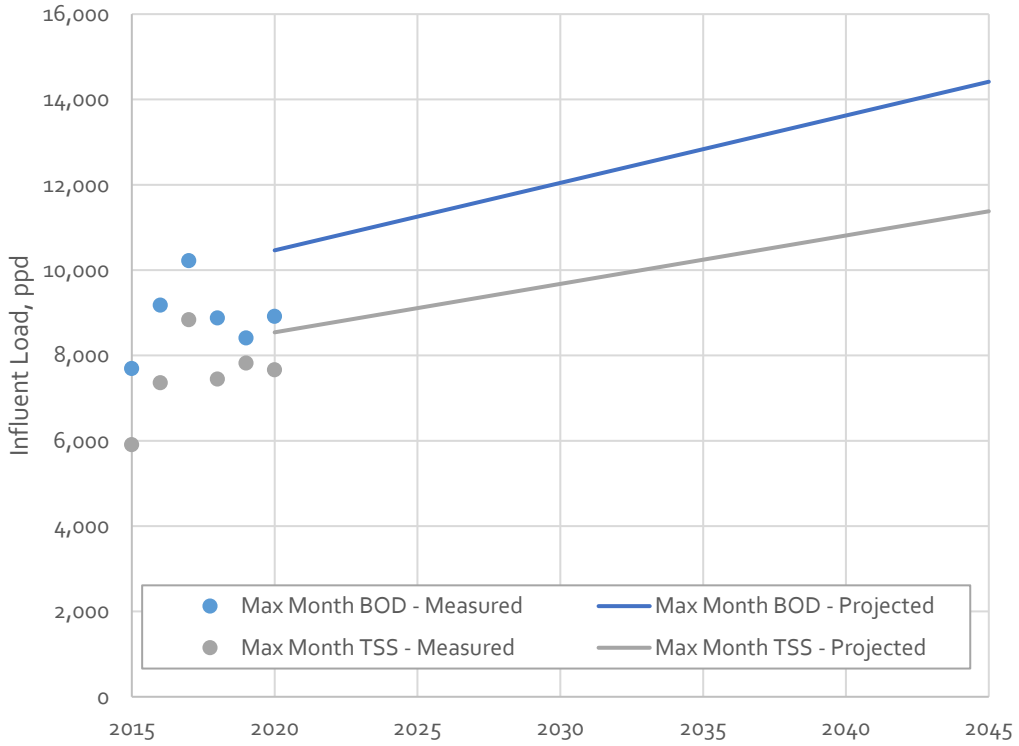

Figure ES.4 Load Projection Summary

The projected flows and loads developed in Chapter 3 were compared against the rated capacity for each of the WWTP's unit processes to determine whether expansion would be required within the planning period. The findings of this capacity analysis are discussed in the next section.

ES.5 Capacity Analysis

Summaries of plant process area capacity assessments and conclusions are presented in this Plan. These assessments focus on the need for improvements or upgrades to existing facilities to address capacity deficiencies identified in the course of Master Plan evaluations. A site plan of the City's existing WWTP is presented in Figure ES.5.

Chapter 4 identifies existing capacity ratings and deficiencies for the liquid and solids stream treatment processes at the City's WWTP. Analyses are based on operational practices in place at the time and existing effluent limits established by the WWTP's National Pollutant Discharge Elimination System (NPDES) permit. Biological process modeling was performed using BioWin version 6.2 to predict plant performance under current and future flow and loading conditions to assess when unit process capacities may be exceeded within the planning period (present through 2045).

A summary of the capacity assessment completed and presented in Chapter 4 is detailed below in Table ES.2.

LEGEND:

1 - DEWATERING & DRYING BUILDING
2 - PROCESS GALLERY
3 - SECONDARY CLARIFIER NO. 1
4 - SECONDARY CLARIFIER NO. 2
5 - UV DISINFECTION SYSTEM
6 - WORKSHOP
7 - SECONDARY PROCESS FACILITY
8 - STABILIZATION BASIN
9 - SLUDGE STORAGE BASINS AND BIOFILTERS 12 - SECONDARY CLARIFIER NO. 3
10 - HEADWORKS
11 - DISK FILTERS
12 - COOLING TOWERS
13 - W3 REUSE PUMP STATION
14 - OPERATIONS BUILDING
15 - SITE ENTRANCE

0 30' 60' 120'
SCALE: 1" = 60'

Figure ES.5
EXISTING WILSONVILLE WWTP
CITY OF WILSONVILLE

carollo

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Table ES.2 Unit Process Capacity Assessment

Unit Process	Capacity Assessment
Preliminary Treatment	
Screening	There is sufficient hydraulic capacity for both mechanical screens to accommodate the projected 2045 PHF.
Grit Removal	Capacity is adequate for providing full treatment of the projected 2045 PHF.
Secondary Treatment	
Secondary Treatment	Based on maximum week MLSS predicted from BioWin modeling at peak day flow with all clarifiers in service (and assuming a 5-day SRT), there is only sufficient capacity through 2038.
Secondary Clarifiers	The secondary clarifiers are expected to stay under the maximum hydraulic loading criteria for the entirety of the planning period.
Aeration Blowers	The air demands of the secondary treatment process are projected to exceed the firm capacity of the aeration blowers under peak conditions by 2035.
Tertiary Treatment and Disinfection	
Disk Filters	The existing disk filter capacity is expected to be exceeded by 2037 with one unit out of service or in backwash mode based on effluent limitations included in the City's DBO Contract with Jacobs. At this time the City expects to relax these contract limitations rather than invest in additional capacity.
Secondary Effluent Cooling Towers	It is not expected that the total hydraulic capacity of the cooling towers will be exceeded by 2045.
UV Disinfection	The existing UV channels are adequately sized to fully disinfect the 2045 PHF with all units in service, as well as the PDDWF with one channel out of service. The City currently has an older UV unit in place as an emergency backup to the primary system. That backup unit is aging and the City plans replacement during the planning period.
Outfall	Even with the Willamette River at its 100-year flood elevation, it is expected that the outfall pipeline can accommodate approximately 19 mgd before the UV channel effluent weirs are at risk of submergence upstream. Since this flow is well above the hydraulic capacity of the rest of the plant, no expansion will be needed until after 2045.(1)
Solids Handling	
Gravity Belt Thickener	The capacity analysis resultsindicate adequate for thickening the current and projected maximum week WAS loads with one unit out of service.
TWAS Storage	The TWAS storage volume is sufficient to accommodate the expected maximum week solids loads for three days (assuming TWAS is thickened to 4 percent).
Dewatering Centrifuges	The rated capacity of the current centrifuges is sufficient to process the maximum week load with one unit out of service though 2045 assuming operating times of 24 hours per day for 5 days per week, per the criteria detailed in Chapter 4.(2)
Biosolids Dryer and Solids Disposal	The capacity of the biosolids dryer is adequate for handling the current and projected max week solids loads (in year 2045) on the basis of its design evaporation rate, assuming dewatered cake is dried from 20 percent TS to 92 percent TS and the dryer is operated for 24 hour per day for 5 days per week.(3)

Notes:
(1) The existing outfall was recently modified and equipped with five parallel diffuser pipes equipped with duckbill check valves to improve the mixing zone characteristics in the Willamette River.
(2) The centrifuges have exhibited inconsistent performance in recent months. The City recently refurbished these units and expects they will provide sufficient capacity through 2045.
(3) The existing solids dryer has sufficient capacity through 2045 but has exhibited inconsistent performance.. See Alternative 2B, Chapter 6.
Abbreviations: DBO - Design-Build-Operate; gpd/sf - gallons per day per square foot; MLSS - mixed liquor suspended solids, SPA - State Point Analysis; SRT - solids residence time; TS - total solids; TWAS - thickened waste activated sludge.

Table ES.3 further summarizes the capacity assessment by listing each unit process, associated design parameters and year of possible capacity exceedance.

Table ES.3 Unit Process Capacity Year Summary

Unit Process	Design Parameter	Redundancy Criteria[3]	Year of Capacity Exceedance
Influent Screening	PHF	One mechanical screen out of service	>2045
Grit Chamber	PHF	All units in service	>2045
Secondary Treatment	**MW MLSS inventory at PDF**	**All units in service**	**2038**
Aeration Blowers	**Peak BOD Load**	**Largest unit out of service**	**2035**
Secondary Effluent Cooling Towers	June 1 - Sept 30 PDF	All units in service	>2045
Disk Filters	**MWDWF**	**One unit in backwash**	**2037[1]**
UV Disinfection Channels	PHF	All units in service	>2045
Outfall	PHF	-	>2045
Gravity Belt Thickening	MW Load	One unit out of service	>2045
TWAS Storage	MW Load	All units in service	>2045
Dewatering Centrifuges	MW Load	One unit out of service	>2045[2]
Biosolids Dryer	MW Load	All units in service	>2045[2]

Notes:
Unit processes in white are projected to run out of capacity before year 2045.
(1) Existing Disk Filters are predicted to exceed reliable capacity (one unit out of service) in 2037 based on vendor provided design criteria. This conclusion assumes limitations for effluent total suspended solids contained in the WWTP DBO contract, which are far more stringent than the City's NPDES permit.
(2) As noted previously, the existing centrifuges and biosolids dryer appear to have sufficient capacity through the planning year 2045, however condition and age are likely to require replacement during the planning period. It is recommended the City reassess available replacement technologies prior to replacement and consider loading appropriate to the planning horizon of any new units selected.
(3) Reference Appendix D - Reliability requirements, Preparing Wastewater Planning Documents and Environmental Reports for Public Utilities, OR DEQ, 2018, Revised July 2019

ES.6 Regulatory Considerations and Strategy

It is the responsibility of the Oregon Department of Environmental Quality (DEQ) to establish and enforce water quality standards that ensure the Willamette River's beneficial uses are preserved. Discharges from wastewater treatment plants are regulated through the National Pollutant Discharge Elimination System (NPDES). All discharges of treated wastewater to a receiving stream must comply with the conditions of an NPDES permit. The Wilsonville WWTP discharges to the Willamette River at River Mile 38.5 just upstream of the Interstate 5 bridge. The existing permit limits for the Wilsonville WWTP are shown in Table ES.4. This permit became effective on September 1, 2020 and expires July 30, 2025.

Table ES.4 Current Effluent Permit Limits

Parameter	Average Effluent Concentrations		Monthly Average, (ppd)	Weekly Average, (ppd)	Daily Maximum, (lbs)
	Monthly	Weekly			
May 1 - October 31					
$CBOD_5$	10 mg/L	15 mg/L	190	280	380
TSS	10 mg/L	15 mg/L	190	280	380
November 1 - April 30					
BOD_5	30 mg/L	45 mg/L	560	840	1100
TSS	30 mg/L	45 mg/L	560	840	1100
Other Parameters Limitations					
E. coli Bacteria	• Shall not exceed 126 organisms per 100 ml monthly geometric mean. • No single sample shall exceed 406 organisms per 100 ml.				
pH	• Instantaneous limit between a daily minimum of 6.0 and a daily maximum of 9.0				
BOD_5 Removal Efficiency	• Shall not be less than 85% monthly average				
TSS Removal Efficiency	• Shall not be less than 85% monthly average				
ETL June 1 through September 30	• Option A: 39 million kcal/day 7-day rolling average • Option B: Calculate the daily ETL limit				

Notes:
Abbreviations: $CBOD_5$ - five-day carbonaceous biochemical oxygen demand; ETL - excess thermal load; kcal/day - kilocalories per day; lbs - pounds, mg/L - milligrams per liter; ml - milliliter.

The WWTP has been compliant with NPDES permit limits, generally. However due to construction issues that required that aeration basins be offline, equipment failure and issues with solids processing, the WWTP did violate their NPDES permit over eight months between 2015 and 2020 (December 2015, February 2017, April 2017, January 2018, August 2018, May 2020, June 2020 and July 2020). Most of these violations were due to the daily effluent TSS load exceeding the maximum daily load limit in the NPDES permit. It is anticipated that once the issues with solids processing are addressed, the City's current treatment process will be able to meet permit limits.

Chapter 5 details potential regulatory issues the City will need to take into consideration in coming years. Several possible regulatory actions by the Oregon DEQ could drive investments in future improvements at the City's WWTP. The plant discharges to the Willamette River and existing and future effluent limitations contained in the NPDES permit dictate, in large part, the necessary treatment processes and configuration at the WWTP necessary to maintain compliance.

Future treatment upgrades may be required when DEQ establishes total maximum daily loads (TMDL) for the lower Willamette River. Dissolved oxygen and nutrient limits, such as phosphorus limitations, are possible. The dissolved oxygen in the lower part of the river does not always meet water quality standards, and indications of excessive nutrients, such as chlorophyll-a, aquatic weeds, and harmful algal blooms, are present in the lower Willamette River. DEQ has

begun its triennial review of Oregon's water quality criteria. The review could result in more stringent or new discharge requirements, but this process will take several years. For planning purposes, providing plant footprint to accommodate future treatment to remover phosphorus and address dry weather seasonal limits on dissolved oxygen should be anticipated. In addition, the City should continue to engage with DEQ regarding any proposed receiving water temperature regulatory actions.

ES.7 Alternative Development and Evaluation

Chapter 6 presents the methodology and findings of a process improvements alternatives evaluation. The plant's treatment process needs were defined by comparing the plant's existing condition, capacity and reliability, with the projected flows, loads, and regulatory constraints for the recommended alternatives. Where capacity deficiencies were predicted, at least two alternatives were analyzed for each corresponding unit process. Process modifications associated with each alternative were modeled in BioWin using a calibrated model to evaluate the overall impact on plant operations.

As identified in Chapter 4, the secondary treatment process is expected to require additional capacity during the planning horizon (2045). Chapter 6 details two alternatives to address these capacity limitations. The two alternatives considered to increase secondary capacity are:

1. Expansion of the existing conventional activated sludge process; and
2. Intensification of the existing treatment process using membrane bioreactor (MBR) technology.

Due to the higher capital and operating costs of intensification, construction of a new conventional aeration basin is recommended to increase secondary capacity. As flows and loads increase, or regulatory requirements become more stringent, it may be necessary to intensify treatment. It is recommended the City revisit this evaluation as the need for 1) additional capacity to accommodate growth nears or 2) more stringent effluent limitations are considered. This offers the opportunity to take advantage of potential advances in technology as well as confirming the predicted time frame of capacity exceedance. A new aeration basin project is included in the Capital Improvement Plan in Chapter 7.

The existing aeration blower system firm capacity is expected to be deficient by 2035. An additional aeration blower (same size and design air flow rate as the existing high-speed turbo blowers) would ensure there is sufficient blower capacity through the end of the planning period to meet current permit requirements. There is adequate space to add a fourth turbo blower to the same discharge header pipe as the existing turbo blowers. Additionally, intensification of the secondary treatment process would further increase the aeration demands because operating at a higher MLSS reduces oxygen transfer efficiency in the aeration basins. If intensification is reconsidered and selected for the planning period, or if nutrient limits are imposed within the planning period that requires intensification or operation at a higher MLSS, the blower air demands should be revisited.

Additional tertiary filtration capacity is predicted to be needed before 2045 to provide full treatment of the MWDWF with one disc filter out of service or in backwash mode. After discussions with the City, two alternatives were identified to increase capacity:

1. Increase filtration capacity, and
2. Modify the requirement in the WWTP DBO contract to relax effluent limitations which are currently more stringent than those contained in the City's NPDES permit.

The City's WWTP NPDES permit currently requires effluent to contain less than 10 mg/L TSS during the dry season (see Table ES.8). However, the DBO firm's contract with the City requires an effluent TSS of less than five mg/L, or half of the WWTP's permitted effluent quality. At this time, the City has decided to study the performance of the existing tertiary filters over time and expects to relax effluent TSS requirements in the DBO contract unless actual water quality impacts (exceedances of permit limitations) are realized. The City will also consider the option of new technologies for filtration, noting that if the City selected an intensification technology utilizing membranes, this may potentially eliminate tertiary filtration capacity concerns.

While the capacity assessment findings presented in Chapter 4 determined existing solids dewatering centrifuges have sufficient capacity, the remaining equipment service life may require replacement within the planning horizon. The centrifuges, installed in 2014, were recently refurbished, but by 2045, will have been in service for over 30 years. The City should plan for their replacement within the planning horizon and consider whether a capacity increase is needed at the time of replacement based on projections of solids production and processing needs. Additionally, the secondary process was modified in 2020 and has experienced extended periods where mixed liquor concentrations have been elevated above typical ranges for conventional activated sludge or extended aeration processes. Due to the complications with secondary process operation and performance issues with the centrifuges, it is recommended the City study the secondary treatment and dewatering processes to confirm that the assumptions and conclusions regarding centrifuge capacity in Chapter 4 may be relied upon. A dewatering performance optimization study is recommended so the City can collect and analyze secondary treatment and solids processing performance data. For budgeting purposes, an opinion of probable cost for replacing the existing centrifuges is provided in Chapter 7. Timing of that equipment replacement will depend on performance of the existing units, future loading assumptions, and observed condition.

The existing solids dryer has experienced operational issues in recent years, including a fire that caused extensive damage to the equipment in April 2019 and a leaking rotary joint and damaged seal in 2021. As of February 25, 2022, the dryer has been repaired and is operating. Because of the City's commitment to solids drying as the preferred process to achieve Class A biosolids, the alternatives evaluation presented in this Plan for future dryer replacement was conducted with a focus on thermal drying options only.

Chapter 6 details an analysis of the following alternatives to improve the drying system:

1. Alternative 1 - Continue operating the existing biochemical reactor (BCR) paddle dryer and defer replacement.
2. Alternative 2 - Modify the existing Dewatering and Drying Building to accommodate a different solids dryer technology or a redundant dryer.
3. Alternative 3 - Construct a new dryer building with a different solids dryer technology.

While it is anticipated the existing dryer has useful life through at least 2026 (current DBO contract expiration), by 2031 the dryer will have been in operation for over 15 years. It is recommended the planning and design of upgrades to provide reliable dryer capacity begin in 2029, or sooner if further operational concerns arise. The City has indicated a preference for a variation of Alternative 2 which involves expanding the existing Dewatering and Drying Building to accommodate a second solids paddle dryer. This alternative provides backup capacity to allow the City to continue delivering Class A solids during periods of downtime if a mechanical failure occurs or to accommodate regular maintenance of one dryer train. As mentioned previously, this Plan recommends the City complete a study of the secondary sludge quality, performance of that process, chemical addition types and locations, and solids handling process performance overall prior to making a final selection of the preferred dryer alternative from the alternatives detailed in Chapter 6. For purposes of capital planning, this Plan assumes the City will implement Alternative 2b (modification of Dewatering and Drying Building to accommodate a second paddle dryer) with a study and confirmation of this selection beginning in 2029.

Lastly, the City wants to establish a direct connection between the City's fiber optics network and the WWTP. This addition consists of routing two new conduits (one spare) and fiber optic cabling from the WWTP's Operations Building to the site entrance, where the conduits will be tied into the City's fiber optics network. Chapter 6 details one potential routing from the Operations Building to the site entrance that would minimize impact to existing yard utilities. The fiber optic cable addition is included in Chapter 7 and the City's 5-year CIP.

Table ES.5 below summarizes the alternatives evaluated in Chapter 6 including recommendations for future WWTP improvements.

Table ES.5 Summary of Alternatives

Unit Process	Alternatives Considered	Selected Alternative
Secondary Treatment	• Expansion of the existing conventional activated sludge process. • Intensification of the existing treatment process.	• Expansion of the existing conventional activated sludge process through the addition of another aeration basin.
Tertiary Treatment	• Increase filtration capacity. • Eliminate the requirement on the DBO firm to meet effluent limits more stringent than the NPDES permit.	• Eliminate the requirement on the DBO firm to meet effluent limits more stringent than the NPDES permit.
Solids Dryer	• Continue operating the existing BCR paddle dryer and defer replacements. • Modify the existing Dewatering and Drying Building to accommodate a different solids dryer technology or a redundant dryer. • Construct a new dryer building with a different solids dryer technology.	• Modify the existing Dewatering and Drying Building to accommodate a different solids dryer technology or a redundant dryer by expanding the Dewatering and Drying Building to accommodate a second solids paddle dryer.

ES.8 Recommended Alternative

Figure ES.6 presents a WWTP site plan identifying locations of recommended improvements resulting from condition and capacity assessments, including evaluation of alternatives, as described.

Summaries of opinions of probable costs and anticipated phasing for the improvements recommended for inclusion in the City's WWTP CIP are provided in Table ES.6.

The expected cash flow for the planning period was determined for the recommended improvements summarized in Table ES.6. The cash flow through 2045 includes an escalation rate of three percent, and the estimated peak expenditure for any fiscal year is approximately $13,906,000 in fiscal year 2031. The projected CIP expenditures are presented in Figure ES.7.

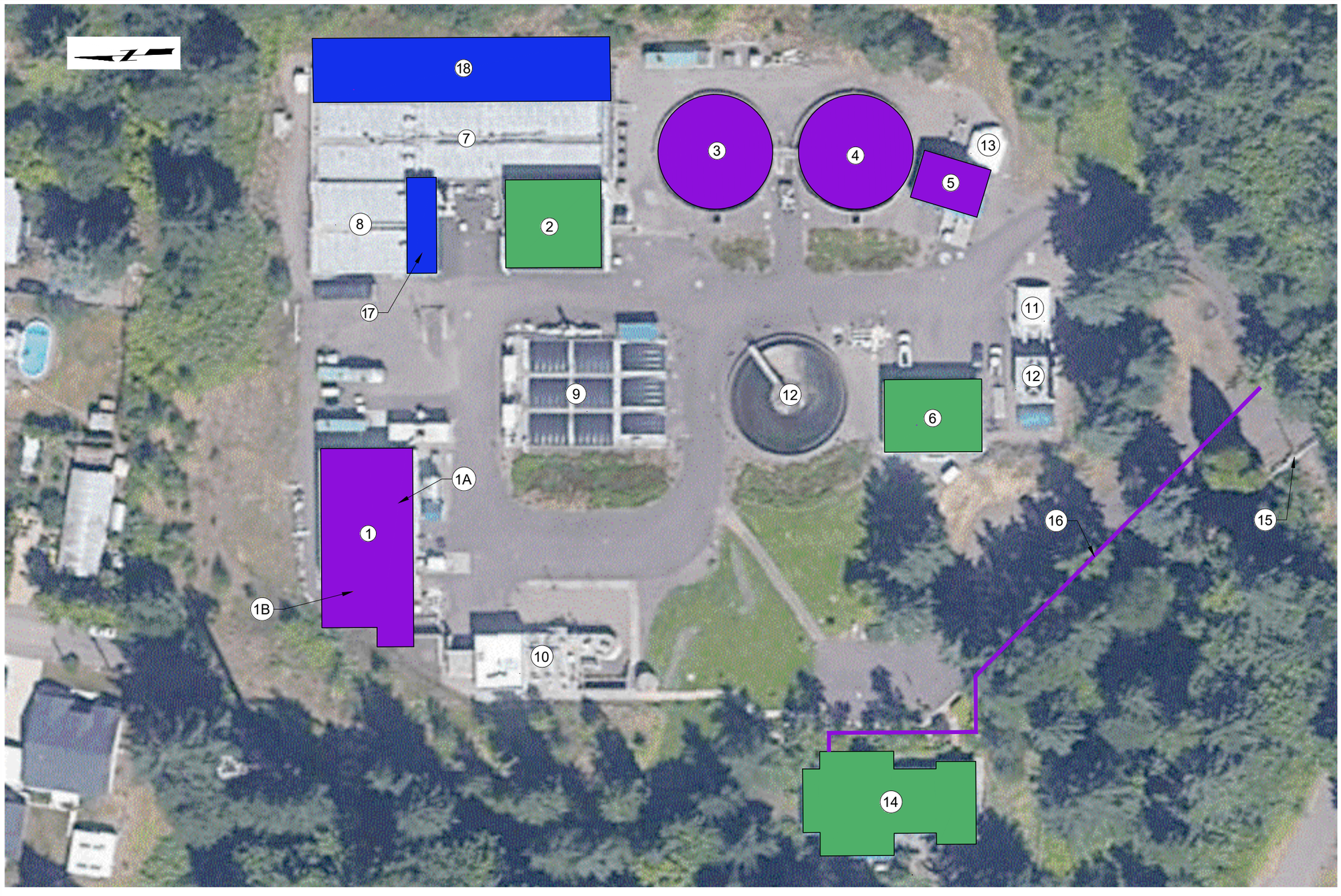
Table ES.6 WWTP CIP - Recommended Alternative Opinion of Probable Cost and Phasing

Plant Area	Project[1]	Opinion of Probable Cost	Approximate Year Online
Solids Handling	Dewatering Performance Optimization	$150,000	2023
Communications/IT	Fiber Optic Cable Addition	$55,000	2023
UV System	Trojan 4000 UV System Improvement	$1,650,000	2024
Support Buildings	Seismic Improvements	$1,015,000	2024
Secondary Treatment	New Secondary Clarifier Mechanisms	$1,665,000	2026
Solids Handling	Solids Dryer Improvement	$16,100,000[6]	2031
Solids Handling	Existing Centrifuge Replacement	$2,200,000[3,5]	2033[4]
Secondary Treatment	New Aeration Blower	$394,000	2035
Secondary Treatment	New Conventional Aeration Basin	$7,895,000	2038
	TOTAL	**$31,124,000**	

Notes:
White rows indicate projects that are in the City's 5-year CIP and blue rows indicate projects that are outside the 5-year CIP window.

(1) Details of each project can be found in Chapter 2 or Chapter 6 of this Master Plan.
(2) The estimated opinion of probable costs include the construction costs plus Engineering, legal and administration fees (ELA, or soft costs). Details on the estimated project costs can be found in Chapter 2 or Chapter 6 of the plan, with the exception of costs for the backup UV system and centrifuges which are presented earlier in Chapter 7.
(3) For budgeting purposes, the Option B centrifuge cost from Table 7.4 is used for the project cost summary and the CIP
(4) Replacement timing dependent upon satisfactory equipment performance
(5) The centrifuges installed with the City's 2014 upgrade project have exhibited inconsistent performance in recent months. The City recently refurbished these units and expects they will provide sufficient capacity through 2045. However, by that time, the units will have been in service for over 30 years. It is recommended the City plan for replacement of these units during the planning horizon of this Master Plan. Assuming replacement occurs in the mid-2030's the City should reassess capacity needs of those units beyond the 2045 horizon, consistent with the expected service life of the new equipment.
(6) The existing solids dryer has sufficient capacity through 2045. As with the dewatering centrifuges, the dryer equipment will soon have been in operation for a decade. It is recommended the City plan for replacement of the dryer during the planning horizon of this Master Plan. The City plans to replace the existing dryer with a new piece of equipment using similar technology and potentially rehabilitate the existing unit to serve as a backup. See Alternative 2B, Chapter 6.

Capital costs estimated in the Plan will be considered as the City assesses the need to adjust sewer enterprise rates and charges in coming months. It will be important to distinguish capacity and condition (repair and replacement) driven improvements in assigning costs to existing rate payers and future users.



LEGEND:

CONDITION OR ADDITION PROJECTS

1 - DEWATERING & DRYING BUILDING

1A - EXISTING CENTRIFUGE REPLACEMENT

1B - SOLIDS DRYER IMPROVEMENT

3 - SECONDARY CLARIFIER NO. 1 - REPLACE MECHANISMS

4 - SECONDARY CLARIFIER NO. 2 - REPLACE MECHANISMS

5 - STANDBY UV SYSTEM REPLACEMENT

16 - FIBER OPTIC CABLE ADDITION

CAPACITY PROJECTS

17 - NEW AERATION BLOWER

18 - NEW AERATION BASIN NO. 3, ACCESS IMPROVEMENTS & GRADING

SEISMIC RETROFIT PROJECTS

2 - PROCESS GALLERY

6 - WORKSHOP

14 - OPERATIONS BUILDING

OTHER FACILITIES

7 - SECONDARY PROCESS FACILITY

8 - STABILIZATION BASIN

9 - SLUDGE STORAGE BASINS AND BIOFILTERS 12 - SECONDARY CLARIFIER NO. 3

10 - HEADWORKS

11 - DISK FILTERS

12 - COOLING TOWERS

13 - W3 REUSE PUMP STATION

15 - SITE ENTRANCE

0 30' 60' 120'

SCALE: 1" = 60'

Figure ES.6

PROPOSED WILSONVILLE WWTP IMPROVEMENTS

CITY OF WILSONVILLE

carollo

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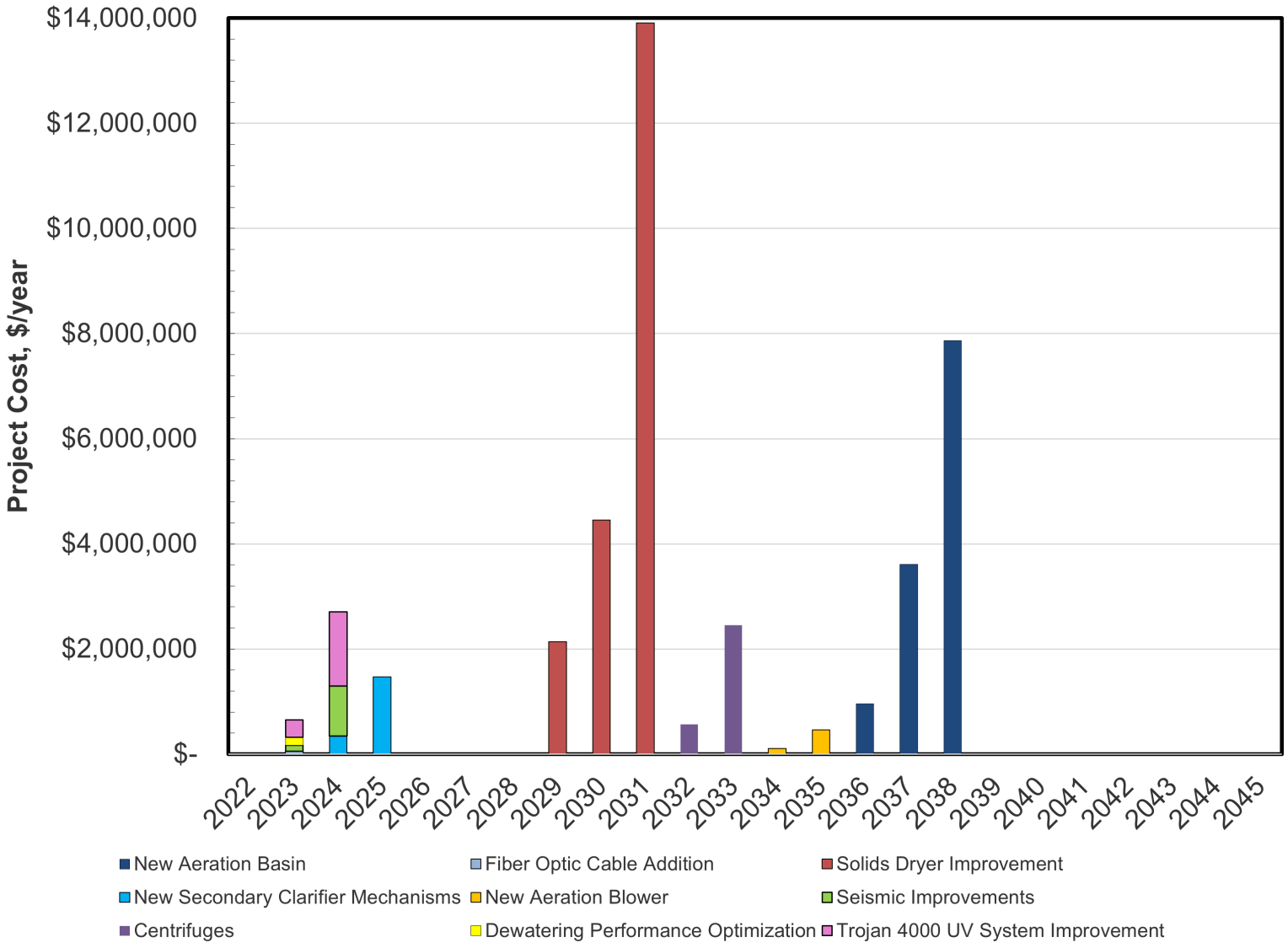

Figure ES.7 Projected 20-Year CIP Expenditures