See pocket folder for complete ordinance

ORDINANCE NO. 571

AN ORDINANCE ADOPTING AN UPDATED AND AMENDED CITY OF WILSONVILLE WASTEWATER FACILITY PLAN AND REPEALING ORDINANCE 447.

WHEREAS, the City currently has a Wastewater Facility Plan that was adopted by Ordinance 447 on August 7, 1995; and

WHEREAS, ORS 197.175 requires cities to prepare, adopt, and implement Comprehensive Plans consistent with statewide planning goals adopted by the Land Conservation and Development Commission; and

WHEREAS, ORS 197.712 (2)e requires cities to develop and adopt a public facilities plan for areas within an Urban Growth Boundary containing a population greater than 2,500 persons and shall include rough cost estimates for projects needed to provide sewer, water, and transportation uses contemplated in the Comprehensive Plan and Land Use Regulations; and

WHEREAS, the Wastewater Facility Plan is a support document to the City's Comprehensive Plan; and

WHEREAS, HDR Engineering, Inc. has prepared a Wastewater Facility Plan Update (attached as Exhibit A) and presented said Plan to the Planning Commission on November 12, 2003; and

WHEREAS, in developing the new Wastewater Facility Plan, the City has sought to carry out federal, state, and regional mandates, provide for alternative improvement solutions to minimize expense, avoid the creation of public nuisances, and maintain the public's health, safety, welfare, and interests; and

WHEREAS, the Wilsonville Planning Commission adopted Resolution No. 02PC05 and recommends that the City Council adopt the Wastewater Facility Plan Update; and

WHEREAS, after providing due notice as required by City Code and State Law, a public hearing was held before the City Council on August 16, 2004, at which time the Council considered the recommendation of the Planning Commission and City staff, gathered additional evidence and afforded all interested parties an opportunity to present oral and written testimony concerning the Plan to the City Council; and

WHEREAS, the Council has carefully considered the public record, including all recommendations and testimony, and being fully advised,

NOW THEREFORE, THE CITY OF WILSONVILLE ORDAINS AS FOLLOWS:

1. Findings. The foregoing recitations, those findings and conclusions in the above named Planning Commission Resolution No. 02PC05, and the staff report in this matter dated August 9, 2004, filed in the record of this matter, are hereby adopted as findings of fact and conclusions of law, save and except the recommendation in the Staff report to substitute the table in a proposed Exhibit B for Table 7-2 in the Wastewater Facility Plan Update is not adopted at this time.
2. Order. Based upon such findings, the City Council hereby adopts the Wastewater Facility Plan Update, Exhibit A, to replace the present Wastewater Facility Plan adopted by Ordinance 447.
3. Repeal. The City Council hereby repeals Ordinance 447.

SUBMITTED to the Wilsonville City Council and read for the first time at a regular meeting thereof on August 16, 2004 and scheduled for a second reading at a special meeting of the City Council on August 30, 2004, commencing at the hour of 7 p.m. at the Wilsonville Community Center.

Sandra C. King

Sandra C. King, CMC, City Recorder

ENACTED by the City Council on the 30th day of August, 2004 by the following votes:

YES: 4 NO: 0

Sandra C. King

Sandra C. King, CMC, City Recorder

DATED and signed by the Mayor this 3rd day of August 2004.

CHARLOTTE LEHAN, MAYOR

SUMMARY OF VOTES:

Mayor Charlotte Lehan	Yes
Council President Kirk	Excused
Councilor Holt	Yes
Councilor Scott-Tabb	Yes
Councilor Knapp	Yes

ORIGINAL

ORDINANCE NO. 571

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YES: 4 NO: 0

Sandra C. King

Sandra C. King, CMC, City Recorder

DATED and signed by the Mayor this 3rd day of August 2004.

Charlotte Lehan

CHARLOTTE LEHAN, MAYOR

SUMMARY OF VOTES:

Mayor Charlotte Lehan	Yes
Council President Kirk	Excused
Councilor Holt	Yes
Councilor Scott-Tabb	Yes
Councilor Knapp	Yes

ORM 2

DLCD NOTICE OF ADOPTION

This form **must be mailed** to DLCD **within 5 working days after the final decision** per ORS 197.610, OAR Chapter 660 - Division 18

(See reverse side for submittal requirements)

Jurisdiction: City of Wilsonville Local File No.: Ordinance No. 571
(If no number, use none)

Date of Adoption: August 30, 2004 (Must be filled in) Date Mailed: September , 2004 (Date mailed or sent to DLCD)

Date the Notice of Proposed Amendment was mailed to DLCD: July 26, 2002

___ Comprehensive Plan Text Amendment ___ Comprehensive Plan Map Amendment

___ Land Use Regulation Amendment ___ Zoning Map Amendment

___ New Land Use Regulation xx Other: Treatment Plant Master Plan
(Please Specify Type of Action)

Summarize the adopted amendment. Do not use technical terms. Do not write "See Attached."

Adoption of a Wastewater Facility Plan.

Describe how the adopted amendment differs from the proposed amendment. If it is the same, write "Same." If you did not give notice for the proposed amendment, write "N/A."

Same

Plan Map Changed from : N/A to ___

Zone Map Changed from: N/A to ___

Location: City wide Acres Involved: N/A

Specify Density: Previous: N/A New: N/A

Applicable Statewide Planning Goals: 11

Was an Exception Adopted? Yes:___ No: xx

DLCD File No.: ___

Did the Department of Land Conservation and Development receive a notice of Proposed

Amendment **FORTY FIVE (45) days prior to the first evidentiary hearing**. Yes: xx No: ____

If no, do the Statewide Planning Goals apply. Yes: ____ No: ____

If no, did The Emergency Circumstances Require immediate adoption. Yes: ____ No: ____

Affected State or Federal Agencies, Local Governments or Special Districts: ____

Please see attached list.

Local Contact: Eldon Johansen Area Code + Phone Number: 503-682-4960

Address: 30000 SW Town Center Loop East

City: Wilsonville Zip Code+4: 97070

ADOPTION SUBMITTAL REQUIREMENTS

This form must be mailed to DLCD **within 5 working days after the final decision**
per ORS 197.610, OAR Chapter 660 - Division 18.

1. Send this Form and TWO (2) Copies of the Adopted Amendment to:

ATTENTION: PLAN AMENDMENT SPECIALIST
DEPARTMENT OF LAND CONSERVATION AND DEVELOPMENT
635 CAPITOL STREET NE, SUITE 150
SALEM, OREGON 97301-2540

2. Submit **TWO (2) copies** the adopted material, if copies are bounded please submit **TWO (2) complete copies** of documents and maps.

3. Please Note: Adopted materials must be sent to DLCD not later than **FIVE (5) working days** following the date of the final decision on the amendment.

4. Submittal of of this Notice of Adoption must include the text of the amendment plus adopted findings and supplementary information.

5. The deadline to appeal will be extended if you submit this notice of adoption within five working days of the final decision. Appeals to LUBA may be filed within **TWENTY-ONE (21) days** of the date, the "Notice of Adoption" is sent to DLCD.

6. In addition to sending the "Notice of Adoption" to DLCD, you must notify persons who participated in the local hearing and requested notice of the final decision.

7. **Need More Copies?** You can copy this form on to 8-1/2x11 green paper only ; or call the DLCD Office at (503) 373-0050; or Fax your request to:(503) 378-5518; or Email your request to Larry.French@state.or.us - ATTENTION: PLAN AMENDMENT SPECIALIST.

Affected State or Federal Agencies, Local Governments or Special Districts

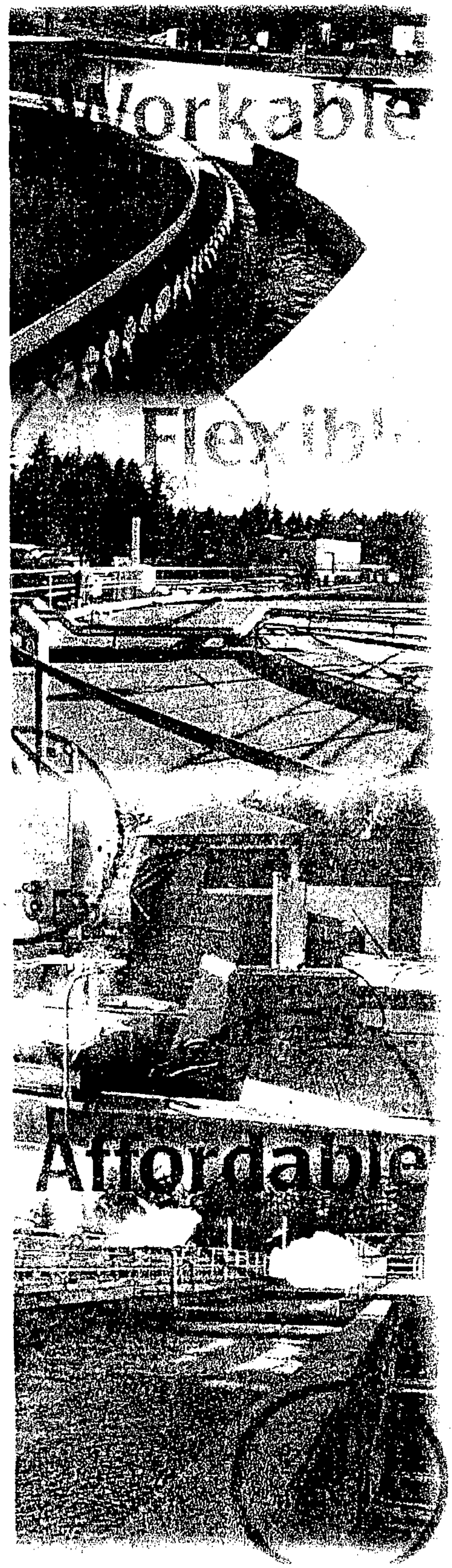
Name	Company	Address	City	State	Zip
Columbia Cable of Oregon		14200 SW Brigadoon Ct.	Beaverton	OR	97005
Tualatin Valley Water District		PO Box 745	Beaverton	OR	97095
Doug McClain	Clackamas Cty Planning Section Mgr	9101 SE Sunnybrook Blvd	Clackamas	OR	97015
Portland General Electric		121 SW Salmon 1 WTC-9	Portland	OR	97204
Tom Wolcott	BPA	PO Box 3621	Portland	OR	97208
Tom Simpson	NW Natural Gas	220 NW 2nd Avenue	Portland	OR	97209
Michael Dennis	Tri-Met Project Planning Dept	4012 SE 175th Avenure	Portland	OR	97202
Oregon Dept of Environ Quality		811 SW Sixth Avenue	Portland	OR	97204
Ray Valone	Metro	600 NE Grand Avenue	Portland	OR	97232
Manager, Community Development	Growth Management Services Metro	600 NE Grand Avenue	Portland	OR	97232
Attn: Development Review	ODOT	123 NW Flanders Street	Portland	OR	97209
John Lilly	Division of State Lands	775 Summer Street, NE	Salem	OR	97310
William Fujii, OWRD	Commerce Building	158 12th Street, NE	Salem	OR	97310
Sherwood School Dist Admin Office		400 N. Sherwood Blvd.	Sherwood	OR	97140
Elaine Self	GTE	PO Box 23416	Tigard	OR	97281
	City of Tualatin	18880 SW Martinazzi Avenue	Tualatin	OR	97062
Roger Woehl	West Linn/Wilsonville School District 3JT	PO Box 35	West Linn	OR	97068
Joe Fender	United Disposal Services	PO Box 186	Wilsonville	OR	97070
Jim Johnston	Portland General Electric	9540 SW Boeckman Road	Wilsonville	OR	97070

EXHIBIT A TO ORDINANCE NO. 571

City of WILSONVILLE in OREGON

DRAFT
Wastewater Facility Plan Update

November, 2002



HDR

Table of Contents

Executive Summary

Introduction

Wilsonville's wastewater treatment plant provides treatment for sanitary sewage and infiltration/inflow from connected homes, businesses, and industries in the city. The last Facility Plan for the plant was prepared in 1995, with capital improvements implemented in 1998. Since then, the City's vision of future growth has changed, as has the regulatory environment. The City has undertaken this Facility Plan to re-evaluate future flow and wasteload projections, analyze current and anticipated future regulations, evaluate the adequacy of existing plant treatment processes to meet future demands, and develop a phased capital improvement program that will allow the plant to continue to meet the City's needs through ultimate build-out.

Overview of the Recommended Plan

The recommended plan includes a combination of treatment technologies that are new to Wilsonville and expansion of existing technologies. The most notable new technologies are membrane bioreactors (MBRs) to reduce the footprint of the secondary treatment process (allowing expansion within a limited area), Fuzzy Filters for filtration of secondary effluent, anaerobic digestion for solids stabilization, and dewatering of digested solids to remove excess water. Anaerobic digestion offers savings in both capital cost and space required, and dewatering is necessary to provide adequate onsite storage of digested biosolids. Both of these processes are commonly used in wastewater treatment. MBRs and Fuzzy Filters are relatively new to the wastewater industry and should be pilot tested prior to implementation to verify operation.

To meet permit compliance and capacity requirements, a three-phased expansion program is recommended. This program allows the City to provide the necessary improvements at the plant without creating an overly complex construction management program.

- **Phase 1 – Immediate Needs.** These improvements address the most urgent process deficiencies and should be operational by Winter 2004 in order to address process deficiencies at the plant. These immediate needs include:
    - Increasing the headworks capacity and enclosing the headworks
    - Modifying primary sludge piping
    - Adding a lime silo and step feed enhancements for secondary treatment
    - Adding dewatering, and providing improved effluent filtration to ensure adequate solids removal in the dewatering centrate
- **Phase 2 – Near-Term Needs.** Near-term needs are improvements that address additional process deficiencies to reach an average dry weather capacity of 4 mgd influent flow, 8,700 lb/day influent BOD, and 8,600 lb/day influent TSS. These improvements are needed by 2010, and include improvements to all plant processes that were not addressed in Phase 1.
- **Phase 2 – Long-term Needs.** Long-term needs are improvements required to meet an average dry weather capacity of 7 mgd influent flow and 14,900 lb/day influent BOD and

TSS. Depending on whether ultimate flow and loading is closer to the high or low projection, this phase of expansion should be operational by 2020 – 2030.

Planning Projections

Future flow and wasteload projections are a function of anticipated growth characteristics in Wilsonville's service area. These characteristics will drive future treatment plant needs.

Wastewater Flow Projections

Projecting future flows requires analysis of both the increase in baseline sanitary flow and the increase in peak flow.

Baseline Sanitary Flow

Baseline sanitary flow (average dry weather flow – ADWF) is that portion of the treatment plant influent flow produced by residential occupants, businesses, and industries in the service area. Baseline sanitary flow is a function of two factors:

- Projected residential, commercial, and industrial growth, and
- The volume of wastewater produced by various customer classes (residential, commercial, industrial, etc.)

Two sets of projections were developed to guide facility planning. High flow projections were based on the City's *2001 Comprehensive Plan*, augmented with information from the City regarding specific developments. Unit flow factors from the recent *Collection System Master Plan* were used to assess influent flows to the treatment plant. Because these estimates were developed for collection system planning, they reflect conservative assumptions. A low flow projection was also developed based on unit flow factors closer to current values.

These two sets of projections are shown in Figure ES-1. Flows are projected to increase from the current average dry weather flow of 2 mgd to between 4.4 mgd and 7 mgd at ultimate buildout in year 2035.

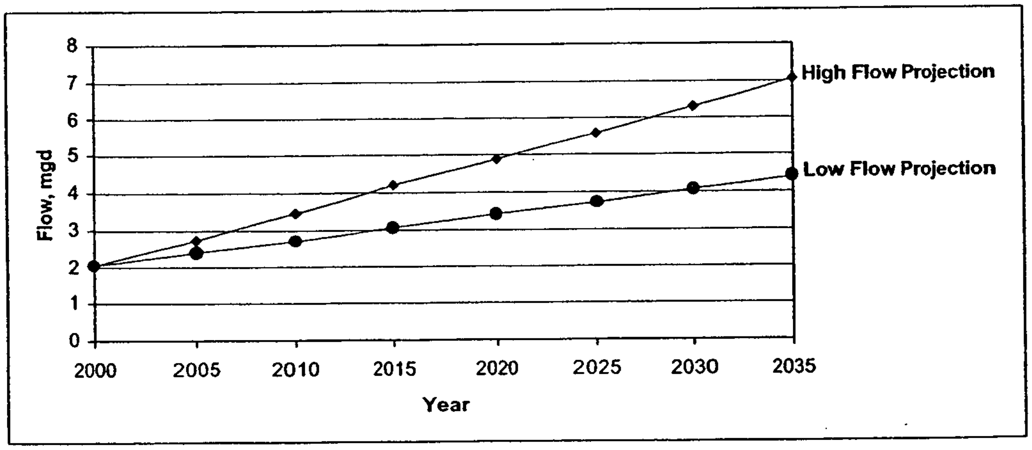


Figure ES-1. Projected Average Dry Weather Flow

Alternatives and site plans were developed based on the high projections to ensure that the plant could accommodate the infrastructure required to treat the high flows. Near-term implementation was based on the low flow projections.

Peak Flow

- Many components of the wastewater treatment plant are designed to treat flows and loads greater than those seen under average dry weather conditions. Flow peaking factors (ratio of a given flow to the average dry weather flow for the corresponding year) were evaluated by examining historical data, using a statistical procedure developed by the Oregon Department of Environmental Quality (DEQ), and by examining inflow and infiltration (I/I) based on the total service area.

Future peaking factors were calculated as the average of the historical peaking factors (which were very close to the values calculated using the DEQ methodology) and the area-based peaking factors. Peaking factors and future flow projections are shown in Tables ES-1 and ES-2.

Table ES-1. High Flow Projections for the Wilsonville Wastewater Treatment Plant

	Peaking Factor	2000	2005	2010	2015	2020	2025	2030	2035
Dry Weather									
Average Day	1.00	2.02	2.73	3.45	4.16	4.88	5.59	6.31	7.02
Maximum Month	1.07	2.15	2.91	3.68	4.44	5.20	5.96	6.72	7.48
Maximum Week	1.13	2.29	3.09	3.90	4.71	5.52	6.33	7.14	7.94
Maximum Day	1.32	2.67	3.61	4.56	5.50	6.45	7.39	8.34	9.28
Wet Weather									
Average Day	1.20	2.42	3.27	4.13	4.98	5.84	6.69	7.55	8.40
Maximum Month	1.38	2.79	3.78	4.77	5.76	6.74	7.73	8.72	9.71
Maximum Week	1.63	3.30	4.47	5.63	6.80	7.97	9.13	10.30	11.47
Maximum Day	1.98	4.00	5.41	6.83	8.24	9.66	11.07	12.49	13.90
Peak Hour	2.95	5.96	8.07	10.17	12.28	14.39	16.49	18.60	20.71

Table ES-2. Low Flow Projections for the Wilsonville Wastewater Treatment Plant

	Peaking Factor	2000	2005	2010	2015	2020	2025	2030	2035
Dry Weather									
Average Day	1.00	2.02	2.36	2.69	3.03	3.37	3.71	4.04	4.38
Maximum Month	1.07	2.15	2.51	2.87	3.23	3.59	3.95	4.31	4.67
Maximum Week	1.13	2.29	2.67	3.04	3.43	3.81	4.20	4.57	4.96
Maximum Day	1.32	2.67	3.12	3.56	4.01	4.46	4.90	5.34	5.79
Wet Weather									
Average Day	1.20	2.42	2.82	3.22	3.63	4.03	4.44	4.83	5.24
Maximum Month	1.38	2.79	3.26	3.72	4.19	4.66	5.13	5.59	6.06
Maximum Week	1.63	3.30	3.85	4.39	4.95	5.50	6.06	6.60	7.15
Maximum Day	1.98	4.00	4.67	5.33	6.00	6.67	7.35	8.00	8.67
Peak Hour	2.95	5.96	6.96	7.94	8.94	9.94	10.94	11.92	12.92

Wasteload Projections

Future influent biochemical oxygen demand (BOD), total suspended solids (TSS), ammonia-nitrogen, and phosphorus loadings were calculated using the following average concentrations based on recent influent characteristics[1]:

- BOD: 248 mg/L
- TSS: 254 mg/L
- NH3-N: 24 mg/L
- Total P: 7.3 mg/L

Although influent concentration data for ammonia-nitrogen and total phosphorus was limited, the values recorded at Wilsonville are similar to textbook values for typical municipal wastewater. BOD and TSS concentrations closely match those used in the previous Facility Plan.

Wasteload peaking factors were evaluated using influent data from plant Daily Monitoring Reports (DMRs), and compared with peaking factors from other cities. Peaking factors based on Wilsonville's historical data are generally within the range of peaking factors experienced at other plants in the region. Therefore, peaking factors based on historical data were used for future planning.

Existing Facilities

The Wilsonville facility was constructed in the early 1970s as a Smith and Loveless package plant. The plant was upgraded through a series of expansions in the 1980s and 1990s. Today, Wilsonville's plant provides primary and secondary treatment, effluent sand filtration, ultraviolet (UV) disinfection, and aerobic digestion. Liquid biosolids are land-applied to various agricultural sites in the area for beneficial reuse. The overall performance of the treatment plant, as well as

[1] Data since 1998 was used in the Facility Plan evaluation.

the capacity and condition of key equipment and processes, was evaluated to determine the adequacy of the existing facility to meet future needs.

Capacity Evaluation

The plant currently has a capacity to treat 7,500 lb/day of influent BOD and TSS (without nitrification), with a peak stated hydraulic capacity of 8 mgd. Actual hydraulic capacity is limited to 2.8 mgd on an average basis mgd (based on primary clarifier capacity) and 4 mgd on a peak basis (based on influent screening capacity). A steady-state mass balance model was developed for major process units. Average and maximum-month flows were modeled during wet and dry seasons. Table ES-3 shows the current capacity of the major unit processes.

Table ES-3. Estimated Current process Capacity for Unit Processes, mgd

Unit Process	Design Basis	Firm Capacity	Total Capacity	Comments
Headworks	Peak Hour Flow	4 mgd	4 mgd	Based on operating experience with fine drum screen. Backup bar screen is capable of passing 8 mgd but cannot be used for normal duty service due to impacts on solids processing and disposal.
Primary Clarification[1]	Maximum Month Flow Peak Hour Flow	2.8 mgd Max Month; 6.9 mgd Peak Hour	2.8 mgd Max Month; 6.9 mgd Peak Hour	Based on conventional design criteria of 1,000 gpd/sf under maximum month conditions and 2,500 gpd/sf under peak hour conditions; firm capacity based on one clarifier in service, providing capacity for 50% of total design flow.
Activated Sludge	Maximum Week Oxygen Demand[2]	2.600 lb/day Primary Effluent BOD	5,200 lb/day Primary Effluent BOD	Based on conventional design criteria of a maximum diurnal peak oxygen uptake rate of 50 mg/L/hr; firm capacity based on one aeration basin in service.
Secondary Clarification	Total Suspended Solids Loading	96,400 lb/day TSS (equivalent to 2.2 mgd, 50% RAS, 3,500 mg/L MLSS	192,900 lb/day TSS (equivalent to 2.2 mgd, 50% RAS, 3,500 mg/L MLSS	Based on conventional design criteria of 25 lb/day/sf solids loading under maximum month conditions and 40 lb/day/sf under peak hour conditions; firm capacity based on one clarifier in service.
Filtration	Average Day Flow Peak Hour Flow	2.3 mgd Average Day 4.6 mgd Peak Hour	3.4 mgd Average Day 6.8 mgd Peak Hour	Based on conventional design criteria of 2 gpm/sf under average day conditions and 4 gpm/sf under peak hour conditions; firm capacity based on two filters in service.
UV Disinfection	Peak Hour Flow	8 mgd	8 mgd	Based on stated design criteria
Gravity Belt Thickening	Maximum Week Primary and WAS Flow	267 gpm (equivalent to 4.5 mgd MWWWF)	534 gpm (equivalent to 7.7 mgd MWWWF)	Based on stated design criteria and 40 hour/week operation; firm capacity based on one GBT in service
Aerobic Digestion	Maximum Month Solids Loading	6,500 gpd (equivalent to 1.7 mgd MMWWF)	12,900 gpd (equivalent to 3.4 mgd MMWWF)	Based on conventional design criteria of 40-day detention time at a temperature of 20°C or greater under maximum month conditions; firm capacity based on one digester in service.
Biosolids Storage	Maximum Month Digested Sludge Flow	1,400 gpd (equivalent to 0.4 mgd MMWWF)	1,700 gpd (equivalent to 0.5 mgd MMWWF)	Based on design criteria of 240 days' storage; firm capacity based on four tanks in service.

1. Total capacity based on operation of both primary clarifiers, which is currently not possible due to limitations in primary sludge piping.
2. Driven by primary effluent BOD

A spreadsheet hydraulic model was also created to develop a hydraulic profile of the plant from the raw sewage influent through the outfall. A range of flows was evaluated to determine the flow at which process control of each unit process is impaired (i.e., submerging a weir or exceeding allowable submergence on a Parshall flume), and the flow at which basins, channels, or other structures are flooded. Table ES-3 shows the influent flows at which control elements are submerged and structures are overtopped at key process locations.

It is important to understand that the "Maximum Process Flows" shown in Table ES-4 are not operating flows, but theoretical maximum flows at which point key hydraulic elements are submerged.

Table ES-4. Estimated Capacity of Hydraulic Elements, mgd

Flow Control Element/Structure	Maximum Process Flow, mgd	Maximum Overtopping Flow, mgd
Fine screen	9.4	9.4
Primary Clarifiers	16.1	17.2
Aeration Basins	17.5	18.1
Secondary Clarifiers	16.2	17.2
Sand Filters	9.9	9.9
UV Disinfection Channel	16.2	17.5

Treatment Performance

Since 1998, with the exception of one period of process upset in May and June of 1998, the plant has not violated permit limits for carbonaceous BOD (CBOD)[2] or TSS. CBOD and TSS concentrations are often in the range of 1 to 3 mg/, and are typically below 5 mg/L. Although the plant is not required to remove ammonia nitrogen (nitrify), effluent concentrations were consistently below 2 mg/L during the summer permit seasons of the years evaluated. Effluent total phosphorus is also low during the summer (under 5 mg/L).

Although the plant did not exceed the monthly median permit limit for *E.Coli* during the period examined, there have been several exceedences of the single sample permit limit of 406 CFUs per 100 mL. Plant staff feel that this is due to programming problems with the UV system and not the capacity or effectiveness of the UV system itself.

Regulatory Review

The Wilsonville facility discharges most of its effluent to the Willamette River. Some of the treated effluent is also used for nonpotable process needs onsite. Liquid biosolids are applied to local agricultural land as a soil amendment. Regulatory requirements dictating the level of treatment provided at the plant are based on current regulations and current permit requirements, as well as anticipated future requirements.

Water Quality Regulations and Requirements

The Clean Water Act and the Endangered Species Act are the key pieces of federal legislation governing the water quality requirements for effluent discharged to the Willamette River. The City's NPDES permit, issued under the Clean Water Act, currently regulates the City's effluent CBOD, TSS, *E. Coli*, pH, copper, cadmium, temperature, and chlorine residual. With the possible exception of the metals, which City is attempting to have decreased or eliminated through a separate effort, these limits are anticipated to remain in effect. For CBOD and TSS,

[2] Plant influent is monitored for BOD, however permit compliance is based on effluent concentration of CBOD, which is the carbonaceous component of BOD (excluding oxygen demand associated with oxidizing ammonia to nitrate)

which are mass-based limits, this means that effluent concentrations must decrease (and treatment performance therefore improve) as flows to the treatment plant increase.

While DEQ has not indicated that future Wilsonville permits will include an ammonia-nitrogen limit, other dischargers on the Willamette do have ammonia limits in their NPDES permits. Furthermore, changes in the characteristics of the influent sewage brought on by the change in potable water supply could impact the City's ability to nitrify during the summer, possibly leading DEQ to conclude that Wilsonville has a "reasonable potential" to exceed toxicity standards for ammonia. Therefore, future facilities should be designed to allow for nitrification, and adequate space reserved to achieve a fully nitrified effluent. There is no indication that a total nitrogen or phosphorus limit will be imposed in the future, however future improvements should not preclude implementation of denitrification and phosphorus removal.

A Mixing Zone Study conducted in conjunction with this Facility Plan shows that the City does not currently cause a measurable increase in stream temperature when the ambient temperature in the river is over 68°F. A measurable increase is predicted under conditions when the River temperature is low, however this increase should not impair the biological integrity of threatened and endangered species (steelhead and chinook salmon). A temperature total maximum daily load (TMDL) for the Middle Willamette River is currently under development which could impact Wilsonville's discharge. The alternatives analysis considers addition of an outfall diffuser to mitigate for temperature discharges from the wastewater treatment plant should this be required in the future.

Table ES-5 summarizes the anticipated effluent concentrations for the Wilsonville facility at current (2001) flow rates, and at projected 2020 and ultimate build-out flow rates under the high flow projection. If flow rates are lower than the high projection, effluent requirements will be less stringent than in Table ES-5.

DRAFT

Table ES-5. Projected Effluent Quality Requirements

Summer Permit Season (May 1 - October 31)									
	Year 2001			Year 2020			Ultimate Build-out		
	Monthly	Weekly	Daily	Monthly	Weekly	Daily	Monthly	Weekly	Daily
$CBOD_5$, mg/L[2]	10	15	NA	4.4	6.1	NA	3.0	4.2	NA
TSS, mg/L[2]	10	15	NA	4.4	6.1	NA	3.0	4.2	NA
Total P, mg/L	——— No Limit ———			——— No Limit ———			——— No Limit ———		
NH_3-N, mg/L	——— No Limit ———			——— No Limit ———			——— No Limit ———		
E. Coli, #/100 mL	126	NA	406	126	NA	406	126	NA	406
Chlorine Residual, mg/L	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dissolved Oxygen, mg/L	——— No Limit ———			——— No Limit ———			——— No Limit ———		
PH	6.0 to 9.0			6.0 to 9.0			6.0 to 9.0		
Copper, mg/L	0.013	NA	0.017	0.013	NA	0.017	0.013	NA	0.017
Cadmium, mg/L	0.00042	NA	0.00065	0.00042	NA	0.00065	0.00042	NA	0.00065
Other Requirements	85% removal of BOD_5 and TSS								
Winter Permit Season (November 1 - April 31)									
	Year 2001			Year 2020			Ultimate Build-out		
	Monthly	Weekly	Daily	Monthly	Weekly	Daily	Monthly	Weekly	Daily
$CBOD_5$, mg/L[2]	30	45	NA	10	13	NA	6.9	8.8	NA
TSS, mg/L[2]	30	45	NA	10	13	NA	6.9	8.8	NA
Total P, mg/L	——— No Limit ———			——— No Limit ———			——— No Limit ———		
NH_3-N, mg/L	——— No Limit ———			——— No Limit ———			——— No Limit ———		
E. Coli, #/100 mL	126	NA	406	126	NA	406	126	NA	406
Chlorine Residual, mg/L	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dissolved Oxygen, mg/L	——— No Limit ———			——— No Limit ———			——— No Limit ———		
pH	6.0 to 9.0			6.0 to 9.0			6.0 to 9.0		
Copper, mg/L	0.013	NA	0.017	0.013	NA	0.017	0.013	NA	0.017
Cadmium, mg/L	0.00042	NA	0.00065	0.00042	NA	0.00065	0.00042	NA	0.00065
Other Requirements	85% removal of BOD_5 and TSS								

Biosolids Regulations and Requirements

Biosolids treatment and reuse is governed by 40 CFR part 503, which are broad-based regulations addressing general requirements, pollutant limits, management practices, operational standards, monitoring frequency and record-keeping requirements, reporting practices, and pathogen and vector attraction requirements for treatment and disposal of all municipal wastewater sludges. The pathogen and vector attraction reduction requirements directly impact the type and quality of treatment provided at the treatment plant. Wilsonville's aerobic digesters provide adequate detention time and volatile solids destruction to produce Class B biosolids.

Class B biosolids require the City to follow site restrictions that have limited the number of land application sites available, particularly during the wet winter season. In the last few years, the number of acres permitted for biosolids application by the City has dwindled and constrained plant operations. There is some indication that DEQ may cease to approve winter application sites in the future.

EPA and DEQ recognize a higher level of treatment that further reduces pathogen content, resulting in a product called Class A biosolids. Because of the additional treatment provided, land application of Class A biosolids is not subject to the same site restrictions as Class B land application. Treatment processes such as composting, lime stabilization, thermophilic aerobic digestion, and prepasteurization are recognized to produce Class A biosolids.

Reuse Regulations and Requirements

Water quality requirements for reuse are defined in the Oregon Reuse Rules. DEQ classifies reclaimed water into four categories: Level I through Level IV. Level IV treatment requirements are the most stringent, allowing reclaimed water to be used on areas open to general public contact (except during the irrigation cycle). Level IV treatment requires chemical coagulation, which is currently not provided at the plant. Offsite reuse would also require maintaining a chlorine residual, which cannot currently be provided.

Alternatives Analysis

A wide range of alternatives was considered for expanding the Wilsonville facility to meet future capacity and effluent quality requirements. Alternatives were identified and developed through a staged process that included the following steps:

- Develop evaluation criteria
- Brainstorm alternatives
- Screen alternatives
- Detailed analysis of alternatives
- Evaluation of alternatives.

Table ES-6 below shows the alternatives and features identified during two brainstorming sessions with City staff. Those alternatives that are crossed out were eliminated during the initial screening because they were not feasible or compatible with the City's long-term goals. The remaining alternatives received detailed evaluation, and were compared with each other and rated based on evaluation criteria developed jointly with the City.

Table ES-6. Wilsonville Facility Alternatives

Process Area	Alternatives	Features
Headworks	• Additional 1 mm internally-fed fine screens; no separate grit removal	• Enclose headworks • Add mechanized gates at the splitter box • Address problem with grit buildup prior to the fine screen
Primary Treatment	• Retrofit existing tanks to serve only as primary clarifiers; add new circular primary clarifiers • Maintain existing clarifiers in current configuration and add new circular primary clarifiers • Add high rate sedimentation • ~~No primary clarifiers~~	• Address piping modifications required at primary clarifier no. 2 • New clarifiers will have stainless steel mechanisms
Secondary Treatment	• Expand nitrifying activated sludge • Membrane bioreactor (MBR) • Biological aerated filter (BAF) • ~~Sequencing batch reactor (SBR)~~	• Examine step feed to increase basin capacity • Compartmentalize basins for improved redundancy • Address alkalinity drop in new drinking water source • Address problems with anoxic manhole (air entrainment, scum recycling) • Identify additional volume required for implementation of full biological nutrient removal (BNR) • Optimize selector size • Address operational issues: foam trap at entrance to basin, algae on secondary clarifiers, need for level sensors
Effluent Filtration	• Improved sand filters • ~~Fuzzy filters – reuse only~~ • Fuzzy filters – entire plant flow • Ballasted sedimentation (Actiflo®) • No filters (with MBR option)	• Investigate chemical addition requirements for reuse
Disinfection	• Medium pressure UV • Low pressure UV • Sodium hypochlorite/ bisulfite • Peracaetic acid	
Outfall	• Add second outfall • Provide detention for peak flows • Pump through existing outfall	• Add diffuser to existing outfall
Thickening	• Continue use of gravity belt thickeners	
Solids Processing	• Class B digestion and hauling to Eastern Oregon • ~~In-vessel composting~~ • ~~Lime stabilization~~ • ~~Heat treatment~~ • Pasteurization • Autothermal thermophilic aerobic digestion ~~(ATAD)~~ • Drying • ~~Class B digestion/land application on poplar plantation~~	• Need to determine when anaerobic digestion becomes more cost-effective • Need to investigate the potential markets for Class B vs. Class A biosolids • Need to add level sensors to digesters • Need to add dewatering and dewatered cake storage

Alternatives were developed for two projected flow and loading conditions: an interim expansion to provide capacity for 4 mgd ADWF (8,700 lb/day BOD and 8,600 lb/day TSS) projected to occur in approximately year 2015, and an ultimate expansion for build-out flows of 7 mgd ADWF (14,900 lb/day BOD and TSS). The ultimate build-out case provided for a long-term economic and non-economic comparison, and identified ultimate facility requirements and space needs.

Reuse Program

The City has initiated an effluent reuse program as documented in a plan submitted to DEQ in May 2000. In the Plan, the City outlined its plans to implement a two-phase reuse program to provide Level IV reuse water for irrigation of Boones Ferry Park and Memorial Park, sewer jet rodding, and storm sewer catch basin cleaning. DEQ approval of the plan was conditional based on adding chemical coagulation and maintaining a 1 mg/L chlorine residual. These conditions have not been met, and therefore the program has not been implemented.

In addition to providing a community benefit, the Facility Plan examined two other reasons that the City may choose to implement reuse:

1. Reduce hydraulic loading to the outfall during the winter peak flow season
2. Reduce contaminant loading to the river during the summer permit season

Meeting these goals requires the City to divert 3 to 5 mgd of flow, respectively, to beneficial reuse demands at ultimate build-out. This is equivalent to over 2,100 acres of turf irrigation required to divert 5 mgd of flow during the summer, or 3 mgd of industrial demand required to divert flow during the winter.

Implementing a reuse program for irrigation of limited public facilities does not impact the level of treatment required for discharge to the Willamette, and does not significantly affect the hydraulic capacity required at the plant. Because the plant does not use chlorine, complying with DEQ requirements for a Level IV reuse system requires constructing a chemical additional process solely to serve the reuse program. Therefore, the City has elected to not pursue Level IV reuse at this time.

Site Master Planning

In addition to providing adequate treatment for future needs, it is imperative that the treatment plant facilities fit on the existing plant site in a manner that optimizes plant operations and is acceptable to the surrounding community. Site layouts were evaluated based on the general site planning criteria described below:

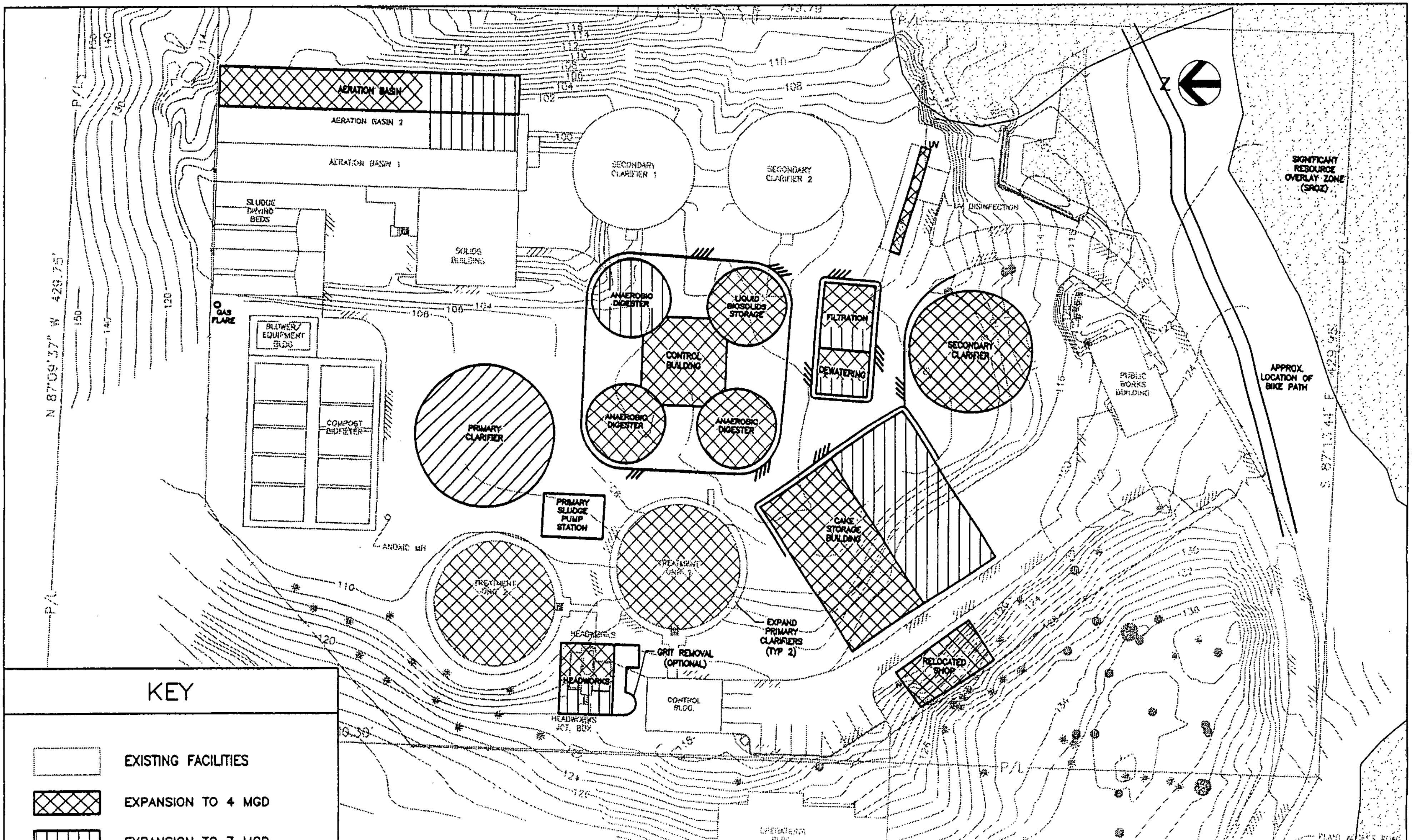
- **Setback and Height Restrictions.** Minimum setback distances are 30 ft at the front and rear and 10 ft on the sides as measured from the property lines, with a maximum structure height of 35 ft.
- **Significant Resource Overlay Zone and Bicycle Path.** The southwest corner of the plant includes a Significant Resource Overlay Zone (SROZ), which is a designated natural resource area. Construction in this area would be difficult to permit, and should be avoided if at all possible. There is also a relatively new bike path located on the City's property in the southwest corner of the plant.

- **Hydraulics.** Energy efficiency is a priority for the City; site plans should allow the City to continue to rely on gravity flow through the plant to the extent possible.
- **Topography.** Steep slopes exist on most of the plant's boundaries. These slopes may prohibit construction, or at a minimum make construction difficult and costly.
- **Geotechnical Issues.** Groundwater at the plant site is high, and previous construction projects have required extensive dewatering. Large boulders have also been encountered in previous excavations, and previous geotechnical investigations revealed the presence of debris such as large pieces of concrete, reinforcing steel , and other debris.
- **Proximity to Existing Structures.** Some of the proposed structures will be constructed below grade and involve a significant amount of excavation. Due to the small area available for construction, sheet piling and shoring will be required to protect existing structures. Of particular concern are dewatering and the problem of driving sheet piling in areas known to contain large boulders.
- **Aesthetics.** Portions of the treatment plant are visible to nearby residents and to traffic on nearby Interstate 5. Blending of the wastewater facilities into the surroundings will be an important consideration for future construction.
- **Potential Odor Impacts.** Solids handling and processing facilities and the headworks will have the potential to generate the most odors at the plant. These facilities will be enclosed and foul air treated, however they should also be located away from residential houses to the extent possible.
- **Lighting Impacts.** The off-site lighting impacts should be minimized.
- **Noise Impacts.** Enclosing noisy equipment in structures will minimize noise impacts.
- **Access and Operational Convenience.** Access and parking for biosolids hauling trucks, vactor trucks, chemical delivery trucks, and maintenance vehicles is crucial for plant operations. Roads and access ways with adequate turning clearance must be provided through the plant.
- **Construction Phasing/Sequencing.** Continued operation of existing treatment facilities during the construction of new facilities is required to meet the City's permit.

Based on these and other process-specific criteria described in Chapter 6, two layouts were developed showing the recommended processes from the alternatives evaluation. While both of the alternatives meet the site planning criteria, Alternative 2, shown in figure ES-2, is the preferred alternative. This alternative has more favorable hydraulics and allows easier access for biosolids hauling trucks. Construction sequencing is also slightly simplified with Alternative 2.

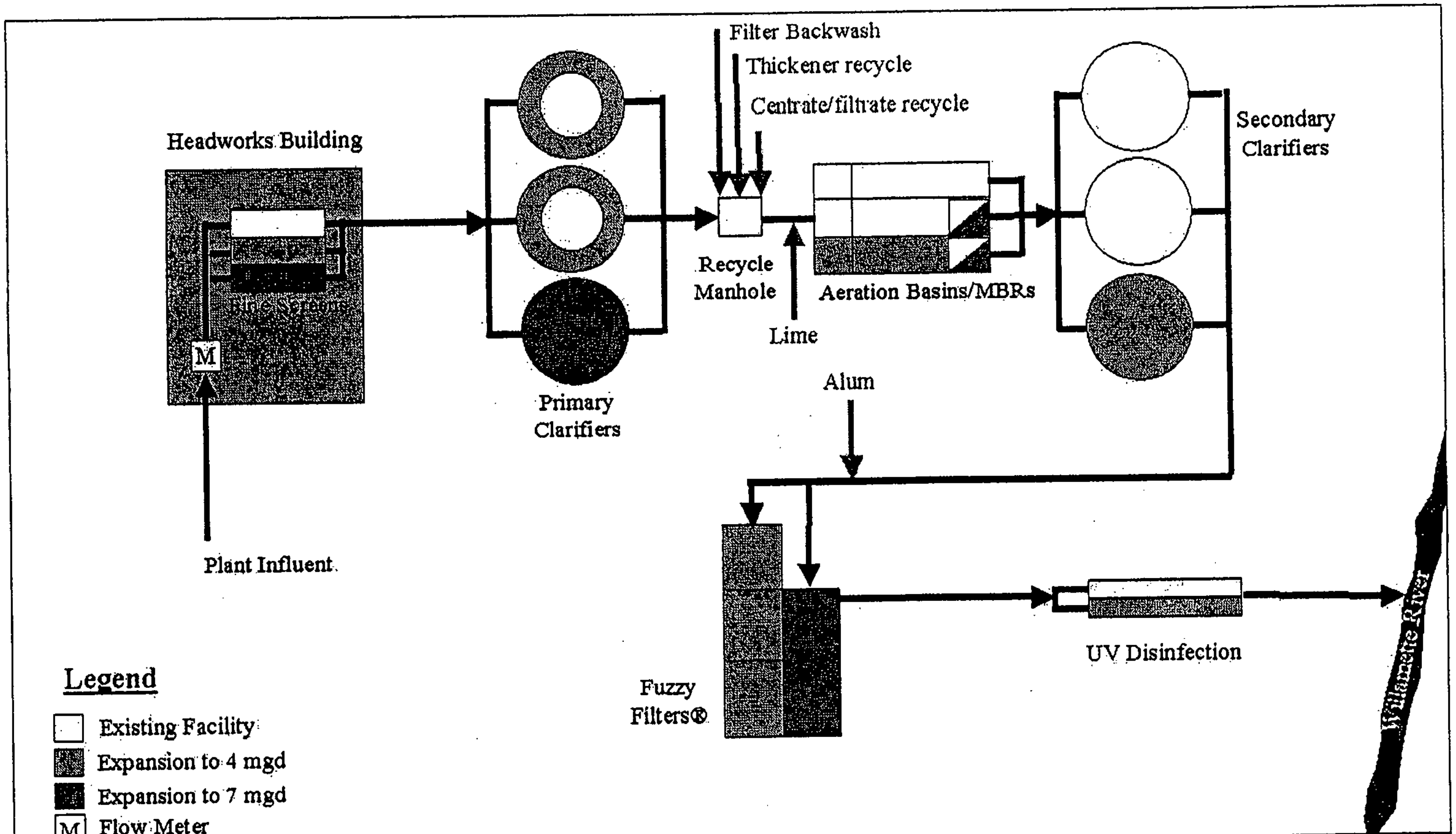
Recommended Plan

The Recommended Plan identifies those improvements needed immediately to meet short-term capacity and process control needs, and also provides a long-term plan for ultimate expansion of the plant. Figure ES-3 shows a simplified flow chart for the proposed liquid stream treatment, and Figure ES-4 shows a similar flow chart for solids treatment. Each of these figures is color coded to indicate when new or modified facilities must be implemented.



HDR
HDR Engineering, Inc.

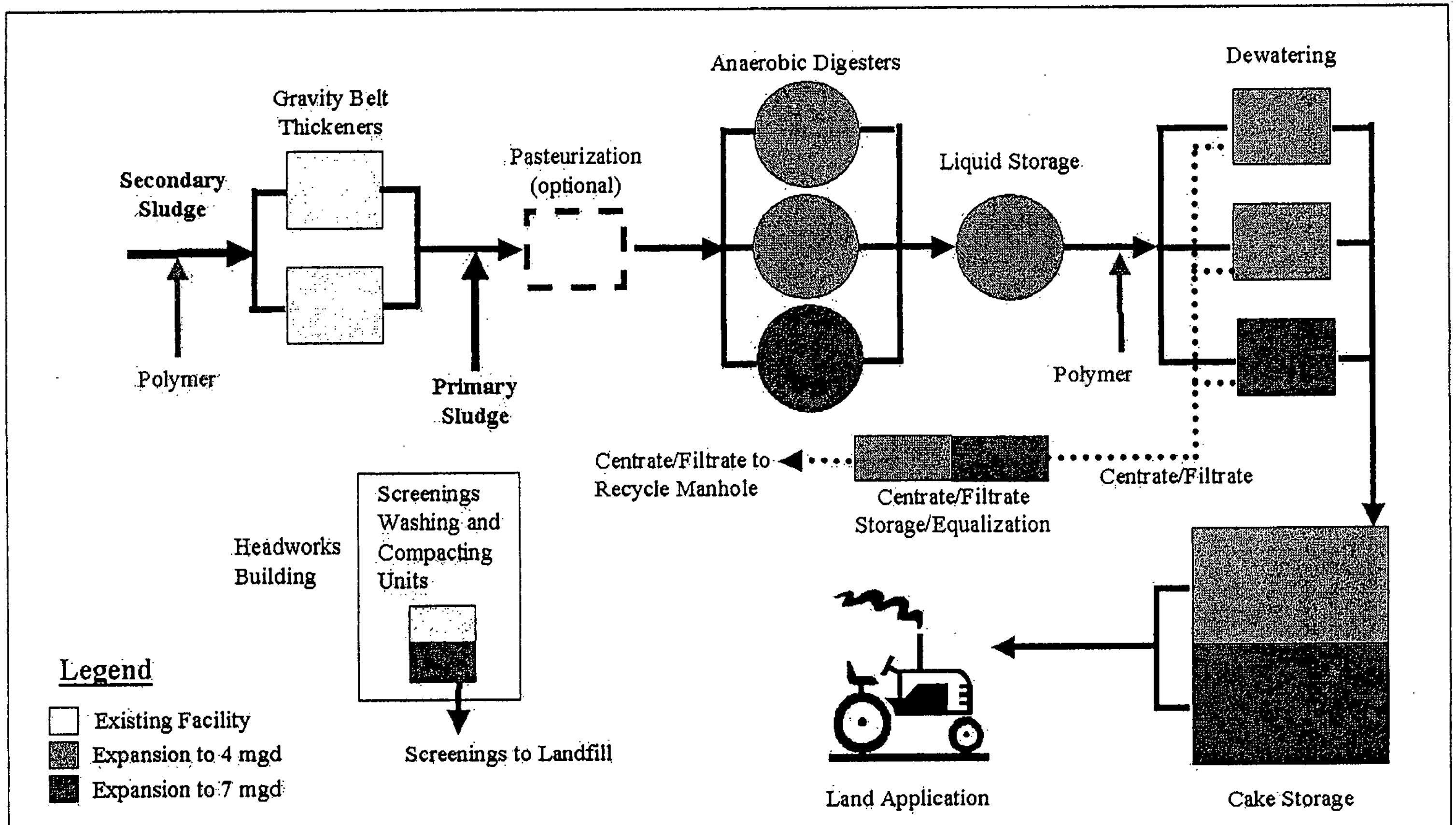
FIGURE ES–2
PROPOSED SITE PLANNING ALTERNATIVE 2



City of Wilsonville
Wastewater Treatment Facilities Plan

Liquid Treatment Schematic at Buildout

Figure ES-3



HDR | City of WILSONVILLE in OREGON | City of Wilsonville Wastewater Treatment Facilities Plan | **Solids Treatment Schematic at Buildout** Figure ES-4

The recommended plan also provides flexibility to incorporate future process changes. Space is allocated to add prepasteurization to produce Class A biosolids, and the secondary treatment process can be operated to achieve biological phosphorus removal should these approaches prove necessary or cost-effective.

Unit Process Needs

The following sections describe recommended facilities for each unit process.

Headworks

The long-term recommendation for the headworks is to provide an enclosed structure for odor control, continuing the current practice of fine screening followed by screenings washing/compaction. Initially, a new influent flow split structure will need to be constructed to direct flow to either the existing screen or a new 10 mgd rotary drum screen. A redundant screenings washing and compaction unit will also be added. Ultimately, the existing bar screen will need to be replaced with a 10 mgd rotary drum screen, giving the plant three rotary drum screens.

Primary Treatment

Additional primary clarifier capacity is a critical need at the plant due to the lack of firm primary treatment capacity. Expansion of the primary treatment facilities will consist of demolishing the existing aerobic digesters and using the structures for primary clarification only. Retrofitting the two existing structures to serve as primary clarifier only will provide adequate capacity until at least 2020. Ultimately, a third primary clarifier will be constructed for ultimate build-out.

Currently, only one primary clarifier is used due to limitations in primary sludge piping. Modifying the primary sludge piping to provide more flexibility will delay the need for retrofitting the primary clarifiers.

Secondary Treatment

Continuation of the current activated sludge technology will present challenges to site planning in the future. The recommended secondary treatment process involves converting a portion of the aeration basins to MBRs in order to minimize footprint and maintain flexibility for future implementation of denitrification or biological phosphorus removal. The initial expansion can be achieved by adding a third conventional activated sludge basin and third secondary clarifier. Ultimately two of the activated sludge basins will be converted to MBR basins. One activated sludge basin and secondary clarifier will continue to operate in the conventional mode, and will be used to buffer peak flows to the MBR basins.

Additional short-term improvements are needed. These include:

- Addition of a lime silo and lime feed system to support complete nitrification
- Enhancements to the existing basins to provide step feed capabilities for process stability and to provide a small increase in capacity
- MBR pilot testing to confirm design parameters for modifications of the activated sludge basins

Effluent Filtration

The recommended plan includes pilot testing Fuzzy Filters to replace the existing mono-media sand effluent filters. Following pilot testing to confirm filter performance and design criteria, a new structure will be constructed to house the initial expansion of fuzzy filters as well as pumping facilities for filtration. Additional filter modules will be added to serve ultimate build-out needs. Chemical feed facilities will also be added for coagulation.

Disinfection

Medium pressure UV disinfection will continue to be used at the plant. A second UV disinfection channel will be constructed, followed by improvements to the existing channel to replace the Parshall flume with magnetic flow measurement and increase the capacity of the channel to over 10 mgd. This change allows flow to be split evenly to the two disinfection channels under all conditions, but requires the addition of flow measurement upstream of disinfection.

Effluent Discharge

The recommended plan for effluent discharge involves continued use of the existing outfall to the Willamette River. No additional outfall capacity is required initially, or through ultimate build-out if peak flows remain under 16 mgd. If additional capacity is required in the future, the City should evaluate options available to upsize the existing outfall. These options should be weighed against future regulatory and permitting issues associated with construction of a second outfall. The existing outfall could also be retrofitted with a diffuser in the future to provide additional dilution if necessary to meet water quality requirements.

Sludge Thickening

The recommended plan for sludge thickening involves continued use of the existing gravity belt thickeners for waste activated sludge (WAS) thickening and continued thickening of primary sludge in the primary clarifiers. No improvements are required through ultimate build-out.

Solids Stabilization

The recommended plan includes constructing new anaerobic digesters and associated control features for solids stabilization. Initial construction is triggered by the primary clarifier construction, and will include two anaerobic digesters, one digested sludge storage tank, and associated systems. A third anaerobic digester will be required for ultimate build-out.

Solids Dewatering and Storage

To provide adequate sludge storage onsite, the City must dewater digested biosolids. The choice of dewatering technology will be postponed until after pilot testing of a rotary press, centrifuge, and belt filter press. At a minimum, two new pieces of dewatering equipment will be required initially in order to meet maximum month conditions with one unit out of service. The dewatering equipment and support facilities will be housed in a new building, which will also contain storage for equalization of dewatering centrate. Dewatering is a critical need and should be implemented as soon as possible.

A new dewatered cake storage building with loadout facilities and odor control will also be constructed. The building can be phased to provide half of the required volume in an initial expansion, with the second half added to serve ultimate build-out. Construction of the storage building can be deferred by providing a small amount of temporary storage onsite, however it will be imperative that the City have a reliable program for hauling and land applying cake sludge.

Phasing and Implementation

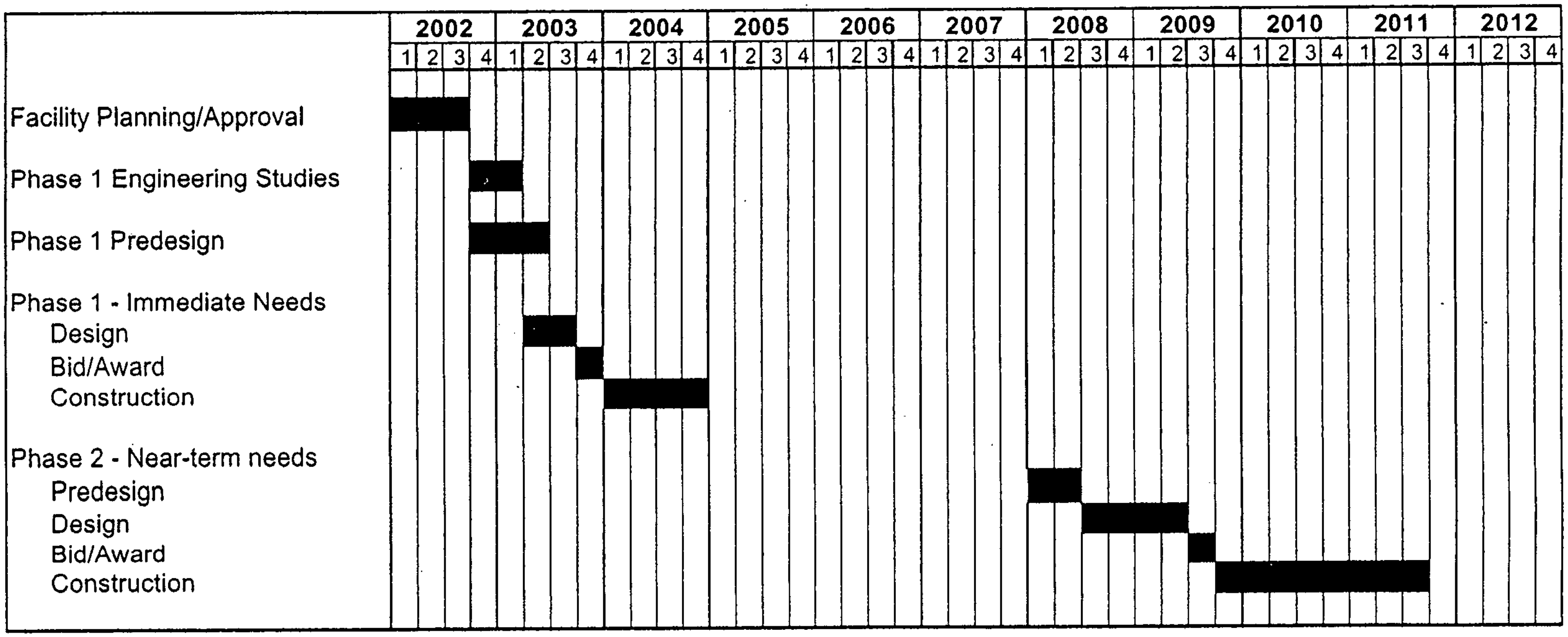
To address critical capacity and performance issues while maintaining manageable construction projects, recommended improvements are divided into three implementation phases. Table ES-7 identifies the specific improvements included in each phase.

Table ES-7. Elements of Implementation Phases

Phase 1	
• Biosolids Management Plan	• Headworks Expansion
• Detailed Plant Odor Analysis	• Biosolids Dewatering
• Evaluation of Willamette River TMDL	• Filtration Expansion
• MBR Pilot Study	• Lime Feed System
• Dewatering Pilot Study	• Step Feed Improvements
• Filtration Pilot Study	• Primary Sludge Piping Improvements
• Phase 1 Predesign	• Temporary Dewatered Sludge Storage
Phase 2	
• Primary Treatment Improvements	• New Anaerobic Digestion Facilities
• Secondary Treatment Expansion	• Liquid Biosolids Storage Tank
• Disinfection Expansion	• Permanent Dewatered Sludge Storage
Phase 3	
• Headworks Expansion	• Filtration Expansion
• New Primary Clarifier	• New Anaerobic Digester
• Secondary Treatment Conversion to MBR	• Dewatering and Cake Storage Expansion

Figure ES-5 shows the schedule for implementation of improvements. This schedule is based on the low flow projections shown in Figure ES-1. The Phase 3 expansion will be needed 10-20 years following completion of Phase 2, depending on whether flows more closely match the high or low projections..

Figure ES-5. Schedule for Implementation of Phase 1 and Phase 2 Expansion



Project Costs

The projected project costs for the Phase 1, 2, and 3 expansions are presented in Table ES-8. Biosolids dewatering costs are based on installation of belt filter presses; actual costs will depend on the type of technology selected. The costs include contingency for miscellaneous costs not itemized, mobilization and bonds, contractor overhead and profit, and engineering, legal, and administrative costs. Costs are presented in 2002 dollars and reflect costs as if all facilities were built today. Actual bonding needs will require consideration of inflation impacts and financing costs.

Table ES-8. Estimated present worth costs for plant expansions (Costs in $1,000s).

Project Element	Phase 1	Phase 2	Phase 3
Headworks	$1,680	$0	$795
Primary Treatment	$125	$3,275	$2,575
Secondary Treatment	$425	$9,669	$20,757
Filtration	$2,690	$0	$1,415
Disinfection	$0	$1,431	$0
Solids Stabilization	$0	$4,812	$1,806
Biosolids Dewatering	$3,840		$1,099
Liquid and Cake Storage	$150	$4,038	$2,878
Sludge Haul/Spread Equip.	$180		
Relocate Maintenance Shop	$0	$550	$0
Site Management	$446	$1,189	$1,566
Landscaping and Mitigation	$446	$1,189	$1,566
Total	**$9,981**	**$26,153**	**$34,458**

ENR-CCI index 3581; markups of 30% for contingency, 8% for mobilization and bonds, 15% for construction contractor overhead and profit, 20% for sitework, and 25% for engineering, legal, and administrative were used. A 5% site management cost was applied to account for the difficulty in managing excavation, equipment storage, and general construction coordination on a small site.

Chapter 1. Introduction

Summary

In May of 2001, the City of Wilsonville authorized HDR to prepare a Facility Plan for its wastewater treatment plant. The purpose of the project was to determine projected flows and loadings to the treatment facility, evaluate current and potential future regulatory guidelines dictating current and anticipated water quality requirements, and recommend short and long term capital improvements and policy direction to allow the City to meet future needs through expansion of the existing plant at the current plant site.

The planning horizon for the Facility Plan is ultimate buildout of the service area in year 2035. This horizon was used to ensure that the recommended plan would address the long-term needs of the City in term of treatment processes and physical plant site space.

The following chapters are included in the Facility Plan.

Chapter 2 Planning Projections

Realistic flow and wasteload projections are critical to defining the wastewater facilities necessary for both existing and build-out conditions. Projections are also necessary for identifying phasing opportunities that balance reliable treatment capacity with affordable user rates. Chapter 2 describes the current flows and wasteloads entering the Wilsonville facility, evaluates wet-season and dry-season peaking factors, and projects future plant flows and loadings. Planning projections are given in five-year increments, with ultimate build-out assumed to occur in approximately 2035.

Chapter 3 Existing Facilities

Chapter 3 describes the treatment systems employed at the Wilsonville facility, reviews historical plant performance, and summarizes the capabilities, limitations, and condition of major treatment facilities. This chapter reviews process and hydraulic capacity of major components of the treatment plant and summarizes the capacity, redundancy, condition, and operational issues associated with each unit process area.

Chapter 4 Regulatory Review

Regulatory requirements governing wastewater treatment, disposal, and reuse continue to evolve through an array of federal, state, and local programs. Chapter 4 summarizes current and anticipated effluent quality requirements for discharge and reuse, treatment standards for beneficial reuse of biosolids, and air quality standards for Wilsonville's treatment facility. The regulatory review assumes that the majority of effluent from the treatment plant will continue to be discharged to the Willamette River and that biosolids produced at the plant will continue to be applied to land for beneficial reuse.

Chapter 5 Alternatives Analysis

A wide range of alternatives was considered for expanding the Wilsonville facility to meet future capacity and effluent quality requirements, and to address existing plant deficiencies. Chapter 5 describes the evaluation process used, identifies alternatives considered, and summarizes the evaluation results. Alternatives are presented by unit process area. Each process area evaluation summarizes design criteria, describes the alternatives considered, compares alternatives, and provides preliminary recommendations.

Chapter 6 Site Master Plan

The objective of Chapter 6 is to define a long-term plan for development of the wastewater treatment plant site. Facilities are defined by the size and capacity requirements of the service area and the treatment process analysis conducted in Chapter 5. Site master planning combines this analysis with input from City staff and leaders, and engineering assessments of site development opportunities and constraints.

Chapter 7 Recommended Plan

Chapter 7 presents the recommended plan for future expansion of the Wilsonville facility, outlining a phased program of planning efforts and capital improvements that will allow the City to meet capacity and treatment requirements through ultimate build-out of the planning area. The implementation program is designed to provide the necessary improvements at the plant in a timely and cost-effective manner.

Implementation

This Plan was intended to be updated as appropriate to continue to serve the City's needs in the future. In order to allow the Plan to be adapted to future conditions, the City should continue to monitor changes in the community that may influence the plan, with specific focus on the following key issues:

Wastewater Flows and Loadings

Improvements included in the recommended plan are triggered by specific influent flow and loading conditions. The City's historical approach to monitoring influent flow and loadings, tracking plant performance, and making appropriate adjustments in the capital improvement program and implementation schedule should be continued.

Regulatory Requirements

The recommended plan provides flexibility to accommodate some potential future regulatory requirements, such as the potential need for nitrification and Class A biosolids. However, environmental regulations may change and future water quality requirements may differ from those currently anticipated. The recommendations of this Plan should be reviewed when any new environmental requirements are imposed that impact plant performance and/or operating conditions.

Chapter 2. Planning Projections

Introduction

Realistic flow and wasteload projections are critical to defining the wastewater facilities necessary for both existing and build-out conditions. Projections are also necessary for identifying phasing opportunities that balance reliable treatment capacity with affordable user rates. Deviations in actual flow and loadings from projected values may alter the timeline for implementation of future facilities, but are not expected to change the nature or types of facilities ultimately required in the future.

This chapter describes the current flows and wasteloads entering the Wilsonville facility, evaluates wet-season and dry-season peaking factors, and projects future plant flows and loadings through ultimate buildout. These projections will be used to determine the required near-term capital improvements, as well as identify future site planning issues. Planning projections are given in five-year increments, with ultimate build-out assumed to occur in 2035 based on the 2001 *Collection System Master Plan*. Flow projection development relied upon recent flow and loading data from the City's Daily Monitoring Reports (DMRs), recent water consumption records from the City, existing documents such as the November 15, 2000 *Comprehensive Plan*, the 2001 *Collection System Master Plan* and the 1995 *Wastewater Facility Plan*, as well as planning data for other nearby agencies and municipalities.

Wastewater Flow Projections

Summary of Terms

As a preface to the discussion of flow projections, it is useful to define the key terms employed:

- **Base sanitary flow**: water-carried wastes from residences, businesses, institutions, and industrial establishments.
- **Inflow/Infiltration (I/I)**: extraneous flow that enters the collection system from surrounding soil (infiltration) or through direct connections such as catch-basin connections, and holes in the tops of manhole covers in flooded streets (inflow).
- **Dry Weather Flow**: wastewater flow during periods of little or no rainfall. For the purpose of this study, the dry weather period is assumed to be May 1 through October 31, consistent with the terms of the City's NPDES permit.
- **Wet Weather Flow**: wastewater flow during periods of moderate to heavy rainfall. For the purpose of this study, the wet weather period is assumed to be November 1 through April 30, consistent with the terms of the City's NPDES permit.
- **Annual Average Flow**: total daily flow that occurs on average for a 12-month calendar year period.
- **Average Dry/Wet Weather Flow**: total daily flow that occurs during the wet or dry period. Abbreviated as ADWF and AWWF.

- **Maximum Month Flow**: highest 30-day average flow that occurs during the dry or wet season. Abbreviated as MMDWF or MMWWF.
- **Maximum Week Flow**: highest 7-day average flow that occurs during the dry or wet season. Abbreviated as MWDWF or MWWWF.
- **Maximum Day Flow**: highest 24-hour average flow that occurs during the dry or wet season. Abbreviated as MDDWF or MDWWF.
- **Peak Instantaneous Flow**: maximum flow that occurs in a one-year period (typically during the wet season). Abbreviated as PIF.

Historical Flow Analysis

The Wilsonville Wastewater Treatment Plant provides treatment for sanitary sewage and infiltration/inflow for connected homes, businesses, and industries in the city. Figure 2-1 shows the current city limits, which coincide with the limits of the sewer service area. The City's population has increased dramatically in the past two decades, with the population almost doubling from 1990 (7,075) to 2000 (approximately 13,000). Increases in plant flow in recent years are consistent with the increased population; average dry weather flow has increased from 1.36 mgd in the summer of 1995 to 1.74 mgd in the summer of 2000. Figure 2-2 shows average monthly and weekly flows at the treatment plant since 1995. Table 2-1 summarizes the historical flows for the various flow conditions described earlier in the chapter. Plant flows are evaluated based on influent flow measurements through November 1997, and on effluent flow records after November 1997[1].

Table 2-1. Analysis of Historical Flow Records (mgd)

Flow Condition	1995-96	1996-97	1997-98	1998-99	1999-2000	2000-01
Annual Average	1.69	1.82	1.74	1.96	1.88	1.76
Dry Weather						
Average Day	1.36	1.49	1.54	1.65	1.67	1.74
Maximum Month	1.56	1.66	1.68	1.83	1.75	1.89
Maximum Week	1.60	1.99	1.87	2.03	1.81	1.99
Maximum Day	1.99	2.95	2.61	2.29	1.96	2.15
Wet Weather						
Average Day	2.02	2.15	1.94	2.27	2.08	1.74
Maximum Month	2.73	2.83	2.35	2.72	2.35	1.82
Maximum Week	3.92	3.60	2.89	3.31	2.63	1.95
Maximum Day	5.25	4.40	3.40	4.64	3.28	2.17

[1] Plant staff indicate that effluent flow measurement is more reliable, however a comparison of influent and effluent flows from January 1995 showed very erratic effluent flow measurements prior to November 1997. Therefore, in early years, influent flow records were used.

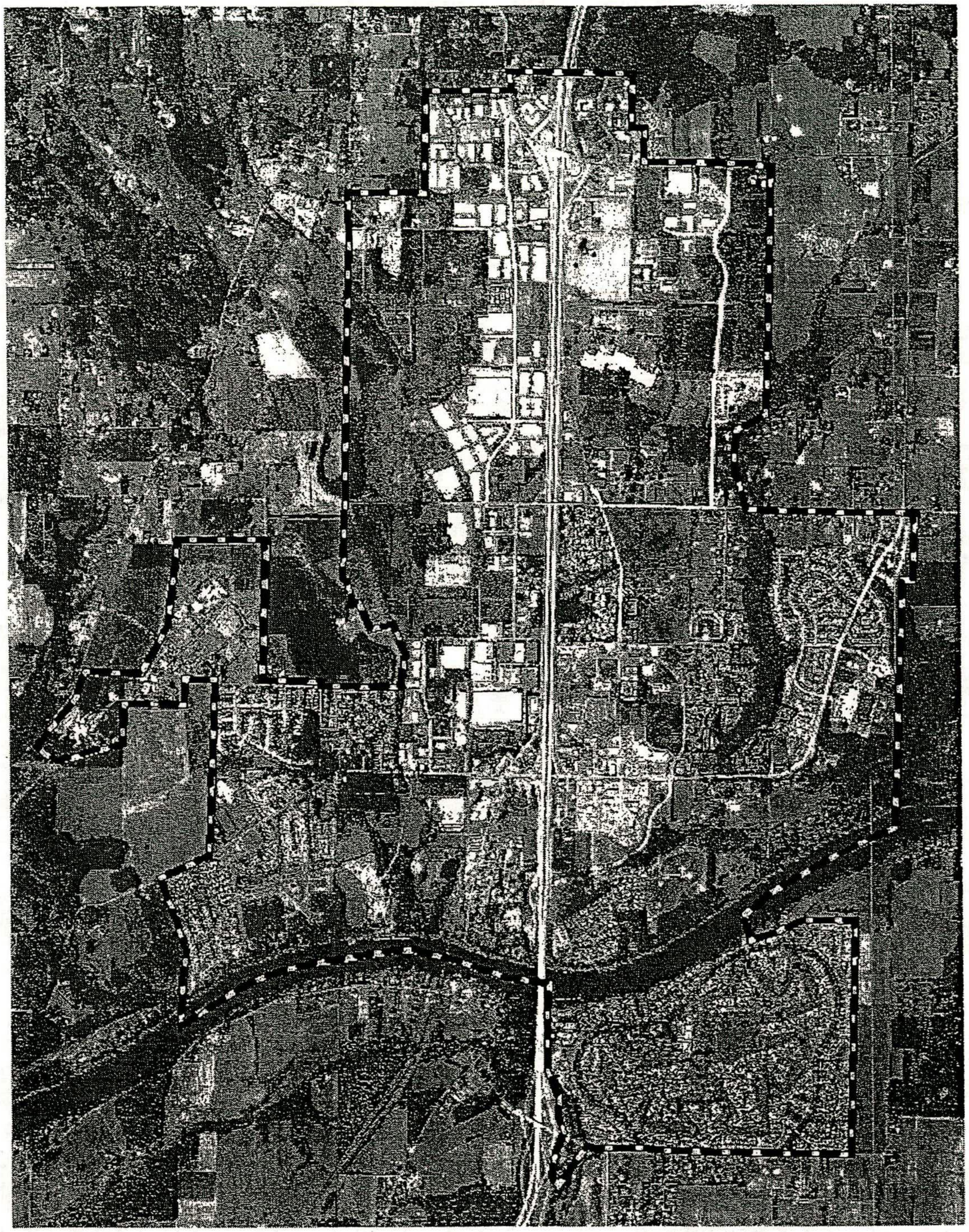


Figure 2-1. Wilsonville City Limits

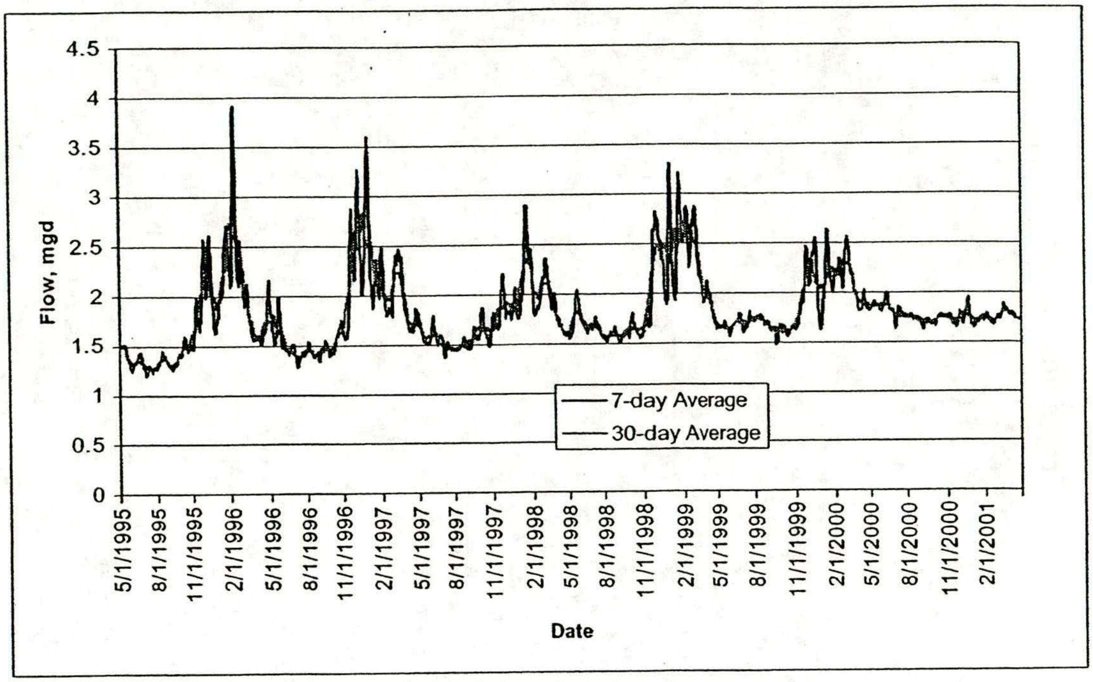


Figure 2-2. Historical Plant Flow at the Wilsonville Treatment Plant

Future Wastewater Flow Projections – Analysis

Projecting future flows involves analysis of two factors:

- Increase in baseline sanitary flow
- Increase in peak flow

Baseline Sanitary Flow Projections

Baseline sanitary flow (equivalent to ADWF) was projected in the 2001 *Collection System Master Plan.* These projections were based on anticipated expansion of the City's service area to include identified Urban Planning Areas, as well as City-developed projections in residential, commercial, and industrial development in each of the City's sub-basins. A unit flow factor for residential development (projected gallons per day per household) was assigned based on recent flow monitoring data, while industrial and commercial unit flow factors (projected gallons per day per developed acre) were assigned based on discussions with the City. The planning values used here for commercial and industrial development are higher than actual values seen in recent years; with the construction of the new water treatment plant, the City anticipates that industrial development will shift toward higher water-consuming industries. Collection system planning values are typically conservative, since subsequent capacity increases are difficult to achieve.

During the course of completing the *Collection System Master Plan*, the City updated its *Comprehensive Plan.* At the City's request, build-out flow projections were re-evaluated using the unit flow factors of the *Collection System Master Plan* and development assumptions from the *Comprehensive Plan*. The *Comprehensive Plan* identifies future development using the following four land use categories: Residential, Commercial, Industrial, and Public Lands

The residential areas include estimates of dwelling unit density, therefore the *Collection System Master Plan* unit flow factors were directly applicable to these land use categories. The fourth category, Public Lands, includes some areas that do not generate significant sanitary flow (i.e., parks and open spaces), and others that do generate baseline sanitary flow (schools, public service buildings, etc.). Areas identified as Public Lands were separated between those areas that are not improved (i.e., do not contribute to baseline sanitary flow), and those that are improved. The designation between these types of public lands was assumed to be the same as that used in the *Collection System Master Plan*, and as in that study, the commercial unit flow factor was applied to improved public lands.

The *Comprehensive Plan* includes several areas adjacent to the existing City Limits, in which development is anticipated but land use planning has not been fully completed. Where the type of development was not specifically stated for these areas, assumptions were made based on the description of likely development plans in the *Comprehensive Plan*. Assumptions made associated with these planning areas are included in Appendix A.

Total residential areas and total dwelling units were evaluated based on mapping provided by the City, as was the total improved Public Lands area. The City provided total commercial and industrial areas at buildout. This analysis resulted in a buildout baseline sanitary flow projection of 7.02 as shown below. This compares well with the *Collection System Master Plan* estimate of 6.7 mgd that was used as the basis for future planning.

Table 2-2. Buildout Sanitary Flow Projection

	Units or Acres	gal/unit or gal/acre	Total Flow, mgd
Residential	15,222	213	3.24
Commercial	344.8	1,500	0.52
Industrial	1,401.6	2,000	2.80
Prison Flow			0.16
Coke Adjustment			0.13
Public - Commercial	114	1,500	0.17
Base Sanitary Flow			**7.02**

Anticipated flows from the prison are based on information from the City. The 108-acre prison site was not included in the residential, commercial, or industrial area estimates. The "Coke adjustment" was added at the City's suggestion to allow for the Coca-Cola facility to discharge the maximum permitted flow on any given day. This adjustment was calculated by determining the total flow that would be contributed by this facility based on the property area and industrial flow factor, and subtracting this value from the total permitted flow.

These flows represent anticipated future conditions, and were estimated conservatively to ensure that conveyance improvements recommended in the *Collection System Master Plan* were adequate to handle potential future flows. This is a reasonable approach for collection system planning, since pipe improvements are constructed for maximum buildout conditions and cannot be implemented in a phased manner. They are also reasonable estimates for site planning at the wastewater treatment plant, since near-term improvements should be consistent with ultimate long-term average of the DEQ and area-based methods. As the figure shows, using the area-based method results in a buildout peak flow projection of just under 15 mgd – very close to the value predicted by the collection system model.

As discussed earlier, the peaking factors used in the *Collection System Master Plan* assume that the area-wide I/I rate experienced now will remain the same in the future. This is a reasonable assumption for collection system planning, since the system actually has additional capacity to convey flow under surcharged conditions. Therefore, if I/I rates do increase in the future due to aging infrastructure, the system will likely handle some additional infiltration without overflowing. However, because key hydraulic elements in the treatment plant (i.e., pumps) are more sensitive to flow increases than sewers, it would be wise for the City to assume that future peaking factors will lie between the current values and area-based values. Recommended future flows and flow peaking factors are shown in Table 2-6 for the high flow projections and in Table 2-7 for the low flow projections. Because DEQ and historical projections yielded very similar peaking factors, and because the historical data includes a full suite of flow conditions, values in the tables reflect the average of historical and area-based peaking factors.

Table 2-6. High Flow Projections for the Wilsonville Wastewater Treatment Plant

	Peaking Factor	2000	2005	2010	2015	2020	2025	2030	2035
Dry Weather									
Average Day	1.00	2.02	2.73	3.45	4.16	4.88	5.59	6.31	7.02
Maximum Month	1.07	2.15	2.91	3.68	4.44	5.20	5.96	6.72	7.48
Maximum Week	1.13	2.29	3.09	3.90	4.71	5.52	6.33	7.14	7.94
Maximum Day	1.32	2.67	3.61	4.56	5.50	6.45	7.39	8.34	9.28
Wet Weather									
Average Day	1.20	2.42	3.27	4.13	4.98	5.84	6.69	7.55	8.40
Maximum Month	1.38	2.79	3.78	4.77	5.76	6.74	7.73	8.72	9.71
Maximum Week	1.63	3.30	4.47	5.63	6.80	7.97	9.13	10.30	11.47
Maximum Day	1.98	4.00	5.41	6.83	8.24	9.66	11.07	12.49	13.90
Peak Hour	2.95	5.96	8.07	10.17	12.28	14.39	16.49	18.60	20.71

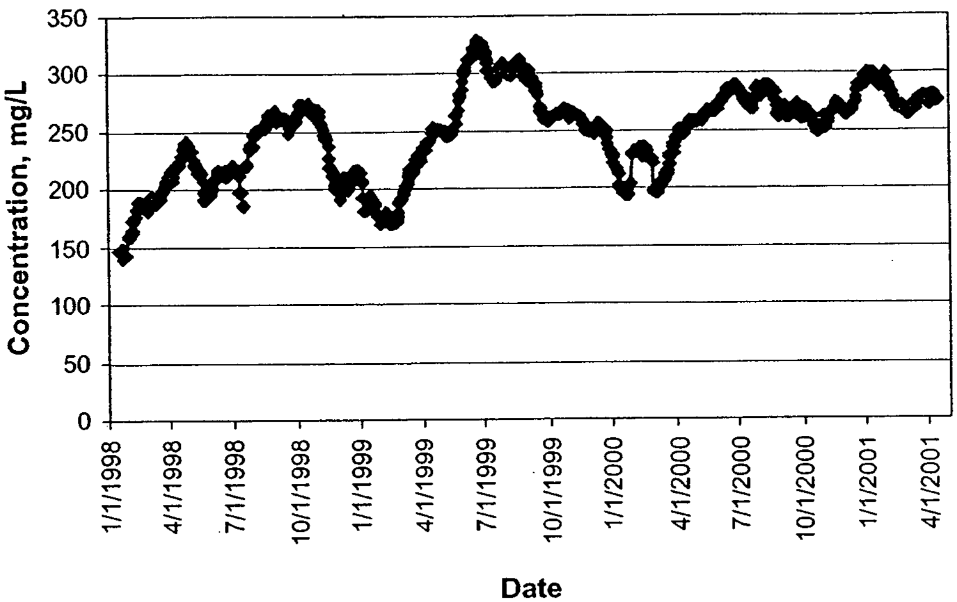


Figure 2-8. 30-Day Average Influent BOD Concentrations

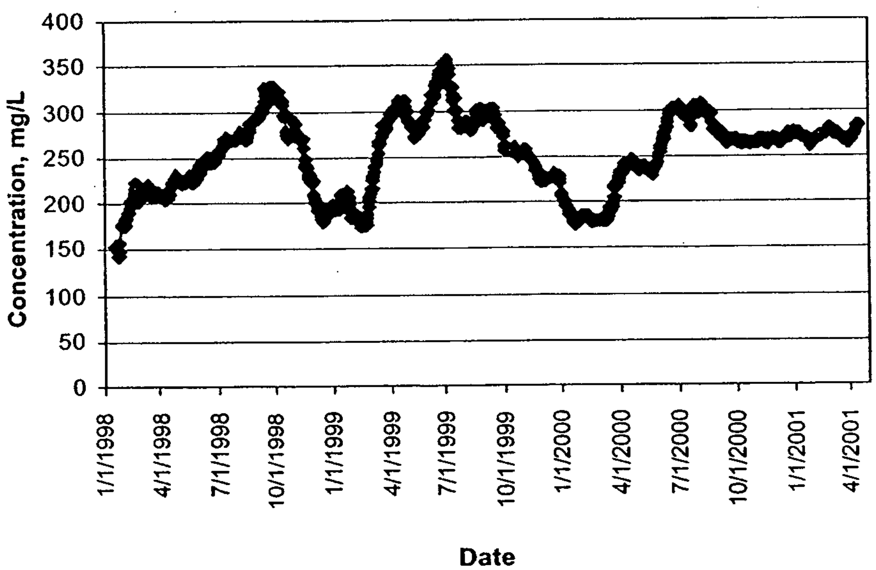


Figure 2-9. 30-Day Average Influent TSS Concentrations

The treatment plant is not currently required to report influent ammonia-nitrogen or phosphorus concentrations, and therefore does not regularly monitor for these constituents. However, for future planning it is important to project influent nutrient concentrations. Results of limited sampling for ammonia-nitrogen and total phosphorus in 1998, 2000, and 2001 are shown in Figure 2-10.

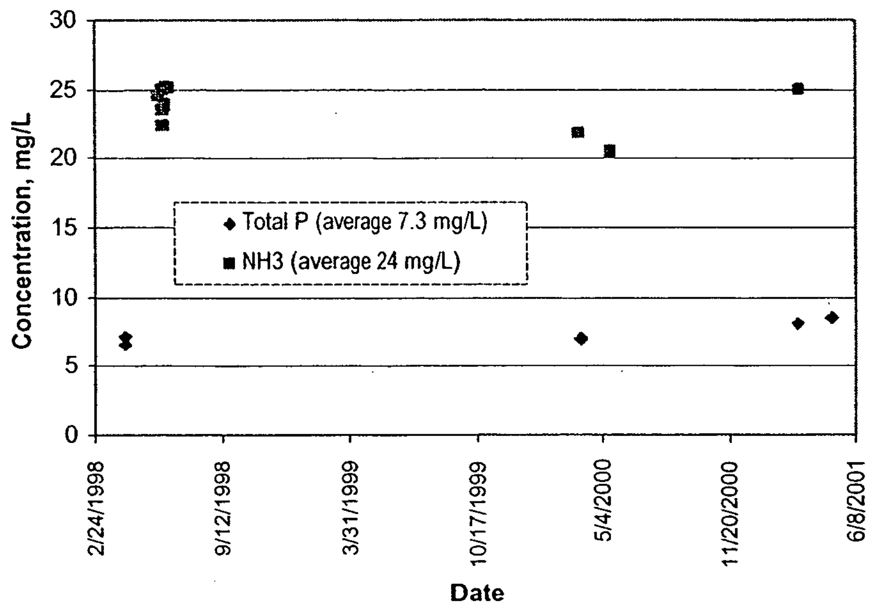


Figure 2-10. Influent NH3 and Total P Concentrations

These values closely resemble textbook values for medium strength wastewater of 7.2 – 8.0 mg/L for total phosphorus and 25 mg/L for ammonia nitrogen[2]. Average values from sampling at the plant will be used as the basis for future projections.

Using ADWF influent flows from Figure 2-3 and influent concentrations as described above, the following wasteload projections for BOD, TSS, NH3, and total P are projected through the planning period (see Table 2-8). Note that the BOD and TSS concentrations compare well to the average concentrations of 249 mg/L and 258 mg/L used for BOD and TSS in the previous Facility Plan. Average dry weather loading projections are also shown in Figure 2-11.As in baseline flow projections, the baseline BOD loading was adjusted to include the maximum possible contribution from the Coca Cola facility. Final BOD projections include an additional 339 lb/day of BOD from the Coca Cola facility. The new prison will use many low flow fixtures, producing waste of higher than average concentrations. However, since the City's planning projections estimate an increase in the percentage of average dry weather flow contributed by commercial and industrial properties, there may not be a net impact on the average concentration seen at the treatment plant. Therefore, projected loadings were not adjusted for the potential influence of the prison.

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[2] Sources: Water Environment Federation, MOP 8, Design of Municipal Wastewater Treatment Plants, and Metcalf & Eddy, Wastewater Engineering.

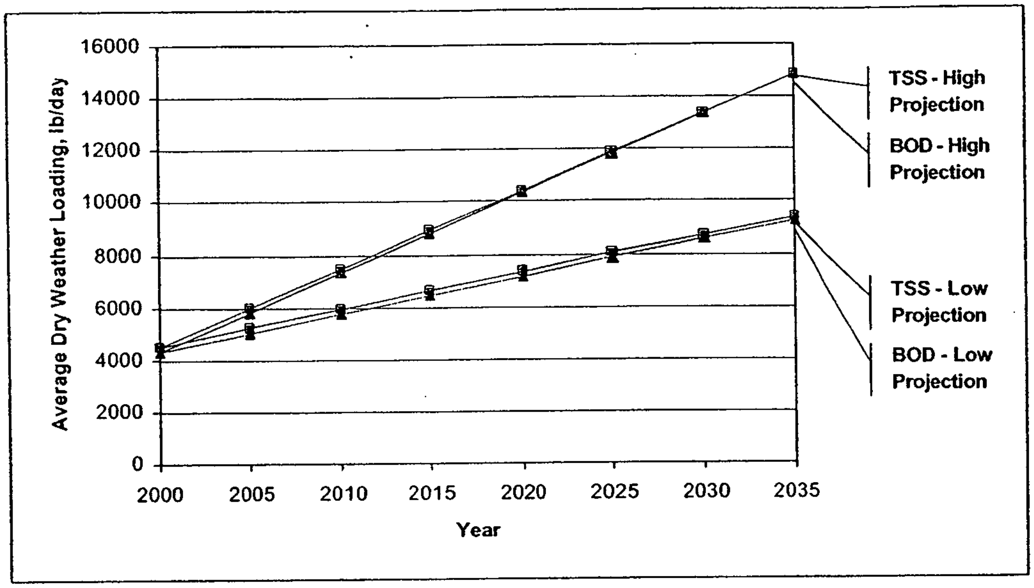

Figure 2-11. Average Dry Weather BOD and TSS Loading

Table 2-8. Baseline Loading Projections for Wilsonville Wastewater Treatment Plant

			BOD, mg/L		TSS, mg/L		NH_3-N, mg/L		Total P, mg/L	
Concentration			248		254		24		7.3	
	ADWF, mgd		BOD, lb/day		TSS, lb/day		NH_3-N, lb/day		Total P, lb/day	
Year	High	Low	High	Low	High	Low	High	Low	High	Low
2000	2.02	2.02	4,517	4,517	4,279	4,279	404	404	123	123
2005	2.73	2.36	5,986	5,220	5,783	4,999	546	472	166	144
2010	3.45	2.69	7,475	5,903	7,308	5,698	691	538	210	164
2015	4.16	3.03	8,943	6,606	8,812	6,419	833	606	253	184
2020	4.88	3.37	10,432	7,309	10,338	7,139	977	675	297	205
2025	5.59	3.71	11,901	8,012	11,842	7,859	1,119	743	340	226
2030	6.31	4.04	13,390	8,695	13,367	8,558	1,263	809	384	246
2035	7.02	4.38	14,859	9,398	14,871	9,278	1,405	877	427	267

Wasteload Peaking Factors

Peaking factors were evaluated using influent data from plant daily monitoring reports, and compared with peaking factors for other municipalities and agencies in the area. The results of this analysis for BOD and TSS are shown in Table 2-9.

Table 2-9. Comparison of BOD and TSS Peaking Factors

BOD Load Peaking Factors					
	Wilsonville - Historical	**Wilsonville - 1995 FP**	**Tryon Creek - Portland**	**Durham - Tigard**	**Rock Creek - Hillsboro**
ADW	1.00	1.00	1.00	1.00	1.00
MMDW	1.13	1.17	1.12	1.30	1.14
MWDW	1.39		1.58	1.50	1.33
MDDW	1.52		2.32	1.90	1.70
AWW	1.09	1.17	1.00	1.00	1.00
MMWW	1.22	1.45	1.17	1.30	1.14
MWWW	1.56		1.42	1.80	1.33
MDWW	2.13		2.16	2.60	1.90
TSS Load Peaking Factors					
	Wilsonville - Historical	**Wilsonville - 1995 FP**	**Tryon Creek - Portland**	**Durham - Tigard**	**Rock Creek - Hillsboro**
ADW	1.00	1.00	1.00	1.00	1.00
MMDW	1.17	1.05	1.18	1.30	1.12
MWDW	1.45		1.73	1.60	1.50
MDDW	1.78		2.86	2.40	2.60
AWW	1.03	1.08	0.99	1.00	1.00
MMWW	1.17	1.14	1.27	1.40	1.30
MWWW	1.31		1.90	1.60	1.60
MDWW	1.68		3.53	2.40	2.30

Table 2-9 shows that peaking factors based on Wilsonville's historical data are generally within the range of peaking factors experienced at other plants in the region. Wilsonville's maximum day dry weather BOD and TSS peaking factors, as well as the peak wet weather factors, are slightly lower than those of other agencies, however there is no reason to expect future peak loadings to be significantly higher than current peak loadings. Therefore, peaking factors based on historical data were used for future planning.

Because of the limited data on influent ammonia and total phosphorus, it is not possible to develop load peaking factors based on historical data. Peaking factors for these constituents will be based on the average of the BOD and TSS peaking factors.

Final Planning Projections

Table 2-10 shows the projected flows and loading to the Wilsonville treatment plant under the high flow scenario. Table 2-11 shows similar information under the low flow scenario.

Table 2-10. Flow and Loading Projections for the Wilsonville Wastewater Treatment Plant (High Flow)

Year	Condition	Flow, mgd	BOD, lb/d[1]	TSS, lb/d	NH3, lb/d	TP, lb/d
2000	Dry Season					
	Ave. Day	2.02	4,517	4,279	404	123
	Max Mo.	2.16	4,721	5,007	464	141
	Max Week	2.28	5,807	6,205	574	175
	Max Day	2.67	6,351	7,617	668	203
	Wet Season					
	Ave. Day	2.42	4,554	4,407	427	130
	Max Mo.	2.81	5,097	5,007	483	147
	Max Week	3.31	6,518	5,606	579	176
	Max Day	4.02	8,899	7,189	770	234
	Peak Hour	5.96				
2005	Dry Season					
	Ave. Day	2.73	5,986	5,783	546	166
	Max Mo.	2.92	6,381	6,766	627	191
	Max Week	3.08	7,849	8,386	776	236
	Max Day	3.60	8,583	10,294	902	274
	Wet Season					
	Ave. Day	3.28	6,155	5,957	578	176
	Max Mo.	3.79	6,889	6,766	653	199
	Max Week	4.48	8,809	7,576	783	238
	Max Day	5.43	12,027	9,716	1,041	317
	Peak Hour	8.05				
2010	Dry Season					
	Ave. Day	3.45	7,475	7,308	691	210
	Max Mo.	3.69	8,063	8,551	792	241
	Max Week	3.90	9,919	10,597	980	298
	Max Day	4.55	10,846	13,009	1,140	347
	Wet Season					
	Ave. Day	4.14	7,778	7,528	730	222
	Max Mo.	4.80	8,706	8,551	825	251
	Max Week	5.66	11,132	9,574	989	301
	Max Day	6.87	15,199	12,278	1,316	400
	Peak Hour	10.18				
2015	Dry Season					
	Ave. Day	4.16	8,943	8,812	833	253
	Max Mo.	4.45	9,723	10,310	955	291
	Max Week	4.70	11,960	12,778	1,182	359
	Max Day	5.49	13,078	15,686	1,375	418

	Wet Season					
	Ave. Day	4.99	9,379	9,077	880	268
	Max Mo.	5.78	10,497	10,310	995	303
	Max Week	6.82	13,423	11,544	1,193	363
	Max Day	8.28	18,327	14,805	1,587	483
	Peak Hour	12.27				
2020	**Dry Season**					
	Ave. Day	4.88	10,432	10,338	977	297
	Max Mo.	5.22	11,406	12,095	1,121	341
	Max Week	5.51	14,030	14,990	1,386	422
	Max Day	6.44	15,342	18,401	1,613	491
	Wet Season					
	Ave. Day	5.86	11,002	10,648	1,032	314
	Max Mo.	6.78	12,314	12,095	1,167	355
	Max Week	8.00	15,746	13,542	1,399	426
	Max Day	9.71	21,499	17,367	1,861	566
	Peak Hour	14.40				
2025	**Dry Season**					
	Ave. Day	5.59	11,901	11,842	1,119	340
	Max Mo.	5.98	13,065	13,855	1,284	390
	Max Week	6.32	16,071	17,170	1,588	483
	Max Day	7.38	17,574	21,078	1,848	562
	Wet Season					
	Ave. Day	6.71	12,602	12,197	1,183	360
	Max Mo.	7.77	14,106	13,855	1,336	407
	Max Week	9.17	18,037	15,513	1,603	488
	Max Day	11.12	24,627	19,894	2,132	648
	Peak Hour	16.49				
2030	**Dry Season**					
	Ave. Day	6.31	13,390	13,367	1,263	384
	Max Mo.	6.75	14,748	15,639	1,449	441
	Max Week	7.13	18,141	19,382	1,793	545
	Max Day	8.33	19,838	23,793	2,086	634
	Wet Season					
	Ave. Day	7.57	14,226	13,768	1,335	406
	Max Mo.	8.77	15,922	15,639	1,509	459
	Max Week	10.35	20,360	17,511	1,810	550
	Max Day	12.56	27,799	22,456	2,407	732
	Peak Hour	18.61				
2035	**Dry Season**					
	Ave. Day	7.02	14,859	14,871	1,405	427

	Max Mo.	7.51	16,407	17,399	1,612	490
	Max Week	7.93	20,182	21,563	1,994	607
	Max Day	9.27	22,070	26,470	2,320	706
	Wet Season					
	Ave. Day	8.42	15,826	15,317	1,485	452
	Max Mo.	9.76	17,714	17,399	1,678	510
	Max Week	11.51	22,651	19,481	2,013	612
	Max Day	13.97	30,927	24,983	2,677	814

Table 2-11. Flow and Loading Projections for the Wilsonville Wastewater Treatment Plant (Low Flow)

Year	Condition	Flow, mgd	BOD, lb/d[1]	TSS, lb/d	NH3, lb/d	TP, lb/d
2000	**Dry Season**					
	Ave. Day	2.02	4,517	4,279	404	123
	Max Mo.	2.16	4,721	5,007	464	141
	Max Week	2.28	5,807	6,205	574	175
	Max Day	2.67	6,351	7,617	668	203
	Wet Season					
	Ave. Day	2.42	4,554	4,407	427	130
	Max Mo.	2.81	5,097	5,007	483	147
	Max Week	3.31	6,518	5,606	579	176
	Max Day	4.02	8,899	7,189	770	234
	Peak Hour	5.96				
2005	**Dry Season**					
	Ave. Day	2.45	5,406	5,190	490	149
	Max Mo.	2.62	5,726	6,072	563	171
	Max Week	2.77	7,044	7,525	696	212
	Max Day	3.23	7,702	9,238	810	246
	Wet Season					
	Ave. Day	2.94	5,523	5,346	518	158
	Max Mo.	3.41	6,182	6,072	586	178
	Max Week	4.02	7,905	6,799	703	214
	Max Day	4.88	10,794	8,719	934	284
	Peak Hour	7.23				
2010	**Dry Season**					
	Ave. Day	2.77	6,068	5,868	554	169
	Max Mo.	2.96	6,474	6,865	636	193
	Max Week	3.13	7,964	8,508	787	239
	Max Day	3.66	8,708	10,445	916	278
	Wet Season					
	Ave. Day	3.32	6,245	6,044	586	178

	Max Mo.	3.85	6,990	6,865	662	201
	Max Week	4.54	8,938	7,687	794	242
	Max Day	5.51	12,203	9,858	1,056	321
	Peak Hour	8.17				
2015	**Dry Season**					
	Ave. Day	3.09	6,730	6,546	618	188
	Max Mo.	3.31	7,222	7,659	710	216
	Max Week	3.49	8,884	9,491	878	267
	Max Day	4.08	9,714	11,651	1,021	311
	Wet Season					
	Ave. Day	3.71	6,966	6,742	654	199
	Max Mo.	4.30	7,797	7,659	739	225
	Max Week	5.07	9,970	8,575	886	270
	Max Day	6.15	13,613	10,997	1,179	358
	Peak Hour	9.12				
2020	**Dry Season**					
	Ave. Day	3.42	7,413	7,245	685	208
	Max Mo.	3.66	7,993	8,476	785	239
	Max Week	3.86	9,832	10,505	972	296
	Max Day	4.51	10,752	12,896	1,130	344
	Wet Season					
	Ave. Day	4.10	7,710	7,462	724	220
	Max Mo.	4.75	8,630	8,476	818	249
	Max Week	5.61	11,035	9,491	981	298
	Max Day	6.81	15,067	12,171	1,304	397
	Peak Hour	10.09				
2025	**Dry Season**					
	Ave. Day	3.74	8,075	7,923	749	228
	Max Mo.	4.00	8,741	9,270	859	261
	Max Week	4.23	10,752	11,488	1,063	323
	Max Day	4.94	11,758	14,102	1,236	376
	Wet Season					
	Ave. Day	4.49	8,432	8,160	791	241
	Max Mo.	5.20	9,437	9,270	894	272
	Max Week	6.13	12,067	10,379	1,073	326
	Max Day	7.44	16,477	13,310	1,426	434
	Peak Hour	11.03				
2030	**Dry Season**					
	Ave. Day	4.06	8,736	8,601	813	247
	Max Mo.	4.34	9,489	10,063	932	284
	Max Week	4.59	11,672	12,471	1,153	351

	Max Day	5.36	12,764	15,309	1,342	408
	Wet Season					
	Ave. Day	4.87	9,153	8,859	859	261
	Max Mo.	5.64	10,245	10,063	971	295
	Max Week	6.66	13,100	11,267	1,164	354
	Max Day	8.08	17,886	14,449	1,548	471
	Peak Hour	11.98				
2035	**Dry Season**					
	Ave. Day	4.38	9,398	9,278	877	267
	Max Mo.	4.69	10,237	10,856	1,006	306
	Max Week	4.95	12,592	13,454	1,244	379
	Max Day	5.78	13,770	16,516	1,448	440
	Wet Season					
	Ave. Day	5.26	9,875	9,557	927	282
	Max Mo.	6.09	11,052	10,856	1,047	319
	Max Week	7.18	14,132	12,155	1,256	382
	Max Day	8.72	19,296	15,588	1,671	508
	Peak Hour	12.92				

Chapter 3. Existing Facilities

Introduction

This chapter describes the treatment systems employed at the Wilsonville facility, reviews the plant's record of performance, and summarizes the capabilities, limitations and condition of major treatment facilities.

Expansion History

The Wilsonville WWTP was constructed in the early 1970s. Originally, it was designed to treat predominantly municipal wastewater. The original plant was a Smith and Loveless package plant, with the primary clarifiers and aeration basins housed in the same structure. There have been three major modifications to the plant since its original construction:

- Rotating biological contactors (RBCs) were added in 1981 and design capacity was increased to 2.25 mgd.
- New headworks, odor control, and RBC blower improvements were constructed in 1993.
- New headworks fine drum screen, new primary clarifier mechanisms, aeration basins, secondary clarifiers, a third sand filter, UV disinfection, biosolids storage, and an operations building were added in 1997.

The plant currently provides primary and secondary treatment, sand filtration, UV disinfection, and aerobic digestion. Digested sludge is land-applied to various agricultural sites in the area for beneficial reuse.

Overview of Current Treatment Scheme

The following sections describe the liquids and solids treatment processes used at the Wilsonville WWTP.

Liquid Treatment

A basic schematic of Wilsonville's summer treatment process is shown in Figure 3-1. Liquid stream treatment at Wilsonville is essentially the same year-round; the only difference between the dry season (May 1 through October 31) and wet season treatment processing is the use of sand filters. Filters are not operated during the wet season due to less restrictive permit requirements. The plant treats the entire influent flow year round including peaks and does not bypass any unit processes.

Flow enters the plant, is measured using a Parshall flume in the influent channel, and is sent through a fine screen with 1 mm openings for removal of rags, debris, and coarse grit. Screenings are compacted and conveyed to a dumpster prior to disposal at the landfill. Downstream of the headworks, two primary clarifiers remove a portion of the settleable solids and BOD. Primary effluent is mixed with secondary scum and return activated sludge (RAS) in an anoxic junction box prior to entering two aeration basins. The aeration basins include an anoxic selector used to control filamentous growth, followed by aeration chambers. Solids-liquids separation is then provided by two secondary clarifiers. During summer months, secondary clarifier effluent is sent to rapid sand filters and filtered water is disinfected with ultraviolet (UV) light. During winter months, secondary effluent is sent directly to UV disinfection. Disinfected water is then discharged to the Willamette River via a single-port gravity outfall.

Solids Treatment

The operation of the solids handling processes at the Wilsonville WWTP is the same year round. Figure 3-2 shows a basic schematic of the solids process. Screenings are deposited in a 3 cubic yard container directly under the compactor discharge and then transferred to a 10 cubic yard dumpster daily. The dumpster is taken by a contract hauler to the Hillsboro landfill on a weekly basis. Primary sludge is pumped to the aerobic digesters and primary scum flows by gravity to the digesters. Waste activated sludge (WAS) is thickened by gravity belt thickeners (GBTs), then fed to the aerobic digesters. Two aerobic digesters are operated in series and provide a total SRT of approximately 74 days. After digestion, biosolids are stored for up to two months in open, aerated tanks. The stored biosolids are trucked to private farmland for final utilization as a soil amendment.

Design Summary

Appendix B lists major process equipment at the Wilsonville facility and presents a summary of current design criteria for the plant.

Process Capacity

Based on operational experience, process modeling, and application of typical unit process design criteria, estimates of the current capacity of major treatment processes were developed. Table 3-1 shows a summary of the capacity estimates. Capacities are presented in terms of the constituent (flow, TSS, or BOD) and condition (average, maximum week, peak, etc.) that determines process capacity.

The plant currently has a capacity to treat 7,500 lb/day of influent BOD and TSS (without nitrification), with a peak stated hydraulic capacity of 8 mgd. Actual hydraulic capacity is limited to 2.8 mgd on an average basis mgd (based on primary clarifier capacity) and 4 mgd on a peak basis (based on influent screening capacity).

A steady-state mass balance model was developed for the major process units. Average and maximum month flows were modeled during wet and dry seasons. The model was calibrated with data from Wilsonville's daily monitoring reports (DMRs) for the past three years and through discussions with operations staff. Model output for current (year 2000) conditions is shown in Appendix C.

Consideration was given to the reliability and level of redundancy for each unit process when the capacities were assessed. As a guide, a set of reliability criteria was developed, which are shown in Table 3-2. Capacity and reliability of individual unit processes will be further discussed later in this chapter.

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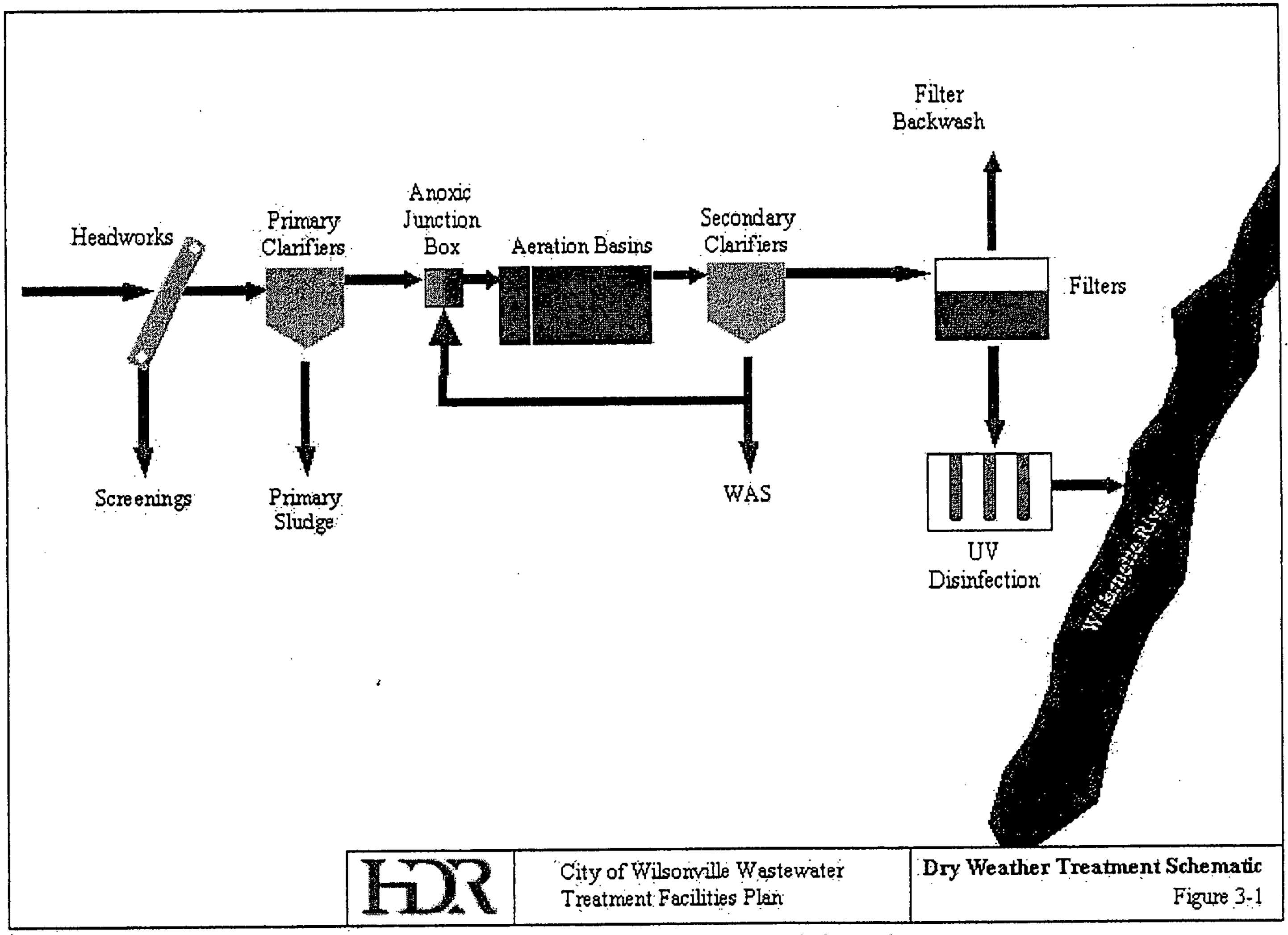

Figure 3-1. Liquid Stream Treatment Schematic

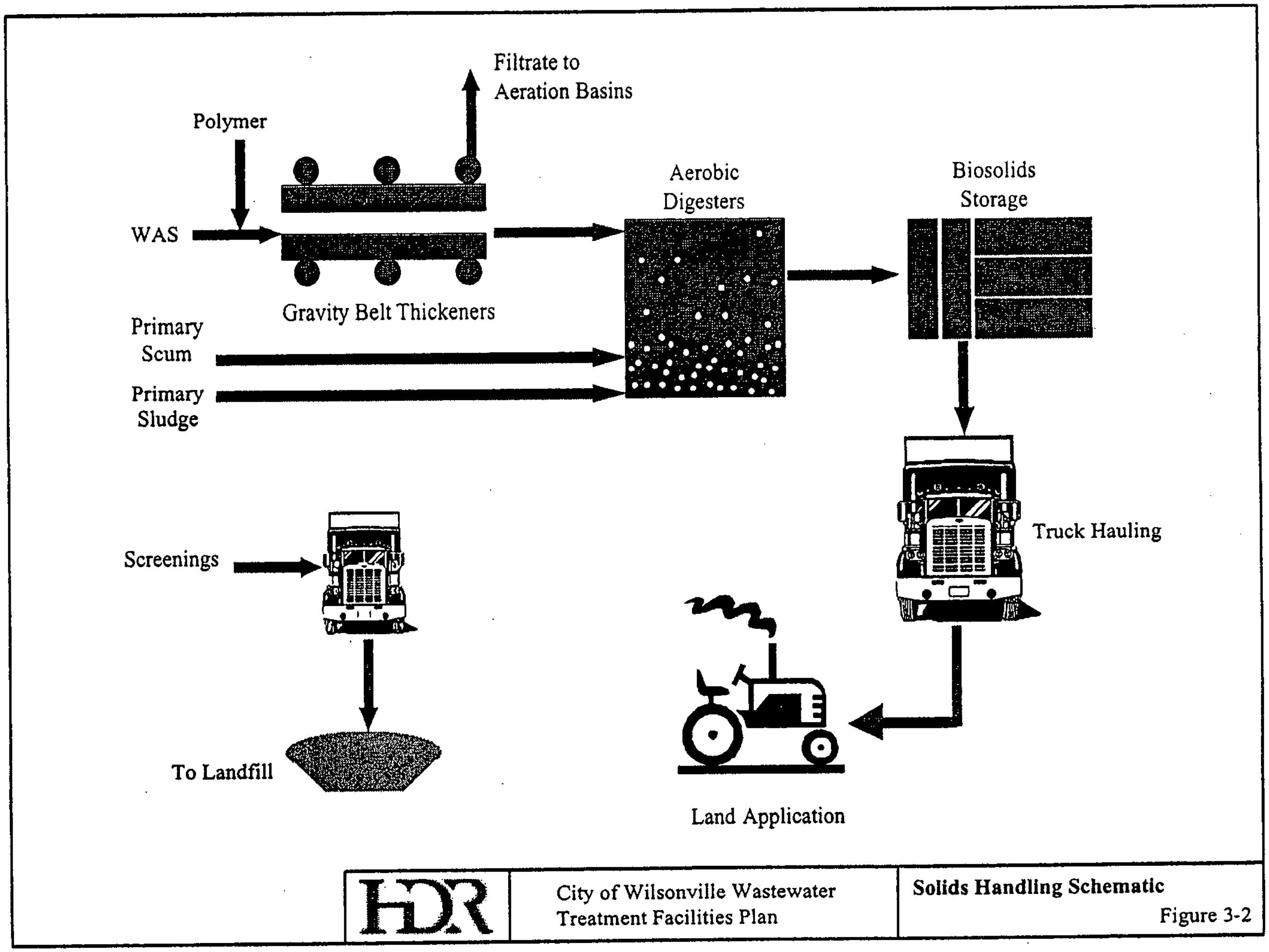

Figure 3-2. Solids Stream Treatment Schematic

Table 3-1. Estimated Current Process Capacity for Unit Processes, mgd.

Unit Process	Design Basis	Firm Capacity	Total Capacity	Comments
Headworks	Peak Hour Flow	4 mgd	4 mgd	Based on operating experience with fine drum screen. Backup bar screen is capable of passing 8 mgd but cannot be used for normal duty service due to impacts on solids processing and disposal.
Primary Clarification[1]	Maximum Month Flow Peak Hour Flow	2.8 mgd Max Month; 6.9 mgd Peak Hour	2.8 mgd Max Month; 6.9 mgd Peak Hour	Based on conventional design criteria of 1,000 gpd/sf under maximum month conditions and 2,500 gpd/sf under peak hour conditions; firm capacity based on one clarifier in service, providing capacity for 50% of total design flow.
Activated Sludge	Maximum Week Oxygen Demand[2]	2.600 lb/day Primary Effluent BOD	5,200 lb/day Primary Effluent BOD	Based on conventional design criteria of a maximum diurnal peak oxygen uptake rate of 50 mg/L/hr; firm capacity based on one aeration basin in service.
Secondary Clarification	Total Suspended Solids Loading	96,400 lb/day TSS (equivalent to 2.2 mgd, 50% RAS, 3,500 mg/L MLSS)	192,900 lb/day TSS (equivalent to 2.2 mgd, 50% RAS, 3,500 mg/L MLSS)	Based on conventional design criteria of 25 lb/day/sf solids loading under maximum month conditions and 40 lb/day/sf under peak hour conditions; firm capacity based on one clarifier in service.
Filtration	Average Day Flow Peak Hour Flow	2.3 mgd Average Day 4.6 mgd Peak Hour	3.4 mgd Average Day 6.8 mgd Peak Hour	Based on conventional design criteria of 2 gpm/sf under average day conditions and 4 gpm/sf under peak hour conditions; firm capacity based on two filters in service.
UV Disinfection	Peak Hour Flow	8 mgd	8 mgd	Based on stated design criteria
Gravity Belt Thickening	Maximum Week Primary and WAS Flow	267 gpm (equivalent to 4.5 mgd MWWWF)	534 gpm (equivalent to 7.7 mgd MWWWF)	Based on stated design criteria and 40 hour/week operation; firm capacity based on one GBT in service
Aerobic Digestion	Maximum Month Solids Loading	6,500 gpd (equivalent to 1.7 mgd MMWWF)	12,900 gpd (equivalent to 3.4 mgd MMWWF)	Based on conventional design criteria of 40-day detention time at a temperature of 20°C or greater under maximum month conditions; firm capacity based on one digester in service.
Biosolids Storage	Maximum Month Digested Sludge Flow	1,400 gpd (equivalent to 0.4 mgd MMWWF)	1,700 gpd (equivalent to 0.5 mgd MMWWF)	Based on design criteria of 240 days' storage; firm capacity based on four tanks in service.

1. Total capacity based on operation of both primary clarifiers, which is currently not possible due to limitations in primary sludge piping.
2. Driven by primary effluent BOD

Table 3-2. Redundancy Criteria for Unit Treatment Processes

Criteria No.	Description
Liquid Treatment Systems	
1	Handle peak instantaneous flow without overflows with all units in service
2	Pumping facilities must handle design process flow with largest unit out of service
3	Handle maximum-day flow with a 3-inch freeboard at weirs, and no submergence or impairment of flow elements, with all units in service
4	Provide full treatment to maximum-day flow with all units in service
Solids Treatment Systems	
5	Handle maximum-week solids loading with all units in service
Liquid and Solids Treatment Systems	
6	Handle maximum-month flow or loading with largest unit out of service (winter condition)[1]
7	No extraordinary manual operation is required if largest unit is out of service.

1. EPA reliability criteria only require primary clarifiers to handle half of design flow with one unit out of service

Hydraulic Capacity

A spreadsheet hydraulic model was developed for the existing facility. All major hydraulic elements from the raw sewage influent to the outfall were modeled. A hydraulic profile of the plant was developed using the model, which defined and identified the limiting hydraulic capacity of the plant. A range of flows were evaluated with all units in operation and two criteria were used to assess the peak flow capacity:

- **Impaired Flow Control or Process Operation.** This occurs when the water surface exceeds a control elevation and limits effective flow control or process operation. Examples include submerging the effluent weir on a clarifier and exceeding the allowable submergence for a Parshall flume. This criteria simply measures hydraulic conditions; it does not guarantee that treatment goals will be met at the stated flows.

- **Overtopping Walls.** This occurs when the water surface elevation exceeds the top of a basin, channel, or manhole wall.

Table 3-3 shows the influent flows at which existing control elements are submerged and structures overtopped at important process locations.

Table 3-3. Estimated Capacity of Hydraulic Elements.

Flow Control Element/Structure	Maximum Process Flow, mgd	Maximum Overtopping Flow, mgd
Fine screen	9.4	9.4
Primary Clarifiers	16.1	17.2
Aeration Basins	17.5	18.1
Secondary Clarifiers	16.2	17.2
Sand Filters	9.9	9.9
UV Disinfection Channel	16.2	17.5

Since the raw sewage flows to, as well as through, the plant by gravity, pumping capacity does not affect the ability of the plant to convey peak flows. Flooding of the fine screen will occur first during an extreme flooding event. Although the hydraulic capacity of the sand filters is similar to that of the fine screen, filters can be bypassed during winter months when peak flow events are most likely to occur.

The model confirmed that all processes are able to convey the current peak design flow without flooding or impaired process control.

Treatment Performance

The performance of the Wilsonville WWTP was evaluated using data from daily monitoring reports for January 1, 1998 through December 31, 2001. Figure 3-3 shows that during this period, average dry weather influent flows typically ranged from 1.5 to 2.0 mgd, with a peak wet weather daily flow of 4.8 mgd.

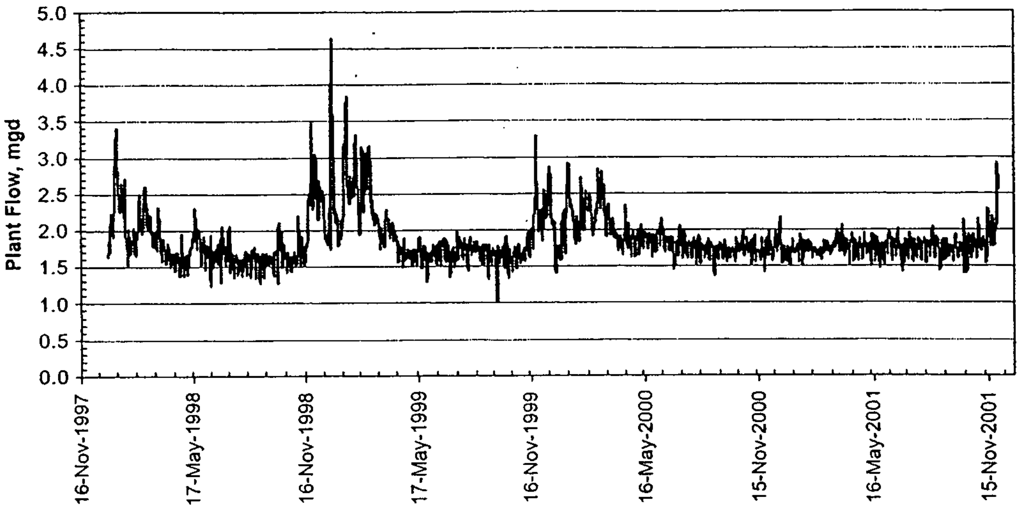

Figure 3-3. Treatment Plant Effluent Flow, mgd.

CBOD and Suspended Solids

Under the current NPDES permit, the Wilsonville WWTP must meet a monthly average concentration of 30 mg/L during the wet season (November 1 – April 30) and 10 mg/L during the dry season (May 1 – October 31) for CBOD and suspended solids. Figure 3-4 shows that during the last 3 years, Wilsonville has only exceeded permit limits during May and June of 1998, when TSS limits were exceeded. Plant staff stated that this was a period of process upset. Since July of 1998, effluent CBOD and suspended solids concentrations have consistently been well below permit limits, with values often in the 1 to 3 mg/L range.

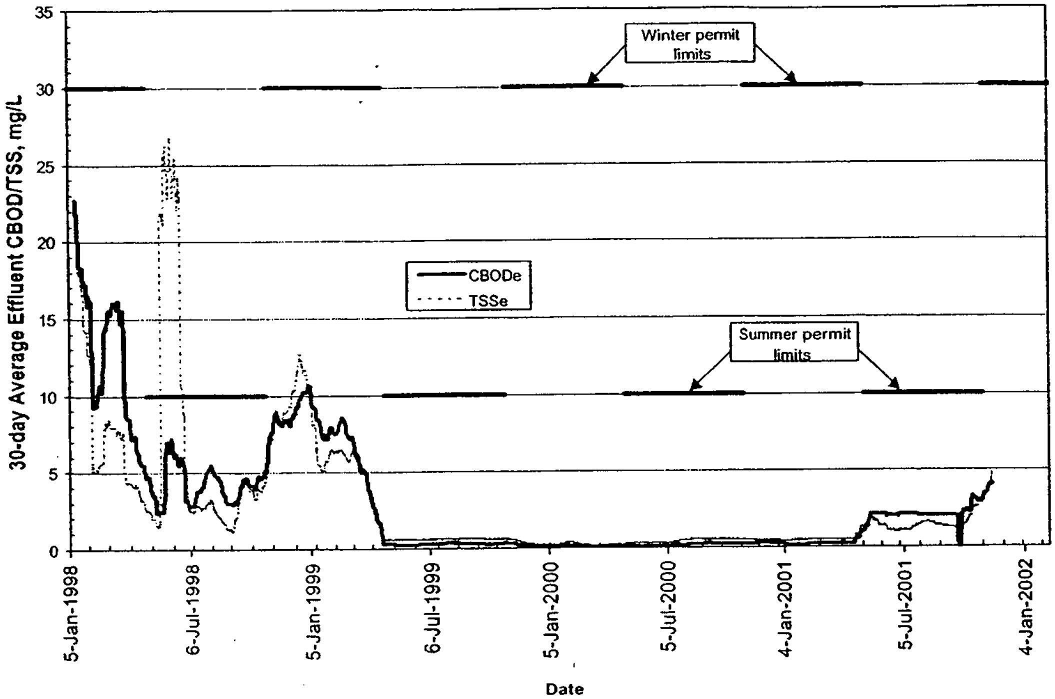

Figure 3-4. Treatment Plant Effluent CBOD/Suspended Solids, mg/L.

Ammonia-Nitrogen

Effluent ammonia-nitrogen concentrations are shown in Figure 3-5. Concentrations are typically measured only during summer months. Wilsonville currently does not have a permit limit for ammonia, but ammonia levels and removal have implications on plant operations and performance. Based on limited sampling, influent ammonia averages approximately 24 mg/L. Effluent concentrations for the past two summers have typically been below 1 mg/L. Effluent concentrations are typically higher at the start of the summer permit season, and then drop to a range of 0 to 2 mg/L.

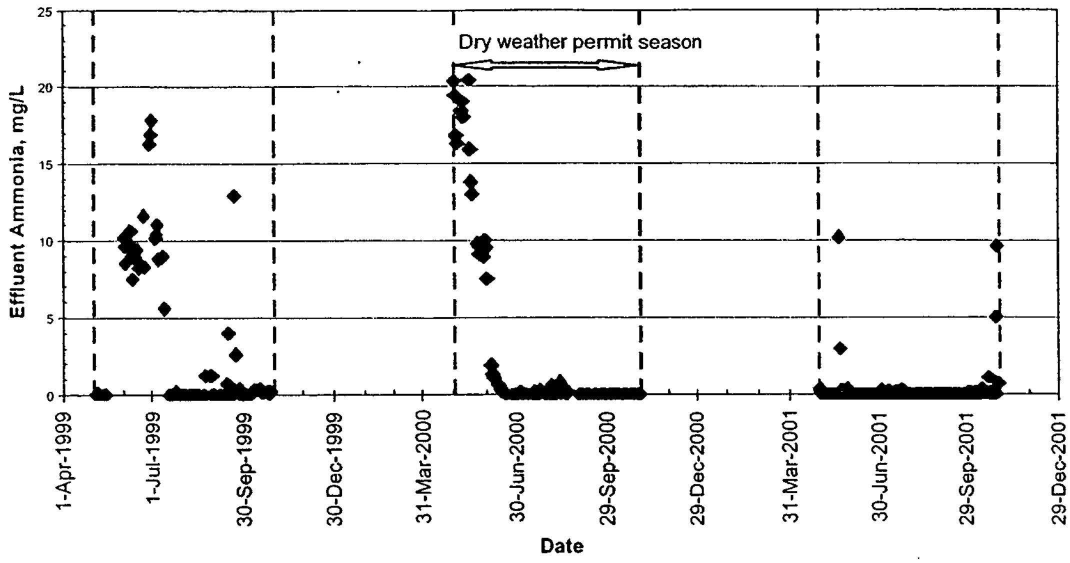

Figure 3-5. Treatment Plant Effluent Ammonia, mg/L.

Given the reduction in ammonia from 24 to less than 1 mg/L during much of the dry season, it is clear that nitrification is taking place. Wilsonville's aeration basin capacity and relatively long SRT (average of 8-10 days during the summer permit season) allow nitrification to take place when wastewater temperatures increase in the dry season.

Plant data also show that roughly 150 mg/L of alkalinity is consumed during the treatment process. In spring 2002, Wilsonville's new water treatment plant was brought on-line. Subsequently, influent alkalinity dropped to under 80 mg/L. Therefore, to maintain adequate alkalinity to support nitrification and maintain buffering capacity, alkalinity addition will be required or nitrification must be suppressed to avoid any upsets to the biological treatment process.

Phosphorus

Wilsonville currently has no permit limit for phosphorus. Wilsonville does not routinely sample the raw influent for phosphorus, however limited sampling indicates that influent total phosphorus is just over 7 mg/L. Weekly sampling during the summer permit seasons of 2000 and 2001 (see Figure 3-6) showed that effluent phosphorus concentrations were routinely less than 1 mg/L, although some samples exceeded 4 mg/L.

Given the low levels of phosphorus in the effluent, it is clear that some biological phosphorus removal is taking place since conventional treatment does not provide removal to such low levels. Biological phosphorus removal is accomplished by exposing bacteria first to high substrate concentrations under anaerobic conditions followed by low substrate concentrations and aeration. These conditions facilitate the development of a biological community capable of phosphorus removal.

Wilsonville operations staff have suggested that the anoxic (little or no oxygen present) selectors at the head of the aeration basins are acting as anaerobic zones, facilitating the growth of phosphorus-removing bacteria. This is an important observation for two reasons. First, the ability of the existing activated sludge process configuration gives an indication of the potential for biological phosphorus removal, should this ever become a permit requirement driven by receiving water conditions. Second, the relationship between liquid stream treatment and solids processing is an important management consideration since removal of the phosphorus in the liquid stream will increase the phosphorus concentration in the biosolids stream. Recent regulatory emphasis on application of biosolids at agronomic rates of both nitrogen and phosphorus could mean that more land is required for biosolids disposal.

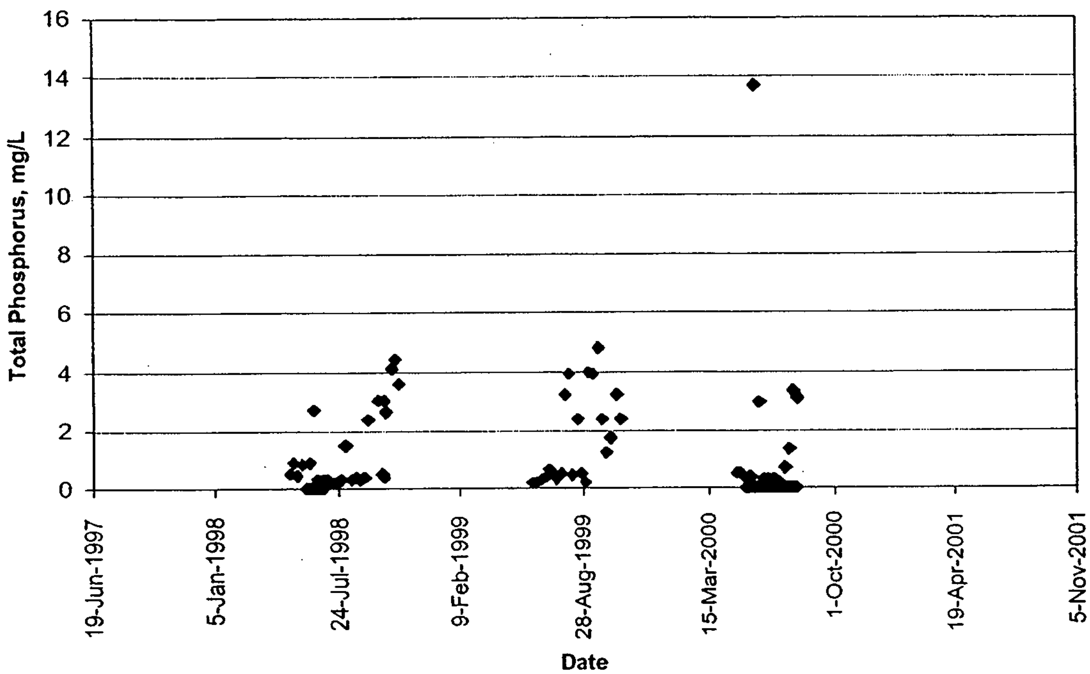

Figure 3-6. Treatment Plant Effluent Total Phosphorus, mg/L.

UV Disinfection

Oregon DEQ changed the bacteria standard from fecal coliform to *E. Coli* bacteria effective August 1, 2000. Figure 3-7 shows the effluent *E. Coli* concentrations (monthly geometric means) for August 1, 2000 through November 30, 2001. No permit violations occurred during this period, and the highest geometric mean *E. Coli* concentration was 76 CFU per 100 mL, significantly less than the permit limit of 126 CFU per 100 mL. There have been several exceedences of the single sample limit of 406 CFUs per 100 mL, however plant staff feel that this is due to programming problems and not associated with the capacity of the UV disinfection unit.

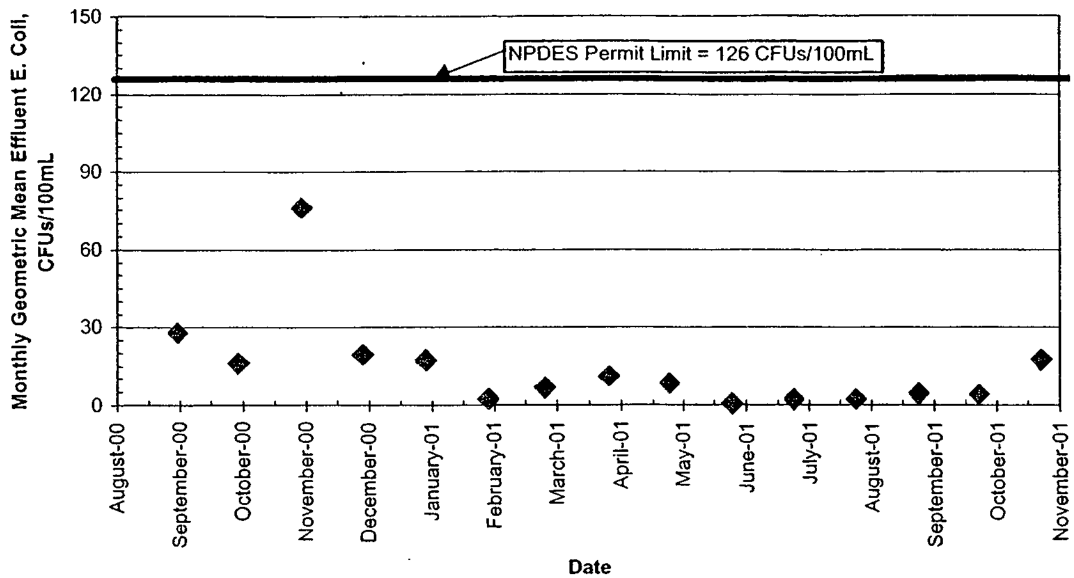

Figure 3-7. Treatment Plant Monthly Mean Effluent E. Coli, CFUs/100 mL.

Unit Process Assessment – Methodology

The next sections of this chapter review the functions and capabilities of individual unit processes and identify key operational, maintenance, or mechanical issues related to the plant processes. The discussion is divided into three major process areas: liquids treatment, solids treatment, and support facilities. The findings were developed through meetings with the City, field inspections, review of performance data, and modeling of process and hydraulic capacity.

Unit Process Assessment – Liquid Treatment

Headworks

Description

Raw wastewater is conveyed to the plant by gravity through a 24-inch pipeline. Wastewater flows through an influent junction box and a Parshall flume prior to entering the headworks. The headworks facility at the Wilsonville WWTP consists of a 5/8-inch bar screen, a rotary drum fine screen with 0.04-inch (1 mm) openings, and associated screenings cleaning, washing, and compacting equipment. Currently, the headworks is not covered, and the headworks processes and open screenings dumpster are a source of odor.

Capacity and Redundancy

Hydraulic modeling shows that the maximum flow that can be routed through the fine screen is 9.4 mgd. Although the design criteria from the previous expansion shows the capacity of the fine screen to be 8 mgd, the plant headworks is not configured to convey flows of this magnitude. Staff say that the installation of the fine screen and operational problems with grease buildup limit hydraulic capacity to approximately 4 mgd. If the actual capacity of the screen were higher, it would still be necessary to provide hydraulic improvements or add another fine screen to prevent the existing flow channel from flooding under peak flows of over 9.4 mgd. The mechanical bar screen functions as a backup when the fine screen is offline for maintenance, but use of the bar screen results in identifiable objects in the sludge, which impacts the biosolids land application program.

Condition and Operational Issues

- A sampling port just upstream of the screening facilities is used to assess influent wastewater characteristics. However, Wilsonville staff have indicated that samples collected from this port may not be representative due to two factors: high velocities just ahead of the screens and plugging of the sample line with unscreened solids.
- Inefficient washing of the screen leads to blinding, limiting the effective capacity of the screen to approximately 4 mgd.
- The original intent of the fine screen was to eliminate the need for separate grit removal facilities. However, Wilsonville staff have indicated that grit collects and settles out in the channel just upstream of the fine screen due to a "rock trap" at that location.
- Electric actuators for the headworks slide gates are desired.
- The headworks should be enclosed for odor control.

Primary Treatment

Description

Primary treatment at the Wilsonville WWTP is currently provided in two 42-foot diameter circular clarifiers in the original Smith and Loveless package units. The primary clarifiers are covered and air from the headspace collected and treated in an activated carbon tower. Two air-operated diaphragm pumps transfer primary sludge from the bottom of the clarifiers to two aerobic digesters. The primary sludge pumps operate continuously. Skimmers remove scum from the surface, which then flows by gravity to the digesters.

Capacity and Redundancy

The capacity of the primary clarifiers is limited by hydraulic loading. Each clarifier is capable of handling a maximum month flow of 1.4 mgd at an overflow rate of 1,000 gpm/sf and a peak hour flow of 3.5 mgd at an overflow rate of 2,500 gpm/sf. With both units in operation, the clarifiers are marginally adequate for the design maximum month flow of 2.9 mgd. Together, the two units can only convey a peak flow of 7.0 mgd rather than the design flow of 8.0 mgd based on the overflow rate criteria. Hydraulically, the clarifiers have more than adequate capacity to convey design flows without submerging the weirs.

Condition and Operational Issues

- The existing primary sludge piping does not allow pumping of sludge from one primary clarifier/digester unit to another. This prevents the aerobic digesters from being operated in series, which is necessary for adequate volatile solids destruction. Currently, the plant is operated with only one primary clarifier in service to alleviate this problem, and this severely limits primary treatment capacity. Modifications to the primary sludge piping are critical, and the listed capacity of the primary clarifiers assumes that these modifications are made.

- The effluent pipe (18-inch diameter) for primary clarifier #2 is believed to be undersized causing frequent air binding in the vertical drop section. This causes flooding to the launder and weir. A PVC air vent was added, but plant staff indicate that this has not alleviated the problem. Primary clarifier #1 has an effluent pipe with a 24-inch diameter.
- The scum trough in primary clarifier #2 plugs regularly, possibly due to a flat-sloped exit pipe. Primary clarifier #1 also has a larger scum trough hopper than primary clarifier #2.
- Plant staff would like a more effective scum trough flushing mechanism for both primary clarifiers.

Secondary Treatment

Description

Secondary treatment is provided by two parallel trains of aeration basins and 70-foot diameter circular secondary clarifiers. Each aeration basin is 170 feet long, 20 feet wide, and 15 feet deep, and the secondary clarifiers have a sidewater depth of 16 feet. Recycle flows are blended with primary effluent in a manhole just upstream the aeration basins. There is an anoxic zone at the head of each aeration basin that is approximately 20 feet in length and is separated from the aerated zone by a divider baffle. Based on design information, approximately 12 percent of the total aeration basin volume is occupied by the anoxic zone. Each anoxic zone is mixed with one vertical turbine blade mixer mounted on a bridge over the basin.

Aeration in the reminder of the tank is provided by membrane disc fine bubble diffusers along the floor of the aerated zone. Centrifugal blowers located in the process gallery adjacent to the aeration basins supply process air. Blower output is automatically controlled to maintain a dissolved oxygen (D.O.) setpoint in the basins. Each basin has a dedicated blower and a third blower serves as a standby unit. Return and waste activated sludge pumps are located in the process gallery and convey sludge from the bottom of the secondary clarifiers to the head of the aeration basins and to the thickening process.

The basins were designed to operate with a sludge age ranging from 3 days in the winter to 8 days in the summer, resulting in mixed liquor suspended solids (MLSS) concentrations of 2,500 to 3,300 mg/L. Operating data indicate that the average sludge age is 8 to 10 days, with a mixed liquor concentration of 4,000 mg/L or higher.

Capacity and Redundancy

The aeration basins have been operating at higher than standard MLSS concentrations without any apparent adverse impacts. Therefore, rather than evaluating capacity based on MLSS concentrations, the maximum treatment capacity was determined by evaluating the peak diurnal oxygen uptake rate (OUR, mg/L/hr) using the process model. This parameter is evaluated under maximum week conditions, since the activated sludge process cannot realistically respond to maximum day flow and loading events. At OURs above 50 mg/L/hr, the ability to transfer air to the sludge and support biological processes of the activated sludge bacteria is compromised. Without the need to nitrify (remove influent ammonia-nitrogen), the basins have a capacity of approximately 4.7 mgd. Allowing for complete nitrification, the basins have a capacity of 3.2 mgd.

Secondary clarifier capacity is evaluated based on solids loading from the aeration basins. To evaluate firm capacity, the system was modeled with both aeration basins in operation and one secondary clarifier out of service. Under this scenario, the maximum month flow to the secondary treatment process is 2.2 mgd, with a peak hour flow of 2.8 mgd. With all units in service, the maximum month and peak hour capacities are 3.1 mgd and 3.9 mgd, respectively. Because of the reduced MLSS concentrations with two basins in operation, as opposed to one basin, the firm secondary clarifier capacity is more than half of the total capacity.

The secondary treatment system can convey approximately 16 mgd of flow without weir submergence; weirs on the secondary clarifiers become submerged at just over 16 mgd and the weir at the outlet of the aeration basins becomes submerged at just over 17 mgd.

Condition and Operational Issues

- Vortexing has been observed in the anoxic junction box, possibly resulting in undesirable air entrainment and introduction of DO into the anoxic zone of the aeration basins.
- The anoxic selector creates a backward floating foam trap due to a lower water surface elevation in the aerated zone relative to the anoxic zone.
- The anoxic selector may be undersized. To compensate, plant staff currently do not aerate the first third of the aerobic zones. This mode of operation decreases the capacity of the aeration basins by approximately one-third. Very infrequent incidents of filamentous growth are easily handled by chlorinating the RAS.
- Alkalinity consumption is an issue now that the Wilsonville water treatment plant is on-line, with Willamette River as the source of drinking water. A significant amount of alkalinity is currently consumed in the aeration basins due to nitrification, and the source water from the Willamette River has very low alkalinity. Sufficient alkalinity cannot be added at the water treatment plant to meet the needs of the WWTP without the potential to impact customer satisfaction with the water. Effluent pH may decrease if the plant begins to fully nitrify and consumes more influent alkalinity. This situation has the potential to jeopardize both process performance and permit compliance. New chemical feed facilities or a change in operations are required in the future.
- Algae growth on the secondary clarifier weirs is a major problem. Chlorination is not an option due to discharge permit restrictions on residual chlorine. Washdown of weirs is required at least once per week.
- The pipe leaving the secondary scum hoppers is very flat, requiring a continuous water flush to prevent plugging.
- Wilsonville staff would like a sampling station between the secondary clarifiers and the sand filters to individually assess the performance of the two processes during the summer permit season.

Sand Filtration

Description

Tertiary filtration is provided by three traveling bridge sand media filters. Filters are continuously backwashed by a traveling bridge, and have a media depth of 12 inches. Filter backwash is sent to a backwash pump station, then pumped to the anoxic junction box.

Capacity and Redundancy

The capacity of the sand filters is approximately 4.6 mgd during average day conditions and 6.8 mgd during peak hour conditions. Capacities are reduced to 2.3 and 3.4 mgd, respectively, with one unit out of service. The hydraulic capacity is slightly higher than the process capacity, with a maximum flow of just under 10 mgd.

Condition and Operational Issues

- The sand filters are relatively high maintenance; each filter requires monthly draining, drying, and raking during dry weather permit season when filters are in operation. High maintenance requirements are due to formation of mud balls and algae growth, and possibly due to the formation of an exocellular algae or bacterial slime. Again, chlorination is not possible due to the effluent permit limit.
- The traveling bridge/hood does not evenly backwash across the width of each cell and performs best in the middle of the cell.
- Plant staff would like to replace the existing sand filters with a more cost effective and lower maintenance system.

Ultraviolet (UV) Disinfection

Description

Disinfection is provided by a single channel of medium pressure UV lamps. The channel has two banks of lamps and one serves as a standby unit. Each bank has three modules of four lamps, for a total of twelve lamps per bank. Filter or secondary effluent (depending on the season), flows by gravity to the channel.

Capacity and Redundancy

The design criteria for the existing UV disinfection system is a minimum dosage of 31 mW-s/cm^2 at the peak design flow rate of 8.0 mgd after 8,760 hours of lamp operation and at 65 percent transmittance. The system is enclosed in a single channel. Redundancy is provided by two banks of UV lamps, with one serving as a backup unit.

Condition and Operational Issues

- The existing UV disinfection system generally works well, however the plant has experienced high bacterial counts in single samples, resulting in permit violations. Staff feel that this issue is associated with programming of the UV system operation and is addressing the problem with the manufacturer of the system.
- The system is served by the standby power system. However, Wilsonville staff are concerned that upon transfer from standby power to utility service, there is an inadequate time delay, resulting in an overlap in utility power and standby power causing an unsynchronized phase condition.

Outfall

Description

The Wilsonville WWTP currently discharges at river mile 38.6 via a submerged outfall. The outfall extends 40 feet into the river from the left bank (looking downstream). The outfall pipe is oriented roughly perpendicular to the direction of flow, and consists of a single 24-inch diameter port.

A team of divers inspected the outfall on June 7, 2001. The results of this inspection are included in Appendix D. No major leaks were detected, and the outfall pipe appeared to be in good condition with no major defects.

Capacity and Redundancy

The capacity of the outfall was examined in the hydraulic analysis. Excessive headloss in the outfall causes flow to back up and overtop the UV disinfection channel at approximately 17.5 mgd, so modifications will be necessary if the existing outfall is to pass the peak build-out flow of over 17.5 mgd.

The City has also raised concerns that the outfall provides limited mixing. A mixing zone analysis was completed in conjunction with this Facility Plan and indicates that dilution with the current outfall configuration ranges from 23:1 to 25:1 at the edge of the mixing zone[1] under design conditions and 1Q10 and 7Q10 flows. Particularly with surfacing of the plume prior to reaching the regulatory mixing zone, the lack of an outfall diffuser may be a concern in the future.

Condition and Operational Issues

- There are no operational issues at this time.

Unit Process Assessment – Solids Treatment

The following sections describe the existing unit processes for solids treatment and handling at the Wilsonville WWTP. Capacity, redundancy, condition, and operational issues are also discussed. A summary of existing solids treatment and handling equipment, including number of units, size, and design criteria is presented in Appendix B.

Grit and Screenings

Description

Following removal in the fine screen, screenings are washed by a high pressure spray, compacted and conveyed to a garbage bin for landfill disposal.

Capacity and Redundancy

The capacity for handling screenings material is sufficient to match the headworks process capacity. However, redundant equipment is not currently provided in the headworks.

Condition and Operational Issues

- The existing washing and compacting system is high maintenance and does not effectively clean the screenings. A considerable amount of liquid drains from the both dumpsters, indicating better compaction and dewatering of screenings is required.

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[1] Under some scenarios, the effluent plume impinged on the water surface before the regulatory mixing zone was reached. In these scenarios, dilution is given at the point of surface impingement.

Sludge Pumping and Thickening

Description

Primary sludge is pumped from the bottom of the primary clarifiers to the aerobic digesters. Two air-operated diaphragm pumps operate continuously. Thickening takes place in the clarifiers and there is no separate thickening system.

Return and waste activated sludge (RAS/WAS) pumps recycle sludge from the bottom of the secondary clarifiers to the anoxic junction box and pump WAS to the thickening process. WAS is thickened by two gravity belt thickeners (GBTs) located in the process gallery, each with a 1.5-meter belt. WAS thickening takes place five days a week during the normal 8-hour day shift. Under normal operation, WAS is conditioned with polymer and thickened to approximately 4% prior to being fed to the digester. The system is capable of producing WAS concentrations as high as 6%, however plant staff have found that 4% is an optimal solids concentration for both air mixing in the digesters and for pumping through the land application sludge "guns" at the final biosolids utilization site.

The plant is configured to allow dewatering of digested sludge using the GBTs, however trials using this operation demonstrated that the dewatering centrate has adverse impacts on performance of the UV disinfection system.

Capacity and Redundancy

Total gravity belt thickener capacity is approximately 8.8 mgd (normalized to peak liquid stream flow), with a firm capacity of 4.4 mgd. These estimates are based on 40 hours/week of thickening. The plant's thickening capacity could be increased, however this impacts plant staffing.

Condition and Operational Issues

- The RAS/WAS pumping system is in excellent condition.
- The thickening system appears to be functioning well.

Aerobic Digestion and Biosolids Storage

Description

The Wilsonville WWTP has two aerobic digesters that treat combined primary and thickened secondary sludge. Each digester is configured as an outer annular ring to a primary clarifier and has three separate cells divided by baffles. Figure 3-8 shows the configuration of the primary clarifier/aerobic digester units. The total volume of each digester is 209,930 gallons. Currently, sludge is fed to the first cell of digester #2, then flows sequentially through the other two cells. Digested sludge from digester #2 is then transferred to digester #1, and sequentially flows through the three cells of this digester. Aeration for the digesters is provided by centrifugal blowers located in the Control Building. Two blowers are used for normal operation, with one blower serving as backup. Digested sludge can flow to the sludge storage tanks or be pumped to the gravity belt thickener. The normal mode of operation is to convey digested sludge directly to sludge storage.

Five biosolids storage tanks with a total volume of 412,000 gallons hold digested biosolids prior to disposal. The tanks are configured to store WAS or thickened sludge from the gravity belt thickeners, however this mode is typically not used. Storage tanks are aerated with coarse bubble diffusers located along the floor of the tank. The tanks are currently uncovered. Covers and odor treatment are being added as part of the 2002 Wilsonville WWTP Odor Control Improvements project. Sludge is pumped from the storage tanks to the sludge loading station where it is loaded into trucks for land application.

Capacity and Redundancy

The aerobic digesters are sized to handle a maximum month influent flow of approximately 6.7 mgd with both digesters in service, and 3.4 mgd with one digester out of service. An HRT of approximately 59 days is currently provided during maximum month wet weather flows; well over the required 40 days at a temperature of 20°C or greater. A review of historical plant data shows that the temperature in the aerobic digesters is consistently above 20°C, and that the volatile solids reduction across the digesters is typically in excess of 45 percent. Part 503 regulations for Class B biosolids specify at least 38 percent volatile solids destruction during digestion.

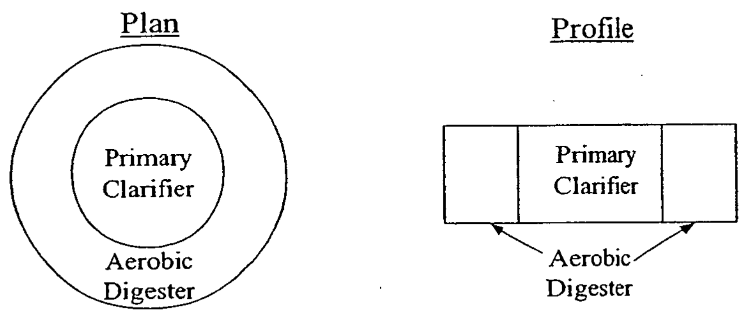


Figure 3-8. Configuration of Primary Clarifier/Aerobic Digester Units.

The current biosolids storage tanks do not provide the 60 days capacity that plant staff desire during maximum month conditions. This limitation became a critical issue during the winter of 2001-02 due to the loss of some land application sites and restrictions on the use of other sites during the wet season.

Condition and Operational Issues

- Wilsonville staff have expressed the desire to convert the existing solids handling program to a produce Class A biosolids.
- Digester withdrawal valves are located inside the digester tanks, which require dewatering the tank to repair or replace the valve. Valves should be located outside the tank for access.
- When the airflow is turned up in the digester, foaming events occur.
- Staff have noted that airflow to the digesters appears to be restricted, possibly due to undersized air piping or restrictions in the diffusers.
- Sometimes there are odor complaints when sludge is transferred from the digesters to biosolids storage tanks.

Unit Process Assessment – Support Facilities

Plant Water (W3)

The following sections describe the existing support facilities at the Wilsonville WWTP. Capacity, redundancy, condition, and operational issues are also discussed. A summary of existing support facilities, including number of units, size, and design criteria is presented in Appendix B.

Description

Wilsonville currently reuses plant effluent for specific non-potable uses, such as chemical makeup, process washwater, and pump seal water. A reuse pump station is located near the UV channel, and two adjustable speed pumps supply effluent to the plant water (W3) distribution system. Pump speed can be controlled to maintain a set pressure in the system, or to maintain a set flow rate. Plant water is distributed for washwater at the fine drum screen and the GBTs, makeup water for the polymer blend units, and for washwater at the aeration basins and the secondary clarifiers.

Capacity and Redundancy

The system has sufficient capacity to supply non-potable water to existing treatment equipment.

Condition and Operational Issues

- The entire non-potable water system at the plant currently operates at a pressure of 110 psi to maximize washing of the fine screen. Wilsonville staff have suggested that the system operate at 60 psi with a booster pump for the fine screen wash spray. The existing pumps could easily be adjusted to the lower pressure.

Plant Utilities

Description

Plant utilities include potable water and electric power supply.

Potable Water

Potable water (W1) is used for drinking water, shower facilities, eyewashes, and the laboratory facility. Potable water is supplied by the City of Wilsonville via a 6" service that enters the site along the entrance road. Separate metered services are provided to the Operations Building, Control Building, and reuse pump station.

The potable water system includes a reduced pressure backflow preventer valve. Non-potable water (W2) used in the process gallery is supplied from the City water source. W2 water does not have backflow prevention and therefore is designated as separate from the potable water supply.

Electric Power Supply

Electrical power is supplied by Portland General Electric (PGE). The service enters the plant through overhead lines. Onsite, the service is routed through electrical manholes into underground ductbanks feeding two PGE transformers. Power to the treatment plant is distributed through a switchboard located in the Aeration Basins Electrical Room. This switchboard delivers power to motor control centers and distribution panels throughout the plant.

The plant has a 500 kW Caterpillar engine generator that supplies backup power for all plant functions. Critical needs include the UV power supply, and minimal activated sludge and digester aeration. These needs currently account for less than half of the total load on the generator. Assuming that the generator only needs to serve critical process needs, additional generator capacity will not be necessary until the plant more than doubles in size.

Chemical Feed Systems

The Wilsonville WWTP has two chemical feed systems for sodium hypochlorite and polymer.

Polymer

Polymer is added using a polymer blend unit prior to the gravity belt thickeners to enhance the thickening process. Two polymer feed units are located in the process gallery near the GBTs, providing redundancy for sludge conditioning. Liquid polymer tote tanks feed two blend tanks. Calibration of the feed rate is manual and each unit is capable of delivering up to 10 pounds of polymer per day.

Sodium Hypochlorite

Chemical metering pumps can be used to add sodium hypochlorite to the secondary clarifier launders and to the RAS line. Separate systems are provided at these two injection points. One feed system is located in the thickening room, and the other is in the chlorine storage room. Since these systems are not used for normal plant operations, redundancy not provided. Chlorination of the secondary clarifier launders is typically not used due to restrictions on effluent residual chlorine.

Odor Control

Description

Odor control is a high priority due to the close proximity of neighbors. The existing odor control system consists of a granular activated carbon (GAC) tower, which treats air from the primary clarifiers and aerobic digesters. The Wilsonville WWTP Odor Control Improvements project is currently underway to design and construct a compost biofilter in the abandoned RBC basins. The biofilter will treat air from the biosolids storage tanks and the headworks area.

Capacity and Redundancy

The activated carbon tower has a design capacity of 5,500 cfm. While this should be adequate for existing air flow from the primary clarifiers and aerobic digesters, odor complaints have become a frequent occurrence. Plant staff report that the activated carbon media requires frequent replacement, indicating that the unit is not performing to its design capacity.

Condition and Operational Issues

- The GAC tower theoretically has adequate capacity, but it requires replacement of carbon every 4 months.
- The plant receives frequent odor complaints during the warm summer months.
- There is no redundant odor control system.

- The odor control system needs to be extended to other areas of the plant, including the screenings storage areas and sludge storage tanks.

Administration, Laboratory, and Maintenance Facilities

New administration and laboratory facilities were included in the 1997 treatment plant upgrade. These improvements added office space, a training and lunch room, men's and women's locker rooms and shower facilities, a control room, laboratory facilities, and storage space. Future improvements will be planned and designed to minimize staffing impacts, and space requirements for laboratory and maintenance needs are not anticipated to increase significantly.

Chapter 4. Regulatory Review and Permit Compliance

Introduction

This chapter summarizes current and anticipated effluent quality requirements for discharge and reuse, treatment standards for beneficial reuse of biosolids, and air quality standards for Wilsonville's treatment facility.

The Wilsonville wastewater treatment plant (WWTP) discharges most of its effluent to the Willamette River. Some of the treated effluent is also used for nonpotable process needs onsite. Biosolids are applied to local agricultural land as a soil amendment. A key assumption in this plant-specific facility plan is that discharge to the Willamette will continue to be the primary end point for wastewater generated in the Wilsonville service area.

Regulatory requirements continue to evolve through an array of federal, state and local programs, leading to potential new requirements for the City of Wilsonville. These trends, and their implications on Wilsonville, are summarized in the following sections.

Clean Water Act

The federal Water Pollution Control Act is the primary legislation that protects surface waters, such as lakes, rivers, and coastal areas. This 1972 legislation, which became known as the Clean Water Act (CWA), provides the foundation for monitoring and reducing water pollution. The U.S. Environmental Protection Agency (EPA) oversees the CWA programs. However, in the state of Oregon, the Department of Environmental Quality (DEQ) is responsible for program implementation.

There are several programs under the CWA that either directly regulate or contribute to the regulation of WWTP effluent quality. These programs, listed below, are summarized in the following section.

- Section 402: National Pollutant Discharge Elimination System (NPDES) Discharge
- Section 303(d): Identification and Protection of Surface Water Uses
- Total Maximum Daily Load (TMDL): Point and Non-point Loads for Pollutants
- Sanitary System Overflow (SSO) Rule: Capacity, Management, Operations, and Maintenance of Sanitary Sewer Systems

Section 402 Discharge Permits

Discharges from the WWTP are regulated under Section 402 of the Clean Water Act. This section established the National Pollutant Discharge Elimination System (NPDES) program. Under the NPDES program any person responsible for the discharge of a pollutant or pollutants into any waters of the United States from any point source must apply for and obtain a permit. The U.S. Environmental Protection Agency (EPA) oversees this program. In the state of Oregon, the Department of Environmental Quality (DEQ) implements the program.

Wilsonville currently has a permit for their point source discharge through an outfall into the Willamette River. This permit includes seasonal and year round limitations on discharge

Effluent Quality Requirements

The existing and potential regulatory requirements summarized above were reviewed, and the potential effect on discharge limits or permits was evaluated. The following discussion provides a parameter-by-parameter discussion of current and anticipated effluent quality requirements for discharge to the Willamette River.

$CBOD_5$ and Suspended Solids - Wet Season

Current Requirements

The wet-season permit period extends from November 1 through April 30. Current requirements for carbonaceous biochemical oxygen demand ($CBOD_5$) and total suspended solids (TSS) are summarized in Table 4-1. The Wilsonville WWTP must also achieve a minimum BOD_5 and TSS removal efficiency of 85 percent, based on monthly average loadings.

Table 4-1. Current Wet-Season $CBOD_5$ and TSS Limits

Parameter	Effluent Concentration, mg/L		Mass Load, lb/day		
	Monthly	Weekly	Monthly	Weekly	Daily
$CBOD_5$	30	45	560	840	1,100
TSS	30	45	560	840	1,100

Pending or Potential Issues

The current wet-season permit limits for $CBOD_5$ and TSS are standard technology based secondary treatment standards and are not set based on site specific water quality conditions in the Willamette River. During the last permit renewal cycle, wet-season mass limits for these parameters were increased.

Recommended Planning Criteria

Two scenarios are possible in future permits and effluent discharge limits. Wet-season $CBOD_5$ and TSS limits may remain unchanged, or loads may be fixed at the current values, requiring increasingly stringent treatment.

- **Scenario 1 – Mass limits are changed by DEQ.** This scenario assumes that Oregon DEQ will change current mass limits based on revised wet weather flows, maintaining the 30 mg/L monthly average concentration limit.
- **Scenario 2 – Current mass limits remain unchanged.** Figure 4-1 presents the effluent concentration that will be required under the future high flow condition given the current mass loads. This figure shows that required winter effluent concentrations would be approximately 7 mg/L under maximum month conditions at ultimate buildout under the high flow projections, and 11 mg/L under the low flow projections.

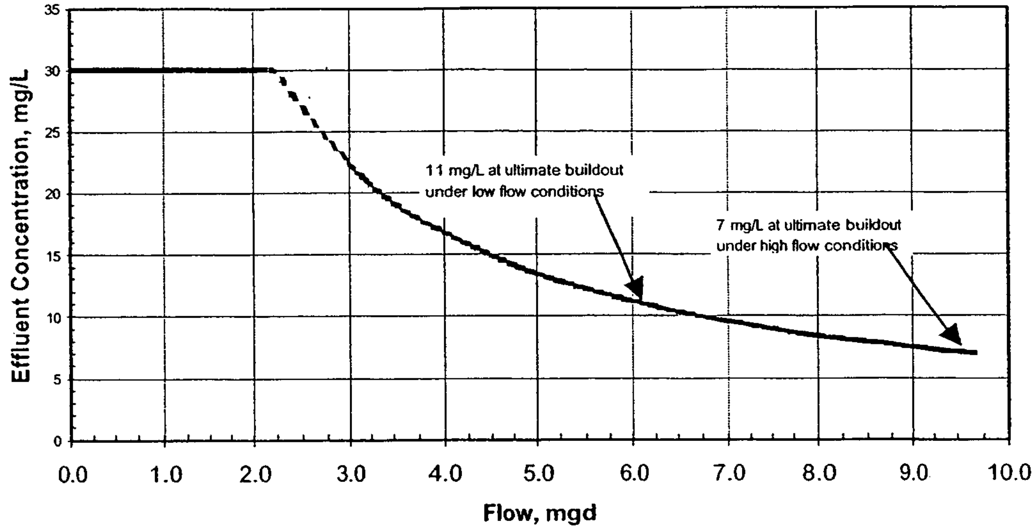


Figure 4-1. Projected Effluent Concentrations for CBOD and TSS: No Increase in Wet-Season, Maximum Month Loading

CBOD and Suspended Solids - Dry Season

The dry-season permit period extends from May 1 through October 31. Current requirements for $CBOD_5$ and TSS are summarized in Table 4-2.

Table 4-2. Current Dry-Season $CBOD_5$ and TSS Limits

Parameter	Effluent Concentration, mg/L		Mass Load, lb/day		
	Monthly	Weekly	Monthly	Weekly	Daily
$CBOD_5$	10	15	190	280	380
TSS	10	15	190	280	380

Pending or Potential Issues

The current dry-season permit limits for $CBOD_5$ and TSS are based on site specific water quality conditions in the Willamette River and are more restrictive than the wet-season limitations.

Recommended Planning Criteria

Two scenarios are possible in future permits and effluent discharge limits. Dry-season $CBOD_5$ and TSS concentration limits may remain unchanged, or the load limits may be fixed at current values, requiring increasingly stringent levels of treatment.

- **Scenario 1 – Mass limits are changed by DEQ.** This scenario assumes that Oregon DEQ will change current mass limits based on revised wet weather flows, maintaining the 10 mg/L monthly average concentration limit.
- **Scenario 2 – Current mass limits remain unchanged.** Figure 4-2 presents the effluent concentration that will be required under the future high flow condition given the current

The guidance document recommends a four-part approach to provide temperature conditions that support salmonids[3]:

- *Development and adoption of thermal potential numeric criteria*
- *Adoption of "interim" species-life-stage numeric criteria*
- *Adoption of a temperature management plan provision*
- *Adoption of provisions to protect existing cold water areas*

This approach is based on the first premise – adoption of a thermal potential numeric criteria – but acknowledges that developing such criteria could be a long process. Therefore, the guidance also allows an interim approach based on the life cycles and stages of salmonid species that must be supported in a stream. Temperature management plans would be used as a means for allowing NPDES dischargers to demonstrate mitigation measures that would be employed, if needed, to mitigate the impacts of the discharge. At the completion of this process a thermal load will be determined for the treatment plant. The temperature load could either be seasonal or year round, however the period of concern will likely be the summer months.

Recommended Planning Criteria

A mixing zone study was completed in conjunction with this Facility Plan. Results of the study indicate that the City's discharge does not cause a significant increase (0.25 degrees F) in the river temperature under the most conservative effluent and ambient flow and temperature conditions, and does not impact the biological integrity of threatened salmonids. Since temperature criteria may be changing and Wilsonville's discharge does not currently require that a Temperature Management Plan be completed, it is recommended that the City postpone completion of the Temperature Management Plan. The City should consider the impact of future changes on the thermal discharge to the River, and mitigation measures should be examined as part of the alternative analysis phase of this Facility Plan.

Turbidity

Current Requirements

There is no effluent limit for turbidity for discharge to the Willamette River. (Effluent used for some irrigation purposes would have an effluent turbidity limitation. See the **Effluent Quality Requirements – Reuse** discussion below.).

Pending or Potential Issues

There are no pending issues related to effluent turbidity limits for Willamette River discharge.

Recommended Planning Criteria

For discharge to the Willamette River, turbidity limits will be driven by the needs of the existing ultraviolet (UV) disinfection system, not regulatory requirements. This will be addressed in alternative analysis.

[3] Draft EPA Region 10 Guidance for State and Tribal Temperature Water quality Standards, October 2001

Bacteria Levels

Current Requirements

Currently, DEQ's bacteriological standard is based on *E. Coli* measurements. Current requirements are a monthly geometric mean not to exceed 126 organisms per 100 mL, with no single sample exceeding 406 organisms per 100 mL.

Pending or Potential Issues

A TMDL is currently under development for bacteria in the Middle Willamette subbasin. Bacteria sources are typically attributed to point source discharges and non-point sources such as agriculture runoff, storm drainage, and septic systems. It is not anticipated that Wilsonville's bacteria limit will be changed as a result of the TMDL.

Recommended Planning Criteria

Continue to expand the existing UV disinfection system as the hydraulic capacity of the plant increases.

Chlorine Residual

Current Requirements

Wilsonville's permit specifies that chlorine and chlorine compounds cannot be used as a disinfecting agent and that no chlorine residual is allowed in the discharge.

Pending or Potential Issues

DEQ is not likely to change this limit in the future.

Recommended Planning Criteria

Maintain zero chlorine residual and continue with the current UV disinfection system.

Toxic Compounds and Sediments

Current Requirements

These issues are driven by water quality limitations in the Willamette River. There are currently no end-of-pipe limits for toxic compounds.

Pending or Potential Issues

Organic toxin discharge is currently addressed with local limits and the zone of initial dilution (ZID). Currently, Oregon DEQ is developing a TMDL for mercury based on fish tissue sampling. Any changes to Wilsonville's permit as a result of the TMDL are unlikely to affect plant operations. If a limit is assigned, the issue should be addressed in Wilsonville's pretreatment program.

The Middle Willamette is also 303(d) listed for biological criteria, specifically fish skeletal deformities. It is unclear what permit changes DEQ will make, but the TMDL will not likely change Wilsonville's permit or plant operations.

The lower Willamette is 303(d) listed for poor sediment quality, and this may affect Wilsonville's metal limits, discussed below.

Recommended Planning Criteria

No permit changes are anticipated. Continue with the current pretreatment program and plant operations.

Metals

Current Requirements

Current copper and cadmium permit limits for the Wilsonville WWTP are shown in Table 4-3. The WWTP is also required to sample for a number of metals semi-annually.

Table 4-3. Year-round copper and cadmium limits for the Wilsonville WWTP.

Parameter	Effluent Concentration, mg/L		Mass Loading, lb/d	
	Monthly	Daily	Monthly	Daily
Copper	0.013	0.017	NA	NA
Cadmium	0.00042	0.00065	NA	NA

Pending or Potential Issues

DEQ will continue to apply the metals criteria as total recoverable metals (rather than soluble), and a change in the permit structure is not anticipated. It is unlikely that environmental challenges will force DEQ to eliminate the ZID (requiring dischargers to meet acute metals criteria at the end of pipe). The metals data will be reviewed prior to the issuance of the next permit to determine if any discharged limits or permit modifications should be made.

Recommended Planning Criteria

The City is attempting to have the metals limits reduced or eliminated from the NPDES permit. However, to be conservative, no permit changes are anticipated.

Summary of Anticipated Effluent Quality Requirements

Table 4-4 summarizes the anticipated effluent concentrations for the Wilsonville facility at current (2001) flow rates, and at projected 2020 and ultimate build-out flow rates under the high flow projection. If flow rates are lower than the high projection, effluent requirements will be less stringent than in Table 4-4. The change in effluent requirements is not significant enough to impact the type of treatment required at ultimate buildout.

Table 4-4. Projected Effluent Quality Requirements for Wilsonville WWTP

Summer Permit Season (May 1 - October 31)									
	Year 2001			Year 2020			Ultimate Buildout		
	Monthly	Weekly	Daily	Monthly	Weekly	Daily	Monthly	Weekly	Daily
$CBOD_5$, mg/L[2]	10	15	NA	4.4	6.1	NA	3.0	4.2	NA
TSS, mg/L[2]	10	15	NA	4.4	6.1	NA	3.0	4.2	NA
Total P, mg/L	--------- No Limit ---------			--------- No Limit ---------			--------- No Limit ---------		
NH_3-N, mg/L	--------- No Limit ---------			--------- No Limit ---------			--------- No Limit ---------		
E. Coli, #/100 mL	126	NA	406	126	NA	406	126	NA	406
Chlorine Residual, mg/L	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dissolved Oxygen, mg/L	--------- No Limit ---------			--------- No Limit ---------			--------- No Limit ---------		
PH	6.0 to 9.0			6.0 to 9.0			6.0 to 9.0		
Copper, mg/L	0.013	NA	0.017	0.013	NA	0.017	0.013	NA	0.017
Cadmium, mg/L	0.00042	NA	0.00065	0.00042	NA	0.00065	0.00042	NA	0.00065
Other Requirements	85% removal of BOD_5 and TSS								
Winter Permit Season (November 1 - April 31)									
	Year 2001			Year 2020			Ultimate Buildout		
	Monthly	Weekly	Daily	Monthly	Weekly	Daily	Monthly	Weekly	Daily
$CBOD_5$, mg/L[2]	30	45	NA	10	13	NA	6.9	8.8	NA
TSS, mg/L[2]	30	45	NA	10	13	NA	6.9	8.8	NA
Total P, mg/L	--------- No Limit ---------			--------- No Limit ---------			--------- No Limit ---------		
NH_3-N, mg/L	--------- No Limit ---------			--------- No Limit ---------			--------- No Limit ---------		
E. Coli, #/100 mL	126	NA	406	126	NA	406	126	NA	406
Chlorine Residual, mg/L	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dissolved Oxygen, mg/L	--------- No Limit ---------			--------- No Limit ---------			--------- No Limit ---------		
pH	6.0 to 9.0			6.0 to 9.0			6.0 to 9.0		
Copper, mg/L	0.013	NA	0.017	0.013	NA	0.017	0.013	NA	0.017
Cadmium, mg/L	0.00042	NA	0.00065	0.00042	NA	0.00065	0.00042	NA	0.00065
Other Requirements	85% removal of BOD_5 and TSS								

Effluent Quality Requirements - Reuse

To date, the Wilsonville WWTP has not implemented a state-certified water reclamation program for effluent reuse. Wilsonville is interested in using a portion of the plant effluent to irrigate school grounds, golf courses, and other green spaces.

Current Requirements

Water quality requirements for recycled wastewater are defined in the Oregon Reuse Rules, adopted in 1990. DEQ classifies reclaimed water into four categories: Level I through Level IV. Level IV treatment requirements are the most stringent, allowing reclaimed water to be used on areas open to general public contact (except during the irrigation cycle). Since the City's interest is in using effluent for irrigation of public open spaces, the following discussion will focus on Level IV reclaimed water.

Key treatment requirements and water quality requirements for Level IV are shown in Table 4-5. Where coagulation is not provided, approval may be granted through consultation with the Oregon Health Division, if the treatment process provides equivalent effluent quality to coagulation. Other Level IV requirements include no direct public contact during the irrigation cycle, signage requirements at the application site specifying that the water is non-potable, and restrictions on its application onto drinking fountains or to areas where food is prepared.

Pending or Potential Issues

No changes to the Oregon Reuse Rules are anticipated. If Wilsonville desires to implement a reuse program, it will need to obtain acceptance from Oregon DEQ for a system to produce Level IV reclaimed water.

Recommended Planning Criteria

In the event the City elects to implement an effluent reuse program, the Wilsonville WWTP should be modified to produce Level IV reuse quality water. A review of Wilsonville's daily monitoring reports for the last 40 months showed that only 3 effluent samples (all 3 were during February and March, 2001) had turbidity values above the 2.0 NTU 7-day median limit for Level IV reuse. However, effluent monitoring reports (DMR's) show that 133 *E. coli* samples exceeded the bacteria limit for Level IV reclaimed water during the last 40 months. Disinfection performance will need to be improved in order for Wilsonville's effluent to meet Level IV reuse standards. Level IV requirements also specify daily sampling, which is more frequent than currently performed.

Table 4-5. Treatment and monitoring requirements for Level IV reclaimed water (from Table 1 of OAR 340 Division 55).

Category	Requirement for Level IV
Biological Treatment	Required
Disinfection	Required
Clarification	Required
Coagulation	Required
Filtration	Required
Total Coliform (organisms/100 mL)	
7-day Median	2.2
Maximum	23
Sampling Frequency	1 per day
Turbidity (NTU)	
7-day Median	2
Maximum	5
Sampling Frequency	Hourly

NA = Not applicable

Biosolids Regulations and Requirements

Currently, the City of Wilsonville produces liquid Class B biosolids. Due to problems associated with procuring and maintaining application sites, Wilsonville is interested in producing Class A biosolids. This section discusses both Class A and Class B biosolids regulations, as well as regulatory trends and monitoring requirements.

Regulations and Regulatory Trends

In February 1993, EPA issued regulations in 40 CFR part 503 which govern treatment and disposal of sludge generated by publicly owned treatment works (POTWs). These rules are entitled "Standards for the Use or Disposal of Sewage Sludge." The state of Oregon has promulgated regulations in Oregon Administrative Rules (OAR) 340-50, titled "Land Application of Domestic Wastewater Treatment Facility Biosolids, Biosolids Derived Products, and Domestic Septage," which address land application of biosolids.

Future biosolids issues include agronomic application rates, dioxins, pesticides, and toxic organic chemicals. EPA may consider requirements agronomic rates of phosphorus application in addition to existing nitrogen limits, but this is not anticipated in the near future. In December, 2001, EPA decided against regulating dioxins and dioxin-like compounds in biosolids based on analytical data from a survey suggesting low levels across the US. However, public pressure may force EPA to revisit metals, pesticides, and other toxic organic compounds in the future.

Biosolids Quality Requirements

The 503 regulations are broad-based, addressing general requirements, pollutant limits, management practices, operational standards, monitoring frequency and record-keeping requirements, reporting requirements, and pathogen and vector attraction requirements for treatment and disposal of municipal wastewater sludges. All common disposal practices, including land application, surface disposal, and incineration are covered in the regulations. From a sludge treatment perspective, major impacts of the 503 regulations include pathogen reduction requirements, vector attraction reduction (VAR), limits on metals content, and operations and performance requirements for treatment processes.

Pathogen Reduction

The 503 regulations create two categories of biosolids with respect to pathogens: Class A and Class B. Class A biosolids are an essentially pathogen-free product that can be given to the public and/or applied to lawns and home gardens. Class B biosolids are not a pathogen-free product, but can be applied to agricultural lands, forest land, or reclamation sites. Regulations require that crop harvesting, animal grazing, and public assess be restricted for specific periods of time after the application of Class B biosolids.

Treatment processes providing pathogen control in municipal sewage sludge are divided into "Processes to Significantly Reduce Pathogens" (PSRP) and "Processes to Further Reduce Pathogens" (PFRP). To meet the Class B pathogen reduction measures, sludge must be treated with a PSRP (or an equivalent process accepted by the permitting authority), or the biosolids must meet certain requirements for the density of either fecal coliform or total coliform. To produce a Class A biosolids, generators must also meet requirements regarding the density of fecal coliform and either treat sludge with a PFRP or analyze biosolids to show that specified enteric virus and helminth ova levels have been attained. PSRP and PFRP processes for Class B and Class A biosolids are summarized in Table 4-6 and Table 4-7, respectively.

Table 4-6. Processes to Significantly Reduce Pathogens (for Class B biosolids)

Process Type	Operational Requirements
Aerobic Digestion	40-day solids retention time at 68 °F, or 60 days at 59 °F
Anaerobic Digestion	15-day solids retention time at 95 to 131 °F, or 60 days at 68 °F
Composting	5 days at 104 °F and 4 hours at 131 °F
Lime Stabilization	pH > 12 for 2 hours
Air Drying	3 months total drying time and 2 months at > 32 °F

Table 4-7. Processes to Further Reduce Pathogens (for Class A biosolids)

Process Type	Operational Requirements
Composting	3 days at 131 °F for in-vessel or aerated static pile; 15 days at 131 °F for windrow, with 5 turnings
Lime Stabilization	pH > 12 for 72 hours with temperature at 126 °F for 12 hours of the high pH period; air dry to 50% solids
Heat Drying	Greater than 90% solids
Heat Treatment	30 minutes at 356 °F
Thermophilic Aerobic Digestion	10 days at 131 to 140 °F
Beta Ray Irradiation	1.0 megarad of beta ray irradiation
Gamma Ray Irradiation	gamma ray irradiation with Cobalt 60 and Cesium 137
Pasteurization	30 minutes at 158 °F

Vector Attraction Reduction

The 503 regulations also require vector attraction reduction (VAR) prior to disposal or land application. The purpose is to make the material less attractive to insects, rodents, and birds. Table 4-8 summarizes accepted vector attraction reduction methods. Only Methods 1 through 10 are applicable to the land application of bulk biosolids.

Exceptional Quality (EQ) biosolids can be produced by meeting the Class A pathogen content requirements and using Methods 1 through 8 of Table 4-8 to meet VAR requirements. Only general loading requirements must be met. If Class A biosolids are applied to agricultural land, VAR requirements can be met using Methods 9 or 10 (injection or disking) in Table 4-8. If Methods 9 or 10 are used, general requirements and management practices must be met. There are no site restrictions or additional management requirements for Class A biosolids.

Table 4-8. Vector Attraction Controls

Method	Description
1	Meet 38% reduction in volatile solids.
2	Demonstrate vector attraction reduction with additional anaerobic digestion in a bench-scale unit.
3	Demonstrate vector attraction reduction with additional aerobic digestion in a bench-scale unit.
4	Meet a specific oxygen uptake rate for aerobically digested biosolids.
5	Use aerobic processes at greater than 104 F for 14 days or longer.
6	Alkali addition under specified conditions.
7	Dry sludge with no unstabilized solids to at least 75% solids content.
8	Dry sludge with unstabilized solids to at least 90% solids content.
9	Inject sludge beneath the soil surface.
10	Incorporate sludge into the soil within 6 hours of application.
11*	Cover sludge placed on a surface disposal site with soil or other material at the end of each operating day.
12*	Alkali addition under more limited conditions than Method 6.

* Only applicable to surface disposal.

Since Class B biosolids may still contain a significant amount of pathogens, site restrictions apply to Class B biosolids, regardless of the vector control method used. These site restrictions specify the amount of time between biosolids application and harvesting of various agricultural crops, limit animal grazing on sites where Class B biosolids are applied, and identify measures to reduce public access and exposure to land application sites.

Pollutant Limits

The 503 regulations also establish pollutant limits for biosolids applied to land for beneficial reuse. The regulations distinguish between biosolids sold or given away in a bag or other container (such as compost), and bulk sewage sludge. Bulk sewage sludge applied to agricultural land, forest sites, public contact sites, or reclamation sites must comply with either a specified cumulative pollutant loading rate or a monthly average pollutant concentration. These values are shown in Table 4-9.

Biosolids sold or given away in a container must under all conditions have pollutant concentrations no higher than the ceiling concentrations stipulated in the 503 regulations. In addition, the biosolids must meet either the monthly average concentrations in Table 4-10, or the total pollutant load must be within certain annual pollutant loading rates. The ceiling concentrations and annual pollutant loading rates from the 503 regulations are shown in Table 4-10.

Table 4-9. Bulk Sewage Sludge Pollutant Limits

Pollutant	Cumulative Pollutant Loading Rate (kg/hectare)	Monthly Average Concentration (mg/kg)
Arsenic	41	41
Cadmium	39	39
Copper	1500	1500
Lead	300	300
Mercury	17	17
Nickel	420	420
Selenium	100	36
Zinc	2800	2800

Table 4-10. Bag/Container Sewage Sludge Pollutant Limits

Pollutant	Ceiling Concentration (mg/kg)	Annual Loading Rate (kg/hectare/365 day period)
Arsenic	75	2.0
Cadmium	85	1.9
Copper	4300	75
Lead	840	15
Mercury	57	0.85
Molybdenum	75	NA
Nickel	420	21
Selenium	100	5.0
Zinc	7500	140

NA = Not applicable

Restrictions on Application of Class B Biosolids

Due to the fact that Class B biosolids are not pathogen free, regulations establish specific restrictions on their application. A brief discussion of restrictions on the application of Class B biosolids is provided below.

Site Restrictions

Based on EPA regulations, Class B biosolids cannot be applied to lawns or home gardens, and sites must meet several criteria before application can begin. The state of Oregon has more stringent regulations in OAR 340-050-0070 including:

1. Normally, tillable agricultural land is suitable for the application of biosolids and domestic septage.
2. To be considered for biosolids or domestic septage land application, sites should meet all of the following conditions:
    a. Sites should be on a stable geological formation not subject to flooding or runoff from adjacent land.

b. At the time when liquid biosolids are applied, the minimum depth to permanent groundwater should be 4 feet and the minimum depth to temporary groundwater should be 1 foot.

c. Topography of the site should be suitable for normal agricultural operations. Where needed, runoff and erosion control measures should be constructed. In general, liquid biosolids should not be surface applied on bare soils where the ground slope exceeds 12 percent. Well vegetated sites with slopes up to 30 percent may be used for dewatered or dried biosolids, or for liquid biosolids application with appropriate management to prevent runoff.

d. Soil should have a minimum rooting depth of 24 inches. The underlying substratum to a depth of at least 24 inches should not be rapidly draining so that leachate will not be short circuited to groundwater.

e. Sites with saline and/or sodic soils should be avoided.

Some of Wilsonville's existing sites do not meet the requirements for minimum depth to groundwater on a year-round basis, therefore land application sites are at a premium during the wet, high-groundwater period. In the last few years, the number of acres permitted for winter biosolids application by the City has dwindled and constrained plant operations. There is some indication that DEQ may cease to approve winter application sites in the future.

State regulations also require that a buffer strip must be maintained that is large enough to "prevent nuisance odors or wind drift if needed." Buffer strips must also be provided along major highways, and strip size as determined by the Oregon DEQ field representative. Approximate buffer strip sizes for various application methods are as follows:

- Direct injection: no limit required;
- Truck spreading (liquid): 0 to 200 feet;
- Spray irrigation: 50 to 500 feet;
- Cake or dried solids: 0 to 50 feet.

Additional details regarding site restrictions for land application of biosolids are provided in OAR 340-050-0070.

Access and Use Restrictions

After application of Class B biosolids, crops harvesting, animal grazing, and public access is restricted. Following is a summary of restrictions[4]:

- Controlled access to bulk Class B domestic biosolids land application sites is required for at least ***12 months*** after surface application of solids. (Access control is assumed on rural private land.)[5]
- Food crops, feed crops, and fiber crops with edible parts that do not touch the surface of the soil, cannot be harvested until ***30 days*** after biosolids application.
- Federal and state regulations limit planting of crops for direct human consumption (fresh market fruits and vegetables) to ***14 months*** after application of Class B biosolids.

[4] A Plain English Guide to the EPA Part 503 Biosolids Rule, USEPA, September, 1994.
[5] OAR 340-050-0065.

- Food crops with harvested parts below the soil surface for 4 months or longer prior to incorporation cannot be harvested until ***20 months*** after Class B biosolids application.
- Food crops with harvested parts below the soil surface for less than 4 months prior to incorporation cannot be harvested until ***38 months*** after Class B biosolids application.
- Turf grown on land where Class B biosolids have been applied cannot be harvested until ***1 year*** after application if the harvested turf will be placed on either land with a high potential for public exposure or a lawn (unless otherwise specified by the permitting authority).
- Animal grazing is prohibited for ***30 days*** after application of Class B biosolids.
- Access to land with a high potential for public exposure (e.g. park or ball field) is restricted for ***1 year*** after Class B biosolids application.
- Access to land with a low potential for public exposure (e.g. private farmland) is restricted for ***30 days*** after Class B biosolids application.

Agronomic Application Rates

One of the general requirements for the land application of biosolids is that application must be performed at an agronomic rate. This means that nitrogen application (dry weight basis) must not exceed that needed by a crop or vegetation. As defined in 40 CFR 503:

"Agronomic rate is the whole sludge application rate (dry weight basis) designed:

(1) To provide the amount of nitrogen needed by the food crop, feed crop, fiber crop, cover crop, or vegetation grown on land; and

(2) To minimize the amount of nitrogen in the sewage sludge that passes between the root zone of the crop or vegetation grown on the land to the groundwater.

Excess nitrogen applied to land could result in nitrate contamination of groundwater. The agronomic rate must be determined by considering total and available nitrogen in the biosolids and the expected yield of the crop or vegetation.

OAR 340-050-0065 states that the application rate "shall not exceed the agronomic rate for the particular cultivar grown," with agronomic rate defined as "a rate of biosolids or domestic septage which matches *nutrient* requirements for a specific crop on an annual basis." Nutrient requirements for particular crops can be obtained from the Oregon State University Extension Service. The Water Environment Research Foundation also provides guidance in the document *Estimating Plant-Available Nitrogen in Biosolids*, Project 97-REM-3, 2000. Rates also must be applied so that runoff, erosion, leaching, nuisance conditions, or groundwater contamination are prevented.

Some newer NPDES permits include conditions that specify that agronomic rates of phosphorus must not be exceeded. However, nitrogen is most commonly used to determine the agronomic rate for biosolids application. While Wilsonville is required by permit to monitor biosolids phosphorus concentrations, phosphorus loading rates have not been evaluated. In general, the agronomic phosphorus loading rates will place more severe restrictions on plants that employ biological phosphorus removal, whereby significant amounts of phosphorus leave the plant site as stored phosphorus in biosolids. This could be an issue for Wilsonville in the future, since the anoxic selector appears to act as an anaerobic selector, resulting in biological phosphorus removal.

Best Management Practices and General Management Requirements

Federal regulations stipulate that all biosolids (Class A or B) must not enter surface waters or wetlands without a permit under Sections 402 or 404 of the Clean Water Act (CWA). Biosolids cannot be applied to land within 50 feet of any ditch, channel, pond, or waterway, or within 200 feet of a domestic water source or well.

The Part 503 rule stipulates that biosolids cannot be applied if application is likely to impact an endangered or threatened species specified under 50 CFR 17.11 and 17.12. The regulations require that the biosolids applier certify that applicable management practices have been met, including requirements concerning endangered species.

Reporting and Recordkeeping

Table 4-11 shows the frequency of monitoring requirements for the pollutants listed in Table 4-9 and Table 4-10. Frequencies in Table 4-11 also apply to pathogen density and VAR requirements. Pathogen and VAR monitoring requirements depend on whether the biosolids are Class A or Class B, and which process is used to meet these requirements. Currently, Wilsonville produces less than 290 metric tons per year on average meaning that only once per year sampling is required. However, according to projected flows and loads discussed in Chapter 2, Wilsonville may be required to monitor once per quarter within the next ten years, depending on future biosolids production.

Table 4-11. Frequency of monitoring requirements for land application of biosolids (Table 1 of CFR 503.16).

Amount of Sewage Sludge (metric tons per 365 Day Period)	Frequency
Greater than zero but less than 290	Once per year.
Equal to or greater than 290 but less than 1,500	Once per quarter (four times per year)
Equal to or greater than 1,500 but less than 15,000	Once per 60 days (six times per year)
Equal to or greater than 5,000	Once per month (12 times per year)

The state of Oregon also requires reporting of the following parameters with the same frequency as specified in Table 4-11:

- Total Kjeldahl Nitrogen (TKN)
- Nitrate Nitrogen (NO_3-N)
- Ammonia Nitrogen (NH_3-N)
- Total Phosphorus (TP)
- Potassium (K)
- pH
- Total Solids (TS)
- Volatile Solids (VS)

Analyses must be presented on a dry weight basis for all eight parameters with the exception of pH.

Air Quality Requirements

Air pollutant emissions is regulated under the Clean Air Act (CAA), the Clean Air Act Amendments of 1990, and Oregon air contaminant discharge permit (ACDP) and Title V programs.

Air pollutants are broadly grouped as either criteria pollutants or hazardous air pollutants (HAPs). The regulated criteria pollutants or criteria pollutant precursors of concern for most facilities are particulate matter (PM), sulfur dioxide (SO_2), nitrogen oxides (NO_X), carbon monoxide (CO), and volatile organic compounds (VOCs). A VOC is defined as any carbon compound (excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides, carbonates, ammonium carbonate) that creates or contributes to atmospheric photochemical reactions. A defined list of nonphotochemically reactive substances is excluded from the VOC category. Regulated HAPs are a defined list of 188 pollutants designated by EPA and adopted by DEQ.

Regulatory Trends

In Oregon, the ACDP program and the Title V permit programs govern air quality. The ACDP program has been in effect in Oregon for many years and regulates both major and minor sources of criteria pollutants. The Title V permit program was created as a result of the Clean Air Act Amendments of 1990 and regulates major sources of criteria pollutants and HAPs. The two permitting programs define major sources differently. This adds confusion to the process of determining the levels at which pollutant emissions will require a permitting action. Table 4-12 shows the significant emission rates for minor and major sources of criteria pollutants under the ACDP program. Sources with emissions below the minor source level are not generally required to have an operating permit. Table 4-13 shows the Title V major source thresholds.

Minor source permits generally require a straightforward and relatively simple permitting process in terms of addressing emissions, air pollution control equipment required, and the stringency of the permit conditions for monitoring, record-keeping, and reporting of emissions to DEQ. Major sources have more stringent monitoring and record-keeping requirements.

Table 4-12. Significant Emission Rates for Air Pollutant Sources in Oregon ACDP Program

Pollutant	Significant Emission Rate (tons/year)	
	Major Source[1]	Minor Source[2]
Particulate	25	5
Fine Particulate	15	5
Sulfur Dioxide	40	10
Nitrogen Oxides	40	10
Carbon Monoxide	100	10
Volatile Organic Compounds	40	10
Hazardous Air Pollutants	not regulated	not regulated

[1] A new source is considered a major source if emissions exceed these levels. A modification of an existing source is considered a major modification if emissions increases exceed these levels. Emissions increases are measured relative to actual emissions in 1977 or 1978 (baseline).

[2] Sources constructed after 1971 with potential emissions greater than these levels require an ACDP. The regulations are unclear as to the applicability of these thresholds to sources constructed prior to 1971, but modified during or after 1971.

Table 4-13. Significant Emission Rates for Air Pollutant Sources in Oregon Title V Program

Pollutant	Major Source Threshold Emission Rate [1] (tons/year)
Criteria Pollutants	100
Hazardous Air Pollutants	10 of any single pollutant 25 of a total of all pollutants

[1] Title V is applicable based on the source's potential to emit. Potential to emit assumes that the plant operates at full capacity 365 days per year, 24 hours per day. In determining if a plant is a major source, all sources of HAP emissions, including fugitive sources, are included. Criteria pollutant fugitives are included in determining if the facility is a major source only for listed source categories.

Requirements for Wilsonville

The Wilsonville WWTP does not currently have an air quality permit. Future considerations include controlling off-gasses from treatment processes and engine generators. Hazardous air pollutants that may be routinely emitted from Wilsonville's wastewater treatment facilities include hydrogen sulfide (H_2S), and specific volatile organic compounds (VOCs) such as benzene. Other criteria can be of concern when permanent engine generators (not back-up) are present.

Hydrogen sulfide emissions from the Wilsonville WWTP are dependent on influent H_2S concentration, the influent dissolved oxygen, and the unit processes in the treatment stream. The influent H_2S concentration is a factor of the ambient temperature in the collection system, since the metabolic rate of bacteria producing H_2S decreases as temperature decreases.

Potential VOC emissions from the Wilsonville WWTP were estimated using an assumed typical influent concentration of 0.4 mg/L, based on Metcalf and Eddy (1991), and a sample calculation is shown in Equation 1.

$$\frac{(2.25mgd)(0.4mg/L)(8.34L \times lb/mg \times 10^6 gal)(365days/year)}{2000lb/ton} \qquad (1)$$

Anticipated VOC emissions for the Wilsonville WWTP under year 2020 and ultimate buildout conditions are as shown in Table 4-14. Based on VOCs, Wilsonville does not qualify as a major or minor source.

Table 4-14. Estimated VOC emissions for current and future conditions.

VOC emissions in 2020, tons/year	VOC emissions at ultimate buildout, tons/year
3.1	4.5

Odors

Odor control is a concern at any wastewater treatment facility, and especially at the Wilsonville WWTP. There are no specific regulations governing odor control at WWTPs other than nuisance standards. The most common odor-producing gases are H_2S and VOCs. Other common odor-producing chemicals are listed in Table 4-15.

Table 4-15. Odorous compounds associated with untreated wastewater.

Odorous Compound	Chemical Formula	Odor Quality
Amines	$CH_3NH_2(CH_3)H$	Fishy
Ammonia	NH_3	Ammonia
Diamines	$NH_2(CH_2)_4NH_2$, $NH_2(CH_2)_5NH_2$	Decayed flesh
Hydrogen Sulfide	H_2S	Rotten eggs
Mercaptans (methyl and ethyl)	CH_3SH, $CH_3(CH_2)SH$	Decayed cabbage
Mercaptans (butyl and crotyl)	$(CH_3)_2S$, $(C_6H_5)_2S$	Skunk
Organic Sulfides	$(CH_3)_2S$, $(C_6H_5)_2S$	Rotten cabbage
Skatole	C_9H_9N	Fecal matter

Oregon DEQ does not currently regulate nuisance levels of odorous compounds. Regardless, the local community and neighbors are sensitive to odors from the wastewater treatment plant. Testing to detect hydrogen sulfide concentrations was conducted in November of 2001. While faint odors were detected at some process locations (influent flume, fine drum screen, under the covers of the aerobic digesters), no negligible odors were detected at the plant perimeter.

The City is moving forward with design and construction of biofilters to treat odorous air from the headworks area, primary clarifiers, aerobic digesters, and digested sludge storage tanks (2002 Wilsonville WWTP Odor Control Improvements project). The biofilters will have capacity for treatment of some future processes, and the alternatives analysis described in Chapter 5 considers the need for odor control for future processes.

Chapter 5. Alternatives Analysis

Introduction

A wide range of alternatives were considered for expanding the Wilsonville facility to meet future capacity and effluent quality requirements, and to address the existing plant deficiencies described in Chapter 3. This chapter describes the evaluation process used, identifies alternatives considered, and summarizes evaluation results.

The chapter focuses on the technical aspects of various process alternatives. Alternatives were evaluated based on the high flow projections. This approach defines the greatest capacity increase that the existing site could need to accommodate, and provides a conservative basis for site planning. Site layout implications and site master plan alternatives are discussed in Chapter 6. The comprehensive recommended plan and implementation approach is described in more detail in Chapter 7.

Organization

This chapter reviews the alternatives evaluation process, and then provides detailed alternatives analysis within each process area of the plant. The analysis is organized by the following major topics:

- **Design Criteria** – This section outlines the flows and loadings for which the process is designed. Where appropriate, this section also gives key process design criteria (clarifier overflow rate, etc.).. When design criteria vary widely between alternatives, the process-specific criteria are included with each alternative developed.
- **Alternatives Considered** – This section develops the alternatives considered for detailed analysis, and provides a description and summary table of the new facilities that would be constructed under each alternative. Key operational and design considerations are also included in this section.
- **Comparison of Alternatives** – This section summarizes the advantages and disadvantages of the alternatives, and presents a summary comparison of capital, operations and maintenance (O&M), and present worth costs. Detailed cost tables are included in the appendix.
- **Preliminary Recommendations** – This section provides a preliminary recommendation based on alternative evaluate criteria determined in a workshop with the City.

Evaluation Process

Alternatives were identified and evaluated through a staged process, as described below:

1. **Develop Evaluation Criteria.** Evaluation criteria that reflected the City's priorities were developed in a workshop with City staff.
2. **Brainstorm Alternatives.** Alternatives for each process area were identified through a series of workshops with City staff.

3. **Screen Alternatives.** A brief screening of all alternatives was conducted to identify any alternatives that were not compatible with the long-term operation of the treatment facility.

4. **Detailed Analysis of Alternatives.** Remaining alternatives were subjected to a detailed analysis according to criteria developed jointly by the City and the consultant.

5. **Evaluation of Alternatives.** Alternatives were evaluated based on the criteria developed in a workshop with the City.

Evaluation Criteria Development

Criteria for evaluation of alternatives were developed by HDR and City staff , and reflect the priorities of the City's wastewater program. These criteria are shown in Table 5-1.

Table 5-1. Evaluation Criteria

Regulatory Compliance	**Implementation**
Meets current NPDES requirements	Ability to logically phase expansion
Flexible – Allows for potential future NPDES requirements	Ease of construction
Meets current and anticipated biosolids regulations	Ability to maintain operation during construction
Operations/Technology	Permit/approval requirements
Proven performance/proven treatment process	**Community/Environmental Considerations**
Low complexity	Odor potential
Operational ease	Noise potential
Operational efficiency	Visual appearance
Ease of automation	Vector potential
Reasonable maintenance	Air quality impacts (non-odor)
Reliability	Truck traffic
Longevity	Hazardous chemicals
Flexible – allows for future growth	Public safety
Compatible with existing facilities	Light pollution
Safe/low use of hazardous chemicals	Compatibility with Significant Resource Overlay Zone
Cost	Height
Construction cost	**Compatibility with Site**
Cash flow	Ability to fit on site
Operations cost	Compatibility with surrounding land uses
Life cycle cost	

Alternatives Brainstorming and Screening

During the brainstorming session, numerous ideas for improving or expanding the Wilsonville facility were identified. In addition, many ideas were generated that were not alternatives themselves, but constituted features of various alternatives. The following table summarizes the alternatives identified in each process area, as well as features to be considered in the alternative analysis.

Table 5-2. Brainstorming Ideas

Process Area	Alternatives	Features
Headworks	• Additional 1 mm internally-fed fine screens; no separate grit removal	• Enclose headworks • Add mechanized gates at the splitter box • Address problem with grit buildup prior to the fine screen
Primary Treatment	• Retrofit existing tanks to serve only as primary clarifiers; add new circular primary clarifiers • Maintain existing clarifiers in current configuration and add new circular primary clarifiers • Add high rate sedimentation • No primary clarifiers	• Address piping modifications required at primary clarifier no. 2 • New clarifiers will have SST mechanisms
Secondary Treatment	• Expand nitrifying activated sludge • Membrane bioreactor (MBR) • Biological aerated filter (BAF) • Sequencing batch reactor (SBR)	• Examine step feed to increase basin capacity • Compartmentalize basins for improved redundancy • Address alkalinity drop in new drinking water source • Address problems with anoxic manhole (air entrainment, scum recycling) • Identify additional volume required for implementation of full biological nutrient removal (BNR) • Optimize selector size • Address operational issues: foam trap at entrance to basin, algae on secondary clarifiers, need for level sensors
Effluent Filtration	• Improved sand filters • Fuzzy filters – reuse only • Fuzzy filters – entire plant flow • Actiflo • No filters (with MBR option)	• Investigate chemical addition requirements for reuse
Disinfection	• Medium pressure UV • Low pressure UV • Sodium hypochlorite/ bisulfite • Peracaetic acid	
Outfall	• Add second outfall • Provide detention for peak flows • Pump through existing outfall	• Add diffuser to existing outfall
Thickening	• Continue use of gravity belt thickeners	
Solids Processing	• Class B digestion and hauling to Eastern Oregon • In-vessel composting • Lime stabilization • Heat treatment • Pasteurization • Autothermal thermophilic aerobic digestion (ATAD) • Drying • Class B digestion/land application on poplar plantation	• Need to determine when anaerobic digestion becomes more cost-effective • Need to investigate the potential markets for Class B vs. Class A biosolids • Need to add level sensors to digesters • Need to add dewatering and dewatered cake storage

Following initial brainstorming, a brief screening was conducted to identify alternatives that were not feasible or compatible with the City's long-term goals. Screening of the liquid stream treatment options was conducted by HDR; solids processing options were screened in a workshop with City staff. Based on this screening process, the following alternatives were dropped from consideration.

Table 5-3. Alternatives Dropped from Detailed Consideration

Alternative	Considerations
No Primary Clarifiers	This alternative precludes the City from moving to anaerobic digestion in the future. Because of this severe limitation, the alternative was not considered in detail.
Sequencing Batch Reactor	This alternative does not offer any benefits over the standard activated sludge process, and was not considered in detail.
Fuzzy Filters – Reuse Only	Future water quality requirements dictate that the City provide tertiary treatment for all flow. While separate filtration options for reuse flow only were not examined in detail, this type of configuration could be included in the recommended plan if appropriate.
In-vessel Composting	Footprint requirements for this technology are much larger than other solids processing alternatives. Given the constraints of the existing site, this technology was determined to be unworkable.
Lime Stabilization	Odors and operational issues associated with lime stabilization were considered fatal flaws for application at the existing treatment plant site.
Heat Treatment	Since this technology is very similar to heat drying and produces an end product that is less desirable than heat drying, it was not considered in detail. Heat treatment has been problematic at many plant sites and has also been a source of odors.
Autothermal Thermophilic Aerobic Digestion (ATAD)	Odor issues associated with ATAD systems were considered a fatal flaw for this technology.
Class B Digestion/Land Application on Poplar Plantation	Procuring land for a poplar plantation at a location reasonably close to the plant was not considered feasible. Therefore, this alternative was not considered further.

Detailed Evaluation of Alternatives

Following the initial brainstorm and screening steps, the remaining alternatives were developed in detail, and compared against evaluation criteria. This section identifies the alternatives evaluated, presents major design criteria used in development of the alternatives, and describes the cost estimating methodology.

Design Criteria

An array of design criteria was established to guide development of the treatment alternatives considered for the Wilsonville treatment plant.

Planning Horizon

In most cases, alternatives were developed for two projected flow and loading conditions: an interim expansion to provide capacity for 4 mgd ADWF (projected to occur in approximately year 2015), and an ultimate expansion to provide capacity for build-out flows of 7 mgd ADWF (projected to occur in approximately year 2035). The ultimate build-out case provided for a long-term economic and non-economic comparison of the alternatives, and identified ultimate facility requirements and space needs.

The recommended plan will address implementation triggers for specific elements of the treatment plant expansion. Implications of specific flow projection assumptions will be evaluated with respect to their impact on the recommended plan implementation.

Flows and Loadings

The initial development of alternatives was based on the flow and loading condition presented in Chapter 2. Since this is recognized to be a conservative estimate allowing for high levels of commercial and industrial development, implementation and phasing of the recommended plan will take into account a more moderate level of development.

Effluent Quality Requirements

Development of all unit processes was based on meeting the effluent quality requirements presented in Table 4-4 of Chapter 4.

Process Sizing Criteria

These criteria specify design loading rates and operating parameters for critical unit treatment processes. Examples include clarifier overflow rates, aeration basin mixed liquor concentrations, filter loading rates, and chlorine contact basin detention times.

Site Development Criteria

Site development criteria are addressed in general in the discussion of alternatives. Detailed information regarding site development criteria and site layout options will be discussed in Chapter 6.

Reliability/Redundancy Criteria

Alternatives were developed to meet EPA's *Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability* criteria (EPA-430-99-74-001), as well as the needs of plant staff. Reliability Class I standards were applied based on the proximity of the Wilsonville discharge to the water treatment plant intake, and the use of the Willamette River near Wilsonville for water contact sports.

Development of Costs

Costs are expressed in 2002 dollars. These estimates are approximations developed without detailed engineering or site-specific data. Estimates of this type can be expected to vary from 50 percent less than to 30 percent more than actual final project costs.

Capital costs include the following allowances and markups:

- Sitework: 20%
- Electrical and Controls: 30% of equipment
- Mobilization and Bonds 8%
- Contractor Overhead and Profit: 15%
- Miscellaneous Costs not Itemized: 30%
- Engineering, Legal, Admininstration 25%

Headworks Alternatives

Existing Facilities

The preliminary treatment system consists of a rotary drum fine screen with 1mm openings, with screenings compaction and storage in a dumpster prior to disposal at a landfill. Following completion of 2002 Wilsonville WWTP Odor Control Improvements project, the screw conveyor will convey screenings from the fine screen to a screenings washer/compactor unit. Screenings will be stored in an uncovered dumpster at the headworks, and if necessary, transferred to a covered dumpster for additional storage prior to disposal at the landfill.

Manual slide gates at the influent split box can be used to divert flow to a 5/8-inch bar screen when the rotary drum screen is offline.

The existing headworks is not covered and is a source of odors. Pilot testing of a screenings washer/compactor unit during the summer of 2001 showed that odors were significantly decreased due to improved screenings washing and compaction. Nevertheless, staff would like to have the entire headworks area enclosed and ventilated for odor reduction as this is a critical priority for the City.

Design Criteria

The headworks must be able to accommodate projected peak flows. Although not required for regulatory compliance, plant staff would also like the headworks to incorporate a backup fine screen for redundancy. Projected peak flows at the treatment plant are shown in Table 5-4. Average dry weather flows (ADWF) are also shown for reference.

Table 5-4. Headworks Design Criteria

Year	Peak Flow, mgd	ADWF, mgd
2005	7.9	2.7
2010	10.0	3.4
2015	12.1	4.1
2020	14.3	4.8
2025	16.4	5.6
2030	18.6	6.3
2035	20.7	7.0

At the design average-day dry-weather flow rates of 4 and 7 mgd, peak hour influent flows are 11.8 and 20.7 mgd, respectively.

Alternatives Considered

The only alternative selected for evaluation in the facility plan was expansion of the existing processes at the headworks. No other technologies for screening, grit removal, and screenings washing/compaction were evaluated. Based on prior plant performance, the City did not feel that additional grit removal was necessary. However, the Plan did consider the following operational issues:

- Addressing the "rock trap" upstream of the fine screen
- Adding electric actuators for the influent gates

- Enclosing the headworks for odor control.

Inadequate pressure washing of the fine screen has historically led to blinding, limiting the effective capacity of the screen to approximately 4 mgd. The 2002 Wilsonville WWTP Odor Control Improvements project is adding a high pressure wash to address grease buildup, which may provide some additional hydraulic capacity. However, for purposes of alternatives analysis, it is assumed that the existing screen capacity will remain at 4 mgd.

Facilities Required/Key Design Information

Table 5-5 summarizes the phasing of improvements, and firm and total capacity after each phase of headworks expansion. In order to provide a firm capacity of 20 mgd at ultimate build-out, three screening channels will be required. The primary issue associated with implementation of improvements at the headworks is phasing of the new screens. Ultimately, two additional screens capable of handling 10 mgd of flow each would provide the required capacity. One of these screens could be located in the existing channel served by the bar screen, with a third channel constructed to the north of the existing fine screen channel. By constructing the new channel first, the City maximizes the firm screening capacity, and also establishes the final footprint of the headworks building. Replacing the existing rotary fine screen with a 10 mgd fine screen would be the last phase of capacity expansion. Although Table 5-5 assumes that the capacity of the existing bar screen is 8 mgd, it is reasonable to assume that close to 10 mgd of flow could be passed by the existing bar screen during a peak flow event, providing adequate firm capacity at ultimate buildout. However, if a fine screen was out of service during a peak flow event, debris would pass through the headworks and could produce identifiables in the biosolids. Wilsonville should explore landfilling options in the future to provide a temporary disposal option in this scenario. If this is not acceptable, Wilsonville could replace the existing bar screen with another fine screen, shown in Table 5-5. A cost saving alternative to this approach would be to replace the existing bar screen with a bar screen with a smaller opening size.

In addition to increasing screening capacity, a redundant screenings washer/compactor unit should be added. The unit currently being installed has a capacity of 150 cu.ft./hr. This capacity is more than adequate to serve the plant through ultimate build-out.

Table 5-5. Required Facilities for Headworks Expansion

Expansion	Additional Equipment	Firm Capacity	Total Capacity	Capital Cost
4.0 mgd expansion	• New fine screen; 10 mgd capacity (all existing equipment remains in place) • Redundant Washer Monster	12 mgd (including existing bar screen)	22 mgd (including existing bar screen)	$ 1,782,000
7.0 mgd expansion	• Replace existing fine screen with new fine screen; 10 mgd capacity	18 mgd (including bar screen)	20 mgd (including bar screen)	$ 795,000
7.0 mgd expansion (optional)	• Replace bar screen with new fine screen; 10 mgd capacity	20 mgd	30 mgd	$ 720,000

As Table 5-5 shows, the ultimate firm capacity is lower than the projected peak hour capacity at ultimate build-out. Since it is not a regulatory requirement that firm screening capacity be provided for peak hour flows, this is assumed to be adequate as long as it is acceptable to plant operations staff. The maximum day projected flow at build-out is 14 mgd, so the headworks' firm capacity more than meets maximum day flows. If, as flows approach build-out projections, the City desires to provide firm screening capacity of 20 mgd, the existing channel can be modified to provide additional hydraulic capacity, and the existing screen could be replaced with a 10 mgd screen.

Preliminary Recommendations

As indicated in Table 5-5, it is recommended that a redundant fine screen and washer monster be added in the near-term. Assuming the third fine screen can be retrofit in the existing bar screen channel, these near-term improvements will define the footprint required for ultimate enclosure of the headworks processes. When the near-term improvements are made, the headworks should be enclosed and all foul air treated in the biofilter being constructed in the 2002 Wilsonville WWTP Odor Control Improvements project.

Modifications to the influent flow split structure will be needed to direct flow to the three screenings channels. A new influent flow split structure will be constructed using mechanized slide gates for flow control.

A grit pump and classifier could be added for automatic or manual removal of grit that collects upstream of the fine screen. However, with a redundant fine screen on line, flow could be diverted to the new screen and grit removed manually as part of the plant's routine maintenance. Under normal operation, grit that builds up above the invert of the fine screen should be scoured out by the influent flow, therefore it is not likely that grit accumulation will affect the hydraulics of flow through the headworks. It is not recommended that any mechanical changes be incorporated to address grit removal upstream of the fine screen.

Finally, the site master plan should allow space for some type of future grit removal, should this technology be required due to operational issues or performance of downstream processes. With the site constraints at the facility, grit removal would likely be added through primary sludge degritting rather than through another liquid stream process downstream of the fine drum screens.

Primary Treatment Alternatives

Design Criteria

Primary clarifiers are typically designed to provide overflow rates not to exceed 1,000 gpd/sf under maximum-month dry-weather conditions, and 2,500 gpd/sf under peak hour conditions. Plant staff desire that the maximum-month dry-weather condition be met with the largest unit out of service; peak hour conditions can be met with all units in service[1]. Based on these design criteria and projected flows, Table 5-6 shows the required primary clarifier surface area.

Table 5-6. Primary Clarifier Design Criteria

[1] EPA and state criteria require only that, "with the largest flow capacity unit out of service, the remaining units shall have a design flow capacity of at least 50 percent of the total design flow to that unit operation". (EPA-430-99-74-001)

Condition	4.0 mgd ADWF	7.0 mgd ADWF
Design Flows, mgd		
Maximum Month Dry-Weather	4.26	7.46
Peak Hour	11.87	20.78
Total Square Feet of Surface Area Required		
Maximum Month Dry-Weather	4,263	7,430
Peak Hour	4,750	8,312

Alternatives Considered

The following alternatives were considered for detailed analysis:

- Alternative 1: No modifications to existing clarifiers; add new circular clarifiers
- Alternative 2: Retrofit existing tanks to serve as clarifiers only; add new circular clarifiers
- Alternative 3: High-rate sedimentation

Alternative 1 – No Modifications to Existing Primary Clarifiers

The existing clarifiers have a total surface area of 2,771 sf. As Table 5-7 shows, constructing one new clarifier initially meets the peak hour overflow rate criteria, but it does not meet the City's redundancy criteria of treating the maximum-month flows at the design overflow rate (1,000 gpm/sf) with one unit out of service. Two new clarifiers would need to be constructed initially, with a third new clarifier added prior to build-out.

Table 5-7. Primary Clarifier Design Criteria; Alternative 1

Parameter	4.0 mgd	7.0 mgd
Existing clarifier area, sf	2,771	2,771
Additional area at MMDWF, sf[1]	1,492	4,689
Additional area at PH, sf[2]	1,979	5,541
Area (sf)per clarifier, new (60' diameter)	2,827	2,827
Additional clarifiers at MMDWF	0.53	1.66
Additional clarifiers at PH	0.70	1.96
No. of new clarifiers built	1	2
Total SF	5,598	8,426
MMDWF gpd/sf (largest out of service)	*4,285*	*7,500*
Overflow rate (gpd/sf) at peak hour (all in service)	2,121	2,466
Assuming redundant clarifier is built for maximum month conditions:		
Existing clarifier area, sf	2,771	2,771
Total no. of new clarifiers built	2	3
New SF	5,655	8,482
Total SF	8,426	11,253
Firm SF	5,598	8,426
Overflow rate (gpd/sf) at MMDWF (firm)	761	885
Overflow rate (gpd/sf) at peak hour (total)	1,409	1,847

1. Based on 1,000 gpd/sf maximum overflow rate
2. Based on 2,500 gpd/sf maximum overflow rate

Facilities Required/Key Design Information

Based on Table 5-7, the following facilities are required for Alternative 1:

Table 5-8. Facilities Required; Alternative 1

Item	Unit	New Facilities at 4.0 mgd ADWF	Total New Facilities at 7.0 mgd ADWF
Primary clarifiers	Number/diameter	2 @ 60 ft	3 @ 60 ft
Primary sludge pumps	Number/gpm	2 @ 50	3 @ 50
Primary scum pumps	Number/gpm	2 @ 10	3 @ 10

New clarifiers were sized at 60-ft diameter to allow for reasonable phasing and provide the total surface area required at ultimate build-out. A flow split structure upstream of the clarifiers would be required to balance flows between the existing smaller clarifiers and the new larger clarifiers.

Alternative 2 – Retrofit Existing Primary Clarifiers

This alternative requires the demolition of the walls between the existing aerobic digesters and primary clarifiers, and retrofitting the basins with new mechanisms and associated improvements to serve as primary clarifiers only. This would greatly increase the surface area of the existing primary clarifiers (to 5,153 sf/clarifier), and require the construction of new digesters. Proposed modifications are shown in Figure 5-1.

Design and redundancy criteria are the same as listed for Alternative 1. The total surface area required based on these criteria is given in Table 5-9. Required surface area is given in terms of nominal design conditions of 4.0 and 7.0 mgd average dry weather flow.

Table 5-9. Primary Clarifier Design Criteria; Alternative 2

Design Flows	**4.0 mgd**	**7.0 mgd**
Additional Square Feet of Surface Area Required		
Maximum Month Dry Weather[1]	0	2,307
Peak Hour[2]	0	0
Number of Additional 80'-diameter Clarifiers Required		
Maximum Month[1]	0	0.5
Peak Hour[2]	0	0

1. Based on 1,000 gpd/sf maximum overflow rate
2. Based on 2,500 gpd/sf maximum overflow rate

For planning purposes, it is assumed that new primary clarifier will be 80 feet in diameter. These would be comparable in size to the retrofitted existing clarifiers (82-foot diameter).

Construction of new digestion facilities would be required before the demolition of clarifier/digester walls. This alternative would work effectively with the transition to anaerobic digestion, discussed later in this chapter

Facilities Required/Key Design Information

Table 5-10 shows the size and quantity of equipment required to meet design criteria at average dry weather flows of 4.0 and 7.0 mgd. Wilsonville could postpone the construction of a new primary clarifier for approximately 10 years by demolition of the existing aerobic digesters.

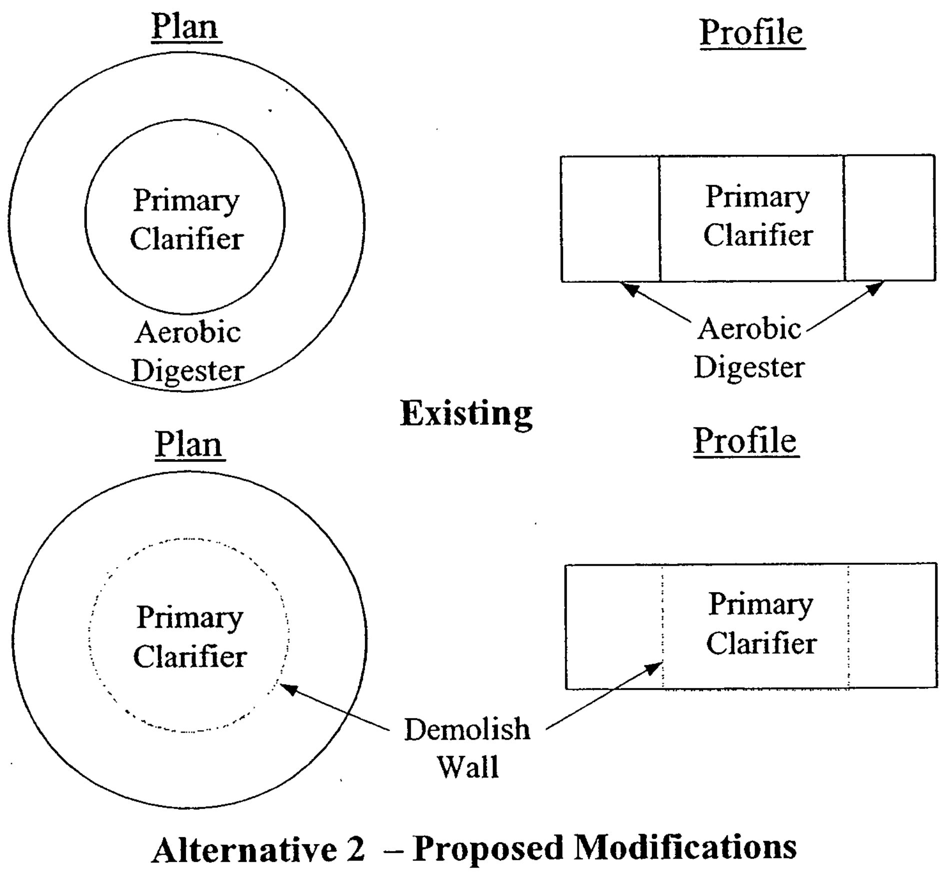


Figure 5-1. Proposed Primary Clarifier Modifications; Alternative 2.

Retrofitting the existing digesters requires new mechanisms, and new primary sludge and scum pumps to accommodate the larger flows.

Construction sequencing of the clarifier retrofit will be tied to the City's decisions regarding both digester and secondary treatment capacity additions. It may be prudent to construct additional secondary treatment capacity prior to modifying the clarifiers, ensuring that adequate downstream capacity is available to compensate for the temporary lack in primary removal.

Table 5-10. Facilities Required; Alternative 2

Item	Unit	New Facilities at 4.0 mgd ADWF	New Facilities at 7.0 mgd ADWF
Primary clarifiers	Number/diameter	2 new mechanisms	1 @ 80 ft
Primary sludge pumps	Number/gpm	3 @ 20	1 @ 20
Primary scum pumps	Number/gpm	3 @ 10	1 @ 10

Alternative 3 – High Rate Sedimentation

High-rate sedimentation processes flocculate influent by using micro-sand, sludge, or other agents to accelerate the settling velocity of influent particles. Two high-rate processes that are commercially available for application in Wilsonville are Actiflo® and DensaDeg®. The Actiflo® processes uses microsand to flocculate solids in the primary influent, whereas the DensaDeg® process flocculates solids using recycled sludge. The disadvantage of a process that uses sludge to increase settling velocity is that when peak flows occur, washout of the sludge is possible. There are few full-scale installations of these technologies for primary treatment of municipal wastewater in the United States, however both processes were pilot tested by the King County Department of Natural Resources in 2001-2. The Actiflo® process produced excellent results. Pilot testing problems with the DensaDeg® process preclude analysis of the primary treatment results.

Manufacturers of high-rate sedimentation systems typically recommend fine screening (3 mm) and grit removal upstream of the process. For Wilsonville, no additional treatment will be required prior to high-rate sedimentation. Typically, polymer and/or coagulant are added to enhance flocculation and settling of raw sewage particles.

The following is a summary of the recommended design criteria for the Actiflo® process, which will be used for planning purposes:

- Injection Tank Detention Time = 1 minute
- Maturation tank detention time = 3 minutes
- Settling tank overflow rate = 50 gpm/sf (72,000 gpd/sf)

Two options for high-rate sedimentation will be considered: 1) retrofit of existing primary clarifier/digester units for clarification only (similar to primary clarifier Alternative 2), with additional capacity added using high-rate sedimentation; and 2) addition of high rate sedimentation for all primary flows. .

Option A. Retrofitting the two existing clarifiers with larger mechanisms would allow them to serve the plant through 2020. Additional flow would be treated using a high-rate sedimentation unit. For planning purposes, it is assumed that flow will be split between the existing clarifiers and the new high-rate clarifier under all flow conditions. However, the plant could be operated by base-loading the conventional primary clarifiers and diverting peak flow to the high rate sedimentation.

Option B. High rate sedimentation could be provided for all plant flow, allowing the City to abandon the existing clarifiers.

Facilities Required/Key Design Information

Table 5-11 shows the size and capacity of process units required for nominal average design flows of 4.0 and 7.0 mgd for options A and B. The table assumes that two trains of Actiflo® are installed.

Table 5-11. Facilities Required; Alternative 3A and 3B

Item	Unit	New Facilities at 4.0 mgd ADWF	New Facilities at 7.0 mgd ADWF
Option 3A			
Injection Tank	Number	—	1 @ 10.1'x7'x14'
Maturation Tank	Number	—	1 @ 14.1'x15'x14'
Settling Tank	Number	—	1@ 15'x15'x14'
Mixers	Number/hp	—	2 @ 5
Sand Recirculation Pump	Number/hp	—	1 @ 25
Scraper Motor	Number/hp	—	1 @ 1.5
Option 3B			
Injection Tank	Number	1 @ 10.1'x7'x14'	1 @ 10.1'x7'x14'
Maturation Tank	Number	1 @ 14.1'x15'x14'	1 @ 14.1'x15'x14'
Settling Tank	Number	1@ 15'x15'x14'	1@ 15'x15'x14'
Mixers	Number/hp	2 @ 5	2 @ 5
Sand Recirculation Pump	Number/hp	1 @ 25	1 @ 25
Scraper Motor	Number/hp	1 @ 1.5	1 @ 1.5

Comparison of Alternatives

Table 5-12 summarizes the advantages and disadvantages of the primary treatment alternatives.

Table 5-12. Comparison of Primary Treatment Alternatives

Primary Treatment Alternative	Advantages	Disadvantages
Alt 1: Use Existing Clarifiers, Add New Circular Clarifiers	• Continues with current technology	• Least compact – requires most overall area on site
Alt 2: Expand Existing Clarifiers, Add New Circular Clarifiers	• Continues with current technology	• Somewhat difficult implementation • Requires demolition of digesters
Alt 3A: Expand Existing Clarifiers, Add New High-Rate Process	• Cost competitive with Alt 2 with much smaller footprint (500 sf vs. 5000 sf) • Greatest flexibility	• Two process trains with different technologies • Requires demolition of digesters
Alt 3B: Remove Existing Clarifiers, Add New High-Rate Process	• Extremely compact	• Most difficult implementation • Requires demolition of digesters

Table 5-13 summarizes the costs of the primary treatment alternatives. A table with detailed cost information is included in the appendix.

Table 5-13. Summary Cost Comparison of Primary Treatment Alternatives (Costs in $1,000s)

	Alternative 1 – Continue Existing Clarifiers		Alternative 2 – Retrofit Existing Clarifiers		Alternative 3A – Retrofit + High-Rate Clarification		Alternative 3B – High Rate Clarification Only	
	4.0 mgd	7.0 mgd	4.0 mgd	7.0 mgd	4.0 mgd	7.0 mgd	4.0 mgd	7.0 mgd
Total Capital Cost	$2,968	$1,484	$3,275	$2,575	$3,155	$4,445	$4,446	$4,087
Annual O&M Cost	$9	$ 19	$ 12	$ 20	$ 12	$ 68	$ 112	$ 201
Present Worth Capital Cost	$2,744	$ 891	$3,028	$1,546	$ 2,917	$ 2,669	$ 4,111	$ 2,454
Total Present Worth Cost	$3,986		$4,970		$6,635		$10,405	

Preliminary Recommendations

The alternatives are ranked with respect to the evaluation criteria on Figure 5-1, shown on the following page. Most of the alternatives are comparable with respect to the evaluation criteria, but two overriding factors drive the overall scoring:

- Difficulty of locating additional primary clarifiers to augment the existing clarifiers in the existing configuration, and
- Cost of completely converting to ballasted flocculation, due to the high annual chemical costs.

Based on the evaluation criteria, alternatives 2 and 3A are equally attractive for providing future primary clarification. For the initial plant expansion to an ADWF capacity of 4 mgd, these alternatives are identical. Therefore, the preliminary recommendation is to retrofit the existing clarifier/digesters to serve as conventional primary clarifiers. Modifications to the clarifiers should also include new stainless steel mechanisms and new covers for odor control. For site planning purposes, a third conventional primary clarifier will be assumed to be added for ultimate build-out. However, because additional primary clarifier capacity will not be required until after 2015, the decision of what type of technology to use can be deferred until a later date.

Modifications to the existing primary clarifiers need to address the problem of weirs in the north primary clarifier becoming submerged at high flows. A flow restriction in primary effluent pipeline is the cause of the problem.

Figure 5-1. Primary Treatment Alternatives Preliminary Evaluation

Evaluation Criteria	Alt 1: Use existing clarifiers, add new circular clarifiers	Alt 2: Retrofit existing clarifiers, add new circular clarifiers	Alt 3A: Expand existing clarifiers, add new high-rate sedimentation process	Alt 3B: Remove existing clarifiers, add new high-rate sedimentation process	Comments
Regulatory Compliance	●	●	●	●	
Operations/ Technology	◑	●	◕	◕	
Implementation	●	◑	◑	◔	Alternatives involving demolition will be most difficult to implement
Community/ Environmental	◕	◕	◕	◕	
Compatibility With Site	○	◑	◕	●	Alternatives involving high-rate sedimentation have a smaller footprint
Cost	◑	◕	◕	○	Alternatives involving high-rate sedimentation have the highest cost
Total	◑	◕	◕	◑	

Worse ○ ◔ ◑ ◕ ● Better

Secondary Treatment Alternatives

Design Criteria

This section evaluates secondary process capacity with respect to effluent permit compliance. Design flows to the secondary treatment process for the nominal 4 mgd and 7 mgd expansions are shown in Table 5-14.

Table 5-14. Design Flows for Secondary Treatment Alternatives

	4.0 mgd	7.0 mgd
ADWF	4.0	7.0
MMDWF	4.3	7.4
MWDWF	4.5	7.9
MDDWF	5.3	9.2
AWWF	4.9	8.5
MMWWF	5.6	9.8
MWWWF	6.6	11.5
MDWWF	7.9	13.9

Typically the conventional activated sludge process is limited by biological loading, oxygen supply, or maximum solids loading rate to the secondary clarifier. For other processes such as the membrane bioreactor (MBR) or biological aerated filter (BAF), the maximum flux rate and hydraulic loading may be the limiting factor. These elements are discussed in further detail in the following section.

Existing Facilities

The performance of the existing system was simulated using a BioWin biological process model. The aeration basin capacity is primarily a function of the oxygen uptake rate, which is reflected in the mixed liquor suspended solids (MLSS) concentration. The capacity also depends on the unaerated basin volume (which could serve as a selector and/or denitirification zone), and the target effluent ammonia concentration. Figures 5-2 through 5-4 below show the capacity per aeration basin under different scenarios, assuming a maximum MLSS concentration of 3,500 mg/L. The results can be summarized as follows:

- With BOD removal only and an anoxic selector, each aeration basin has a capacity of approximately 2.7 mgd (Figure 5-2), and effluent ammonia is approximately 19 mg/L.
- With nitrification only and no selector, each aeration basin has a capacity of approximately 1.6 mgd (Figure 5-3). Under this operating scenario, the effluent ammonia is just over 2 mg/L.
- With nitrification and 25 percent of the basin volume used for a selector or for denitrification, each aeration basin has a capacity of approximately 1.5 mgd (Figure 5-4). Under this operating scenario, effluent ammonia increases to approximately 1.5 mg/L.

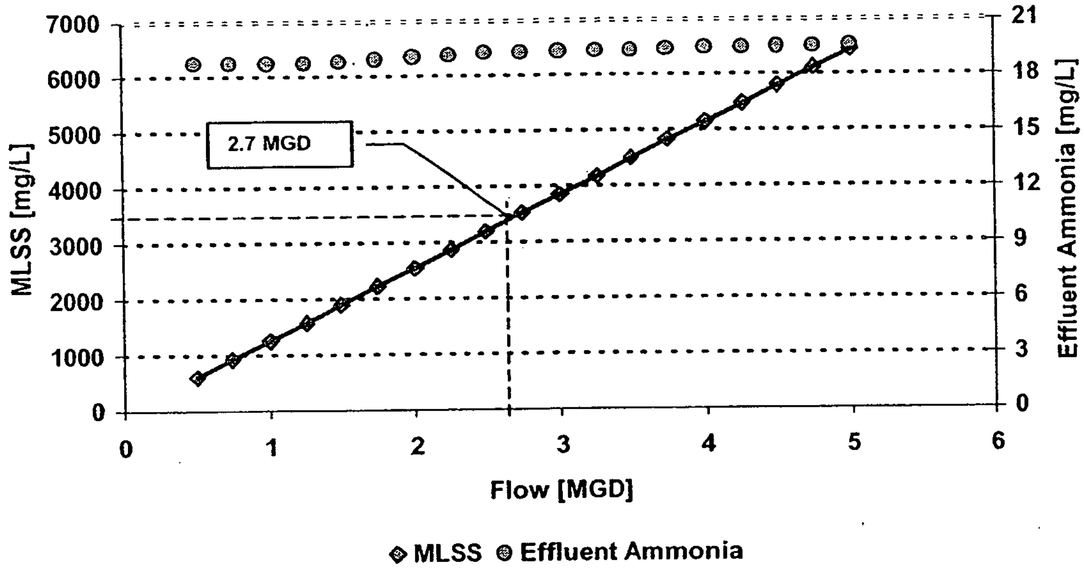


Figure 5-2: Aeration basin capacity when operated for BOD removal only, with anoxic selector

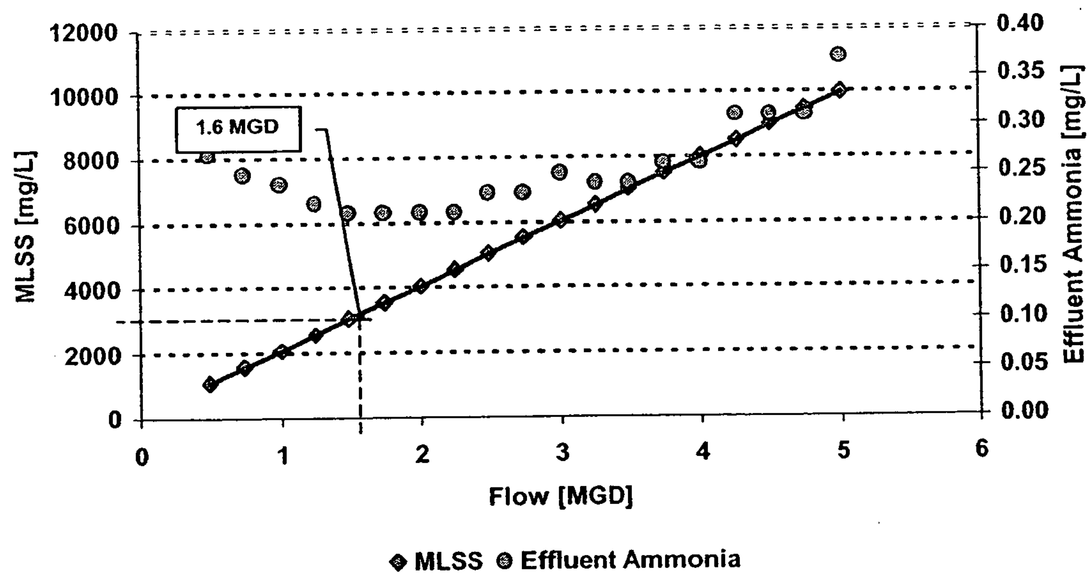


Figure 5-3: Aeration basin capacity when operated for nitrification, no selector.

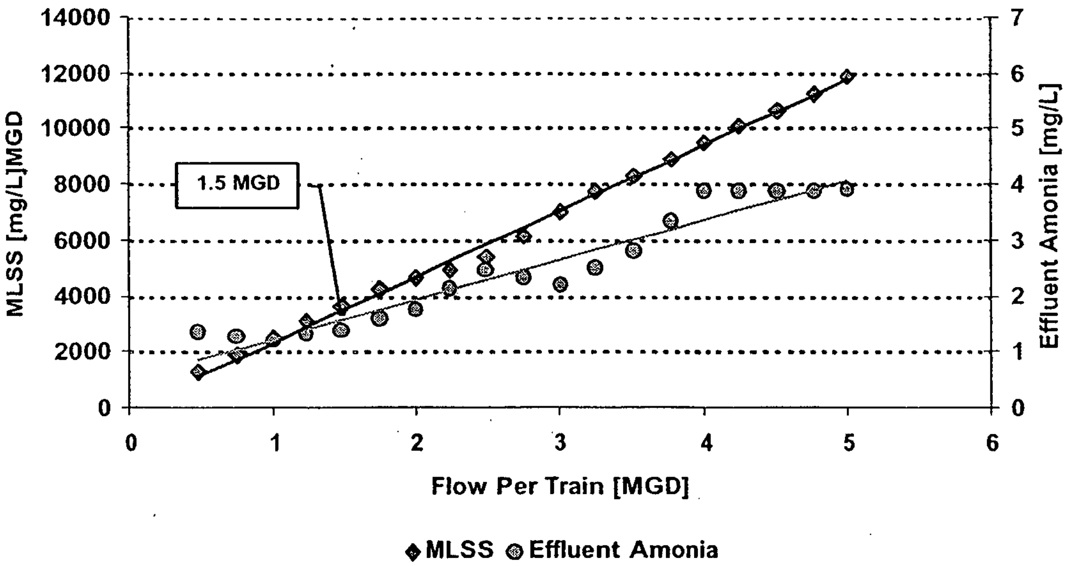


Figure 5-4: Aeration basin capacity when operated for nitrification with 25 percent of the basin volume as an anoxic selector

These simulations are based on a return activated sludge (RAS) recycle rate of 50 percent, and typical influent ammonia concentrations. Assuming future anaerobically-digested solids dewatering, the ammonia load from dewatering centrate typically equates to 15 to 20 percent of the influent ammonia load. The analysis assumes that centrate will be stored and returned to the process flow during off-peak hours so that the maximum ammonia load to the secondary treatment process is not increased.

The capacity of each complete treatment train (aeration basin and secondary clarifier) is determined not only by the aeration basin performance but also by the solids loading on the secondary clarifier. Literature recommendations for design solids loads in secondary clarifiers range from 21 lbs/sf/d to 29 lbs/sf/d with a peak of 48 lbs/sf/d. Figure 5-5 shows the aeration basin flow as a function of MLSS concentration and secondary clarifier loading rate. At a MLSS concentration of 3,500 mg/L, a secondary clarifier loading of 25 lb/sf/day, and a RAS recycle rate of 50 percent, each secondary clarifier is rated at approximately 2.2 mgd. Not including RAS recycle, this flow results in an overflow rate of 570 gpd/sf, which is less than a typical design criteria of 600 gpd/sf at average day flow. Therefore, the aeration basins will control capacity when in the nitrification mode of operation. Alternately, if nitrification is not required, the secondary clarifiers are the controlling component of the system.

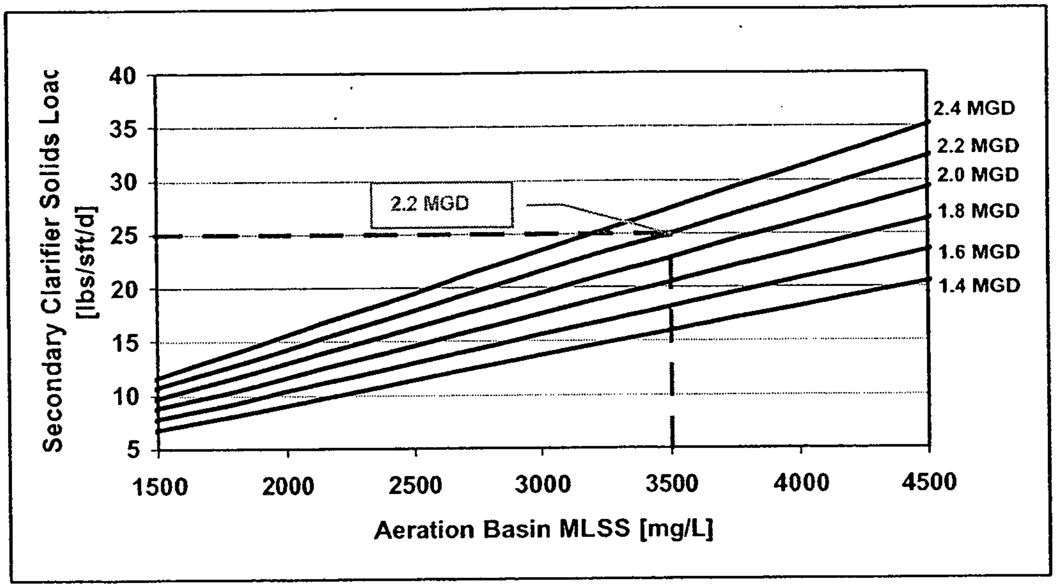


Figure 5-5: Relationship between MLSS, design secondary clarifier solids load and aeration basin capacity.

Alternatives Considered

Three alternatives were considered for expansion of the secondary treatment process:

- Additional conventional activated sludge/secondary clarifier trains
- Addition of membrane bioreactors (MBR) with no secondary clarifiers
- Addition of biological aerated filters (BAF) with no secondary clarifiers

Alternative 1 – Conventional Activated Sludge

This alternative involves continued use of the type of technology currently in place at the plant. The analysis of the existing system capacity was extrapolated to determine the number of treatment trains required for the nominal design average dry weather flows of 4 and 7 mgd. Figure 5-6 shows the number of basins required for BOD removal only, nitrification only, or nitrification and partial denitrification including a 25 percent anoxic zone. The anoxic zone would select against the growth of filamentous bacteria, as well as providing additional alkalinity to maintain a stable culture of nitrifying organisms. Some supplemental alkalinity addition (typically provided in the form of hydrated lime) may be required, depending on the level of influent alkalinity typically observed after the new water treatment plant has reached stable operation.

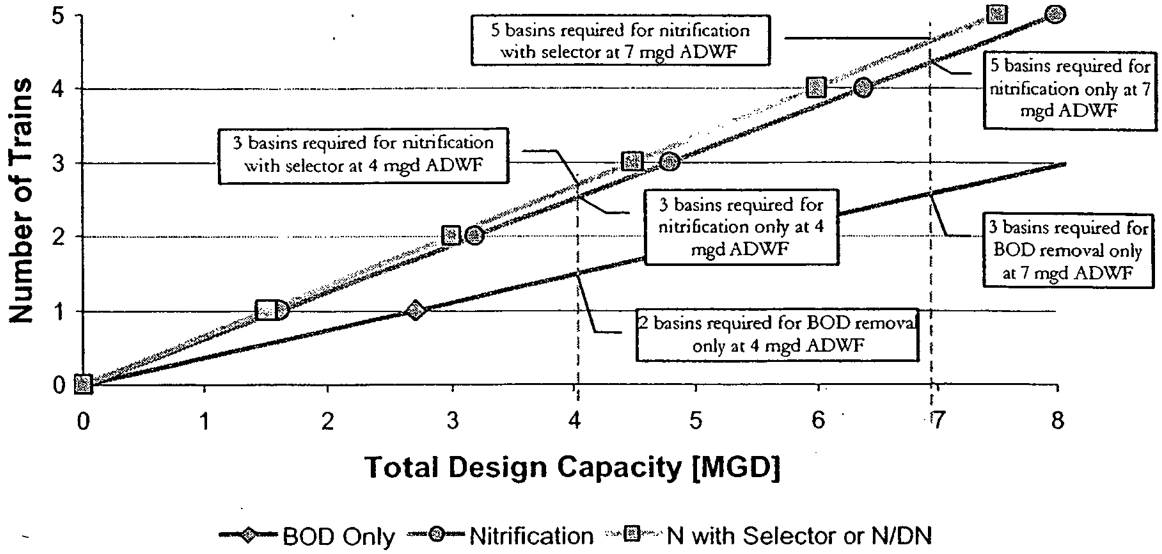


Figure 5-6: Aeration basin capacity vs. MLSS and Effluent Ammonia.

As Figure 5-6 shows, assuming nitrification is required, a third aeration basin/secondary clarifier train is needed to treat an equivalent ADWF of 4 mgd, with two additional trains required to meet ultimate build-out flow and loading projections. If nitrification were not required, the three aeration basins originally planned in the 1995 Facilities Plan would be sufficient through build-out, although additional secondary clarifier capacity would be required.

If 25 percent of the basin volume is operated in an anoxic mode, the projected effluent ammonia from the treatment process is approximately 1.5 mg/L. If a lower ammonia limit is imposed in the future, additional aeration capacity would be required. This could be achieved by providing additional basin volume, or reducing the selector volume and relying entirely on chemical addition to supply the necessary alkalinity.

Facilities Required/Key Design Information

Based on Figure 5-6, in order to continue operation with nitrification and an anoxic selector, the following facilities are required. Anoxic recycle pumps will be provided for the two existing aeration basins and for the new basins. Sizing for anoxic recycle pumps is based on a recycle flowrate of 200 percent.

Table 5-15. Facilities Required; Alternative 1

Item	Unit	New Facilities at 4.0 mgd ADWF	New Facilities at 7.0 mgd ADWF
Aeration Basins	Number/volume	1 @ 0.79 MG	2 @ 0.79 MG
Secondary Clarifiers	Number/diameter	1 @ 70 ft	2 @ 70 ft
RAS pumps	Number/gpm	1 @ 1000	2 @ 1000
Anoxic Recycle pumps	Number/gpm	3 @ 2100	2 @ 2100
Blower/RAS Building	sf		1 @ 3300

Alternative 2 – Membrane Bioreactors

The membrane bioreactor (MBR) treatment process is a suspended growth process in which effluent is drawn through hollow-fiber membranes immersed in an aerated tank. Clarified secondary effluent is withdrawn by applying a slight vacuum to the membrane. A conventional aeration basin provides the process air requirements and system operation for BOD removal, nitrification, deintrificaiton, or biological phosphorus removal. Return activated sludge (RAS) is returned from the membrane tank to the head end of the aeration basin as in conventional activated sludge. Since the limitation on solids loading to a secondary clarifier is removed, MBRs can be operated at higher mixed liquor suspended solids concentrations provided a reasonable oxygen uptake rate is maintained. Solids retention times (SRTs) in MBR basins typically range from 10-20 days, with mixed liquor suspended solids concentrations as high as 10,000 mg/L. MBRs are sensitive to high fluctuations in flow and loading.

The membrane modules used in MBRs can be mounted in the aeration basin or in a separate tank. For Wilsonville's facility, it is assumed that the membranes would be mounted in the existing aeration basins, or in new basins of similar configuration.

The following design criteria were used to determine the potential capacity of the existing aeration basins operated in MBR mode:

Design MLSS:	12,000 mg/L
Design Oxygen Update Rate (OUR):	100 mg/L/h
Max OUR:	150 mg/L/h
Max Hydraulic Capacity:	1.2 x secondary treatment capacity
Design SRT:	15 days

Figures 5-7 through 5-10 show the maximum capacity of the existing aeration basins retrofitted as MBR basins under different configurations. Figure 5-7 shows that a fully aerated basin retrofitted as a MBR could process 4.4 mgd of flow without exceeding the maximum MLSS concentration of 12,000 mg/L, producing effluent with ammonia concentrations under 0.3 mg/L. Figure 5-8 shows that the design capacity is only 4.2 mgd based on OUR criteria. Therefore, the capacity of the MBR basins is determined by OUR design criteria.

If 25 percent of the basin volume is reserved as an anoxic zone, the treatment capacity of the existing basins is reduced to 3.8 mgd, and the effluent ammonia concentration increases to approximately 2 mg/L (Figure 5-9). Under this scenario, the OUR never exceeds 100 mg/L/hr, so the design MLSS value of 12,000 mg/L controls the design capacity of the basin (Figure 5-10).

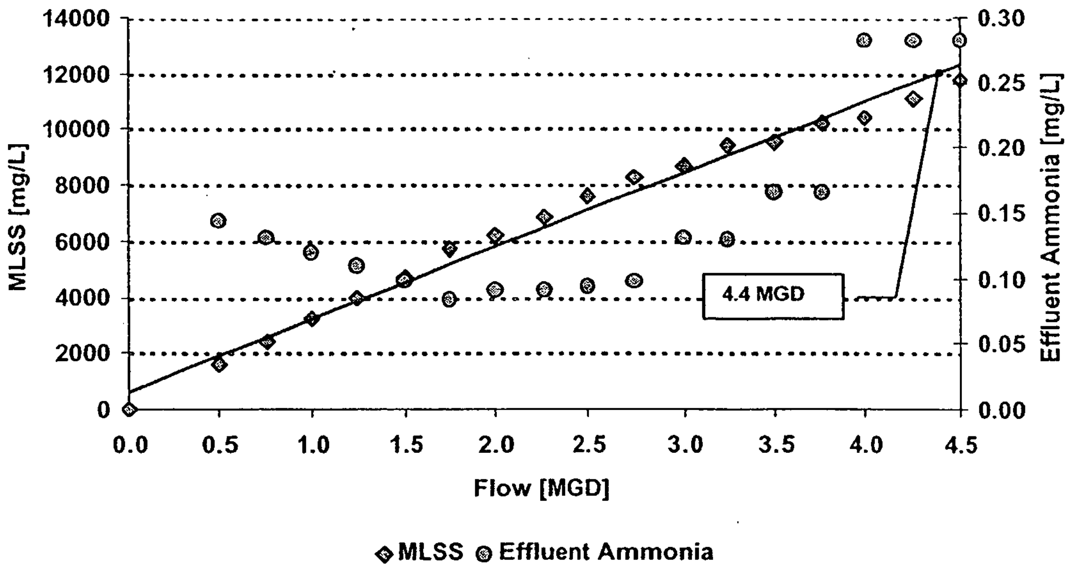


Figure 5-7: MBR capacity vs. MLSS and Effluent Ammonia; basin fully aerated

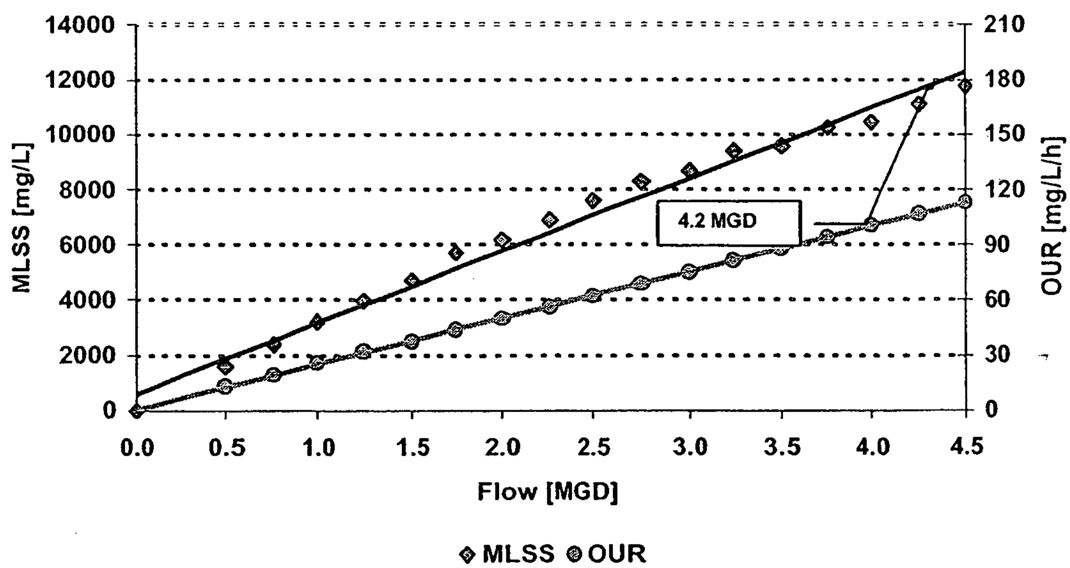


Figure 5-8: MBR capacity vs. OUR; basin fully aerated

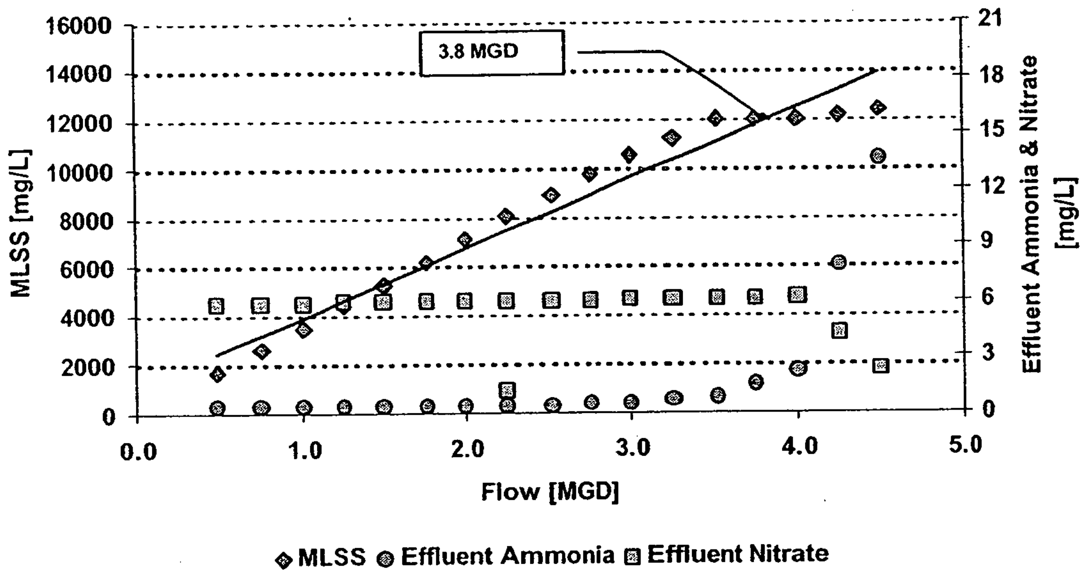


Figure 5-9: MBR capacity vs. MLSS and Effluent Ammonia; 25 percent anoxic volume

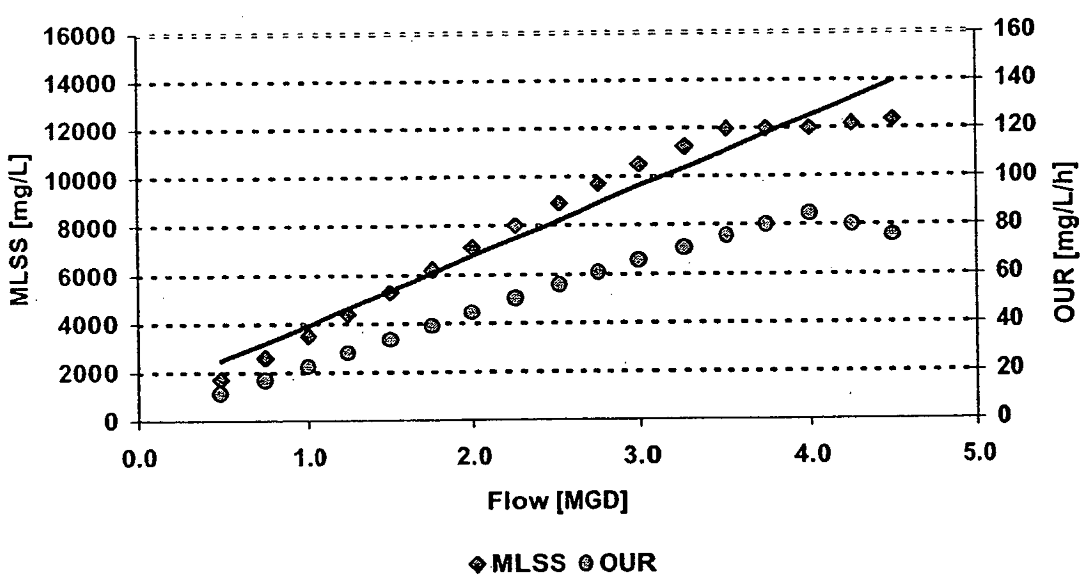


Figure 5-10: MBR capacity vs. OUR; 25 percent anoxic volume

Facilities Required/Key Design Information

At build-out, two MBR trains and one conventional activated sludge train would be required. The main purpose for maintaining one conventional activated sludge train is to absorb peak flows and minimize the diurnal alternation in required membrane flux in the MBR. Facilities required for Alternative 2 are shown in Table 5-16.

Table 5-16. Facilities Required; Alternative 2

Item	Unit	New Facilities at 4.0 mgd ADWF	New Facilities at 7.0 mgd ADWF
Aeration Basins	Number/volume	0	1 @ 0.79 MG
Secondary Clarifiers	Number/diameter	0	0
RAS pumps	Number/gpm	0	1 @ 1000
Membrane Modules	Number	1	2
Anoxic Recycle Pumps	Number/gpm	2 @ 2,100	1 @ 2,100

Table 5-16 reflects initial installation of an MBR module in an existing basin, with no future secondary clarifiers constructed. However, the short-term decision of whether to retrofit an existing basin for MBR or construct a third conventional activated sludge basin must weigh the following considerations:

- By retrofitting one existing basin to an MBR basin in the near future, and constructing one additional MBR basin in the long-term, the City can avoid the cost (in both capital expenditures and site footprint) of constructing a third secondary clarifier.
- The cost of membrane modules is decreasing while the size of installations and the length of operational experience in the United States are increasing. Deferring installation of membrane modules in one of the existing basins may be strategic in terms of City decision-making.

Alternative 3 – Biological Aerated Filter

The biological aerated filter (BAF) process is a biological fixed-film process. At present, there are two suppliers of BAF process equipment in the market: the BIOFOR® BAF manufactured by Ondeo Degrémont; and the BIOSTYR® BAF manufactured by USFilter. In both types, primary effluent flows upward through a media bed (expanded sand media in BIOFOR® or synthetic expanded floating polystyrene media in BIOSTYR®), with aeration supplied to create an aerobic environment. The biomass attached to the filter media removes soluble pollutants biologically and insoluble pollutants by filtration, eliminating the need for a separate solids separation stage for effluent clarification. Fine screening and primary clarification are required to protect the media and nozzles from plugging and to keep the organic and solids loading consistent with the hydraulic loading rate so the system can be more cost effective. The BAF process is a very high rate and compact wastewater treatment process, however it is sensitive to high fluctuation sin flow and loading.

The BAF is a separate stage process, requiring separate units for BOD removal, nitrification, and denitrification. Typical design criteria are as follows:

BOD loading: 320 – 400 lbs BOD/1000 ft^3/day

Ammonia loading: 160 – 200 lbs NH_3/1000 ft^3/d

While performance is sensitive to flow and load variations, under stable conditions, a single-stage BAF system can produce effluent TSS and BOD concentrations of 30 mg/L. A two-stage nitrifying installation can reliably produce effluent ammonia concentration of less than 0.5 mg/L. In order to accomplish denitrification, a third stage most likely would be necessary. No secondary clarification is necessary.

Since the BAF units are operated in upflow mode, feed pumping is required. Backwash storage is also required

Facilities Required/Key Design Information

Based on the design criteria in the previous section, and assuming that the two existing treatment trains remain in operation, the volume requirements at build-out are 27,800 ft^3 for BOD removal only, and 55,600 ft^3 for two-stage nitrification. An additional 14,400 ft^3 of media would be required to achieve denitrification. Using the BIOFOR® BAF height of 17 ft and the width of the existing aeration basin (20 ft), the required BAF footprint for different operating scenarios are:

- BOD removal only: 20 ft x 90 ft
- Nitrification: 20 ft x 170 ft
- Nitrification/Denitrification: 20 ft x 205 ft

If all future secondary treatment capacity is provided with BAFs, the footprint requirement is roughly equivalent to that of a third aeration basin. It is assumed that the BAF basin will be constructed to the east of the existing basins in two phases of expansion. The existing activated sludge trains will be maintained for flow equalization, minimizing fluctuations in flow and loading to the BAF units. Facility requirements for Alternative 3 are shown in Table 5-17.

Table 5-17. Facilities Required; Alternative 3

Item	Unit	New Facilities at 4.0 mgd ADWF	New Facilities at 7.0 mgd ADWF
BAF feed pumping[1]	mgd	2.0	8.0
BAF volume installed	1000 cf	17	42.5
BAF Units	#, sf area	3 @ 500	7 @ 500
BAF backwash volume	Gal/day	50,000	125,000
Anoxic Recycle Pumps	Number/gpm	2 @ 2100	0

1. Assumes flow to BAF units is limited to 200% of ADWF, with excess treated by existing conventional activated sludge trains.

Biological phosphorous removal is not possible with the BAF. Therefore, a chemical feed system would be required for permit compliance. This could negate the benefit of eliminating a third secondary clarifier with the BAF units, since it would require adding a chemical clarifier.

Comparison of Alternatives

Table 5-18 summarizes the advantages and disadvantages of the secondary treatment alternatives.

Table 5-18. Comparison of Secondary Treatment Alternatives

Primary Treatment Alternative	Advantages	Disadvantages
Alt 1: Conventional Activated Sludge	• Least complex, most proven treatment process • Familiar to operations staff • Can achieve multiple goals (nitrification, denitrification/ alkalinity recovery, phosphorus removal) in one process	• Largest footprint requirement • Requires tertiary treatment
Alt 2: Membrane Bioreactors	• Produces highest quality effluent • Eliminates need for secondary clarifiers (in MBR trains) • Can provide Class IV reuse water from MBR trains • Removal of TSS positively impacts UV performance • Can achieve multiple goals (nitrification, denitrification/ alkalinity recovery, phosphorus removal) in one process • Smallest footprint requirement	• Limited full-scale operation • Most US installations are less than 1 mgd • Requires maintaining one conventional aeration train for flow and load equalization • Sensitive to flow fluctuations • Tertiary treatment still required to produce Class IV reuse from conventional activated sludge train •
Alt 3: Biological Aerated Filters	• Small footprint requirement • Small module size eases construction staging	• Requires separate stage treatment for BOD and ammonia removal. • Highest effluent BOD/TSS concentrations • Requires maintaining conventional aeration trains for flow and load equalization • Produces very dilute sludge • High backwash volumes • Requires tertiary treatment

Table 5-19 compares the costs of the three alternatives. Alternative 2 is shown with a significantly higher annual O&M cost due to the cost of periodic membrane replacements. As operational experience with MBRs grows and costs continue to decrease, these O&M costs may decrease in the future.

Table 5-19. Summary Cost Comparison of Secondary Treatment Alternatives (Costs in $1,000s)

	Alternative 1 – Activated Sludge		Alternative 2 – MBR		Alternative 3 – BAF	
	4.0 mgd	**7.0 mgd**	**4.0 mgd**	**7.0 mgd**	**4.0 mgd**	**7.0 mgd**
Total Capital Cost	$9,669	$24,195	$7,207	$22,450	$10,865	$15,539
Annual O&M Cost	$ 30	$ 60	$ 24	$ 449	$ 84	$ 123
Present Worth Capital Cost	$8,939	$ 14,531	$6,664	$13,484	$ 10,045	$ 9,333
Total Present Worth Cost	$24,586		$26,488		$21,888	

Preliminary Recommendations

The alternatives are ranked with respect to the evaluation criteria on Figure 5-11 below.

Evaluation Criteria	Alt 1: Conventional Secondary Treatment	Alt 2: Membrane Bioreactors	Alt 3: Biological Aerated Filters	Comments
Regulatory Compliance	◕	●	◕	
Operations/ Technology	●	◑	◑	Either MBR or BAF option requires operating two types of treatment processes. Both are also emerging technologies in the United States.
Implementation	●	◕	●	MBR could require construction of a clarifier that is not ultimately needed.
Community/ Environmental	◕	●	◑	MBR produces a cleaner effluent; easier to implement reuse. BAF potentially has lowest water quality.
Compatibility With Site	◔	●	●	Conventional secondary treatment is not suited for buildout on this site.
Cost	◕	◑	●	
Total	◕	◕	◕	

Worse ← → Better

○ ◔ ◑ ◕ ●

Figure 5-11. Secondary Treatment Alternatives Preliminary Evaluation

Due to site constraints, it would be difficult for the City to continue to use conventional activated sludge through ultimate build-out without sacrificing other processing needs (such as solids processing and storage). Although both the initial capital and long-term operating costs of MBRs exceed the BAFs, it is recommended that the City plan to move toward MBR secondary treatment in the future. This technology produces the highest quality effluent of any secondary treatment process, and continued advances in technology make the process easier to operate and maintain.

Input from the City will be required to determine whether it is appropriate to convert an existing activated sludge basin to an MBR basin in the near-term, or whether a new conventional activated sludge train will be added to achieve the additional capacity required for a 4 mgd ADWF.

Tertiary Treatment Alternatives

Design Criteria

Tertiary treatment options were evaluated with respect to the ability to meet two goals:

- Meet projected effluent quality requirements for discharge to the Willamette through ultimate build-out.
- Produce Class IV reuse water

Criteria for meeting these goals are described below.

Water Quality-Based Criteria

Unless membrane filtration is provided as part of the secondary treatment system, tertiary treatment will be required to reliably produce effluent of the quality required based on Table 4-4. Ultimately, the plant must produce effluent BOD and suspended solids of 3 mg/L during the summer and 7 mg/L during the winter.

If dewatering is implemented in the future, removing solids returned from the dewatering centrate is a primary concern. In this situation, it would be desirable to have the ability to chemically treat the secondary effluent, providing enhanced flocculation for removal of colloidal solids in tertiary treatment.

Tertiary treatment must accommodate the following flows at nominal average dry weather influent flow of 4 and 7 mgd:

Table 5-20. Design Flows for Tertiary Treatment

	4 mgd	7 mgd
ADWF	4.0	7.0
MDDWF	5.3	9.3
AWWF	4.8	8.4
MDWWF	7.9	13.9
PH	11.9	20.8

Reuse-Based Criteria

Currently, Oregon regulations for Class IV reuse water specify that disinfection, clarification, coagulation, and filtration are required. The Oregon Department of Environmental Quality (DEQ) has indicated that membrane filtration with disinfection would be an acceptable alternative as long as turbidity and E. Coli limits are met. If chemical coagulation is provided to address dewatering centrate (as described above), three of the four tertiary treatment alternatives would provide Class IV reuse water. Although the effluent from MBR basins would meet the Class IV reuse standards, blended effluent from MBR basins and a conventional activated sludge basin would not.

Alternatives Considered

The following alternatives were evaluated in detail:

- Alternative 1: Improved sand filtration
- Alternative 2: Fuzzy Filters®
- Alternative 3: Actiflo®
- Alternative 4: No filters

Alternatives 1, 2, and 3 involve providing tertiary treatment as a separate step in the treatment process. Alternative 4 involves demolishing existing filters and relying on a membrane bioreactor (MBR) to provide effluent polishing for permit compliance.

Alternative 1 – Improved sand filtration

This alternative involves constructing dual media filters to augment the capacity of the existing filters. The existing traveling bridge (automatically backwashed) filters have a 12-inch single-media layer of sand. While this design minimizes the downtime for backwashing, the filters cannot be loaded at a very high rate. Dual-media filters are similar to single-media filters, but typically the entire unit is backwashed at once. Loading rates of 6 gallons per minute per square foot (gpm/sf) are possible with proper design and operation. Table 5-21 shows the design criteria for dual-media sand filtration.

Table 5-21. Design Criteria for Dual-Media Filters.

Condition	Design Filtration Rate
Average Day Dry Weather	3 gpm/sf
Peak Hour Wet Weather	6 gpm/sf

Coagulant addition and flocculation would be desirable to remove solids in the centrate return and to provide added protection in the event of a plant upset. Coagulant addition would be required to produce Class IV reuse water. Dual media filtration would also require the most monitoring and operator attention to meet reuse standards of any of the filtration alternatives.

Given the large number of filters required at build-out, redundancy does not drive the design. Average day dry weather capacity drives the design.

Facilities Required/Key Design Information

Table 5-22 presents the required facilities for dual-media filtration at ADWF flows of 4.0 and 7.0 mgd. This analysis assumes that the existing filters will remain single-media, thus 7 filters (three existing sand filters and four new dual media filters) would be operated for ultimate build-out conditions. Retrofitting the existing filters to a dual-media system would eliminate the need to construct a seventh filter at build-out. Retrofitting the existing filters would allow the City to save the footprint and possibly the tanks associated with the existing filters, but substantial modifications to the existing filter would be required.

Table 5-22. Facilities Required for Dual-Media Filtration.

Item	Unit	New Facilities at 4.0 mgd ADWF	New Facilities at 7.0 mgd ADWF
Dual-media filters	Number/sf	2 @ 396 each	2 @ 396 each
Backwash pumps	Number/gpm	2 @ 5,000	1 @ 5,000
Backwash water storage	Volume	100,000 gal	–

Alternative 2 – Fuzzy Filters®

Fuzzy Filters® are similar to conventional sand filters except for two significant differences: high-porosity media, and the ability to adjust the filtration rate by compressing the media. Fuzzy Filters® are capable of filtration rates up to 30 gpm per square foot (sf), and with chemical coagulation are capable of producing Class IV reuse quality water. They are backwashed in the same manner and at a similar rate as conventional sand filters.

Fuzzy Filters® are commercially available from Schreiber in sizes of 4 sf to 64 sf. Filters can be designed to operate in upflow or downflow mode. Typically, the media is compressed during active filtration. During backwash, the media is decompressed and allowed to move freely to scour solids that have accumulated on the filter media. After backwash, the media is compressed again and operated in filtration mode for a few minutes to flush the system. During backwash and flushing, effluent is typically recycled to the aeration basins for treatment. All three parts of the cycle are usually operated in upflow mode. Figure 5-12 shows the three cycles.

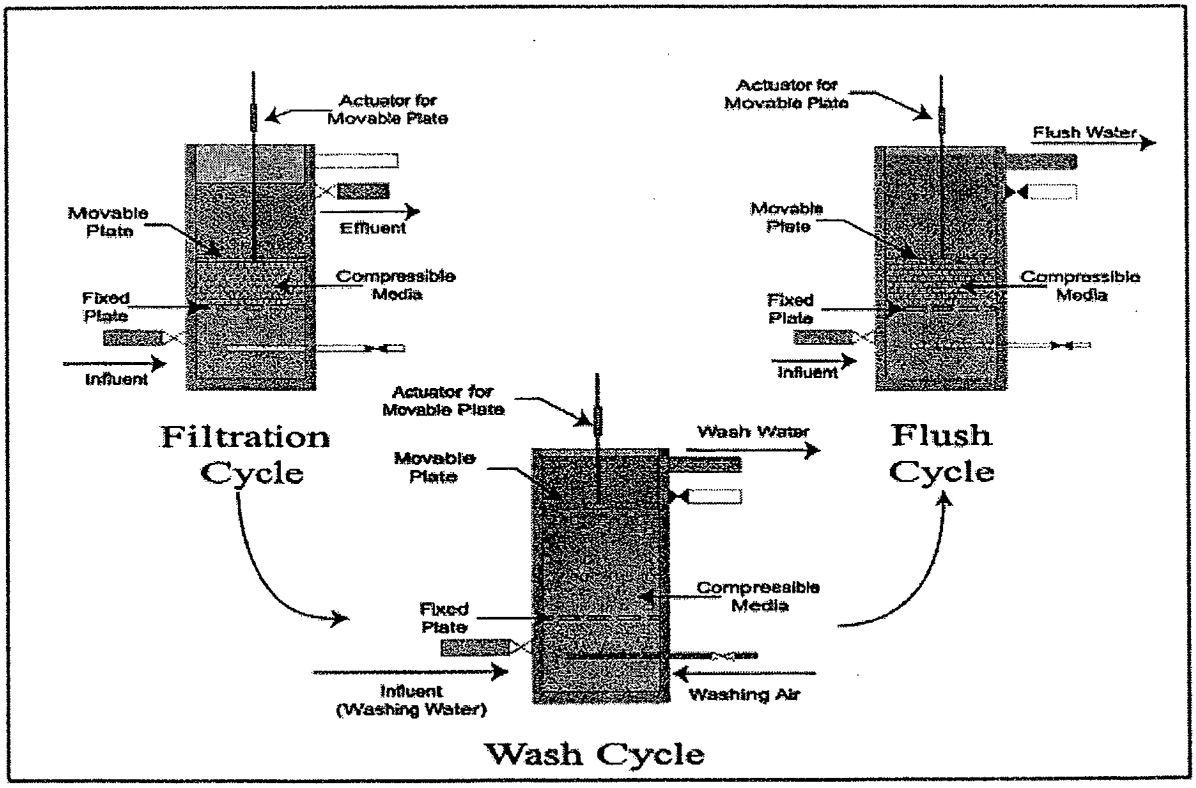


Figure 5-12. Fuzzy filter filtration cycle (courtesy of Schreiber website).

Design criteria for Fuzzy Filters® are shown in Table 5-23. These criteria are recommended by the manufacturer, and are similar to those observed during a recent pilot study by King County, WA.

Table 5-23. Design Criteria for Fuzzy Filters®.

Condition	Design Filtration Rate
Max. Day Dry Weather	20 gpm/sf
Max. Day Wet Weather	30 gpm/sf

Facilities Required/Key Design Information

Table 5-24 presents the required equipment for this system, assuming the existing sand filters remain in place. Typically, pumps can be used for both filtration and backwash modes. If the filters are not operated in an upflow mode, pumps will only be required for backwashing.

If the existing filters are decommissioned and all filtration provided by the Fuzzy Filters®, four filters would be required at 4 mgd ADWF, with three additional filters provided to reach the 7 mgd ADWF (seven filters total at build-out).

Table 5-24. Facilities Required for Fuzzy Filtration.

Item	Unit	New Facilities at 4.0 mgd ADWF	New Facilities at 7.0 mgd ADWF
Fuzzy filters	Number/sf	3 @ 49 each[1]	2 @ 49 each[1]
Influent/backwash pumps	Number/gpm	3 @ 2,400	2 @ 2,400
Filtered water storage	Volume	5,000 gal	5,000 gal

1. Increase number of filters to 4 at 4 mgd and 3 at 7 mgd if existing sand filters are decommissioned.

As with Alternative 2, coagulant addition would be preferable from a water quality standpoint to provide enhanced solids removal in the filters, and would be required to produce Class IV reuse water.

Alternative 3 – Actiflo®

The Actiflo® processes uses microsand to flocculate solids in the primary influent. The Actiflo® process produced excellent results. The manufacturer recommends fine screening (3 mm slot openings or finer) and grit removal upstream of the process. For Wilsonville, no additional treatment would be required prior to Actiflo®. Typically, polymer and/or coagulant are added to enhance flocculation and settling of raw sewage particles.

The Actiflo® process was considered for primary treatment, and is also well suited for tertiary treatment. Polymer and coagulant addition are required to enhance flocculation and settling of raw sewage particles. This process is approved by Oregon DEQ for producing Class IV reuse water as well.

The following is a summary of the recommended design criteria for the Actiflo® process, which will be used for planning purposes:

- Injection Tank Detention Time = 1 minute
- Maturation tank detention time = 4 minutes
- Settling tank overflow rate = 40 gpm/sf (57,600 gpd/sf)

Facilities Required/Key Design Information

Table 5-25 shows the size and capacity of process units required for nominal average design flows of 4.0 and 7.0 mgd. The table assumes one train of Actiflo® would be required at build-out. Existing filters would be operated at capacity, and Actiflo® would treat flows beyond existing capacity.

Table 5-25. Facilities Required for Actiflo® Tertiary Treatment.

Item	Unit	New Facilities at 4.0 mgd ADWF	New Facilities at 7.0 mgd ADWF
Injection Tank	Number	1 @ 8.1'x8.1'x15'	–
Maturation Tank	Number	1 @ 15.7'x16.8'x15'	–
Settling Tank	Number	1@ 16.8'x16.8'x15'	–
Mixers	Number/hp	2 @ 5	–
Sand Recirc. Pump	Number/hp	2 @ 25	–
Scraper Motor	Number/hp	1 @ 1.5	–

Alternative 4 – No filters

This alternative would be coupled with a membrane bioreactor (MBR) system for secondary treatment. With the high quality effluent produced by an MBR, the blended effluent from the one activated sludge train and two MBR trains would meet the projected water quality standards necessary for discharge to the River.

Currently, Oregon regulations for Class IV reuse water specify that disinfection, clarification, coagulation, and filtration are required. However, DEQ has indicated that membrane filtration with disinfection would be an acceptable alternative as long as turbidity and *E. coli* limits are met. Recently, DEQ approved the City of Ashland, Oregon's membrane filtration system for Class IV reuse water production. If the MBR secondary treatment option were implemented, additional discussion with DEQ would be necessary to determine whether filtration would be required for the effluent from the conventional activated sludge train, or whether the blended effluent from the conventional and MBR processes would be considered adequate to meet Class IV reuse standards.

Comparison of Alternatives

Table 5-26 summarizes the advantages and disadvantages of the tertiary treatment alternatives.

Table 5-26. Advantages and Disadvantages of Tertiary Treatment Alternatives.

Filtration Alternative	Advantages	Disadvantages
Alt 1: Improved Sand Filtration	• Conventional technology	• Large footprint - requires largest area of 4 alternatives • Cannot produce Class IV reuse water without additional facilities (coagulant feed, flocculation)
Alt 2: Keep existing sand filters, add Fuzzy Filters®	• Small footprint • Similar to conventional technology • Greatest flexibility (largest number of units, adjustable filtration rate)	• Relatively expensive • Requires pumping • May require coagulation and flocculation to produce Class IV reuse water
Alt 3: Keep existing sand filters, add Actiflo®	• Relatively small footprint	• Relatively expensive • Requires chemical addition
Alt 4: No filters	• Extremely compact - smallest footprint of 4 alternatives	• May not be implemented with initial treatment plant expansion • Coagulation/ filtration will be required for effluent from conventional activated sludge train if Class VI reuse is desired

Table 5-27 summarizes the costs of the alternatives.

Table 5-27. Summary Cost Comparison of Tertiary Treatment Alternatives

	Alternative 1 Improved Sand Filtration		Alternative 2 – Sand Filters/ Fuzzy Filters		Alternative 3 – Sand Filters/Actiflo		Alternative 4 – MBR Filters[1]	
	4.0 mgd	7.0 mgd	4.0 mgd	7.0 mgd	4.0 mgd	7.0 mgd	4.0 mgd	7.0 mgd
Total Capital Cost	$1,817	$1,155	$2,694	$1,415	$2,851	$0	$0	$0
Annual O&M Cost	$ 9	$ 14	$ 17	$ 29	$ 30	$ 91	$ 0	$ 0
Present Worth Capital Cost	$1,680	$ 694	$2,491	$850	$ 2,636	$ 0	$ 0	$ 0
Total Present Worth Cost	$2,657		$3,904		$4,176		$0	

1. MBR costs included in the secondary treatment alternatives

Preliminary Recommendations

Figure 5-13 below compares the four alternatives with the evaluation criteria. All of the alternatives provide adequate treatment, meet community/environmental concerns, and can be easily implemented. Alternative 4 has the lowest cost since it does not require any additional capital expenditure associated solely with tertiary treatment (the filtration costs are included in secondary treatment).

Overall, both the Fuzzy Filter® and MBR options ranked favorably. It may be prudent to implement a combination of Fuzzy Filters® and MBRs depending on the final use of the effluent. Depending on the City's decision with respect to secondary treatment and the quantity of reuse water required, any of the following scenarios may be implemented:

- MBR selected for secondary treatment; no additional tertiary treatment and all flow discharged to the Willamette River.
- MBR selected for secondary treatment, and some reuse water required. Coagulation and filtration with Fuzzy Filters® provided for the secondary effluent from the conventional activated sludge train.

- MBR not selected for secondary treatment. Filtration with Fuzzy Filters® provided for all flow, potentially with coagulation for centrate capture and/or production of Class IV reuse water.

Figure 5-13. Tertiary Treatment Alternatives Preliminary Evaluation

Evaluation Criteria	Alt 1: Improved sand filtration	Alt 2: Fuzzy Filters®	Alt 3: Actiflo ®	Alt 4: No filters	Comments
Regulatory Compliance	●	●	●	●	
Operations/ Technology	●	●	◑	◑	Actiflo® and MBR require the most operatorattention and have the least experience.
Implementation	●	●	●	●	Construction of any alternative can occur during the winter.
Community/ Environmental	●	●	●	●	
Compatibility With Site	◔	◕	◕	●	Alternative 4 requires the least amount of footprint; conventional sand filters require the most.
Cost	●	◕	◑	●	
Total	◕	●	◑	●	

Worse ○ ◔ ◑ ◕ ● Better

Disinfection Alternatives

Design Criteria

Disinfection design flows are similar to filtration, as shown in Table 5-28.

Table 5-28. Design Flows for Disinfection

	4 mgd	7 mgd
ADWF	4.0	7.0
MDDWF	5.3	9.3
AWWF	4.8	8.4
MDWWF	7.9	13.9
Peak Hour	11.9	20.8

Design criteria for the alternatives vary significantly, and will be described with each alternative.

Alternatives Considered

Alternative 1 – Medium Pressure UV Disinfection

This alternative involves the continued use of medium pressure ultraviolet (UV) light for disinfection of all plant flows. The simplest strategy to add medium pressure UV capacity is to split the flow evenly between the existing and new channels. In order to accomplish this, the peak capacity of the existing channel must be increased from 8 mgd to 10.4 mgd. The existing UV channel was designed for a maximum flow of 8 mgd, however the manufacturer has indicated that with adequate transmissivity (70 percent) and acceptable headloss, flows of over 10 mgd can be conveyed through the existing channel. At these flows, the Parshall Flume will cause excessive headloss, and will need to be removed and replaced with a motorized weir gate or a serpentine weir to control the level in the channel and maintain submergence of the lamps. The effluent flow measurement currently provided by the Parshall Flume will be replaced with alternate flow measurement, such as magnetic flow meters on the filter effluent pipe upstream of UV disinfection.

To provide treatment of ultimate peak flows, a second UV channel will be needed. This channel would be identical in configuration to the existing channel.

Facilities Required/Key Design Information

The following table shows the facilities required for continued use of medium pressure UV disinfection. One channel will be added, with two modules of 12 lamps each. Based on this design, the original channel must be modified to convey 10.4 mgd peak flow. Since the peak flow to the plant will exceed 10.4 mgd before the ADWF reaches 4 mgd, the second channel is currently shown as part of the first phase of treatment plant expansions.

Table 5-29. Facilities Required for Medium Pressure UV Disinfection.

Item	Unit	New Facilities at 4.0 mgd ADWF	New Facilities at 7.0 mgd ADWF
UV Reactors/Channels	Number	1	—
Banks per Reactor	Number	2	—
UV Lamps per Bank	Number	12	—
Total UV Lamps	Number	24	—

Decisions made with respect to other treatment processes at the plant will impact the capacity and function of the UV disinfection system. As discussed earlier, fine solids recycled to the secondary treatment process in the centrate return can reduce the percent transmittance and disinfection performance. Selection of the proper coagulant to remove these fine solids must address the potential for fouling of the UV lamps. The use of iron-based coagulants is not recommended in plants with UV systems, however alum addition should not cause a problem.

Lime addition can potentially cause fouling of the UV bulbs if the hardness of the water is too high. Calcium carbonate becomes less soluble at high temperatures, resulting in scaling on UV bulbs in plants where the secondary or filtered effluent has near saturation concentrations of calcium carbonate. For this reason, it will be important to not overdose lime for alkalinity addition. However, if secondary effluent alkalinity is on the order of 100 mg/L as calcium carbonate, scaling should not be a factor. Scaling of the UV bulbs should be given due consideration in the design of a new lime system, described in Chapter 7.

Alternative 2 – Low Pressure UV Disinfection

Medium pressure UV disinfection offers the benefit of requiring the fewest number of lamps to achieve the desired level of inactivation. Disadvantages of medium-pressure systems include operation at high temperatures and relatively high energy consumption. Low pressure high output (LPHO) UV installations offer improved performance over standard low pressure UV lamps, without the high energy requirements of medium pressure lamps. Low pressure high output installations require approximately 60 percent more bulbs than medium pressure installations to achieve the same level of disinfection.

Facilities Required/Key Design Information

The following table shows the facilities required for LPHO UV disinfection. One channel will be added, with two modules of 20 lamps each. It is assumed that one channel of LPHO disinfection will be added in the near term and operated in parallel with the existing medium pressure UV system. For ultimate build-out, the existing medium pressure UV system could be replaced with a LPHO system for operational simplicity and to reduce energy consumption. As with Alternative 1, this requires removing the existing Parshall flume and providing a different means of effluent flow measurement.

Table 5-30. Facilities Required for Low Pressure UV Disinfection.

Item	Unit	New Facilities at 4.0 mgd ADWF	New Facilities at 7.0 mgd ADWF
UV Reactors/Channels	Number	1	1
Banks per Reactor	Number	2	2
UV Lamps per Bank	Number	20	20
Total UV Lamps	Number	40	40

Alternative 3 – Sodium Hypochlorite Disinfection/Sodium Bisulfite Dechlorination

Liquid sodium hypochlorite is commonly used for wastewater disinfection. The chemical is delivered by trucks as a 12.5-15 percent solution, and stored onsite in tanks for a maximum of 30 days to avoid degradation. For optimal operational performance, hypochlorite is typically delivered to disinfection application point(s) in an undiluted ("neat") form, and dissolved in the liquid stream flow using static or mechanical mixing. Providing a loop system whereby hypochlorite is pumped out of storage tanks, routed to each point of injection, and returned to the storage tank, allows any accumulated gas to be vented to the atmosphere under controlled conditions at the storage tank. If hypochlorite is used only for effluent disinfection, the loop system could be replaced with a single supply line. However, depending on the final treatment processes selected, there will likely be advantages to providing hypochlorite for other process needs at key locations.

Chlorine contact basins for hypochlorite disinfection are designed to provide 60 minutes of contact time under average flows, or 20 minutes at maximum day flows. Typical design application rates used to size pumping and conveyance systems are 5 mg/L at average flow and 15 mg/L at peak flows. Storage volume is based on 20-25 days of storage at average demand, with the storage volume capable of meeting peak demand for no fewer than three days. Based on these criteria, the sodium hypochlorite system sizing is shown in Table 5-31.

Table 5-31. Sodium Hypochlorite System Sizing

	4.0 mgd ADWF		7.0 mgd ADWF	
Hypochlorite Storage	**Average**	**Peak**	**Average**	**Peak**
Flow, mgd	4.0	11.9	20.8	20.8
Dose, mg/L	5.0	15.0	5.0	15.0
Demand, gal/day	133	1,188	234	2,080
Storage, days	30	3	30	3
Storage Volume, gallons	4,003	3,564	7,006	6,239
Chlorine Contact	**Average**	**Max Day**	**Average**	**Max Day**
Flow, mgd	4.0	8.0	7.0	13.9
Contact Time Required, min	60	20	60	20
Volume Required, gal	166,700	110,600	291,700	193,500

Dechlorination is provided by feeding sulfur dioxide solution to the effluent using a chemical induction mixer or vertical turbine mixer. Dechlorination is nearly an instantaneous reaction; consequently, there is no capacity limit to this process provided that adequate mixing takes place. However, redundant mixers are required.

Facilities Required/Key Design Information

Facilities required under this alternative are shown in Table 5-32.

Table 5-32. Facilities Required for Sodium Hypochlorite Disinfection

Item	Unit	New Facilities at 4.0 mgd ADWF	New Facilities at 7.0 mgd ADWF
Chlorine Contact Basins	Number/Gallons	1 @ 166,700	1 @ 125,000
Hypochlorite Storage Volume	Gallons	4,000	7,000
Storage Tanks	Number/Gallons	2 @ 2000	1 @ 3000
Loop Pumps	Number/gpm	2 @ 120 gph	0
Injection Pumps	Number	2	2
Chemical Induction Mixers	Number	4	0

Tanks for both hypochlorite and sulfur dioxide could be housed outside in a covered area, but most likely would be enclosed in a new building to simplify containment. This building would also house mechanical and electrical systems associated with disinfection/dechlorination. Since the life of a hypochlorite storage tank is only 5 to 8 years, multiple tanks would be provided initially, allowing one tank to be removed from service for repair or replacement.

Alternative 4 – Peracetic Acid

Peracetic acid is a strong oxidizing agent made of acetic acid and hydrogen peroxide. It has been used for disinfection on small applications and as a sanitizer in the food and beverage industry, and is now being introduced to the municipal wastewater treatment market. The chemical is produced with a molar excess of either acetic acid or hydrogen peroxide. A molar excess of acetic acid results in an increase in BOD once the chemical is reduced; a molar excess of hydrogen peroxide results in an increase in oxygen. Ultimately, peracetic acid degrades into water, oxygen, and carbon, and therefore does not require dechlorination.

There are currently only two EPA-approved manufacturers of peracetic acid in the United States, and the chemical can only be supplied in 55-gallon drums.

Given the lack of full-scale applications in municipal wastewater treatment, exact design criteria for peracetic acid disinfection systems are uncertain. However, based on batch tests at a wastewater treatment plant in Canada[2], a design dose of 2 mg/L and contact time of 1 hour are assumed. Detailed discussions with regulatory authorities would be required to determine whether these design criteria are acceptable to meet Class IV reuse requirements.

Comparison of Alternatives

Table 5-34 summarizes the advantages and disadvantages of the disinfection alternatives.

Table 5-34. Advantages and Disadvantages of Disinfection Alternatives.

Disinfection Alternative	Advantages	Disadvantages
Alt 1: Medium Pressure UV	• Familiar to operators • High level of treatment • Provides maximum treatment in minimum footprint	• High energy consumption • Lower lamp life than Low Pressure High Output • Installation for build-out requires replacing effluent flow measurement
Alt 2: Low Pressure High Output UV	• Lower energy consumption than existing system • Longer lamp life than existing system • Greatest flexibility (largest number of units, adjustable filtration rate)	• Requires operation of two different systems (different spare equipment, etc.) • Requires more channel space • Installation for build-out requires replacing effluent flow measurement
Alt 3: Sodium Hypochlorite	• Hypochlorite can be used for other process needs onsite	• Requires chlorine contact basin – large footprint • Requires chemical addition • Requires dechlorination

Table 5-35 compares the costs of the alternatives. Because of the limited experience and lack of suppliers of peracetic acid in the United States, a detailed cost analysis of this alternative was not prepared.

[2] Colgan, Sarah and Ronald Gehr, November 2001. *Disinfection.* Water Environment & Technology, p.29-33.

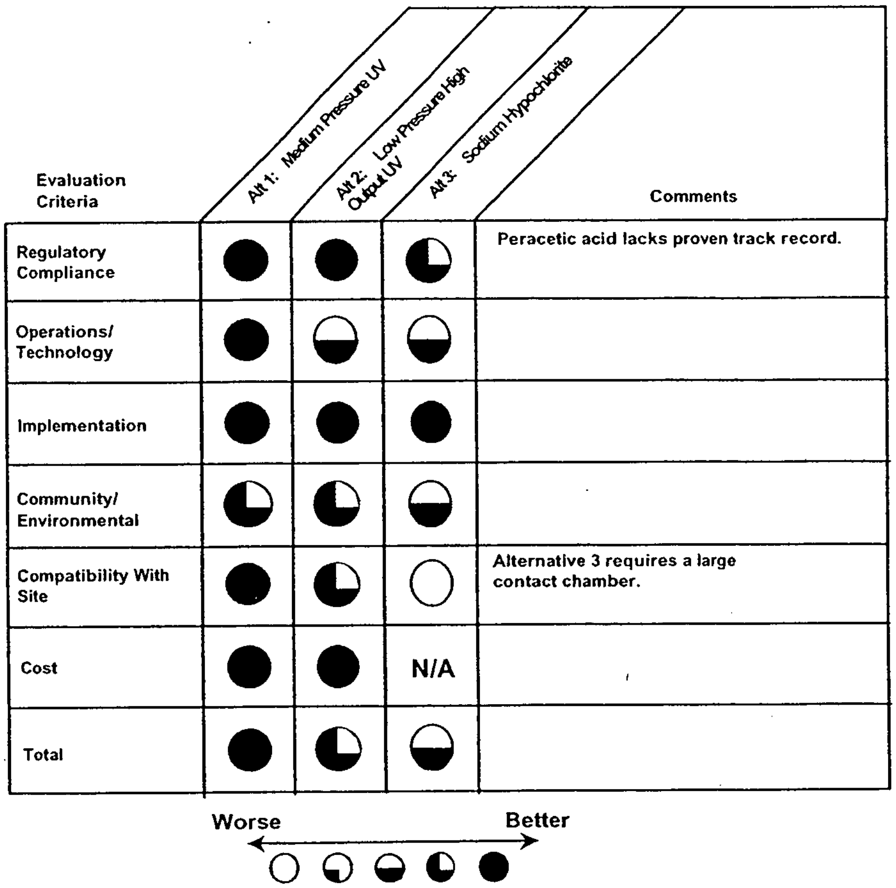
Table 5-35. Summary Cost Comparison of Disinfection Alternatives (Costs in $1,000s)

	Alternative 1 – Medium Pressure UV		Alternative 2 – Low Pressure High Output UV		Alternative 3 – Sodium Hypochlorite	
	4.0 mgd	**7.0 mgd**	**4.0 mgd**	**7.0 mgd**	**4.0 mgd**	**7.0 mgd**
Total Capital Cost	$1,430	$0	$1,098	$701	$1,806	$620
Annual O&M Cost	$ 20	$ 34	$ 22	23	$ 18	23
Present Worth Capital Cost	$1,322	$ 0	$1,015	$421	$ 1,669	$ 372
Total Present Worth Cost	$1,993		$1,970		$2,529	

Preliminary Recommendations

The alternatives are ranked with respect to the evaluation criteria in Figure 5-14 below. Based on this evaluation, it is recommended that the City continue to use medium pressure UV disinfection. Constructing a second UV disinfection channel in the near term does not preclude the City from converting to low pressure high output bulbs in the future, should power costs rise and the O&M differential between high pressure and low pressure high output becomes more substantial.

Figure 5-14. Disinfection Alternatives Preliminary Evaluation



Effluent Discharge Alternatives

All flow to the plant is currently conveyed by gravity to the Willamette River through a 24-inch diameter single-port outfall. Based on the hydraulic analysis presented in Chapter 3, under the current plant configuration, the outfall is capable of conveying approximately 17.5 mgd to the river without surcharging the UV disinfection channel and 16.2 mgd without impairing the operation of upstream process control elements.

The design flow projections assumed that commercial and industrial flows will increase when the building moratorium is lifted. However, if unit flows from commercial and industrial properties remain closer to historical values, the plant flow may not exceed the existing outfall capacity. Figure 5-15 compares the current outfall capacity with the design flow projections and the lower flow projections based on historical commercial and industrial flows.

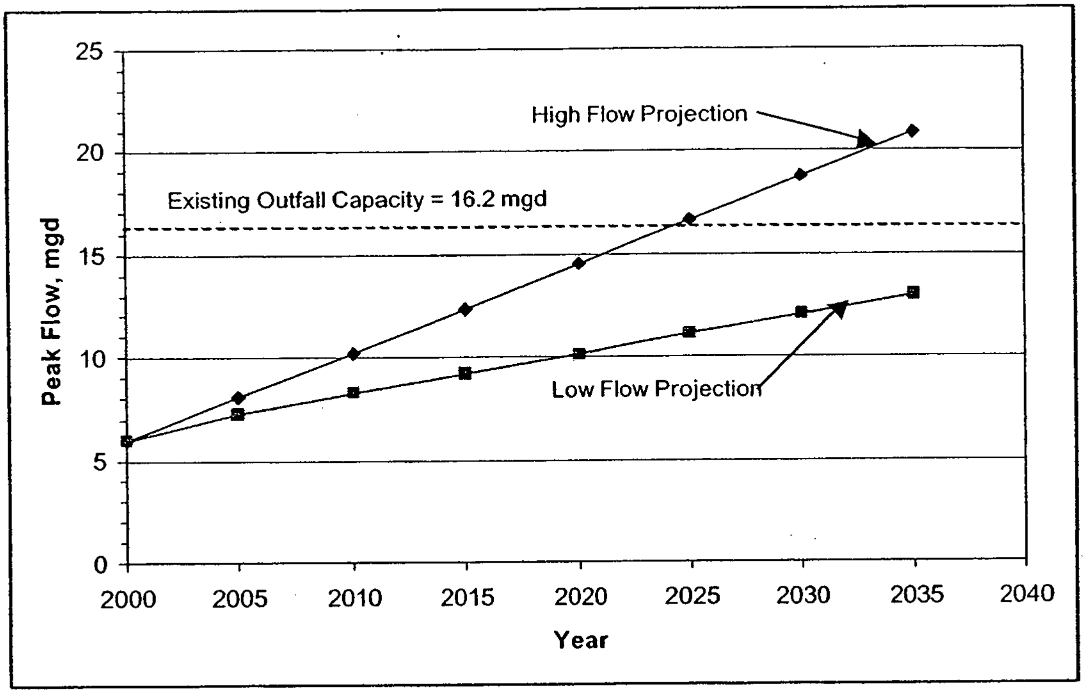


Figure 5-15. Comparison of outfall capacity with flow projections

Design Criteria

The outfall must have sufficient capacity to convey the peak hour flow from the plant to the Willamette River. Projected design peak hour flows at the nominal 4 mgd and 7 mgd plant capacities are 11.9 mgd and 20.8 mgd, respectively.

Alternatives Considered

Two issues associated with potential improvements to the existing outfall must be considered:

- Improvements to provide additional hydraulic capacity
- Improvements to provide additional water quality benefits

To meet these needs, four alternatives were evaluated to address these issues:

1. Alternative 1A – Add second outfall
2. Alternative 1B – Provide detention for peak flows
3. Alternative 1C – Pump through existing outfall
4. Alternative 2 – Add diffuser to existing outfall

Alternative 1A – Add a second outfall

This alternative would convey all flow to the Willamette River through two outfalls without effluent pumping. The two outfalls would be interconnected to provide maximum capacity during peak flows, and to allow the potential to take one outfall offline if necessary during low flow periods. To maximize dilution in the receiving stream, it is assumed that flow would be split between the two outfalls during normal, non-peak flow conditions; however, alternative flow control modes (such as base flow/excess overflow mode) could be provided for roughly the same cost.

A complete hydraulic analysis including potential future treatment processes would be required in order to fully assess the capacity of the existing outfall and determine the necessary capacity of a new outfall. However, for planning purposes, it is assumed that peak flow would be split between the two outfalls, requiring a second outfall with 10.4 mgd capacity. This could be provided in an 18-inch outfall.

Alternative 1B – Provide Detention of Peak Flows

A second alternative is to detain peak flows in order to limit the flow to the existing outfall. A flow of 16.2 mgd could be expected to occur for longer than one hour, but less than one day. Assuming 6 hours of detention of the peak flows, a total detention volume of 1,1250,000 gallons is required. With a 35-foot sidewater depth and 2 feet of freeboard, this equates to approximately 4,600 sf of surface area, or a 76-foot diameter tank. Locating this volume of storage on the existing plant site would be challenging due to space constraints. Pumping would also be required to convey flow either to the tank (for an above-ground tank) or from the tank (for a below-ground tank).

Alternative 1C – Pump Through Existing Outfall

A third alternative to convey the peak flow is to pump through the existing outfall. Information on the outfall is limited. It is likely constructed of C76 concrete pipe, which has limited capability to withstand pressure flow. Providing segmented steel liners for the existing outfall pipe would give the structural capability to withstand pressures during pumping. A portion of the pipe would need to be excavated in order to install the liner segments. This would require bypass pumping of a portion of the existing outfall. The diameter of the outfall would also be reduced, reducing the capacity for gravity flow.

Alternative 2 – Add a Diffuser to Existing Outfall

A CORMIX model was used to estimate the change in dilution using the existing outfall configuration and with the addition of an outfall diffuser. For evaluation purposes, the effluent flow was modeled at design dry weather capacity for current and build-out conditions (Scenario 1), and at peak hour capacity for current and build-out conditions (Scenario 2). While dilution ratios apply to any water quality parameter, temperature was used for comparison of options. The impact of the dilution ratio on temperature change at the edge of the regulatory mixing zone (RMZ) was used to demonstrate the impact of the change in dilution. Table 5-36 below shows the results of the evaluation for the current outfall configuration.

Table 5-36. CORMIX Model Scenarios and Results; Current Outfall Configuration

Model Scenario	Effluent Flow (mgd)	Effluent Temp. °C	Ambient Velocity (ft/sec)	Ambient Temp. °C	Dilution at RMZ	Temperature Change °C
1a. Current[1]	2.25	19	0.380	17	25	.08
1b. Build-out[1]	7.0	19	0.380	17	26	.08
2a. Current[2]	5.7	17.5	1.36	11.1	19	.33
2b. Build-out[2]	20.7	17.5	1.36	11.1	18	.36

1. Based on average dry weather design effluent flow, 7Q10 ambient flow, and 50th percentile ambient and effluent temperature.
2. Based on peak hourly effluent flow, average April ambient flow, and average April ambient and effluent temperature.

As Table 5-36 illustrates, under the conditions modeled, dilution at the edge of the RMZ ranges from 18 to 19 under peak hour flows and winter conditions to 25 to 26 under dry summer conditions. This is true at both current design flows and at projected build-out flows.

For comparison, a peak-hour discharge simulation was run including a 50-foot diffuser with ten 6-inch ports oriented perpendicular to the diffuser and parallel with the current (facing downstream). Under this scenario, the dilution at the edge of the RMZ increased to 64. This is greater than a three-fold increase over peak hour dilution with the current single port configuration.

Constraints on Outfall and Outfall Diffuser Construction

There are both physical and regulatory constraints associated with construction of a new outfall or an outfall diffuser. From a regulatory standpoint, Wilsonville would have to obtain permits involving consultations with DEQ, the Corps of Engineers, National Marine Fisheries Service, Oregon Department of Fish and Wildlife, and possibly U.S. Fish and Wildlife Service. A typical timeframe to obtain the permits is 2 years from the initiation of design.

The outfall diffuser also is an added source of hydraulic headloss in the system. In order to complete a diffuser design, parameters such as the diameter of the manifold pipe, length of the diffuser, number of ports, port diameter, and port orientation would be evaluated to meet water quality requirements with the minimum headloss through the diffuser. Although the length of the diffuser manifold and riser angles will contribute to minor headloss, the most significant factors are effluent flow and port size. Figure 5-16 shows the relationship between effluent flow and headloss for a range of port sizes from 0.25 to 0.75 ft in diameter (assuming a 10-port diffuser).

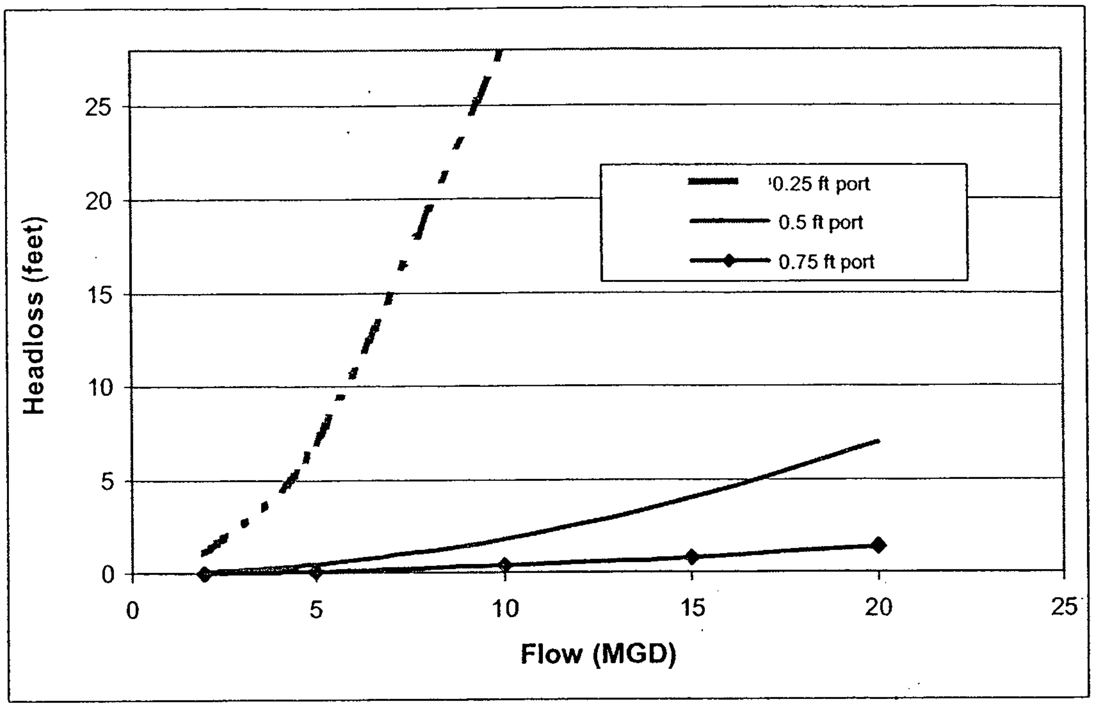


Figure 5-16. Comparison of Headloss for Various Diffuser Port Sizes

Comparison of Alternatives

Table 5-37 presents the key advantages and disadvantages of the effluent discharge alternatives.

Table 5-37. Summary Comparison of Effluent Discharge Alternatives

Alternative	Advantages	Disadvantages
1A. Second Outfall	• Can be constructed with least impact to existing operation. • Water quality benefits achieved due to improved dilution with discharge through two outfalls.	• Difficult permitting
1B. Peak Flow Detention	• Provides operational flexibility	• Large footprint requirement on a constrained plant site. • Unless storage is downstream of filtration and disinfection, odors could be a problem.
1C. Pump through Existing Outfall	• Eliminates need for construction of additional conveyance facilities • Eliminates need for permitting associated with a new outfall	• Requires new pumping station • Requires extensive retrofit of existing outfall. • Reduces gravity capacity of existing outfall • Requires bypassing existing outfall during construction
2 – Add Diffuser	• Minimizes water quality impacts of treatment plant discharge • Potentially increases the allowable concentration for some effluent constituents limited by water quality conditions at the edge of the mixing zone	• Permitting requirements for construction in the River could be extensive • Adds headloss, decreasing the maximum flow that can be conveyed through the existing outfall by gravity

Preliminary Recommendations

Since the existing outfall has adequate capacity to convey flows well into the future, and possibly through the lifetime of the treatment facility, the decision regarding how to increase effluent discharge capacity can be deferred until a later time. It is not likely that adequate peak flow detention can be provided on the existing site in the future to make Alternative 1B viable. With changes in the regulatory environment and potential improvements in pipeline construction and rehabilitation techniques, it is difficult to decide at this time whether it would be more advantageous for the City to plan for construction of a second outfall, or try to maximize the conveyance capacity of the existing outfall by retrofitting it for pressure flow.

It may be prudent for the City to consider addition of an effluent diffuser at some time in the future based upon the analysis conducted for this plan. Regulatory agencies frequently call for greater initial dilution than a single port diffuser can provide. Further, the addition of an effluent diffuser may provide the City with advantages in terms of effluent limits, depending upon the dilution assumptions utilized in establishing discharge permit limits. The effluent dilution estimates presented above under Alternative 2 illustrate the dramatic increase in dilution provided by a diffuser. For these reasons, it is recommended that provisions be made to allow future addition of a diffuser section in the selected effluent discharge option. This will allow the City to adapt to potential future regulatory changes and negotiate an adequate amount of time for permitting and construction of the necessary modifications.

Sludge Thickening Alternatives

Waste activated sludge is currently thickened on gravity belt thickeners (GBTs) prior to feeding to the digesters. Primary sludge is fed directly from the primary clarifiers to the digesters. This analysis examines future sludge thickening options.

Design Criteria

Sludge volumes were predicted by the plant mass balance model described in Chapter 3. Waste activated sludge characteristics will vary depending on the secondary treatment process selected. Waste solids concentrations from a conventional activated sludge and MBR system are assumed to be comparable. Sludge in a conventional system will be thickened in secondary clarifiers. Although no clarifiers are used with an MBR, the solids concentrations in the mixed liquor are similar to WAS concentrations from conventional secondary clarifiers. Sludge from a BAF process, on the other hand, is very dilute, resulting in high sludge flows.

Table 5-38 shows projected sludge quantities to the thickening process under the following conditions:

- Waste activated sludge only, from a conventional activated sludge or MBR process (primary sludge thickened in the primary clarifiers)
- Waste activated sludge only, from a BAF process (primary sludge thickened in the primary clarifiers)
- Combined waste activated and primary sludge

Suspended solids in filter backwash from a BAF are typically 500-1,000 mg/L. Because of the dilute nature of BAF backwash solids, gravity belt thickeners are not an applicable technology. Another mode of separation such as gravity thickening would be required upstream of the gravity belt thickeners.

Table 5-38. Projected Sludge Thickening Flow and Loadings

Sludge Thickening Flows and Loads Conventional/MBR				
2000		Avg.	Max. Month	Max. Week
Dry Season				
Flow	gpd	24,000	25,680	27,120
TSS	lb/d	2,322	2,717	3,367
TSS	%	1.2		
Wet Season				
Flow	gpd	28,800	33,360	39,360
TSS	lb/d	2,612	3,056	3,422
TSS	%	1.1		
4.0 mgd				
Dry Season				
Flow	gpd	35,700	38,199	40,341
TSS	lb/d	4,744	5,550	6,879
TSS	%	1.6		
Wet Season				
Flow	gpd	42,840	49,623	58,548
TSS	lb/d	5,693	6,661	7,458
TSS	%	1.6		
7.0 mgd				
Dry Season				
Flow	gpd	47,300	50,611	53,449
TSS	lb/d	8,241	9,642	11,949
TSS	%	2.1		
Wet Season				
Flow	gpd	56,760	65,747	77,572
TSS	lb/d	9,889	11,570	12,955
TSS	%	2.1		

Sludge Thickening Flows and Loads - BAF				
2000		Avg.	Max. Month	Max. Week
Dry Season				
Flow	gpd	278,250	297,728	314,423
TSS	lb/d	2,322	2,717	3,367
TSS	%	0.1		
Wet Season				
Flow	gpd	333,901	386,768	456,331
TSS	lb/d	2,612	2,717	3,042
TSS	%	0.1		
4.0 mgd				
Dry Season				
Flow	gpd	568,484	608,278	642,387
TSS	lb/d	4,744	5,550	6,879
TSS	%	0.1		
Wet Season				
Flow	gpd	682,181	790,193	932,314
TSS	lb/d	4,886	5,550	6,215
TSS	%	0.1		
7.0 mgd				
Dry Season				
Flow	gpd	987,537	1,056,665	1,115,917
TSS	lb/d	8,241	9,642	11,949
TSS	%	0.1		
Wet Season				
Flow	gpd	1,185,045	1,372,677	1,619,561
TSS	lb/d	8,488	9,642	10,796
TSS	%	0.1		

Sludge Thickening Flows and Loads Co-thickening (WAS and Primary Sludge)				
2000		Avg.	Max. Month	Max. Week
Dry Season				
Flow	gpd	35,700	38,199	40,341
TSS	lb/d	4,280	5,008	6,206
TSS	%	1.4		
Wet Season				
Flow	gpd	42,840	49,623	58,548
TSS	lb/d	4,408	5,008	5,607
TSS	%	1.2		
4.0 mgd				
Dry Season				
Flow	gpd	59,700	63,879	67,461
TSS	lb/d	8,799	10,295	12,759
TSS	%	1.8		
Wet Season				
Flow	gpd	71,640	82,983	97,908
TSS	lb/d	9,063	10,295	11,527
TSS	%	1.5		
7.0 mgd				
Dry Season				
Flow	gpd	89,400	95,658	101,022
TSS	lb/d	15,350	17,960	22,258
TSS	%	2.1		
Wet Season				
Flow	gpd	107,280	124,266	146,616
TSS	lb/d	15,811	17,960	20,109
TSS	%	1.8		

Sludge thickening facilities must be sized based on the following redundancy criteria:

- Unit processes must handle solids associated with wet-weather maximum-month flows with the largest unit out of service
- Unit processes must handle solids associated with wet-weather maximum-week flows with all units in service
- Pumping facilities must handle solids associated with the design process flow with the largest unit out of service.

Alternatives Considered

Continued use of gravity belt thickening was the only alternative selected for detailed consideration. Other options for sludge thickening include gravity thickening and dissolved air flotation thickening. Gravity belt thickeners (GBTs) require a solids concentration equal to or greater than approximately 0.4 percent, thus thickening solids from a BAF will require pre-thickening in order for the GBT to operate at optimum performance. GBT operation was examined for both secondary sludge thickening only (requires thickening of primary sludge in the primary clarifiers), and co-thickening of primary and secondary sludge.

Thickening in the existing GBTs is currently limited to a maximum solids concentration of approximately 4 percent due to limitations at higher concentrations on air mixing in the digesters at higher concentrations and the ability to pump liquid digested sludge for land application. As both of these constraints will likely be removed in the future, alternatives assume that sludge will be thickened to 6 percent. This is well within the range of normal GBT operation, which with the use of polymer can achieve up to 8 percent solids.

Based on the projections shown in Table 5-38 and a hydraulic loading rate of 150 gpm/meter of belt width, the following table describes the capabilities of the existing system to meet future loading and redundancy criteria processing secondary or combined primary and secondary sludge (excluding BAF backwash solids).

If BAFs are installed for secondary treatment capacity, an additional thickening step will be required. This option is not compatible with the City's desire to continue to use GBTs as the sole source of thickening. For this reason, the alternative was not considered further.

Table 5-39. Capacity of Existing Facilities to meet Future Thickening Needs

Sludge Thickening Flows and Loads - Conventional/MBR			
4.0 mgd		Max. Month	Max. Week
Flow	gpm	144.7	170.8
Req'd width	m	1.0	1.1
Added width	*m*	—	—
7.0 mgd			
Flow	gpm	191.8	226.3
Req'd width	m	1.3	1.5
Added width	*m*	—	—
Sludge Thickening Flows and Loads – Co-thickening			
4.0 mgd		Max. Month	Max. Week
Flow	gpm	242.0	285.6
Req'd width	m	1.6	1.9
Added width	*m*	*0.1*	—
7.0 mgd			
Flow	gpm	362.4	427.6
Req'd width	m	2.4	2.9
Added width	m	*0.9*	—

Option 1A – Primary sludge thickening in primary clarifiers/GBT thickening of WAS

As Table 5-39 shows, the existing GBT capacity is adequate to thicken future WAS flows from either a conventional activated sludge process or an MBR process. The calculations assume a design capacity of 225 gpm for each existing GBT. If primary sludge is thickened in the primary clarifiers, it would be essential to provide covers and treatment of foul air to control odors.

Option 1B – Co-thickening of primary and secondary sludges

This is a variation on Option 1A, where primary sludge and WAS would be mixed in a blend tank or an inline mixer and co-thickened on the existing gravity belt thickeners. The advantage of this option is that it allows the primary clarifier operation to be optimized for clarification, and may eliminate the need for odor covers on the primary clarifiers. Based on the sludge volumes projected in Table 5-36 and the capacity of the existing GBTs, sludge associated with an ADWF of 4 mgd can be processed using the existing equipment during normal 8-hour/day, 5-day/week shifts. Additional thickening capacity is required to provide ultimate build-out capacity. This can be provided by:

- Increasing thickening time to 54 hours/week by adding shifts
- Replacing the existing GBTs with larger (2-m belt) units
- Adding another 1.5-m GBT.

Comparison of Alternatives

Table 5-40 presents the key advantages and disadvantages of the three sludge thickening alternatives.

Table 5-40. Summary Comparison of Sludge Thickening Alternatives

Alternative	Advantages	Disadvantages
1A. GBTs – conventional secondary/MBR sludge only	• Smallest number of GBTs required	• Requires two processes to be operated for thickening (primary clarifiers and GBTs) • Covering of primary clarifiers is required to address potential odors from sludge thickening
1B. GBTs – Co-thickening of primary and secondary (conventional/MBR) sludges	• Reduces volume of solids sent to digester; less digester volume required • Primary clarifier operation can be optimized for clarification	• Requires additional equipment or extended thickening hours

The costs of the alternatives are presented in Table 5-41.

Table 5-41. Summary Cost Comparison of Thickening Alternatives (Costs in $1,000s)

	Alternative 1A – GBTs (Conventional/MBR)		Alternative 1B – GBTs (Co-thickening)	
	4.0 mgd	**7.0 mgd**	**4.0 mgd**	**7.0 mgd**
Total Capital Cost	$54	$0	$1,985	$0
Annual O&M Cost	$22	$45	$45	$67
Present Worth Capital Cost	$50	$0	$1,835	$0
Total Present Worth Cost	$1,724		$4,625	

Preliminary Recommendations

The alternatives do not differ significantly in terms of regulatory compliance or implementation. Both have operational drawbacks: operations will ultimately be impacted by co-thickening as the projected sludge volumes cannot be processed in the current 8-hour/day, 5-day/week shifts; separate thickening of primary sludge and WAS reduces weekly thickening time, but requires the primary clarifiers to be operated for dual purposes. Co-thickening will likely produce the most odors. However, since the thickening process is already enclosed, odors can easily be contained and treated.

Since there are no driving forces for moving to co-thickening, and since the existing GBTs need only minor improvements to process projected sludge quantities through ultimate build-out, it is recommended that primary sludge continue to be thickened in the primary clarifiers with gravity belt thickening of secondary sludge only. Figure 5-17 shows a comparison of alternatives 1A and 1C with the evaluation criteria.

Figure 5-17. Sludge Thickening Alternatives Preliminary Evaluation

Evaluation Criteria	Alt A: Secondary sludge thickening only (conventional/MBR)	Alt B: Co-thickening primary and secondary sludges	Comments
Regulatory Compliance	●	●	
Operations/ Technology	◕	◕	Co-thickening requires operation of an additional GBT.
Implementation	●	●	
Community/ Environmental	●	◕	Co-thickening requires primary sludge handling, which has the potential to produce odors.
Compatibility With Site	●	◕	Co-thickening requires a larger footprint than other options.
Cost	●	◑	
Total	●	◕	

Worse ○ ◔ ◑ ◕ ● Better

Solids Stabilization Alternatives

Design Criteria

The process model was used to project design flows for solids stabilization at projected influent flows and loadings associated with ADWF flows of 4 and 7 mgd. Digester feed is assumed to consist of primary sludge at 4 percent solids and WAS at 6 percent solids. This is a conservative assumption in that it gives the City the flexibility to either co-thicken primary sludge and WAS, or operate separate thickening processes. If co-thickening were practiced, the required digester volume would be reduced.

Table 5-42. Design Flows for Solids Stabilization.

Condition	Units	Average	Max. Month	Max. Week
4.0 mgd				
Summer				
Flow	Gpd	20,800	22,256	23,504
TSS	lb/d	8,427	9,860	12,219
VSS	lb/d	6,591	7,711	9,557
Winter				
Flow	Gpd	24,960	28,912	34,112
TSS	lb/d	10,112	11,832	13,247
VSS	lb/d	7,909	9,254	10,361
7.0 mgd				
Summer				
Flow	Gpd	36,200	38,734	40,906
TSS	lb/d	14,690	17,187	21,301
VSS	lb/d	11,480	13,432	16,646
Winter				
Flow	Gpd	43,440	50,318	59,368
TSS	lb/d	17,628	20,625	23,093
VSS	lb/d	13,776	16,118	18,047

Any solids stabilization option must meet the current and future regulations set forth in 40 CFR Part 503, which are different for Class A and Class B biosolids production. Key regulatory requirements for biosolids are as follows:

- **Vector attraction reduction (VAR).** Volatile solids (VS) must be reduced by 38 percent.
- **Metals concentration limits.** Any land applied biosolids must meet concentration or application limits for eight heavy metals. This requirement must be met through source control and management practices.

The key difference between Class A and Class B biosolids requirements is pathogen reduction. Class B biosolids must meet a fecal coliform limit of 2,000,000 MPN/g TS, while Class A biosolids must have fecal coliforms less than 1,000 MPN/ g TS, or *Salmonella* sp. less than 3 MPN/ 4g TS. Certain processes have been designated by EPA as Class A and Class B, and requirements can be met through operational criteria rather than pathogen concentrations.

Redundancy criteria for digestion and solids handling processes are as follows:

- Handle wet weather maximum-month flow with largest unit out of service
- Provide full treatment to wet weather maximum-week flow with all units in service.

Alternatives Considered

In the Alternatives Kickoff Workshop held on February 13, 2002 several stabilization alternatives were suggested for evaluation. An additional meeting was held on February 27, 2002 to further screen alternatives, and the following were selected for evaluation:

- Alternative 1: Aerobic Digestion (Class B Biosolids)
- Alternative 2A: Anaerobic Digestion (Class B Biosolids)
- Alternative 2B: Anaerobic Digestion with Prepasteurization (Class A Biosolids)
- Alternative 2C: Anaerobic Digestion with Thermal Drying/Pelletizing (Class A Biosolids)

Alternative 1 – Aerobic Digestion (Class B Biosolids)

Aerobic digestion is currently practiced at the Wilsonville WWTP. The existing aerobic digesters would provide the required 40-day detention time until approximately 2015.

Table 5-43. Design criteria for aerobic digestion.

Parameter	Minimum Value
HRT – maximum month	40[1]
HRT – maximum month; one digester out of service	40[2]
Temperature	68°F

[1] Wet season loading rate
[2] Dry season loading rate

Continued use of the existing aerobic digesters precludes the use of the digester/clarifier tanks for retrofit for primary clarification use only, as described in the liquid stream discussion above. This alternative assumes that the existing digesters will remain in service, augmenting the existing capacity with new digester capacity as required in the future. Therefore, this alternative must be examined in conjunction with the primary clarifier alternatives.

This alternative also limits the City in terms of future conversion to Class A biosolids. Class A treatment of aerobic sludge often involves a high temperature process (ATAD). Operating a high temperature process in the existing basin may not be feasible, and through sharing a common wall with the primary clarifiers, this could increase the temperature of the liquid stream flow. Odors are would also be an overriding concern with an option such as ATAD.

Facilities Required/Key Design Information

Table 5-44 shows the facilities required for nominal average dry weather design flows of 4.0 and 7.0 mgd. It is assumed that the new digesters will be 55 feet square with a 35-foot sidewater depth. The square aerobic digester configuration is used to provide for compact construction.

Table 5-44. Facilities required for Alternative 1.

Item	Unit	New Facilities at 4.0 mgd ADWF	New Facilities at 7.0 mgd ADWF
Aerobic digesters	Number/dimensions	1 @ 55 ft x 55 ft x 35[1] ft	1 @ 55 ft x 55 ft x 35[1] ft
Blowers	Capacity	6,700 scfm	11,700 scfm
Sludge feed pumps	Number/gpm	2 @ 200	1 @ 200

[1] Side water depth

Alternative 2 – Anaerobic Digestion

Anaerobic digestion is the conversion of organic material to methane and carbon dioxide with no dissolved oxygen present. Anaerobic digesters are heated and mixed but not aerated. They also require covers and a gas collection and management system. Gas recovery and utilization systems provide the potential for meeting the heating requirements of the digesters and generating energy for other uses such as space heating and cogeneration of electrical power.

Digestion Phases

Several types of bacteria are involved in the anaerobic decomposition of organic material. Two distinct groups perform separate functions in an anaerobic digester:

- **Acid-forming bacteria** (also known as acidogens) convert complex organic compounds to soluble organic compounds using exocellular enzymes. Soluble compounds are then converted to volatile fatty acids (VFAs), primarily acetic and propionic acid. These organisms grow relatively quickly, requiring a solids retention time (SRT) of 0.5 to 2 days, and can grow and function under low pH (less than 4) conditions.
- **Methane-forming bacteria** (also known as methanogens) convert VFAs to methane and carbon dioxide. Methanogens are slow-growing organisms and require a SRT greater than approximately 5 days, depending on temperature. Anaerobic digesters are typically designed to provide an SRT of 15-20 days . Methanogens are very pH sensitive, and require the pH to be very close to neutral to grow and function. If the pH of the digester is reduced, failure could ensue. This condition is commonly referred to as a "sour" digester, from the odor that develops when methanogenic activity ceases.
- **Hydrogen-producing and hydrogen-consuming bacteria** also play an important role in anaerobic digesters. Hydrogen-consuming bacteria are required to keep hydrogen levels low. If hydrogen levels are too high, failure can ensue.

In conventional anaerobic digestion, these groups of bacteria function in the same digester. All of the groups of bacteria in an anaerobic digester work together to degrade sludge and form methane and carbon dioxide.

Temperature Conditions

Anaerobic digesters can be operated at a variety of temperatures, but research has shown that the process has two optimal temperature ranges: the mesophilic range at around 95°F; and the thermophilic range around 130°F. The alternatives evaluated for Wilsonville focus on mesophilic digestion. Thermophilic digesters generate significant odors and require complex operation. Thermophilic digestion is also not classified by EPA as a process to further reduce pathogens (PFRP) in 40 CFR 503, and unless operated in a batch mode, would need to be approved for Class A production based on a site-specific evaluation. Conventional anaerobic digesters could be constructed to allow future operation at high temperatures, giving the City the flexibility to convert to thermophilic operation in the future.

Gas Production and Energy Balance

Anaerobic digesters typically produce between 12 to 16 cubic feet of gas per pound of volatile solids destroyed. Gas composition depends on the nature of the feed, but is typically 60 to 70 percent methane (CH_4) and 30 to 40 percent carbon dioxide (CO_2). Trace amounts of hydrogen, hydrogen sulfide, nitrogen, and other gases are also present. The energy value of digester gas is typically between 600 to 700 BTU per cubic foot. This will provide enough energy to heat the digesters with energy to spare. A heat exchange loop including heat exchangers, boilers, ancillary piping, and space heaters would be provided to convert digester gas to heat. A small water supply connection is also required for the hot water loop. Excess gas can be combusted in waste gas burners or used to power co-generation units. However, the payback periods for co-generation at small to medium-sized plants can be relatively long, especially in the Pacific Northwest where power costs are moderate.

If anaerobic digestion is included in the recommended plan, the City should conduct a detailed energy management plan in order to fully evaluate potential onsite or nearby uses for power recovered through cogeneration, and to examine potential opportunities with local power utilities. Many utilities in the Northwest provide grant support and advantageous power purchase agreements that can make cogeneration beneficial.

Storage and equalization of digester gas is an important component of the design of an anaerobic digestion process. Gas production rates flucuate depending on feed sludge flows and characteristics. Equalization is important to prevent flucuating pressures in the headspace of digesters, and structural problems with digester covers.

Operational Issues

Anaerobic digester gas contains moisture that condenses as the gas cools. Gas collection piping should include condensate traps to prevent plugging. Materials of construction for gas collection and handling systems are particularly important due to the corrosive nature of anaerobic digester gas. Hydrogen sulfide content in anaerobic digester gas can also cause operational problems with cogeneration engines as well as contributing to air pollution. This issue should be addressed during the energy management plan and during preliminary design of the anaerobic digestion system.

Other maintenance issues associated with the heat exchangers and other ancillary equipment include scaling and plugging. High temperatures in the heat exchange loop can cause scaling in the heat exchangers and associated piping. Required cleaning frequencies range from 1 to 10 years or more, and depend on influent characteristics, digester mixing, and grit removal facilities. Rags and other large particles that are removed in liquid stream processes can plug heat exchangers. However, fine screening at Wilsonville will eliminate most of this problem. In addition, a sludge grinder just upstream of the heat exchanger will prevent most plugging problems.

Anaerobic digesters are susceptible to grit buildup over time. Grit buildup reduces the active volume of a digester and the detention time as a result. Digester cleaning equipment should be provided with new digesters, especially as Wilsonville does not have a grit removal system. However, well-mixed digesters will only need infrequent cleaning.

Chemical precipitation of phosphorus, typically in the form of struvite ($MgNH_4PO_4$), is common in anaerobic digesters and ancillary piping due to the high levels of soluble ammonium and phosphorus in anaerobic digesters. Struvite formation is especially common in plants with biological phosphorus removal, but can be minimized with proper design.

Alternative 2A – Anaerobic digestion (Class B biosolids)

Table 5-45 summarizes the design criteria for this alternative.

Table 5-45. Design criteria for anaerobic digestion.

Parameter	Minimum Value
HRT – maximum month wet weather	20
HRT – maximum week wet weather	17
HRT – maximum month dry weather; one digester out of service	15
Temperature	95°F

Based on the criteria in Table 5-45, the required number and size of anaerobic digesters at the Wilsonville WWTP for nominal design flows of 4.0 and 7.0 mgd are shown in Figure 5-18. Volumes shown assume two digesters total for a flow of 4.0 mgd, and three digesters for a flow of 7.0 mgd.

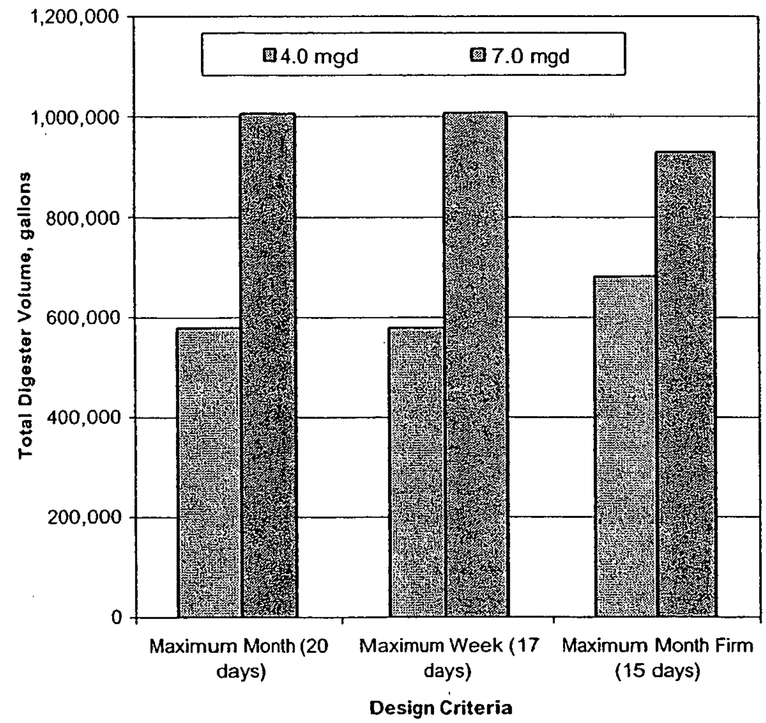


Figure 5-18. Digester Volume Requirements for Anaerobic digestion Alternatives.

Using volumes shown in Figure 5-18, two 45-foot diameter digesters with 30-foot sidewater depths, will need to be constructed before 2015, when a third identically-sized digester will need to be constructed. Table 5-46 shows an estimate of the annual energy produced by anaerobic digestion for Wilsonville based on the volatile solids destruction in the anaerobic digesters. After accounting for heat lost through the digester cover and walls, and energy used to heat the feed sludge, Table 5-46 shows that approximately 60 to 70 percent of the gas produced in the digester could be recovered for other beneficial uses.

Table 5-46. Anaerobic Digester Gas Production and Energy Value.

Volatile Solids Destruction (%)	Gas Production (cf/day)	Energy Value (MBTU/yr)	Heat Loss/Sludge Heating (MBTU/yr)	Percentage Excess
4.0 mgd				
50	50,571	11,114	4,570	59%
60	60,901	13,337	4,570	66%
70	71,051	15,560	4,570	71%
7.0 mgd				
50	88,396	19,359	7,776	60%
60	106,075	23,230	7,776	67%
70	123,754	27,102	7,776	71%

Facilities Required/Key Design Information

Table 5-47 shows the necessary anaerobic digestion facilities for nominal design flows of 4.0 and 7.0 mgd.

Table 5-47. Anaerobic Digestion Facilities Required.

Item	Unit	New Facilities at 4.0 mgd ADWF	New Facilities at 7.0 mgd ADWF
Anaerobic digesters	Number/diameter/liquid height	2 @ 45 ft dia x 30 ft high	1 @ 45 ft dia x 30 ft high
Digester mixers	Number/hp	2 @ 50	1 @ 50
Heat exchangers	Number, 1000 BTU/hr	2 @ 500	1 @ 500
Boilers	Number, 1000 BTU/hr	2 @ 550	1 @ 550
Gas storage	Volume (cf)	20,000	36,000
Sludge feed pumps	Number/gpm	2 @ 200	1 @ 200

Option 2B – Anaerobic Digestion with Prepasteurization (Class A Biosolids)

Option B is identical to Option A except it includes facilities for prepasteurization of raw sludge prior to digestion. Only pasteurization facilities will be discussed in this section; it is assumed that anaerobic digestion requirements will be similar to Option A. However, detention time requirements to meet PSRP criteria would no longer apply since Class A pathogen requirements would be met by the pasteurization system. Volatile solids reduction of 38 percent would be required, although it is likely that this could be achieved with less than a 15 day detention time at maximum month conditions. If performance testing indicated that the target volatile solids reduction could be achieved with a lower design SRT, the digester volume requirements would decrease and construction of the third digester could be delayed or possibly avoided.

Pasteurization is a process to further reduce pathogens (PFRP) described in the Part 503 regulations [503.32(a)(7)]. It is defined as maintaining the sludge temperature at or above 70°C (158°F) for at least 30 minutes. Under this alternative, the fecal coliform or *Salmonella* densities must also be less than specified levels. Batch or plug-flow processing is required by the regulations to prohibit short-circuiting of pathogens.

Typically, several small steel tanks are used to process the sludge. One vendor recommends three small tanks, each with a detention time of 1 hour. During normal operation, one tank would be filling, one reacting, and one withdrawing, creating a continuous operation out of three

Table 5-50. Comparison of advantages and disadvantages of solids stabilization alternatives (continued)

Alternative	Advantages	Disadvantages
2B. Anaerobic digestion with prepasteurization (Class A biosolids)	• Fewer restrictions on final end uses of Class A biosolids, which may facilitate management of the final biosolids product • Smaller footprint than Alt 2C. • No additional odors – completely enclosed process • No restrictions on application	• Increased capital costs • Requires specialized heat exchangers and proprietary process equipment • Energy intensive
2C. Anaerobic digestion with thermal drying/pelletizing (Class A biosolids)	• Fewer restrictions on final end uses of Class A biosolids, which may facilitate management of the final biosolid product • Lowest truck traffic at plant site for biosolids transport • Potentially most marketable end product • Most easily stored biosolids product • Greatest volume reduction • No restrictions on application • Full utilization of digester gas	• Highest cost alternative • Very energy intensive • Lowest final sludge volume; lowest storage requirements • Foul air emissions from dryer • Potential explosion hazard due to dust

Table 5-51 summarizes the costs of the alternatives. A detailed cost analysis is included in the appendix.

Table 5-51. Summary Cost Comparison of Solids Stabilization Alternatives (Costs in $1,000s)

	Alternative 1a Aerobic Digestion using Exist. Basins		Alternative 1b – Aerobic Digestion with all New Basins		Alternative 2A – Class B Anaerobic Digestion		Alternative 2B – Anaerobic Digestion/ Prepasteurization		Alternative 2C – Anaerobic Digestion/ Drying	
	4.0 mgd	7.0 mgd	4.0 mgd	7.0 mgd	4.0 mgd	7.0 mgd	4.0 mgd	7.0 mgd	4.0 mgd	7.0 mgd
Total Capital Cost	$1,917	$1,917	$3,765	$1,917	$4,812	$1,807	$6,956	$1,807	$9,760	$1,807
Annual O&M Cost	$ 228	$ 296	$ 179	$237	$95	$ 116	$ 140	$ 166	$ 281	$ 330
Present Worth Capital Cost	$1,723	$ 1,152	$3,481	$ 1,152	$4,449	$ 1,085	$6,431	$ 1,085	$9,023	$ 1,085
Total Present Worth Cost	$16,004		$15,021		$10,789		$15,147		$25,375	

Preliminary Recommendations

Figure 5-20 shows a comparison of the alternatives with respect to the evaluation criteria. Key considerations are as follows:

- Class A alternatives (2B and 2C) offer easier regulatory compliance, but are more complicated to operate and maintain.
- Because Wilsonville's solids flows are relatively small compared to the size of drying equipment available, implementation of Alternative 2C cannot be logically phased.
- Life cycle costs for the drying and pelletizing option are almost fifty percent higher than the next most expensive alternative. Other than reducing the sludge storage volume, this option does not have significant benefits that outweigh the high cost.
- Aerobic digestion requires the largest tank volume.

Based on the analysis shown below and the considerations in Table 5-50, it is recommended that the City provide anaerobic digestion for all future flows. A location should be identified for a potential future prepateurization building if the City determines that producing Class A biosolids is a priority.

batch reactors. The heat exchange loop for pasteurization is relatively complex: sludge-to-sludge heat exchangers are used to transfer heat from pasteurized sludge to the feed, then the feed sludge is heated to 70°C by passing through a hot water loop (maintained by another set of heat exchangers). As such, significant heat exchanger capacity, pumps, piping, valving, and other equipment are typically required. Pasteurization facilities are typically housed in a small building, and sited near digestion facilities.

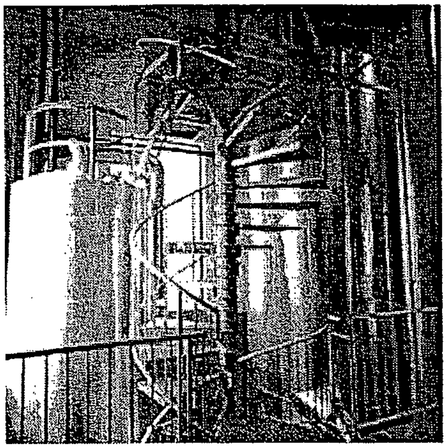


Figure 5-19 AutoTherm™ pasteurization vessels (courtesy of Chicago Bridge & Iron website).

Additional Facilities Required/Key Design Information

Table 5-48 shows the required size of pasteurization tanks for nominal design flows of 4.0 and 7.0 mgd. Typically, a system with the capacity to treat build-out flows would be implemented in one phase as it is more cost-effective. Even with one stage of expansion, the size of the prepasteurization tanks is relatively small. Additional costs for elements such as the structure, piping, etc. would be incurred with the first expansion, so the incremental savings associated with reducing the tank size and phasing tank installation is small.

Additional equipment is required for a pasteurization system. Pasteurization tanks would need to be exhausted and foul air treated due to gas production by fermentative bacteria. A cooling system would also need to be provided for the building due to the high temperatures of the process. A benefit to such a system is that heat exchange requirements for the digesters would be much less with a pasteurization system, as the pasteurization process would bring the sludge temperature to 95°F.

Table 5-48. Facilities Required for Pasteurization.

Item	Unit	New Facilities at 4.0 mgd ADWF	New Facilities at 7.0 mgd ADWF
Pasteurization building	Dimensions	40 ft x 40 ft	—
Pasteurization vessels	Number/volume	3 @ 6,300 gal	—
Mixers	Number/hp	3 @ 10 hp	—
Heat exchangers	Number	2	—
Sludge grinder	Number/hp	1 @ 5	—
Pumps	Number/gpm	3 @ 100 (sludge)	—

Operational Issues

Since there are few pasteurization facilities in North America, information on operational issues is scarce. Pasteurization facilities require a relatively complex heat exchange loop that is typically automated. However, the effort required for maintenance of heat exchangers and heat exchange equipment is a concern with this technology.

Option C – Anaerobic Digestion with Thermal Drying/Pelletizing (Class A Biosolids)

Thermal drying of sludge/biosolids has increased in popularity due to the marketability of the final product, ease of storage, and volume reduction. Heat drying is a USEPA approved PFRP, defined in the Part 503 regulations as follows:

> "Sewage sludge is dried by direct or indirect contact with hot gases to reduce the moisture content to 10 percent or lower. Either the temperature of the sewage sludge particles exceeds 80°C (176°F) or the wet bulb temperature of the gas in contact with the sewage sludge as it leaves the dryer exceeds 80°C (176°F)."[3]

Drying methods include flash dryers, spray dryers, rotary dryers, and steam dryers. Each process can be categorized as direct or indirect drying. Direct drying involves direct contact of hot gases (or other heat transfer medium) with the wet sludge, and produces foul air emissions. Indirect drying separates the hot gases and the sludge with a solid surface, resulting in less foul air. Direct drying at the Wilsonville WWTP may require an air quality permit and would result in substantial odor production. Therefore, direct drying was not considered.

Digestion is not required prior to a drying process, but installations that operate without digestion have experienced severe maintenance issues and difficult operations. Therefore, anaerobic digestion prior to drying is assumed.

Manufacturers of indirect dryers include US Filter/Davis Products, Komline-Sanderson, Andritz, and Fenton Environmental. Systems are available to dewater and dry solids in the same unit. One such system uses a combination diaphragm plate filter press and evaporator to produce a dried solids (J-VAP, US Filter). Such systems have higher energy costs than systems with separate dewatering and drying processes. Thermal drying systems are typically sized by equipment vendors, and equipment is procured as a package.

Important design considerations include:

- Energy source – Most indirect dryers are capable of operating on anaerobic digester gas. However, the quantity of methane produced during digestion will not be sufficient to both heat the digester and power a thermal dryer. Also, the equalization volume required to store digester gas and allow for 40 hour a week operation of the dryer would not be feasible. Natural gas will be required to supplement digester gas.
- Multiple pass system vs. single pass system – Multi-pass dryers require additional equipment and have higher operating costs than single-pass units. Single-pass units, however, cannot produce a high-quality, uniformly graded dried biosolids pellet. Due to the high cost of producing a dried biosolids acceptable for a fertilizer broker or bagging operation (e.g.

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[3] US EPA. 1999. Environmental Regulations and Technology: Control of Pathogens and Vector Attraction in Sewage Sludge.

multi-pass dryer), it is assumed that biosolids will be dried in a single-pass unit and will be hauled by truck and land applied.

- Operation – To simplify controls and operations, the drying process should be synchronized with the dewatering process. Dryers and their wet scrubbers/regenerative thermal oxidizers (RTO) require a significant amount of warm-up time (typically 2 hours). In general, a solids drying process will operate more efficiently if run for long periods of time. For example, it would be better to operate a drying process for 24 hours a day, 2 days a week than to operate 8 hours a day, 6 days a week.

Marketing is key to the success of a biosolids drying program. For marketing, important aspects of a dried biosolids product are as follows[4]:

- Nitrogen content – should be at least 3 to 4 percent for direct application as a fertilizer. If the nitrogen content is lower, is can still be used as a constituent of blended fertilizer.
- Moisture content – must be 10 percent or less to meet EPA criteria for PFRP. Should be less than 5 percent to eliminate combustion potential during storage.
- Durability – dried particles must be durable enough to withstand breakage during storage and transport.
- Dustless product – dried biosolids must be dust free to eliminate problems in storage and handling.
- Ability to dissolve in soil – dried biosolids must dissolve in soil over time to release nutrients into solution for plant uptake.
- Odor free – to prevent odors at the plant and the final disposal site, the final product must be as odor-free as possible.
- Free of extraneous material – dried biosolids should be free of plastics, rags, and other extraneous materials.

Implementation of a thermal drying process would require a significant initial capital expenditures. An aggressive marketing effort would also be required prior to implementation due to the fundamental change in product from the current liquid biosolids product.

There are very few installations of thermal drying systems in the Pacific Northwest. The market for dried biosolids in the Northwest is not clear, and needs to be researched during preliminary design if thermal drying is chosen as the preferred alternative. However, one manufacturer guarantees that they will accept the dried product produced by their equipment at no cost to the utility, so disposal of the end product will not require the use of a fertilizer broker.

Additional Facilities Required/Key Design Information

Table 5-49 shows the facilities required to implement this alternative for nominal design flows of 4.0 and 7.0 mgd. Equipment shown in the table are based on the Andritz DDS-10 dryer system. Other drying systems may require different equipment of a different size. Due to the size of commercially available drying systems, it is assumed that a drying process will be adequately sized for build-out flows. A redundant dryer should be provided to maintain operation during maintenance shutdowns. Alternatively, only one solids dryer would be needed if Wilsonville chose to provide adequate dewatered cake storage to continue dewatering operations during dryer shutdowns.

[4] WEF Manual of Practice No. 8. 1998. Design of Municipal Wastewater Treatment Plants, 4th ed., vol. III.

Table 5-49. Facilities Required for Thermal Drying.

Item	Unit	New Facilities at 4.0 mgd ADWF	New Facilities at 7.0 mgd ADWF
Solids Dryer	Number @ (ton/day)	2 @ 7	—
Feed hopper	Number	1	—
Wet scrubber (RTO)	Number	1	—
Condenser	Number	1	—

Operational Issues

King County, Washington, operated a drying facility during the 1990s but abandoned the facility due to an explosion caused by dust. However, more recent installations throughout the US have been successful. Common operational issues include equipment breakdowns and dust production.

Comparison of Alternatives

Table 5-50 summarizes the key advantages and disadvantages of the solids stabilization alternatives.

Table 5-50. Comparison of advantages and disadvantages of solids stabilization alternatives

Alternative	Advantages	Disadvantages
1. Aerobic digestion (Class B biosolids)	• Least amount of capital expenditures • Small footprint required with compact square construction	• Increased energy use for aerobic solids stabilization • Produces the highest volume of digested sludge • Potentially higher operations cost due to long distance hauling • Increased management, permitting, and tracking required for Class B biosolids • Site restrictions for land application • Difficult to meet VAR requirements • Foaming problems typically more severe than anaerobic digestion
2A. Anaerobic digestion (Class B biosolids)	• Lowest present worth cost • Greater VSS destruction than aerobic digestion • Easier to meet VAR requirements than aerobic digestion • Less energy use and lower operating costs due to gas recovery	• Potentially higher operations cost due to long distance hauling • Potential new odor source at the plant site • Increased management, permitting, and tracking required for Class B biosolids • Site restrictions for land application

Figure 5-20. Solids Stabilization Alternatives Preliminary Evaluation

Evaluation Criteria	Alt 1: Aerobic digestion (Class B biosolids)	Alt 2A: Anaerobic digestion (Class B biosolids)	Alt 2B: Anaerobic digestion with prepasteurization	Alt 2C: Anaerobic digestion with thermal drying/pelletizing	Comments
Regulatory Compliance	◑	◕	●	●	
Operations/ Technology	●	◕	◑	◑	Class A alternatives will require more maintenance and are more difficult to operate
Implementation	●	●	●	◕	Thermal drying would require an extensive marketing effort or the use of a fertilizer broker
Community/ Environmental	◕	◑	◑	●	Alternatives 2A and 2B have the most potential to produce odors during biosolids storage at the plant.
Compatibility With Site	◔	●	◕	◑	Aerobic treatment requires large footprint.
Cost	◑	◕	◑	○	Class A alternatives are more Expensive, with thermal drying being by far the most expensive alternative.
Total	◑	◕	◑	◔	

Worse ← → Better

○ ◔ ◑ ◕ ●

Dewatering and Dewatered Biosolids Storage Alternatives

Design Criteria

Dewatering/Recycle Management Design Criteria

Dewatering facilities are typically designed based on maximum-week solids loadings. Reliability criteria established for this project stipulate that maximum-week conditions can be met with all units in service; whereas maximum-month conditions must be met with the largest unit out of service.

Daily and weekly throughput capacities depend on the number of hours that the dewatering units are operated each day or week. It is assumed that all dewatering facilities will be operated on a five day a week, eight hours a day schedule. This requires additional capacity and higher capital expenditures, but is the simplest operational strategy.

Several factors influence the performance of dewatering processes:

- Digested solids characteristics – aerobically digested solids are usually more difficult to dewater than anaerobically digested solids. Dewatering aerobically digested solids typically requires more polymer to achieve the same cake solids concentration as anaerobically digested solids. The ratio of primary to secondary sludge also influences dewatering – secondary sludge is more difficult to dewater than primary sludge.
- Temperature of solids – In general, the higher the temperature, the more effective the dewatering process. The temperatures of anaerobically digested solids are normally higher than aerobically digested solids.
- Solids retention time (SRT) – long activated sludge SRTs can be difficult to dewater.
- Feed solids concentration – dilute feed sludges will require more conditioning and result in lower cake solids concentrations than thicker feed sludges.

Since dewatering performance varies dramatically from plant to plant, pilot testing is recommended for developing accurate design criteria. However, typical performance of alternative processes can be used for evaluation.

Filtrate/centrate streams from dewatering processes typically contain very high concentrations of ammonia. Direct return of filtrate to the liquid stream treatment process can significantly impact the secondary treatment capacity for nitrification. For planning purposes, it is assumed that all dewatering options will include 8 hours of filtrate/centrate storage. This allows the centrate to be stored during the normal dewatering period and returned during the evening/night-time hours.

Biosolids Storage Design Criteria

Design criteria for liquid, dewatered cake, and dried biosolids storage facilities depend on the desired flexibility in the biosolids management program and the market for final disposal of the biosolids. The choice of solids stabilization, dewatering, and drying alternatives will dramatically affect the size and design of biosolids storage facilities. Forty hour/week dewatering operations will be assumed. For dried biosolids storage facilities, it is assumed that thermal drying will operate three days per week, eight hours per day.

DEQ indicates that a minimum of four months of storage must be provided, with six months preferred due to the lack of suitable winter storage sites. This storage can be in a combination of forms (liquid, dewatered, and dried sludge). Because of this storage requirement, continued production of liquid biosolids only was not considered. The City has examined the concept of off-site biosolids storage, and concluded that it is not feasible.

Projected flow and loadings for dewatering and dewatered sludge storage vary depending on the type of digestion selected. Table 5-52 shows digested biosolids flows and loadings based on 38 percent volatile solids (VS) destruction (aerobic digesters) and 50 percent VS destruction (anaerobic digesters).

Table 5-52. Digested Biosolids Flows and Loads.

38% VS destruction (Aerobic digestion)					50% VS destruction (Anaerobic digestion)				
		Average	Max. Month	Max. Week			Average	Max. Month	Max. Week
4.0 mgd - Dry Season					**4.0 mgd - Dry Season**				
Flow	gpm	49	52	55	Flow	gpm	49	52	55
TSS	lb/hr	1,036	1,213	1,503	TSS	lb/hr	898	1,051	1,302
TSS	%	4.2%			TSS	%	3.7%		
4.0 mgd - Wet Season					**4.0 mgd - Wet Season**				
Flow	gpm	59	68	80	Flow	gpm	59	68	80
TSS	lb/hr	1,244	1,455	1,629	TSS	lb/hr	1,078	1,261	1,412
TSS	%	4.2%			TSS	%	3.7%		
7.0 mgd - Dry Season					**7.0 mgd - Dry Season**				
Flow	gpm	86	92	97	Flow	gpm	86	92	97
TSS	lb/hr	1,807	2,115	2,621	TSS	lb/hr	1,566	1,833	2,271
TSS	%	4.2%			TSS	%	3.6%		
7.0 mgd - Wet Season					**7.0 mgd - Wet Season**				
Flow	gpm	103	119	141	Flow	gpm	103	119	141
TSS	lb/hr	2,169	2,537	2,841	TSS	lb/hr	1,880	2,199	2,462
TSS	%	4.2%			TSS	%	3.6%		

The volume of dewatered cake produced depends on the type of dewatering/drying selected. Table 5-53 shows projected maximum month flows and loadings of dewatered cake or dried biosolids.

Table 5-53. Maximum Month Wet-Weather Dewatered Cake/Dried Biosolids Flows and Loads.

Condition	Units	15% Cake	25% Cake	90% Cake
4.0 mgd				
Flow	Gpd	5,756	3,453	959
TSS	lb/d	7,205	7,205	7,205
7.0 mgd				
Flow	Gpd	10,039	6,023	1,673
TSS	lb/d	12,566	12,566	12,566

Alternatives Considered

The following alternatives were evaluated for dewatering (D) and sludge storage (S):

- Alternative D1 – Rotary press dewatering
- Alternative D2 – Centrifuge dewatering
- Alternative D3 – Belt filter press dewatering
- Alternative S1 – Keep all existing liquid biosolids storage; add cake storage

- o Alternative S2 – Cake storage for ultimate needs; limited liquid biosolids storage
- o Alternative S3 – Dried/palletized biosolids storage

Alternative D1 – Rotary press dewatering

The rotary press is a new technology for dewatering municipal solids, and is manufactured by Fournier (Black Lake, Quebec). The process is relatively simple. Figure 5-21 shows a multi-pass unit. Solids are fed to a rectangular channel, then rotated between two parallel revolving screens. Rotation is slow compared to a centrifuge, typically less than 3 rpm. Filtrate is squeezed out to the sides of the screen and collected. Sludge is increasingly dewatered as it travels around the circular channel.

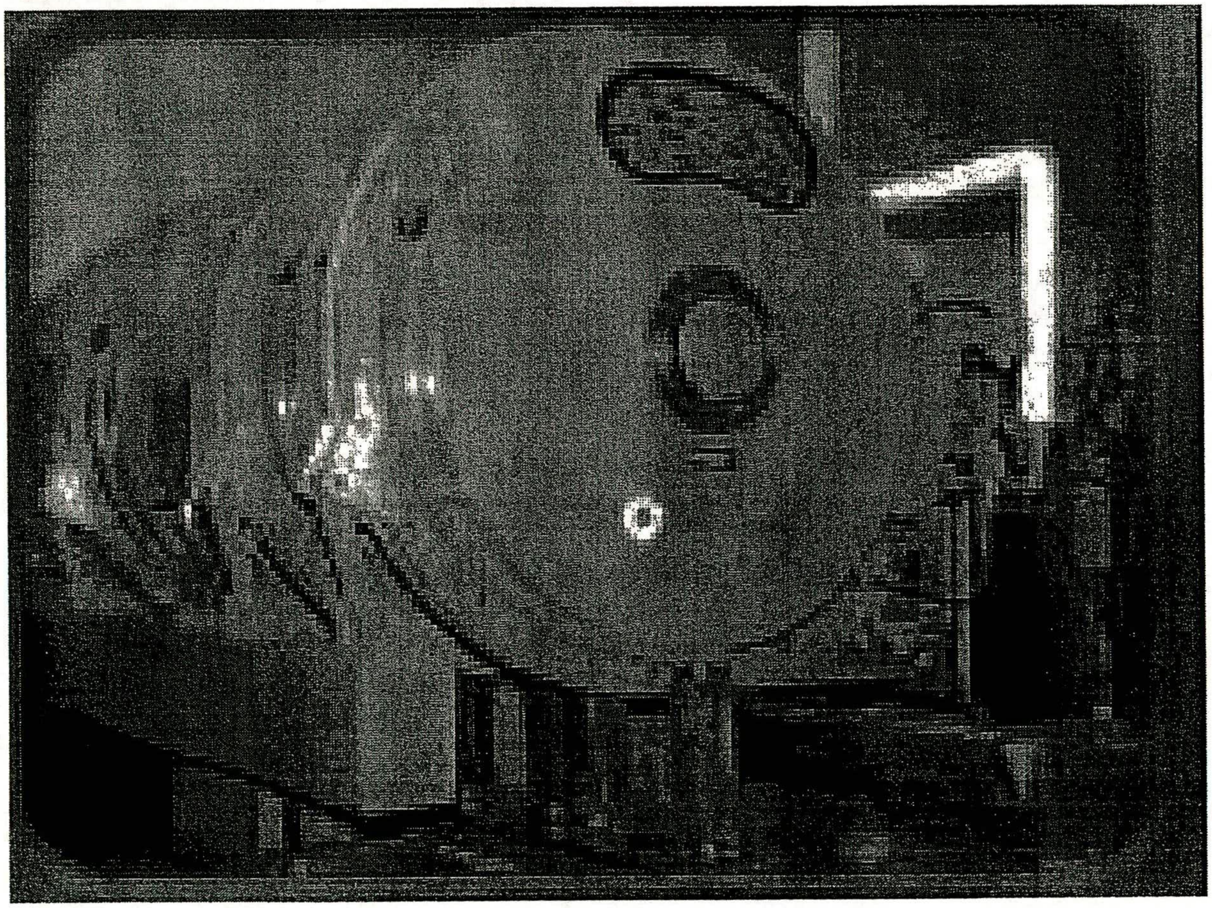

Figure 5-21. Multi-Channel Rotary Press (courtesy of Fournier Industries website).

Rotary presses provide optimal dewatering on sludges that have significant primary fractions, or significant fibrous material. In order to determine the performance on Wilsonville's sludge, the manufacturer recommends first sending sludge samples for analysis, then conducting pilot testing.

If liquid biosolids storage is available until 2015 (Storage Alternative 1), it may be possible to operate without redundant units. This would delay construction of additional rotary press units.

Facilities Required/Key Design Information

Table 5-54 presents the equipment and facilities required for a rotary press dewatering process at nominal design flows of 4.0 and 7.0 mgd. Washwater flows were assumed to be negligible since the units are only washed once a day. Also, because the rotary press is automated to adjust polymer dosage, the manufacturer claims that polymer use is less than for other comparable dewatering processes.

Table 5-54. Facilities Required for Rotary Press Dewatering.

Item	Unit	New Facilities at 4.0 mgd ADWF	New Facilities at 7.0 mgd ADWF
Rotary Presses	Number/channels	1 @ 4	1 @ 4
Filtrate Equalization Tank	Volume	23,000 gal	17,000 gal
Filtrate Pumps	Number/gpm	2 @ 15	1 @ 15
Polymer Feed System (including pumps, mixing tanks, and mixers)	Number/(lb/hr)	2 @ 10	1 @ 10

Alternative D2 – Centrifuge Dewatering

Centrifuge dewatering is the process of applying a centrifugal force to digested solids. Force is applied by rapidly spinning (1000 to 4000 rpm) digested solids, separating dewatered cake and clarified centrate, which is recycled back to the liquid treatment process. Centrate quality depends on the method of solids digestion and the solids capture rate of the dewatering process. Centrate quality can have significant impacts on liquid treatment processes. Centrifuge dewatering usually requires chemical conditioning prior to centrifugation, typically polymer and/or coagulant.

Several types of centrifuges are commercially available including disk nozzle, imperforate basket, and solid bowl. Disk nozzle and imperforate basket centrifuges are not capable is producing acceptable cake solids concentrations for digested biosolids, and are not discussed further. Manufacturers of solid bowl centrifuges include Humboldt and Sharples.

Centrifuge design is based on the solids feed rate, as rated capacity is specified by the manufacturer. Structural support is an important design issue for centrifuges as well. Due to the high rotational speed of the units, the foundation for a centrifuge should be isolated from the rest of building. Noise levels are also a concern for centrifuges, with typical levels in the range of 89 to 90 dbA at a distance of 3 feet[5]. Noise dampening is usually included with centrifuge equipment, but noise abatement should also be addressed in the building design.

Facilities Required/Key Design Information

Table 5-55 shows the facilities required for centrifuge dewatering at Wilsonville. Forty hour a week operation of dewatering equipment is assumed. For centrate equalization and pumping, the washwater flowrate was assumed to be negligible. A polymer feed rate of 20 pounds polymer per dry ton of solids at a polymer concentration of 0.1 percent by weight was assumed for the polymer feed system sizing. This is a conservative estimate of polymer dosage, and actual dosage may be less depending on the type of digestion and other factors. Centrifuges would be housed in an enclosed building with odor control.

[5] Design of Municipal Wastewater Treatment Plants, 4th ed. WEF Manual of Practice 8, 1998.

Table 5-55. Facilities Required for Centrifuge Dewatering.

Item	Unit	New Facilities at 4.0 mgd ADWF	New Facilities at 7.0 mgd ADWF
Centrifuges	Number / (lb/hr)	2 @ 1,400	1 @ 1,400
Centrate Equalization/Storage	Volume	23,000 gal	17,000 gal
Centrate Pumps	Number/gpm	2 @ 15	1 @ 15
Polymer Feed System (including pumps, mixing tanks, and mixers)	Number/gpm	2 @ 25	1 @ 25

Alternative D3 – Belt Filter Press Dewatering

Belt filter press (BFP) dewatering is performed by squeezing solids between two porous belts. Typically, solids are first allowed to drain by gravity, similar to a gravity belt thickener. The gravity zone is typically 2 to 4 m in length. Solids are then squeezed with increasing pressure between two belts passing through a series of rollers. Pressures are typically 5 to 15 psi, and can be changed by adjusting belt tension. Like the other alternatives, polymer and/or coagulant are used to condition the solids prior to dewatering.

Belts require continuous washing during normal operation, using potable or non-potable water. Washwater needs to be pressurized, and a booster pump would be required if the pressure in the plant's non-potable water loop is reduced to 60 psi in the future. A reduction in pressure is being considered as part of the 2002 Wilsonville WWTP Odor Control Improvements project. The continuous wash increases the amount of filtrate to be handled, and requires splash curbs around the unit.

BFPs are commercially available from several manufacturers, and can be purchased in belt widths from 0.5 to 3.5 meters in 0.5-meter increments. BFPs are sized by the hydraulic and/or solids loading to the unit. A maximum capacity of 50 gpm/meter was assumed.

Facilities Required/Key Design Information

Table 5-56 shows the facilities and equipment required for a BFP process at nominal design conditions of 4.0 and 7.0 mgd. Forty hour a week operation of dewatering equipment is assumed. For filtrate equalization and pumping, a washwater flowrate of 60 gpm per 1.5-meter BFP was assumed. A polymer feed rate of 20 pounds polymer per dry ton of solids at a polymer concentration of 0.1 percent by weight was assumed for the polymer feed system sizing. This is a conservative estimate of polymer dosage, and actual dosage may be less depending on the type of digestion and other factors. Belt filter presses would be housed in an enclosed building with odor control.

Table 5-56. Facilities Required for Belt Filter Press Dewatering.

Item	Unit	New Facilities at 4.0 mgd ADWF	New Facilities at 7.0 mgd ADWF
Belt Filter Presses	Number/width	1 @ 1.5 m	1 @ 1.5 m
Filtrate Equalization	Volume	42,000 gal	36,000 gal
Filtrate Pumps	Number/gpm	2 @ 50	1 @ 50
Polymer Feed System (including pumps, mixing tanks, and mixers)	Number/gpm	2 @ 25	1 @ 25

Alternative S1 – Keep All Liquid Biosolids Storage, Add Cake Storage

This alternative would give Wilsonville the flexibility to land apply dewatered cake or liquid biosolids. The most likely scenario is that liquid biosolids would be produced and applied during summer months, and dewatered cake would be produced and stored during winter months. Hauling and application of cake to an arid area (e.g. Eastern Oregon) is also possible during the winter.

Restrictions on biosolids hauling and application are as follows:

- Land application slope requirements are eased – cake can be applied to slopes up to 30 percent, while liquid biosolids can only be applied to slopes up to 12 percent.
- New hauling and spreading equipment for cake application would be required if this is not contracted out. Alternately, a contract operation could be used for this service.
- Hauling costs would be dramatically reduced if biosolids are applied at sites close to the plant, or biosolids could be hauled and applied to sites further away from the plant at a comparable cost.
- Oregon DEQ requires that cake be sampled and analyzed for pathogens before application if cake is stored for an extended period of time. Pathogen regrowth is an issue with cake storage.

Facilities Required/Key Design Information

Table 5-57 shows the equipment and facilities required for new cake storage facilities, keeping all existing liquid biosolids storage. The cake storage building would be a relatively tall building – aproximately 30 feet high – likely directly connected to or near the dewatering facilities to minimize conveyance distance. Cake solids would be conveyed to the top of the building by belts or screw conveyors and dropped into a truck loading bay. Hauling trucks would park underneath a hopper/silo, and cake would be loaded into trucks via a separate conveyor system. A screw conveyor would be located in the middle of the floor of the building. A front-end loader could be used to move cake to the middle of the bay as cake was removed. The building would be enclosed for odor control, and ventilated air would be routed to the compost biofilter. Table 5-57 assumes that dewatered cake will be produced at 25 percent solids and can be piled 20 feet high. This type of facility has been used successfully to minimize solids storage footprint at the McMinnville, OR treatment plant. Figure 5-22 shows a schematic of the conceptual storage building.

Table 5-57. Facilities Required for Cake Solids Storage, Keeping All Liquid Biosolids Storage.

Item	Unit	New Facilities at 4.0 mgd ADWF	New Facilities at 7.0 mgd ADWF
Cake Storage	Volume, cy	3,009	3,277
Cake Storage Building	Area/Depth	4,100 sf/20 ft	4,400 sf/20 ft

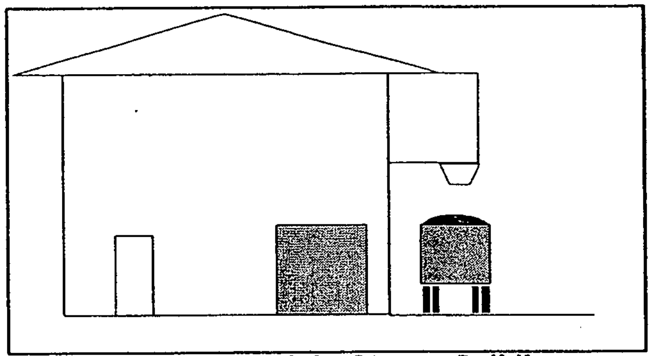

Figure 5-22 – Cake Storage Building

Alternative S2 – Phase Out Liquid Biosolids Production, Add Cake Storage

This alternative is very similar to Alternative S1 except that the existing liquid biosolids storage would be phased out over a period of several years.

Digested solids storage will still be required to provide equalization of the digester effluent with dewatering operations. A tank the same size as the anaerobic digesters should be provided at 4.0 mgd. However, the tank would have either a traveling cover or a membrane cover to accommodate gas storage and fluctuating liquid levels. At build-out, this tank will provide approximately 5 days of liquid storage during maximum week flows.

Facilities Required/Key Design Information

Table 5-58 presents the equipment and facilities required for cake storage, thereby phasing out the existing liquid biosolids storage.

Table 5-58. Facilities Required for Cake Solids Storage, Phase-Out of Liquid Biosolids Storage.

Item	Unit	New Facilities at 4.0 mgd ADWF	New Facilities at 7.0 mgd ADWF
Cake Storage	Volume	3,383 cy	3,327 cy
Cake Storage Building	Area/Depth	4,600 sf/20 ft	4,500 sf/20 ft
Liquid biosolids storage tank	Number/diameter/liquid height	1 @ 45 ft dia x 30 ft high	—

Alternative S3 – Dried Biosolids Storage

This alternative would only be appropriate in combination with thermal drying of biosolids (Solids Stabilization alternative 2C). Dried solids are typically stored in above-ground silos. Ninety days of storage volume will be assumed for the alternative. This is generally considered sufficient storage for dried biosolids.

An important design issue with dried biosolids is their potential to spontaneously combust if the moisture content is greater than 10 percent. If the moisture content cannot be kept below 10 percent, nitrogen gas can be added to the storage silo to keep it oxygen-free. However, this approach is relatively expensive. A better solution is to design the drying process to achieve 92 percent solids. The evaluation of this alternative in the solids stabilization analysis assumes that the drying process will meet this criteria, and this discussion assumes that a nitrogen supply system will not be required. Also, the discussion assumes that dried biosolids will be hauled away by truck and not bagged. A bagging operation would require a more sophisticated and expensive drying operation.

Implications on Wilsonville's biosolids application program are as follows:

- Class A biosolids – no regulations regarding site restrictions, etc.
- Some farmers are less willing to accept dried solids. However, in general, dried biosolids are more marketable than cake solids.
- Substantially smaller volume of biosolids to haul and apply

Facilities Required/Key Design Information

Required facilities for dried biosolids storage are shown in Table 5-59. Storage and conveyance equipment is often included with the thermal drying equipment under one procurement contract. Costs presented earlier for thermal drying facilities do not include storage.

Table 5-59. Facilities Required for Dried Biosolids Storage.

Item	Unit	New Facilities at 4.0 mgd ADWF	New Facilities at 7.0 mgd ADWF
Dried biosolids storage (silo/hopper)	Volume	356 cy	265 cy
Cake solids storage (hopper)	Volume	96 cy	71 cy

Comparison of Alternatives

Table 5-60 presents the major advantages and disadvantages of the three dewatering alternatives, and Table 5-61 presents a similar comparison for biosolids storage alternatives.

Table 5-60. Comparison of Advantages and Disadvantages of Solids Dewatering Alternatives.

Alternative	Advantages	Disadvantages
1. Rotary Press Dewatering	• Lowest capital expenditures • Enclosed-no additional odors • Energy efficient • Low speed rotation-less maintenance	• Few municipal installations • May not produce high solids content cake with dewatered primary/WAS • Sole source equipment
2. Centrifuge Dewatering	• Best performance (e.g. cake solids concentration) of three alternatives • Enclosed-no additional odors • Easily automated • Lower equalization volume than BFPs	• Energy intensive • Difficult maintenance • Building requires additional structural support • Startup and shutdown can take up to an hour
3. Belt Filter Press Dewatering	• Similar operation to existing GBTs • Process can be visually inspected	• Not enclosed, odor issues • More filtrate generated, larger equalization tanks and pumps • Requires protection of belts-additional grinder, etc. • Frequent maintenance

Table 5-61. Comparison of Advantages and Disadvantages of Biosolids Storage Alternatives.

Alternative	Advantages	Disadvantages
1. Keep All Liquid Storage, Add Cake Storage	• Greatest flexibility	• Largest footprint • Most operational complexity
2. New limited liquid storage, Add Cake Storage	• Space savings over Alt 1.	• Need some liquid biosolids storage for equalization of digestion and dewatering • Most difficult product handling (all cake solids)
3. Dried Biosolids Storage	• Lowest odor potential • Smallest storage volume/footprint required • Easiest product handling	• Combustion hazard

Summaries of costs for the alternatives are shown in Table 5-62 and 5-63. Detailed cost evaluations are included in the appendix.

Table 5-62. Summary Cost Comparison of Dewatering Alternatives (Costs in $1,000s)

	Alternative 1 – Rotary Press		Alternative 2 – Centrifuge		Alternative 3 – Belt Filter Press	
	4.0 mgd	**7.0 mgd**	**4.0 mgd**	**7.0 mgd**	**4.0 mgd**	**7.0 mgd**
Total Capital Cost	$2,861	$1,243	$6,423	$2,014	$3,837	$1,099
Annual O&M Cost	$ 98	$ 146	$ 135	$ 191	$ 142	$ 206
Present Worth Capital Cost	$2,645	$ 747	$5,938	$1,209	$ 3,548	$ 660
Total Present Worth Cost	$9,480		$15,291		$12,898	

Table 5-63. Summary Cost Comparison of Biosolids Storage Alternatives (Costs in $1,000s)

	Alternative 1 – Existing Liquid/ New Cake		Alternative 2 – New Liquid /New Cake		Alternative 3 – Dried Biosolids Storage	
	4.0 mgd	7.0 mgd	4.0 mgd	7.0 mgd	4.0 mgd[1]	7.0 mgd[1]
Total Capital Cost	$2,479	$2,718	$4,037	$2,878	$0	$0
Annual O&M Cost	$ 5	$ 8	$ 3	$ 5	$ 3	$ 5
Present Worth Capital Cost	$2,291	$1,633	$3,733	$1,729	$ 0	$ 0
Total Present Worth Cost	$4,242		$5,649		$187	

1. Capital costs were included in solids stabilization alternative 2C.

Preliminary Recommendations

Dewatering

Figure 5-23 shows a comparison of the dewatering alternative with respect to the evaluation criteria. The rotary press is clearly advantageous from a cost standpoint. This technology is also simple to operate and maintain, and is less likely to require operator attention than a centrifuge. All of the dewatering options have relatively small footprints, and will be enclosed in a building to provide odor control.

The primary drawback with the rotary press is its lack of operational experience and the uncertainty of its performance with respect to final dewatered sludge quality. Because the dewatered sludge solids concentration critically impacts the volume of sludge storage required, it is essential that performance standards be established before a final dewatering process is selected. Samples should be provided to Fourier Industries as soon as possible for analysis, followed by pilot testing. Once performance on Wilsonville's sludge has been established, the impacts on dewatered sludge storage volume requirements can be assessed to determine whether this is a reasonable technology to use. If performance is not satisfactory, gravity belt thickeners should be installed.

Figure 5-23. Sludge Dewatering Alternatives Preliminary Evaluation

Evaluation Criteria	Alt 1: Rotary press dewatering	Alt 2: Centrifuge dewatering	Alt 3: Belt filter press dewatering	Comments
Regulatory Compliance	●	●	●	
Operations/ Technology	◔	◑	◕	Rotary press is new technology; operational characteristics unproven
Implementation	●	●	●	
Community/ Environmental	●	●	◑	Belt filter presses produce odors.
Compatibility With Site	●	●	◑	
Cost	●	◕	◑	
Total	●	●	◑	

Worse ← → Better

○ ◔ ◑ ◕ ●

Sludge Storage

Figure 5-24 shows a comparison of sludge storage options with respect to the evaluation criteria. Dewatered solids should be stored in a new dewatered sludge storage building, phasing out the liquid sludge storage tanks in favor of a digested sludge storage tank to be located with at a new digester complex. When viewed independently from biosolids processing, dried biosolids storage appears to be the most attractive option. However, it is unlikely that this technology will be implemented for biosolids stabilization.

Figure 5-24. Sludge Storage Alternatives Preliminary Evaluation

Evaluation Criteria	Alt 1: Add cake storage, keep all liquid storage	Alt 2: Add cake storage, limited new liquid storage	Alt 3: Dried biosolids storage	Comments
Regulatory Compliance	●	●	●	
Operations/ Technology	◕	◕	●	Alternatives including both liquid and cake storage will be slightly more complicated to operate
Implementation	●	●	●	
Community/ Environmental	◑	◕	●	Higher storage volumes could result in higher volumes of truck traffic
Compatibility With Site	◔	◑	●	
Cost	◕	◕	●	
Total	◑	◕	●	

Worse ← ○ ◔ ◑ ◕ ● → Better

Biosolids Management Program

The City currently has a Class B biosolids land application program whereby aerobically digested liquid biosolids are applied to local agricultural property in the vicinity of the city. Table 5-64 summarizes the current sludge quality, based on the City's recent Biosolids Annual Reports.

Table 5-64. Biosolids Quality for 1999-2001

	1999	2000	2001	Average
Total Kjeldahl Nitrogen (% dry weight)	0.81	2.67	2.54	2.01
Nitrate (% dry weight)	0.00	0.10	0.02	0.04
Ammonia (% dry weight)	0.70	1.26	1.13	1.03
Phosphorus (% dry weight)	0.79	1.35	1.77	1.30
Potassium (% dry weight)	0.32	0.61	0.83	0.59

Land Requirements for Biosolids Application

As mentioned in Chapter 4, one of the primary requirements for the land application of biosolids is that application must be performed at an agronomic rate. This means that nitrogen application (by dry weight) must not exceed that needed by a crop or vegetation. Based on the City's recent annual biosoilds reports, nitrogen loadings to the existing sites average approximately 75 lb N/acre. This is consistent with the planning value of 80 lb N/acre used in the 1995 Facility Plan. Assuming that crops grown on future land application sites will have similar agronomic nitrogen loading rates to those on the existing sites, a planning value of 80 lb N/acres can be used to estimate future land requirements. With average nitrogen content of 2% on a dry weight basis (Table 5-64), approximately 515 acres will be required for biosolids disposal associated with an influent ADWF of 4 mgd, and 900 acres for disposal of biosolids associated with an influent ADWF of 7 mgd.

Considerations for Future Biosolids Management Program

As the City has experienced recently, identifying landowners willing to accept biosolids can be challenging. Identifying sites that are adequate for year-round biosolids land application is even more challenging. Very recently, DEQ has indicated that it may cease to approve winter land application of Wilsonville's biosolids, which would have serious implications for the City's biosolids management program.

In order to provide a secure biosolids reuse program for the future and to continue to comply with DEQ requirements, the City should complete a thorough Biosolids Management Plan in which ultimate processing needs at the treatment plant are matched to the City's goals for ultimate reuse of the final biosolids. A number of considerations associated with various processing options are outlined in Table 5-65.

Table 5-65. Considerations of Biosolids Processing Options

Biosolids End-Product	Beneficial Reuse Considerations
Class B Liquid Biosolids	• Most stringent requirements with respect to acceptable land application sites (i.e., slopes). • Highest volume of sludge to haul to land application sites.
Class B Dewatered Biosolids	• Most stringent requirements with respect to acceptable land application sites. • Lowers volume of sludge to haul, possibly facilitating application on sites farther from the treatment plant. • Provides a product that may be more marketable to large commercial land application programs (i.e., eastern Oregon)
Class A Dewatered Biosolids	• Least stringent requirements with respect to acceptable land application sites. • Final product resembles Class B sludge; marketing effort may be required to identify, educate, and entice landowners.
Class A Dried Biosolids	• Least stingent requirements with respect to acceptable land application sites. • May be the most marketable product, however detailed market analysis would be required prior to implementing sludge drying.

In addition, the City could consider new arrangements to allocate the risk associated with biosolids reuse between the City and other parties. These options include:

- Disposal of biosolids on agricultural land owned by 3rd party (current practice)
- Disposal of dewatered biosolids at a landfill
- Disposal on City-owned land that is leased to farmers
- Disposal of dewatered biosolids through contractual arrangement at large-scale land application site(s)
- Disposal through contractual arrangement with retailer or 3rd party vendor

Reuse Program

The City has initiated an effluent reuse program as documented in a plan submitted to Oregon DEQ in May 2000. In the Plan, the City outlines its plans to implement a two-phase reuse program consisting of:

- Phase I: Providing Class IV reuse water for sewer jet rodding, storm sewer catch basin cleaning, and landscaping at Boones Ferry Park.
- Phase II: Providing Class IV reuse water for irrigation at Wilsonville Memorial Park.

The City received conditional approval for this plan, provided that the following conditions are met:

- Provide chemical coagulation
- Maintain a chlorine residual of 1.0 mg/L

Because these conditions cannot be met with the current treatment process, the reuse program has not been implemented.

Future Reuse Opportunities

In addition to providing a community benefit, there are two reasons that the City may choose to pursue an expanded reuse program in the future:

1. Reduce contaminant loading to the river during the summer permit season
2. Reduce hydraulic loading to the outfall during the winter peak flow season

Summer Water Quality-Driven Reuse

Given fixed mass limits, diverting flow from the River during the summer permit season would relax the effluent concentration requirements on the remaining flow discharged through the outfall. For example, under maximum-month summer conditions at ultimate build-out, the projected effluent concentration requirement is 3 mg/L BOD and TSS. Reducing the flow to the river from the projected maximum-month dry weather flow of 7.5 mgd to 4.6 mgd allows an effluent discharge of with 5 mg/L BOD and TSS. In order to maintain 10 mg/L BOD and TSS in the plant effluent, flows over 2.4 mgd would be diverted to reuse applications, up to a maximum flow of over 5 mgd at build-out.

Assuming turf irrigation similar to that proposed in the City's reuse plan, the land requirements would increase gradually to a maximum of 2,100 acres at ultimate build-out. Because this value far exceeds the City-owned property that can be irrigated, a more detailed analysis would be required to identify landowners interested in Class IV reuse water for irrigation or process needs. Contact would start with the following types of potential customers:

- Golf courses
- Athletic facilities/fields
- Business parks
- Manufacturing plants

Once the market for reuse water has been established, the costs of providing Class IV reuse water should be balanced with the cost of providing any additional treatment required at the treatment plant for discharge of all flow to the river. The previous sections on Secondary and Tertiary Treatment addresses the ability of the proposed technologies to meet Class IV reuse standards.

Winter Peak Flow-Driven Reuse

Reuse can also be used as a tool to reduce peak flows through the outfall at ultimate build-out. As described earlier, the capacity of the existing outfall falls short of projected peak flows to the treatment plant by approximately 3 mgd. Rather than provide a second outfall or rehabilitate the existing outfall to accommodate higher peak flows, a reuse program could be targeted at reducing the winter peak flows to the river.

Because the peak flow season does not coincide with typical irrigation needs, this type of reuse program would target high water use industrial customers with year-round demands.

Required Facility Improvements

The Tertiary Treatment section of this chapter described the facilities necessary to meet both process and reuse needs. It is highly likely that improvements in solids processing (e.g., the addition of dewatering with the return of dewatering centrate) will require chemical coagulation in order to maintain a high transmissivity in the UV disinfection channel. Therefore, the first condition required for DEQ approval will be met.

Effluent chlorination will be necessary to meet DEQ's second requirement. Depending on the extent of the reuse program, this could be provided through a small sodium hypochlorite feed or on-site generation system. Flow will need to be diverted to effluent chlorination downstream of UV disinfection to avoid potential fouling of the UV lamps.

Additional facility requirements such as conveyance, pumping, and off-site storage will need to be examined on a case-by-case basis.

Cost Tables

Headworks

	Phase 1	Phase 2	Phase 3
	2004	2015	2015
Excavation	$ 8,000	$ -	$ -
Structure	$ 212,800	$ -	$ -
New Flow Split	$ 75,000	$ -	$ -
Piping and Valving	$ 25,000	$ 7,500	$ 7,500
Screen	$ 234,000	$ 234,000	$ 234,000
Washer Monster	$ 84,000	$ -	$ -
Add'l Equipment (Conveyer)	$ 25,000	$ 25,000	$ -
Sitework @ 20%	$ 132,760	$ 53,300	$ 48,300
Electrical and Controls@ 30% of equipment	$ 102,900	$ 77,700	$ 70,200
Subtotal A	**$ 891,460**	**$ 397,500**	**$ 360,000**
Misc. Costs Not Itemized (30% of B)	$ 267,438	$ 119,250	$ 108,000
Subtotal B	**$ 1,158,898**	**$ 516,750**	**$ 468,000**
Mobilization and Bonds (8% of A)	$ 92,712	$ 41,340	$ 37,440
Contractor's Overhead and Profit (15% of A)	$ 173,835	$ 77,513	$ 70,200
Subtotal C	**$ 1,425,445**	**$ 635,603**	**$ 575,640**
Engineering, Legal, Admin. (25% of C)	$ 356,361	$ 158,901	$ 143,910
Total Capital Cost	**$ 1,781,806**	**$ 794,503**	**$ 719,550**
Present Worth Capital Cost	**$ 1,647,380**	**$ 477,158**	**$ 432,143**

Primary Treatment Alternatives

Improvement	Immediate Improvements	Alternative 1		Alternative 2		Alternative 3A		Alternative 3B	
		4.0 mgd	7.0 mgd	4.0 mgd	7.0 mgd	4.0 mgd	7.0 mgd	4.0 mgd	7.0 mgd
Piping Mods	$ 50,000								
Scum trough flushing	$ 50,000								
Primary Clarifiers									
General Conditions		$ 50,000	$ 25,000	$ 20,000	$ 35,000	$ 20,000			
Demolition				$ 100,000		$ 100,000		$ 150,000	
Equipment		$ 240,000	$ 120,000	$ 320,000	$ 160,000	$ 320,000			
Concrete		$ 200,000	$ 100,000		$ 150,000				
Misc. Items		$ 100,000	$ 50,000		$ 100,000				
Piping and Valving		$ 130,000	$ 65,000	$ 170,000	$ 100,000	$ 170,000			
Covers				$ 351,800	$ 175,900	$ 351,800	$ 175,900		
Primary Sludge Pump Station									
Pumps		$ 50,000	$ 25,000	$ 15,000	$ 10,000	$ 15,000			
Piping and Valving		$ 130,000	$ 65,000	$ 170,000	$ 100,000	$ 170,000			
Housing/Concrete		$ 200,000	$ 100,000	$ 50,000	$ 150,000				
Sitework @ 20%	$ 20,000	$ 220,000	$ 110,000	$ 239,360	$ 196,180	$ 229,360	$ 35,180	$ 30,000	$ -
Electrical and Controls@ 30% of equipment	$ -	$ 165,000	$ 82,500	$ 202,500	$ 111,000	$ 202,500	$ -	$ -	$ -
High-rate Sedimentation							$ 793,381	$ 806,694	$ 806,694
Excavation									
Equipment							$ 249,480	$ 249,480	$ 249,480
Concrete							$ 291,060	$ 291,060	$ 291,060
Steel									
Labor							$ 69,889	$ 83,202	$ 83,202
Piping and Valving							$ 108,108	$ 108,108	$ 108,108
Pumps							$ 74,844	$ 74,844	$ 74,844
Sitework @ 20%	$ -	$ -	$ -	$ -	$ -	$ -	$ 317,353	$ 322,677	$ 322,677
Electrical and Controls@ 15% of equipment	$ -	$ -	$ -	$ -	$ -	$ -	$ 108,524	$ 108,524	$ 108,524
Subtotal A	**$ 120,000**	**$ 1,485,000**	**$ 742,500**	**$ 1,638,660**	**$ 1,288,080**	**$ 1,578,660**	**$ 2,223,719**	**$ 2,224,588**	**$ 2,044,588**
Misc. Costs Not Itemized (30% of A)	$ 36,000	$ 445,500	$ 222,750	$ 491,598	$ 386,424	$ 473,598	$ 667,116	$ 667,377	$ 613,377
Subtotal B	**$ 156,000**	**$ 1,930,500**	**$ 965,250**	**$ 2,130,258**	**$ 1,674,504**	**$ 2,052,258**	**$ 2,890,835**	**$ 2,891,965**	**$ 2,657,965**
Mobilization and Bonds (8% of B)	$ 12,480	$ 154,440	$ 77,220	$ 170,421	$ 133,960	$ 164,181	$ 231,267	$ 231,357	$ 212,637
Contractor's Overhead and Profit (15% of B)	$ 23,400	$ 289,575	$ 144,788	$ 319,539	$ 251,176	$ 307,839	$ 433,625	$ 433,795	$ 398,695
Subtotal C	**$ 191,880**	**$ 2,374,515**	**$ 1,187,258**	**$ 2,620,217**	**$ 2,059,640**	**$ 2,524,277**	**$ 3,555,727**	**$ 3,557,117**	**$ 3,269,297**
Engineering, Legal, Admin. (25% of C)	$ 47,970	$ 593,629	$ 296,814	$ 655,054	$ 514,910	$ 631,069	$ 888,932	$ 889,279	$ 817,324
Total Capital Cost	**$ 239,850**	**$ 2,968,144**	**$ 1,484,072**	**$ 3,275,272**	**$ 2,574,550**	**$ 3,155,347**	**$ 4,444,658**	**$ 4,446,396**	**$ 4,086,621**
Present Worth Capital Cost	**$ 239,850**	**$ 2,744,200**	**$ 891,300**	**$ 3,028,200**	**$ 1,546,200**	**$ 2,917,300**	**$ 2,669,300**	**$ 4,110,900**	**$ 2,454,300**
O&M Costs									
Energy		$ 2,614	$ 6,535	$ 3,485	$ 5,228	$ 3,485	$ 8,673	$ 8,079	$ 14,138
Materials		$ 4,800	$ 7,200	$ 6,400	$ 9,600	$ 6,400	$ 9,304	$ 2,904	$ 5,808
Labor		$ 2,040	$ 5,100	$ 2,160	$ 5,400	$ 2,160	$ 6,084	$ 12,169	$ 18,355
Chemicals							$ 44,238	$ 88,476	$ 162,206
Annual O&M Total	**$ -**	**$ 9,454**	**$ 18,835**	**$ 12,045**	**$ 20,228**	**$ 12,045**	**$ 68,299**	**$ 111,627**	**$ 200,506**
O&M Present Worth (4%, 13 years)		$ 94,404		$ 120,280		$ 120,280		$ 1,114,669	
O&M Present Worth (4%, 20 years)	$ -		$ 255,973		$ 274,905		$ 928,209		$ 2,724,948
Total Present Worth	**$ -**	**$ 2,838,604**	**$ 1,147,273**	**$ 3,148,480**	**$ 1,821,105**	**$ 3,037,580**	**$ 3,597,509**	**$ 5,225,569**	**$ 5,179,248**
Total Alternative Present Worth	**$ 239,850**	**$ 3,985,877**		**$ 4,969,585**		**$ 6,635,089**		**$ 10,404,817**	

Secondary Treatment Alternatives

Improvement	Alternative 1 - Activated Sludge		Alternative 2 - MBR		Alternative 3 - BAF	
	4.0 mgd	7.0 mgd	4.0 mgd	7.0 mgd	4.0 mgd	7.0 mgd
Aeration Basin Tank	$ 1,200,000	$ 3,200,000	$ 1,200,000	$ -	$ -	$ -
Secondary Clarifier	$ 1,300,000	$ 2,600,000	$ 1,300,000	$ -	$ -	$ -
Treatment Equipment (MBR, BAF)	$ -	$ -	$ -	$ 8,400,000	$ 1,890,000	$ 2,520,000
Other Equipment (Pumping, Blowers, etc.)	$ 800,000	$ 2,000,000	$ -	$ -	$ 1,000,000	$ 2,000,000
RAS/WAS Pump Station	$ -	$ 825,000	$ -	$ -		
Flow Split Modification	$ 50,000		$ 80,000	$ -	$ 80,000	
Piping and Valving	$ 125,000	$ 250,000	$ 80,000	$ 125,000	$ 150,000	$ 175,000
Primary Effluent Pumping	$ -	$ -	$ -	$ -	$ 200,000	$ 160,000
Backwash Storage	$ -	$ -	$ -	$ -	$ 450,000	$ 450,000
Sitework @ 20%	$ 695,000	$ 1,775,000	$ 532,000	$ 150,000	$ 754,000	$ 1,061,000
Electrical and Controls@ 30% of equipment	$ 667,500	$ 1,455,000	$ 414,000	$ 2,557,500	$ 912,000	$ 1,408,500
Subtotal A	**$ 4,837,500**	**$ 12,105,000**	**$ 3,606,000**	**$ 11,232,500**	**$ 5,436,000**	**$ 7,774,500**
Misc. Costs Not Itemized (30% of A)	$ 1,451,250	$ 3,631,500	$ 1,081,800	$ 3,369,750	$ 1,630,800	$ 2,332,350
Subtotal B	**$ 6,288,750**	**$ 15,736,500**	**$ 4,687,800**	**$ 14,602,250**	**$ 7,066,800**	**$ 10,106,850**
Mobilization and Bonds (8% of B)	$ 503,100	$ 1,258,920	$ 375,024	$ 1,168,180	$ 565,344	$ 808,548
Contractor's Overhead and Profit (15% of B)	$ 943,313	$ 2,360,475	$ 703,170	$ 2,190,338	$ 1,060,020	$ 1,516,028
Subtotal C	**$ 7,735,163**	**$ 19,355,895**	**$ 5,765,994**	**$ 17,960,768**	**$ 8,692,164**	**$ 12,431,426**
Engineering, Legal, Admin. (25% of C)	$ 1,933,791	$ 4,838,974	$ 1,441,499	$ 4,490,192	$ 2,173,041	$ 3,107,856
Total Capital Cost	**$ 9,668,953**	**$ 24,194,869**	**$ 7,207,493**	**$ 22,450,959**	**$ 10,865,205**	**$ 15,539,282**
Present Worth Capital Cost	**$ 8,939,500**	**$ 14,530,800**	**$ 6,663,700**	**$ 13,483,500**	**$ 10,045,500**	**$ 9,332,500**
O&M Costs						
Energy	$ 7,913	$ 13,696	$ 7,913	$ 13,696	$ 10,939	$ 16,722
Materials	$ 16,000	$ 40,000	$ -	$ 420,000	$ 57,800	$ 90,400
Labor	$ 6,240	$ 6,240	$ 15,600	$ 15,600	$ 15,600	$ 15,600
Chemicals	$ -	$ -	$ -	$ -	$ -	$ -
Annual O&M Total	**$ 30,153**	**$ 59,936**	**$ 23,513**	**$ 449,296**	**$ 84,339**	**$ 122,722**
O&M Present Worth (4%, 13 years)	$ 301,098		$ 234,793		$ 842,182	
O&M Present Worth (4%, 20 years)		$ 814,545		$ 6,106,074		$ 1,667,830
Total Present Worth	**$ 9,240,598**	**$ 15,345,345**	**$ 6,898,493**	**$ 19,589,574**	**$ 10,887,682**	**$ 11,000,330**
Total Alternative Present Worth	**$ 24,585,942**		**$ 26,488,067**		**$ 21,888,011**	

Tertiary Treatment Alternatives

Improvement	Alternative 1		Alternative 2		Alternative 3	
	4.0 mgd	7.0 mgd	4.0 mgd	7.0 mgd	4.0 mgd	7.0 mgd
Filtration Facilities						
Excavation						
Demolition						
Equipment	$ 122,000	$ 75,000	$ 470,000	$ 360,000	$ 297,000	
Concrete	$ 71,000	$ 48,000			$ 346,500	
Steel	$ 35,000	$ 24,000				
Labor	$ 258,000	$ 172,000	$ 58,500	$ 43,700	$ 112,000	
Piping and Valving	$ 168,000	$ 100,000	$ 75,000	$ 50,250	$ 128,700	
Pumps	$ 25,000	$ 15,000	$ 40,000	$ 26,800	$ 89,100	
Housing			$ 400,000			
Sitework @ 20%	$ 135,800	$ 86,800	$ 128,700	$ 96,150	$ 194,660	
Electrical and Controls @ 30% of equipment	$ 94,500	$ 57,000	$ 175,500	$ 131,115	$ 258,390	
Subtotal A	**$ 909,300**	**$ 577,800**	**$ 1,347,700**	**$ 708,015**	**$ 1,426,350**	**$ -**
Misc. Costs Not Itemized (30% of A)	$ 272,790	$ 173,340	$ 404,310	$ 212,405	$ 427,905	$ -
Subtotal B	**$ 1,182,090**	**$ 751,140**	**$ 1,752,010**	**$ 920,420**	**$ 1,854,255**	**$ -**
Mobilization and Bonds (8% of B)	$ 94,567	$ 60,091	$ 140,161	$ 73,634	$ 148,340	$ -
Contractor's Overhead and Profit (15% of B)	$ 177,314	$ 112,671	$ 262,802	$ 138,063	$ 278,138	$ -
Subtotal C	**$ 1,453,971**	**$ 923,902**	**$ 2,154,972**	**$ 1,132,116**	**$ 2,280,734**	**$ -**
Engineering, Legal, Admin. (25% of C)	$ 363,493	$ 230,976	$ 538,743	$ 283,029	$ 570,183	$ -
Total Capital Cost	**$ 1,817,463**	**$ 1,154,878**	**$ 2,693,715**	**$ 1,415,145**	**$ 2,850,917**	**$ -**
Present Worth Capital Cost	**$ 1,680,300**	**$ 693,600**	**$ 2,490,500**	**$ 849,900**	**$ 2,635,800**	**$ -**
O&M Costs						
Energy	$ 1,767	$ 2,738	$ 7,008	$ 11,680	$ 9,227	$ 18,454
Materials	$ 5,325	$ 8,554	$ 5,850	$ 10,221	$ 10,296	$ 10,296
Labor	$ 1,789	$ 3,025	$ 4,200	$ 7,000	$ 5,962	$ 12,179
Chemicals					$ 4,851	$ 50,125
Annual O&M Total	**$ 8,881**	**$ 14,317**	**$ 17,058**	**$ 28,901**	**$ 30,336**	**$ 91,055**
O&M Present Worth (4%, 13 years)	$ 88,683		$ 170,335		$ 302,924	
O&M Present Worth (4%, 20 years)		$ 194,573		$ 392,767		$ 1,237,461
Total Present Worth	**$ 1,768,983**	**$ 888,173**	**$ 2,660,835**	**$ 1,242,667**	**$ 2,938,724**	**$ 1,237,461**
Total Alternative Present Worth	**$**	**2,657,155**	**$**	**3,903,502**	**$**	**4,176,185**

Disinfection Alternatives

Improvement	Alternative 1 - Medium Pressure UV		Alternative 2 - Low Pressure High Output UV		Alternative 3 - Sodium Hypochlorite	
	4.0 mgd	7.0 mgd	4.0 mgd	7.0 mgd	4.0 mgd	7.0 mgd
Demolition	$ 50,000	$ -	$ 50,000	$ -	$ -	$ -
Chlorine Contact Channel	$ 92,200	$ -	$ 92,200	$ -	$ -	$ -
Chlorine Contact Basin	$ -	$ -	$ -	$ -	$ 291,000	$ 190,500
UV Disinfection Equipment	$ 289,000	$ -	$ 233,903	$ 233,903	$ -	$ -
Flow Split	$ 50,000	$ -				
Flow Metering Equipment	$ 20,000	$ -	$ -	$ -	$ -	$ -
Storage Tanks	$ -	$ -	$ -	$ -	$ 6,000	$ 4,500
Storage Building	$ -	$ -	$ -	$ -	$ 225,000	$ -
Pumping and Piping	$ -	$ -	$ -	$ -	$ 57,200	$ -
Sodium Bisulfite Feed	$ -	$ -	$ -	$ -	$ 50,600	$ 19,000
Miscellaneous Equipment	$ -	$ -	$ -	$ -	$ 14,400	$ -
Sitework @ 20%	$ 100,240	$ -	$ 75,221	$ 46,781	$ 104,400	$ 39,000
Electrical and Controls@ 30% of equipment	$ 114,360	$ -	$ 97,831	$ 70,171	$ 154,800	$ 57,150
Subtotal A	**$ 715,800**	**$ -**	**$ 549,154**	**$ 350,854**	**$ 903,400**	**$ 310,150**
Misc. Costs Not Itemized (30% of A)	$ 214,740	$ -	$ 164,746	$ 105,256	$ 271,020	$ 93,045
Subtotal B	**$ 930,540**	**$ -**	**$ 713,901**	**$ 456,111**	**$ 1,174,420**	**$ 403,195**
Mobilization and Bonds (8% of B)	$ 74,443	$ -	$ 57,112	$ 36,489	$ 93,954	$ 32,256
Contractor's Overhead and Profit (15% of B)	$ 139,581	$ -	$ 107,085	$ 68,417	$ 176,163	$ 60,479
Subtotal C	**$ 1,144,564**	**$ -**	**$ 878,098**	**$ 561,016**	**$ 1,444,537**	**$ 495,930**
Engineering, Legal, Admin. (25% of C)	$ 286,141	$ -	$ 219,524	$ 140,254	$ 361,134	$ 123,982
Total Capital Cost	**$ 1,430,705**	**$ -**	**$ 1,097,622**	**$ 701,270**	**$ 1,805,671**	**$ 619,912**
Present Worth Capital Cost	**$ 1,322,800**	**$ -**	**$ 1,014,800**	**$ 421,200**	**$ 1,669,400**	**$ 372,300**
O&M Costs						
Energy	$ 12,075	$ 24,150	$ 7,913	$ 13,696	$ 5,751	$ 10,064
Materials	$ 2,000	$ 4,000	$ 1,600	$ 3,200	$ 2,500	$ 3,500
Labor	$ 6,240	$ 6,240	$ 12,480	$ 6,240	$ 9,360	$ 9,360
Chemicals	$ -	$ -	$ -	$ -	$ -	$ -
Annual O&M Total	**$ 20,315**	**$ 34,390**	**$ 21,993**	**$ 23,136**	**$ 17,611**	**$ 22,924**
O&M Present Worth (4%, 13 years)	$ 202,858		$ 219,615		$ 175,855	
O&M Present Worth (4%, 20 years)		$ 467,371		$ 314,421		$ 311,542
Total Present Worth	**$ 1,525,658**	**$ 467,371**	**$ 1,234,415**	**$ 735,621**	**$ 1,845,255**	**$ 683,842**
Total Alternative Present Worth	**$**	**1,993,030**	**$**	**1,970,036**	**$**	**2,529,097**

Sludge Thickening Alternatives

Improvement	Alternative 1A GBTs (conventional/MBR)		Alternative 1B GBTs (Co-thickening)	
	4.0 mgd	7.0 mgd	4.0 mgd	7.0 mgd
GBTs and associated facilities				
GBTs	$ -	$ -	$ 250,000	$ -
Housing	$ -	$ -	$ 465,000	$ -
Piping and Valving			$ 50,000	
Sitework @ 20%	$ -	$ -	$ 153,000	$ -
Electrical and Controls @ 30% of equipment	$ -	$ -	$ 75,000	$ -
Subtotal A	**$ -**	**$ -**	**$ 993,000**	**$ -**
Misc. Costs Not Itemized (30% of A)	$ -	$ -	$ 297,900	$ -
Subtotal B	**$ -**	**$ -**	**$ 1,290,900**	**$ -**
Mobilization and Bonds (8% of B)	$ -	$ -	$ 103,272	$ -
Contractor's Overhead and Profit (15% of B)	$ -	$ -	$ 193,635	$ -
Subtotal C	**$ -**	**$ -**	**$ 1,587,807**	**$ -**
Engineering, Legal, Admin. (25% of C)	$ -	$ -	$ 396,952	$ -
Total Project Cost	**$ -**	**$ -**	**$ 1,984,800**	**$ -**
Present Value Project Cost	**$ -**	**$ -**	**$ 1,835,100**	**$ -**
O&M Costs				
Energy	$ 1,120	$ 2,240	$ 2,240	$ 3,360
Materials	$ 2,500	$ 5,000	$ 5,000	$ 7,500
Labor	$ 18,720	$ 37,440	$ 37,440	$ 56,160
Polymer	$ 5,891	$ 10,948	$ 10,175	$ 18,788
Annual O&M Total	$ 22,340	$ 44,680	$ 44,680	$ 67,020
O&M Present Value (4%, 13 years)	$ 557,267		$ 1,114,534	
O&M Present Value (4%, 20 years)		$ 1,116,902		$ 1,675,354
Total Present Value	**$ 557,267**	**$ 1,116,902**	**$ 2,949,634**	**$ 1,675,354**
Total Alternative Present Value	***$ 1,674,000***		***$ 4,625,000***	

Sludge Digestion Alternatives

Improvement	Alternative 1		Alternative 1		Alternative 2A		Alternative 2B		Alternative 2C	
	4.0 mgd	7.0 mgd	4.0 mgd	7.0 mgd	4.0 mgd	7.0 mgd	4.0 mgd	7.0 mgd	4.0 mgd	7.0 mgd
Digesters										
Process equipment	$ 60,000	$ 60,000	$ 120,000	$ 60,000	$ 170,000	$ 85,000	$ 170,000	$ 85,000	$ 170,000	$ 85,000
Digester tanks	$ 635,000	$ 635,000	$ 1,270,000	$ 635,000	$ 760,000	$ 380,000	$ 760,000	$ 380,000	$ 760,000	$ 380,000
Piping and Valving	$ 10,000	$ 10,000	$ 20,000	$ 10,000	$ 33,000	$ 16,500	$ 33,000	$ 16,500	$ 33,000	$ 16,500
Misc. Items	$ 61,000	$ 61,000	$ 100,000	$ 61,000	$ 184,000	$ 92,000	$ 184,000	$ 92,000	$ 184,000	$ 92,000
Control building										
Process equipment					$ 116,000	$ 58,000	$ 116,000	$ 58,000	$ 116,000	$ 58,000
Housing					$ 500,000		$ 500,000		$ 500,000	
Piping and Valving					$ 94,000	$ 47,000	$ 94,000	$ 47,000	$ 94,000	$ 47,000
Class A Alternatives										
Process equipment							$ 715,000		$ 1,650,000	
Sitework @ 20%	$ 153,200	$ 153,200	$ 302,000	$ 153,200	$ 371,400	$ 135,700	$ 514,400	$ 135,700	$ 701,400	$ 135,700
Electrical and Controls @ 30% of equipment	$ 39,300	$ 39,300	$ 72,000	$ 39,300	$ 179,100	$ 89,600	$ 393,600	$ 89,600	$ 674,100	$ 89,600
Subtotal A	**$ 959,000**	**$ 959,000**	**$ 1,884,000**	**$ 959,000**	**$ 2,408,000**	**$ 904,000**	**$ 3,480,000**	**$ 904,000**	**$ 4,883,000**	**$ 904,000**
Misc. Costs Not Itemized (30% of A)	$ 287,700	$ 287,700	$ 565,200	$ 287,700	$ 722,400	$ 271,200	$ 1,044,000	$ 271,200	$ 1,464,900	$ 271,200
Subtotal B	**$ 1,247,000**	**$ 1,247,000**	**$ 2,449,000**	**$ 1,247,000**	**$ 3,130,000**	**$ 1,175,000**	**$ 4,524,000**	**$ 1,175,000**	**$ 6,348,000**	**$ 1,175,000**
Mobilization and Bonds (8% of B)	$ 99,760	$ 99,760	$ 195,920	$ 99,760	$ 250,400	$ 94,000	$ 361,920	$ 94,000	$ 507,840	$ 94,000
Contractor's Overhead and Profit (15% of B)	$ 187,050	$ 187,050	$ 367,350	$ 187,050	$ 469,500	$ 176,250	$ 678,600	$ 176,250	$ 952,200	$ 176,250
Subtotal C	**$ 1,533,810**	**$ 1,533,810**	**$ 3,012,270**	**$ 1,533,810**	**$ 3,849,900**	**$ 1,445,250**	**$ 5,564,520**	**$ 1,445,250**	**$ 7,808,040**	**$ 1,445,250**
Engineering, Legal, Admin. (25% of C)	$ 383,453	$ 383,453	$ 753,068	$ 383,453	$ 962,475	$ 361,313	$ 1,391,130	$ 361,313	$ 1,952,010	$ 361,313
Total Project Cost	**$ 1,917,263**	**$ 1,917,263**	**$ 3,765,338**	**$ 1,917,263**	**$ 4,812,375**	**$ 1,806,563**	**$ 6,955,650**	**$ 1,806,563**	**$ 9,760,050**	**$ 1,806,563**
Present Value Project Cost	**$ 1,772,600**	**$ 1,151,500**	**$ 3,481,300**	**$ 1,151,500**	**$ 4,449,300**	**$ 1,085,000**	**$ 6,430,900**	**$ 1,085,000**	**$ 9,023,700**	**$ 1,085,000**
O&M Costs										
Energy	$ 101,741	$ 125,812	$ 72,283	$ 91,073	$ 19,251	$ 24,064	$ 49,077	$ 53,890	$ 95,237	$ 123,965
Materials	$ 16,980	$ 23,107	$ 14,629	$ 20,129	$ 8,619	$ 10,417	$ 13,119	$ 15,917	$ 28,619	$ 35,417
Labor	$ 109,170	$ 146,895	$ 92,220	$ 125,595	$ 66,990	$ 81,060	$ 77,490	$ 96,060	$ 156,990	$ 171,060
Annual O&M Total	$ 227,891	$ 295,814	$ 179,132	$ 236,797	$ 94,860	$ 115,541	$ 139,686	$ 165,867	$ 280,846	$ 330,442
O&M Present Value (4%, 13 years)	$ 5,684,725		$ 4,468,440		$ 2,366,287		$ 3,484,471		$ 7,005,701	
O&M Present Value (4%, 20 years)		$ 7,394,757		$ 5,919,429		$ 2,888,293		$ 4,146,342		$ 8,260,377
Total Present Value	**$ 7,457,325**	**$ 8,546,257**	**$ 7,949,740**	**$ 7,070,929**	**$ 6,815,587**	**$ 3,973,293**	**$ 9,915,371**	**$ 5,231,342**	**$ 16,029,401**	**$ 9,345,377**
Total Alternative Present Value	***$***	***16,004,000***	***$***	***15,021,000***	***$***	***10,789,000***	***$***	***15,147,000***	***$***	***25,375,000***

Sludge Dewatering Alternatives

Improvement	Alternative 1 Rotary Press		Alternative 2 Centrifuges		Alternative 3 Belt Filter Presses	
	4.0 mgd	7.0 mgd	4.0 mgd	7.0 mgd	4.0 mgd	7.0 mgd
Dewatering Facilities						
Equipment	$ 418,000	$ 432,300	$ 1,375,000	$ 715,000	$ 715,000	$ 357,500
Pipe and Valves	$ 76,142	$ 46,153	$ 79,219	$ 59,959	$ 88,769	$ 65,600
Odor Control	$ 175,000		$ 175,000		$ 175,000	
Dewatering Building	$ 400,000		$ 685,000		$ 420,000	
Sitework @ 20% (if appropriate)	$ 213,828		$ 462,844		$ 279,754	
Electrical and Controls @ 30% of equipment	$ 148,243	$ 143,536	$ 436,266	$ 232,488	$ 241,131	$ 126,930
Subtotal A	**$ 1,431,200**	**$ 622,000**	**$ 3,213,300**	**$ 1,007,400**	**$ 1,919,700**	**$ 550,000**
Mobilization and Bonds (8% of B)	$ 114,496	$ 49,760	$ 257,064	$ 80,592	$ 153,576	$ 44,000
Contractor's Overhead and Profit (15% of B)	$ 214,680	$ 93,300	$ 481,995	$ 151,110	$ 287,955	$ 82,500
Subtotal B	**$ 1,760,400**	**$ 765,100**	**$ 3,952,400**	**$ 1,239,100**	**$ 2,361,200**	**$ 676,500**
Misc. Costs Not Itemized (30% of A)	$ 528,120	$ 229,530	$ 1,185,720	$ 371,730	$ 708,360	$ 202,950
Subtotal C	**$ 2,288,520**	**$ 994,630**	**$ 5,138,120**	**$ 1,610,830**	**$ 3,069,560**	**$ 879,450**
Engineering, Legal, Admin. (25% of C)	$ 572,130	$ 248,658	$ 1,284,530	$ 402,708	$ 767,390	$ 219,863
Total Project Cost	**$ 2,860,700**	**$ 1,243,300**	**$ 6,422,700**	**$ 2,013,500**	**$ 3,837,000**	**$ 1,099,300**
Present Value Project Cost	**$ 2,644,900**	**$ 746,700**	**$ 5,938,100**	**$ 1,209,300**	**$ 3,547,500**	**$ 660,200**
O&M Costs						
Energy	$ 1,755	$ 2,284	$ 23,769	$ 31,726	$ 5,479	$ 7,558
Materials	$ 5,192	$ 7,218	$ 8,231	$ 9,783	$ 8,170	$ 10,932
Labor	$ 32,500	$ 37,000	$ 45,000	$ 49,740	$ 70,410	$ 87,555
Polymer	$ 58,096	$ 99,732	$ 58,096	$ 99,732	$ 58,096	$ 99,732
Annual O&M Total	$ 97,543	$ 146,234	$ 135,095	$ 190,981	$ 142,155	$ 205,776
O&M Present Value (4%, 13 years)	$ 2,433,199		$ 3,369,949		$ 3,546,040	
O&M Present Value (4%, 20 years)		$ 3,655,546		$ 4,774,133		$ 5,143,981
Total Present Value	**$ 5,078,099**	**$ 4,402,246**	**$ 9,308,049**	**$ 5,983,433**	**$ 7,093,540**	**$ 5,804,181**
Total Alternative Present Value	***$***	***9,480,000***	***$***	***15,291,000***	***$***	***12,898,000***

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Sludge Storage Alternatives

Improvement	Alternative 1 Add Cake Storage, Keep Liquid Storage		Alternative 2 Add Cake Storage, Phase-Out Liquid		Alternative 3 Dried Biosolids Storage	
	4.0 mgd	7.0 mgd	4.0 mgd	7.0 mgd	4.0 mgd	7.0 mgd
Storage and Land Application Facilities						
Digested sludge storage tank			$ 650,000			
Cake Storage Building	$ 820,000	$ 880,000	$ 920,000	$ 900,000		
Equipment	$ 280,000	$ 320,000	$ 300,000	$ 360,000		
Sitework @ 20%	$ 56,000	$ 64,000	$ 60,000	$ 72,000	$ -	$ -
Electrical and Controls @ 30% of equipment	$ 84,000	$ 96,000	$ 90,000	$ 108,000	$ -	$ -
Subtotal A	**$ 1,240,000**	**$ 1,360,000**	**$ 2,020,000**	**$ 1,440,000**	**$ -**	**$ -**
Misc. Costs Not Itemized (30% of B)	$ 372,000	$ 408,000	$ 606,000	$ 432,000	$ -	$ -
Subtotal B	**$ 1,612,000**	**$ 1,768,000**	**$ 2,626,000**	**$ 1,872,000**	**$ -**	**$ -**
Mobilization and Bonds (8% of B)	$ 128,960	$ 141,440	$ 210,080	$ 149,760	$ -	$ -
Contractor's Overhead and Profit (15% of B)	$ 241,800	$ 265,200	$ 393,900	$ 280,800	$ -	$ -
Subtotal C	**$ 1,982,760**	**$ 2,174,640**	**$ 3,229,980**	**$ 2,302,560**	**$ -**	**$ -**
Engineering, Legal, Admin. (25% of C)	$ 495,690	$ 543,660	$ 807,495	$ 575,640	$ -	$ -
Total Capital Cost	**$ 2,478,450**	**$ 2,718,300**	**$ 4,037,475**	**$ 2,878,200**	**$ -**	**$ -**
Present Worth Capital Cost	**$ 2,291,466**	**$ 1,632,541**	**$ 3,732,873**	**$ 1,728,572**	**$ -**	**$ -**
O&M Costs						
Energy						
Materials						
Labor	$ 5,250	$ 7,500	$ 3,000	$ 4,500	$ 3,000	$ 4,500
Annual O&M Total	$ 5,250	$ 7,500	$ 3,000	$ 4,500	$ 3,000	$ 4,500
O&M Present Worth (4%, 13 years)	$ 130,961		$ 74,835		$ 74,835	
O&M Present Worth (4%, 20 years)		$ 187,485		$ 112,491		$ 112,491
Total Present Worth	**$ 2,422,427**	**$ 1,820,025**	**$ 3,807,707**	**$ 1,841,063**	**$ 74,835**	**$ 112,491**
Total Alternative Present Worth	$	*4,242,453*	$	*5,648,771*	$	*187,326*

Chapter 6. Site Master Planning

Introduction

The objective of this chapter is to define a long-term plan for development of the wastewater treatment plant site. Facilities are defined by the size and capacity requirements of the service area and the treatment process analysis conducted in earlier chapters. Site master planning combines this analysis with input from City staff and leaders, and engineering assessments of site development opportunities and constraints.

Wastewater Treatment Plant Site

The existing Wilsonville WWTP is located in south Wilsonville, just north of the Willamette River, and just west of I-5. An aerial view of the plant (take prior to the most recent plant expansion) is shown in Figure 6-1. Residential neighborhoods are situated to the north, west, and south of the plant site. An Oregon Department of Transportation (ODOT) maintenance yard is located on the plant's east boundary.

Land Use and Zoning

The plant site is comprised of two parcels, which are divided along a north-south line. All of the existing treatment facilities reside on the eastern parcel, with the exception of the administration building. The eastern parcel is currently zoned as "PF," or a Public Facility. Sewage treatment plants require a conditional use permit under Section 4.136(.03) of the Wilsonville planning and land development ordinance. However, the Section 4.136(.08)B of the ordinance states the following:

> "As part of either a permitted or conditional use, the Planning Commission may review and approve a Master Plan for an entire development or area...Approval of a Master Plan would allow all uses provided in the Master Plan without further review. Minor changes which do not have off-site impact or increase visitor capacity may be reviewed by the Planning Director."

The western parcel of the treatment plant is currently zoned as "Residential." Site planning alternatives assume that no new treatment facilities will be constructed in the western parcel to avoid re-zoning issues.

General Site Planning Criteria

The following section describes the site planning criteria developed by HDR and City staff, as well as development and process constraints to expanding the plant. Site planning criteria are qualitative in nature and a qualitative ranking of the criteria is shown in the alternatives discussion.

Figure 6-1. Aerial view of Wilsonville wastewater treatment plant (Note: to be replaced with current aerial)

Setback and Height Restrictions

Table 6-1 summarizes the setback and height restrictions for public facilities as stated in Section 4.136 of the Wilsonville planning and land development ordinance.

Table 6-1. Setback and height restrictions for public facilities in Wilsonville.

Minimum setback distance as measured from property lines	
Front and rear yards	30 ft
Sideyards	10 ft
Maximum height	35 ft

Since the maximum height of any new structures is 35 feet above grade, potential treatment facilities must not include structures higher than this limit without special provision. The highest structure in the expanded treatment plant will likely be the truck loadout attached to the cake storage facilities. Careful design of the cake storage facility should allow the City to comply with this limit.

Significant Resource Overlay Zone and Bicycle Path

The southwest corner of the plant site includes a significant resource overlay zone (SROZ). Wilsonville's Planning and Land Development Ordinance define an SROZ as follows:

> "The delineated outer boundary of a significant natural resource that includes: a significant Goal 5 natural resource, lands protected under metro's Urban Growth Management Functional Plan Title 3 (Water Quality Resource Areas), riparian corridors, and significant wildlife habitat."

As part of the permitting process for development in an SROZ, the applicant must submit a significant resource impact report (SRIR), which more specifically evaluates the natural resources and the impact of development in the SROZ. City staff have indicated that future plant expansions should avoid this part of the plant site given the effort that would be involved in the permitting of construction in this area.

Currently, a bicycle/jogging path crosses through the southwest corner of the plant site. City staff have indicated that the plant property to the south of the path should be avoided in future plant expansions. The path also runs through the SROZ, which will not be developed in future expansions. Therefore, the southwest corner of the plant site is not considered for future expansions at this time.

Hydraulics

Energy efficiency is a priority for the City, and an effort was made in the development of potential site plans to rely on gravity flow as much as possible through the plant. The recommended plan includes Fuzzy Filters® for effluent filtration, which will likely operate in an upflow mode. Pumping will be required upstream of the Fuzzy Filters®, which provides flexibility in siting new filtration facilities. A detailed hydraulic analysis was not performed as part of this site planning effort. Chapter 7 describes a recommended study involving a detailed hydraulic analysis and refinement of the site plan.

Topography

Given the nature of the soils at the site and the steep slopes on the west and southeast sides of the plant, slope stability will be an important issue during future plant expansions. The north and northwest boundaries of the plant site include steep slopes that prohibit construction of facilities. Slopes in the southwest corner of the plant and just east of the main access road leading into the plant also present challenges for siting new facilities. Residential houses line the top of the slope on the west side of the plant, making construction in the slopes problematic. The recommended site plan will consider requirements to stabilize slopes.

Geotechnical Issues

Before the Wilsonville WWTP was constructed on the existing site, the State of Oregon operated a quarry in the vicinity of the plant. The quarry was closed when the rock being extracted became too large to use. The City later purchased the site and the Wilsonville WWTP was constructed in early 1970's.

Geotechnical information has been collected as part of past plant construction projects. An investigation during the Phase III expansion (1979) found gravelly soils throughout the plant. At that time the water table was between elevation 92 and 94 feet, approximately 8 to 15 feet below the existing grade. The most recent geotechnical investigation was conducted in 1995 as part of the last plant expansion. Six test pits were excavated to the groundwater table (approximate elevation 92 feet). Boulders were encountered in all test pits at relatively shallow depths and some were characterized as large as small cars. City staff stated that large boulders were also encountered during excavation for the filter backwash manhole. The 1995 geotechnical investigation revealed the presence of debris such as large pieces of concrete, rebar, and debris between the existing secondary clarifiers and UV channel at a relatively shallow depth (6 feet). In summary, the underlying strata at the plant site present many challenges for excavation and construction of new facilities.

Soils at the plant site are relatively wet during much of the year and many of the proposed structures are at least partially below grade. Plant staff stated that extensive dewatering of groundwater was required for construction of the secondary clarifiers, which took place during the flood of February 1996. It is likely that dewatering of the groundwater will be required during construction of many of the recommended facilities, increasing the cost of construction.

Proximity to Existing Structures

Some of the proposed structures will be constructed below grade and involve a significant amount of excavation. Ideally, adequate distance between structures would be available to allow excavation cuts to be laid back at a slope of two to one or more. If adequate space is not available, more expensive construction techniques, such as sheet pile shoring, may be required. Of particular concern is the problem of driving sheet piling in areas known to contain large boulders. Access roads between structures are also required and are discussed in more detail below.

Aesthetics

Plant aesthetics are a priority for Wilsonville, given that some of the nearby residents view the plant from their homes. Blending the wastewater facilities into the surroundings is an important consideration for the site master planning effort. This is typically accomplished by screening major facilities with trees or other plants and using architectural treatment on structures.

Potential Odor Impacts

Solids handling and processing facilities and the headworks have the potential to generate the most odors at the plant. New and existing primary clarifiers will continue to be covered and ventilated to odor control facilities.

Residential houses are in close proximity to the north and southeast of the plant site, and odors are a major concern for residents living next to the plant. Site layouts should locate treatment processes with the most potential for odor away from and provide adequate barriers to minimize the potential for odors to leave the plant. In addition to locating optimally on the plant site, major odor-producing facilities (such as dewatering and biosolids storage) will be enclosed and foul air treated in the existing or an expanded biofilter.

Lighting Impacts

Minimizing off-site lighting impact is important to the plant neighbors. While it is necessary to provide adequate on-site lighting for plant operations, off-site lighting and glare should be minimized.

Noise Impacts

Due to the pumps and mechanical equipment that will be added during future plant expansions, minimizing potential noise impacts to the surrounding community is important. Equipment such as variable frequency drives and dewatering centrifuges can generate significant amounts noise. Fortunately, new equipment planned for plant improvements will be located inside buildings and gallery spaces designed for machines.

Access and Operational Convenience

Access for biosolids hauling trucks, vactor trucks, chemical delivery trucks, and maintenance vehicles is crucial for plant operations. Roads and access ways with adequate turning clearance must be provided through the plant. Key access points include the dewatered biosolids cake storage/truck loadout facility, chemical delivery points (thickening, dewatering, and filtration) the maintenance shop, drying beds, and the administration building. All of the proposed site layouts include access roads for these key points in the plant.

The ability to easily walk between different units of the same treatment process is also an important criteria for plant staff. Preference is given to site layouts that keep similar units relatively close to one another.

Construction Phasing/Sequencing

Continued operation of existing treatment facilities during the construction of new facilities is required to meet the City's permit. Construction of new facilities will require a phased approach that allows continuous plant operation during construction. All proposed site plans must meet this requirement. However, some site plans may provide an easier transition during future expansions, and hence will be considered more desirable.

Specific Site Planning Criteria for Unit Processes

The following section describes the siting requirements for individual unit processes. The discussion begins with the most critical processes in terms of location and describes the most important siting criteria for each.

Dewatered Biosolids Cake Storage

The proposed dewatered biosolids cake storage building and associated equipment represent the largest single new unit in terms of footprint. Odor control and access are also important site planning considerations for this facility.

The new building will be partially constructed in the early stage of the plant expansion and expanded in the last phase of plant expansion. Logical phasing of the construction of the cake storage facility with the broader plant expansion is critical to maintaining plant operations and minimizing disruptions. Locating the building in close proximity to biosolids dewatering facilities will minimize solids conveyance requirements, odor potential, and operating costs. Given the land use restrictions at the plant, the facility must be designed to be less than 35 feet high.

Biosolids Dewatering and Centrate/Filtrate Storage

Biosolids dewatering and centrate/filtrate storage facilities will most likely be housed together in an enclosed building. Odor control is an important consideration in siting this facility. Siting this building in close proximity to the existing and proposed digestion and liquid biosolids storage facilities and the proposed cake storage facilities is preferable. . This minimizes piping and conveyance requirements, as well as operating costs.

Chemical deliveries to the dewatering building are required and access roads must be provided for this purpose. Truck access is also important for equipment removal when repairs, replacement, and installation of new units during long-term expansions are necessary.

Solids Stabilization and Liquid Biosolids Storage

Odor potential and aesthetics are important factors in siting the proposed anaerobic digesters. Potential digester foaming events also present challenges in terms of aesthetics and odor potential. The ideal location of the anaerobic digesters is in close proximity to the existing thickening facilities, the existing and proposed primary clarifiers, and the proposed dewatering facilities. The liquid biosolids storage tank will be located next to the anaerobic digesters in all site layout options, as this is its most logical location.

Primary Treatment

The recommended plan involves retrofitting the existing primary clarifier/digester and constructing a third clarifier in the last phase of expansion. To maintain hydraulic distribution between units, the third clarifier should have a hydraulic distribution structure upstream of it so that there is a proper distribution of flow and loading between clarifiers. Geotechnical issues are also important, as the foundation of the new clarifier will extend approximately 16 feet below grade. Odor potential from the new clarifier should will be addressed with covers and not be an issue, as it will be covered and connected to the existing compost biofilter.

Filtration

The recommended plan involves a new pumping facility to convey secondary effluent to filters. Therefore, locating the filters near the secondary clarifiers and UV disinfection channel is not an overriding constraint in terms of plant hydraulics.

The effluent filters, pumps, and associated equipment will be housed inside a building, so noise impacts will be limited and aesthetic issues are not a major concern.

Secondary Treatment

A third secondary clarifier and a third aeration basin is included in the recommended plan. The location of the clarifier is more critical given its size, shape, and plant hydraulics. To provide an equalized gravity flow split between the aeration basins and the new clarifier, a properly designed flow control structure should be provided. Locating the third secondary clarifier near the existing secondary clarifiers will make the design of the flow control structure less difficult.. Geotechnical issues are also a major concern given that the clarifier is expected to be approximately 16 feet below grade, depending on its location. The new clarifier should be located away from steep slopes if possible to minimize the need for a retaining wall.

All site layout alternatives assume that the proposed third aeration basin will be located on the east side of the existing aeration basins. Geotechnical and construction issues are extremely important given that the third basin will be built directly next to the existing aeration basin to the east.

Headworks

The recommended plan includes expansion of the headworks facilities. Given the plant hydraulics, the strategic location for all new fine screens and screenings handling facilities is next to the existing headworks. The entire headworks will be enclosed and landscaped to mitigate visual impacts. The proposed headworks building will be ventilated and odor control will be provided via the compost biofilter.

Alternative site plans leave space for a future grit removal facility, should this process be found to be necessary in the future. Potential approaches include primary sludge degritting process or a liquid stream inertial separation system. While the existing plant does not have grit removal facilities and relies on influent fine screens, the sensitivity to grit accumulations within treatment processes will increase with the addition of anaerobic digesters.

Disinfection

The second UV disinfection channel is assumed to be located next to the existing channel. Geotechnical issues are a concern, given that the channel will be approximately 15 feet below grade.

Site Layout Options

Based on the criteria discussed in the previous section, two alternative site layouts were developed. These site plans accommodate ultimate build-out of the service area, and identify the location and phasing of facilities required in the short- and long-term.

Figures 6-2 and 6-3 show proposed site planning alternatives 1 and 2, respectively. Facilities are shaded to distinguish between existing structures and future facilities constructed in initial and ultimate plant expansions. The advantages and disadvantages of the alternative layouts are discussed below in relation to siting criteria.

Setback and Height Restrictions

Both alternatives comply with setback and height requirements. Therefore, the alternatives are equal with respect to these criteria.

Significant Resource Overlay Zone and Bicycle Path

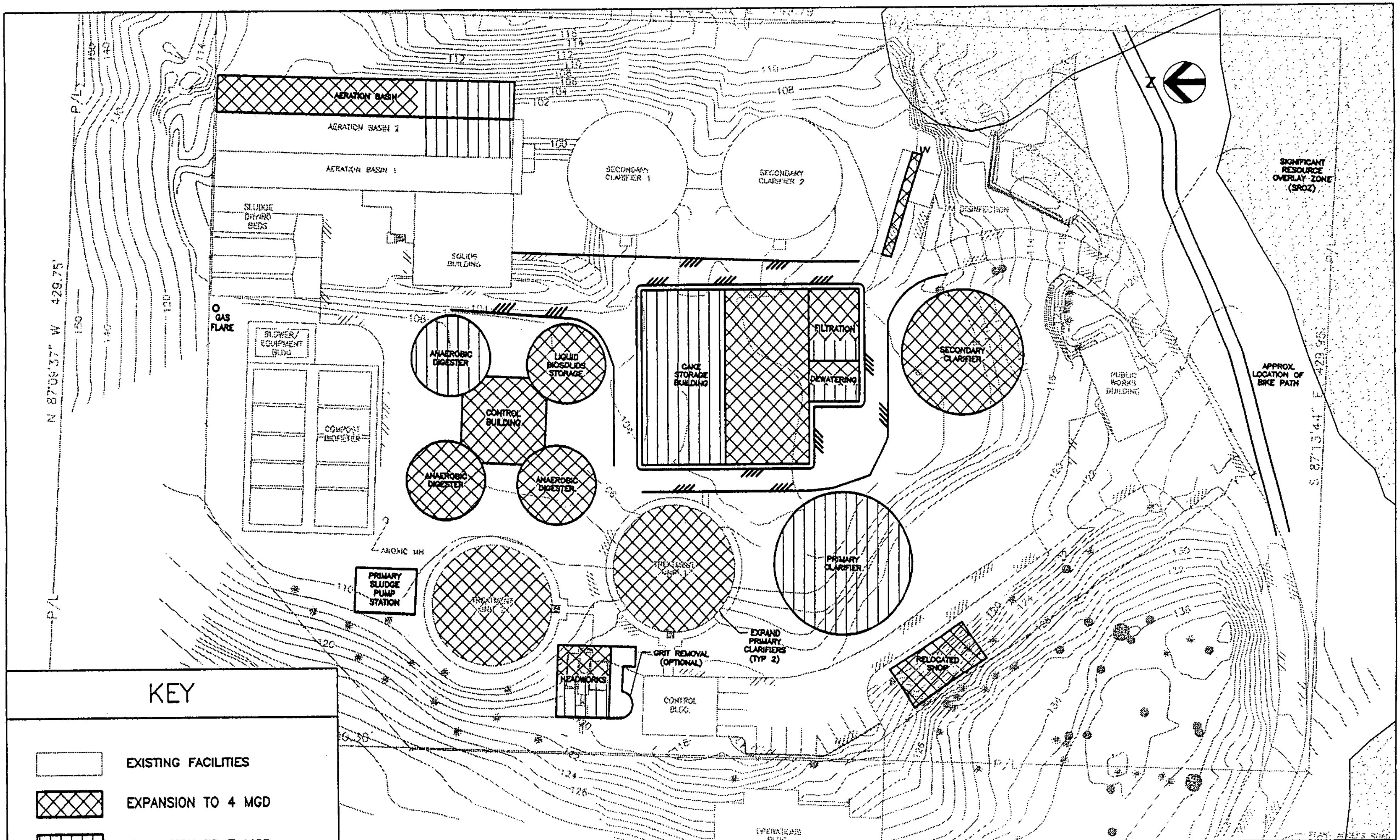
Neither alternative has any future facilities in the SROZ of south of the bicycle path. Therefore, the alternatives are equal with respect to these criteria.

Hydraulics

A proper distribution of flow between similar units is critical to plant operations. Flow proportioning structures will be required for the primary and secondary clarifiers. Of the two alternative site plans, designing such a structure would be more challenging in Alternative 1 given that the third primary clarifier will be located in a hillside (See Figure 6-2).

Topography

Both alternatives are similar with respect to excavation into the surrounding hillsides. Alternative 1 shows the third primary clarifier to be constructed into the hillside just east of the access road leading to the Administration Building, while Alternative 2 places the cake storage facilities in this location. Although the cake storage building is a larger facility, the primary clarifier would be built about 16 feet below grade. Both alternatives place the third secondary clarifier partially into the hillside just north of the SROZ and the bicycle path.



KEY

EXISTING FACILITIES

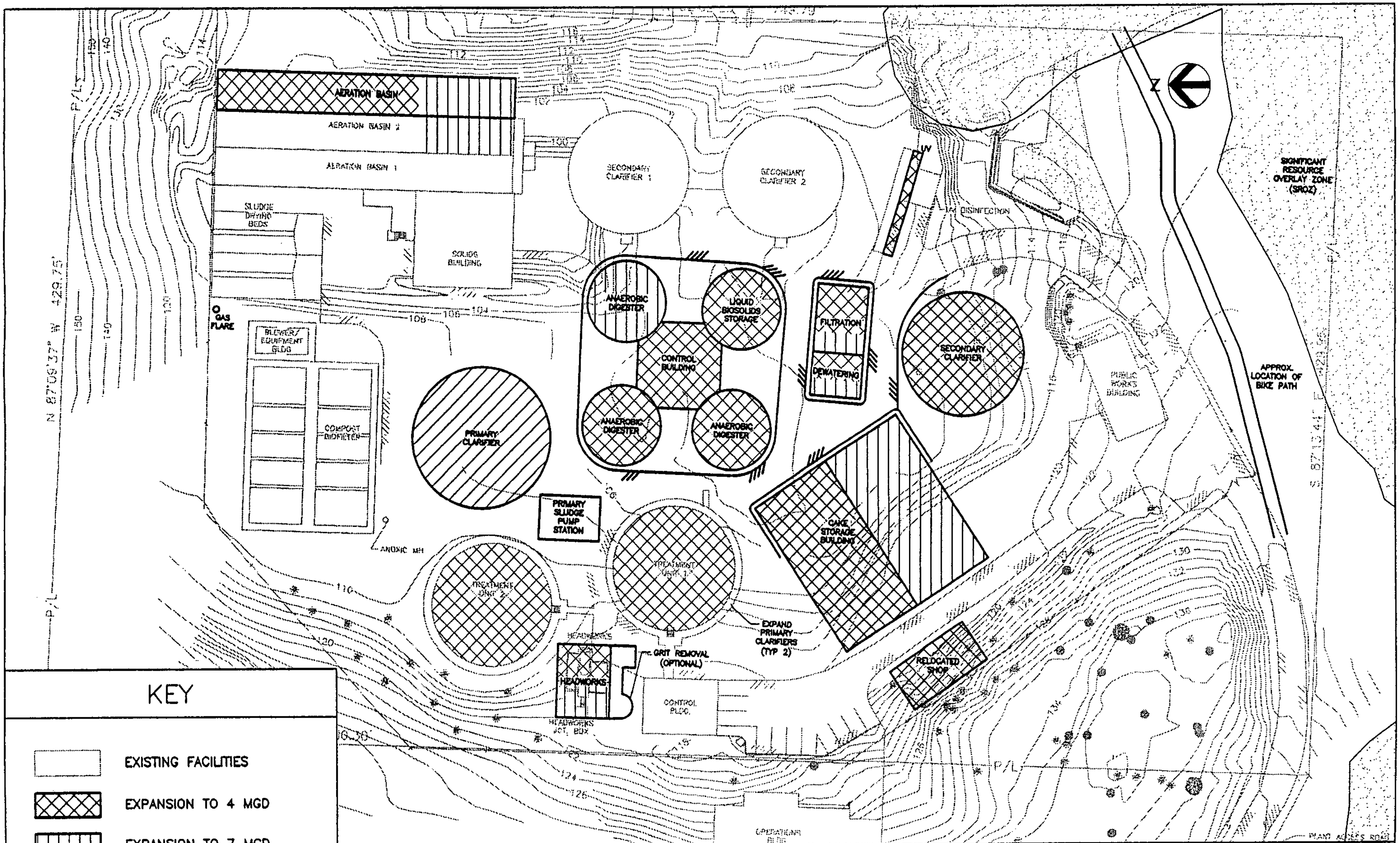
EXPANSION TO 4 MGD

EXPANSION TO 7 MGD

SCALE: 1"=50'

HDR
HDR Engineering, Inc.

FIGURE 6–2
PROPOSED SITE PLANNING ALTERNATIVE 1



KEY

	EXISTING FACILITIES
	EXPANSION TO 4 MGD
	EXPANSION TO 7 MGD

SCALE: 1"=50'

HDR
HDR Engineering, Inc.

FIGURE 6-3
PROPOSED SITE PLANNING ALTERNATIVE 2

Geotechnical Concerns

Both alternatives involve construction of recommended facilities into the hillside just east of the access road leading to the Administration/Operations Building (See Figures 6-2 and 6-3). A retaining wall will be required for either alternative. Slope stability needs to be investigated and an appropriate design prepared.

Alternative 1 involves constructing a primary clarifier into the hillside near the existing shop (see Figure 6-2) and will involve excavation approximately 16 feet below the elevation at the toe of the slope. This will require a large, expensive retaining wall to stabilize the slope and access road above. Another option would be to construct a rectangular primary clarifier at this location, with the width parallel to the slope. Although a retaining wall would still be required, this approach could significantly reduce the construction cost of the third primary clarifier.

Alternative 2 shows the dewatered biosolids cake storage building just east of the access road and into the hillside, presenting geotechnical issues similar to those described above. The building slab will likely be constructed on grade, requiring less excavation than a primary clarifier. A cost-saving option would be to construct the first phase of the cake storage building (half the size of the facility at build-out) and find an alternative location for additional cake storage. This would dramatically reduce the costs related to excavation and a retaining wall.

Either alternative will involve challenging soil conditions and excavation. A thorough geotechnical investigation is required as the basis for the design of these facilities.

Proximity to Existing Structures

Both alternative plant site layouts involve constructing new structures in close proximity to one another and to existing facilities. Providing space for excavation will be crucial for clarifiers and anaerobic digesters. Both alternatives will involve special construction techniques. Alternatives are identical with respect to the location of the third aeration basin and the second UV disinfection channel. Alternative 1 will most likely require shoring around all new anaerobic digestion facilities, the new liquid biosolids storage tank, and the third primary and secondary clarifiers. Alternative 2 will also likely require shoring around the third primary and secondary clarifiers, as well as between the existing secondary clarifiers and the new anaerobic digestion facilities. Construction of the anaerobic digesters will probably present the most difficult construction challenges. Therefore, Alternative 1 is preferred with respect to proximity criteria because new anaerobic digesters are located farther away from existing structures.

Aesthetics

The plant site layout alternatives are similar in aesthetics. Key differences are that the third primary clarifier will be more visible to neighbors to the north in Alternative 2. Digesters will be slightly more visible from the bicycle/jogging path and neighbors to the south in Alternative 2.

Potential Odor Impacts

The plant site layout alternatives are similar with respect to potential odor impacts.

Lighting Impacts

The plant site layout alternatives are similar with respect to lighting impacts.

Noise Impacts

The plant site layout alternatives are similar with respect to noise impacts. Dewatering and filtration facilities are in the same approximate location in both alternatives.

Access and Operational Convenience

Alternative 2 is superior in terms of access because it allows for easier access for biosolids hauling trucks. Biosolids hauling trucks would loop around the cake storage building in Alternative 1, whereas in Alternative 2, trucks could make a shorter loop around the Filtration Building and the Dewatering Building. Access for chemical deliveries would be similar for both alternatives.

Construction Phasing/Sequencing

Both site planning alternatives pose difficult construction phasing issues. Alternative 1 requires demolition of at least part of the existing liquid biosolids storage tanks before the new liquid storage tank is constructed. However, dewatering and biosolids cake storage facilities will be online at this point in the plant expansion and the existing liquid storage tanks will be serving as equalization between digestion and dewatering operations. The first phase of the new biosolids cake storage facility will have to be constructed in close proximity to the existing sand filters and will require careful construction of the building footing.

Alternative 1 may require relocation of the existing filter backwash storage and filter backwash pump station to make space for the new biosolids cake storage facility. However, if the first phase of the facility is constructed in a rectangular configuration and lengthwise into the hillside east of the plant access road, this may not be necessary.

Alternative 2 requires that the proposed anaerobic digestion facilities be constructed in the location of the existing liquid biosolids storage tanks. Therefore, during construction there will be no liquid biosolids storage, and liquid levels in the existing aerobic digesters will flucuate due to dewatering operation.

Preferred Site Layout

Based on biosolids truck access and construction phasing, plant site layout Alternative 2 is the preferred site plan. If the City's priorities and/or site planning criteria change in the future, the site plan recommendation should be re-examined. The recommended plan includes the opportunity for additional refinement of the site plan in the future based on results of a detailed hydraulic analysis. During predesign of future plant expansions, development of alternative facility configurations may present opportunities for slight variations on this site plan.

Chapter 7. Recommended Plan

Introduction

This chapter presents the recommended plan for future expansion of the Wilsonville WWTP. Development of the recommended plan was based on the alternatives analysis presented in Chapter 5, the site planning considerations in Chapter 6, and input from the City's wastewater staff, the City's community development and public works departments. The chapter also provides a phased incremental construction program to meet capacity and treatment requirements for the next 35 years. The implementation program is designed to provide the necessary improvements at the plant in a timely and cost-effective manner.

Recommended Facilities

Overview

The recommended plan includes a combination of treatment technologies that are new to Wilsonville and expansion of existing technologies. The most notable new technologies are membrane bioreactors (MBRs) to reduce the footprint of the secondary treatment process (allowing expansion within a limited area), Fuzzy Filters for filtration of secondary effluent, anaerobic digestion for solids stabilization, and dewatering of digested solids to remove excess water. Anaerobic digestion offers savings in both capital cost and space required, and dewatering is necessary to provide adequate onsite storage of digested biosolids. Both of these processes are commonly used in wastewater treatment. MBRs and Fuzzy Filters are new to the wastewater industry in the U.S. and should be pilot tested prior to implementation to verify operation.

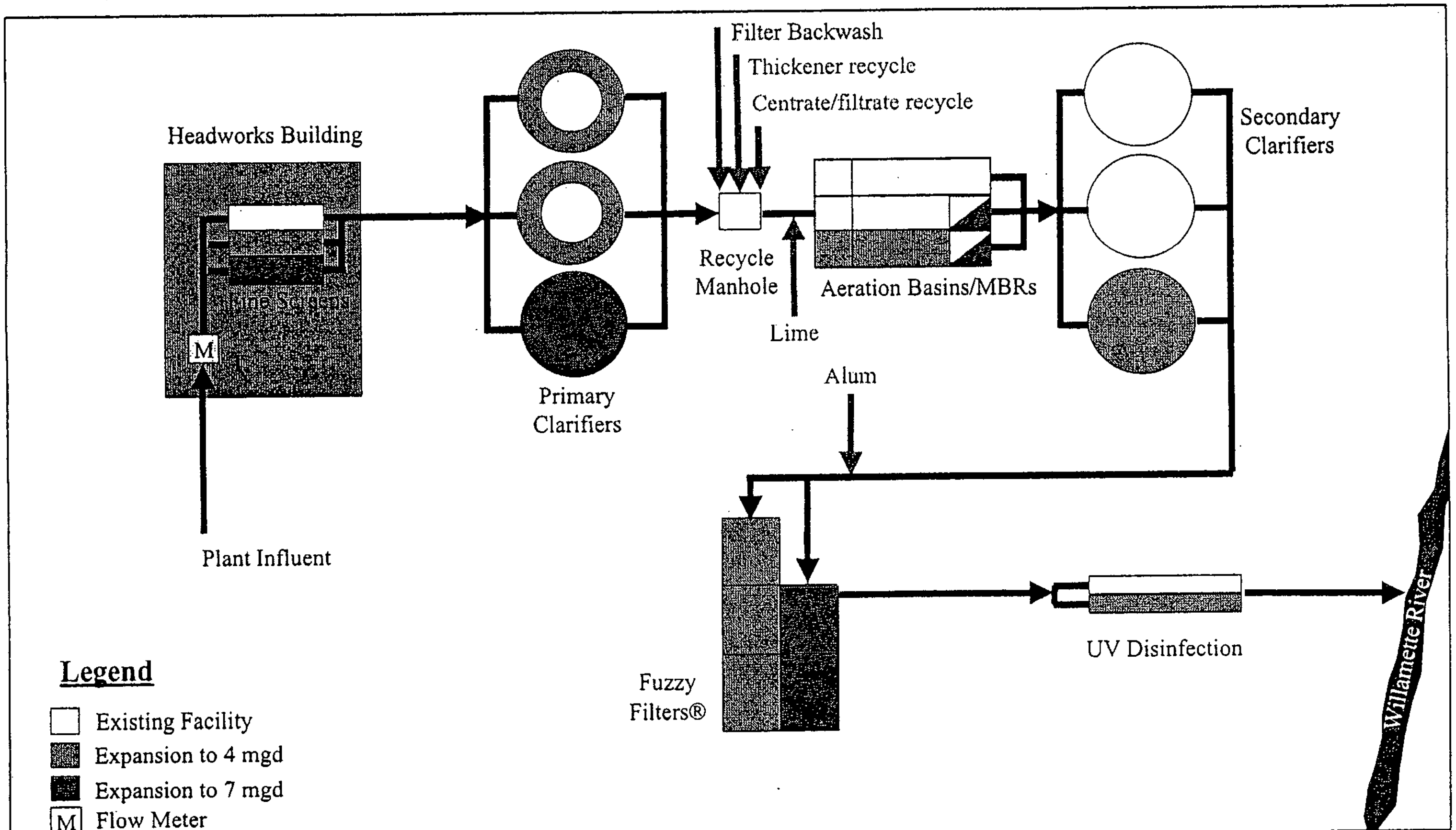
The plan also provides flexibility to incorporate future process changes such as pasteurization to produce Class A biosolids should these approaches prove necessary or cost-effective. An overview of the recommended plan is shown in Table 7-1.

To meet permit compliance and capacity requirements, a three-phased expansion program is recommended. This program provides an initial phase to address immediate needs (Phase 1), a second phase to meet additional near-term capacity improvement requirements (Phase 2), and a third phase which will be necessary 10-20 years following Phase 2, depending on whether future flows follow the high or low projections. The third phase of improvements will provide capacity through build-out at the high projections (ADWF conditions of 7 mgd, 14,900 lb/day BOD and TSS).

Figures 7-1 and 7-2 show the liquids and solids treatment flow schematics, respectively, at build-out and following the second phase of expansion to 4 mgd ADWF (8,700 lb/day BOD and 8,600 lb/day TSS). The second phase of expansion is expected to occur in approximately 2010 based on the low flow projections. The figures are color coded to show existing and new facilities, and to show the different phases of expansion.

Table 7-1. Draft Wilsonville WWTP Facilities Plan Implementation Phasing

	Phase 1	Phase 2	Phase 3
Studies/ Predesign	1. Solids dewatering pilot study 2. Membrane bioreactor (MBR) pilot study 3. Effluent filtration (Fuzzy Filter®) pilot study 4. Willamette River TMDL evaluation 5. Odor analysis (optional) 6. Biosolids Management Plan 7. Phase 1 predesign, including: • Hydraulic analysis • Geotechnical analysis for dewatering and excavation sheeting/shoring	1. Phase 2 predesign	1. Phase 3 predesign
Engineering/ Capital Projects	Design and construction of: 1. Lime feed and storage system 2. Step feed modifications to the secondary treatment activated sludge system 3. Primary sludge piping modifications 4. Dewatering facility 5. Temporary dewatered cake storage 6. Expanded/enclosed headworks 7. New effluent filtration	Design and construction of: 1. Primary clarifier modifications, demolition of aerobic digesters 2. Aeration basin 3. Secondary clarifier 4. Modifications to existing UV channel and new UV channel 5. Anaerobic digesters and a control building 6. Liquid biosolids storage tank 7. Permanent dewatered cake storage and odor control	Design and construction of: 1. Headworks expansion 2. New primary clarifier 3. Conversion of two aeration basins to MBRs 4. New Fuzzy Filters® 5. New anaerobic digester 6. New dewatering unit 7. Cake storage expansion



HDR | City of WILSONVILLE in OREGON | City of Wilsonville Wastewater Treatment Facilities Plan

Liquid Treatment Schematic at Buildout
Figure 7-1

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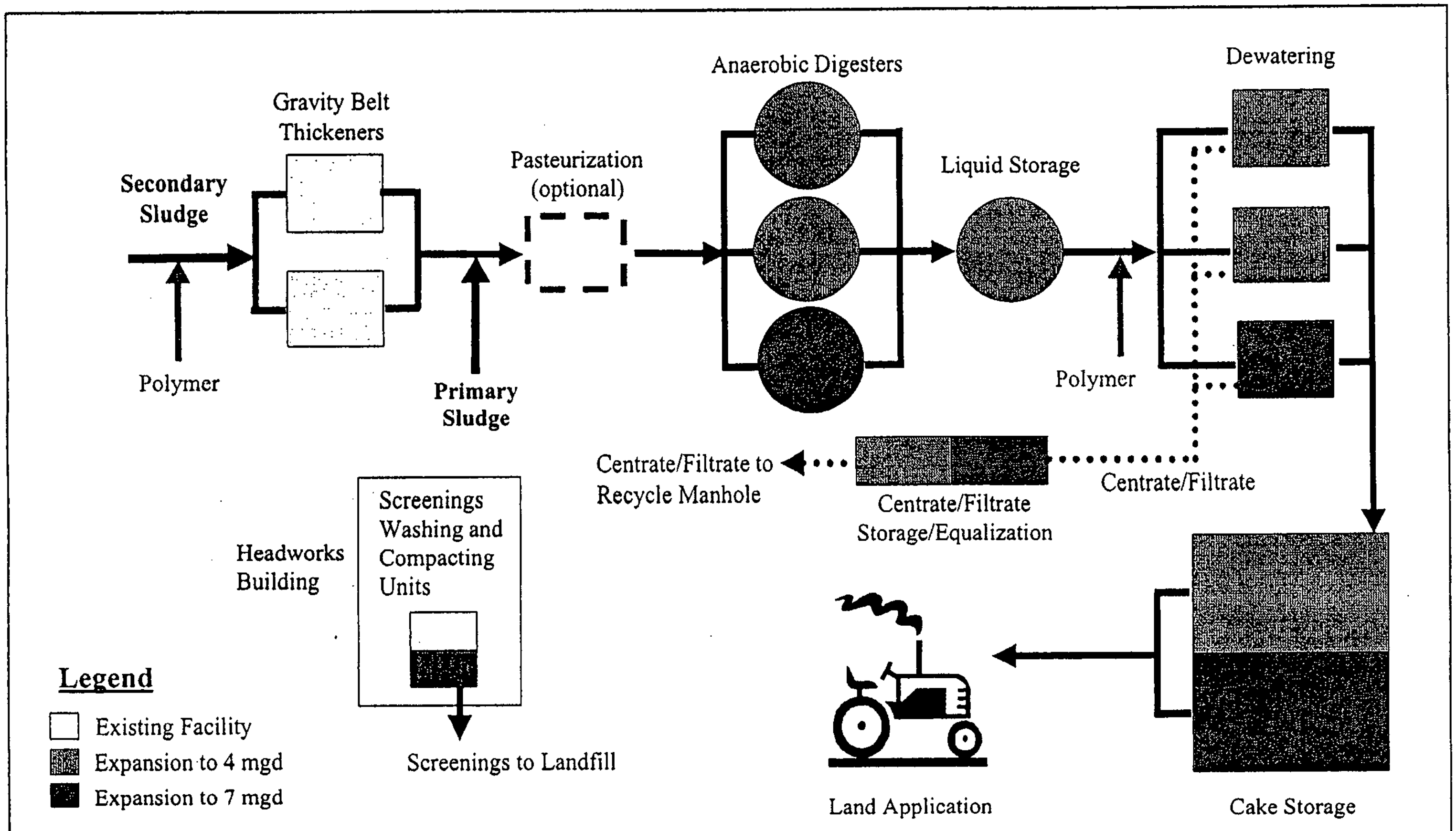


HDR | City of WILSONVILLE in OREGON | City of Wilsonville Wastewater Treatment Facilities Plan | **Solids Treatment Schematic at Buildout** Figure 7-2

The following sections present the recommended facilities for each unit process. Recommendations include facilities required to address capacity deficiencies, as well as to meet future effluent quality requirements. Specific improvements are designed to provide adequate capacity for the projected build-out condition at a nominal flow of 7 mgd. Each section includes a figure showing the current and proposed future capacity of the unit process, and the influent constituent on which process capacity is assessed (flow, BOD, or TSS loading).

Headworks

Design Basis: Flow

The long-term recommendation for the headworks is to provide additional rotary drum screens with 1 mm slot size and a redundant screenings washing and compacting unit.

Required improvements for 4 mgd capacity include:

- Adding one screening channel and screen.
- Adding one screenings washing and compacting unit including screenings conveyance.
- Enclosing the headworks and adding odor control.
- Modifications to the influent flow split structure.

Required improvements for 7 mgd capacity include replacing the existing bar screen with a rotary fine screen.

Currently, grit accumulates just upstream of the fine screen because of the configuration of the channel. It is not recommended that any mechanical changes be incorporated to address this issue. Once the second fine screen is online, the deficiencies in the existing screen could be addressed by taking the existing screen offline and modifying the channel. The site master plan allows space for future grit removal facilities, should they be required due to operational issues or performance of downstream processes.

The recommended plan for the headworks relies on use of the bar screen to provide firm capacity under peak hour flow conditions. In other words, if a drum screen is out of service when a peak flow occurs, the bar screen will be brought into service. As the City's biosolids program develops, it will be important to continue to revisit this criteria and assess its impact on biosolids reuse.

Figure 7-3 shows the current and projected future capacity of the headworks.

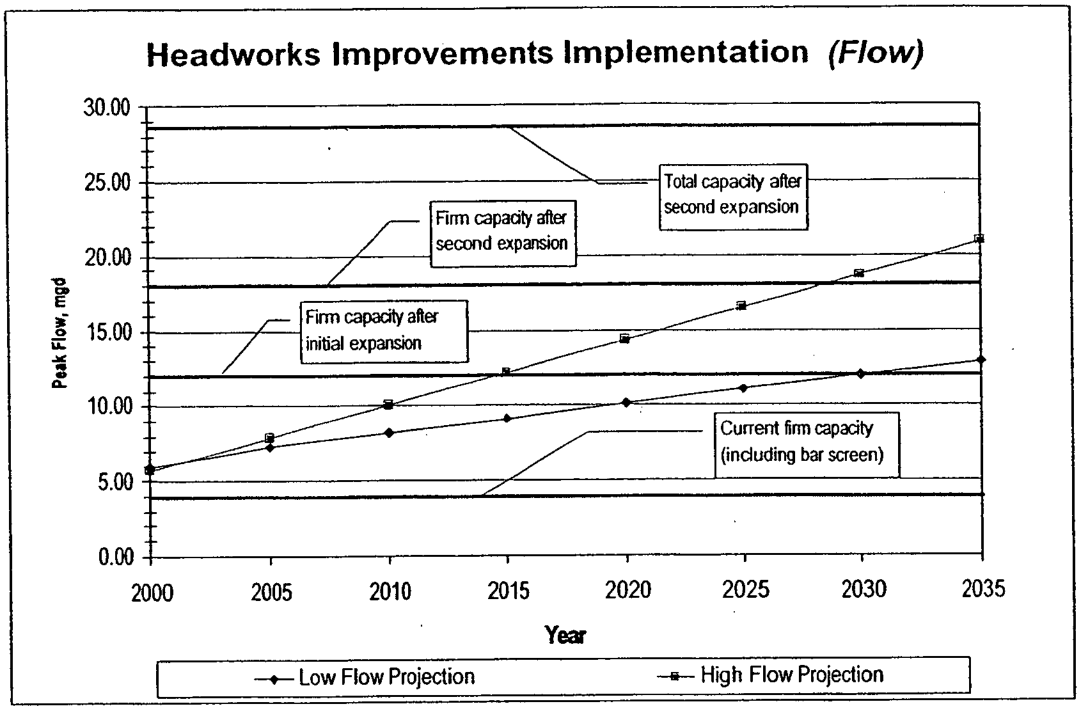


Figure 7-3. Headworks Capacity and Phasing

Primary Treatment

Design Basis: Flow

Expansion of the primary treatment facilities should consist of demolishing the existing aerobic digesters and using the structures entirely for primary clarification. Required improvements for 4 mgd capacity include:

- Demolition of the aerobic digesters and expansion of the existing primary clarifiers.
- Providing stainless steel sludge-collector mechanisms and odor control for the expanded primary clarifiers.
- Elimination of the flow restriction in the effluent pipeline of the north primary clarifier.

Construction sequencing is the most important issue in this expansion. Primary clarifiers will be taken offline sequentially after construction of the new digester complex and after step feed modifications to the activated sludge system.. Primary treatment will be limited during construction of improvements, transferring load downstream to the secondary process.

Required upgrades for 7 mgd capacity include construction of a third primary clarifier.

The lack of flexibility in the primary sludge piping is currently a serious limitation in primary clarifier capacity. Primary sludge can only be directed to the adjacent digester. Therefore, with the digesters operating in series, only one primary clarifier can be used to feed primary sludge to the digester. Addressing this limitation in primary sludge piping would enable the plant to take full advantage of the existing primary clarifier capacity. According to plant staff, the facility is currently operated with only one primary clarifier due to this limitation, and no decrease in primary removal performance has been observed. This equates to an overflow rate of 1500 gpd/sf under maximum month conditions, as compared to the design value of 1000 gpd/sf.

Under peak flow, which is currently limited by the headworks capacity of approximately 4 mgd, the overflow rate to the single clarifier is approaching 3,000 gpd/sf. Following upgrade of the headworks, the peak overflow rate will be 4,200 gpd/sf.

Figure 7-4 shows current and projected future primary clarifier capacity based on the design criteria stated in Chapter 3. If the primary sludge piping limitation is addressed and both primary clarifiers are allowed to operated at overflow rates currently seen by the single primary clarifier, the total primary capacity is as shown in the dashed line on Figure 7-4.

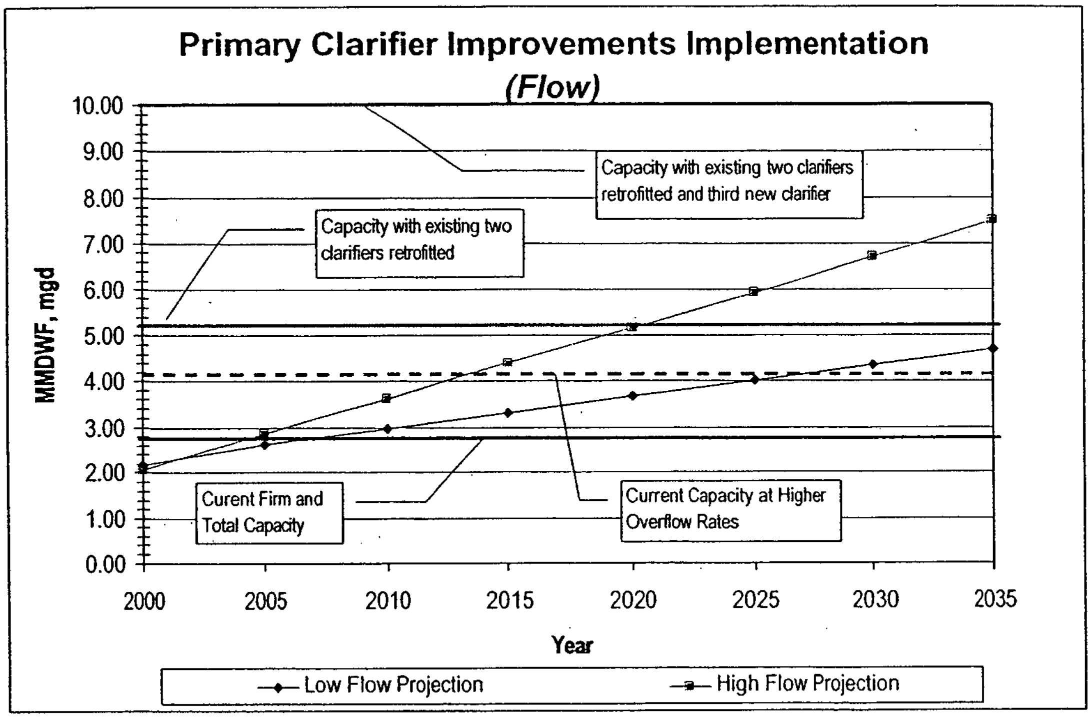


Figure 7-4. Primary Clarifier Capacity and Phasing

Secondary Treatment

Design Basis: BOD/TSS

Continuation of conventional activated sludge technology will present challenges to site planning in the future. In addition, since Wilsonville has permanently switched its potable water source to the Willamette River, pH adjustment facilities are required to maintain process control in the activated sludge process in the immediate future. Required improvements for 4 mgd (8,700 lb/day BOD, 8.600 lb/day TSS) capacity include:

- Addition of step feed provisions to increase capacity in the existing basins.
- Addition of a third conventional secondary treatment train (activated sludge basin and secondary clarifier).
- Addition of RAS/WAS pumps and blowers associated with the third train (to be housed in existing building.)

- Addition of a lime silo and lime feed system.
- Initiate pilot testing of an MBR unit to provide capacity for future expansion in excess of 8,600 lb/day BOD.

If pilot testing demonstrates that MBR technology is viable, required improvements for 7 mgd (14,900 lb/day BOD) capacity include conversion of two aeration basins to MBRs.

The current recommendations are not designed to provide biological phosphorus removal. However, the recommended improvements will allow the City to modify operations to achieve biological phosphorus removal if necessary. Figure 7-5 shows the current and future secondary treatment capacity based on influent BOD loading.

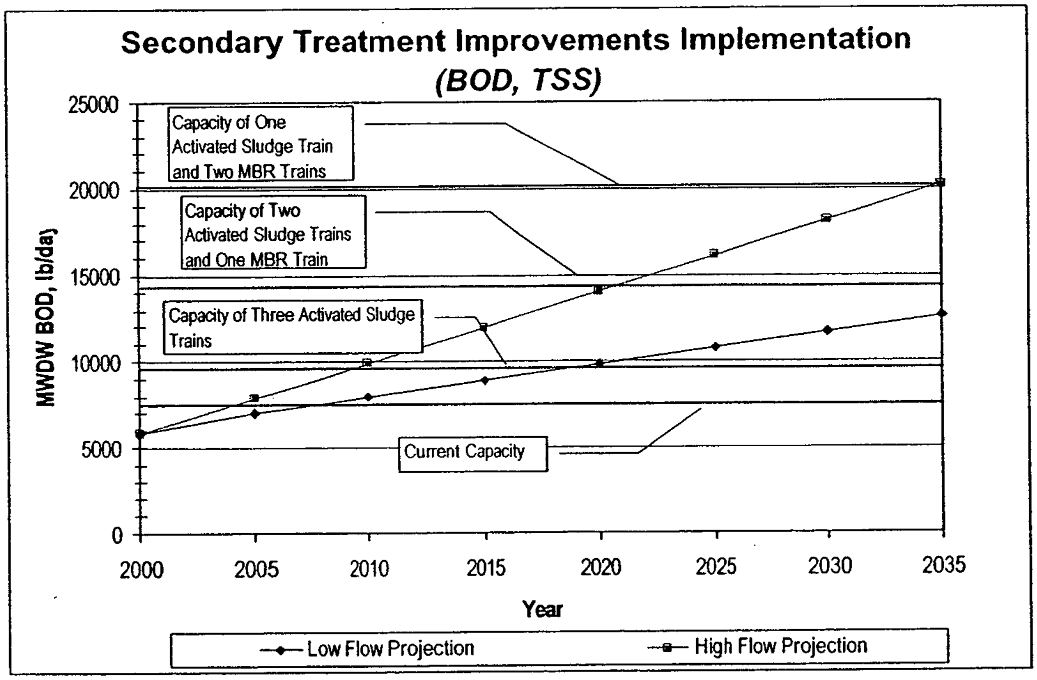


Figure 7-5. Secondary Treatment Capacity and Phasing

Effluent Filtration

Design Basis: BOD/TSS

Future permit limits are expected to tighten and plant staff are not comfortable with continued operation of the existing mono-media sand filters. Therefore, the recommended plan involves a change in the filtration process to Fuzzy Filters®. Required improvements for 4 mgd capacity include:

- Conduct pilot testing of effluent filters (Fuzzy Filters®)
- Demolish the existing sand filters and replace with Fuzzy Filters® (following pilot testing).
- Provide pumping facilities for filtration.
- Provide chemical feed system for coagulation.

Required upgrades for 7 mgd capacity include construction of additional Fuzzy Filters®. Figure 7-6 shows current and projected future effluent filtration capacity.

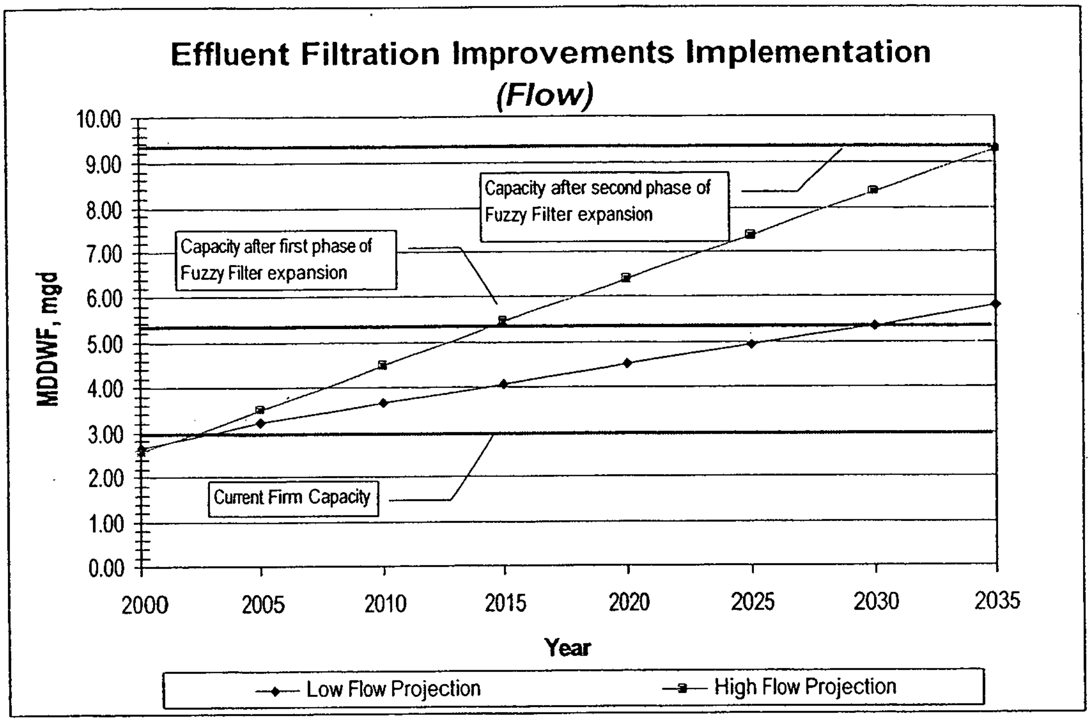


Figure 7-6. Effluent Filter Capacity and Phasing

Disinfection

Design Basis: BOD/TSS

The recommended plan for disinfection involves continued use of medium-pressure UV technology. Required upgrades for 4 mgd capacity include:

- Modifying the existing UV channel to treat a peak flow of 10 mgd by removing the existing Parshall flume.
- Adding new effluent flow metering.
- Adding a second medium-pressure UV channel and UV system.

Upgrades described above will provide capacity for an ultimate build-out peak flow of over 20 mgd, as shown in Figure 7-7.

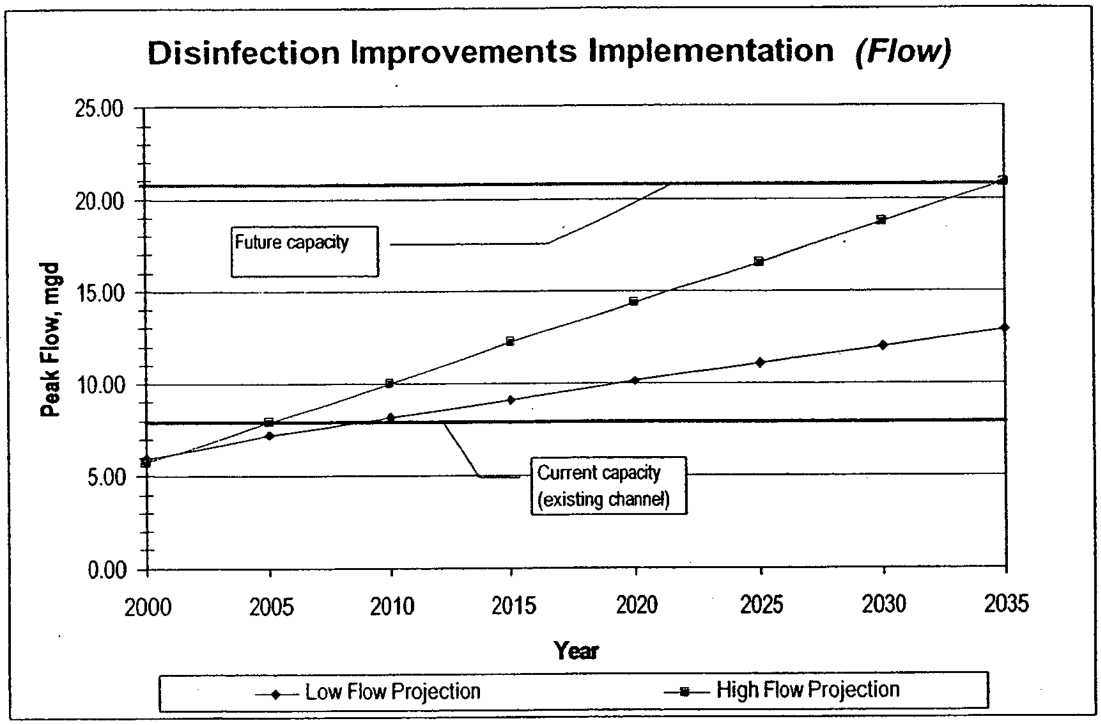


Figure 7-7. Disinfection Capacity and Phasing

Effluent Discharge

Design Basis: BOD/TSS

The recommended plan for effluent discharge involves continued use of the existing outfall discharging to the Willamette River. No upgrades are currently anticipated through the first two phases of expansion. If the City needs to add a diffuser in the future to address water quality issues, the adequacy of the outfall to convey peak flows should be reevaluated.

Sludge Thickening

Design Basis: BOD/TSS

The recommended plan for sludge thickening involves continued use of the existing gravity belt thickeners for WAS thickening and continued thickening of primary sludge in the primary clarifiers. No improvements are required as existing facilities meet thickening needs at ultimate build-out.

Solids Stabilization

Design Basis: TSS

The recommendation for solids stabilization involves a change in technology. The recommended anaerobic digestion process is a well-established technology utilized in most mid to large municipal wastewater treatment plants in the US. Anaerobic digestion will produce Class B biosolids without an additional treatment process. If it becomes necessary for Wilsonville to produce Class A biosolids, sludge pasteurization is currently the most attractive technology of the alternatives examined in Chapter 5. Space will be reserved on the site plan for future pasteurization facilities. Required improvements for a maximum month wet weather solids loading of 10,100 lb/day TSS (equivalent to 4 mgd ADWF capacity) and changing the stabilization process to anaerobic digestion are as follows:

- Construction of two anaerobic digesters.
- Construction of one digested sludge storage tank.
- Construction of a control building to house process equipment.
- Construction of an excess gas flare and gas management system.

Providing capacity for the ultimate MMWW TSS loading of 17,400 lb/day requires construction of a third anaerobic digester.

Figure 7-8 shows the current and future digester capacity.

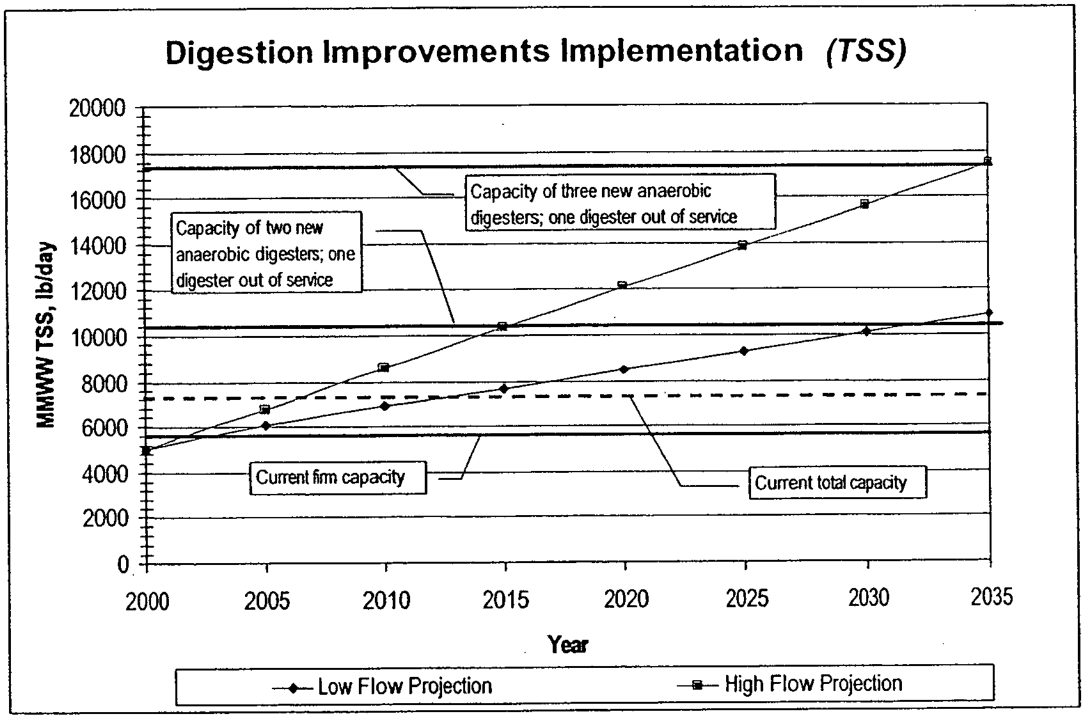


Figure 7-8. Digester Capacity and Phasing

Figure 7-8 also shows the total capacity of the two digesters. Because the plant does have aerobic digested sludge storage, this storage volume can be used to meet the required 40 day detention time and provide additional volatile solids destruction.

Solids Dewatering and Storage

Design Basis: TSS

The recommended plan is to dewater digested biosolids. The choice of dewatering technology will be postponed until after pilot testing of the rotary press and potentially centrifuge and/or belt filter press dewatering. Required facilities for a maximum month wet weather influent TSS loading of 10,100 lb/day (equivalent to 4 mgd ADWF capacity) are as follows:

- Addition of two dewatering units (centrifuge, belt filter press, or rotary press).
- Construction of a dewatering building to house dewatering equipment and centrate/filtrate storage facilities and equipment.

Required facilities for ultimate buildout (17,400 lb/day MMWW TSS, equivalent to 7 mgd ADWF) capacity are as follows:

- Addition of one dewatering unit (centrifuge, belt filter press, or rotary press).
- Expansion of centrate/filtrate storage facilities and equipment.

Currently, Wilsonville has liquid biosolids storage tanks that do not provide adequate capacity. Since the recommended plan involves implementing a dewatering process, dewatered cake storage is required for winter months. Required facilities for 10,100 lb/day MMWW influent TSS include:

- Construction of a cake storage building with a capacity of 3,383 cubic yards.
- Expansion of the odor control biofilter

Required facilities for ultimate buildout include expansion of the cake storage building to provide an additional 3,327 cubic yards of capacity.

Phasing of dewatering and sludge storage is shown in Figure 7-9. Because the City does not have any onsite dewatered sludge storage, the storage facility would ideally be coupled to the addition of dewatering equipment. It may be possible to delay construction of a large storage facility by providing a small covered structure, however there are two important considerations associated with this approach:

- The City must coordinate with DEQ to gain regulatory buy-in for a phased approach to providing 6 months of onsite storage.
- The temporary storage area will be a covered open-air facility, and thus will have the potential to produce odors. While cooler winter temperatures will help reduce odors, this type of facility has the potential to produce noticeable offsite odors.

In addition to the new processing and storage facilities, the City will need to purchase a new truck to transport dewatered biosolids, and a tractor and spreader for land applying cake solids.

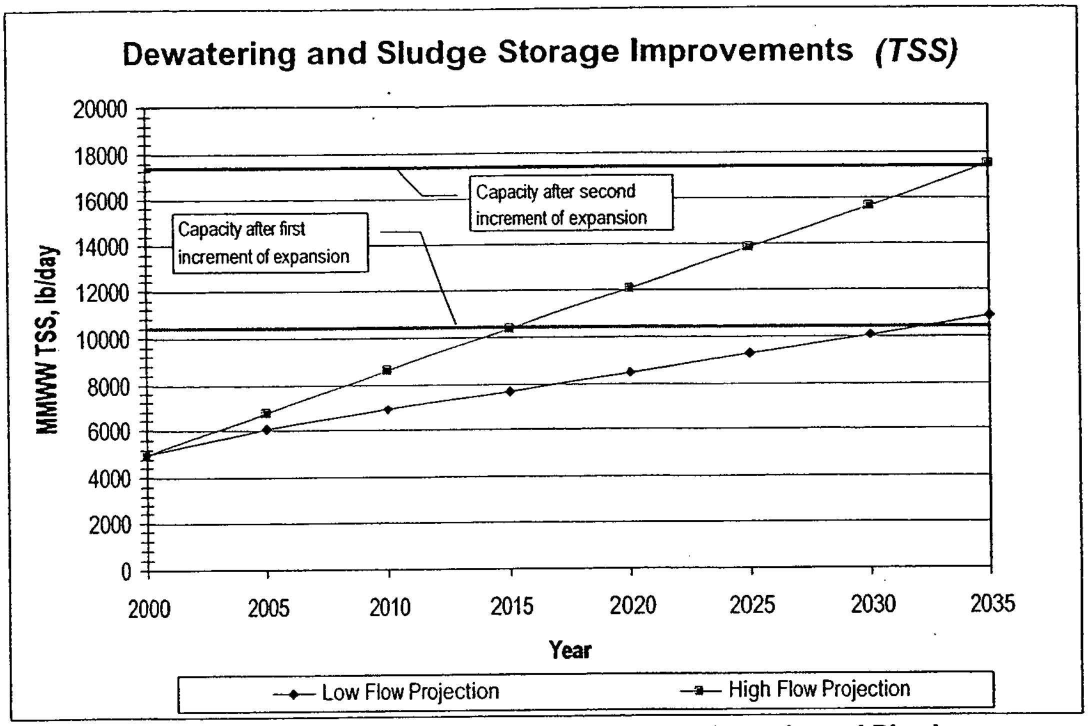


Figure 7-9. Dewatering and Sludge Storage Capacity and Phasing

Project Phasing

Several options for construction phasing were considered. The ultimate goal in project phasing was to address critical needs at the plant while minimizing the initial capital expenditure. Based on this approach, the following phases were identified. Influent flow, BOD, and TSS loadings will trigger actual implementation of the Phase 2 and Phase 3 expansions. However, for purposes of project planning, the first two phases assume flow and loadings will develop according to the low flow projection. The timing of the third expansion will depend on how flows and loads actually increase, but is likely to be 20-30 years in the future.

- **Phase 1 – Immediate Needs.** These improvements address the most urgent process deficiencies and should be operational by Winter 2004 in order to address process deficiencies at the plant. These critical needs include:
  - Increasing the headworks capacity and enclosing the headworks
  - Modifying primary sludge piping
  - Adding a lime silo and step feed enhancements for secondary treatment
  - Adding dewatering, and providing improved effluent filtration to ensure adequate solids removal in the dewatering centrate

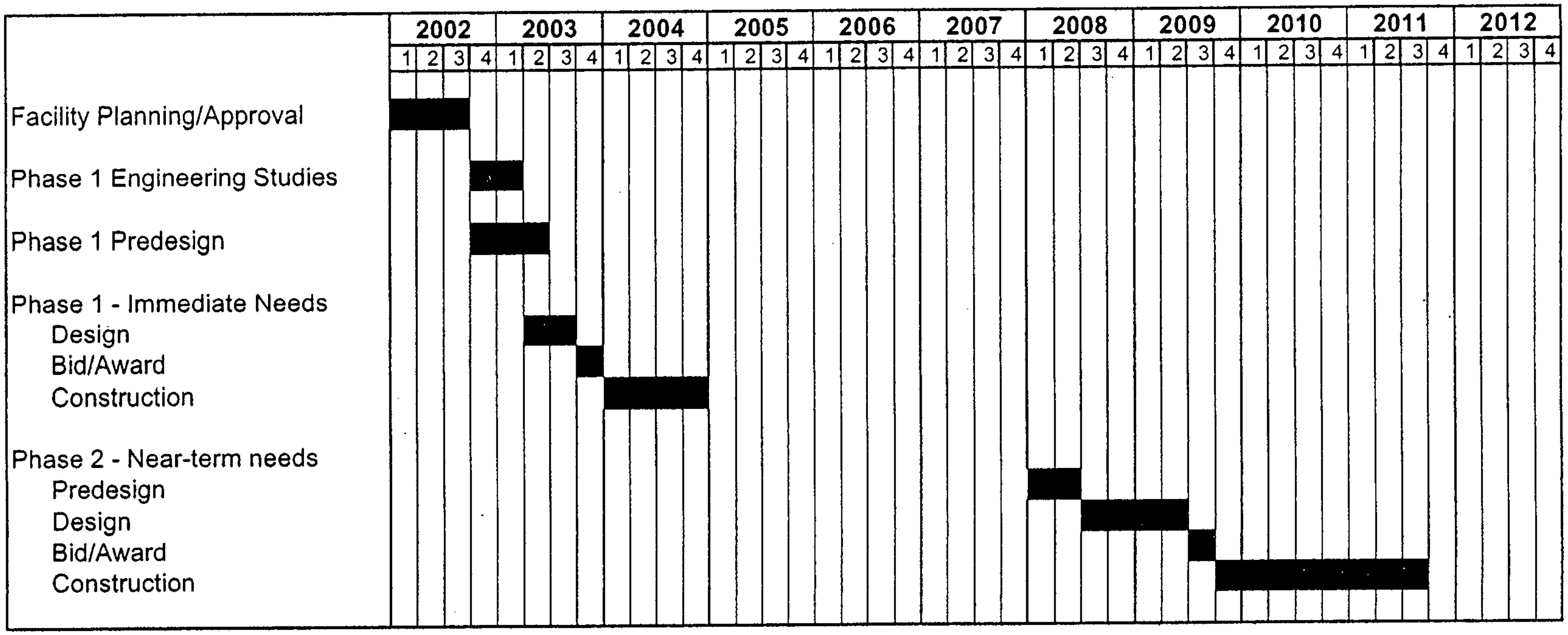
  The primary clarifier, digester, and sludge storage improvements were initially identified as immediate needs, however due to the substantial capital investment required for these expansions, the City chose to delay these expansions. The digester expansion is driven by the need to rebuild the existing primary clarifiers. This will require operating the clarifiers at overflow rates slightly higher than design values; based on current experience, this will not significantly decrease their performance. Modifying primary sludge piping to allow use of both clarifiers and delaying the clarifier expansion until 2010 will result in a peak overflow rate of 3,000 gpd/sf.

A small dewatered sludge storage area will be added in the sludge drying beds. However, provisions must be made for offsite disposal of dewatered biosolids until a larger storage facility can be constructed.

- **Phase 2 – Near-Term Needs.** Near-term needs include improvements that address additional process deficiencies to reach an average dry weather capacity of 4 mgd influent flow, 8,700 lb/day influent BOD, and 8,600 lb/day influent TSS. These improvements are needed by 2010, and include improvements to all plant processes that were not addressed in Phase 1.
- **Phase 2 – Long-term Needs.** Long-term needs are improvements required to meet an average dry weather capacity of 7 mgd influent flow and 14,900 lb/day influent BOD and TSS. Depending on whether ultimate flow and loading is closer to the high or low projection, this phase of expansion should be operational by 2020 – 2030.

The recommended schedule for the first two phases of improvements is shown in Figure 7-10. The following lists the specific elements included in each of the three construction phases.

Figure 7-10. Schedule for Implementation of Phase 1 and Phase 2 Improvements



Phase 1 - Immediate Needs

In the course of developing the facility plan, several deficiencies in Wilsonville's wastewater treatment plant and program were identified. Those that need to be addressed in the next 24 months are discussed in the following sections. It should be noted that Wilsonville has already proceeded with a plan to provide near-term odor improvements. This project is called the 2002 Wilsonville WWTP Odor Control Improvements project.

Predesign Studies

- **Biosolids management plan.** Oregon DEQ requires that all wastewater treatment facilities that apply biosolids to land must have an approved biosolids management plan. This document covers all aspects of biosolids application including the detailed information about the quality of biosolids produced, where and how much is applied, sampling and analysis, and future goals for the program. This project should be scheduled for fiscal year 2003. The biosolids management plan would evaluate, among other things, the costs and benefits associated with constructing a $4 million dewatered sludge storage facility versus operating an offsite biosolids storage facility in a rural area.
- **Plant odor analysis.** Additional sampling for plant odors should be performed during the warm weather period of maximum odor potential to confirm the reduction in odors provided by the 2002 Wilsonville WWTP Odor Control Improvements project. This will help better define the remaining processes producing the most odors at the plant. Sampling could be done even if odor control improvements are not in place, since the purpose of the project would be to define the potential for odors. This study should be done in late summer/early fall 2002.
- **Phase 1 predesign/hydraulic analysis.** A predesign effort should be completed to further develop design of the Phase 1 elements. The predesign will include a detailed hydraulic analysis, geotechnical evaluation, process and instrumentation diagrams, and preliminary plans and sections for major facilities.
- **Evaluate Willamette River total maximum daily load (TMDL).** Oregon DEQ is expected to issue a TMDL for the Willamette River near Wilsonville in the next two years. The wasteload allocations developed in the TMDL process may have a significant impact on the viability of the Wilsonville discharge and the cost of treatment. For these reasons, it is important that the City is an active participant it this process. It is recommended that Wilsonville participate in this process and dedicate resources to assess the potential impacts of the TMDL on the Wilsonville effluent discharge. . This project will take place in fiscal year 2003 to allow plant staff or a consultant to participate in the TMDL process and/or document its impacts.
- **Membrane Bioreactor (MBR) pilot study**: Testing the feasibility of an MBR process at Wilsonville will provide project-specific design criteria and confirm performance characteristics prior to final design. The objectives of a pilot study are to identify operational issues and provide data on the performance of the MBR technology.
- **Predesign for Phase 1 and Phase 2 Improvements**. To adequately coordinate projects, it is recommended that predesign for Phase 1 and Phase 2 improvements be completed as a single project. This will ensure that short-term designs are conceived within the context of the long-term plans for the facility.

Engineering/Capital projects

The following improvements are recommended in Phase 1. Costs for these elements are shown in Table 7-2 at the end of this chapter.

- **Lime addition and storage facilities.** Wilsonville's change in water supply from groundwater to surface water (Willamette River) has resulted in a reduction in influent wastewater alkalinity. The current secondary treatment process consumes alkalinity and there is a potential for pH variations. Lime addition will provide the required process control to prevent an upset of the biological treatment process. Lime addition should be brought online as soon as possible to provide adequate alkalinity for nitrification during the summer of 2003.
- **Primary sludge piping modifications.** Modifying the primary sludge piping to allow sludge from either clarifier to be conveyed to either digester will provide the flexibility needed for these processes to stay in use through 2010.
- **Step feed modifications.** Modifying Wilsonville's plug-flow activated sludge process to a step feed process could expand the treatment capacity of the existing system by several years. In addition, it will provide a more robust system to account for higher peak overflow rates and possible decreased primary removal efficiency at high flows.
- **Headworks.** One new screening channel and rotary fine screen identical to the existing fine screen will be required for redundancy and to address the existing capacity limitation. One new washing and compacting unit for screenings will also be required for redundancy. The headworks will be enclosed as part of this project.
- **Biosolids dewatering.** Determining the appropriate dewatering technology requires pilot testing. Capital improvement cost estimates are based on construction of belt filter presses.
- **Biosolids dewatering and cake storage.** Winter biosolids storage and reuse is currently a weak link in the City's program. With a decreasing number of winter application sites, it is crucial that the city dewater the liquid sludge. This dramatically decreases the storage volume required, and provides more flexibility for emergency provisions for final reuse and disposal (i.e., landfilling). Ultimately, the City needs to provide 6 months of onsite storage for dewatered biosolids. To delay this cost, a minimal amount of cake storage will be added (enough to provide 2-3 days of dewatered cake storage). Plant staff will need to take dewatered cake from the dewatering building to the storage area using trucks or loaders. Loading from the storage area into haul vehicles will also be a manual operation.

  The City will need new equipment to haul and land apply dewatered cake storage. The recommended plan includes purchase of a new truck to transport the biosolids, and a tractor with a manure spreader for application.
- **Filtration facilities for dewatering centrate/filtrate.** Additional filtration facilities are required to protect the existing sand filters from blinding, maintain optimal transmissivity for UV disinfection, and allow Wilsonville to continue to meet permit requirements while operating dewatering facilities.

Phase 2 - Near-Term Needs

- **Primary treatment.** Demolish the aerobic digesters and expand the existing primary clarifiers. Improvements will include new stainless steel clarifier collector mechanisms and a new primary sludge pumping station. The construction will require that one primary clarifier be taken offline, preferably during summer.

- **Secondary treatment.** One new aeration basin and one new secondary clarifier will be constructed. New RAS/WAS pumps and blowers will be included in this improvement project.
- **Disinfection.** One new UV channel and a medium-pressure UV system will be constructed. After bringing the new system online, modifications to the existing channel and system will be made to increase the capacity to 10 mgd peak flow.
- **Solids stabilization.** Two new anaerobic digesters, one new liquid biosolids storage tank, and a digester control building will be constructed. Digesters must be completed prior to demolition of the existing aerobic digesters can commence.
- **Sludge storage.** A new sludge storage building with odor control will be constructed to provide 6 months of storage for the dewatered biosolids.

Phase 2 - Long-Term Needs

Studies/Engineering

- Predesign for Phase 2 improvements.

Capital projects

- **Headworks.** One new screening channel and rotary fine screen will be constructed. The existing bar screen will be replaced with another rotary fine screen.
- **Primary treatment.** One new primary clarifier will be constructed.
- **Secondary treatment.** Two of the aeration basins will be converted to membrane bioreactors pending the results of a pilot study. One of the secondary clarifier basins could be taken offline at this point.
- **Effluent filtration.** Additional Fuzzy Filters® will be constructed in the filtration building constructed in Phase 1.
- **Solids stabilization.** One new anaerobic digester will be constructed.
- **Biosolids dewatering and cake storage.** One new dewatering unit (process will be decided in Phase 1 predesign) will be constructed in the dewatering building constructed in Phase 1. The cake storage facility will be expanded as well.

Biosolids Hauling Policy

Currently, the City hauls and applies the liquid biosolids produced at the plant to local farmland. In the last few years, the number of acres permitted for biosolids application by the City has dwindled and constrained plant operations. There is some indication that DEQ may cease to approve winter application sites in the future. The Recommended Plan assumes that the City will continue to pursue a local land application program implemented using City staff. However, it is important that the City have at least one alternative for biosolids disposal, especially during the winter months. If for any reason land application is not possible, it is assumed that dewatered biosolids would be disposed in a landfill.

Implementation

Funding, Financing and User Charges

It is recommended that the City prepare a detailed financial plan and rate study to update the existing rate analysis with the capital project costs discussed in this chapter. The rate study must also develop an equitable distribution of costs among the users of Wilsonville's wastewater facilities.

Capital Requirements

Table 7-2 presents a summary of estimated project costs for capital projects included in each phase of the recommended plan. These are preliminary, planning level cost estimates and are subject to change as the implementation process and facility requirements become further refined. Biosolids dewatering costs are based on installation of belt filter presses; actual costs will depend on the type of technology selected. Project costs include estimated capital costs and allowances for engineering, legal, and administrative activities. Note that costs in Table 7-2 do not reflect expenditures for collection system improvements.

Table 7-2. Estimated project costs for plant expansions (Costs in $1,000s).

Project Element	Phase 1	Phase 2	Phase 3
Headworks	$1,680	$0	$795
Primary Treatment	$125	$3,275	$2,575
Secondary Treatment	$425	$9,669	$20,757
Filtration	$2,690	$0	$1,415
Disinfection	$0	$1,431	$0
Solids Stabilization	$0	$4,812	$1,806
Biosolids Dewatering	$3,840		$1,099
Liquid and Cake Storage	$150	$4,038	$2,878
Sludge Haul/Spread Equip.	$180		
Relocate Maintenance Shop	$0	$550	$0
Site Management	$446	$1,189	$1,566
Landscaping and Mitigation	$446	$1,189	$1,566
Total	**$9,981**	**$26,153**	**$34,458**
ENR-CCI index 3581; markups of 30% for contingency, 8% for mobilization and bonds, 15% for construction contractor overhead and profit, 20% for sitework, and 25% for engineering, legal, and administrative were used. A 5% site management cost was applied to account for the difficulty in managing excavation, equipment storage, and general construction coordination on a small site.			

Of the Phase 1 costs shown in Table 7-2, only the biosolids dewatering operation will add appreciably to the current plant operation and maintenance costs. Actual costs will depend on the dewatering technology selected, and will likely be between $100,000 and $150,000 per year. Over half of this cost is associated with the energy and polymer use associated with dewatering. Labor costs will depend strongly on the type of dewatering equipment selected. Additional staff efforts will also be required to move dewatered sludge from the dewatering building to the temporary storage area, although reportedly this effort can be accomplished with existing staff.

Regulatory Approval and Council Adoption

The facility plan and its recommended plan should be approved by Oregon DEQ before proceeding with design and construction. After DEQ approval, the facility plan and recommended plan should be adopted by the City of Wilsonville, and predesign and design of the Phase 1 improvements should commence immediately.

Appendix A – Land Use Assumptions

The following assumptions are based on the descriptions of the Areas of Special Concern given in the City of Wilsonville Comprehensive Plan, November 2000.

Area A – Development is primarily commercial, industrial, and high-density residential as shown on Wilsonville Comprehensive Plan map

Area B – Dammasch Master Planning Area – ultimate development of 2,300 residential units based on note on Wilsonville Comprehensive Plan map

Area C – Limited development will occur. Assumed development at 0-1 DU/acre

Area D - Development is as shown on Wilsonville Comprehensive Plan map

Area E – Ultimate development is assumed to be industrial, based on existing use, high potential for redevelopment, and potential conflicts with residential uses.

Area F - Development is as shown on Wilsonville Comprehensive Plan map

Area G - Development is as shown on Wilsonville Comprehensive Plan map

Area H – Prison site (108 acres) assumed to contribute 160,000 gpd of flow based on information from the City. Of remaining acreage, assume 115 acres are developable at 6-7 DU/acre

Area I – Planning in this area is uncertain, therefore a low residential density (2-3 DU/acre) was assigned to the entire area.

Area J – This area has been identified as a suitable location for a new I-5 interchange. It is assumed to not contribute flow to the sanitary system.

Area K – This area has been designated for "river-focused development". Half of the area is assumed to develop at a moderate density of 6-7 DU/acre

Area L – This area is assumed to develop at half of the Metro density, or 5 DU/acre.

Appendix B – Design Criteria for Existing WWTP

Description	Design Criteria
Plant Flows and Loadings	
Design Year	2015
Design Population	18,000
Design Flow	
Average dry weather flow (ADWF), mgd	2.70
Maximum month dry weather flow (MMDWF), mgd	2.90
Maximum day dry weather flow (MDDWF), mgd	5.32
Average wet weather flow (AWWF), mgd	3.43
Maximum day wet weather flow (MDWWF), mgd	6.26
Peak wet weather flow (PWWF), mgd	8.00
Design Loadings	
Maximum month BOD loading, lb/day	8,580
Maximum month TSS loading, lb/day	8,580
Liquid Unit Process Criteria	
Fine Drum Screen	
Number	1
Spacing, mm	1
Motor, hp	5
Mechanical Bar Screen	
Number	1
Spacing, in.	5/8
Motor, hp	5
Primary Clarifiers	
Number	2
Type	Circular
Diameter, ft.	42
Sidewater Depth, ft.	11
Surface Area, ea., sf.	1,385
Volume, gal.	114,000
Design Overflow Rate, gpd/sf, both units in service	
At ADWF	975
At AWWF	1,240

Note: Design ratings as specified in the record drawings set (CH2M Hill, 1998).

Description	Design Criteria
Aeration Basins	
Number	2
Type	Plug Flow
Size, ea., ft.	175x20x15
Total Volume, gal	785,500
Anoxic zone size, ea., ft	20x20x15
Anoxic zone volume, gal.	44,880
Anoxic mixers	
Number	2
Design SRT, days, MMDWF	8
Design SRT, days, AWWF	3
Design MLSS, mg/L, ADWF	3,340
Design MLSS, mg/L, AWWF	2,520
Aeration Blowers	
Number	3
Type	Multistage Centrifugal
Capacity, lbs O2/day	9,700
Total connected hp	525
Secondary Clarifiers	
Number	2
Type	Circular
Diameter, ft.	70
Sidewater Depth, ft.	16
Surface Area, ea., sf.	3,850
Volume, ea., gal.	460,600
Overflow Rate, gpd/sf, both units in service	
At ADWF	350
At AWWF	445
Filters	
Number	3
Type	Traveling Bridge
Total Area, sf.	1,188
Basin Geometry, ea., ft.	44x9x6
Loading, ADWF, one unit out of service, gpm/sf	2.5
Min. Backwash Surface Loading Rate, gpm/sf/cell	2.5
Disinfection	
Type	Ultraviolet
Channels	1
Delivered Dose, mW-s/SQcm for 200/400 FC	31
Detention Time, sec.	7.7

Solids Unit Process Criteria	
Primary Sludge Pumps	
Number	2
Type	Air-operated Diaphragm
Capacity, ea., gpm	125 gpm
Return Sludge Pumps	
Number	3
Type	Screw Centrifugal, Adjustable Speed
Capacity, ea., gpm	400-1,000
Motor hp	10
Waste Sludge Pumps	
Number	2
Type	Screw Centrifugal
Capacity, ea., gpm	100-400
Motor hp	5
WAS/Biosolids Thickening	
Number	2
Type	Gravity Belt
Size	1.5 m
Hydraulic Loading, gpm/m at 0.5% feed concentration	150-200
Digesters	
Number	2
Type	Aerobic
Total Volume, gal.	862,000
Digester Concentration, %	2.5
Digestion retention time, days	23
Design temperature, Deg. C	25-30
Volatile Solids Reduction, %	38
Biosolids Storage	
Number	5
Type	Existing Tankage
Volume, gal.	412,000
Design solids concentration, %	6
Digested sludge storage time, days	46
Aeration	
Type	Diffused Air
Number	2
Capacity, scfm, at 20 psi	10,000
Biosolids Disposal	
Annual sludge weight, dry tons	850
Annual sludge volume, million gallons	3.4

Support Systems Unit Process Criteria	
Plant Water Pumps	
Number	2
Type	Centrifugal
Capacity, ea., gpm	300
Motor hp	15
Plant Drain Pumps	
Number	2
Type	End-suction Centrifugal
Capacity, ea., gpm	200-600
Motor hp	25
Sodium Hypochlorite Feed Pumps	
Number	2
Capacity, gph	5
Polymer mix/feed units	
Number	2
Capacity, lbs/day	10

Appendix C – ENVision Model Output

Summary Report For
Wilsonville Facility Plan Update

by HDR Engineering, Inc.

HDR

October 30, 2002

Prepared By Greg Moen

Dry Weather (year 2000)

Process/Loading	Units	ADWF	MMDW	MWDW
Summary Processes				
Influent 1				
Flow	mgd	2.02	2.15	2.29
Biochemical oxygen demand concentration	mg/L	248	248	248
Total suspended solids concentration	mg/L	254	254	254
Percentage of total solids consisiting of volatile solids	%	80	80	80
Ammonia concentration	mg/L	24	24	24
Total Kjeldahl Nitrogen	mg/L	35	35	35
Phosphorous concentration	mg/L	7.3	7.3	7.3
Alkalinity concentration	mg/L	100	100	100
Screening and Grit 1				
Number of grit units	none	1	1	1
Grit removal rate	cu yrd/MG	0	0	0
Screenings removal rate	cu yrd/MG	0.56	0.56	0.56
Number of screen units	none	1	1	1
Grit Production	cu yrd/d	0	0	0
Screenings Production	cu yrd/d	1.138	1.211	1.289
Primary Sedimentation 1				
Number of primary clarifiers	none	2	2	2
Diameter	ft	42	42	42
Depth	ft	11	11	11
TSS removal efficiency	%	55	55	55
BOD removal efficiency	%	25	25	25
Primary sludge TSS concentration	%	4	4	4
Skimmings	cu ft/MG	1	1	1
Clarifier Area (Total)	sq ft	2,771	2,771	2,771
Clarifier Volume (Total)	cu ft	30,480	30,480	30,480
Hydraulic Surface Loading Rate	gpd/sq ft	733.6	780.4	830.7
HRT	hr	2.692	2.531	2.377
Solids Loading Rate	lb/sq ft/d	1.582	1.683	1.793
Weir Loading (single side)	gpd/ft	7,675	8,165	8,692
Activated Sludge 1				
Number of basins	none	2	2	2
Length	ft	155	155	155
Width	ft	20	20	20
Depth	ft	15	15	15
Liquid temperature	C	20	20	20
Oxygen field transfer efficiency as percentage per unit depth above the diffusers	%/ft	1.5	1.5	1.5
Dissolved oxygen setpoint	mg/L	2	2	2
O2 for nitrification	none	4.57	4.57	4.57
Nitrogen in VSS	g N/g VSS	8.00E-02	8.00E-02	8.00E-02
Basin Volume (Total)	Mgal	0.6956	0.6956	0.6956
Sludge Age (w/o clarifier)	days	10	10	10
Sludge Age (w/ clarifier)	days	11.97	12.08	12.19
Minimum Nitrification SRT	days	11.39	11.39	11.39
Hydraulic Retention Time	hr	7.116	6.745	6.386
MLSS	mg/L	3,892	4,138	4,403
F/M	lb BOD/lb VSS/d	0.1884	0.1885	0.1885
Observed Growth Yield	lb VSS/lb BOD	0.5308	0.5306	0.5304
Carb 02 Required	lb O2/lb BOD	1.033	1.032	1.031
Total O2 Required	lb O2/lb BOD	1.033	1.032	1.031
Oxygen Uptake Rate	mg/L/h	24.38	25.9	27.54
Diurnal OUR Peak	mg/L/h	32.91	34.96	37.17
Air Required	SCFM	1,981	2,104	2,237
Air Energy Required	hp	94.33	100.2	106.5
Secondary Sedimentation 1				
Number of secondary clarifiers	none	2	2	2
Diameter	ft	70	70	70
Depth	ft	16	16	16
TSS concentration in liquid effluent stream	mg/L	6	6	6
Clarifier Area (Total)	sq ft	7,697	7,697	7,697
Clarifier Volume (Total)	cu ft	123,200	123,200	123,200
Hydraulic Surface Loading Rate	gpd/sq ft	302.4	319.2	337.3
Solids Loading Rate	lb/sq ft/d	13.85	15.54	17.46
Weir Loading (single side)	gpd/ft	5,292	5,586	5,902
HRT (w/ recycle)	hr	6.731	6.379	6.04
HRT (w/o recycle)	hr	9.498	8.999	8.516
RAS Concentration	mg/L	13,340	14,200	15,130
Max SVI Allowed	mL/g	74.93	70.41	66.11

Dry Weather (year 2000)

Process/Loading	Units	ADWF	MMDW	MWDW
Summary Processes				
Split Box 1				
Return activated sludge rate as a percentage of activated sludge influent	%	40	40	40
Sand Filtration				
Number of filtration units	none	3	3	3
Surface area per unit	sq ft	396	396	396
Depth	in	30	30	30
Filter run time	hr	24	24	24
Backwash rate	gpm/sq ft	18	18	18
Backwash duration	min	15	15	15
Area (total)	sq ft	1,188	1,188	1,188
Hydraulic Loading (avg)	gpm/sq ft	1.361	1.436	1.517
Hydraulic Loading (1 off line)	gpm/sq ft	2.041	2.154	2.276
Backwash Flow (avg)	gpm	222.8	222.8	222.8
Backwash Flow (instantaneous)	gpm	7,128	7,128	7,128
Sludge Thickening 1				
Number of centrifuges	none	2	2	2
BOD concentration in centrate stream	mg/L	800	800	800
Capacity per centrifuge	gpm	200	200	200
Polymer dose	lb/dry ton	9.2	9.2	9.2
TSS removal efficiency	%	95	95	95
Thickened sludge TSS concentration	%	4	4	4
Firm Installed Capacity	gpm	200	200	200
Total Installed Capacity	gpm	400	400	400
Sludge Digestion 1				
Number of digesters	none	1	1	1
Diameter	ft	75.12	75.12	75.12
Depth	ft	13	13	13
Percentage of VSS destroyed during digestion	%	38	38	38
Supernatant flow as a percentage of influent flow	%	0	0	0
BOD concentration in supernatant stream	mg/L	0	0	0
Digester Volume (total)	1000 cu ft	57.62	57.62	57.62
Detention Time	days	32.88	30.9	29.02
Organic Loading Rate	lb BOD/1000 cu ft/d	33.65	35.91	38.34
Solids Loading Rate	lb VSS/1000 cu ft/d	59.75	63.58	67.7
Sludge Digestion 2				
Number of digesters	none	1	1	1
Diameter	ft	75.12	75.12	75.12
Depth	ft	13	13	13
Percentage of VSS destroyed during digestion	%	38	38	38
Supernatant flow as a percentage of influent flow	%	0	0	0
BOD concentration in supernatant stream	mg/L	0	0	0
Digester Volume (total)	1000 cu ft	57.62	57.62	57.62
Detention Time	days	32.88	30.9	29.02
Organic Loading Rate	lb BOD/1000 cu ft/d	17.02	18.11	19.29
Solids Loading Rate	lb VSS/1000 cu ft/d	37.05	39.42	41.97

Wet Weather (2000)

Process/Loading	Units	AWWF	MMWW	MWWW
Summary Processes				
Influent 1				
Flow	mgd	2.42	2.79	3.3
Biochemical oxygen demand concentration	mg/L	248	248	248
Total suspended solids concentration	mg/L	254	254	254
Percentage of total solids consisiting of volatile solids	%	80	80	80
Ammonia concentration	mg/L	24	24	24
Total Kjeldahl Nitrogen	mg/L	35	35	35
Phosphorous concentration	mg/L	7.3	7.3	7.3
Alkalinity concentration	mg/L	100	100	100
Screening and Grit 1				
Number of grit units	none	0	0	0
Grit removal rate	cu yrd/MG	0	0	0
Screenings removal rate	cu yrd/MG	0.56	0.56	0.56
Number of screen units	none	1	1	1
Grit Production	cu yrd/d	0	0	0
Screenings Production	cu yrd/d	1.364	1.57	1.855
Primary Sedimentation 1				
Number of primary clarifiers	none	2	2	2
Diameter	ft	42	42	42
Depth	ft	11	11	11
TSS removal efficiency	%	45	45	45
BOD removal efficiency	%	23	23	23
Primary sludge TSS concentration	%	4	4	4
Skimmings	cu ft/MG	1	1	1
Clarifier Area (Total)	sq ft	2,771	2,771	2,771
Clarifier Volume (Total)	cu ft	30,480	30,480	30,480
Hydraulic Surface Loading Rate	gpd/sq ft	878.9	1,012	1,195
HRT	hr	2.247	1.951	1.652
Solids Loading Rate	lb/sq ft/d	1.903	2.194	2.595
Weir Loading (single side)	gpd/ft	9,201	10,590	12,510
Activated Sludge 1				
Number of basins	none	2	2	2
Length	ft	155	155	155
Width	ft	20	20	20
Depth	ft	15	15	15
Liquid temperature	C	17	17	17
Oxygen field transfer efficiency as percentage per unit depth above the diffusers	%/ft	1.5	1.5	1.5
Dissolved oxygen setpoint	mg/L	2	2	2
O2 for nitrification	none	4.57	4.57	4.57
Nitrogen in VSS	g N/g VSS	8.00E-02	8.00E-02	8.00E-02
Basin Volume (Total)	Mgal	0.6956	0.6956	0.6956
Sludge Age (w/o clarifier)	days	8	8	8
Sludge Age (w/ clarifier)	days	9.844	10.09	10.43
Minimum Nitrification SRT	days	16.3	16.3	16.3
Hydraulic Retention Time	hr	6.074	5.357	4.608
MLSS	mg/L	4,374	5,030	5,935
F/M	lb BOD/lb VSS/d	0.209	0.2093	0.2099
Observed Growth Yield	lb VSS/lb BOD	0.5982	0.5973	0.5956
Carb 02 Required	lb O2/lb BOD	0.9881	0.9859	0.9828
Total O2 Required	lb O2/lb BOD	0.9881	0.9859	0.9828
Oxygen Uptake Rate	mg/L/h	28.88	33.17	39.11
Diurnal OUR Peak	mg/L/h	38.98	44.79	52.8
Air Required	SCFM	2,305	2,648	3,122
Air Energy Required	hp	109.8	126.1	148.7
Secondary Sedimentation 1				
Number of secondary clarifiers	none	2	2	2
Diameter	ft	70	70	70
Depth	ft	16	16	16
TSS concentration in liquid effluent stream	mg/L	6	6	6
Clarifier Area (Total)	sq ft	7,697	7,697	7,697
Clarifier Volume (Total)	cu ft	123,200	123,200	123,200
Hydraulic Surface Loading Rate	gpd/sq ft	354.1	401.8	467.7
Solids Loading Rate	lb/sq ft/d	18.24	23.78	32.62
Weir Loading (single side)	gpd/ft	6,196	7,032	8,184
HRT (w/ recycle)	hr	5.745	5.067	4.358
HRT (w/o recycle)	hr	8.112	7.148	6.142
RAS Concentration	mg/L	14,970	17,260	20,430
Max SVI Allowed	mL/g	66.79	57.92	48.96

Wet Weather (2000)

Process/Loading	Units	AWWF	MMWW	MWWW
Summary Processes				
Split Box 1				
Return activated sludge rate as a percentage of activated sludge influent	%	40	40	40
Sand Filtration				
Number of filtration units	none	3	3	3
Surface area per unit	sq ft	396	396	396
Depth	in	30	30	30
Filter run time	hr	24	24	24
Backwash rate	gpm/sq ft	18	18	18
Backwash duration	min	15	15	15
Area (total)	sq ft	1,188	1,188	1,188
Hydraulic Loading (avg)	gpm/sq ft	1.593	1.808	2.104
Hydraulic Loading (1 off line)	gpm/sq ft	2.39	2.712	3.156
Backwash Flow (avg)	gpm	222.8	222.8	222.8
Backwash Flow (instantaneous)	gpm	7,128	7,128	7,128
Sludge Thickening 1				
Number of centrifuges	none	2	2	2
BOD concentration in centrate stream	mg/L	800	800	800
Capacity per centrifuge	gpm	200	200	200
Polymer dose	lb/dry ton	7.3	7.3	7.3
TSS removal efficiency	%	95	95	95
Thickened sludge TSS concentration	%	4	4	4
Firm Installed Capacity	gpm	200	200	200
Total Installed Capacity	gpm	400	400	400
Sludge Digestion 1				
Number of digesters	none	1	1	1
Diameter	ft	75.12	75.12	75.12
Depth	ft	13	13	13
Percentage of VSS destroyed during digestion	%	38	38	38
Supernatant flow as a percentage of influent flow	%	0	0	0
BOD concentration in supernatant stream	mg/L	0	0	0
Digester Volume (total)	1000 cu ft	57.62	57.62	57.62
Detention Time	days	27.8	24.13	20.42
Organic Loading Rate	lb BOD/1000 cu ft/d	42.19	48.91	58.18
Solids Loading Rate	lb VSS/1000 cu ft/d	70.2	80.85	95.53
Sludge Digestion 2				
Number of digesters	none	1	1	1
Diameter	ft	75.12	75.12	75.12
Depth	ft	13	13	13
Percentage of VSS destroyed during digestion	%	38	38	38
Supernatant flow as a percentage of influent flow	%	0	0	0
BOD concentration in supernatant stream	mg/L	0	0	0
Digester Volume (total)	1000 cu ft	57.62	57.62	57.62
Detention Time	days	27.8	24.13	20.42
Organic Loading Rate	lb BOD/1000 cu ft/d	20.19	23.26	27.49
Solids Loading Rate	lb VSS/1000 cu ft/d	43.52	50.13	59.23

Summary for ADWF

Process	Flow		BOD		TSS		VSS	
	mgd	gpm	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d
Mixing Unit 2								
Influent	2.02	1,403	248	4,178	254	4,279	203.2	3,423
Effluent (Liquid/First)	2.033	1,412	251.4	4,263	258.5	4,382	206.6	3,503
Screening and Grit 1								
Influent	2.033	1,412	251.4	4,263	258.5	4,382	206.6	3,503
Effluent (Liquid/First)	2.033	1,412	251.4	4,263	258.5	4,382	206.6	3,503
Primary Sedimentation 1								
Influent	2.033	1,412	251.4	4,263	258.5	4,382	206.6	3,503
Effluent (Liquid/First)	2.025	1,407	189.3	3,197	116.7	1,972	93.32	1,576
Effluent (Solid/Second)	7.23E-03	5.017	17,680	1,066	40,000	2,410	31,970	1,927
Mixing Unit 3								
Influent	2.025	1,407	189.3	3,197	116.7	1,972	93.32	1,576
Effluent (Liquid/First)	2.346	1,629	168	3,287	105	2,055	83.84	1,641
Mixing Unit 4								
Influent	2.346	1,629	168	3,287	105	2,055	83.84	1,641
Effluent (Liquid/First)	3.285	2,281	1,888	51,730	3,888	106,500	3,006	82,340
Activated Sludge 1								
Influent	3.285	2,281	1,888	51,730	3,888	106,500	3,006	82,340
Effluent (Liquid/First)	3.285	2,281	1,807	49,500	3,892	106,600	3,007	82,380
Secondary Sedimentation 1								
Influent	3.285	2,281	1,807	49,500	3,892	106,600	3,007	82,380
Effluent (Liquid/First)	2.328	1,616	5.514	107	6	116.5	4.636	89.99
Effluent (Solid/Second)	0.957	664.6	6,189	49,400	13,340	106,500	10,310	82,290
Split Box 1								
Influent	0.957	664.6	6,189	49,400	13,340	106,500	10,310	82,290
Effluent (Liquid/First)	0.9385	651.7	6,189	48,440	13,340	104,500	10,310	80,700
Effluent (Solid/Second)	1.86E-02	12.89	6,189	958	13,350	2,066	10,310	1,596
Sand Filtration								
Influent	2.328	1,616	5.514	107	6	116.5	4.636	89.99
Effluent (Liquid/First)	2.007	1,394	1	16.74	2	33.47	1.545	25.86
Effluent (Solid/Second)	0.3208	222.8	33.75	90.3	31.03	83	23.97	64.13
Plant Discharge 1								
Influent	2.007	1,394	1	16.74	2	33.47	1.545	25.86
Sludge Thickening 1								
Influent	1.86E-02	12.89	6,189	958	13,350	2,066	10,310	1,596
Effluent (Liquid/First)	1.27E-02	8.804	800	84.58	976.9	103.3	754.7	79.8
Effluent (Solid/Second)	5.88E-03	4.085	17,800	873.4	40,000	1,962	30,900	1,516
Sludge Digestion 1								
Influent	1.31E-02	9.103	17,740	1,939	40,000	4,373	31,490	3,443
Effluent (Solid/Second)	1.31E-02	9.103	8,970	980.6	28,030	3,064	19,530	2,135
Mixing Unit 6								
Influent	7.23E-03	5.017	17,680	1,066	40,000	2,410	31,970	1,927
Effluent (Liquid/First)	1.31E-02	9.103	17,740	1,939	40,000	4,373	31,490	3,443
Sludge Digestion 2								
Influent	1.31E-02	9.103	8,970	980.6	28,030	3,064	19,530	2,135
Effluent (Solid/Second)	1.31E-02	9.103	6,596	721.1	20,610	2,253	12,110	1,323
Landfill 1								
Influent	1.31E-02	9.103	6,596	721.1	20,610	2,253	12,110	1,323

Summary for MMDW

Process	Flow		BOD		TSS		VSS	
	mgd	gpm	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d
Mixing Unit 2								
Influent	2.15	1,493	248	4,447	254	4,554	203.2	3,644
Effluent (Liquid/First)	2.162	1,502	251.1	4,529	258.6	4,664	206.8	3,728
Screening and Grit 1								
Influent	2.162	1,502	251.1	4,529	258.6	4,664	206.8	3,728
Effluent (Liquid/First)	2.162	1,502	251.1	4,529	258.6	4,664	206.8	3,728
Primary Sedimentation 1								
Influent	2.162	1,502	251.1	4,529	258.6	4,664	206.8	3,728
Effluent (Liquid/First)	2.155	1,496	189	3,397	116.8	2,099	93.37	1,678
Effluent (Solid/Second)	7.69E-03	5.34	17,650	1,132	40,000	2,565	31,970	2,051
Mixing Unit 3								
Influent	2.155	1,496	189	3,397	116.8	2,099	93.37	1,678
Effluent (Liquid/First)	2.475	1,719	169.3	3,495	105.9	2,186	84.54	1,745
Mixing Unit 4								
Influent	2.475	1,719	169.3	3,495	105.9	2,186	84.54	1,745
Effluent (Liquid/First)	3.466	2,407	2,003	57,880	4,133	119,500	3,195	92,340
Activated Sludge 1								
Influent	3.466	2,407	2,003	57,880	4,133	119,500	3,195	92,340
Effluent (Liquid/First)	3.466	2,407	1,921	55,520	4,138	119,600	3,197	92,390
Secondary Sedimentation 1								
Influent	3.466	2,407	1,921	55,520	4,138	119,600	3,197	92,390
Effluent (Liquid/First)	2.457	1,706	5.684	116.5	6	122.9	4.635	94.97
Effluent (Solid/Second)	1.009	700.5	6,586	55,400	14,200	119,500	10,970	92,300
Split Box 1								
Influent	1.009	700.5	6,586	55,400	14,200	119,500	10,970	92,300
Effluent (Liquid/First)	0.9901	687.6	6,586	54,380	14,200	117,300	10,970	90,600
Effluent (Solid/Second)	1.86E-02	12.88	6,586	1,019	14,200	2,197	10,970	1,697
Sand Filtration								
Influent	2.457	1,706	5.684	116.5	6	122.9	4.635	94.97
Effluent (Liquid/First)	2.136	1,483	1	17.81	2	35.63	1.545	27.52
Effluent (Solid/Second)	0.3208	222.8	36.87	98.64	32.64	87.31	25.21	67.45
Plant Discharge 1								
Influent	2.136	1,483	1	17.81	2	35.63	1.545	27.52
Sludge Thickening 1								
Influent	1.86E-02	12.88	6,586	1,019	14,200	2,197	10,970	1,697
Effluent (Liquid/First)	1.23E-02	8.537	800	82.02	1,072	109.9	827.8	84.87
Effluent (Solid/Second)	6.26E-03	4.346	17,950	936.9	40,000	2,088	30,900	1,613
Sludge Digestion 1								
Influent	1.40E-02	9.686	17,790	2,069	40,000	4,653	31,490	3,663
Effluent (Solid/Second)	1.40E-02	9.686	8,971	1,043	28,030	3,261	19,530	2,271
Mixing Unit 6								
Influent	7.69E-03	5.34	17,650	1,132	40,000	2,565	31,970	2,051
Effluent (Liquid/First)	1.40E-02	9.686	17,790	2,069	40,000	4,653	31,490	3,663
Sludge Digestion 2								
Influent	1.40E-02	9.686	8,971	1,043	28,030	3,261	19,530	2,271
Effluent (Solid/Second)	1.40E-02	9.686	6,596	767.3	20,610	2,398	12,110	1,408
Landfill 1								
Influent	1.40E-02	9.686	6,596	767.3	20,610	2,398	12,110	1,408

Summary for MMWW

Process	Flow		BOD		TSS		VSS	
	mgd	gpm	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d
Mixing Unit 2								
Influent	2.79	1,938	248	5,771	254	5,910	203.2	4,728
Effluent (Liquid/First)	2.804	1,947	250.7	5,863	260	6,080	207.8	4,858
Screening and Grit 1								
Influent	2.804	1,947	250.7	5,863	260	6,080	207.8	4,858
Effluent (Liquid/First)	2.804	1,947	250.7	5,863	260	6,080	207.8	4,858
Primary Sedimentation 1								
Influent	2.804	1,947	250.7	5,863	260	6,080	207.8	4,858
Effluent (Liquid/First)	2.796	1,941	193.6	4,515	143.4	3,344	114.6	2,672
Effluent (Solid/Second)	8.20E-03	5.695	19,720	1,349	40,000	2,736	31,960	2,186
Mixing Unit 3								
Influent	2.796	1,941	193.6	4,515	143.4	3,344	114.6	2,672
Effluent (Liquid/First)	3.116	2,164	180.3	4,685	132.8	3,452	106	2,755
Mixing Unit 4								
Influent	3.116	2,164	180.3	4,685	132.8	3,452	106	2,755
Effluent (Liquid/First)	4.363	3,030	2,401	87,350	5,028	182,900	3,860	140,400
Activated Sludge 1								
Influent	4.363	3,030	2,401	87,350	5,028	182,900	3,860	140,400
Effluent (Liquid/First)	4.363	3,030	2,320	84,420	5,030	183,000	3,859	140,400
Secondary Sedimentation 1								
Influent	4.363	3,030	2,320	84,420	5,030	183,000	3,859	140,400
Effluent (Liquid/First)	3.093	2,148	7.51	193.7	6	154.8	4.603	118.7
Effluent (Solid/Second)	1.27	882	7,951	84,230	17,260	182,900	13,240	140,300
Split Box 1								
Influent	1.27	882	7,951	84,230	17,260	182,900	13,240	140,300
Effluent (Liquid/First)	1.247	865.7	7,951	82,660	17,260	179,500	13,240	137,700
Effluent (Solid/Second)	2.36E-02	16.36	7,951	1,562	17,260	3,392	13,240	2,602
Sand Filtration								
Influent	3.093	2,148	7.51	193.7	6	154.8	4.603	118.7
Effluent (Liquid/First)	2.772	1,925	1	23.12	2	46.24	1.534	35.47
Effluent (Solid/Second)	0.3208	222.8	63.77	170.6	40.57	108.5	31.12	83.26
Plant Discharge 1								
Influent	2.772	1,925	1	23.12	2	46.24	1.534	35.47
Sludge Thickening 1								
Influent	2.36E-02	16.36	7,951	1,562	17,260	3,392	13,240	2,602
Effluent (Liquid/First)	1.39E-02	9.651	800	92.73	1,463	169.6	1,122	130.1
Effluent (Solid/Second)	9.66E-03	6.708	18,240	1,469	40,000	3,222	30,690	2,472
Sludge Digestion 1								
Influent	1.79E-02	12.4	18,920	2,818	40,000	5,958	31,270	4,658
Effluent (Solid/Second)	1.79E-02	12.4	8,997	1,340	28,120	4,188	19,390	2,888
Mixing Unit 6								
Influent	8.20E-03	5.695	19,720	1,349	40,000	2,736	31,960	2,186
Effluent (Liquid/First)	1.79E-02	12.4	18,920	2,818	40,000	5,958	31,270	4,658
Sludge Digestion 2								
Influent	1.79E-02	12.4	8,997	1,340	28,120	4,188	19,390	2,888
Effluent (Solid/Second)	1.79E-02	12.4	6,640	989	20,750	3,091	12,020	1,791
Landfill 1								
Influent	1.79E-02	12.4	6,640	989	20,750	3,091	12,020	1,791

Appendix D – Outfall Inspection Report

Memorandum

COSMOPOLITAN ENGINEERING GROUP

117 South 8th Street
Tacoma, WA 98402

Phone (253) 272-7220
Fax (253) 272-7250
mktp@cosmogrp.com

DATE: June 25, 2001

TO: Heather Stephens
HDR Engineering, Inc.
Suite 500
10300 SW Greenburg Road
Portland, OR 97223

FROM: Merita Kay Trohimovich MKT

RE: City of Wilsonville Outfall Inspection

FILE: HDR.004

cc: file

OUTFALL DESCRIPTION

The City of Wilsonville WPCF outfall is located in the Willamette River. The outfall was extended from a sidebank outfall to a submerged, single port outfall in 1981. The extension was accomplished by elbowing the existing sidebank outfall and extending the pipe approximately 40 feet offshore. The area of the elbow was then encased in concrete to provide armoring, anchoring and stability. The concrete anchoring was clearly visible at the river's edge on the date of the inspection. The concrete anchoring is shown on Photo 1. The majority of the outfall extension is below the river bottom.

DIVE LOG

The inspection was completed the afternoon of June 7, 2001. The dive inspectors were Bill Fox and Merita Trohimovich. The divers accessed the river from the shoreline. The divers were equipped with an underwater camera. Currents were minimal during the inspection. River stage on June 7, 2001 was reported at 4.07 feet at the United States Geological Service (USGS) gage station 14211720 Willamette River at Portland, OR. The gage at this location is 1.55 feet above sea level.

The outfall is noted as being approximately 40 feet offshore from the elbow. An anchor line was set as a guide for the divers upstream and 40 feet offshore of the approximate location of the elbow. Rhodamine WT dye was injected into the effluent following UV disinfection to aid the divers in locating the outfall and to help detect leaks. Only one dye plume was observed in the river from the surface and during the underwater investigation. This indicates that no major leaks are present in this underwater portion of the outfall.

The divers descended in the location of the dye plume. Visibility was approximately 3 feet. The river bottom consisted of a combination of soft sediments, large rocks and woody debris. When the bottom sediments were disturbed, visibility went to zero. The outfall was found in a "hole" on the river bottom approximately four feet by four feet. The outfall is 24-inch CMP pipe. It appears the CMP is coated with a protective tape coating. The outfall drawings indicate that the underwater portion of the outfall is encased in concrete. No concrete was noted on the exposed portion of the outfall. The outfall is buried to within 1 foot of the terminus. Photo 2 shows the outfall discharging the dyed effluent.

The invert of the outfall was approximately 16 feet below the water at the time of the inspection.. The outfall pipe appears to be in good shape with no major defects. The outfall was flowing freely. There is woody debris in the vicinity of the outfall terminus. The debris is not blocking the outfall terminus nor does the debris appear to pose any hazard to the outfall. A small amount of gravel has been deposited at the bottom of the outfall, however, the deposits are not hindering flow from the outfall.

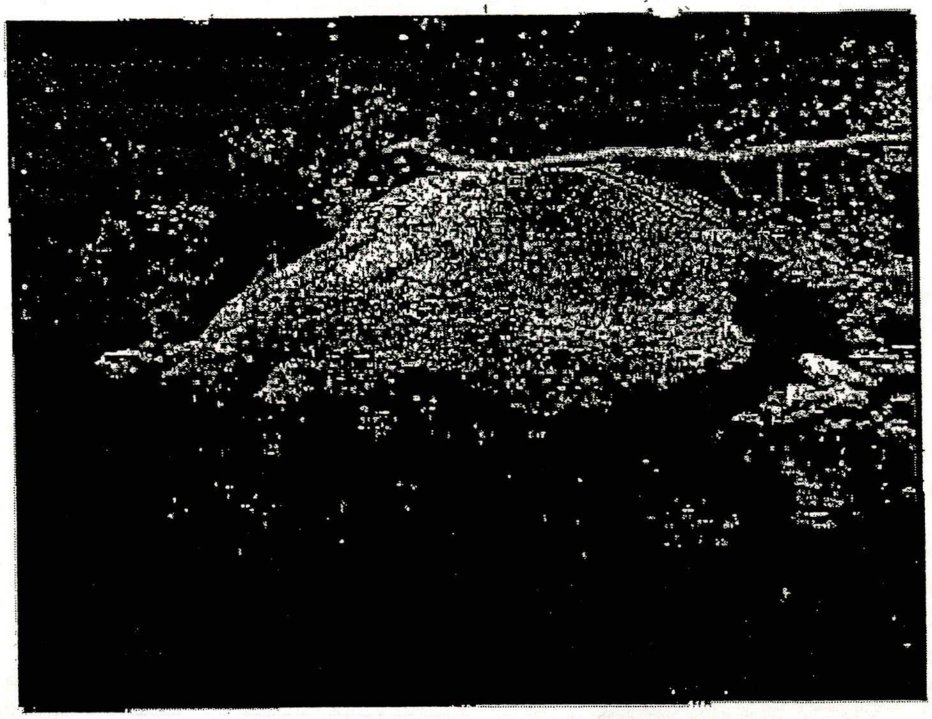


Photo 1: Concrete Armoring at River's Edge

Photo 2: Outfall Terminus with Dye in Effluent

Appendix E – NPDES Permit

Expiration Date: June 30, 2005
Permit Number: 101888
File Number: 97952

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM WASTE DISCHARGE PERMIT

Department of Environmental Quality
Northwest Region – Portland Office
2020 SW 4th Ave., Suite 400, Portland, OR 97201
Telephone: (503) 229-5263

Issued pursuant to ORS 468B.050 and The Federal Clean Water Act

SSUED TO:

of Wilsonville
SW Town Center Loop
ville, OR 97070

SOURCES COVERED BY THIS PERMIT:

Type of Waste	Outfall Number	Outfall Location
Treated Wastewater	001	R.M. 38.6 *
Reclaimed Water	002	Reuse
Collection System Emergency Overflow Points:		
Corral Creek pump station	003	R.M. 39.8
Rivergreen pump station	004	R.M. 39.6
Charbonneau pump station	005	R.M. 38.6
River Village pump station	006	R.M. 38.5
Parkway pump station	007	R.M. 37.6
Memorial Park pump station	008	R.M. 37.6
Canyon Creek pump station	009	R.M. 37.6
Morey's Landing pump station	010	R.M. 39.6

ITY TYPE AND LOCATION:

ed Sludge
ville STP
SW Tauchman Road
nville

tment System Class: Level IV
ection System Class: Level III

RECEIVING STREAM INFORMATION:

Basin: Willamette
Sub-Basin: Middle Willamette

Receiving Stream: Willamette River
Hydro Code: 22=-WILL 38.6 D
County: Clackamas

REFERENCE NO: OR-002276-4

ed in response to Application No. 991478 received February 3, 1998.
s permit is issued based on the land use findings in the permit record.

Robert P. Baumgartner

obert P. Baumgartner, Water Quality Manager
orthwest Region

July 10, 2000
Date

PERMITTED ACTIVITIES

Until this permit expires or is modified or revoked, the permittee is authorized to construct, install, modify, or operate a wastewater collection, treatment, control and disposal system and discharge to public waters adequately treated wastewater only from the authorized discharge point or points established in Schedule A and only in conformance with all the requirements, limitations, and conditions set forth in the attached schedules as follows:

Unless authorized by another NPDES permit, each other direct and indirect discharge to public waters is prohibited.

SCHEDULE A

Waste Discharge Limitations not to be exceeded after permit issuance.

1. Treated Effluent Outfall 001, Willamette River discharge

a. May 1 - October 31:

Parameter	Average Effluent Concentrations Monthly	Average Effluent Concentrations Weekly	Monthly* Average lb/day	Weekly* Average lb/day	Daily* Maximum lbs
$CBOD_5$ (See Note 1)	10 mg/L	15 mg/L	190	280	380
TSS	10 mg/L	15 mg/L	190	280	380

b. November 1 - April 30:

Parameter	Average Effluent Concentrations Monthly	Average Effluent Concentrations Weekly	Monthly* Average lb/day	Weekly* Average lb/day	Daily* Maximum lbs.
BOD_5	30 mg/L	45 mg/L	560	840	1100
TSS	30 mg/L	45 mg/L	560	840	1100

* Average dry weather design flow to the facility equals 2.25 MGD. Mass load limits based upon average dry weather design flow to the facility. Schedule C, Condition 1 requires the permittee to select the basis for calculating winter time (November 1 through April 30 each year) mass load limits. Upon review and approval of the engineering study to determine the design average wet weather flow, pursuant to OAR 340-41-120 (9), and upon request of the permittee, the Department intends to modify this permit and include revised mass load limits.

c.

Other parameters (year-round)	Limitations
E. coli Bacteria	Shall not exceed 126 organisms per 100 mL monthly geometric mean. No single sample shall exceed 406 organisms per 100 mL. (See Note 2)
pH	Shall be within the range of 6.0 - 9.0
BOD_5 and TSS Removal Efficiency	Shall not be less than 85% monthly average for BOD_5 and 85% monthly for TSS.
Temperature	Shall not exceed 77 °F (25°C)
Copper	Shall not exceed a daily maximum of 0.017 mg/L or a monthly average of 0.013 mg/L.
Cadmium	Shall not exceed a daily maximum of 0.00065 mg/L or a monthly average of 0.00042 mg/L.

85% removal = 25 mg/L @ Required winter flow ?! 8.3 MGD

d. Except as provided for in OAR 340-45-080, no wastes shall be discharged and no activities shall be conducted which violate Water Quality Standards as adopted in OAR 340-41-445 except in the following defined mixing zone:

The allowable mixing zone is that portion of the Willamette River within one hundred fifty (150) feet downstream from the point of discharge. The Zone of Immediate Dilution (ZID) shall be defined as that portion of the allowable mixing zone that is within fifteen (15) feet of the point of discharge.

e. Chlorine and chlorine compounds shall not be used as a disinfecting agent of the treated effluent and no chlorine residual shall be allowed in the discharged effluent due to chlorine used for maintenance purposes.

f. Temperature Management Plan (TMP): An evaluation indicates that the discharge will not cause a measurable increase in stream temperature. The permit incorporates portions of a TMP requiring monitoring to evaluate compliance with the effluent temperature limits. See Schedule D, Condition 9.

2. Reclaimed Water (Outfall 002):

a. No discharge to state waters is permitted. When used for irrigation, all reclaimed water shall be distributed on land for dissipation by evapotranspiration and controlled seepage by following sound irrigation practices so as to prevent:
   (1) Prolonged ponding of treated reclaimed water on the ground surface;
   (2) Surface runoff or subsurface drainage through drainage pipe;
   (3) The creation of odors, favorable conditions for fly and mosquito breeding or other nuisances;
   (4) The overloading of land with nutrients or other pollutant parameters; and
   (5) Impairment of existing or potential beneficial uses of groundwater.

b. Prior to any use of reclaimed water it shall receive at least Level IV treatment as defined in OAR 340-55 and meet the following limitations:

   Total coliform/ 100 mL shall not exceed a seven-day median of 2.2 with no samples exceeding 23 organisms/ 100 mL and Turbidity shall not exceed a 24-hour mean of 2 NTU or exceed 5 NTU for more than 5% of the 24-hour period.

3. Sewer system overflows (Outfalls 003, 004, 005, 006, 007 & 008):

a. Except as provided for in OAR 340-45-080, no wastes shall be discharged and no activities shall be conducted which violate water quality standards as adopted in OAR 340-41-445.

b. Raw sewage discharges are prohibited to waters of the State from November 1 through May 21, except during a storm event greater than the one-in-five-year, 24-hour duration storm, and from May 22 through October 31, except during a storm event greater than the one-in-ten-year, 24-hr duration storm.

? If an overflow occurs between May 21 and June 1, and if the permittee demonstrates to the Department's satisfaction that no increase in risk to beneficial uses occurred because of the overflow, no violation shall be triggered if the storm associated with the overflow was greater than the one-in-five-year, 24-hour duration storm.

4. Groundwater:

No activities shall be conducted that could cause an adverse impact on existing or potential beneficial uses of groundwater.

NOTES:

The $CBOD_5$ concentration limits are considered equivalent to the minimum design criteria for BOD_5 specified in Oregon Administrative Rules (OAR) 340-41. These limits and $CBOD_5$ mass limits may be adjusted (up or down) by permit action if more accurate information regarding $CBOD_5/BOD_5$ becomes available.

If a single sample exceeds 406 organisms per 100 mL, then five consecutive re-samples may be taken at four-hour intervals beginning within 28 hours after the original sample was taken. If the log mean of the five re-samples is less than or equal to 126 organisms per 100 mL, a violation shall not be triggered.

SCHEDULE B

Minimum Monitoring and Reporting Requirements (unless otherwise approved in writing by the Department). The permittee shall monitor the parameters as specified below at the locations indicated. The laboratory used by the permittee to analyze samples shall have a quality assurance/quality control (QA/QC) program to verify the accuracy of sample analysis. If QA/QC requirements are not met for any analysis, the results shall be included in the report, but not used in calculations required by this permit. When possible, the permittee shall re-sample in a timely manner for parameters failing the QA/QC requirements, analyze the samples, and report the results.

a. Influent

The facility influent sampling location is the following:
At headworks

Item or Parameter	Minimum Frequency	Type of Sample
Total Flow (MGD)	Daily	Measurement
Flow Meter Calibration	Semi-Annual	Verification
BOD_5	2/Week	Composite
TSS	2/Week	Composite
pH	3/Week	Grab
Toxics:		
Metals (Ag, As, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Se, Zn) & Cyanide, measured as total is mg/L (See Note 1)	Semi-annually using 3 consecutive days between Monday and Friday, inclusive	24-hour daily composite (See Note 2)

b. Treated Effluent Outfall 001

The facility effluent sampling location is the following:

Discharge from UV disinfection

Item or Parameter	Minimum Frequency	Type of Sample
Total Flow (MGD)	Daily	Measurement
Flow Meter Calibration	Semi-Annual	Verification
BOD_5	2/Week - Winter	Composite
$CBOD_5$	2/Week - Summer	Composite
TSS	2/Week	Composite
pH	3/Week	Grab
Temperature	3/Week	Record
E. coli	2/Week	Grab (See Note 4)
UV Radiation Intensity	Daily	Reading (See Note 5)
Pounds Discharged (BOD_5 and TSS)	2/Week	Calculation
Average Percent Removed (BOD_5 and TSS)	Monthly	Calculation
Ammonia (NH3-N)	2/Week-Summer	Composite
Toxics:		
Metals (Ag, As, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Se, Zn) & Cyanide, measured as total in mg/l (See Note 1)	Semi-annually using 3 consecutive days between Monday and Friday, inclusive	24-hour daily composite (See Note 2)
Bioassay (See Note 3)	Quarterly	Acute & chronic

c. Biosolids Management

Item or Parameter	Minimum Frequency	Type of Sample
Biosolids analysis including: Total Solids (% dry wt.) Volatile solids (% dry wt.) Biosolids nitrogen for: NH_3-N; NO_3-N; & TKN (% dry wt.) Phosphorus (% dry wt.) Potassium (% dry wt.) pH (standard units)	Annually	Composite sample to be representative of the product to be land applied from the Digester withdrawal line (See Note 6)
Biosolids metals content for: Ag, As, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Se & Zn, measured as total in mg/kg	Semi-Annually	Composite sample to be representative of the product to be land applied from the Digester withdrawal line (See Note 6)
Record of locations where biosolids are applied on each DEQ approved site. (Site location maps to be maintained at treatment facility for review upon request by DEQ)	Each Occurrence	Date, volume & locations where biosolids were applied recorded on site location map.
Record of % volatile solids reduction accomplished through stabilization	Monthly	Calculation (See Note 7)
Record of digestion days (mean cell residence time)	Monthly	Calculation (See Note 8)
Daily Minimum Sludge Temperature	Daily	Record

d. Reclaimed Wastewater Outfall 002

Item or Parameter	Minimum Frequency	Type of Sample
Quantity Irrigated (inches/acre)	Daily	Measurement
Flow Meter Calibration	Annually	Verification
UV Radiation Intensity	Daily	Reading (See Note 5)
pH	2/Week	Grab
Total Coliform	Daily	Grab
Turbidity	Hourly	Reading
Nutrients (TKN, NO_2+NO_3-N, NH_3, Total Phosphorus)	Quarterly	Grab

e. Willamette River (See Note 9)

Item or Parameter	Minimum Frequency	Type of Sample
Temperature (upstream)	2/week	Measurement
Temperature (downstream)	2/week	Measurement

2. Reporting Procedures

a. Monitoring results shall be reported on approved forms. The reporting period is the calendar month. Reports must be submitted to the Department's Northwest Region - Portland office by the 15th day of the following month.

b. State monitoring reports shall identify the name, certificate classification and grade level of each principal operator designated by the permittee as responsible for supervising the wastewater collection and treatment systems during the reporting period. Monitoring reports shall also identify each system classification as found on page one of this permit.

c. Monitoring reports shall also include a record of the quantity and method of use of all sludge removed from the treatment facility and a record of all applicable equipment breakdowns and bypassing.

3. Report Submittals

a. The permittee shall have in place a program to identify and reduce inflow and infiltration into the sewage collection system. An annual report shall be submitted to the Department by February 1 each year, which details sewer collection maintenance activities that reduce inflow and infiltration. The report shall state those activities that have been done in the previous year and those activities planned for the following year.

b. For any year in which biosolids are land applied, a report shall be submitted to the Department by February 19 of the following year that describes solids handling activities for the previous year and includes, but is not limited to, the required information outlined in OAR 340-50-035(6)(a)-(e).

c. By no later than January 15 of each year, the permittee shall submit to the Department an annual report describing the effectiveness of the reclaimed water system to comply with approved reclaimed water use plan, the rules of Division 55, and the limitations and conditions of this permit applicable to reuse of reclaimed water.

NOTES:

- For influent and effluent cyanide samples, at least six (6) discrete grab samples shall be collected over the operating day. Each aliquot shall not be less than 100 mL and shall be collected and composited into a larger container which has been preserved with sodium hydroxide for cyanide samples to insure sample integrity.

- Daily 24-hour composite samples shall be analyzed and reported separately. Toxic monitoring results and toxics removal efficiency calculations shall be tabulated and submitted with the Pretreatment Program Annual Report as required in Schedule E. Submittal of toxic monitoring results with the monthly Discharge Monitoring Report is not required.

- Beginning no later than January 1, 2001, the permittee shall conduct bioassay testing for a period of one (1) year in accordance with the frequency specified above. If the bioassay tests show that the effluent samples are not toxic at the dilutions determined to occur at the Zone of Immediate Dilution and the Mixing Zone, no further bioassay testing will be required during this permit cycle. Note that bioassay test results will be required along with the next NPDES permit renewal application. All bioassay reports shall include an evaluation of the teratogenicity of the effluent.

E. coli monitoring must be conducted according to any of the following test procedures as specified in Standard Methods for the Examination of Water and Wastewater, 19th Edition, or according to any test procedure that has been authorized and approved in writing by the Director or his authorized representative:

Method	Reference	Page	Method Number
mTEC agar, MF	Standard Methods, 19th Edition	9-28	9213 D
NA-MUG, MF	Standard Methods, 19th Edition	9-63	9222 G
Chromogenic Substrate, MPN	Standard Methods, 19th Edition	9-65	9223 B
Colilert QT	Idexx Laboratories, Inc.		

The intensity of UV radiation passing through the water column will affect the systems ability to kill organisms. To track the reduction in intensity, the UV disinfection system must include a UV intensity meter with a sensor located in the water column at a specified distance from the UV bulbs. This meter will measure the intensity of UV radiation in mWatts-seconds/cm2. The daily UV radiation intensity shall be determined by reading the meter each day. If more than one meter is used, the daily recording will be an average of all meter readings each day.

Composite samples from the digester withdrawal line shall consist of at least 4 aliquots of equal volume collected over an 8-hour period and combined.

Inorganic pollutant monitoring must be conducted according to Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Second Edition (1982) with Updates I and II and third Edition (1986) with Revision I.

Calculation of the % volatile solids reduction is to be based on comparison of a representative grab sample of total and volatile solids entering each digester (a weighted blend of the primary and secondary clarifier solids) and a representative composite sample of solids exiting each digester withdrawal line (as defined in note 6 above).

The days of digestion shall be calculated by dividing the effective digester volume by the average daily volume of sludge production.

Willamette River temperature shall be obtained upstream from the outfall location. The downstream Willamette River temperature shall be taken at the edge of the mixing zone and from within the effluent plume. In stream monitoring is only required from May through October. All measurements shall be instantaneous values measured within a one (1) hour period.

SCHEDULE C

Compliance Schedules and Conditions

1. By no later than 12 months after permit issuance, the permittee shall submit either an engineering evaluation which demonstrates the design average wet weather flow, or a request to retain the existing mass load limits. The design average wet weather flow is defined as the average flow between November 1 and April 30 when the sewage treatment facility is projected to be at design capacity for that portion of the year. Upon acceptance by the Department of the design average wet weather flow determination, the permittee may request a permit modification to include higher winter mass loads based on the design average wet weather flow.

2. Within 180 days of permit modification to include higher winter mass load limits as specified in Condition 1 of this Schedule, the permittee shall submit to the Department for review and approval a proposed program and time schedule for identifying and reducing inflow. Within 60 days of receiving written Department comments, the permittee shall submit a final approvable program and time schedule. The program shall consist of the following:

   a. Identification of all overflow points and verification that sewer system overflows are not occurring up to a 24-hour, 5-year storm event or equivalent;

   b. Monitoring of all pump station overflow points;

   c. A program for identifying and removing all inflow sources into the permittee's sewer system over which the permittee has legal control; and

   d. If the permittee does not have the necessary legal authority for all portions of the sewer system or treatment facility, a program and schedule for gaining legal authority to require inflow reduction and a program and schedule for removing inflow sources.

3. Within 24 months of permit issuance, the permittee shall complete a dilution/mixing zone study to establish effluent concentrations found at the edge of the mixing zone and the zone of initial dilution. The study shall include an analysis of the mixing zone with regard to critical salmon habitat.

4. The permittee is expected to meet the compliance dates which have been established in this schedule. Either prior to or no later than 14 days following any lapsed compliance date, the permittee shall submit to the Department a notice of compliance or noncompliance with the established schedule. The Director may revise a schedule of compliance if he determines good and valid cause resulting from events over which the permittee has little or no control.

SCHEDULE D

Special Conditions

Temp @ Water plant?

1. Prior to increasing thermal load from the facility (design flow or temperature), the Permittee shall notify the Department in writing and obtain necessary approval. *

2. All biosolids shall be managed in accordance with the current, DEQ approved biosolids management plan, and the site authorization letters issued by the DEQ. Any changes in solids management activities that significantly differ from operations specified under the approved plan require the prior written approval of the DEQ.

   All new biosolids application sites shall meet the site selection criteria set forth in OAR 340-50-0070 and must be located within Clackamas and Marion counties. All currently approved sites are located in Clackamas and Marion counties. No new public notice is required for the continued use of these currently approved sites. Property owners adjacent to any newly approved application sites shall be notified, in writing or by any method approved by DEQ, of the proposed activity prior to the start of application. For proposed new application sites that are deemed by the DEQ to be sensitive with respect to residential housing, runoff potential or threat to groundwater, an opportunity for public comment shall be provided in accordance with OAR 340-50-0030.

3. This permit may be modified to incorporate any applicable standard for biosolids use or disposal promulgated under section 405(d) of the Clean Water Act, if the standard for biosolids use or disposal is more stringent than any requirements for biosolids use or disposal in the permit, or controls a pollutant or practice not limited in this permit.

4. Whole Effluent Toxicity Testing

   a. The permittee shall conduct whole effluent toxicity tests as specified in Schedule B of this permit.

   b. Bioassay tests may be dual end-point tests only for the fish tests, in which both acute and chronic end-points can be determined from the results of a single chronic test (the acute end-point shall be based upon a 48-hour time period).

   c. Acute Toxicity Testing - Organisms and Protocols

      (1) The permittee shall conduct 48-hour static renewal tests with the Ceriodaphnia dubia (water flea) and the Pimephales promelas (fathead minnow).

      (2) The presence of acute toxicity will be determined as specified in **Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, Fourth Edition, EPA/600/4-90/027F, August 1993.**

      (3) An acute bioassay test shall be considered to show toxicity if there is a statistically significant difference in survival between the control and 100 percent effluent, unless the permit specifically provides for a Zone of Immediate Dilution (ZID) for biotoxicity. If the permit specifies such a ZID, acute toxicity shall be indicated when a statistically significant difference in survival occurs at dilutions greater than that which is found to occur at the edge of the ZID. Req'd by Schedule

   d. Chronic Toxicity Testing - Organisms and Protocols

      (1) The permittee shall conduct tests with: *Ceriodaphnia dubia* (water flea) for reproduction and survival test endpoint, *Pimephales promelas* (fathead minnow) for growth and survival test

endpoint, and *Raphidocelis subcapitata*(green alga formerly known as *Selanastrum capricornutum*) for growth test endpoint.

(2) The presence of chronic toxicity shall be estimated as specified in Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, Third Edition, EPA/600/4-91/002, July 1994.

(3) A chronic bioassay test shall be considered to show toxicity if a statistically significant difference in survival, growth, or reproduction occurs at dilutions greater than that which is known to occur at the edge of the mixing zone. If there is no dilution data for the edge of the mixing zone, any chronic bioassay test that shows a statistically significant effect in 100 percent effluent as compared to the control shall be considered to show toxicity.

e. Quality Assurance

(1) Quality assurance criteria, statistical analyses and data reporting for the bioassays shall be in accordance with the EPA documents stated in this condition and the Department's Whole Effluent Toxicity Testing Guidance Document, January 1993.

f. Evaluation of Causes and Exceedances

(1) If toxicity is shown, as defined in sections c.(3) or d.(3) of this permit condition, another toxicity test using the same species and Department approved methodology shall be conducted within two weeks, unless otherwise approved by the Department. If the second test also indicates toxicity, the permittee shall follow the procedure described in section f.(2) of this permit condition.

(2) If two consecutive bioassay test results indicate acute and/or chronic toxicity, as defined in sections c.(3) or d.(3) of this permit condition, the permittee shall evaluate the source of the toxicity and submit a plan and time schedule for demonstrating compliance with water quality standards. Upon approval by the Department, the permittee shall implement the plan until compliance has been achieved. Evaluations shall be completed and plans submitted to the Department within 6 months unless otherwise approved in writing by the Department.

g. Reporting

Along with the test results, the permittee shall include the dates of sample collection and initiation of each toxicity test and the flow rate at the time of sample collection. Effluent at the time of sampling for bioassay testing should include split samples of required parameters stated under Schedule B, condition 1. of this permit.

h. Reopener

If bioassay testing indicates acute and/or chronic toxicity, the Department may reopen and modify this permit to include new limitations and/or conditions as determined by the Department to be appropriate, and in accordance with procedures outlined in Oregon Administrative Rules, Chapter 340, Division 45.

A priority pollutant scan shall be performed at least once during the term of this permit and must be submitted to the Department as part of the Permittee's NPDES permit renewal application. The permittee shall perform chemical analysis of its influent, effluent and biosolids to be beneficially used for the specific toxic pollutants listed in Tables endpoint, and *Raphidocelis subcapitata*(green alga formerly known as *Selenastrum capricornutum*) for growth test endpoint.

(2) The presence of chronic toxicity shall be estimated as specified in Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, Third Edition, EPA/600/4-91/002, July 1994.

(3) A chronic bioassay test shall be considered to show toxicity if a statistically significant difference in survival, growth, or reproduction occurs at dilutions greater than that which is known to occur at the edge of the mixing zone. If there is no dilution data for the edge of the mixing zone, any chronic bioassay test that shows a statistically significant effect in 100 percent effluent as compared to the control shall be considered to show toxicity.

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Along with the test results, the permittee shall include the dates of sample collection and initiation of each toxicity test and the flow rate at the time of sample collection. Effluent at the time of sampling for bioassay testing should include split samples of required parameters stated under Schedule B, condition 1. of this permit.

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A priority pollutant scan shall be performed at least once during the term of this permit and must be submitted to the Department as part of the Permittee's NPDES permit renewal application. The permittee shall perform chemical analysis of its influent, effluent and biosolids to be beneficially used for the specific toxic pollutants listed in Tables

II and III of Appendix D of 40 CFR Part 122. The influent and effluent samples shall be 24-hour daily composites, except where sampling volatile compounds. In this case, six (6) discrete samples (not less than 100 mL) collected over the operating day are acceptable. The permittee shall take special precautions in compositing the individual grab samples for the volatile organics to insure sample integrity (i.e. no exposure to the outside air). Alternately, the discrete samples collected for volatiles may be analyzed separately and averaged. For biosolids analyses, a composite of weekly grab samples for the final product shall be used.

6. The permittee shall meet the requirements for use of reclaimed water under Division 55, including the following:

a. All reclaimed water shall be managed in accordance with the approved Reclaimed Water Use Plan. No substantial changes shall be made in the approved plan without written approval of the Department.

b. No reclaimed water shall be released by the permittee to another person, as defined in Oregon Revised Statute (ORS) 468.005, for use unless there is a valid contract between the permittee and that person that meets the requirements of OAR 340-55-015(9).

c. The permittee shall notify the Department within 24 hours if it is determined that the treated effluent is being used in a manner not in compliance with OAR 340-55. When the Department offices are not open, the permittee shall report the incident of noncompliance to the Oregon Emergency Response System (Telephone Number 1-800-452-0311).

d. No reclaimed water shall be made available to a person proposing to recycle unless that person certifies in writing that they have read and understand the provisions in these rules. This written certification shall be kept on file by the sewage treatment system owner and be made available to the Department for inspection.

7. Unless otherwise approved in writing by the Department, a deep-rooted, permanent grass cover shall be maintained on the land irrigation area at all times. Grass shall be periodically cut and removed to ensure maximum evapotranspiration and nutrient capture.

8. The permittee shall comply with Oregon Administrative Rules (OAR), Chapter 340, Division 49, "Regulations Pertaining To Certification of Wastewater System Operator Personnel" and accordingly:

a. The permittee shall have its wastewater system supervised by one or more operators who are certified in a classification and grade level (equal to or greater) that corresponds with the classification (collection and/or treatment) of the system to be supervised as specified on page one of this permit.

Note: **A "supervisor" is defined as the person exercising authority for establishing and executing the specific practice and procedures of operating the system in accordance with the policies of the permittee and requirements of the waste discharge permit. "Supervise" means responsible for the technical operation of a system, which may affect its performance or the quality of the effluent produced. Supervisors are not required to be on-site at all times.**

b. The permittee's wastewater system may not be without supervision (as required by Special Condition 8.a. above) for more than thirty (30) days. During this period, and at any time that the supervisor is not available to respond on-site (i.e. vacation, sick leave or off-call), the permittee must make available another person who is certified at no less than one grade lower then the system classification.

c. If the wastewater system has more than one daily shift, the permittee shall have the shift supervisor, if any, certified at no less than one grade lower than the system classification.

d. The permittee is responsible for ensuring the wastewater system has a properly certified supervisor available at all times to respond on-site at the request of the permittee and to any other operator.

e. The permittee shall notify the Department of Environmental Quality in writing within thirty (30) days of replacement or redesignation of certified operators responsible for supervising wastewater system operation. The notice shall be filed with the Water Quality Division, Operator Certification Program, 811

SW 6th Ave., Portland, OR 97204. This requirement is in addition to the reporting requirements contained under Schedule B of this permit.

f. Upon written request, the Department may grant the permittee reasonable time, not to exceed 120 days, to obtain the services of a qualified person to supervise the wastewater system. The written request must include justification for the time needed, a schedule for recruiting and hiring, the date the system supervisor availability ceased and the name of the alternate system supervisor(s) as required by 8.b. above.

9. The permit for this facility includes monitoring requirements for effluent temperature and stream temperature. The Department will evaluate the information gathered during the permit cycle to determine whether the facility needs to develop and implement a temperature reduction component for their temperature management plan. The Department may modify the permit sooner and require the development and implementation of a temperature management plan if the information collected by the permittee indicates the discharge is having a measurable increase in temperature or otherwise potentially impairing use as described in OAR 340-41-442.

10. The permittee shall notify the DEQ Northwest Region - Portland Office (phone: (503) 229-5263) in accordance with the response times noted in the General Conditions of this permit, of any malfunction so that corrective action can be coordinated between the permittee and the Department.

equipment downtime. This condition is not satisfied if adequate backup equipment should have been installed in the exercise of reasonable engineering judgement to prevent a bypass which occurred during normal periods of equipment downtime or preventative maintenance; and

(c) The permittee submitted notices and requests as required under General Condition B.3.c.

(2) The Director may approve an anticipated bypass, after considering its adverse effects and any alternatives to bypassing, when the Director determines that it will meet the three conditions listed above in General Condition B.3.b.(1).

c. Notice and request for bypass.

(1) Anticipated bypass. If the permittee knows in advance of the need for a bypass, it shall submit prior written notice, if possible at least ten days before the date of the bypass.

(2) Unanticipated bypass. The permittee shall submit notice of an unanticipated bypass as required in General Condition D.5.

4. Upset

a. Definition. "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operation error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventative maintenance, or careless or improper operation.

b. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology based permit effluent limitations if the requirements of General Condition B.4.c are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

c. Conditions necessary for a demonstration of upset. A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

(1) An upset occurred and that the permittee can identify the causes(s) of the upset;

(2) The permitted facility was at the time being properly operated;

(3) The permittee submitted notice of the upset as required in General Condition D.5, hereof (24-hour notice); and

(4) The permittee complied with any remedial measures required under General Condition A.3 hereof.

d. Burden of proof. In any enforcement proceeding the permittee seeking to establish the occurrence of an upset has the burden of proof.

Treatment of Single Operational Event

For purposes of this permit, A Single Operational Event which leads to simultaneous violations of more than one pollutant parameter shall be treated as a single violation. A single operational event is an exceptional incident which causes simultaneous, unintentional, unknowing (not the result of a knowing act or omission), temporary noncompliance with more than one Clean Water Act effluent discharge pollutant parameter. A single operational event does not include Clean Water Act violations involving discharge without a NPDES permit or noncompliance to the extent caused by improperly designed or inadequate treatment facilities. Each day of a single operational event is a violation.

6. Overflows from Wastewater Conveyance Systems and Associated Pump Stations

a. Definitions

(1) "Overflow" means the diversion and discharge of waste streams from any portion of the wastewater conveyance system including pump stations, through a designed overflow device or structure, other than discharges to the wastewater treatment facility.

(2) "Severe property damage" means substantial physical damage to property, damage to the conveyance system or pump station which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of an overflow.

(3) "Uncontrolled overflow" means the diversion of waste streams other than through a designed overflow device or structure, for example to overflowing manholes or overflowing into residences, commercial establishments, or industries that may be connected to a conveyance system.

b. Prohibition of overflows. Overflows are prohibited unless:

(1) Overflows were unavoidable to prevent an uncontrolled overflow, loss of life, personal injury, or severe property damage;

(2) There were no feasible alternatives to the overflows, such as the use of auxiliary pumping or conveyance systems, or maximization of conveyance system storage; and

(3) The overflows are the result of an upset as defined in General Condition B.4. and meeting all requirements of this condition.

c. Uncontrolled overflows are prohibited where wastewater is likely to escape or be carried into the waters of the State by any means.

d. Reporting required. Unless otherwise specified in writing by the Department, all overflows and uncontrolled overflows must be reported orally to the Department within 24 hours from the time the permittee becomes aware of the overflow. Reporting procedures are described in more detail in General Condition D.5.

7. Public Notification of Effluent Violation or Overflow

If effluent limitations specified in this permit are exceeded or an overflow occurs, upon request by the Department, the permittee shall take such steps as are necessary to alert the public about the extent and nature of the discharge. Such steps may include, but are not limited to, posting of the river at access points and other places, news releases, and paid announcements on radio and television.

8. Removed Substances

Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall be disposed of in such a manner as to prevent any pollutant from such materials from entering public waters, causing nuisance conditions, or creating a public health hazard.

SECTION C. MONITORING AND RECORDS

Representative Sampling

Sampling and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge. All samples shall be taken at the monitoring points specified in this permit and shall be taken, unless otherwise specified, before the effluent joins or is diluted by any other waste stream, body of water, or substance. Monitoring points shall not be changed without notification to and the approval of the Director.

Flow Measurements

Appropriate flow measurement devices and methods consistent with accepted scientific practices shall be selected and used to ensure the accuracy and reliability of measurements of the volume of monitored discharges. The devices shall be installed, calibrated and maintained to insure that the accuracy of the measurements is consistent with the accepted capability of that type of device. Devices selected shall be capable of measuring flows with a maximum deviation of less than ± 10 percent from true discharge rates throughout the range of expected discharge volumes.

Monitoring Procedures

Monitoring must be conducted according to test procedures approved under 40 CFR Part 136, unless other test procedures have been specified in this permit.

Penalties of Tampering

The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate, any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than two years, or by both. If a conviction of a person is for a violation committed after a first conviction of such person, punishment is a fine not more than $20,000 per day of violation, or by imprisonment of not more than four years or both.

Reporting of Monitoring Results

Monitoring results shall be summarized each month on a Discharge Monitoring Report form approved by the Department. The reports shall be submitted monthly and are to be mailed, delivered or otherwise transmitted by the 15th day of the following month unless specifically approved otherwise in Schedule B of this permit.

Additional Monitoring by the Permittee

If the permittee monitors any pollutant more frequently than required by this permit, using test procedures approved under 40 CFR 136 or as specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the Discharge Monitoring Report. Such increased frequency shall also be indicated. For a pollutant parameter that may be sampled more than once per day (e.g., Total Chlorine Residual), only the average daily value shall be recorded unless otherwise specified in this permit.

Averaging of Measurements

Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean, except for bacteria which shall be averaged as specified in this permit.

Retention of Records

Except for records of monitoring information required by this permit related to the permittee's sewage sludge use and disposal activities, which shall be retained for a period of at least five years (or longer as required by 40 CFR part 503), the permittee shall retain records of all monitoring information, including all calibration and maintenance records of all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of the sample, measurement, report or application. This period may be extended by request of the Director at any time.

9. Records Contents

Records of monitoring information shall include:

a. The date, exact place, time and methods of sampling or measurements;

b. The individual(s) who performed the sampling or measurements;

c. The date(s) analyses were performed;

d. The individual(s) who performed the analyses;

e. The analytical techniques or methods used; and

f. The results of such analyses.

10. Inspection and Entry

The permittee shall allow the Director, or an authorized representative upon the presentation of credentials to:

a. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;

b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

c. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit, and

d. Sample or monitor at reasonable times, for the purpose of assuring permit compliance or as otherwise authorized by state law, any substances or parameters at any location.

ECTION D. REPORTING REQUIREMENTS

. Planned Changes

The permittee shall comply with Oregon Administrative Rules (OAR) 340, Division 52, "Review of Plans and Specifications". Except where exempted under OAR 340-52, no construction, installation, or modification involving disposal systems, treatment works, sewerage systems, or common sewers shall be commenced until the plans and specifications are submitted to and approved by the Department. The permittee shall give notice to the Department as soon as possible of any planned physical alternations or additions to the permitted facility.

Anticipated Noncompliance

The permittee shall give advance notice to the Director of any planned changes in the permitted facility or activity that may result in noncompliance with permit requirements.

Transfers

This permit may be transferred to a new permittee provided the transferee acquires a property interest in the permitted activity and agrees in writing to fully comply with all the terms and conditions of the permit and the rules of the Commission. No permit shall be transferred to a third party without prior written approval from the Director. The permittee shall notify the Department when a transfer of property interest takes place.

t. Compliance Schedule

Reports of compliance or noncompliance with, or any progress reports on interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each schedule date. Any reports of noncompliance shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirements.

i. Twenty-Four Hour Reporting

The permittee shall report any noncompliance that may endanger health or the environment. Any information shall be provided orally (by telephone) within 24 hours, unless otherwise specified in this permit, from the time the permittee becomes aware of the circumstances. During normal business hours, the Department's Regional office shall be called. Outside of normal business hours, the Department shall be contacted at 1-800-452-0311 (Oregon Emergency Response System).

A written submission shall also be provided within 5 days of the time the permittee becomes aware of the circumstances. If the permittee is establishing an affirmative defense of upset or bypass to any offense under ORS 468.922 to 468.946, and in which case if the original reporting notice was oral, delivered written notice must be made to the Department or other agency with regulatory jurisdiction within 4 (four) calendar days. The written submission shall contain:

a. A description of the noncompliance and its cause;

b. The period of noncompliance, including exact dates and times;

c. The estimated time noncompliance is expected to continue if it has not been corrected;

d. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance; and

e. Public notification steps taken, pursuant to General Condition B.7.

The following shall be included as information that must be reported within 24 hours under this paragraph:

a. Any unanticipated bypass which exceeds any effluent limitation in this permit.

b. Any upset which exceeds any effluent limitation in this permit.

c. Violation of maximum daily discharge limitation for any of the pollutants listed by the Director in this permit.

The Department may waive the written report on a case-by-case basis if the oral report has been received within 24 hours.

Other Noncompliance

The permittee shall report all instances of noncompliance not reported under General Condition D.4 or D.5, at the time monitoring reports are submitted. The reports shall contain:

a. A description of the noncompliance and its cause;

b. The period of noncompliance, including exact dates and times;

c. The estimated time noncompliance is expected to continue if it has not been corrected; and

d. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

7. Duty to Provide Information

The permittee shall furnish to the Department, within a reasonable time, any information that the Department may request to determine compliance with this permit. The permittee shall also furnish to the Department, upon request, copies of records required to be kept by this permit.

Other Information: When the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or any report to the Department, it shall promptly submit such facts or information.

. Signatory Requirements

All applications, reports or information submitted to the Department shall be signed and certified in accordance with 40 CFR 122.22.

. Falsification of Information

A person who supplies the Department with false information, or omits material or required information, as specified in ORS 468.953 is subject to criminal prosecution.

0. Changes to Indirect Dischargers - **[Applicable to Publicly Owned Treatment Works (POTW) only]**

The permittee must provide adequate notice to the Department of the following:

a. Any new introduction of pollutants into the POTW from an indirect discharger which would be subject to section 301 or 306 of the Clean Water Act if it were directly discharging those pollutants and:

b. Any substantial change in the volume or character of pollutants being introduced into the POTW by a source introducing pollutants into the POTW at the time of issuance of the permit.

c. For the purposes of this paragraph, adequate notice shall include information on (i) the quality and quantity of effluent introduced into the POTW, and (ii) any anticipated impact of the change on the quantity or quality of effluent to be discharged from the POTW.

1. Changes to Discharges of Toxic Pollutant - **[Applicable to existing manufacturing, commercial, mining, and silvicultural dischargers only]**

The permittee must notify the Department as soon as they know or have reason to believe of the following:

a. That any activity has occurred or will occur which would result in the discharge, on a routine or frequent basis, of any toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels:

(1) One hundred micrograms per liter (100 μg/L);

(2) Two hundred micrograms per liter (200 μg/L) for acrolein and acrylonitrile; five hundred micrograms per liter (500 μg/L) for 2,4-dinitrophenol and for 2-methyl-4,6-dinitrophenol; and one milligram per liter (1 mg/L) for antimony;

(3) Five (5) times the maximum concentration value reported for that pollutant in the permit application in accordance with 40 CFR 122.21(g)(7); or

(4) The level established by the Department in accordance with 40 CFR 122.44(f).

b. That any activity has occurred or will occur which would result in any discharge, on a non-routine or infrequent basis, of a toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

(1) Five hundred micrograms per liter (500 µg/L);

(2) One milligram per liter (1 mg/L) for antimony;

(3) Ten (10) times the maximum concentration value reported for that pollutant in the permit application in accordance with 40 CFR 122.21(g)(7); or

(4) The level established by the Department in accordance with 40 CFR 122.44(f).

SECTION E. DEFINITIONS

1. BOD means five-day biochemical oxygen demand.
2. TSS means total suspended solids.
3. mg/L means milligrams per liter.
4. kg means kilograms.
5. m^3/d means cubic meters per day.
6. MGD means million gallons per day.
7. Composite sample means a sample formed by collecting and mixing discrete samples taken periodically and based on time or flow.
8. FC means fecal coliform bacteria.
9. Technology based permit effluent limitations means technology-based treatment requirements as defined in 40 CFR 125.3, and concentration and mass load effluent limitations that are based on minimum design criteria specified in OAR 340-41.
10. CBOD means five day carbonaceous biochemical oxygen demand.
11. Grab sample means an individual discrete sample collected over a period of time not to exceed 15 minutes.
12. Quarter means January through March, April through June, July through September, or October through December.
13. Month means calendar month.
14. Week means a calendar week of Sunday through Saturday.
15. Total residual chlorine means combined chlorine forms plus free residual chlorine.
16. The term "bacteria" includes but is not limited to fecal coliform bacteria, total coliform bacteria, and E. coli bacteria.
17. POTW means a publicly owned treatment works.

Exhibit C to Ord. 571

STAFF REPORT
WILSONVILLE CITY COUNCIL
Wilsonville Engineering Division

HEARING DATE:	August 16, 2004
DATE OF REPORT:	August 9, 2004
APPLICATION NO.:	02PC05
REQUEST:	Update the Wastewater Facility Plan, April 1995, to plan and provide for adequate wastewater facilities for the City of Wilsonville.
APPLICANT:	City of Wilsonville
CRITERIA:	Statewide Planning Goals #6 and #11; Wilsonville Comprehensive Plan: Public Facilities & Services Policy 3.1.1. and 3.1.4; Wilsonville Code Sections 4.000-4.033, and 4.198
STAFF REVIEWER:	Eldon Johansen, Community Development Director; Mike Stone, City Engineer; Laurel Byer, Assistant City Engineer.

DESCRIPTION OF ACTION:
First reading for adoption of Ordinance No. 571, would adopt the Wastewater Facility Plan Update (November 2002).

BACKGROUND/SUMMARY OF ISSUES:
The City of Wilsonville Planning Commission held a duly advertised public hearing on November 12, 2003 and adopted Resolution No. 02PC05 which recommends that the City Council adopt the Wastewater Facility Plan Update. At the public hearing, the Planning Commission moved to "Include in the Wastewater Facility Plan Update a trigger for review of the Plan prior to Phase 2 of development and to look at alternatives at appropriate times in the development." This motion stemmed from the Planning Commission's desire to have staff investigate other modes of biosolids handling, including incineration, as well as other less traditional treatment processes. Additional analysis information was included in the staff reports for the Planning Commission public hearing. The original staff report dated October 8, 2003 and addendum, dated November 5, 2003 are attached to this staff report and are contained in the Wastewater Facilities Plan Planning Commission Record for case file 02PC05. The minutes from the November 12, 2003 Planning Commission Public Hearing are included in that record.

Attached to Ordinance No. 571 is a Capital Improvements Projects List (Exhibit B) that spans over three phases. The third phase was included to account for the long-term needs of the facility and determine if the existing site would be able to accommodate the City's needs past 2020. Since these costs are beyond our immediate and short-term needs, they will not be included in the Sanitary Sewer System Development Charge calculations.

The first priority project that staff is currently working on is improving biosolids handling at the plant. The existing sludge storage tanks have a limited capacity, so in order to allow for more storage, the digested biosolids must be dewatered. To date, Staff has pilot tested two options for dewatering, including a belt filter press and a centrifuge. While one of these products may allow for more on-site storage, it will not address the issue of dwindling land application sites for our current Class 'B' program. Therefore, staff is very interested in pursuing the option of treating and dewatering the sludge to the point that produces a Class 'A' biosolid. As stated in the Wastewater Facility Plan Update, Class 'A' biosolids do not have the same strict regulations that a Class 'B' product does and can be applied in more locations. It was also indicated in the report, that more than likely, the City may be required to produce Class 'A' biosolids on a regular basis in the near future. Staff believes that it would be most economical to address the Class 'B' restrictions at this time, since we are currently planning a dewatering facility for the site. Approaching the project in this manner will require that the Capital Improvement Plan, as outlined in the Wastewater Facility Plan Update, be modified slightly. An updated Table 7-2, which shows the acceleration of a portion of the Solids Stabilization projects from Phase 2 to Phase 1, is included as Exhibit "B" to the Ordinance.

CONCLUSIONARY & SUMMARY FINDINGS:

The findings that were outlined in the original Staff Report for the October 8, 2003 Planning Commission public hearing are still applicable and have not changed.

STAFF RECOMMENDATION:

Based on the Findings of Fact and information included in the Staff Report dated August 9, 2004; and based on information received from a duly advertised public hearing, Staff recommends that the City Council approve the first reading of Ordinance No. 571 which adopts the Wastewater Facility Plan Update and set the date for the second reading of Ordinance No. 571 for August 30, 2004.

EXHIBITS:

A. Draft Ordinance No. 571
B. Planning Commission Record containing:
    1) City of Wilsonville Staff Report to the Planning Commission, October 8, 2003.
    2) City of Wilsonville Staff Report Addendum to the Planning Commission, November 5, 2003.
    3) Minutes from the November 12, 2003 Planning Commission Public Hearing.

02PC05

Wastewater Facilities Plan

Planning Commission Record Index

02PC05
Wastewater Facilities Plan
Planning Commission Record Index

Planning Commission actions at the November 12, 2003 meeting:

- Notice of Decision – Planning Commission Recommendation to City Council
- 02PC05 Resolution
- Motions
- Adopted Minutes

Distributed at the November 12, 2003 Planning Commission Meeting:

Exhibit 10: A flow chart showing the different steps of Wastewater Facility's Current Operation, Drying Alternative and Incineration Alternative.
Exhibit 9: An email dated November 10, 2003, from Commissioner Hinds.

Staff Report Addendum dated November 5, 2003, for the November 12, 2003 Planning Commission meeting with attached:

Exhibit 5: Additional Biosolids Treatment Alternatives - Incineration Technical Memorandum, HDR Engineering, Inc., November 2003.
Exhibit 6: Memorandum from HDR Engineering, Inc. addressing initial Planning Commission questions, November 2003.
Exhibit 7: An article regarding Living Machines submitted by Debra Iguchi.
Exhibit 8: An article, "Scientists Question Safety of Sludge," from the Sunday, October 12, 2003 edition of The Oregonian, submitted by Debra Iguchi.

Staff Report dated October 1, 2003 for an October 8, 2003 Planning Commission meeting with attached:

Exhibit 1: Draft Resolution No. 02PC05
Exhibit 2: DRAFT Wastewater Facility Plan Update, November 2002
Exhibit 3: Additional Biosolids Treatment Alternatives Technical Memorandum, HDR Engineering, Inc., October 2003.
Exhibit 4: Background information on Facility Plan Update process.

a. A memorandum dated November 7, 2002, from Eldon Johansen, regarding Draft Wastewater Treatment Plant Facilities Plan.
b. HDR Engineering, Inc. Slideshow Presentation from January 8, 2003.
c. Adopted minutes of the January 8, 2003, Planning Commission Work Session for 02PC05.

The following is located in the Project File located in the Planning Division:
Affidavits of posting and mailing dated September 18, 2003.

DLCD Notice of Proposed Amendment, dated July 26, 2002 with attached:

- Public Hearing Notice (for a September 11, 2002 meeting which did not happen)
- List of affected agencies
- Executive Summary of the Wilsonville Wastewater Facilities Plan, dated July 23, 2002.

Planning Commission Actions

at the

November 12, 2003 meeting:

City of
WILSONVILLE
in OREGON

30000 SW Town Center Loop E
Wilsonville, Oregon 97070
(503) 682-1011
(503) 682-1015 Fax
(503) 682-0843 TDD

NOTICE OF DECISION

PLANNING COMMISSION

RECOMMENDATION TO CITY COUNCIL

FILE NO.:	**02PC05 – Wastewater Facility Plan Update**
APPLICANT:	**City of Wilsonville**
REQUEST:	**Adoption of a Wastewater Facilities Plan Update**

After conducting public hearings on October 8, 2003 and November 12, 2003, the Planning Commission adopted Resolution No. 02PC05, recommending this action to the City Council.

The City Council is scheduled to conduct a Public Hearing on this matter on Thursday, January 22, 2004, at 7:00 p.m., at the Wilsonville Community Development Annex, 8445 SW Elligsen Road.

For further information, please contact the Wilsonville Community Development Department, Community Development Annex, 8445 S.W. Elligsen Road, or telephone (503) 682-4960.

PLANNING COMMISSION
RESOLUTION NO. 02PC05

A WILSONVILLE PLANNING COMMISSION RESOLUTION RECOMMENDING THAT THE CITY COUNCIL ADOPT A WASTEWATER FACILITY PLAN UPDATE, FOR THE CITY OF WILSONVILLE.

WHEREAS, the Wilsonville City Engineer submitted proposed Wastewater Facility Plan Update to the Planning Commission, along with a Staff Report, in accordance with the public hearing and notice procedures that are set forth in Sections 4.008, 4.010, 4.011 and 4.012 of the Wilsonville Code (WC); and

WHEREAS, the Planning Commission, after providing the required notice, held Public Hearings at regular public meetings on October 8, 2003 and November 12, 2003, to review the Staff Report and to gather additional testimony and evidence regarding the Wastewater Facility Plan Update; and

WHEREAS, the Commission has afforded all interested parties an opportunity to be heard on this subject and has entered all available evidence and testimony into the public record of their proceeding; and

WHEREAS, the Planning Commission has duly considered the subject, including the staff recommendations and all the exhibits and testimony introduced and offered by all interested parties; and

NOW, THEREFORE, BE IT RESOLVED that the Wilsonville Planning Commission does hereby adopt all Planning Staff Reports along with the findings and recommendations contained therein and, further, recommends that the Wilsonville City Council approve and adopt the Wastewater Facility Plan Update, as reviewed and amended by the Planning Commission; and

BE IT RESOLVED that this Resolution shall be effective upon adoption.

ADOPTED by the Planning Commission of the City of Wilsonville at a regular meeting thereof this 12th day of November, 2003, and filed with the Planning Administrative Assistant on November 12, 2003.

Wilsonville Planning Commission

Attest:

Linda Straessle

Linda Straessle, Administrative Assistant I

SUMMARY of Votes:

Chair Iguchi:	Nay
Commissioner Hinds:	Absent
Commissioner Faiman:	Aye
Commissioner Guyton	Aye
Commissioner Maybee:	Aye
Commissioner Pruitt:	Aye
Commissioner Wortman:	Aye

PLANNING COMMISSION
November 12, 2003

Application No. 02PC05
Request: Adoption of a Wastewater Facility Plan Update
Location: Citywide
Applicant: City of Wilsonville

MOTIONS

Commissioner Pruitt moved that based on the Findings included in the Staff Report dated October 8, 2003 and the Staff Report Addendum dated November 5, 2003, on tonight's public comments, HDR testimony and answers, and the discussion of the Planning Commission, he moves that the Planning Commission adopt Resolution No. 02PC05 which recommends that the City Council adopt the Wastewater Facility Plan Update, as proposed. Commissioner Faiman seconded the motion.

Discussion:

- Commissioner Wortman suggested that HDR Engineering has done a thorough analysis and has cost-effective proposals in the Plan Update that are viable with current and foreseeable technology.

Chair Iguchi moved to amend the motion to include in the Wastewater Facility Plan Update, a triggering mechanism for reviewing the Wastewater Facility Plan periodically, and for considering technological alternative systems at every possible opportunity. Commissioner Wortman seconded the motion.

Discussion:

- Commissioner Faiman suggested Chair Iguchi language was too broad and that the "every possible opportunity" language could be a bit more modest.
  - Chair Iguchi responded that it is important for the City to take every opportunity to look at all possibilities to do something that could help in the long run. For instance, if development comes in it may be appropriate to utilize the "living machine" system (as explained in Exhibit 7). She suggested "living machines" have been shown to be effective and have been incorporated into parklands, educational facilities, and some people drink wastewater after it has been processed this way.
  - Commissioner Guyton suggested that a time frame could be stated for when the Wastewater Facility Plan should be reviewed.
  - Commissioner Faiman suggested that "every possible opportunity" could be construed to mean that the Plan has to be reviewed every time a new article is published about wastewater treatment.
  - Commissioner Pruitt suggested that instead of saying "every possible opportunity" state "at appropriate points in the development process" because there will be times that this issue could be looked at and times that this review could be very disruptive.
  - Mr. Johansen suggested that the Plan could undergo a full-scale review prior to Phase 2 of plant expansion as listed on page 7-19 of the Wastewater Facility Plan Update.
    - He explained that the consultants have reviewed Phase 1 of plant expansion thoroughly and have proposed state-of-the-art technology as much as the City wants to go.
  - Commissioner Wortman suggested that Chair Iguchi is suggesting additional alternative concepts beyond a central facility be considered. Chair Iguchi agreed that this is what she is suggesting.
  - It was suggested that the amending motion is addressing two issues, one of which is that when a development comes along that presents an opportunity to review the Plan that this review be done. The Metro industrial lands analysis as mentioned by Mr. Johansen present such an opportunity.

- Mr. Johansen explained that his concern is if something triggers a review of the Plan and an alternate site is looked at, a whole neighborhood gets upset.
  - For example, the Villebois sewer line has to come down either Evergreen Avenue or Barber Street, and if a plant is put in for that area it would have to be put right next to the Montebello residential area. He does not want to get a neighborhood upset about something that probably is not even feasible.
  - He doesn't have a problem if the trigger is put in based on development of the two industrial lands (the Frog Pond area and south of the Willamette River identified by Metro), but to base the trigger on every project that comes before the City, people are going to get needlessly upset.

Commissioner Wortman moved to amend Chair Iguchi's amending motion to state that that the Wastewater Facility Plan Update is to be reviewed prior to Phase 2 of the plant expansion. Commissioner Guyton seconded the motion.

Commissioner Faiman moved to amend Commissioner Wortman's amending motion to state that review of the Wastewater Facility Plan be triggered by the inclusion of the industrial land in the Frog Pond area and south of the Willamette River as described by Mr. Johansen. Commissioner Wortman seconded the amending motion.

Discussion:

- Chair Iguchi stated that she liked the idea of the trigger by the inclusion industrial land, but suggested that this should be qualified by stating any "new" industrial lands that come into the City limits.
  - Mr. Johansen explained that the industrial land in the prison area is not in the current City limits but is included in Phases 2 and 3 of the plant expansion; the pipes are sized to handle it.
  - Chair Iguchi stated that she would like the language to state that when industrial lands are annexed into City, the City could review them and determine whether they are included in the Plan.
  - Commissioner Faiman noted that he had specifically referred to the industrial lands in the Frog Pond area and the area south of the Willamette River.

The amending motion failed 2 to 3 with Commissioner Wortman and Commissioner Faiman voting for the amending motion, Commissioner Pruitt, Chair Iguchi and Commissioner Guyton opposing the amending motion and Commissioner Maybee abstaining from voting.

Commissioner Wortman's amending motion to trigger a review of the Wastewater Facility Plan Update prior to Phase 2 of plant expansion passed 5 to 1 with Commissioner Pruitt opposing.

Chair Iguchi stated that based on the amending motions and discussions, and the failure of Commissioner Faiman's amending motion, she would like to change her amending motion to state, "Include in the Wastewater Facility Plan Update, a trigger for review the Plan prior to Phase 2 of plant expansion and to look at alternatives at appropriate times in the development. She asked City staff if they had any comments about this language.

- Mr. Johansen responded this language works for him as long as he doesn't have to get people upset needlessly.
- Commissioner Pruitt suggested that "appropriate" is a very vague term.

Chair Iguchi's amending motion passed 6 to 0.

The main motion passed 5 to 1 with Chair Iguchi opposing.

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PLANNING COMMISSION

Wednesday
November 12, 2003
7:00 P.M.

Wilsonville Community Development Annex
8445 SW Elligsen Road
Wilsonville, Oregon

Minutes

I. CALL TO ORDER - ROLL CALL

Chair Iguchi called the meeting to order at 7:00 p.m. Those present:

Planning Commission:	Debra Iguchi, Craig Faiman, Susan Guyton, Joe Maybee, and Mark Pruitt were present. Randy Wortman arrived shortly after the Consideration of the Minutes. Mary Hinds was absent.
City Staff:	Paul Lee, Eldon Johansen, Mike Stone, Chris Neamtzu and Linda Straessle.

V. CONTINUED PUBLIC HEARING

Application No. 02PC05

Request:	Adoption of a Wastewater Facility Plan Update
Location:	Citywide
Applicant:	City of Wilsonville

The following was distributed at the beginning of the Meeting:
Exhibit 9: An email dated November 10, 2003, from Commissioner Hinds.

Chair Iguchi read the Legislative Hearing Procedure for the record. She opened the Public Hearing for 02PC05 at 7:05 p.m. and called for the Staff Report.

City Engineer Mike Stone noted that Planning Commission had opened and continued this Public Hearing at the October 8, 2003 meeting. He listed the exhibits to the Staff Report in the meeting packet. He explained that the City staff recommendation regarding 02PC05 is for approval of the Wastewater Facility Plan Update with the addition of Exhibit 4: "Technical Memorandum on Additional Biosolids Treatment Alternative – Incineration." He introduced HDR Engineering, Inc. consultants, Heather Stephens and John Holroyd.

Ms. Stephens recapped the information provided to the Planning Commission:

- The Draft Wastewater Facility Plan Update, dated November 2002 (Plan), was distributed to the Commissioners in the Fall 2002.

  - The Plan outlines recommendations for phased expansion of the Wastewater Treatment Plant that would serve the community through ultimate build-out.
  - Subsequent to build-out, the Plan addresses short-term constraints that the City has with its biosolids management.
  - It looks at cost-effective treatments.
- Ms. Stephens gave a brief overview of the exhibits that HDR Engineering provided for the Planning Commission October 8, 2003 and November 12, 2003 Staff Reports:

  Exhibit 3: Additional Biosolids Treatment Alternatives Technical Memorandum, HDR Engineering, Inc., October 2003.

  Exhibit 5: Additional Biosolids Treatment Alternatives - Incineration Technical Memorandum, HDR Engineering, Inc., November 2003.
  - Ms. Stephens stated when comparing the recommendations in the first memorandum (Exhibit 3) for the alternative drying system with the incineration alternative as described in the second memorandum (Exhibit 5), the two technologies achieve many of the same objectives.
    - They both result in a significant decrease in the volume of sludge that is produced at the treatment plants, which is a primary objective as the product might have to be stored up to six months of the year at the facility.
    - The operational costs of the dryer are significantly lower than incinerators. The dryer produces a product with a higher level of treatment, which addresses some of the public health concerns that have been raised by the Commission. It is a beneficial reuse product that is accepted and desired by numerous farmers around Wilsonville.

Ms. Stephens explained:
- The first improvement recommended by HDR Engineering is to add a dewatering system, a mechanical separation step that will reduce the volume of sludge. She distributed a flow chart showing the different steps of the Wastewater Facility's Current Operation, Drying Alternative and Incineration Alternative (Exhibit 10).
  - There are several different treatment options, and dewatering is an integral in any of the biosolids treatment processes.
  - Dewatering allows continued land use application with more certainty of being able to find sites that can be approved for winter land application.
  - Dewatering is a critical step prior to either drying or incineration.
  - It is recommended that the City move forward with the Dewatering step as soon as possible, and to have it online before Winter 2004.

PUBLIC TESTIMONY

Tim Knapp, 11615 SW Jamaica, Wilsonville. Mr. Knapp explained that he owns a commercial/light industrial property development project in Old Town. His concerns include:
- There have been issues related to odor emissions from the wastewater treatment plant in the Old Town area during the 17 years that he has been in Wilsonville.
  - City staff has been saying over the years that they were working to eliminate the odor.
  - He has concerns about the performance of the current wastewater plant and whether it will continue to perform adequately throughout the City's growth. He referred to the Villebois development in terms of how much it would impact the Wastewater Treatment Plant.
  - While he admits that the odor problem in Old Town is not as frequent nor as intensive as it once was, it has not gone away either.
  - The odor problem can severely inhabit his ability to get tenants for his buildings.
  - He does not think that citizens, the development community, and commercial centers should be subjected to this type of problem.

- He has seen articles about the handling of biosolids applications but does not know very much about it. He hopes that the Planning Commission has enough information to make a decision regarding the Plan.

The Commissioners questioned Mr. Knapp regarding his testimony:
- Commissioner Wortman asked Mr. Knapp how often odor problems occurred in Old Town.
  - Mr. Knapp answered that this question is difficult to answer with any accuracy, but he thought about once a month and varies by the season of the year. He has noticed an odor problem on occasion at 1:00 a.m. He questioned why there would be a problem at this time of night.
- Commissioner Wortman asked Mr. Knapp if he complains to the City when there is an odor problem.
  - Mr. Knapp responded that in years past, he has called several times a year about the problem, but has not called the City in recent months.
  - He does not have the City's 24-hour telephone number to report those occasions when the odor is noticeable at 1:00 a.m.
- Chair Iguchi asked Mr. Knapp if incineration of the waste would be an issue to him.
  - Mr. Knapp questioned what the potential for airborne particulates composition and volume would be with the incineration process.
  - He would like to compare the experiences of other jurisdictions that use incineration and the measured effects they have experienced with incineration.
  - He is open to the possibility that incineration might be a viable method of dealing with waste.
  - He suggested that the land use application of biosolids is going to become more difficult due to citizen concern about the dangers and issues of this practice.

Chair Iguchi closed the Public Testimony for 02PC05.

Chair Iguchi noted the email from Commissioner Hinds (Exhibit 9) that was distributed at the beginning meeting. Commissioner Guyton read the email into the record at Commissioner Hinds's request.

The Commissioners discussed their concerns regarding the Plan:
Commissioner Guyton:
- Agreed with many of Commissioner Hinds's comments in the email.
  - She is concerned that the Plan offers only a short-term "fix" and will not solve long-term problems.
  - Suggested that other solutions should be looked at and that incineration might be one of the other solutions.
    - It has been suggested that incineration is not the thing to do now, but it is still an option.
    - Incineration could be a long-term solution.
- Suggested that federal and state agencies could change the regulations because they are subject to the public sway.

Commissioner Faiman:
- Stated that Mr. Knapp had summarized his concerns.
- There is not enough information to make a decision.
  - The studies he would like to see have not been done yet.
  - There are questions regarding the political acceptability of the current program of using waste solids for fertilizer.
  - Because there are so many unknowns, his decision would be to go with the lowest cost alternative for now and review the subject at a future time once more information is available.
    - The City should not spend a lot of money on options where there is no strong evidence that it is the correct direction to go.

Commissioner Maybee:

- Agreed with the preceding comments.
  - This is a complex subject and he does not think that it is going to lend itself to an easy solution.
  - Commissioner Guyton, Commissioner Hinds and Commissioner Faiman have pointed out that there are numerous viewpoints on this subject.
  - Looking at the incremental cost of going with the simplest solution to the alternative solutions, it might be in the City's best interests to find out what the baseline cost might be and what the incremental costs would be should the City decide in the future to go to an alternative option.

Commissioner Pruitt:

- Asked that the difference between a Class A and a Class B land applications be explained.
  - Ms. Stephens responded that the federal regulations for biosolids treatment recognize two different levels of treatment.
    - Class A sludge is the highest level of treatment to further reduce pathogens. Its land application is universal for soil augmentation. It can be applied in significantly more local areas than Class B sludge can.
    - The City currently produces Class B sludge. It has not undergone as sophisticated treatment for pathogen reduction as Class A sludge, therefore, the use is protected by putting limits on the land application.
  - Commissioner Pruitt asked if the pathogen level could be quantified for easier understanding.
    - Mr. Holroyd explained that he is the chief engineer at the Portland office of HDR Engineering. He stated that a criterion for counts per dry gram of material can be difficult to track. Regulators address the Class A and Class B distinctions by defining the acceptable level of treatment; what treatment might give a typical acceptable kill of pathogens.
    - Mr. Holroyd explained that regulation is based on both a sampling of the biosolids and on ensuring that the treatment process meets a standard.
- Commissioner Pruitt asked if there are fewer heavy metals in Class A sludge than in Class B sludge.
  - Ms. Stephens answered that Class A treatment processes are aimed at pathogen reduction and not at metals removal. The heavy metals level in Class A sludge is similar the level found in Class B sludge.
- Commissioner Pruitt asked Ms. Stephens and Mr. Holroyd to explain HDR Engineering's experience with wastewater treatment plants and their design.
  - Ms. Stephens explained that Class B land application is the most prevalent current biosolids program.
    - In planning for the future, it is common to look at Class A treatments given public concerns and the uncertainty of regulation in terms of where the legislation will go in the future.
    - Many facilities are moving toward Class A treatments. The majority of the facilities that HDR Engineering look at use some sort of beneficial use as opposed to an alternative such as incineration. There are some uses for the ash resulting from incineration. Land application of sludge for soil amendment is considered to be a beneficial use from a regulatory viewpoint
  - Mr. Holroyd explained that HDR Engineering is one of the top five wastewater design firms in the country.
    - The Portland office is engaged with twenty-plus treatment plant expansions and design projects at any given time.
    - He listed wastewater treatment plants that HDR Engineering has worked on in the Portland and Seattle areas.
    - Ms. Stephens explained that HDR Engineering primarily designs wastewater treatment plants, but also have operation services and have treatment plant operators on staff. HDR Engineering puts operational recommendations into facility plans. They also have incinerator operators on staff so HDR Engineering has experience with incineration plant operation.
  - Ms. Stephens stated that HDR Engineering has been in business since 1923.

  - Mr. Holroyd explained that the Portland office employs about 55 people in the region and over 300 people in four or five offices.
  - Mr. Holroyd stated that HDR Engineering is considered to be experts in the wastewater treatment field.
- Commissioner Pruitt asked that the costs of drying versus burning be qualified.
  - Ms. Stephens explained that in terms of capital costs, the drying option is about $10 million, whereas the incineration cost is about $14 million.
  - The major difference between drying and incineration costs is the operating cost. Incineration operation costs five times more than drying operating costs.
    - The drying operation cost is just under $100,000 a year versus $500,000 for the incineration costs.
    - Costs are based on the current staffing level at the Wastewater Treatment Plant. Staffing costs for a 24-hour operation are three to four times higher than for plants that operate with a single shift, as Wilsonville's Wastewater Treatment Plant currently does. It may not be necessary to go to a 24-hour shift full time with the incineration process, but there are labor costs with a partial 24-hour operation.
    - Wilsonville's dry product doesn't need to be sent to Eastern Oregon because the limitations on Class A land application have been removed.
    - Mr. Holroyd reported that Class A sludge is in demand for land application and is sometimes bagged and sold as fertilizer.
    - The City of McMinnville has a Class A treatment operation and makes compost which is sold without difficulty.
  - Mr. Stone noted that technical memorandum prepared by HDR Engineering dated November 3, 2003 (Exhibit 5 in the meeting packet) included information about the costs.
  - It was noted that the biosolids dewatering process would be required in both the drying and incineration process.
- Commissioner Pruitt noted Ms. Stephens comments that dewaterization is done in both the drying and incineration processes, and referred to Commissioner Hinds's statement in her email that the sludge has no odor after dewaterization, and asked if this were true.
  - Mr. Holroyd responded that his understanding of Commissioner Hinds's email was that there is no odor after incineration.
  - Mr. Holroyd confirmed that dewaterization would be done before land applications for Class A, Class B, incineration, and drying systems products: the water has to be removed before the product can be shipped or combusted.
- Commissioner Pruitt asked if Commissioner Hinds was correct that the Phase 3 expansion of the Wastewater Treatment Plant would not be needed with the incineration alternative: would these two options have different long-term bearing on the expansion that would be needed for the Wastewater Treatment Plant?
  - Ms. Stephens answered that the initial capital investment would be made for both methods, which would last for the life of the facility.
    - Phase 3's total cost was $30 to $35 million, which included many liquid processing improvements as well. These would still be needed regardless of the biosolids treatment option.

Commissioner Guyton:
- Noted that the small site for the Wastewater Treatment Plant and asked what would happen when there is no more room for expansion.
  - Mr. Stone explained that HDR Engineering was told to make recommendations based on the current Wastewater Treatment Plan site, which is not going to get bigger than it currently is.
    - Costs will be 20% to 30% higher in construction costs because of the site's size limitation.
    - A portion of the current site belongs to ODOT.

* Mr. Johansen stated that there are three phases for the Wastewater Treatment Plant expansion.
  - The first two phases will take the capacity of the Plant to 4 million gallons per day (mgd). Currently the Plant runs a slightly above a 2 mgd capacity. If Wilsonville's current rate of generating sewage for each area continues the way it is now, it will generate 4 mgd through Phase 2.
  - Phase 3 would bring the capacity of the Plant up to 7 mgd on this site. He estimated that Wilsonville would produce 4 to 7 mgd of sewage at full build-out even if additional areas are brought into the City or areas redevelop and produce more sewage than they currently do. There is enough space at the current site to handle this amount, but it will be crowded.
  - The City needs to negotiate with ODOT for acquisition of that portion of land adjacent to the current site, as this would allow expansion away from the neighbors of the site.
- Mr. Johansen referred to page 7-19 of the Wastewater Facility Plan Update, Table 7-2 "Estimated project costs for plant expansion (Costs in $1,000s)" and noted that there are three phases.
  * Phase 1 includes the biosolids dewatering that would be needed no matter what method is used for processing the wastes.
  * The City will readdress how the solids should be handled the next time the Plan is updated.
    - There will be one, possibly two, more updates of the Plan before the incineration or low temperature belt drying methods would be built.
    - There is enough space on the current site for the inclusion of either the drying or incineration methods.
    - The main concern at this time is to get the initial improvements approved, making sure that the initial improvements are compatible with whatever is built in the future. He is not locked into one method.
- Mr. Johansen explained that the City only produces about half the volume of sewage that is needed to make the incineration method effective because it takes as much manpower to run a very small operation as it does a much larger operation. It would be extremely expensive to operate an incineration.
  * He suggested that with technology changes smaller incineration systems might come down in size and become more efficient. It may make more sense to wait until it is time to build the system before locking in a particular method due to possible technology changes.
- Mr. Holroyd noted that a couple of the major wastewater utilities in this area have decommissioned their incinerators recently, including plants in Clackamas and Durham, because of the high level of maintenance.

Commissioner Maybee:
- Asked if there were any correlation between odor emission and work shifts; are there more nighttime odors from plants that are under single-shift operations? Is there some reservoir approach to holding waste that comes in at night, or is the entire plant automated?
  * Ms. Stephens explained that most of the Wastewater Treatment Plant is automated so that the processes run 24 hours a day. Intermittent odors tend to be during the day. She could not think of anything that would be happening that would be causing odors at night.
- Asked how pathogens from solid waste from a Class A process measured against ambient pathogens in the environment. How quickly does this drop off?
  * Mr. Holroyd stated that most of the focus is on fecal bacteria. The wastewater business is trying primarily to reduce the organic content and reduce the harmful, or pathogenic, microbial community. The microbes that are in the soil are much less likely to cause health problems as raw or partially treated wastewater or sewage sludge might.

Commissioner Wortman:
- Referred to page 8 of 20 of the Staff Report, Table 1. "Estimate of Probable Capital and Operating Costs for Solids Incineration", and suggested that Table 1 only addresses two of the three phases

referred to earlier by Mr. Johansen. He noted that there are no capital costs associated with the Phase 2 expansion.

- Ms. Stephens stated that Table 1 is more equivalent to Phase 2 and Phase 3 of the expansion. The Phase I improvements in the Plan address existing capacity deficiencies. Phase 2 is the first major capacity increase at the plant.
- Commissioner Wortman suggested that the million gallons per day figures do not line up with the 7 mgd that Mr. Johansen was speaking about earlier.
  - Ms. Stephens stated that the Plan looks at the low projection costs and high projection costs and the numbers in Table 1 are based on the low projection costs.
  - Ms. Stephens using a enlarged copy of a page from the PowerPoint presentation shown to the Planning Commission in January 2003 (paper copies of which were provided in Exhibit 4 in the October 8, 2003 Staff Report), showing the graph "Flow and Loading Projections," explained that the high projections were looked at primarily from a site planning point of view to make sure that City growth at full build-out can be accommodated at the current plant site.
  - The difference in the numbers noted by Commissioner Wortman is because HDR Engineering believes that growth might be closer to the low projection.
- Commissioner Wortman asked if the actual build-out capacity comes in at the high flow projections, would there be additional capacity expense to Table 1?
  - Ms. Stephens stated that there would be; another $14 million expansion would be needed.
- Commissioner Wortman asked that the reasons for the difference between the "Initial Expansion" Total Operation and Maintenance Costs and costs for the "Ultimate Expansion" be explained.
  - Ms. Stephens explained that it would be due to the additional operating time because the equipment will be running longer as the loading of the Plant increases.

- Commissioner Wortman asked which phase of waste treatment produces the ongoing odor problems.
  - Ms. Stephens stated that HDR Engineering has identified the major odor sources. She listed those sources.
    - The headworks. The first phase of improvements in the Plan includes improvements to the headworks and treating the air from the headworks.
    - The sludge storage. She noted that the recent odor control project addressed the sludge storage basin, which is one of the major sources of odor.
  - Commissioner Wortman asked if HDR Engineering is the current advisor on operations and problems.
    - Ms. Stephens answered that they have been since 2001.
  - Commissioner Wortman discussed problems in the past that were created by Coca-Cola operations and asked if Coca-Cola continues to be a significant source of the odor problems.
    - Mr. Johansen responded that they are becoming less of a factor as the City grows and there are other sources of sewage. The wastewater treatment system the City used 10 to 14 years ago did not respond well to increases in strength; the current system responds very well to changes in strength during the day.
  - Mr. Johansen suggested that a source of the intermittent odor is when the sludge storage covers are cleaned, there are odors for about an hour.
  - Mr. Stone explained that there could be a substantial impact to the odor problems during the day because of the winds that blow during the day. Winds tend to calm down during the night so the odors tend not to be blown away by the wind.
  - Mr. Stone and Mr. Holroyd explained the sources of the odors.
    - The screening materials are contained a dumpster and odor escapes when the lid is opened to put in another load.
    - A couple of places for odor-causing potential are the sludge storage and the headworks, which have not been enclosed, because this is where the sewage first comes in. This is not a place that is conducive to nice smells. There is a project in the works to reduce the odors here, which should be operational in mid-2005.

- Commissioner Guyton stated that as a resident of Old Town she seldom notices the odors but that might be because she is far enough north of the Wastewater Treatment Plant that it is not noticeable. She suggested that the odors are worse during specific times of the year because of the wind, although the odors are better now than they were several years ago.

Chair Iguchi:

- Chair Iguchi referred to previous testimony that the odor occurs during the dewatering process and asked if the odor congregates in the water.
  - Ms. Stephens explained that the odor is associated with the solids processing steps. She explained this process in further detail. The dewatering process does have some odors associated with it and HGR Engineering is recommending that that this process be enclosed in a building.
  - Mr. Stone explained that every improvement that has been done to the Wastewater Treatment Plant has helped with the odor problems. He listed the various projects. He stated that he believes that eventually the odor problem will be eliminated.
- Asked if the higher construction costs due to the constrained site of the Wastewater Treatment Plant had been compared to what it would cost to acquire additional land somewhere else, aside from the physical structure.
  - Mr. Johansen stated that when he had worked for another jurisdiction he had to find an alternate site for the wastewater treatment plant, and the experience was not good. He has not done a comparison of costs between building onsite, and locating to another site.
    - Operation costs would be too high if there are two smaller sites as there would be basically the same operation at both sites. He estimated that the capital costs for building onsite or at another site would be similar, but the operation costs would be exorbitant.
  - Ms. Stephens suggested that there would be significant additional capital costs due to pumping and piping that would offset any construction savings from building on another site.
  - Commissioner Wortman asked if another site could be located outside the City limits. The answer was inaudible on the audio tape.
- Chair Iguchi expressed concern that the Plan is a short-range way of handling a problem that is ongoing; the City is going to continue to grow and produce more waste.
  - It bothers her that Wilsonville's waste will be trucked out of Wilsonville.
    - Wilsonville needs to find a constructive way of taking care of its own wastes here. This Plan does not address this in any way.
- Chair Iguchi expressed concern that HDR Engineering was not charged with looking at other technologies that are available.
  - She is concerned that the City is going to be putting in infrastructure that is going to take additional waste from the northern part of the City, the Villebois and Coffee Lake areas, and will be piping that waste all the way to the Willamette River when Mr. Johansen just said that capital costs in acquiring additional land could be similar. She suggested that the cost would not be so high for locating another site when compared to the expense of the piping. She suggested that this has not been looked at and has not been addressed in the Plan. She would prefer it if the Plan looked at alternatives more closely since obviously they have not been researched at this point.
    - The idea that incinerators could go down into a reasonable cost within a short period of time is of concern to her because this has not been addressed in this Plan.
    - It looks like we are just going to continue to build as much as can be built on the current site and continue to treat it in a relatively similar way to what we have.
    - The drying belt system is going to be brought in to improve the quality of the sludge but there is nothing in the Plan about looking at other alternatives that might arise or that are already in existence that could be viable and might serve Wilsonville's needs now and into the future.
  - For this reason, she is not willing to recommend the adoption of the proposed Wastewater Facility Plan as it is now.

Commissioner Pruitt

- Asked the range of time that the Plan covers.
  - Ms. Stephens responded that the Plan looks at the ultimate build-out of the current urban growth area and urban planning areas, making sure that the short-term improvements don't preclude something that would be a logical long-term alternative, recognizing that technology continues to advance and that the City will revisit the Plan.
    - More focus was put onto the short-term alternatives because this where there is the most certainty. Additional capital improvements identified some pilot studies and other investigations, which the City can continue to do in the short-term in order to help refine the decisions that need to be made 10 to 15 years down the road.
  - Chair Iguchi suggested that if the City is building infrastructure to go down to the existing site for the short-term and all the capital expenses for putting in all the additional enclosures and other improvements, then there is a lot of money sunk into this short-term Plan. She questioned how likely would other less expensive alternatives be looked at in the future?
  - Commissioner Pruitt asked what the planning horizon of the Plan was and if the improvements in the Plan for the short-term would be usable for the long-term upgrades, and how long would it be before any additional upgrades would need to be made beyond this Plan?
    - Ms. Stephens explained that the planning horizon of the Plan is 2035.
    - The Plan could be used in the long term in terms of going back and checking where the growth actually occurs compared to what was planned. HDR Engineering tried to identify triggers that would allow the City to go back to the Plan to do the improvements in the Plan.
    - Commissioner Pruitt suggested that since the Plan has a 30-year planning horizon that it is not a short-term Plan given technology changes over the next 30 years.
    - Commissioner Wortman suggested that other than adding additional land within the City limits, this Plan covers full build-out of the City.
  - Mr. Stone explained that when a facility plan such as this Plan is put together, both the City staff and consultants make certain assumptions based on current technologies or technologies that could be utilized in a relatively short period of time.
    - The Plan was last updated in 1996. By the time that construction started in 1996 or 1997, there were two technologies that were implemented with those improvements that were relatively untried in the State of Oregon. He listed those improvements.
    - By the time that the City addresses the issues related to producing a Class A product, City staff will be coming back to the Planning Commission with a recommendation that may or may not be in conformance with what is in this Plan.
    - DEQ is very supportive of technologies that improve an existing process.
  - Mr. Holroyd stated that he takes exception to the comment that HDR Engineering is only recommending the "tried and true" old technology.
    - Membrane reactors are state-of-the-art. They are currently under construction in two places in Washington and there are no installations in Oregon.
    - The sludge drying facility that HDR Engineering is suggesting will produce a Class A sludge. This is recognized in Europe to be the most sustainable way of dealing with biosolids. To his knowledge, there is not a facility in operation in the United States that uses this process. This is not "cookbook" technology selection.
    - HDR Engineering is looking at things that are expected to prove themselves out over time and this is not standard wastewater treatment. Wilsonville's Wastewater Treatment Plant site demands some innovative thinking.
    - HDR Engineering's goal is to be able to provide the capacity within the given constraints.
    - A fairly wide array of technologies was looked at to get to the recommendations in the Plan.
  - Chair Iguchi asked if HDR Engineering had considered the Living Machine process of treating wastewater as outlined in Exhibit 7 (in the meeting packet).

- Mr. Holroyd stated that there is a response regarding the Living Machine in the meeting packet (Item 6 of Exhibit 6). He explained that he had assisted the City of Ashland in its evaluation of Living Machines, and there were concerns about when the ponds were cleaned; the flow would create problems for the wastewater treatment plant. The cost associated with this and the land area were many times higher than what they were projecting for the cost of expanding their current treatment plant.
- Mr. Holroyd explained that the Living Machine systems are using the exact same kind of biology that currently being used in Wilsonville's Water Treatment Plant. The Living Machine processes are being accelerated by adding power, heat and chemicals to make up for not having vast land areas to do the treatment.
- Chair Iguchi stated that her understanding is that the Living Machine uses a compressed land area and won't do full treatment.
- Chair Iguchi suggested that the City should be using other technologies as the City expands and that the Living Machine option would be good to include in the Plan. Mr. Holroyd stated that this could be done, but these are systems that are not forgiving for high water fluctuations and peak flow. This system is typically used for small, residential, or more contained flow conditions.

Commissioner Wortman

- Asked if building a system to convey Villebois wastewater to the current Wastewater Treatment Plant would eliminate the possiblity for doing a local treatment system in the Villebois area later.
- Mr. Holroyd stated that it is a fair assumption that this sets the course for centralized waste treatment.
  - He suggested that from an economic standpoint there are very few cases where the economy on having one treatment plant, one discharge, and one operations group has not paid dividends over numerous scattered systems.
  - From a regulatory standpoint, getting multiple discharge permits in a community is unlikely.
  - Chair Iguchi suggested that once committed to a centralized treatment system it would not make any sense to include options for alternative systems in the Plan. Once the City has committed to taking all its wastes down to the Willamette River, it precludes looking at other alternatives altogether.
  - Mr. Holroyd explained that there are communities that looked for pretreatment opportunities within their system in a local area, and then send it off to a final area for treatment and disposal. This concept would not be precluded by a centralized system.
  - Ms. Stephens explained that other alternatives could be considered when there is a need, such as an industrial need or the amount of acreage that needs irrigation. HDR Engineering could not identify any need in Wilsonville that would create this alternative opportunity.
    - Mr. Holroyd explained that this would be a pretreatment or supplementary treatment as opposed to alternative systems. Typically those pretreatment applications are associated with industries of some size.
  - Mr. Johansen explained that there are two potential developments that alternative systems could be considered for, both of which are part of Metro's industrial lands studies for lands that are outside of the planned service area.
    - Large pipe would have to be run all the way to the Wastewater Treatment Plant.
    - City staff thinks that this would be a logical area to look at the alternative systems.
    - He clarified that these lands are outside the current City limits. One is south of the Willamette River and the other is east of the City.

Chair Iguchi moved that language be included in the Wastewater Facility Plan Update to allow for triggers to review this process and also to consider alternatives at every possible opportunity in the future.

Commissioner Wortman suggested that it would be better if this motion were an amendment to a main motion.

Chair Iguchi withdrew her motion

Commissioner Pruitt moved that based on the Findings included in the Staff Report dated October 8, 2003 and the Staff Report Addendum dated November 5, 2003, on tonight's public comments, HDR Engineering testimony and answers, and the discussion of the Planning Commission, that the Planning Commission adopt Resolution No. 02PC05 which recommends that the City Council adopt the Wastewater Facility Plan Update, as proposed. Commissioner Faiman seconded the motion.

Discussion:

- Commissioner Wortman suggested that HDR Engineering has done a thorough analysis and has cost-effective proposals in the Plan Update that are viable with current and foreseeable technology.

Chair Iguchi moved to amend the motion to include in the Wastewater Facility Plan Update, a triggering mechanism for reviewing the Wastewater Facility Plan periodically, and for considering technological alternative systems at every possible opportunity. Commissioner Wortman seconded the motion.

Discussion:

- Commissioner Faiman suggested Chair Iguchi language was too broad and that the "every possible opportunity" language could be a bit more modest.
  - Chair Iguchi responded that it is important for the City to take every opportunity to look at all possibilities to do something that could help in the long run. For instance, if development comes in it may be appropriate to use utilize the "Living Machine" system (as explained in Exhibit 7). She suggested "Living Machines" have been shown to be effective and have been incorporated into parklands, educational facilities, and some people drink their wastewater after it has been processed this way.
  - Commissioner Guyton suggested that a time frame could be stated for when the Wastewater Facility Plan should be reviewed.
  - Commissioner Faiman suggested that "every possible opportunity" could be construed to mean that the Plan has to be reviewed every time a new article is published about wastewater treatment.
  - Commissioner Pruitt suggested that instead of saying "every possible opportunity" state "at appropriate points in the development process" because there will be times that this issue could be looked at and times that this review could be very disruptive.
  - Mr. Johansen suggested that the Plan could undergo a full-scale review prior to Phase 2 as listed on page 7-19 of the Wastewater Facility Plan Update.
    - He explained that the consultants have reviewed Phase 1 thoroughly and have proposed state-of-the-art technology as much as the City wants to do.
  - Commissioner Wortman suggested that Chair Iguchi is suggesting additional concepts beyond a central facility when considering alternatives. Chair Iguchi agreed that this is what she is suggesting.
  - It was suggested that the amending motion is addressing two issues, one of which is that when a development comes along that presents an opportunity to review the Plan, that this review be done. The industrial lands as mentioned by Mr. Johansen present such an opportunity.
  - Mr. Johansen explained that his concern is that every time an alternate site is looked at, a whole neighborhood gets upset. For example, the Villebois sewer line has to come down Evergreen Road or Barber Street, and if a plant is put in for that area it would have to be put right next to the Montebello residential area. He does not want to get a neighborhood upset about something that

probably is not even feasible. So if a trigger is built in to make a formal review and report, people will become upset. He doesn't have a problem if the trigger is put in based on development of the two industrial lands, but to base the trigger on every project that comes before the City, people are going to get needlessly upset.

Commissioner Wortman moved to amend Chair Iguchi's amending motion to state that that the Wastewater Facility Plan Update is to be reviewed prior to Phase 2. Commissioner Guyton seconded the motion.

Commissioner Faiman moved to amend Commissioner Wortman's amending motion to state that a review of the Wastewater Facility Plan be triggered by the inclusion of the industrial land in the Frog Pond area and south of the Willamette River as described by Mr. Johansen. Commissioner Wortman seconded the amending motion.

Discussion:

- Chair Iguchi stated that she liked the idea of the trigger by the industrial land, but suggested that this should be qualified by stating any "new" industrial lands that come into the City limits.
  - Mr. Johansen explained that the industrial land in the prison area is not in the current City limits but is included in Phases 2 and 3; the pipes are sized to handle it.
  - Chair Iguchi stated that she would like the language to state that it would be industrial lands that are annexed into City and that at the time of annexation, the City could review them and say that they are included and move on.
  - Commissioner Faiman noted that he had specifically referred to the industrial lands in the Frog Pond area and the area south of the Willamette River.

The amending motion failed 2 to 3 with Commissioner Wortman and Commissioner Faiman voting for the amending motion, Commissioner Pruitt, Chair Iguchi and Commissioner Guyton opposing the amending motion and Commissioner Maybee abstaining.

Commissioner Wortman's amending motion to trigger a review of the Wastewater Facility Plan prior to Phase 2 carried 5 to 1 with Commissioner Pruitt opposing.

Chair Iguchi stated that based on the amending motions and discussions, and the failure of Commissioner Faiman's amending motion, she would like to change her amending motion to state, **"Include in the Wastewater Facility Plan Update a trigger for review the Plan prior to Phase 2 of development and to look at alternatives at appropriate times in the development."** She asked City staff if they had any comments about this language.

- Mr. Johansen responded this language works for him as long as he doesn't have to get people upset needlessly.
- Commissioner Pruitt suggested that "appropriate" is a very vague term.

Chair Iguchi's amending motion passed 6 to 0.

The main motion passed 5 to 1 with Chair Iguchi opposing.

Respectfully Submitted,

Linda Straessle, Administrative Assistant

N:\planning\straessle\ Planning Commission\ Minutes\111203 PC Minutes.doc

Distributed

at the

November 12, 2003

Planning Commission Meeting:

Straessle, Linda

From: Neamtzu, Chris
Sent: Wednesday, November 12, 2003 8:38 AM
To: Straessle, Linda
Subject: FW: Wastewater Treatment Plant Facility Master Plan

02PC05
Exhibit 9

-----Original Message-----
From: Mary Hinds [mailto:mary.hinds@verizon.net]
Sent: Monday, November 10, 2003 5:05 PM
To: Sue
Cc: Chris Neamtzu
Subject: Wastewater Treatment Plant Facility Master Plan

November 10, 2003
To Wilsonville Planning Commissioners:
I regret not being at the Planning Commission meeting November 12.
My opinion is that there are alternatives that are cheaper and more ecologically sound than biosolid spreading, more energy saving long lasting than the current plant expansion in the master plan.

I have a few comments on the Report Addendum from HDR Engineering, Inc concerning O2PC05.
Oregon and states around the country advocate reuse of sludge through spreading on agricultural lands to capture the fertilizing and other benefits that it contains. Spreading has to be done at certain times of the year, and most cities like Portland pay to have it hauled to Eastern Oregon where there are large tracts of land that the. DEQ and EPA prefer it used on. The cost in diesel fuel to haul it, the need to store dry cakes until weather permits spreading, and the minimal testing of the product before spreading has economic and possible health effects. Politically for the agricultural stakeholders and anyone who likes to see waste reused, biosolids spreading is favorable.

On page 7 of 20 in the packet HDR asserts in the report that the permit for incineration would be "difficult to obtain, and would require an air quality model, dispersion testing and a plan for ash dispersal."

These components are also required for **any** wastewater treatment system, perhaps even expansion of one. Incinerated sludge ash disposal would amount to 90% less volume than sludge disposal, and could be disposed of potentially through local use in construction material, amendment to leaf composting or as an agricultural soil amendment.

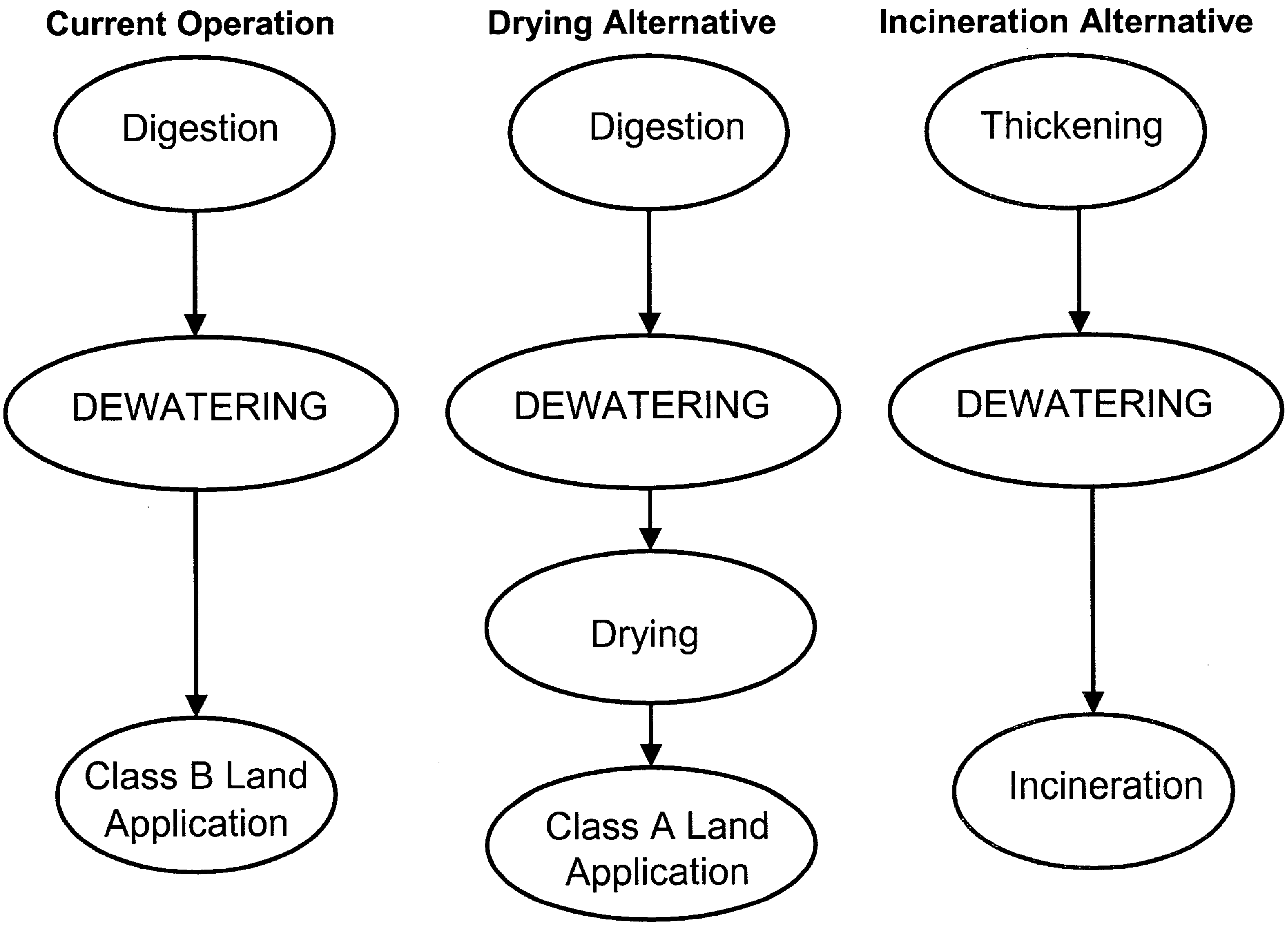
The report says on page 7 of 20 " Depending on the level of citizen concern with incineration," the notification process "could force the city to abandon its plans for solids incineration." Vancouver Washington did not experience any negative public reaction to its plans to build an incineration plant that processes 2 tons an hour of biosolids, 24 hours/day. The fact that after dewaterization, there is NO odor associated with it as in digestion or composting could actually LESSEN public resistance.

There are some advantages to solids incineration that I want you to consider before dismissing incineration (referring to Table 2 on Page 9 of 20).
Additional benefits:
Large solids volume reduction is equal to about 10% of biosolids. This could mean no "Ultimate expansion" needed, no phase 3 of expansion. Although Incineator building costs are high, the long range costs could be reduced by the cost of phase 3 -ultimate expansion projected to be $35 million in 20-30 years.
No contracts with 3rd parties for sludge transport and spreading. If you look at the costs of these contracts, they could double when time to renew them, if there are parties still taking the product.
Potential to reuse the ash Reduce diesel used to haul sludge 200 miles to Eastern Oregon by using in concrete, composting, soil amendment.
(Reduce air pollution by hauling less product shorter distances)
Not affected by weather

Exhibit 10

Wilsonville Planning Commission
November 12, 2003

Exhibit 10



V. CONTINUED PUBLIC HEARING

Application No. 02PC05

Request:	Adoption of a Wastewater Facility Plan Update
Location:	Citywide
Applicant:	City of Wilsonville

Planning Commission
November 12, 2003

City of
WILSONVILLE
in OREGON

30000 SW Town Center Loop E
Wilsonville, Oregon 97070
(503) 682-1011
(503) 682-1015 Fax
(503) 682-0843 TDD

STAFF REPORT ADDENDUM
WILSONVILLE PLANNING DIVISION
Wilsonville Planning Commission

HEARING DATE:	November 12, 2003
DATE OF REPORT:	November 5, 2003
APPLICATION NO.:	02PC05
REQUEST:	Update the Wastewater Facility Plan, April 1995, to plan and provide for adequate wastewater facilities for the City of Wilsonville.
APPLICANT:	City of Wilsonville
CRITERIA:	Statewide Planning Goals #6 and #11; Wilsonville Comprehensive Plan: Public Facilities & Services Policy 3.1.1. and 3.1.4; Wilsonville Code Sections 4.000-4.033, and 4.198
STAFF REVIEWER:	Eldon Johansen, Community Development Director; Mike Stone, City Engineer; Laurel Byer, Assistant City Engineer; Ron Morrow, Environmental Services Manager

DESCRIPTION OF ACTION:
Adopt the Wastewater Facility Plan Update, November 2002.

BACKGROUND/SUMMARY OF ISSUES:
The public hearing for the review of the Wastewater Facility Plan Update was scheduled and duly advertised for October 8, 2003. However, due to the duration of another public hearing scheduled for the same date, the Wastewater Facility Plan Update was continued to November 12, 2003.

Since October 8, 2003, City staff directed HDR Engineering, Inc. to further investigate incineration as a Biosolids Handling alternative. The result of the analysis is included in Exhibit '5' attached to this staff report. Simultaneously, City staff further investigated Alternative 3: Onsite Sludge Drying/Storage using a Belt Drying System as outlined in Exhibit '3' of the original staff report. City staff met with the manufacturer of the proposed belt drying system, Andritz, and through discussions with the manufacturer and HDR Engineering, it appears that the annual operational costs of the system may be much lower than the fluidized bed incinerator that is summarized in Exhibit '5.' HDR Engineering also prepared a memorandum addressing some of the questions and concerns raised by the Planning Commission since the last work session and it is included as Exhibit '6' of the staff report.

CONCLUSIONARY & SUMMARY FINDINGS:

The findings that were outlined in the original Staff Report for the October 8, 2003 public hearing are still applicable and have not changed due to the additional information.

STAFF RECOMMENDATION:

Based on the Findings of Fact and information included in the Staff Report dated October 8, 2003 and the Staff Report Addendum dated November 5, 2003; and based on information received from a duly advertised public hearing, Staff recommends that the Planning Commission adopt Resolution No. 02PC05, which recommends City Council adoption of the Wastewater Facility Plan Update.

ADDITIONAL EXHIBITS:

5. Additional Biosolids Treatment Alternatives - Incineration Technical Memorandum, HDR Engineering, Inc., November 2003.
6. Memorandum from HDR Engineering, Inc. addressing initial Planning Commission questions, November 2003.
7. An article regarding Living Machines submitted by Debra Iguchi.
8. An article, "Scientists Question Safety of Sludge," from the Sunday, October 12, 2003 edition of The Oregonian, submitted by Debra Iguchi.

Technical Memorandum Additional Biosolids Treatment Alternative - Incineration

Summary

The City of Wilsonville currently land applies aerobically digested (Class B) liquid biosolids on local farms through a year-round land application program. Through the ongoing efforts of Environmental Services staff, the City has developed strong agricultural partners that beneficially use biosolids for soil augmentation during the summer months. However, due to severe regulatory cutbacks on winter land application sites and changes in ownership or management of several key reuse properties, the City has struggled over the past years with winter biosolids management. The assumptions used in the Draft Facility Plan regarding biosolids management led to the recommendation of installing dewatering and enclosed storage to provide six months of onsite storage at the facility. The capital improvements associated with this recommendation proved difficult to finance, leading the City to request new options that were not considered or were considered but eliminated in the initial Facility Plan development. This memorandum provides a preliminary overview of an additional treatment/disposal option previously not evaluated in detail – incineration of all solids generated at the treatment plant.

It is recommended that the City continue its Class B land application program in partnership with local landowners in the short term, and implement improvements to bring greater flexibility to the program in terms of acceptable reuse or disposal options. The City should also continue to investigate Class A treatment technologies such as solids drying, and implement solids treatment improvements in a way that facilitate moving toward producing Class A biosolids in the future. Incineration of solids is considered a less viable alternative for the City due to permitting, operating and maintenance requirements, and public acceptance issues.

Introduction

Incineration has been used to manage solids at municipal wastewater treatment facilities in the US since 1936. The main advantage of incineration over other solids management options is the large volume reduction. The key issues for the design and operation of a solids incinerator are permitting and regulatory considerations related to incinerator emissions, public acceptance, equipment and energy requirements, and ash management. Each of these issues is discussed in the following sections.

Essentially, there are two incineration technologies available that have been successfully applied in the US: multiple hearth furnaces, and fluidized bed incinerators. Due to the fact that fluidized bed incinerators are considered to be more capable of meeting stringent air quality requirements than multiple hearth furnaces, and their ability to more easily be shut down and restarted, and that the two technologies have comparable costs, this analysis will focus solely on fluidized bed incinerators.

A typical process schematic of a fluidized bed incinerator is shown in Figure 1. Typically, fluidized bed incinerators operate at temperatures of approximately 1400 to 1500°F, resulting in near complete combustion of nearly everything except the inert material in wastewater solids. The fluidized bed incinerator furnace is vertically-oriented, and units are commercially available with diameters ranging from 9 to 34 feet in diameter. A bed of sand and the influent solids feed at the bottom of the unit is "fluidized" by blowing air at a pressure of 3 to 5 psig through a refractory (e.g. temperature resistant material) grate or set of diffusers. Oxygen for near complete oxidation of combustible material is required, and typically, air quantities in excess of the requirements are maintained to minimize supplemental fuel requirements and ensure that air quality requirements can be met.

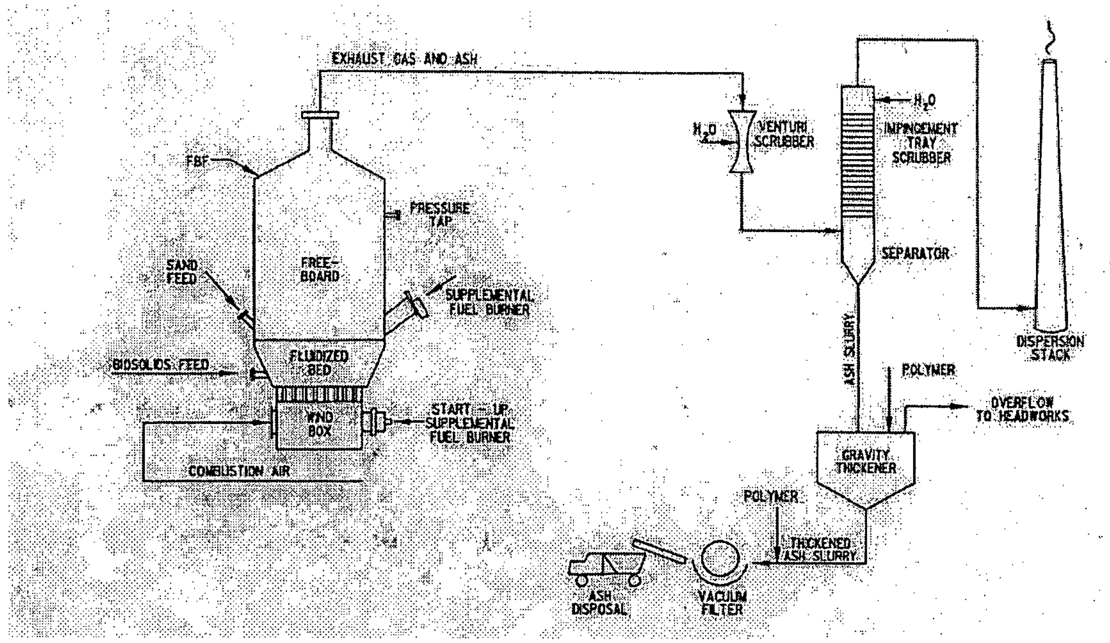


Figure 1. Typical fluidized bed incinerator schematic (from NBP, 2000).

Operations and maintenance costs can be significant for fluidized bed incineration systems. Unless the solids concentration is in excess of approximately 28 percent, the incineration process requires supplemental fuel. Natural gas or No. 2 fuel oil is most commonly used. A small amount of sand from the bed of the unit also escapes with the gas and must be periodically replaced. Waste heat recovery can be performed in several ways, but most typically, combustion air is heated with furnace exhaust prior to entering the fluid bed furnace. Other forms of heat recovery include injecting exhaust gas directly into the furnace, and using bed coils around the furnace.

The exhaust gas and ash exits through the top of the furnace and is treated further to remove the ash and particulates and for emissions control. The characteristics of the ash depend on the exhaust gas processing, but may require concentration in either a gravity thickener or other thickening process. The following sections describe emissions control and ash management in more detail.

Wilsonville could operate an incineration system with a one shift per day, five day per week operating staff. The high temperatures involved in the incineration process combined with the nature of wastewater solids would likely result in operations and maintenance issues that may require more staff at the Wilsonville WWTP to manage the incineration process than would a Class B land application program using anaerobic digestion and cake storage.

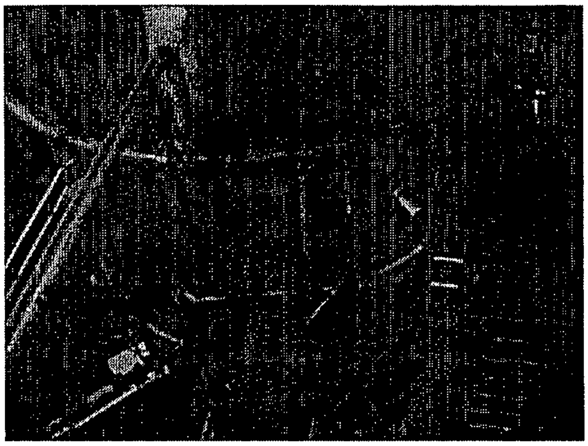


Figure 2. Fluidized bed furnace at Edmonds WWTP (courtesy of City of Edmonds, Washington).

Experience of Other Pacific Northwest Utilities

Several Pacific Northwest utilities currently use incineration to manage municipal wastewater solids. Washington utilities currently using incineration include Lynnwood, Anacortes, Edmonds, Marysville, Bellingham, and Vancouver. However, there are no municipal solids incinerators operating in the state of Oregon. Clean Water Services, the municipal wastewater utility for Washingon County, Oregon, previously incinerated solids but moved to a Class B biosolids land application program due to operational and other problems. Oregon law has promoted land application of biosolids since approximately 1990 (see later discussion under Current Regulatory Considerations). While Washington law currently indicates a similar preference, most of the facilities listed above were constructed prior to the 1990s, and some (such as Lynnwood and Edmonds) have been in operation since the late 1960s. Some have other constraints that favor incineration – the Edmonds facility, for example, is located in downtown Edmonds where minimizing truck traffic to and from the facility is a primary concern.

Incinerator Emissions

When properly designed and operated, municipal biosolids incinerators can completely combust the solids to produce emissions of carbon dioxide, water, and sulfur dioxide (National Biosolids Partnership, 2000). However, incomplete combustion of biosolids can produce hydrocarbons, volatile organic compounds (VOCs), and carbon monoxide, all of which can significantly degrade air quality. Particulates, some heavy metals, nitrous oxides, and sulfur oxides are also a concern in incinerator emissions.

Due to the vaporization of some heavy metals at the high temperatures of the incineration process, environmental release of heavy metals into the air is a significant concern. Metals expected to at least partially vaporize during incineration include cadmium, lead, mercury, and zinc (National Biosolids Partnership, 2000). Modern pollution control equipment can capture most of these metals, but mercury presents a challenge when vaporized.

Any solids incineration system must be designed with a significant amount of air pollution control equipment. Obtaining air quality permits is typically the most challenging part of implementing solids incineration. This issue is discussed further in the section titled Current Regulatory Considerations.

Ash Management

Incineration of wastewater solids reduces the volume to approximately 20 to 40 percent of the dry weight of the raw solids (National Biosolids Partnership, 2000). In fluidized bed incineration systems, most of the ash in carried out of the top of the furnace to be processed by the air pollution control equipment. Scrubbers remove the particulates using a water spray, then the particulate/water slurry is processed in a separator.

Ash can be beneficially reused, as it typically contains relatively high concentrations of phosphorus and potassium. Beneficial uses include agricultural fertilizer, and structural additive for building materials. There is no risk of pathogens in the ash, as they cannot survive the high temperature incineration process. For landfilling, ash required further concentration in a gravity thickener and potentially a dewatering device. Ash needs concentration to pass the Paint Filter Test, which is required for disposal in a landfill.

Current Regulatory Considerations

The Draft Facility Plan outlined current and potential future biosolids regulations and requirements, but did not consider the air quality regulations that would apply to a solids incinerator. The following sections presents a review of pertinent federal and state regulations.

Federal Requirements

40 CFR Part 503 Rule regulates emissions from municipal solids incinerators for total hydrocarbons (THC), carbon monoxide, and the following heavy metals:

- Arsenic
- Beryllium
- Cadmium
- Chromium
- Lead
- Mercury
- Nickel

The Rule uses different approaches for different heavy metals:

- "Risk-specific concentrations" (e.g. limiting the concentration in the feed solids) are used for arsenic, cadmium, chromium and nickel,
- The National Ambient Air Quality Standard (NAAQS) is used to regulate lead,
- A technology-based operational standard is used for total hydrocarbons, and
- The National Emissions Standards for Hazardous Air Pollutants (NESHAPS) are used for beryllium and mercury.

40 CFR Parts 50, 51, and 52 establish national ambient air quality standards. This regulation forms the basis of the Part 503 regulations for arsenic, cadmium, chromium, nickel, and lead. 40 CFR Part 61 is titled the National Emissions Standards for Hazardous Air Pollutants (NESHAPS), and Subpart E lists the requirements for beryllium and mercury emissions from municipal solids incinerators, which are 10 grams and 3,200 grams emitted in a 24-hour period, respectively. For all heavy metals, the Part 503 Rule regulates the feed solids concentration.

State Requirements

Wilsonville would need to obtain an Oregon Air Contaminant Discharge Permit (ACDP) prior to constructing an incinerator, as the City does not currently have one. A "Standard" version of the

ACDP would be required due to the potential to discharge hazardous pollutants, and the permit application fee is $10,000, not including the annual fee of $6,400. This permit would require a significant amount of effort to obtain, and would require an air quality model, dispersion testing, and a plan for ash disposal.

There are public notice requirements in the ACDP process that would alert plant neighbors to the fact that the City plans in construct and operate an incinerator at the plant. According to the Oregon Department of Environmental Quality (DEQ), current public perception of any type of incineration facility is very negative (Broad, 2003). Depending on the level of citizen concern with incineration, this process could force the City to abandon plans for solids incineration.

DEQ also indicates that mercury emissions are of particular to citizens and leaders across the state (Broad, 2003). DEQ would scrutinize any permit application or plan to emit mercury (such as a municipal solids incinerator), and may not permit such a facility. Additional investigation, potentially including pilot testing, would be required to determine whether or not incineration is a viable alternative from a regulatory perspective.

Finally, the Oregon Administrative Rules promote the land application of treated biosolids over other forms of disposal due to the agricultural value of the material. OAR 340-50-006 states that "The Environmental Quality Commission (EQC) encourages the land application of treated domestic wastewater biosolids, biosolids derived products, and domestic septage which are managed in a manner which protects the public health and maintains or improves environmental quality. These beneficial recyclable materials improve soil tilth, fertility, and stability and their use enhances the growth of agricultural, silvicultural, and horticultural crops." DEQ confirmed verbally that both DEQ and EPA would prefer land application of treated biosolids over incineration due to the beneficial reuse value of the biosolids product (Henderson, 2003).

Analysis of Alternative

The following sections describe the conceptual design of a solids incineration process at the Wilsonville WWTP.

Design Criteria

Digestion would not be necessary and is not desirable in combination with an on-site incineration process due to the following:

- Digestion results in a reduction in fuel value of the solids.
- Raw solids have enhanced dewatering characteristics compared to digested solids.
- There is a cost savings associated with eliminating the digestion process.

Therefore, the raw solids flows and loads would be applicable for design of an incineration process. According to the Draft Facility Plan, the annual average raw solids load at the initial expansion point would be approximately 9,000 lb/d, and the raw solids load at the ultimate expansion point would be approximately 15,500 lb/d.

Since the plant is not staffed 24 hours per day, seven days per week, the incineration process will need to be sized to process the solids during normal working hours to avoid increased staffing. Operation of storage/thickening and dewatering on a five day per week, eight hours per day schedule is assumed. This would allow thickening and dewatering operations to coincide with incineration without the need for additional solids storage.

Incineration Costs

Table 1 presents the estimated costs for an incineration system at Wilsonville, given the design criteria discussed in the previous section. Capital costs assume that an incineration facility capable of handling ultimate solids flows and loads would be constructed in the initial expansion. Therefore, no capital expenditures would be necessary for the ultimate expansion, as shown in Table 1. The table shows that incineration is cost intensive, both in capital and O&M costs.

Table 1. Estimate of Probable Capital and Operating Costs for Solids Incineration.

Capital Costs	Initial Expansion (3.4 mgd ADWF)	Ultimate Expansion (4.4 mgd ADWF)
Fluidized Bed Furnace	$ 1,200,000	$ -
Sludge Storage/Blend Tank	$ 250,000	$ -
Sludge Feed Pump (Piston)	$ 150,000	$ -
Fluidizing Blower	$ 350,000	$ -
Heat exchanger	$ 250,000	$ -
Fuel Storage and Feed System	$ 100,000	$ -
Air Pollution Control Equipment	$ 750,000	$ -
Ash Thickening and Dewatering	$ 500,000	$ -
Ancillary Equipment	$ 250,000	$ -
Building	$ 900,000	$ -
Misc. Utilities	$ 25,000	$ -
Electrical and Controls @ 20%	$ 1,417,500	$ -
Sitework @ 15%	$ 945,000	$ -
Subtotal A	**$ 7,087,500**	**$ -**
Misc. Costs Not Itemized (30% of A)	$ 2,126,250	$ -
Subtotal B	**$ 9,213,750**	**$ -**
Mobilization and Bonds (8% of B)	$ 737,100	$ -
Contractor Overhead and Profit (15% of B)	$ 1,382,063	$ -
Subtotal C	**$ 11,332,913**	**$ -**
Engineering, Legal, Admin. (25% of C)	$ 2,833,228	$ -
Total Capital Costs	**$ 14,166,141**	**$ -**
Annual Operations and Maintenance Costs		
Labor	$ 108,000	$ 126,000
Electricity	$ 70,000	$ 70,000
Fuel	$ 146,000	$ 244,000
Water	$ 82,500	$ 138,000
Spare Parts and Misc. Materials	$ 20,000	$ 20,000
Disposal (Landfill)	$ 45,000	$ 75,000
Annual permit fee	$ 6,400	$ 6,400
Total Operations and Maintenance Cost	**$ 471,500**	**$ 673,000**

Annual labor costs for the incineration options equate to approximately 1.7 full time equivalent (FTE) employees associated with the incineration process. These costs are associated with startup and shutdown during each shift, management of the ash product, and maintenance resulting from high wear and tear due to the frequent heating and cooling cycles. These annual O&M costs are approximately 50% higher than the most expensive alternative examined in the Facility Plan.

Advantages and Disadvantages of Solids Incineration

Table 2 lists the advantages and disadvantages of incineration versus a land application program for biosolids management. The disadvantages of incineration appear to outweigh the advantages, mainly due to permitting, public acceptance, and operations and maintenance costs.

Table 2. Advantages and Disadvantages of Incineration.

Advantages	Disadvantages
Large solids volume reduction	Potential emission of hazardous air pollutants
Minimal truck traffic in and out of treatment facility	Difficult and expensive permitting process
Enhanced solids dewatering	Negative political and public perception
Space savings at plant	Energy intensive
	Maintenance intensive
	Destruction of valuable organic fertilizer; loss of economic benefits to local agricultural community

Recommendations

While incineration is potentially a viable option for solids management at Wilsonville, it is not the preferred option due to stringent and potentially unattainable permitting requirements, high operations and maintenance costs, and the potential negative perception of neighbors in the immediate vicinity of the treatment plant. Incineration does remove pathogens beyond levels achieved in a Class B system, and significantly reduces the volume of solids leaving the plant site. However, these benefits can also be achieved through a Class A treatment process, which allows continued use of the treated biosolids for land application as is preferred by EPA and DEQ at a lower cost than incineration. Therefore, incineration is not recommended for further consideration.

References

Broad, J. (2003), Oregon Department of Environment Quality, personal communication.

Henderson, B (2003), Oregon Department of Environmental Quality, personal communication.

National Biosolids Partnership, (2000), National Manual of Good Practice for Biosolids.

USEPA (1979), Process Design Manual: Sludge Treatment and Disposal.

USEPA (1994), A Plain English Guide to the Part 503 Biosolids Rule.

Water Environment Federation (1994), Beneficial Use Programs for Biosolids Management.

Water Environment Federation (1998), Design of Municipal Wastewater Treatment Plants, Manual of Practice 8.

HDR | ONE COMPANY *Many Solutions*℠

Memo

To:	Laurel Byer – City of Wilsonville		
From:	Heather Stephens – HDR	Project:	Wilsonville Wastewater Facility Plan
CC:	Eldon Johansen – City of Wilsonville Mike Stone – City of Wilsonville Ron Morrow – City of Wilsonville John Holroyd – HDR		
Date:	November 3, 2003	Job No:	10333-005-102

Document1

RE: Planning Commission/Council Questions on Draft Facility Plan

This memorandum describes HDR's responses to questions posed by the Planning Commission and City Council subsequent to initial review of the Draft Facility Plan.

1. *What are the possibilities of the City using an incinerator for our solids like Vancouver does? Can we then use the ash for the production of concrete?*

   A separate memorandum has been prepared to address this question. While incineration may be a viable option, it is not the preferred biosolids management alternative.

2. *Woodburn owns land that they use for biosolids handling where they grow poplar trees and then sell the trees to paper mills for pulp. Can we do this in the urban park areas to grow trees? ..... If not urban parks, other options?*

   This would be an excellent use of the solids. However, the EPA and Oregon DEQ have strict requirements for how biosolids are used depending on the type of treatment provided. The restrictions on the use of Class B biosolids, which the City currently produces, require that public access to sites be restricted for a period after the application. There is also growing concern among the public on a national level with respect to the public health impacts of exposure to sewage sludge.

   In order to alleviate public concerns and reduce the restrictions on use of the biosolids, the City would need to employ a different technology than is typically recommended – one that provides a higher level of treatment than currently provided (or than recommended in the short term in the Facility Plan) to produce Class A biosolids. The additional cost of this treatment is approximately $3 million.

   Finally, this use would only account for a small fraction of the biosolids produced at the City's treatment facility. Therefore, while it would be a good beneficial reuse and demonstration of the public benefits of the City's treatment process (presuming Class A treatment is provided), it would not be the primary means of biosolids reuse.

3. *Portland captures methane in their treatment processes to create fuel cells for local businesses.*

   The City's existing aerobic digestion process does not produce methane. The Facility Plan recommends moving to anaerobic digestion as the plant loading increases (a new anaerobic digester complex is part of the Phase 2 improvements). When this change is made, the design would include a digester gas (methane) recovery process. At a minimum, it is likely that the recovered methane could be used to serve some of the needs at the plant site (perhaps heating for a Class A treatment process, building heat, etc.)

4. *Silverton land applies at the Oregon Gardens. Are they at capacity or are they shopping for more?*

   The City of Silverton actually only sends the Oregon Gardens a fraction of the flow that it planned. The City's goal was to send most or all of the flow to the Garden during the summer irrigating season, and use the river outfall primarily during the winter. In reality, due to limitations in the Garden's need and the available infrastructure, the Silverton plant discharges to the River year-round.

5. *Hillsboro and Salem both have pilot studies going on for wetland treatment of effluent. Is this something that Wilsonville could look into instead of discharging to the River?*

   This is an option that the City could look into, particularly if temperature becomes a problem after the Willamette Temperature TMDL is completed. However, it is important to understand that wetland treatment such as Salem's Natural Reclamation System is not an end use – discharge to a River or reuse of the effluent would still be required. The Facility Plan evaluated effluent reuse as an option to providing a higher level of treatment at the treatment plant. This analysis determined that the City would need to find approximately 1,000 acres of irrigable land per 1 mgd of effluent diverted from the river.

6. *Are Living Machines an appropriate technology for Wilsonville?*

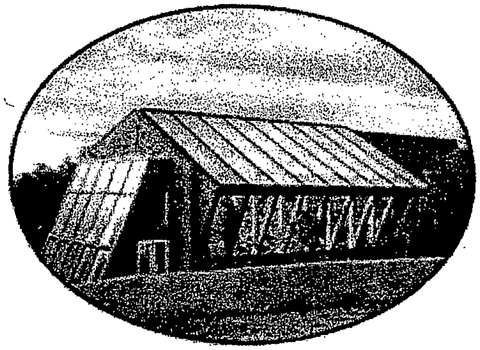
   Based on a limited review of Living Machines, the application at Wilsonville is summarized as follows:

   - Plant-based treatment systems are generally very land intensive. The Living Machines seem to have overcome this somewhat by incorporating plant growth in more conventional treatment processes, however it is highly unlikely all of Wilsonville's projected flow (even under the low flow projection) could be treated using Living Machines on the existing plant site. There are no typical design criteria available, so it's difficult to say exactly what the facility footprint would be. However, for comparison, John Holroyd previously assisted the City of Ashland in evaluating the use of Living Machines for discharge from a duck pond in a public park, and the land requirements led the City to drop this alternative.

   - The systems currently in operation are very small - generally under 100,000 gpd. They are used at industrial facilities, small developments, etc. Applying this technology for full scale treatment at a large municipal facility is untested.

   - The City would still have a river discharge, and be subject to an NPDES permit under DEQ. While the Living Machines are typically promoted as "total reuse" systems, they rely on the Owner having a land application site available for effluent reuse. A brief analysis of reuse in the Facility Plan showed that, while it could be a component of the City's overall effluent management strategy (provided chlorination is added), the City could not likely divert enough flow to reuse to change the type of treatment required. In other words, the City would need to employ treatment processes to meet stringent future NPDES permit requirements, in addition to incurring the capital and operating cost of a reuse system.

ubmitted by Debra Iguchi



Biolarium space with Living Machine™ System at the Latir Mountain Ranch - NM - USA

Living Machines, Inc. was formed for the purpose of providing a natural-systems approach to wastewater treatment using the principles of ecological design and engineering. Since its beginnings, Living Machines, Inc. has been involved with the design, construction, and operation of innovative wastewater treatment facilities for communities, educational institutions, resorts, and industrial users. These facilities, which include more than thirty commercial-scale and pilot facilities located throughout the United States and seven other countries, range in size between 300 and 750,000 gallons per day. Given this diverse and extensive experience Living Machine™ systems have become the most recognized brand in the evolving field of eco-engineering and the development of natural wastewater treatment technology.

Living Machines, Inc. designs ecologically engineered treatment systems for advanced wastewater treatment. Every Living Machine™ system has three simple and practical design criteria; high quality effluent with potential for reuse, stable operation, and aesthetic appeal. We design systems for decentralized wastewater treatment for medium and small flows with sizes ranging from towns and suburban developments to households. In these markets, a wastewater treatment system must enhance the neighborhood where it is located. A Living Machine™ system does this and more by providing a lush green facility that is both practical and beautiful.

Possibly the greatest value in the Living Machine™ system is the inherent potential for reuse of the high quality treated effluent. Potential re-use options include

- Agricultural and landscape
- Industrial activities such as cooling and process needs
- Groundwater recharge
- Recreational and environmental uses such as golf courses, parks, and habitat restoration
- Non-potable urban uses, such as toilet flushing, fire protection, and construction

Living Machines, Inc. is part of the Dharma group of companies, a multi-disciplinary environmental solutions corporation. Among our various services and products, we offer land-use planning and sustainable architecture in addition to safe, secure chlorine-free water disinfection systems that eliminate undesirable by-products and the need for expensive Risk Management Programs (RMP).

For more information or to inquire about partnering opportunities for developers, architects consultants, and contractors contact us at:

LIVING MACHINES, INC.
125 LA POSTA RD.-8018 NDCBU
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Living Machines, Inc.

Site Navigator...

The Living
Machine

Technical background to the Living Machine Waste Water Treatment System

The research behind this technology has been carried by Dr. John Todd, an eminent Canadian biologist, through the non-profit research organisation - Ocean Arks International of Falmouth, Massachusetts. For his work in pioneering the development of Living Machines, Dr. Todd has received a number of honours including the Teddy Roosevelt Conservation Award from the White House in 1990, and the Chrysler Award for Industrial Design in 1994.

PERFORMANCE

This will vary according to circumstances. At Findhorn for example, the objective is to treat sewage to advanced wastewater treatment (tertiary) standards. The following table provides information on the influent and effluent of the Living Machine at Findhorn.

1	BOD before treatment 250 mg/l	after treatment less than10 mg/l
2	TSS before treatment160 mg/l	after treatment less than 10 mg/l
3	TKN before treatment 40 mg/l	after treatment less than 10 mg/l
4	NH4 before treatment 50 mg/l	after treatment less than 2 mg/l
5	NO3 before treatment 0 mg/l	after treatment less than 5 mg/l
6	TP before treatment 7 mg/l	after treatment less than 5 mg/l

1 **BOD** =	Biological Oxygen Demand, (the oxygen being consumed by the wastewater)
2 **TSS** =	Total Suspended Solids (the level of solids suspended in the water)
3 **TKN** =	A measure of the nitrogen level in the water
4 **NH4** =	Ammonia levels in the water
5 **NO3** =	Levels of nitrate in the water. The system converts ammonia into nitrates and then to nitrogen gas
6 **TP** =	Total phosphorous levels

DESIGN

Again using the Findhorn example, the Living Machine is housed in a single-span greenhouse, approximately 10 Metres (M) wide by 30 M long. The flow from the Park at Findhorn has a loading of approximately 300 person equivalents. In other words about 50m3 waste water per day.

Anaerobic Primary

The first component of the treatment process is 3 anaerobic bioreactors buried

Case Study I

"As we move into the 21st century we all need to be developing ways to manage waste using ecological systems. Supporting projects like the Living Machine™ system is consistent with a progressive and forward-thinking economic development strategy"

- Chuck Hafter, South Burlington City Manager

Over 350 plant species have been tested at the South Burlington Living Machine®.

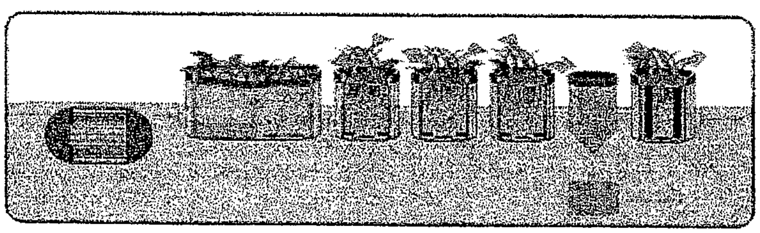
South Burlington, Vermont...
is located on the shores of beautiful Lake Champlain.

South Burlington's Living Machine® is located close to Lake Champlain.

South Burlington was established in 1865 following a break from the city of Burlington. The current population of the community is 13,000 citizens.

Background
Built in late 1995, the South Burlington Living Machine™ system was ramped-up to full design flow by April 1996. This facility was built with a grant from the Environmental Protection Agency for innovative technology. This Living Machine™ system has demonstrated excellent treatment performance, even at very cold temperatures.

Waste
The South Burlington Living Machine™ system treats 80,000 gallons per day of municipal sewage, an amount typically generated by approximately 1,600 residential users. The waste stream is diverted from the City's conventional treatment plant.



Process
Sewage flows to a greenhouse with two treatment trains, each with five aerobic reactors, a clarifier and three Ecological

Fluidized Beds. The open aerobic reactors have aerators and are planted with a variety of aquatic plant species in floating plant racks. The air and plants provide an environment that hosts a variety of organisms that eat the waste in the wastewater. Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS) are reduced and ammonia nitrified in this stage of treatment. A clarifier follows the open aerobic reactors to settle out the solids.
Ecological Fluidized Beds (EFBs) in each train follow the clarifier for final 'polishing'. These beds operate aerobically and provide final polishing, nitrification, and suspended solids digestion.

Benefits
Designed to achieve stable nutrient removal, this Living Machine™ system is a cost-competitive, alternative treatment to a conventional system. With its aesthetic beauty and lack of offensive odor, this system is also compatible with a residential environment.

Education and Community Outreach
The South Burlington Living Machine™ system is also used as a teaching tool for many different schools and universities in the region. Elementary, middle and high school science students tour the facility for first hand lessons on ecology, engineering and environmental stewardship. University students get more involved in the intricacies of each ecosystem, and research. Living Machines Inc.has provided many students the opportunity to work in and around the Living Machine™ system.

Wastewater Characteristics	Units	Influent	Target Effluent	Actual Effluent
Chemical Oxygen Demand (COD)	mg/L	454	<50	31
Biochemical Oxygen Demand (BOD)	mg/L	219	<10	5.9
Total Suspended Solids (TSS)	mg/L	174	<10	4.8
Total Nitrogen	mg/L	23	<10	2.2
Total Kjeldahl Nitrogen	mg/L	23	5	1.3
Ammonia	mg/L	14.0	1	0.25
Total Phosphorous	mg/L	4.8	3	2.2
Fecal Coliform	col/100ml	9,380,833	<2,000	1177

Home | Living Machines, Inc.
For The Planet | Case Studies

Living Machines, Inc.

MERTS Phase III, "The Living Machine®"
A Cost-Effective Means To Clean Waste Water

Innovative And Ecologically Sound Wastewater Treatment - The First Of Its Kind In The Pacific Northwest

Tours

How It Works

MERTS Living Machine® History

Construction archives

Dedication Ceremony

A cost-effective pilot program which uses aquatic plants and creatures to clean wastewater is now the operational sewage treatment plant for the MERTS Campus at South Tongue Point.

This facility, a modified greenhouse, is a valuable component of the MERTS campus and its vision, providing a regional demonstration site. Representatives of smaller communities, business and industry are welcome to visit this unique installation to learn how to adapt the technology to their own needs.

Such systems can be found in a number of locations around the country and the globe. A company based in Taos, New Mexico, provided the final engineering for installation of the aptly-named "Living Machine®" at the South Tongue Point site. The company, Living Machines Inc., estimates that the Living Machine® costs half that of a wastewater system which would pump South Tongue Point's waste stream to the city's treatment lagoon.

The MERTS campus Living Machine® system is split into two treatment trains to facilitate operational flexibility and the support of research initiatives. A series of ecological habitats housed in small fiberglass tanks will serve as the main treatment components in the system. The final polishing of the wastewater takes place in constructed wetlands followed by an ultraviolet disinfection unit. All of these processes take place within greenhouse enclosure. See How It Works for a condensed look at the step-by-step process.

For more information, contact Ann Gyde (503) 338-2304 or email agyde@clatsopcc.edu

Project Associates

United States EPA | DEQ | Living Machines, Inc. | MERTS | Clatsop Community College
Portland State University | Oregon Graduate Institute | Mahlum Architects

Submitted by Debra Iguchi

The Sunday Oregonian

Metro

SUNDAY ♦ OCTOBER 12, 2003 NEWSROOM ♦ 503-221-8100

FREDRICK D. JOE/THE OREGONIAN

Gary Taylor and Tuong Nguyen (mostly obscured), workers at the Columbia Boulevard Wastewater Treatment Plant in Portland, prepare to do some maintenance on one of the plant's 1.4 million gallon clarifiers, which allow sludge to settle to the bottom and wastewater to be drained off the top. The plant is the largest in Oregon, producing about 45 truckloads of sludge per week.

Scientists question safety of sludge

Dozens of environmental groups petition the EPA for a ban on using sludge as a fertilizer, warning about its contents

By **ALLISON PYBURN**
THE OREGONIAN

For more than 30 years, Oregon's farmers have spread tens of thousands of tons of treated sewage sludge on their fields as fertilizer, assured by state officials that it is safe for people and crops.

Now, a growing number of scientists and former government officials contend those assurances are unfounded. They say the government has done little testing to establish safe limits for an array of potentially toxic chemicals that can taint ordinary sewage.

Last week, 73 environmental groups petitioned the Environmental Protection Agency for a national ban on the use of sludge as a fertilizer, saying its contents are "inherently unpredictable and inherently hazardous." The federal agency has 60 days to respond.

The issue has implications across the state. Portland disposes of more than 12,000 dry tons of sludge

Please see **SLUDGE,** Page B2

V. PUBLIC HEARING

Application No. 02PC05

Request: **Adoption of a Wastewater Facility Plan Update**

Location: **Citywide**

Applicant: **City of Wilsonville**

Commission members; please bring your Draft Wastewater Facility Plan that was reviewed at the January 8, 2003 meeting.

October 9, 2003

Sludge: State officials don't track health complaints

Continued from Page B1

a year. Most of it ends up on fields in Eastern Oregon. Cities of all sizes, from Eugene to Canby, similarly send their sludge to farmers who grow grass seed, hay and other crops.

Under pressure from a lawsuit filed in Oregon, federal officials are now weighing whether to impose limits on dioxins, some of the most hazardous chemicals known to man. A decision is expected this week.

Critics say the EPA should go much further. They note that European countries are considering much tighter rules on the amount of pollutants sludge can contain.

Oregon follows federal rules on what constitutes safe sludge. Those regulations require sewage plants to test for only about 1 percent of the chemicals in sludge, according to Robert Hale, a marine science professor at the Virginia Institute of Marine Science who studies organic chemicals in sludge.

Among the substances that go unregulated: testosterone, caffeine and polybrominated diphenyl ethers, a widely used ingredient in flame retardants.

"I'd like nothing more than saying, why don't you bring in a couple truckloads to my property? ... but I wouldn't do it," said Hale, who grazes horses on several acres in Southeast Virginia.

Industry officials defend the existing program and say it has played a crucial role in the cleanup of America's rivers and streams. Sludge, they say, is a cost-effective fertilizer that can bring lifeless, even polluted, soil back to life. Few people in the United States have reported adverse health effects from sludge, they say.

Kent Madison, who uses Portland's sludge on his ranch in Echo, told the city that the fertilizer helped his field so much that after 12 years, he was grazing 1,800 cattle on land that used to feed 250.

Dewey Hofer has been spreading sludge on his grass seed fields near Eugene for the past five years. He said he fertilizes 200 to 300 acres of his fields for free, saving him about $7,500 a year.

"It's become very popular in the area," Hofer said, "and sometimes, there's not enough to go around."

In Oregon, there have been scattered reports ranging from burning eyes and difficulty breathing to diarrhea. But the state, like the EPA, has no specific way of tracking health complaints about sludge sites.

Florence city officials in 1996 settled a lawsuit after two families drank tap water contaminated with virtually untreated sludge. The families received about $300,000, said Will Pritchett, the group's lead plaintiff. The city wouldn't confirm the amount.

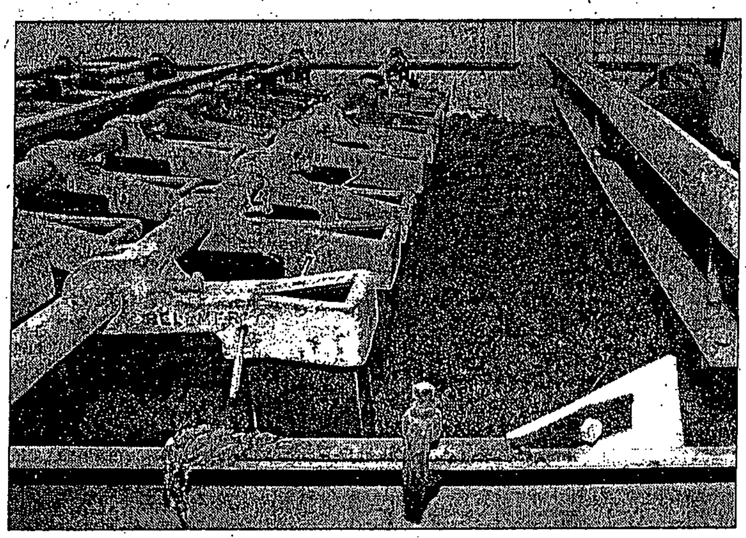
"I had diarrhea for months," Pritchett said.

Critics say the potential dangers from ingesting or breathing low levels of toxic chemicals or pathogens are difficult to detect without conducting detailed, long-term scientific studies. Some people may be suffering from sludge-induced illnesses without knowing the cause, they say.

In Georgia, a jury in June awarded a farmer $550,000 after 300 cows died after eating hay grown on a field fertilized with sludge.

In California, water quality officials cited the city of Atwater in 1996 for excessive sludge applications after 13 cows on two farms died of nitrate poisoning.

Oregon has invested little to track either the spreading of sludge or its chemical composition. The DEQ has the equivalent of three employees to keep an eye on the state's 332 treatment plants capable of producing more than 60,000 dry tons a year of sludge.



FREDRICK D. JOE/THE OREGONIAN

Sludge moves through a belt-filter press designed to separate water from dry matter at the Columbia Boulevard Wastewater Treatment Plant. The material entering the machine is about 3 percent dry matter and comes out about 20 percent dry matter.

> *"I'd like nothing more than saying, why don't you bring in a couple truckloads to my property? ... but I wouldn't do it."*
>
> **ROBERT HALE,**
> PROFESSOR, VIRGINIA INSTITUTE OF MARINE SCIENCE

◆

Chris Rich, a Portland environmental lawyer who spent four years in the DEQ's enforcement section, said the agency doesn't have enough staff to properly approve sludge site applications, much less to monitor them after they're approved.

"The concept that nothing has gone wrong or can go wrong is wrong," Rich said.

The history of sludge

The mountain of sludge disposed of each year can be traced to the good intentions of Congress.

In 1972, when lawmakers passed the Clean Water Act, most sewage sludge was poured untreated into the nation's rivers and oceans. The law required cities to treat their waste and offered billions in federal dollars to create and expand sewage treatment plants that could filter out sludge and pollutants from water.

The sludge had to be put someplace.

One option was fields and pastures. It was cheaper than landfills or incineration. Cities had until 1992 to stop dumping sludge into water.

From the beginning, federal officials understood that sludge could contain a wide array of chemical and organic pollutants. Creating rules to regulate a substance that some within the agency viewed as toxic waste was a challenge.

In 1987, Congress ordered the EPA to create rules to protect people and the environment when sludge is applied to land.

When the EPA missed its deadline to create the rules by several years, an Oregon group, Citizens Interested in Bull Run, sued the agency in 1991.

The case pushed the EPA to finish its first sludge regulations in 1993.

"That was our intention back then — to get them on the stick," said Frank Gearhart of Gresham, the group's president. "However, they're still dragging their feet."

Oregon system barely working

The system that evolved has safeguards. Cities must get the DEQ's approval before spreading sludge on a site. They must pick sites that are relatively flat and dry, and stay away from wells and rivers to avoid contaminating water.

The public is supposed to have limited contact with the sludge for a year, animals can't graze on it for 30 days, and farmers have to wait anywhere from several months to several years to grow certain types of crops.

At times, the agency's records show that local authorities seem to have trouble following the rules. State officials don't have time to visit most sludge sites unless they receive a complaint.

A DEQ database includes 74 sludge related complaints dating from 1990. But nearly half of them were reported between 2000 and 2002.

Forty people complained that treatment plants or commercial companies failed to follow procedures when spreading sludge. Twenty-eight complained about odors, and five said sludge had made them sick.

Two Florence families, their friends and relatives became ill in 1996 after a giant sprinkler-like device called a "big gun" malfunctioned, causing what the city estimated was 300 gallons of sludge to flow down a hillside and into a creek from which the families drew their water.

The sludge was applied inappropriately for seven months, according to court documents. And the city had been in such a hurry to get rid of the sludge that it was virtually untreated to reduce pathogens, according to court and DEQ documents.

In addition to settling with the families, the city was fined $7,200 by the DEQ.

A Metolius family in 1998 abandoned their home after it became flooded during a rainstorm with sludge applied to a nearby hillside.

The DEQ paid part of a $45,000 settlement.

The Oregon attorney general's office, which provides DEQ with legal representation, promptly urged DEQ to take protective action — not against sludge mishaps but against lawsuits aimed at the agency.

An assistant attorney general counseled the agency to include a "defend and hold harmless" agreement in future DEQ sludge permits.

"Even though these matters may be 100 percent safe, or at least comparable to any other type of human activity or commercial fertilizer, the perception of industrial and human waste being added in an environment close to areas where people live can create a perfect recipe for a lawsuit," wrote Robert Patterson of the attorney general's office.

In the summer of 2002, a group of parents complained repeatedly to the DEQ when their children, playing little league baseball, tromped through sludge while retrieving baseballs from a field across from Beavercreek Elementary near Oregon City.

The DEQ hung warning signs on the fence surrounding the field and required that the sludge be spread farther away from the fence.

Science

Pressure from scientific reports, lawsuits and self-proclaimed sludge victims is pushing the EPA to prove that its 1993 sludge regulations are tough enough.

A 2002 report by the agency's office of the inspector general said the EPA "cannot assure the public that current land application practices are protective of human health and the environment."

A report by the National Academies of Science the same year pointed out the agency hasn't updated the science on which it bases its chemical limits for more than a decade.

For now, Oregon follows the EPA's rule that calls for limiting amounts of nine heavy metals in sludge. Treatment plants also must reduce pathogens and check pH levels. Oregon law also requires treatment plants to check nitrogen levels in fields.

Some plants conduct more tests than required. Portland, for example, has tested its sludge for dioxin levels for years and has conducted human health tests from time to time.

In July, nearly 200 sewage officials, scientists and sludge victims attended a research summit on sludge in Alexandria, Va. The group set as its top priority further study of whether sludge is causing illness. Participants also recommended an updated test of the kinds of pathogens and chemicals in sludge.

"This is not a low-risk situation," said Ellen Harrison, who heads Cornell University's Waste Management Institute. Harrison, a member of the NAS committee, has compiled a list of more than 300 people during the past 10 years who say they became ill from sludge.

Partly in response to the NAS report and lawsuits, the EPA is considering a group of 799 pollutants for further study. Chemicals that will be considered for further study will be announced in January.

Even most critics acknowledge that it's not practical to test for every pollutant in sludge. For example, a single sample of dioxins typically costs at least $1,000 to analyze.

"To test for several hundred chemicals, or even all 800 chemicals would be an extremely expensive procedure," said Alan Rubin, an EPA senior scientist who helped draft the sludge regulations.

John Walker, an EPA official who has long backed sludge as a fertilizer, said he knows there is growing concern that sludge is causing illnesses.

"Personally, I don't know whether it does or not, but I want to find out what the exposure limits are," he said.

Hale, the Virginia Institute of Marine Science professor and an organizer of the July summit, said he's seen a shift in attitude at the EPA.

If someone raised a question about biosolids a year ago, no one would take them seriously, Hale said. "Now they're starting to say, 'Yeah, we need to get more information on it,'" he said.

◆

Allison Pyburn: 503-294-5920; allisonpyburn@news.oregonian.com

Planning Commission
02PC05 November 12, 2003
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City of
WILSONVILLE
in OREGON

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STAFF REPORT
WILSONVILLE PLANNING DIVISION
Wilsonville Planning Commission

HEARING DATE: October 8, 2003

DATE OF REPORT: October 1, 2003

APPLICATION NO.: 02PC05

REQUEST: Update the Wastewater Facility Plan, April 1995, to plan and provide for adequate wastewater facilities for the City of Wilsonville.

APPLICANT: City of Wilsonville

CRITERIA: Statewide Planning Goals #6 and #11; Wilsonville Comprehensive Plan: Public Facilities & Services Policy 3.1.1. and 3.1.4; Wilsonville Code Sections 4.000-4.033, and 4.198

STAFF REVIEWER: Eldon Johansen, Community Development Director; Mike Stone, City Engineer; Laurel Byer, Assistant City Engineer; Ron Morrow, Environmental Services Manager

DESCRIPTION OF ACTION:
Adopt the Wastewater Facility Plan Update, November 2002.

BACKGROUND/SUMMARY OF ISSUES:
The Wastewater Facility Plan was updated in April 1995. Since then, the City's vision of future growth has changed, as has the regulatory environment. The City, with HDR Engineering, Inc. assistance, undertook to update the Plan. The Wastewater Facility Plan Update, November 2002, was distributed to the Planning Commission in October 2002, and summarized at the January 8, 2003 Planning Commission meeting where the issues were outlined and discussed.

Since the January 8, 2003 Planning Commission meeting, City staff directed HDR Engineering, Inc. to further investigate Biosolids Handling options. The result of the analysis is included as Exhibit '3' attached to the staff report. The public hearing for the Wastewater Facility Plan Update was also deferred until City staff and the Planning Commission was complete with the review and approval process for the first phase of Villebois.

City staff is now satisfied that the Wastewater Facility Plan Update is ready for public hearing. The Planning Commission has the authority to recommend any changes to the Wastewater Facility Plan Update based on the record created by the conclusion of the Commission's hearing on this matter.

CONCLUSIONARY FINDINGS:

Statewide Goal 6:
To maintain and improve the quality of the air, water and land resources of the state.

Finding 1. In that the proposed Wastewater Facility Plan Update provides guidance for the necessary wastewater infrastructure, and provides for coordination within the applicable river basins, and addresses state environmental quality statutes, rules, standards and implementation plans; this proposed Plan meets Statewide Goal 6.

Statewide Goal 11:
To plan and develop a timely, orderly and efficient arrangement of public facilities and services to serve as a framework for urban and rural development.

Finding 2. In that the proposed Wastewater Facility Plan Update does not propose to extend the sewer system outside the urban growth boundary, and does provide for future wastewater and services based upon anticipated demand at the time required to provide the service, financial cost, and levels of service needed and desire; this proposed Plan meets Statewide Goal 11.

Comprehensive Plan Public Facilities and Services Goal 3.1:
The City's Goal 3.1 is to assure good quality public facilities and services are available with adequate capacity to meet community needs and are in harmony with the community's commitment to provision of adequate facilities and services.

Policy 3.1.1 The City of Wilsonville shall provide public facilities to enhance the health, safety, educational and recreational aspects of urban living.

Finding 3. In that the proposed Wastewater Facility Plan Update assures provision of adequate wastewater facilities for the existing development and for future buildout of the City, the proposed Plan complies with this Policy.

Policy 3.1.4 The City of Wilsonville shall continue to operate and maintain the wastewater treatment plant and system in conformance with federal, state, and regional water quality standards.

Finding 4. In that the proposed Wastewater Facility Plan Update provides a plan and proposed schedule for the future expansion of the wastewater treatment plant based upon existing development and for future buildout of the City, all in conformance with the appropriate federal, state, and regional water quality standards, the proposed Plan complies with this Policy.

Development Code Sections 4.000 – 4.033.
Sections 4.000 through 4.003 lists the requirements for bringing applications to public hearings.

Finding 5. In that the Planning Commission public hearing was duly noticed, the proposed Wastewater Facilities Plan complies with local notice and procedural requirements.

Finding 6. In that Chapter 2 of the Wilsonville Code grants the Planning Commission the authority to review and make recommendations to the City Council on legislative changes to, or adoption of new elements or sub-elements of, the Comprehensive Plan; the Planning Commission has the authority to recommend any changes to the Wastewater Facility Plan that it finds to be needed, based on the record that will created by the conclusion of the Commission's hearing on this matter.

Wilsonville Development Code Section 4.198, Wilsonville Comprehensive Plan Changes:
Proposed Wilsonville Plan amendments must be submitted in compliance with notice procedures in Section 4.008, including a public hearing duly advertised. Proposed text changes must show compliance with applicable Comprehensive Plan Goals; that the public interest is served and best served by approving an amendment at this time, and that there are no conflicts with applicable State requirements.

Finding 7. In that a public need is best served by updating the Wastewater Facility Plan at this time as the additional sewage flows from the Coffee Correctional Facility, the Villebois development, and Urban Reserve Areas were not anticipated in 1995, the proposed Wastewater Facility Plan Update meets an identified public need.

Finding 8. In that the proposed language amendment updates an ancillary document (Wastewater Facility Plan) to the Comprehensive Plan, and in that no changes are proposed to Comprehensive Plan goals or policies; the proposed update to the Wastewater Facility Plan will not result in conflicts with any portion of the Comprehensive Plan that is not being amended.

Finding 9. In that the Wastewater Facility Plan Update supports applicable Statewide Planning Goals, this finding has been met.

Finding 10. In that the public hearing for 02PC05 was duly noticed, the requirement in Development Code Section 4.012 has been met.

SUMMARY FINDINGS:

Finding 11. Based on the findings of fact, analysis, and Conclusionary Findings 1 through 10 of this Staff Report, the proposed Wastewater Facility Plan Update meets all applicable standards and requirements.

STAFF RECOMMENDATION:
Based on the Findings of Fact and information included in this Staff Report; and based on information received from a duly advertised public hearing, Staff recommends that the Planning Commission adopt Resolution No. 02PC05, which recommends City Council adoption of the Wastewater Facility Plan Update.

EXHIBITS:

1. Draft Resolution No. 02PC05
2. DRAFT Wastewater Facility Plan Update, November 2002
3. Additional Biosolids Treatment Alternatives Technical Memorandum, HDR Engineering, Inc., October 2003.
4. Background information on Facility Plan Update process.
   a. A memorandum dated November 7, 2002, from Eldon Johansen, regarding Draft Wastewater Treatment Plant Facilities Plan.
   b. HDR Engineering, Inc. Slideshow Presentation from January 8, 2003.
   c. Adopted minutes of the January 8, 2003, Planning Commission Work Session for 02PC05.

Exhibit 1

PLANNING COMMISSION
RESOLUTION NO. 02PC05

A WILSONVILLE PLANNING COMMISSION RESOLUTION RECOMMENDING THAT THE CITY COUNCIL ADOPT A WASTEWATER FACILITY PLAN UPDATE, FOR THE CITY OF WILSONVILLE.

WHEREAS, the Wilsonville City Engineer submitted proposed Wastewater Facility Plan Update to the Planning Commission, along with a Staff Report, in accordance with the public hearing and notice procedures that are set forth in Sections 4.008, 4.010, 4.011 and 4.012 of the Wilsonville Code (WC); and

WHEREAS, the Planning Commission, after providing the required notice for a October 8, 2003 Public Hearing, to review the proposed Wastewater Facility Plan and to gather testimony and evidence regarding the proposed Wastewater Facility Plan; and

WHEREAS, the Commission has afforded all interested parties an opportunity to be heard on this subject and has entered all available evidence and testimony into the public record of their proceeding; and

WHEREAS, the Planning Commission has duly considered the subject, including the staff recommendations and all the exhibits and testimony introduced and offered by all interested parties; and

NOW, THEREFORE, BE IT RESOLVED that the Wilsonville Planning Commission does hereby adopt all Planning Staff Reports along with the findings and recommendations contained therein and, further, recommends that the Wilsonville City Council approve and adopt the Wastewater Facility Plan Update, as reviewed by the Planning Commission; and

BE IT RESOLVED that this Resolution shall be effective upon adoption.

ADOPTED by the Planning Commission of the City of Wilsonville at a regular meeting thereof this 8th day of October 2003, and filed with the Planning Administrative Assistant on ________________________, 2003.

____
Wilsonville Planning Commission

Attest:

____
Linda Straessle, Administrative Assistant I

SUMMARY of Votes:

Chair Iguchi:	______
Commissioner Hinds:	______
Commissioner Faiman:	______
Commissioner Guyton	______
Commissioner Maybee:	______
Commissioner Pruitt:	______
Commissioner Wortman:	______

Exhibit 2

Consists of the
Draft Wastewater Facility Plan Update,
dated November 2002.

Exhibit 3

Technical Memorandum
Additional Biosolids Treatment Alternatives

Summary

The City of Wilsonville currently land applies aerobically digested (Class B) liquid biosolids on local farms through a year-round land application program. Through the ongoing efforts of Environmental Services staff, the City has developed strong agricultural partners that accept biosolids for soil augmentation during the summer months. However, due to severe regulatory cutbacks on winter land application sites and changes in ownership or management of several key reuse properties, the City has struggled over the past years with winter biosolids management. The assumptions used in the Draft Facility Plan regarding biosolids management led to the recommendation of installing dewatering and enclosed storage to provide six months of onsite storage at the facility. The capital improvements associated with this recommendation proved difficult to finance, leading the City to request new options that were not considered or were considered but eliminated in the initial Facility Plan development. This memorandum provides a preliminary overview of the additional treatment/disposal options, which include:

- Third party biosolids hauling and application
- Land acquisition for offsite storage and land application
- Onsite sludge drying/storage using a belt drying system (BDS)
- Continuing existing treatment and reuse program, and investigating the possibility of emergency assistance from nearby communities.

It is recommended that the City continue its Class B land application program in partnership with local landowners in the short term, and implement improvements to bring greater flexibility to the program in terms of acceptable reuse or disposal options. The City should also continue to investigate Class A treatment technologies such as the BDS, and implement solids treatment improvements in a way that facilitate moving toward Class A treatment in the future. To add flexibility, the City should complete the following activities:

- Implement biosolids dewatering as recommended in the Draft Facility Plan, along with a nominal amount (several days) of dewatered sludge (cake) storage
- Develop a contract that, at a minimum, allows the to City use a third party vendor if local land application sites cannot be secured to reuse all of the biosolids generated during the winter

By adding dewatering and minimal cake storage, and developing relationships with third party vendors, the City will have a robust biosolids program through which biosolids can be transported off of the plant site under any circumstance. With the recent DEQ approval of a new 70-acre winter land application site and lease of new spreading equipment, the local land application will likely meet the City's needs in the near term. If the City produces more biosolids than can be land-applied locally during the winter, the biosolids could be reused east of the Cascades through the third party vendor. If this option is not available (due, for example, to temporary freeway closure during the winter), the City could store biosolids in the existing liquid sludge storage basins and new cake storage area for a limited time. Finally, in an extreme situation, the City could dispose of dewatered cake in a local landfill.

In parallel with these efforts, the City should continue to monitor changes in federal biosolids reuse regulations and development of the State's Biosolids General Permit program requirements, and review biosolids management plans based on regulatory changes.

Current Regulatory Considerations

The Draft Facility Plan outlined current and potential future biosolids regulations and requirements, indicating that the potential for NPDES-permitted phosphorus loading rates could have significant impacts on the amount of land required for a land-application program, especially for facilities that experience Enhanced Biological Phosphorus Removal (EBPR). In recent months, there has been considerable debate at the national, regional, and local level regarding the future of the Class B land application requirements contained in 40 CFR 503, and the method by which land application requirements will be permitted and enforced. Some of the current trends and considerations that impact Wilsonville's biosolids program are summarized below.

Biosolids General Permits

The EPA is in the process of developing a "General Permit for Facilities that Generate, Treat, and/or Use/Dispose of Sewage Sludge by Means of Land Application, Landfill and Surface Disposal Under the National Pollutant Discharge Elimination System". It is likely that the general permits will be issued initially in Idaho and Alaska (at the end of 2004), and will become effective in Oregon and Washington in 2006-2007. Because there is no consistent national approach on biosolids land application general permits from various EPA regions, and because Region 10 is likely to give significant latitude to the states, standards may vary from state to state. Standard requirements are expected to include the following provisions:

- A facility must identify its future planned sites where biosolids may be applied in the permit term.
- Public notice requirements will be stipulated for sites that a facility plans to use for land application within the permit.

The new permits are also likely to include agronomic phosphorus loading limitations, which are currently not regulated at the federal level. The potential agronomic phosphorus regulatory approaches may include:

- Fertilizer Guide (Limits to Extension Service guidelines)
- Environmental Soil Phosphorus Threshold Concentrations (this is the approach used in Region 8 EPA, whereby no additional biosolids can be applied if the soil phosphorus level as determined by the Olsen extraction method is over 100 ppm)
- Phosphorus Index (risk management based approach)

The first two of these approaches have limited flexibility and would likely result in more restrictive requirements on land application. It appears likely that Oregon will implement a Phosphorus Index approach, which is discussed in more detail below. However, because Idaho will be the first state in the region to address implementation of the Biosolids General Permits, the policies and practices adopted there may set a precedent all of Region 10.

Phosphorus Index

Many states, including Oregon, have adopted or are considering using a Phosphrous Index to manage phosphorus loading on land application sites. The Phosphorus Index is a risk management-based approach that takes into account transport and source factors to estimate the potential for off-site movement of phosphorus from a given land application site. The Natural Resources Conservation Services developed a Phosphorus Index for Oregon (*NRCS Agronomy Technical Note No. 26 – Revised, October 2001*). This guidance document was developed as an assessment tool to help land managers assess the risk of offsite phosphorus migration for an individual site, but was not designed to determine compliance with water quality regulations.

The Phosphorus Index for Oregon includes separate worksheets for Western and Eastern Oregon land application sites. The worksheets generate a site rating based on transport and source factors, and use the site rating to assign a vulnerability class (low, medium, high, very high) indicating the potential for offsite transport. This process uses the following transport and source factors:

Table 1. Phosphorus Index for Oregon Transport and Source Factors

Transport Factors	Source Factors
Soil erosion (sheet and rill, wind)	Soil test P concentration
Irrigation-induced erosion	Commercial P fertilizer application rate
Runoff class	Commercial P fertilizer application method
Flooding frequency	Organic P source application rate
Distance to surface waters/buffer width	Organic P source application method
Subsurface drainage	

Additional research is being conducted at Oregon State University regarding the use of phosphorus indices, and it is not clear what methodology the State will adopt for managing phosphorus loading on land application sites. Regardless of the methodology, agronomic phosphorus loading limitations may increase land requirements two to three times beyond that required based on agronomic nitrogen loadings.

Alternatives Analysis

Flow Projections

The Draft Facility Plan developed two sets of flow projections – a high flow projection based on future peaking factors from the *2001 Collection System Master Plan*, and a low flow projection based on peaking factors similar to those experienced in recent years at the plant. The Draft Facility Plan's alternative analysis and cost estimates use the high flow projections, to allow the analysis to consider the ultimate site planning impacts of various process selection. However, the City feels that near-term flows are more likely to develop in a manner consistent with the low flow projections. Therefore, the analysis described in this Technical Memorandum is based on the low flow projections. Under these projections the plant would initially be expanded to an average-day dry weather flow (ADWF) capacity of 3.4 mgd. Ultimately, the plant capacity would be expanded to 4.4 mgd.

Alternative 1: Third Party Biosolids Management

One way to address the current regulatory uncertainty is to contract with a third party biosolids management company for hauling and land application of the City's biosolids. There are a number of vendors that offer turn-key biosolids management services. Table 2 summarizes the vendors contacted regarding third party biosolids management.

Table 2. Third Party Biosolids Management Vendors

Name	Location	Representative Oregon Clients	Likely Land Application Program
Agri-Tech	Albany, OR	Salem Clean Water Services Silverton Depot Bay	Summer application locally; winter application east of Cascades
Sumas	Bellingham, WA	Portland Salem Eugene	Horse Heaven Hills (property owned by Sumas in Southwest Washington)
Synagro	El Dorado Hills, CA	None	Unknown

Vendors can provide the following services. The level of services provided depends on whether the vendor has (or can obtain) property that has been approved for land application and can be set aside for Wilsonville's exclusive use.

- Site identification
- Negotiation with property owners
- Site permitting and regulatory approval
- Analysis of agronomic application rates
- Transportation of liquid or dewatered biosolids
- Biosolids storage
- Land application
- Site and soil monitoring

Under industry-standard contract terms, a municipality will enter into a 3-5 year contract with the vendor, with optional one-year extensions for 2-3 additional years. For example, a new customer may choose a 3-year contract, with the option to extend to 5 years. Some vendors indicated that the initial contract terms are flexible (i.e., they would consider shorter initial contracts), however the cost of the services is typically lower for longer term contracts.

Under this alternative, the vendor assumes responsibility for hauling and land application of the biosolids. This alleviates the owner's need to maintain onsite storage, and if the vendor has approved land application sites, it can reduce the owner's risk associated with obtaining adequate land application sites. It does not remove the owner's legal responsibility for the ultimate use of the biosolids. Vendors may use property that they own and farm, or may establish relationships with local farmers for land application. Both of the vendors with operations in Oregon would pursue land application options east of the Cascades for the winter months, and possibly during the summer months as well. In previous investigations on behalf of the City, Agri-Tech was unable to locate local land application sites that would allow them to haul and apply Wilsonville's liquid biosolids in a local land application program.

Because management programs are unique to each customer, most venders were unable to offer ballpark costs. Sumas indicated that for clients in the Portland/Salem area, costs would be approximately $18-$25/wet ton. For comparison, the City of Portland current pays approximately $30/wet ton for hauling, land application, and land and equipment lease associated with their Eastern Oregon land application program. Table 3 below shows the range of projected annual costs at $30/wet ton. This unit cost was used rather than the lower cost quoted by the vendor because the City would only be exercising this option on an intermittent basis as needed based on the local land application program. If the City were to choose long-term third party biosolids management, the unit cost would likely be lower. Table 3 below compares costs under the existing operation (no dewatering) and after implementation of the recommended dewatering improvements for third party reuse of all of the biosolids generated at the plant during the winter. For comparison, the current cost of the City's existing program is under $100,000/year.

Table 3. Third Party Biosolids Management Cost Estimates

	Liquid Biosolids (No Dewatering			With Dewatering	
	Current Sludge Production	Initial Expansion (3.4 mgd ADWF)	Ultimate Expansion (4.4 mgd ADWF)	Initial Expansion (3.4 mgd ADWF)	Ultimate Expansion (4.4 mgd ADWF)
Wet tons/winter (avg.)	8,200	13,000	17,100	2,400	3,100
$/Wet Ton	$30	$30	$30	$30	$30
Annual Cost	$246,000	$390,000	$513,000	$72,000	$93,000

With the option of third party biosolids reuse, the City can significantly reduce the amount of onsite storage provided. The storage volume should be determined based on detailed discussion with the vendor regarding issues such as the frequency of biosolids pickups and seasonal limitations on hauling (i.e., winter road restrictions). Generally, utilities with winter land application programs east of the Cascades maintain 1-2 weeks of onsite storage. The City can currently meet this storage requirement with the existing liquid biosolids storage, although a minimal amount of dewatered sludge storage (2-3 days) would be needed for ease of normal operation. This reduction in storage would result in significant short-term and long-term savings over the initial $4 million and subsequent $3 million capital investments in biosolids storage identified in the Draft Facility Plan.

Alternative 2: Land Acquisition for Offsite Storage and Land Application

One limitation of the City's current biosolids management program is that it relies on private landowners to provide agricultural property for land application of the Class B biosolids. As the City has seen over the past several years, a variety of circumstances can lead property owners to withdraw their participation in the land application program, resulting in a lack of adequate, DEQ-approved properties for land application. One option to provide more stability in the program is to eliminate the reliance on private participation through City purchase of property for storage and application of biosolids. This property could be farmed by the City, with crops sold to cover part or all of the cost of farming, or it could be leased to private farmers. (Note, leasing also introduces some uncertainty, but this could be addressed to some extent through terms of the lease agreement).

For the City to evaluate this option, it is necessary to identify:

- Constraints associated with the property
- Appropriate characteristics of the property
- The amount of land required
- The approximate cost of the alternative
- Future steps required for implementation

Property Needs

The land required for biosolids land application depends largely on the following factors:

- Pollutant concentrations
- Agronomic application rates
- Site usage

Pollutant Limits (40 CFR 501.13)

To ensure that human health and the environment are protected equally while still allowing the land application of biosolids of variable quality, Part 503 provides the following four sets of pollutant limits:

- **Ceiling Concentrations** – The maximum concentration measured in milligrams per kilogram (mg/Kg) of each pollutant that biosolids can contain and still be land applied. Each sample of biosolids analyzed must meet the ceiling concentrations. The City of Wilsonville biosolids concentrations are below the ceiling concentrations.
- **Pollutant Concentration Limits** – The land applier has no land application requirements relative to pollutants for biosolids meeting these limits. Pollutant concentrations are based on monthly average concentrations. The City of Wilsonville biosolids concentrations meet these limits.

Part 503 also specifies restrictions to cumulative pollutant loadings and annual pollutant loading rates for biosolids that meet ceiling concentrations but do not meet pollutant concentrations. Because Wilsonville's biosolids meet the pollutant concentration limits, these annual and cumulative loading limits do not apply.

Agronomic Application Rates

As indicated in Chapter 4 of the Draft Facility Plan, Part 503 also requires that biosolids applied to a site be at or below agronomic rates. As defined in the federal regulation:

"Agronomic rate is the whole sludge application rate (dry weight basis) designed:

(1) To provide the amount of nitrogen needed by the food crop, feed crop, fiber crop, cover crop, or vegetation grown on land; and

(2) To minimize the amount of nitrogen in the sewage sludge that passes between the root zone of the crop or vegetation grown on the land to the groundwater.

Factors to consider when deriving an agronomic rate include (*EPA/625/R-95/001, September 1995*):

- The amount of nitrogen needed by the crop
- The amount of plant available nitrogen (PAN) in biosolids
- Nitrogen remaining from previous application of nitrogen containing materials (previous applications of biosolids)
- The amount of nitrogen left from biological nitrogen fixation by leguminous crops that is mineralized and becomes available for crops to use
- The type of soil at the site and the amount of nitrogen mineralized from soil organic matter
- Denitrification losses of nitrate and/or volatilization losses of ammonia.

As discussed earlier, phosphorus loading limitations will likely be a primary factor in future biosolids permitting and development of biosolids management plans.

Site Usage

Site restrictions for Class B biosolids are related to the following:

- Public access to the land application site
- Crop harvest and grazing of animals

In public areas (parks, golf courses, etc.), public access must be restricted for one year following biosolids application. In rural areas where biosolids is applied to farmland (as would be expected in Wilsonville's program), public access is only restricted for 30 days following biosolids application.

Figure 1 provides a flowchart linking crop harvest and animal grazing restrictions for land receiving Class B biosolids. The following definitions apply to the figure:

- **Food Crop** – Crops consumed by humans, including but not limited to fruits, grains, vegetables, and tobacco
- **Feed Crop** – Crops produced primarily for consumption by animals (e.g., corn and grass)
- **Fiber Crop** – Crops such as flax and cotton were included in Part 503 because products from these crops (e.g., cotton seed oil) may be consumed by humans.

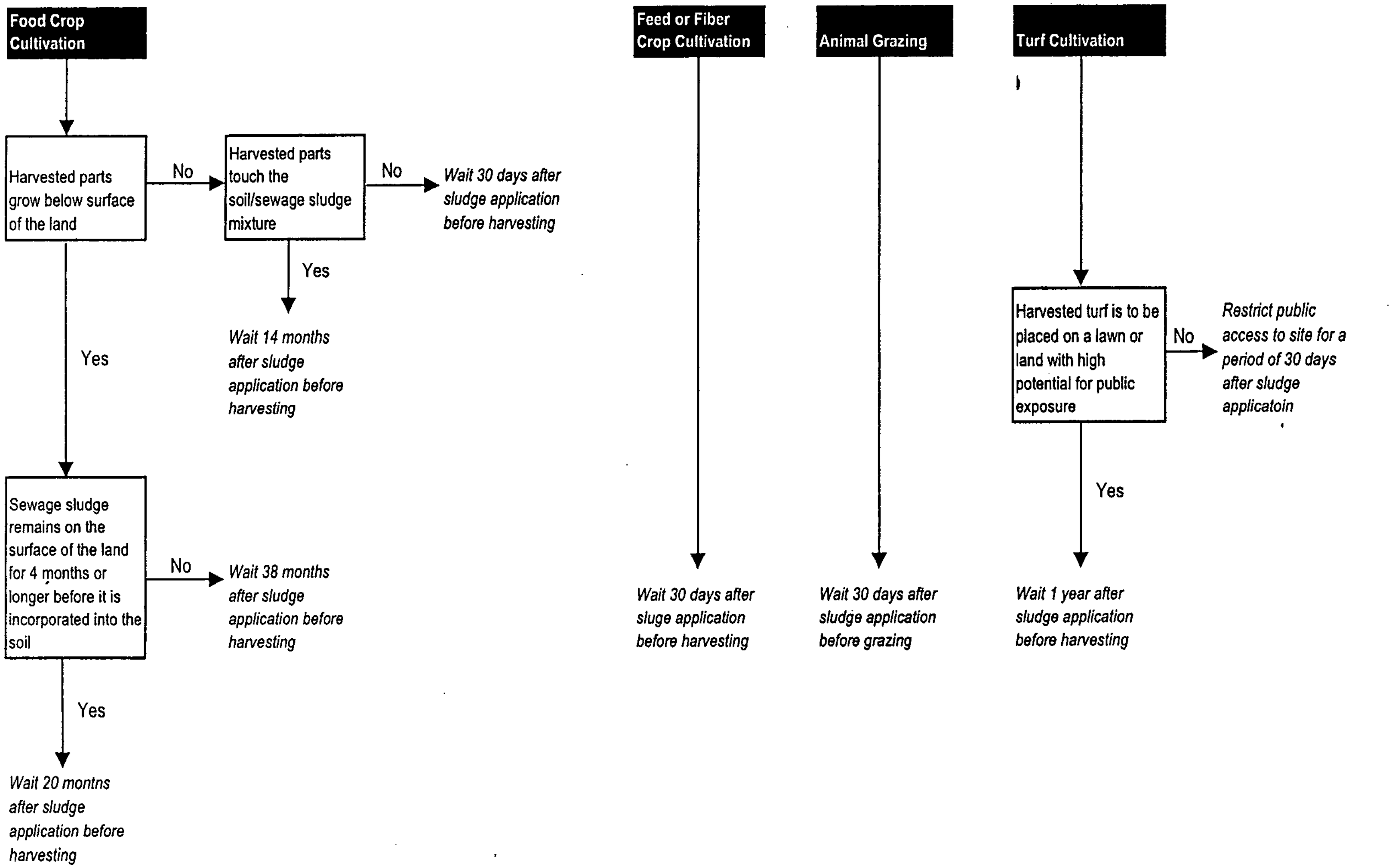


Figure 1. Crop and Grazing Requirements for Class B Biosolids

Site Characteristics

The following characteristics can be used to identify potential sites if the state adopts a Phosphorus Index for assessing potential land application sites. These characteristics would lead to a low potential for off-site migration of phosphorus:

- Site/crop that requires no sprinkler irrigation, or minimal irrigation such that the application rate is less than the infiltration rate.
- Minimal slope
- No flooding, or flooding on rare occasions
- Over 500 feet from surface water, or minimum 30 foot buffer next to surface waters
- Available phosphorus under 60 ppm
- Minimal phosphorus application through commercial fertilizer or other organic source

Required Land Application Area

Based on the City's recent annual biosolids reports, typical plant biosolids include 52 lbs of plant-available nitrogen per dry ton of biosolids. Typical crop nitrogen requirements range from roughly 80 lb/acre for pasture, to 200 lb/acre for corn. These crop requirements translate into biosolids application rates from 1.6 to 3.9 dry tons (DT) per acre. Total land requirements at ultimate buildout under the low flow projection are shown in Table 4 below. The City currently applies biosolids to approximately 180 acres per year, which represents crop use between the low and high numbers given in Table 4. The table shows requirements based on nitrogen loading only, as well as approximate costs assuming that pending phosphorus restrictions increase land requirements by three times that needed based on nitrogen.

Table 4. Ultimate Land Requirements for Land Application

Item	Requirement – Low N Crop	Requirement – High N Crop
Crop Area (acres)	730	290
Buffer (acres)	73	30
Non-Crop Uses[1] (acres)	73	30
Total Land Requirement (acres) – N only	890	350
Total Land Requirement (acres) – N and P	2,700	1,100
Cost per Acre [2]	$5,000	$5,000
TOTAL LAND COST – N ONLY	**$4,450,000**	**$1,750,000**
TOTAL LAND COST – N AND P	**$13,500,000**	**$5,500,000**

1. Includes dewatered sludge storage, maintenance/equipment area, roads, and other non-planted areas
2. Based on advertised farm property in the Willamette Valley

Alternative 3: Onsite Sludge Drying/Storage using a Belt Drying System

A preliminary evaluation of Class A biosolids treatment technologies was conducted during the Draft Facility Plan alternative development. Drying systems are attractive for Wilsonville because they produce a Class A product with fewer land application restrictions. They also produce a product that is 90-95% solids, significantly reducing storage area requirements. However, at the time of the analysis, even the smallest units offered were far oversized for Wilsonville's projected solids generation, and therefore were not considered for detailed evaluation.

Since the initial analysis, a Low Temperature Belt Drying System (BDS) manufactured by Andritz has been introduced into the market specifically to provide sludge drying technology to smaller facilities. A budgetary proposal for the BDS is included as an attachment to this Technical Memorandum.

The BDS system collects wet cake from the sludge dewatering process and mixes it with previously dried granulate in a screw that combines the two sludges and feeds them to the dryer inlet. The mixture of wet cake and dried granulate has a consistency of approximately 70% dry solids when it enters the belt dryer. Once discharged from the screw, a feed roller distributes the sludge across the belt width. Hot air passes through the belt from top to bottom in three separate zones: an initial drying zone of 285 °F, a second drying zone of 265 °F, and a cooling zone that uses ambient air. The final product discharged from the BDS has a temperature of approximately 125 °F. Dried granulate is discharged into a collection bin, from which the product is either recycled for mixing with the wet cake, or transported for final cooling prior to storage. The BDS process is illustrated in Figure 2.

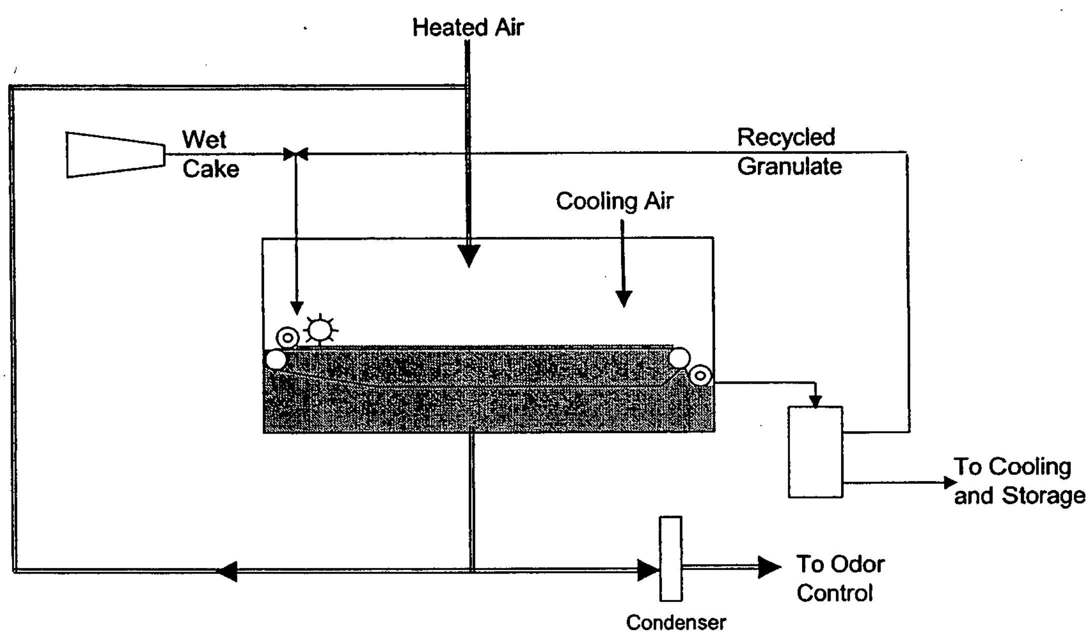


Figure 2. Belt Drying System

Most process air from the BDS is returned to the furnace for optimal combustion; waste air is passed through a condenser to reduce the moisture content, and then sent through odor control before exhausting the air to the atmosphere. Water from the condenser is returned to the plant recycle stream. Plant process water can be used for the BDS' automatic belt washing system.

The BDS is available in model sizes from 15 to 60 wet tons per day. Based on the values show in Table 3, Wilsonville's dewatered biosolids production will be approximately 15 wet tons per day at ultimate buildout under the low flow projections. Therefore, a single unit (with one backup unit) would provide adequate capacity for all of Wilsonville's generated biosolids. The manufacturer recommends a BDS-05 unit, which has a footprint of 36 feet by 28 feet, and height of 14 feet. The budgetary price of $975,000 includes the following:

- Wet cake reception bin
- Recycle bin
- Discharge/mixing screw
- Conveyor and bulk handling equipment
- Furnace
- Belt dryer
- Condenser
- Air recirculation system
- Granulate handling system
- Fugitive dust control system
- MCCs and control systems

The budgetary price does not include a building to house the BDS, product cooling, product storage, or odor control for exhaust air. Including these additional considerations, a planning-level project cost is shown in Table 5.

Table 5. Capital Cost of Belt Dryer System

Item	Units	Number	Unit Cost	Total Cost
Belt Dryer System	EA	2	$ 975,000	$ 1,950,000
Installation (30%)	EA	2	$ 292,500	$ 585,000
Building	SF	4032	$ 150	$ 605,000
Product Cooling	EA	1	$ 26,000	$ 26,000
Handing & Storage	LS	1	$ 479,000	$ 479,000
Odor Control	LS	1	$ 200,000	$ 200,000
Electrical & Controls @ 30%[1]	LS	1	$ 970,200	$ 970,000
Sitework @ 20%[2]	LS	1	$ 262,000	$ 262,000
Subtotal A				**$ 5,077,000**
Misc Costs Not Itemized (30% of A)				$ 1,523,000
Subtotal B				**$ 6,600,000**
Mobilization and Bonds (8% of B)				$ 528,000
Contractor's Overhead and Profit (15% of B)				$ 990,000
Subtotal C				**$ 8,118,000**
Engineering, Legal, Admin. (25% of C)				$ 2,030,000
TOTAL CAPITAL COST				**$ 10,148,000**
(Liquid/Cake Storage Cost Without BDS)				***$ 7,066,000***
Incremental Capital Cost of BDS				***$ 3,082,000***

1. 30% of BDS, Building, Handling & Storage, and Odor Control
2. 20% of Building, Product Cooling, Handing & Storage, and Odor Control

The total capital cost of the BDS and associated facilities is approximately $10.1 million. However, construction of the facilities listed in Table 5 eliminates the need for the dewatered cake storage recommended in the Draft Facility Plan (approximately $7.1 million). Therefore, the incremental cost of the BDS over the Draft Facility Plan recommended plan is $3.1 million. This investment provides the following benefits to the City:

- Reduced footprint (5,000 sf total for new building and storage, compared with 10,000 sf for dewatered cake storage)
- Class A biosolids product, which reduces the risk associated with the biosolids management program.

Because the nature of the dried biosolids product is significantly different than dewatered cake, the City should conduct initial product marketing prior to design and installation of any sludge drying system to determine whether the product will be accepted by the local agricultural community.

Alternative 4: Emergency Assistance Options

This alternative is not a long-term biosolids management option, but rather an evaluation of backup treatment/disposal options that the City could use in an emergency while implementing improvements to the long term storage/reuse program.

The City of Vancouver was identified as one potential source during workshops with the City. Vancouver incinerates its biosolids, and is therefore not subject to the same constraints as Wilsonville with respect to land application limitations.

HDR contacted Vic Ehrlich, City Engineer from the City of Vancouver, to discuss their system. Vancouver processes all biosolids at the West Side plant, which uses gravity belt thickeners, gravity thickeners, and centrifuges to thicken biosoilds prior to incineration. The solids handling improvements were completed in 1999, and the City currently has excess solids treatment capacity. Vancouver would be willing to accept some or all of Wilsonville's biosolids during an emergency while the City addresses an unanticipated problem, but is not interested in providing interim biosolids processing while Wilsonville implements solids handling improvements.

At Vancouver's suggestion, HDR also contacted Clark County Public Works to inquire about the possibility of sending biosolids to the Salmon Creek facility for an interim period or during an emergency. The Salmon Creek plant is struggling with the same issues as Wilsonville, and Clark County is currently conducting a Facility Plan to examine alternatives to the existing winter local land application program. The County has investigated many of the same issues as Wilsonville (providing additional storage, adding biosolids drying to reduce storage volume, and hauling biosolids to drier climates through a third party). At the time of the discussion, the County was leaning toward using third-party hauling and land application in eastern Washington.

Recommendations

Of the four alternatives reviewed in this Technical Memorandum, only the first three were investigated as potential long-term biosolids management approaches. Elements of two of these options are recommended to be included in the City's long-term biosolids management program.

One critical improvement that should be pursued immediately is the addition of biosolids dewatering as recommended in the Draft Facility Plan. This addition to the treatment process significantly increases the flexibility of the biosolids program, reduces the operating cost associated with third-party reuse, reduces the volume of onsite storage area required, and allows the City to dispose of biosolids in a landfill if absolutely necessary. Initial discussions with some landowners indicate that dewatered biosolids may have the added benefit of being more acceptable for agricultural use, and therefore may help extend the life of the local land application program.

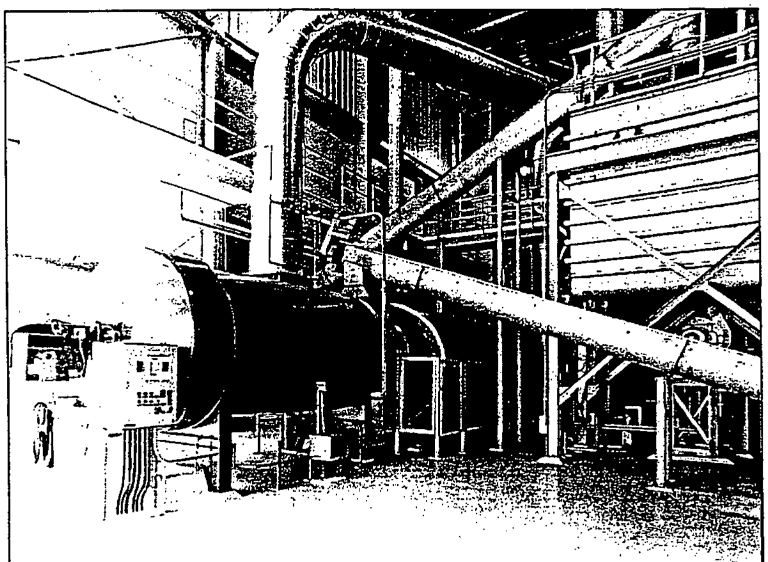
With these changes, the current biosolids program may be viable for many years. However, even with added flexibility, this program is not likely to be a long term solution for beneficial reuse of the City's biosolids. Proposed regulatory changes will, at a minimum, significantly increase the amount of land required for Class B land application. In the extreme, land application of Class B biosolids may be disallowed in the future. To prepare for these changes, the City should implement treatment plant improvements in a ,manner that facilitates moving to Class A treatment in the future. Drying systems such as the BDS can easily be added downstream of dewatering, producing a Class A product that maximizes the City's flexibility for long-term beneficial reuse.

Appendix A – Budget Proposal for Andritz Belt Drying System

1 Introduction

Thank you for your interest in the Andritz thermal drying technology and it is our pleasure to take this opportunity to introduce the Andritz low temperature belt drying system and our company to you.

With more than 28 years of experience in the field of thermal drying there are currently nominally 63 operating plants around the world that use our drying technology and more in the construction phase. In 1993, Andritz – Ruthner Inc. offered the drum drying technology to the North American market and to date, we have constructed, or are in the process of constructing, eighteen (18) drum dryer lines with more orders already committed for the future.



Drum Drying System (DDS)

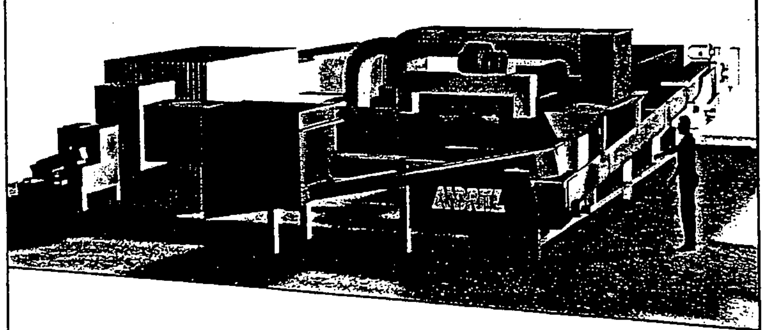
Capitalizing on this vast experience in thermal drying Andritz have further expanded the range of drying technology on offer to include the Low Temperature Belt Drying System (BDS) aimed specifically at the smaller waste water treatment plant.

The BDS dryer has a small footprint, is simple to operate and maintain and provides a quick start up (20 minutes) and shut down (20 minutes).

With model sizes available to treat from 15 to 60 wet tons per day (WTD) capacity the most cost effective and ideally sized unit can be selected to suit the specific needs of your WWTP.

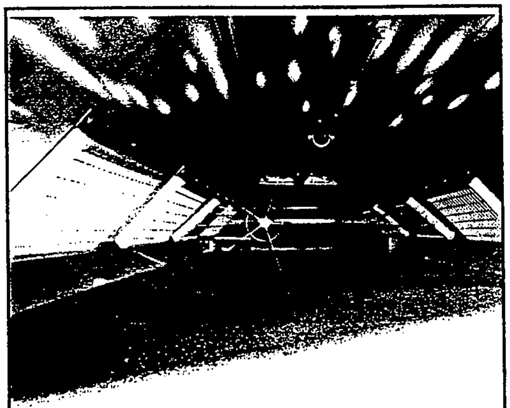
The process is so simple and incorporates many of the features of the well-proven drum drying system to provide a Class A granulate.

The pre mixing of the wet cake and previously dried material contributes to the formation of the granulate for ease of drying and transportation. The use of low temperature air to evaporate the water makes this a safe and simple dryer to use.



Belt Dryer System (BDS)

A final granulate of Class A quality @ > 90%DS is achieved from the process with the added benefit of substantial volume reduction. The BDS is manufactured in stainless steel to provide you with a high quality unit suitable for long life expectancy.



Inside the BDS

ENVIRONMENT AND PROCESS TECHNOLOGIES

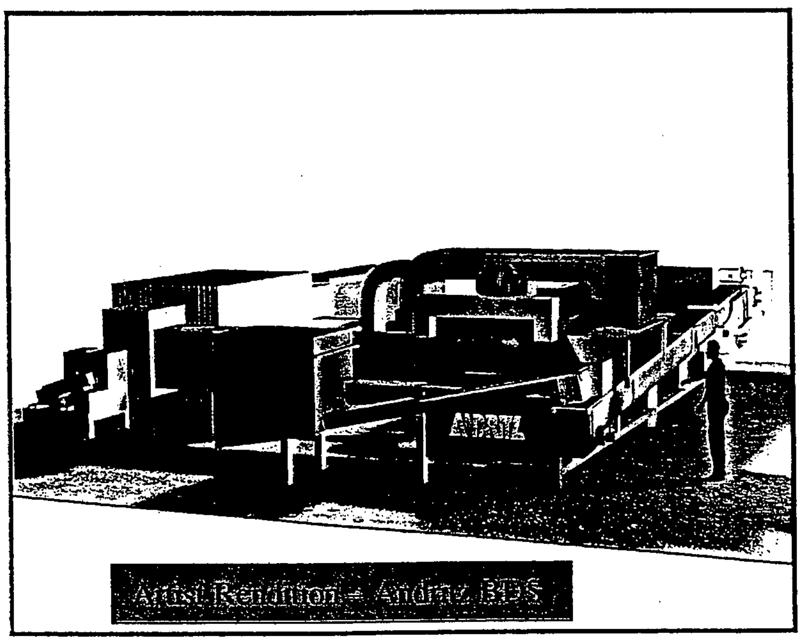
BUDGET PROPOSAL

REF: DS 605

ANDRITZ THERMAL DRYING SYSTEM
For
Wilsonville, OR

TYPE BDS 05

CUSTOMER:	**Heather Stephens, P.E.**	
	HDR One Company	
	1001 SW 5th Avenue, Suite 1800	
	Portland, OR 97204	
	Tel:	**(503) 423 - 3775**
	Fax:	**(503) 423 - 3737**
	Email:	**Heather.Stephens@hdinc.com**
Representitive:	**Connie Boag**	
	APSCO	
	Tel:	**(877) 251 - 9174**
	Email:	**cboag@apsco.org**
COMPLIED BY:	**BOB HILL**	
	REGIONAL MANAGER, DRYER SYSTEMS	
	Tel:	**(817) 419 - 1790 - 9174**
	Email:	**bobhill@andritz-arl.com**
Date:	**June 9, 2003**	



Artist Rendition – Andritz BDS

One significant advantage of the Andritz BDS is its ability to utilize the most cost effective energy source available. From a simple direct fired natural gas system to an indirectly fired system using waste heat (steam, exhaust heat etc..) the best solution can be tailored to meet your specific needs.

The pre-heated air is fed downwards through the belt. The heated air is directed onto the belt at two separate zones. In Zone 1 the heated air will be in the region of 285°F dryer and at Zone 2 the heated air will be in the region of 265°F.

A stream of cooling air (ambient) is introduced at the discharge end of the belt system. Final product temperatures will be in the region of 125°F

2.3 Granulate Handling System

The now dried granulate @ > 90%DS is discharged from the BDS into the Granulate Handling System collection bin. The material for recycling is drawn off by a variable speed screw conveyor, as required, and fed to the discharge screw for mixing with the wet cake. The surplus material weirs over the collection bin discharge plate to a screw conveyor which will then transport the granulate to the chosen storage method.

The approx. temperature of the dried granulate at this stage will be <125°F. Additional cooling is recommended for silo storage. Andritz offer an optional product cooling system to further reduce the final product temperature.

2.4 Process Air Handling System

The humid process gas ~~is~~ removed from the dryer is then further processed in the system condenser. The condenser reduces the moisture content of the process gas by cooling the air and condensing out the water.

The condenser water is returned to the treatment plant for reuse.

The majority of the process gases are returned to the furnace to provide optimum combustion conditions.

The remaining portion of non-condensable gases and air is routed to atmosphere or to the system odor control unit (typically a biofilter which can be offered as an optional extra).

2.5 Control System

The BDS dryer is controlled and monitored by a microprocessor based PLC. The controls and inherent stability of the dryer system allows the dryer to be operated with the minimum operator input.

The BDS start and stop sequences are fully automated and the BDS is capable of being started from cold in 20 minutes. The same time is necessary for shutdowns.

In the event of a power failure or requirement to shut down the BDS dryer for short periods of time it is possible to restart the BDS dryer in 10 minutes.

2.6 BDS Cleaning System

The BDS Dryer incorporates a belt wash water system comprising of water spray nozzles mounted on the inside of the BDS top cover directly over the belt surface area. Cleaning of the belt is carried out as necessary with the fully automatic cleaning system.

2.7 Safety

The safe operation of the BDS dryer is of primary importance to Andritz. Feature included to ensure safe operation include:

- Low temperature operation.
- Equipment and process design (low belt speed; very low dust concentrations in the process gas).
- Interlocks, guards and safety system
- CO level monitoring in the process air circuit, recycle bin and final product bin.
- Water injection system (the wash water system can be used an emergency quench).
- Sensors: speed & temperature

3 Design Data

PLANT LOCATION			
City:	Wisonville	State:	OR
WWTP:		Contact: Tel:	 ( ) -
Engineer:	HDR One Company	Contact: Tel:	Heather Stephens, P.E. (503) 423 - 3775
Rep:	APSCO	Contact: Tel:	Connie Boag (503) 631 - 4025

4025

DETAILS OF SLUDGE BEFORE DRYING		
Sludge type:	Anaerobically Digested	
Wet sludge quantity:	280 - 367	lbs per hour DS
Wet sludge dry solids content:	25	% DS

REQUIREMENT FOR GRANULATE AFTER DRYING		
Dry solids content:	≥90	% DS

DRYER DESIGN DATA		
Water evaporation design capacity:	1,100	Pounds H20 per hour

5 Budget Proposal

We are pleased to submit our budget proposal for the supply only of the following equipment:-

One - Andritz thermal direct triple pass drum drying system type <u>**BDS05**</u> each complete with the following:-

- ⇒ **Wet cake reception bin**
  for temporary storage of the dewatered sludge prior to mixing.
- ⇒ **Recycle bin**
  to store recycled product prior to mixing.
- ⇒ **Discharge/mixing screw**
  to control feed rate of cake & recycled product and to pre mix the material to nominally 70%DS..
- ⇒ **All necessary conveyor and bulk handling equipment.**
  to safely move and control the transfer rate between process stages.
- ⇒ **Furnace**
  to provide the heat for the drying air.
- ⇒ **Belt dryer**
  to evaporate the water and produce >90%DS.
- ⇒ **Condenser**
  for partial condensation of the water from the circulating air.
- ⇒ **Air recirculation system**
  To recirculate the majority of the process air thus reducing the heating energy requirements and the make up air volumes.
- ⇒ **Granulate handling system**
  to store and collect dried material for recycling and to final storage
- ⇒ **Fugitive dust control system**
  to capture and control the fugitive dust.
- ⇒ **Instrumentation, controls & electrical systems**
  Including MCC's and control systems
- ⇒ **Design drawings, O & M manuals, start-up, commissioning & training**
  all as per project agreements

Exclusions:

Components and services which are not specifically mentioned in this offer are to be provided by others or can be included within our scope subject to agreement. These components and services include, but are not limited to the following:

⇒ Packing, transportation, Delivery and unloading to site
⇒ Site surveys
⇒ All civil works.
⇒ Buildings
⇒ Foundation bolts
⇒ Lighting & ventilation
⇒ Potable water
⇒ Cooling water
⇒ Dewatering equipment
⇒ Polymer systems
⇒ Transfer system for dewatering to wet cake reception bin.
⇒ Electrical supply including to the MCC
⇒ UPS
⇒ Collection system for waste water
⇒ Odor control system
⇒ Cladding and/or insulation
⇒ Additional product cooling
⇒ Infrastructure
⇒ Transportation and lifting equipment
⇒ Permits and authorization.

6 Commercial

The project data and the parameters detailed within this offer form the basis of our budget proposal. Our scope of supply is generally as outlined but can be subject to negotiations.

Please advise if the information used is incorrect.

BUDGET PRICING		
To design, manufacture, supply & commission the following system:	One	BDS05 belt drying system
Budget Price:	**$975,000 (ninehundred and seventy five thousand dollars)**	

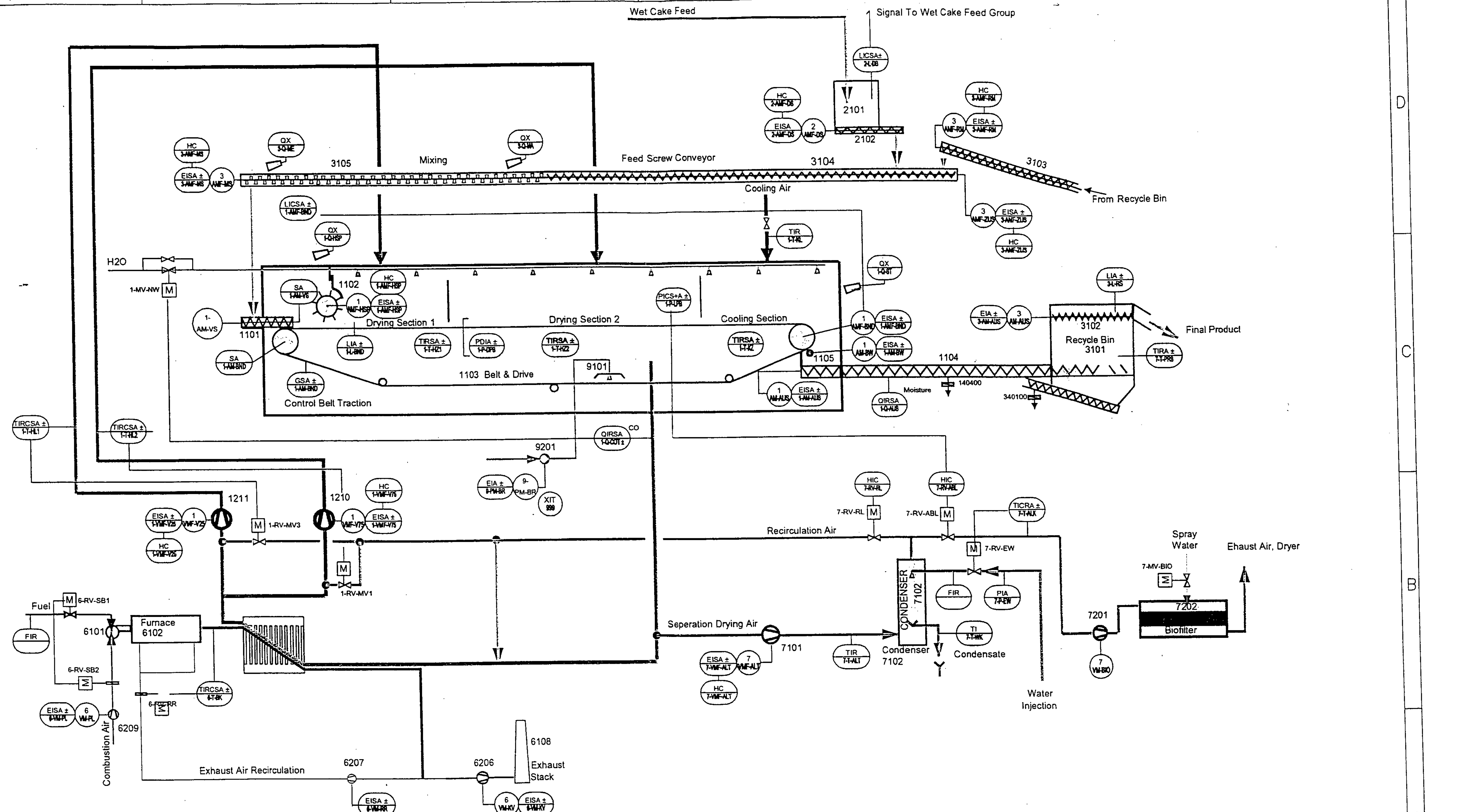
OPTIONAL BUDGET PRICING		
Final product cooling	$	Price on request
Dual Fuel	$	Price on request
Odor System (Biofilter)	$	Price on request
Steel Structure	$	Price on request
Cabling	$	Price on request
Insulation/paint	$	Price on request

VALIDITY
This offer is budgetary only. The price and scope will be required to be verified prior to a firm price submission.

TERMS & CONDITIONS
As per Andritz-Ruthner, Inc. standard conditions attached.

AVAILABILITY
Typically 5 to 6 months from receipt of order and clarification of all commercial and technical details.

PAYMENT TERMS
To be agreed.



Burner Control Not Shown

ESTIMATED WEIGHT IN LBS:	DRAWN BY: DATE
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES	CHECKED BY: DATE
FABRICATION TOLERANCES .XX±.040 ANG±1° HOLE±.020	APPROVED BY: DATE
MACHINING TOLERANCES .XXX±.005 ANG±.5° HOLE±.020	THIRD ANGLE PROJECTION
MILL FINISH ALL OVER	

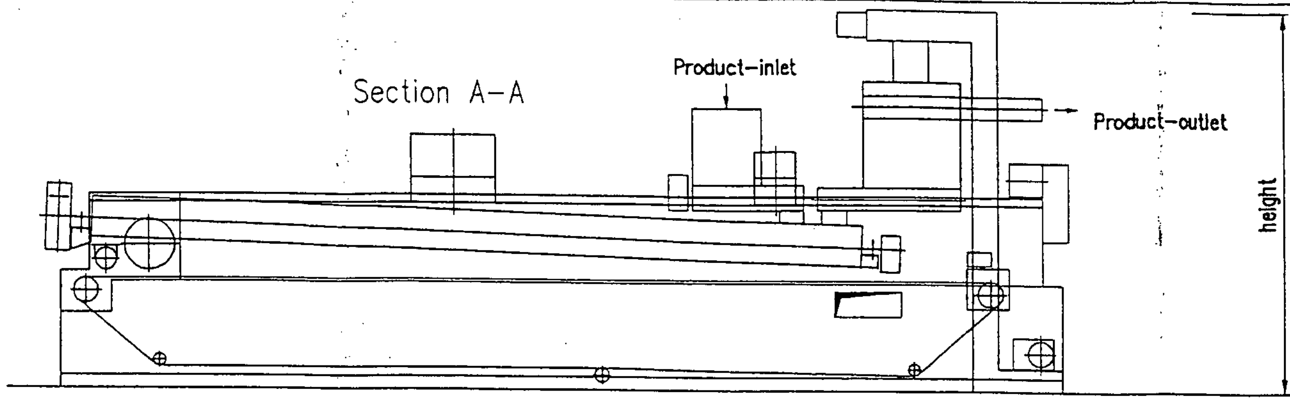
REV	EIR	REVISION	BY	APVD	DATE

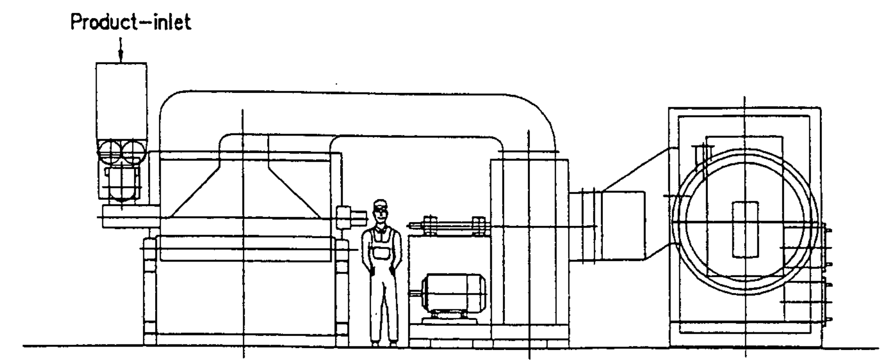
ANDRITZ

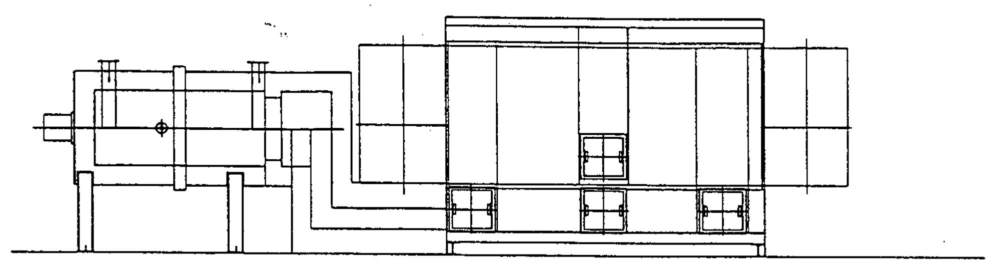
ANDRITZ-RUTHNER, INC.
1010 COMMERCIAL BLVD. SOUTH
ARLINGTON, TEXAS 76001
PHONE: (817) 465-5611

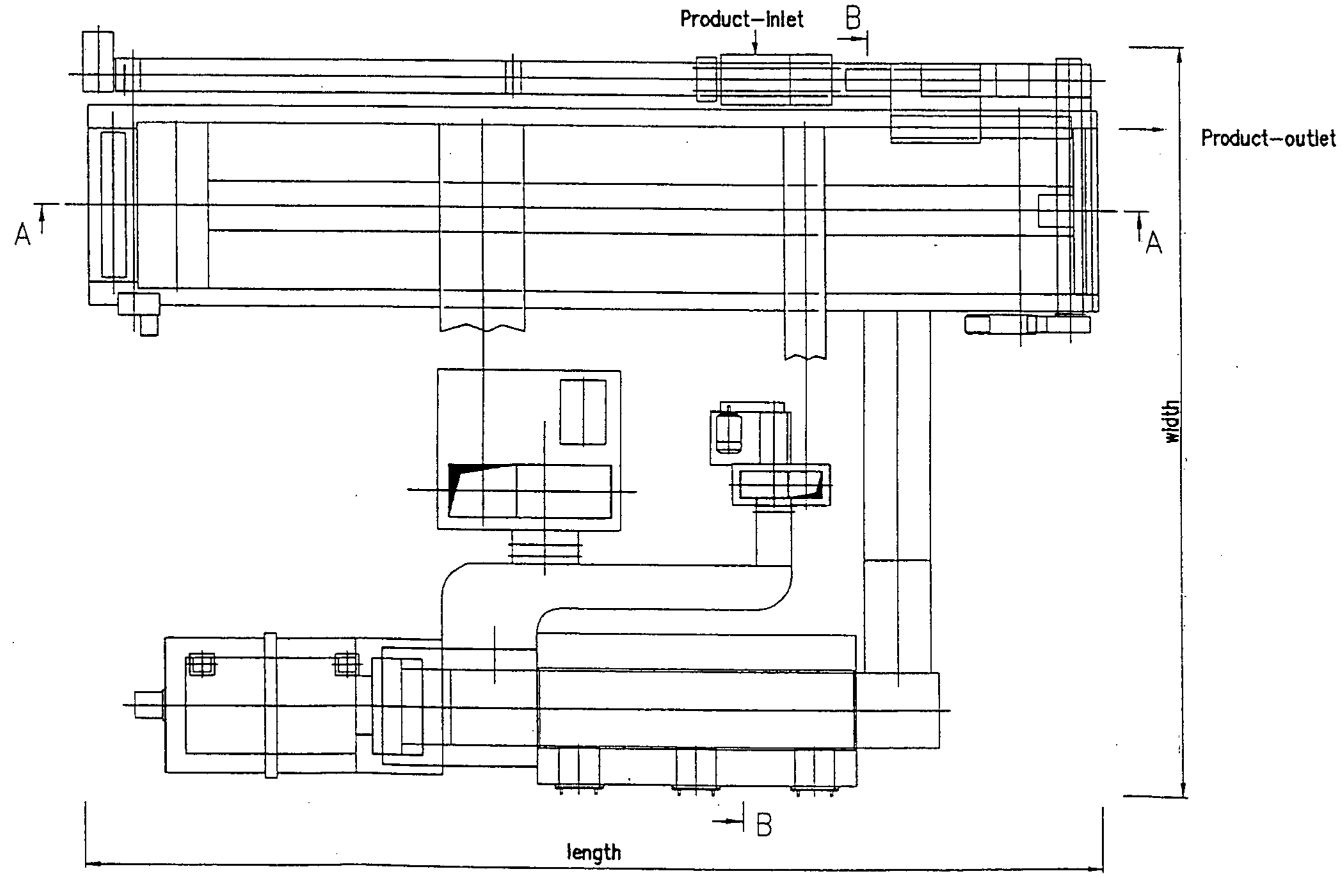
TITLE
ANDRITZ - BDS
BELT DRYING SYSTEM
FLOW SCHEMATIC

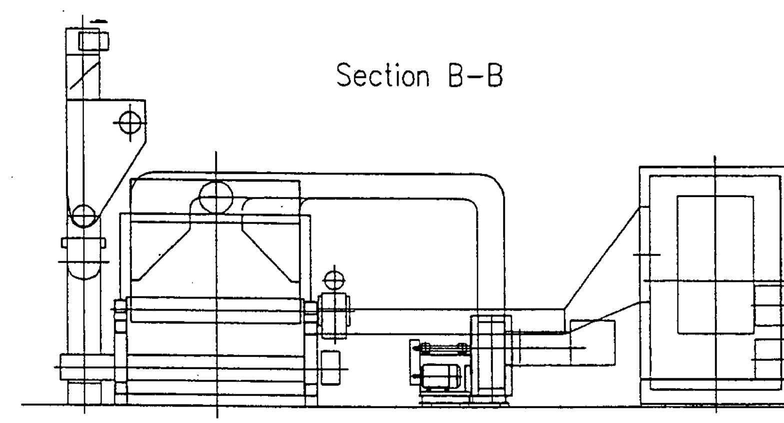
SIZE	PROJECT	DRAWING NUMBER	REV
	BDS03-07010-3		A
SCALE	FILE BDS03-07010-3	SHEET 1 OF 1	











For information only

Typ	length	width	height
05	11000	8600	4300
075	12100	9000	4500
1	14500	10200	5500
1.5	19500	11000	6000
2	17000	13600	6700
2.5	20500	14000	7300
3	23500	14500	7500

REV	EIR	REVISION	BY	APVD	DATE

ESTIMATED WEIGHT IN LBS:

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES

FABRICATION TOLERANCES .XXX±.040 ANG±1° HOLE±.020

MACHINING TOLERANCES .XXX±.005 ANG±.5° HOLE±.020

MILL FINISH ALL OVER

DRAWN BY: | DATE

CHECKED BY: | DATE

APPROVED BY: | DATE

THIRD ANGLE PROJECTION

ANDRITZ
ANDRITZ-RUTHNER, INC.
1010 COMMERCIAL BLVD. SOUTH
ARLINGTON, TEXAS 76001
PHONE: (817) 465-5611

TITLE
BELT DRYING SYSTEM

SIZE	PROJECT	DRAWING NUMBER	REV
	BDS	2-09000	A

SCALE NONE | FILE BDS | SHEET 1 OF 1

Team works

A successful team

Andritz is a leading supplier of liquid/solid separation equipment with a history of 30 years in the industry. Municipal and industrial customers from all around the world place confidence in us. Based on key components which we design and manufacture, we build complete systems for treatment of water and waste water and for process applications.

Success through competence
Long-term experience, proven technologies and continuous development work form the backbone of our solutions. A large worldwide installation base is proof of our success.

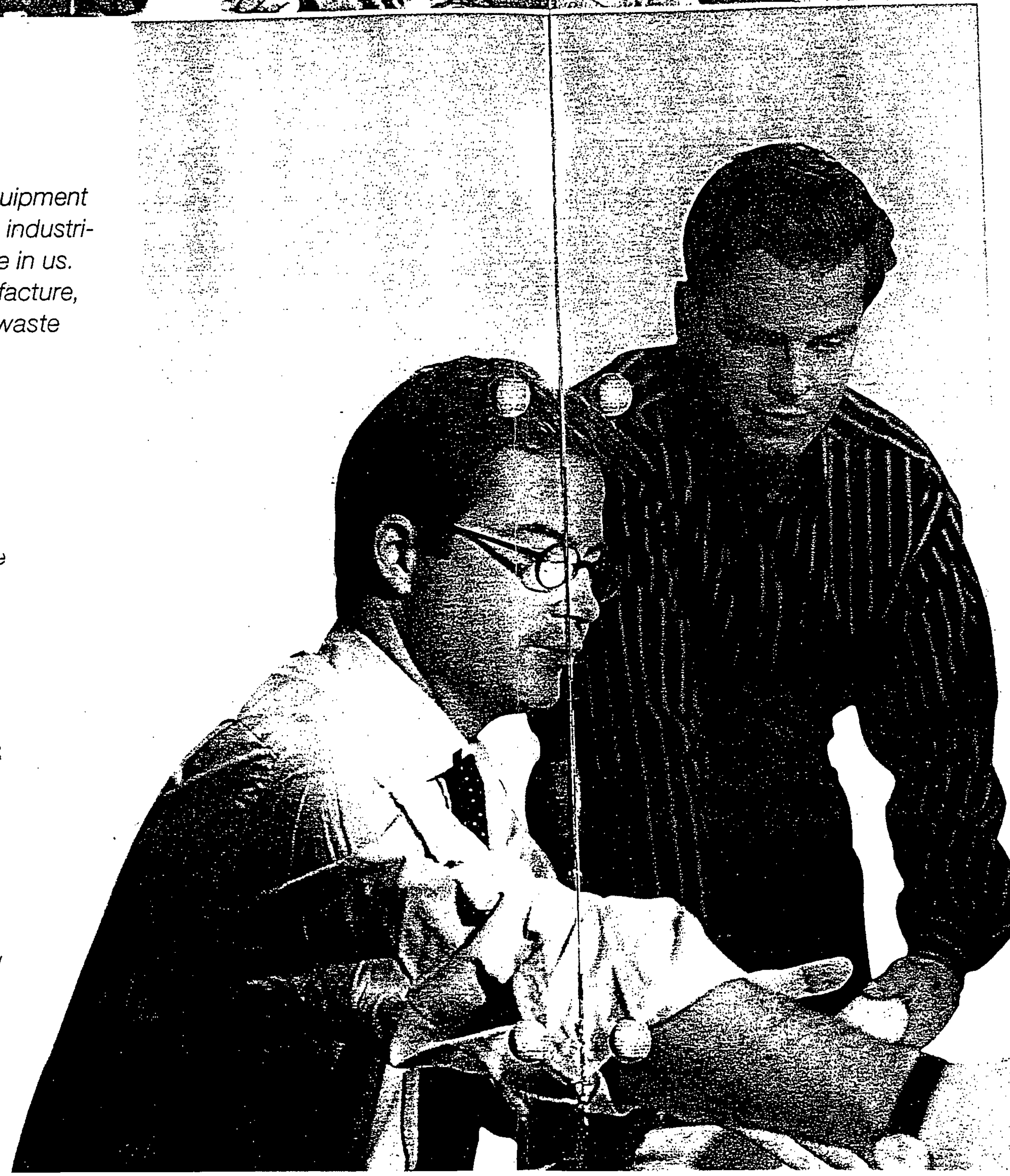
Competence

Success through commitment
We believe in building a partnership with our customers and we work in a team with them, with each employee strongly committed to project goals.

Commitment

Success through versatility
Our wide range of products and services embraces the requirements and needs of our customers: in water and waste water treatment, and in industrial process applications.

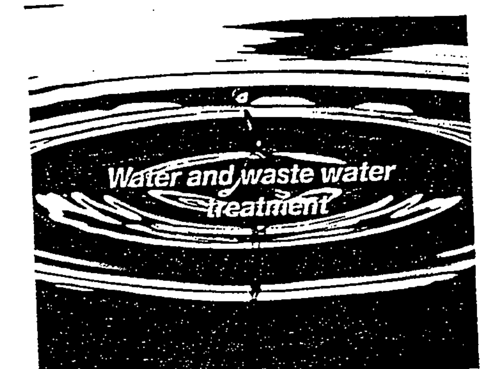
Versatility



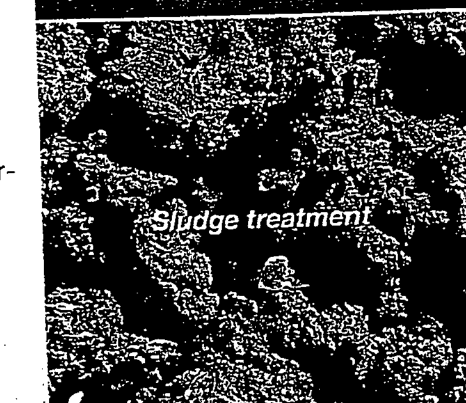
ANDRITZ

Successful performance

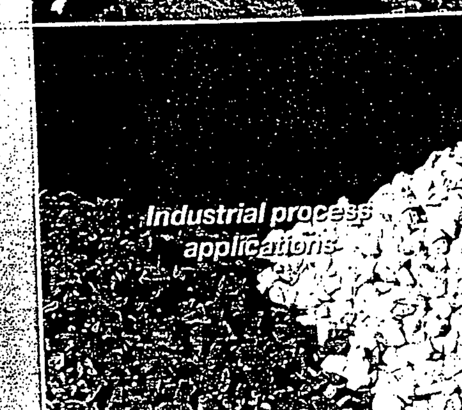
- Mechanical and physical treatment systems for process and waste water



- Plants for thickening, dewatering, drying and thermal sludge utilization in municipal and industrial applications



- Filtration and drying of slurries in industrial processes

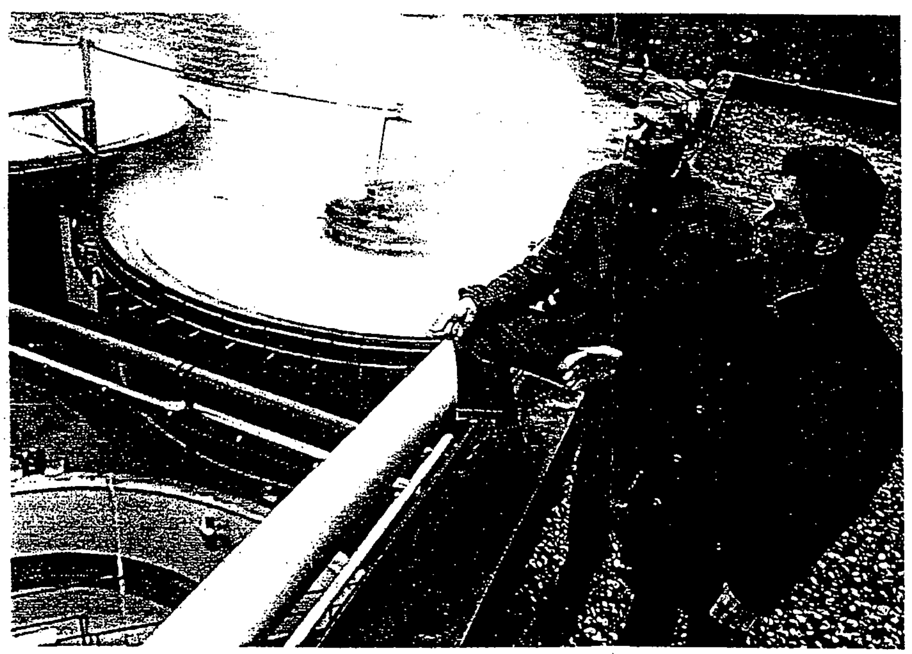


ANDRITZ

Water

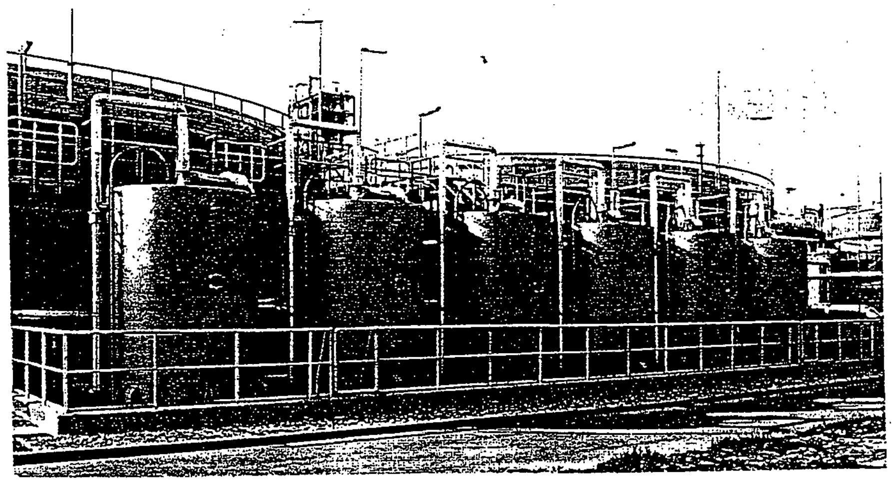
Water and waste water treatment

Cleaning water is, to us, a clear enough case. From screening to fine filtration, Andritz provides efficient and economical solutions.



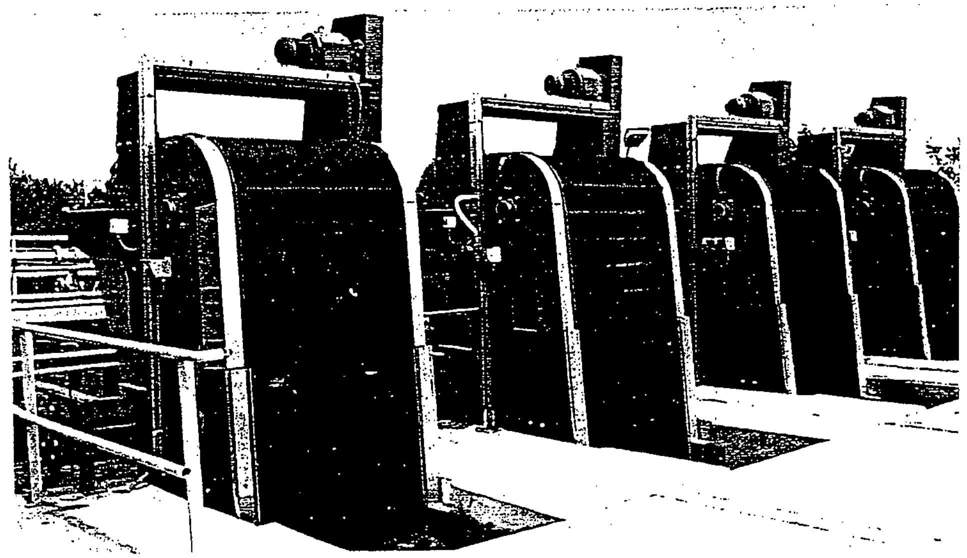
Consider the following:

- Aqua-Guard®: continuous self-cleaning fine screen; over 6,000 units sold worldwide
- Girapac®: slotted drum filters; also in conjunction with Rotopress® as compact unit for mechanical, first-stage cleaning in small-to-medium size sewage treatment works; over 600 units in use
- Hydrasand®: sand bed filter with continuous filter sand cleaning; over 200 units in operation
- Aqua-Screen®: punched plate fine screen, over 100 units sold worldwide

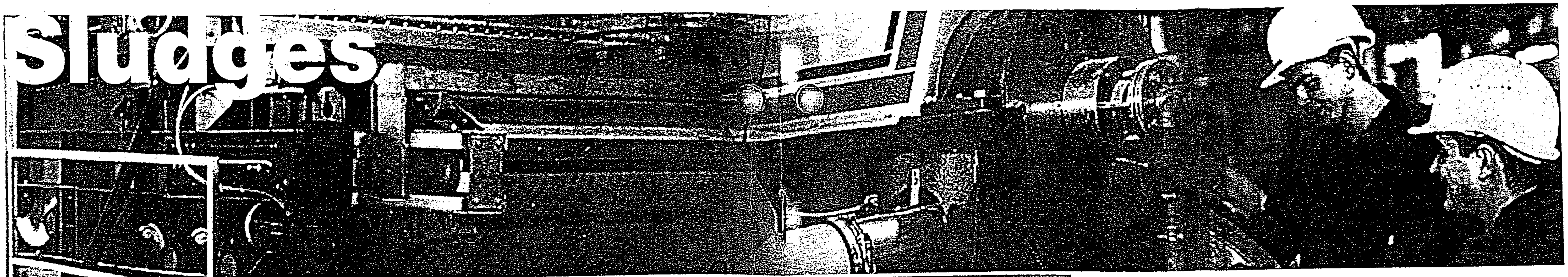


What we offer:

- Self-cleaning raked and perforated plate screens
- Static and rotary fine screens
- Sand filtration systems
- Micro screening

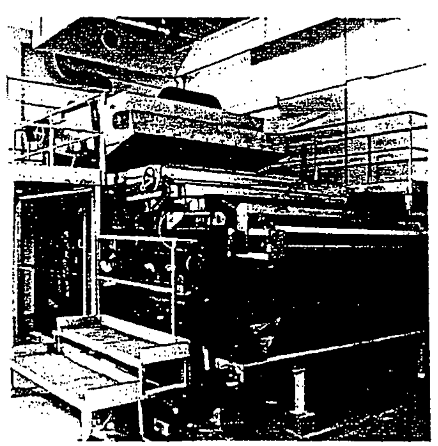


Sludges



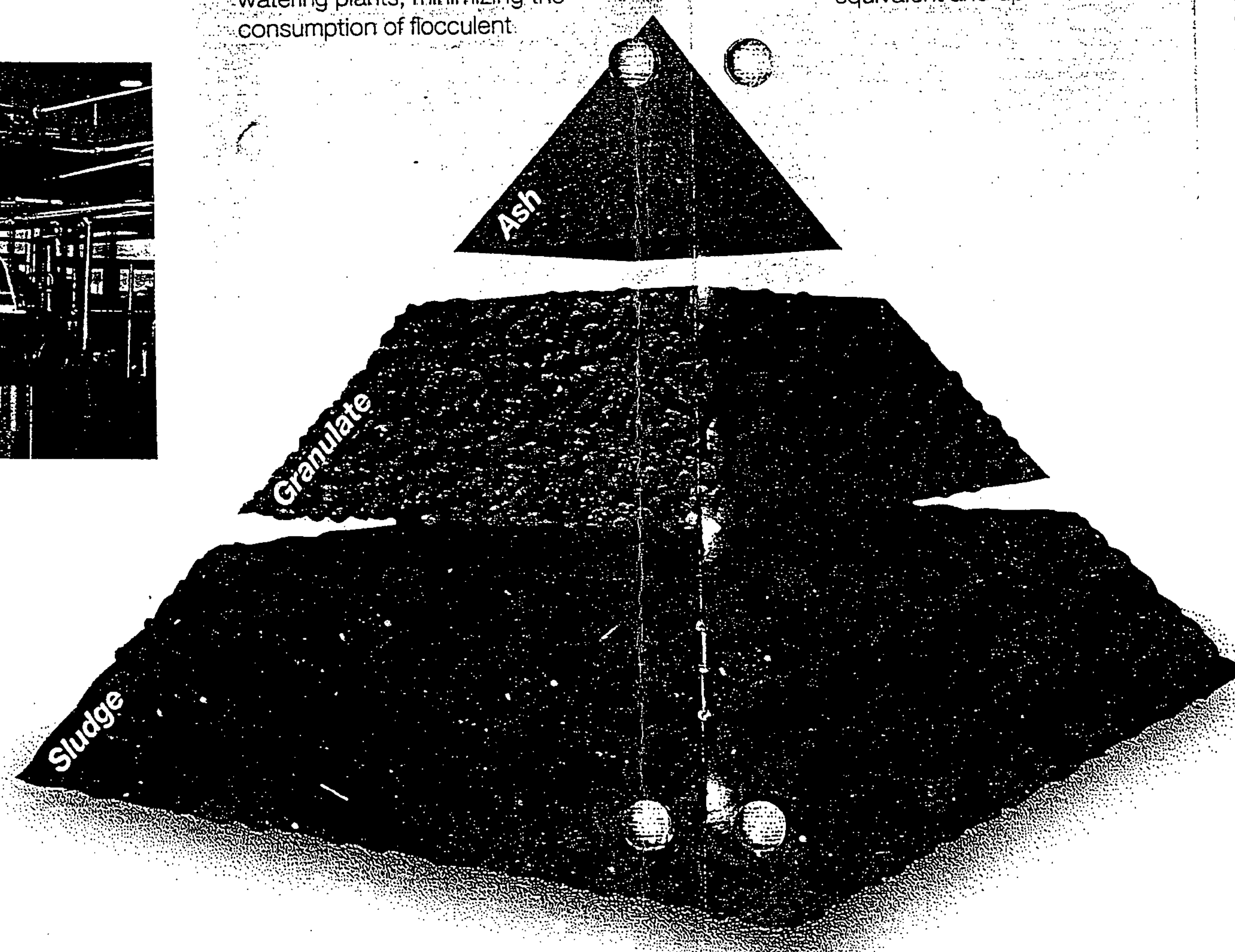
Sludge treatment

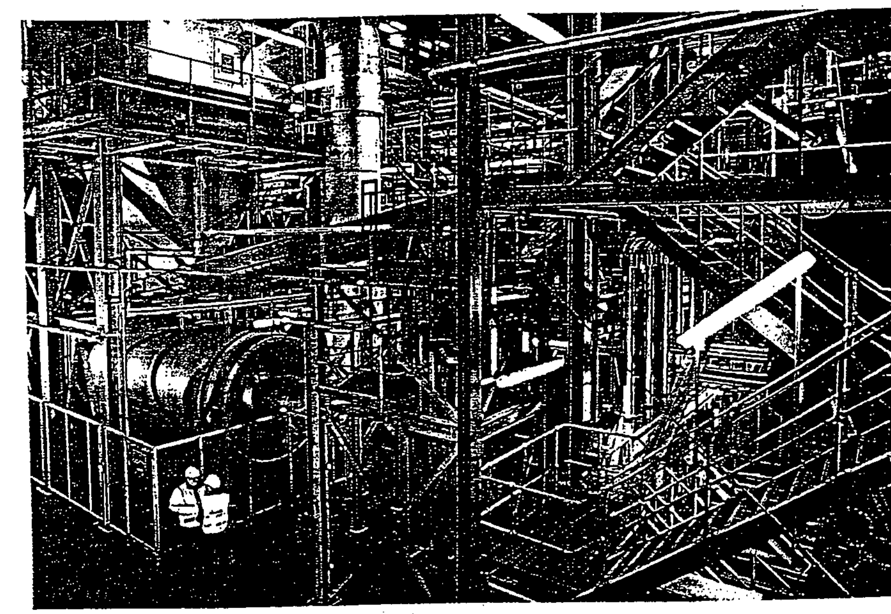
Responsible disposal - or better still - beneficial reuse of municipal and industrial sludges requires suitable treatment. Andritz has the complete process chain: thickening - dewatering - drying - thermal utilization - all from a single source.

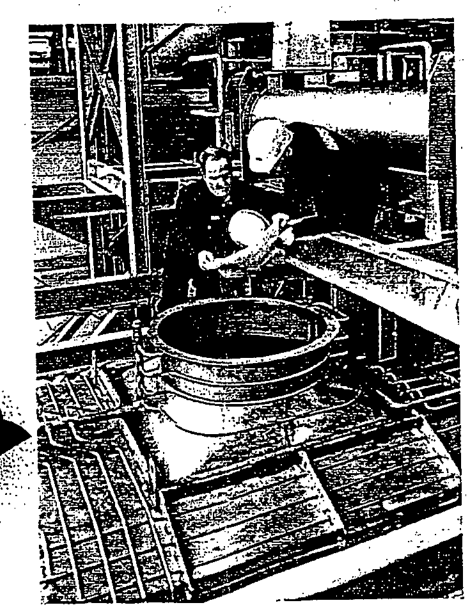


Consider the following:

- More than 4,900 reference plants worldwide, including sludge thickeners, belt presses and decanter centrifuges
- FlocSave: the new, fully automatic control system for dewatering plants, minimizing the consumption of flocculent
- Over 100 reference installations for sludge drying, including Bran Sands, Europe's largest sludge drying plant
- DynaDry - the new, compact drying system for sewage treatment for 10,000 population equivalent and up







What we offer:

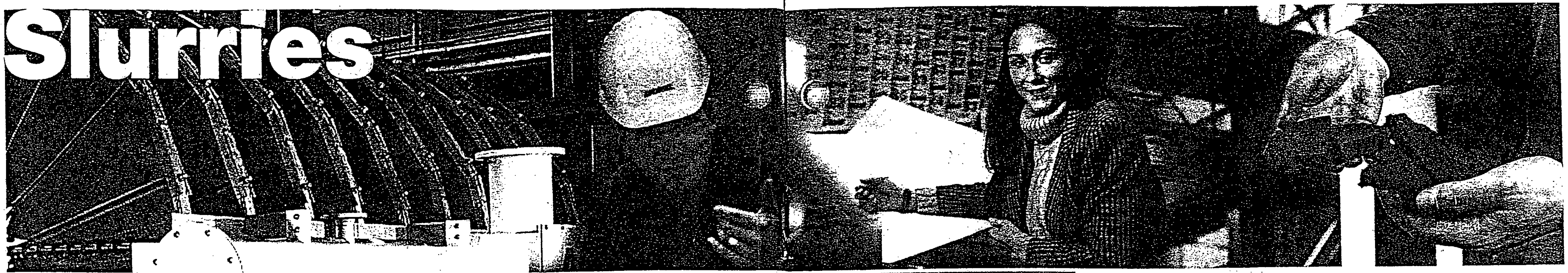
Thickeners:
- Belt thickeners
- Drum thickeners
- Decanter centrifuges

Dewatering equipment:
- Belt presses
- Decanter centrifuges

Dryers:
- Drum dryers
- Fluidized bed dryers
- DynaDry compact drying plants

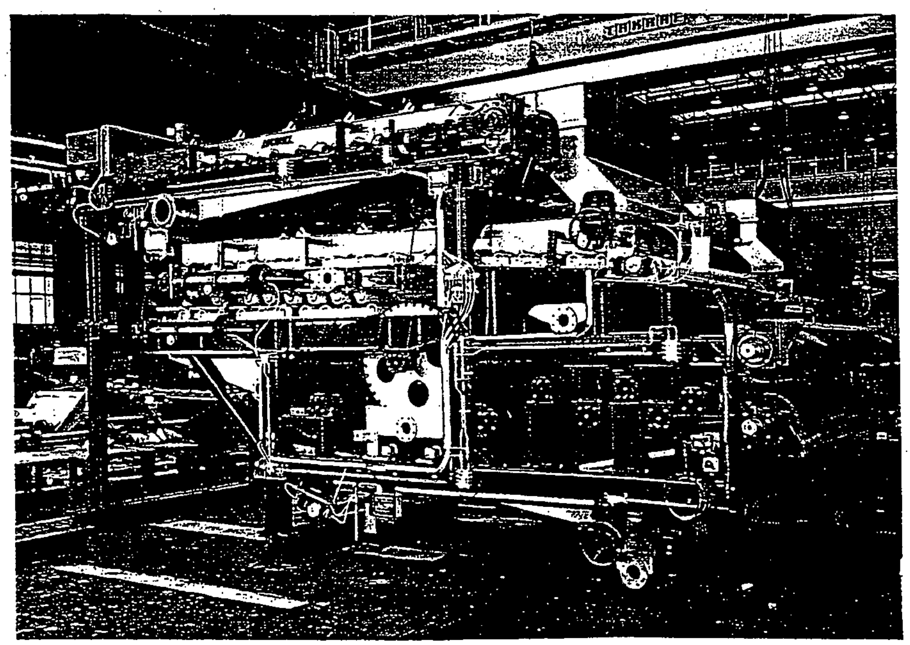
Thermal utilization plants:
- EcoDry® system

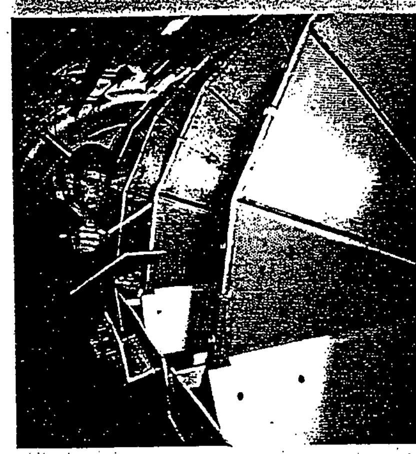
Slurries



Industrial process applications

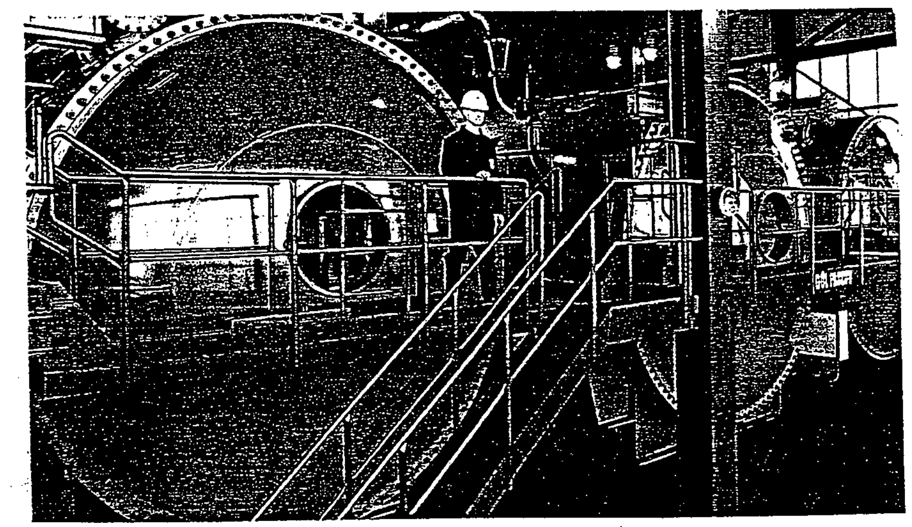
Filtration of coal slurry, treatment of mineral and ore suspensions, cleaning contaminated soils, filtration of slurries in the chemical industry - our systems handle all these, even under the most stringent requirements.

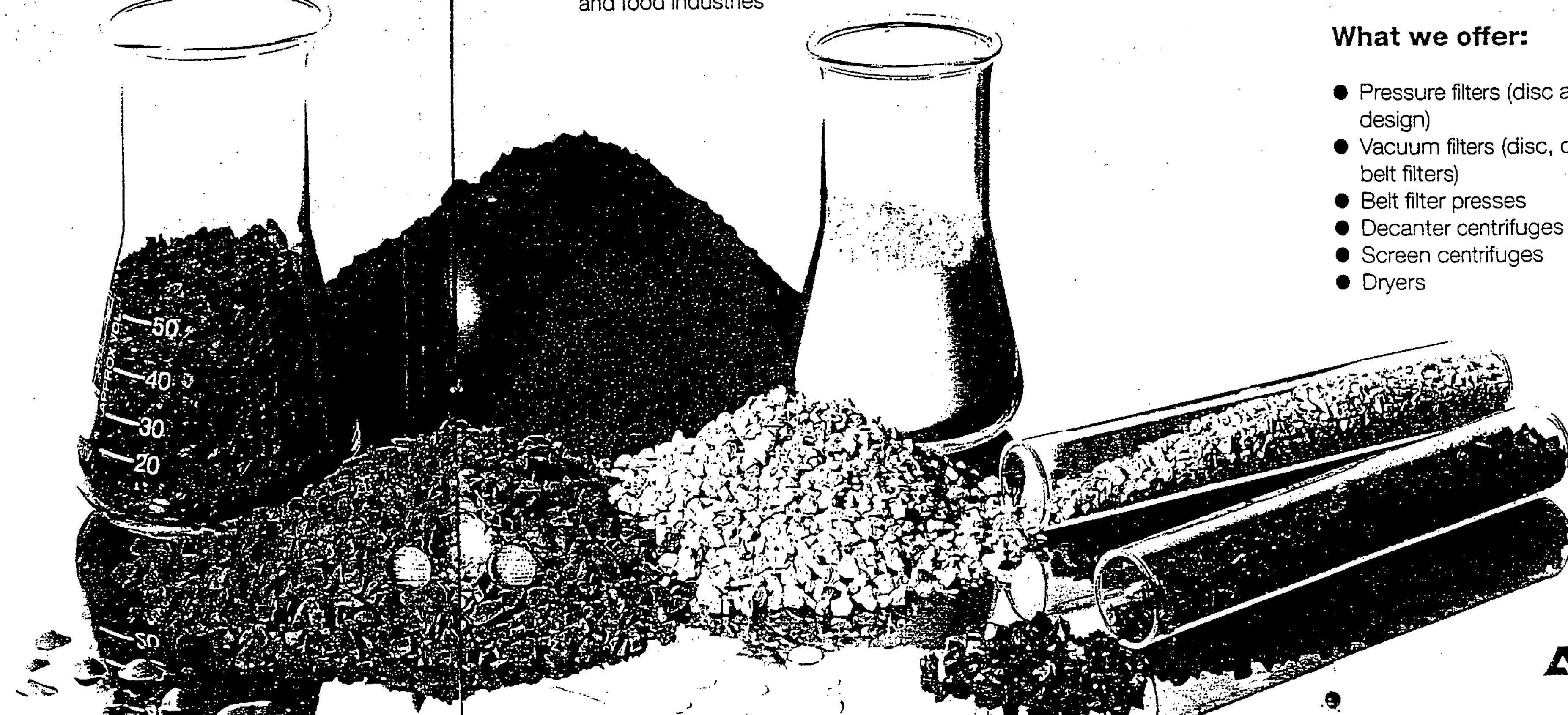




Consider the following:

- World market leader for hyperbaric filtration
- Supplier of the world's largest pressure filtration systems for coal and copper ore treatment
- Belt presses and centrifuges for recovering crude oil from oil mud and for special applications in the chemical and food industries
- Drying systems for the chemical and food industries





What we offer:

- Pressure filters (disc and drum design)
- Vacuum filters (disc, drum and belt filters)
- Belt filter presses
- Decanter centrifuges
- Screen centrifuges
- Dryers

You are making the right choice

Our team draws on the resources of the globally successful Andritz Group.

Andritz Pilot Plants and Mobile Testing Installations

We customize our systems to any given requirements by conducting tests in our research laboratories and also on site. Intensive research and development work - our investment in the future !

Andritz Manufacture

Quality and on-time delivery are strongpoints of the Andritz production sites worldwide. Our long-term experience as machine and engineering suppliers comes as a clear benefit.

Andritz Automation

Our in-house team develops and builds control systems specifically designed for the application, resulting in a high degree of automation, ease of use and trouble-free operation.

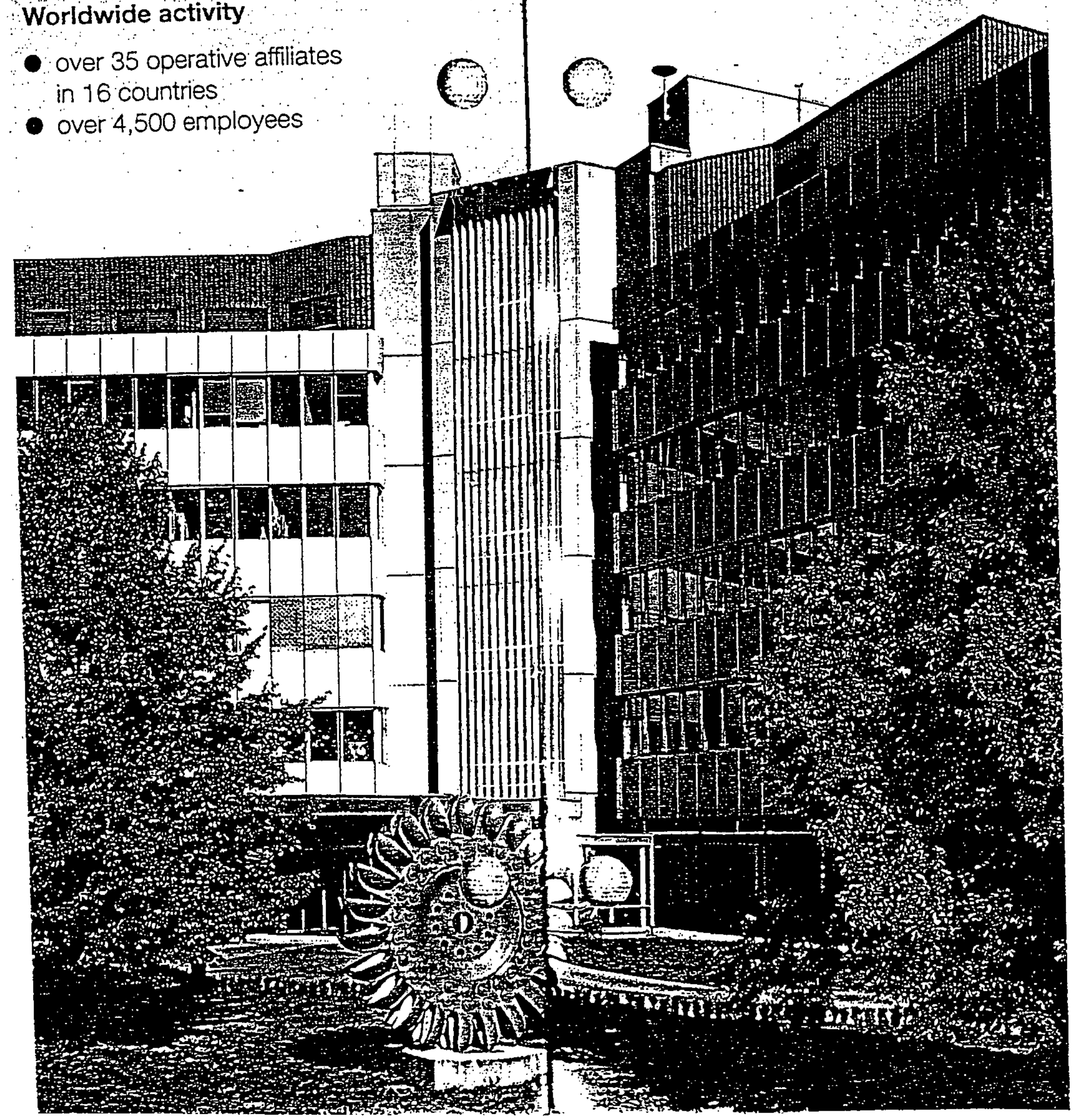
Andritz Group

Has top skills for

- Environment and Process
- Pulp and Paper
- Rolling Mills and Strip Treatment
- Feed Technology
- Hydraulic Machines

Worldwide activity

- over 35 operative affiliates in 16 countries
- over 4,500 employees

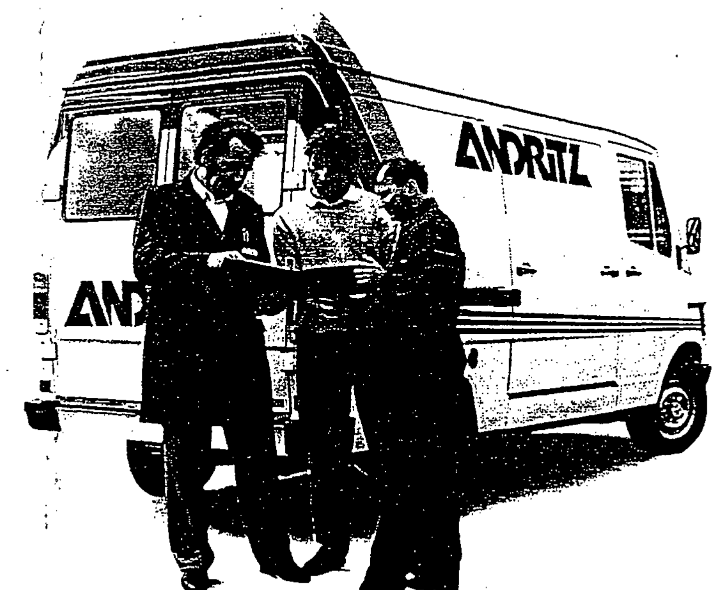


Andritz Quality Management

Our ISO 9001 accreditation gained in 1992 ensures that every phase of the project, from the first offer to plant take-over, is subject to strict Quality Assurance and Management procedures.

Andritz Service

Our world-wide network of affiliates and agents guarantees quick response and an all-out service.



Andritz DDS

Simply consider the following:

A final product of high quality
The Andritz triple-pass drum, where the sludge is pneumatically conveyed in the hot air stream, ensures that the final product, the granulate, is of the highest quality:

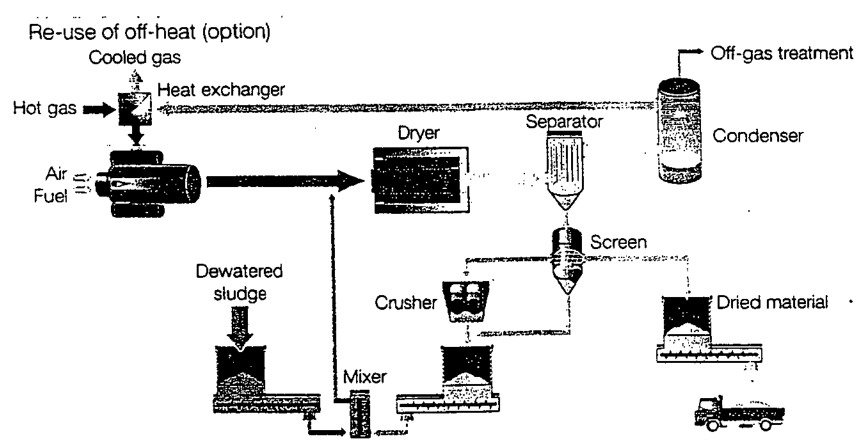
- Stable and free-flowing
- Virtually dust-free
- Pasteurized

Intelligent controls
The advanced temperature control system allows plants to function automatically and adapt to variations in the incoming sludges.

Optimum energy utilization
The DDS process uses available energy to the optimum for drying.

- Use of available "waste" heat or alternative energy sources
- Utilization of the energy content in the dryer air stream
- Maximum utilization of the heat in the dryer with three cylinders

DDS Drum Drying Process

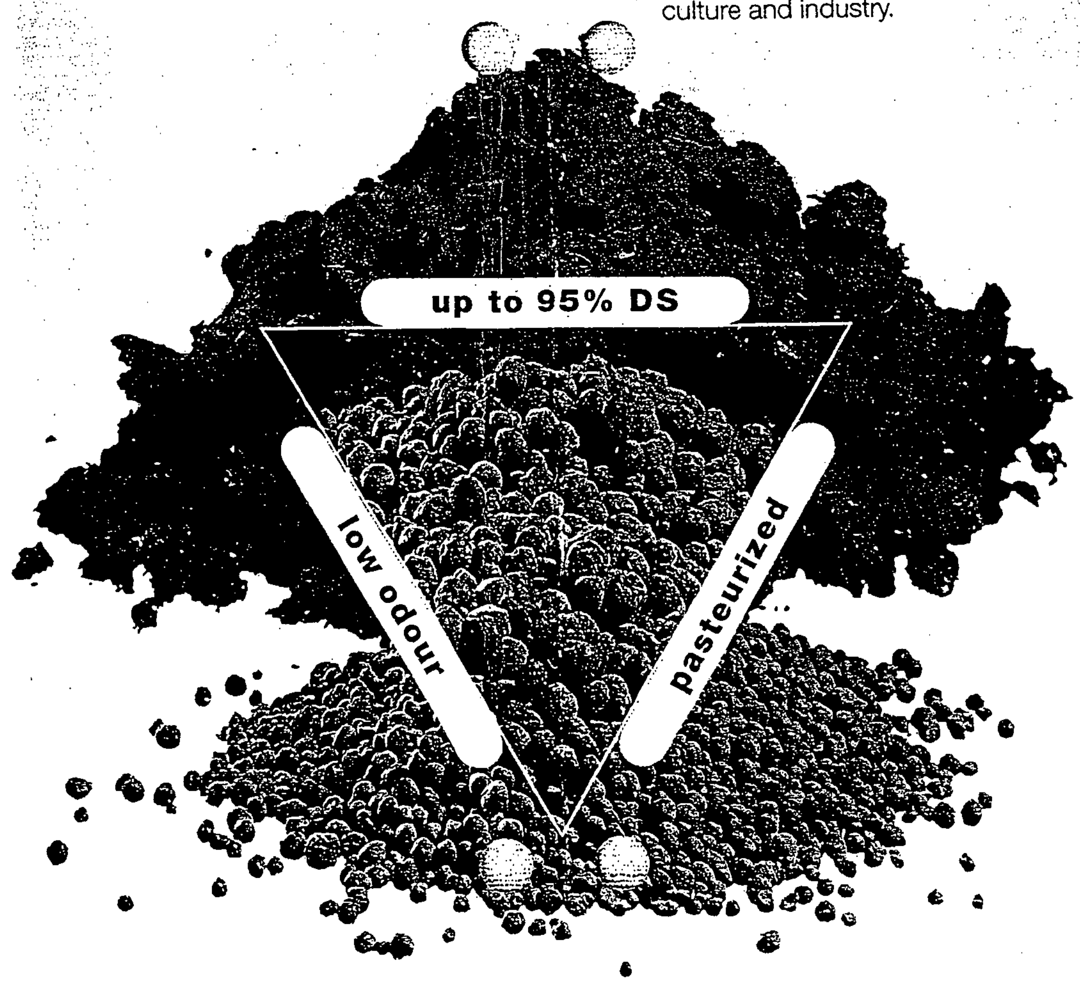


A process for drying and granulating

The Andritz DDS Drum Drying System dries and granulates different types of municipal, industrial and agricultural sludges.

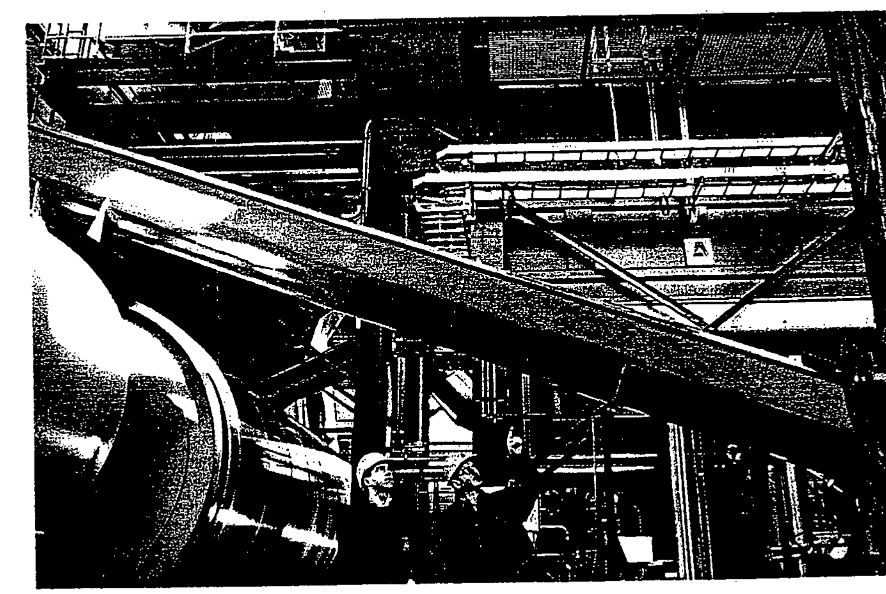
The dewatered sludge is granulated in a mixer tailored to the application. It is then dried in the triple-pass drum. This drum consists of three concentric cylinders revolving around a joint axis. The sludge is pneumatically conveyed by the stream of hot air ensuring an evenly dried and pasteurized product.

The final product - granulate - can be used profitably in agriculture and industry.



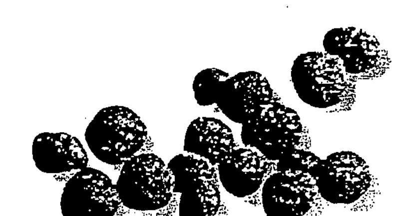
Worldwide success

Our DDS is the product of 25 years of experience. Reference plants located all over the world prove its versatility and reliability.



Profit from:

- A final product which can be put to economic use
- Low operating costs
- Ease of operation
- Low off-gas volume due to closed air circuit
- Proven safety system
- Flexible service on site and by modem
- In-house design and manufacture of major plant items and control systems
- Complete solutions, from dewatering to drying through to thermal reuse



ANDRITZ

ANDRITZ

7 Andritz-Ruthner, Inc. - Standard Terms and Conditions of Sale

1. TERMS APPLICABLE

The Terms and Conditions of Sale listed below are the exclusive terms and conditions applicable to quotations made and orders accepted by Andritz Ruthner, Inc. ("Seller") for the sales of products, equipment and parts relating thereto ("Products"). This quotation or acknowledgment and acceptance is expressly made conditional upon Buyer's assent to such terms and conditions. Any of Buyer's terms and conditions which are in addition to or different from those contained herein, which are not separately agreed to by Seller in writing, are hereby objected to and shall be of no effect. Objections to any terms and conditions contained herein shall be deemed waived if Seller does not receive written notice thereof within 20 days of the date of this acknowledgment. Buyer in any event will be deemed to have assented to the terms and conditions contained herein if Buyer either makes any payment to Seller or accepts any delivery of the Product. The term "this Agreement" as used herein means this quotation or acknowledgment together with any attachment hereto, any documents expressly incorporated by reference and these Standard Terms and Conditions of Sale.

2. DELIVERY

(a) Delivery dates are good faith estimates and do not mean that "time is of the essence". Buyer's failure to promptly make advance or interim payments, supply technical information, drawings and approvals will result in a commensurate delay in delivery. Unless otherwise agreed in writing by Seller, title and risk of loss or damage to the Products shall pass to Buyer upon delivery of the Products F.O.B., Seller's plant (F.O.B., point of manufacture for any Product shipped direct to Buyer from any location other than Seller's plant).

(b) Seller shall not be liable for any loss or delay due to acts of governmental authority, laws or regulations, strikes, fires, floods, earthquakes, severe weather, epidemics, quarantine restrictions, war, riot, acts of Buyer, wrecks, delays in transportation, inability to obtain necessary labor or materials from usual sources, or other causes beyond the reasonable control of Seller. In the event of any such delay in performance due to such causes, the date of delivery or performance shall be deferred for a period equal to the time lost by the reason of the delay.

3. WARRANTY

(a) Seller warrants to Buyer that the Products will be delivered free from defects in material and workmanship. This warranty shall commence upon delivery of the Products and shall expire on the earlier to occur of 12 months from initial operation of the Products and 18 months from delivery thereof (the "Warranty Period"). If during the Warranty Period Buyer discovers a defect in material or workmanship and gives Seller written notice thereof within 10 days of such discovery, Seller will, at its option, either deliver to Buyer a replacement part or repair the defect in place. Seller will have no warranty obligations under this paragraph 3(a): (i) if Buyer fails to ensure that the Products are operated and maintained in accordance with generally approved industry practice and with Seller's specific written instructions; (ii) if the Products are used in connection with any mixture or substance or operating condition other than that for which they were designed; (iii) if Buyer fails to give Seller such written 10 day notice; (iv) if the Products are repaired by someone other than Seller or have been intentionally or accidentally damaged, or (v) corrosion, erosion, ordinary wear and tear or in respect of any parts which by their nature are exposed to severe wear and tear or are considered expendable.

(b) Seller further warrants to Buyer that at delivery, the Products will be free of any liens or encumbrances. If there are any such liens or encumbrances, Seller will cause them to be discharged promptly after notification from Buyer of their existence.

(c) THE EXPRESS WARRANTIES SELLER MAKES IN THIS PARAGRAPH 3 ARE THE ONLY WARRANTIES IT WILL MAKE. THERE ARE NO OTHER WARRANTIES, WHETHER STATUTORY, ORAL, EXPRESS OR IMPLIED. IN PARTICULAR, THERE ARE NO IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

(d) The remedies provided in paragraphs 3(a) and 3(b) are Buyer's exclusive remedy for breach of warranty.

4. LIMITATION OF LIABILITY

The remedies of buyer set forth herein are exclusive and the aggregate liability of seller for all claims of any kind for any loss or damage resulting from, arising out of or connected with this agreement or from the performance or breach thereof, or from the manufacture, sale, delivery, resale, repair or use of any product, shall in no event exceed the price allocable to the product which gave rise to the claims. The foregoing notwithstanding, if applicable, any claims for (a) delay shall not exceed 10% and (b) breach of performance guarantees shall not exceed 20% of the price. In no event shall seller be liable to buyer or any party for special, incidental or consequential damages of any nature, including, but not limited to, loss of profits or revenue or business opportunity, loss by reason of shutdown of facilities or inability to operate any facility at full capacity, or cost of obtaining replacement power. The limitations and exclusions of liability set forth in this paragraph shall apply to any claim, whether based on contract, warranty, tort (including negligence), fault, strict liability, indemnity, or otherwise. All liability of Seller to Buyer, arising out of this Agreement, shall terminate at the expiration of 3 years after final acceptance. The provisions of this paragraph 4 shall supersede any inconsistent provisions in any instrument forming part of this agreement.

5. TAXES

Seller's prices do not include any sales, use, excise or other taxes. In addition to the price specified herein, the amount of any present or future sales, use, excise or other tax applicable to the sale or use of the Products shall be billed to and paid by Buyer unless Buyer provides to Seller a tax-exemption certificate acceptable to the relevant taxing authorities.

6. SECURITY INTEREST

Seller shall retain a purchase money security interest in the Products until all payments have been made in full. Buyer agrees to do all acts necessary to perfect and maintain such security interest in Seller and to protect Seller's interest in the Products.

7. SET OFF

Neither Buyer nor any of its affiliates shall have any right to set off claims against Seller or any of its affiliates for amounts owed under this Agreement or otherwise.

8. PATENTS

Unless the Products or any part thereof are designed to Buyer's specifications and provided the Product or any part thereof is not used in any manner other than as specified or approved by Seller in writing, (i) Seller shall defend against any suit or proceeding brought against Buyer to the extent based on a claim that any Product, or any part thereof, infringes any United States patents; provided Seller is notified promptly in writing and given authority, information and assistance for the defense of such suit or proceeding; (ii) Seller shall satisfy any judgment for damages entered against Buyer in such suit; and (iii) if such judgment enjoins Buyer from using any Product or a part thereof, then Seller shall at its option: (a) obtain for Buyer the right to continue using such Product or part; (b) eliminate the infringement by replacing or modifying all or part of the Products; or (c) take back such Product or part and refund to Buyer all payments on the purchase price which Seller has received, in which case neither Buyer nor Seller will have any claim against the other under this Agreement or arising out of the subject matter of this Agreement. The foregoing states Seller's entire liability for patent infringement by any Product or part thereof.

9. CANCELLATION

Buyer may only cancel its order upon written notice to Seller and upon payment to Seller of Seller's cancellation charges, which shall be specified to Buyer and shall take into account among other things expenses (direct and indirect) incurred and commitments already made by Seller and an appropriate profit. In the event of the bankruptcy or insolvency of Buyer or in the event of any bankruptcy or insolvency proceeding brought by or against Buyer, Seller shall be entitled to cancel any order outstanding at any time during the period allowed for filing claims against the estate and shall receive reimbursement for its cancellation charges.

10. CHANGES

Seller will not make changes in the Products unless Buyer and Seller have executed a written Change Order for such change. Such Change Order will include an appropriate price adjustment. If the change impairs Seller's ability to satisfy any of its obligations to Buyer, the Change Order will include appropriate modifications to this Agreement. If after the date of this quotation or acknowledgment, new or revised governmental requirements should require a change in the Products, the change will be subject to this paragraph 10.

11. CONFIDENTIALITY

Buyer acknowledges that the information which Seller submits to Buyer in connection with this quotation or acknowledgment includes Seller's confidential and proprietary information, both of a technical and commercial nature. Buyer agrees not to disclose such information to third parties without Seller's prior written consent. Buyer further agrees not to permit any third party to fabricate the Products or any parts thereof from Seller's drawings. Buyer will defend and indemnify Seller from any claim, suit, or liability based on personal injury (including death) or property damage related to any Product or part thereof which is fabricated by a third party without Seller's prior written consent and from and against related costs, charges and expenses (including attorneys fees). All copies of Seller's drawings shall remain Seller's property and may be reclaimed by Seller at any time.

12. END USER

If Buyer is not the end user of the Products sold hereunder (the "End User"), then Buyer will use its best efforts to obtain the End User's written consent to be bound to Seller by the provisions of paragraphs 3, 4, 5, and 11 hereof. If Buyer does not obtain such End User's consent, Buyer shall defend and indemnify Seller and Seller's agents, employees, subcontractors, and suppliers from any action, liability, cost, loss or expense for which Seller would not have been liable or from which Seller would have been indemnified if Buyer had obtained such End User's consent.

13. GENERAL

(a) Seller represents that any Products or parts thereof manufactured by Seller will be produced in compliance with all applicable Federal, state and local laws applicable to their manufacture and in accordance with Seller's engineering standards. Seller shall not be liable for failure of the Products to comply with any other specifications, standards, laws or regulations.

(b) This Agreement shall inure only to the benefit of Buyer and Seller and their respective successors and assigns. Any assignment of this Agreement or any of the rights or obligations hereunder, by either party without the written consent of the other party shall be void.

(c) This Agreement contains the entire and only agreement between the parties with respect to the subject matter hereof and supersedes all prior oral and written understandings between Buyer and Seller concerning the Products, and any prior course of dealings or usage of the trade not incorporated herein.

(d) This Agreement (including these standard terms and conditions of sale) may be modified, supplemented or amended only by a writing signed by an authorized representative of Seller. Seller's waiver of any breach by Buyer of any terms of this Agreement must also be in writing and any waiver by Seller or failure by Seller to enforce any of the terms and conditions of this Agreement at any time, shall not affect, limit or waive Seller's right thereafter to enforce and compel strict compliance with every term and condition thereof.

(e) This Agreement and the performance thereof will be governed by and construed according to the laws of the State of Texas. The parties hereto irrevocably submit to the jurisdiction of the Federal and State courts sitting in Tarrant County, Texas and waive any claims as to inconvenient forum. In the event this Agreement pertains to the sale of any goods outside the United States, the parties agree that the United Nations Convention for the International Sale of Goods shall not apply to this Agreement.

8 Drawings

City of
WILSONVILLE
in OREGON

30000 SW Town Center Loop E
Wilsonville, Oregon 97070
(503) 682-1011
(503) 682-1015 Fax
(503) 682-0843 TDD

EXHIBIT 4

ENGINEERING DEPARTMENT MEMO

DATE: October 1, 2003

TO: Planning Commission Members

FROM: Laurel Byer PE, Assistant City Engineer

RE: ***Additional Background for the Proposed Wastewater Facility Plan Update(02PC05)***

The following attachments are background materials regarding the process the proposed Wastewater Facility Plan Update has been through to date. Included are:

- A memorandum dated November 7, 2002, from Eldon Johansen, regarding the Draft Wastewater Treatment Plant Facilities Plan.
- A copy of the PowerPoint Presentation shown by HDR Engineering, Inc. at the January 8, 2003 Planning Commission Work Session for 02PC05.
- Adopted minutes of the January 8, 2003, Planning Commission Work Session for 02PC05.

Our goal is for these items to serve as a refresher for most of you and an introduction to the Facility Plan for the new Commissioners. If you have any questions or concerns, staff will work with the Commission to address them.

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COMMUNITY DEVELOPMENT
STAFF REPORT

Date: **November 7, 2002**

To: **Planning Commission**

From: **Eldon R. Johansen, Community Development Director**

Subject: **_Draft Wastewater Treatment Plant Facilities Plan**

The Wastewater Treatment Plant Facilities Plan was updated in April 1995. The update changed the planned method of treatment from rotating biological contactors to an activated sludge system with selector technology. The rotating biological contactors work very well with domestic waste, however, the higher strength industrial waste were not adequately treated by the rotating biological contactors. For this reason the 1995 Facilities Plan recommended the change to activated sludge with selector technology. In the late 1990s the rotating biological contactors were replaced with two activated sludge basins, the intake system was improved and the filtration system at the tail end of the treatment process was renovated. In addition the system for chlorination of the liquid waste prior to discharge into the Willamette was changed to use ultra radiation for disinfections. The solids handling portion of the plant was not upgraded with the recognition that this would be a project that would be needed in future years.

The projected life of the plant with the exception of the solids handling facilities was to provide adequate service capacity to serve through 2015. The plant is performing very much as anticipated. One significant change that will require earlier than anticipated expansion of the activated sludge plant is the addition of sewage flows from the Coffee Correctional Facility to the Treatment Plant. Although we have collected the funds from the Department of Corrections for their use of capacity in the Wastewater Treatment Plant we will need to expand the liquids handling processes earlier than anticipated. This will be second phase of plant expansion.

The first phase will be a major modification of the solids handling process. At the time plant was last expanded the City was having no problems in obtaining land to apply the effluent. Changes in property ownership and concerns of the Department of Environmental Quality have greatly increased the urgency for improvements of the solids handling process. Attached is memorandum from Ron Morrow, Environmental Services Manager, which provides additional background on the urgency for upgrading the solids handling process.

Currently there is a project for odor control in progress at the plant.

C:\Documents and Settings\Somerville\Desktop\Staff Draft Wastewater Treatment Plant Facilities Plan.doc

Our general approach will be to have HDR summarize the Facilities Plan at the Planning Commission Planning Session on November 13, 2002. The comments from the Planning Commission will be incorporated into the draft and a public hearing will be scheduled. Following a recommendation for approval from the Planning Commission, the Facilities Plan will be forwarded to Council for approval. Simultaneously with the Planning Commission and Council actions on the Facilities Plan, staff will work with the consulting firm of Galardt Consulting to update the sewer rate and systems development charge study. Assuming that everything moves forward as anticipated, staff will initiate the budgeting for the solids handling improvements in the 2003/04 budget. This has been a substantial over simplification of a topic that is of most-interest to Ron Morrow and the undersigned. If you have further questions, either HDR or staff will be available on November 13 to answer those questions.

Eldon R. Johansen

Eldon R. Johansen
Community Development Director

ERJ:bjh

Attachments

INTEROFFICE MEMORANDUM

TO: JEFF BAUMAN, ELDON JOHANSEN, MIKE STONE, AND GARY WALLIS

FROM: RON MORROW

SUBJECT: BIOSOLIDS PROGRAM

DATE: 11/7/2002

CC: JANEEN ADAMO

In last Tuesday's meeting, Gary asked a very important question that I would like to take a moment to elaborate on. Gary asked what were the driving forces behind the expenditures being proposed in the facilities plan for biosolids. While it is true that solids handling was not addressed in the last expansion, a more complete answer needs to include our regulators (DEQ), and the concerns they have with all winter application programs.

The City of Wilsonville produces 50,000 gallons a week of biosolids and we have an on-site storage capacity of only eight weeks. During the summer, with the abundance of dry land, and the popularity with the soil conditioning and fertilizer properties of our product, we have developed a good market. However, due to this limited storage capacity, and large volumes of biosolids produced, Wilsonville is also obligated to a winter biosolids program. Without going into the boring details, sites suitable for winter use need to conform to some very specific conditions as to soil type, drainage, and crops, and are more difficult to find than summer sites. All of these aspects of our program are strictly regulated, and each site (summer and winter) goes through a ridged state approval process.

So what has changed? While other communities were responding to pressures from the DEQ and EPA and moving away from winter liquid programs (we may be one of the last), Wilsonville became dependent upon one or two large properties that had been with our program for many years, and approved long ago for winter application. Just prior to my arrival, with changes in ownership, and farm practices, we lost these properties. We then entered into a regulatory climate that had become increasingly reluctant to approve any winter application sites for liquid biosolids, and whose goal is the elimination of all winter spray irrigation systems in the Willamette valley.

Why? The EPA and DEQ are arguing is that with the colder temperatures, slower growing crops, and increased rainfall, the winter programs have an increased risk to the environment for runoff, and ground water pollution. While farmers favor spray irrigation, our regulators have increasing concerns about over spray, odors, and wind drift.

Where does that leave us? We need to change. The days of spray irrigation of liquid biosolids on winter sites in the Willamette valley will soon be gone. We need to reduce our biosolids volume through cake production, and increase our storage capacity of our program to cover the winter months. In the meantime, the DEQ will only approve additional winter sites for the City of Wilsonville, providing we can find them, if we have a plan in place that takes us to a cake and additional storage, and out of the liquid spray irrigation program. Once we have a cake product, we will then have many more options available to us, and the program will be off in a new and exciting direction.

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PLANNING COMMISSION

Community Development Annex
8445 SW Elligsen Road
Wilsonville, Oregon

January 8, 2003

Minutes

I. CALL TO ORDER - ROLL CALL

Chair Bunn called the meeting to order at 7:02 p.m. Those present:

Planning Commission:	Paul Bunn, Debra Iguchi, Mary Hinds, and Randy Wortman were present. Susan Guyton was absent. City Council Liaison John Helser was also present.
City Staff:	Arlene Loble, Eldon Johansen, Maggie Collins, Danielle Cowan, Paul Lee, John Michael, Paul Cathcart and Linda Straessle.

VI. WORK SESSION

Application No. 02PC05
Request: Adoption of a Wastewater Facility Plan Update
Location: Citywide
Applicant: City of Wilsonville

A DRAFT Wastewater Facility Plan Update, November 2002, was distributed for the November 13, 2002 meeting.

Mr. Johansen introduced Rob Morrow, the City's Environmental Services Manager. He explained:

- The Wastewater Facility Plan was last updated in 1994.
- A major expansion of the Wastewater Treatment Plan was done in the 1996 to 1998 timeframe.
  - The approach at that time was to make sure that liquid handling was being handled well.
  - Numerous farms have been available to take the solids.

   - The City is working on the solids handling earlier than anticipated because the assumptions about the number of farms able to take the solids and the City's ability to obtain the necessary permits distribute the solids to the farms were incorrect.
- HDR Engineering updated the Wastewater Facility Plan.
- The approval for the Wastewater Facility Plan Update is to be an approval of an ancillary document to the Comprehensive Plan.

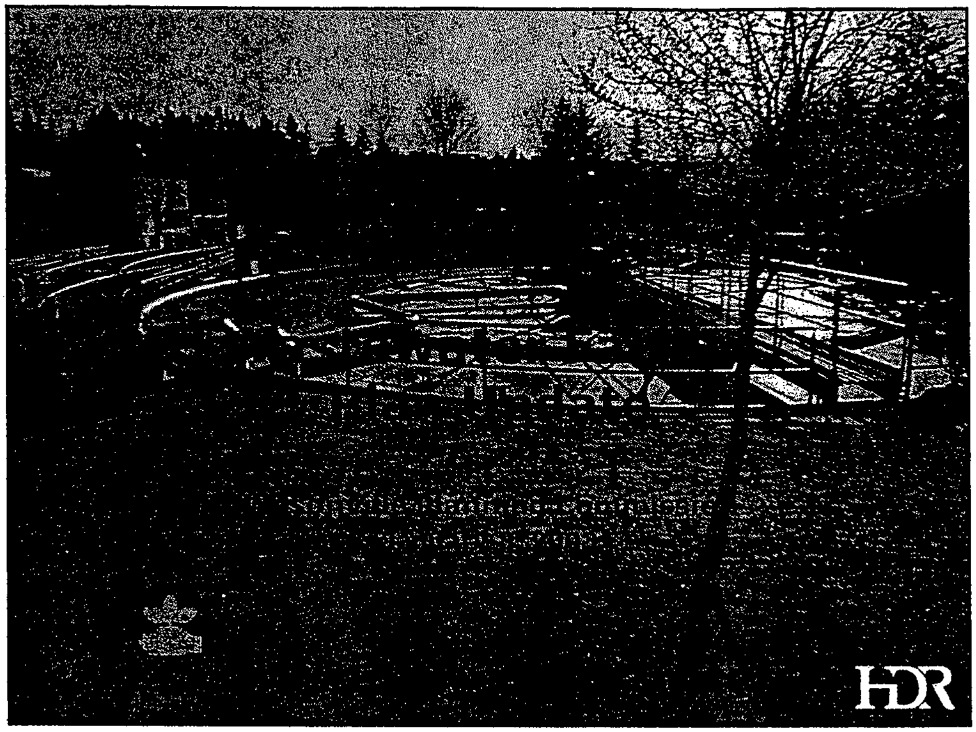
Heather Stevens and John Holroyd of HDR Engineering presented a PowerPoint presentation (attached).
Mr. Holroyd's additional comments during the presentation included:
- The Wastewater Facility Plant expansion is going to address both liquid stream and solid stream improvements.
- Phase I will include odor control improvements.
- A dewatering step is being added in the first phase.
- Capacity and the ability to store sludge are being added during the second phase of expansion.
- In the long-term, the City is looking at providing up to six months of cake storage as specified by DEQ.
- In the near term, a small increment of storage of three or four days is being considered in order to get through the peak period when land application is a challenge.
- Phase 2 includes about $500,000 in the sludge stabilization or digestion.
  - There will be a large increment cost for the long-term sludge storage and cake solids storage facility.
    - This facility will be a significant structure, over 20 feet tall, with odor control.
    - When that expansion is necessary, it is going to cost approximately $26 million.
- The costs include a 30% contingency in recognition that this is a challenging site.
  - Mr. Holroyd listed a number of the site constraints which included issues related to its size and location.
  - There are higher costs related to the site constraints.
- Some of the technologies that are going to be used are innovative.
  - Pilot testing will be done to see how the smaller scale units perform with Wilsonville's particular biosolids and water chemistry.
  - The pilot testing should proceed immediately so that the system can be on line. Even if construction starts on the new system tomorrow, this facility won't be up and running until early 2005.

The Commissioners questioned Ms. Stevens and Mr. Holroyd with these issues being addressed:
- Whether there would be room on the site for onsite storage at build-out. Different technologies were looked because of the site size constraints.
- The Willamette River has been identified as being water-quality limited for temperature so that the temperature of the river is optimum for the species in it.
  - DEQ and the Oregon Administrative Rules say that if the discharge has a measurable impact, which is defined as a specific increment in temperature or if it impedes the passage of endangered species, the City is required to have a temperature management plan which is a written document that is submitted to DEQ and has mitigation steps in it.
  - The City has a temperature limit in its NPDES (National Pollutant Discharge Elimination System) Permit. The City was well under this permit requirement and there is no impact on the river.

- This could be subject to change depending upon the outcome of the total maximum daily load that is being developed for the Willamette River.

- The higher costs related to the physical constraints of the site were discussed.
  - Costs of further development on the present site were compared to what it would cost to move the wastewater facilities plant to another site with fewer constraints. Mr. Holroyd questioned whether a move to another site could be implemented.
  - Mr. Holroyd suggested that putting the cake storage on another site is an alternative that could be pursued.
  - The "decision point" for locating the large storage facility for sludge on another location would be after Phase I and before Phase 2 due to DEQ considerations.
  - Staff has asked for a small amount of cost-effective storage to get through some near-term difficulties to make sure that that the City stays in compliance with regulations.
- DEQ is reviewing the guidelines and rulings for municipalities such as Wilsonville for long-term liquid and solid sludge application.
- Different kinds of biological processes for taking care of wastes were looked at but the processes that use plants and wetlands take more space than what is available.
  - Different variations of biological treatment such as the activated sludge processes that are at the plant now were also looked at.
- Rules for land application of sludge are in transition right now relative to DEQ's acceptance of a liquid/sludge product application on agricultural land in the winter. DEQ is being resistant to providing additional permits for new sites to apply sludge in its liquid form during the winter.
  - Wintertime sites are becoming harder to find due to restrictions. The summertime application program is working very well. Wilsonville has an outstanding biosolid's application program.
- The maximum period of time that sludge would be stored would be six months. This is what DEQ is looking for in terms of long-term sludge storage.
- Lime is mixed with water and metered into the process slowly. Ms. Stevens did not have the cost of the equipment for applying the lime with her.
- The visual impacts of the 20-ft tall storage buildings are to be screened. Perimeter landscaping is significant with any plant expansion.

The public hearing for 02PC05 Wastewater Facility Plan Update is scheduled for Wednesday, February 12, 2003.



Background

- Last Facility Plan completed in 1995
- Improvements constructed in late 1990s, including
  - Upgraded headworks
  - New aeration basin and clarifier
  - New UV disinfection system
  - New operations building
- No significant solids handling improvements

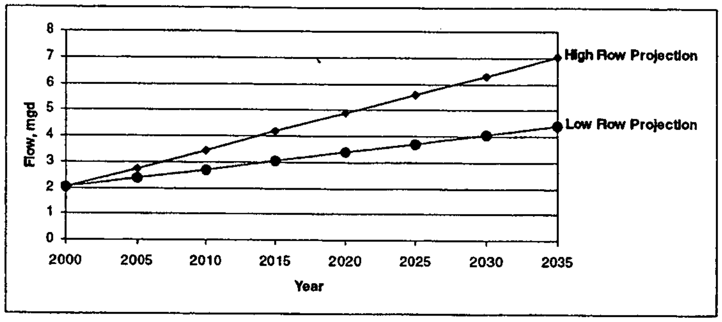
Current Facility Plan Objectives

- Update flow and loading projections
- Address current and potential future regulations
- Evaluate biosolids treatment and management
- Confirm long-term suitability of WWTP site
- Evaluate effluent reuse

Flow and Loading Projections

- Projections serve two purposes
  - Define ultimate needs
  - Identify near-term improvements
- Two projections developed
  - Low projections reflect current water consumption
  - High projections accommodate increased water use

Flow and Loading Projections



- High flow projections used for ultimate build out site planning

Existing Capacity

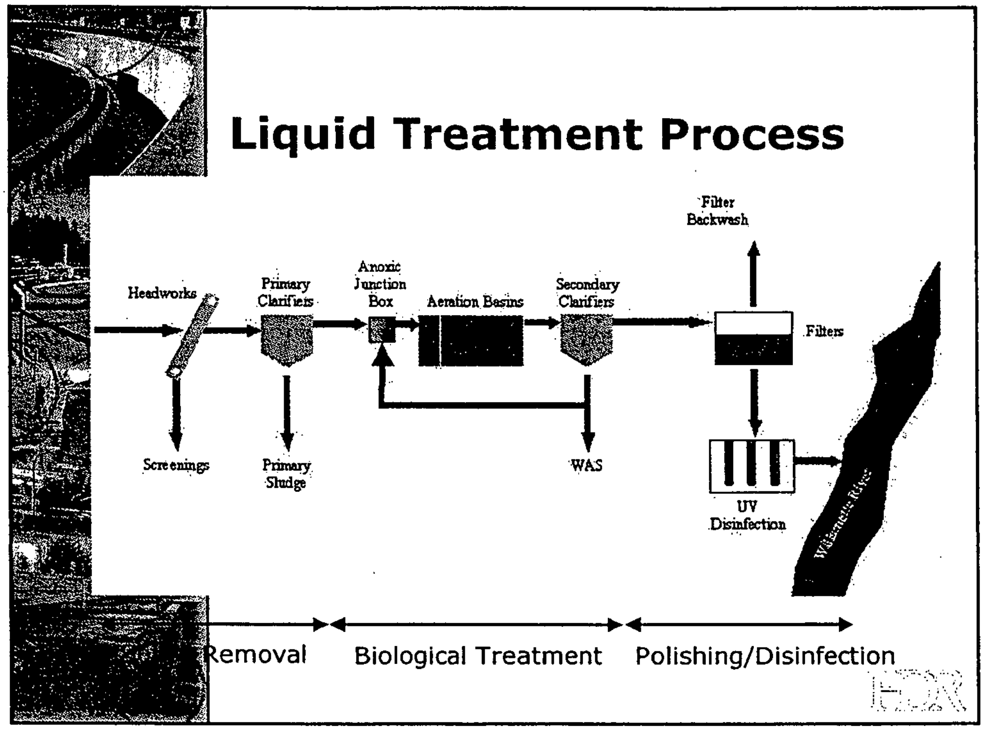
- Plan evaluates capacity of all treatment processes
- Most significant deficiency is in biosolids storage
- Near-term limitations in liquid treatment

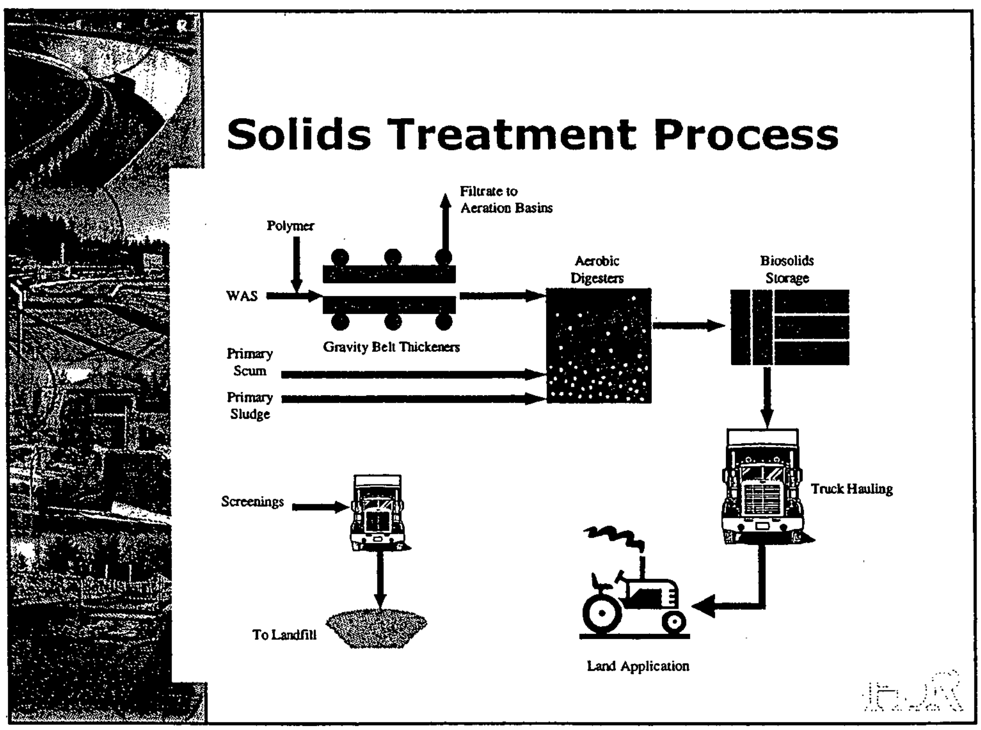
Regulatory Requirements

- NPDES Permit
  - CBOD and TSS mass limits will remain
  - Ammonia limit likely
- Biosolids Management
  - Limits on winter land application
  - 6 months onsite storage required
- Temperature
  - Mixing Zone Study appears to indicate no significant impact
  - Total Maximum Daily Load (TMDL) in progress

Alternatives Analysis

- Development and analysis focused on:
  - Providing for ultimate build out at current site
  - Community impacts
  - Flexibility for meeting future requirements
  - Cost

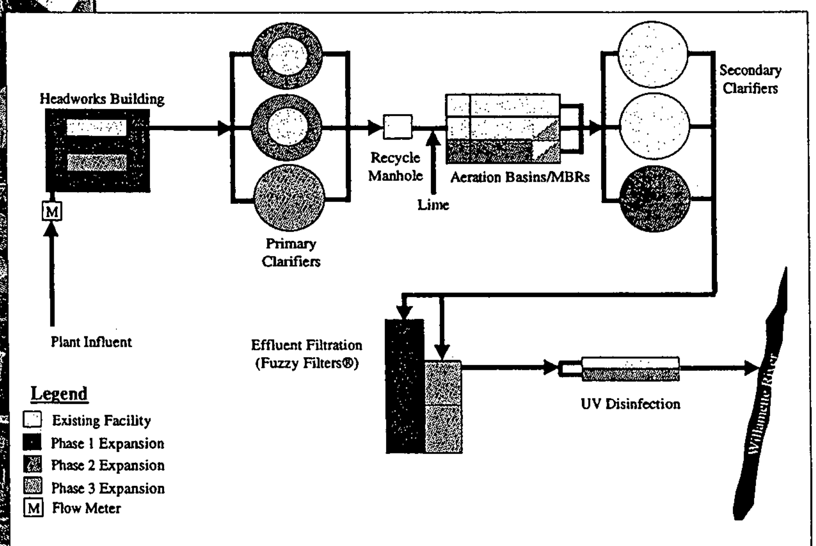

Liquid Treatment Process
Filter Backwash
Headworks
Primary Clarifiers
Anoxic Junction Box
Aeration Basins
Secondary Clarifiers
Filters
Screenings
Primary Sludge
WAS
UV Disinfection
Removal
Biological Treatment
Polishing/Disinfection


Solids Treatment Process
Filtrate to Aeration Basins
Polymer
WAS
Gravity Belt Thickeners
Aerobic Digesters
Biosolids Storage
Primary Scum
Primary Sludge
Screenings
Truck Hauling
To Landfill
Land Application

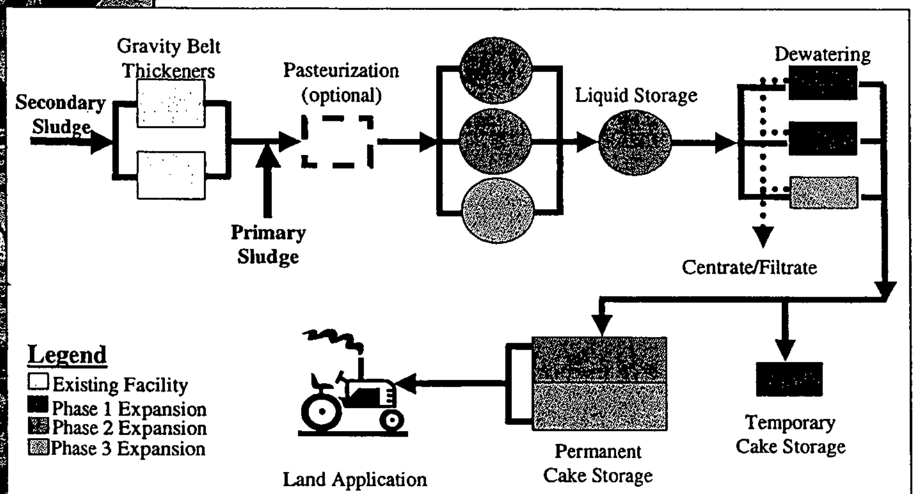
Recommended Plan

- Three improvement phases identified:
  - Immediate Needs (Online by 2005)
  - Near-term Needs (6-8 years)
  - Long-term (Ultimate buildout) (20-30 years)
- Recommendations phased to minimize initial costs

Recommended Plan



Recommended Plan



Recommended Plan - Costs

Project Element	Phase 1	Phase 2
Headworks	$1,680	$0
Primary Treatment	$125	$3,275
Secondary Treatment	$425	$9,669
Filtration	$2,690	$0
Disinfection	$0	$1,431
Solids Stabilization	$0	$4,812
Biosolids Dewatering	$3,840	
Liquid and Cake Storage	$150	$4,038
Sludge Haul/Spread Equip.	$180	
Relocate Maintenance Shop	$0	$550
Site Management	$446	$1,189
Landscaping and Mitigation	$446	$1,189
Total	$9,981	$26,153

- Phase 3 Expansion: $35M (in 20-30 years, as required based on influent flow and loading)

Next Steps

- Pilot testing needed immediately
  - Dewatering technologies
  - Fuzzy filters
  - Membrane bioreactors
- Phase 1 predesign
- Phase 1 design should start by 2nd quarter 2003

Alternatives Analysis

Headworks	•Additional Fine Screens
Primary Clarifiers	•Retrofit Existing •New Circular •High Rate Clarification
Secondary Treatment	•Activated Sludge •Biological Aerated Filter •Membrane Bioreactor
Filtration	•Sand Filters •Fuzzy Filters •Ballasted Filtration
Disinfection	•High Pressure UV •Medium Pressure UV •Sodium Hypochlorite

Alternatives Analysis

Thickening	**•Gravity Belt Thickeners**
Digestion	**•Class B Anaerobic Digestion** **•Autothermal Thermophilic Aerobic Digestion** **•Prepasterization** **•Drying**
Dewatering	**•Gravity Belt Thickener** **•Centrifuge** **•Rotary Press**
Sludge Storage	**•Onsite storage**

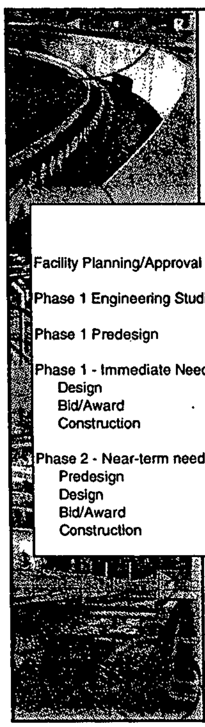
Effluent reuse not included in recommended plan

Implementation

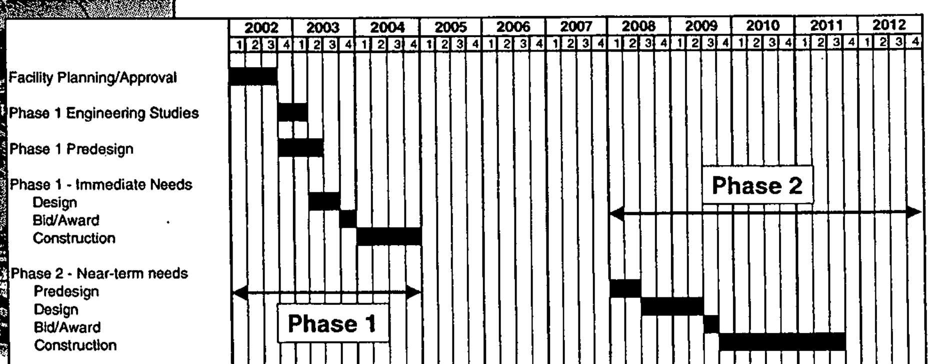
- Phase 1 - Immediate Needs
  - Critical needs: Dewatering, Headworks
  - Dewatering
    - Based on new regulatory requirement
    - Drives need for Filtration, Temporary Sludge Storage
  - Pilot testing, conceptual design required
  - Permanent sludge storage deferred to Phase 2

Recommended Plan

- Phase 2 - Near-Term Needs
  - Permanent dewatered sludge storage
  - Primary Clarifiers/Digestion & Liquid Sludge Storage
  - Secondary Treatment
  - Disinfection



Recommended Plan



Phase 3 expansion required in 20-30 years depending on influent flow and loading

COPY

ORDINANCE NO. 591

AN ORDINANCE AMENDING CITY OF WILSONVILLE WASTEWATER FACILITY PLAN.

WHEREAS, the City currently has a Wastewater Facility Plan that was adopted by Ordinance No. 571 on August 30, 2004; and

WHEREAS, ORS 197.175 requires cities to prepare, adopt, and implement Comprehensive Plans consistent with statewide planning goals adopted by the Land Conservation and Development Commission; and

WHEREAS, ORS 197.712 (2)e requires cities to develop and adopt a public facilities plan for areas within an Urban Growth Boundary containing a population greater than 2,500 persons and shall include rough cost estimates for projects needed to provide sewer, water, and transportation uses contemplated in the Comprehensive Plan and Land Use Regulations; and

WHEREAS, the Wastewater Facility Plan is a support document to the City's Comprehensive Plan; and

WHEREAS, HDR Engineering, Inc. prepared a Wastewater Facility Plan Update and presented said Plan to the Planning Commission on November 12, 2003; and

WHEREAS, in developing the new Wastewater Facility Plan, the City has sought to carry out federal, state, and regional mandates, provide for alternative improvement solutions to minimize expense, avoid the creation of public nuisances, and maintain the public's health, safety, welfare, and interests; and

WHEREAS, the Wilsonville Planning Commission adopted Resolution No. 02PC05 and recommended that the City Council adopt the Wastewater Facility Plan Update; and

WHEREAS, after providing due notice as required by City Code and State Law, a public hearing was held before the City Council on August 16, 2004 and, at which time the Council considered the recommendation of the Planning Commission and City staff, gathered additional evidence and afforded all interested parties an opportunity to present oral and written testimony concerning the Plan to the City Council; and

WHEREAS, the City Council adopted the Wastewater Facility plan on August 30, 2004 except for a table illustrating the phasing of project improvements; and

WHEREAS, the City Council asked the Planning Commission to consider a revised phasing plan; and

WHEREAS, the Planning Commission conducted a public hearing on July 13, 2005; and

WHEREAS, the Council has carefully considered the public record, including all recommendations, testimony and the approved Planning Commission Resolution No. LP 2005-05-00008 that recommends the revised phasing schedule to the Mayor and City Council.

NOW THEREFORE, THE CITY OF WILSONVILLE ORDAINS AS FOLLOWS:

1. Findings. The foregoing recitations, those findings and conclusions in the above named Planning Commission Resolution No. 02PC05, and the staff report in this matter dated July 7, 2005 filed in the record of this matter, are hereby adopted as findings of fact and conclusions of law.
2. Order. Based upon such findings, the City Council hereby adopts the revised phasing plan, marked 'Exhibit A' attached hereto and incorporated by reference as if fully set forth herein, to amend the 2004 Wastewater Facility Plan, hereby changing the phasing of capital improvements to the facility; and adopts the memorandum dated October 11, 2005 from Mike Greene, Veolia Water North America Project Manager to Jeff Bauman, Public Works Director, marked 'Exhibit B' attached hereto and incorporated by reference as if fully set forth herein; and adopts as 'Exhibit C' the revised memorandum prepared by Eldon Johansen, Interim Community Development Director, dated November 1, 2005, attached hereto and incorporated by reference as if fully set forth herein.

SUBMITTED to the Wilsonville City Council and read for the first time at a regular meeting thereof on September 19, 2005 and scheduled for a second reading at a regular meeting of the City Council on November 7th, 2005, commencing at the hour of 7 p.m. at the Wilsonville Community Center.

Sandra C. King, MMC, City Recorder

ENACTED by the City Council on the 7th day of November, 2005 by the following votes:

YES: -4- NO: -0-

____

Sandra C. King, MMC, City Recorder

DATED and signed by the Mayor this _____ day of November, 2005.

____

CHARLOTTE LEHAN, MAYOR

SUMMARY OF VOTES:

Mayor Charlotte Lehan	Yes
Council President Kirk	Yes
Councilor Holt	Yes
Councilor Knapp	Yes

Ordinance No. 591
Exhibit A

Wastewater Facility Plan Update
Capital Improvement Plan
November 7, 2005

Estimated present worth costs for plant expansions (Costs in $1,000's)

Project Element	Phase 1	Phase 2	Phase 3	Total
Headworks	$1,680	$0	$795	$2,475
Primary Treatment	$125	$3,275	$2,575	$5,975
Secondary Treatment	$425	$9,669	$20,757	$30,851
Filtration	$2,690	$0	$1,415	$4,105
Disinfection	$0	$1,431	$0	$1,431
Solids Stabilization*	$2,500	$2,312	$1,806	$6,618
Biosolids Dewatering	$3,840	$0	$1,099	$4,939
Liquid & Cake Storage	$150	$4,038	$2,878	$7,066
Sludge haul/Spread Equipment	$180	$0	$0	$180
Relocate Maintenance Shop	$0	$550	$0	$550
Site Management	$446	$1,189	$1,566	$3,201
Landscaping & Mitigation	$446	$1,189	$1,566	$3,201
Total	**$12,482**	**$23,653**	**$34,457**	**$70,592**
ENR-CCI Index 3581; markups of 30% for contingency, 8% for mobilization and bonds, 15% for construction contractor overhead and profit, 20% for site work, and 25% for engineering, legal and administrative were used. A 5% site management cost was applied to account for the difficulty in managing excavation, equipment storage, and general construction coordination on a small site				

Table 7-2 of the Wastewater Facility Plan Update is amended by accelerating a portion of Solids Stabilization project from Phase 2 to Phase 1.

Ordinance No. 591
Exhibit A

Wastewater Facility Plan Update
Capital Improvement Plan
November 7, 2005

Estimated present worth costs for plant expansions (Costs in $1,000's)

Project Element	Phase 1	Phase 2	Phase 3	Total
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Table 7-2 of the Wastewater Facility Plan Update is amended by accelerating a portion of Solids Stabilization project from Phase 2 to Phase 1.