Final Report

Volume 1: Wastewater Treatment

Wastewater Facilities Plan

Prepared for

City of Woodburn, Oregon

May 2010

Prepared by

CH2MHILL

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Acronyms and Abbreviations

AA	average annual
AAGR	average annual growth rate
ABS	acrylonitrile butadiene-styrene
ACP	asbestos cement pipe
ADWF	average dry weather flow
BFP	belt filter press
BOD	biochemical oxygen demand
BOD_5	5-day biochemical oxygen demand
$CBOD_5$	5-day carbonaceous biochemical oxygen demand
CCTV	closed circuit television
CEPT	chemically enhance primary treatment
CFR	Code of Federal Regulations
CSP	cement sewer pipe
dBA	decibel (A-weighted scale)
DAFT	dissolved air flotation thickener
DDE	dichlorodiphenyldichloroethene
DDT	dichlorodiphenyltrichloroethane
DEQ	Oregon Department of Environmental Quality
DO	dissolved oxygen
ENR-CCI	*Engineering News-Record* Cost Construction Index
EOA	Economic Opportunities Analysis
EPA	U.S. Environmental Protection Agency
F/M	food to microorganism ratio
FSL	facultative sludge lagoon
FTE	full-time equivalent
FWPCA	Federal Water Pollution Control Act or Clean Water Act

GBT	gravity belt thickener
gpad	gallons per acre per day
gpd	gallons per day
gpd/sf	gallons per day per square foot
gpm/sf	gallons per minute per square foot
HGL	hydraulic grade line
hp	horsepower
I&C	instrumentation and control
icfm	inlet cubic foot of air per minute
I/I	infiltration and inflow
IMD	Internal Management Directive
kW	kilowatt
kWh	kilowatt-hour
lb/hr/m	pounds per hour per meter
lb/sf/hr	pounds per square foot per hour
m	meter
MBR	membrane bioreactors
MCL	maximum contaminant level
MDDWF	maximum day dry weather flow
MDWWF	maximum day wet weather flow
mgd	million gallons per day
mg/L	milligrams per liter
MM	maximum month
$MMDWF_{10}$	maximum monthly average dry-weather flow with a 10 percent probability of occurrence
$MMWWF_5$	maximum monthly average wet-weather flow with a 20 percent probability of occurrence
mL	milliliter
MLSS	mixed liquor suspended solids
MPCAC	Master Plan Community Advisory Committee

NEC	National Electric Code
NEHRP	National Earthquake Hazards Reduction Program
NFPA	National Fire Protection Association
NPDES	National Pollutant Discharge Elimination System
NTU	nephelometric turbidity units
OAR	Oregon Administrative Rule
O&M	operations and maintenance
$PDAF_5$	peak day average flow associated with a 5-year storm
pH	hydrogen ion concentration
PIF_5	peak instantaneous flow attained during a 5-year PDAF
PLC	programmable logic controller
POTW	publicly owned treatment works
ppd	pounds per day
ppd/sf	pounds per day per square foot
PVC	polyvinyl chloride
PWWF	peak wet weather flow
q/Q	maximum dry-weather flow rate to design flow rate ratio
RAS	return activated sludge
RCP	reinforced-concrete pipe
RDII	rainfall dependent infiltration and inflow
RMZ	regulatory mixing zone
RPA	Reasonable Potential Analysis
rpm	revolutions per minute
scfm	standard cubic feet per minute
sf	square feet
SIU	significant industrial user
SRT	solids retention time
SSO	sanitary sewer overflow
SVI	sludge volume index

SWD	side wall depth
TDH	total dynamic head
TMDL	total maximum daily load
TSS	total suspended solids
TWAS	thickened waste activated sludge
UV	ultraviolet
VCP	vitrified clay pipe
VS	volatile solids
VSS	volatile suspended solids
WAS	waste activated sludge
WLA	waste load allocation
ZID	zone of initial dilution

Executive Summary

Purpose

The City of Woodburn prepared this Facilities Plan to identify and address wastewater system improvements needed to continue reliable service to the area for the next planning period. The key factors and objectives of the Facilities Plan are summarized in Table ES-1

TABLE ES-1
Key Factors and Woodburn Facilities Plan Objectives

Factor	Objectives
Total Maximum Daily Loads (TMDLs) and Mutual Agreement and Order (MAO)	■ Engage DEQ to provide input before TMDL is finalized. ■ Incorporate flexibility in planning effort to accommodate the TMDL schedule. ■ Review proposed improvements in light of overall facilities planning to ensure they best meet system-wide goals. ■ Incorporate facilities to satisfy MAO requirements.
Future regulatory uncertainty	■ Incorporate system flexibility to address future requirements. ■ Establish systems to track collection system assets to lay the groundwork for Collection Systems Management Operations and Maintenance (CMOM) compliance.
Growth	■ Define collection and treatment system improvements to in new service areas as well as increasing density. ■ Accurately allocate the costs of public infrastructure to new development, protecting existing ratepayers while accommodating critical jobs and growth.
Data management	■ Collect data and develop systems to manage wastewater geographical information system (GIS) data systems compatible with other City systems. ■ Develop improved collection system maintenance tools and processes.
Available funding	■ Incorporate annual costs, including staff requirements, into the alternatives analysis. ■ Assess capital-intensive solutions versus labor-intensive solutions. ■ Incorporate operationally efficient features and tools for both treatment and collection systems.
Financial constraints	■ Maximize capacity of existing infrastructure based on a clear understanding of system capacity, condition, and performance. ■ Identify most cost-effective solutions for system as a whole considering interplay between collection system, process/mechanical, and natural treatment systems. ■ Develop defensible plan and position for state revolving fund (SRF) funding.
Public concern	■ Engage the public. ■ Clearly define importance and value of improvements relative to service development charges and rates. ■ Adequately document need for improvements for reference by public and City officials. ■ Accommodate agricultural and urban interests.

Approach

Facilities Plan Organization

The Woodburn Facilities Plan was developed in accordance with the Oregon Department of Environmental Quality (DEQ) *Guidelines for the Preparation of Facilities Plans and*

Environmental Reviews for Community Wastewater Projects (December 2005) and tailored as required to address the specific needs of the Woodburn facilities planning process.

The report is divided into three volumes as follows:

- Volume 1: Wastewater Treatment
- Volume 2: Wastewater Collection and Transmission System
- Volume 3: Wastewater Rate and System Development Charge Study

Wastewater Facilities Plan Advisory Committee

The City of Woodburn established a Wastewater Facilities Plan Citizen's Advisory Committee (WCAC) of citizen volunteers in 2008 to assist in the development of a wastewater facilities plan that reflects community values and concerns.

Regular meetings were held with the WCAC with presentations and discussions with City wastewater division staff and consultant engineers throughout the facilities planning process. Meeting topics included study area characteristics, population projections, regulatory requirements, collection system mapping and evaluation, treatment plant and collection system condition assessments, flow and load analysis, collection system hydraulic modeling and capacity deficiency results, pilot testing, and the formulation of planning criteria.

The WCAC provided input concerning development and evaluation of treatment alternatives, development and evaluation of reuse and discharge alternatives, selection of a recommended plan, cost estimates, public involvement, and implementation plan and schedule.

Project Selection

The recommended plan resulted from an evaluation of the alternatives developed for the wastewater collection system, treatment system, and reuse and discharge system. The alternatives were evaluated considering technical feasibility and life-cycle costs to select the most cost-effective and environmentally sound plan for the City of Woodburn. In accordance with DEQ State Revolving Fund requirements, the plan evaluated alternatives and developed a recommended plan for a 20-year project life. Consequently, the design year for the Facilities Plan is 2030. In keeping with the previous facilities planning effort and to maintain consistency with City land-use planning, costs were developed and are presented for 2020.

Projected Design Flows

The primary components of City of Woodburn wastewater flows are residential, commercial, and industrial. For the purposes of this Facilities Plan, the design flows are assumed to include allocated industrial flows from the two largest food processing facilities in Woodburn. The City currently has permits in place that accommodate these food processing flows. Actual industrial flows are significantly less than the allocated flows. If the City were to decide to renegotiate the allocated flows provided in these permits to reflect a projected growth rate based on actual industrial flows, this would reduce future capacity requirements accordingly. This is discussed as an alternative approach as part of the implementation plan below.

Recommended Plan

Wastewater Collection and Transmission System

Capacity Improvements

Improvements for capacity are determined through hydraulic modeling to evaluate and mitigate the potential for surface or basement flooding. Specific improvements were identified based on relieving capacity deficiencies during specific design scenarios: existing conditions, 2020, 2030, and build-out. Table ES-2 indicates the recommended improvements and the scenario in which the deficiency was identified. Recommended improvements are shown in Figure ES-1.

The Mill Creek Pump Station is recommended for improvement in two separate phases of construction. It is anticipated that the existing structure and pump casings can accommodate improvements that nominally increase firm capacity while also improving system performance via installation of a low flow pump. The current configuration suffers from short pump cycle times that affect treatment plant processes and deterioration of the pumps. This project would be constructed first, intended to make use of existing facilities to the greatest extent possible. The next phase of work on the Mill Creek Pump Station is intended to meet expected flows in the 2020 land use scenario, and these improvements cannot be accommodated within the existing facility. A major reconfiguration or new construction will be required for this needed future capacity upgrade.

TABLE ES-2
Collection System Capacity Improvements

Project Name	Current Firm Capacity (mgd)		Scenario with Identified Deficiency
Pump Stations and Force Mains			
Mill Creek Pump Station (First and Second Phase)	16		Existing
I-5 Pump Station and Force Main	1.7		2020
Stevens Pump Station and Force Main*	0.3		2020
Gravity Pipelines			
Project Name	**Length (feet)**	**Diameter (inches)**	**Scenario with Identified Deficiency**
Young Street Pipeline	1,840	18	Existing
Front Street Pipeline	1,080	18	Existing
Progress Way Pipeline	1,546	12 to 18	Existing
Hayes Street Pipeline	2,350	12 to 15	Existing

TABLE ES-2
Collection System Capacity Improvements

Project Name	Length (feet)	Diameter (inches)	Scenario with Identified Deficiency
Brown Street Pipeline	1,050	12	2020
Mill Creek Interceptor (First Phase)	2,680	24	2030
Mill Creek Interceptor (Second Phase)	600	24	Build-out

*The future northwest expansion area could be served by a gravity pipeline in lieu of increasing the capacity of the Stevens Street Pump Station.

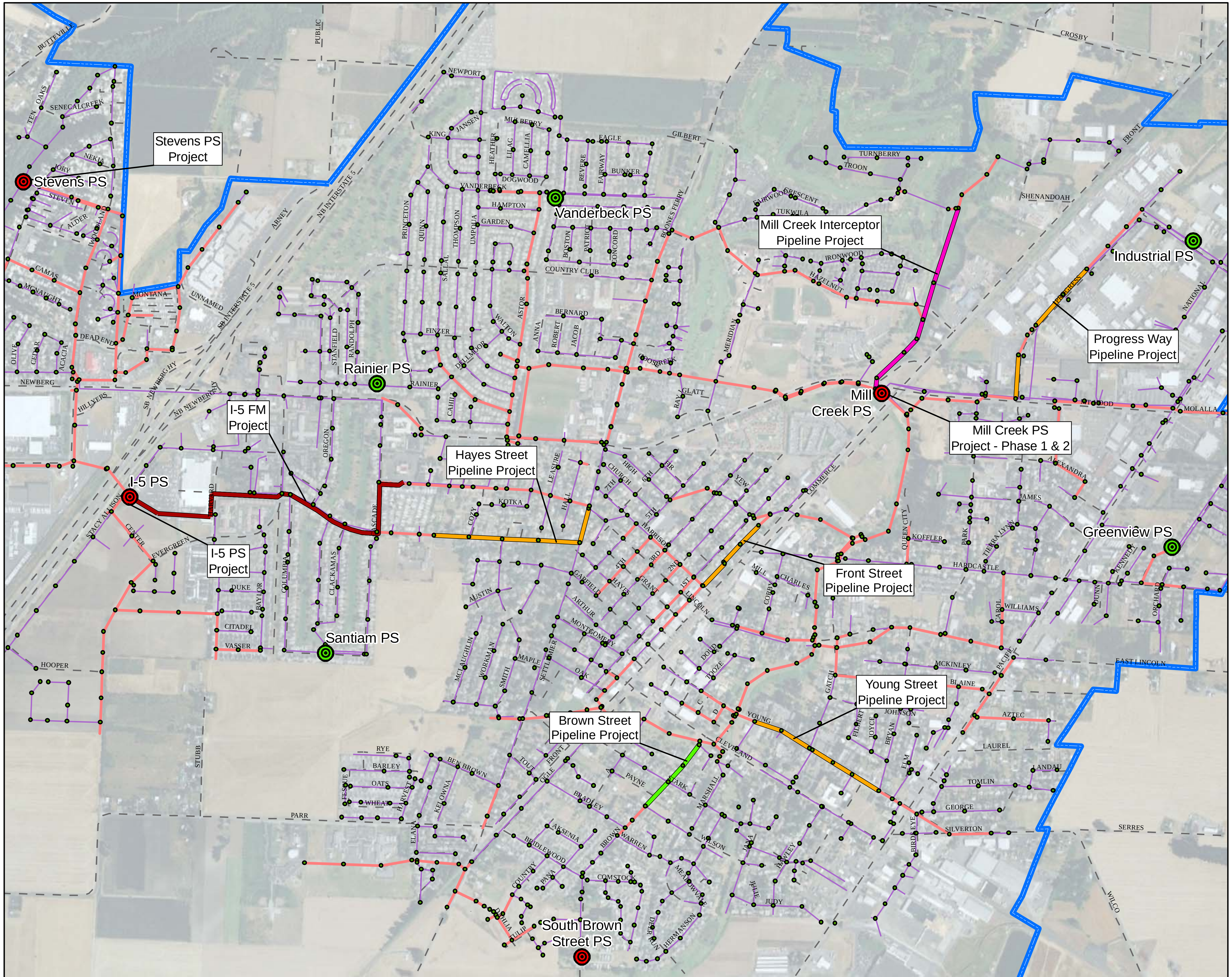
Service to Unsewered Areas

Within the current city boundary, two areas that are not currently served by sanitary sewer are expected to experience growth within the planning horizon. These areas, in the southwest and northern fringes of the currently developed City, must be provided with sewer service. The strategy for this service has not changed significantly from the 2005 Facilities Plan. In the southwest, the strategy includes gravity piping and a proposed pump station at Brown Street. There may be an opportunity to serve this area entirely by gravity, but a pump station project is retained for planning and budgeting purposes. During a predesign for this project, a life-cycle cost-benefit analysis can be performed to select the most cost-effective alternative. The northern area is proposed to be served by gravity sewer.

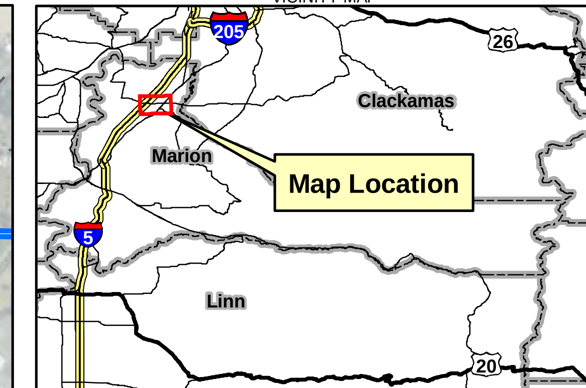
Potential future service areas on all sides of the City will require gravity sewers and construction of new pump stations, based on expected growth areas and topographic features.

Condition and Maintenance Improvements

Collection system elements deteriorate through use and aging processes. Over time, replacement or rehabilitation become an important part of a capital improvement plan. When possible, improvements due to condition or maintenance-related causes are coupled with capacity improvements. However, some projects are needed to maintain the current level of service, and are not directly related to any capacity deficiency. Table ES-3 identifies a number of known condition-related projects.



VICINITY MAP



LEGEND

- Pump Station Improvement
- Pump Station (PS)
- Manhole
- Existing Pipe Improvements
- 2020 Pipe Improvements
- 2030 Pipe Improvements
- Force Main Pipe Improvements
- SWMM Pipes 10" or Greater
- Collection System Pipe
- UGB (2005)
- Roadway Centerlines

N

0 600 1,200
Feet

FIGURE ES-1
Identified Capital Improvements
City of Woodburn

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TABLE ES-3
Collection System Identified Condition or Maintenance Improvements

Project	Deficiency	In Current CIP?
Pump Stations and Force Mains		
Santiam Pump Station	Reliability	Partial funding
Rainier Pump Station	Reliability/Repairs	Partial funding
I-5 Pump Station	Reliability	No
Stevens Pump Station	Reliability	No
Industrial Pump Station	Reliability	No
Vanderbeck Pump Station	Reliability	No
Greenview Pump Station	Reliability	No
Gravity Pipelines		
Cascade Drive	Infiltration	Yes
West Hayes	Infiltration	Yes
Cleveland to Wilson Street	Frequent Maintenance	Yes
Rainier Road	Frequent Maintenance	Yes
North Trunk rehab	N/A	Yes
Carol Street	Sag in line	No
Young Street	Clogging and slow flow	No
Brown Street	Clogging and slow flow	No
Gatch Street	Frequent Maintenance	No
Northeast Basin 15-inch PVC	Sag in line	No
West Basin	Design flaw	No

As part of good stewardship of the collection system, it can be anticipated that a certain percentage of the system will require repair or rehabilitation each year. It is difficult to predict far in advance specifically which elements (pipe segments, for example) of the system will deteriorate sufficiently to require repair. Using a risk-based approach to consider the likelihood of failure and its consequences will allow the City to prioritize project improvements. For financial planning purposes, a replacement or rehabilitation allowance was included for those pipes that will exceed a 75-year installed use life during the planning period.

Asset Management Recommendations

As part of the implementation of best practices for collection system management and operation, a number of recommendations resulted from the Facilities Plan effort:

- An initial condition assessment was conducted as part of this Facilities Plan, but additional, detailed evaluations are needed. A separate Pump Station Reliability Study is suggested to provide a thorough investigation of all current pump stations operated by the City. Evaluate compliance with DEQ reliability requirements including electrical and alarm systems. Perform repairs as needed to ensure continued compliance.
- Assess staffing and equipment needs for continued implementation of a rigorous maintenance program. Performing sanitary sewer maintenance activities requires highly trained staff and specialized vehicles and equipment. A new tank and vacuum-cleaning vehicle for pipe maintenance (vactor truck) is needed to maintain existing system level of service.
- Enhance the current routine repair, rehabilitation, and replacement schedule and begin to set aside additional funds for the program. A program level budget may wish to focus on the rehabilitation or limited replacement of the 111,000 feet of sewer lines constructed in 1954 or before.
- An initial condition assessment was conducted as part of this Facilities Plan, along with some general assessment of risk, but additional, detailed risk assessments are needed to ensure that limited maintenance funds are directed at the highest priority projects. Perform risk assessment of pipes to identify those that exhibit highest vulnerability to failure, either because of location or service area. This ensures that investment is made in the right parts of the system first.
- Perform a pilot program for spot repairs and in-situ repairs to evaluate effectiveness and costs for various repair methods. The City may determine that spot repairs may more cost effectively extend the useful life of the collection sewers than major rehabilitation or replacement of pipe segments.

The recommended plan requires the City to continue its proactive maintenance of the collection system. This approach is essential for the following reasons:

- Growth includes a future allowance for rainfall dependent infiltration and inflow (RDII), but no increase is assumed.
- Existing RDII must be managed to maintain the selected improvement.

To avoid the potential cost consequences of allowing RDII to increase, a meaningful and adequately funded system maintenance program employing best practices must be an integral part of the recommended plan.

These practices are summarized as follows:

- Repair known structural problems
- Perform source identification activities
- TV inspection
- Smoke testing
- Incorporate field investigation results in capital improvement program projects
- Perform flow monitoring
- Replace/line pipe in selected areas

- Continue system data management mapping and records storage activities

Wastewater Treatment

The recommended wastewater treatment improvements include (1) creation of a separate industrial wastewater treatment system to be used during the dry weather season, (2) capacity increases and treatment upgrades at the existing Woodburn POTW, (3) condition and operational improvements at the Woodburn POTW, and (4) capacity increase and upgrades to the Woodburn POTW natural treatment systems including expansion of the poplar reuse system and the addition of treatment wetlands.

Separate Industrial Wastewater Treatment

Because existing secondary capacity at the Woodburn POTW is exhausted during the planning horizon, the recommended plan is to treat industrial flows separately from residential and commercial flows, which will continue to be treated at the Woodburn POTW. Pretreated flows from local food processing industries that are currently discharged to the collection system and treated at the Woodburn POTW will be diverted from July 1 to September 30 to a storage lagoon for flow equalization. From the storage lagoon, flow will be pumped to local agricultural fields for irrigation at agronomic rates. The estimated storage volume required is 17.5 million gallons. Assuming irrigated pasture, the industrial land application system will require 114 acres.

From October 1 through June 30, however, industrial flows will be conveyed via the existing collection system to the Woodburn POTW for combined treatment with the municipal flow; this is the current practice. Treatment of these industrial flows at the Woodburn POTW will include secondary treatment and land application of biosolids.

Discussions with DEQ indicate that this approach will require a Water Pollution Control Facilities (WPCF) permit for land application of the industrial flows during the summer season. For the industrial treatment system, it is assumed that:

- Storage lagoon will be located within a half mile of the industries.
- Land application sites will be located within a quarter mile of the storage lagoon.
- Flow can be generated at the industries 16 hours/day, 7 days/week.
- Pretreated flow will be land applied 8 hours/day, 7 days/week.

Since actual industrial flows and loads have been and continue to be significantly lower than allocated flows and loads, the Facilities Plan recommends that the City re-negotiate agreements with the industries to significantly reduce future treatment costs.

Woodburn POTW Upgrades

The recommended 2030 Woodburn POTW upgrades include improvements to meet reliability requirements, meet water quality standards including the newly promulgated Pudding River TMDL, and increase capacity. Recommended upgrades are summarized in Table ES-4. Figure ES-2 shows the POTW site plan including the recommended facilities.

TABLE ES-4
Recommended 2030 Woodburn POTW Upgrades

Unit Process	Upgrade
Influent Screens	**Increase Capacity of Existing Screening Channels:** The existing two mechanically-raked screens will be replaced with newer technology that provides higher capacity in the same channel. Continuously-cleaned bar screens will provide a capacity of 12 mgd in each of the two channels. To meet Class I reliability criteria, a manual bar screen will be installed in the middle channel. A new washer compactor will be provided.
Grit Removal	**Add a third and fourth grit chamber:** Add a third and fourth influent grit channel, 8 mgd circular vortex concrete tank, grit trap, mounted grit pump, and classifier with cyclone.
Primary Sedimentation	**Convert Wet Weather Clarifiers to Primary Clarifiers and Add a Primary Clarifier:** Rehabilitate wet weather clarifiers and construct primary effluent pump station to lift wet weather clarifier flow to secondary treatment and primary sludge pump station to pump from the wet weather clarifiers to the sludge blend tank. Construct new primary clarifier and add additional sludge pump within existing Primary Sludge pumping system.
Secondary Process	**Blower and Aeration System Upgrades:** Complete rework of DO and blower system (valves, instrumentation and control system) is recommended as an early project to define the design SVI that can be utilized for the secondary design. Replace two existing 1,050 scfm blowers with 3,000 scfm blowers. Assumes existing blower facility and air distribution system is adequate for increased capacity.
Secondary Process	**Contact Stabilization Modifications and One New Secondary Clarifier:** Install piping from the influent channel through the anoxic zone into the aerated zone with an isolation valve in the influent channel to allow for diversion of flow to the midpoint of the aerated zone under high flow conditions. Construct one new secondary clarifier identical to existing clarifiers.
Filtration	**Replace Filters:** Replace existing filters with higher-capacity/newer technology filters, for example, cloth media filters.
UV Disinfection	**Expand Existing and Add Additional Units:** Add third and fourth UV channels and additional UV capacity improvements such as expanded inflow structure.
Outfall	**Increase Capacity:** Construct a bypass around the reaeration structure in Outfall 001A and upsize the 12-inch diameter portion of Outfall 001B to 24-inch diameter.
Standby Power	**Increase Capacity:** Install an additional 500 kW generator to supplement the existing 500 kW generator.

Woodburn POTW Condition and Operational Improvements

Recommended improvements to address condition and operational issues and proposed phasing are listed in Table ES-5. Prioritization and subsequent phasing were based on discussions with City staff.

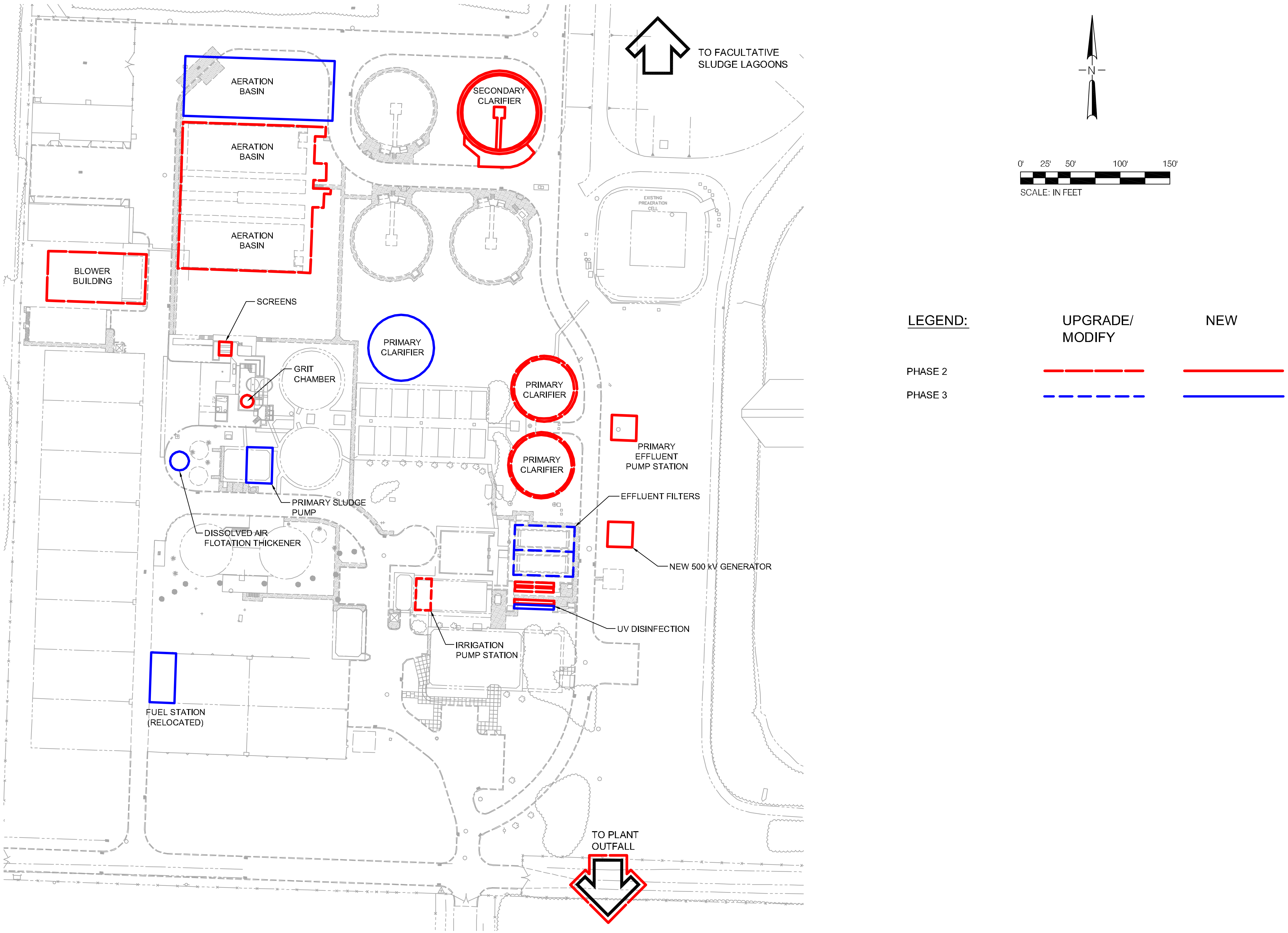

FIGURE ES-2
WOODBURN POTW
SITE PLAN
WOODBURN, OREGON

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TABLE ES-5
Recommended Woodburn POTW Condition and Operational Improvements

Item	Recommended Improvements	Phase
Septage Receiving	Provide direct connection for RV waste disposal to headworks; install receiving station and chopper pump	2C
	Provide complete septage station upgrade, including capacity upgrade, freeze protection and operational improvements.	2C
	Replace trench drain at headworks loadout/septage receiving.	2A
Headworks	Replace headworks channel covers.	2B
	Provide sump pump for grit pumping area.	2C
	Protect headworks electrical by replacing/relocating to blower building.	2B
	Consolidate screening and grit handling to one dumpster.	2C
Secondary Treatment	Provide lifting device for blowers.	2C
	Install sluice gates in RAS pits on RAS feed lines to allow for isolation and access to RAS pumps.	2B
	Replace diffuser membranes.	2A
	Replace aeration basin scum removal system. Add baffling and telescoping valve to AB effluent channel.	2A
	Provide heat tracing and insulation of secondary clarifier and RAS systems.	2B
Filtration	Provide drainage in bypass channels.	2C
Disinfection	Replace grating to address unguarded 16-inch opening at UV slide gate.	2A
	Replace NaOCl feed system, including building and appropriate containment.	2A
	Install ultrasonic flow meters over UV effluent weirs to provide appropriate signal for UV system operation.	2A
	Add coarse bubble diffusers in the influent channel to prevent solids deposition.	2C
Thickening	Modify DAFT equipment to allow parallel operation.	2C
	Provide separate scum lines to DAFT so that scum can be thickened, effectively providing additional digestion capacity.	2C
	Run DAFT on plant air, not solar units supplied.	2C
Digestion	Seal west digester cover to capture additional digester gas for beneficial reuse and reduce errant emissions.	2C
	Recoat digester roofs and improve roof drainage.	2C
	Improve gas compressor redundancy and enlarge hub drain for seal water.	2C
	Repair brick facing on digesters.	2C
Digester Control Facility	Provide portable gantry crane specific to digester control facility basement.	2B
	Provide permanent air supply system for pneumatic controls.	2B
	Replace sump pumps with higher head pumps to eliminate basement flooding concerns.	2B
	Provide heat pump for digester electrical room to eliminate corrosion issues associated with existing heating unit.	2B
Civil/Site	Improve roadway(s) to allow for better access for harvest equipment. Road drainage is not anticipated as part of these improvements as they would likely trigger new permit issues.	2A
	Provide stormwater lift station to divert storm flows into lagoon wetland.	2A
Non Process	Upgrade/replace W3 system. Provide a new complete loop of 6-inch pipe around the site. Include freeze protection for W3 supply. Coordinate with sodium hypochlorite improvements.	2A-2C

TABLE ES-5
Recommended Woodburn POTW Condition and Operational Improvements

Item	Recommended Improvements	Phase
	Upgrade plant security system.	2C
	Improve Lab HVAC.	2C
	Repave and enlarge entry to allow for truck access.	2A
	Pump supernatant back to plant in lieu of gravity drain.	2C
	Provide plant SCADA software licensing upgrade, Windows 2000 upgrade to NT. Integrate poplar irrigation system into main SCADA system, test and install.	2A

Woodburn Natural Treatment System Upgrades

The recommended 2030 Woodburn Natural Treatment System upgrades are summarized in Table ES-6.

TABLE ES-6
Recommended 2030 Woodburn Natural Treatment System Upgrades

Unit Process	Upgrade
Poplar Tree Reuse System	**Expand Existing Poplar Tree Reuse System to Increase Capacity:** Develop an additional 38 acres on City-owned land and 59 acres on additional purchased land.
Constructed Wetlands	**Construct Wetlands to Cool Effluent and Meet New Thermal Load Limits:** Develop a 10 acre wetland within the existing effluent lagoons and 14 acres of wetlands within the Pudding River floodplain on City-owned property.
Outfall	**Install New Outfall for Floodplain Wetlands:** This new outfall is needed to convey flows sent to the floodplain wetlands out to the Pudding River.

Cost Estimates

The recommended plan cost estimates are summarized in Table ES-7. These are total project costs, and include estimated construction costs plus an additional 25 percent for engineering, administrative and legal (EAL) costs.

TABLE ES-7
Woodburn Wastewater Facilities Recommended Plan Cost Estimates*

Item	Phase 2 (2020)	Phase 3 (2030)	Total
Collection System			
Mill Creek PS Project - Phase 1	$500,000		$500,000
Mill Creek PS Project - Phase 2	$2,605,000		$2,605,000
I-5 PS Project	$1,307,000		$1,307,000
I-5 FM Project	$3,093,000		$3,093,000
Stevens PS Project	$990,000		$990,000
Young Street Pipeline Project	$1,773,000		$1,773,000

TABLE ES-7
Woodburn Wastewater Facilities Recommended Plan Cost Estimates*

Item	Phase 2 (2020)	Phase 3 (2030)	Total
Front Street Pipeline Project	$1,040,000		$1,040,000
Progress Way Pipeline Project	$1,362,000		$1,362,000
Hayes Street Pipeline Project	$2,030,000		$2,030,000
Brown Street Pipeline Project	$931,000		$931,000
Current CIP Projects (Funds 465, 472)	$460,000		$460,000
Equipment Replacement (VAC Truck)	$350,000		$350,000
Pump Station Upgrades (Existing Upgrades - Reliability)	$275,000		$275,000
Replacement Costs-Collection System Piping	$3,400,000	$4,600,000	$8,000,000
Mill Creek Interceptor Pipeline Project (Phase 1)		$1,855,000	$1,855,000
Sanitary Sewer Service to North Area (2005 PFP Project)		$ 5,219,000	$5,219,000
Sanitary Sewer Service to South Area - South Brown Street Pump Station	$800,000		$800,000
Sanitary Sewer Service to Southwest Industrial Area (2005 PFP Pipeline Project)		$9,722,000	$9,722,000
Area Outside UGB		$8,560,000	$8,560,000
Collection System - Subtotal	**$20,916,000**	**$29,956,000**	**$50,872,000**
Separate Industrial Wastewater Treatment			
Industrial Land Application	-	$8,200,000	**$8,200,000**
Woodburn POTW Upgrades and Improvements			
Screening	$1,900,000	-	$1,900,000
Grit Removal	$1,300,000	$1,300,000	$2,600,000
Primary Sedimentation – Convert WW Clarifiers	$1,750,000	-	$1,750,000
Primary Sedimentation – PEPS	$3,000,000	-	$3,000,000
Primary Sedimentation – New Primary Clarifier	-	$2,400,000	$2,400,000
Secondary Process – Blower and DO Control Upgrades	$1,300,000	-	$1,300,000
Secondary Process – Contact Stabilization Modifications	$300,000	-	$300,000
Secondary Process – New Secondary Clarifier	$2,500,000	-	$2,500,000
Filtration	$1,900,000	-	$1,900,000
UV Disinfection – Expand Existing Equipment	$400,000	-	$400,000
UV Disinfection – Add UV Channels	$2,100,000	$1,300,000	$3,400,000

TABLE ES-7
Woodburn Wastewater Facilities Recommended Plan Cost Estimates*

Item	Phase 2 (2020)	Phase 3 (2030)	Total
Outfall – Bypass Aerator	$100,000	-	$100,000
Outfall – Upsize Outfall B	$500,000	-	$500,000
Condition Improvements	$3,700,000	-	$3,700,000
Septage and RV Dump Station Improvements	$1,700,000	-	$1,700,000
Emergency Generator	$300,000	-	$300,000
Woodburn POTW Upgrades - Subtotal	**$22,750,000**	**$5,000,000**	**$27, 750,000**
Woodburn Natural Treatment System Upgrades			
Poplar tree expansion on City-owned land	$1,064,000	-	$1,064,000
Land Purchase	$885,000	-	$885,000
Poplar tree expansion on additional land	$1,540,000	$112,000	$1,652,000
Lagoon Wetlands	$1,100,000	-	$1,100,000
Floodplain Wetlands	$1,400,000	-	$1,400,000
Wetland conveyance and new river outfall	$1,620,000	-	$1,620,000
Natural Treatment System - Subtotal	**$7,609,000**	**$112,000**	**$7,721,000**
Total	$51,280,000	$43,270,000	$94,540,000

*All cost estimates are order-of-magnitude estimates as defined by the American Association of Cost Engineers (AACE). An order-of-magnitude estimate is made without detailed engineering data and uses techniques such as cost curves and scaling factors applied to estimates developed for similar projects. The overall expected level of accuracy of the cost estimates presented is -30 percent to +50 percent. This means that bids can be expected to fall within a range of 30 percent under to 50 percent over the estimate for each project. These ranges are consistent with the guidelines established by the AACE for planning level studies.

Implementation Plan

The proposed implementation plan replaces the Phase 2 (2020 planning horizon) recommendations from the 1995 Facilities Plan. The Phase 2 improvements have been modified in scope through the evaluation work in this current Facilities Plan and are still intended to address capital needs through 2020. The Phase 3 improvements described in this Facilities Plan recommend facilities to meet the 2030 planning horizon.

Because allocated industrial flows identified in the existing permits significantly increase Woodburn's projected wastewater flows and loads, it would be worthwhile to renegotiate the City's industrial pretreatment permits with local food processors to reduce consequential capital improvement costs. This approach offers the greatest potential cost savings to the City and would defer or eliminate some projects.

In the meantime, this plan assumes that allocated industrial flows will be accommodated in the future according to the agreements. However, the proposed project phases incorporate the flexibility to address treatment needs as they develop and avoid investments in capital improvements that may become unnecessary if allocated industrial flows and loads are renegotiated to more closely reflect actual conditions.

Financing Strategy

The local funding sources for the proposed Woodburn wastewater facilities improvements will be City of Woodburn sewer rates and system development charges (SDCs). An analysis of this funding source is provided in *Volume 3: Wastewater Rate and System Development Charge Study* of this Facilities Plan. The City of Woodburn also plans to seek additional funding through the DEQ Clean Water State Revolving Fund (CWSRF), supplementing CWSRF funding that has already been secured.

Recommended Actions

In addition to the recommended facility improvements identified in this Facilities Plan and Capital Improvement Plan, following are recommended actions that Woodburn should consider initiating as soon as possible in the short-term:

- Renegotiate permits with food processors to reduce allocated industrial flows. This approach could be very beneficial to the City. If these permits were adjusted to accommodate actual flows, the capital projects required would be significantly reduced.
- Perform wetland delineation within the floodplain portions of the McNulty property to better define wetland restoration opportunities and possible constructed wetland footprints and to refine cost assumptions for developing wetlands in the floodplain.
- Begin permitting and predesign for the temperature control facilities.
- Contract for the dredging and removal of biosolids from the facultative sludge lagoons to reclaim biosolids storage capacity and draw biosolids accumulation down within safe operating levels.
- Update the Biosolids Management Plan and obtain approvals to apply biosolids on the City-owned McNulty property.
- Negotiate an agreement with MacLaren Youth Correctional Facility and/or other adjacent land owners to provide City of Woodburn with additional land for poplar trees.
- Begin to actively identify additional agricultural lands that could be purchased near the Woodburn POTW and Sabroso to meet the projected implementation schedules as required for dry weather treatment of allocated industrial flow.
- Renegotiate provisions of the Woodburn POTW NPDES permit outlined in the Facilities Plan.

- Harvest and replant approximately half of the existing planted 84-acres of poplar trees in each of the next 2 years with the first harvest/replant occurring before the 2010 growing season and the second harvest/replant occurring before the 2011 growing season.
- Perform a financial evaluation of the septage program at Woodburn to better define the true treatment costs and to determine whether septage rates need to be increased to cover the additional costs for biosolids management.
- Continue and complete pilot studies research project to develop information about viability of incorporating hyporheic discharge as a facet of the future constructed wetland systems and viability of irrigating poplar trees at a greater than agronomic rate in areas where biosolids will not be applied. These approaches could be used to reduce the required footprints of the natural treatment systems and to improve temperature reduction and nutrient removal.
- File water right applications with the Oregon Water Resources Department on future municipal effluent flows to be discharge to the Pudding River to protect these flows for instream uses.
- Perform a financial evaluation of the Industrial Pretreatment Program; consider future development and implementation of the industrial pretreatment permit fees for monitored customers.

Schedule

Table ES-7 subdivides the recommended projects into Phases for implementation. Additional schedule details will need to be developed during predesign to incorporate additional planning and engineering efforts, land purchase agreements, and contracting timelines.

The TMDL-related deadlines of the City of Woodburn MAO with DEQ will control the necessary timing of the most immediate improvements described within this Facilities Plan. Modifications to the MAO schedule are currently being negotiated with DEQ at the time of this final report.

SECTION 1

Introduction, Purpose, and Need

1.1 Introduction

The City of Woodburn prepared this Facilities Plan to identify and address wastewater system improvements needed to continue reliable service to the area for the next planning period. This report updates the previous 1995 City of Woodburn facilities plan to provide a clear understanding of the capital improvements needed for the wastewater system and how they will be financed.

1.2 Purpose and Need

As shown in Figure 1-1, a significant number of factors affect the City's need for a comprehensive facilities planning effort. To provide the City with a clear path forward, the facilities planning process was performed to meet the related objectives outlined in Table 1-1.

FIGURE 1-1
Key Planning Factors and Elements of a Clear Path Forward

A copy of the Woodburn Publicly Owned Treatment Works (POTW) National Pollutant Discharge Elimination System (NPDES) Permit 101558 is provided in Appendix A. The City's Mutual Agreement Order (MAO) NO. WQ/M-WR-07-082 with the Oregon Department of Environmental Quality (DEQ) is provided in Appendix B.

TABLE 1-1
Key Factors and Woodburn Facilities Plan Objectives

Factor	Objectives
Total Maximum Daily Loads (TMDLs) and Mutual Agreement and Order (MAO)	■ Engage DEQ to provide input before TMDL is finalized. ■ Incorporate flexibility in planning effort to accommodate the TMDL schedule. ■ Review proposed improvements in light of overall facilities planning to ensure they best meet system-wide goals.
Future regulatory uncertainty	■ Incorporate system flexibility to address future requirements. ■ Establish systems to track collection system assets to lay the groundwork for following the proposed Collection Systems Management Operations and Maintenance (CMOM) guidelines.
Growth	■ Define collection and treatment system improvements needed to serve growth in existing and new service areas. ■ Accurately allocate the costs of public infrastructure to new development, protecting existing ratepayers while accommodating critical jobs and growth.
Data management	■ Collect data and develop systems to manage wastewater geographical information system (GIS) data systems compatible with other City systems. ■ Develop improved collection system maintenance tools and processes.
Available funding	■ Incorporate annual costs, including staff requirements, into the alternatives analysis. ■ Assess capital-intensive solutions versus labor-intensive solutions. ■ Incorporate operationally efficient features and tools for both treatment and collection systems.
Financial constraints	■ Maximize capacity of existing infrastructure based on a clear understanding of system capacity, condition, and performance. ■ Identify most cost-effective solutions for system as a whole considering interplay between collection system, process/mechanical, and natural treatment systems. ■ Develop defensible plan and position for state revolving fund (SRF) funding.
Public concern	■ Engage the public. ■ Clearly define importance and value of improvements relative to service development charges and rates. ■ Adequately document need for improvements for reference by public and City officials. ■ Accommodate agricultural and urban interests.

1.3 Intended Readers

This Facilities Plan was written for:

- DEQ regulatory staff for review, as a source of information for permitting, and to meet potential funding requirements.
- Managers and staff of the City to document the overall plan, continue providing reliable service, meet regulatory requirements, protect the public, protect the environment, and support the long-term goals of the community.
- Members of the public to provide a better understanding of the City's services and responsibilities, ongoing operations and maintenance activities, facility condition, and recommended concepts to meet current and future needs and requirements.
- Subsequent engineering design teams for successful project implementation.

1.4 Organization of this Document

To facilitate review, this Facilities Plan is generally organized as described in the DEQ *Guidelines for the Preparation of Facilities Plans and Environmental Reviews for Community Wastewater Projects* (December 2005) with some exceptions to address the specific needs of the Woodburn facilities planning process.

The report is divided into three volumes as follows:

- Volume 1: Wastewater Treatment. The recommended plan in this volume summarizes the overall wastewater facilities recommended plan, including wastewater treatment and collection and transmission system improvements.
- Volume 2: Wastewater Collection and Transmission System.
- Volume 3: Wastewater Rate and System Development Charge Study.

SECTION 2

Study Area Characteristics

This section discusses study area characteristics relevant to the development of the wastewater facilities plan. It discusses climate, soils, geologic hazards, public health hazards, energy production and consumption, water resources, environmentally sensitive areas, air quality and noise, socio-economic trends, population projections, land use regulations, and intergovernmental agreements.

2.1 Study Area

The City of Woodburn is situated on the Pudding River in Marion County, Oregon. The City, incorporated in 1889, is located 30 miles south of Portland and 17 miles north of Salem along the I-5 Interstate Highway.

The current *City of Woodburn Comprehensive Plan*, adopted by the City in 2005, presents growth and land use planning through the year 2020. It is likely that additional land, beyond the 2005 urban growth boundary (UGB), will eventually be needed for residential and commercial purposes. Based on soils, it would be prudent to recognize the probability that the UGB will likely expand in all directions and that wastewater facilities need to be programmed to last at least 50 years. The study area is intended to be large enough to attempt to accommodate efficient long-term public facilities expansions.

The Woodburn Publicly Owned Treatment Works (POTW) and collection system now serves the area within the City of Woodburn UGB. There are also several small areas outside the UGB that are served by the Woodburn POTW or are planned to be in the future. The wastewater facilities plan for Woodburn will specifically address the expected growth and land use presented in the 2005 comprehensive plan, addressing all planned development through the year 2030, while anticipating additional population and expansion beyond the year 2030.

2.2 Physical Environment

The City of Woodburn is located in the Pudding River drainage basin in northwestern Oregon. The City lies at the north end of the Willamette Valley. It is situated in the northeastern corner of the French Prairie, which slopes northeast from Salem and varies in elevation from 170 to 200 feet above sea level. The generally flat prairie contains several narrow ravines with deeply cut streams. The study area drains generally north-northeast through Mill Creek and the Pudding River.

For the most part, the City of Woodburn is bounded by the Pudding River and Highway 99E east of the City and the I-5 Interstate Highway to the west of the City. Mill Creek bisects the City as it flows to the northeast. The Union Pacific Railroad line bisects the City as it extends north-south, paralleling Front Street through the City.

2.2.1 Climate

The City of Woodburn is located at the north end of the Willamette Valley (east of the Coast Range) and thus enjoys a drier, more continental climate than the coastal areas. The area has a mild and temperate climate with a dry summer season and a rainy winter. Westerly winds generally pick up moisture from the Pacific Ocean. As a result of the orographic effect of the Coast Range, precipitation decreases as the winds flow eastward into the Willamette Valley. On the east side of the range, the amount of rainfall decreases sharply on the lower slopes and on the valley floors.

Historical climatic data for the Woodburn area are summarized in Table 2-1. The data in this table are from the closest National Weather Service reporting station, located at the North Willamette Experiment Station near Aurora.

Although summer days can be consistently sunny, hot weather that is continuous and prolonged is rare and nights are generally cool. Similarly, continuous and prolonged subfreezing weather is rare during the winter; snowfall is usually light. Approximately 74 percent of the mean annual precipitation falls during the wet season, November through April (based on data from Table 2-1).

TABLE 2-1
Historical Climatic Data: N. Willamette Experimental Station 1971–2000

Month	Average Maximum Temperature (˚F)	Average Minimum Temperature (˚F)	Average Mean Temperature (˚F)	Mean Precipitation (inches)
January	46.9	33.0	40.0	5.94
February	51.0	34.5	42.8	5.07
March	55.9	36.8	46.4	4.28
April	60.5	39.7	50.1	3.14
May	66.9	44.5	55.7	2.50
June	73.0	49.3	61.2	1.75
July	80.1	52.8	66.5	0.73
August	80.4	52.7	66.6	0.83
September	75.3	48.7	62.0	1.77
October	64.1	41.8	53.0	3.36
November	52.3	37.6	45.0	6.48
December	46.2	33.1	39.7	6.75
Annual Average	62.7	42.0	52.4	42.60

Note: Dry weather season data are shaded.

2.2.2 Geology

Troutdale formation materials and Willamette silts overlie Columbia River basalt in the Woodburn area. Depth to the basalt is unknown, but is estimated to be about 600 feet.

The Troutdale formation consists of alternate layers of clay, silt, sand, and gravel. These materials were deposited by streams entering the valley from the south and east.

The Willamette silt formation consists of stratified silt, sandy silt, clayey silt and silty clay, and frequently has poor drainage capabilities. Groundwater is occasionally found at or very near the surface in these areas and can cause construction problems and septic tank malfunctions.

2.2.3 Soils

Amity silt loams and Woodburn silt loams are the two major soil types found within the facilities plan study area. These and other significant soil types found within the UGB are described below. Also, the soil capability classes of soils in subareas of the proposed urban reserve area (URA) surrounding Woodburn are mapped.

2.2.3.1 Amity Series

The Amity series consists of somewhat poorly drained soils that have formed in mixed alluvial silts. These soils have slopes of 0 to 2 percent. They occur on broad valley terraces at elevations of 150 to 350 feet. The average annual precipitation is between 40 and 45 inches. The average annual air temperature is 52° to 54°F, and the length of the frost-free season is 190 to 210 days. In areas that are not cultivated, the vegetation is mainly grasses, shrubs, hardwoods, and scattered Douglas-firs. Amity soils are associated with Dayton and Concord soils. In a typical profile, the surface layer is very dark grayish-brown silt loam that is mottled in the lower part and is about 17 inches thick. The subsurface layer is mottled dark-gray silt loam about 7 inches thick. A substratum of mottled olive-brown silt loam underlies the subsoil. The Amity soils are used mainly for cereal grains, grass grown for seed, and pasture. When irrigated, areas that are drained can be used for all the crops commonly grown in the survey area. Amity soils are found within the UGB and in all of the URA subareas.

2.2.3.2 Woodburn Series

The Woodburn series consists of moderately well drained soils that have formed in silty alluvium and loess of mixed mineralogy. These soils are on broad valley terraces. They have slopes of 0 to 20 percent. Elevations range from 150 to 350 feet. The average annual precipitation is 40 to 45 inches; the average annual air temperature is 52° to 54°F; and the length of the frost-free season is 200 to 210 days. In areas that are not cultivated, the vegetation is mainly grass and Douglas-fir. Woodburn soils are associated with Willamette soils.

In a typical profile, the surface layer is about 17 inches thick and is very dark brown silt loam in the upper part and dark-brown silt loam in the lower part. The subsoil is about 37 inches thick. It is dark yellowish-brown silty clay loam in the upper part; mottled dark-brown silty clay loam in the middle part; and mottled, dark-brown silt loam in the lower part. The substratum is dark-brown silt loam that extends to a depth of 68 inches or more. The Woodburn soils are used mainly for small grains, pasture, hay, orchards, berries, and vegetables. Woodburn soils range from Class II to IV and are the predominant soil type in within the UGB and all the URA subareas except Subarea 7 (identified in Figure 2-1), which includes substantial portions of Amity and Concord soils.

2.2.3.3 Other Significant Soil Types

The course of Mill Creek is etched in Bashaw clay, consisting of poorly drained soils formed in alluvium. The surface layer in a typical profile is 31 inches thick and consists of mottled dark gray and black clay. The Bashaw soils are used mainly for pasture, but support perennial grasses, wild blackberries, sedges, rushes, willows, and some ash and oak trees. Dayton soils and terrace escarpments are also found in a few isolated areas throughout the study area.

2.2.3.4 Urban Reserve Area

Figure 2-1 presents the soil types found in the proposed urban reserve area (URA) surrounding Woodburn. Soil type is one of the most critical criteria when considering future areas around Woodburn for inclusion in the UGB. Additional detail regarding the soil types in the subareas of the proposed URA is included in Appendix C.

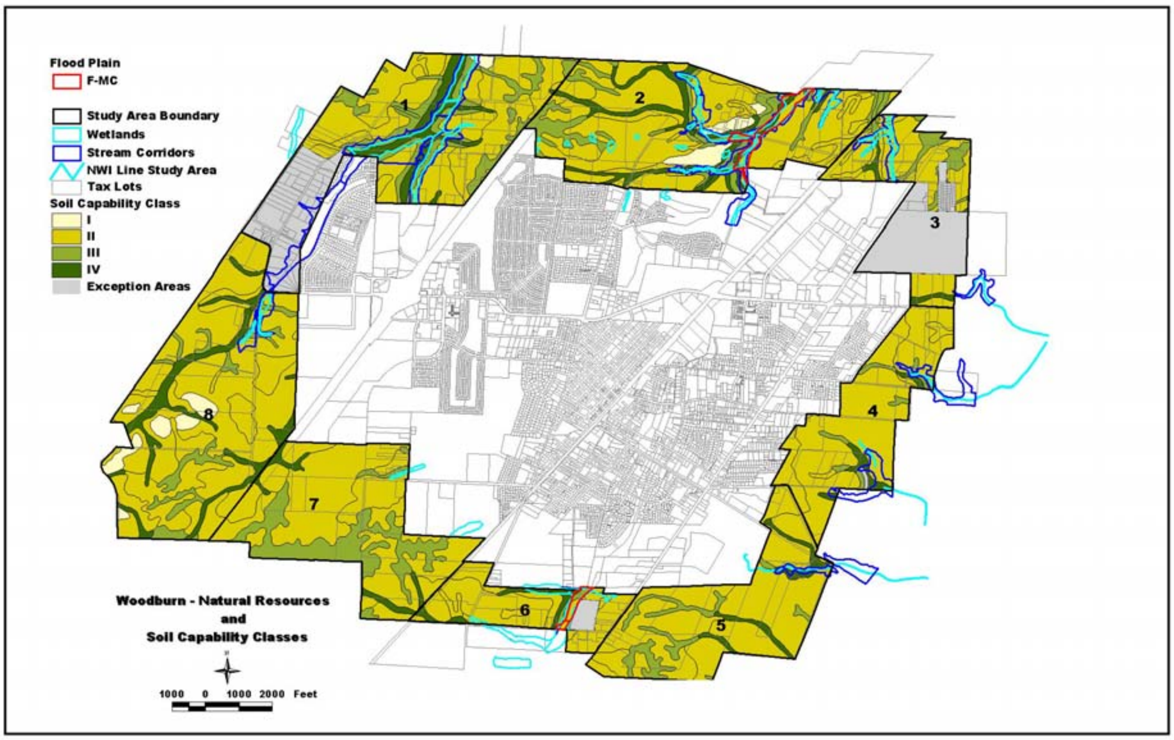

FIGURE 2-1
Soil Types and URA Subareas

2.2.4 Seismicity

2.2.4.1 Sources of Seismic Activity

Sources of seismic activity relevant to the Woodburn POTW and wastewater collection system are summarized below.

Current understanding of the seismic setting of western Oregon is frequently being updated as new information is gathered on existing faults, new faults are mapped, and earthquakes occur. For this Facilities Plan, the primary references used to establish the seismic setting were Geomatrix Consultants (1995), Blakely et al. (1995), Wong et al. (2000), and the U.S. Geological Survey (USGS) Quaternary Fault and Fold Database (2006).

Fault activity, as defined herein, describes fault movement within the Holocene epoch (last 13,000 years), determined through paleo-seismic evidence, or historical seismicity associated with the fault.

The principal tectonic feature of the Pacific Northwest is the active Cascadia Subduction Zone (CSZ), where the Juan de Fuca plate subducts beneath the North American plate along the Cascadia margin. This subduction zone begins off the coast of Oregon and dips downward beneath western Oregon. Two primary seismic source mechanisms are associated with the subduction zone: an interface source mechanism and an intraplate source mechanism. In addition, there is the potential for earthquakes from shallow crustal sources resulting from built-up tectonic stresses within the North American plate. The following three subsections describe these three sources in more detail.

Cascadia Subduction Zone—Juan de Fuca-North American Plate Interface

Interface earthquakes occur at the interface boundary between the Juan de Fuca Plate and the North American Plate. This interface is a thrust fault and is located at depths of less than about 18 miles. Earthquakes generated from subduction zone interface sources are historically the largest earthquakes observed worldwide. According to Native American legends (Ludwin et al., 2005) and paleo-seismic and geologic evidence gathered from offshore and coastal regions of Washington and Oregon during the past several decades, very large earthquakes, with an estimated moment magnitude (M_w) of 8 to 9, have occurred. The USGS probabilistic seismic hazard study equally weighted M_w 8.3 and 9.0 events for the interface source (Frankel et al., 2002) when generating the national seismic hazard maps.

Evidence indicates that these large earthquakes occur at intervals of 200 to 1,500 years, with an average return period of 500 to 600 years (Goldfinger et al., 2003). The last large earthquake occurred approximately 300 years ago, around the year 1700, and was estimated to be a magnitude of approximately 9.0 (Satake et al., 1996). On the basis of this information, the interface source is considered to be an active source, and it is anticipated to affect the project site.

The thrust fault dips at approximately 10 degrees to the east, and it has been suggested that the seismogenic part of the fault is located near the Oregon coast (Wong et al., 2000), approximately 62 miles from the project site. It has also been suggested recently by McCaffrey (2002) that, according to recent global positioning system (GPS) measurements and modeling, the locked zone lies farther offshore, approximately 80 miles from the project site.

Cascadia Subduction Zone—Intraplate Events

Intraplate earthquakes occur within the subducting Juan de Fuca Plate, have a deeper focus than interface earthquakes, and typically occur along normal faults as a result of stress and physical changes in the subducting slab as it is pushed deeper into the asthenosphere. The events associated with this source are estimated to range from 6 to 7.5, based on historical occurrences (Geomatrix, 1995).

Three earthquakes in recent history have been attributed to the intraplate source: the 1949, 1965, and 2001 earthquakes in the Puget Sound region, with M_w of 7.1, 6.5, and 6.8, respectively. No large intraplate earthquakes (M_w greater than 5.0) have occurred beneath the Portland region (although the Puget Sound earthquakes were felt in Portland), and there is controversy over whether the intraplate source is active in Oregon. When generating the national seismic hazard maps, USGS (2006) considered the intraplate source active. The intraplate source lies approximately 28 to 31 miles beneath the project site (McCrory et al., 2006).

Crustal Sources

Crustal sources are shallow earthquakes occurring in the North American plate. Crustal earthquakes are further categorized as occurring on *discrete fault sources* where repeated earthquakes have occurred in the geologic past, or within *areal source zones* where earthquakes have been observed and will probably occur again but have not been associated with any specific geologic features. The USGS Fault and Fold Database (2006) shows four crustal faults within an approximate 15-mile radius of the project site, one of which crosses the project site. These faults are thought to have been active at least since the Miocene epoch and younger (approximately 5 million years before present). These faults are considered "Class A" faults by the USGS, which means "Geologic evidence demonstrates the existence of a Quaternary fault of tectonic origin, whether the fault is exposed by mapping or inferred from liquefaction or other deformational features" and that they will contribute to the overall seismic hazard. These faults are listed below, along with characteristics obtained from the USGS Quaternary Fault and Fold Database (USGS, 2006):

- Mount Angel Fault: This fault crosses the project site. This fault trends in the northwest to southeast direction and is approximately 19 miles (30 km) in length. This fault is estimated to have a slip rate of less than 0.2 mm/year and is estimated to have ruptured within the last 15,000 years. Earthquake focal mechanisms from the 1993 Scotts Mills Earthquake indicate a northeast dip of 60 to 70 degrees. This fault is classified as a thrust/right lateral fault.

- Newberg Fault: This fault is located approximately 11 miles northwest of the project site. The Newberg fault trends from west to east and is approximately 3 miles (5 km) in length. This fault has an estimated slip rate of less than 0.2 mm/year and is estimated to have ruptured within the last 1.6 million years. This fault is classified as a right lateral/reverse fault or possibly a reverse fault.

- Canby–Molalla Fault: This fault is approximately 12 miles northeast of the project site. The Canby–Molalla fault trends in the northwest to southeast direction and is approximately 31 miles (50 km) in length. This fault has an estimated slip rate of less than 0.2 mm/year and is estimated to have ruptured within the last 15,000 years. This fault is classified as a right lateral/reverse fault.

- Waldo Hills Fault: This fault is approximately 15 miles southwest of the project site. The Waldo Hills fault trends in the southwest to northeast direction and is approximately 7 miles (12 km) in length. This fault has an estimated slip rate of less than 0.2 mm/year and is estimated to have ruptured within the last 1.6 million years. This fault is classified as a normal fault.

These faults are not long and uninterrupted, as they are in California, but instead are relatively short and offset at right angles by other faults. Generally, the faults described above have little or no geomorphic expression and, thus, are more difficult to identify than faults in California. These faults are mapped and located using a variety of geologic evidence, including magnetic anomalies, seismic refraction profiles, water well data, emplacement of basalt flows, lineaments in surficial geologic deposits, and changes in stream patterns. Despite the geologic evidence, the actual surface traces of most of the faults are not precisely known. In some cases, the faults have not ruptured young sediments and, therefore, no recent fault scarps are present. Where fault scarps are present, they may be hidden by vegetation cover. Additionally, sediments from the Lake Missoula Floods, which occurred between 15,000 and 13,000 years ago, bury some of the fault traces, and the sediments have not been offset by the faults—thus, the fault traces remain concealed at the surface. Therefore, the exact surface traces of most of the faults are inferred.

Because of the presence of these geologic hazards in the vicinity, seismic conditions will need to be considered during the design of City of Woodburn wastewater facilities.

2.2.4.2 Seismic Hazards

The seismic hazards expected to be associated with the Woodburn POTW and wastewater collection system are summarized below.

Ground Shaking

In order to better define and quantify the site specific ground shaking hazard at the project site a geotechnical exploration program that includes the advancement of soil borings will need to be performed. However, for facilities planning purposes a limited evaluation of seismic ground motion parameters at the site was performed. Firm rock horizontal PGA was obtained from national maps prepared by the USGS National Seismic Hazard Mapping Project (USGS, 2002). Using the location of the center of downtown Woodburn (latitude of 45.150 degrees north and longitude of 122.860 degrees west), the PGA on a rock/stiff soil site (National Earthquake Hazards Reduction Program [NEHRP] B-C Boundary) is estimated to be 0.36g for an earthquake with a 2 percent probability of being exceeded in 50 years (an approximate 2,500-year return period). The 2007 edition of *State of Oregon 2007 Structural Specialty Code (OSSC) Amendments* (ICC, 2007) and NEHRP (BSSC, 2003) designate the 2 percent in 50 years earthquake as the maximum considered earthquake (MCE) event. For non-essential facilities, the 2007 OSSC and NEHRP also designate the design earthquake (DE) to be equal to two-thirds of the MCE.

Based on geologic mapping (Walker and MacLeod, 19), it is expected that the subsurface conditions at the project site consist of unconsolidated to semiconsolidated lacustrine clay, silt, sand, and gravel soil. Mudflow and fluvial deposits and discontinuous layers of peat are also present at certain locations. Due to the expected varying subsurface conditions across the project site, generalized site class amplification factors given by NEHRP (based on the soil profile at each specific location of interest) will need to be selected to estimate the amplified peak ground accelerations at the ground surface.

Liquefaction

Liquefaction refers to the loss of shear strength that saturated soil deposits can experience during undrained cyclic loading, such as earthquake loading. Cyclic liquefaction occurs when pore pressures within the soil increase to the point where the effective stress in the soil approaches zero. When the effective stress approaches zero, the shear strength of the soil decreases and permanent deformations within the soil can accumulate to large values (greater than 5 percent strain). These deformations can cause slope failure or lateral spread on sloping ground, or settlement and loss of bearing capacity on level ground. The susceptibility of a soil deposit to liquefaction is a function of the degree of saturation, soil grain size, relative density, percent of fines, age of deposit, plasticity of fines, earthquake ground motion characteristics, and several other factors.

Based on the local and regional geology, soils susceptible to liquefaction are expected to be present at some locations within the project site. Hazards associated with liquefaction include ground settlement, bearing capacity failure, and lateral spread. As stated previously, in order to define and quantify the site specific hazards associated with liquefaction at the project site a geotechnical exploration program that includes the advancement of soil borings will need to be performed.

2.2.5 Public Health Hazards

The Woodburn POTW sewer system provides service to the entire area; only a handful of private subsurface wastewater disposal systems (septic tanks) still exist within the service area. The City of Woodburn has a policy in place to transition these systems over to the public sewer system where possible.

2.2.6 Energy Production and Consumption

Power supply in the area is adequate to reliably operate the POTW and collection system pump stations. Utilization of digester gas for energy production is not currently practiced at the POTW. However, digester gas is captured for beneficial reuse and burned in boilers to provide process heat for the digestion system. Additional renewable energy projects are currently being considered at the POTW, including increased utilization of digester gas and cost-effective energy conversion from harvested poplar trees.

2.2.7 Water Resources

2.2.7.1 Pudding River

The Pudding River is the main surface water feature in the Woodburn area. The 62-mile-long river originates in the Waldo Hills and flows sluggishly in a northerly direction in a meandering channel with little slope. It has numerous tributaries. The upper 7 miles are typical of foothill drainage, and the lower 56-miles are typical of flat valley drainage. The Pudding River empties into the Molalla River, which flows into the Willamette River at river mile 36 near Wilsonville.

The drainage area for the Pudding River is 480 square miles. Average monthly flows for the Pudding River range from 63 cubic feet per second (cfs) in the summer to about 2,600 cfs in the winter. Streamflow responds to both rainfall and snowmelt, with snowmelt maintaining high flows into late spring. The river occasionally floods severely in winter and spring months. There is a marked decline in streamflow during the drier summer months, which impacts (among other things) the assimilation of waste from waste treatment sources.

The entire length of the Pudding River is zoned for Exclusive Farm Use and its land-use designation is Primary Agriculture. The *Marion County Comprehensive Plan* designates the Pudding River as warm water habitat. Many species of fish use the Pudding River year-round, as well as seasonal salmon and cutthroat trout runs.

The Pudding River is the receiving water for the Woodburn POTW. Effluent from the POTW discharges to the river through two outfalls: a 24-inch outfall and a 12-inch outfall. The National Pollutant Discharge Elimination System (NPDES) permit stipulates the allowable mixing zone shall not extend farther than 10 feet upstream of the outfall to a point 200 feet downstream from each outfall. Additional mixing zone studies were conducted and will be considered as part of the upcoming NPDES renewal process.

2.2.7.2 Mill Creek

Mill Creek is the major drainage course through Woodburn; it bisects the City. The creek flows 8 miles to the northeast and empties into the Pudding River just south of Aurora. Mill Creek is generally confined to the area between Highway 99E and the I-5 Interstate Freeway. Mill Creek is deeply incised in an otherwise generally flat plain.

2.2.7.3 Senecal Creek

Senecal Creek drains a small portion of the study area west of the I-5 Interstate Freeway. Senecal Creek discharges to Mill Creek near Aurora. It is poorly defined in some areas and clogged by brush. Senecal Creek is downgradient from the North Marion County Disposal Facility. The facility is an ash monofill where ash is disposed of in lined earthen cells. The monofill has been in operation since the mid-1980s and accepts ash from the waste-to-energy facility located in Brooks, south of Woodburn. In the 1980s and 1990s leachate from the monofill was irrigated on grass fields adjacent to the facility. The leachate was very high in total dissolved solids and caused a local contamination of the shallow groundwater aquifer. Impacts from the contamination also impacted Senecal Creek. The practice of irrigating leachate was stopped in the late 1990s when the impacts were documented. The quality of the groundwater and Senecal Creek has improved since then and will continue to improve in the future.

2.2.8 Environmentally Sensitive Areas

Shapiro and Associates prepared *City of Woodburn Local Wetlands Inventory and Riparian Assessment Report,* for Woodburn in January 2000. Approximately 99.88 acres (thirty-one systems) were identified by the local wetland inventory and classified as an individual wetland, wetland system, or wetland body. Most of these wetlands are directly associated with the main drainages in Woodburn. Ten wetlands, those along Mill, Senecal, East Senecal, and Goose Creeks, were determined to be locally significant due to their hydrologic control functions in the drainage basin. Nine of these ten wetlands are also significant due to their water quality functions. Palustrine emergent (PEM), palustrine forested (PFO), palustrine scrub/shrub (PSS), and open water wetlands (POW) are the four major wetland types within the current study area. Descriptions of these wetland types are taken directly from Shapiro and Associates as follows.

2.2.8.1 Palustrine Emergent (PEM)

Palustrine emergent wetlands comprise the majority of wetlands mapped in the inventory. All the wetlands along the main stem of Mill and Goose Creeks are PEM. The northern half of wetlands in East Senecal Creek is also PEM. In addition, all the wetlands not directly associated with the main stem drainages are PEM, except the water hazards on the Tukwila golf course and four other isolated sites. Reed canary grass is the dominant plant in the main stem drainage PEM wetlands. It is mowed to reduce fire hazard, but is still able to compete successfully with other plant species, preventing them from forming large populations. With the exception of the golf course water hazards and four other sites noted above, wetlands not directly associated with the main stem drainages are in agricultural fields. These wetlands vary from mostly bare soil surface to a variety of agricultural species and invasive vegetation common to disturbed sites.

2.2.8.2 Palustrine Forested (PFO)

Palustrine forested wetlands were mapped on Senecal Creek and the southern half of East Senecal Creek. The dominant tree is Oregon ash, with a few specimens of black cottonwood. The understory includes clustered wild rose, red-osier dogwood, and willow species. Herbaceous vegetation under the canopy is dominated by reed canary grass. Some wetlands in the Mill Creek basin are also PFO. The wetland that extends west onto Tukwila golf course from Mill Creek is partly PFO, with Oregon ash, red alder, black cottonwood, and willow trees. North of the confluence of this wetland and the wetland on the main stem of Mill Creek is a stand of large, black cottonwoods. This is the largest PFO wetland remaining in the Mill Creek bottomlands. Two isolated wetlands also were classified as PFO. One is a linear stand of black cottonwood trees on the western side of the Southern Pacific Railroad tracks, just south of the intersection of the railroad and Settlemier Street. A second cottonwood stand is located on the western side of the commercial property on the southeast corner of the intersection of Hood Avenue and Highway 99E.

2.2.8.3 Palustrine Scrub/Shrub (PSS)

Palustrine scrub/shrub wetlands are found in several places in the inventory area. Scattered, small pockets of PSS wetlands are found along Mill Creek and in the wetland that extends from Mill Creek onto the golf course. Two isolated wetlands also were classified as PSS. At the northern end of Progress Way, water in a drainage ditch supports a PSS wetland dominated by willow species. This wetland extends northeast to the edge of the inventory area. The second isolated PSS wetland is on the future site of Centennial Park. This wetland is in an excavated area in a large, unused field. The combination of hydric soil and excavation apparently produces saturation or possibly shallow ponding in the excavation early in the growing season. Black cottonwood saplings are the dominant wetland vegetation on the site.

2.2.8.4 Open Water Wetlands (POW)

Open water wetlands are uncommon in Woodburn. A water feature consisting of the excavated floodplain of Mill Creek, which ponds approximately 1 acre of water, is the main open water feature in Woodburn’s wetland system. The pond includes two small islands. Shoreline vegetation is predominantly reed canary grass and Himalayan blackberry (*Rubus discolor*). At the time of the inventory, the surface of the pond had been reduced by evaporation and percolation to expose the pond bottom around the edges. Turbidity was high, possibly from algal growth and suspended sediments resulting from feeding activities of resident waterfowl observed on the pond.

Table 2-2 presents the wetland types found within the current Woodburn UGB.

TABLE 2-2
Woodburn Wetlands, Areas, and Classification

Drainage Basin	U.S. Fish and Wildlife Service Wetland Classification				Total Acreage
	PEM	PFO	PSS	POW	
Mill Creek	47.00	3.01	4.01	6.70	60.72
Senecal Creek	6.06	11.51	21.59	0	39.16
Total	53.06	14.52	25.60	6.70	99.88

Source: Shapiro and Associates *City of Woodburn Local Wetlands Inventory and Riparian Assessment Report*, January 2000.

In addition, Winterbrook Planning prepared a Natural Resources Inventory (Technical Report 2A) for Woodburn in 2002 as part of the Periodic Review process. This Natural Resources Inventory describes agricultural lands, wetlands, stream corridors, wildlife habitat, and floodplains for each of 8 study areas surrounding the Woodburn UGB. This natural resource inventory provides good information relative to parcels just outside the 2005 UGB, but also is applicable to some areas within the 2005 UGB (those most recently brought into the UGB). Appendix D summarizes the location, quantity, and quality of natural resources within individual planning subareas within the URA.

2.2.9 Air Quality and Noise

2.2.9.1 Air Quality

Oregon received approval from U.S. Environmental Protection Agency (EPA) for its Clean Air Act Implementation Plan in 1972, which established air quality standards to protect “public health.” The Oregon Clean Air Act goes a step further, however, in an effort to provide for the "public welfare" and prevents pollution problems from occurring.

Air quality is monitored throughout the Sate of Oregon and standards are enforced on a regional basis. The Salem office of DEQ has jurisdiction over Woodburn.

Woodburn is located in the Willamette Valley air shed. The valley is approximately 125 miles long (north to south) and 30 miles wide (east to west). It is bordered on the east by the Cascade Mountain Range, which has an average height of 5,500 feet, and on the west by the Coast Range, which reaches an average height of 3,400 feet. The valley is closed off in the north and south as the two ranges come together. Prevailing wind direction is from the southwest in winter and from the north in summer. Because of these geologic features, pollution generated in the valley becomes trapped. Pollution from industry and automobile emissions in the metropolitan areas and from field burning, slash burning, and other agricultural practices in rural areas combine in the atmosphere and are dispersed the entire length of the valley.

Natural ventilation is limited primarily to two breaks along the Columbia River. There are several smaller breaks along the Coast Range where air may "leak" over the rims of surrounding mountains from the west. During periods of atmospheric stagnation, normally during late summer and early fall, warm temperatures virtually form a lid over the valley, trapping pollution at low elevations. This pollution would normally disperse at higher elevations or be vented out of the area by the wind.

The air pollutants of greatest concern are:

- Ground-level ozone, commonly known as smog
- Fine particulate matter (mostly from wood smoke, other combustion sources, cars and dust) known as:
  - PM10 (10 micrometers and smaller diameter)
  - PM2.5 (2.5 micrometers and smaller diameter)
- Hazardous air pollutants (also called air toxics)
- Carbon monoxide (mostly from motor vehicles)
- Greenhouse gases

DEQ calculates an Air Quality Index (AQI) for cities statewide. The chart for Salem (provided in Figure 2-2) is indicative of AQI at Woodburn; AQI for Salem is based on PM2.5 and shows how many days in each of five health categories, the most recent year for which data are available. In 2006, the AQI was good to moderate. Data for ozone are similar.

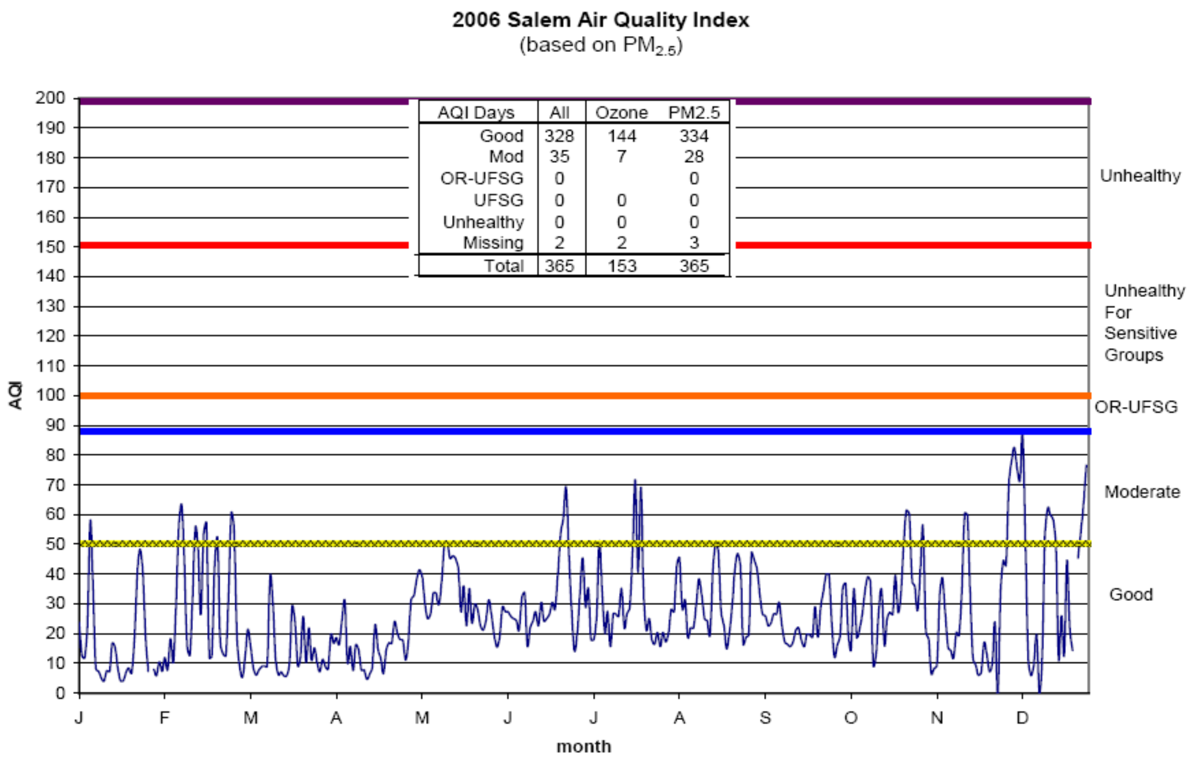

FIGURE 2-2
Salem Air Quality Index for 2006

Woodburn's land use designations consider effects upon air quality caused by automobiles, industries, and agricultural burning.

The use of automobiles is a major source of pollution, especially in the urban area. Excess use of the automobile is discouraged through land use development. More compact urban designs and proximity of jobs and services to residences are examples of land uses that limit automobile pollution. Industrial air pollution is less significant in Woodburn due to limited industry.

Probably the most pronounced problem with air quality in Woodburn occurs from burning grass seed production waste and forest management waste. These are agricultural and forest management practices that are performed in late summer and early fall at the same time as stagnant air and temperature inversion characteristics occur. These weather conditions magnify air pollution conditions of the smoke producing activities. This smoke tends to concentrate in areas of high population density causing discomfort and complaints.

DEQ does not have the authority to regulate agricultural burning. However, some fire departments require agricultural burning permits. The Woodburn Fire District regulates open burning in the District, which is allowed on approved burn days. The District designated a special control area within the Woodburn city limits and surrounding areas up to 3 miles from the city limits. Inside Special Control Areas, burning is usually allowed March 1 through June 15, and Oct. 1 through Dec. 15. Outside Special Control Areas, burning may occur on any approved burn day.

It is the policy of Woodburn to comply with applicable state and federal air quality standards.

2.2.9.2 Noise

Exposure to excessive noise levels over prolonged periods can be a threat to health. Noise pollution is not a pervasive problem in many areas of Woodburn, but excessive noise from certain industries, highly traveled roads, or airports could reduce the livability of nearby dwellings. Through noise level regulations adopted by DEQ, specific noise standards have been established for motor vehicles, industrial and commercial noise sources, motor racing facilities, and a rule to control airport related noise has been established. Much of the program attempts to achieve control over excessive noise by controlling the sources. Despite these controls, residences close to a heavily traveled road could be adversely affected. For example, 50 feet from a dwelling, the sound level of a single new accelerating automobile is about 80 decibels.

During the daytime, it is common to experience numerous loud noises for short periods. These same noises, if they occur at night, are greater nuisances. The DEQ defined excessive noise in its rules for industrial and commercial noise sources for two different times of the day. From 7:00 a.m. to 10:00 pm., noises above 55 decibels will disturb normal conversation and are considered potentially harmful. Between the hours of 10:00 p.m. and 7:00 a.m. sounds above 45 decibels inside a dwelling will disturb sleep.

Outside noise measured inside a building is 10 decibels lower with the windows open and 20 decibels lower with the windows closed. This means that if outside sound levels do not exceed 55 dBa, the ability to converse in outdoor areas and the ability to sleep in a building would be protected. Although DEQ sound controls are achieving a reduction in noise, there are instances where excessive noise is a problem. New dwellings located in close proximity to the noise source can be adversely affected. Setbacks, building orientation, soundproof construction, barriers, and other feasible means are considered in attempting to mitigate noise impacts. In addition to DEQ controls, Woodburn and Marion County consider noise impacts when approving development near certain sources. Primary noise sources in and near the city include:

- **Highway 99E**: This state highway traverses Woodburn in a north-south direction. Over the years, commercial and residential uses were established along the road.
- **I-5 Freeway**: The opening of I-5 greatly changed the routing of traffic through Woodburn. Development has taken place near the freeway and at interchanges.
- **Aurora Airport**: The Aurora Airport in northern Marion County is a public airport outside the UGB. Its use is projected to increase, so the noise impacts can be expected to become more significant.
- **Industrial**: All industrial development in Woodburn must meet DEQ regulations. Their regulations are sufficient to provide adequate noise protection for surrounding areas.
- **Commercial**: Noise generated by commercial use includes the Woodburn Drag Strip. This facility is located about 2.5 miles west of the city and is surrounded by farms and some existing residential uses. Complaints from nearby residents indicate that noise is a serious problem. Racing rules will mitigate noise impacts to a limited extent, but existing residents will continue to be impacted during motor racing events. Except for the possibility of new farm dwellings near the strip, the farm zone and related regulations applied to surrounding land will adequately control new noise conflicts.

2.3 Socio-Economic Environment

Woodburn's Residential Land Needs Analysis (Exhibit 2) describes recent (1990–2000) socio-economic trends in detail. Some of these trends and their implications are described below.

2.3.1 Sociological Trends

2.3.1.1 Age

Woodburn has become a relatively young city, with an unusually high proportion of young adults and families. This trend can be explained in terms of immigration of younger workers, who often have large families. However, Woodburn has retained a high percentage of retirement-age residents, which can be explained by the presence of a large senior housing development (Woodburn Senior Estates) and by long-term residents.

The lack of family wage jobs in Woodburn may have contributed to an out-migration of working age people who were born in Woodburn.

Typically, households at the bottom and top of the age pyramid have less disposable income to spend on housing, while households headed by middle-aged workers have higher-paying jobs and demand higher cost housing. Woodburn's policy is to provide more family-wage jobs, thus retaining younger and middle-aged workers in the community. This will have the effect of increasing demand for traditional single-family housing, and decreasing demand for more affordable housing types such as apartments and manufactured homes.

2.3.1.2 Education

The general educational level of adults in Woodburn is relatively low, and the percentage of persons with no high school experience has risen over the last 10 years. These lower educational levels can be explained by the large numbers of recent immigrants who often are poorly educated. People with lower educational levels typically have lower incomes and generally cannot afford higher-priced housing. Part of Woodburn's economic development strategy is to provide improved educational and job training services. As educational levels increase, so will household incomes. Recent housing trends indicate an increase in multi-family housing, which generally is more affordable than single-family housing. As Woodburn's newer residents become better educated, they are more likely to afford homeownership, and to demand more traditional single-family housing.

2.3.1.3 Households by Type

Woodburn increased from 69 to 72 percent in family households, and dropped in all other categories. This means that a vast majority (calculated to 79 percent) of new households between 1990 and 2000 in Woodburn were occupied by families. The 4 percent drop in householders aged 65 and above in Woodburn reflects the younger age of new Woodburn residents. Woodburn should plan to meet the needs of these young families as they become more established in the community and integrated into the workforce. Woodburn should not just plan for development to serve the existing and future young families, but realize many of the families now in Woodburn will (1) be able to develop wealth to afford ownership housing and (2) will have young adults moving out of the family home and needing affordable rental housing.

2.3.1.4 Household Size

The rise in household size in Woodburn can be explained largely by in-migration of young and growing families, who typically have low educational levels and low incomes. Woodburn's immigrant families have been mostly of Central European or Hispanic heritage, two groups that typically have more children and therefore larger household sizes. However, based on the experience of other immigrant groups in America, household size can be expected to more closely approximate County-wide averages as young families mature, children create their own households, educational and income levels increase, and the cultural expectations change.

Part of Woodburn's economic development strategy is to provide improved educational and employment opportunities. Thus, it is reasonable to project that household sizes will remain high, but will more closely approximate household sizes in Marion County as a whole by the Year 2020. Woodburn should plan both to provide affordable single family homes, and maintain a supply of affordable multi-family housing opportunities, such as provided by Nuevo Amanacer and Esperanza Court.

2.3.2 Economic Conditions and Trends

ECONorthwest prepared an *Economic Opportunities Analysis* (EOA) in May 2001 that considered Woodburn's comparative advantages and identified the types of employment and industries that Woodburn can reasonably attract during the planning period. To address Oregon Revised Statute 197.212 (Economic Development) and Goal 9 (Economy of the State) requirements, ECONorthwest also determined the types of sites that will be needed to attract targeted industries, in a subsequent document entitled *Site Requirements for Woodburn Target Industries* (February 2003). These documents recognize the City's locational advantages and outline a strategy for the City to target specific high-wage industries for future growth. Both documents conclude the City will need additional land with specific size and access characteristics to achieve the City's economic development goals. These two ECONorthwest documents serve to determine Woodburn's employment land needs through 2020.

In March of 2003, ECONorthwest also analyzed the effects of a successful economic development strategy on household incomes, and therefore on housing needs, in a document called *Woodburn Occupation/Wage Forecast*. The successful implementation of Woodburn's economic development strategy will have a significant impact on the city's wage distribution. The strategy will result in fewer low-paying retail and service jobs, and more high-wage manufacturing, construction, and skilled occupations.

Chapter 4 and Appendix B of Woodburn's EOA identify "target industries" based on Woodburn's comparative economic advantages and local policy objectives, and describe the site requirements of each "targeted" employment category and for master planned employment parks. In simple terms, the EOA and EDA recommend that Woodburn capitalize on its principal comparative advantages:

- The City's I-5 location between Salem and Portland.
- The availability of large tracts of flat land with direct access (i.e., within 2 miles of) the I-5 Interchange with Highway 214.
- The City's commitment and ability to provide required urban services to these sites in the short-term.

The EOA also determined that Woodburn lacked an adequate supply of suitable sites within its existing UGB to attract targeted employers, and noted that the City's population was growing at a much faster rate than projected in Marion County's "coordinated" forecast. In 2002–2003, ECONorthwest identified the site *size* requirements for targeted employment categories identified in the EOA.[1]

To implement the recommendations of the EOA and ECONorthwest's *Target Industries Site Requirements Memorandum* (2003), Winterbrook recommended inclusion of some 400 gross acres within a Southwest Industrial Reserve (SWIR) comprehensive plan overlay designation and zoning district. To ensure direct access from the west to I-5, while minimizing inclusion of Class I and II agricultural soils, the SWIR is located immediately west and south of developed I-5 industrial land.

The SWIR district reserves land exclusively for targeted employment categories identified in the EOA, and requires master planning to ensure efficient provision of public facilities and

[1] Please see "Site Requirements for Woodburn Target Industries" (ECONorthwest, 2003) and "Population and Employment Projections 2000-2020" (ECONorthwest, 2003). Woodburn's 2020 population projection of 34,919 was adopted in November of 2004 by the Marion County Board of Commissioners. The 2005 plan and ordinance amendment package is based on ECONorthwest's high employment projection of 8,374 new employees. These projections represent a population increase of 74% from 2000-2020, in contrast to an employment increase of 81% for the same period.

services, and retention of sites in parcel sizes prescribed in ECONorthwest's 2003 *Target Industries Site Requirements Memorandum*.

As noted in Woodburn's Goal 14 Boundary Location findings, most of the SWIR is considered serviceable and available for development by 2010. Land on the west side of I-5 and east of Butteville Road can be served immediately with sanitary sewer, water, drainage and transportation services. The City Council expects SWIR parcels served by Parr Road and the planned extension of Evergreen Road to be development-ready by 2010.

By 2015, the remainder of the SWIR will become development ready, as industrial land developers pay (through frontage improvements, local improvement districts, and systems development charges) for street extensions for Evergreen Road to the "South Arterial," Butteville and Parr Roads, and for the "South Arterial" connecting Evergreen Road with Butteville Road (including the Butteville Road Overpass) and for utility extensions.

2.3.3 Population

Population projections form the basis of the projected flows and loads (5-day biochemical oxygen demand [BOD_5] and total suspended solids [TSS]) for the Woodburn POTW. The City of Woodburn adopted a comprehensive plan in 2005 that expanded the UGB and provided population projections through 2020. This population will be utilized as the basis of planning through 2020. However, additional planning values are necessary to consider future needs beyond 2020 in light of currently planned improvements.

A range of population projections for the period from 2020 to 2060 was developed and a memorandum was prepared by Winterbrook Community Resource Planning. A growth rate of 1.9 percent is recommended for the period beyond 2020. Applying the proposed growth rates over the planning horizon, population projections are summarized below, and described in more detail in Section 4, Wastewater Characteristics, of this Facilities Plan.

2.3.3.1 Year 2020 Population Projection

Woodburn's 2005 Plan and UGB amendment package is based on a Year 2020 population projection of 34,919 with an average annual growth rate (AAGR) of 2.8 percent. The Marion County Board of Commissioners adopted this projection as part of the *Marion County Comprehensive Plan* in November of 2004. This population projection represents an increase of 14,819 persons from Woodburn's 2000 U.S. Census population of 20,100 and an increase of 14,059 persons from Woodburn's 2002 PSU population estimate.[2] This coordinated and acknowledged population projection serves as the basis for projecting residential and public/semi-public land needs through the year 2020.

ECONorthwest's April 29, 2002, memorandum entitled *Woodburn Population and Employment Projections, 2002–2020* justifies a 34,919 year 2020 population projection and explains why the previous projection of 26,290—with an AAGR of 2.13 percent—was unreasonably low.[3] In simple terms, Woodburn's population grew at an average annual rate of 3.3 percent from 1970 to 2000. Woodburn's location along I-5 between Salem and Portland will contribute to

[2] Portland State University Center for Population Research estimate.

[3] This ECONorthwest memorandum served as the basis for agreement among Woodburn, Marion County, the Department of Land Conservation and Development (DLCD) and the Oregon Department of Transportation (ODOT) to use this projection for planning purposes in April of 2002. See April 2002 letter from Les Sasaki, Marion County Senior Planner.

sustained population growth during the planning period. See *Marion County Comprehensive Plan Amendments to Update the Coordinated 2020 Population Projections for the City of Woodburn and for Marion County* (Winterbrook Planning, November 10, 2004).

2.3.3.2 Years 2030 and 2060 Population Forecast

Winterbrook prepared a population forecast that extended population growth into the urban reserve timeframe of 2020–2060. The URA forecast provided three growth scenarios: low, mid-range, and high.

The *Marion County Comprehensive Plan* recognizes that Woodburn is the growth center for northern Marion County. Therefore, it is reasonable to assume that Woodburn will have an increasing percentage of the County's overall population. However, given the OEA projection for Marion County as a whole, it is probably unreasonable to assume that Woodburn will continue to grow at 2.8 percent from 2020 to 2060.

The mid-range projection for Woodburn from 2020 to 2060 is 1.9 percent—midway between the County OEA projection of 1 percent and Woodburn's 2005–2020 growth rate of 2.8 percent. If Woodburn were to grow at 1.9 percent each year from 2020 to 2060, then Woodburn would have a 2030 population of 42,151 and a 2060 population of 74,136.

2.4 Land Use Regulations

Land uses in and near Woodburn are controlled by City of Woodburn land use regulations, as well as Marion County land use regulations. Land use for both Woodburn and Marion County are defined in detail in the comprehensive plans, with separate plans for the City of Woodburn and for Marion County. The general framework of each regulatory scheme is described below. Additional detail can be found in the comprehensive plans for each jurisdiction.

2.4.1 City of Woodburn

The City of Woodburn's land use regulations are based on the goals and policies within the *Woodburn Comprehensive Plan*, and implemented by the Development Ordinance.

The *Woodburn Comprehensive Plan* includes the Economic Development Strategy (EDS), Public Facilities Plan (PFP), Transportation Systems Plan (TSP) and Land Development Ordinance (WDO). The framework is as follows:

- *Woodburn Comprehensive Plan* amendments (City of Woodburn, 2005):
- *Woodburn Comprehensive Plan* Map (City of Woodburn, 2005);
- Woodburn Economic Development Strategy (ECONorthwest, 2002);
- Woodburn Public Facilities Plan Project Tables and Maps (City of Woodburn, 2005); and
- *Woodburn Transportation Systems Plan Update* (CH2M HILL, 2005).
- Woodburn Land Development Ordinance and Map Amendments (City of Woodburn, 2005).

The *Woodburn Comprehensive Plan* describes three residential plan designations: medium density residential, low density residential, and public. These residential designations are implemented by six zones:

- Single Family Residential (RS)—projected 5.5 dwelling units per acre
- Nodal Single Family Residential (RSN)—projected 8 dwelling units per acre
- Retirement Community Single Family Residential (R1S)—no new development projected for this zone
- Medium Density Residential (RM)—projected 14 dwelling units per acre
- Nodal Medium Density Residential (RMN)—projected 18 dwelling units per acre
- Public & Semi-Public (P/SP)

Woodburn has two employment plan designations: industrial and commercial. These employment designations are implemented by five zones:

- Commercial Office (CO)
- Commercial General (CG)
- Downtown Development and Conservation (DDC)
- Industrial Park (IP)
- Light Industrial (IL)

2.4.2 Buildable Lands in Woodburn

Table 2-3 describes the 2005 supply of buildable land in Woodburn.

TABLE 2-3
Buildable Land by Plan Designation

Plan Designation	Net Buildable Acre Supply
LDR (Low Density Residential)	371
Exception Area LDR	107
Nodal LDR	220
MDR (Medium Density Residential)	80
Exception Area MDR	8
Nodal MDR	73
All Residential	854
Commercial (Retail, Office)	127
Industrial / Basic Employment	407
All Employment	534

2.4.3 Public Facilities

The *Woodburn Comprehensive Plan* discusses Public Facilities in Chapter I. Woodburn's key public facilities and wastewater goals are:

Goal I-1: Public facilities and services shall be provided at levels necessary and suitable for existing uses. The provision for future public facilities and services in these areas shall be based upon approved master plans that consider: (1) the time required to provide the service, (2) reliability of service, (3) financial cost, and (4) levels of service needed and desired.

Goal I-2: Develop a system that will comply with regulatory treatment requirements of the Clean Water Act for anticipated wastewater flows and reduce the amount of pollutants that are released to the environment.

Goal I-3: Develop a plan that will economically provide for the treatment of wastewater generated by the City's sewer customers accounting for projected growth through the year 2020.

2.4.4 Marion County

Marion County's land use regulations are based on the Goals and Policies within the *Marion County Comprehensive Plan*, and implemented by two zoning ordinances: the Marion County Urban Zoning Ordinance and the Marion County Rural Zoning Ordinance. The Urban Ordinance governs lands within UGBs but outside of City Limits. The Rural Ordinance governs lands outside of UGBs.

Land within Woodburn's City Limits is governed by Woodburn. Land within Woodburn's UGB but outside its City Limits is governed by Marion County under the Urban Ordinance. Land outside Woodburn's UGB is governed by Marion County under the Rural Ordinance. The Woodburn POTW is currently located outside of the UGB. Future expansions and improvements to the Woodburn POTW may require county land use review and approval.

2.4.5 Intergovernmental Agreements

In 2004–2006, Woodburn staff coordinated with Marion County, Oregon Youth Authority (OYA) MacLaren Youth Correctional Facility, and Oregon Department of Transportation (ODOT) in drafting the following agreements:

- Urban Growth Boundary Coordination Agreement (UGBCA) with Marion County (October 2005). Addresses the Marion County Growth Management Framework Plan (Framework Plan) policy requirement that a new intergovernmental agreement be in place before the County adopts City comprehensive plan amendments that require County approval.
- Intergovernmental Agreement (IGA) with OYA MacLaren Youth Correctional Facility (August 2005). Addresses renewing the November 1998 agreement between Woodburn and OYA which will continually provide sewage disposal service to the OYA MacLaren Youth Correctional Facility.
- IGA with ODOT establishing an Interchange Management Overlay District (January 2006). Addresses implementation and monitoring of new development with the Interchange Management Area (IMA) Overlay District.
- IGA with ODOT establishing a funding plan for modernization of the I-5 Woodburn Interchange (April 2006). Addresses funding for the modernization of the I-5 Woodburn interchange and defines the City's total funding contribution.

SECTION 3

Existing Wastewater Treatment Facilities

This section is intended to provide an understanding of the Woodburn Publicly Owned Treatment Works (POTW) capabilities and limitations in order to ascertain the risk associated with continued use of each key component, as well as identifying opportunities to maximize the capacity and value of the existing facilities through modifications or rehabilitation. In addition, the condition assessment is intended to identify facilities that no longer meet capacity and redundancy requirements, safe and efficient operability requirements, and facilities that no longer meet today's standards for wastewater treatment.

This section documents the current age, capacity, condition and performance of the existing facilities. Each major process area and pump station was assessed on the basis of structural and electrical condition, process performance (i.e., capacity, redundancy, stability, etc.) and code compliance.

3.1 Plant History

The Woodburn POTW was constructed in 1980 and is located outside the City limits on the west bank of the Pudding River. The POTW is located on 4.5 acres of MacLaren School land leased from the State of Oregon. The plant was converted from a rotating biological contactor (RBC) facility to a biological nutrient removal (BNR) facility with the last expansions in 1995 and 1999.

Table 3-1 summarizes the age of the major components of each unit process as compared with the expected service life based on industry standards. Concrete structures at wastewater treatment facilities can often have a useful life greater than 50years, but mechanical and electrical systems seldom remain functional beyond 20 years. The majority of the components are relatively new and well within their expected useful life.

TABLE 3-1
Woodburn POTW Facility Component Age and Expected Life

Facility	Component	Year Installed	Age	Expected Useful Life (years)
Septage Receiving Station	Structure	1979	29	50
	Mechanical Equipment	1979/1999	9	20
	Electrical and Instrumentation	1999	9	20
Headworks	Structure	1995	13	50
	Mechanical Equipment	1995	13	20
	Electrical and Instrumentation	1995	13	20
Grit Removal	Structure	1995	13	50

TABLE 3-1
Woodburn POTW Facility Component Age and Expected Life

Facility	Component	Year Installed	Age	Expected Useful Life (years)
	Mechanical Equipment	1995	13	20
	Electrical and Instrumentation	1995	13	20
	Underground Piping	1995	13	50
Primary Clarifiers	Basin Structure	1979/1999	29/9	50
	Mechanical Equipment	1999	9	20
	Electrical and Instrumentation	1999	9	20
	Underground Piping	1979/1999	29/9	50
	Primary Sludge Pumps	1979	29	50
Wet Weather Clarifiers	Basin Structure	1979	29	50
	Mechanical Equipment	1979	29	20
	Electrical and Instrumentation	1979	29	20
	Underground Piping	1979/1999	29/9	50
	Wet Weather Sludge Pump	1979	29	50
Aeration Basins	Structures	1999	9	50
	Diffusers	1999	9	20
	Electrical and Instrumentation	1999	9	20
	Underground Piping	1999	9	50
Blower Building	Structures	1999	9	50
	Blowers	1999	9	20
	Electrical and Instrumentation	1999	9	20
Secondary Clarifiers	Structures	1999	9	50
	Drives, RAS Pumps, WAS Pumps	1999	9	20
	Electrical and Instrumentation	1999	9	20
Filters	Basin Structure	1999	9	50
	Mechanical Equipment	1999	9	20
	Electrical and Instrumentation	1999	9	20
Ultraviolet Disinfection	Structures	1999	9	50
	Mechanical Equipment	1999	9	20
	Electrical and Instrumentation	1999	9	20
Hypochlorite Disinfection	Structures	1979	29	50
	Mechanical Equipment	1999	9	20

TABLE 3-1
Woodburn POTW Facility Component Age and Expected Life

Facility	Component	Year Installed	Age	Expected Useful Life (years)
	Electrical and Instrumentation	1999	9	20
Irrigation Supply System	Structures	1979	29	50
	Mechanical Equipment	1999	9	20
	Electrical and Instrumentation	1999	9	20
Potable Water Supply System	Structures	1979	29	50
	Mechanical Equipment	1999	9	20
	Electrical and Instrumentation	1999	9	20
Outfalls	12-inch Outfall	1979	29	50
	24-inch Outfall	1999	9	20
Waste Activated Sludge Thickening	Structure	1979	29	50
	Dissolved Air Flotation/Mechanical Equipment	1999	9	20
	Polymer Systems	1999	9	20
	Electrical and Instrumentation	1999	9	20
Anaerobic Digestion	Digester 1			
	Structure	1979	29	50
	Mechanical Equipment	1999	9	20
	Electrical/Instrumentation	1999	9	20
	Digester 2			
	Structure	1979	29	50
	Mechanical Equipment	1999	9	20
	Electrical/Instrumentation	1999	9	20
	Digester Building			
	Structure	1979/1999	29/9	50
	Mechanical Equipment	1999	9	20
	Electrical/Instrumentation	1999	9	20
Facultative Sludge Lagoon	Lagoon Liner	1999	9	50
	Mechanical Equipment	2008	0	20
	Electrical/Instrumentation	2008	0	20
Standby Generator	Structure	1979	29	50

TABLE 3-1
Woodburn POTW Facility Component Age and Expected Life

Facility	Component	Year Installed	Age	Expected Useful Life (years)
	Mechanical Equipment	1999	9	20
	Electrical/Instrumentation	1999	9	20
Plant Electrical Feed	Electrical	1999	9	20
	Structure	1999	9	50
Administration Building		1979/1999	9	50

3.2 Plant Design Criteria

Table 3-2 summarizes the existing major unit processes within the plant and their stated design capacity.

TABLE 3-2
Woodburn POTW Inventory of Process Facilities and Equipment

Equipment/Unit Process	Number of Units	Size (each)	Total Capacity
Preliminary Treatment			
Mechanically Cleaned Screen	2	36 inches wide; 7/16-inch spacing	16 mgd
Grit Chambers	2	12-foot diameter	16 mgd
Primary Treatment			
Primary Clarifiers	2	55-foot diameter 10-foot SWD	700 gpd/sf (ADWF) 3,370 gpd/sf (PWWF)
Wet Weather Primary Clarifiers	2	55-foot diameter 10-foot SWD	1,200 gpd/sf (PWWF with primaries @ 5 mgd each)
Secondary Treatment			
Aeration Basins	2	0.925 million gallons 15-foot SWD	4.1 mgd (MMDWF)
Anaerobic/Anoxic Cells	4/basin	54,000 gallons	
Aeration Blowers (multistage centrifugal)	4	2 @ 1,050 scfm 2 @ 2,100 scfm	6,300 scfm
Secondary Clarifiers	3	75-foot diameter 18-foot SWD	1,210 gpd/sf (PWWF) 22.4 ppd/sf (MDWWF)
Filtration			
Continuous Backwash Filters	2	46 feet by 16 feet 8 inches anthracite; 8 inches sand	1.6 gpm/sf (ADWF) 3.6 gpm/sf (MDDWF)

TABLE 3-2
Woodburn POTW Inventory of Process Facilities and Equipment

Equipment/Unit Process	Number of Units	Size (each)	Total Capacity
Effluent Disinfection			
Medium Pressure Ultraviolet	2	64 lamps	12 mgd
Outfalls			
Primary Outfall	1	24-inch	3.3 mgd
Secondary Outfall	1	12-inch	14 mgd
Waste Activated Sludge Thickening			
Dissolved Air Flotation	2	17-foot diameter	0.26 lb/sf/hr (average) 0.70 lb/sf/hr (peak)
Anaerobic Digestion			
Digesters	2	50-foot diameter 22-foot SWD; 23-foot SWD 48,400 cubic feet; 45,400 cubic feet	21 day SRT
Sludge Storage			
Facultative Sludge / Storage Lagoons	2	2.5 acres 15 feet deep; 3-foot water cap	16.5 ppd/1,000 sf (AA) 25 ppd/1,000 sf (MM)

Reference: *Wastewater Treatment Plan Expansion and Upgrade – Contract 3, Design Data sheets G15–G18,* Brown & Caldwell, November 2001.

3.3 Unit Process Deficiencies

Some components of the existing POTW still have remaining capacity for future conditions; however, others do not have sufficient capacity even for current conditions. Table 3-3 illustrates the capacity of each unit process as compared with the corresponding current flow or load condition. The development of these current values is described in Section 4.6 and includes the current full industrial flow and load allocations.

TABLE 3-3
Unit Process Capacities

Unit Process	Basis for Capacity	Design Criteria	Existing Capacity		Current Flow/Load Value
			Firm Capacity	Total Capacity	
Screening	Peak Hour Flow	Headloss	16 mgd	16 mgd	17.4 mgd
Grit Removal	Peak Hour Flow	Headloss	16 mgd	16 mgd	17.4 mgd
Primary Sedimentation	Peak Hour Flow	2,500 gpd/sf	11.9 mgd	11.9 mgd	17.4 mgd
Aeration Basin (summer)	MMDW aerobic SRT (ppd PE BOD)	12 days	7,500 ppd	7,500 ppd	6,470 ppd
Aeration Blowers (summer)	MDDW Load (ppd PE BOD, ppd PE NH_4)		4,200 scfm	6,300 scfm	4,700 scfm
Secondary Clarification (summer)	MDDW SLR	25 ppd/sf	6.2 mgd	8.3 mgd	4.75 mgd
Aeration Basin (winter)	MMWW aerobic SRT (ppd PE BOD)	5 days	11,030 ppd	11,030 ppd	8,400 ppd
Aeration Blowers (winter)	MDWW Load (ppd PE BOD, ppd PE NH_4)		4,200 scfm	6,300 scfm	4,800 scfm
Secondary Clarification (winter)	MDWW SLR	35 ppd/sf	10.4 mgd	13.9 mgd	14.5 mgd
	Peak Hour Hydraulic Loading Rate	1,500 gpd/sf	17.7 mgd	19.8 mgd	17.4 mgd
Filtration	MDDWF	3 gpm/sf	3.2 mgd	6.4 mgd	4.75 mgd
UV Disinfection	Peak Hour Flow	$mW\text{-}sec/cm^2$	12 mgd	12 mgd	17.4 mgd
Outfall	Peak Hour Flow	100 yr flood elev.	NA	17.3 mgd	17.4 mgd
DAFT	Max Month Loading (ppd WAS)	0.60 lb/sf hr*	3,300 ppd	6,500 ppd	5,300 ppd
Anaerobic Digestion	Max Month Hydraulic Retention Time (gpd Digester Feed)	15 days	NA	46,800 gpd	39,200 gpd
FSL	Max Month VSS Loading (ppd FSL Feed)	50 ppd VSS/KSF	NA	10,809 ppd	3,000 ppd

Condition and performance assessments have also been developed based on several visits to the Woodburn POTW. The focus of these visits was to identify deficiencies associated with each unit process.

Detailed discipline-specific condition assessment memorandums are included in Appendix E. The following summarizes the key recommendations to address condition-related deficiencies for the facilities planning effort.

3.3.1 Headworks

- Ensure adequate access is provided for maintenance of the existing and/or proposed screens. Consider replacement of channel covers with more substantial materials to address current degradation due to corrosion, errant odor emissions, and to prevent further corrosion.
- Consider relocation or improved protection of electrical equipment feeding headworks in order to prevent continued corrosion issues.
- Define drivers (if any) for future odor control. Consider mechanisms to address this potential future need.
- Document system deficiencies such as National Electric Code (NEC) compliance, trench drain, handrail installation, weather and freeze protection, instrumentation and equipment lifting provisions for further consideration during subsequent design activities.

3.3.2 Wet Weather Clarification

- Define potential options for usage of these units in a fashion consistent with operational philosophy and permit limitations, or demolish.

3.3.3 Primary Clarification

- Evaluate hydraulics and flow split associated with additional primary clarifier.
- Document system deficiencies such as NEC compliance, polyvinyl chloride effluent piping, and weir submergence during peak flows for further consideration during subsequent design activities.

3.3.4 Aeration Basins

- Define actual capacity of existing basins associated with new discharge requirements.
- Consider alternative process configurations/operations for wet weather and dry weather. Consider opportunities to optimize secondary treatment to address water quality requirements and/or provide energy savings.
- Document system deficiencies such as electrical installation, scum removal, and instrumentation and control issues for further consideration during subsequent design activities.

3.3.5 Blower Building

- Define required blower capacity associated with aeration improvements. Identify impacts of future increased blower demand on system layout/configuration.

- Further define extent of reinforcing in building walls during subsequent design activities to define potential seismic code-related improvements.
- Document system deficiencies such as instrumentation and control loop issues, building ventilation, and compressed air system issues for further consideration during subsequent design activities.

3.3.6 Secondary Clarification

- Evaluate hydraulics and flow split associated with additional secondary clarifier.
- Document system deficiencies such as electrical installation and operational and maintenance issues for further consideration during subsequent design activities.

3.3.7 Filtration

- Consider complete filtration system replacement with alternative filtration mechanisms.

3.3.8 Ultraviolet Disinfection/Effluent Flow monitoring

- Improve system operation to account for flow split between discharge and reuse.
- Consider improvements to hydraulics and access and protection for operations and maintenance activities.
- Address unguarded 16-inch opening at slide gate (when gate is closed).
- Document system deficiencies such as instrumentation and control issues for further consideration during subsequent design activities.

3.3.9 Effluent Discharge

- Address hydraulic limitations of existing reaeration structure.

3.3.10 Septage Receiving

- Define anticipated required capacity based on current and proposed operation.
- Document system deficiencies for further consideration during subsequent design activities.

3.3.11 Primary Sludge Pumping

- Confirm 6 air changes/hour are provided in building.
- Consider options for inclusion of additional primary sludge pump in dissolved air flotation building.
- Document system deficiencies such as equipment lifting provisions for further consideration during subsequent design activities.

3.3.12 WAS Thickening

- Define required dissolved air flotation thickening capacity associated with system improvements. Investigate capacity associated with parallel operation.
- Document system deficiencies such as equipment lifting provisions for further consideration during subsequent design activities.

3.3.13 Sludge Blend Tank

- Consider odor control as part of an ultimate plant-wide system.

3.3.14 Anaerobic Digestion

- Assess mixing system performance when vessels are taken offline.
- Document system deficiencies such as equipment lifting provisions for further consideration during subsequent design activities.

3.3.15 Facultative Sludge Lagoons

- Investigate impact of ammonia return on secondary process. Assess proposed operation with new dredge and consider a side-stream treatment mechanism if warranted.
- Document system deficiencies such as struvite generation and scum break performance for further consideration during subsequent design activities.

3.3.16 Irrigation Storage and Supply/Plant 3-Water System

- Define mechanism to address lack of fire suppression in the winter—this is a significant safety issue.
- Consider plant-wide non-potable water demand; identify impacts of increased demand on existing undersized system.
- Consider complete overhaul of 3-water system.
- Document system deficiencies such as system reliability, freeze protection, and instrumentation and control issues for further consideration during subsequent design activities.

3.3.17 Chemical Storage

- Define safety and code issues associated with continued utilization of existing building for hypochlorite storage. Consider a new facility designed specifically for chemical storage.
- Consider options for polymer usage within the dissolved air flotation thickener components.
- Consider future hypochlorite demand; identify impacts of increased demand on existing undersized system.

3.3.18 Potable Water

- Consider future potable water demand and likely source for increased supply; identify impacts of increased demand on existing system and supply line.

3.3.19 Main Electrical Feed and Backup Power

- Confirm PGE feed and plant electrical distribution system is adequate to handle projected electrical demand.
- The existing backup generator system performs well. Consider supplementing capacity with a separate system rather than retrofitting and/or revising the existing system.
- Address inadequate anchorage of transformers to their foundation slabs.
- Document system deficiencies such as fueling and ventilation control issues for further consideration during subsequent design activities.

3.3.20 Plant Access/Site

- Document system deficiencies such as inadequate roadway configuration and durability for further consideration during subsequent design activities.

3.3.21 Laboratory/Administration

- Identify staffing and space utilization impacts associated with proposed improvements.
- Document system deficiencies such as inadequate heating, ventilation, and air conditioning systems for further consideration during subsequent design activities.

3.3.22 Plant-Wide issues

The following represent issues observed plant-wide, associated with equipment or material selection or installation practices from the previous expansion:

- Consider integration of new programmable logic controller components and supervisory control and data acquisition improvements with existing system.
- Electrical installation was not well thought out or executed. The original electrical contractor filed for bankruptcy during the 1999 construction project and a second contractor was hired to complete the installation.
- Tile roofs on original buildings are deteriorating and are an ongoing maintenance issue.
- Document system deficiencies such as inadequate heat tracing systems and note manufacturers of problematic equipment for further consideration during subsequent design activities.
- In many instances, bracing of tall electrical equipment, panels, light fixtures, piping, etc., is absent, representing a hazard under seismic conditions.

3.4 Conclusions

In general, the Woodburn POTW components are in good condition, as would be expected for a facility that is mainly comprised of components less than 10 years old. Few major condition-related improvements are identified as part of this evaluation.

Based on increases to flow and load projections and changes to regulatory criteria, expansions of some of the liquids processes are expected. Attention to specific code criteria that may be triggered by an expansion are identified where expansions to existing facilities are expected. However, most of the expansions are anticipated to be new structures with minimal modifications to existing structures.

Certain areas of the facilities, subject to NEC requirements for wastewater facilities, do not meet the full extent of current NEC codes (identified in the electrical assessment included in Appendix E). If work is performed in these areas, it is likely the electrical system that feeds that facility will need to be brought up to code.

The largest condition and performance-related shortfalls are found in the ancillary systems, such as the non-potable water system, chemical storage system, and plant fire protection system. Specific attention to these systems is required. In several cases, these represent potential safety hazards, and at best result in annoying and inefficient maintenance issues.

SECTION 4

Wastewater Characteristics

4.1 Introduction

Understanding and documenting the influent wastewater flow and load characteristics is necessary to establish design criteria for the facility improvements to the City of Woodburn Publicly Owned Treatment Works (POTW) and wastewater conveyance system.

This section documents an analysis of the historical wastewater flow and load parameters associated with the City facilities. Projected flow and loading estimates for the facilities throughout the planning period are also summarized. The projected values developed in this section through the year 2030 will be used as the design basis for all improvements proposed during the planning period.

4.2 Planning Period

This Facilities Plan addresses sewer services for the City through the near-term planning period and potential future growth and regulatory changes in development and selection of improvements.

A 20-year planning period is generally considered when conducting facility planning for wastewater treatment facilities even though facility design life often exceeds 20 years. Wastewater collection facilities also typically have a design life of 50 to 75 years. Collection facilities consider the maximum foreseeable population and economic growth in the project area. This is referred to as the ultimate planning period. When sizing and siting treatment facilities, the ultimate planning period is also used to consider whether adequate space is available for expanding treatment facilities to meet ultimate capacity needs (even though capacity at treatment facilities can more easily be implemented in a phased manner).

The planning period for the Woodburn Facilities Plan is defined by the following schedule:

- 2011—Year 1 of planning period
- 2020—Year 10 of planning period
- 2030—Year 20 of planning period
- 2060—Year 50 of planning period (ultimate)

4.3 Service Area Projections

The City of Woodburn adopted a comprehensive plan in 2005 that expanded the urban growth boundary (UGB) and provided population projections through 2020. This population will be used as the basis of planning through 2020. However, funding rules require that a 20 year planning horizon be used for facilities planning.

A range of population projections for the period 2020–2060 is presented in Appendix F, prepared by Winterbrook Community Resource Planning. As described in meeting notes included in Appendix G, a growth rate of 1.9 percent is recommended for the period beyond 2020. Applying the proposed growth rates over the planning horizon, the population was projected as shown in Table 4-1.

TABLE 4-1
Projected City of Woodburn Population

Year	Population
2020	34,919
2030	42,151
2060	74,136

Commercial growth is expected to exceed residential growth within the 10-year planning horizon. By the year 2020, there will be demand for additional commercial land. For the purposes of this planning effort, it is assumed that in 2020, all commercial parcels within the 2005 UGB will be developed. Beyond 2020, commercial growth is assumed to be consistent with residential growth. Service area projections up to 2020 are based on the City of Woodburn 2005 comprehensive plan. For discussion of projections beyond 2020 refer to Appendixes F and G.

Industrial lands added by the 2005 UGB expansion will accommodate employment growth through the year 2020. However, the City's projections assume that some of this land will not be fully developed by 2020. For the purposes of this planning effort, it is assumed that 75 percent of the industrial land will be developed by 2020, and 100 percent of the industrial land is developed by 2030. Some of the industries targeted to fill the industrial lands within the new 2005 UGB are expected to be different types of industries than the current group of food processors, etc., that operate in Woodburn. For example, hospitals, secondary education centers, and similar service oriented industries are likely to be located on expanded industrial lands within the 2005 UGB. This planning effort assumes that industrial-zoned land in and around existing industries (primarily along the existing rail lines in the eastern part of town) will grow with industries similar to those already in place (food processing, etc.). Industrial land along I-5 (some existing and some new) is assumed to develop with targeted industries such as education and health care/hospital facilities.

4.4 Historical Flows and Loads

4.4.1 Historical Flow Characteristics

In order to predict the hourly, monthly, weekly and seasonal variability in flow, historical flow conditions were evaluated. Figure 4-1 illustrates the flows observed at the Woodburn POTW over the past 6 years. Table 4-2 summarizes historical flow data from April 2001 through December 2007.

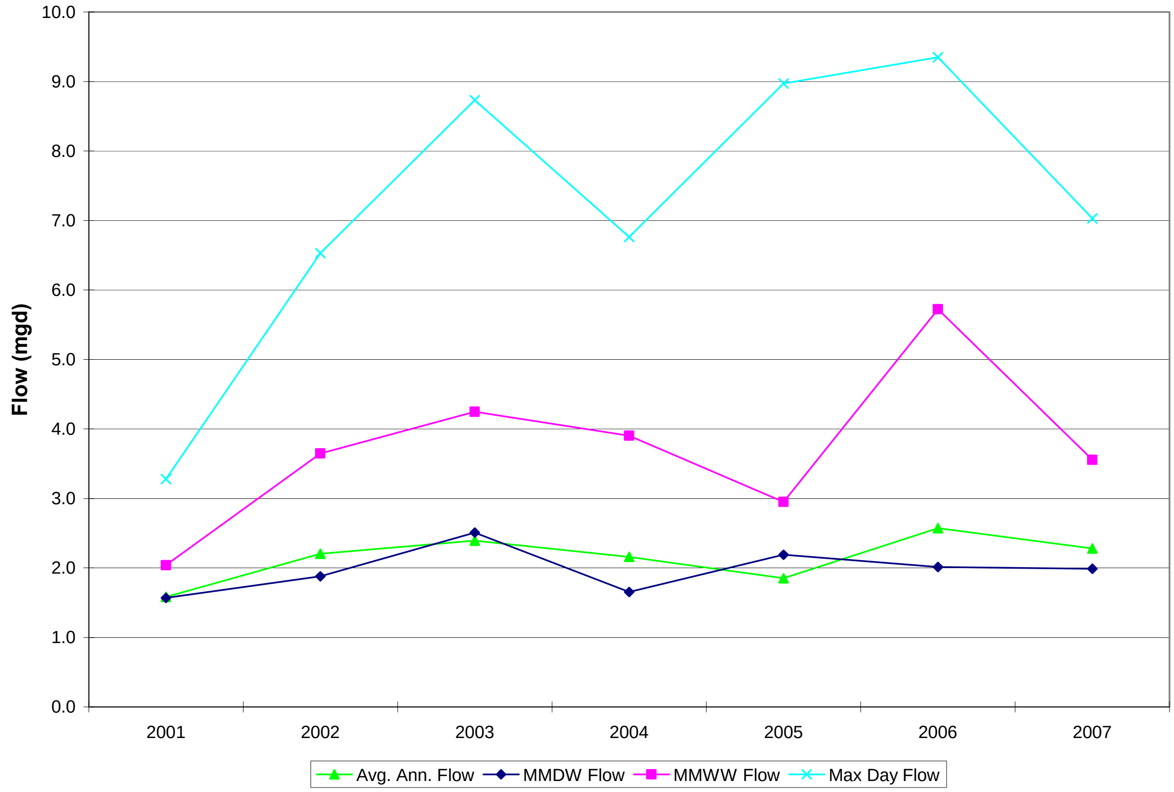

FIGURE 4-1
Historical Woodburn POTW Flow Data

TABLE 4-2
Historical Woodburn POTW Flows (mgd)

Condition	Annual (Jan–Dec)	Wet Weather (Jan–Apr; Nov–Dec)	Dry Weather (May–Oct)
Minimum Month	-	-	1.3
Average Daily	2.1	2.6	1.7
Maximum Month	-	5.7	2.5
Maximum 7-Day	-	6.3	3.5
Maximum Day	-	9.4	3.3

The observed POTW flow includes industrial, commercial, and residential components. Because these components are expected to grow at various rates, it is necessary to separate them to define current flows associated with each. Table 4-3 lists the flow components separately.

The City of Woodburn tracks wastewater contributions from significant industrial users through its industrial pretreatment program. These recorded, historical flows are separated from plant flows to define the non-industrial flow contribution (residential plus commercial).

Currently developed commercial acreage (as compared to zoned commercial acreage) is available through the City's geographical information system (GIS) system. By applying an assumed flow/acre, a total commercial flow can be estimated. Commercial flows are typically in the range of 750–1,200 gallons/acre/day (gpad). Domestic water usage associated with these commercial properties is also available. Domestic water usage on a per acre basis is 700 gpad. Therefore, 750 gpad is used to estimate the existing commercial flow contribution. Commercial flow for 2007 is estimated by multiplying the currently developed commercial acreage by 750 gpad.

Residential flow is then calculated by subtracting estimated commercial flow from the non-industrial flow.

TABLE 4-3
2007 Woodburn Wastewater Flow Components

Flow Component	Flows (mgd)
Recorded Industrial Flow	0.131
Estimated Commercial Flow	0.310
Estimated Residential Flow	1.84
Total Plant Flow	**2.28**

Applying this methodology to the last several years of data, the residential flow/capita is calculated to be approximately 90 gpcd.

4.4.2 Historical Flow Peaking Factors

For each year of data, annual average daily flow was calculated. The minimum month, average daily, maximum month, maximum week, and maximum day flows were calculated for both wet-weather and dry-weather conditions as needed for sizing future facilities. The peaking factor for each of these conditions is the ratio of that condition to the annual average condition. Table 4-4 shows a summary of the historical peaking factors observed at the Woodburn POTW.

TABLE 4-4
Summary of Historical Woodburn POTW Flow Peaking Factors Relative to Annual Average Day Flow

Condition	Wet Weather (Jan–Apr; Nov–Dec)	Dry Weather (May–Oct)
Minimum Month	NA	0.59
Average Daily	1.21	0.79
Maximum Month	2.23	1.18
Maximum 7-Day	2.95	1.45
Maximum Day	4.85	1.59

NA = Not applicable to sizing of future facilities.

4.4.3 Historical Waste Load Characteristics

Treatment facilities must also handle the monthly, weekly, and seasonal variability in loading. To estimate these conditions, historical load conditions were evaluated. Table 4-5 summarizes historical load data from April 2001 through December 2007. Data are based on carbonaceous biochemical oxygen demand (CBOD), total suspended solids (TSS), and ammonia measured at the headworks. The data collected do not include plant recycle streams.

TABLE 4-5
Historical Woodburn POTW Loads

Condition	Annual (Jan–Dec)	Wet Weather (Jan–Apr, Nov–Dec)	Dry Weather (May–Oct)
CBOD (ppd)			
Average Day	4,155	4,084	4,205
Maximum Month	-	5,426	5,674
Maximum 7-Day	-	7,474	6,418
Maximum Day	-	10,567	7,138
TSS (ppd)			
Average Daily	4,373	4,525	4,221
Maximum Month	-	6,914	6,798
Maximum 7-Day	-	10,864	12,621
Maximum Day	-	17,689	16,720
Ammonia (ppd)			
Average Daily	393	410	335
Maximum Month	-	571	478

ppd = pounds per day

4.4.4 Historical Load Peaking Factors

For each year of data, annual average daily influent loading was calculated. The average daily, maximum month, maximum week and maximum day were calculated for both wet-weather and dry-weather conditions for sizing future facilities. The peaking factor for each of these conditions is the ratio of that condition to the annual average daily condition.

Table 4-6 shows a summary of the historical peaking factors observed at the POTW.

TABLE 4-6
Summary of Historical Woodburn POTW Load Peaking Factors Relative to Annual Average Day Load

Condition	Wet Weather (Jan–Apr, Nov–Dec)	Dry Weather (May–Oct)
CBOD		
Average Daily	0.99	1.01
Maximum Month	1.31	1.19
Maximum 7-Day	1.86	1.37
Maximum Day	2.63	1.51
TSS		
Average Daily	1.04	0.96
Maximum Month	1.51	1.47
Maximum 7-Day	2.37	2.72
Maximum Day	3.86	3.61
Ammonia		
Average Daily	1.02	0.98
Maximum Month	1.37	1.11

4.5 Projected Flows and Loads

Figure 4-2 illustrates the rate at which flows and loads observed at the POTW have increased over the past several years. It should be noted that 2004 values reflect the absence of production by industry. Smuckers operated its facility until 2003; in 2004 it was not used and was acquired by Sabroso, which resumed production in 2005. A linear regression was developed for each parameter and used to define the baseline (2007) condition. This was used as the basis for projecting flow and load values forward. Baseline values are shown in Table 4-7. A baseline concentration for each load parameter was developed from the baseline flow and baseline mass loads.

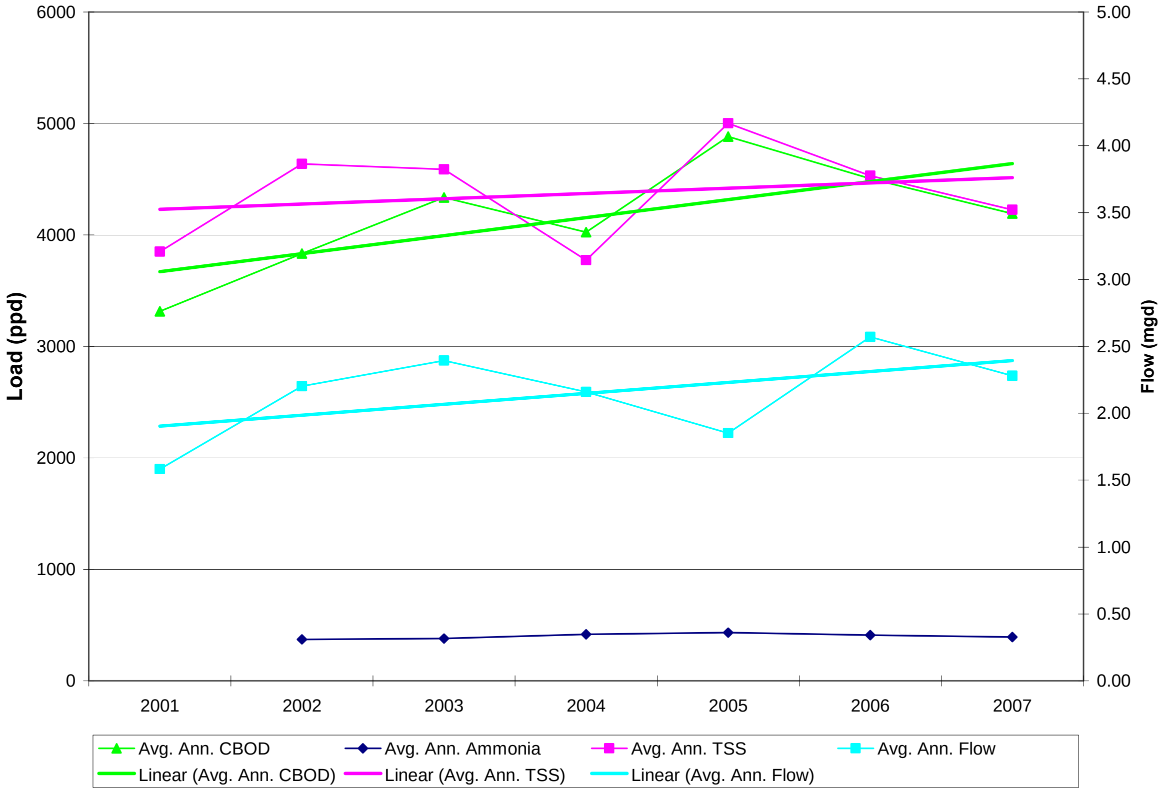

FIGURE 4-2
Woodburn Wastewater Flow and Load Trends

TABLE 4-7
Baseline 2007 Woodburn Wastewater Values

Parameter	Baseline Flow and Load Values	
Flow	2.4 mgd	
CBOD	4,640 ppd	232 mg/L
TSS	4,515 ppd	225 mg/L
Ammonia	410 ppd	20 mg/L

Several industries have a defined capacity allocation, which allows them to discharge flows/loads up to a maximum amount, based on their pretreatment permit. Although these industries do not currently discharge their maximum allocation to Woodburn's wastewater system, they have been allocated that capacity in the wastewater system, and are currently permitted to discharge up to those maximum levels. The capacity allocations associated with Sabroso and Townsend Farms represent a significant contribution to the Woodburn system.

The current capacity allocations for the City's significant industrial users (SIUs) are summarized in Table 4-8, along with the corresponding 2007 reported values. CBOD data are not available for the SIUs. The ammonia concentration associated with Sabroso and Townsend Farms is typically on the order of 0 to 0.5 mg/L, meaning that CBOD is approximately equal to total biochemical oxygen demand (TBOD). The ammonia concentration associated with Specialty Polymers' discharge is on the order of 200 to 300 mg/L. Because the flow contribution from this SIU is quite small, for the purposes of this evaluation, TBOD is assumed to equal CBOD. If their discharge is nitrifying, this is a conservative approach, slightly overstating the influent CBOD (given the relatively small contribution of this SIU). If their discharge does not nitrify, the values are correct.

TABLE 4-8
Summary of Significant Woodburn Industrial Users with a Capacity Allocation

	Flow (gpd)	TBOD (ppd)	TSS (ppd)
Townsend Farms			
Capacity Allocation	142,680 (Monthly)	950 (Daily)	200 (Daily)
2007 Recorded Data	14,840	65	13
Sabroso			
Capacity Allocation	800,000 (Daily) 520,000 (Monthly)	4,300 (Daily) 2,700 (Monthly)	2,700 (Daily) 1,300 (Monthly)
2007 Recorded Data	51,410	229	28
Specialty Polymers			
Capacity Allocation	591 (Monthly)	100 (Daily)	No limit
2007 Recorded Data	8,660	59	No Data*
Winco Foods			
Capacity Allocation	820 (Monthly)	No limit	No limit
2007 Recorded Data	2,710	No Data*	No Data*

*Where no data are available, load concentrations are assumed to equal the baseline concentrations defined in Table 4-8.

gpd = gallons per day

ppd = pounds per day

Where the historical industrial contribution from SIUs is less than the pretreatment permit capacity allocation, the baseline values in Table 4-7 must be adjusted upwards to account for these potential flows and loads. Adjusted baseline values are included in Table 4-9.

TABLE 4-9
Adjusted Baseline Woodburn Wastewater Values

Parameter	Baseline Flow and Load Values
Flow	2.99 mgd
CBOD	7,995 ppd
TSS	5,974 ppd
Ammonia	410 ppd

4.5.1 Flow Projections

Table 4-10 illustrates the proposed flow projections, based on the following assumptions:

- Residential flows are projected based on a 2.8 percent increase between now and 2020 and a 1.9 percent increase from 2020 to 2060. The effects of infiltration and inflow are discussed in Volume 2: Wastewater Collection and Transmission System of this facilities plan.
- 2020 commercial flows are based on a 750 gpad of zoned commercial land, assuming land currently zoned as residential (within the 2005 UGB) will be 100 percent developed by that time. 2030 commercial flows are then based on a 1.9 percent growth rate (consistent with residential population growth) from 2020 to 2060.
- Industrial flows are based on a 750 gpad of zoned industrial land, assuming 75 percent of the industrial land within the 2005 UGB is developed by 2020, and 100 percent of the industrial land is developed by 2030. For the purposes of this effort, it is assumed that the current SIU capacity allocations for each permitted industry remain in place for the entire planning horizon. No additional flows or loads are allocated to these existing industries.

TABLE 4-10
Average Annual Woodburn Wastewater Flow Projections by Component
In million gallons per day

	2007	2020	2030	2060
Industrial				
Sabroso and Townsend Farms	0.66	0.66	0.66	0.66
Other Industrial Users	0.36	0.53	0.70	0.70
Commercial	0.31	0.40	0.48	0.84
Residential	1.66	2.38	2.87	5.05
Total	**2.99**	**3.96**	**4.71**	**7.25**

Historical peaking factors are applied to all annual average flow projections, except for flow projections associated with Sabroso and Townsend Farms (0.66 mgd), to estimate flow rates for various conditions over the planning horizon. It is assumed that Sabroso and Townsend Farms will not exceed their current full allocations through the year 2060. Therefore, to calculate projected maximum flows and loads, the peaking factor is applied to all but flows associated with Sabroso and Townsend Farms. The corresponding flow projections are described in Table 4-11.

TABLE 4-11
Projected Woodburn Wastewater Flows

Flow Condition	Annual (Jan–Dec)	Wet Weather (Jan–Apr; Nov–Dec)	Dry Weather (May–Oct)
2020 Flows (mgd)			
Minimum Month	-	-	2.35
Average Daily	3.96	4.65	3.28
Maximum Month	-	8.01	4.56
Maximum 7-Day	-	10.40	5.46
Maximum Day	-	16.93	6.20
Peak Hour	-	23	-
2030 Flows (mgd)			
Minimum Month	-	-	2.80
Average Daily	4.71	5.56	3.88
Maximum Month	-	9.68	5.45
Maximum 7-Day	-	12.62	5.89
Maximum Day	-	20.56	7.40
Peak Hour	-	26	-
2060 Flows (mgd)			
Minimum Month	-	-	4.30
Average Daily	7.25	8.63	5.90
Maximum Month	-	15.33	8.45
Maximum 7-Day	-	20.12	9.59
Maximum Day	-	32.88	11.45
Peak Hour	-	40	-

4.5.2 Load Projections

Table 4-12 illustrates the proposed load projections, based on the following assumptions:

- Current load capacity allocations for Sabroso and Townsend Farms remain in place for the entire planning horizon and therefore are not subject to peaking factors.

- Baseline concentrations defined in Table 4-7 are applied to average annual flow projections in Table 4-11 (with the exception of flows associated with Sabroso and Townsend Farms capacity allocations) to establish annual average load projections
- The ammonia load associated with SIUs is not significant, and the baseline concentration defined above is applied consistently to the total flow projections to estimate ammonia loads.

TABLE 4-12
Average Annual Wastewater Load Projections by Component

	Baseline 2007 (ppd)	2020 (ppd)	2030 (ppd)	2060 (ppd)
CBOD				
Sabroso and Townsend Farms	3,650	3,650	3,650	3,650
Residential and Commercial	4,640	6,395	7,849	12,774
Total CBOD	**8,290**	**10,045**	**11,499**	**16,424**
TSS				
Sabroso and Townsend Farms	1,500	1,500	1,500	1,500
Residential and Commercial	4,515	6,224	7,638	12,431
Total TSS	**6,015**	**7,724**	**9,138**	**13,931**
Ammonia	**410**	**678**	**807**	**1,242**

Historical peaking factors are applied to annual average load projections not associated with Sabroso and Townsend Farms to estimate flow rates for various conditions over the planning horizon. The corresponding load projections associated with the various conditions are then added to the permitted loads for Sabroso and Townsend Farms and are shown in Table 4-13.

TABLE 4-13
Projected Woodburn Wastewater Loads

Flow Condition	Annual (Jan–Dec)	Wet Weather (Jan–Apr; Nov–Dec)	Dry Weather (May–Oct)
2020 CBOD (ppd)			
Average Daily	10,045	9,946	10,110
Maximum Month	-	12,052	11,230
Maximum 7-Day	-	15,527	12,428
Maximum Day	-	22,042	14,895
2030 CBOD (ppd)			
Average Daily	11,499	11,377	11,578
Maximum Month	-	13,960	12,952

TABLE 4-13
Projected Woodburn Wastewater Loads

Flow Condition	Annual (Jan–Dec)	Wet Weather (Jan–Apr; Nov–Dec)	Dry Weather (May–Oct)
Maximum 7-Day	-	18,225	14,422
Maximum Day	-	25,857	17,087
2060 CBOD (ppd)			
Average Daily	16,424	16,226	16,553
Maximum Month	-	20,431	18,789
Maximum 7-Day	-	27,372	21,182
Maximum Day	-	38,789	24,515
2020 TSS (ppd)			
Average Daily	7,724	7,946	7,503
Maximum Month	-	10,879	10,625
Maximum 7-Day	-	16,236	18,440
Maximum Day	-	26,893	25,342
2030 TSS (ppd)			
Average Daily	9,138	9,410	8,866
Maximum Month	-	13,009	12,698
Maximum 7-Day	-	19,584	22,289
Maximum Day	-	32,344	30,441
2060 TSS (ppd)			
Average Daily	13,931	14,374	13,489
Maximum Month	-	20,233	19,726
Maximum 7-Day	-	30,932	35,335
Maximum Day	-	50,822	47,724
2020 Ammonia (ppd)			
Average Daily	678	697	663
Maximum Month	-	929	751
2030 Ammonia (ppd)			
Average Daily	807	829	788
Maximum Month	-	1,104	893
2060 Ammonia (ppd)			
Average Daily	1,242	1,277	1,213
Maximum Month	-	1,700	1,374

TABLE 4-13
Projected Woodburn Wastewater Loads

Flow Condition	Annual (Jan–Dec)	Wet Weather (Jan–Apr; Nov–Dec)	Dry Weather (May–Oct)

4.5.3 Peak Wet-Weather Flow and Design Storm

DEQ has developed an approach based on rainfall records to determine the expected system flows during a 5-year, 24-hour event. This method is based on a linear regression to establish a rainfall-system flow relationship that can be extrapolated to extreme events, assuming no recorded data are available for a comparable historic event.

DEQ establishes a relationship between precipitation and sanitary sewer flows by use of a regression analysis. Historical rainfall data coupled with plant influent data determine the DEQ Maximum Monthly Average Dry Weather Flow with a 10-year storm ($MMDWF_{10}$), Maximum Monthly Average Wet-Weather Flow with a 5-year storm ($MMWWF_5$), along with a Peak Daily Average Flow with a 5-year storm ($PDAF_5$) for "Current" conditions. These "Current" conditions are depicted on Figure 4-3 in blue.

The DEQ method assumes the following probabilities of occurrence:

- Average annual flow is equivalent to the mean summer (ADWF), and winter (AWWF) has a 50 percent probability of occurring (6 months/12 months per year)
- Peak monthly flow, $MMWWF_5$, has an 8.3 percent probability of occurring (1 month/12 months per year)
- Peak weekly flow has a 1.9 percent probability of occurring (1 week/52 weeks per year)
- Peak daily average flow, $PDAF_5$, has a 0.27 percent probability of occurring (1 day/365 days per year)
- Peak instantaneous flow, PIF_5, is equivalent to peak hourly flow and has a 0.011 percent probability of occurring (1/8,760 hours per year)

Plotting forecasted annual average flows along with current DEQ calculated flows on a log-log graph determines the correlation between average annual and PIF_5 flows at the Woodburn POTW. This correlation enables a projection of year 2020 and year 2030 PIF_5 values.

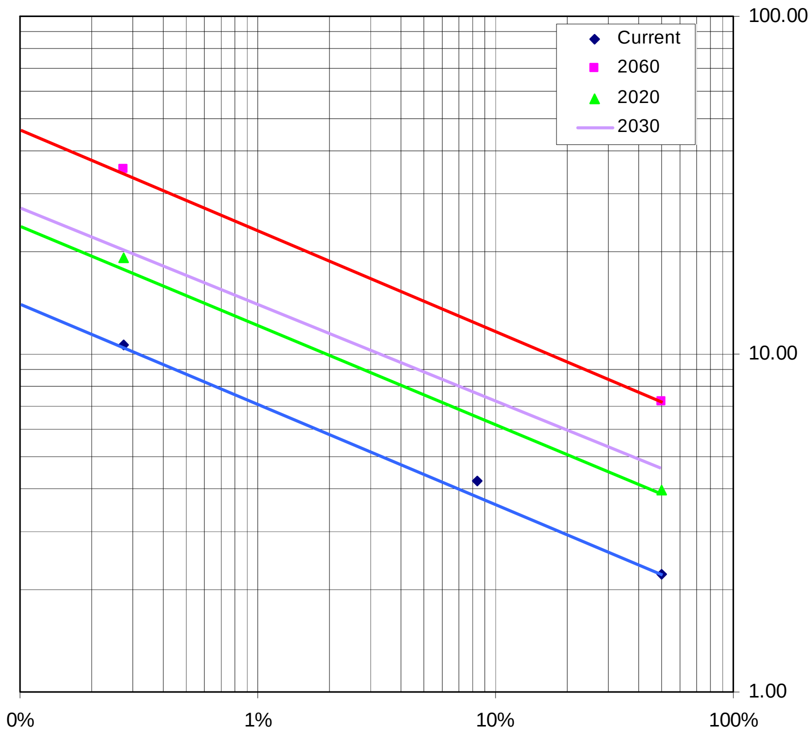

FIGURE 4-3
Woodburn Rainfall-System Flow Relationship

Design flow rates calculated per DEQ guidelines are summarized in Table 4-14.

TABLE 4-14
Design Flow Rates as Calculated per DEQ Guidelines

Event	Current	2020	2030
$MMWWF_5$	4.22	3.96	4.71
$PDAF_5$	10.63	19.21	22.84
PIF_5	13	23	26

4.6 Design Flows and Loads

4.6.1 Key Flow and Load Projections

Table 4-15 presents key flow and load projections to be referenced during development and evaluation of wastewater treatment alternatives.

TABLE 4-15
Woodburn POTW Design Flows and Loads

Parameters	Current Conditions	2020	2030	2060
Flows (mgd)				
Average Annual	2.99	3.96	4.71	7.25
Maximum Month Wet Weather	6.66	8.01	9.68	15.33
Maximum Month Dry Weather	3.54	4.56	5.45	8.45
Maximum Day	14.49	16.93	20.56	32.88
Peak Hour	17	23	26	40
CBOD (ppd)				
Average Annual	7,995	10,045	11,499	16,424
Maximum Month Wet Weather	10,504	12,052	13,960	20,431
Maximum Month Dry Weather	9,476	11,230	12,952	18,789
TSS (ppd)				
Average Annual	5,974	7,724	9,138	13,931
Maximum Month Wet Weather	9,002	10,879	13,009	20,233
Maximum Month Dry Weather	8,759	10,625	12,698	19,726
Ammonia (ppd)				
Average Annual	410	678	807	1,242
Maximum Month Wet Weather	561	929	1,104	1,700
Maximum Month Dry Weather	453	751	893	1,374

The methodology used to produce these projections takes into account the unusually high number of residents per household in Woodburn, along with allowances for seasonal or transient segments of the population. Assuming that future demographics and social characteristics will reflect the current characteristics of Woodburn, projecting the future flows based on current actual flow data provides a method for accounting for segments of the population that may not be accurately represented in official census numbers.

4.6.2 Summer Flow Projections

Average daily flows used for planning of excess thermal loads under current and future flow conditions were calculated based on historical peaking factors for those time periods described in Table 4-16. These flows are utilized as the basis for summer temperature compliance.

TABLE 4-16
Average Daily Flows for Excess Thermal Load Compliance Periods*

Time Period	2008	2020	2030
June 1–30	3.16	4.10	4.88
July 1–14	2.97	3.84	4.56
July 15–August 31	2.72	3.50	4.14
September 1–15	2.68	3.45	4.08
September 16–30	2.78	3.58	4.24

*Flows include municipal and allocated industrial flows.

SECTION 5

Basis of Planning

5.1 Basis for Design

This section summarizes current and proposed regulations, and establishes the design criteria to be used in the development of the various treatment and disposal alternatives for the City of Woodburn wastewater treatment system. The criteria listed include the Willamette Basin standards, the Willamette River and Pudding River discharge criteria, reuse criteria for land application of effluent and biosolids, and EPA criteria for reliability and redundancy. The information presented is based on review of existing regulations and preliminary discussions with the Oregon Department of Environmental Quality (DEQ) regarding future regulations. The promulgation of future DEQ regulations is currently unknown and some engineering judgment has been applied based on an interpretation of the likelihood of the application of these anticipated regulatory requirements.

5.1.1 Regulatory Requirements

The Federal Water Pollution Control Act (FWPCA or Clean Water Act) Amendments of 1972 through 1987 established the National Pollutant Discharge Elimination System (NPDES) and provided authority to regulatory agencies to control point source pollution discharges to specified effluent limitations. DEQ is the regulatory agency charged with the administration of the NPDES permit program in the State of Oregon.

The standards for the Willamette River basin in the State of Oregon are established by DEQ through the Oregon Administrative Rules (OAR) 340-41-345. The official review period for setting new or modifying existing standards via these rules is 3 years, referred to as the triennial review process.

The City's wastewater treatment plant currently operates under the NPDES Permit Number 101558, issued by DEQ on December 28, 2004 (provided in Appendix A). Under the terms of this permit, the Woodburn POTW is required to provide advanced treatment for wastewater discharged to the Pudding River. The current NPDES permit expired on November 30, 2009, and is scheduled to be renewed in mid 2010.

Mutual Agreement and Order (MAO) NO. WQ/M-WR-07-082 is also in effect. This enforcement action includes a compliance schedule for pH, temperature and winter ammonia limits, and defines interim ammonia and pH limits until completion of corrective actions described in the MAO. A copy of the MAO is provided in Appendix B. The MAO compliance schedule was modified as described in the November 6, 2009, DEQ letter to the City (copy provided in Appendix B).

5.1.1.1 BOD, TSS, DO, and E. coli

The effluent limits and requirements for the Woodburn POTW are defined in Schedule A of the current NPDES permit. The treated effluent discharge has both mass load and concentration limits for 5-day carbonaceous biochemical oxygen demand ($CBOD_5$), and total suspended solids (TSS), shown in Table 5-1. The permit also includes concentration limits for ammonia and mass load limits for temperature. These limits are further defined for seasonal variations in POTW flows and loads and Pudding River flows.

TABLE 5-1
Current Woodburn POTW NPDES Discharge Requirements

Parameters	Monthly Average [a]		Weekly Average [a]		Daily Maximum
Dry Season (May 1 – October 31)					
Carbonaceous Biochemical Oxygen Demand, $CBOD_5$[b]	10 mg/L	420 ppd	15 mg/L	630 ppd	830 ppd
Total Suspended Solids, TSS[b]	10 mg/L	420 ppd	15 mg/L	630 ppd	830 ppd
Wet Season (November 1 - April 30)					
Carbonaceous Biochemical Oxygen Demand, $CBOD_5$[b]	25 mg/L	940 ppd	40 mg/L	1,400 ppd	1,900 ppd
Total Suspended Solids, TSS[b]	30 mg/L	1,100 ppd	45 mg/L	1,700 ppd	2,200 ppd
Year-round (except as noted)					
E. coli Bacteria	126 org./100 mL		406 org./100 mL		
pH	Shall be within the range of 6.5 to 9.0 standard units				
Other Parameters (June 1 – October 31)					
$CBOD_5$ and TSS	Shall not exceed 20 mg/L daily maximum				
Dissolved Oxygen	Shall not be less than 6.5 mg/L daily average				

[a]Arithmetic mean except for *E. coli* bacteria, which is a geometric mean.
[b]30-day average percent removal shall not be less that 85 percent of influent concentration.
mg/L = milligrams per liter
mL = milliliter
ppd = pounds per day

These current concentration and corresponding mass load limits for $CBOD_5$ and TSS are based on state regulation for secondary treatment standards (OAR 340-041-0345). The permit further requires 85 percent removal for BOD_5 and TSS through the treatment plant.

5.1.1.2 Ammonia

DEQ has included both summer and winter effluent ammonia limitations in the NPDES permit. The summer limitations are based on dissolved oxygen requirements in the 1993 Pudding River TMDL. The winter limitations are based on ammonia toxicity.

Summer Ammonia Limits

The current summer ammonia limits vary across four distinct time periods from June 1 through October 31 and vary with Pudding River flow (Table 5-2). The City's effluent reuse program provides a reasonable alternative to Pudding River discharges, allowing operations staff the flexibility to vary river discharge depending upon Pudding River flows. Although the operations staff cannot easily adjust the level of biological treatment in response to increases (or decreases) in Pudding River flow, modifying the amount of irrigated reuse water diverted from the Pudding River discharge does allow operations staff to adjust operations to meet the ammonia limits.

TABLE 5-2
Current Woodburn POTW NPDES Discharge Requirements – Effluent Limitations for Ammonia-N, mg/L

Pudding River Monthly Avg. Flow (cfs)	Monthly Avg. Effluent Flow 0 to 1.0 mgd	Monthly Avg. Effluent Flow >1.0 to 2.0 mgd	Monthly Avg. Effluent Flow >2.0 to 3.0 mgd	Monthly Avg. Effluent Flow: >3.0 to 4.0 mgd	Monthly Avg. Effluent Flow >4.0 mgd
June 1 – 30					
> 150	10	10	9.6	7.4	6.0
100 – 150	10	9.0	5.8	4.2	3.2
50 – 100	7.2	3.4	2.2	1.5	1.2
< 50	6.0	2.9	1.8	1.2	1.0
July 1 – August 31					
> 100	10	7.0	5.0	3.0	2.5
60 – 100	8.0	4.0	2.5	1.5	1.0
30 – 60	5.0	2.5	1.5	1.0	0.7
< 30	1.5	0.5	0.1	0.1	0.1
September 1– 30					
> 100	10	10	10	7.8	6.2
60 – 100	10	8.0	5.0	3.7	3.1
30 – 60	10	5.6	3.5	2.6	2.0
< 30	2.4	1.3	0.7	0.4	0.3
October 1 – 31					
> 100	10	10	10	7.8	6.2
60 – 100	10	8.0	5.0	3.7	3.1
< 60	10	6.4	4.2	3.1	2.4

mgd = million gallons per day

If additional flexibility is needed, other Oregon wastewater agencies have negotiated with DEQ to structure their permits to allow the ammonia limitations to be based on the river flows for a previous period of time, rather than the current period of time. (A precedent of sorts for this is the Clean Water Services permit, where weekly ammonia limitations for Durham and Rock Creek are based on Tualatin River dissolved oxygen concentrations for the previous week). A consideration for Woodburn may be a weekly ammonia limitation based on the previous week's river flow, although this may not provide any more operational advantage to the present situation. Woodburn may want to further investigate these options, and if appropriate, present these options to DEQ along with the permit renewal application.

Winter Ammonia Limits

The current permit includes concentration limits for ammonia during the winter period (November 1 through May 31) that are based on Pudding River flow (Table 5-3). Compliance with these limits is required per the schedule dictated by upcoming revisions to the MAO.

TABLE 5-3
Current Woodburn POTW NPDES Discharge Requirements—Winter-time Effluent Limitations for Ammonia-N

Parameters	Monthly Average *	Weekly Average *	Daily Maximum
Ammonia-N (Nov. 1 – May 31); river flow < 200 cfs	5.7 mg/L	Not applicable	13 mg/L
Ammonia-N (Nov. 1 – May 31); 200 cfs < river flow < 360 cfs	9.6 mg/L	Not applicable	22 mg/L
Ammonia-N (Nov. 1 – May 31); river flow > 360 cfs		No limitation	

*Arithmetic mean except for *E. coli* Bacteria, which is a geometric mean.
cfs = cubic feet per second
mg/L = milligrams per liter
mL = milliliter
ppd = pounds per day

The current permit also makes explicit reference to the potential change in the Oregon water quality criteria for ammonia. The Oregon Environmental Quality Commission has approved a change in these criteria to criteria based on the 1999 U.S. Environmental Protection Agency (EPA) recommendations. However, this change has not yet been approved by EPA. This ammonia criteria change was submitted to EPA as a package with other toxics criteria changes, including a change in how criteria for metals are expressed (dissolved versus total recoverable.) Including ammonia in this package has apparently slowed the process of approval. There has recently been some discussion of de-coupling the ammonia criteria from the other criteria, and this may allow the approval process for the ammonia criteria to proceed. If this takes place, the permit already includes alternate winter effluent limitations for ammonia that would automatically go into effect without a permit modification. These alternate limitations are shown in Table 5-4.

TABLE 5-4
Woodburn POTW NPDES Discharge Requirements—Alternate Winter Ammonia-N Limitations

Stream Flow	Effluent Limitation
When monthly average stream flow is less than 200 cfs	Shall not exceed a monthly average concentration of 20 mg/L and a daily maximum of 45 mg/L
When monthly average stream flow is equal to or greater than 200 cfs but less than 360 cfs	Shall not exceed a monthly average concentration of 27 mg/L and a daily maximum of 60 mg/L
When monthly average stream flow is equal to or greater than 360 cfs	No limitation

This facility planning process relies on the current permit requirements (Table 5-3) and not the alternate winter ammonia limitations outlined in Table 5-4. Continued discussions with DEQ and monitoring of the progress of DEQ discussions with EPA are recommended. If the alternate winter ammonia limitations were implemented, the criteria for secondary process design could be changed, and the overall capacity of the existing secondary process could be extended.

5.1.1.3 Thermal Load Limits

Temperature limits are established on the basis of an allowable excess thermal load (ETL). The ETL limits are calculated using effluent discharge flows and temperature deviations above the set river temperature criteria, T_c, and provide for a limited exceedence of the T_c.

Current Limits

The current NPDES Permit (Schedule A) established an ETL limit of 9.2 million kilocalories (kcal)/day measured as a weekly average over the period from May 1 through October 31. However, the MAO modifies the required implementation schedule for compliance with these limits. Consequently, the POTW is not currently required to meet any ETL limits.

Future Limits

As established in the MAO, the POTW will be required to comply with the ETL limits established for the "Woodburn WWTP" as presented within the Mollala-Pudding Subbasin TMDL & WQMP during the months of June through September. The applicable Pudding River T_c used as the basis for developing ETL limits are presented in Table 5-5.

TABLE 5-5
Applicable Pudding River Temperature Criteria, T_c, at Woodburn POTW (Table D-3 from TMDL)

Time Period	Applicable Criteria, T_c (˚C)
June 1 to June 30	18.0
July 1 to July 14	20.1
July 15 to August 31	21.6
September 1 to September 15	18.2
September 16 to September 30	18.0

DEQ has allocated a heat load equivalent to a 0.20 ^{0}C stream temperature increase in the Pudding River to the City of Woodburn POTW. Depending upon the combination of effluent and Pudding River flow, the ETL limits vary as shown in Table 5-6. At Pudding River flows at or below 15 cubic feet per second (cfs), the ETL allocation is 8.85 million kcal/day for effluent discharge flows of 2 million gallons per day (mgd). The ETL allocation increases to 50.4 million kcal/day for the same effluent discharge flows when Pudding River flows increase to 100 cfs.

Depending upon the applicable T_c for the given time period (Table 5-5) and the allowable ETL based on the combination of Pudding River flow and effluent discharge flow (Table 5-6), the allowable effluent temperature changes as described by Equation 5 and Tables D-4a through D-4e of Chapter 2 in the TMDL.

TABLE 5-6
Woodburn POTW Excess Thermal Load (ETL) Allocations (million kcal/day)
For Various river and effluent flow combinations—June 1 to September 30 (Table 2 – 16 from TMDL)

Effluent Flow (mgd)	**Excess Thermal Load (million kcal/day)**					
Pudding River Woodburn gage flow rate (cfs):	**≤15**	**20**	**25**	**30**	**35**	**40**
0.1	7.42	9.86	12.31	14.76	17.2	19.65
0.2	7.49	9.94	12.38	14.83	17.28	19.72
0.3	7.57	10.01	12.46	14.91	17.35	19.8
0.5	7.72	10.17	12.61	15.06	17.51	19.95
0.7	7.87	10.32	12.76	15.21	17.66	20.1
1	8.1	10.54	12.99	15.44	17.88	20.33
1.5	8.48	10.92	13.37	15.82	18.26	20.71
2	8.85	11.3	13.75	16.19	18.64	21.09
2.5	9.23	11.68	14.13	16.57	19.02	21.47
3	9.61	12.06	14.5	16.95	19.4	21.84
4	10.37	12.81	15.26	17.71	20.15	22.6
5	11.12	13.57	16.02	18.46	20.91	23.36
Pudding River Woodburn gage flow rate (cfs):	**50**	**60**	**70**	**80**	**90**	**100**
0.1	24.5	29.4	34.3	39.2	44.1	49
0.2	24.6	29.5	34.4	39.3	44.2	49.1
0.3	24.7	29.6	34.5	39.4	44.3	49.2
0.5	24.8	29.7	34.6	39.5	44.4	49.3
0.7	25	29.9	34.8	39.7	44.6	49.5
1	25.2	30.1	35	39.9	44.8	49.7
1.5	25.6	30.5	35.4	40.3	45.2	50.1
2	26	30.9	35.8	40.7	45.6	50.4
2.5	26.4	31.3	36.1	41	45.9	50.8
3	26.7	31.6	36.5	41.4	46.3	51.2
4	27.5	32.4	37.3	42.2	47.1	52
5	28.3	33.1	38	42.9	47.8	52.7

Excess thermal load limits will be most challenging for the City to meet during September.

The TMDL reads that "at times when the NTP temperatures are less than biologically based numeric criteria (e.g., early June and late September), the loading capacity may be greater than the heat load allowed by the human use allowance in the TMDL, provided the additional heat load does not result in violation of the temperature criterion downstream." The City requested and received clarification from DEQ on this point. DEQ has reiterated that the thermal loads as defined by the equations in the TMDL will stand even when the NTP is less than the biologically based numeric criteria. The City may wish to have ongoing discussions with DEQ on this point.

In the final Molalla-Pudding temperature TMDL, as with other TMDLs such as the Willamette Basin and Tualatin Subbasin TMDLs, DEQ has been clear that water quality trading is an option for a discharger to achieve compliance with the waste load allocation (WLA). Thermal load credits can be purchased from another source or project that has implemented measures to reduce their thermal load below their WLA, or credits can be generated from activities such as riparian shading.

5.1.1.4 UV Disinfection

Based on preliminary discussions with DEQ, it is possible, but unlikely, that river flows might allow for chlorine residual requirements to be waived during peak flow events. Further discussion regarding peak flow design criteria for disinfection and dechlorination is warranted. The worst case evaluation would need to meet the following criteria: 0.019 mg/L at the zone of initial dilution (ZID) (centerline) and 0.011 mg/l at the edge of the mixing zone. Dilution to meet these criteria will be difficult. Modifications to the chlorine residual requirements could allow peak flows to be disinfected with chlorine rather than expanded UV disinfection systems.

5.1.1.5 Tertiary Filters

Since the tertiary filters are not EPA grant-funded, the system does not necessarily need to be operated in the wet season—as long as water quality criteria can be met. Technology-based limits apply: 30/30, pH, and 85 percent removal. To address dry weather reliability requirements, Woodburn has wetlands, poplars and other systems to provide redundancy and reliability if existing filters fail. Preliminary discussions with DEQ indicate this approach to dry weather reliability may be acceptable.

5.1.1.6 pH

The current permit limit for pH (6.5 to 9.0) was developed based on lack of dilution during Pudding River, 7Q10 flows[4]. The MAO provided for relaxed pH limits on an interim basis and stipulated inclusion of a chemical alkalinity addition system to be included in the temperature and winter ammonia improvements. Increasing the anoxic volumes in the aeration basins may provide sufficient alkalinity recovery so as to avoid a chemical addition system.

Higher river flows could allow relaxed pH limits since Woodburn has had historical difficulties with meeting this limit. The pH limits in the permit could be modified to be

[4] Stream flow over 7 consecutive days with a 10-year recurrence interval.

seasonal, or flow-based. Woodburn should work with DEQ as part of upcoming permit negotiations to determine at what flows a pH of 6.0 could be acceptable.

5.1.1.7 Air Quality/Greenhouse Gas Emissions

Oregon DEQ has recently drafted rules that would require facilities such as Woodburn (greater than 1 mgd) to start tracking greenhouse gas (GHG) emissions in 2010 for reporting in 2011. These new rules are posted on the DEQ website at (http://www.deq.state.or.us/aq/climate/reporting.htm). These new rules were adopted by the Environmental Quality Commission (EQC) at the August 2008 EQC meeting. DEQ's efforts to quantify GHG emissions are connected to regional efforts through the Western Climate Initiative (WCI) and a national database maintained by The Climate Registry (TCR). DEQ is working closely with WCI partners and TCR to develop sector-based reporting protocols and emissions quantification methodologies. DEQ is a member of the WCI and is participating in developing a mandatory reporting program for a market-based regional program to reduce greenhouse gases. In order to maintain consistency in reporting across six other western states and four Canadian provinces, essential requirements for this type of program have been identified and developed into a model rule.

On July 16, 2009, Western Climate Institute released the final version of Essential Requirements for Mandatory Reporting for the first collection of reporting requirements and emissions quantification methodologies. The emissions quantification methodologies included in this version apply to 15 source categories. There are approximately 18 other source categories, including wastewater agencies, with emissions quantification methodologies currently under development by the WCI. These draft methodologies will be issued later this year for stakeholder review.

Nonetheless, it is likely that additional monitoring and reporting efforts on the part of wastewater agencies like Woodburn will be required. Solutions implemented as a result of this facility planning effort should consider the effect of future greenhouse gas emission limits.

5.1.1.8 Micro-contaminants

Micro-contaminants such as pharmaceuticals, herbicides, and pesticides are garnering more attention as environmental concerns increase, and science and technology advances. There is some potential for a requirement to begin monitoring for micro-contaminants, but it is unlikely that these constituents will be regulated in NPDES permits in the near future.

It is not possible at this time to predict whether micro-contaminants will be regulated in the form of discharge limitations at some point in the future. However, if micro-contaminants are proven to adversely impact water quality, increase human health risk, or increase risk to aquatic life, it is reasonable to assume some regulation will occur. Such regulation may take the form of source control, discharge limitations, or some combination of the two. In addition to source control and discharge limitations, consumer product regulation combined with public education will very likely be part of this emerging area of concern.

This Facilities Plan will not consider removal of micro-contaminants during the planning period, but will allow for flexibility to accommodate their regulation within the life of planned facilities.

5.1.1.9 SB 737 Toxics Reduction Plans

A ban on mixing zones in Oregon has been pursued by a coalition of environmental groups, some statewide political candidates, and other interested stakeholders. This effort was not successful in the 2007 session, but Senate Bill 737 emerged as a compromise measure. This bill requires DEQ to develop a list of priority persistent pollutants, and by 2011 requires permittees to develop and implement a plan to reduce these pollutants. There is still a potential for an initiative petition to ban mixing zones in the future and this would have a significant impact on Woodburn and its current outfall/discharge methods.

5.1.1.10 Toxic Substance Limitations

OAR 340-041-0033 requires that the levels of toxic substances shall not exceed the criteria listed in Table 20 (attached as Attachment B) and toxic substances shall not be introduced above the natural background levels in amounts that may be harmful in the environment or may accumulate in sediments or bioaccumulate in aquatic life. DEQ has published an IMD on Reasonable Potential Analysis (RPA). RPA is a calculation designed to estimate whether there is a reasonable potential for a toxic pollutant to cause or contribute to an exceedance of a water quality criterion in the receiving water. If a reasonable potential for a pollutant is found, then the NPDES permit is required to contain an effluent limitation for that pollutant. Potential elimination of mixing zones, as previously mentioned, may significantly affect the RPA.

The RPA analysis conducted by DEQ for the 2004 NPDES permit showed positive RPA for a number of parameters including copper, cyanide, lead, mercury, silver, and zinc. As a result, the City began implementing clean sampling techniques.

In a March 2008 letter to the City, DEQ outlined the monitoring requirements to enable an updated RPA analysis to be conducted prior to permit renewal. The requirements in this letter should be considered a minimum because more sample results are often beneficial to the discharger when the analysis is performed. The analysis is based on the maximum effluent value for each parameter, and this maximum value is further multiplied by a factor that is based on the variability of the data, and the number of data points. Assuming a constant or lower coefficient of variation, more data points lower the multiplier.

Also, it is important that analytical techniques with low detection levels be used for the analysis of metals. EPA 200.8 and EPA 1631 for mercury should be used, with corresponding careful sampling techniques to avoid sample contamination as much as possible. It is recommended that these analytical techniques be used for all permit-required effluent monitoring for metals, and that an updated RPA analysis be performed following effluent monitoring this summer.

5.1.1.11 Mercury

The Mercury TMDL for the Willamette River was issued by DEQ and approved by EPA in September 2006. This mercury TMDL also applies to the Pudding River. The TMDL includes a phased approach, with sector requirements, which initially requires NPDES permittees to monitor for mercury and methyl mercury in effluent and receiving waters using ultra clean sampling techniques, and develop and implement mercury reduction plans as interim implementation measures. The DEQ order requiring this monitoring has not yet been issued. Numeric mercury WLAs may be implemented following issuance of the revised 2011 mercury TMDL.

5.1.1.12 Sanitary Sewer Overflows

Perhaps the most significant impact to potential future treatment technologies lies in the changing regulations for sanitary sewer overflow (SSO) restrictions. Currently, untreated emergency SSOs have specific limits on the seasonal timing and storm event conditions that create circumstances such that these discharges are unavoidable and allowable under Oregon state law. Woodburn's current permit, based on Oregon's current SSO rules embedded in the bacteria water quality standard, prohibits raw sewage discharges into the Pudding River, but does make specific exceptions for emergency overflows during large storm events. Effective January 2010, no overflows are allowed during the wet season (November 1st to May 21st) except during a 5-year 24-hour storm event or greater, and no overflows are permitted during the dry season (May 22nd to October 31st) except during a 10-year 24-hour storm event or greater.

Proposed federal rule changes for SSO requirements are currently moving slowly through the review process. More restrictive future federal rules on SSOs will override the Oregon regulations. SSO requirements are a major driver for significant future wet weather improvements to the collection system as well as the treatment facility. Further, even where an SSO may be permitted during specific intensity storm events, there is potential of violation of water quality standards. DEQ is currently working with EPA to resolve their concerns about current DEQ permit language regarding SSOs. When this issue is resolved with EPA, any changes to current permit language regarding SSOs will probably be made in the next permit.

5.1.1.13 Effluent Blending

The current Woodburn POTW NPDES permit does not allow blending. However, in December 2005, EPA published a draft policy that would allow POTWs to practice blending during certain wet weather events after an analysis that demonstrates that there are no feasible alternatives to blending. EPA is working with NACWA [National Association of Clean Water Agencies] and environmental organizations to define the final policy. Indecision has slowed the DEQ process for issuing new permits. No new permits have been issued since EPA commented on the Tillamook, Oregon, permit in November 2007.

The current NPDES permit includes a suspension of the daily mass load limit on any day in which the flow to the treatment facility exceeds 6.66 million gallons per day (mgd) (twice the design average dry weather flow of the Phase I facilities). Even though the POTW has wet weather clarifiers to provide primary treatment of peak flows, it does not currently use these blending provisions to manage high flows. As with SSOs, authorization of blending in Oregon permits is also a current issue with EPA. This includes the conditions under which blending is allowed and how the blending is accomplished. Any blending concept will need to meet all discharge and permit requirements, including percent removal.

For the facilities planning effort, blending could be considered, given the existence of wet weather clarifiers at the treatment plant, and conveyance piping that could be used for that purpose. Before blending is accepted, DEQ would also look at infiltration and inflow for Woodburn. The city's system meets the EPA criteria for infiltration and inflow (I/I).

5.1.1.14 Mixing Zone

DEQ issued its *Regulatory Mixing Zones Internal Management Directive* in December 2007. This new IMD clarifies the requirements for mixing zone studies that will be required by DEQ as part of the NPDES permit renewal application package.

An outfall mixing study was conducted in accordance with the IMD. Extracts from the report are provided in Appendix H. CORMIX 3 was used for the dilution modeling. Modeling was performed using current and projected (2015 Woodburn effluent flows and seasonal 1Q10 and 7Q10 low flow, annual 30Q5 and harmonic mean flow and off-design season [March-April]) river flow conditions. The minimum dilutions for the Woodburn effluent flows are listed in Table 5-7.

TABLE 5-7
Minimum Effluent Flow Dilutions

Discharge Conditions	Case	Minimum Dilution at ZID	Minimum Dilution at RMZ
1Q10 Low Flow (Summer)	2008 (3.34 mgd)	1.2	Not applicable
	2015 (5.56 mgd)	1	Not applicable
7Q10 Low Flow (Summer)	2008 (2.1 mgd)	Not applicable	1.7
	2015 (4.09 mgd)	Not applicable	1.4
30Q5 Annual Flow Condition	2008 (2.13 mgd)	Not applicable	2.2
	2015 (3.56 mgd)	Not applicable	1.7
Harmonic Mean Flow Condition	2008 (2.13 mgd)	Not applicable	7.5
	2015 (3.56 mgd)	Not applicable	3.7
Off-Design Flow Condition (March- April)	2008 (2.69 mgd)	Not applicable	45
	2015 (7.11 mgd)	Not applicable	15

Based on the minimum dilution factor at the regulatory mixing zone (RMZ) boundary under 7Q10 low river flow conditions, the Woodburn POTW discharge will comply with all of the thermal plume provisions of the Oregon water quality standards, with the potential exception of the migration blockage during a few weeks in late August and early September. However, during these periods, a portion of the effluent will be directed to poplar irrigation and/or cooling wetlands and flow will be significantly below the effluent flow modeled.

In accordance with the Oregon DEQ's *Reasonable Potential Analysis for Toxic Pollutants – Internal Management Directive* (Oregon DEQ, September 2005), a reasonable potential analysis (RPA) was conducted on more than four years of effluent ammonia and metals data. The RPA showed that the Woodburn effluent does not have a reasonable potential to exceed acute or chronic aquatic life criteria for ammonia, except the chronic criteria during low river flow. The RPA for effluent metals shows that the discharge does not have a reasonable potential to exceed aquatic life acute or chronic chemical criteria, with the exception of copper or zinc. One copper and one zinc value triggered the RPA and additional sampling with ultra-clean sampling methods at the Woodburn WWTP was implemented to resolve this trigger.

5.1.1.15 Water Rights

The City of Woodburn POTW contributes a significant amount of summer-time flow to the Pudding River. However, DEQ has made it clear that once the effluent leaves City of Woodburn property and is discharged to the Pudding River, it becomes waters of the state. Thus, the City cannot create a water right for flows in the Pudding River, but it can possibly register dedicated irrigation for effluent. Discussions with the Water Master or a water rights specialist are recommended. Silverton has established unique rights with regard to its effluent reuse system that may be applicable to the City of Woodburn. Further discussions with Oregon Water Resources Department are needed, relative to allowing Woodburn to maintain control of the water that is beneficially discharged to the Pudding River.

5.1.1.16 Reclaimed Water

An alternative to direct river discharge of treated effluent during dry weather is to apply treated effluent to meet irrigation demands on agricultural lands or landscaped areas. Effluent can also be beneficially reused as reclaimed water for specific nonagricultural industrial uses, such as cooling water. The standards for effluent reuse in Oregon are established by DEQ through OAR Chapter 340 Division 55 (340-55). These rules have recently been updated and adopted by DEQ, which presents new opportunities for Woodburn. The previous and updated Division 55 rules are summarized here to demonstrate some of these opportunities. These rules are relevant and applicable to the poplar tree irrigation system already in use by the City and any future reuse of reclaimed water.

1990 Version of the Division 55 Reclaimed Water Rules

Through OAR 340-55, DEQ established treatment and monitoring requirements for potential agricultural and nonagricultural uses of treated effluent. These rules served as the basis for permitting the poplar reuse system at Woodburn and are presented here for comparison with the new rules presented in the next section.

In the 1990 version, DEQ classified reclaimed water into four categories or levels and assigned a minimum degree of treatment required for each category:

- Level I: Less than biological treatment or biological treatment without disinfection
- Level II: Biological treatment plus disinfection
- Level III: Biological treatment plus disinfection (stricter coliform limit)
- Level IV: Biological treatment, clarification, coagulation, and filtration plus disinfection

Limits for total coliform (organisms/100 mL) and turbidity [nephelometric turbidity units (NTUs)] were established for the four categories. These standards served as a general guideline for defining the water quality required for various uses. In addition to the water quality limits, DEQ provided standards for the minimum monitoring required for total coliform and turbidity based on the four categories. Table 5-8 summarizes the treatment and monitoring requirements for the four reuse categories. DEQ could also include additional permit effluent limitations and/or other permit conditions other than those shown in Table 5-8 if they had reason to believe that the reclaimed water may contain physical or chemical contaminants that would impose potential hazards to the public or environment.

TABLE 5-8
Treatment and Monitoring Requirements for Use of Reclaimed Water—1990 Rules

Category	Level I	Level II	Level III	Level IV
Biological Treatment	X	X	X	X
Disinfection		X	X	X
Clarification				X
Coagulation				X
Filtration				X
Total Coliform (organisms/100 mL):				
Two Consecutive Samples	N/L	240	N/L	N/L
7-Day Median	N/L	23	2.2	2.2
Maximum	N/L	N/L	23	23
Sampling Frequency	N/R	1 per week	3 per week	1 per day
Turbidity (NTU):				
24-Hour Mean	N/L	N/L	N/L	2
5% of Time During a 24-Hour Period	N/L	N/L	N/L	5
Sampling Frequency	N/R	N/R	N/R	Hourly
Public Access	Prevented (fences, gates, locks)	Controlled (signs, rural or nonpublic lands)	Controlled (signs, rural or nonpublic lands)	No direct public contact during irrigation cycle

N/L: No limit.
N/R: Not required.
X: Required treatment for this treatment level.

2008 Version of the Division 55 Recycled Water Rules

The Oregon reclaimed water rules have recently been updated by Oregon DEQ, creating a newly defined categories of recycled water—Classes A, B, C, and D. The new Recycled Water Rules were adopted at the Environmental Quality Commission (EQC) meeting on April 25, 2008. An Internal Management Directive (IMD), dated June 19, 2009, was also developed to guide wastewater agencies and DEQ staff in the implementation of these new rules.

According to DEQ, the objectives of these proposed rule changes are:

- To allow more use of recycled water through additional beneficial purposes protective of human health and the environment.
- Clarify requirements for the treatment and use of recycled water.
- Clarify the regulatory process for recycled water use projects.
- To reduce the amount of potable water supplies being used for nonpotable uses.

This is positive news for Woodburn's program, and potentially creates a whole new set of opportunities for reusing Woodburn's treated effluent on nearby agricultural and horticultural lands. The facilities planning effort and associated process modeling will evaluate the expected effluent quality from the plant and determine if the treated effluent can be expected to meet the new Class A standards.

The treatment requirements and possible beneficial uses described in the new recycled water rules are summarized in Tables 5-9 and 5-10.

TABLE 5-9
General Treatment and Monitoring Requirements for Use of Reclaimed Water—2008 Rules

Category	Class A	Class B	Class C	Class D	Non-Disinfected
Biological Treatment (Oxidized)	X	X	X	X	X
Disinfection	X	X	X	X	
Filtration	X				
E. Coli (organisms/100 mL):					
30-Day Log Mean	N/L	N/L	N/L	126	N/L
Single Sample Maximum	2.2	2.2	N/L	406	N/L
Turbidity (NTU):					
24-Hour Mean	2	N/L	N/L	N/L	N/L
5% of Time During a 24-Hour Period	5	N/L	N/L	N/L	N/L
Maximum at Any Time	10	N/L	N/L	N/L	N/L
Sampling Frequency	Hourly	N/R	N/R	N/R	N/R
Total Coliform (organisms/100 mL):					
Median of Last 7 Samples	2.2	2.2	23	N/L	N/L
Maximum of Any 2 Consecutive Samples	N/L	N/L	240	N/L	N/L
Single Sample Maximum	23	23	N/L	N/L	N/L
Sampling Frequency	1 per day	3 per week	1 per week	1 per week	As in NPDES or WPCF permit
E. coli:					
30-day Log Mean	N/L	N/L	N/L	126	N/L
Maximum at Any Time	N/L	N/L	N/L	406	N/L
Sampling Frequency	N/R	N/R	N/R	1 per week	N/R

TABLE 5-9
General Treatment and Monitoring Requirements for Use of Reclaimed Water—2008 Rules

Category	Class A	Class B	Class C	Class D	Non-Disinfected
Public Access	Controlled: Same as Class D for some uses and unrestricted for others	Controlled: Same as Class D	Controlled: Same as Class D plus direct contact restrictions for some uses	Controlled: Notification of personnel and signs posted around the perimeter of the use area	Prevented: fences, gates, locks
Set-Back Requirements					
From property line where irrigation is applied directly to the soil	N/R	10 feet	10 feet	10 feet	Site specific
From property line where sprinkler irrigation is used	N/R	50 feet	70 feet	100 feet	Site specific
From food preparation or serving area or drinking fountain to edge of sprinkler irrigation	Cannot be sprayed directly on to use area	10 feet	70 feet	70 feet	Site specific
From edge of irrigation to water supply source for human consumption	N/R	N/R	100 feet	100 feet	150 feet

N/L: No limit.
N/R: Not required.
X: Required treatment for this treatment level.

TABLE 5-10
Allowable Uses for Reclaimed Water—2008 Rules

Beneficial Purpose	Class A	Class B	Class C	Class D	Non-disinfected
Irrigation					
Fodder, fiber, seed crops not intended for human ingestion, commercial timber	Yes	Yes	Yes	Yes	Yes
Firewood, ornamental nursery stock, Christmas trees	Yes	Yes	Yes	Yes	No
Sod	Yes	Yes	Yes	Yes	No
Pasture for animals	Yes	Yes	Yes	Yes	No
Processed food crops	Yes	Yes	Yes	No	No
Orchards or vineyards if an irrigation method is used to apply recycled water directly to the soil	Yes	Yes	Yes	No	No

TABLE 5-10
Allowable Uses for Reclaimed Water—2008 Rules

Beneficial Purpose	Class A	Class B	Class C	Class D	Non-disinfected
Golf courses, cemeteries, highway medians, industrial or business campuses	Yes	Yes	Yes	No	No
Any agricultural or horticultural use	Yes	No	No	No	No
Parks, playgrounds, school yards, residential landscapes, other landscapes accessible to the public	Yes	No	No	No	No
Industrial, Commercial, or Construction					
Industrial cooling	Yes	Yes	Yes	No	No
Rock crushing, aggregate washing, mixing concrete	Yes	Yes	Yes	No	No
Dust control	Yes	Yes	Yes	No	No
Nonstructural fire fighting using aircraft	Yes	Yes	Yes	No	No
Street sweeping or sanitary sewer flushing	Yes	Yes	Yes	No	No
Stand alone fire suppression systems in commercial and residential buildings	Yes	Yes	No	No	No
Non-residential toilet or urinal flushing, floor drain trap priming	Yes	Yes	No	No	No
Commercial car washing	Yes	No	No	No	No
Fountains when the water is not intended for human consumption	Yes	No	No	No	No
Impoundments or Artificial Groundwater Recharge					
Water supply for landscape impoundments including, but not limited to, golf course water ponds and non-residential landscape ponds	Yes	Yes	Yes	No	No
Restricted recreational impoundments	Yes	Yes	No	No	No
Nonrestricted recreational impoundments including, but not limited to, recreational lakes, water features accessible to the public, and public fishing ponds	Yes	No	No	No	No
Artificial groundwater recharge	Yes	No	No	No	No

With the new rule, DEQ no longer requires a contract between POTW and user of reuse water. DEQ still recommends that a contract be put in place, but DEQ is no longer reviewing these contracts. The City still has the responsibility to assure that reuse water is appropriately applied; for example, it cannot be applied at higher than agronomic rates, without specific adjustments to the permit. While the City currently only irrigates on the City-owned poplar reuse system, this would become important if the City expanded its recycled water program to privately-owned property.

It is important to continue to monitor DEQ's implementation of these rules and the new IMD, and it is appropriate for Woodburn to adopt these new recycled water rules as planning criteria for this current Woodburn facility planning effort. Additional discussions with Oregon DEQ will help to clarify the implementation of these new recycled water rules for Woodburn.

Permit Requirements

The current NPDES permit authorizes the use of treated effluent for irrigation of poplars (Outfall 002). In addition to requirements for sound irrigation practices to prevent ponding, surface runoff, odors, etc., Level III treatment is required as described in Table 5-4, with daily monitoring for chlorine used and residual chlorine concentration, twice weekly monitoring for pH, three times weekly monitoring for total coliform, and quarterly monitoring for nutrients. With the new rules, Woodburn's current Level III reclaimed water would be immediately reclassified as Class B recycled water and could qualify as Class A recycled water with additional disinfection and filtration. If the City decided to expand its recycled water program to include privately owned property, then ultimately both parties would be responsible to manage the recycled water under the new recycled water user rules with or without a contract in place.

While the current permit requirements (Level III) stipulate production of an equivalent Class B recycled water prior to irrigation, the current use of the recycled water for poplar tree irrigation could allow as low of quality as a non-disinfected water based on the 2008 rules. Poplar tree production falls into the category of a “fiber crop not intended for human ingestion,” which is the least restrictive of the allowable recycled water uses under the 2008 rules. Pathogen limits placed on effluent discharge to the Pudding River, however, require that the POTW always produce at least a Class D water.

When the poplar tree irrigation system was first developed and the NPDES permit conditions were crafted, the City had plans to develop a public visitor center within the tree plantation and volunteered to produce a higher quality of recycled water than was necessary for the crop use. Although the City commonly leads guided tours through the tree plantation today, there are no longer any plans for a visitor center open to unaccompanied public access and relaxing the recycled water treatment requirements is now appropriate. With the use of Class D water, the current guided tour activities would still be allowed.

The primary benefit of changing the recycled water classification to Class D in the permit is the reduction in additional chlorination required prior to irrigation use on the poplar tree plantation. This is described in more detail within Section 7, where disinfection alternatives are discussed. Changing the treatment requirements for recycled water used for poplar tree irrigation should be discussed with DEQ during the next permit renewal.

Buffer requirements will need to be addressed in the change from Class B to Class D recycled water. In the establishment of existing irrigation buffers (35 to 50 feet from property boundaries) the low potential public contact due to the low-trajectory micro-spray irrigation within the tree canopy and rural nature of the site allowed the City and DEQ to establish site specific buffer requirements, which is still appropriate.

5.1.1.17 Biosolids

Both federal and state regulations apply to land application of biosolids from wastewater treatment plants. Federal regulations include 40 Code of Federal Regulations (CFR) 257 and approved 40 CFR, Part 503. State of Oregon regulations include OAR 340-50. Since the passing of the federal 503 regulations, the state has prepared and passed amendments to OAR 340-50 that adopt provisions outlined in the 503 regulation. In some instances, state regulations may impose more stringent requirements than federal regulations. However, federal regulations apply if no state regulations are declared.

The primary biosolids treatment requirements necessary to produce a Class B product for land application fall into two categories: 1) pathogen reduction; and 2) vector attraction reduction. Other biosolids quality issues include cumulative pollutant (heavy metal) loading rates and nutrient content. While there are no specific limits on nutrient content, the nutrient content is accounted for in the calculation of allowable land application rates.

Pathogen and Vector Attraction Reduction

Under the federal regulations 40 CFR, Part 503 and OAR 340-050, the City has met the requirements for Class B biosolids in the past by employing the following treatment options:

- Pathogen Reduction – Anaerobic digestion where "Sewage sludge is agitated with air or oxygen to maintain aerobic conditions for a specific mean cell residence time (i.e., solids retention time) at a specific temperature. Values for the mean cell residence time and temperature shall be between 40 days at 20ºC (68ºF) and 60 days at 15ºC (59ºF)."
- Vector Attraction Reduction – "At least 38% reduction in volatile solids during sewage sludge treatment"

Biosolids stored in the facultative sludge lagoons (FSLs) have also met the pathogen reduction requirements by the alternate criteria of having "less than either 2 million Most Probable Number (MPN) or 2 million Colony Forming Units (CFU) per gram of total solids (dry weight basis)." However, as basis for planning, the currently used treatment options listed above are assumed.

Heavy Metals

Under the federal regulations 40 CFR, Part 503, ceiling (maximum allowable) concentrations, cumulative pollutant loading rates, average pollutant limits for "clean biosolids" have been established for nine heavy metals. Table 5-11 shows the acceptable levels for land application. These rates are used to determine site life, which is the number of years that biosolids with a uniform metal content can be applied to a specific site. Note that if biosolids heavy metal concentrations are maintained under the "clean biosolids" concentration limits, then the cumulative pollutant loading rates and annual pollutant loading rates do not apply. Once the "clean biosolids" concentration limits have been exceeded and land applied to a site, the permittee is required to track cumulative pollutant loading for that that site during the remaining time the site is used.

TABLE 5-11
Federal Regulations for Heavy Metals*

Parameter	Ceiling Concentration (mg/kg)	Cumulative Loading (kg/ha)	Average Concentration (Clean Biosolids) (mg/kg)
Arsenic	75	41	41
Cadmium	85	39	39

TABLE 5-11
Federal Regulations for Heavy Metals*

Parameter	Ceiling Concentration (mg/kg)	Cumulative Loading (kg/ha)	Average Concentration (Clean Biosolids) (mg/kg)
Copper	4,300	1,500	1,500
Lead	840	300	300
Mercury	57	17	17
Molybdenum	75	18	-
Nickel	420	420	420
Selenium	100	100	100
Zinc	7,500	2,800	2,800

*From 40 CFR, Part 503 (December 1992).

The City's pretreatment program has developed local limits for industrial discharges that are based in part on maintaining biosolids metals concentrations below the "clean biosolids" limitations. Preliminary sampling of lagoon feed sludge indicates that the biosolids should meet the requirements defined in Table 5-11. However, once land application begins, if it is determined that constituents do not meet these criteria, it is critical that this issue be revisited to identify potentially controlling design criteria.

5.1.2 Effluent Quality

The Woodburn POTW has consistently met its current NPDES permit discharge requirements since the Phase 1 upgrades, even with strict summer ammonia limits. However, new temperature regulations and excess thermal load (ETL) limits will present a new challenge requiring additional effluent quality adjustments during the summer months. Historical effluent quality data were incorporated into the effluent discharge analysis presented in Section 5.15 and the unit process modeling presented in Section 7.

5.1.3 Treatment Effectiveness

The technology-based requirement of 85 percent removal for BOD_5 and TSS through the treatment plant is assumed to remain in place over the course of the planning horizon.

5.1.4 Plant Reliability Criteria

EPA requires that wastewater facilities meet the requirements for reliability and redundancy in their treatment components and associated equipment. The reliability standards establish minimum levels of reliability for three classes of wastewater works. Oregon DEQ has also established minimum standards governing the reliability of mechanical, electrical, and fluid systems used in wastewater systems. The standards are intended to protect the environment, particularly receiving waters, against unacceptable degradation resulting from power failure, flood, peak loads, equipment failure, and maintenance shutdowns. The standards are divided into three, decreasingly stringent, classes of reliability: I, II, and III.

The reliability class appropriate for the Woodburn POTW is dependent on the effluent disposal receiving stream or body of water. The previous expansion defined the reliability classification for the facility as Class II. However, per EPA guidelines and DEQ requirements, Woodburn will need to meet Class I requirements. DEQ has indicated that all facilities in the Willamette Valley are Class I facilities. It is unclear why existing Woodburn facilities were approved as Class II facilities. Class I requirements will compel Woodburn to provide backup power source for aeration blowers and additional redundancy within the primary clarifier, secondary clarifier and filtration systems. The Class I requirements are outlined in Table 5-12.

TABLE 5-12
Requirements for Reliability Class I

Component	Reliability Criteria
Pumps, Lift Stations, Raw sewage, RAS, and WAS Effluent	A backup pump shall be provided for each set of pumps performing the same function. The capacity of the pumps shall be such that, with any one pump out of service, the remaining pumps will have the capacity to handle the peak flow.
Mechanically Cleaned Bar Screens	A backup bar screen (manually or mechanically cleaned) shall be provided. Facilities with only two bar screens shall have at least one manually cleaned bar screen.
Primary Clarifiers	The units shall be sufficient in number and size so that, with the largest unit out of service, the remaining units have capacity for at least 50 percent of the design flow.
Aeration Basins	At least two equal volume basins shall be provided.
Aeration blowers or mechanical aerators	With the largest unit out of service, remaining units shall be able to maintain design oxygen transfer. A backup unit may be uninstalled.
Air Diffusers	With the largest section of diffusers isolated or out of service, oxygen transfer capacity shall not be measurably impaired.
Secondary Clarifiers	The units shall be sufficient in number and size so that, with the largest unit out of service, the remaining units have capacity for at least 75 percent of the design flow.
Filters	The units shall be sufficient in number and size so that, with the largest unit out of service, the remaining units have capacity for at least 75 percent of the design flow.
Disinfection Process	The process units shall be sufficient in number and size so that, with the largest unit out of service, the remaining units have capacity for at least 50 percent of the design flow.
Electrical power sources	Two separate and independent electric power sources from either two separate utility substations or one substation and one standby generator shall be provided for conveyance system lift stations and the treatment plant. The backup power source shall be sufficient to operate all main pumping, screening, primary treatment, secondary treatment, final clarification, advanced treatment (filtration) and disinfection facilities, along with critical lighting and ventilation during peak wastewater flow conditions. The provision of capacity for degritting and sludge handling and treatment is optional.
Sludge Holding Tanks	The volume of the holding tank shall be based on the expected time necessary to perform maintenance and repair of the component in question.
Anaerobic sludge digestion	At least two digestion tanks shall be provided. Backup sludge mixing equipment shall be provided or the system shall be flexible enough such that with one piece of equipment out of service, total mixing capacity is not lost. Backup equipment may be uninstalled.

TABLE 5-12
Requirements for Reliability Class I

Component	Reliability Criteria
Sludge Pumping	Pumps sized to pump peak sludge quantity with one pump out of service. Backup pump may be uninstalled.

In addition to the standards listed in Table 5-12, unit operations must be designed to pass the peak hydraulic flow with one unit out of service. Also, mechanical components in the facility must be designed to enable repair or replacement without violating the effluent limitations or causing control diversion.

A Class I reliability rating is also applicable for the pump stations. A minimum of two pumps must be provided at each lift station so that peak flow can be pumped with the largest pump out of service. An emergency power source must be provided to allow continuous pump operation.

Further discussion is needed with DEQ regarding the reliability and redundancy requirements of natural treatment systems.

5.1.5 Design Concepts and Constraints

The addition of excess thermal load limits on top of the existing restrictive summer ammonia limits introduces a new complexity with summer period effluent discharge flow and quality management. Furthermore, the use of constructed wetlands for end-of-pipe effluent cooling is also a new application in Oregon and has not yet been permitted and operated at full scale for temperature TMDL compliance. These issues are address within this section to help establish a basis for later alternatives evaluations.

5.1.5.1 Future Effluent Discharge Limitations

The future effluent discharge limits set by existing summer ammonia limits and the future ETL limits require an assessment of historical effluent temperature, ammonia concentrations, and flow compared to the regulatory requirements.

Effluent Temperature

Comparing the average effluent temperatures from discharge monitoring reports (DMRs) over the 2000 through 2007 period to the T_c in the TMDL reveals that effluent temperatures generally exceed the T_c throughout the June through September compliance period (Table 5-13).

TABLE 5-13
Average Effluent Temperatures in Comparison to the Applicable Pudding River Temperature Criteria, T_c

Time Period	Applicable Criteria, T_c (˚C)	Average Effluent Temperature (˚C)
June 1 to June 30	18.0	20.6
July 1 to July 14	20.1	21.9
July 15 to August 31	21.6	23.1

TABLE 5-13
Average Effluent Temperatures in Comparison to the Applicable Pudding River Temperature Criteria, T_c

Time Period	Applicable Criteria, T_c (˚C)	Average Effluent Temperature (˚C)
September 1 to September 15	18.2	22.7
September 16 to September 30	18.0	21.6

The ETL limits allow effluent temperatures to exceed the T_c to some degree based on the effluent flow discharged to the Pudding River.

Ammonia Concentrations and Effluent Flow

An assessment of ETLs requires assessment of both discharge temperature and flow rate. Discharge to the Pudding River in June through October is restricted by NPDES permit limitations relating to river flow, POTW discharge flow, and effluent ammonia concentrations. These limitations are most restrictive during July and August when the maximum allowable river discharge flow is 3 mgd for effluent ammonia-N concentrations less than 0.1 mg/L and is reduced to 2 mgd for effluent ammonia-N concentrations less than 0.5 mg/L.

With the current plant processes, ammonia concentrations < 0.5 mg/L are reliably met in July (0.16 mg/L average in 2007 DMRs) and August (0.11 mg/L average in 2007 DMRs), allowing a river discharge of up to 2 mgd. While reliably meeting effluent ammonia-N concentrations < 0.1 mg/L is technically feasible at the Woodburn POTW, it would require significant operational enhancements and would reduce the operational factor of safety.

Assumptions made for reliable ammonia treatment standards are tied to the NPDES permit requirements and are based on past plant performance as outlined in Table 5-14. The lowest target maximum ammonia-N concentration used for this Facilities Plan is 0.3 mg/L and would occur in September.

TABLE 5-14
Target POTW Effluent Ammonia Limits and Allowable Effluent Discharge to the Pudding River under Low River Flow Conditions

Compliance Period	Target Maximum Monthly Average Effluent Ammonia-N (mg/L)	Monthly Average Pudding River Flow (cfs)	Maximum Allowable Monthly Average Effluent Discharge to the Pudding River (mgd)
June 1 to June 30	1.0	< 50	No limit
July 1 to August 31	0.5	< 30	2.0
September 1 to September 30	0.3	< 30	No limit
October 1 to October 31	2.4	< 60	No limit

cfs = cubic feet per second

2008 Conditions

The allowable Pudding River discharge flows were determined using the average effluent temperatures and ETL limits for each of the five temperature compliance periods along with the flow limits based on summer ammonia criteria. As shown in Figure 5-1, the POTW 2008 effluent flows exceed the effluent flows that will be allowed by the ETL limits between July

15 and September 30. As a result, ETL reductions would be required immediately upon enforcement of the ETL limits presented within the temperature TMDL.

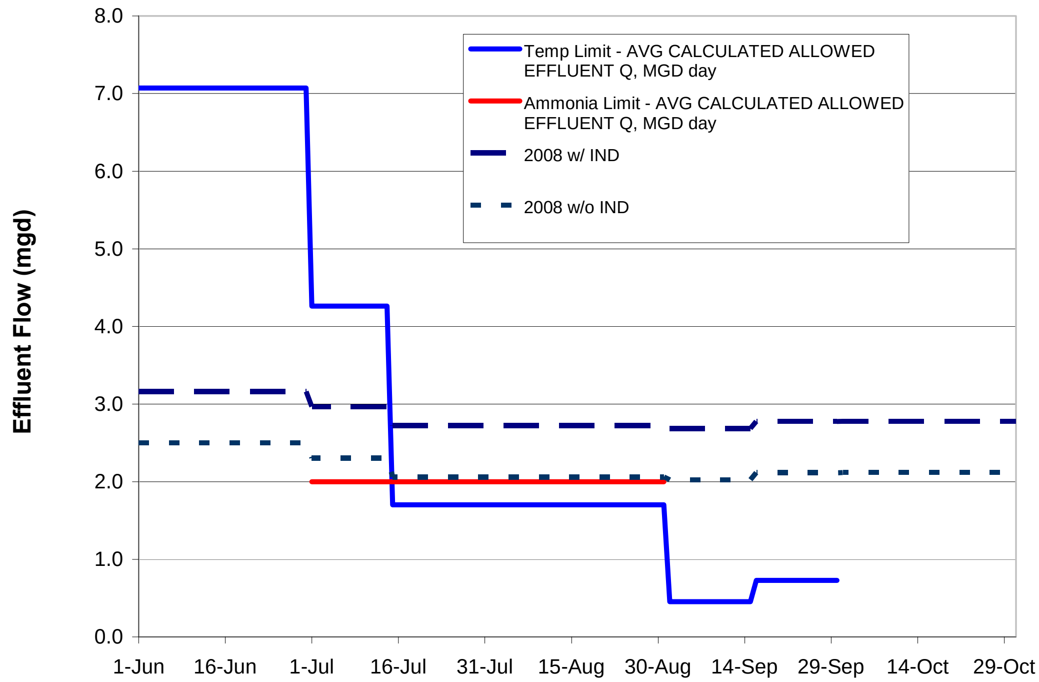

FIGURE 5-1
Woodburn POTW 2008 Effluent Flows Compared with Dry Weather Allowable Effluent Flows to the Pudding River Based on Temperature and Ammonia Limits
Ammonia limit assumes a < 0.5 mg/L effluent ammonia concentration in July and August and < 0.3 mg/L effluent ammonia concentration in September based on achievable limits with existing operation.

The degree of ETL exceedence varies throughout the compliance period, affecting the critical period for which ETL reduction alternatives will need to be sized as described by compliance periods below.

June 1 through June 30

During this period, there is no ammonia driven flow limit when effluent ammonia concentrations are maintained below 1 mg/L (Table 5-14). Furthermore, ETL limits allow more discharge flow than current effluent flows and existing effluent temperatures.

July 1 through July 15

During this period, effluent irrigation is used to limit Pudding River discharge flows to less than 2 mgd, allowing the summer-time ammonia limits to be met. The ETL limits during this period allow more discharge flow than current effluent flows and existing effluent temperatures.

July 15 through August 31

ETL limits are more restrictive than the summer-time ammonia limits during this period. Even with a reduction in discharge flow to less than 2 mgd, some effluent cooling would be required in order to allow the full 2 mgd discharge flow to be within the ETL limit.

September 1 through September 15

This is the most restrictive period for ETL limits. Effluent irrigation has generally ceased or been substantially reduced during this period and the allowed discharge flow (assuming no effluent cooling) is the lowest of all compliance periods.

September 16 through September 30

ETL limits during this period are slightly less restrictive than the September 1 through September 15 period but would still require substantial effluent cooling in order to allow the entire POTW discharge flow to be within the ETL limit.

2030 Conditions

Under 2030 flow conditions, the controlling temperature compliance periods do not change, but the requirements for ETL reduction become larger (Figure 5-2). This evaluation is used later in Section 8 for sizing of the reuse and discharge alternatives.

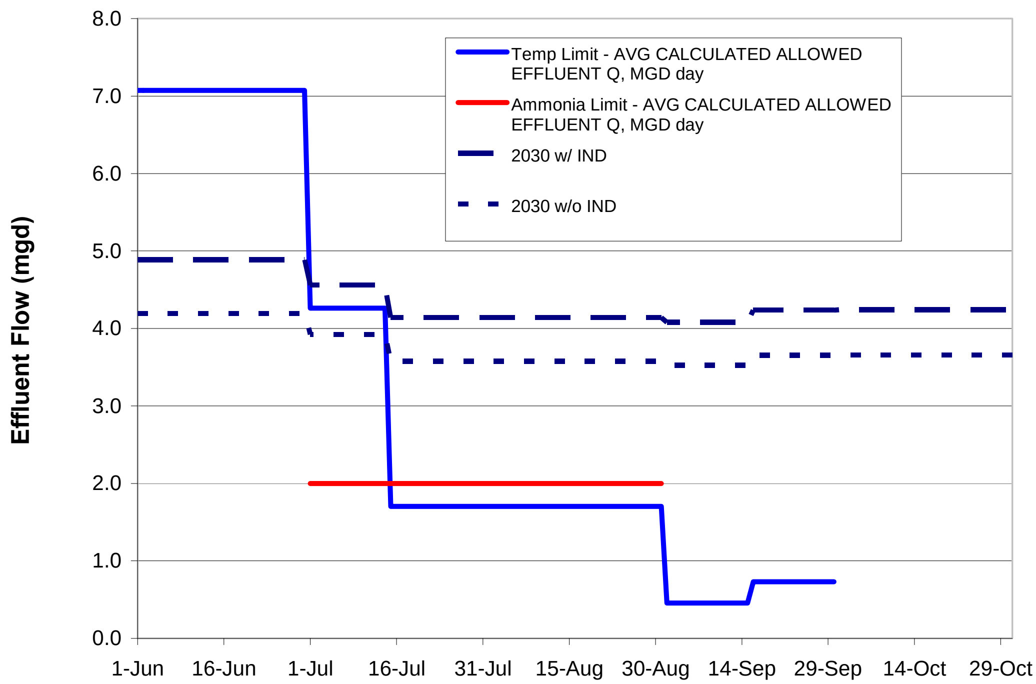

FIGURE 5-2
Woodburn POTW 2030 Projected Effluent Flows Compared with Dry Weather Allowable Effluent Flows to the Pudding River Based on Temperature and Ammonia Limits
Ammonia limit assumes a < 0.5 mg/L effluent ammonia concentration in July and August and < 0.3 mg/L effluent ammonia concentration in September based on achievable limits with existing operation.

5.1.5.2 Constructed Wetlands Permitting

Meetings with DEQ to discuss this alternative have established two important premises for the implementation of constructed wetlands used for effluent cooling.

1. Compliance Monitoring: All effluent discharge compliance parameters aside from discharge flow and temperature would continue to be monitored at their current locations within the POTW. The compliance points for temperature and discharge flow would be located at the point of discharge from the wetland systems out to the river outfalls.
2. Period of Discharge: For constructed wetlands developed within the floodplain, effluent would not be discharged into the wetlands during periods of flooding.
3. Flood Proofing: For constructed wetlands developed within the floodplain, wetland berms, conveyance piping, and hydraulic structures will be placed below the 100-year and 500-year flood elevations. These systems will be designed to preserve the structural integrity under flooding conditions.

These premises form the basis for the associated temperature compliance alternatives evaluated within this Facilities Plan.

5.1.6 Unit Design Considerations

Unit process design criteria are defined for each of the unit processes in Chapter 7 and Chapter 8.

5.2 Basis for Cost Estimate

Planning level construction, operation, maintenance, and salvage value cost opinions are developed to allow comparison of alternatives for the short- and long-term planning period. The basis utilized for cost estimate development is summarized in the following sections.

5.2.1 Capital Cost Parameters

Costs are based on facilities to accommodate the projected flows and loads for the planning period under considerations. For example, if the 20-year planning period is under consideration, all costs include facilities sized for the 2030 flows and loads. The costs are order-of-magnitude estimates developed using CH2M HILL's cost estimating tool CPES *(CH2M HILL Parametric Cost Estimating System*) data. The CPES model is supplemented with vendor supplied budgetary quotes for equipment where applicable, as well as bid costs for comparable projects.

All costs are estimated and presented in 2008 dollars. If construction costs are based on costs of other facilities constructed before 2008, they are adjusted to 2008 dollars. Adjustments to costs are made with the Engineering News Record (ENR) Construction Cost Index (CCI) for Seattle. The current Seattle ENR-CCI for 2008 is 8534. All construction costs include a contingency of 30 percent, a factor of 15 percent to account for contractor's overhead and profit and a factor of 10 percent for meeting general conditions and bonding. Actual construction costs will depend on a variety of factors such as the final project scope and market conditions at the time of project bidding.

All cost estimates are order-of-magnitude estimates as defined by the American Association of Cost Engineers (AACE). An order-of-magnitude estimate is made without detailed engineering data and uses techniques such as cost curves and scaling factors applied to estimates developed for similar projects. The overall expected level of accuracy of the cost estimates presented is -30 percent to +50 percent. This means that bids can be expected to fall within a range of 30 percent under to 50 percent over the estimate for each project. These ranges are consistent with the guidelines established by the AACE for planning level studies.

Capital costs for significant equipment costs that differ between alternatives are developed and included in this evaluation.

Project costs are defined as the sum of the construction cost, plus engineering, administration, and legal (EAL) costs at 25 percent of the total construction cost estimate. Costs are rounded as appropriate.

5.2.2 Annual Cost Parameters

Operation and Maintenance (O&M) costs are based on the following factors:

- Assumed labor rate of $40/hour
- Power cost at $0.06/kilowatt-hour (kWh)
- Current chemical and materials costs

O&M costs are in 2008 dollars and are estimated for design average flows and loads.

5.2.3 Discount Rate

All present-worth analyses are based on a real discount rate of 3 percent per year.

5.2.4 Present-Worth Analysis

All present worth evaluations are reported in 2008 dollars. The present worth of O&M costs is estimated with a geometric series present-worth factor. This factor brings O&M costs back to 2008

Present worth is defined as:

$PW = P_w \text{ (capital)} + P_w \text{ (O\&M)}$

5.3 Water Quality Impact

5.3.1 Background Data on the Receiving Stream

The Pudding River is a tributary of the Molalla River, which is a tributary of the Willamette River. In addition to being subject to the criteria for the Willamette River, the Pudding River has also been defined as water-quality limited.

The State of Oregon is required to establish total maximum daily loads (TMDLs) for stream segments that do not meet water quality standards. The TMDL identifies the level of pollutants that a water body can absorb and still meet water quality standards. TMDLs take into account pollution from all sources, including discharges from industry and sewage treatment facilities; runoff from farms, forests, and urban areas; and natural sources. The TMDLs are then used to determine what changes must take place to achieve water quality standards. The changes may affect wastewater discharge permits, both for industries and sewage treatment facilities. Water quality management plans (WQMPs) are also developed based on the TMDLs. These plans document the ways that local landowners, agencies, forest and agricultural land managers (including federal agencies), DEQ, and others will implement a specific TMDL and work to improve water quality.

Background data on water quality of the Pudding River is comprehensively addressed within the December 2008 Mollala-Pudding Subbasin TMDL & WQMP.

5.4 Design Capacity of Conveyance System and Wastewater Treatment Plant

5.4.1 Conveyance System

Refer to *Volume 2: Wastewater Collection and Transmission System* of this Facilities Plan.

5.4.2 Wastewater Treatment Plant Facilities

The planning criteria for flow and load at the Woodburn POTW are summarized in Table 5-15. These design criteria provide the basis for future treatment unit process design.

TABLE 5-15
Woodburn POTW Design Flows and Loads

Parameters	Current Conditions	2020	2030	2060
Flows (mgd)				
Average Annual	2.99	3.96	4.71	7.25
Maximum Month Wet Weather	6.66	8.01	9.68	15.33
Maximum Month Dry Weather	3.54	4.56	5.45	8.45
Maximum Day	14.49	16.93	20.56	32.88
Peak Hour	17	23	26	40
CBOD (ppd)				
Average Annual	7,995	10,045	11,499	16,424
Maximum Month Wet Weather	10,504	12,052	13,960	20,431
Maximum Month Dry Weather	9,476	11,230	12,952	18,789
TSS (ppd)				
Average Annual	5,974	7,724	9,138	13,931
Maximum Month Wet Weather	9,002	10,879	13,009	20,233
Maximum Month Dry Weather	8,759	10,625	12,698	19,726
Ammonia (ppd)				
Average Annual	410	678	807	1,242
Maximum Month Wet Weather	561	929	1,104	1,700

TABLE 5-15
Woodburn POTW Design Flows and Loads

Parameters	Current Conditions	2020	2030	2060
Maximum Month Dry Weather	453	751	893	1,374

5.4.3 Seasonal Land Irrigation

The existing permitted 84 acre poplar tree plantation allows the City to meet the summer ammonia limits in the months of July and August. As defined in the July 1999 *Reclaimed Water Reuse Management Plan for the Woodburn WWTP Poplar Plantation*, the 84 acre tree plantation has a 0.9 mgd capacity for irrigation reuse in July and August, when covered with mature trees. When accounting for the effects of tree harvesting and reduced irrigation requirements during regrowth periods, the stand-averaged capacity is approximately 0.83 mgd.

The City is currently involved in a pilot testing effort to determine if irrigation rates above agronomic rate offer advantages as a discharge mechanism and can be effectively managed in compliance with the new DEQ IMD for *Disposal of Municipal Wastewater Treatment Plant Effluent by Indirect Discharge to Surface Water via Groundwater or Hyporheic Water*. However, sufficient data to conclude whether this approach can be sustainably implemented will not be available until after the completion of this Facilities Plan. Consequently, past agronomic irrigation rates employed on the poplar tree plantation are used for the basis in establishing the capacity of the existing seasonal land irrigation area.

SECTION 6

Development and Evaluation of Collection System Alternatives

Development and evaluation of collection system alternatives is described in *Volume 2: Wastewater Collection and Transmission System* of this Facilities Plan.

SECTION 7

Development and Evaluation of Wastewater Treatment Alternatives

7.1 Introduction

Wastewater treatment alternatives were developed and evaluated, taking into account study area characteristics, condition and performance of existing facilities, projected wastewater flows and loads, regulatory requirements, design constraints, and City of Woodburn objectives. The evaluations addressed industrial and municipal wastewater treatment management strategies, liquid treatment alternatives, and solids management alternatives.

Collection system alternatives are evaluated in Section 6, and Woodburn Publicly Owned Treatment Works (POTW) reuse and disposal alternatives are evaluated in Section 8.

7.2 Industrial and Municipal Wastewater Treatment Management Strategies

Pretreated flow from local food processing industries is currently discharged to the collection system and treated at the Woodburn POTW along with municipal flow from other sources (residential and commercial). Water quality and quantity of flow is regulated by existing industrial waste discharge permits.

The City of Woodburn currently holds industrial waste discharge agreements with two of the largest food-processing industries:

- Sabroso Company (Sabroso)
- Townsend Farms, Inc. (Townsend Farms)

The local food processing facility, Bruce-Pac, is not within City limits and does not discharge to the City's system.

Sabroso and Townsend Farms discharge a significant portion of the total industrial flow for the City. However, their current level of discharge is significantly less than their permit with the City allows. Actual and allocated flows and loads from Sabroso and Townsend Farms are summarized in Table 7-1, and are shown in Figure 7-1.

TABLE 7-1
Actual and Allocated Flows from Sabroso and Townsend Farms

Month	2002–2007 Actual Flows and Loads (average day)			Allocated Flows and Loads		
	Flow (gpd)	BOD (ppd)	TSS (ppd)	Flow (gpd)	BOD (ppd)	TSS (ppd)
January	60,052	366	33	660,000	3,650	1,500
February	56,709	356	32	660,000	3,650	1,500
March	49,811	390	28	660,000	3,650	1,500
April	58,193	380	45	660,000	3,650	1,500
May	79,149	496	49	660,000	3,650	1,500
June	170,946	730	124	660,000	3,650	1,500
July	144,800	976	134	660,000	3,650	1,500
August	80,854	759	46	660,000	3,650	1,500
September	80,055	646	102	660,000	3,650	1,500
October	79,241	552	43	660,000	3,650	1,500
November	69,505	559	100	660,000	3,650	1,500
December	75,903	682	6	660,000	3,650	1,500

BOD = biochemical oxygen demand

ppd = pounds per day

TSS = total suspended solids

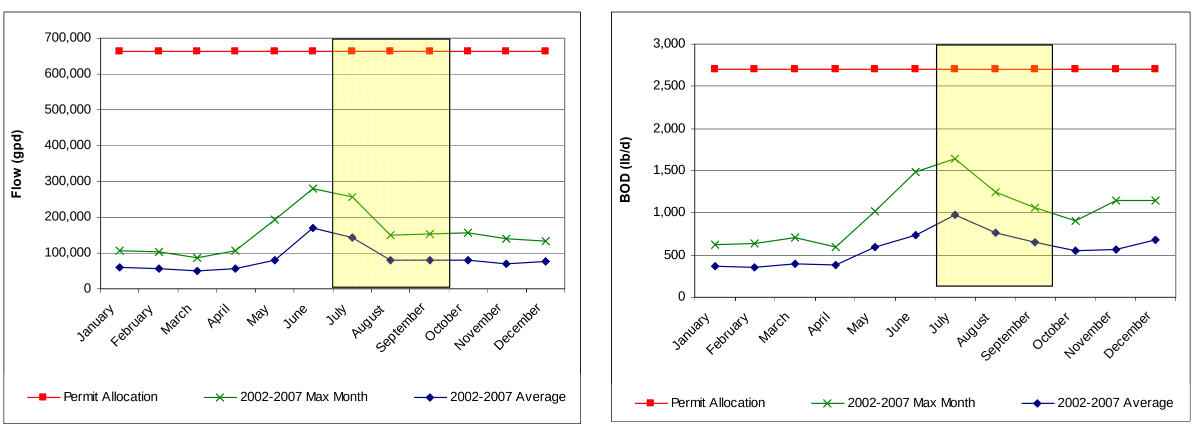

FIGURE 7-1
Comparison of Actual Sabroso and Townsend Farms Flows and BOD Contributions with Total Permit Allocations

Because the City is obligated to treat the flows and loads agreed to in their current pretreatment permits, industrial treatment alternatives were developed for the fully allocated flows and loads. However, alternative costs are provided in this chapter for both allocated and actual food processing flows to quantify the full impact of industrial allocations.

7.3 Development of Industrial Wastewater Treatment Management Strategy

The following alternatives were considered for future treatment of industrial flows:

- Alternative IND 1: Treat Industrial Flow Separately in July through September
- Alternative IND 2: Store Industrial Flow in July through September
- Alternative IND 3: Treat Industrial Flow Year-round at the POTW (current treatment scheme)

These alternatives are shown schematically in Figure 7-2.

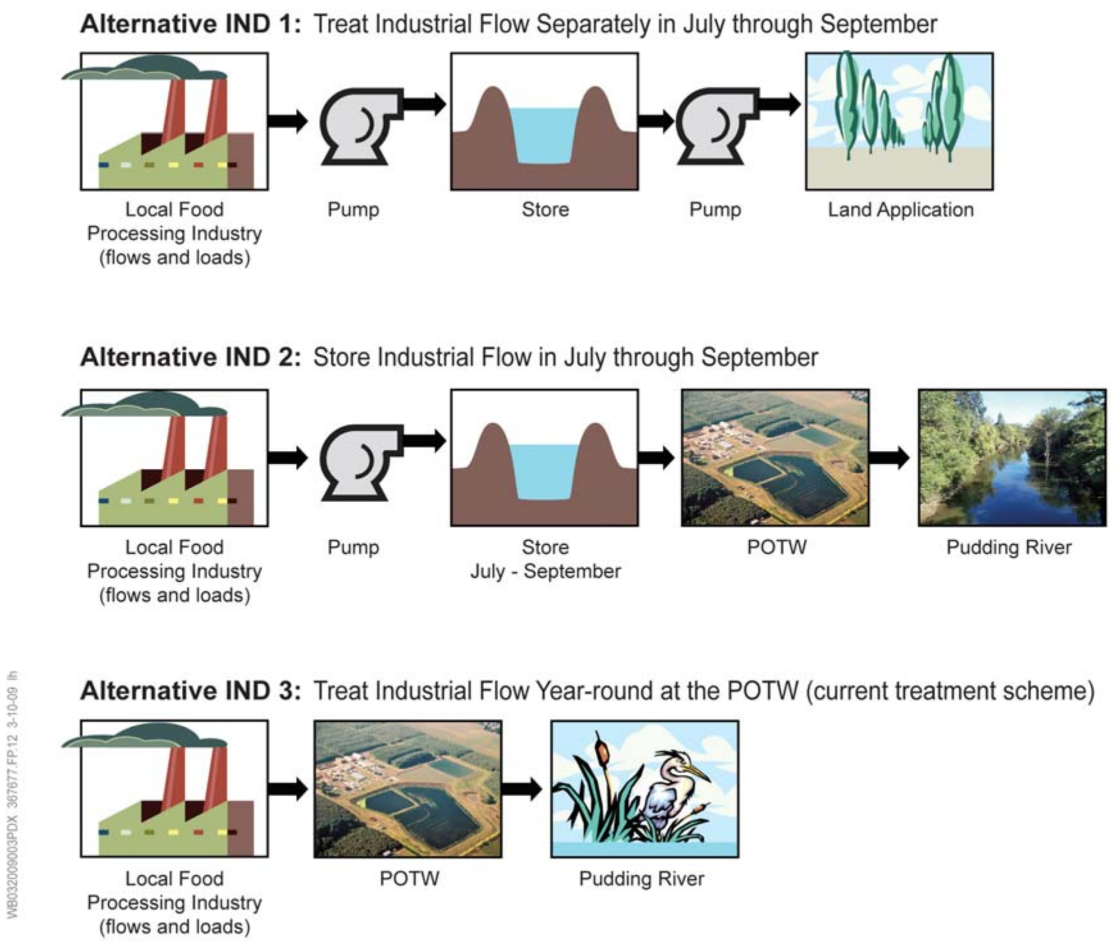

FIGURE 7-2
Industrial Wastewater Treatment Alternatives

These alternatives assume that the industries will continue onsite pretreatment of their effluents to the current level of pretreatment. Pretreatment requires screening and settling before discharge to the POTW according to the industrial waste discharge permits.

7.3.1 Alternative IND 1: Treat Industrial Flow Separately in July through September

This alternative includes treating flow from Sabroso and Townsend Farms separately during July through September when restrictions on discharge to the Pudding River are most restrictive. Flow could be treated either by land application or with mechanical treatment. These sub-alternatives IND 1A and IND 1B are described separately below.

Sub-Alternative IND 1A: Store and Land Apply Industrial Flow in July through September

With this sub-alternative, industrial flows and biosolids would not be treated at the Woodburn POTW from July 1 through September 30. Instead, they would be land applied. During this period, flow would be pumped to a storage lagoon for flow equalization. From the storage lagoon, flow would be pumped to local agricultural fields for irrigation and would be applied at agronomic rates.

From October 1 through June 30, however, industrial flows would be conveyed via the existing collection system to the Woodburn POTW for combined treatment with the municipal flow; this is the current practice. Treatment of these industrial flows at the Woodburn POTW (from October 1 through June 30) would need to include treatment at the POTW and land application of biosolids.

Storage and land application acreage requirements for this alternative are summarized in Table 7-2, providing adequate storage and land application acreage to manage all the flows during the July 1 through September 30 time period.

TABLE 7-2
Sub-Alternative IND 1A Storage and Land Application Acreage Requirements

Flow	Storage Volume (million gallons)	Land Application* (acres)
Actual Flow	4.9	32
Allocated Flow	17.5	114

*Sized based on irrigated pasture, which is compatible with existing farming practices in the area. It's possible that this water could be land applied for crops with higher agronomic rates, but sizing to pasture provides a conservative estimate for the number of acres needed to implement this alternative.

Discussions with the Oregon Department of Environmental Quality (DEQ) indicate that this approach would require a Water Pollution Control Facilities (WPCF) permit for land application during the summer season. During the wet weather season, when the flow would be pumped to the treatment plant, the food processing flows would be governed by the City's National Pollutant Discharge Elimination System (NPDES) permit.

Sub-Alternative IND 1A assumes:

- Storage lagoon will be located within a half mile of the industries.

- Land application sites will be located within a quarter mile of the storage lagoon.
- Flow will be generated at the industries 8 hours/day, 7 days/week.
- Pretreated flow will be land applied 8 hours/day, 7 days/week.

Sub-Alternative IND 1B: Provide Separate Mechanical Treatment for Industrial Flow in July through September

The characteristics of food processing waste make it suitable for relatively inexpensive onsite mechanical treatment processes such as aerated lagoons. However, in the case of Woodburn, treating the flow separately offers little advantage because the treated flows from these food processors would still need to be conveyed through the Woodburn POTW to the Pudding River or water reuse facilities.

Since this alternative does not eliminate the need for summer discharge of the flow, it provides limited value in meeting NPDES permit requirements at the POTW. In addition, the cost of onsite mechanical treatment would exceed the cost of a dedicated land application process for these food processors. Therefore, this sub-alternative was eliminated from further consideration.

7.3.2 Alternative IND 2: Store Industrial Flow in July through September

With this alternative, industrial effluent produced from July 1 through September 30 would be held in a storage lagoon sized to hold the maximum month flows. On October 1, the flow from the food processing operation as well as the stored flow would be conveyed via the existing collection system to the POTW for combined treatment with municipal flow, as is the current practice.

Capital costs for this alternative include an apportionment of the capital value of the collection system and POTW, which was derived from the 2007 fixed asset record for the collection and treatment facilities.

By holding the industrial flow through the summer when discharge is restricted, industrial flow does not need to be accounted for in the sizing of poplar irrigation or cooling wetland acreage since the flow will be treated outside the July to September period. Biosolids associated with the flow would continue to be land applied on poplar acreage. The cost of the required poplar acreage is included in the estimated cost for this alternative.

Table 7-3 summarizes storage volume required for actual and allocated industrial flow.

TABLE 7-3
Alternative IND 2 Storage Volume Requirements

Flow	Storage Volume (million gallons)
Actual Flow	16
Allocated Flow	61

7.3.3 Alternative IND 3: Treat Industrial Flow Year-round at the POTW

With this alternative, the current practice of discharging industrial flows into the collection system and combined treatment of municipal and industrial flows at the POTW would continue. Costs associated with this alternative include the cost of conveying the flow to and treating the flow with the same treatment processes employed at the existing Woodburn POTW. Those costs were derived in a similar manner as described for Alternative IND 2. Also included are the estimated costs of cooling wetland acreage and effluent irrigation and land application of biosolids on poplar tree acreage.

7.3.4 Woodburn POTW Poplar and Wetland Acreage Requirements for Industrial Alternatives

The poplar irrigation, poplar biosolids application, and cooling wetlands acreage for POTW effluent were estimated for industrial flows. Because Alternative IND 1 diverts all Sabroso and Townsend industrial flows to a separate land application system, it does not require poplar or cooling wetland facilities at the POTW. (The acres of pasture land required for Alternative IND 1 land application are listed in Table 7-2.) With Alternatives IND 2 and IND 3, however, the acreages required will be increased. Table 7-4 summarizes the additional acreage required at the Woodburn POTW for each of the industrial alternatives for the 2030 condition. Since IND 2 stores summertime flow, the industrial flows would not be sent to the Woodburn POTW poplar reuse system or cooling wetland during the summer growing season, but the biosolids from treatment of industrial flows during the wet season would be land applied at the poplar reuse system.

TABLE 7-4
Estimated Additional Poplar and Cooling Wetland Acreage Required at the Woodburn POTW for Industrial Treatment Alternatives

Natural Treatment System at Woodburn POTW	Alternative IND 1A Store and Land Apply Industrial Flow in July through September	Alternative IND 2 Store Industrial Flow in July through September	Alternative IND 3 Treat Industrial Flow at POTW
Actual Industrial Flow			
Poplar Irrigation and Biosolids Land Application	0	5[a]	20[b]
Cooling Wetlands	0	0	2
Allocated Industrial Flow			
Poplar Irrigation and Biosolids Land Application	0	18[a]	65[b]
Cooling Wetlands	0	0	6

[a]Biosolids land application only.

[b]Irrigation acreage required to meet ammonia standard in Pudding River.

7.3.5 Evaluation of Industrial Treatment Alternatives

The industrial alternatives were evaluated on both an economic and non-economic bases.

Economic Evaluation of Industrial Alternatives

Estimated capital costs for the industrial treatment alternatives are presented in Table 7-5.

TABLE 7-5
Estimated Capital Costs of Industrial Treatment Alternatives, Including Land Costs
Millions in 2008 Dollars

Item	Alternative IND 1A Store and Land Apply Industrial Flow in July through September	Alternative IND 2 Store Industrial Flow in July through September	Alternative IND 3 Treat Industrial Flow at POTW
Actual Industrial Flow			
Storage	NA	$1,800,000	NA
Separate Storage and Land Application for Industrial Flow	$3,400,000	NA	NA
Collection System and POTW[a]	NA	$700,000	$700,000
Poplar Irrigation and Biosolids Land Application at POTW	NA	$200,000[b]	$900,000[c]
Cooling Wetlands at POTW	NA	NA	$200,000
Total Capital Cost	**$3,400,000**	**$2,700,000**	**$1,800,000**
Allocated Industrial Flow			
Storage	NA	$6,800,000	NA
Storage and Land Application	$8,200,000	NA	NA
Collection System and POTW[a]	NA	$6,600,000	$12,800,000
Poplar Irrigation and Biosolids Land Application	NA	$800,000[b]	$2,800,000[c]
Cooling Wetlands	NA	NA	$700,000
Total Capital Cost	**$8,200,000**	**$14,200,000**	**$16,300,000**

[a]Calculated as apportionment of wastewater assets. Source: *City of Woodburn Annual Financial Report* (Boldt, Carlisle & Smith, 2007)

[b]Biosolids land application only.

[c]Irrigation acreage required to meet ammonia standard in Pudding River.

NA = not applicable.

Estimated annual operation and maintenance costs for the three industrial treatment alternatives are presented in Table 7-6. It is assumed for the purposes of this evaluation that the City of Woodburn would operate any new or upgraded industrial treatment facility or land application program.

TABLE 7-6
Estimated Annual Operation and Maintenance Cost of Industrial Treatment Alternatives
In 2008 Dollars

Item	Alternative IND 1A Store and Land Apply Industrial Flow in July through September	Alternative IND 2 Store Industrial Flow in July through September	Alternative IND 3 Treat Industrial Flow at POTW
Actual Industrial Flow			
Power	$2,000	-	-
Labor	$6,600	-	-
Chemicals	$0	-	-
Total	$8,600	$50,000*	$61,000 *
Allocated Industrial Flow			
Power	$5,900	-	-
Labor	$6,600	-	-
Chemicals	$0	-	$0
Total	$12,500	$187,000 *	$250,000 *

* Calculated as apportionment of wastewater operating budget. Source: *City of Woodburn Annual Financial Report* (Boldt, Carlisle & Smith, 2007)

Table 7-7 presents the total present worth costs of the industrial treatment alternatives.

TABLE 7-7
Estimated Present Worth Cost of Industrial Treatment Alternatives
In 2008 Dollars

Item	Alternative IND 1A Store and Land Apply Industrial Flow in July through September	Alternative IND 2 Store Industrial Flow in July through September	Alternative IND 3 Treat Industrial Flow at POTW
Actual Industrial Flow			
Capital Cost	$3,400,000	$2,700,000	$1,800,000
Present Worth O&M Cost	$100,000	$700,000	$1,100,000
Total Present Worth Cost	$3,500,000	$3,400,000	$2,900,000
Allocated Industrial Flow			
Capital Cost	$8,200,000	$14,200,000	$16,300,000
Present Worth O&M Cost	$200,000	$300,000	$4,000,000
Total Present Worth Cost	$8,400,000	$17,200,000	$20,300,000

Non-Economic Evaluation of Industrial Alternatives

The non-economic factors for industrial treatment alternatives are compared in Table 7-8.

TABLE 7-8
Non-Economic Comparison of Industrial Treatment Alternatives

Evaluation Criteria	Alternative IND 1A Store and Land Apply Industrial Flow in July through September	Alternative IND 2 Store Industrial Flow in July through September	Alternative IND 3 Treat Industrial Flow at POTW
Performance	Decreases flow to be discharged under the NPDES permit.	Improves summer POTW performance by deferring discharge.	No change from current operation.
Beneficial to the Environment	Provides irrigation water and reduces discharge to the Pudding River.	Reduces summer discharge to the Pudding River.	Provides additional wetland acreage.
Flexible	No flexibility with industrial flows.	No flexibility with industrial flows.	Current operation provides dry weather flexibility.
Acceptable to the Public	Potential for odor at the storage lagoon and land application site.	Potential for odor at the storage lagoons.	No change from current operation.
Implementable	Requires purchase of storage and land application sites.	Requires purchase of acreage for storage lagoon.	No change from current operation. Ultimately requires purchase of additional poplar acreage.
Expandability	Difficult to expand storage volume.	Difficult to expand storage volume.	Would require POTW, wetland, and poplar expansion.
Reliability	Reliable treatment process.	Highly reliable.	No change from current operation.
Ease of Operation	Increased operational demands for remote treatment facility.	Increased operational demands for remote treatment facility.	No change from current operation.

7.3.6 Recommended Industrial Wastewater Treatment Management Strategy

The uncertainty of future industrial flows is a significant factor in planning of future industrial wastewater management. As shown in Table 7-7, for the actual industrial flows, it is most cost-effective to continue to treat the flow at the treatment plant through the planning horizon (year 2030). The results of this cost comparison are driven by the existing excess treatment capacity at the Woodburn POTW and the existing natural system acreage owned by the City. For actual industrial flows, the additional cooling wetland and poplar acreage required by the 2020 flows is still within the acreage owned by the City.

The existing treatment plant itself has adequate capacity for even the allocated industrial flow through the 2020 planning period. However, the City would need to acquire a significant amount of additional property to construct the natural treatment systems required by the fully allocated food processing flow. In addition, the proportional POTW capital and O&M cost for the industrial flow is significant for the fully allocated industrial flow. As a result, for the fully allocated flow, treating the flow separately, with land application near the food processing industries, is more cost-effective.

Although this facilities planning effort must take into account the allocated industrial flows for which the City is obligated to provide treatment, the reality is that industrial flows are significantly below the allocated values. Because of this, it is recommended that the City continue, in the near-term, to treat industrial flows at the POTW. At the same time, it is recommended that the City enter into discussions with industries to ascertain future plans and modify industrial waste discharge permits to more closely reflect actual practices.

In the long-term, capped thermal limits, municipal growth and/or higher industrial flows will increase the need to look at alternatives to treatment at the POTW and discharge to the Pudding River. Continued population growth and increased flows/loads from that growth will drive the City toward separate treatment of these food processing flows after the year 2020. Therefore, separately treating industrial flows by land application should remain as a long-term plan for the City and the City should consider the purchase of land for separate treatment of food processing flows in the vicinity of the existing food processing facilities.

7.4 Development of Municipal Wastewater Management Strategies

Satellite treatment with membrane-bioreactors (MBRs) was considered for a portion of the municipal flow with the goal of reducing effluent loading to the Pudding River and while providing a beneficial use.

Figures 7-3 and 7-4 illustrate the allowable summer-time Pudding River discharge, assuming an effluent ammonia concentration of 0.5 mg/L. For the purposes of this evaluation, it is assumed that temperature mitigation (described in Chapter 8) will allow discharge at the limits established by discharge ammonia criteria. (For a discussion about the relationship between temperature mitigation and ammonia criteria refer to Section 5.1.5, Design Concepts and Constraints and Figures 5-1 and 5-2.) Effluent flows in excess of this discharge restriction are used for poplar irrigation in July and August. The allowable irrigation rate in July and August is estimated to be 1.2 mgd for 112 acres of poplar trees. These 112 acres are composed of 80 existing planted acres as well as 32 acres of poplar tree expansion onto city-owned property. Figures 7-3 and 7-4 compare the total available volumetric effluent discharge to the Pudding River and poplar irrigation with the projected influent flows for 2020 (Figure 7-3) and 2030 (Figure 7-4). A satellite MBR facility must be sized for this difference so as to avoid an expansion of reuse facilities (poplar or other) at the POTW.

From Figures 7-3 and 7-4, it can be seen that the allowable discharges to the Pudding River and for poplar irrigation provide enough discharge capacity to accommodate projected influent flows through 2020 and comply with discharge limitations, but additional effluent discharge options are required for 2030 flows. Two options are available: (1) expand poplar reuse system by purchasing additional land or (2) perform satellite treatment with membrane-bioreactors (MBRs). With the second approach, MBRs would be installed out in the collection system. Effluent would be reused nearby and solids would be discharged to the sewer for conveyance to the POTW.

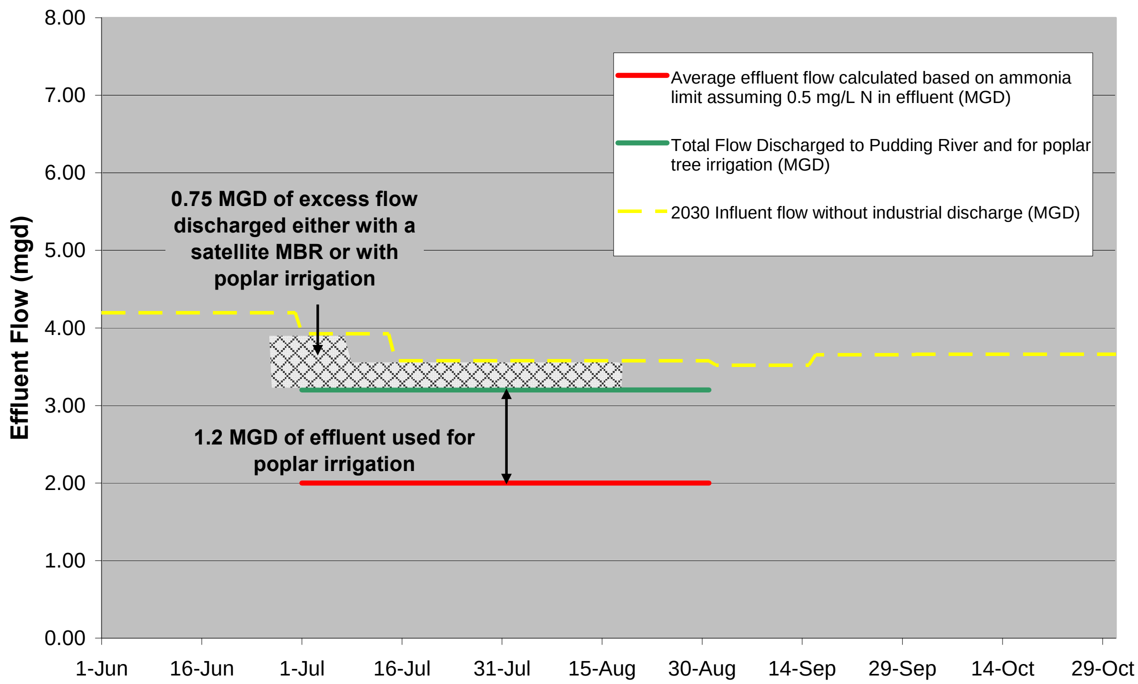

FIGURE 7-3
2020 Available Effluent Discharge Compared to Project Influent Flows

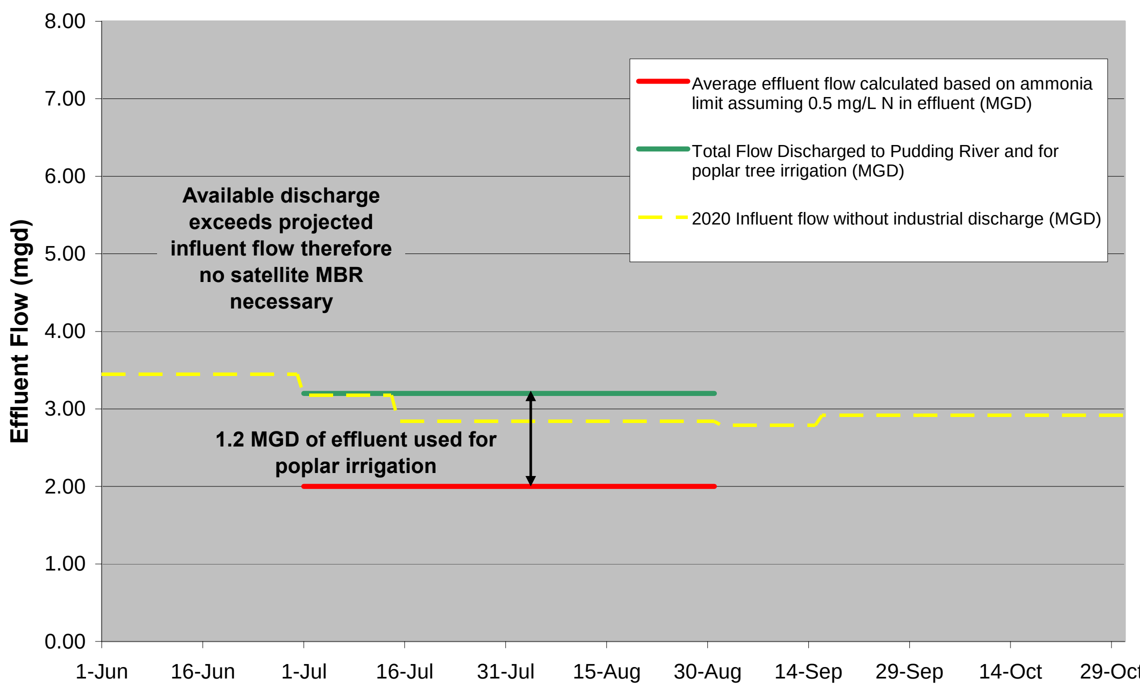

FIGURE 7-4
2030 Available Effluent Discharge Compared to Project Influent Flows

The capital cost of the MBR option is estimated to be $15 to $20 million compared to an estimated $3 million for land acquisition and development of an irrigation system to expand the popular reuse system. The order of magnitude costs for a satellite MBR system compared to poplar reuse system expansion eliminate satellite MBRs as an alternative. It may be worthwhile to consider satellite treatment sometime in the future if MBR costs come down and the right situation arises—for example, a new development with no sewers and a potential reuse customer nearby, such as a large golf course or nursery.

At present, the recommended strategy is to continue to treat all municipal flow at the Woodburn POTW. It should be noted that the poplar tree reuse systems are only irrigated in July and August. With an effluent ammonia concentration of 0.5 mg/L, there is still a flow imbalance at the treatment facility for the 2030 planning horizon as shown in Figure 7-4. If the treatment process can reliably achieve an effluent ammonia concentration of 0.3 mg/L, the volumetric flow imbalance is eliminated for the month of September.

7.5 Wastewater Treatment Alternatives

Flows and loads to the treatment plant continue to increase, based on population growth and industrial contributions. The expansion of the urban growth boundary in 2005 is resulting in the conveyance of additional flows and loads to the POTW, and the need to expand treatment facility capacity to accommodate those flows and loads. In addition, some of the existing treatment facilities require upgrades or improvements to effectively operate and maintain these systems. The following section briefly describes the existing unit processes (both liquid stream and solids), their specific needs and shortcomings, and the recommended upgrades. The existing POTW process flow is show diagrammatically in Figure 7-5.

7.5.1 Wastewater Treatment Plant Liquid Stream Treatment Alternatives

The existing liquid stream treatment processes are generally performing well. Some system components have remaining capacity, while others do not have sufficient capacity even for current conditions. This section describes the existing unit process facilities and the recommendations for expansion or upgrades to the existing liquid processes. These upgrades are driven by existing deficiencies, the treatment redundancy requirements of a Class I facility, continued growth and operational and maintenance improvements.

The existing component capacities along with future capacity requirements of the liquid stream treatment process are shown in Table 7-9. For each unit process, the table shows the basis for capacity, design criteria, existing capacity, and 2030 projections for municipal flows with industrial flows and without.

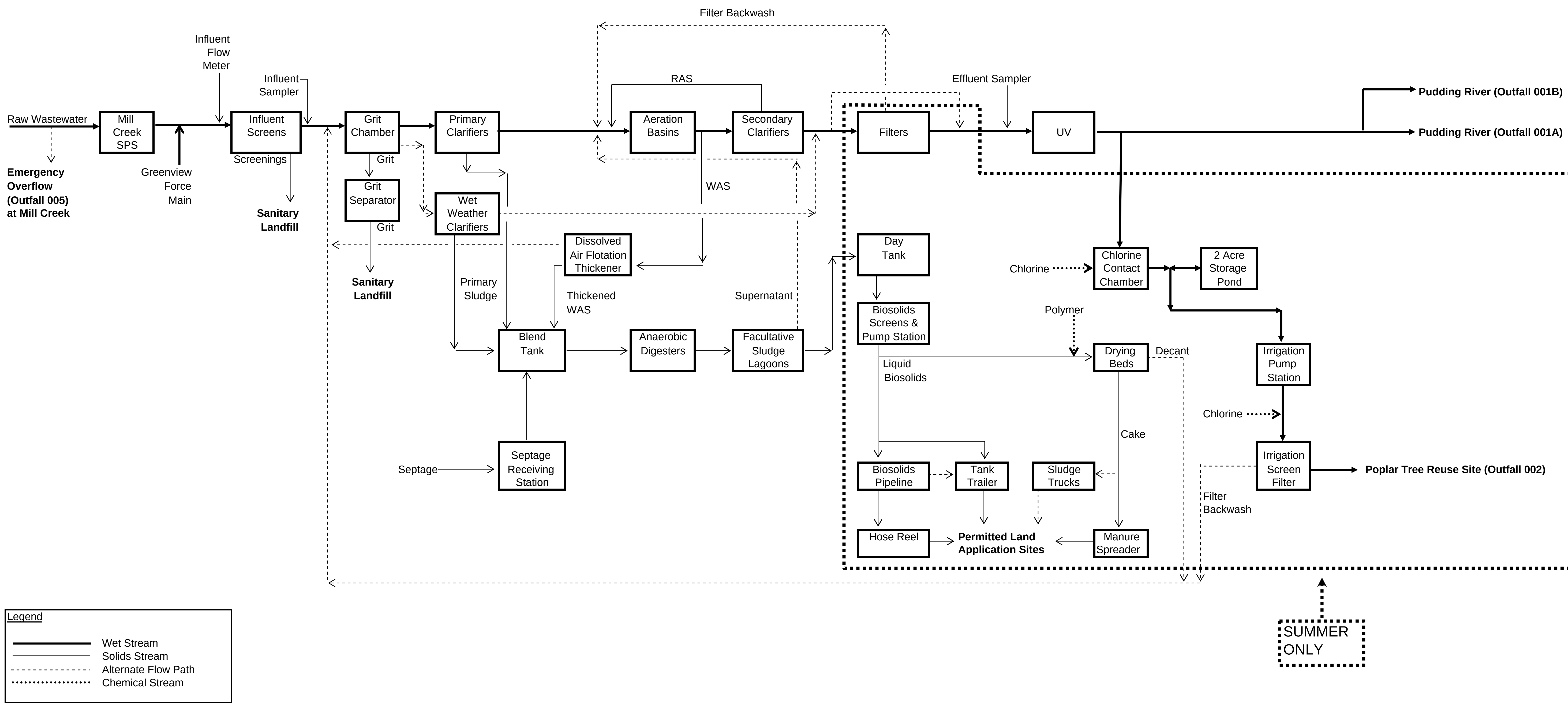

Figure 7-5
Existing Woodburn POTW Process Flow Diagram

TABLE 7-9
Liquid Stream Unit Process Capacity

			Existing Capacity		2030 Projections	
Unit Process	**Basis for Capacity**	**Design Criteria**	**Firm Capacity**	**Total Capacity**	**Actual Industrial Flows**	**Allocated Industrial Flows**
Screening	Peak Hour Flow	Headloss	16 mgd	16 mgd	NA	26 mgd
Grit Removal	Peak Hour Flow	Headloss	16 mgd	16 mgd	NA	26 mgd
Primary Sedimentation	Peak Hour Flow	2,500 gpd/sf	12	12	NA	26 mgd
Aeration Basin (summer)	MMDW aerobic SRT (ppd PE BOD)	12 days	7,500 ppd	7,500 ppd	5,500 ppd	8,600 ppd
Aeration Blowers (summer)	MDDW Load (ppd PE BOD, ppd PE NH_4)		4,200 scfm	6,300 scfm	4,700 scfm	6,900 scfm
Secondary Clarification (summer)	MDDW SLR	25 ppd/sf	6.2 mgd	8.3 mgd	6.3 mgd	7.4 mgd
Aeration Basin (winter)	MMWW aerobic SRT (ppd PE BOD)	5 days	11,030 ppd	11,030 ppd	NA	10,900 ppd
Aeration Blowers (winter)	MDWW Load (ppd PE BOD, ppd PE NH_4)		4,200 scfm	6,300 scfm	5,600 scfm	7,400 scfm
Secondary Clarification (winter)	MDWW SLR	35 ppd/sf	10.4 mgd	13.9 mgd	NA	20.6 mgd
	Peak Hour Hydraulic Loading Rate	1,500 gpd/sf	17.7 mgd	19.8 mgd	NA	26 mgd
Filtration	MDDW Flow	3 gpm/sf*	3.2 mgd[1]	6.4 mgd[1]	6.3 mgd	7.4 mgd
UV Disinfection	Peak Hour Flow	$mW\text{-}sec/cm^2$	12 mgd	12 mgd	NA	26 mgd
Outfall	Peak Hour Flow	100 yr flood El.	NA	17.3 mgd	NA	26 mgd

*Capacity based on filter design criteria; however, plant staff indicates filters perform at a significantly lower loading rate.

Preliminary Treatment

The headworks or preliminary treatment system consists of two back-raked mechanically-cleaned bar screens and two vortex grit removal systems. The headworks are not enclosed.

Influent Screens

The screening area of the headworks consists of three channels, two of which are equipped with John Munier Cont-Flo bar screens with 7/16-inch openings. The center channel currently serves as a bypass channel and was designed to be equipped with a third screen. The capacity of each existing bar screen is 8 million gallons per day. To pass the design peak hour flow of 26 mgd, an additional 10 mgd of capacity must be added.

For the 2030 planning horizon, two alternatives were considered for expansion of the influent screens:

- **Alternative SC1: Add a Third Screen in a New Channel**. In this alternative, the headworks would be expanded to add a fourth channel with a new back-cleaned mechanical screen. The existing empty channel would remain as a bypass channel. The spacing of the channels in the existing headworks structure is not adequate for a new screen and maintenance access between the screens. The capacity of the three screens would be 26 mgd. The new channel would include isolation gates. The screenings conveyor/compactor would be extended to the third screen. The capital cost for this alternative includes the headworks expansion, a third bar screen, gates, extension of the screenings conveyor/compactor, and a small electrical building to house electrical equipment for the headworks equipment.
- **Alternative SC2: Increase Capacity of Existing Screening Channels**. In this alternative the existing two mechanically-raked screens would be replaced with newer technology that provides higher capacity in the same channel. Continuously-cleaned bar screens such as Mahr or Huber would provide a capacity of 13 mgd in each of the two channels. To meet Class I reliability criteria, a manual bar screen would be installed in the middle channel. A new washer compactor would be provided. The capital cost for this alternative includes equipment and housing for electrical equipment.

Estimated present worth costs for the screening alternatives are presented in Table 7-10. Operation and maintenance costs include an allowance for weekly maintenance, annual preventive maintenance and power. Slightly higher maintenance labor requirements were allocated to the existing equipment because of its age. Non-economic evaluation of the screening alternatives is summarized in Table 7-11.

TABLE 7-10
Screening Alternative Cost Estimates

Item	Alternative SC1: Add a Third Screen in a New Channel	Alternative SC2: Increase Capacity of Existing Screening Channels
Capital Cost	$1,300,000	$1,900,000
Annual Operation and Maintenance Costs	$23,000	$15,000
Present Worth O&M Costs	$380,000	$220,000
Total Present Worth Cost	$1,700,000	$2,000,000

TABLE 7-11
Non-Economic Evaluation of Screening Alternatives

Evaluation Criteria	Alternative SC1: Add a Third Screen in a New Channel	Alternative SC2: Increase Capacity of Existing Screening Channels
O&M Considerations	Existing equipment is aging. More equipment to maintain.	Modern technology reduces O&M requirements. Fewer units to maintain.
Performance	Reliable	Reliable
Reliability	Aging equipment is less reliable	Superior performance
Flexibility	Three units provide more flexibility	Meets redundancy standards with manual screen
Complexity	Same as existing	Same as existing
Energy Use	Same as existing	Same as existing

At a planning level, if costs for alternatives are within 10 percent of each other, they should be considered equal given the level of accuracy of the estimate. Based on the information presented in Tables 7-10 and 7-11, Alternative SC2 is recommended. This will allow for a cleaner installation and greater flexibility for future headworks capacity upgrades.

Grit Removal

The existing grit removal system includes two Jones and Atwood induced vortex units, each with a capacity of 8 mgd. The addition of a third and fourth grit chamber is required. Previous expansions and upgrades to headworks provided for the addition of a third influent grit channel. Therefore, capital costs presented here include two 8 mgd circular vortex concrete tanks, grit traps, mounted grit pumps, and classifiers with cyclones. The estimated capital cost for the additional grit basins is $2,600,000. Hydraulic modifications to the Headworks may be required to accommodate the fourth grit unit.

Primary Treatment

The primary treatment system at the POTW includes two primary clarifiers and two wet weather clarifiers. The wet weather clarifiers, secondary clarifiers in the original plant, sit lower on the hydraulic profile, just upstream of disinfection. There are no dedicated sludge pumping facilities associated with the wet weather clarifiers; rather, collected sludge is discharged to the plant drain system and reintroduced into the head of the plant. Although the current process design allows wet weather clarifier effluent to bypass secondary treatment and go directly to disinfection to offload the secondary process during high flows, plant staff has not used this ability to split primary influent. The mechanisms in the wet weather clarifiers are beyond their useful life and would require replacement if they were to be used.

The total capacity of the two existing primary clarifiers is 12 mgd.

For the 2030 planning horizon, the following alternatives were considered for primary treatment:

- Alternative PC1: Construct three new primary clarifiers
- Alternative PC2: Split treatment using wet weather clarifiers and add a primary clarifier
- Alternative PC3: Convert wet weather clarifiers to primary clarifiers and add a primary clarifier

These alternatives are described below.

Alternative PC1: Construct Three New Primary Clarifiers

With this alternative, three new primary clarifiers would be constructed. The clarifiers would be the same diameter as the existing clarifiers, but would be designed with the currently accepted design depth of 14 feet. The total capacity of the clarifiers would be 30 mgd. A new primary sludge pump station would be constructed to serve two of the new clarifiers; a fourth primary sludge pump would be added to the existing sludge pumping system to serve one of the new clarifiers. The primary splitter box was designed for the addition of one additional clarifier and would need to be modified. All primary effluent would go to secondary treatment.

Alternative PC2: Split Treatment Using Wet Weather Clarifiers and Add a Primary Clarifier

With this alternative, one new primary clarifier would be constructed and the wet weather clarifiers would be used for flows that exceed 18 mgd. Primary effluent from the two existing primary clarifiers and new primary clarifier would flow to secondary treatment. A new primary sludge pump station would be constructed to serve the wet weather clarifiers; a fourth primary sludge pump would be added to the existing sludge pumping system to serve the new clarifier. Effluent from the wet weather clarifiers would go directly to disinfection. This flow stream would be blended with secondary effluent to meet discharge requirements. Since flow from the wet weather clarifiers cannot hydraulically go to secondary treatment, it is questionable whether this alternative would accepted as meeting Reliability Class I requirements for primary treatment.

Alternative PC3: Convert Wet Weather Clarifiers to Primary Clarifiers and Add a Primary Clarifier

This alternative would provide full treatment for 26 mgd. The wet weather clarifiers would be rehabilitated and a primary effluent pump station would be constructed to lift flow from the wet weather clarifiers to secondary treatment. Primary sludge from the wet weather clarifiers would be pumped with a new primary sludge pump station located at the existing wet weather clarifiers to the sludge blending tank. A new primary clarifier would be constructed, an additional pump would be added to the existing primary sludge pump station and electrical/mechanical would be retrofitted.

Economic Evaluation

Estimated costs of the primary treatment alternatives are summarized in Table 7-12.

TABLE 7-12
Estimated Cost of Primary Treatment Alternatives
In 2008 Dollars

Item	Alternative PC1: Construct Three New Primary Clarifiers	Alternative PC2: Split Treatment Using Wet Weather Clarifiers and Add a Primary Clarifier	Alternative PC3: Convert Wet Weather Clarifiers to Primary Clarifiers and Add a Primary Clarifier
New Primary Clarifiers	$7,100,000	$2,400,000	$2,400,000
New Primary Sludge Pump Station	$700,000	$800,000	$700,000
Add additional Primary Sludge Pump	$50,000	$50,000	$50,000
Rehabilitate Wet Weather Clarifiers	-	$1,000,000	$1,000,000
New Primary Effluent Pump Station	-		$2,950,000
Total	$7,850,000	$4,150,000	$7,100,000

The operation and maintenance costs for the three primary treatment alternatives include the operation of the primary clarifiers under average condition and are equal for the alternatives. Therefore, they were not calculated for this evaluation. Since the energy cost associated with the primary effluent pump station is very infrequent, it does not represent a significant cost on a present worth basis.

Non-Economic Evaluation

The non-economic factors for primary treatment alternatives are compared in Table 7-13.

TABLE 7-13
Non-Economic Comparison of Primary Treatment Alternatives

Evaluation Criteria	Alternative PC1: Construct Three New Primary Clarifiers	Alternative PC2: Split Treatment Using Wet Weather Clarifiers and Construct One Primary Clarifier	Alternative PC3: Convert Wet Weather Clarifiers to Primary Clarifiers and Construct One Primary Clarifier
O&M Considerations	O&M requirements comparable to existing.	Requires startup and shutdown of wet weather clarifiers.	Adds a pump station.
Reliability	Highly reliable.	Likely does not meet Class I reliability criteria.	Satisfactory reliability.
Performance	New deeper clarifiers would provide superior performance.	Not reliable at high flows.	Comparable to existing.
Flexibility	Most flexible.	Does not provide flexibility.	Somewhat flexible.
Complexity	Comparable to existing. Least complex.	Requires startup and shutdown of wet-weather clarifiers.	Two hydraulic grade lines. Most complex.

TABLE 7-13
Non-Economic Comparison of Primary Treatment Alternatives

Evaluation Criteria	Alternative PC1: Construct Three New Primary Clarifiers	Alternative PC2: Split Treatment Using Wet Weather Clarifiers and Construct One Primary Clarifier	Alternative PC3: Convert Wet Weather Clarifiers to Primary Clarifiers and Construct One Primary Clarifier
Energy Use	Comparable to existing.	Relatively low energy use.	Relatively high energy use due to re-pumping of flow under high flow conditions.

Alternative PC3 is recommended due to the lower capital cost and reliance on existing infrastructure.

Secondary Treatment Alternatives

The secondary treatment process consists of two aeration basins and three secondary clarifiers, return activated sludge (RAS), and waste sludge (WAS) pumping systems. The process provides CBOD and TSS removal year-round as well as enhanced nitrification in the dry weather permit season and minimal nitrification in the wet weather permit season. The aeration basins are equipped with selectors for alkalinity recovery and filamentous control.

Secondary treatment capacity must be evaluated on both a dry and wet weather basis. In the dry weather, the capacity of the system is controlled by the capacity of the biological process. In wet weather, hydraulic capacity is usually limiting and the aeration basins and the secondary clarifiers are integrated in the evaluation.

Dry Weather

The impact of the industrial CBOD contribution is significant in the summer and must be taken into account in the evaluation of the capacity of the aeration basins. Table 7-14 presents the anticipated summer design loadings and capacity of the secondary system. The table shows that the existing process has adequate capacity in the summer months if industrial flow is treated separately. Therefore, no basin capacity improvements are required for the dry weather season; however, additional blower capacity is required. The estimated cost to replace the two smaller 1,050 scfm blowers with 3,000 scfm blowers is $800,000. It is assumed the existing aeration piping is adequate. The existing diffusers have capacity to handle the projected air demands.

TABLE 7-14
Dry Weather Capacity of the Secondary Process

			Existing Capacity		2030 Projections	
Unit Process	**Basis for Capacity**	**Design Criteria**	**Firm Capacity[a]**	**Total Capacity**	**Actual Industrial**	**Allocated Industrial**
Aeration Basins	MMDW aerobic SRT (ppd PE BOD)	12 days[b]	7,500 ppd	7,500 ppd	5,500 ppd	8,600 ppd
Aeration Blowers	MDDW Load (ppd PE BOD, ppd PE NH_4)		4,200 scfm	6,300 scfm	4,700 scfm	6,900 scfm
Secondary Clarifiers	MDDW SLR	25 ppd/sf	6.2 mgd[c]	8.3 mgd[c]	6.3 mgd	7.4 mgd

[a] Per DEQ Reliability and Redundancy Requirements.
[b] Based on MLSS = 3,500 mg/L and yield = 0.6 lb WAS/lb BOD.
[c] Based on SVI = 200, MLSS = 3,000, and RAS rate of 60 percent.

Wet Weather

Table 7-15 presents the design wet weather loading and capacity of the secondary treatment process. The table shows that the existing process does not have adequate capacity in the wet weather months.

TABLE 7-15
Wet Weather Capacity of the Secondary Process

			Existing Capacity		2030 Projections	
Unit Process	**Basis for Capacity**	**Design Criteria**	**Firm Capacity[a]**	**Total Capacity**	**Actual Industrial**	**Allocated Industrial**
Aeration Basins	MMWW aerobic SRT (ppd PE BOD)	5 days[a]	11,030 ppd	11,030 ppd	N/A	10,900 ppd
Aeration Blowers	MDDW Load (ppd PE BOD, ppd PE NH4)		4,200 scfm	6,300 scfm	N/A	7,400 scfm
Secondary Clarifiers	MDWW Solids Loading Rate (SLR)	35 ppd/sf	10.4 mgd[b]	13.9 mgd[b]	N/A	20.6 mgd
Secondary Clarifiers	Peak Hour Hydraulic Loading Rate	1,500 gpd/sf	17.7 mgd	19.8 mgd	N/A	26 mgd

[a] Based on MLSS = 2,500 mg/L and Yield = 0.7 lb WAS/lb BOD.
[b] Based on SVI = 200, MLSS = 2,500, and RAS rate of 60 percent.

The existing aeration basins were designed with a great amount of flexibility. Each basin includes four selector zones that can be operated as anoxic or aerobic zones. Primary effluent can be introduced into any of these four zones. RAS is introduced into the first zone. These components allow for various process configurations to optimize treatment and manage flows. The NPDES permit around which the system was designed included strict summer ammonia discharge requirements. These requirements likely served as the controlling condition for the secondary system design. Winter nitrification was not a specific design consideration, but the secondary treatment system can be operated to meet this winter condition as well.

During winter conditions, nitrification becomes more difficult as increased wet weather flows and lower temperatures require additional basin volume for complete nitrification. Woodburn staff has not been required to nitrify in the winter, and, therefore, typically used just one basin during those periods. Nitrification often occurred anyway due to low flows and high dissolved oxygen (DO) levels in the basins.

The Pro2D process model calibrated for winter conditions was used to ascertain the capability of the existing facility to meet the revised winter ammonia permit limits. Table 7-16 summarizes the major process criteria and assumptions used in the modeling effort. These criteria and assumptions were based on historical plant process data for winter operation.

TABLE 7-16
Process Criteria and Assumptions

Influent Parameter	Parameter
Minimum wastewater temperature, °F	58
Minimum wet weather influent pH	6.6
Solids retention time, days	6
Sludge volume index	200
Mixed liquor suspended solids concentration @ Max Month, mg/L	3,500

The assumptions used for this capacity evaluation are based on the minimum wastewater temperature occurring under the highest winter flow and load conditions with the most stringent ammonia requirement. Taken together, this is a very conservative basis upon which to evaluate capacity. The model also assumed recycle from the thickening process and facultative sludge lagoons was approximately 2 percent of influent flows and the ammonia load in the recycle was approximately 13 percent of the influent ammonia load. The aeration basin configuration used was based on the Modified Ludzack-Ettinger (MLE) configuration, which is the configuration typically used at the facility. This configuration introduces all primary effluent, mixed liquor recycle, and RAS flow through the first cell of the basin. The first four cells are maintained as anoxic zones, and the remaining two cells are maintained as aerobic zones.

The process modeling indicates that with both basins online there is adequate volume in the existing aeration basins to nitrify in the winter, meeting the most stringent ammonia permit limit of 5.7 mg/L (on a monthly average) under both current and 2020 conditions. There is currently sufficient blower capacity to facilitate this level of nitrification, though additional blower capacity is required to meet 2020 conditions.

However, under peak wet weather events, there is insufficient secondary clarifier capacity. In order to nitrify, the solids retention time (SRT) and associated mixed liquor suspended solids (MLSS) must be increased. This results in a significant increase in the solids loading to the secondary clarifiers.

The proposed alternatives for evaluation are:

- Blower and Aeration System Upgrades

In conjunction with one of these alternatives:

For the 2030 planning horizon, two wet weather alternatives were considered for process expansion:

- Alternative SP1: Construct one aeration basin and one secondary clarifier
- Alternative SP2: Construct contact stabilization modifications to the aeration basins and one secondary clarifier

The proposed alternatives represent two approaches to alleviating the secondary clarifier capacity shortfall. The first is a capital solution and the second is an operational solution. Both were evaluated to ensure permit compliance and incorporate operational flexibility, allowing plant staff to meet permit conditions in the most cost-effective means possible.

Blower and Aeration System Upgrades

The aeration control system has historically presented operational challenges, which have compromised the ability to optimize process performance. A key indicator of process stability is sludge volume index (SVI), which is the measure of the settling characteristics of an activated sludge system. Poor settling directly increases the risk of a permit violation. Figure 7-3 illustrates the process performance of the secondary system at Woodburn.

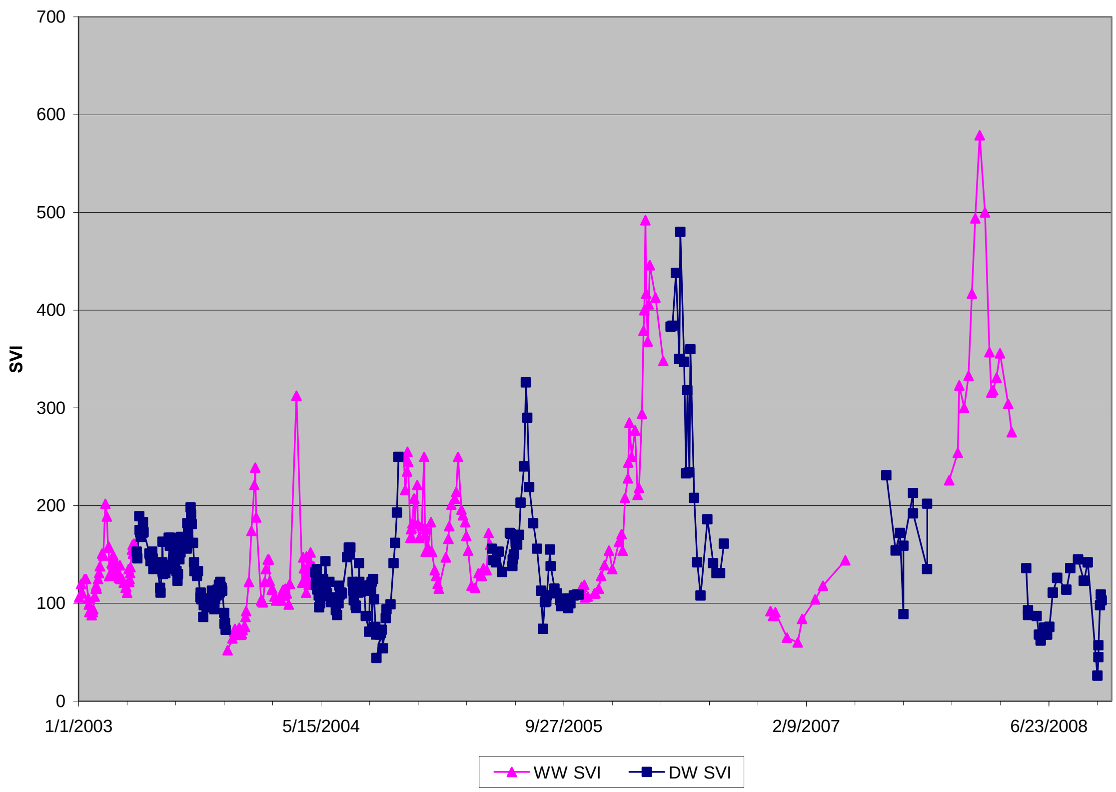

FIGURE 7-6
Historical Secondary Performance, as a Function of SVI

This unsatisfactory performance has not resulted in permit violations because the secondary process is not operating near its rated capacity. As flows and loads increase, the risk of permit violation increases if a settleable sludge is not reliably and consistently produced.

It is believed that the major reason for this instability is the poor DO and blower control, documented in Section 3, Existing Wastewater Treatment Facilities. Complete rework of that system (valves, instrumentation and control system) is recommended as an early project to define the design SVI that can be utilized for the secondary design. The estimated cost for this modification is $500,000.

For the purposes of this evaluation, a design SVI of 200 is utilized. As shown in Figure 7-6, this is much lower than what has been observed at the facility. As a point of comparison, a well designed secondary process should expect to see maximum SVIs in the range of 120 to 150. Resolving this process performance issue is critical to the sizing of the secondary process and will result in significant cost savings to the proposed secondary improvements.

This improvement relates to winter ammonia removal since the increased solids loading to the clarifiers drives additional clarification capacity. Controlling SVI is the most cost-effective manner to retain solids within the secondary process and ensure process control. The recommended blower and DO control modifications will also enhance the robustness of the secondary process during peak wet weather events that represent the highest stress to the system.

Alternative SP1: Construct One Aeration Basin and One Secondary Clarifier

With this alternative, one new aeration basin would be constructed to the north of the existing basins and one new secondary clarifier would be constructed to round out the quad with the existing three. The aeration basin would be the same layout and dimensions as the existing aeration basins. This additional aeration volume would drop the mixed liquor concentration, reducing the loading on the secondary clarifiers, bringing the solids loading rate within acceptable design criteria with the inclusion of the fourth clarifier. The basin would incorporate a new influent feed channel. The original aeration basin design anticipated an additional aeration basin, so little modification of the effluent channels is expected. The new secondary clarifier would be the same size, depth, and configuration as the existing secondary clarifiers. The original flow split anticipated four clarifiers, so little modifications to the flow split mechanism are anticipated.

Alternative SP2: Construct Contact Stabilization Modifications and One Secondary Clarifier

This alternative provides an operational solution to the capacity shortfall, rather than a capital-intensive solution. The current design is based on passing peak flows through the entire basin during wet weather flows. This places the design point for the secondary clarifiers at a maximum day event, with a solids loading rate based on a mixed liquor concentration of 3,500 mg/L. This alternative allows for introduction of primary effluent to the midpoint of the aerated volume rather than the front end of the basin. This strategy stores solids in Cells 1 through 5 at RAS concentrations during wet weather events, thus greatly reducing the solids load on the secondary clarifiers. This is essentially a contact stabilization operation. Operation in this mode essentially eliminates all solids loading limitations, and the secondary capacity is limited only by hydraulic capacity.

This capability can be fairly simply provided by installing a pipe (or two, depending on structural requirements) from the influent channel through the anoxic zone into the aerated zone. The piping would have an isolation valve in the influent channel that would allow for diversion of flow to the midpoint of the aerated zone under high flow conditions. This is functionally identical to the current ability to divert influent flow to any of Cells 1 through 4.

One new secondary clarifier would be constructed to round out the quad with the existing three. The additional secondary clarifier is required to meet peak hour hydraulic loading criteria while provide adequate redundancy per Class I requirements. The new secondary clarifier would be the same size, depth, and configuration as the existing secondary clarifiers. The original flow split anticipated four clarifiers, so little modifications to the flow split mechanism are anticipated.

Alkalinity considerations

Since the nitrification process utilizes alkalinity, the requirement to nitrify in the winter suggests an evaluation of the need for alkalinity addition at the POTW. This was evaluated based on process monitoring data collected from December 2, 2009 through April 7, 2009.

Nitrification consumes alkalinity at a rate of 7.2 mg as $CaCO_3$ per mg NH4-N nitrified. To maintain a stable effluent pH, the influent wastewater must have at least this ratio of influent alkalinity to influent ammonia. Additionally, there should be excess alkalinity remaining in the water after treatment to ensure it has adequate buffering capacity to avoid unexpected pH shifts – especially when the treatment facility is operating under permit required effluent pH limits. To keep the effluent alkalinity above 50 mg/L as $CaCO_3$, the required influent alkalinity to ammonia ratio should be 8–12 g as $CaCO_3$ to g NH_4-N depending on the influent ammonia concentration.

The analysis assumed complete nitrification of all incoming ammonia and no alkalinity recovery from nitrification. Table 7-17 summarizes the results of this analysis.

TABLE 7-17
Summary of Alkalinity Data and Analysis

Date	Influent NH_4-N (mg/L)	Influent alkalinity (mg/L as $CaCO_3$)	Measured ratio (mg as $CaCO_3$/mg NH_4-N)	Required ratio (mg as $CaCO_3$/mg NH_4-N)	Potential Alkalinity limitation?
12/16/08	47.8	307	6.42	8.25	Y
12/23/08	41.6	279	6.71	8.40	Y
2/11/09	28.8	260	9.03	8.94	
2/12/09	26.6	291	10.94	9.08	
2/17/09	27.2	249	9.15	9.04	
2/19/09	34.9	230	6.59	8.63	Y
2/26/09	25.9	223	8.61	9.13	Y
3/10/09	28.9	220	7.61	8.93	Y
3/19/09	41.2	400	9.71	8.41	
3/31/09	22.6	242	10.71	9.41	
4/2/09	18.2	209	11.48	9.95	
4/7/09	30.0	239	7.97	8.87	Y

The results in Table 7-17 show that the average measured alkalinity to ammonia ratio is just below the required ratio in six of the twelve measurements. Thus, if the POTW were to completely nitrify the influent ammonia concentrations measured on these dates, a low effluent pH could result. The POTW did not consume all the available alkalinity during the dates shown in Table 1, however, because the treatment plant was able to recover some alkalinity through denitrification. Based on the above data set, if denitrification can be reliably provided, alkalinity addition is not required. Proposed modifications to the blower and DO control systems will provide a more robust system, resolving some of the control issues that have led to loss of denitrification (and its corresponding alkalinity recovery) in the past. It is recommended that infrastructure to allow alkalinity addition be further considered during the Predesign process based on additional data.

Economic Evaluation

Estimated costs of the secondary treatment alternatives are summarized in Table 7-18.

TABLE 7-18
Estimated Cost of Secondary Treatment Alternatives

Item	Alternative SP1: One Aeration Basin and One Secondary Clarifier*	Alternative SP2: Contact Stabilization and One Secondary Clarifier*
New Aeration Basin	$4,300,000	-
New Secondary Clarifier	$2,500,000	$2,500,000
Blower and DO Control Upgrades	$1,300,000	$1,300,000
Contact Stabilization Modifications	-	$300,000
Total	$8,100,000	$4,100,000

*Costs are in 2008 Dollars.

Non-Economic Evaluation

The non-economic factors for secondary treatment alternatives are compared in Table 7-19.

TABLE 7-19
Non-Economic Evaluation of Secondary Process Alternatives

Evaluation Criteria	Alternative SP1: One Aeration Basin and One Secondary Clarifier	Alternative SP2: Contact Stabilization Modifications and One New Secondary Clarifier
O&M Considerations	O&M requirements comparable to existing.	O&M requirements comparable to existing.
Reliability	Highly reliable.	Highly reliable.
Performance	Comparable to existing.	Comparable to existing.
Flexibility	Less aeration basin flexibility in wet weather.	Provides flexibility with existing tankage.
Complexity	Comparable to existing.	Requires operation modification during wet weather.
Energy Use	Comparable to existing.	Comparable to existing.

Alternative SP2 is recommended due to the lower cost and enhanced system flexibility.

Tertiary Treatment

Tertiary treatment consists of two dual media filters. The filters are used in the summer discharge season to achieve a reliable effluent TSS concentration of 10 mg/L. Total filter design rated capacity is 6.4 mgd maximum day dry weather flow (MDDWF). However, plant staff indicates that the filters are operationally limited at approximately 3 mgd total flow to filters. This appears to be due to a limited ability to build up enough head to drive flow through the filters. If the existing filters are kept, additional monitoring and evaluation is recommended to define the true capacity of the filtration system.

The design MDDWF is 6.3 mgd if industrial flow is treated separately. Class I reliability criteria require that the filters be able to treat 75 percent of the design flow, or 4.7 mgd with one unit out of service.

In lieu of constructing additional filters the necessary reliability can be provided through reliance on the natural treatment systems. Since the filters operate only in the dry season, scheduled or routine maintenance could be performed when they are not in use. In addition, Woodburn's natural treatment systems provide flexibility so that a portion of the effluent could bypass filters, be disinfected, and still be reliably treated or reused (Class D) should a filter be unavailable as illustrated in Figure 7-7.

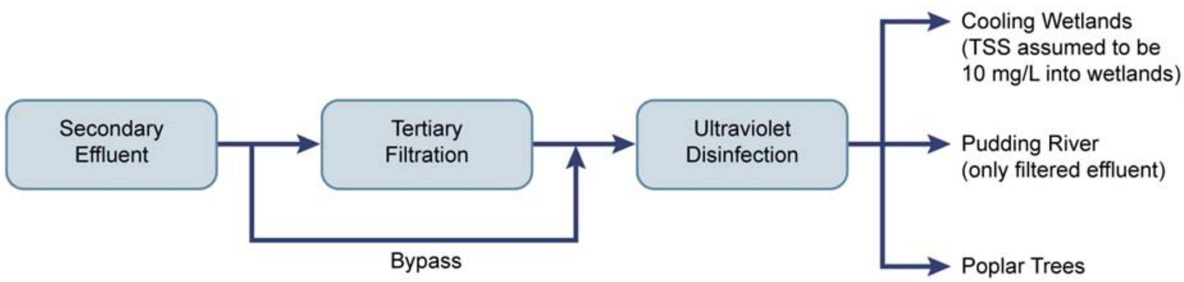

FIGURE 7-7
Tertiary Filtration Flow Diagram

As shown, secondary effluent could be disinfected and discharged to the wetlands. It is anticipated that the compliance point for TSS will be upstream of the wetlands. Operating experience has shown that the 10 mg/L limit can normally be met upstream of the filters.

For the 2030 planning horizon, two alternatives were considered for process expansion:

- Alternative F1: Expand existing sand filter
- Alternative F2: Replace existing filters with higher capacity/newer technology filters

Economic Evaluation

Estimated costs of the filtration alternatives are summarized in Table 7-20.

TABLE 7-20
Economic Evaluation of Filtration Alternatives

Item	Alternative F1: Add New Filter	Alternative F2: Replace with New Technology
Capital Cost	$2,400,000	$1,900,000
Present Worth O&M Cost	$16,700	-
Total Present Worth Cost	$2,400,000	$1,900,000

Costs are in 2008 dollars.

Non-Economic Evaluation

The non-economic factors for the filtration alternatives are compared in Table 7-21.

TABLE 7-21
Non-Economic Evaluation of Filtration Alternatives

Evaluation Criteria	Alternative F1: Construct Third Filter	Alternative F2: Alternative Filtration Technology
O&M considerations	O&M requirements comparable to existing	Modern technology reduces O&M requirements
Performance	Reliable	Reliable
Reliability	Historically underperforms	Superior performance
Flexibility	Three units provide more flexibility	Two units provide less flexible than three
Complexity	Same as existing	Package unit provides simplicity
Energy use	Same as existing	Relatively low energy use

Alternative F2 is recommended due to the lower cost and enhanced performance and reliability.

Disinfection

The existing disinfection system consists of ultraviolet light (UV) disinfection for Pudding River discharge. Supplemental disinfection is provided by sodium hypochlorite for flow used for poplar tree irrigation as required under the existing NPDES permit.

The UV system consists of two channels equipped with Trojan 4000 medium pressure systems. The capacity of each channel is 6 mgd and is expandable with the addition of another module to 8 mgd per channel.

For the 2030 planning horizon, additional capacity will need to be added as shown in Figure 7-8 at an estimated capital cost of $3,800,000 for UV disinfection capacity improvements.

The new reuse regulations (see Section 5) provide for application of Class D recycled water on the poplar trees. The existing UV system is adequate to meet the disinfection requirements for Class D water, which represent the same pathogen limitations included in the NPDES permit for effluent discharge to the Pudding River. By changing the recycled water quality requirements from a Class B equivalent to Class D, the City could eliminate the need for additional chlorination within the chlorine contact chamber prior to poplar tree irrigation. This practice is currently needed in order to provide enough contact time in order to meet the Class B (Level III) pathogen requirements. In the future water sent to the constructed wetlands would most likely be conveyed through the chlorine contact chamber. Continued addition of chlorination within this chamber would present a challenge for flow separation between water sent to the poplars and water directed to wetlands followed by river discharge. Changing the recycled water classification in the permit would eliminate this problem. To avoid regrowth and subsequent clogging of the irrigation equipment, however, it is recommended that the City continue limited hypochlorite application in their recycled water, which could be injected into existing ports in the irrigation pipeline downstream of the irrigation screen filters.

According to the manufacturer, the UV equipment can also provide adequate disinfection for more restrictive recycled water uses for smaller flows. For example, with the expanded system, one channel could be used to provide disinfection for up to approximately 2 mgd of Class A, B, or C recycled water. However, to use in this manner, channel modifications are required to allow for one UV bank to be isolated to deliver a side stream Class A, B, or C reuse flow. As upgrades to the UV system occur, incorporation of this feature should be considered.

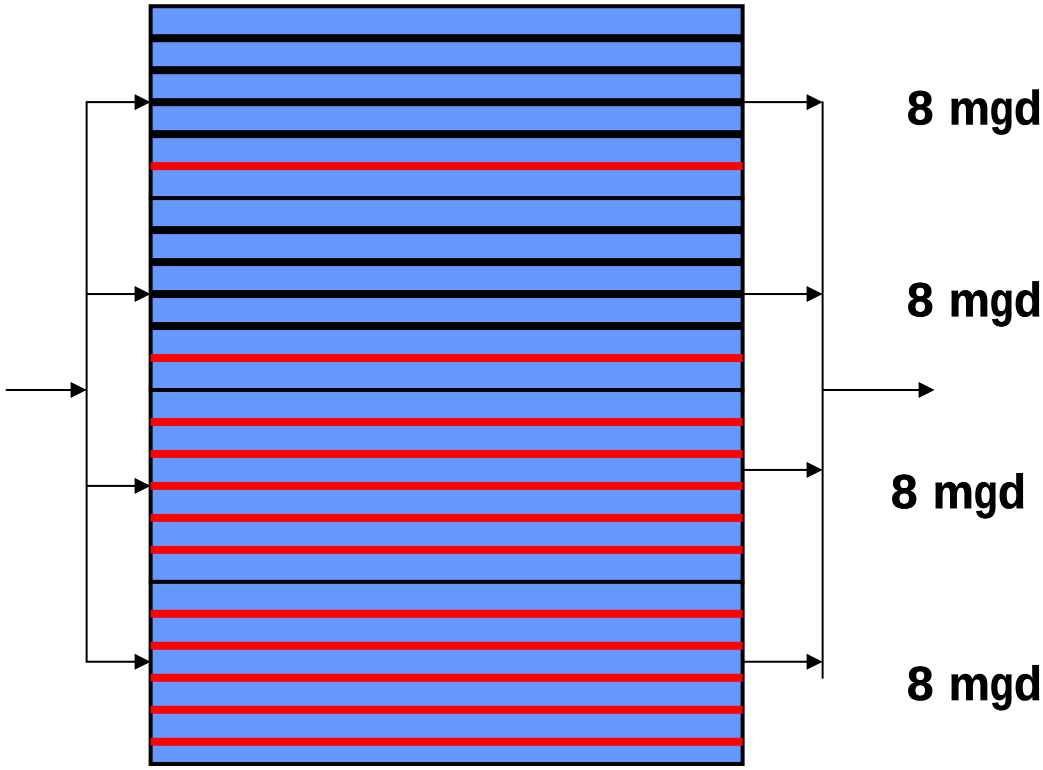

FIGURE 7-8
UV Disinfection Upgrade for 2030
Black represents existing; red represents new.

With the shift in disinfection requirements for flow delivered to the poplars, the amount of hypochlorite dosed to the reuse system can be greatly reduced. A new hypochlorite facility, sized specifically for maintaining a residual within the irrigation and plant water systems, and coupled with non-process water system improvements is recommended.

Outfall

Currently, flow is normally discharged to the Pudding River via Outfall 001A, which enters the Pudding River at River Mile 21.5. Outfall 001A consists of 2,120 feet of buried 24-inch concrete cylinder pipe to the manhole at the top of the river bank (MH-2). From MH-2 at the top of the river bank slope, the outfall pipe is 18-inch steel pipe with a 30-foot section of corrugated 20-inch steel pipe inserted for effluent re-aeration followed by 18-inch steel pipe to MH-3 on the river bank slope (80-foot length). The last 40 feet of buried outfall pipe consists of 24-inch steel pipe from MH-3 to outfall terminus.

The outfall is equipped with a reaeration structure to assist with maintaining a minimum dissolved oxygen (DO) level in plant effluent. Calculations show that the outfall capacity is approximately 12 mgd at the 100-year flood level in the river. Sampling has shown that the plant complies with the DO requirements upstream of the reaeration structure. Experience has shown, and calculations confirm, that the reaeration structure is a hydraulic bottleneck. Providing a bypass around the structure would increase outfall capacity to approximately 18 mgd.

When effluent flow exceeds the capacity of Outfall 001A, it overflows to the original outfall 001B. This outfall is 12-inch diameter for a portion of its length and 24-inch diameter for a portion. It enters the river near to the main outfall. The capacity of this outfall is 3 mgd for an existing total outfall capacity of 15 mgd.

Improvements to the outfalls should provide the ultimate POTW build-out capacity of approximately 40 mgd. In addition, Outfall 001B may be used as an outfall from the planned wetland and will need a capacity to convey the design maximum week dry weather flow (MWDWF) of 5.5 mgd. Constructing a bypass around the reaeration structure in Outfall 001A and upsizing the 12-inch diameter portion of Outfall 001B to 24-inches will result in a total outfall capacity of more than 40 mgd.

It should be noted that the capacity of the existing effluent flume is approximately 23 mgd. A second flume would need to be added when design peak flow exceeds the capacity of the existing flume. Since this would occur outside of the planning horizon, the cost of this improvement was not included in the outfall improvement cost.

Table 7-22 summarizes the estimated costs for the outfall improvements.

TABLE 7-22
Estimated Capital Cost of Outfall Improvements

Item	Estimated Cost*
Construct reaeration structure bypass in Outfall 001A	$100,000
Upsize 12-inch diameter portion of Outfall 001B	$500,000

*Costs are in 2008 Dollars.

7.5.2 Solids Treatment Alternatives

The existing solids treatment processes are generally performing well, with significant remaining capacity. This section describes the existing solids process facilities and the recommendations for expansion or upgrade. For the solids treatment facilities, these upgrades are driven primarily by operational and maintenance improvements.

The existing capacity and future capacity requirements of the solids treatment process are shown in Table 7-23. For each unit process, the table shows the basis for capacity, design criteria, existing capacity, and the 2030 flow projections with and without industrial flows.

TABLE 7-23
Solids Processing Capacity

			Existing Capacity		2030 Projections	
Unit Process	**Basis for Capacity**	**Design Criteria**	**Firm Capacity**	**Total Capacity**	**Actual Industrial Flows**	**Allocated Industrial Flows**
DAFT	Max Month Loading (ppd WAS)	0.60 lb/sf hr*	3,300 ppd	6,500 ppd	5,500 ppd	7,500 ppd
Anaerobic Digestion	Max Month Hydraulic Detention Time (gpd Digester Feed)	15 days 10 days	NA	46,800 gpd 70,200 gpd	47,300 gpd	54,000 gpd
FSL	Max Month VSS Loading (ppd FSL Feed)	50 ppd VSS/KSF	NA	10,890 ppd VSS	4,000 ppd VSS	4,800 ppd VSS

*Metcalf and Eddy, 4th Edition, 2003.

Solids that are produced as part of the wastewater treatment process must be treated and reused or disposed of in an environmentally and economically acceptable manner. The solids management facilities at the Woodburn POTW include thickening of waste activated sludge (WAS) from the secondary process with dissolved air flotation thickeners (DAFTs). Primary sludge (PSL) is thickened in the primary clarifiers. Since 1999, the Woodburn POTW has discharged biosolids to its onsite facultative sludge lagoons. These solids stabilization and handling processes consistently result in Class B biosolids meeting both the Pathogen and Vector Attraction Reduction requirements described in Chapter 5.

Solids Thickening

Solids thickening is provided by two dissolved air flotation thickeners. The plant wastes directly off of the mixed liquor. The existing DAFTs have been operating successfully at loading rates of 0.26 lb/sf hr with one unit online operating continuously. Without polymer addition, the DAFTs thicken the secondary sludge to approximately 3 percent dry solids. At this processing rate, with industrial flow treated separately, the DAFTs could process the projected maximum month secondary sludge production with both units operating.

Primary sludge and thickened secondary sludge are mixed in the sludge blend tank prior to being pumped to the anaerobic digesters.

Solids Stabilization and Storage

Primary and secondary sludge is stabilized using mesophilic anaerobic digestion. The plant includes two digesters operating in parallel with a total capacity of 700,000 gallons. One tank is equipped with a gas holding cover. The capacity of the digesters is sufficient to maintain a 15 day hydraulic residence time (HRT) through the planning horizon, under a maximum month condition without industrial flows.

Currently, biosolids flow from the digester overflow pipe to the facultative sludge lagoons. The two 6.5-million-gallon (MG) FSLs have provided long-term storage for the biosolids and have recently been equipped with a dredge to off-load their contents. Currently, the FSLs are at capacity. The Facilities Plan assumes that the FSLs will be emptied to the extent necessary. See Section 8 for further discussion on biosolids management alternatives. This

HRT allows production of Class B biosolids, meeting the pathogen reduction requirements in 40 CFR Part 503.

In the long-term (beyond the planning horizon), when the digesters have reached their capacity, it is recommended consideration be given to processing the solids in the digesters for a minimum of 10 days to capture most of the methane produced from the process, then in the FSLs to complete the stabilization process. Consistent operation of a digestion system at a 10 day SRT can be problematic, resulting in instability. Therefore, as loads to plant increase and the SRT decreases, reliance on the DAFTs for WAS thickening will become more critical. As the operating SRT decreases over time, the decision about when to construct additional digestion capacity should be revisited.

Recommended Solids Management Strategies

Based on the proposed flows and loads, no capacity related improvements are required to the solids treatment facilities. End-use biosolids management alternatives are presented in Section 8.

7.5.3 Backup Power Requirements

Currently, all power demands are serviced by the onsite 500 kilowatt (kW) generator. The previous design assumed EPA Class II reliability requirements. EPA requirements for a Class I facility, as described in Section 5.1.6 state that there should be a backup power source, sufficient to operate all main pumping, screening, primary treatment, secondary treatment, final clarification, filtration and disinfection facilities, along with critical lighting and ventilation during peak wastewater flow conditions, with the provision of capacity for degritting and sludge handling and treatment being optional. This shift in reliability requirements requires additional backup power capacity. Future (2030) power demands by unit process are shown in Table 7-24.

TABLE 7-24
Basis for Emergency Generator Sizing

Facility	Connected Horsepower	Peak kW	Critical Load?	Critical kW
Septage Transfer	5	89	N	0
Headworks	104	77.6	Y	77.6
Primary Clarifiers	316	161.3	Y	161.3
Aeration Basins	96	71.6	Y	71.6
Blowers	600	335.6	Y	335.6
Secondary Clarifiers	4	3	Y	3
RAS/WAS Pump Station	169.2	63.5	Y	63.5
Anthracite Sand Filters	25	14.2	Y	14.2
UV Disinfection	64	48	Y	48
Plant Water	60	14.9	Y	14.9
Solids Handling	30	22.4	N	0

TABLE 7-24
Basis for Emergency Generator Sizing

Facility	Connected Horsepower	Peak kW	Critical Load?	Critical kW
Anaerobic Digesters	22.5	16.8	N	0
Digester Control Building	51	38	N	0
Facultative Sludge / Storage Lagoons	80	29.8	N	0
Significant HVAC / Odor Control	55	41	Y	41
TOTAL	**756**	**1,026.7**	**-**	**830.7**

Due to this increase in power requirement, it is suggested that an additional 500 kW generator be added onsite to supplement the existing 500 kW generator.

SECTION 8

Development and Evaluation of Reuse and Discharge Alternatives

8.1 Introduction

Reuse and discharge alternatives were developed and evaluated in close coordination with the municipal and industrial wastewater treatment alternatives presented in Section 7, Development and Evaluation of Wastewater Treatment Alternatives. This section focuses on poplar tree irrigation and wetland alternatives that are proposed for reuse of Woodburn Publicly Owned Treatment Works (POTW) effluent. These elements are needed to enable compliance with the ammonia and temperature limitations on discharge of POTW effluent to the Pudding River, which are largely driven by July through September limitations each year, and to provide land application area for beneficial reuse of municipal biosolids.

8.1.1 Industrial Wastewater Treatment Alternatives

As discussed in Section 7.2, Industrial and Municipal Wastewater Treatment Management Strategies, three industrial wastewater treatment alternatives were evaluated. Of these, two were carried forward for analysis of the associated reuse and discharge requirements at the POTW:

- **Alternative IND 1**: Treat Industrial Flow Separately in July through September. With this alternative, industrial flows are not sent to the POTW in July through September. Instead, they are stored and land applied in a separate system during these discharge limited months.
- **Alternative IND 3**: Treat Industrial Flow Year-round at the POTW (current treatment scheme). With this alternative, industrial flows are sent to the Woodburn POTW year-round and the effluent is sent to a combination of poplar tree irrigation, treatment wetlands, and Pudding River discharge.

In keeping with Section 7, the corresponding reuse alternatives at the Woodburn POTW were evaluated for two industrial flow scenarios: actual and allocated. Actual refers to historical maximum monthly industrial flows; allocated refers to the flows that participating industries are allowed to discharge according to their permits with the City of Woodburn.

8.1.2 Integrated Industrial and Municipal Wastewater Treatment Alternatives

Municipal and industrial wastewater flows that are conveyed to the Woodburn POTW must be treated, reused, and/or discharged in compliance with all requirements established in the Woodburn POTW NPDES permit. Since 1999, the City of Woodburn POTW has reused up to 0.9 million gallons per day (mgd) during the months of July and August for irrigation at its 84 acre poplar reuse system. This practice has helped to keep the Woodburn POTW in compliance with ammonia criteria for discharge to the Pudding River during July and

August, while at the same time providing a beneficial use of the recycled water for growing a marketable tree crop. The poplar tree reuse system was also designed to be the primary biosolids land application area for the City. However, increases in POTW dry weather flows and increased biosolids production will eventually exceed the hydraulic and nutrient loading capacity of the existing poplar tree reuse system.

Within the next National Pollutant Discharge Elimination System (NPDES) permit renewal, new limits will be placed on the thermal loads associated with wastewater discharge to the Pudding River as described by the Pudding River temperature total maximum daily load (TMDL). Compliance with the new thermal load standards will be required based on final negotiated compliance schedule defined in a revised MAO, currently under negotiation between DEQ and the City of Woodburn. The new excess thermal load limits will require cooling of the plant effluent before Pudding River discharge, diversion of effluent to other uses or storage during the summertime temperature compliance periods, or implementation of thermal offsets elsewhere within the Pudding River watershed.

This section presents the alternatives that were evaluated for the end use of liquids and solids produced at the POTW under the primary constraints of:

- July and August ammonia criteria for Pudding River discharge
- July through September excess thermal load allocations for Pudding River discharge
- Year-round biosolids production

Reuse and discharge alternatives were developed and evaluated for flow and load scenarios that account for actual and allocated industrial flows and future municipal flow and biosolids production increases for the 2020 and 2030 planning horizons. Flow and loads and facility sizing for current (2008) conditions are also presented to provide the basis for scheduling the implementation of facility improvements through 2030.

8.2 Alternatives Analysis

Several alternatives were evaluated to aid in identifying the most cost-effective means for meeting the POTW compliance requirements in the future. These alternatives are summarized in the following sections according to the primary regulatory constraints.

8.2.1 Ammonia Compliance Alternatives

Based on discharge flow limitations described in Table 8-2, three alternatives were evaluated for compliance with the July and August ammonia limitations:

- Diversion all flows above 2 mgd for irrigation reuse to poplar trees ($2.8M/mgd to $4.3M/mgd depending upon whether the acreage is City owned or purchased)

- Diversion and storage of all flows above 2 mgd for later discharge back to the Pudding River in the fall and winter months ($7.7M/mgd to $11.9M/mgd depending upon whether property is City owned or purchased)

- Scalping of flow using a Satellite MBR plant as presented in Section 7 ($26.7M/mgd to $40M/mgd)

Continued poplar tree irrigation during the months of July and August is the most cost-effective of these alternatives.

Another alternative that could be explored with the Oregon Department of Environmental Quality (DEQ) is to revise the ammonia compliance criteria established in the NPDES permit. Currently, these criteria change on increments of 1 mgd of effluent discharge to the river. Changing the NPDES permit compliance criteria to include ammonia limits at intermediate effluent discharge flows or to convert the table-based values to equation-based calculations could allow Woodburn to optimize augmentation flows to the Pudding River. Allowing more discharge of effluent to the Pudding River during low river flow periods while still achieving the river water quality objectives is generally viewed as a benefit to the river. This alternative would require additional discussion and negotiations with DEQ, but might reduce the size and cost of future required poplar tree irrigation expansion.

8.2.2 Temperature Compliance Alternatives

The Pudding River temperature TMDL establishes river temperature criteria and an implementation plan targeted to meet the criteria on a basin-wide scale. As part of the implementation plan, the Woodburn POTW is allocated excess thermal load (ETL) limits for periods when effluent temperatures exceed the river temperature criteria.

Several alternatives were evaluated and ranked on a comparative capital construction cost basis in the *Planning Document for the Selection of Temperature and Ammonia Reduction Alternatives* (CH2M HILL, 2006) including:

- Wetland cooling with wetlands constructed in the existing effluent lagoon ($120,000/mgd)
- Wetland cooling with wetlands constructed on the McNulty property ($480,000/mgd)
- High rate irrigation (150 percent of agronomic rate) to poplar trees ($567,000/mgd)
- Riparian restoration with temperature trading ($727,000/mgd)
- Agronomic rate irrigation to poplar trees ($850,000/mgd)

Note that the cost assumptions have changed since the 2006 planning document, but the ranking of alternatives has not been affected. Wetlands cooling was the most cost effective alternative of those evaluated. Use of cooling towers was also investigated, but could not meet the temperature criteria without combining this approach with other alternatives listed above. Cooling towers with the associated pumps and fans were the most energy intensive alternative and required biocides and more O&M than the natural treatment alternatives.

8.2.3 Biosolids Management Alternatives

The current biosolids management system relies upon the facultative sludge lagoons (FSLs) for seasonal storage and the poplar tree irrigation area for seasonal application of liquid biosolids. The major physical components of this system include:

- FSLs for biosolids stabilization and storage
- Dredge for removing biosolids from the FSLs
- Day tank for storing biosolids prior to pumping

- Liquid biosolids pump station
- Drying beds for dewatering a portion of produced solids
- Buried pipe distribution system within the 84 acre poplar tree reuse system
- Hose reel irrigation machine, tractor, and tank trailer for applying liquid biosolids
- Manure spreader, tractor, and sludge truck for applying dewatered biosolids

Although the FSLs were initially constructed in 1999, there was no means to remove and land apply biosolids until a dredge was installed in late 2008. Consequently, the FSLs have been accumulating solids since 1999 and were nearly at capacity in early 2009. Biosolids management alternatives for future planning need to address both the short-term need to reduce biosolids volumes in the FSLs and the long-term need to provide a sustainable system for managing future production and seasonal storage of biosolids. A detailed analysis of short-term and long-term biosolids production, storage, use, and operations and management costs is provided in Appendix I.

The following biosolids management alternatives were evaluated:

1. Land application to the existing poplar tree reuse system
2. Land application to an expanded poplar tree reuse system
3. Dewatering and composting of biosolids
4. Contract hauling and land application to other permitted sites
5. City-operated hauling and land application to other permitted sites.

All of these alternatives, except for dewatering and composting, were selected to aid in providing a balanced biosolids management program. In order to free up storage space within the nearly full FSLs, Alternative 4 is needed in the short-term. After needed storage volume is reclaimed in the FSLs from a contract hauling operation, Alternatives 1 and 2 can handle the majority of biosolids produced on an annual basis. Alternatives 4 and/or 5 can then provide the additional capacity needed in the future to correct any annual imbalance in biosolids supply and demand to keep storage volumes within the FSLs in check.

8.3 Proposed Alternatives

A balanced combination of strategies needs to be employed to address the increasingly stringent constraints on Pudding River discharge during the dry weather period and to manage the long-term production of solids. A conceptual plan for development of the proposed facilities in Phases 2 and 3 is presented in Figure 8-1 with identification of facilities required on City-owned lands and needs for additional land. Although specific land parcels have not been identified for any expansion of facilities onto newly acquired lands, Figure 8-2 identifies approximately 500 acres of agricultural lands within a ½ mile radius of the POTW that could be considered for purchase and poplar tree irrigation development.

Figure 8-1

Phase 2 and 3 Poplar Tree Irrigation and Wetland Facilities

City of Woodburn Facilities Plan

Legend

- Future Conveyance Pipe
- Existing Outfalls
- Flow Arrows
- City-Owned 'McNulty' Property
- Constructed Wetlands
- Poplar Trees

N

0 200 400 600 800
Feet

CH2MHILL

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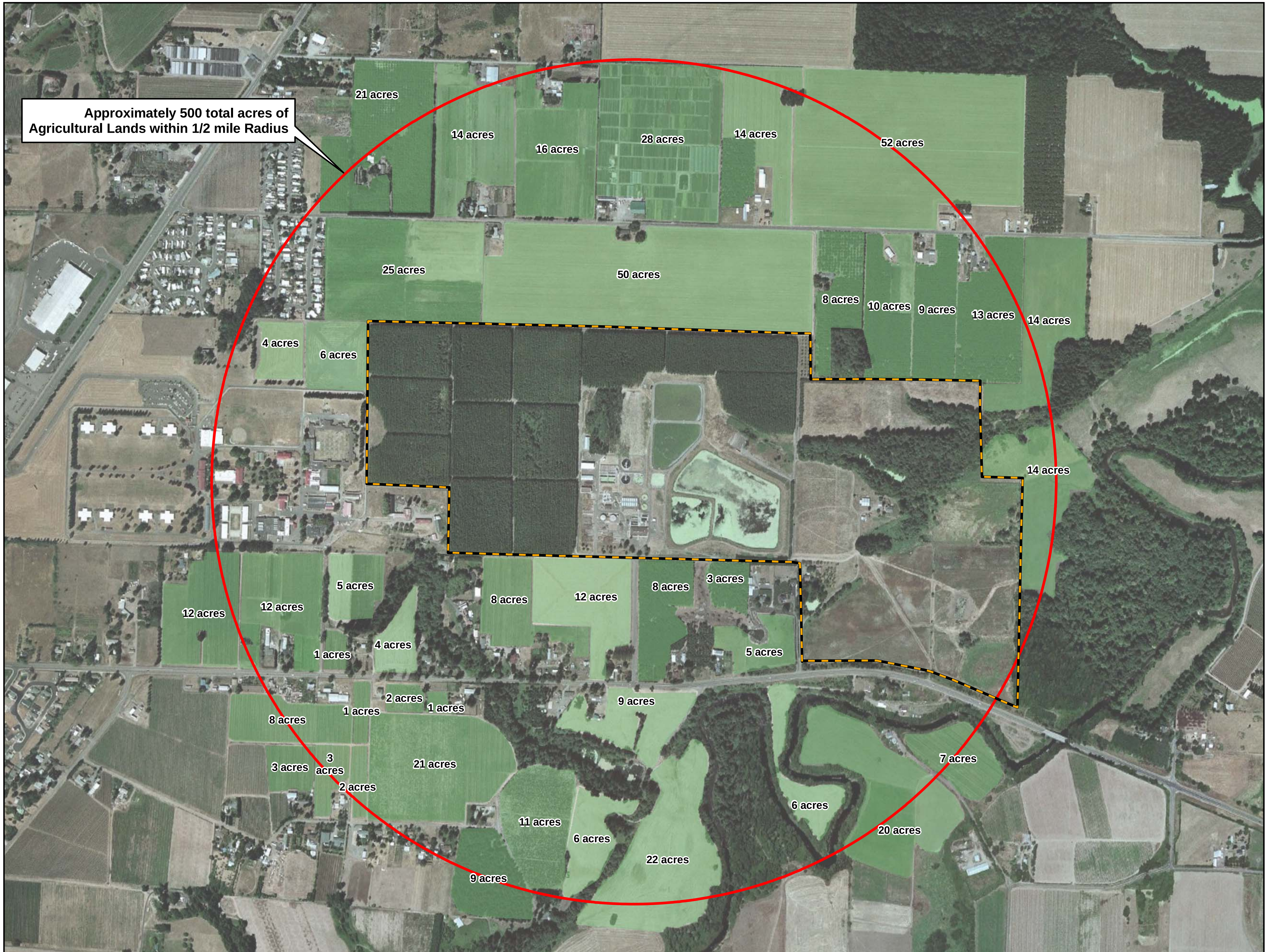

Figure 8-2

Agricultural Lands Within Half-Mile Radius of POTW

City of Woodburn Facilities Plan

Legend

- Half-Mile Radius
- Agricultural Lands
- City-Owned Land

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Miles

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8.3.1 Poplar Tree Expansion for Biosolids and Effluent Reuse

A decision was made to size future poplar tree expansion areas based on the requirements for meeting the July/August ammonia discharge limitations. Although these areas will be utilized for both effluent and biosolids reuse, the poplar tree expansion areas will not be sufficient to utilize all biosolids produced on an annual basis. This fundamental sizing decision was developed using the results of a cost/benefit analysis that concluded the cost of a contract hauling operation for land application to other permitted sites would have a lower cost than purchasing land and developing a poplar tree reuse system solely for the utilization of biosolids. Therefore, poplar tree expansion areas are only planned where they can be utilized to both meet July/August ammonia discharge limitations and provide for biosolids reuse.

Future poplar tree expansion areas would first be developed onto suitable lands located on the adjacent City-owned McNulty property. Expansion of the poplar reuse system into this area can be accomplished cost-effectively with extension of the irrigation mainline and biosolids distribution pipelines over to the edge of the POTW property and into the new irrigation areas.

Poplar Tree Irrigation Area Sizing

Because the poplar tree irrigation areas may be used for both recycled water irrigation and for land application of biosolids, both hydraulic loading and nutrient loading limitations were assessed.

Biosolids loading limits were established based on allowable nitrogen (N) loading rates to poplar trees. The average net N loading rate across the tree reuse system given a 10 year harvest scenario was set at 218 pounds per acre per year (lb/ac/yr) for planning purposes. This value was based on a net plant N uptake of 50, 120, 200, 220, and 240 lb/ac/yr for hybrid poplar in Washington for years 1, 2, 3, 4, and 5–10 respectively[5]. When agronomic rate irrigation is practiced, effluent contributes approximately 65 lb/ac of plant available nitrogen (PAN) on an annual basis. Subtracting 65 lb/ac/yr from 218 lb/ac/yr, this leaves 153 lb/ac/yr of reuse system capacity available to satisfy liquid biosolids land application requirements. Lagoon-stored biosolids were assumed to contribute 55 lb PAN per dry ton on a long-term basis after accounting for soil N mineralization rates. Combining these design criteria, allowable biosolids loading rates were assumed to average 2.8 dry ton/ac/yr.

Hydraulic loading limitations for spray irrigated poplar trees at Woodburn were established during the original poplar tree reuse system development. Operation of this system follows the irrigation operations procedures outlined in the *Reclaimed Water Reuse Management Plan for the Woodburn WWTP Poplar Plantation* (CH2M HILL, 1999). Utilizing available soil water storage capacity to maximize mid-season irrigation rates, this plan presents schedules for irrigation up to 12.5 inches per month in July and August and up to 6 inches being applied in September (30.9 inches total). At these rates, up to 0.9 mgd was planned for irrigation to

[5] Washington Department of Ecology. 999. *Managing Nitrogen from Biosolids*. Washington State Department of Ecology Publication 99-508.

the 84 acre poplar tree reuse system (93 acres/mgd). When accounting for the effects of tree harvesting and reduced irrigation requirements during regrowth periods, the stand-averaged reuse system capacity is 0.01 mgd/acre (101 acres/mgd) or 0.83 mgd for an 84 acre reuse system.

With the future development of constructed wetlands for temperature control, additional consumptive use (CU) demands will need to be satisfied during the July and August critical ammonia period. These CU demands, which are required to maintain wetland hydrology through the summer months, have been subtracted from the total flow diversion out of the river in calculating necessary poplar tree irrigation areas. The CU rate assumed for wetlands during this period was 0.0044 mgd/ac.

A summary of the minimum poplar tree land area requirements under each design scenario is presented in Table 8-1.

TABLE 8-1
Total Required Poplar Tree Irrigation Acreage Based on Nutrient and Hydraulic Loading Limitations

Scenario	July–August Flow to Irrigation (mgd)	Annual Solids to Poplars (lb dry solids/yr) [a]	Total Poplar Area for Jul-Aug Irrigation (acres) [b]	Total Poplar Area for Biosolids Reuse (acres)
2008 Municipal Flows Only (IND 1)	0.12	859,028	7	154
2020 Municipal Flows Only (IND 1)	0.92	1,121,171	85	202
2030 Municipal Flows Only (IND 1)	1.65	1,382,977	157	249
2008 Actual Industrial Flows (IND 3)	0.32	915,671	27	165
2020 Actual Industrial Flows (IND 3)	1.12	1,177,814	105	212
2030 Actual Industrial Flows (IND 3)	1.85	1,401,823	177	252
2008 Full Industrial Allocation (IND 3)	0.78	1,060,477	72	191
2020 Full Industrial Allocation (IND 3)	1.58	1,322,620	150	238
2030 Full Industrial Allocation (IND 3)	2.31	1,605,980	222	289

[a] Solids production has been discounted by 10 percent for volatile solids destruction within FSLs during the first year of storage.

[b] Values have been adjusted to account for the consumptive use from wetland areas required under each alternative.

Although the poplar tree expansion areas would be larger if sized for utilization of all biosolids produced (Table 8-1), future expansion areas will be sized based upon the requirements for meeting the July/August ammonia discharge limitations as described previously. As time progresses out to 2030, the difference between poplar tree irrigation area requirements using the two separate criteria diminishes but still results in a deficit of acreage needed for utilization of all biosolids produced. Additional biosolids utilization capacity will be gained through contract hauling or City-operated hauling for land application to other permitted sites.

Estimated Acreage and Cost

The total additional area of poplar tree irrigation needed is based on the following design flow scenarios:

- 2008, 2020, and 2030 municipal flow only during July through September (IND 1)
- 2008, 2020, and 2030 municipal flow with actual industrial flows (IND 3)
- 2008, 2020, and 2030 municipal flow with full industrial flow allocation (IND 3)

The expansion area sizing for these scenarios was selected to meet hydraulic loading requirements during the July–August restricted river discharge period. Areas required and projected costs for the scenarios are presented in Table 8-2.

TABLE 8-2
Poplar Tree Irrigation Expansion Acreage and Cost

Scenario	Expansion Area on City-Owned Land (acres) [a]	Additional Land Requirement (acres) [b]	Capital Cost [c]
2008 Municipal Flows Only (IND 1)	0	0	$0
2020 Municipal Flows Only (IND 1)	15	0	$420,000
2030 Municipal Flows Only (IND 1)	38	59	$3,601,000
2008 Actual Industrial Flows (IND 3)	0	0	$0
2020 Actual Industrial Flows (IND 3)	28	0	$784,000
2030 Actual Industrial Flows (IND 3)	36	81	$4,491,000
2008 Full Industrial Allocation (IND 3)	9	0	$252,000
2020 Full Industrial Allocation (IND 3)	38	51	$3,257,000
2030 Full Industrial Allocation (IND 3)	32	130	$6,486,000

[a] 26 acres of City-Owned land on the terrace to the east of the POTW can receive full agronomic rate irrigation, while poplar expansion into floodplain areas is assumed to allow 1/2 the agronomic rate for hydraulic loading.

[b] Additional land requirements for irrigation and poplar tree area expansion are estimated at $15,000/ac based on recent land sales in the vicinity of the POTW.

[c] Costs include land acquisition, field prep and tree planting, grading and gravelling of access roads, buried PVC irrigation and biosolids piping, valve manifolds and I&C, and all aboveground micro-spray irrigation components.

Expansion acreage required for the actual industrial flow scenario is available on the City-owned McNulty property until Phase 3 (after 2020). However, the full industrial allocation scenario would require purchase, lease, and/or water use agreements with neighboring landowners to expand the irrigated area early in Phase 2.

Annual operations costs for contract hauling or City-operated hauling for land application of biosolids to other permitted sites are detailed in Appendix I. An annual solids balance is presented that details biosolids production rates, utilization within City-owned and operated poplar reuse systems with consideration of harvest impacts, and excess consumption needed by offsite hauling to maintain a storage balance within the FSLs.

8.3.2 Wetlands for Effluent Cooling

Use of wetlands for passive effluent cooling was selected as the primary means for temperature compliance. The most cost-effective wetland development would occur within the limits of the existing effluent lagoon where minimal grading, water control structures, and vegetation could be used to create a suitable shaded wetland environment for effluent cooling. Wetland development at this location allows for return discharge to the existing Pudding River effluent outfalls.

Additional wetland cooling area required for temperature compliance could be created or enhanced at the adjacent city-owned McNulty property. Development of wetlands at this location will require a new outfall to be constructed for discharge to the Pudding River as shown in Figure 8-1.

Based on the predominance of hydric soils (i.e., Bashaw, Wapato, and McBee soil series) within county soil maps and the known presence of wetland indicator plants and seasonal wetland hydrology, wetlands may occupy portions of the floodplain area on the McNulty property. Some of the wetlands appear to be jurisdictional waters, whereas other historical wetlands may be effectively tiled and drained. Farmed wetlands are subject to federal and state wetland regulations, which have exemptions for normal farming practices and allow continued agricultural uses (such as poplar cultivation) but do not allow unmitigated changing of wetland status. Drained wetlands that no longer function as wetlands do not have the same jurisdictional protections and could allow unmitigated development of constructed wetlands. A wetlands delineation of the floodplain area is needed before specific plans can be developed for constructed wetland siting and possible mitigation or enhancement strategies.

In the event that sufficient area is not available within the floodplain to construct wetlands without mitigation or enhancement for impacts to jurisdictional wetlands, there are several alternatives that can be pursued. These include restoring, creating, or enhancing wetlands in the Pudding River floodplain as mitigation credit wetlands, or as self-mitigating wetland habitat enhancement, or buying into offsite compensatory wetland mitigation. Following jurisdictional wetland delineation and the conceptual design of floodplain wetlands, resource agency consultation can be conducted to determine specific mitigation and/or enhancement scenarios.

Permitting and agency consultations can have a real impact on the cost and schedule of the selected alternative. Issues that may need to be addressed as part of the Biological Assessment and Remove/Fill Permit consultations for this project include:

- Impact to jurisdictional wetlands and mitigation and/or enhancement strategies (U.S. Army Corps of Engineers and Oregon Department of State Lands are lead agencies)
- Determination of state water quality criteria for discharge of treated effluent into a jurisdictional wetland (DEQ is lead agency) in the event that flow is routed through jurisdictional wetlands prior to river discharge
- Potential effect of the project on Endangered Species Act-listed fish or their critical habitat (U.S. National Marine Fisheries Service [NMFS] and Oregon Department of Fish and Wildlife [ODFW] are lead agencies)

- Developing a grading and water control plan that avoids significant flood storage impacts (Marion County is lead agency)

These permitting issues should be addressed early in the project planning process to ensure that project implementation and compliance schedules can be met.

Wetland Sizing

Wetland sizing for a range of effluent flows was accomplished by using the Willamette Partnership Thermal Credit Screening Tool. This tool was developed for estimating water cooling through a densely shaded constructed wetland operated without hyporheic discharge similar to the City of Salem constructed wetland complex. The tool was used with Woodburn DMR reported POTW effluent temperatures and was optimized to meet target wetland effluent temperatures based on the draft Pudding River temperature TMDL. The September 1–15 temperature compliance period required the largest wetland surface area and was therefore used as the basis for wetland sizing. Results of the sizing analyses are summarized in Figure 8-3.

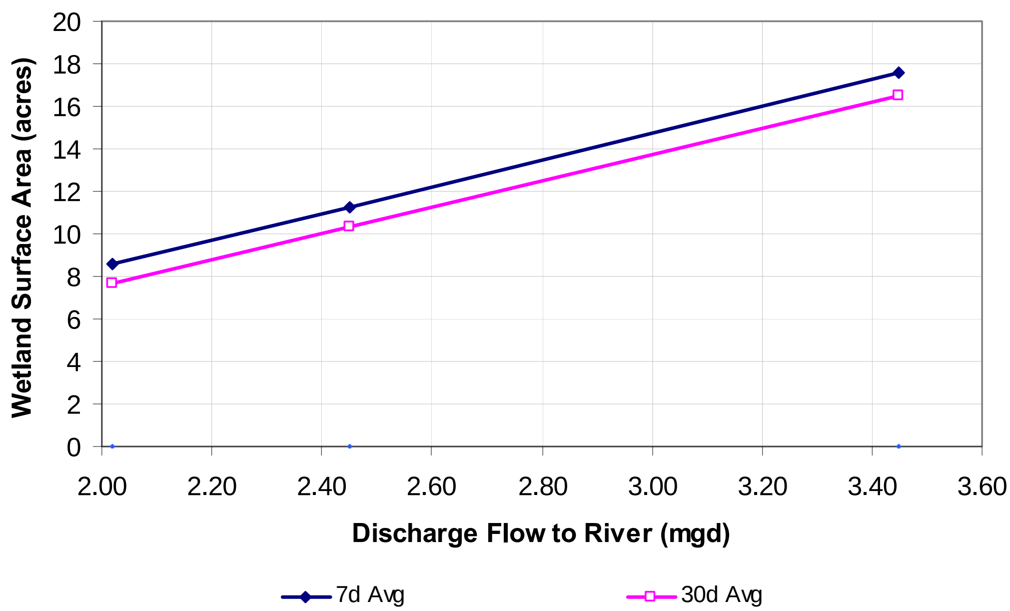


FIGURE 8-3
Wetland Water Surface Area Required to Meet Temperature TMDL September 1–15

For sizing of total wetland land area required, the values from Figure 8-3 were further scaled up by 10 percent to account for berms and other unused area and again by 20 percent as a safety factor to account for suboptimal vegetation growth and shading.

Estimated Acreage and Cost

The total area of wetlands needed is based on the following design flow scenarios:

- 2008, 2020, and 2030 municipal flow only during July through September (IND 1)
- 2008, 2020, and 2030 municipal flow with actual industrial flows (IND 3)
- 2008, 2020, and 2030 municipal flow with full industrial flow allocation (IND 3)

The areas required and projected costs of the scenarios are presented in Table 8-3.

TABLE 8-3
Wetland Acreage and Cost

Scenario	Effluent Flow to River (mgd)	Lagoon Wetland Area (acres)	Floodplain Wetland Area (acres)	Capital Cost*
2008 Municipal Flows Only (IND 1)	2.07	10	2	$2,920,000
2020 Municipal Flows Only (IND 1)	2.86	10	8	$3,520,000
2030 Municipal Flows Only (IND 1)	3.59	10	14	$4,120,000
2008 Actual Industrial Flows (IND 3)	2.22	10	3	$3,020,000
2020 Actual Industrial Flows (IND 3)	3.01	10	10	$3,720,000
2030 Actual Industrial Flows (IND 3)	3.74	10	16	$4,320,000
2008 Full Industrial Allocation (IND 3)	2.73	10	7	$3,420,000
2020 Full Industrial Allocation (IND 3)	3.52	10	14	$4,120,000
2030 Full Industrial Allocation (IND 3)	4.25	10	20	$4,720,000

*For lagoon wetlands, costs include grading and planting of 10-ac wetlands within the existing effluent lagoon, inlet/outlet structures in lagoon, piping from the lagoon to existing outfall pipes, and a new 10hp low lift pump in the chlorine contact chamber. For the floodplain wetlands, costs include drain-tile abandonment, grading and planting of wetlands, and inlet/outlet structures plus inlet modifications at the effluent lagoon, conveyance piping from effluent lagoon to floodplain wetlands, conveyance piping from floodplain wetlands to the new river outfall, single-port diffuser in river channel, and gravelling of existing roads from effluent lagoon down to the floodplain wetlands.

8.3.3 Summary of Proposed Alternatives

The additional acreages required and capital cost estimates for expansion of the POTW poplar reuse system and installation of a treatment wetland are compared for Industrial Wastewater Treatment Management Alternatives IND 1 and IND 3 in Table 8-4.

TABLE 8-4
Poplar Reuse System Expansion and Treatment Wetland Sizing and Costs

	2020 (Phase 2)			2030 (Phase 3)		
Industrial Wastewater Treatment Management Alternative	**Poplar Trees (acres)**	**Wetlands (acres)**	**Capital Cost ($1,000)**	**Poplar Trees (acres)**	**Wetlands (acres)**	**Capital Cost ($1,000)**
IND 1—Separate Land Application						
Municipal Flow Only*	15	18	$3,940	97	24	$7,721
IND 3—Treat Industrial Flow at POTW						
Actual Industrial Flow	28	20	$4,504	117	26	$8,811
Allocated Industrial Flow	89	24	$7,377	162	30	$11,206

*With this alternative, all industrial flows are conveyed to a separate storage and land application system (assumed to be irrigated pasture); industrial flows do not go to the Woodburn POTW. See Section 7 for acreages and costs associated with this land application system for industrial flows.

8.3.4 Hyporheic Discharge and High Rate Irrigation

The City is currently undertaking several research pilot studies in coordination with CH2M HILL and Oregon State University (OSU) to refine innovative new approaches for operating natural treatment systems. Initial results of this work are anticipated in late 2009. While the results of this work will not affect the selection of proposed alternatives, they may affect the implementation and sizing of these alternatives. Possible results of the pilot studies could include:

- Cooling wetlands may be designed for hyporheic discharge from a leaky wetland complex. Hyporheic discharge involves infiltration (recharge) of recycled water into the subsurface and shallow groundwater system, followed by exfiltration (discharge) of the water from the groundwater system into surface water of a stream or river. Benefits of this technology might include a reduced wetland footprint with additional temperature reduction and enhanced nutrient removal in the subsurface.
- Poplar tree irrigation areas not receiving biosolids application might be designed for high rate (greater than agronomic rate) irrigation application. Under these operations, excess applied water would recharge underlying shallow groundwater after being further polished by nutrient removal within the tree root zone. Benefits of this approach might include a reduced irrigated area footprint with additional temperature reduction and enhanced nutrient removal in the subsurface.

One key prerequisite for a hyporheic discharge project would be land control between the point of recharge into the subsurface and the point of discharge into the Pudding River. This is required in order to prevent any potable groundwater wells from being impacted by the hyporheic discharge. The ongoing pilot studies are still in the process of defining the groundwater capture zones and the area required to be under land control. Once defined, user agreements, leases, or land purchase will be necessary to secure downgradient land control. Since these costs are undefined at this time, the proposed alternatives in this Facilities Plan assumed wetland and poplar irrigation development without hyporheic discharge or high rate irrigation.

While the environmental benefits of a combined hyporheic discharge and high rate irrigation project could be realized immediately upon implementation, the economic benefits of such a project would likely not be felt until Phase 3. At that time, the irrigation area requirements to handle July and August flows exceed the land available under current City ownership, requiring significant additional land to be secured. Implementation of hyporheic discharge and high rate irrigation projects at that time might significantly reduce the amount of additional land that needs to be secured.

Results of these studies should be evaluated during the design of expansion facilities. At that time, a decision can be made about the potential risks and rewards of developing wetlands for hyporheic discharge and poplar areas using high rate irrigation. At a minimum, some component of continued research into these methods is recommended in order to build the operational experience and performance documentation required by DEQ in order to approve such a proposal. The use of hyporheic discharge will need to be reviewed and approved by DEQ in accordance with the *Disposal of Municipal Wastewater Treatment Plant Effluent by Indirect Discharge to Surface Water via Groundwater or Hyporheic Water Internal Management Directive* (DEQ, 2007).

8.3.5 Other Irrigated Reuse

The City of Woodburn plans to pursue other reuse opportunities as they arise, especially those that are water demand driven, can be implemented cost-effectively, and offset other surface or groundwater uses within the basin. Proximity to the POTW and the cost of conveyance to reuse areas will likely be a significant issue affecting the cost feasibility of such opportunities. Some reuse opportunities may also require more disinfection at the POTW to meet higher recycled water classifications. For these opportunities, the capital cost and operational requirements of providing additional disinfection and production and distribution of two different recycled water qualities also must be carefully addressed. Consequently, each specific opportunity will need to be evaluated on a case by case basis to determine the feasibility and cost-effectiveness of such projects. These projects could reduce the poplar expansion and wetland area requirements presented previously and as such, avoided costs of reduced poplar expansion and wetland area should be considered.

One potential reuse opportunity is with the McLaren Youth Correctional Facility, whose property abuts the existing poplar tree reuse system on the West side. Discussions with McLaren are ongoing but are in the preliminary stages at this time.

SECTION 9

Rate Study

Refer to *Volume 3: Wastewater Rate and System Development Charge Stud*y of this Facilities Plan.

SECTION 10

Recommended Plan

10.1 Introduction

This section presents the recommended plan for the City of Woodburn wastewater collection and treatment facilities for both the 2020 (Phase 2) and 2030 (Phase 3) planning horizons. Included is a summary of the project selection process, projected design flows, and project costs, and detailed project descriptions and design criteria data and capital cost estimates. This section concludes with a proposed financing strategy, implementation plan and schedule.

10.2 Project Selection

Recommended projects were selected based on an evaluation of the alternatives developed for the wastewater collection system, treatment system, and reuse and discharge system, as documented in Sections 6, 7, and 8, respectively. The alternatives were evaluated considering technical feasibility and costs to select the most cost-effective and environmentally sound system for the City of Woodburn. Based on input from City staff and the City of Woodburn Wastewater Citizen's Advisory Committee (WCAC), preferred alternatives were developed for implementation. The public outreach process is described in Section 12.

10.3 Projected Design Flows

The primary components of City of Woodburn wastewater flows are residential, commercial, and industrial. For the purposes of this Facilities Plan, the design flows are assumed to include allocated industrial flows from the two largest food processing facilities in Woodburn. The City currently has permits in place that accommodate these food processing flows. As explained in Section 7, actual industrial flows are significantly less than the allocated flows. If the City were to decide to renegotiate the allocated flows provided in these permits to reflect a projected growth rate based on actual industrial flows, this would reduce future capacity requirements accordingly. This is discussed as an alternative approach as part of the implementation plan below. The projected design flows (with the allocated industrial flows) are shown in Table 10-1.

TABLE 10-1
Woodburn Facilities Plan Design Flows [a]
(in million gallons per day)

	2020		2030		2060	
Flow Condition	**Wet Weather**	**Dry Weather**	**Wet Weather**	**Dry Weather**	**Wet Weather**	**Dry Weather**
Minimum Month	-	2.35	-	2.80	-	4.30
Average Daily	4.65	3.28	5.56	3.88	8.63	5.90
Maximum Month	8.01	4.56	9.68	5.45	15.33	8.45
Maximum 7-Day	10.40	5.46	12.62	5.89	20.12	9.59
Maximum Day	16.93	6.20	20.56	7.40	32.88	11.45
Peak Hour	23	-	26	-	40	-
July/August Maximum Month	-	3.58	-	3.65 [b]	-	-
September Maximum Month	-	3.52	-	3.59 [b]	-	-

[a] Design flows include the allocated industrial contributions.
[b] Municipal flows only because industrial flows are diverted to land application facility by 2030.

10.4 Detailed Project Descriptions and Design Data

10.4.1 Collection System

10.4.1.1 Capacity Improvements

Improvements for capacity are determined through hydraulic modeling to evaluate and mitigate the potential for surface or basement flooding. Specific improvements were identified based on relieving capacity deficiencies during specific design scenarios: existing conditions, 2020, 2030, and build-out. Table 10-2 indicates the recommended improvements and the scenario in which the deficiency was identified.

The Mill Creek Pump Station is recommended for improvement in two separate phases of construction. It is anticipated that the existing structure and pump casings can accommodate improvements that nominally increase firm capacity while also improving system performance via installation of a low flow pump. The current configuration suffers from short pump cycle times that affect treatment plant processes and deterioration of the pumps. This project would be constructed first, intended to make use of existing facilities to the greatest extent possible. The next phase of work on the Mill Creek Pump Station is intended to meet expected flows in the 2020 land use scenario, and these improvements cannot be accommodated within the existing facility. A major reconfiguration or new construction will be required for this needed future capacity upgrade.

TABLE 10-2
Collection System Capacity Improvements

Pump Stations and Force Mains

Project Name	Current Firm Capacity (mgd)	Scenario with Identified Deficiency
Mill Creek Pump Station (First and Second Phase)	16	Existing
I-5 Pump Station and Force Main	1.7	2020
Stevens Pump Station and Force Main*	0.3	2020

Gravity Pipelines

Project Name	Length (feet)	Diameter (inches)	Scenario with Identified Deficiency
Young Street Pipeline	1,840	18	Existing
Front Street Pipeline	1,080	18	Existing
Progress Way Pipeline	1,546	12 to 18	Existing
Hayes Street Pipeline	2,350	12 to 15	Existing
Brown Street Pipeline	1,050	12	2020
Mill Creek Interceptor (First Phase)	2,680	24	2030
Mill Creek Interceptor (Second Phase)	600	24	Build-out

*Stevens Pump Station may be replaced with a gravity pipeline in lieu of increased capacity

10.4.1.2 Service to Unsewered Areas

Within the current city boundary, two areas that are not currently served by sanitary sewer are expected to experience growth within the planning horizon. These areas, in the southwest and northern fringes of the currently developed City, must be provided with sewer service. The strategy for this service has not changed significantly from the 2005 Public Facility Plan update. Figure 5-8 in *Volume 2: Wastewater Collection and Transmission System* of this Facilities Plan indicates the strategy for service to these areas. In the southwest, the strategy includes gravity piping and a proposed pump station at Brown Street. There may be an opportunity to serve this area entirely by gravity, but the pump station project is retained for planning and budgeting purposes. During a predesign for this project, a life-cycle cost-benefit analysis can be performed to select the most cost-effective alternative. The northern area is proposed to be served by gravity sewer.

A potential future service area is also shown on Figure 5-8 in *Volume 2: Wastewater Collection and Transmission System* of this Facilities Plan. These service areas, on all sides of the City, require gravity sewers and construction of new pump stations, based on expected growth areas and topographic features.

10.4.1.3 Condition and Maintenance Improvements

Collection system elements deteriorate through use and aging processes. Over time, replacement or rehabilitation become an important part of a capital improvement plan. When possible, improvements due to condition or maintenance-related causes are coupled with capacity improvements. However, some projects are needed to maintain the current level of service, and are not directly related to any capacity deficiency. Table 10-3 identifies a number of known condition-related projects.

TABLE 10-3
Collection System Identified Condition or Maintenance Improvements

Project	Deficiency	In Current CIP?
Pump Stations and Force Mains		
Santiam Pump Station	Reliability	Partial funding
Rainier Pump Station	Reliability/Repairs	Partial funding
I-5 Pump Station	Reliability	No
Stevens Pump Station	Reliability	No
Industrial Pump Station	Reliability	No
Vanderbeck Pump Station	Reliability	No
Greenview Pump Station	Reliability	No
Gravity Pipelines		
Cascade Drive	Infiltration	Yes
West Hayes	Infiltration	Yes
Cleveland to Wilson Street	Frequent Maintenance	Yes
Rainier Road	Frequent Maintenance	Yes
North Trunk rehab	N/A	Yes
Carol Street	Sag in line	No
Young Street	Clogging and slow flow	No
Brown Street	Clogging and slow flow	No
Gatch Street	Frequent Maintenance	No
Northeast Basin 15-inch PVC	Sag in line	No
West Basin	Design flaw	No

As part of good stewardship of the collection system, it can be anticipated that a certain percentage of the system will require repair or rehabilitation each year. It is difficult to predict far in advance specifically which elements (pipe segments, for example) of the system will deteriorate sufficiently to require repair. Using a risk-based approach to consider the likelihood of failure and its consequences will allow the City to prioritize project improvements. For financial planning purposes, a replacement or rehabilitation allowance was included for those pipes that exceeded a 75-year installed use life during the planning period.

10.4.1.4 Asset Management Recommendations

As part of the implementation of best practices for collection system management and operation, a number of recommendations resulted from the Facilities Plan investigation:

- An initial condition assessment was conducted as part of this Facilities Plan, but additional, detailed evaluations are needed. A separate Pump Station Reliability Study is suggested to provide a thorough investigation of all current pump stations operated by the City. Evaluate compliance with DEQ reliability requirements including electrical and alarm systems. Perform repairs as needed to ensure continued compliance.
- Assess staffing and equipment needs for continued implementation of a rigorous maintenance program. Performing sanitary sewer maintenance activities requires highly trained staff and specialized vehicles and equipment. A new tank and vacuum-cleaning vehicle for pipe maintenance (vactor truck) is needed to maintain existing system level of service.
- Enhance the current routine repair, rehabilitation, and replacement schedule and begin to set aside additional funds for the program. A program level budget may wish to focus on the rehabilitation or limited replacement of the 111,000 feet of sewer lines constructed in 1954 or before.
- An initial condition assessment was conducted as part of this Facilities Plan, along with some general assessment of risk, but additional, detailed risk assessments are needed to ensure that limited maintenance funds are directed at the highest priority projects. Perform risk assessment of pipes to identify those that exhibit highest vulnerability to failure, either because of location or service area. This ensures that investment is made in the right parts of the system first.
- Perform a pilot program for spot repairs and in-situ repairs to evaluate effectiveness and costs for various repair methods. The City may determine that spot repairs may more cost effectively extend the useful life of the collection sewers than pipe segment major rehabilitation or replacement.

The recommended plan requires the City to continue its proactive maintenance of the collection system. This approach is essential for the following reasons:

- Growth includes a future allowance for rainfall dependent infiltration and inflow (RDII), but no increase is assumed.
- Existing RDII must be managed to maintain the selected improvement.

To avoid the potential cost consequences of allowing RDII to increase, a meaningful and adequately funded system maintenance program employing best practices must be an integral part of the recommended plan.

These practices are summarized as follows:

- Repair known structural problems

- Perform source identification activities
- TV inspection
- Smoke testing
- Incorporate field investigation results in capital improvement program projects
- Perform flow monitoring
- Replace/line pipe in selected areas
- Continue system data management mapping and records storage activities

10.4.2 Wastewater Treatment

The recommended wastewater treatment improvements include (1) creation of a separate industrial wastewater treatment system to be used during the dry weather season, (2) capacity increases and treatment upgrades at the existing Woodburn POTW, (3) condition and operational improvements at the Woodburn POTW, and (4) capacity increase and upgrades to the Woodburn POTW natural treatment systems including expansion of the poplar reuse system and the addition of treatment wetlands.

10.4.2.1 Separate Industrial Wastewater Treatment

Because industrial flow allocations are significant, these flows will be treated separately during dry weather to avoid expensive improvements at the Woodburn POTW that would be necessary to treat the flows and meet the most stringent summer treatment requirements associated with discharging effluent to the Pudding River during low flows.

As existing secondary capacity at the Woodburn POTW is exhausted, the recommended plan is to treat industrial flows separately from residential and commercial flows, which will continue to be treated at the Woodburn POTW. Pretreated flows from local food processing industries that are currently discharged to the collection system and treated at the Woodburn POTW will be diverted from July 1 to September 30 to a storage lagoon for flow equalization. From the storage lagoon, flow will be pumped to local agricultural fields for irrigation at agronomic rates. The estimated storage volume required is 17.5 million gallons. Assuming irrigated pasture, the industrial land application system will require 114 acres.

From October 1 through June 30, however, industrial flows will be conveyed via the existing collection system to the Woodburn POTW for combined treatment with the municipal flow; this is the current practice. Treatment of these industrial flows at the Woodburn POTW will include secondary treatment and land application of biosolids.

Discussions with the Oregon Department of Environmental Quality (DEQ) indicate that this approach will require a Water Pollution Control Facilities (WPCF) permit for land application during the summer season. During the wet weather season, when the flow will be pumped to the treatment plant, the food processing flows will be governed by the City's National Pollutant Discharge Elimination System (NPDES) permit.

For the industrial treatment system, it is assumed that:

- Storage lagoon will be located within a half mile of the industries.
- Land application sites will be located within a quarter mile of the storage lagoon.
- Flow can be generated at the industries 16 hours/day, 7 days/week.
- Pretreated flow will be land applied 8 hours/day, 7 days/week.

10.4.2.2 Woodburn POTW Upgrades

The recommended 2030 Woodburn POTW capacity upgrades described in Chapter 7 are summarized in Table 10-4.

TABLE 10-4
Recommended 2030 Woodburn POTW Upgrades

Unit Process	Upgrade
Influent Screens	**Increase Capacity of Existing Screening Channels:** The existing two mechanically-raked screens will be replaced with newer technology that provides higher capacity in the same channel. Continuously-cleaned bar screens will provide a capacity of 12 mgd in each of the two channels. To meet Class I reliability criteria, a manual bar screen will be installed in the middle channel. A new washer compactor will be provided.
Grit Removal	**Add a third and fourth grit chamber:** Add a third and fourth influent grit channel, 8 mgd circular vortex concrete tank, grit trap, mounted grit pump, and classifier with cyclone.
Primary Sedimentation	**Convert Wet Weather Clarifiers to Primary Clarifiers and Add a Primary Clarifier:** Rehabilitate wet weather clarifiers and construct primary effluent pump station to lift wet weather clarifier flow to secondary treatment and primary sludge pump station to pump from the wet weather clarifiers to the sludge blend tank. Construct new primary clarifier and add additional sludge pump within existing Primary Sludge pumping system.
Secondary Process	**Blower and Aeration System Upgrades:** Complete rework of DO and blower system (valves, instrumentation and control system) is recommended as an early project to define the design SVI that can be utilized for the secondary design. Replace two existing 1,050 scfm blowers with 3,000 scfm blowers. Assumes existing blower facility and air distribution system is adequate for increased capacity.
Secondary Process	**Contact Stabilization Modifications and One New Secondary Clarifier:** Install piping from the influent channel through the anoxic zone into the aerated zone with an isolation valve in the influent channel to allow for diversion of flow to the midpoint of the aerated zone under high flow conditions. Construct one new secondary clarifier identical to existing clarifiers.
Filtration	**Replace Filters:** Replace existing filters with higher-capacity/newer technology filters, for example, cloth media filters.
UV Disinfection	**Expand Existing and Add Additional Units:** Add third and fourth UV channels and additional UV capacity improvements such as expanded inflow structure.
Outfall	**Increase Capacity:** Construct a bypass around the reaeration structure in Outfall 001A and upsize the 12-inch diameter portion of Outfall 001B to 24-inch diameter.
Standby Power	**Increase Capacity:** Install an additional 500 kW generator to supplement the existing 500 kW generator.

Specific design criteria for the recommended alternative are described in Appendix J. Figure 10-1 [provided at the end of this section] depicts the preliminary site layout for the recommended alternative. A process flow diagram is shown on Figure 10-2. The hydraulic profile for the recommended alternative is summarized in Table 10-5.

TABLE 10-5
Hydraulic Profile Summary for Recommended Alternative
Woodburn POTW (Peak Hour Flow 26 mgd)

Location	Water Surface Elevation (feet)	Top of Slab (feet)
Headworks	185.0	188.00
Primary Clarifier	182.2	184.17
Aeration Basin	179.6	182.00
Secondary Clarifier	175.9	178.50
Filter	173.6	176.25
UV Channel	172.3	176.25
Effluent Flume	168.8	
Pudding River 100 YR Flood Elevation	127.0	

10.4.2.3 Woodburn POTW Condition and Operational Improvements

Recommended improvements to address condition and operational issues and proposed phasing are listed in Table 10-6. These improvements were identified based on the condition assessment described in Section 3. Prioritization and subsequent phasing were based on discussions with City staff.

TABLE 10-6
Recommended Woodburn POTW Condition and Operational Improvements

Item	Recommended Improvements	Phase
Septage Receiving	Provide direct connection for RV waste disposal to Headworks; install receiving station and chopper pump	2C
	Provide complete septage station upgrade, including capacity upgrade, freeze protection and operational improvements.	2C
	Replace trench drain at headworks loadout/septage receiving.	2A
Headworks	Replace Headworks channel covers.	2B
	Provide sump pump for grit pumping area.	2C
	Protect headworks electrical by replacing/relocating to blower building.	2B
	Consolidate screening and grit handling to one dumpster.	2C
Secondary Treatment	Provide lifting device for blowers.	2C
	Install sluice gates in RAS pits on RAS feed lines to allow for isolation and access to RAS pumps.	2B
	Replace diffuser membranes.	2A
	Replace aeration basin scum removal system. Add baffling and telescoping valve to AB effluent channel.	2A
	Provide heat tracing and insulation of secondary clarifier and RAS systems.	2B
Filtration	Provide drainage in bypass channels.	2C

TABLE 10-6
Recommended Woodburn POTW Condition and Operational Improvements

Item	Recommended Improvements	Phase
Disinfection	Replace grating to address unguarded 16-inch opening at UV slide gate.	2A
	Replace NaOCl feed system, including building and appropriate containment	2A
	Install ultrasonic flow meters over UV effluent weirs to provide appropriate signal for UV system operation.	2A
	Add coarse bubble diffusers in the influent channel to prevent solids deposition.	2C
Thickening	Modify DAFT equipment to allow parallel operation.	2C
	Provide separate scum lines to DAFT so that scum can be thickened, effectively providing additional digestion capacity.	2C
	Run DAFT on plant air, not solar units supplied.	2C
Digestion	Seal west digester cover to capture additional digester gas for beneficial reuse and reduce errant emissions.	2C
	Recoat digester roofs and improve roof drainage.	2C
	Improve gas compressor redundancy and enlarge hub drain for seal water.	2C
	Repair brick facing on digesters.	2C
Digester Control Facility	Provide portable gantry crane specific to digester control facility basement.	2B
	Provide permanent air supply system for pneumatic controls.	2B
	Replace sump pumps with higher head pumps to eliminate basement flooding concerns.	2B
	Provide heat pump for digester electrical room to eliminate corrosion issues associated with existing heating unit.	2B
Civil/Site	Improve roadway(s) to allow for better access for harvest equipment. Road drainage is not anticipated as part of these improvements as they would likely trigger new permit issues.	2A
	Provide stormwater lift station to divert storm flows into lagoon wetland.	2A
Non Process	Upgrade/replace W3 system. Provide a new complete loop of 6-inch pipe around the site. Include freeze protection for W3 supply. Coordinate with Sodium Hypochlorite improvements.	2A-2C
	Upgrade plant security system.	2C
	Improve Lab HVAC.	2C
	Repave and enlarge entry to allow for truck access.	2A
	Pump supernatant back to plant in lieu of gravity drain.	2C
	Provide Plant SCADA software licensing upgrade, Windows 2000 upgrade to NT. Integrate poplar irrigation system into main SCADA system, test and install.	2A

10.4.2.4 Woodburn Natural Treatment System Upgrades

The recommended 2030 Woodburn Natural Treatment System upgrades are summarized in Table 10-7.

TABLE 10-7
Recommended 2030 Woodburn Natural Treatment System Upgrades

Unit Process	Upgrade
Poplar Tree Reuse System	**Expand Existing Poplar Tree Reuse System to Increase Capacity:** Develop an additional 38 acres on City-owned land and 59 acres on additional purchased land.
Constructed Wetlands	**Construct Wetlands to Cool Effluent and Meet New Thermal Load Limits:** Develop a 10 acre wetland within the existing effluent lagoons and 14 acres of wetlands within the Pudding River floodplain on City-owned property.
Outfall	**Install New Outfall for Floodplain Wetlands:** This new outfall is needed to convey flows sent to the floodplain wetlands out to the Pudding River.

Specific design criteria for the recommended alternative are described in Section 8. Figure 8-1 depicts the preliminary site layout for the recommended alternative.

10.5 Cost Estimates

The recommended plan cost estimates are summarized in Table 10-8. These are total project costs, and include estimated construction costs plus an additional 25 percent for engineering, administrative and legal (EAL) costs.

TABLE 10-8
Woodburn Wastewater Facilities Recommended Plan Cost Estimates

Item	Phase 2	Phase 3	Total
Collection System			
Mill Creek PS Project - Phase 1	$500,000		$500,000
Mill Creek PS Project - Phase 2	$2,605,000		$2,605,000
I-5 PS Project	$1,307,000		$1,307,000
I-5 FM Project	$3,093,000		$3,093,000
Stevens PS Project	$990,000		$990,000
Young Street Pipeline Project	$1,773,000		$1,773,000
Front Street Pipeline Project	$1,040,000		$1,040,000
Progress Way Pipeline Project	$1,362,000		$1,362,000
Hayes Street Pipeline Project	$2,030,000		$2,030,000
Brown Street Pipeline Project	$931,000		$931,000
Current CIP Projects (Funds 465, 472)	$460,000		$460,000
Equipment Replacement (VAC Truck)	$350,000		$350,000
Pump Station Upgrades (Existing Upgrades - Reliability)	$275,000		$275,000
Replacement Costs-Collection System Piping	$3,400,000	$4,600,000	$8,000,000
Mill Creek Interceptor Pipeline Project (Phase 1)		$1,855,000	$1,855,000

TABLE 10-8
Woodburn Wastewater Facilities Recommended Plan Cost Estimates

Item	Phase 2	Phase 3	Total
Sanitary Sewer Service to North Area (2005 PFP Project)		$ 5,219,000	$5,219,000
Sanitary Sewer Service to South Area - South Brown Street Pump Station	$800,000		$800,000
Sanitary Sewer Service to Southwest Industrial Area (2005 PFP Pipeline Project)		$9,722,000	$9,722,000
Area Outside UGB		$8,560,000	$8,560,000
Collection System - Subtotal	**$20,916,000**	**$29,956,000**	**$50,872,000**
Separate Industrial Wastewater Treatment			
Industrial Land Application	-	$8,200,000	**$8,200,000**
Woodburn POTW Upgrades and Improvements			
Screening	$1,900,000	-	$1,900,000
Grit Removal	$1,300,000	$1,300,000	$2,600,000
Primary Sedimentation – Convert WW Clarifiers	$1,750,000	-	$1,750,000
Primary Sedimentation – PEPS	$3,000,000	-	$3,000,000
Primary Sedimentation – New Primary Clarifier	-	$2,400,000	$2,400,000
Secondary Process – Blower and DO Control Upgrades	$1,300,000	-	$1,300,000
Secondary Process – Contact Stabilization Modifications	$300,000	-	$300,000
Secondary Process – New Secondary Clarifier	$2,500,000	-	$2,500,000
Filtration	$1,900,000	-	$1,900,000
UV Disinfection – Expand Existing Equipment	$400,000	-	$400,000
UV Disinfection – Add UV Channels	$2,100,000	$1,300,000	$3,400,000
Outfall – Bypass Aerator	$100,000	-	$100,000
Outfall – Upsize Outfall B	$500,000	-	$500,000
Condition Improvements	$3,700,000	-	$3,700,000
Septage and RV Dump Station Improvements	$1,700,000	-	$1,700,000
Emergency Generator	$300,000	-	$300,000
Woodburn POTW Upgrades - Subtotal	**$22,750,000**	**$5,000,000**	**$27, 750,000**
Woodburn Natural Treatment System Upgrades			
Poplar tree expansion on City-owned land	$1,064,000	-	$1,064,000
Land Purchase	$885,000	-	$885,000
Poplar tree expansion on Additional land	$1,540,000	$112,000	$1,652,000

TABLE 10-8
Woodburn Wastewater Facilities Recommended Plan Cost Estimates

Item	Phase 2	Phase 3	Total
Lagoon Wetlands	$1,100,000	-	$1,100,000
Floodplain Wetlands	$1,400,000	-	$1,400,000
Wetland conveyance and new river outfall	$1,620,000	-	$1,620,000
Natural Treatment System - Subtotal	**$7,609,000**	**$112,000**	**$7,721,000**
Total	$51,280,000	$43,270,000	$94,540,000

*For municipal (residential and commercial) flow increases only, because recommended plan is to treat industrial flows separately with land application system. Also, does not include land costs.

10.6 Implementation Plan

The proposed implementation plan replaces the Phase 2 (2020 planning horizon) recommendations from the 1995 Facilities Plan. The Phase 2 improvements have been modified in scope through the evaluation work in this current Facilities Plan and are still intended to address capital needs through 2020. The Phase 3 improvements described in this Facilities Plan recommend facilities to meet the 2030 planning horizon. Because allocated industrial flows identified in the existing permits significantly increase Woodburn's projected wastewater flows and loads, it would be worthwhile to renegotiate the City's industrial pretreatment permits with local food processors to reduce consequential capital improvement costs. This approach offers the greatest potential cost savings to the City and would defer development of some plant expansion components.

In the meantime, this plan assumes that allocated industrial flows will be accommodated in the future according to the agreements. However, the proposed project phases incorporate the flexibility to address treatment needs as they develop and avoid investments in capital improvements that may become unnecessary, depending on how much the allocated industrial flows are changed.

10.6.1 Project Triggers

This section describes the triggers utilized for improvements at the existing POTW, as well as improvements associated with the natural treatment systems. These triggers are based on continued growth in flows and loads coming to the treatment facilities, and an actual estimated trigger date is provided, based on Woodburn's projected flows and loads. (Note that triggers for the collection system improvements are identified separately, in Table 10-2).

Utilizing this information, preliminary packaging and phasing is developed for project implementation. A summary of specific triggers for each major improvement by unit process are identified in Table 10-9. Approximate trigger dates establish the basis for packaging of improvements, described in Section 10.6.2.

For the purposes of this effort, project triggers have been grouped into four categories:

- *Capacity.* Capacity triggers are based on an increase in flow or load to a given unit process.

  Capacity shortfalls are based on current inadequacies in the system and/or increased ability of the collection system to deliver flows to the POTW.

  Capacity for Growth. In this instance, this trigger is based on increases in influent flows and loads due to growth within the service area.

- *Water Quality.* Water quality triggers are those improvements required to address changing regulatory criteria. Several of the current discharge requirements are more stringent than those in place during previous planning and design efforts.
- *Reliability.* The improvements are based on meeting EPA's Class I requirements for reliability and redundancy. Previous improvements were designed to meet Class II requirements. Reliability triggers are therefore improvements necessary to meet the increased reliability requirements associated with Class I.
- *Condition.* Condition triggers are based on deteriorating condition of system components. These improvements are recommended to address the increased maintenance and reduced performance and reliability associated with the failing component. Ongoing prioritization of improvements within this category should rely on POTW staff knowledge, based on a detailed understanding of the costs associated with maintaining aged equipment or poorly designed systems, coupled with the risk associated with poor performance and reduced reliability.

TABLE 10-9
Trigger Schedule

Category	Improvement Description	Trigger Description	Trigger Value	Trigger Units	Approximate Trigger Date
Preliminary Treatment					
Capacity for Growth / Reliability	Replace Bar Screens	PHWW Influent Flow	16	mgd	2010
Capacity for Growth	Add third grit removal unit	PHWW Influent Flow	16	mgd	2010
Capacity for Growth	Add fourth grit removal unit	PHWW influent Flow	24	mgd	2022
Primary Treatment					
Water Quality / Reliability	Convert wet weather clarifiers to primary clarifiers	PHWW Influent Flow	12	mgd	2010
Capacity for Growth	Add third new primary clarifier	PHWW Influent Flow	24	mgd	2022
Secondary Treatment					
Condition / Capacity Shortfall	Blower and aeration system upgrades	MDWW Influent Load			2010
Capacity Shortfall	Contact stabilization modifications	MDWW Influent Flow	10.4	mgd	2010
Reliability	Construct one new secondary clarifier	PHWW Influent Flow	17.7	mgd	2012
Filtration					
Capacity Shortfall / Reliability	Replace with cloth filters	MDDW Influent Flow	3 [a]	mgd	2010
Disinfection					
Capacity Shortfall	Expand existing UV system	PHWW Influent Flow	12	mgd	2010
Capacity for Growth	Add third UV unit	PHWW Influent Flow	16	mgd	2010
Capacity for Growth	Add fourth UV unit	PHWW Influent Flow	24	mgd	2022
Outfall					
Capacity Shortfall	Bypass Aerator	PHWW Influent Flow	12	mgd	2010

TABLE 10-9
Trigger Schedule

Category	Improvement Description	Trigger Description	Trigger Value	Trigger Units	Approximate Trigger Date
Capacity for Growth	Upsize Outfall B	PHWW Influent Flow	17.8	mgd	2012
Emergency Generation					
Reliability	Install additional emergency generator				2010
Reuse and Discharge (Natural Treatment Systems)					
Capacity for Growth	Poplar tree expansion on City-owned land	Jul/Aug MMDW Flow	2.9	mgd	2010
Capacity for Growth	Land Purchase	Jul/Aug MMDW Flow	3.2	mgd	2010
Capacity for Growth	Poplar tree expansion on Additional land	Jul/Aug MMDW Flow	3.2	mgd	2012
Water Quality	Lagoon Wetlands	TMDL	0.5	mgd	Note b
Water Quality	Floodplain Wetlands	TMDL and September AD Flow	2.0	Mgd	Note b
Water Quality	Wetland conveyance and new river outfall	Need for Floodplain Wetlands – Same Trigger	2.0	mgd	Note b
Industrial Treatment					
Capacity for Growth	Industrial Land Application				

[a] Based on observations of plant staff. Additional monitoring and evaluation is recommended to better define existing filtration system capacity.
[b] Per compliance schedule in revised MAO, currently under negotiation.

10.6.1.1 Peak Hour Flow Delivered to POTW

The POTW improvements detailed in Table 10-9 that are triggered by Peak Hour Wet Weather flow are based not just on the flow generated within the service area, but by the ability of the collection system to deliver that flow to the POTW. The approximate dates listed in Table 10-9 are based on service area flow projections. However, the actual timing of the POTW improvements should be coordinated with Mill Creek PS improvements.

10.6.1.2 Sequence for Natural Treatment System Expansion

The Woodburn POTW natural treatment system expansion is triggered by the MAO schedule for temperature compliance and July/August effluent flows for ammonia compliance. It is recommended that the City begin with development on the land the City currently owns. This includes the development of 10 acres of constructed wetlands within the existing effluent lagoon and 38 acres of poplar tree plantation and 14 acres of constructed wetlands (and associated outfall) on the adjacent City-owned McNulty property. During the build-out of existing City-owned property, the City would need to identify additional, adjacent property for purchase or long-term lease to provide capacity for the next phase of poplar tree system expansion.

10.6.2 Capital Improvements Program

Utilizing the trigger dates described in Section 10.6.1 as a guide, preliminary construction packages for the POTW improvements were developed by grouping improvements into phases. This is based on the timing of improvements established in the trigger schedule above, as well as construction efficiencies. When work is planned in a certain process area there is often efficiency in performing other improvements within the same area concurrently. This effectively moves some improvements up in the planning horizon. Timing of certain improvements is based on City input and budgeting constraints.

It is assumed that each grouping of improvements within the POTW represents a single construction contract to minimize site coordination problems and maximize efficiencies.

For the natural treatment systems, immediate improvements (required to meet mutual agreement and order [MAO] with Oregon DEQ) should also be packaged together to meet the near-term temperature and ammonia criteria. Further expansion of the poplar and wetland systems in subsequent years can be approached as individual projects or packaged when appropriate.

A detailed capital improvement plan (CIP) was developed for the planning horizon through discussions with City staff. Detailed costs for each improvement and the CIP are shown in Table 10-10. Projects are assumed to be spread over 2 or 3 years, depending on the size.

10.7 Financing Strategy

The local funding sources for the proposed Woodburn wastewater facilities improvements will be City of Woodburn sewer rates and system development charges (SDCs). An analysis of this funding source is provided in *Volume 3: Wastewater Rate and System Development Charge Study* of this Facilities Plan. The City of Woodburn also plans to seek additional funding through the DEQ Clean Water State Revolving Fund (CWSRF), supplementing CWSRF funding that has already been secured.

10.8 Recommended Actions

In addition to the recommended facility improvements identified in this Facilities Plan and Capital Improvement Plan, following are recommended actions that Woodburn should consider initiating as soon as possible in the short-term:

- Renegotiate permits with food processors to reduce allocated industrial flows. This approach could be very beneficial to the City. For example, if these permits were adjusted to accommodate actual flows, the capital projects required would be significantly reduced, as demonstrated in the alternative CIP and implementation schedule shown in Table 10-11.
- Perform wetland delineation within the floodplain portions of the McNulty property to better define wetland restoration opportunities and possible constructed wetland footprints and to refine cost assumptions for developing wetlands in the floodplain.
- Begin permitting and pre-design for the temperature control facilities.
- Contract for the dredging and removal of biosolids from the facultative sludge lagoons to reclaim biosolids storage capacity and draw biosolids accumulation down within safe operating levels.
- Update the Biosolids Management Plan and obtain approvals to apply biosolids on the City-owned McNulty property.
- Negotiate an agreement with MacLaren Youth Correctional Facility and/or other adjacent land owners to provide City of Woodburn with additional land for poplar trees.
- Begin to actively identify additional agricultural lands that could be purchased near the Woodburn POTW and Sabroso to meet the projected implementation schedules.
- Renegotiate Woodburn POTW NPDES permit based on comments in Section 5 (Basis of Planning) of this Facilities Plan.
- Harvest and replant approximately half of the existing planted 84-acres of poplar trees in each of the next two years with the first harvest/replant occurring before the 2010 growing season and the second harvest/replant occurring before the 2011 growing season.
- Perform a financial evaluation of the septage program at Woodburn to better define the true treatment costs and to determine whether septage rates need to be increased to cover the additional costs for biosolids management.
- Continue and complete pilot studies research project to develop information about viability of incorporating hyporheic discharge as a facet of the future constructed wetland systems and viability of irrigating poplar trees at a greater than agronomic rate in areas where biosolids will not be applied. These approaches could be used to reduce

the required footprints of the natural treatment systems and to improve temperature reduction and nutrient removal.

- File water right applications with the Oregon Water Resources Department on future municipal effluent flows to be discharge to the Pudding River to protect these flows for instream uses.

10.9 Schedule

The Capital Improvement Plan (Table 10-10) provides a general schedule for implementation of the recommended improvements. Additional schedule details will need to be developed during predesign to incorporate additional planning and engineering efforts, land purchase agreements, and contracting timelines.

- The TMDL-related deadlines of the City of Woodburn MAO with DEQ will control the necessary timing of the most immediate improvements described within this Facilities Plan. Modifications to the MAO schedule are currently being negotiated with DEQ at the time of this final report.

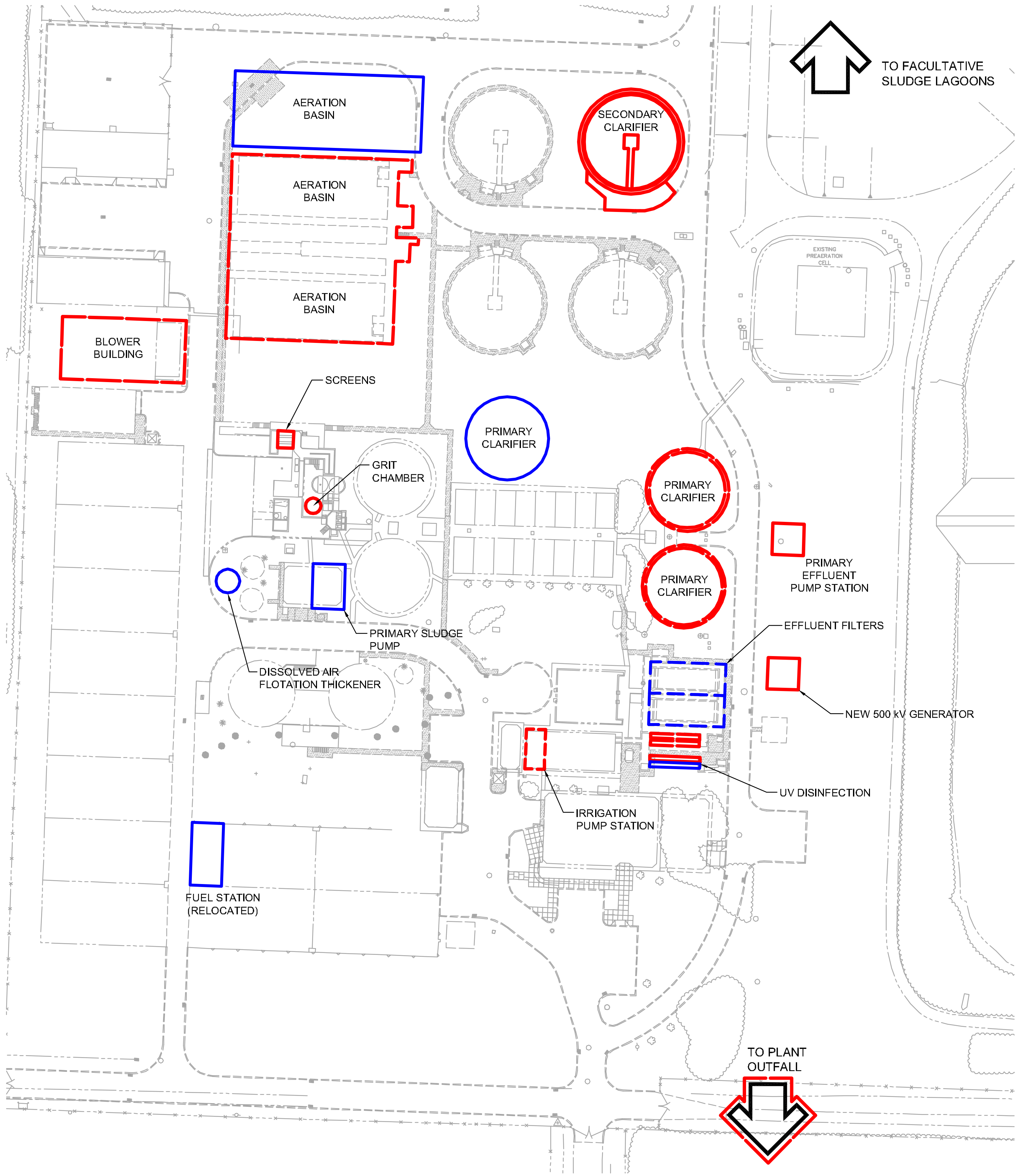
Table 10-10
Recommended CIP Using Allocated Food Processing Flows

City of Woodburn
Facilities Plan
Capital Improvement Plan Implementation Summary

	Calendar Year													
	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020	2009-2020	2021-2030	2009-2030
PEAK FLOW, MGD	19	19.5	20	20.5	21	21.5	22	22.5	23	23.5	24	Roll-up	Roll-up	Total
Jul-Aug Flow to Poplar (mgd)	0.8	0.9	0.9	1.0	1.1	1.2	1.3	1.3	1.4	1.5	1.6	Total	Total	
Floodplain Wetland Area Needed (ac)	7	8	8	9	10	11	11	12	13	13	14			
Collection System												$ -	$ -	$ -
Mill Creek PS Project - Phase 1	$ 100,000	$ 400,000										$ 500,000	$ -	$ 500,000
Mill Creek PS Project - Phase 2									$ 521,000	$ 1,042,000	$ 1,042,000	$ 2,605,000	$ -	$ 2,605,000
I-5 PS Project				$ 261,000	$ 1,046,000							$ 1,307,000	$ -	$ 1,307,000
I-5 FM Project				$ 619,000	$ 2,474,000							$ 3,093,000	$ -	$ 3,093,000
Stevens PS Project							$ 198,000	$ 792,000				$ 990,000	$ -	$ 990,000
Young Street Pipeline Project						$ 355,000	$ 1,418,000					$ 1,773,000	$ -	$ 1,773,000
Front Street Pipeline Project							$ 208,000	$ 832,000				$ 1,040,000	$ -	$ 1,040,000
Mill Creek Interceptor Pipeline Project												$ -	$ 1,855,000	$ 1,855,000
Progress Way Pipeline Project				$ 272,000	$ 1,090,000							$ 1,362,000	$ -	$ 1,362,000
Hayes Street Pipeline Project	$ 406,000	$ 1,624,000										$ 2,030,000	$ -	$ 2,030,000
Brown Street Pipeline Project						$ 186,000	$ 745,000					$ 931,000	$ -	$ 931,000
Sanitary Sewer Service to North Area (2005 PFP Project)												$ -	$ 5,219,000	$ 5,219,000
Sanitary Sewer Service to South Area - South Brown Street Pump Station					$ 200,000	$ 600,000						$ 800,000	$ -	$ 800,000
Sanitary Sewer Service to Southwest Industrial Area (2005 PFP Pipeline Project)												$ -	$ 9,722,000	$ 9,722,000
Area Outside UGB												$ -	$ 8,560,000	$ 8,560,000
Current CIP Projects (Funds 465, 472)	$ 460,000											$ 460,000	$ -	$ 460,000
Replacement Costs-Collection System Piping		$ 200,000	$ 200,000	$ 200,000	$ 250,000	$ 250,000	$ 460,000	$ 460,000	$ 460,000	$ 460,000	$ 460,000	$ 3,400,000	$ 4,600,000	$ 8,000,000
Equipment Replacement (VAC Truck)			$ 350,000									$ 350,000	$ -	$ 350,000
Pump Station Upgrades (Existing Upgrades - Reliability)	$ 50,000	$ 75,000	$ 75,000	$ 75,000								$ 275,000	$ -	$ 275,000
SUBTOTAL - COLLECTION SYSTEM	**$ 1,016,000**	**$ 2,299,000**	**$ 625,000**	**$ 1,427,000**	**$ 5,060,000**	**$ 1,391,000**	**$ 3,029,000**	**$ 2,084,000**	**$ 981,000**	**$ 1,502,000**	**$ 1,502,000**	**$ 20,916,000**	**$ 29,956,000**	**$ 50,872,000**
SUBTOTAL INDUSTRIAL LAND APPLICATION	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	$ -	**$ 8,200,000**	**$ 8,200,000**
POTW			**PHASE 2A**			**PHASE 2B**				**PHASE 2C**				
Headworks - Screening					$ 380,000	$ 760,000	$ 760,000					$ 1,900,000	$ -	$ 1,900,000
Headworks - Grit Removal									$ 260,000	$ 520,000	$ 520,000	$ 1,300,000	$ 1,300,000	$ 2,600,000
Primary Sedimentation - PEPS					$ 600,000	$ 1,200,000	$ 1,200,000					$ 3,000,000	$ -	$ 3,000,000
Primary Sedimentation - Convert WW Clarifiers		$ 50,000			$ 340,000	$ 680,000	$ 680,000					$ 1,750,000	$ -	$ 1,750,000
Primary Sedimentation - New Primary Clarifier												$ -	$ 2,400,000	$ 2,400,000
Secondary Process - Blower and DO Upgrades	$ 260,000	$ 1,040,000										$ 1,300,000	$ -	$ 1,300,000
Secondary Process - Contact Stabilization Modifications					$ 60,000	$ 120,000	$ 120,000					$ 300,000	$ -	$ 300,000
Secondary Process - New Secondary Clarifier									$ 500,000	$ 1,000,000	$ 1,000,000	$ 2,500,000	$ -	$ 2,500,000
Filtration					$ 380,000	$ 760,000	$ 760,000					$ 1,900,000	$ -	$ 1,900,000
UV Disinfection - Expand Existing Equipment	$ 20,000	$ 60,000	$ 320,000									$ 400,000	$ -	$ 400,000
UV Disinfection - Add Additional Channel/Unit									$ 420,000	$ 840,000	$ 840,000	$ 2,100,000	$ 1,300,000	$ 3,400,000
Outfall - Bypass Aerator	$ 5,000	$ 15,000	$ 80,000									$ 100,000	$ -	$ 100,000
Outfall - Upsize Outfall B									$ 100,000	$ 200,000	$ 200,000	$ 500,000	$ -	$ 500,000
Condition Improvements	$ 110,000	$ 330,000	$ 880,000	$ 880,000	$ 140,000	$ 280,000	$ 280,000		$ 160,000	$ 320,000	$ 320,000	$ 3,700,000	$ -	$ 3,700,000
Septage / RV Dump Station Improvements									$ 340,000	$ 680,000	$ 680,000	$ 1,700,000	$ -	$ 1,700,000
Generator						$ 60,000	$ 240,000					$ 300,000	$ -	$ 300,000
SUBTOTAL - POTW	**$ 395,000**	**$ 1,495,000**	**$ 1,280,000**	**$ 880,000**	**$ 1,900,000**	**$ 3,860,000**	**$ 4,040,000**	**$ -**	**$ 1,780,000**	**$ 3,560,000**	**$ 3,560,000**	**$ 22,750,000**	**$ 5,000,000**	**$ 27,750,000**
Natural Treatment Systems (NTS)														
Poplar Tree Expansion on City Owned Land	$ 212,800	$ 851,200										$ 1,064,000	$ -	$ 1,064,000
Land Purchase		$ 885,000										$ 885,000	$ -	$ 885,000
Poplar Tree Expansion on Additional Purchased Land			$ 350,000	$ 350,000			$ 364,000	$ 364,000			$ 112,000	$ 1,540,000	$ 112,000	$ 1,652,000
Lagoon Wetlands	$ 220,000	$ 880,000										$ 1,100,000	$ -	$ 1,100,000
Floodplain Wetlands	$ 200,000	$ 100,000	$ 700,000	$ 200,000	$ 200,000							$ 1,400,000	$ -	$ 1,400,000
Wetland Conveyance and New River Outfall	$ 324,000	$ 162,000	$ 1,134,000									$ 1,620,000	$ -	$ 1,620,000
SUBTOTAL - NATURAL TREATMENT SYSTEMS	**$ 956,800**	**$ 2,878,200**	**$ 2,184,000**	**$ 550,000**	**$ 200,000**	**$ -**	**$ 364,000**	**$ 364,000**	**$ -**	**$ -**	**$ 112,000**	**$ 7,609,000**	**$ 112,000**	**$ 7,721,000**
Total	**$ 2,370,000**	**$ 6,670,000**	**$ 4,090,000**	**$ 2,860,000**	**$ 7,160,000**	**$ 5,250,000**	**$ 7,430,000**	**$ 2,450,000**	**$ 2,760,000**	**$ 5,060,000**	**$ 5,170,000**	**$ 51,280,000**	**$ 43,270,000**	**$ 94,540,000**

Table 10-11
Recommended CIP Using Actual Food Processing Flows

	Calendar Year													
	2009-2010	**2010-2011**	**2011-2012**	**2012-2013**	**2013-2014**	**2014-2015**	**2015-2016**	**2016-2017**	**2017-2018**	**2018-2019**	**2019-2020**	**2009-2020**	**2021-2030**	**2009-2030**
PEAK FLOW, MGD	**19**	**19.5**	**20**	**20.5**	**21**	**21.5**	**22**	**22.5**	**23**	**23.5**	**24**	**Roll-up**	**Roll-up**	**Total**
Jul-Aug Flow to Poplar (mgd)	**0.8**	**0.9**	**0.9**	**1.0**	**1.1**	**1.2**	**1.3**	**1.3**	**1.4**	**1.5**	**1.6**	**Total**	**Total**	
Floodplain Wetland Area Needed (ac)	**7**	**8**	**8**	**9**	**10**	**11**	**11**	**12**	**13**	**13**	**14**			
Collection System												$ -	$ -	$ -
Mill Creek PS Project - Phase 1	$ 100,000	$ 400,000										$ 500,000	$ -	$ 500,000
Mill Creek PS Project - Phase 2									$ 521,000	$ 1,042,000	$ 1,042,000	$ 2,605,000	$ -	$ 2,605,000
I-5 PS Project				$ 261,000	$ 1,046,000							$ 1,307,000	$ -	$ 1,307,000
I-5 FM Project				$ 619,000	$ 2,474,000							$ 3,093,000	$ -	$ 3,093,000
Stevens PS Project							$ 198,000	$ 792,000				$ 990,000	$ -	$ 990,000
Young Street Pipeline Project						$ 355,000	$ 1,418,000					$ 1,773,000	$ -	$ 1,773,000
Front Street Pipeline Project							$ 208,000	$ 832,000				$ 1,040,000	$ -	$ 1,040,000
Mill Creek Interceptor Pipeline Project										$ 371,000	$ 1,484,000	$ 1,855,000	$ 1,855,000	$ 1,855,000
Progress Way Pipeline Project				$ 272,000	$ 1,090,000							$ 1,362,000	$ -	$ 1,362,000
Hayes Street Pipeline Project	$ 406,000	$ 1,624,000										$ 2,030,000	$ -	$ 2,030,000
Brown Street Pipeline Project						$ 186,000	$ 745,000					$ 931,000	$ -	$ 931,000
Sanitary Sewer Service to North Area (2005 PFP Project)												$ -	$ 5,219,000	$ 5,219,000
Sanitary Sewer Service to South Area - South Brown Street Pump Station					$ 200,000	$ 600,000						$ 800,000	$ -	$ 800,000
Sanitary Sewer Service to Southwest Industrial Area (2005 PFP Pipeline Project)												$ -	$ 9,722,000	$ 9,722,000
Area Outside UGB												$ -	$ 8,560,000	$ 8,560,000
Current CIP Projects (Funds 465, 472)	$ 460,000											$ 460,000	$ -	$ 460,000
Replacement Costs-Collection System Piping		$ 200,000	$ 200,000	$ 200,000	$ 250,000	$ 250,000	$ 460,000	$ 460,000	$ 460,000	$ 460,000	$ 460,000	$ 3,400,000	$ 4,600,000	$ 8,000,000
Equipment Replacement (VAC Truck)			$ 350,000									$ 350,000	$ -	$ 350,000
Pump Station Upgrades (Existing Upgrades - Reliability)	$ 50,000	$ 75,000	$ 75,000	$ 75,000								$ 275,000	$ -	$ 275,000
SUBTOTAL - COLLECTION SYSTEM	**$ 1,016,000**	**$ 2,299,000**	**$ 625,000**	**$ 1,427,000**	**$ 5,060,000**	**$ 1,391,000**	**$ 3,029,000**	**$ 2,084,000**	**$ 981,000**	**$ 1,873,000**	**$ 2,986,000**	**$ 22,771,000**	**$ 29,956,000**	**$ 50,872,000**
SUBTOTAL INDUSTRIAL LAND APPLICATION	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	$ -	**$ -**	**$ -**
POTW			**PHASE 2A**			**PHASE 2B**				**PHASE 2C**				
Headworks - Screening					$ 380,000	$ 760,000	$ 760,000					$ 1,900,000	$ -	$ 1,900,000
Headworks - Grit Removal									$ 260,000	$ 520,000	$ 520,000	$ 1,300,000	$ 1,300,000	$ 2,600,000
Primary Sedimentation - PEPS					$ 600,000	$ 1,200,000	$ 1,200,000					$ 3,000,000	$ -	$ 3,000,000
Primary Sedimentation - Convert WW Clarifiers		$ 50,000			$ 340,000	$ 680,000	$ 680,000					$ 1,750,000	$ -	$ 1,750,000
Primary Sedimentation - New Primary Clarifier												$ -	$ 2,400,000	$ 2,400,000
Secondary Process - Blower and DO Upgrades	$ 260,000	$ 1,040,000										$ 1,300,000	$ -	$ 1,300,000
Secondary Process - Contact Stabilization Modifications					$ 60,000	$ 120,000	$ 120,000					$ 300,000	$ -	$ 300,000
Secondary Process - New Secondary Clarifier									$ 500,000	$ 1,000,000	$ 1,000,000	$ 2,500,000	$ -	$ 2,500,000
Filtration					$ 380,000	$ 760,000	$ 760,000					$ 1,900,000	$ -	$ 1,900,000
UV Disinfection - Expand Existing Equipment	$ 20,000	$ 60,000	$ 320,000									$ 400,000	$ -	$ 400,000
UV Disinfection - Add Additional Channel/Unit									$ 420,000	$ 840,000	$ 840,000	$ 2,100,000	$ 1,300,000	$ 3,400,000
Outfall - Bypass Aerator	$ 5,000	$ 15,000	$ 80,000									$ 100,000	$ -	$ 100,000
Outfall - Upsize Outfall B									$ 100,000	$ 200,000	$ 200,000	$ 500,000	$ -	$ 500,000
Condition Improvements	$ 110,000	$ 330,000	$ 880,000	$ 880,000	$ 140,000	$ 280,000	$ 280,000		$ 160,000	$ 320,000	$ 320,000	$ 3,700,000	$ -	$ 3,700,000
Septage / RV Dump Station Improvements									$ 340,000	$ 680,000	$ 680,000	$ 1,700,000	$ -	$ 1,700,000
Generator						$ 60,000	$ 240,000					$ 300,000	$ -	$ 300,000
SUBTOTAL - POTW	**$ 395,000**	**$ 1,495,000**	**$ 1,280,000**	**$ 880,000**	**$ 1,900,000**	**$ 3,860,000**	**$ 4,040,000**	**$ -**	**$ 1,780,000**	**$ 3,560,000**	**$ 3,560,000**	**$ 22,750,000**	**$ 5,000,000**	**$ 27,750,000**
Natural Treatment Systems (NTS)														
Poplar Tree Expansion on City Owned Land	$ 156,800	$ 627,200										$ 784,000	$ -	$ 784,000
Land Purchase										$ 1,335,000		$ 1,335,000	$ -	$ 1,335,000
Poplar Tree Expansion on Additional Purchased Land											$ 630,000	$ 630,000	$ 1,890,000	$ 2,520,000
Lagoon Wetlands	$ 220,000	$ 880,000										$ 1,100,000	$ -	$ 1,100,000
Floodplain Wetlands	$ 300,000	$ 300,000		$ 200,000	$ 200,000					$ 300,000	$ 300,000	$ 1,600,000	$ -	$ 1,600,000
Wetland Conveyance and New River Outfall	$ 324,000	$ 162,000	$ 1,134,000									$ 1,620,000	$ -	$ 1,620,000
SUBTOTAL - NATURAL TREATMENT SYSTEMS	**$ 1,000,800**	**$ 1,969,200**	**$ 1,134,000**	**$ 200,000**	**$ 200,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 1,635,000**	**$ 930,000**	**$ 7,069,000**	**$ 1,890,000**	**$ 8,959,000**
Total	**$ 2,410,000**	**$ 5,760,000**	**$ 3,040,000**	**$ 2,510,000**	**$ 7,160,000**	**$ 5,250,000**	**$ 7,070,000**	**$ 2,080,000**	**$ 2,760,000**	**$ 7,070,000**	**$ 7,480,000**	**$ 52,590,000**	**$ 36,850,000**	**$ 87,580,000**



LEGEND:

	UPGRADE/ MODIFY	NEW
PHASE 2	(red dashed line)	(red solid line)
PHASE 3	(blue dashed line)	(blue solid line)

FIGURE 10-1
WOODBURN POTW
SITE PLAN
WOODBURN, OREGON

367677FP

CH2MHILL

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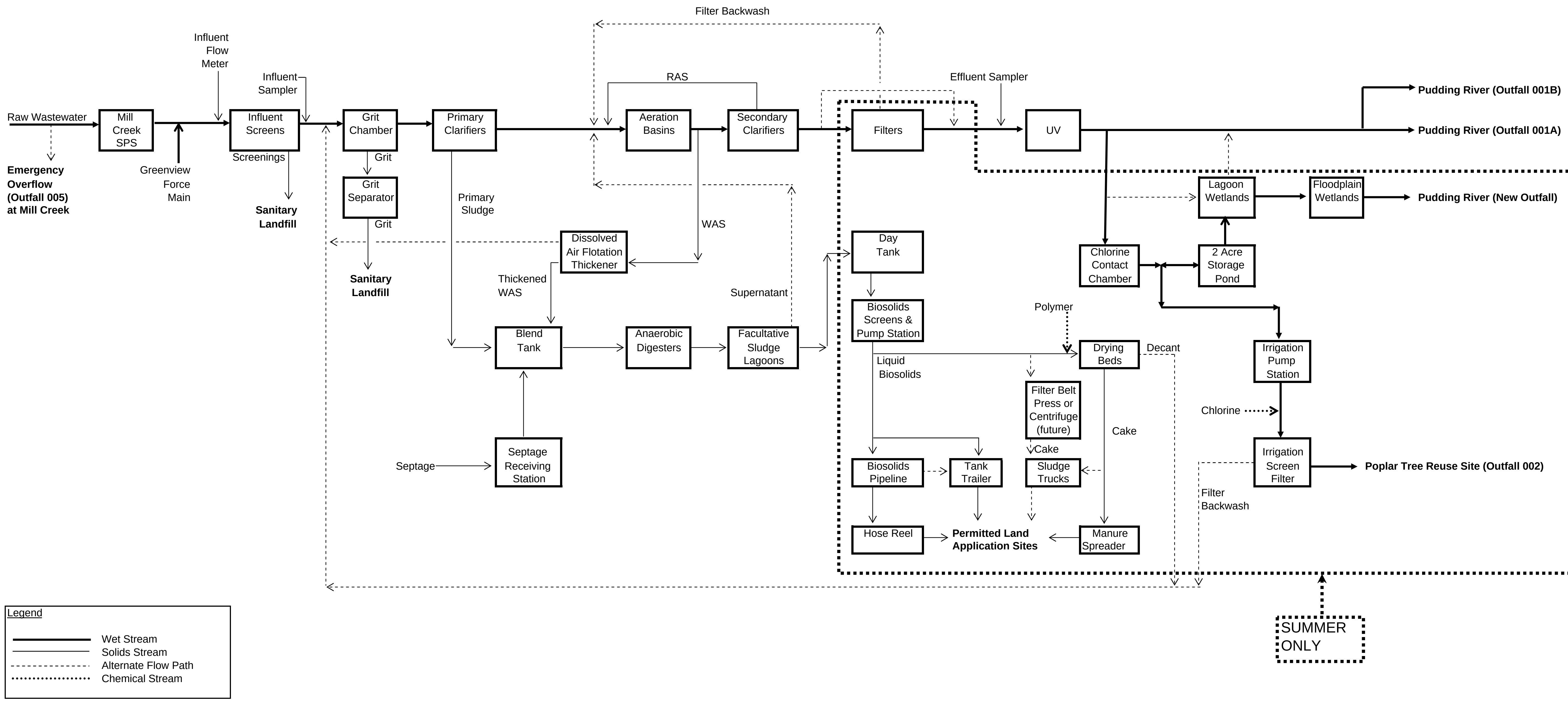

Figure 10-2
Proposed Woodburn POTW Process Flow Diagram

SECTION 11

Environmental Report

The City of Woodburn prepared a draft environmental review of the Wastewater Treatment Upgrade Project as described in the *City of Woodburn Planning Document for the Selection of Temperature and Ammonia Reduction Alternatives* (CH2M HILL, August 2006) to serve as Exhibit F of its loan application to the Oregon Department of Environmental Quality (DEQ) Clean Water State Revolving Fund (CWSRF) Program. No additional environmental review has been performed as part of this facilities planning effort.

SECTION 12

Public Outreach

The City of Woodburn established a Wastewater Facilities Plan Citizen's Advisory Committee (WCAC) of citizen volunteers in 2008 to assist in the development of a wastewater facilities plan that reflects community values and concerns. Regular meetings were held with the WCAC with presentations and discussions with City wastewater division staff and consultant engineers regarding all aspects of the facilities planning process. This included study area characteristics, population projections, regulatory requirements, collection system mapping and evaluation, treatment plant and collection system condition assessments, flow and load analysis, collection system hydraulic modeling and capacity deficiency results, pilot testing, and the formulation of planning criteria.

The WCAC provided input concerning development and evaluation of treatment alternatives, development and evaluation of reuse and discharge alternatives, selection of a recommended plan, cost estimates, public involvement, and implementation plan and schedule. The WCAC met on the following dates:

April, 24, 2008
May 22, 2008
July 10, 2008
September 15, 2008
October 16, 2008
December 4, 2008
January 29, 2009
March 17, 2009
March 31, 2009
September 29, 2009

Meeting agendas and presentations are included in Appendix K.

Open houses were held for the public in November 2008 and July 2009 with refreshments. The first open house included display of a series of informational posters, a WCAC slide presentation, Liquid Assets video, and Woodburn Poplar video. The second open house included updated informational posters and a presentation by City staff.

SECTION 13

References

Blakely, R.J., R.E. Wells, T.S. Yelin, I.P. Madin, and M.H. Beeson. 1995. "Tectonic Setting of the Portland-Vancouver Area, Oregon and Washington: Constraints from Low-Altitude Aeromagnetic Data." *GSA Bulletin*. Vol. 107, No. 9. Pages 1051-1062. September.

Brown and Caldwell. *2001. Wastewater Treatment Plan Expansion and Upgrade – Contract 3, Design Data sheets G15–G18.* November 2001.

Building Seismic Safety Council (BSSC). 2003. *NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures*. Prepared for the Federal Emergency Management Agency (FEMA)—National Earthquake Hazards Reduction Program (NEHRP), FEMA 303, Part 1—Provisions.

Frankel, A.D., M.D. Peterson, C.S. Mueller, K.M. Haller, R.L. Wheeler, E.V. Leyendecker, R.L. Wesson, S.C. Harmsen, C.H. Cramer, D.M. Perkins, and K.S. Rukstales. 2002. *Documentation for the 2002 Update of the National Seismic Hazard Maps*. U.S. Geological Survey Open File Report 02-240.

Geomatrix Consultants. 1995. *Seismic Design Mapping, State of Oregon, Final Report*. Prepared for Oregon Department of Transportation.

Goldfinger, C., C.H. Nelson, and J.E. Johnson. 2003. "Deep-water Turbidites as Holocene Earthquake Proxies: The Cascadia Subduction Zone and Northern San Andreas Fault Systems." *Annual Reviews of Earth and Planetary Sciences*. Vol. 32. Pages 555-577.

International Code Council (ICC). 2007. *State of Oregon 2007 Structural Specialty Code (OSSC) Amendments*. Amendments based on the 2006 International Building Code.

Ludwin, R.S., R. Dennis, D. Carver, A.D. McMillan, R. Losey, J. Clague, C. Jonientz-Trisler, J. Bowechop, J. Wray, and K. James. 2005. "Dating the 1700 Cascadia Earthquake: Great Coastal Earthquakes in Native Stories." *Seismological Research Letters*. Vol. 76, No. 2. Pp. 140-148. March/April. Seismological Society of America. U.S. Geological Survey (USGS). 2006. National Seismic Hazard Mapping Project, Quaternary Fault and Fold Database. http://earthquake.usgs.gov/regional/qfaults/ Accessed October 2008.

McCaffrey, R. 2002. "Crustal Block Rotations and Plate Coupling." *Plate Boundary Zones.* S. Stein and J.T. Freymueller, eds. AGU Geodynamic Series 30, 2002. Pages 101-122.

McCrory, P.A., J.L. Blair, D.H. Oppenheimer, and S.R. Walter. 2006. "Depth to the Juan de Fuca Slab Beneath the Cascadia Subduction Margin—A 3-D Model for Sorting Earthquakes." U.S. Geological Survey (USGS) Data Series 91. Available online at: http://pubs.usgs.gov/ds/91.

Satake, K., K. Shimazaki, Y. Tsuji, and K. Ueda. 1996. "Time and Size of a Giant Earthquake in Cascadia Inferred from Japanese Tsunami Records of January, 1700." *Nature* 379:246-49.

U.S. Geological Survey (USGS). 2002. National Seismic Hazard Mapping Project. http://geohazards.cr.usgs.gov/eq/index.html.

Walker, George W. and Norman S. MacLeod. 2002. Spatial Digital Database for the Geologic Map of Oregon Geology. Open File Report 03-67. Digital database, version 2.0. Map originally published in 1991.

Wong, Ivan, Walter Silva, Jacqueline Bott, Douglas Wright, Patricia Thomas, Nick Gregor, Sylvia Li, Matthew Mabey, Anna Sojourner, and Yumei Wang. 2000. *Earthquake Scenario and Probabilistic Ground Shaking Maps for the Portland, Oregon, Metropolitan Area.* Oregon Department of Geology and Mineral Industries (DOGAMI) Interpretive Map Series IMS-16.

APPENDIX A

Woodburn POTW NPDES Permit

APPENDIX B

Mutual Agreement Order

APPENDIX C

URA Subarea Soil Types

APPENDIX C

URA Subarea Soil Types

Descriptions of the soil types found in subareas of the proposed urban reserve area (URA) surrounding Woodburn are presented as follows.

Amity Series The Amity series consists of somewhat poorly drained soils that have formed in mixed alluvial silts. These soils have slopes of 0 to 2 percent. They occur on broad valley terraces at elevations of 150 to 350 feet. The average annual precipitation is between 40 and 45 inches. The average annual air temperature is 52° to 54°F, and the length of the frost-free season is 190 to 210 days. In areas that are not cultivated, the vegetation is mainly grasses, shrubs, hardwoods, and scattered Douglas-firs. Amity soils are associated with Dayton and Concord soils. In a typical profile, the surface layer is very dark grayish-brown silt loam that is mottled in the lower part and is about 17 inches thick. The subsurface layer is mottled dark-gray silt loam about 7 inches thick. A substratum of mottled olive-brown silt loam underlies the subsoil. The **Amity soils are used mainly for cereal grains, grass grown for seed, and pasture. When irrigated, areas that are drained can be used for all the crops commonly grown in the survey area. Amity soils are found in all subareas.**

Bashaw Series The Bashaw series consists of poorly drained and very poorly drained soils that have formed in alluvium. These soils are in backwater areas of the flood plains and in drainage channels of silty alluvial terraces. They have slopes of 0 to 1 percent. Elevations range from 100 to 400 feet. The average annual precipitation is between 40 and 45 inches, the average annual air temperature is 52° to 54°F, and the length of the frost-free season is 200 to 210 days. In areas that are not cultivated, the vegetation is mainly annual and perennial grasses, wild blackberries, sedges, rushes, willows, and a few ash and oak trees. Bashaw soils are associated with Wapato soils. In a typical profile, the surface layer is about 31 inches thick and consists of mottled very dark gray clay in the uppermost 3 inches and of mottled black clay below. The upper part of the substratum, just beneath the surface layer, is very dark gray clay that extends to a depth of 48 inches. The lower part of the substratum is dark grayish-brown clay or sandy clay that extends to a depth of 60 inches or more. The substratum is mottled throughout. The Bashaw soils are used mainly for pasture. Bashaw soils are found in Subareas 2 and 6, underlying riparian portions of each subarea.

Concord Series The Concord series consists of poorly drained soils that have formed in alluvium of mixed mineralogy. These soils are on broad valley terraces, in slightly concave depressions and in drainageways. They have slopes of 0 to 2 percent. Elevations range from 125 to 350 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52° to 54°F, and the length of the frost-free season is 200 to 210 days. In areas that are not cultivated, the vegetation is mainly rushes, sedges, wild blackberry, hazel, annual grasses, and ash trees. Concord soils are associated with Amity and Dayton soils. In a typical profile, the surface layer is very dark grayish-brown silt loam about 6 inches thick. The subsurface layer is mottled dark-gray silt loam about 9 inches thick. Just below the subsurface layer is a layer of mottled gray and dark-gray silty clay about 4 inches thick. The subsoil is about 10 inches thick. It consists of mottled grayish-brown silty clay in the upper part and of mottled dark grayish-brown silty clay in the lower part. The substratum of mottled dark grayish-brown silt loam extends to a depth of 60 inches or more. Concord soils that are neither drained nor irrigated are used mainly for cereal grains, pasture, hay, and grass grown for seed. When irrigated, the drained areas are used mainly for berries and vegetables. Concord soils are found in Subareas 1, 2, 3, 4, 5, 7, and 8.

Dayton Series The Dayton series consists of soils that are poorly drained. These soils have formed mainly in old mixed alluvium, but their upper layers may have been influenced, to some extent, by loess. The soils are on broad valley terraces, and they occur in drainageways and in shallow depressions. Slopes range from 0 to 2 percent, and elevations range from 125 to 350 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52° to 54°F, and the length of the frost-free season is 190 to 210 days. In areas that are not cultivated, the vegetation is mainly annual and perennial grasses, wild rose, and scattered ash trees. Dayton soils are associated with Amity and Concord soils. In a typical profile, the surface layer is very dark grayish-brown silt loam about 7 inches thick. The subsurface layer is mottled dark-gray silt loam about 6 inches thick. The subsoil is mottled and consists of a layer of clay about 33 inches thick. It is dark gray in the upper part and is grayish brown in the lower part. The substratum is mottled grayish-brown silty clay loam that extends to a depth of 60 inches or more. The Dayton soils are used mainly for small grains, pasture, hay, and grass grown for seed. Daytona Soils are found in Subareas 1, 2, 3, 5, 6, 7, and 8.

Labish Series The Labish series consists of poorly drained soils that have formed in mixed mineral and organic material. These soils have slopes of 0 to 1 percent. They occur on the bottoms of former shallow lakes at elevations of 150 to 175 feet. The average annual precipitation is between 40 and 45 inches, the average annual air temperature is 53°F, and the length of the frost-free season is 200 to 210 days. In areas that are not cultivated, the vegetation is mainly sedges, tussocks, and willows. Labish soils are associated with Semiahmoo soils. In a typical profile the surface layer is black and is about 7 inches tick. It consists of silty clay loam in the upper part and of silty clay in the lower part. The next layer is very dark brown silty clay about 9 inches thick. Below this is very dark gray clay that extends to a depth of 60 inches or more. The Labish soils are used mainly for onions, small grains, pasture, and hay. Labish soils are found primarily in Subarea 2, with a small inclusion in Subarea 3.

Terrace Escarpments Terrace escarpments (Te) consists of gravelly and silty alluvium that is too variable in characteristics to be classified as soil. It is moderately steep or steep and occurs along the sidewalls of the major streams, on terrace scarps, and on the side slopes bordering channels of intermittent streams. The vegetation is mainly Douglas-fir, maple, hazel, swordfern, brackenfern, poison-oak, tussock, sedges, and grasses. This land type is suitable for pasture and for use as woodland. The short, steep slopes make tillage impracticable. Terrace escarpments are found in Subareas 2, 4, and 5.

Wapato Series The Wapato series consists of poorly drained soils that have formed in mixed alluvium. These soils are nearly level. They occur in depressions and overflow channels on flood plains at elevations of 100 to 650 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is about 53°F, and the length of the frost-free season is 200 to 210 days. In areas that are not cultivated, the vegetation is mainly willow, ash, tussocks, sedges, and grasses. Wapato soils are associated with McBee and Bashaw soils. In a typical profile, the surface layer is mottled very dark brown silty clay loam about

16 inches thick. The subsoil is mottled very dark grayish-brown silty clay loam about 20 inches thick. The substratum is mottled dark-brown silty clay loam that extends to a depth of 60 inches or more. The Wapato soils are used mainly for pasture, hay, small grains, vegetables, and caneberries. The Willamette series consists of deep, well-drained soils that have formed in silty alluvium. These soils are on low, broad valley terraces. They have slopes of 0 to 12 percent. Elevations range from 150 to 350 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 50° to 54°F, and the length of the frost-free season is 200 to 210 days. In areas that are not cultivated, the vegetation is mainly oatgrass and other native grasses, hazel, blackberry, Oregon white oak, and Douglas-fir. Willamette soils are associated with Woodburn soils. In a typical profile, the surface layer is very dark grayish-brown silt loam about 12 inches thick. A subsurface layer that also consists of very dark grayish-brown silt loam and that is about 5 inches thick is just beneath the surface layer. The upper part of the subsoil is dark-brown silt loam about 7 inches thick; the middle part of the subsoil is dark-brown silty clay loam about 14 inches thick; and the lower part is dark-brown silt loam about 16 inches thick. A substratum of dark yellowish-brown silt loam underlies the subsoil, and it extends to a depth of 65 inches or more. The Willamette soils are used mainly for small grains, pasture, hay, orchards, berries, and vegetables. Willamette soils are Class I soils around Woodburn and are found in Subareas 2, 3, and 8.

Woodburn Series The Woodburn series consists of moderately well drained soils that have formed in silty alluvium and loess of mixed mineralogy. These soils are on broad valley terraces. They have slopes of 0 to 20 percent. Elevations range from 150 to 350 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52° to 54°F, and the length of the frost-free season is 200 to 210 days. In areas that are not cultivated, the vegetation is mainly grass and Douglas-fir. Woodburn soils are associated with Willamette soils. In a typical profile, the surface layer is about 17 inches thick and is very dark brown silt loam in the upper part and dark-brown silt loam in the lower part. The subsoil is about 37 inches thick. It is dark yellowish-brown silty clay loam in the upper part; mottled dark-brown silty clay loam in the middle part; and mottled, dark-brown silt loam in the lower part. The substratum is dark-brown silt loam that extends to a depth of 68 inches or more. The Woodburn soils are used mainly for small grains, pasture, hay, orchards, berries, and vegetables. Woodburn soils range from Class II to IV and are the predominant soil type in all subareas except Subarea 7, which includes substantial portions of Amity and Concord soils.

Table C-1 presents the wetland types found within the Woodburn URA.

TABLE C-1
Soil Types and Study Areas

Map Unit Name	Map Symbol	Capability Unit	High Value Farmland	Subareas*
Amity Silt Loam	Am	IIw-2	Yes	0-8
Bashaw Clay	Ba	IVw-2	Yes	2, 6
Concord Silt Loam	Co	IIIw-2	Yes	1-5, 7-8
Dayton Silt Loam	Da	IVw-1	Yes	1-3, 5-8

TABLE C-1
Soil Types and Study Areas

Map Unit Name	Map Symbol	Capability Unit	High Value Farmland	Subareas*
Labish Silty Clay Loam	La	IIIw-2	No	2, 3
Terrace Escarpments	Te	IVe-2	No	2, 4, 5
Wapato Silty Clay Loam	Wc	IIIw-2	No	2, 3, 8
Woodburn Silt Loam	WuA, WuC, WuD	IIw-1, IIe-1, IIIe-1	Yes	0-6, 8

Note: Subarea 0 represents the area within the UGB.

Figure C-1 presents the soil types found in the proposed urban reserve area (URA) surrounding Woodburn.

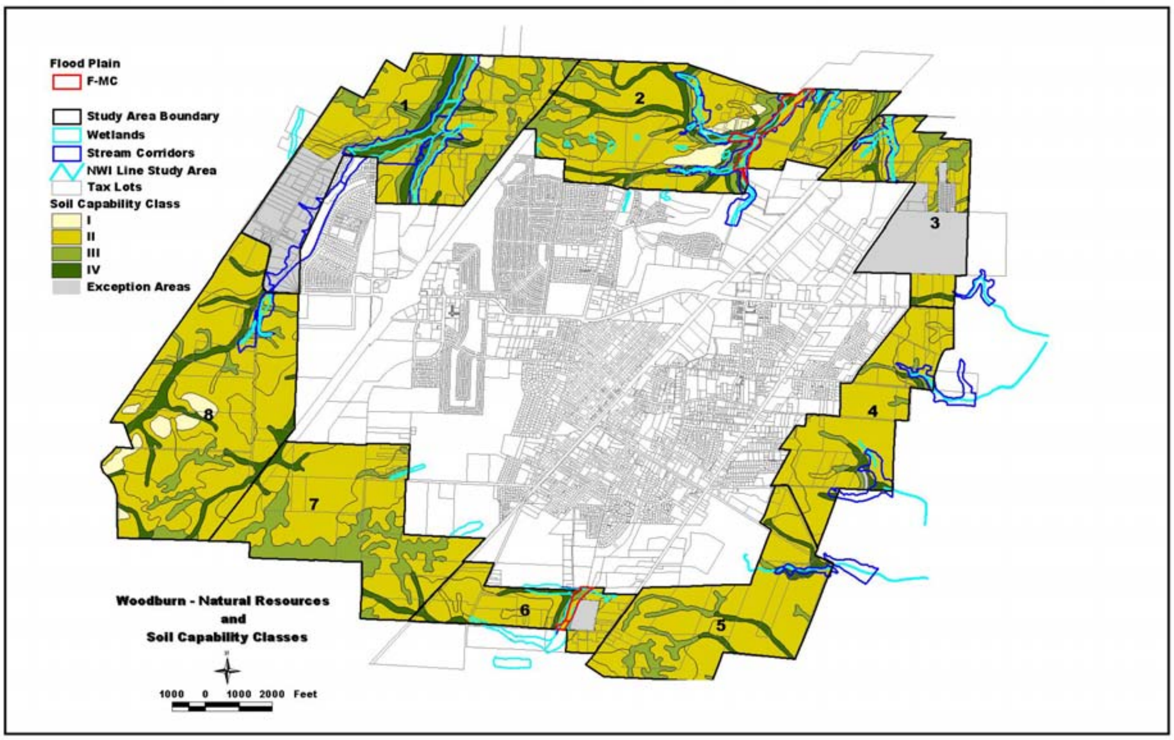

FIGURE C-1
Soil Types and Subareas

APPENDIX D

URA SubArea Natural Resources

APPENDIX D

URA SubArea Natural Resources

Winterbrook Planning prepared a Natural Resources Inventory (Technical Report 2A) for Woodburn in 2002 as part of the Periodic Review process. This Natural Resources Inventory describes agricultural lands, wetlands, stream corridors, wildlife habitat, and floodplains for each of eight subareas surrounding the Woodburn UGB. The subareas are numbered in Figure D-1. This natural resource inventory provides good information relative to parcels just outside the 2005 UGB, but also is applicable to some areas within the 2005 UGB (those most recently brought into the UGB).

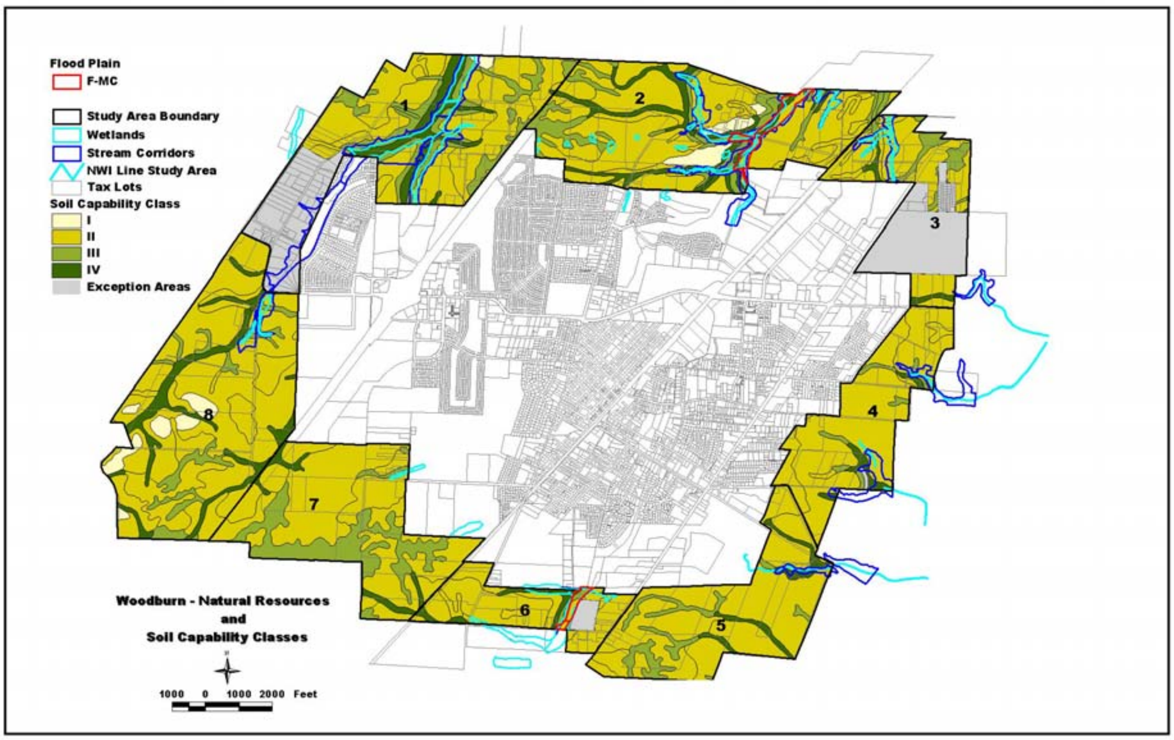

FIGURE D-1
URA Subareas

The following section summarizes the location, quantity and quality of natural resources within individual planning subareas. The subareas range in size from 191 to 755 acres, and have a combined size of 3,886 acres.

Subarea 1

Subarea 1 is 655 acres in size and located in the northwest portion of the study area (Figure D-1). This site is bounded to the east by Interstate 5 and the UGB, west by Oregon Electric Railway, south by Highway 214 (Newberg Hwy.), and north by a line approximately 1,000 feet north of and parallel to Crosby Road.

Agricultural and Exceptions Lands Summary

Subarea 1 contains a 137-acre exception area along Butteville Road north of Highway 219 (Newberg Road). This area is zoned Acreage Residential (AR) and includes single-family housing and some agricultural (nursery) uses.

Resource (non-exception) lands within the subarea include 5 acres (1%) Class I soils, 342 acres (66%) Class II soils, 111 acres (21%) Class III soils, and 59 acres (11%) Class IV soils. All resource lands within the subarea are designated high value farmland.

Natural Resource Summary

This section summarizes Goal 5 and 7 resource findings for planning Subarea 1. Table D-1 presents a summary of wetlands, stream corridors, floodplains, and special status species. The table is organized by resource category (type), providing information on the location, quality, and quantity of each resource within the category, and summarizing the percentage of area affected by natural resource constraints.

TABLE D-1
Subarea 1 Natural Resources

Resource Type	Resource / Code	Location	Quality	Quantity (acres)
Wetlands	W-SC-1	Senecal Creek	High – PFO/EM1Y, PFO1W, PEM1Y	35.61
	W-SC-2	East Senecal Creek	High - PFO1W, PEM1Y	12.20
	W-SC*	Pond/lagoon	Low - POWKZx	6.56
Stream Corridors	S-SC Senecal Creek	East of Butteville Rd.	High water quality, fish & wildlife habitat functions	76.67
	S-SC-E East Senecal Creek	East of Woodland Ave.	High water quality, wildlife habitat functions	19.58
Floodplains	F-SC	Senecal Creek, East Senecal Creek	High floodplain functioning	16.89
Special Status Species	Cutthroat trout	Senecal Creek	Moderate to high quality instream and riparian habitat	Within stream channel (above)
	Red-legged frog	Senecal Creek, East Senecal Creek, ponds and wetlands	High quality habitat; potential breeding sites	Within wetlands and stream corridors (above)

* These wetlands do not meet the significance criteria and will not be factored in the subsequent analysis.

Subarea 2

Subarea 2 is 675 acres in size and located in the north portion of the study area (Figure B-1). This site is bounded to the west by Interstate 5, east by Union Pacific Railway and N. Front

Street, south by the UGB, and north by a line approx. 1,000 feet north of and parallel to Crosby Road.

Agricultural and Exceptions Lands Summary

No exception areas are located in Subarea 2.

Resource lands within the subarea include 30 acres (4%) Class I soils, 463 acres (69%) Class II soils, 101 acres (15%) Class III soils, and 81 acres (12%) Class IV soils. Approximately 613 acres (91%) of resource lands within the subarea are designated high value farmland.

Natural Resource Summary

Table D-2 provides a summary of findings for wetlands, stream corridors, floodplains, and special status species within planning subarea 2. The table is organized by resource category (type), providing information on the location, quality, and quantity of each resource within the category, and summarizing the percentage of area affected by natural resource constraints.

TABLE D-2
Subarea 2 Natural Resources

Resource Type	Resource / Code	Location	Quality	Quantity (acres)
Wetlands	W-MC-8	Mill Creek	Moderate - PEM1Y	20.28
	W-MC-N	North Mill Creek tributary	Moderate - PFO1Y	5.03
	W-MC-S	South Mill Creek tributary	Moderate - PFO1W, PEM1Y partly filled by golf course	2.86
	W-MC-G (group, incl. MC-26)	Golf Course ponds	Low except for hydro-logic control function (POWKZx)	1.29
	W-MC-F2 (group of farmed wetlands)*	Cropland bet/I-5 and Boones Ferry Road	Low (Farmed)	4.98
Stream Corridors	S-MC Mill Creek	Between Boones Ferry Road and Front Street	Moderate water quality, wildlife habitat functions	62.47
Floodplains	F-MC	Mill Creek	Moderate to high floodplain functioning	40.62
Special Status Species	Western pond turtle	Pond east of I-5 near Hovenden Lane; potential at other ponds	Moderate to high quality habitat	Within pond
	Painted turtle	Potential in pond east of I-5, other ponds	Moderate to high quality habitat	Within pond
	Red-legged frog	Potential in ponds and along stream corridor	Low to moderate quality habitat	Within wetlands and stream corridors

TABLE D-2
Subarea 2 Natural Resources

Resource Type	Resource / Code	Location	Quality	Quantity (acres)

* These wetlands do not meet the significance criteria and will not be factored in the subsequent analysis.

Subarea 3

Subarea 3 is 330 acres in size and located in the southeast portion of the study area (Figure D-1). This site is bounded to the west by Union Pacific Railway and the UGB, east by the MacLaren School for Boys, north by Dimmick Road NE, and south by Highway 211 (Estacada Hwy).

Agricultural and Exceptions Lands Summary

Subarea 3 contains a 145-acre exception area which includes a small area of housing and a portion of the MacLaren School for Boys east of Highway 99E. This area is zoned Acreage Residential (AR) and Public (P).

Resource (non-exception) lands within the subarea include no Class I soils, 149 acres (81%) Class II soils, 28 acres (15%) Class III soils, and 10 acres (5%) Class IV soils. All but 1 acre of resource lands within the subarea are designated high value farmland.

Natural Resource Summary

Table D-3 provides a summary of findings for wetlands, stream corridors, floodplains, and special status species within planning subarea 3. The table is organized by resource category (type), providing information on the location, quality, and quantity of each resource within the category, and summarizing the percentage of area affected by natural resource constraints.

TABLE D-3
Subarea 3 Natural Resources

Resource Type	**Resource / Code**	**Location**	**Quality**	**Quantity (acres)**
Wetlands	W-MC-19	Mill Creek tributary east of Front Street	Low to Moderate - PFO1Y, PEM1Y	4.18
	W-MC-P	Pond east of Front Street	Moderate except for hydro-logic control function (POWKZx)	1.91
	W-MC-F3 (farmed wetlands)*	Cropland east of Front Street	Low (Farmed)	0.85
Stream Corridors	S-MC Mill Creek tributary	Between Front Street and Hwy. 99E	Low to moderate water quality, habitat functions	14.90

TABLE D-3
Subarea 3 Natural Resources

Resource Type	Resource / Code	Location	Quality	Quantity (acres)
	S-PR Pudding River tributaries	Southeast of MacLaren School	Moderate to high water quality, fish and wildlife habitat functions	0.04
Floodplains	N/A			0
Special Status Species	Western pond turtle	Potential in pond east of Front Street	Moderate quality habitat	Within ponds
	Painted turtle	Potential in pond east of Front Street	Moderate quality habitat	Within ponds
	Red-legged frog	Potential in ponds and along stream corridors	Low to moderate quality habitat	Within wetlands and stream corridors

* These wetlands do not meet the significance criteria and will not be factored in the subsequent analysis.

Subarea 4

Subarea 4 is 343 acres in size and located in the east portion of the study area (Figure D-1). This site is bounded to the west by the UGB and Cooley Road, east by properties within ½ mile of the UGB (Pudding River plateau, reservoir), north by Dimmick Road NE, and south by Highway 214.

Agricultural and Exceptions Lands Summary

No exception areas are located in Subarea 4.

Resource lands within the subarea include no Class I soils, 310 acres (90%) Class II soils, 15 acres (5%) Class III soils, and 16 acres (5%) Class IV soils. Approximately 325 acres (95%) of resource lands within the subarea are designated high value farmland.

Natural Resource Summary

Table D-4 provides a summary of findings for wetlands, stream corridors, floodplains, and special status species within planning subarea 4. The table is organized by resource category (type), providing information on the location, quality, and quantity of each resource within the category, and summarizing the percentage of area affected by natural resource constraints.

TABLE D-4
Subarea 4 Natural Resources

Resource Type	Resource / Code	Location	Quality	Quantity (acres)
Wetlands	W-PR	Pudding River tributaries east of Cooley, north of Hwy. 214	Moderate to High - PFO1Y, PEM1Y	2.46
	W-PR-F4 (farmed wetlands)*	Cropland south of Hwy. 211	Low (Farmed)	0.73
Stream Corridors	S-PR Pudding River tributaries	South of Hwy. 211	Moderate to high water quality, fish and wildlife habitat functions	18.48
Floodplains	N/A			0
Special Status Species	Red-legged frog	Potential along stream corridors	Moderate quality habitat	Within wetlands and stream corridors

* These wetlands do not meet the significance criteria and will not be factored in the subsequent analysis.

Subarea 5

Subarea 5 is 431 acres in size and located in the east portion of the study area (Figure D-1). This site is bounded to the west by Highway 99E (Pacific Hwy) and the UGB, east by properties within ½ mile of the UGB (Pudding River plateau), north by Highway 214, and south by Geschwill Lane NE.

Agricultural and Exceptions Lands Summary

No exception areas are located in Subarea 5.

Resource lands within the subarea include no Class I soils, 357 acres (83%) Class II soils, 46 acres (11%) Class III soils, and 28 acres (6%) Class IV soils. Approximately 416 acres (97%) of resource lands within the subarea are designated high value farmland.

Natural Resource Summary

Table D-5 provides a summary of findings for wetlands, stream corridors, floodplains, and special status species within planning subarea 5. The table is organized by resource category (type), providing information on the location, quality, and quantity of each resource within the category, and summarizing the percentage of area affected by natural resource constraints.

TABLE D-5
Subarea 5 Natural Resources

Resource Type	Resource / Code	Location	Quality	Quantity (acres)
Wetlands	N/A			0
Stream Corridors	S-PR Pudding River tributaries	South of Hwy. 211	Moderate to high water quality, fish and wildlife habitat functions	6.15
Floodplains	N/A			0
Special Status Species	Red-legged frog	Potential along stream corridors	Moderate quality habitat	Within wetlands and stream corridors

Subarea 6

Subarea 6 is 191 acres in size and located in the southeast portion of the study area (Figure D-1). This site is bounded to the east by Highway 99E (Pacific Hwy), west by Southern Pacific Railroad, north by the UGB, and south by Belle Passe Road.

Agricultural and Exceptions Lands Summary

Subarea 6 contains a 14-acre exception area comprised of single-family housing and farm uses along Highway 99E. These lands are zoned AR and P.

Resource (non-exception) lands within the subarea include no Class I soils, 156 acres (88%) Class II soils, 5 acres (3%) Class III soils, and 16 acres (9%) Class IV soils. All resource lands within the subarea are designated high value farmland.

Natural Resource Summary

Table D-6 provides a summary of findings for wetlands, stream corridors, floodplains, and special status species within planning subarea 6. The table is organized by resource category (type), providing information on the location, quality, and quantity of each resource within the category, and summarizing the percentage of area affected by natural resource constraints.

TABLE D-6
Subarea 6 Natural Resources

Resource Type	Resource / Code	Location	Quality	Quantity (acres)
Wetlands	W-MC-1	Mill Creek	Moderate - PEM1Y	10.72
	W-MC-F6 (farmed wetlands)*	Cropland west of Hwy. 99E	Low (Farmed)	4.58

TABLE D-6
Subarea 6 Natural Resources

Resource Type	Resource / Code	Location	Quality	Quantity (acres)
Wetlands	W-MC-1	Mill Creek	Moderate - PEM1Y	10.72
	W-MC-F6 (farmed wetlands)*	Cropland west of Hwy. 99E	Low (Farmed)	4.58
Stream Corridors	S-MC Mill Creek	West of Hwy. 99E	Moderate water quality, wildlife habitat functions	15.34
Floodplains	F-MC	Mill Creek	Moderate to high floodplain functioning	11.38
Special Status Species	Red-legged frog	Potential along stream corridor	Low to moderate quality habitat	Within wetlands and stream corridors

* These wetlands do not meet the significance criteria and will not be factored in the subsequent analysis.

Subarea 7 - Southeast

Subarea 7 is 506 acres in size and located in the southeast portion of the study area (Figure D-1). This site is bounded to the east by Southern Pacific Railroad, west by Interstate 5, north by the UGB, and south by Belle Passe Road (extension).

Agricultural and Exceptions Lands Summary

No exception areas are located in Subarea 7.

Resource lands within the subarea include no Class I soils, 362 acres (71%) Class II soils, 124 acres (25%) Class III soils, and 19 acres (4%) Class IV soils. All resource lands within the subarea are designated high value farmland.

Natural Resource Summary

Table D-7 provides a summary of findings for wetlands, stream corridors, floodplains, and special status species within planning subarea 7. The table is organized by resource category (type), providing information on the location, quality, and quantity of each resource within the category, and summarizing the percentage of area affected by natural resource constraints.

TABLE D-7
Subarea 7 Natural Resources

Resource Type	Resource / Code	Location	Quality	Quantity (acres)
Wetlands	W-MC-15A	Mill Creek	Moderate - PEM1Yx	0.79

TABLE D-7
Subarea 7 Natural Resources

Resource Type	Resource / Code	Location	Quality	Quantity (acres)
	W-MC-F7 (farmed wetlands)*	Cropland west of Union Pacific Railroad	Low (Farmed)	0.09
Stream Corridors	N/A			0
Floodplains	N/A			0
Special Status Species	N/A			0

* These wetlands do not meet the significance criteria and will not be factored in the subsequent analysis.

Subarea 8 – Northwest

Subarea 8 is 755 acres in size and located in the northwest portion of the study area (Figure D-1). This site is bounded to the east by Interstate 5 and the UGB, west by Oregon Electric Railway, north by Highway 214 (Newberg Hwy.), and south by property south of Parr Road NE.

Agricultural and Exceptions Lands Summary

No exception areas are located in Subarea 8.

Resource lands within the subarea include 40 acres (5%) Class I soils, 578 acres (77%) Class II soils, 55 acres (7%) Class III soils, and 81 acres (11%) Class IV soils. All but 1 acre of resource lands within the subarea are designated high value farmland.

Natural Resource Summary

Table D-8 provides a summary of findings for wetlands, stream corridors, floodplains, and special status species within planning Subarea 8. The table is organized by resource category (type), providing information on the location, quality, and quantity of each resource within the category, and summarizing the percentage of area affected by natural resource constraints.

TABLE D-8
Subarea 8 Natural Resources

Resource Type	Resource / Code	Location	Quality	Quantity (acres)
Wetlands	W-SC-1	Senecal Creek	Moderate – PFO/EM1Y	4.43
Stream Corridors	S-SC Senecal Creek	East Oregon Electric Railway	Moderate to high water quality, fish & wildlife habitat functions	14.09

TABLE D-8
Subarea 8 Natural Resources

Resource Type	Resource / Code	Location	Quality	Quantity (acres)
Floodplains	F-SC	Senecal Creek, East Senecal Creek	Moderate floodplain functioning	0.26
Special Status Species	Cutthroat trout	Senecal Creek	Moderate quality instream and riparian habitat	Within stream channel
	Red-legged frog	Senecal Creek, wetlands	High quality habitat; potential breeding sites	Within wetlands and stream corridors

APPENDIX E

POTW Condition Assessment Technical Memorandums

APPENDIX F

Population Projections

APPENDIX G

Meeting Notes

APPENDIX H

Outfall Mixing Study Extracts: Introduction and Conclusions

APPENDIX I

Proposed Biosolids Management Strategy

APPENDIX J

Specific Design Criteria

APPENDIX K

Public Outreach Meeting Materials