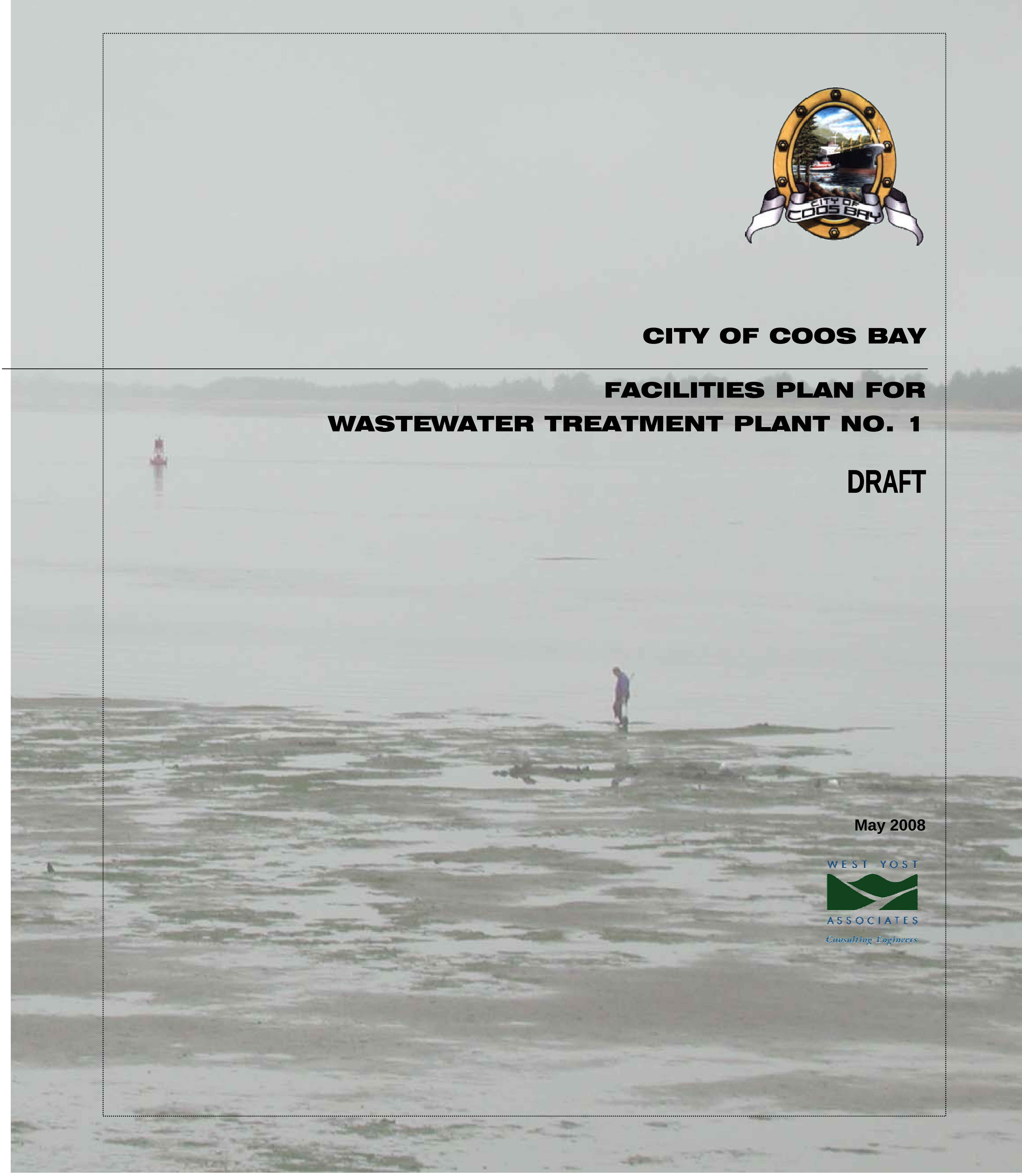


CITY OF COOS BAY

FACILITIES PLAN FOR WASTEWATER TREATMENT PLANT NO. 1

DRAFT

May 2008

WEST YOST ASSOCIATES
Consulting Engineers

CHAPTER 1. EXECUTIVE SUMMARY

This facilities plan presents the results of the planning effort conducted for the City of Coos Bay's Wastewater Treatment Plant No. 1. The plan summarizes the service area and wastewater characteristics, identifies the components of the existing wastewater collection system and treatment system, evaluates the performance of the treatment system with respect to water quality and regulatory standards, and analyzes alternatives for improvements that will remedy system deficiencies and accommodate future growth. Based on this analysis, the facilities plan recommends specific projects for inclusion in the wastewater treatment system Capital Improvement Plan (CIP). These projects will ensure that Wastewater Treatment Plant No. 1 continues to provide adequate and reliable service for the community.

This wastewater management planning study has been conducted to ensure a cost-effective and environmentally responsible approach. Planning for community growth and meeting water quality requirements were both influential factors that guided the development of the recommended plan. Since the planning period for this study is 20 years, the projections and analysis are conducted through the year 2027. Following is a summary of the planning work that has been completed and subsequent recommendations.

SERVICE AREA CHARACTERISTICS

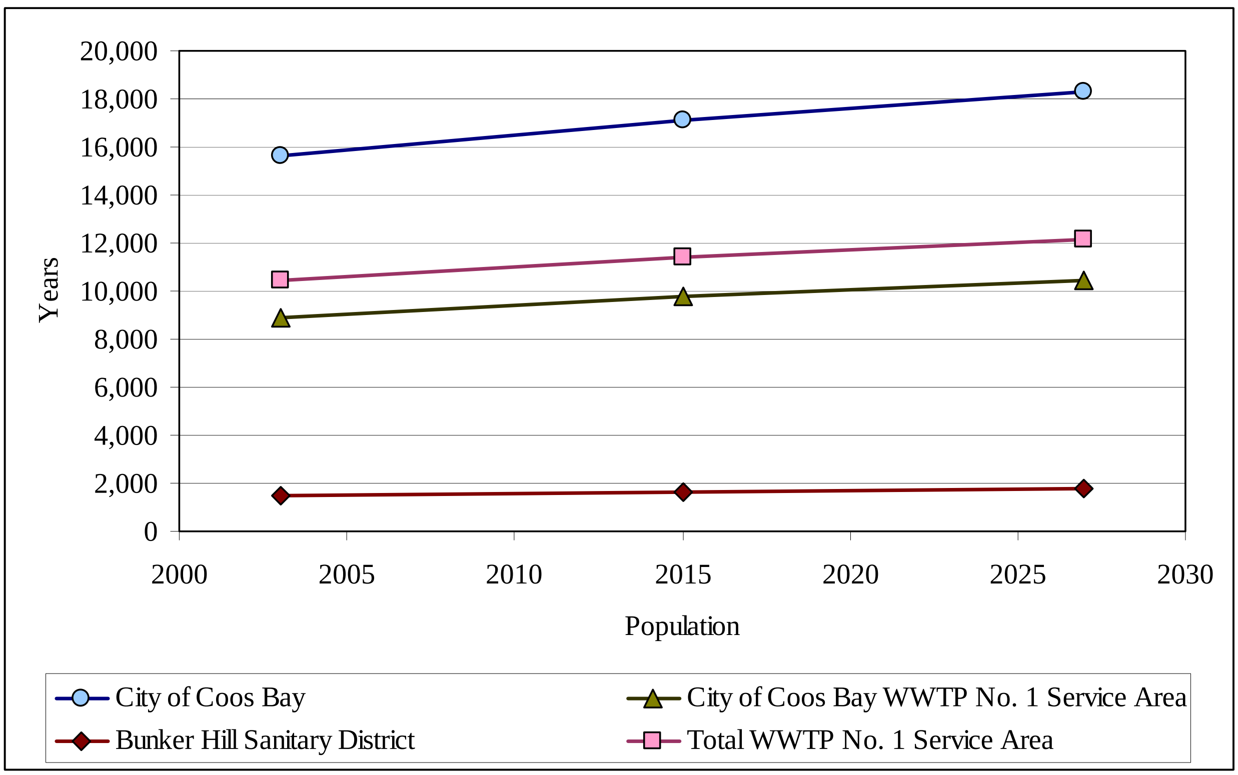
The City of Coos Bay is located on the southwestern Oregon coast, approximately 200 miles south of the Columbia River as shown on Figure 2-1. The eastern part of Coos Bay is in the Coaledo basin, which is a small area of low hills. These hills divide the City's service area into two primary basins for gravity collection, served by two treatment plants. Wastewater from the eastern area is treated at Wastewater Treatment Plant No. 1, while Wastewater Treatment Plant No. 2 treats wastewater from the western area. Together these treatment plants serve the City of Coos Bay, Charleston Sanitary District and Bunker Hill Sanitary District. Wastewater Treatment Plant No. 1 serves 3,020 acres, totaling 48 percent of the City's serviceable land area.

The current population and projected population growth within the service area are the key parameters in projecting future sewage flows and loads. These projections are used to assess the adequacy of existing infrastructure and develop design criteria for future treatment. Based on work by the for Population Research Center at Portland State University, the 2003 certified population estimate for Coos Bay is 15,650 people. This estimate refers to the number of people living within the city limits of Coos Bay. The population served by Wastewater Treatment Plant No. 1 was estimated based on information regarding service area boundaries provided by city staff and a breakdown of the population developed for the City's Transportation System Plan (DKS Associates, 2004). The resulting year 2003 population within the Coos Bay city limits contributing to Wastewater Treatment Plant No. 1 is estimated to be 8,920.

The Coos County Planning Department projects the growth rate for both the city and county to be 0.4%. For the purposes of this Facilities Plan, a growth rate of 0.75% will be used until 2015 and thereafter a rate of 0.56% will be used to be consistent with the latest amendment to the City's comprehensive plan. This results in a population of 10,431 within the city limits to be served by Wastewater Treatment Plant No. 1. The 2003 population for the Bunker Hill Sanitary District was derived from Transportation System Plan and city population data. The 2003 population is estimated to be 1,490. Using the same growth rate as that used for the city, the 2027 population is expected to be 1,742. Therefore, the total population to be served by Wastewater Treatment Plant No. 1 in 2027 is 12,174.

Figure 1-1 illustrates the expected population growth for both the city and the Wastewater Treatment Plant No. 1 service area.

Figure 1-1. City of Coos Bay and Wastewater Treatment Plant No. 1 Service Area Population Projections



WASTEWATER CHARACTERISTICS

The key wastewater characteristics at a wastewater treatment plant are the flow, solids and organic loadings that are treated by the facility. Analysis of historical plant influent flow and loading data allows for a characterization of the City's system under current conditions and provides the basis for developing flow and load projections for the system in the future.

Table 1-1 summarizes current wastewater flows and Table 1-2 summarizes current loads.

Table 1-1. Current Wastewater Flows

Flow Parameter	Flow Rate, mgd
Average Dry Weather Flow (ADWF)	1.6
Average Wet Weather Flow (AWWF)	3.2
Maximum Month Dry Weather Flow (MMDWF)	2.9
Maximum Month Wet Weather Flow (MMWWF)	5.5
Peak Day Flow (PDF)	10.0
Peak Wet Weather Flow (PWWF)	15.0

Table 1-2. Current Plant Influent Loads

Parameter	BOD load, lbs/day	TSS load, lbs/day
Average	2,500	3,200
Max month	3,200	4,400
Peak day	5,300	9,400

Flow and load projections are based on current flow and loads and anticipated community growth. Using population growth information, future flows and loads projections are developed. Table 1-3 presents flow projections and Table 1-4 presents load projections for the year 2027. The peak flow projections take into account the effect of ongoing infiltration and inflow (I/I) reduction activities as well as lower levels of I/I from future sewer system extensions.

Table 1-3. Coos Bay WWTP No. 1 Projected Flow

Parameter	Year 2027, mgd
Average Dry Weather Flow (ADWF)	1.9
Average Wet Weather Flow (AWWF)	3.7
Maximum Month Dry Weather Flow (MMDWF)	3.4
Maximum Month Wet Weather Flow (MMWWF)	6.4
Peak Day Flow (PDF)	11.7
Peak Wet Weather Flow (PWWF)	20.0

Table 1-4. Coos Bay WWTP No. 1 Projected Plant Loads

Parameter	Year 2027	
	BOD, lbs/day	TSS, lbs/day
Annual Average	2,700	3,400
Maximum Month	3,500	4,800
Peak Day	5,900	9,900

TREATMENT REQUIREMENTS

The City of Coos Bay recognizes the importance of protecting the water quality of Coos Bay. The estuary provides recreational opportunities for tourists and local residents, serves as wildlife habitat, and is an important fishery and harbor resource.

The NPDES permit has recently been revised to reflect current water quality issues, therefore, no major changes in discharge requirements are anticipated. The projected flow for the plant is well within the current designated NPDES capacity so no restrictions related to dry weather mass loads are anticipated.

The bacteria standard for discharge into marine waters and estuarine shellfish growing waters are more stringent than other waters. The existing permit stipulates these requirements and the Mutual Agreement and Order (MAO) provides a schedule for implementation of the plant improvements required to meet these limits.

Dechlorination equipment has been installed to ensure compliance with the chlorine toxicity requirements

DEQ conducted a reasonable potential analysis for heavy metals as part of the permit renewal process. Only silver indicated a reasonable potential for exceeding water quality criteria. Based on this finding, DEQ required additional monitoring of silver but this requirement was suspended in the permit modification based on the evaluation of the additional data.

The only pending TMDL for the Bay is for bacteria. Since the existing permit requires the plant to comply with the water quality standard at the end of pipe, the allocations from the TMDL should not be more restrictive.

LIQUID STREAM ALTERNATIVES

The liquid stream treatment facilities at Wastewater Treatment Plant No. 1 are currently able to satisfy the requirements set forth in its National Pollution Discharge Elimination System (NPDES) permit. Some process improvements are necessary in the near term to maintain regulatory compliance. In addition, long term upgrades are necessary to ensure that the facilities can handle increased flow and loads from the City's growing population.

Liquid Stream Improvement Alternatives by Treatment Process

Several of the liquid stream unit processes at Wastewater Treatment Plant No. 1 will require improvements over the next twenty years. For each process area, an evaluation was performed to determine the most appropriate approach to the improvements.

Headworks and Grit Removal. The existing mechanical screen is in poor condition. It and the manual bar rack are not sized to accommodate the design year peak flow of 20 mgd. The mechanical screen should be replaced and the manual bar screen should be replaced with a mechanical bar screen to provide a reliable 20 mgd screening capacity.

The existing aerated grit chamber has a design capacity of 10 mgd. Due to the sand content of the influent flow, grit removal should be provided for as much flow as feasible into the plant. Two alternatives for grit removal were evaluated:

> **Grit Removal Alternative G1.** Construct a second 10 mgd capacity aerated grit chamber.
>
> **Grit Removal Alternative G2.** Continue with one aerated grit chamber for 10 mgd of influent flow and treat up to 7 mgd of additional flow by degritting primary sludge. This alternative will provide grit removal for more than the maximum day flow.
>
> **Evaluation of Headworks Alternatives.** Alternative G2, continuing with one aerated grit chamber for 10 mgd flow and removing the remainder of the grit by degritting primary sludge is the least cost alternative because it does not require constructing an additional aerated grit tank. It is therefore the recommended alternative.

Treatment Facilities. New treatment facilities are required to provide reliability and comply with NPDES permit requirements as flows and loads increase. Two treatment alternatives were considered:

> **Alternative T1.** This treatment alternative does not increase the primary sedimentation capacity. A secondary clarifier is added for redundancy and expanded secondary treatment capacity. All flow up to 7 mgd will receive full primary and secondary treatment. When flow exceeds 7 but is less than 13 mgd, 7 mgd will receive full primary and secondary treatment. Flow in excess of 7 mgd will bypass primary treatment and receive secondary treatment. When flow exceeds 13 mgd, 7 mgd will receive primary treatment. Flow up to 13 mgd will receive secondary treatment including a portion of the 7 mgd from primary treatment. When flow reaches 20 mgd, 7 mgd will receive primary treatment and disinfection and 13 mgd will receive secondary treatment.
>
> **Alternative T2.** Full primary and secondary treatment for all flow.

Evaluation of Treatment Alternatives. Treatment alternative T1 provides secondary treatment for flows exceeding maximum day conditions. It limits the flow through the primary sedimentation tank to its demonstrated treatment capacity and provides an additional secondary clarifier for reliability and additional secondary capacity. Because this alternative improves treatment and another primary sedimentation basin would not be constructed, this is the lowest cost and preferred alternative.

Note: The EPA is currently developing guidance on peak wet weather flow diversions. The guidance will address bypassing around secondary treatment at high flow and will describe conditions under which diversion can be authorized in NPDES permits. The conditions will include demonstration that there is no feasible alternative to blending of flows within the treatment plant. It is recommended that the City follow up this Facilities Plan by demonstrating that conditions allowing bypassing are met once the guidance is issued.

SOLIDS PROCESSING ALTERNATIVES

Alternative S1. This alternative includes continuing to thicken primary sludge in the rectangular primary sedimentation basin and thickening WAS in the circular primary clarifier under all flow conditions. The digesters would process WWTP No. 1 sludge along with thickened sludge from WWTP No. 2 until capacity of the digesters is reached. At this time Digester No. 1 at WWTP No. 2 will need to be rehabilitated and used to its capacity. A portion of the sludge will be digested at WWTP No. 2 and a portion will be digested at WWTP No. 1.

Alternative S2. This alternative consists of thickening primary sludge in the existing circular primary clarifier under all flow conditions; thickening WAS with a gravity belt thickener, and on-site anaerobic digestion with thickened sludge from WWTP No. 2.

Evaluation of Alternatives. The solids processing alternatives were evaluated using both economic and non-economic factors. Removing dilute primary sludge from the rectangular sedimentation basin as recommended in Alternative S2, will significantly improve the performance of that basin. Removing dilute sludge from the primary sedimentation basin can also accommodate a lower cost grit removal alternative. Therefore, Alternative S2, considered with grit removal alternative G2 is the lower cost and preferred alternative.

RECOMMENDED PLAN

Based on an assessment of the capacity of the existing unit processes and alternatives for improvements, recommendations are made for the wastewater treatment system CIP. Estimated costs for the recommended improvements are summarized in Table 1-5. These costs are shown at year 2004 cost levels and are adjusted when planning for projects that will be implemented in the future. CIP projects are organized according to the anticipated improvement period.

Table 1-5. Recommended Plan Cost Summary
(2004 Dollars at ENR CCI 7314)

Description	Cost			
	Construction	Contingency 25%	E&A 20%	Total
Phase 1 Improvement Projects (present to 2008)				
Replace piston pump	115,810	28,953	28,953	173,715
New level elements on influent flumes	20,222	5,056	5,056	30,333
Demo Cover on Digester 1	33,643	8,411	8,411	50,465
Replace floating cover on Digester 1	245,643	61,411	61,411	368,465
Improve cover on Digester 2	185,643	46,411	46,411	278,465
Construct new waste gas burner	53,643	13,411	13,411	80,465
Outfall	282,000	70,500	70,500	423,000
New handrails on digesters	45,643	11,411	11,411	68,465
Total Phase 1 Cost				**1,473,400**
Phase 2 Improvements (2008 to 2012)				
New blower	120,000	30,000	30,000	180,000
Mixed liquor split box	110,000	27,500	27,500	165,000
New secondary clarifier	961,000	240,250	240,250	1,441,500
New RAS pump	120,000	30,000	30,000	180,000
New WAS pump	114,000	28,500	28,500	171,000
Chlorine Contact Basin Improvements	53,000	13,250	13,250	79,500
Site piping	81,000	20,250	20,250	121,500
Total Phase 2 Cost				**2,338,500**
Phase 3 Improvements (2018-2022)				
New boiler, heat exchangers, gas and hot water piping	340,810	85,203	85,203	511,215
Mixing heating and recirc for Digester 1	236,405	59,101	59,101	354,608
Mixing heating and recirc for Digester 2	236,405	59,101	59,101	354,608
Digester building repair	123,643	30,911	30,911	185,465
Total Phase 3 Cost				**1,405,900**
Phase 4 Improvements (2023-2026)				

Description	Cost			
	Construction	Contingency 25%	E&A 20%	Total
Demolish manual bar screen	20,222	5,056	5,056	30,333
New mechanical bar screen	167,722	41,931	41,931	251,583
Replace mechanical bar screen	167,722	41,931	41,931	251,583
Demolish existing stairs	18,222	4,556	4,556	27,333
New grit chamber bypass channel and gate	55,222	13,806	13,806	82,833
New grit cyclone and classifier	134,722	33,681	33,681	202,083
Degritted primary sludge pump	55,722	13,931	13,931	83,583
Site piping	20,222	5,056	5,056	30,333
Inline primary sludge grinder	110,810	27,703	27,703	166,215
WAS Gravity Belt Thickener	680,810	170,203	170,203	1,021,215
Thickened WAS pump	137,810	34,453	34,453	206,715
Thickening Building	123,643	30,911	30,911	185,465
Yard piping	48,643	12,161	12,161	72,965
Total Phase 4 Cost				**2,612,200**
Total Cost				**7,830,000**

CHAPTER 10. FINANCING

Project financing is a key element for the successful implementation of the recommended capital improvement program (CIP) outlined in Chapter 9. The CIP is structured to provide the necessary improvements to the existing wastewater treatment facilities over time, as necessary. The CIP presented in Chapter 9 is a 20-year plan that lays out a series of City projects and their associated costs. This chapter presents information that the City will need to make financing and implementation decisions. The impact of inflation is included in the following evaluation which has a significant impact on future cost levels.

This chapter first provides a summary of the numbers of ratepayers and the background information regarding the historical costs. These provide the base for the City's annual cost projections for wastewater services. Next, financing of the capital improvements is evaluated including an assessment of the projected cost increases to account for inflation, and an estimate of the sewer rate impacts. Finally, different financial options are analyzed and the recommended financing and revised rate plans are identified.

USER PROFILE

The existing user profile for the City, Bunker Hill and Charleston service areas consists of a mix of single family residential, multi family residential, commercial, high strength, and public use customers as presented in Table 10-1. During 2005, a typical single family residential user in the City pays $22.00 per month. This is based on the revenue collected in the Fiscal Year 2004-2005 from the single family user category and the number of single family dwelling units that are in this category of use. The multi-use, commercial, high strength, and public user categories are converted to Equivalent Dwelling Units (EDUs) based on the revenue collected from each user group. For example, the number of EDUs for multi-use customers during the period July 2004 - June 2005 is calculated as the average revenue generated ($40,657) divided by $22.00. This generates a total of 1,848 EDUs of multi-use customers. The City collects revenue from a total of 11,592 equivalent dwelling units.

Table 10-1. Existing User Profile

Description	No. of EDUs
City of Coos Bay	
Residential	4,732
Multiple Use	1,848
Commercial	1,031
High Strength	812
Public	681
Subtotal	9,104
Charleston and Bunker Hill	2,488
Total EDUs	11,592

EXISTING COSTS

Wastewater services are provided by the City with the revenue collected from sewer user fees. Debt service costs associated with the general obligation bonds sold by the City is paid with tax revenue. Existing operation and maintenance costs include labor, materials and services, and minor recurring capital expenditure. The City also funds stormwater operation and maintenance costs with revenue generated by wastewater service charges. Historical costs for these are summarized in Table 10-2.

Table 10-2. Operation and Maintenance Costs

	Fiscal Year				
	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006
Description	Actual	Actual	Actual	Actual	Adopted
Administrative Department					
Personal Services	21,782	26,287	26,623	28,680	41,648
Materials and Services	49,031	47,031	47,381	47,381	49,350
Other	0	20,000	20,000	20,000	20,000
Subtotal	70,813	93,318	94,004	96,061	110,998
Plant 1					
Personal Services	29,651	24,007	19,289	20,321	48,380
Materials and Services	559,505	599,389	621,313	648,425	678,928
Recurring Capital Expenses	10,837	5,900	9,526	12,297	21,970
Subtotal	599,993	629,296	650,128	681,043	749,278
Plant 2					
Personal Services	29,651	24,007	19,289	20,321	64,104
Materials and Services	393,873	430,855	443,355	477,979	494,959
Recurring Capital Expenses	6,356	1,280	6,500	4,417	3,600
Subtotal	429,880	456,142	469,144	502,717	562,663
Collection System					
Personal Services	71,130	79,760	39,350	41,025	57,917
Materials and Services	561,111	549,544	400,781	493,059	592,066
Recurring Capital Expenses	23,472	8,770	44,407	23,626	55,310
Subtotal	655,713	638,074	484,538	557,710	705,293
Stormwater					
Personal Services	0	0	42,989	40,783	54,993
Materials and Services	0	1,700	158,559	159,646	227,498
Recurring Capital Expenses	0	0	29,299	4,577	11,210
Subtotal	0	1,700	230,847	205,006	293,701
Total Operation and Maintenance Cost	1,756,399	1,818,530	1,928,661	2,042,537	2,421,933

In addition to the operation and maintenance costs, capital costs are incurred due to the construction of wastewater and storm water improvements. Historical capital costs are summarized in Table 10-3. Total annual costs are summarized in Table 10-4.

Table 10-3. Capital Costs

Description	Fiscal Year				
	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006
Administrative Department					
Transfer to G/O Bond Fund	28,908	35,377	36,487	36,713	36,523
Transfer to WW Reserve Fund	0	50,000	50,000	50,000	350,000
Subtotal	28,908	85,377	86,487	86,713	36,524
Plant 1					
Construction - DEQ Compliance	0	0	49,014	215,333	10,600
Plant 2					
Construction - DEQ Compliance	0	0	24,430	103,246	20,000
Collection System					
Construction - DEQ Compliance	0	0	0	63,318	70,000
Construction	54,998	4,796	2,554	4,836	1,276,000
Subtotal	54,998	4,796	2,554	68,154	1,346,000
Stormwater					
Construction	0	0	94,825	287,369	20,000
Total Capital Cost	83,906	90,173	257,310	760,815	1,783,124

Table 10-4. Annual Cost Summary

Description	Fiscal Year 2001-2002	2002-2003	2003-2004	2004-2005	2005-2006
Operation and Maintenance	1,756,399	1,818,530	1,928,661	2,042,537	2,421,933
Capital Costs	83,906	90,173	257,310	760,815	1,783,124
Existing General Obligation Bond Debt Service[a]	536,755	537,155	536,575	539,892	537,107
Total Annual Costs	1,840,305	1,908,703	2,185,971	2,803,352	4,205,057

(a) Existing bond debt service is paid by tax revenue

PROJECTED ANNUAL COSTS

Future operation and maintenance costs will increase as inflation occurs and the following projections include a provision for inflation. Inflation is included at a rate of 3.5 percent per year. Table 10-5 presents the projected annual costs for operation and maintenance. Projections are included in this table for the next five fiscal years. For estimating the long term impact of the improvements, the costs were projected for the full 20-year planning period and these projections are included in the appendices.

Capital costs presented in Table 10-3 were a one-time expense and do not recur in the subsequent years. The existing general obligation bond debt service was refinanced for a more favorable rate and is paid off as of September 1, 2007.

Table 10-5. Projected Operation and Maintenance Costs for Existing Treatment Systems[(a)]

Description	Fiscal Years									
	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014
Administrative Department										
Personal Services	28,680	41,648	43,106	44,614	46,176	47,792	49,465	51,196	52,988	54,842
Materials and Services	47,381	49,350	51,077	52,865	54,715	56,630	58,612	60,664	62,787	64,985
Other	20,000	20,000	20,700	21,425	22,174	22,950	23,754	24,585	25,446	26,336
Plant 1										
Personal Services	20,321	48,380	50,073	51,826	53,640	55,517	57,460	59,471	61,553	63,707
Materials and Services	648,425	678,928	702,690	727,285	752,740	779,085	806,353	834,576	863,786	894,019
Recurring Capital Expenses	12,297	21,970	22,739	23,535	24,359	25,211	26,093	27,007	27,952	28,930
Plant 2										
Personal Services	20,321	64,104	66,348	68,670	71,073	73,561	76,135	78,800	81,558	84,413
Materials and Services	477,979	494,959	512,283	530,212	548,770	567,977	587,856	608,431	629,726	651,766
Recurring Capital Expenses	4,417	3,600	3,726	3,856	3,991	4,131	4,276	4,425	4,580	4,741
Collection System										
Personal Services	41,025	57,917	59,944	62,042	64,214	66,461	68,787	71,195	73,687	76,266
Materials and Services	493,059	592,066	612,788	634,236	656,434	679,409	703,189	727,800	753,273	779,638
Recurring Capital Expenses	23,626	55,310	57,246	59,249	61,323	63,469	65,691	67,990	70,370	72,833
Stormwater										
Personal Services	40,783	54,993	56,918	58,910	60,972	63,106	65,314	67,600	69,966	72,415
Materials and Services	159,646	227,498	235,460	243,702	252,231	261,059	270,196	279,653	289,441	299,571
Recurring Capital Expenses	4,577	11,210	11,602	12,008	12,429	12,864	13,314	13,780	14,262	14,761
Total Operation and Maintenance Cost	2,042,537	2,421,933	2,506,701	2,594,435	2,685,240	2,779,224	2,876,497	2,977,174	3,081,375	3,189,223

Table 10-5. Projected Operation and Maintenance Costs for Existing Treatment Systems, cont'd...

Description	Fiscal Years									
	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023	2023-2024
Administrative Department										
Personal Services	56,762	58,749	60,805	62,933	65,136	67,415	69,775	72,217	74,745	77,361
Materials and Services	67,259	69,613	72,050	74,571	77,181	79,883	82,678	85,572	88,567	91,667
Other	27,258	28,212	29,199	30,221	31,279	32,374	33,507	34,680	35,894	37,150
Plant 1										
Personal Services	65,937	68,245	70,633	73,106	75,664	78,312	81,053	83,890	86,826	89,865
Materials and Services	925,309	957,695	991,214	1,025,907	1,061,814	1,098,977	1,137,441	1,177,252	1,218,455	1,261,101
Recurring Capital Expenses	29,943	30,991	32,076	33,198	34,360	35,563	36,807	38,096	39,429	40,809
Plant 2										
Personal Services	87,367	90,425	93,590	96,866	100,256	103,765	107,397	111,155	115,046	119,072
Materials and Services	674,578	698,189	722,625	747,917	774,094	801,187	829,229	858,252	888,291	919,381
Recurring Capital Expenses	4,906	5,078	5,256	5,440	5,630	5,827	6,031	6,242	6,461	6,687

Table 10-5. Projected Operation and Maintenance Costs for Existing Treatment Systems, cont'd...

Description	Fiscal Years									
	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023	2023-2024
Collection System										
Personal Services	78,935	81,698	84,557	87,517	90,580	93,750	97,031	100,427	103,942	107,580
Materials and Services	806,925	835,168	864,398	894,652	925,965	958,374	991,917	1,026,634	1,062,566	1,099,756
Recurring Capital Expenses	75,382	78,020	80,751	83,577	86,502	89,530	92,664	95,907	99,264	102,738
Stormwater										
Personal Services	74,950	77,573	80,288	83,098	86,007	89,017	92,132	95,357	98,695	102,149
Materials and Services	310,056	320,908	332,140	343,765	355,797	368,250	381,139	394,478	408,285	422,575
Recurring Capital Expenses	15,278	15,813	16,366	16,939	17,532	18,146	18,781	19,438	20,118	20,822
Total Operation and Maintenance Cost	3,300,846	3,416,376	3,535,949	3,659,707	3,787,797	3,920,370	4,057,583	4,199,598	4,346,584	4,498,714

(a) Costs for improving treatment facilities are not included.

FINANCING

The City does not have funds available to construct the projects outlined in the CIP. Thus, financing of the improvements can be accomplished through either pay-as-you-go, sale of bonds or through acquiring loans and grants.

Pay-As-You-Go

Pay-as-you-go financing is the least cost financing option since no interest costs are incurred. Communities with high growth rates and modest expenditures have successfully financed improvements with pay-as-you-go through a combination of system development charges and user fees.

For the capital requirements shown in the CIP, user fee increases to fund improvements on a pay-as-you-go basis are shown in Table 10-6. The table shows that the monthly rate for an average single-family dwelling fluctuates each year. The rates are higher when substantial improvements needed at the treatment facilities. Based on the rather severe fluctuations and very high rates required early in the planning period, pay-as-you-go financing is not recommended.

Table 10-6. Estimated Pay-As-You-Go Rates

Fiscal Year	Monthly Rate, $/EDU	Fiscal Year	Monthly Rate, $/EDU
2004-2005	21.30	2015-2016	54.20
2005-2006	24.20	2016-2017	55.90
2006-2007	33.90	2017-2018	52.80
2007-2008	45.50	2018-2019	59.10
2008-2009	59.10	2019-2020	63.30
2009-2010	86.50	2020-2021	65.40
2010-2011	63.20	2021-2022	67.60
2011-2012	50.00	2022-2023	56.90
2012-2013	55.20	2023-2024	66.10
2013-2014	58.70	2024-2025	79.70
2014-2015	60.60	2025-2026	82.40

Debt Financing

Several alternative debt financing options are available to the City including bonds and borrowing from the state revolving fund (SRF). The Coos Bay city charter requires voter approval for both general obligation and revenue bonds. Under current conditions, the interest rate offered by the SRF is very favorable (3.5 percent including service fees) which represents the lowest cost for borrowing money by the City.

With the CIP presented in Table 9-5, borrowing will be necessary during the planning period, which will increase annual costs to cover the debt service costs. One year of debt service cost must be maintained in reserve which is included in the financing evaluation. Table 10-7 shows the cash flow requirements and the corresponding debt service for financing the improvements with debt service. Annual debt service costs are based on an interest rate of 4.5 percent and a 20-year term.

Table 10-7. Financing Costs

Fiscal Year	Cost, $ 1000				
			Annual Debt Service		
	Capital Cost	Bond Sale	Interest	Principal	Total
2004-2005	761	0	0	0	0
2005-2006	311	0	0	0	0
2006-2007	1,209	0	0	0	0
2007-2008	2,409	5,300	239	169	407
2008-2009	3,818	10,000	681	495	1,176
2009-2010	6,761	0	659	518	1,176
2010-2011	4,106	0	635	541	1,176
2011-2012	2,564	11,200	1,115	922	2,037
2012-2013	3,051	0	1,073	964	2,037
2013-2014	3,341	0	1,030	1,007	2,037
2014-2015	3,458	0	985	1,052	2,037
2015-2016	2,631	0	937	1,100	2,037
2016-2017	2,723	0	888	1,149	2,037
2017-2018	2,261	5,300	1,075	1,370	2,445
2018-2019	2,848	0	1,013	1,432	2,445
2019-2020	3,209	0	949	1,496	2,445
2020-2021	3,322	0	881	1,563	2,445
2021-2022	3,438	0	811	1,634	2,445
2022-2023	2,096	0	737	1,707	2,445
2023-2024	3,006	0	661	1,784	2,445
2024-2025	4,411	0	580	1,864	2,445

Recommended Financing

Based on the analysis of pay-as-you-go financing, the fluctuations in rate that would be required are not desirable and debt financing is recommended. Low interest funds may be available through the SRF loan program and the City should pursue these funds. The Oregon Economic and Community Development Department has provided wastewater grants of up to $750,000 to communities for wastewater system improvements. The City should participate in a One-Stop meeting with the State to begin the financing process to ensure all options are being pursued.

USER FEES

The existing user fees for the City's wastewater utility are summarized in Table 10-8. Currently, (2006-2007) a typical single-family residential user pays a flat fee of $11.56 per month plus an additional fee of $4.15 per unit of water consumed. The average service fee is $26.50 (based on July through November 2006 data) per month for a single family dwelling but this does not include the taxes paid for the general obligation bonds. Given the existing mix of residential, commercial, and public use, the City collects revenue for the equivalent of 11,592 EDUs. The current rates are not adequate to cover the costs outlined in the CIP.

Revised rates would accommodate additional debt service costs incurred and the cost associated with inflation. Projected annual costs are shown in Table 10-9. User fees will need to be increased to meet the revenue requirements as estimated in Table 10-10. These rates include an annual allowance for inflation of 3.5 percent.

Table 10-8. User Fees for Wastewater Service
Fiscal Year 2006-2007

Description	Base Rate $/month	Volumetric $/100 cubic feet
Single-Family Residential	11.56	4.15
Multi-Family Residential	11.56	4.15
Public (schools, city, county, state, and federal)	11.56	4.15
High Strength Users (restaurants, markets with garbage disposal units, bakeries, etc.)	11.56	5.14
Commercial	11.56	4.15

Table 10-9. Projected Annual Cost Summary

Description	Fiscal Year 2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015
Operation and Maintenance	2,421,933	2,506,701	2,594,435	2,685,240	2,779,224	2,876,497	2,977,174	3,081,375	3,189,223	3,300,846
New Debt Service	0	0	407,444	1,176,205	1,176,205	1,176,205	2,037,218	2,037,218	2,037,218	2,037,218
Total Annual Costs	2,421,933	2,506,701	3,001,879	3,861,445	3,955,429	4,052,702	5,014,392	5,118,593	5,226,441	5,338,064

Description	Fiscal Year 2015-2016	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023	2023-2024	2024-2025
Operation and Maintenance	3,416,376	3,535,949	3,659,707	3,787,797	3,920,370	4,057,583	4,199,598	4,346,584	4,498,714	4,656,169
New Debt Service	2,037,218	2,037,218	2,444,661	2,444,661	2,444,661	2,444,661	2,444,661	2,444,661	2,444,661	2,444,661
Total Annual Costs	5,453,594	5,573,167	6,104,368	6,232,458	6,365,031	6,502,244	6,644,259	6,791,245	6,943,376	7,100,831

Table 10-10. Recommended Rates

Fiscal Year	Base Rate	Consumption $/100 cubic feet	Monthly Rate, $/EDU	% Increase per year
2005-2006	7.90	2.84	24.00	12.0%
2006-2007	11.56	4.15	26.50	8.7%
2007-2008	12.20	4.40	28.00	5.4%
2008-2009	13.70	5.00	32.00	12.5%
2009-2010	14.50	5.30	34.00	5.9%
2010-2011	15.70	5.80	37.20	8.6%
2011-2012	17.50	6.50	42.00	11.4%
2012-2013	18.70	6.90	45.00	6.7%
2013-2014	20.00	7.40	48.50	7.2%
2014-2015	21.90	8.10	53.50	9.3%

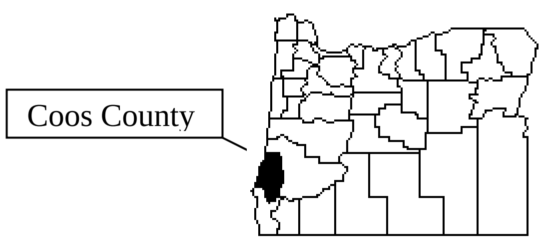
CHAPTER 2. STUDY AREA CHARACTERISTICS

A review of the region's study area characteristics is an important initial step in the process of developing facility plans for wastewater treatment plants in the City of Coos Bay. The description of the study area characteristics includes the study area location, physical environment and socioeconomic environment. These characteristics provide the context for evaluating alternative strategies for long-term wastewater treatment and disposal.

STUDY AREA LOCATION

The City of Coos Bay is located on the southwestern Oregon coast, approximately 200 miles south of the Columbia River as shown on Figure 2-1. The eastern part of Coos Bay is in the Coaledo basin, which is a small area of low hills. These hills divide the City's service area into two primary basins for gravity collection, served by two treatment plants. Wastewater from the eastern area is treated at Wastewater Treatment Plant No. 1, while Wastewater Treatment Plant No. 2 treats wastewater from the western area. Together these treatment plants serve the City of Coos Bay, Charleston Sanitary District and Bunker Hill Sanitary District. Figure 2-2 shows the service area of Wastewater Treatment Plant No. 1. In total, Wastewater Treatment Plant No. 1 serves 3,020 acres, totaling 48 percent of the city's serviceable land area.

Figure 2-1. Location of Coos County in Oregon



PHYSICAL ENVIRONMENT

The physical environment includes the topography, geology, soils, and climate of the region. This section presents a brief overview of these physical characteristics as they relate to wastewater facilities planning. The topography, geology and soils of a region can have a significant impact on the design and construction of wastewater collection and treatment systems. Climatic characteristics such as precipitation and temperature influence the amount of wastewater entering the system, treatment system performance, and the potential for temperature impacts on discharges to Coos Bay.

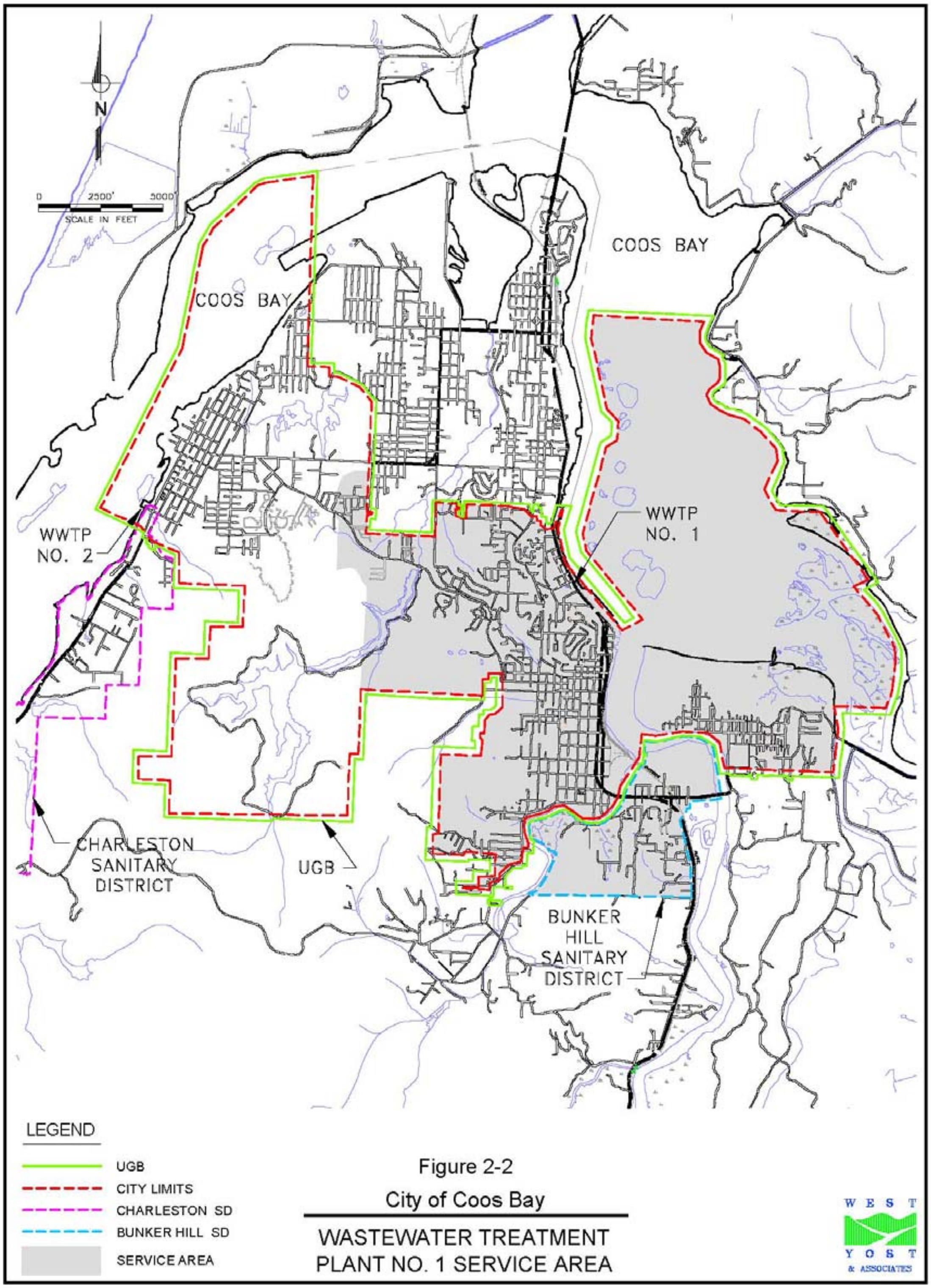


Figure 2-2. Wastewater Treatment Plant No. 1 Service Area

Topography

The City of Coos Bay is bordered to the east and west by Coos Bay, by the city of North Bend to the north, and by the Coast Mountain Range to the south. A ridge running north to south just west of 35th Street defines the City's drainage basins. Wastewater Treatment Plant No. 1 serves the area east of the ridge.

Geology and Soils

Coos Bay is underlain with bedrock, clayey and silty material, sandstone and marine terraces. Minable coal deposits can be found in the sandstone layer. There are no significant beaches in Coos Bay. Stabilized dunes, mountainous areas, and filled land generally characterize the city's geology.

A survey conducted by the Natural Resources Conservation Service and the United States Department of Agriculture identifies approximately 46 different named soils in Coos County. The City of Coos Bay is dominated primarily by loamy and sandy soils that are either poorly or excessively drained. Sandy soils, including the Bandon and Westport soils, that are formed in eolian material are common in sand dune areas on the west side of the city and near the bay. This area is also dominated by the alluvial or water-deposited soils that appear as sand and gravel deposits. The eastern and central parts of the City have sandy and silty soils (Bullard soils). A major problem associated with these soils is erosion; particularly after protective vegetative covering is removed.

Climate

The climate of Coos Bay can be described as mid-latitude marine with mild summers and wet, cool winters. Although the nearest weather station is located in North Bend, the weather data is applicable to Coos Bay due to its proximity and similarity in geographic and topographic conditions. Monthly average temperatures and precipitation are summarized in Table 2-1. Extreme temperatures are usually not experienced in the area due to the moderating influence of the Pacific Ocean. As shown in Table 2-1, there is only a 15-degree difference between the mean temperature during the coldest and warmest months.

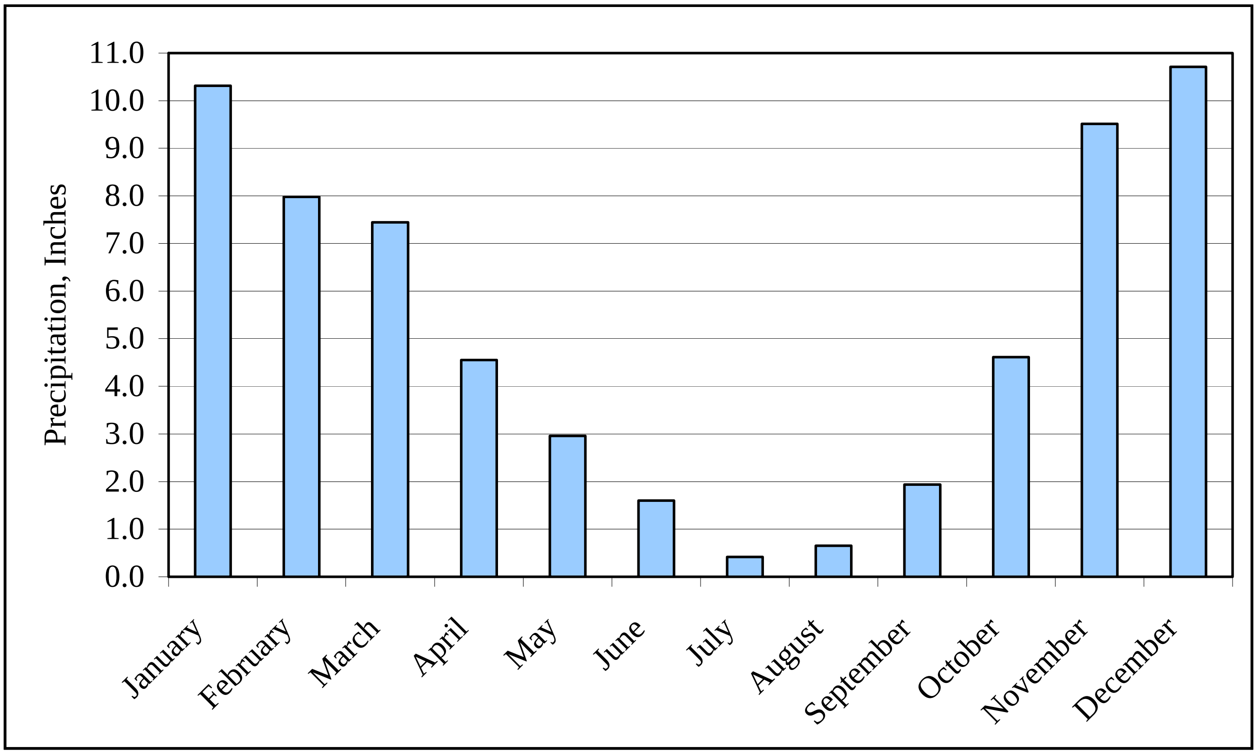
Figure 2-3 illustrates the variation in monthly average precipitation over the course of a year. Most of the precipitation occurs in the months of November through March in the form of rain. Only mild, occasional snowfall is seen in the area. Figure 2-4 shows the historical annual precipitation for last 30 years.

Table 2-1. Climatic Summary for North Bend

Month	Temperature[1], degrees F			Precipitation[2]
	Average	Average Daily		Average, Inches
		Maximum	Minimum	
January	46.05	52.59	39.52	10.31
February	47.63	54.56	40.7	7.98
March	48.26	55.26	41.26	7.44
April	49.83	56.84	42.82	4.55
May	53.69	60.57	46.8	2.96
June	57.29	63.93	50.65	1.60
July	59.53	66.39	52.68	0.42
August	60.24	67.46	53.01	0.65
September	58.8	67.18	50.43	1.94
October	54.77	63.19	46.35	4.61
November	50.21	57.15	43.28	9.52
December	46.62	52.97	40.28	10.71
Annual	52.72	59.81	45.62	62.70

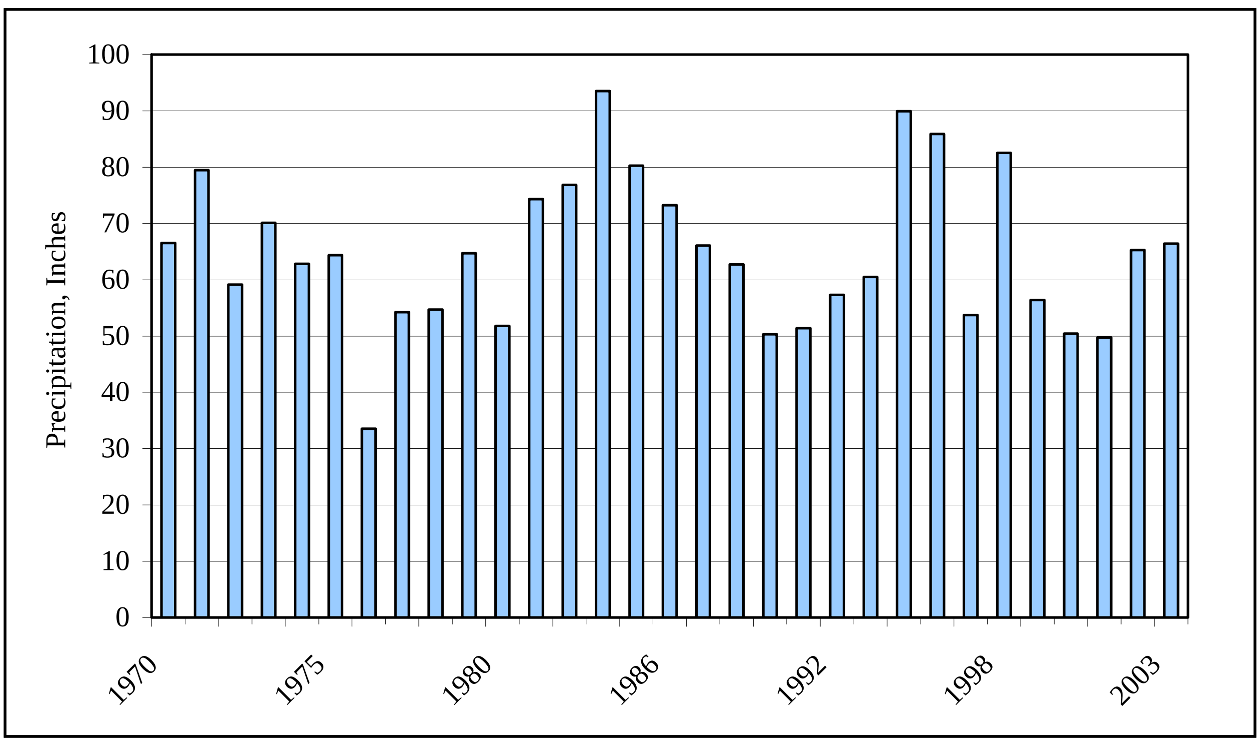
Source: Oregon Climate Services, for North Bend, Oregon.
(1) Averages from 1961 to 2003.
(2) Averages from 1911 to 2002.

Figure 2-3. North Bend Monthly Average Precipitation (1911-2002)



Source: Oregon Climate Services

Figure 2-4. North Bend Historical Annual Precipitation



Geologic Hazards

The Coos Bay area is prone to flooding, tsunamis, earthquakes, erosion, high groundwater, ponding, and windthrow.

The existing WWTP No. 1 site contains three different zones mapped by the Federal Emergency Management Agency (FEMA, 1984). Zone A2, the 100-year floodplain of Coos Bay, is the southern third of the site. Zone B, (an area between the limits of the 100-year floodplain and the 500-year floodplain of Coos Bay), is mapped for the central and northern portions of the site. Zone B may be subject to 100-year flooding with average depths less than one foot. Zone B also includes areas protected by levees from the base flood and areas where the contributing drainage area is less than one square mile (FEMA, 1984). Lastly, Zone C, an area of minimal flood potential, is within Zone B in the center of the site. The existing outfall is within the 100-year floodplain of Coos Bay (FEMA, 1984).

Earthquakes are generally not a major hazard in the area, however earthquakes centered in California are capable of causing some local damage.

The WWTP No. 1 is in the tsunami hazard zone. A tsunami is a series of sea waves usually caused by a displacement of the ocean floor by an undersea earthquake. As tsunamis enter shallow water near land, they increase in height and can cause great loss of life and property damage. For the Coos Bay – North Bend area, the tsunami evacuation routes were developed by local officials and reviewed by the Oregon Department of Emergency Management. These maps are published by the Oregon Department of Geology and Mineral Industries.

Public Health Hazards

The WWTP No. 1 service area comprises of eastern part of the City of Coos Bay and Bunker Hill Sanitary District. All the developments within the City limits are sewered and flow in to the WWTPs. The old part of the City (2nd Street and 3rd Street) has aged cedar wood pipe that are leaky and are deemed to be at the end of their useful life. These sewers flood the streets and basements of several houses routinely during high rainfall and high tide periods (November through February).

The Bunker Hill area has several old on-site systems such as old rusted septic tanks, cesspools, and gray water discharges that need to be replaced/repaired.

Energy Production and Consumption

The principal energy source utilized in the Coos Bay area is electricity, most of which is consumed by the growing residential sector. Few, in any non-renewable sources exist in the Coos Bay area and there are no hydro-electric, thermal, or nuclear energy-producing plants. Utilization of alternative energy sources such as solar, wind, waste biomass, and tides is minimal.

Water Resources

The Coos Bay estuary, a sub-basin of the South Coast Watershed, covers approximately 13,348 acres and is fed by a number of creeks and rivers including Coos River, Willanch Creek, Kentuck Creek, Larson Creek, and Palouse Creek. The town of North Bend and the City of Coos Bay are situated on a peninsula that roughly divides Coos Bay into a western and an eastern portion. The western portion of Coos Bay is protected by North Spit - a narrow landmass with sand dunes. The tidally influenced mud flats along the shores of Coos Bay are ideal for shellfish production. Land use surrounding the bay includes agriculture, private and public timberlands, the Oregon Dunes National Recreation Area, wildlife reserves, and urban centers.

Domestic Water Supply

The domestic water supply for City of Coos Bay and surrounding areas are served by the Coos Bay North Bend Water Board from the Pony Creek Reservoir. The reservoir water is treated by the Pony Creek Treatment Plant located on Ocean Boulevard. This plant was placed in service in 1991 and produces water meeting or exceeding all United States Environmental Protection Agency (EPA) and Oregon Health Division (OHD) primary water quality standards.

The water treatment plant's current design capacity is 8.0 million gallons per day. Current annual daily average demand for treated water is 4.0 million gallons per day with occasional summer demands of 7.1 million gallons per day.

Flora and Fauna

The presence of fish, wildlife, and vegetation in the study area was determined from a review of the Oregon Natural Heritage Information Center database (ONHIC, 2005), and a site visit on January 26, 2005. The affected environment includes the existing WWTP site and Coos Bay near the existing outfall. The existing WWTP site is developed and provides limited wildlife habitat. Common birds observed at the facility in January 2005 were the yellow-rumped warbler, common crow, and various gull species. Other common wildlife species anticipated to occur adjacent to the WWTP in residential areas include the American robins, black-capped chickadee, wrens, woodpeckers, squirrels, raccoons, opossums, and small rodents. The little amount of vegetation present on the WWTP No. 1 site includes mowed grass and a few landscaped trees.

The effluent outfall is located in Coos Bay. In general, estuaries are highly productive systems that provide habitat for a multitude of resident and migratory species, including fish, marine mammals, terrestrial mammals, and birds. No shellfish beds are located within the mixing zone of the WWTP No. 1 outfall on the east side of Coos Bay. Fish and aquatic species present in Coos Bay include: rock fish, Dungeness crab, Pacific lamprey, sturgeon, anchovy, herring, chum salmon, coho salmon, steelhead, surf perch, and lingcod.

Air Quality

The climate of Coos Bay is characterized by mild summers and wet, cool winters. Temperatures range from 46 to 67° F between May and October and 39 to 57° F from November to April. The average annual precipitation is 62 inches with most of the rainfall occurring October to April (National Weather Services, 2003).

The average wind velocity for the project vicinity is approximately 8 miles per hour with gusting up to 29 and 38 mph (National Weather Service, 2005). Wind direction is variable. Sufficient wind is present in the project area throughout the year to disperse air pollutants released into the atmosphere.

Potential odor and air pollutant-producing activities on the site include the primary sedimentation, aeration, and the digester. The digesters are in need of repair, including the floating cover on Digester No. HH1. Nearby sources of odor include exhaust from vehicles on Highway 101 and exposed mud and sand at low tide.

No significant sources of air pollution are designated by the Environmental Protection Agency (EPA) for the project site or vicinity (EPA, 2004). The nearest area that exceeds ambient air quality standards is the Eugene-Springfield area (EPA, 2004).

Noise

Residences are located at west of the WWTP No. 1 site with the closest residences located between 75 and 150 feet away. Sensitive receptors also include patrons at the Best Western and Red Lion hotels located one block away. It was noted during the January 2005 field visit that the operating equipment at the existing facility was audible from western perimeter, but blended in with traffic noise from Highway 101.

The human ear responds to a wide range of sound intensities. The decibel scale used to describe sound is a logarithmic rating system that accounts for the large differences in audible sound intensities. This scale accounts for the human perception of a doubling of loudness as an increase of 10 decibels (dBA). Hence, a 70 dBA sound level will sound twice as loud as a 60 dBA sound level. People generally cannot detect differences of 1 dBA, but a 5 dBA change would likely be perceived under normal conditions.

Floodplains

The WWTP No. 1 site contains three different zones mapped by the Federal Emergency Management Agency (Figure 5, Appendix A) (FEMA, 1984). Zone A2, the 100-year floodplain of Coos Bay, is mapped for the southern third of the site. Zone B, or an area between the limits of the 100-year floodplain and the 500-year floodplain of Coos Bay, is mapped for the central and northern portions of the site. Zone B may be subject to 100-year flooding with average depths less than one foot. Zone B also includes areas protected by levees from the base flood and areas where the contributing drainage area is less than one square mile (FEMA, 1984). Lastly, Zone C, an area of minimal flooding, is mapped as a polygon within Zone B in the center of the site. The existing outfall is within the 100-year floodplain of Coos Bay (FEMA, 1984).

Environmentally Sensitive Areas

At the existing WWTP No. 1 site, according to the National Wetlands Inventory (NWI), no wetlands are mapped for the project site or immediate vicinity (USFWS, 1989). The nearest mapped wetlands are intertidal mudflats located approximately 0.25 miles to the east in Coos Bay. The existing WWTP is built on historic fill and no wetland vegetation, soils, or hydrology were observed during a January 2005 visit.

Zoning

Plant 1 is zoned "Industrial Commercial (I-C)" and the facility fits within zoning designation. However, a Site Plan and Architectural Review are required for the intensification of a use within 400 feet of a residential zone.

The western boundary of the site is adjacent to a R-2 zoning district; therefore, a SPAR approval by the Planning Commission is required for Plant upgrades.

The outer edges of the eastern portion of the property lies in ZONE B of the floodplain. The northeast corner of the property lies in ZONE A, the 100-year floodplain.

SOCIOECONOMIC ENVIRONMENT

The City of Coos Bay's population and land use patterns have the most important influence on flows and loads to the wastewater treatment system. The current population and projected population growth within the service area are the key parameters used in projecting future sewage flows and loads. These projections are used to assess the adequacy of existing infrastructure and develop design criteria for future treatment systems.

The planning period for this study is 20 years. Since the planning period should extend 20 years beyond the time when plant improvements are implemented, projections are provided for the year 2027.

Economic Conditions

The median family income for the City of Coos Bay residents in the year 1999 was $38,721 (Census 2000 Summary File 3, Series P-77, Median Family Income, U.S. Census Bureau, 2003). Approximately 90 percent of the residents of the City of Coos Bay are white, with 5 percent a mix of two or more races and the rest of the ethnic groups in the population representing 2 percent or less. In comparison, Coos County residents are 92 percent white, 4 percent a mix of other races, 3 percent American Indian, and the remaining ethnic groups in the population representing 1 percent or less (Census 2000 Summary File 3, Series P-6 Race, U.S. Census Bureau, 2003).

Low-income populations were identified using statistical poverty thresholds from the Census 2000 Summary File 3, Series P-87 Poverty Status in 1999 by Age (U.S. Census Bureau, 2003). These thresholds were derived from information collected in the Census 2000. Poverty status is defined by a set of income thresholds that vary by family size and composition. Families or individuals with income below their appropriate poverty thresholds are classified as poor. In 1999, 17 percent of City of Coos Bay residents were at or below poverty level standards compared to 15 percent of Coos County residents. The percentage of residents at or below poverty level at the national and state level is approximately 12 percent. No readily identifiable groups of low-income persons living in geographic proximity to the project area were identified from the income data.

Population Projections

Based on work by the Population Research Center at Portland State University, the 2003 certified population estimate for Coos Bay is 15,650 people. This estimate refers to the number of people living within the city limits of Coos Bay. The population served by Wastewater Treatment Plant No. 1 was estimated based on information regarding service area boundaries provided by city personnel and a breakdown of the population developed for the city's Transportation System Plan (DKS Associates, 2004). In the modeling work that was done for the Plan, the city's population was broken down into Transportation Analysis Zones (TAZ). Using the TAZ estimates and mapping data, the population was proportionately allocated to each of the City's two treatment plants based on the plants' service areas.

The resulting year 2003 population within the Coos Bay city limits contributing to Wastewater Treatment Plant No. 1 is estimated to be 8,920.

The growth rate from 1990 to 2003 both in the city of Coos Bay and in Coos County was 0.3% according to Portland State University's Population Research Center. The Coos County Planning Department projects the growth rate for both the city and county to be 0.4%. The Transportation System Plan allows a more detailed look at expected growth patterns within the city and shows a higher rate of growth on the west side of the City in the area served by Wastewater Treatment Plant No. 2 than in the east side served by Wastewater Treatment Plant No. 1. For the purposes of this Facilities Plan, a growth rate of 0.75% will be used until 2015 and thereafter a rate of 0.56% will be used to be consistent with the latest amendment to the City's comprehensive plan.

The population of Bunker Hill was 1,462 in 2000 according to Census Data. The 2003 population was estimated to be 1,296 based on a 2007 population of 1,335. A future growth rate consistent with that used for Coos Bay gives a 2027 population of 1,482.

Table 2-2 summarizes current and future population estimates for the City and the Wastewater Treatment Plant No. 1 service area, including Bunker Hill. Figure 2-5 illustrates the expected population growth. These population projections are used later in the Facilities Plan to project future wastewater flows and loads.

Table 2-2. City of Coos Bay and Wastewater Treatment Plant No.1 Service Area Population Projections

	2003	2015	2027
City of Coos Bay	15,650	17,123	18,301
City of Coos Bay WWTP No. 1 Service Area	8,920	9,760	10,431
Bunker Hill Sanitary District	1,296	1,418	1,482
Total WWTP No. 1 Service Area	10,216	11,178	11,913

Land Use

Land use in the city of Coos Bay and surrounding service areas consists of a typical mix of urban development including residential, commercial, industrial, and public land. Table 2-3 identifies the acreage within each of the primary land use categories for properties within the city limits and within the service areas of the city's wastewater treatment plants.

Figure 2-5. City of Coos Bay and Wastewater Treatment Plant No. 1 Service Area Population Projections

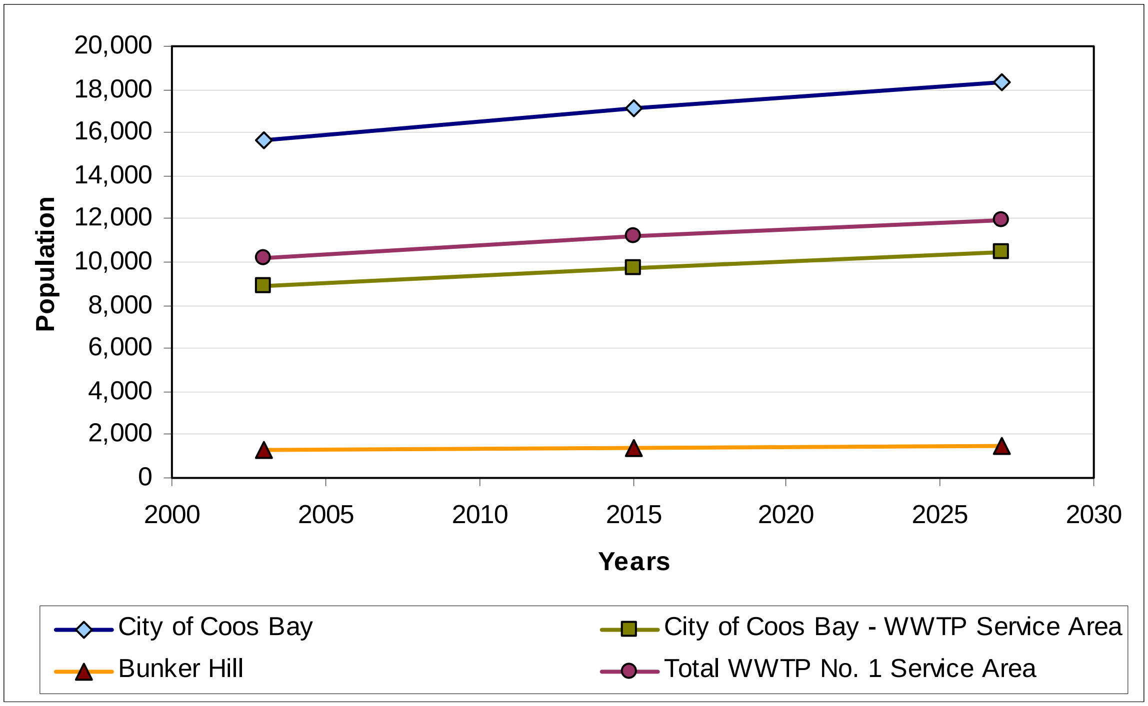


Table 2-3. Land Use Designations Within the Coos Bay City Limits and Surrounding Service Districts[(1)]

Land Use Category	Acreage			
	Within City Limits[2]	Bunker Hill	Charleston	Total
Developed				
Residential	800	362	732	1,894
Commercial	320		14	334
Industrial	70	33		103
Public And Semi-Public	540		4	544
Total Developed	1730	395	750	2,875
Vacant And Open	2160		474	2,634
Not Developable	3010	155	892	4,057
Total Area	6900	550	2,116	9,566

(1) City limits include 3,561 acres in the Coos Bay waterway. This acreage is not included in the total land acreage.
(2) Estimated from City mapping and City's Comprehensive Plan (2000).

Along with land inside the city limits there is an additional inventory of land within the urban growth boundary (UGB) that will become eligible for wastewater service upon annexation to the city. This land totals 81 acres and is currently not zoned (no designation). Upon annexation WWTP No. 2 would serve 66 acres and 15 acres would be served by WWTP No. 1. Figure 2-6 illustrates these land use designations within the service area.

City Comprehensive Plan

The most recent Comprehensive Plan was completed in 2000. The document merged the previously developed Eastside Comprehensive Plan and Comprehensive Plan to provide an encompassing plan for the City. The City has subsequently developed a Transportation Master Plan which was financed and approved by the Department of Land Conservation and Development (DLCD). A growth rate of 0.4% for the area was developed in the Transportation Plan and has been adopted by the City and County.

City or County Zoning Ordinance

Plant 1 is zoned "Industrial Commercial (I-C)." The use is permitted outright. However, a Site Plan and Architectural Review is required for the intensification of a use within 400 feet of a residential zone.

The western boundary of the site is adjacent to a R-2 zoning district; therefore, a SPAR approval by the Planning Commission is required.

The outer edges of the eastern portion of the property lies in ZONE B of the floodplain. The northeast corner of the property lies in ZONE A, the 100-year floodplain.

Intergovernmental Agreements

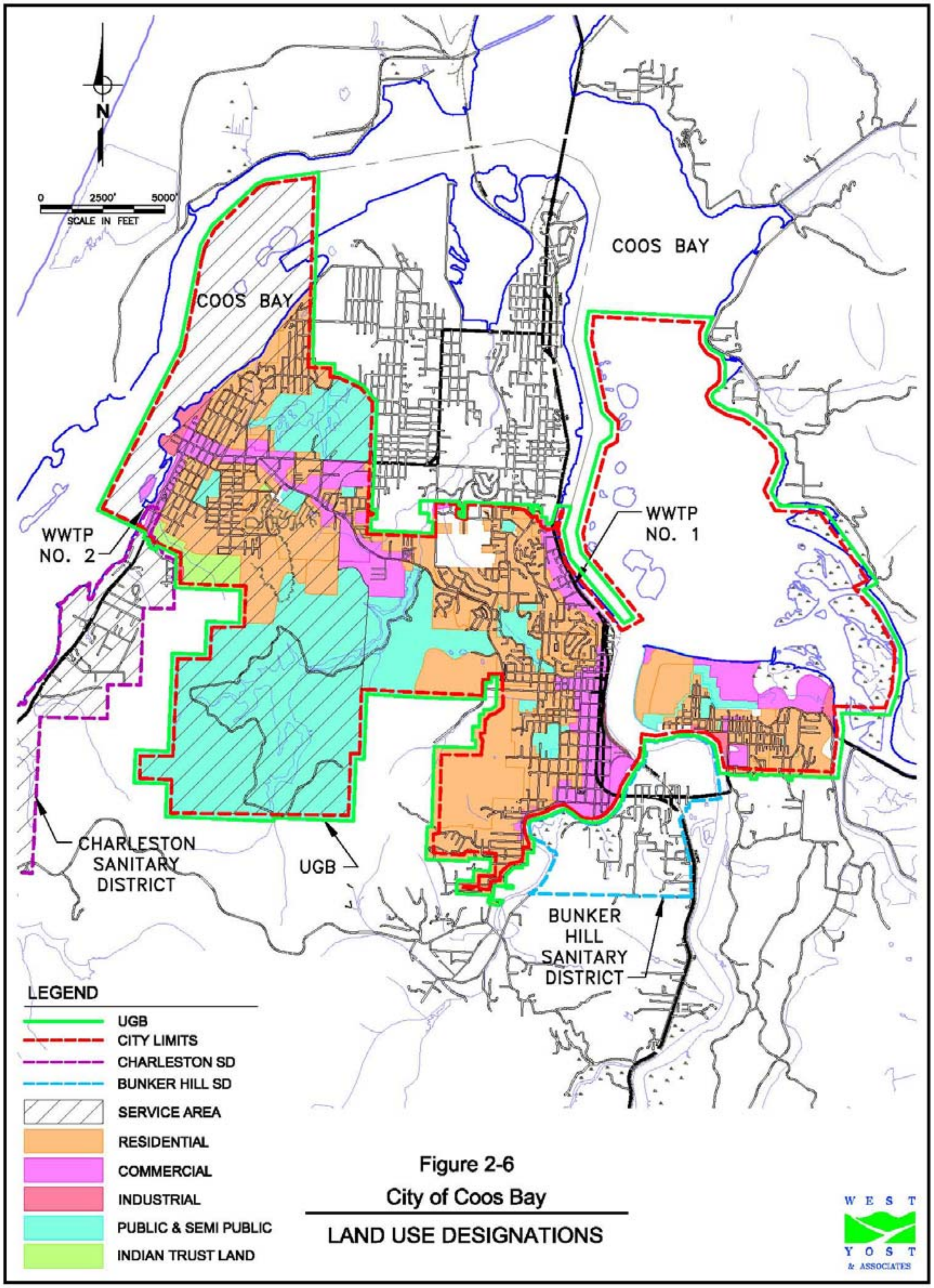


Figure 2-6. Land Use Designations

CHAPTER 3. WASTEWATER COLLECTION SYSTEM

The collection system conveys wastewater from residential, commercial, and public users to the City's wastewater treatment facilities. Wastewater Treatment Plant No. 1 serves the city's east side and the Bunker Hill Sanitary District. The City is responsible for operating and maintaining the collection system within the City's boundaries. The Bunker Hill Sanitary District operates and maintains facilities within its service area. This chapter describes the existing collection system, and estimates the influence of infiltration and inflow (I/I) in the system.

Note: This Chapter 3 is not intended to be a Collection System Master Plan, rather a quick inventory of existing infrastructure and operation.

SYSTEM DESCRIPTION

The City's collection system that is tributary to Wastewater Treatment Plant No. 1 consists of approximately 220,000 ft of gravity sewers, 16,000 ft of force mains and 15 pump stations. The area is served by a separate storm drain system. The collection system generally flows south and east from the ridge in the central area of town toward the treatment plant. The existing collection system is shown in Figure 3-1. Tables 3-1 provide an inventory of gravity pipes in the collection system according to pipe diameter.

Table 3-1. Coos Bay Wastewater Treatment Plant No. 1 Collection System Inventory – Gravity Sewers

Pipe Diameter, inches	Pipe Material	Pipe Length, feet
4	ABS	650
6	Concrete, PVC, AC, Cast Iron	16,480
8	Concrete, PVC, AC, B&S	166,530
10	Concrete, PVC, AC	14,300
12	Concrete	12,790
14	Concrete	2,510
15	Concrete	4,370
18	Concrete	1,320
24	Concrete	240
30	Concrete	520
Total		220,000

The Bunker Hill Sanitary District is located south of the treatment plant. It is described in detail in the Bunker Hill Economical Development Plan for Bunker Hill Sanitary District (May, 1997)

Gravity Sewers

The gravity sewers are composed primarily of PVC, concrete, and clay. Most of the system is 8-inch diameter pipe with 4- and 6-inch pipe in the upper reaches of the system and up to 30-inch pipe in the lower elevations.

Pump Stations

Fifteen pump stations convey sewage to Wastewater Treatment Plant No. 1 from the City. Run times for the pumps provide an indication of the ability of the pump stations to meet demand. A review of these run times indicates all pump stations have adequate capacity. Basic design data for the pump stations are shown in Table 3-2.

Figure 3-1. Wastewater Treatment Plant No. 1 Collection System

Table 3-3. Wastewater Treatment Plant No. 1 Collection System Pump Stations

Item	Pump Station 1	Pump Station 2	Pump Station 3*	Pump Station 4	Pump Station 5	Pump Station 6	Pump Station 9	Pump Station 10	Pump Station 12	Pump Station 13	Pump Station 17	Pump Station 18	Pump Station 19	Pump Station 20	Pump Station 21
Location	690 1st Street	834 1st Street	1499 6th Street	299 S. 10th Street	2006 Woodland Dr.	400 Kruse Street	1890 Southwest Blvd.	2599 Woodland Dr.	3000 Ocean Blvd.	2366 SE Ocean Blvd.	699 6th Street	545 Whitty	321 9th Ave.	1465 Old Wireless Lane	1742 Coos River Hwy.
Date Constructed	1991	1991	1973	1973	1974	1991	1974	1974	1992	1992	1998	1980	2001	2002	1980
Pumps															
Type	centrifugal	centrifugal	centrifugal	centrifugal	centrifugal	centrifugal	submersible	submersible	submersible	submersible	submersible	centrifugal	submersible	submersible	submersible
Number	4	3	2	2	2	3	2	2	2	2	2	2	2	2	2
Capacity, each, gpm	2@2110 2@4190	3@2800	2@700 1@?	2@325	2@225	3@400	2@200	2@500	2@300	2@480	2@700	2@200	2@400	2@40	2@100
Horsepower, each	2@30 2@60	3@25	2@15	2@10	2@30	3@30	2@7.5	2@75	2@15	2@25	2@25	2@15	2@30	2@1.5	2@5
Overflow point	Bay Isthmus Sl. River Mile 13.85	Bay Isthmus Sl. River Mile 14.6	Bay Isthmus Sl. River Mile 113.85	Bay Isthmus Sl. River Mile 14.4	Pony Creek, River Mile 8.85	Coal Bank Slough, River Mile 14.65	Coal Bank slough River Mile 14.65	Pony Creek, River Mile 8.85	Pony Creek, River Mile 8.85	Pony Creek, River Mile 8.85	Coos Bay, River Mile 5.25	Isthmus Slough, River Mile 15.0	Coos River Mile 15	Coos River, River Mile 15.5	Coos River, River Mile 15.5
Time to Overflow, min	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Summer 2.1 Winter 1.0	Unknown	Unknown	Unknown	Unknown
Level Control	sonic	sonic	floats	floats	floats	sonic	floats	floats	floats	floats	sonic	sonic	sonic	floats	floats
Forcemain															
Diameter, inches	14”@ 3490’	10”@ 1370’	8”	6”	6”	12”	6”’	10”	6”	6”	8”,10”,12”	6”	6”	3”	4”
Length, ft	24”@ 3620’	18”@ 1370’	150’	390’	1970’	590”	190”	3650’	830’	453’	8,400’	480’	970’	770’	500’
Standby Power	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Discharge Manhole	Plant One Head works	Pump Station 1	Plant One Head works	Pump Station 1	Pump Station 1	Pump Station 2	Pump Station 6	Pump Station 3	Pump Station 13	Pump Station 10	Pump Station 2	Pump Station 2	Pump Station 17	Pump station 9	Pump Station 19
Location	Plant One Head works	35BA-7	Plant One Head works	DD27-15	27BD-9	35BD-6	3AA-15	22BD-10	21DC-10	21DD-10	40’ south of PS#2 no manhole	36BB-11	36BA-21	3AC-20	36AA-6
Condition	Fair	Fair	Poor	Poor	Poor	Fair	Fair	Poor	Fair	Fair	No manhole	Good	Good	Fair	Fair

* Improvements are under construction.

CONDITION ASSESSMENT

Inspection of the City's collection system is done on a routine basis. A review of problem and remote lines are consistently being performed. From this, staff develops an extensive line-cleaning list to be proactive in preventing overflows and blockages. As cleaning continues, every buried manhole is raised to grade level for preventive maintenance and reduction of inflow. In areas where the manhole is not accessible, roads are constructed. Site or land title restrictions preclude construction of an access road, trails have been constructed and maintained for inspection and cleaning purposes. Manholes in these remote locations are visually inspected on a monthly basis. Whenever there is a problem within the collection system, there is a process in place to make sure the problem is documented and is addressed by the collection crew. This process continues for 120 days and consists of periodic inspections, line cleaning, and documentation. After 120 days the sanitary sewer line will be reviewed to determine if the line needs to be placed on the list of a more frequent cleaning schedule.

The City also conducts limited smoke testing. The sewers are cleaned on a rotating basis so that pipes are cleaned approximately every five years.

INFILTRATION AND INFLOW ANALYSIS

Infiltration is groundwater that enters the system from the surrounding soil through defective pipes, joints, or manholes. Inflow is stormwater that directly enters the system from sources such as illicit drainage connections, flooded manhole covers, roof downspouts, and other rain induced flow.

Flows associated with I/I offset some of the available capacity of the collection system. I/I is also an indicator of the condition of the system. High peak flows can signify system deterioration.

EPA Guidelines for Infiltration and Inflow

EPA guidelines for the screening of I/I flows in a wastewater collections system are based upon per capita flow rates. If the measured per capita flow rate of the collection system exceeds EPA guidelines (120 gallons per capita per day (gpcd)), then the sources of infiltration in the collection system may warrant active management to reduce peak wet weather flows. The 120 gpcd flow rate includes domestic wastewater flow, infiltration, and nominal industrial and commercial flows. These regulations provide that no further I/I analysis work is necessary if the 120 gpcd guideline is not exceeded and there are no hydraulic overloads in the system.

The EPA guideline for infiltration is based on a high groundwater dry weather flow rate defined as the highest 7-day average flow recorded over a seven to fourteen day period during high groundwater season. In Oregon, this condition occurs during the winter months when there is little or no precipitation for a continuous period of seven to fourteen days. For the population of 10,410 contributing to Wastewater Treatment Plant No. 1, the EPA guideline translates into a total system flow of 1.25 million gallons per day (mgd). The average high groundwater dry weather flow at the treatment plant is 2.53 (243 gpcd) which suggests that there is groundwater infiltration contributing to the wastewater flow. During wintertime dry periods in the past five years, 7-day average flows ranged between 1.77 and 3.62 mgd as summarized in Table 3-4.

Because EPA's I/I guidelines are exceeded, an analysis is performed to determine if an I/I reduction program for the City is cost effective.

Table 3-4. High Groundwater Dry Weather Flows

Period	7-Day Average Flow, mgd	7-Day Average Flow, gpcd	Total Rainfall, Inches
4/1/2000 - 4/11/2000	1.77	170	0.00
12/24/2000 - 12/31/2000	2.40	230	0.00
2/24/2002 – 3/4/2002	2.08	200	0.00
3/27/2002 – 4/7/2002	1.96	188	0.00
2/2/2003 – 2/12/2003	3.36	322	0.00
1/14/03 - 1/20/03	3.62	348	0.00
Average	2.53	243	0.00
EPA Guidelines	1.25	120	0.00

The EPA guideline for evaluating inflow is based on the highest daily flow recorded during a storm event. The EPA suggests that inflow problems may warrant attention if the measured high daily flow is greater than 275 gpcd. For Wastewater Treatment Plant No. 1, this results in a total system flow of 2.90 mgd. A review of plant records is summarized in Table 3-5 and shows that the highest recorded daily flow was 11.4 mgd (1,094 gpcd) on December 16, 2002. The current peak day wet weather flow is estimated at 10.0 mgd (961 gpcd).

Table 3-5. Wastewater Treatment Plant No. 1 Peak Day Flows

Date	Flow, mgd	Flow, gpcd
12/16/02	11.4	1,094
1/13/00	11.4	1,093
12/13/03	11.0	1,053
12/30/02	10.8	1,034
1/6/02	9.9	950
12/15/02	9.7	931
2/26/00	9.1	874
EPA Guideline	2.9	275

COST EFFECTIVENESS ANALYSIS FOR I/I REMOVAL

To meet the stipulations of the NPDES permit (Schedule D, Item 10), the following analysis has been completed to establish that the flows experienced at the plant are not result of excessive infiltration and inflow.

Estimation of I/I Contribution to Plant Flow

Municipal wastewater can be split into three components: sanitary wastewater, base infiltration, and rainfall dependent infiltration and inflow (RDI/I). Sanitary wastewater is the wastewater produced by residents and businesses in the service area. Base infiltration is the groundwater that leaks into the collection system during periods of no rainfall and low groundwater levels. RDI/I is normally defined as the flow associated with direct inflow of rainfall and snowmelt, and infiltration due to rainfall-induced high groundwater.

In order to determine the amount of I/I in the collection system, it is first necessary to estimate sanitary wastewater flows. The City experiences lowest flows during the summer months, when little or no precipitation occurs.

These conditions are most likely to occur during July through September. Table 3-6 lists flows and rainfall for recent summer months. Based on this information, it appears that low summer flows range from 1.10 to 1.51 mgd. This is representative of the base sanitary wastewater and base infiltration flow.

Table 3-6. Summer Dry Weather Wastewater Flows

Month	Average Flow, mgd
Jul-99	1.39
Aug-99	1.51
Sep-99	1.38
Jul-00	1.26
Aug-00	1.21
Sep-00	1.20
Jul-01	1.19
Aug-01	1.17
Sep-01	1.10
Jul-02	1.30
Aug-02	1.25
Sep-02	1.12
Jul-03	1.51
Aug-03	1.42
Sep-03	1.40

Table 3-7 lists winter wastewater flows for November through January when groundwater levels are low. These flows represent base sanitary and RDI & I flows and range from 1.59 to 4.43 mgd.

Table 3-7. Winter Low Groundwater Wastewater Flows

Month	Average Flow, mgd	Rainfall, in/mo
Nov-99	2.87	10.72
Dec-99	2.96	11.57
Jan-00	4.43	11.61
Nov-00	1.59	11.53
Dec-00	2.27	11.55
Jan-01	1.86	9.73
Nov-01	2.16	10.18
Dec-01	3.56	9.85
Jan-02	4.08	10.80
Nov-02	1.73	9.13
Dec-02	4.35	8.72
Jan-03	3.53	8.57

Typical wastewater unit flow rates for a similar size City's service area are 80 to 100 gallons per capita per day (gpcd) and Table 3-6 shows that actual rates of 105 – 145 gpcd. The higher unit rates are due to the discharge from large commercial sources which is not accounted in the typical generic unit flow rates. Thus, a base infiltration range of 0.5 to 2.9 mgd for the plant can be determined as the difference between the low wintertime flow and sanitary wastewater flow.

For an average annual flow of 2.4 mgd with largely residential sources and a small amount of commercial and industrial flow, the textbook sanitary wastewater peaking factor is 3.5 (Wastewater Engineering, Metcalf and Eddy, 2nd Edition, 1979). Applying this factor to the base sanitary flow range of 1.10 to 1.51 mgd gives a peak sanitary flow range of 3.9 to 5.3 mgd. RDI/I can be estimated as the difference between the peak wet weather flow (PWWF, or peak instantaneous flow) and the sum of the peak sanitary flow plus the base infiltration. The current PWWF is listed in Chapter 5 as 15 mgd; therefore, groundwater infilter can be estimated between 9.7 and 11.2 mgd. Wastewater flow component ranges are summarized in Table 3-8.

Table 3-8. Wastewater Flow Component Ranges

Item	Low End of Range	High End of Range
Low wintertime flow, mgd	1.6	4.4
Base sanitary flow, mgd	1.1	1.5
Base infiltration, mgd	0.5	2.9
Peak sanitary flow, mgd	2.8	3.8
RDI/I, mgd	8.3	11.8

Cost Effectiveness Analysis

Collection system flow monitoring data is unavailable for the City's system. However, the City is currently conducting a separate collection system master plan. Bunker Hill Sanitary District identified I/I issues within their system in their 1997 Economical Development Plan. For the purposes of this analysis, a range of peak I/I flows will be considered. The range will be from moderate I/I, double the overall collection system average, or 6,500 gallons per acre per day (gpad) to high I/I, four times the overall collection system average, or 13,500 gpad. Generally, wastewater collection systems will exhibit a range of conditions where the oldest and most degraded parts of the system have a much higher amount of inflow than the newer systems. By using a range of I/I factors, the sensitivity of the analysis can be assessed. Therefore, even though specific information on the location of the worst areas is not available at this time, an assessment can be made whether such areas should ultimately be rehabilitated.

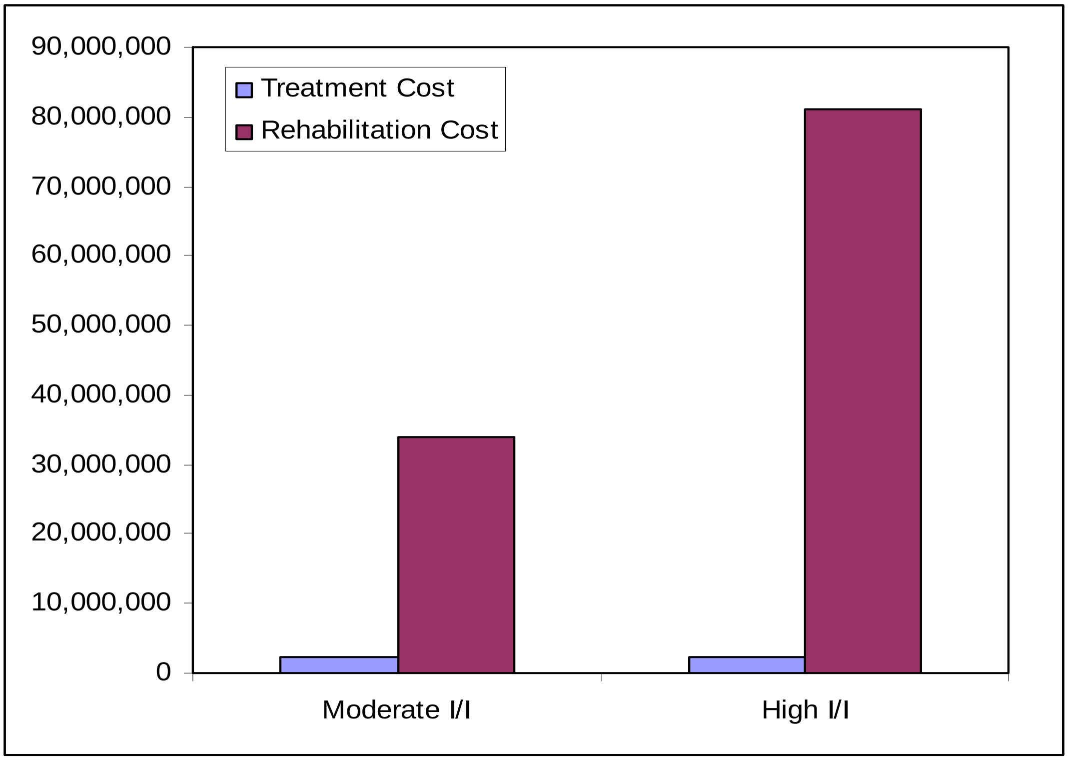
Assuming the collection system were to be completely rehabilitated, including service lateral replacement, the peak I/I could be reduced to that of a well-constructed new system, or 1,500 gpad. For a typical residential area, costs for comprehensive collection system rehabilitation are approximately $45,000 per acre. So, each acre rehabilitated would reduce peak flows by 5,000 to 12,000 gpd and would cost $45,000. The unit cost for peak I/I reduction is therefore $3.75-$9 per gpd removed.

Wastewater treatment facilities impacted by the high peak flows are the screens and grit removal basins, secondary clarification and chlorine contact basin. The estimated cost of the treatment plant improvements strictly associated with increasing treatment plant capacity is $2.4 million including engineering and contingencies. Theoretically, peak I/I can be reduced by the difference between the PWWF and peak sanitary flow, or 9 mgd, through collection system rehabilitation. If this were done, treatment plant expansion costs would be reduced by $2.4 million. Figure 3-2 shows the relative cost of rehabilitation to treating the flow for the range of I/I flow evaluated.

At $3.75 per gpd removed, reducing peak flows by 9 mgd through collection system rehabilitation would cost $34 million. At $9 per gpd, the cost would be $81 million.

While the basis for this approach is approximate, it is clear that the cost for rehabilitation that would be required to reduce peak flows would be much higher than the cost for providing the required treatment capacity. Accordingly, it can be stated with assurance that no excessive I/I will be treated at the City's facility.

Figure 3-2. Pipeline Rehabilitation vs. Treatment Cost



CAPACITY ASSURANCE, MANAGEMENT, OPERATION AND MAINTENANCE (CMOM)

Proper operation and maintenance of sanitary sewer systems is vital to protect public health, property, and waterways. The EPA may possibly propose a new rule in the future to support sanitary sewer overflow (SSO) control. The objectives of CMOM are briefly described below:

- Address capacity, management, operation and maintenance requirements for municipal sanitary sewer collection systems
- Minimizes SSOs.
- Establish requirements for reporting, public notification, and record keeping for discharges from municipal sanitary sewer system

Conforming to the above-proposed rules will help the City to upgrade its wastewater collection system and potentially reduce SSOs. The City currently has an Overflow Notification and Response Plan (ONRP) in place. The plan includes procedures on spill notification, location identification, notification contacts, sampling and cleanup procedures, prevention and training. CMOM will further require the City to:

- Establish general performance standards. A CMOM program will ensure that the collection system can collect and transport all base and appropriate peak flows to the City's treatment facility and, develop a procedure for notifying those who could be affected by SSO.
- Implement a management program. A management program should address the program goals; identify administrative and maintenance personnel responsible for implementing the CMOM program; establish legal authority through collection system use ordinances, service agreements, or other legally binding documents to manage flow effectively; identify existing system deficiencies and appropriately design performance requirements; and monitor the progress of the CMOM program.
- System Evaluations and Capacity Assurance Plan (SECAP). SECAP will identify deficient parts of the collection system and prioritize maintenance programs to assure that the collection system has sufficient capacity.
- Submit to periodic audits of the CMOM program. CMOM will require regular, comprehensive audits, done by the City's personnel. These audits will help identify non-compliance of CMOM regulations so problems can be addressed quickly. All findings, proposed corrective actions, and upcoming improvements, should be documented in the audit report.

CONCLUSIONS

While it is clear that a comprehensive program to remove I/I would not be cost effective, the City should nevertheless implement a program of I/I identification and removal as part of their overall maintenance program. The following program elements are recommended:

- Limited flow monitoring in areas with suspected high I/I.
- Systematic sewer televising to identify problem areas.
- A user-friendly collection system maintenance management program that provides a comprehensive database of the system; provides locations and descriptions of I/I sources and structural defects; and helps with work orders, customer complaint tracking, and generates system management.
- Repair of structural defects and leaks as part of street reconstruction projects.
- Elimination of other significant I/I sources as funds and staff are available.
- Development of a collection system master plan.

CHAPTER 4. EXISTING WASTEWATER TREATMENT FACILITIES

A review of the city of Coos Bay's existing wastewater treatment facilities forms the framework for the development of a long-term plant upgrade strategy. Analysis of historical plant operating data can reveal any ongoing performance deficiencies. Identification of the design capacity of each existing unit process can indicate the need to expand facilities when compared to the projections of future flows and loads. In addition, the existing facilities information allows for the determination of how new facilities can be best integrated into the system to achieve long-term upgrade requirements.

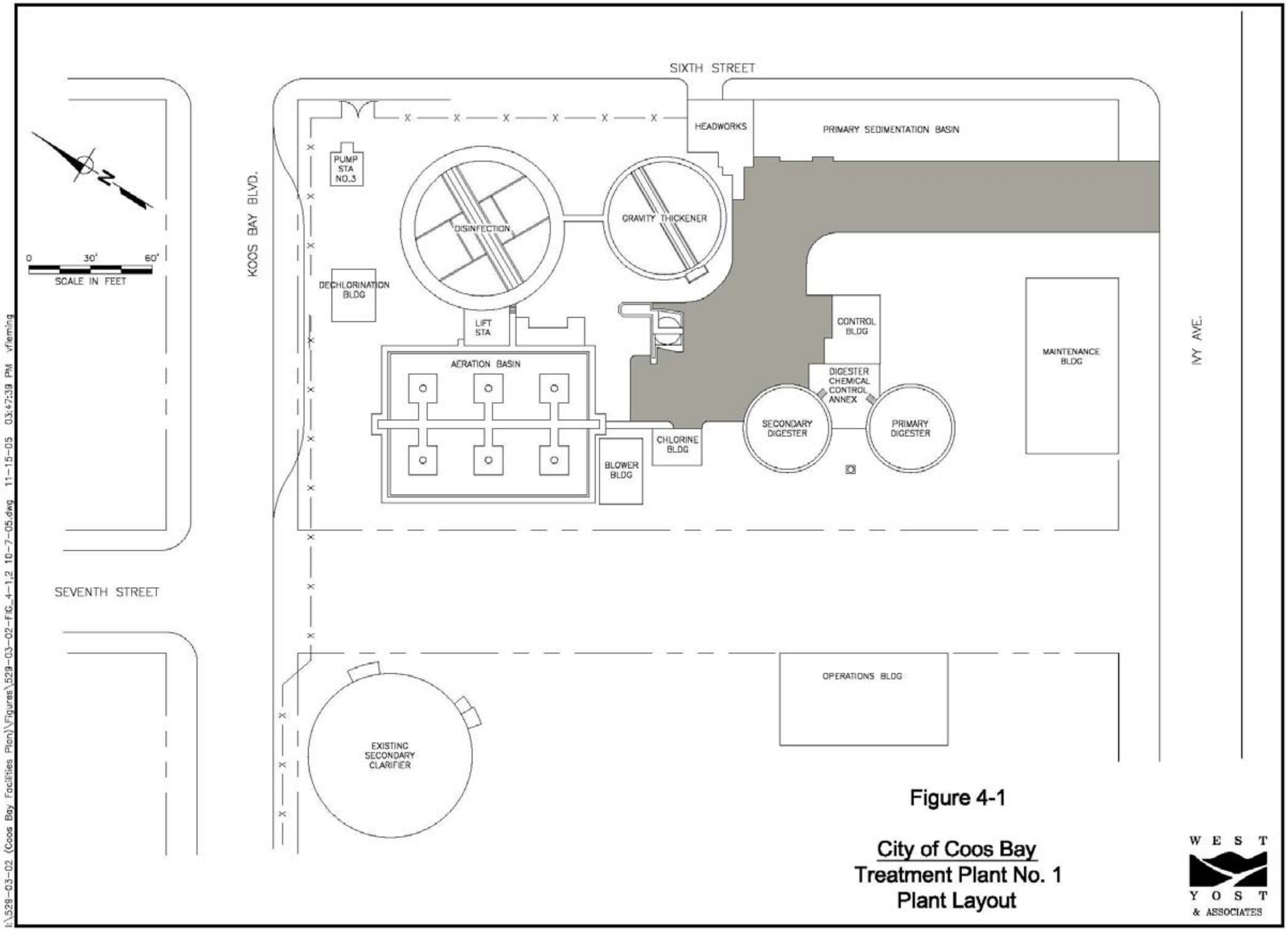
TREATMENT PLANT DESCRIPTION

The Coos Bay Wastewater Treatment Plant No. 1 is owned by the City of Coos Bay, and is managed and operated by Operations Management International, Inc. (OMI). Located on the east side of the City on 6th Avenue just off of Highway 101, Wastewater Treatment Plant No. 1 serves the east side of Coos Bay and the Bunker Hill Sanitary District. The plant was originally built in 1954 as a primary treatment plant for combined sanitary sewage and stormwater. Secondary treatment was added in 1973. The plant was extensively upgraded in 1990 to provide Class I mechanical and electrical reliability up to an instantaneous peak hydraulic flow of 15 million gallons per day (mgd) under the National Discharge Elimination system (NPDES) permit. At that time new headworks, primary clarifier and second secondary clarifier were added to the plant. The existing secondary clarifier was converted to a chlorine contact basin and the existing primary clarifier was converted into a sludge thickening tank. Plant treatment processes now include screening, grit removal, primary sedimentation, activated sludge secondary treatment, secondary clarification, disinfection, dechlorination, and anaerobic digestion of sludge.

The existing layout of Wastewater Treatment Plant No. 1 is shown in Figure 4-1. The site is bordered by 6th Street to the east, 8th Street to the west, Ivy Avenue to the south and Koos Bay Boulevard to the north.

Table 4-1 outlines the design data for the existing treatment units and major equipment. Figure 4-2 shows a flow schematic of Wastewater Treatment Plant No. 1. The functions of the unit processes are described in the following sections.

Figure 4-1. Layout of Treatment Plant No. 1



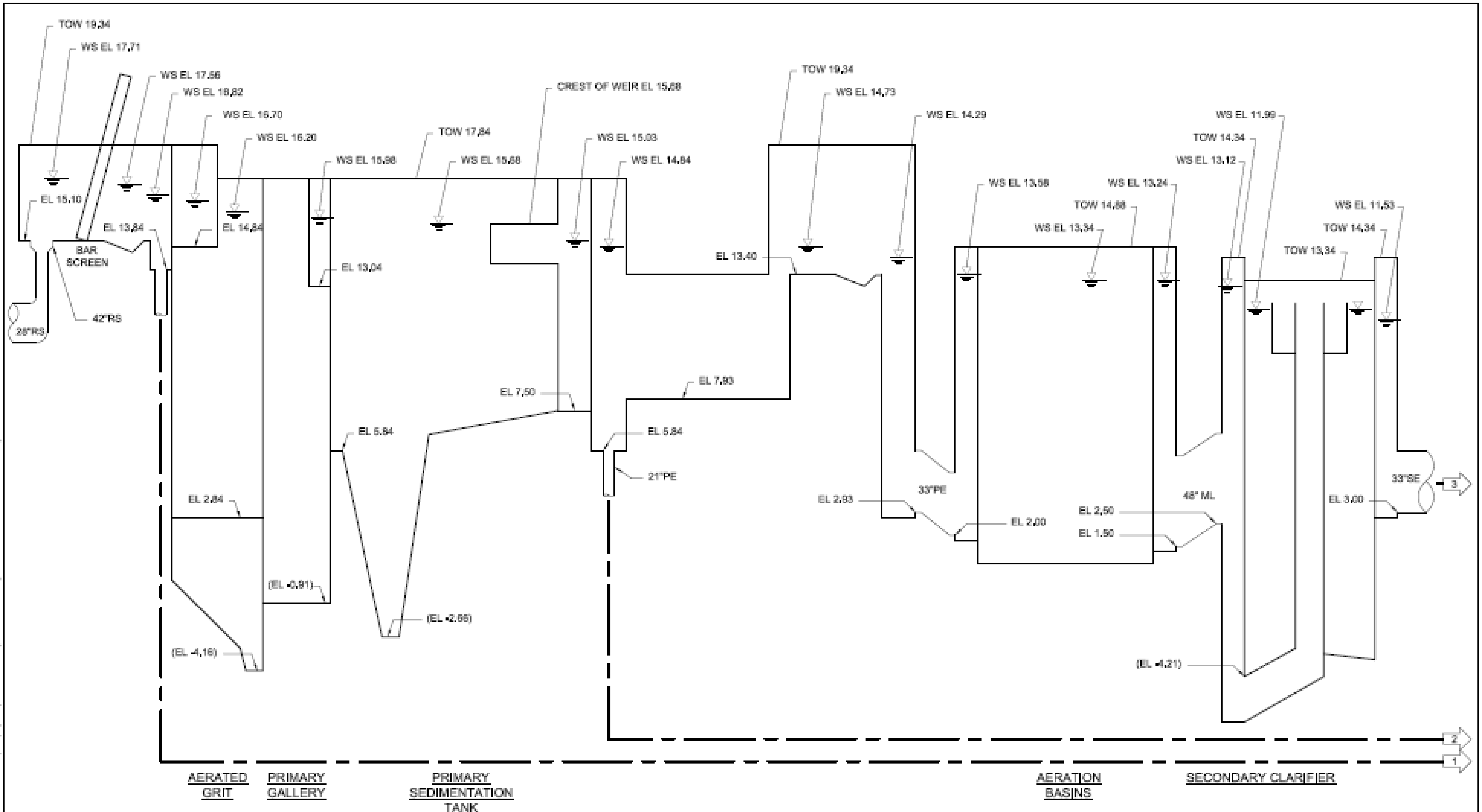


Figure 4-2

Coos Bay WWTP No.1

HYDRAULIC PROFILE

SHT 1 of 2

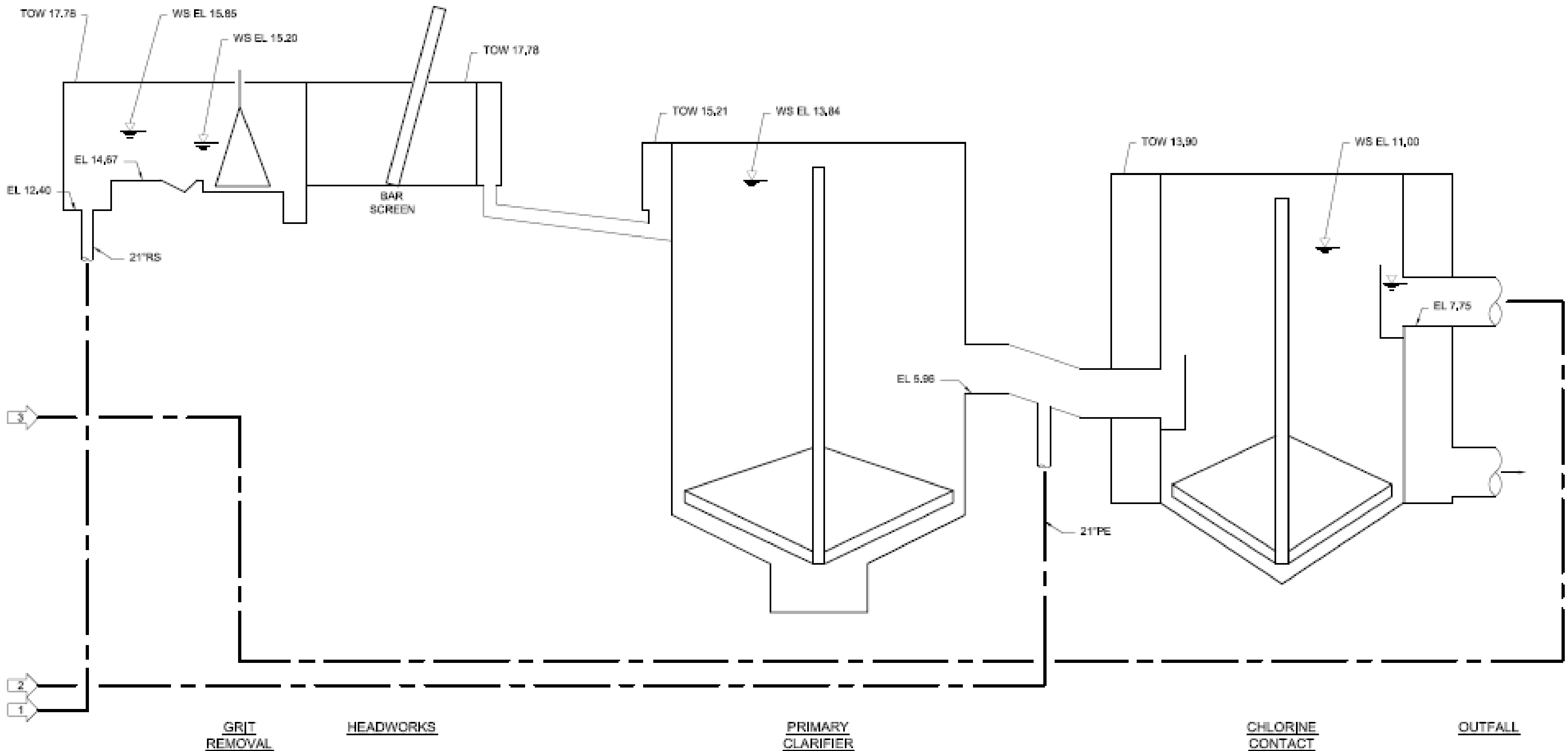


Figure 4-2

Coos Bay WWTP No.1

HYDRAULIC PROFILE

SHT 2 of 2

Table 4-1. Design Data for the Existing Wastewater Treatment Plant No. 1

Description	Value
GENERAL DESIGN CRITERIA	
Design Flows, mgd	
Average Dry Weather (ADWF)	2.9
Maximum Month (MMF)	4.9
Maximum Day (MDF)	9.6
Peak Wet Weather Flow (PWWF)	15.0
Split-stream Treatment, mgd	
Primary Treatment and Disinfection Capacity	15
Secondary Treatment Capacity	6
Design Loadings, lbs/day	
BOD Loading	
Average	2,670
Maximum Month	3,870
Total Suspended Solids Loading	
Average	3,410
Maximum Month	5,170
PRELIMINARY TREATMENT	
Old Headworks	
Existing Grit Chamber	
Number	1
Capacity, mgd	5
Grit Transfer Pump	
Number	1
Type	Centrifugal
Capacity, gpm	270
New Headworks	
Mechanical Bar Screen	
Number	1
Type	Front Cleaned Climber
Bar Spacing, in.	0.75
Manual Bar Screen	
Number	1
Bar Spacing, in	1.5

Description	Value
Screenings Compactor	
Number	1
Capacity, cubic feet/hour	34
Upper Screw, HP	1
Lower Screw, HP	3
Aerated Grit Tank	
Number	1
Capacity, mgd	10
Grit Pumps	
Number	2
Capacity, each, gpm	270
Grit Cyclone	
Number	1
Capacity, gpm	270
Grit Washer	
Number	1
Capacity, gpm	30
FLOW MEASUREMENT	
Number	2
Type	Parshall Flume
Size, in.	18
Number of Transmitters	1
PRIMARY TREATMENT	
Primary Sedimentation	
Circular Primary Sedimentation Basin	
Number	1
Diameter, ft	54
Overflow Rate, gpd/sf	
ADWF	700
PWWF	2,180
Rectangular Primary Sedimentation Basin	
Number	1
Width, ft	21.5
Length, ft	145

Description	Value
Overflow rate, gpd/sf	
ADWF	930
PWWF	3,210
Primary Sludge Pumps	
Number	2
Type	Rotary Lobe
Capacity, *each, gpm*	50
Primary Scum Pump	
Number	1
Type	Rotary Lobe
Capacity, gpm	50
Thickened WAS Pump	
Number	1
Type	Piston
Capacity, gpm	60
FLOW MEASUREMENT	
Quantity	1
Type	Parshall Flume
Size, in.	18
INTERSTAGE PUMPING STATION	
Lift Pumps	
Quantity	3
Type	Centrifugal
Capacity, each, mgd	2.7
RAS Pumps	
Quantity	3
Type	Centrifugal
Capacity, each, gpm	625
SECONDARY TREATMENT	
Aeration Basins	
Number	2
Width, each, ft	34
Length, ft	96
Sidewater Depth, ft	15.5

Description	Value
Total Volume, gal	757,000
MLSS concentration, mg/L	2,000
Hydraulic Detention Time, hours	
ADWF	6.3
Maximum Flow	3.0
Diffuser Type	Fine Bubble Tubes
Blowers	
Number	3
Type	Centrifugal
Capacity, each, scfm	1,200
Pressure, psi	8.0
Secondary Clarifier	
Number	1
Diameter, ft	80
Side water depth, ft	16
Overflow rate, gpd/sf	
ADWF	580
Maximum Flow	1,200
RAS Pump	
Number	2
Type	Centrifugal
Capacity, gpm	1,500
WAS Pump	
Number	1
Type	Centrifugal
Capacity, gpm	360
Secondary Scum and Tank Drain Pump	
Number	2
Capacity, each, gpm	340
CHLORINATION AND DECHLORINATION	
Chlorination Facilities	
Type	Sodium Hypochlorite
Contact Tank	
Number	1

Description	Value
Volume, gal	370,000
Hydraulic detention time, minutes	
ADWF	333
PWWF	36
Sodium Hypochlorite Storage Tanks	
Number	2
Total Storage Volume, gal	3,600
Feed pumps, number	
Number	3
Type	Diaphragm
Capacity, each, gph	20
Dechlorination Facilities	
Type	Sodium Bisulfite
Sodium Bisulfite Storage Tanks	
Number	2
Volume	1,500
Feed pumps	
Number	2
Type	Diaphragm
Capacity, each, gph	12.7
Mixer	
Number	1
Type	Vertical
Motor Size, Hp	5
OUTFALL	
Length, ft	715
Diameter, in	42
Diffuser, number of ports	5
ANAEROBIC DIGESTION	
Primary Digester	
Number	1
Diameter, ft	45
Depth, ft	26
Volume, gal	331,150

Description	Value
Hydraulic detention time, days	17
Digester Mixing	Mechanical
Mixer Size, Hp	15
Secondary Digester	
Number	1
Diameter, ft	40
Depth, ft	26
Total volume, gal	253,660
Hydraulic detention time, days	13
Digester Mixing	
Type	Gas Circulation Compressor
Capacity, cfm	150
Operating pressure, psig	15
Heat Exchanger	
Number	2
Type	Spiral
Recirculation Pump	
Number	2
Type	Recessed Impeller
Capacity, each, gpm	150
Sludge Transfer Pump	
Number	1
Capacity, gpm	450
Waste Gas Burner	
Number	1
Capacity, cfh	5,800
BIOSOLIDS STORAGE	
Facultative Sludge Lagoon	
Surface Area, acres	4
Depth, ft	11
UTILITIES	
Nonpotable Water	
Low Pressure Pump	
Number	1

Description	Value
Type	Centrifugal
Booster Pump	
Number	1
Type	Centrifugal
Plant Water Pumps	
Number	2
Type	Centrifugal
Emergency Generator	
Size, kW	200
Fuel	Diesel

FLOW CONTROL STRATEGY

Wastewater Treatment Plant No. 1 is operated in several modes depending on the influent flow rate as summarized below:

- When the influent flow rate is less than 2.5 mgd, all flow receives full preliminary, primary and secondary treatment, disinfection and dechlorination. The new headworks and the older, smaller, circular primary sedimentation basin are used.
- When the influent flow rate is between 2.5 and 6 mgd, all the flow receives full preliminary, primary and secondary treatment, disinfection and dechlorination. The newer rectangular primary sedimentation basin is used for primary treatment.
- When the influent flow rate is between 6 and 10 mgd, all flow receives preliminary treatment and primary treatment using the rectangular sedimentation basin. Up to 6 mgd receives secondary treatment. Primary effluent over 6 mgd goes directly to the chlorine contact chamber for disinfection, dechlorination and discharge.
- When the influent flow rate exceeds 10 mgd, 10 mgd receives preliminary treatment in the new headworks and primary treatment in the rectangular primary sedimentation basin. After primary treatment, 6 mgd of flow is directed to secondary treatment and 4 mgd flows directly to the chlorine contact basin. Flow in excess of 10 mgd is treated in the old headworks and the older circular primary sedimentation basin. All flow up to 15 mgd is disinfected in the chlorine contact basin and dechlorinated before discharge.

RELIABILITY/REDUNDANCY CRITERIA

Reliability/redundancy criteria were developed for the major unit processes at the Coos Bay WWTP No. 1. System reliability and redundancy classifications and requirements for wastewater facilities were established by the EPA and are described in the EPA's Technical Bulletin "Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability" EPA (430-99-74-001). These requirements are intended to maintain a minimum level of treatment if there is a failure of a process component. The Coos Bay WWTP No. 1 is a Class I facility as defined in the EPA criteria because its discharge:

1. Is into public water supply, shellfish, or primary contact recreation waters, or
2. As a result of its volume and/or character, could permanently or unacceptably damage or affect the receiving waters or public health if normal operations were interrupted.

The criteria for reliability/redundancy applicable to the Coos Bay No. 1 WWTP and the design features that address these criteria are summarized in Table 4-2.

TREATMENT PROCESS DESCRIPTION

Headworks

The headworks were expanded in 1990. The old headworks consist of a rectangular grit chamber that is currently used only when the flow rate exceeds 10 mgd. When the level of flow in the new bar screen channel exceeds a preset level, a gate is opened which directs excess wastewater to the old headworks. The signal is interlocked so that when the gate opens, the grit collector in the old grit chamber and the grit transfer pump start. The grit transfer pump sends grit to the aerated grit tank in the new headworks.

The new headworks consist of a front cleaned, mechanical bar screen that is 4.5 feet wide with ¾-inch openings. A manual bar screen is located in a bypass channel. The material accumulated on the screens is collected in a screenings compactor and discharged to a dumpster for landfill disposal. The influent flow rate is measured in a Parshall Flume downstream of the screens.

Headworks

Operators report that there is significant rusting of equipment, covers and conduits in the headworks area. The transducers on the flumes are old and in need of replacement.

Table 4-2. Process Reliability/Redundancy Criteria

Process	EPA Requirements[1]	Coos Bay WWTP No. 1 Design
INFLUENT PUMP STATION		
	Parallel pumps with ability to pump maximum day flow with single largest unit out of service, and peak wet weather flow with all units in service.	Parallel pumps with ability to pump maximum day flow with single largest unit out of service, and peak wet weather flow as defined in the plant design criteria with all units in service.
PRELIMINARY TREATMENT		
Screening System	At least two screens must be provided. WWTPs with only two bar screens must have one bar screen designed to permit manual cleaning.	Parallel screens sized to pass peak wet weather flow with all units in service.
Grit Removal System	Where a single grit removal unit is utilized, a bypass must be provided.	One grit basin sized to pass the peak wet weather flow is provided with a bypass channel.
PRIMARY TREATMENT		
Primary Clarifiers	Parallel clarifiers designed for maximum month wet weather flow with all units in service. Redundant clarifier provided for maximum month dry weather flow.	Single clarifier is designed for peak wet weather flow.
Primary Sludge/Scum Pumps	Parallel pumps with ability to pump maximum sludge load with single largest unit out of service.	Parallel pumps with ability to pump maximum sludge load with single largest unit out of service.
SECONDARY TREATMENT		
Aeration Basins	At least two equal volume basins shall be provided.	Two equal volume basins are provided to treat the primary effluent flow.
Aeration Blowers/Mechanical Aerators	There shall be a sufficient number of mechanical aerators to enable the design oxygen transfer to be maintained with the largest capacity unit out of service. The backup unit may be uninstalled, provided that the installed unit can be easily removed and replaced. At least two units shall be installed.	Two installed surface aerators per basin are provided.
Secondary Clarifiers	There must be at least two units designed so that, with the largest capacity unit out of service, the remaining unit(s) can handle at least 75% of the design flow.	Two clarifiers designed to handle peak wet weather flow with all units in service. The small clarifier alone can handle 2.2 mgd at peak overflow rate.

Table 4-2. Process Reliability/Redundancy Criteria, cont'd...

Process	EPA Requirements[1]	Coos Bay WWTP No. 1 Design
DISINFECTION		
Chlorine Contact Basins	The basins shall be sized such 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.	One basin with a minimum contact time of 30 minutes during peak wet weather flow conditions is provided. During average conditions, a portion of the basin can be taken out for service for maintenance.
SOLIDS TREATMENT		
Anaerobic Digestion	At least two digestion tanks shall be provided.	Two digesters are provided. One digester is used for storage.
Biosolids Storage	Biosolids Storage	Designed for 6 months wet weather storage

Notes:

1. "Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability" EPA Technical Bulletin No. 430-99-74-001.

Grit Removal

Following screening and measurement, wastewater flows into an aerated grit tank that is 15 feet deep, 17.5 feet long and 11 feet wide and contains two chambers. Grit is pumped alternatively from the chambers about every thirty minutes. The cycle begins with agitation air and non-potable water (NPW) being added for grit suspension. After a pre-set interval, a grit pump conveys the grit slurry into a cyclone separator. Following separation in the cyclone, the grit is dewatered and discharged to a dumpster for disposal.

Grit from Wastewater Treatment Plant No. 2 is trucked to the grit chamber for processing and subsequent hauling to the landfill.

Primary Treatment

Rectangular Primary Clarifier

The rectangular primary sedimentation tank is 145 feet long, 21.5 feet wide and has an average side water depth of 9 feet. It is used only when flow exceeds 2.5 mgd to minimize operation costs and odors that occur when it is used at lower flow rates.

The older circular primary sedimentation basin is 54 feet in diameter and 10 feet deep. The basin is original to the plant and was converted to a sludge thickener in the 1990 expansion. It is used as a primary sedimentation basin when flows are lower than 2.5 mgd and when they exceed 10 mgd. When the influent flow rate is between 2.5 and 10 mgd, waste activated sludge (WAS) and primary sludge are thickened in this tank. The sludge is co-thickened to about 2% solids. Primary sludge, scum and WAS are pumped to the digesters on a pre-set timer. The primary sludge pump is a piston pump that is original to the plant.

Activated Sludge

Up to 6 mgd of primary effluent flows through a Parshall Flume to two aeration basins. The basins are equipped with baffles to allow operation in plug-flow or step-feed modes. Each basin is separated into four zones. In the current operating mode, the first two zones act as selectors. RAS is fed into the first two zones and primary effluent is fed into the third zone. Three centrifugal blowers supply air to the basin. Air is fed to the aeration basins through Parkson membrane tube diffusers. The process is operated at an MLSS concentration of 2000 mg/l.

Dewatered Aeration Basin

Secondary Clarification

Secondary Clarifier

The treatment plant's single flat bottom secondary clarifier is 80 feet in diameter and 16 feet deep. The basic clarifier configuration consists of a center-feed well with perimeter overflow V-notch weirs. The clarifier mechanisms draws sludge into a central pit where suction lines draw off the return activated sludge (RAS). The secondary effluent leaves the clarifiers via a 33-inch line and the settled solids are removed by RAS and waste activated sludge (WAS) pumps. The WAS is pumped to the old circular primary sedimentation tank for thickening via modified flexible tubing. Secondary scum is conveyed to the old circular primary clarifier with the old tank drain pump.

Interstage Pumps

The interstage pump station consists of 3 centrifugal pumps, each with capacity of 1,850 gpm. The pumps are operated as drain pumps for the aeration basins.

It should be noted that components such as conduits and electrical boxes are rusting throughout the interstage pump station.

Chlorination/Dechlorination

The chlorine contact basin is a 68-foot diameter retrofitted secondary clarifier equipped with over and under baffles to enhance plug flow conditions. Flow is fed peripherally and exits at V-notch weirs near the center of the tank.

Sodium hypochlorite is used to disinfect secondary effluent. Sodium hypochlorite is diluted with treated effluent and fed into the 33-inch secondary effluent pipe as it enters the chlorine contact basin. The sodium hypochlorite solution is fed through a perforated PVC pipe and there is a coarse bubble diffuser to provide mixing. Contact time in the basin is 36 minutes at peak wet weather flow. Chlorine is paced off of the influent flow meter.

Chlorine Contact Basin

Dechlorination facilities consist of sodium bisulfite metering pumps; storage tanks with spill containment, and feed piping and a mixer. The bisulfite will be injected at the chlorine contact basin overflow weir. Plant effluent is sampled for chlorine residual in a manhole in the outfall pipe prior to discharge into the Coos Bay. Dechlorination has compound loop control using the influent flow rate and sulfite residual as inputs.

Outfall

Treated effluent is discharged into Coos Bay at the eastern end of Koos Bay Boulevard at River Mile 13.2. The outfall consists of a 42-inch lined and coated steel pipe with a 20-foot five-port diffuser. The pipe is approximately 715 feet long and discharges 200 feet from the shore at an approximate depth of 20 feet. The outfall is a combined outfall with 12- and 24-inch storm drains connecting to the treatment plant effluent pipe at a vault at the intersection of Koos Bay Boulevard and 6th Street. Operators have noted that an overflow occurs at this location during high storm events. The overflow is likely due to the heavy storm water flow into the outfall. The condition of the outfall pipe is poor and some of the structural supports are missing.

Anaerobic Digestion

The plant has two anaerobic digesters, one 40 feet in diameter and one 45 feet in diameter. The 45-foot diameter tank, the primary digester, is equipped with a floating cover. The smaller tank, the secondary digester, has a fixed cover. The secondary digester is currently neither heated nor mixed and is used for storage prior to the sludge being pumped to lagoon for storage. A boiler and heat exchanger provide heat for the primary digester. Sludge is circulated with two recessed impeller pumps. Gas not used for digester heating is sent to a waste gas burner.

Primary Digester Floating Cover

The floating cover on the primary digester sunk into the tank several years ago and has been temporarily repaired. The handrails around both tanks are rusted. The rail around the secondary digester has broken. Operators report that controls on the boiler are not reliable and the temperature control valves on the hot water line into the heat exchanger do not function correctly. The electrical system in the control building is old and windows are cracked. The waste gas burner is in poor repair and not used consistently.

Biosolids Drying and Disposal

Digested sludge is pumped to the City's facultative sludge lagoon for storage, curing and storage. The bentonite clay- lined lagoon has a surface area of approximately 4 acres, is 11 feet deep, and contains two inlet ports. Supernatant from the lagoon is aerated and pumped to the City sewer system for return to the treatment plant. A floating dredger reaps the sludge which is land applied to approximately 250 acres of DEQ- approved private farmlands and forest sites between June and October each year.

Plant Utilities

The treatment plant has the following utility systems:

- **Non-potable Water (3W) Pumps.** Four pumps provide non-potable water for in-plant uses. One pump provides water for general use. Two booster pumps provide high-pressure flow for wash down and irrigation, and one pump is dedicated to providing dilution water to the hypochlorite feed system.
- **Standby Power.** A 200 kW generator with fuel storage is available for use in the event of a power outage. The generator was installed in 1997 and an automatic transfer switch was installed in 2003. The generator is capable of supplying power to the entire plant.

UNIT PROCESS CAPACITY

The capacities of each unit process was estimated based on calculations and information available in operating manuals and are summarized in Table 4-2.

Table 4-2. Unit Process Capacity Summary

Unit Process	Basis for Capacity	Design Criteria	Total Estimated Capacity
Bar Screen	PWWF	Screen Head loss	15 mgd
Aerated Grit Chamber	PDF	HRT at PDF: 3 minutes	10 mgd
Primary Sedimentation	PWWF	Rectangular: 3500 gpd/sf Circular: 3000 gpd/sf	17 mgd
Aeration Basins	SRT at Max Month Load HRT at Max Month Flow	4 days SRT 4 hours HRT	3475 lb/day BOD[1] 4.5 mgd
Aeration System	BOD loading	1.1 lb O2/lb BOD 20% SOTE	3030 lb/d BOD[1]
Secondary Clarification	Peak Flow to Secondary Treatment	1200 gpd/sf	6 mgd
Chlorine Contact Basin	PWWF	30 minute contact time	17 mgd
Outfall	PWWF	100 year flood elevation of 9.0	15 mgd
RAS Pumping	25% Peak Flow to Secondary Treatment	Firm Capacity	2.2 mgd
Anaerobic Digestion	Hydraulic Detention Time at Max Month Loading	17 days	14,000 gal/d

Unit Process	Basis for Capacity	Design Criteria	Total Estimated Capacity
Lagoon	Average Organic Loading, lbVSS/ksf//day	20 lb VSS/ksf/day	3500 lb VSS/day

(1) Load to secondary treatment. Capacity does not take into account uptake by nitrification.

The following sections provide additional information on the capacity evaluation for each unit process.

Bar Screen

The headworks includes one mechanical bar screen and a manual bar screen. The capacity of the screens is typically calculated based on the mechanical bar screen only with the manual bar screen reserved for back-up service. The manual bar screen has wider bar spacing which allows more debris into downstream processes and is therefore only used for flows above the hydraulic capacity of one mechanical screen when the mechanical bar screen must be bypassed.

The mechanical bar screen is rated at 15 mgd according to design drawings. At 15 mgd, the velocity through the bars, assuming 35% blinding, is calculated to be approximately 5.2 fps and the head loss is approximately 0.5 feet. The recommended velocity range is 1 to 4 feet per second so at peak flow the screen's effectiveness is reduced. However, the influent under these conditions is dilute (combined stormwater & sewage) and the higher velocities are allowable for brief periods under these conditions. The head loss through the screen is such that the flow is well below the operating floor upstream of the screen at peak flow.

Aerated Grit Chamber

The aerated grit chamber capacity is rated at 10 mgd. Flow in excess of 10 mgd is routed to the old grit chamber but the grit is pumped back to the new aerated grit chamber. Also, grit from Treatment Plant No. 2 headworks is added to the aerated grit chamber for processing. A minimum hydraulic detention time at peak flow of 3 minutes is recommended. At 10 mgd, detention time is approximately 3 minutes.

Primary Sedimentation

The primary sedimentation tank capacity is based on the surface overflow rate. Generally, a higher overflow rate can be allowed to a rectangular tank than a circular basin. Using the criteria listed in Table 4-2, the capacity of the rectangular basin slightly exceeds 10 mgd and the capacity of the circular tank is 6.9 mgd for a total primary sedimentation capacity of 17 mgd.

Aeration Basins

Aeration basins that treat municipal wastewater are typically designed based on solids retention time (SRT) and, to a lesser extent, hydraulic retention time (HRT). To maintain an SRT of 4 days at a mixed liquor suspended solids (MLSS) concentration of 2,000 milligrams per liter (mg/l), the influent BOD load to the aeration basins would be approximately 4340 lbs/day at maximum month conditions. Capacity could be increased by increasing the MLSS concentration.

HRT is a secondary design criterion that serves as a check of SRT. In general, a 4-hour HRT at maximum month flow is considered reasonable. However, HRTs of as low as 3 hours are acceptable provided the SRT is maintained within limits. A flow of 4.5 mgd to the aeration basin yields an HRT of 4 hours. At 6 mgd, the peak design flow to the aeration basin, the HRT is 3.0 hours.

Aeration System

The capacity of the aeration equipment is based on its estimated oxygen transfer rate and the oxygen requirements of the wastewater. Based on a 20% standard oxygen transfer efficiency (SOTE) and oxygen requirements of 1.1 lb of oxygen per lb of BOD, the allowable BOD to the aeration basins is 3475 lb/day. The calculation does not take into account some oxygen uptake due to nitrification that is known to occur in the summer months. The uptake by nitrification that currently occurs in summer months reduces the capacity of the system to approximately 2260 lb/day BOD.

Secondary Clarification

The surface overflow rate at the maximum flow condition is typically the criteria considered for secondary clarifier capacity. A typical value for a circular secondary clarifier is 1200 gpd/sf. Above this overflow rate, performance will begin to decline. At 6 mgd, the rated maximum flow to the secondary treatment system, the overflow rate of the secondary clarifier is 1200 gpd/sf.

Chlorine Contact Basin

The capacity evaluation of the chlorine contact basin is based on the proper hydraulic detention time and optimum dimensions to achieve acceptable disinfection. Baffling in the converted secondary clarifier provides an increased length-to-width ratio although the configuration is not ideal for a contact basin.

A minimum hydraulic detention time of 30 minutes is typical at peak flows. At a 30-minute detention time, the peak capacity of the chlorine contact basin is 17 mgd.

Outfall

The existing outfall serves as an outfall for both the wastewater treatment plant and the stormwater system. The 100-year flood elevation in the area is 9.0 feet above mean sea level (MSL) according to the 1990 design documents. If manhole lids were bolted as shown in the 1990 upgrade plans, the overflow point would be the chlorine contact basin weir at about elevation 11.0.

Return Activated Sludge Pumping

The firm capacity of the RAS pumping system is based on the capacity of the system with the largest pump out of service. Assuming the second pump, which is also used for WAS, could also be used for RAS pumping, the capacity is 1500 gpm or 2.2 mgd. This estimate is based on the reported rated capacity of each pump.

Anaerobic Digestion

The capacity of the anaerobic digestion facilities was evaluated based on solids retention time criteria. To reduce pathogens and vector attraction adequately, the digesters need to provide a solids retention time of 17 days at maximum month loading. Based on the volume of the primary digester, the digesters are operating at capacity. Plant data shows that the digesters are operating near capacity.

Facultative Lagoon

The lagoon acts as a storage facility for stabilized sludge. The loading rate to the lagoon should be kept below 20 lb volatile solids/1000 square feet (sf) of lagoon surface area per day to avoid odors, although in the summer months, the loading rate can be increased for short periods of time. The lagoon receives digested sludge from both plants. With four acres of surface area, it has the capacity to receive 3500 lb VSS/day. It is currently loaded at an annual average rate of 600 lb VSS/day.

WASTEWATER TREATMENT PLANT PERFORMANCE

A review of recent plant influent and effluent quality data is useful for characterizing the current performance of the wastewater treatment system. As shown in Table 4-3, the treatment plant produced high quality effluent in 2005.

Table 4-3. 2005 Plant Performance Summary

Month	Influent Flow, mgd		Effluent Concentration, mg/l			
			BOD		TSS	
	Average Day	Maximum Day	Average Day	Maximum Day	Average Day	Maximum Day
January	2.89	5.66	8.26	11.90	7.14	8.40
February	1.86	2.19	8.01	9.70	6.35	11.20
March	2.17	5.27	9.49	11.60	8.22	18.80
April	2.60	3.63	6.85	9.40	3.58	4.90
May	2.27	4.88	9.42	12.60	5.71	16.80
June	1.72	2.40	9.77	11.80	4.01	8.50
July	1.40	1.52	10.58	12.10	6.53	12.40
August	1.36	1.43	7.93	10.90	5.96	7.60
September	1.32	1.46	10.30	15.80	4.60	7.40
October	1.42	1.99	8.99	12.00	5.69	7.50
November	2.70	4.02	11.90	30.10	7.96	15.80
December	3.79	10.55	11.03	17.60	9.30	18.90

Table 4- . Unit Process Capacity Summary

Unit Process	Basis for Capacity	Design Criteria	Firm Capacity	Total Capacity
Screening	PWWF	Headloss across the screens	19 mgd	34 mgd
Grit Basin Capacity	PWWF	Flow, Channel Depth and Channel Velocity of 2 to 3 FPS per manufacturer	5 mgd	15 mgd
Primary Clarifiers	PWWF	?? gpd/sf	5 mgd	15 mgd
Aeration Basin	HRT at MMWWF SRT at Maximum Month Load		12 mgd	24 mgd
Secondary Clarifiers	Hydraulic overflow rate at peak flow	1,200 gpd/sf	-	9 mgd
RAS Pumping	Reported capacity	Firm capacity	1,500 gpm	3,000 gpm
WAS Pumping	Reported capacity	Firm capacity	340 gpm	680 gpm
Chlorine Contact Basins	PWWF	30 minute detention time at PWWF	-	17 mgd
Outfall	PWWF		-	35 mgd
Anaerobic Digestion	Detention Time	24 days	24 days	
Facultative Lagoon	Solids loading rate	20 lb volatile solids/1000 sf /day	3500 lb VSS/day	

CHAPTER 5. WASTEWATER CHARACTERISTICS

The Coos Bay Wastewater Treatment Plant No. 1 (WWTP No. 1) is operated by Operations Management International, Inc. (OMI). OMI personnel monitor important wastewater characteristics for the plant and report these plant conditions to the City of Coos Bay and to the Oregon Department of Environmental Quality (DEQ) on a monthly basis as required by the NPDES permit. This chapter summarizes data from the discharge monitoring reports (DMRs) and analyzes recent data to define the flows and loads that characterize the City's wastewater under current conditions. Current flow and load estimates are used along with the population projections presented in Chapter 2 to develop flow and load projections for future conditions. The flow and load projections serve as the basis for assessing the adequacy of existing treatment systems and sizing new treatment facilities.

CURRENT FLOWS AND LOADS

Analysis of flows and load data forms an important initial step in developing wastewater flow projections. The following assessment of current flow and load conditions for the Coos Bay WWTP No. 1 is based on operational data from the plant. The flow and load analysis presented herein were developed based on the data from 1995 through 2005 so that larger storms that occurred between 1995 and 1999 could be included in the analysis. . A review of the data showed that there was no significant difference between the peak flows resulting from data analysis for a period from 1995-1999 and 1999-2005. Therefore, average and maximum month flows and loads were developed based on data from January 1999 through December 2005.

Wastewater Flows

Because wastewater flow rates can be quite variable, a number of different flow conditions are important in sizing and evaluating wastewater treatment plants. This section defines the flows of interest and develops estimates of monthly and peak flows.

Definitions

The flow rates and related parameters discussed in this chapter are defined below:

- The *average annual flow* (AAF) is the average flow for the entire year.
- The *average dry weather flow* (ADWF) is the average daily flow at the plant during the dry weather season, typically May through October.
- The *average wet weather flow* (AWWF) is the average daily flow at the plant during the wet weather season, typically November through April.
- The *maximum month dry weather flow* (MMDWF) is defined as the flow recorded at the plant when total rainfall quantities are at the 1-in-10 year probability level for the month of May.

- The *maximum month wet weather flow* (MMWWF) is defined as the plant flow when total rainfall quantities are at the 1-in-5 year probability level for the month of January. However, the wet season maximum month for the plant is December. Therefore, based on DEQ's recommendation, December rainfall data was to determine the MMWWF.
- The *Maximum Week Wet Weather Flow* (MWWWF) is the weeks flow with a recurrence probability of 1.92 percent in a given year.
- The *peak day flow* (PDF) is the flow rate that corresponds to a 24-hour storm event with a 1-in-5 year recurrence interval that occurs during a period of high groundwater and saturated soils.
- The *peak wet weather flow* (PWWF) is expected to occur during the peak day flow. The PWWF is the highest flow at the plant sustained for one hour. The PWWF dictates the hydraulic capacity of the treatment system. PWWF is also referred to as the peak instantaneous flow, or peak hour flow.
- *Infiltration and inflow* (I/I) refers to water that enters the wastewater collection system due to deterioration or illicit connections. Infiltration is groundwater that enters the system from the surrounding soil through defective pipes, joints, or manholes. Inflow is storm water that directly enters the system from sources such as drainage connections, flooded manhole covers, and sewer defects that respond quickly to saturated ground conditions.

Rainfall Records

Since rainfall has a large effect on wastewater treatment plant flow rates, DEQ flow projection guidelines recommend that rainfall records and statistical analyses be considered when analyzing WWTP flows. Daily rainfall data are collected at WWTP No. 1.

The National Oceanic and Atmospheric Administration (NOAA) prepares statistical summaries of climatologic data for selected meteorological stations. The meteorological station with statistical summaries closest to Coos Bay WWTP No. 1 is located at the North Bend Airport. The most recent climatologic summary for areas of Oregon was issued in 2004 and is based upon data collected from 1971 through 2000. Table 5-1 compares the average monthly total rainfall recorded at WWTP No. 1 and rainfall statistics for the North Bend Airport Meteorological Station obtained from the climatologic summary. The relative similarity in rainfall totals indicates that historical data from the North Bend Airport Meteorological Station provides a reasonable representation of rainfall distribution at the Coos bay WWTP No. 1.

Table 5-1. Average Monthly Rainfall at Coos Bay WWTP No. 1, 1999-2005 and Statistical Rainfall Summary for the North Bend AP Meteorological Station, 1971-2000

Month	1999-2005 WWTP No. 1 Average Rainfall, inches	1999-2005 OCS Average Rainfall, inches	1971-2000 NOAA Average Rainfall, inches	Greatest Monthly Rainfall, inches (North Bend)	Greatest Daily Rainfall, inches (North Bend)	1-in-5 Year Monthly Rainfall, inches (North Bend)	1-in-10 Year Monthly Rainfall, inches (North Bend)
January	9.48	10.26	9.54	20.96	4.02	13.67	17.07
February	6.66	6.95	8.12	16.26	5.16	11.10	13.36
March	4.19	5.82	7.94	14.13	4.02	10.74	12.83
April	2.77	5.21	5.19	11.13	2.65	7.43	9.25
May	1.89	3.03	3.40	9.30	4.35	5.04	6.50
June	0.87	1.72	1.72	4.80	2.72	2.62	3.46
July	0.13	0.33	0.51	2.79	1.29	0.84	1.23
August	0.35	0.49	0.88	2.72	1.51	1.45	2.16
September	0.44	1.50	1.73	5.70	2.05	2.87	4.46
October	2.51	3.87	4.62	12.46	11.17	7.09	9.47
November	7.72	7.32	10.36	22.69	6.67	14.58	17.94
December	9.01	12.33	10.42	20.76	5.60	14.95	18.70
Wet Season	38.83	47.89	51.57	22.69	6.67	14.95	18.70
Dry Season	6.19	10.94	12.86	12.46	11.17	7.09	9.47

Flow Analysis

Analysis of plant influent flows provides the basis for developing flow projections for the system in the future.

The average dry weather flow (ADWF) is the average flow during the dry weather season months of May through October. Since little rainfall occurs during these months, rain dependent I/I sources do not significantly affect ADWF. The average wet weather flow (AWWF) is the average flow during the wet weather season months of November through April during a year with average rainfall. Table 5-2 presents a summary of the wet and dry season rainfall and flows for the period 1999 through 2005. Based on the information in the table and a review of rainfall data for those years, the ADWF is estimated to be 1.6 mgd, the highest dry weather average for those years and AWWF is estimated to be 3.1 mgd. The relatively large difference between the ADWF and AWWF indicates that the seasonal variations in wastewater flow caused by rainfall dependent I/I are significant.

Table 5-2. Summary of WWTP No. 1 Wet and Dry Season Rainfall and Influent Flow

Season	Water Year[(a)]	Total Season Rainfall, in	Average Plant Influent Flow, mgd
Dry Season[(b)]	1999	8.64	1.57
	2000	9.69	1.43
	2001	6.87	1.32
	2002	2.67	1.28
	2003	3.10	1.53
	2004	14.79	1.59
	2005	13.08	1.58
Average Dry Season		8.41	1.47
Wet Season[(c)]	1999	31.42	3.50
	2000	44.85	3.11
	2001	16.45	2.00
	2002	41.27	2.90
	2003	48.52	3.05
	2004	33.23	2.79
	2005	27.30	2.34
Average Wet Season		34.72	2.81

(a)Water year runs from the preceding November through October.

The maximum month dry weather flow (MMDWF) is defined by DEQ as the influent plant flow that would be expected to occur when rainfall is at the 1-in-10 year probability level for the wettest month of the dry weather season. For the Coos Bay area October is the wettest dry weather month for the area but the average May rainfall is used for this analysis because groundwater levels are higher in the spring. This is consistent with the data observed at the WWTP No. 1, i.e. the observed average May plant influent flow is greater than the average October plant influent flow although the rainfall is higher in the month of October.

From Table 5-1, the 1-in-10 year May rainfall at the North Bend Airport Meteorological Station is 6.50 inches. DEQ guidelines for projecting the MMDWF rely on relating the monthly average influent plant flow for January through May against the total rainfall for each respective month. Data from the 2004 and 2005 seasons were used. By approximating a linear relationship, as illustrated in Figure 5-1, the MMDWF is estimated to be approximately 3.1 mgd.

Similarly, the MMWWF is defined by DEQ as the flow expected to occur when rainfall is at the 1-in-5 year probability level for the month of December. The 1-in-5 year December rainfall is approximately 15.0 inches (Table 5-1). As illustrated in Figure 5-1, the MMWWF is estimated at 5.2 mgd. The computed maximum month flows compare well with the observed flows at the treatment plant as shown in Table 5-3.

Figure 5-1. Coos Bay WWTP No. 1 Monthly Influent Flow Versus Rainfall, January 2004 - December 2005

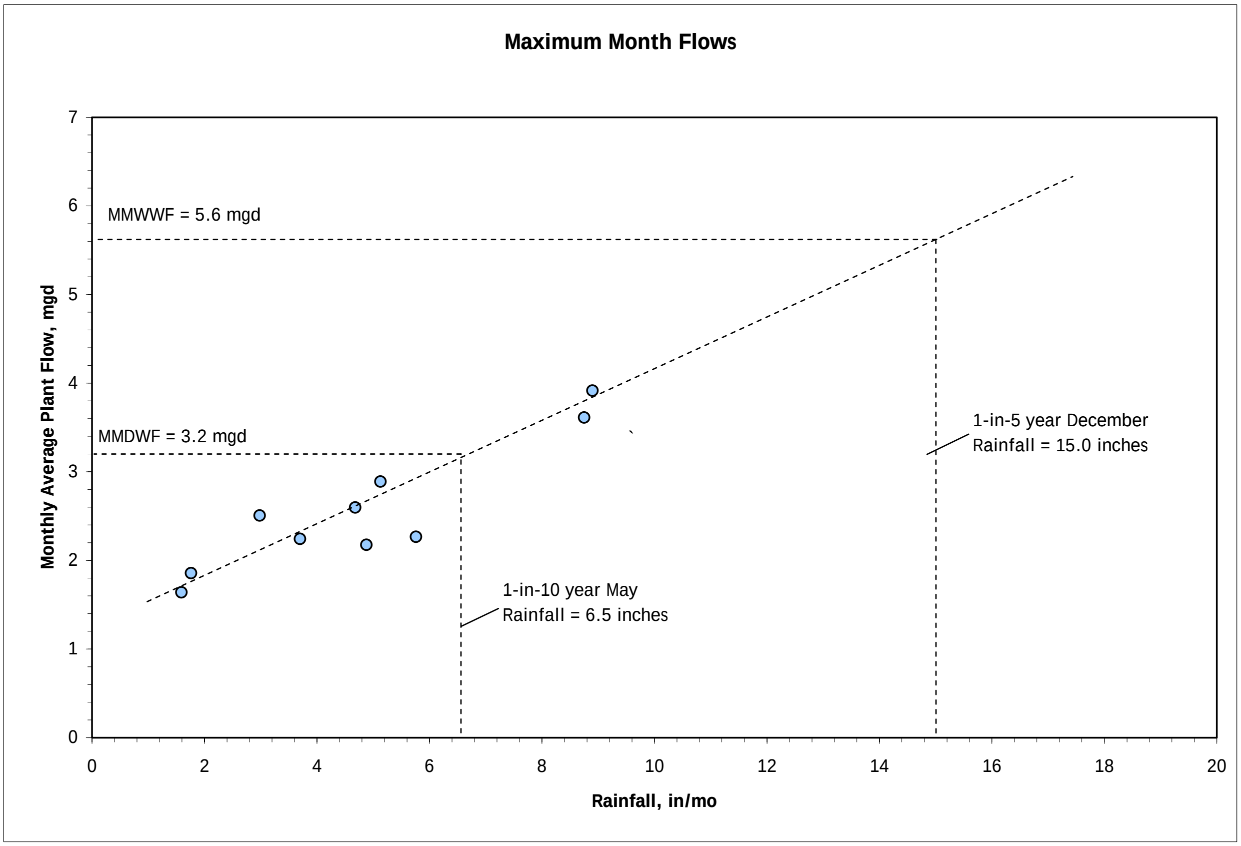


Table 5-3. Maximum Month Flow Comparison between Observed and Computed (2004 and 2005 Data Only)

Month	Maximum Month Flow, mgd	
	Observed	Computed
May	3.36	3.2
December	6.81	5.6

The peak day flow (PDF) is defined as the daily average plant flow rate that occurs during the 1-in-5 year, 24-hour storm event. For the Coos Bay area, this is approximately 4.5 inches of rainfall, based on isopluvial map found in the NOAA Atlas 2; Volume X. Figure 5-2 presents flows and corresponding rainfall totals from significant wet season storm events for the period of record. In order to ensure that soils were saturated and infiltration/inflow was significant, this analysis considered only those days with over 1.25 inches of daily recorded rainfall and at least two inches of cumulative rainfall in the previous 4 days. The DEQ methodology for estimating the PDF assumes that there is an approximately linear relationship between influent flow and rainfall, where influent flows steadily increase with larger rainfall events. Based on Figure 5-2, the PDF is estimated at 10.1 mgd.

Peak wet weather flow (PWWF) and maximum week wet weather flow (MWWWF) were estimated by projecting flow on a log-probability graph using average, maximum month and peak day flows as presented in Figure 5-3. The capacity of the upstream sewage pump stations is 20 mgd.

Figure 5-2. Daily Influent Flow Versus Rainfall for Significant Events

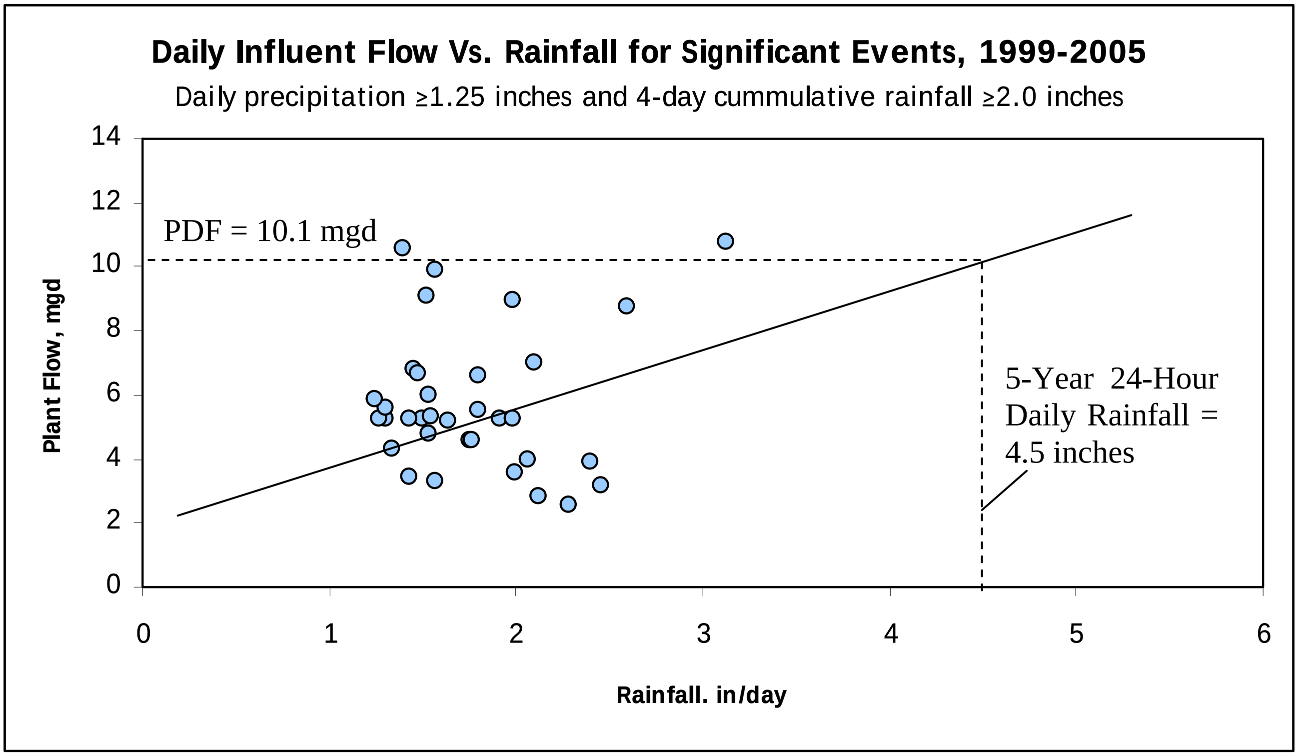


Figure 5-3. Probability Analysis for PWWF Determination (1999-2005 data)

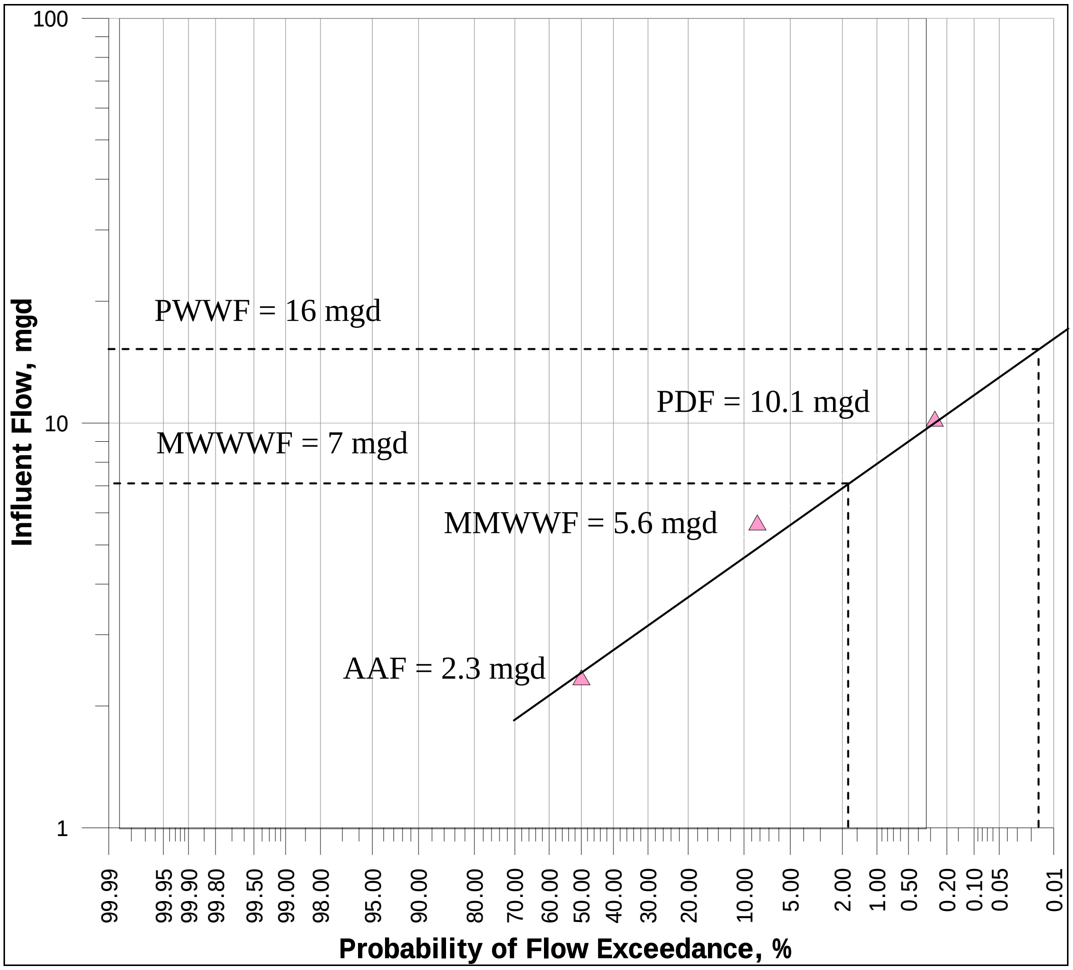


Table 5-4 summarizes the current wastewater flows and peaking factors for Wastewater Treatment Plant No. 1.

Table 5-4. Current Wastewater Flows

Flow Parameter	Flow Rate, mgd	Peaking Factor
Average Dry Weather Flow (ADWF)	1.6	1.0
Average Wet Weather Flow (AWWF)	3.1	1.9
Average Annual Flow (AAF)	2.3	1.4
Maximum Month Dry Weather Flow (MMDWF)	3.2	2.0
Maximum Month Wet Weather Flow (MMWWF)	5.6	3.5
Maximum Week Wet Weather Flow (MWWWF)	7.0	4.4
Peak Day Flow (PDF)	10.1	6.3
Peak Wet Weather Flow (PWWF)	16.0	10.0

Another useful flow analysis parameter is the wet weather I/I rate for the community in terms of gallons per acre per day (gpad). Since the wet weather I/I rate is approximately equal to the difference between the PWWF and the ADWF, the I/I rate for Coos Bay WWTP No. 1 is 19.4 mgd. Based on an estimated overall developed area of 2,480 acres as reported in Chapter 2 and the combined PWWF of both treatment plants of 23 mgd, the I/I rate for the system is estimated at 9,275 gpad. This I/I rate is very high relative to the 1,500 gpad typically associated with new construction.

BOD and TSS Loads

Biochemical oxygen demand (BOD) and total suspended solids (TSS) are indicators of the organic loading on a wastewater treatment facility. BOD is a measure of the amount of oxygen required to biologically oxidize the organic material in the wastewater over a specific time period. A 5-day BOD test is conventionally used for wastewater testing. As its name suggests, TSS is a measure of the particulate material suspended in the wastewater. The BOD and TSS loading on the WWTP influence the following:

- **Treatment Process Sizing.** The size of biological treatment units, such as aeration basins, is approximately proportional to a plant's organic loading.
- **Aeration System Sizing.** Treating higher BOD loads requires higher capacity aeration equipment. A wastewater treatment facility's aeration system is typically sized to provide oxygen during peak day BOD loading conditions.
- **Sludge Production.** BOD and TSS removed by the plant are converted into sludge. Higher BOD and TSS loads result in increased sludge quantities.

BOD and TSS Records

Daily BOD and TSS concentrations are recorded approximately twice per week. The daily plant loading for BOD and TSS from January 1999 to December 2005 is shown in Figures 5-3 and 5-4 respectively. As illustrated in Figures 5-4 and 5-5, the highest BOD and TSS loads recorded for this period occurred in the late fall. Investigation into the rainfall data revealed that the high concentrations of BOD and TSS correspond to the first major storm event that occurs at the end of a dry season. Thus, the spikes in the BOD and TSS levels are likely due to the flushing of accumulated solids from the sewer system after the extended dry, low flow period.

Figure 5-4. Daily Plant Loading: Biochemical Oxygen Demand (BOD)

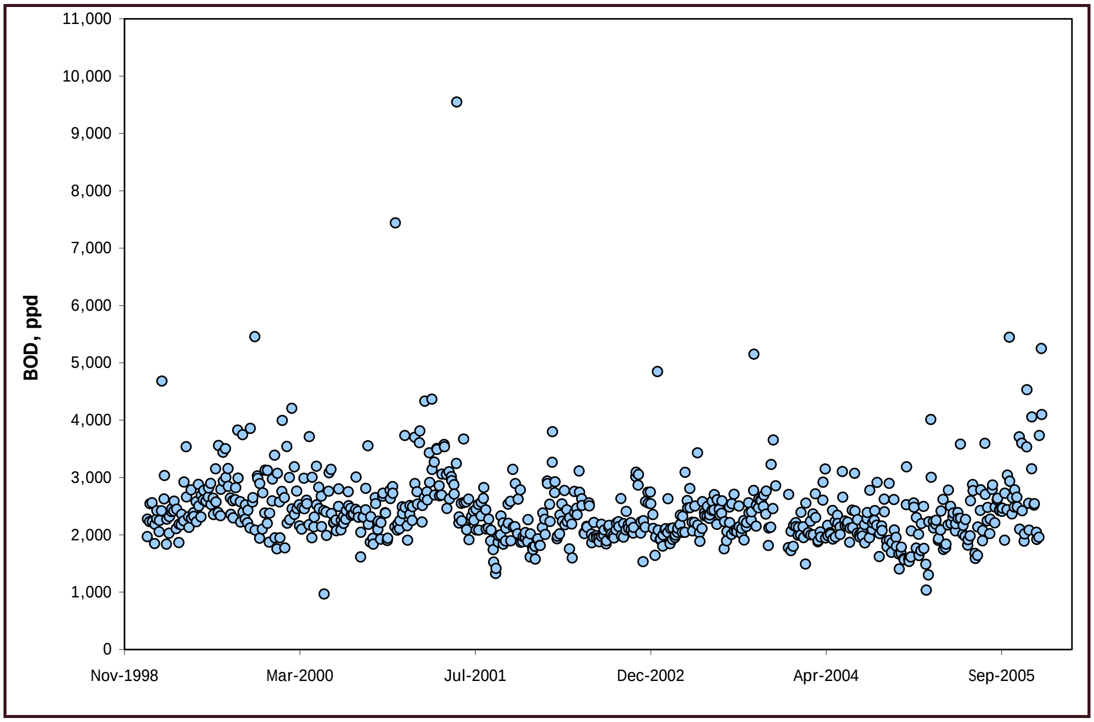
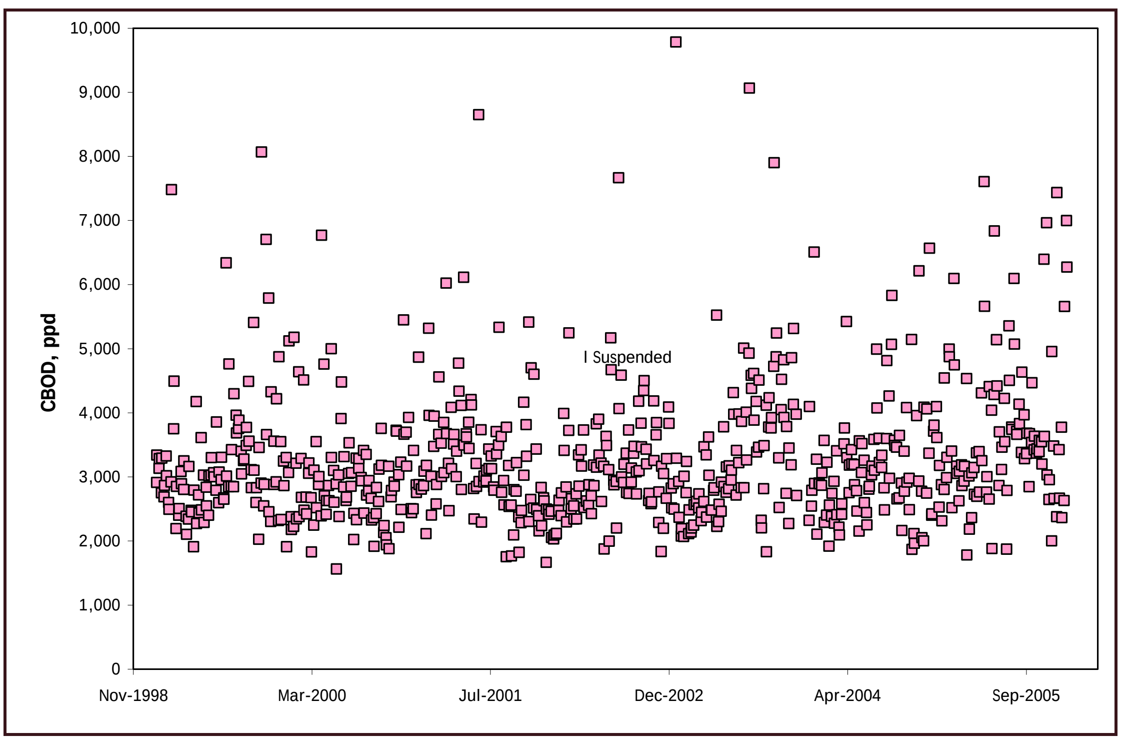


Figure 5-5. Daily Plant Loading: Total Suspended Solids (TSS)



Unit Loading Values

The development of unit loading values provides the basis for future loading projections. Analysis of loading levels and population allows for the calculation of the unit design values for the wastewater loads. The average unit loading value in pounds per capita per day (ppcd) can be applied to the population projections to estimate future sanitary loads. Table 5-5 presents the calculated unit design loads for BOD and TSS for WWTP No. 1 Service Area. These values are consistent with textbook average loading rates for communities with largely residential and commercial developments. Table 5-6 reports the estimated maximum and average BOD and TSS loads for the WWTP No. 1 Service Area.

Table 5-5. Current Unit Design Loads

Period	Population	Average BOD, ppd	Average TSS, ppd	BOD Unit Load, ppcd	TSS Unit Load, ppcd
2003 Wet Weather	10,600	2,100	3,500	0.21	0.34
2003 Dry Weather	10,600	2,500	3,900	0.24	0.38
Average	10,600	2,300	3,700	0.23	0.36

Table 5-6. Current Plant Influent Loading (1999-2005)

Description	BOD, ppd	Peaking Factor	TSS, ppd	Peaking Factor
Dry Weather				
Average	2,400	1.0	3,400	1.0
Max Month	3,500	1.5	4,700	1.4
Peak Day	5,400	2.3	9,100	2.7
Wet Weather				
Average	2,400	1.0	3,200	1.0
Max Month	3,300	1.4	4,200	1.3
Peak Day	7,400	3.1	9,800	3.1
Average				
Average	2,400	1.0	3,300	1.0
Max Month	3,500	1.5	4,700	1.4
Peak Day	6,400	2.7	9,500	2.9

Nutrients

Nutrients of primary concern at a wastewater treatment facility are nitrogen and phosphorus. Typically, the majority of the nitrogen in raw sewage is in the form of ammonia; concentrations range from 15 to 30 mg/L. Raw sewage phosphorus concentrations are usually between 4 and 8 mg/L, with the majority of the phosphorus in a soluble form, such as phosphate. Influent ammonia and phosphate are not regularly sampled at the Coos Bay WWTP No. 1. However, ammonia is measured at Coos Bay WWTP No. 2 and the values are typical for raw sewage.

FLOW AND LOAD PROJECTIONS

The flow and load projections are based on current flows and loads and anticipated community growth. As identified in Chapter 2, the population of Coos Bay is expected to be 18,301 by the year 2027. For the WWTP No. 1 service area, (comprised of a portion of Coos Bay and Bunker Hill), the current (2003) and future population (2027) is anticipated to be 10,216 and 11,913 persons, respectively.

To complete the projection analysis, the current flows, loads, and population were used to create unit design values. For example, based on the current ADWF of 1.6 mgd and the current service area population of 10,216, the unit ADWF value is approximately 157 gallons per capita per day. This unit flow is high compared to other cities in the Western Oregon and may be due to high infiltration flows. Similarly, based on the current average BOD loading of 2,300 pounds per day, the unit value is 0.22 pounds of BOD per capita per day. The unit design values were used in conjunction with projected future populations to estimate future flows and loads for the City.

Flow Projections

The sanitary flow generated in the WWTP No. 1 service area comes from a wide variety of collection system users. The average wastewater flows from these users are expected to grow at approximately the same rate as the overall population. Therefore, future sanitary flows are projected by applying the anticipated population growth rate to the current sanitary flows. Projection of ADWF, AWWF, MMDWF and MMWWF are made using this unit design value method.

Projection of the future peak wet weather flows requires additional consideration due to the variability of I/I rates among existing and future developments. Peak flows are estimated using current wet weather I/I rates for existing portions of the collection system while using lower rates in areas with new sewers. The current PWWF of 16.0 mgd is greatly influenced by the presence of collection system deficiencies in the older parts of town. Since improved construction materials and techniques in new portions of the collection system should exclude most I/I sources, the projections of future peak wet weather flow must account for lower wet weather I/I rates in new developments. Therefore, for the purposes of the PWWF projections, new developments are assigned a wet weather I/I rate of 3,000 gpad.

Similar to the PWWF, the PDF is sensitive to I/I rates in the collection system. To maintain consistency with the growth of the PWWF relative to the ADWF, the PDF is estimated by interpolating a linear relationship between the peak wet weather flow, average annual flow, and MMWWF on a logarithmic flow probability chart. Future flow rates are shown in Figure 5-6 and flow projections are summarized in Table 5-7.

Figure 5-6. Coos Bay WWTP No. 1 Future Peak Daily Flow

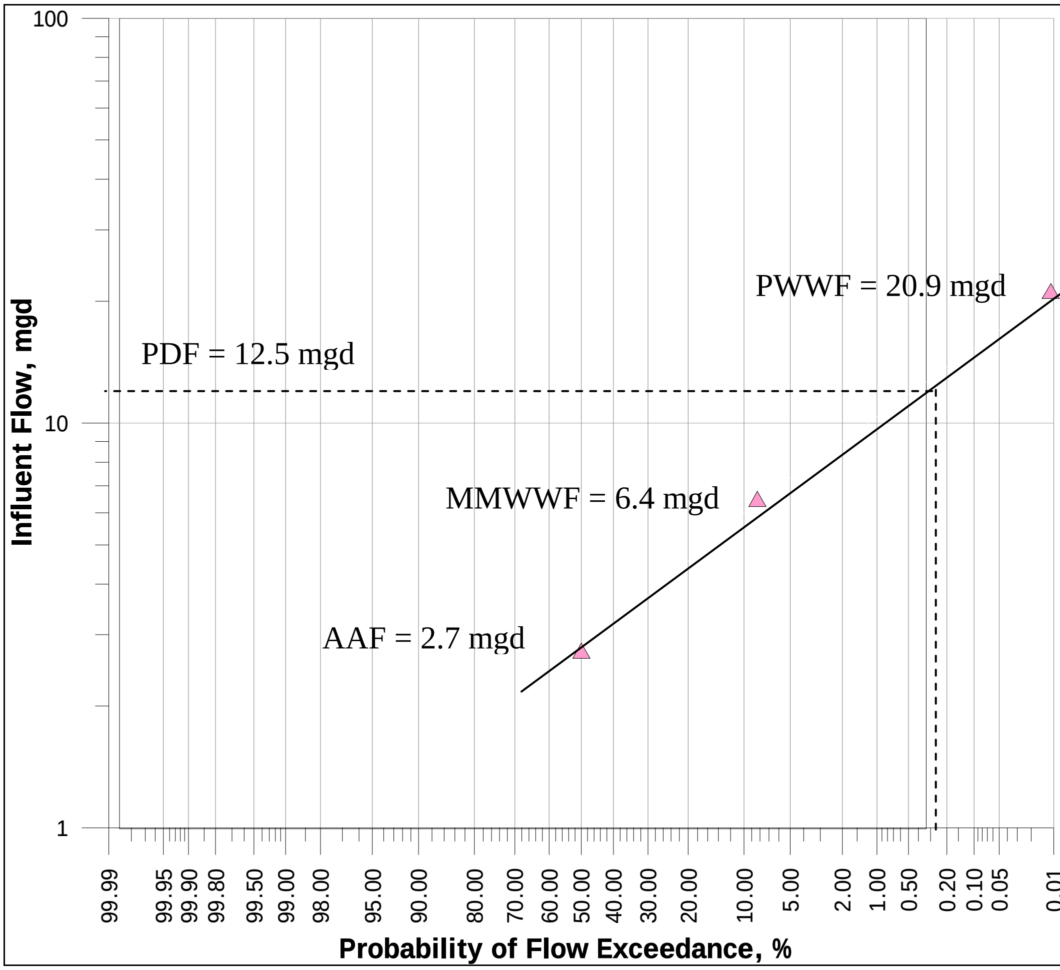


Table 5-7. Coos Bay WWTP No. 1 Design Flow Projection

Flow Parameter	Year 2027 Flow, mgd
Average Dry Weather Flow (ADWF)	1.8
Average Wet Weather Flow (AWWF)	3.5
Average Annual Flow (AAF)	2.7
Maximum Month Dry Weather Flow (MMDWF)	3.7
Maximum Month Wet Weather Flow (MMWWF)	6.4
Maximum Week Wet Weather Flow (MWWWF)	8.1
Peak Day Flow (PDF)	12.5
Peak Wet Weather Flow (PWWF)	20.9

Load Projections

Future plant loads, summarized in Table 5-8, are estimated by applying unit design factors from Tables 5-4 and 5-5 to the year 2027 population of 11,913.

Table 5-8. Projected Plant Influent Loads

Parameter	Year 2027 BOD, lbs/day	Year 2027 TSS, lbs/day
Annual Average	2,450	4,080
Maximum Month	3,570	5,810
Peak Day	6,530	11,750

WASTEWATER CHARACTERISTICS SUMMARY

Table 5-9 summarizes the flow and load projections developed in previous sections.

Table 5-9. Wastewater Characteristics Summary

Wastewater Characteristics Factor	2005	2027
Flows, mgd:		
Average Dry Weather Flow (ADWF)	1.6	1.8
Average Wet Weather Flow (AWWF)	3.1	3.5
Average Annual Flow (AAF)	2.3	2.7
Maximum Month Dry Weather Flow (MMDWF)	3.2	3.7
Maximum Month Wet Weather Flow (MMWWF)	5.6	6.4
Maximum Week Wet Weather Flow (MWWWF)	7.0	8.0
Peak Day Flow (PDF)	10.1	12.5
Peak Wet Weather Flow (PWWF)	16.0	20.9
Loads:		
BOD, ppd		
Average	2,400	2,450
Max month	3,500	3,570
Peak day	6,400	6,530
TSS, ppd		
Average	3,300	4,080
Max month	4,700	5,810
Peak day	9,500	11,750

CHAPTER 6. REGULATORY REQUIREMENTS

The City of Coos Bay recognizes the importance of protecting the water quality of Coos Bay. The estuary provides recreational opportunities for tourists and local residents, serves as wildlife habitat, and is an important fisheries and harbor resource. This chapter discusses the regulatory aspects of protecting water quality, examines the water quality standards for the Bay, and presents the anticipated wastewater treatment requirements.

REGULATORY FRAMEWORK

The regulatory environment surrounding water quality protection in Oregon is relatively complex, requiring interaction and cooperation between a number of federal, state, and local agencies. The first step in the process is to assign beneficial uses to the water body. This task is the responsibility of the Oregon Water Resources Department (OWRD). A water body's beneficial uses depend on characteristics such as its size and location. The following are the designated beneficial uses for the South Coast Basin. (Oregon Administrative Rules—OAR 340-041-0300)

- Industrial Water Supply
- Anadromous Fish Passage
- Salmonid Spawning and Rearing[a]
- Resident Fish and Aquatic Life
- Wildlife & Hunting
- Fishing
- Boating
- Water Contact Recreation
- Aesthetic Quality
- Commercial Navigation & Transportation

(a) This is a basin-wide use and does not apply to the Bay

It is the responsibility of the Oregon Department of Environmental Quality (DEQ) to establish and enforce water quality and waste treatment standards that ensure the Bay's beneficial uses are preserved. The DEQ's general policy is one of antidegradation of surface water quality. Discharges from wastewater treatment plants (WWTPs) are regulated through the National Pollutant Discharge Elimination System (NPDES). All discharges of treated wastewater to a receiving stream must comply with the conditions of an NPDES permit. The Environmental Protection Agency (EPA) oversees state regulatory agencies, and can intervene if the state agencies do not successfully protect water quality.

Local governments must operate their WWTPs so that they comply with all waste treatment standards and the requirements of the NPDES permit. If a WWTP is regularly out of compliance, the municipality typically enters into an agreement with DEQ to make improvements to the plant and ensure that standards are met. This agreement is known as a Mutual Agreement and Order (MAO).

This section summarizes the regulatory requirements pertinent to wastewater facilities planning for Coos Bay.

Oregon Administrative Rules for Wastewater Treatment

The state surface water quality and waste treatment standards for Coos Bay are detailed in the following sections of the Oregon Administrative Rules (OARs):

- OAR 340-041-0004 lists policies and guidelines applicable to all basins. DEQ's policy of antidegradation of surface waters is set forth in this section.
- OAR 340-041-0007 through 340-041-0036 describes the standards that are applicable to all basins.
- OAR 340-041-0300 through 340-041-0305 contain requirements that are specific to the South Coast basin including the minimum beneficial uses, water quality standards, and design criteria for waste treatment in the South Coast basin.

The surface water quality and waste treatment standards in the OARs are viewed as minimum requirements. Additional, more stringent limits developed though the TMDL process supersedes the basin standards.

Clean Water Act Section 303(d) List

DEQ issued the Section 303(d) list of water quality limited water bodies in January 2003. The list contains over 1,000 stream segments that are water quality limited for one or more parameters. Coos Bay has been designated water quality limited for bacteria in the vicinity of the two treatment plants.

Total Maximum Daily Loads

When receiving water is water quality limited, DEQ is required to establish TMDLs for the pollutant(s) that are causing the problem. Since the Coos Bay estuary is listed for bacteria, a bacteria management plan will be developed. For Treatment Plant No. 1, the NPDES permit will be the bacteria management plan and DEQ will likely reopen the permit once the bacteria management plan has been developed.

Groundwater Protection

OAR 340-040 details state standards for protection of groundwater quality. Paragraph 340-040-0030(3)(b) states that for new facilities, the groundwater pollutant concentration limits shall be at background levels for all contaminants. Historically, DEQ's interpretation of this standard has required that all earthen impoundments for wastewater or treated effluent—including sewage treatment lagoons, effluent holding ponds, and constructed wetlands—be lined with impervious material to prevent leakage into the underlying groundwater. This standard also precludes the discharge of treated effluent to groundwater unless all contaminants are first treated to background levels.

Reliability Criteria

EPA has established reliability criteria for wastewater treatment plant treatment processes. Plant No. 1 discharges to the Bay where recreation takes place including fishing and boating. This plant is required to meet Class II reliability criteria as outlined by EPA in their technical bulletin entitled "Design Criteria for Mechanical, Electrical, and Fluid System and Component Reliability". While some redundancy is required, the criteria are not as stringent as the criteria for Class I.

Effluent Reuse

Requirements for reuse of treated WWTP effluent for irrigation are listed in OAR 340-055. State reuse standards are designed to ensure that groundwater resources are protected. Therefore, reclaimed water must be applied at agronomic rates. This requirement applies to the constituents in the water as well as the application of the water itself. Four reclaimed water treatment levels are defined in the OARs. In general, as the level of treatment is increased, public access is less restrictive, the number of approved uses is expanded, and the required size of buffer areas is reduced. For example, Level I requires only biological treatment and no disinfection. However, public access must be prevented, buffer zones must be established, and the water can only be used to irrigate non-food crops. Conversely, Level IV reclaimed water requires the highest level of treatment, including coagulation and filtration, and can be used essentially without restriction.

Biosolids Treatment and Reuse

OAR 340-050 describes state standards for biosolids treatment and reuse. The state standards are based on the federal sludge regulations, which are contained in Part 503 of Chapter 40 of the Code of Federal Regulations (40 CFR 503). The Part 503 Sludge Regulations were developed by EPA during the early 1990s. Both DEQ and EPA encourage the beneficial reuse of biosolids on agricultural land as a soil amendment; therefore, the Part 503 Regulations focus on treatment and application requirements for reuse. Biosolids must be applied at agronomic rates.

Vector Attraction Reduction. The Part 503 Regulations list two categories of treatment requirements: vector attraction reduction and pathogen reduction. Vector attraction reduction requirements concentrate on reducing the volatile solids content of the sludge. The Part 503 Regulations list 10 options for meeting vector attraction requirements. Sludge must comply with vector attraction reduction requirements before it is applied on agricultural land.

Pathogen Reduction. With respect to pathogen reduction requirements, the Part 503 Regulations recognize two categories of biosolids: Class A and Class B. Class A biosolids has low levels of pathogenic bacteria and is considered safe for public use. In addition to complying with bacteria population limits, Class A biosolids must treated through one of several specific methods, known as Processes to Further Reduce Pathogens (PFRPs). These include high pH treatment, high temperature treatment, composting, heat drying, irradiation, and pasteurization. The treatment requirements for Class B biosolids are less stringent than those for Class A. However, unlike Class A biosolids, Class B biosolids cannot be given directly to the public. In addition, public access to agricultural sites is restricted for at least 30 days after application of Class B biosolids. A number of methods are available for creating a Class B biosolids; these are known as Processes to Significantly Reduce Pathogens (PSRPs).

Producing a Class A biosolids expands a City's reuse options. However, the additional flexibility of a Class A biosolids must be weighed against the added cost. Treatment processes for creating Class A biosolids are more expensive, complex, and labor intensive than processes for Class B biosolids.

Metals. The metals concentration of biosolids applied to agricultural land is also a concern. Two types of metals concentration limits are of interest: Ceiling Concentration Limits and Pollutant Concentration Limits. Ceiling Concentration Limits are the maximum allowable metals concentrations that the biosolids can contain. If these limits are exceeded, the biosolids cannot be land applied.

Pollutant Concentration Limits are lower than Ceiling Concentration Limits. If a plant's biosolids comply with Pollutant Concentration Limits, application can take place without concern over cumulative metals loadings. If the metals content of the biosolids exceeds Pollutant Concentration Limits but complies with Ceiling Concentration Limits, agricultural reuse is allowed, but application of metals must be tracked to ensure that the total metals load does not exceed the cumulative capacity of the site. Generally, unless the wastewater system receives a significant industrial contribution, metals concentrations usually fall within Pollutant Concentration Limits.

Classification of Sludge. Sludge is categorized depending on degree of pathogen reduction and metals content. The four types of sludge in descending level of quality are:

- Exceptional Quality. Exceptional Quality sludge is the highest quality biosolids, meeting both the Class A pathogen reduction requirements and the Pollutant Concentration Limits for metals.
- Pollutant Concentration. Pollutant Concentration sludge complies with the stringent Pollutant Concentration Limits for metals, but is only treated to Class B pathogen reduction standards.
- Annual Pollutant Loading Rate. This sludge is treated to Class A pathogen reduction standards, but does not comply with Pollutant Concentration Limits for metals. It does, however, comply with metals Ceiling Concentration Limits.
- Cumulative Pollutant Loading Rate. The lowest quality sludge that can be applied to agricultural land, Cumulative Pollutant Loading Rate sludge meets Class B pathogen reduction requirements. Metals concentrations fall between Pollutant Concentration

Limits and Ceiling Concentration Limits; therefore, site cumulative metals loading must be tracked.

To qualify for any of the sludge categories described above, the biosolids must also comply with vector attraction reduction requirements.

WATER QUALITY

This section discusses water quality issues applicable to Coos Bay.

Temperature

High water temperatures adversely affect salmonid fish, such as trout and salmon, as well as other cold-water aquatic species. Temperatures in the mid-to-high 70 degree F range can be lethal to adult salmonids. Temperatures in the mid 60 degree F to low 70 degree F range cause physiological stress which, when combined with other survival pressures, can increase mortality. Table 6-1 summarizes temperature limits for Spring Chinook and Coho salmon.

Temperature is also important because it controls the solubility of dissolved oxygen (DO) in water. As temperature increases, the DO saturation concentration decreases and it becomes more difficult to maintain adequate DO levels.

Table 6-1. Temperature Preference for Spring Chinook and Coho Salmon

Life-stage	Spring Chinook	Coho
Egg incubation	42.1°F to 55.0°F	39.9°F to 55.9°F
Juvenile rearing	50.0°F to 58.6°F	53.2°F to 58.3°F
Adult migration	37.9°F to 55.9°F	45.0°F to 60.1°F
Spawning	42.1°F to 55.0°F	39.9°F to 48.9°F
Upper lethal limit	71.6°F	77.0°F

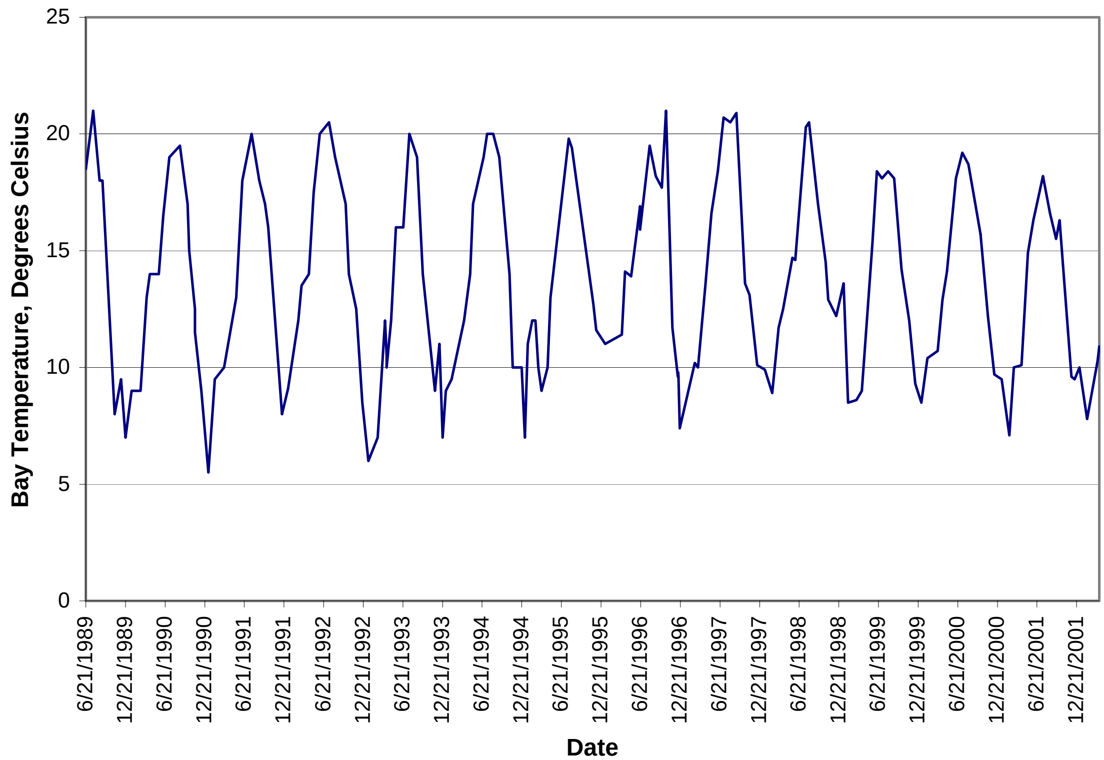
Source: DEQ, 1995

OAR 340-041-0028 establishes the temperature standards that apply to Coos Bay:

> *(7) Oceans and Bays: Except for the Columbia River above mile 7, ocean and bay waters many not be warmed by more than 0.3 degrees Celsius (0.5 degrees Fahrenheit) above the ambient condition unless a greater increase would not reasonably be expected to adversely affect fish or other aquatic life.*

Temperatures in the Bay near the Plant No. 1 outfall are shown in Figure 6-1. Temperatures range in value between a minimum of 6 degrees Celsius (42.8 degrees F) and a maximum of 21 degrees Celsius (69.8 degrees F). At Plant No. 1, the available mixing at the edge of the Regulatory Mixing Zone (RMZ) is 60:1. Winter effluent temperatures are about 14 degrees Celsius (57.2 degrees F), which results in a temperature impact at the edge of the mixing zone that is well within the standard. Summer temperature differentials between the effluent and the Bay are similar and will not cause the standard to be exceeded.

Figure 6-1. Coos Bay Water Temperature at the Coast Guard Dock



Dissolved Oxygen

DO is necessary to support aquatic life. Salmonid fish are very sensitive to low DO levels, particularly during the early stages of development. The numeric DO standards consider two factors: whether salmonid fish are present and, if present, whether the fish are in the critical spawning, egg development, and fry emergence stages. The DO standard for the estuary stipulates that the concentration shall not be below 6.5 milligrams per liter (mg/L).

pH

The pH standard for the Coos Bay estuary states that pH must be maintained between 6.5 and 8.5 (OAR 340-041-0305 (1)(a). The permitted discharge pH ranges between 6.0 and 9.0. With the available mixing, no pH excursions will occur as a result of the Plant No. 1 discharge.

Bacteria

The Bay at the Plant No. 1 discharge area is not a designated as shellfish growing waters and the following bacteria standard is applicable for the Bay:

(A) A 30-day log mean of 126 E. coli organisms per 100 milliliters, based on a minimum of five samples:

(B) No single sample may exceed 406 E. coli organisms per 100 milliliters.

Since the Bay is listed for exceeding the fecal coliform requirements for the shellfish growing areas, DEQ established a fecal limit in the permit with the stipulation that the permit will be re-opened once the bacteria allocations have been completed as part of the TMDL process.

Toxic Substances

OAR 340-041-0033 regulates the discharge of toxic substances to Coos Bay. DEQ has adopted the toxicity limits set forth in EPA's *Quality Criteria for Water* (1986). This document lists toxicity limits for over 120 substances. *Quality Criteria for Water* lists standards for both acute toxicity and chronic toxicity. Acute toxicity limits are the values that cannot be exceeded for more than 1 hour every 3 years. Chronic toxicity limits represent the maximum 4-day-average value that cannot be exceeded more than once every 3 years.

OAR 340-041-0053 allows DEQ to designate an RMZ to allow for dilution of WWTP effluent with the Bay. The area within the RMZ must comply with all acute toxicity limits; however, chronic toxicity standards may be exceeded. The area outside of the RMZ must comply with chronic toxicity standards. DEQ may also designate a zone of immediate dilution (ZID) within which acute toxicity limits may be exceeded. If assigned, ZIDs are typically 10 percent of the size of the RMZ. DEQ has established an RMZ based on a 100-foot radius around the discharge and a ZID with a 10-foot radius. The respective mixing for these zones is 60:1 and 5:1.

DEQ conducted a reasonable potential analysis for heavy metals as part of the permit renewal process. No metals show a reasonable potential for exceeding water quality criteria.

Chlorine Toxicity. For marine discharges, the chronic and acute toxicity limits are 0.0075 mg/L and 0.013 mg/L respectively. Since adequate disinfection cannot be accomplished with these levels of chlorine residual, DEQ has required dechlorination equipment to be installed at the plant to ensure compliance with these limits.

Ammonia Toxicity. Ammonia toxicity is affected by the temperature and pH of the water. DEQ completed a reasonable potential analysis for ammonia and determined that no reasonable potential exists for exceeding the ammonia standard in the Bay for Plant No. 1.

Other Parameters

A number of other water quality standards which are not considered to be problematic in the Coos Bay Estuary are detailed in OAR 340-041-0007. However, these parameters must be considered to ensure continued compliance:

- Turbidity. The maximum allowable cumulative increase in turbidity is 10 percent.
- Liberation of dissolved gases. The liberation of dissolved gases which cause objectionable odors or are harmful to aquatic life or recreational opportunities is not allowed.
- Objectionable tastes and odors. The creation of objectionable tastes and odors which adversely affect the potability of drinking water or the palatability of fish is not allowed.
- Bottom deposits. The formation of appreciable bottom deposits is not permitted.
- Objectionable water surface conditions. The creation of objectionable discoloration, a scum layer, floating material, or an oily sleek is not allowed.
- Aesthetic conditions. The creation of objectionable aesthetic conditions is not allowed.
- Radioisotopes. Radioisotope concentrations shall not exceed maximum acceptable values.
- Dissolved gas concentrations. The concentration of dissolved gases shall not exceed 110 percent of saturation level.

TREATMENT REQUIREMENTS

DEQ has the responsibility to establish wastewater treatment requirements which ensure the protection of the Bay's beneficial uses and compliance with all in-stream water quality standards. This section discusses the Plant No. 1 discharge requirements.

Current Discharge Permit

Plant No. 1's NPDES permit was issued on August 21, 2003, and was modified on December 15, 2004. The permit is provided as Appendix A and discharge limits are summarized in Table 6-2.

Table 6-2. Existing Discharge Permit

Parameter	Average Effluent Concentrations Monthly, mg/L	Average Effluent Concentrations Weekly, mg/L	Monthly average, ppd	Weekly average, ppd	Daily maximum, ppd
<u>May 1 - October 31:</u>					
BOD - 5	20	30	480	730	970
TSS	20	30	480	730	970
<u>November 1 - April 30:</u>					
BOD - 5	30	45	730	1100	1500
TSS	30	45	730	1100	1500
<u>Other parameters:</u>					
Fecal Coliform Bacteria	Shall not exceed a monthly mean of 126 organisms per 100 mL. No single sample shall exceed 406 organisms per 100 mL.				
pH	6.0 - 9.0				
BOD and TSS Removal Efficiency	Shall not be less than 85%				
Total Residual Chlorine	0.03 mg/l monthly 0.06 mg/l daily				
Excess Thermal Load (May 1 – October 31)	57 Million kcals/day as a weekly average				

The loads shown are based on an average dry weather flow of 2.9 mgd. Once the City of Coos Bay has acquired and accepted legal authority to implement the provisions of OAR 340-041-0120(9)(a)(G)(iv), the mass limits during the wet season will be increased for both BOD-5 and TSS. The wet weather monthly, weekly, and daily limits will be 900, 1400, and 1800 pounds per day respectively. These are based on an average wet weather design flow of 3.6 mgd. Daily mass load limits will be suspended when the flows to the plant exceed 5.8 mgd.

Upon approval of an engineering study that demonstrates that flows are not excessive, the removal efficiency will be modified. Once modified, the following removal efficiencies will be required when monthly average flows are 4.26 mgd or more:

(a) 71-percent monthly average for BOD-5

(b) 76-percent monthly average for TSS

Anticipated Discharge Permit

Because the NPDES permit has recently been revised to reflect current water quality issues, no major changes in discharge requirements are anticipated. The projected flow for the plant is within the current design capacity so no restrictions related to dry weather mass loads are anticipated.

The only pending TMDL for the Bay is for bacteria. Once the load allocations are completed for the Bay, it is anticipated that the DEQ will establish a bacteria load for Plant No. 1 that will not likely be more restrictive than the existing permit.

DEQ has initiated studies in anticipation of a modified turbidity standard. While the final promulgation of the standard is not expected for several years, it is believed that the new standard will be less restrictive than the current standard. It is not anticipated that additional treatment will be mandated to meet the new turbidity standard. Most of the current work has focused on streams and the impact on estuaries is not well defined at this time.

CHAPTER 7. LIQUID STREAM TREATMENT ALTERNATIVES

The liquid stream treatment facilities at Coos Bay Wastewater Treatment Plant (WWTP) No. 1 are generally able to satisfy the requirements set forth in its National Pollutant Discharge Elimination System (NPDES) permit. However, upgrades are necessary to provide facilities that can reliably treat increased flows and loads from Coos Bay's growing population. The planning and implementation of these improvements will ensure that Coos Bay WWTP No. 1 will continue to satisfy its permit requirements in the years to come.

The wastewater characteristics analysis presented in Chapter 5 provides the flow and load projections used during the development of the following liquid stream treatment alternatives. Based on the flow and load projections and the capacity of the facilities, the plant capacity needs to be expanded to treat the projected peak wet weather flow. While the existing facilities have adequate capacity for the peak day flow, there are short term periods when the incoming flows exceed the treatment capacity of the plant.

CATEGORIES OF IMPROVEMENTS

Three factors were used to guide the planning for the upgrade of the liquid stream treatment processes:

- Improve plant reliability by providing multiple process units where applicable.
- Optimize utilization of existing facilities to the extent possible to reduce costs.
- Optimize utilization of available space.

The following sections analyze alternatives for potential improvements by grouping facilities into one of two categories:

- Headworks: Headworks consist of screening and grit removal.
- Treatment: Treatment consists of primary sedimentation, biological treatment, secondary clarification and disinfection.

ANALYSIS OF LIQUID STREAM IMPROVEMENTS

Improvements to liquid stream treatment processes are examined in this section.

Improvements Common to All Alternatives

The following recommendations are common to all liquid stream alternatives:

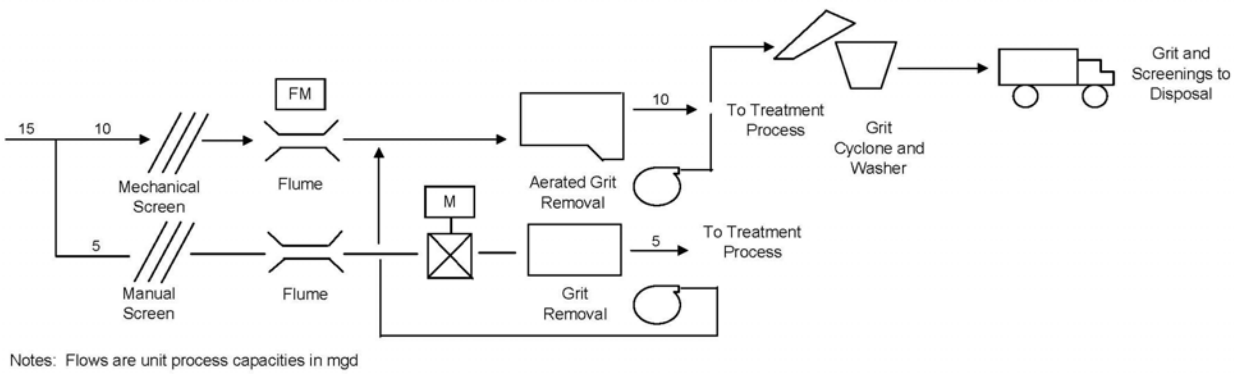
- New transducers on influent flumes.
- Replace existing mechanical bar screen.

- Remove existing manual bar screen and install new mechanical screen.
- Site piping improvements.
- Electrical and SCADA/process control improvements. The power distribution system would be upgraded as required to serve new equipment. Control system improvements would focus on reducing labor and energy costs.

Headworks and Grit Removal

The existing headworks are shown schematically in Figure 7-1.

Figure 7-1. Existing Plant No. 1 Headworks



The existing mechanical screen and manual bar rack are not sized to accommodate the design year peak flow of 20 mgd. The operators report severe rusting on the mechanical bar screen. Due to inadequate capacity and poor performance, this unit should be replaced. The manual bar screen should be replaced with a mechanical bar screen to provide at least 20 mgd screening capacity. New screens should have no more than a 3/8-inch bar spacing to improve performance.

The transducer on the main flume is in need of repair. The transducer on the bypass flume is not functional. Both transducers should be replaced.

The existing aerated grit chamber has a design capacity of 10 mgd. The original grit removal basin downstream from the manual screen performs poorly and is only used for peak flows. In fact, grit from the original chamber is recycled to the aerated grit chamber for subsequent removal. Due to the sand content of the influent flow, grit removal should be provided for all flow into the plant. Two alternatives were evaluated:

> **Grit Removal Alternative G1.** Construct a second aerated grit chamber.
>
> **Grit Removal Alternative G2.** Continue with one aerated grit chamber for 10 mgd flow and treat remainder of flow by degritting primary sludge.

Grit Removal Alternative G1. Alternative G1 consists of continuing to use the existing aerated grit chamber to its 10 mgd capacity and adding a second aerated grit chamber with a capacity of 10 mgd. The second chamber would be built adjacent to the existing grit chamber. A new grit pump is recommended so the operators can run the grit pumps continuously during the first storm flushes when the grit load is heavy. The air requirement for the additional grit chamber is small and the existing blowers have adequate capacity to supply air to the second tank.

Figure 7-2. Grit Removal Alternative G1

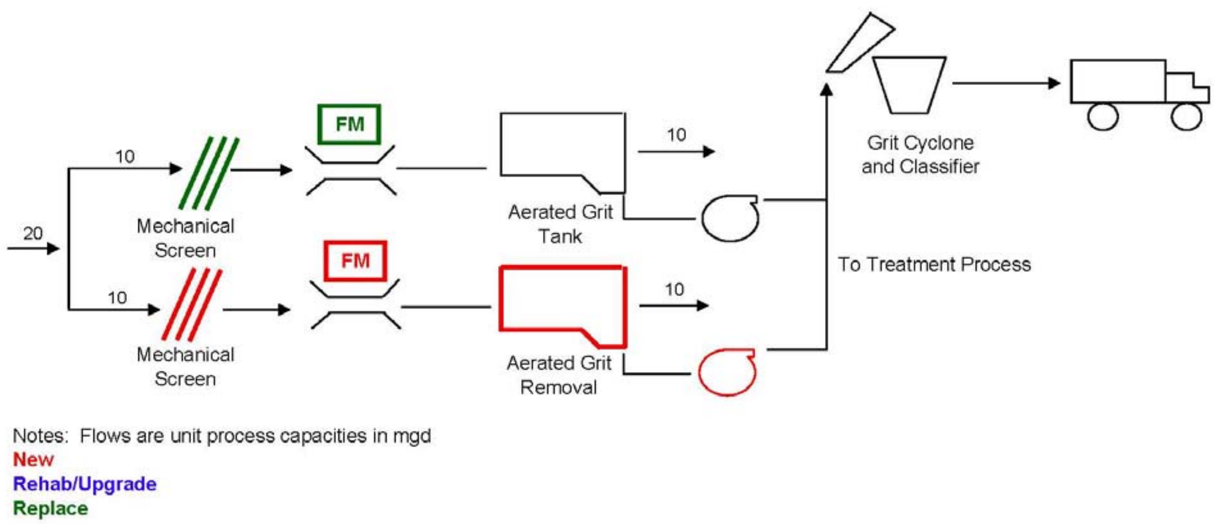


Table 7-1 shows exiting and future design data for grit removal facilities for Alternative G1.

Table 7-1. Alternative G1 Design Data

Description	Existing Value	New Value
INFLUENT FLOW MEASUREMENT		
Parshall Flume		
Number	2	2
Size, inches	18	18
Number of Flow Transmitters	1	2
Old Headworks		
Existing Grit Chamber		
Number	1	-
Capacity, mgd	5	-
Grit Transfer Pump		

Description	Existing Value	New Value
Number	1	-
Type	Centrifugal	-
Capacity, gpm	270	-
1990 Headworks		
Mechanical Bar Screen		
Number	1	2
Type	Front Cleaned Climber	TBD
Bar Spacing, in.	0.75	3/8
Manual Bar Screen		
Number	1	-
Bar Spacing, in	1.5	-
Screenings Compactor		
Number	1	1
Capacity, cubic feet/hour	34	34
Upper Screw, HP	1	3
Lower Screw, HP	3	1
Aerated Grit Tank		
Number	1	2
Capacity, each, mgd	10	10
Grit Pumps		
Number	2	4
Capacity, each, gpm	270	270
Grit Cyclone		
Number	1	2
Capacity, each, gpm	270	270
Grit Washer		
Number	1	1
Capacity, gpm	30	30

Grit Removal Alternative G2. Alternative G2 consists of continuing to use the existing aerated grit chamber for flow up to 10 mgd. When influent flow exceeds 10 mgd, the aerated grit chamber would continue to operate to its capacity. The remaining flow would pass directly to the rectangular primary sedimentation basin. Dilute primary sludge will be pumped from the sedimentation basin and degritted in a cyclone/classifier. A new cyclone and classifier will be provided for the sludge degritting. A pump is included to transfer degritted sludge to thickening.

This alternative includes construction of a new channel to bypass flow around the aerated grit chamber directly to the rectangular sedimentation basin and installation of a gate in the existing channel between the aerated grit basin and the primary sedimentation basin. A schematic of this alternative is shown in Figure 7-3.

Figure 7-3. Grit Removal Alternative G2

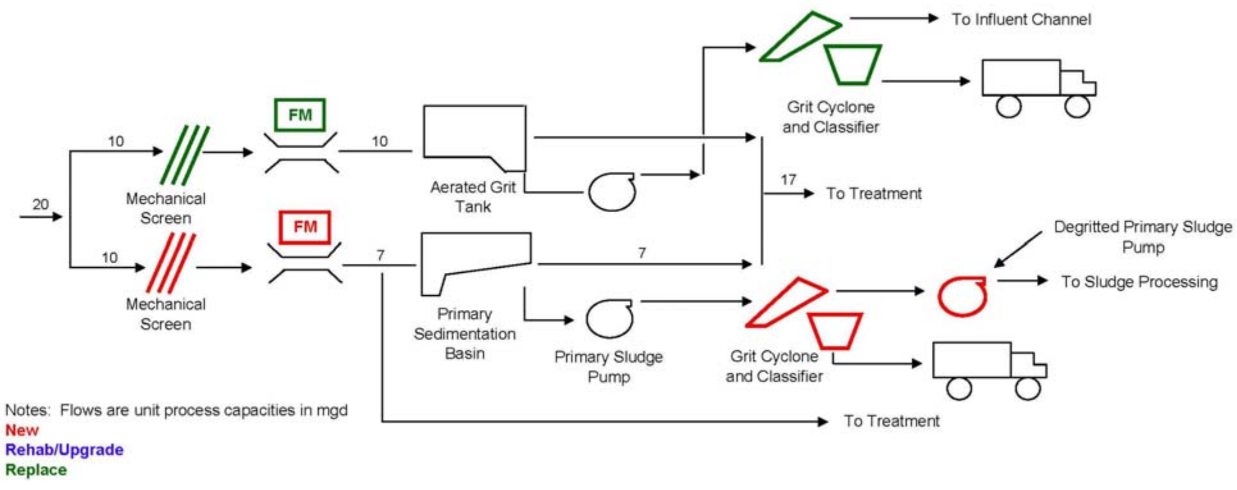


Table 7-2 shows existing and future design data for grit removal facilities for Alternative G2.

Table 7-2. Alternative G2 Design Data

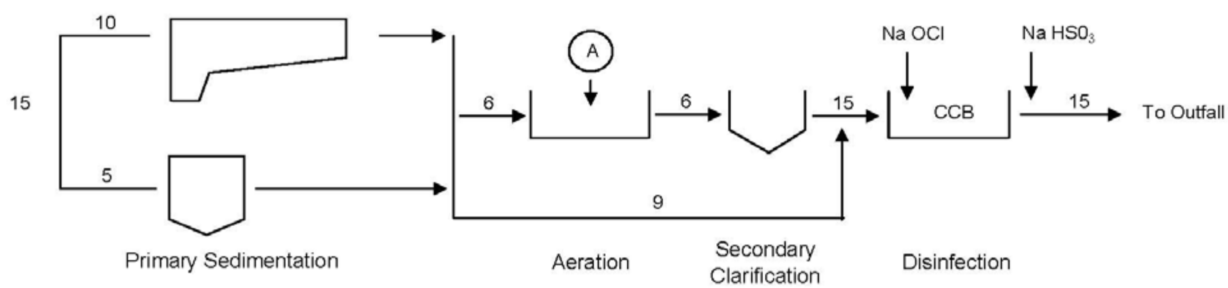
Description	Existing Value	New Value
INFLUENT FLOW MEASUREMENT		
Parshall Flume		
Number	2	2
Size, inches	18	18
Number of Flow Transmitters	1	2
PRELIMINARY TREATMENT		
Old Headworks		
Existing Grit Chamber		
Number	1	-
Capacity, mgd	5	-
Grit Transfer Pump		
Number	1	-
Type	Centrifugal	-
Capacity, gpm	270	-
New Headworks		
Mechanical Bar Screen		
Number	1	2
Type	Front Cleaned Climber	TBD
Bar Spacing, in.	0.75	3/8
Manual Bar Screen		
Number	1	-
Bar Spacing, in	1.5	-
Screenings Compactor		
Number	1	1
Capacity, cubic feet/hour	34	34
Upper Screw, HP	1	1
Lower Screw, HP	3	1
Aerated Grit Tank		
Number	1	1
Capacity, each, mgd	10	10
Grit Pumps		

Description	Existing Value	New Value
Number	2	2
Capacity, each, gpm	270	270
Degritted Primary Sludge Pump		
Number	-	1
Capacity, each gpm	-	270
Grit Cyclone		
Number	1	2
Capacity, gpm	270	270
Grit Washer		
Number	1	2
Capacity, gpm	30	30

Treatment

The existing treatment process is shown schematically in Figure 7-4.

Figure 7-4. Existing WWTP No. 1 Treatment Process



Notes: Flows are unit process capacities in mgd

Primary Sedimentation

Under the current operational scenario, flow up to 2.5 mgd is treated in the older circular primary sedimentation basin. When flow is between 2.5 and 10 mgd, the rectangular sedimentation basin is used and when flow exceeds 10 mgd, 10 mgd is treated in the rectangular basin and the circular basin treats 5 mgd. The primary effluent from the circular basin flows via gravity to secondary treatment. Primary sludge is thickened in the sedimentation basins.

While the design criteria for the plant indicates treatment capacities of 10 mgd for the rectangular basin, plant data shows that the performance of the basin is considerably below that mark as shown in Figures 7-5 and 7-6.

Figure 7-5. Primary Sedimentation Basin BOD Removal Performance

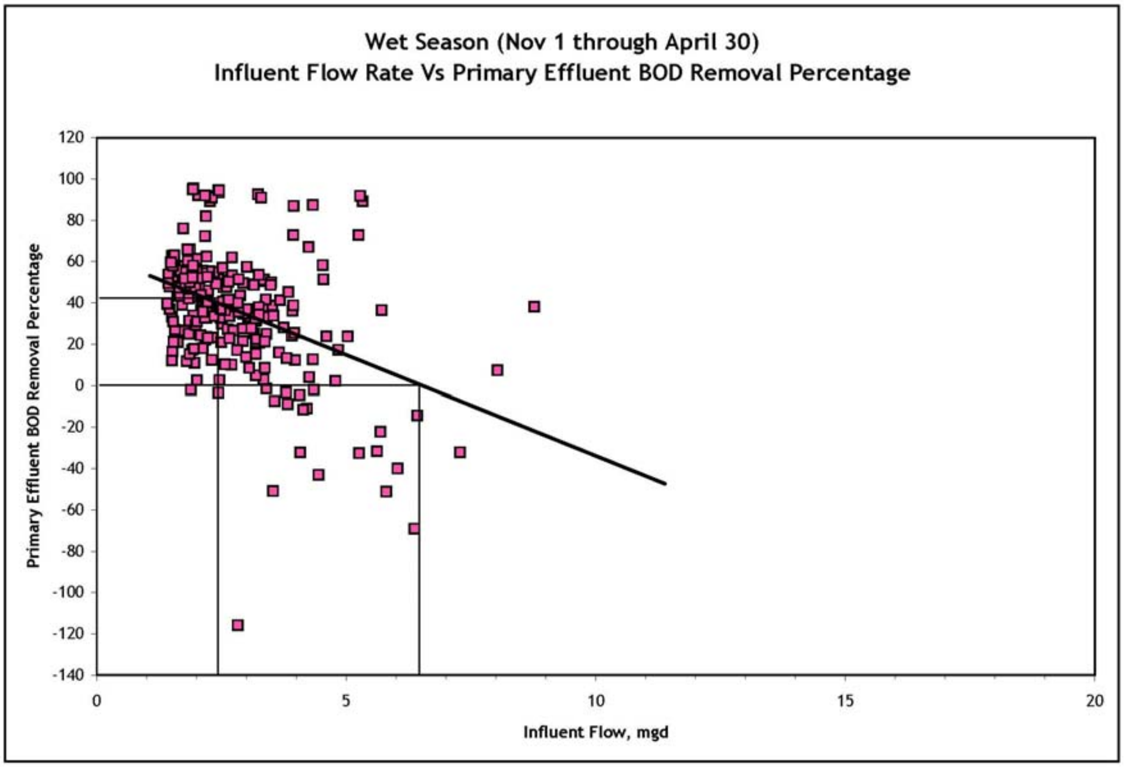
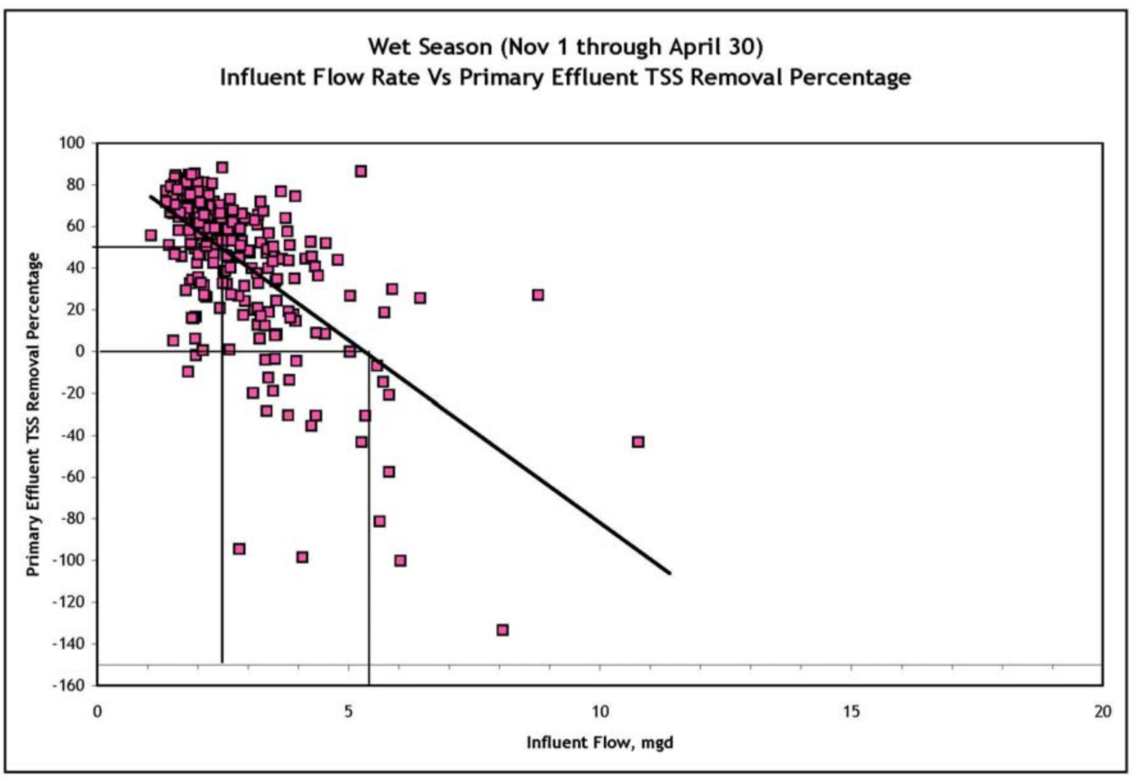


Figure 7-6. Primary Sedimentation Basin TSS Removal Performance



The basin essentially provides no removal beyond 6 mgd. This flow corresponds to an overflow rate of 1920 gpd/sf, well below the basin design overflow rate of 3200 gpd/sf. The basin has adequate influent flow baffling but is shallow with a depth of only 8 feet at its shallowest point. To improve basin performance, it is recommended that dilute primary sludge be removed from the basin and thickened outside. This will lower the sludge blanket and improve performance. For the treatment process alternatives, it is assumed that primary sludge will be thickened in the existing circular primary sedimentation basin.

Two treatment process alternatives were evaluated:

Treatment Process Alternative T1. Blended Treatment

Treatment Process Alternative T2. Full primary and secondary treatment for all flow.

Treatment Process Alternative T1. Treatment Alternative T1 is shown in Figure 7-7. This treatment alternative does not increase the primary sedimentation capacity. A secondary clarifier is added for redundancy and expanded secondary treatment capacity.

All flow up to 6 mgd will receive full primary and secondary treatment. When flow exceeds 6 but is less than 13 mgd, 6 mgd will receive full primary and secondary treatment and disinfection. Flow in excess of 6 mgd will bypass primary treatment and all flow will receive secondary treatment. When flow exceeds 13 mgd, flow up to 13 mgd will be treated as described. Flow in excess of 13 mgd will receive disinfection.

All flow up to 7 mgd will receive full primary and secondary treatment. When flow exceeds 7 but is less than 13 mgd, 7 mgd will receive full primary and secondary treatment and disinfection. Flow in excess of 7 mgd will bypass primary treatment and receive secondary treatment. When flow exceeds 13 mgd, 7 mgd will receive primary treatment. Flow up to 13 mgd will receive secondary treatment including a portion of the 7 mgd from primary treatment. When flow reaches 20 mgd, 7 mgd will receive primary treatment and disinfection and 13 mgd will receive secondary treatment.

Figure 7-7. Alternative T-1 Process Flow Diagrams

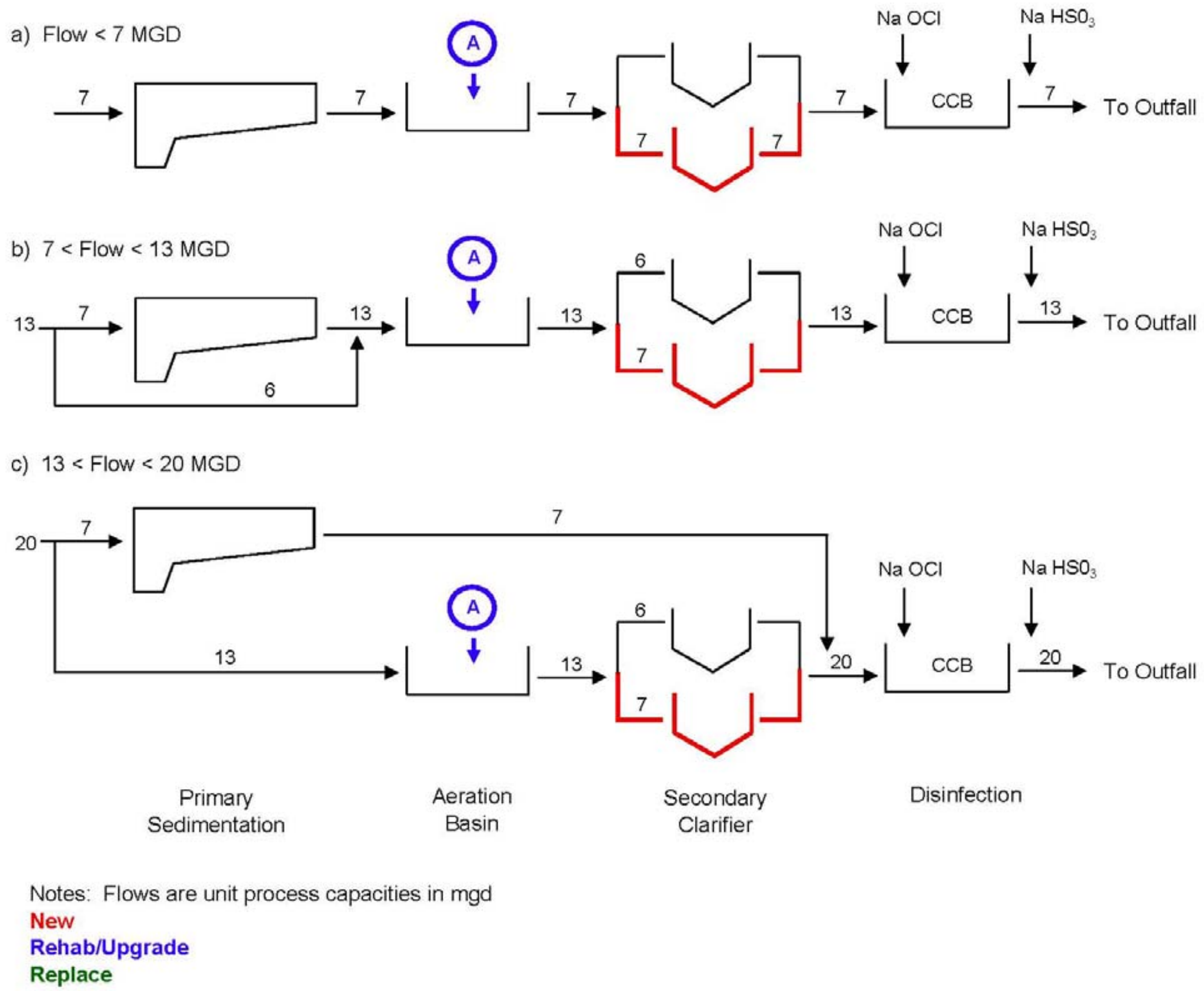


Table 7-3 shows existing and future design data for treatment facilities for Alternative T1.

Table 7-3. Alternative T1 Design Data

Description	Existing Value	New Value
PRIMARY TREATMENT		
Primary Sedimentation		
Circular Primary Sedimentation Basin		
Number	1	-
Diameter, ft	54	-
Overflow rate, PWWF, gpd/sf		
PWWF	2,180	-
Rectangular Primary Sedimentation Basin		

Description	Existing Value	New Value
Number	1	1
Width, ft	21.5	21.5
Length, ft	145	145
Overflow rate, gpd/sf		
PWWF	3,200	2,200[(a)]
SECONDARY TREATMENT		
Aeration Basins		
Number	2	2
Width, ft	34	34
Length, ft	96	96
Sidewater Depth, ft	15.5	15.5
Total Volume, gal	756,000	756,000
MLSS, mg/l	2,000	2,000
Hydraulic Detention Time, hours		
ADWF	11.3	10.7
MMWWF	3.3	3.1
Diffuser Type	Fine Bubble Tubes	Fine Bubble Tubes
Blowers		
Number	3	4
Type	Centrifugal	Centrifugal
Capacity, each, scfm	1,200	1,200
Pressure, psi	8.0	8.0
Secondary Clarifiers		
Existing Clarifier		
Diameter, ft	80	80
Sidewater Depth, ft	16	16
Overflow Rate, gpd/sf		
Peak Flow to Secondary Treatment	1200	1200
New Clarifier		
Diameter, ft	-	90
Sidewater Depth, ft	-	18
Overflow Rate, gpd/sf		
Peak Flow to Secondary Treatment	-	1200
RAS pumps		

Description	Existing Value	New Value
Number	2	3
Type	Centrifugal	Centrifugal
Capacity, each, gpm	1,500	1,500
WAS Pump		
Number	1	2
Type	Centrifugal	Centrifugal
Capacity, each, gpm	360	360
Secondary Scum and Tank Drain Pump		
Number	1	1
Capacity, each, gpm	340	340

a. At peak flow to process, 7 mgd.

Treatment Process Alternative T2. Treatment Alternative T2 would provide full primary and secondary treatment for the design peak flow of 20 mgd. As shown in Figure 7-8, screened, degritted raw sewage would flow to primary sedimentation. A second primary sedimentation basin would be constructed. Aeration basin volume would not be increased; however a blower would be added. A new secondary clarifier would be constructed.

Figure 7-8. Treatment Process Alternative T2

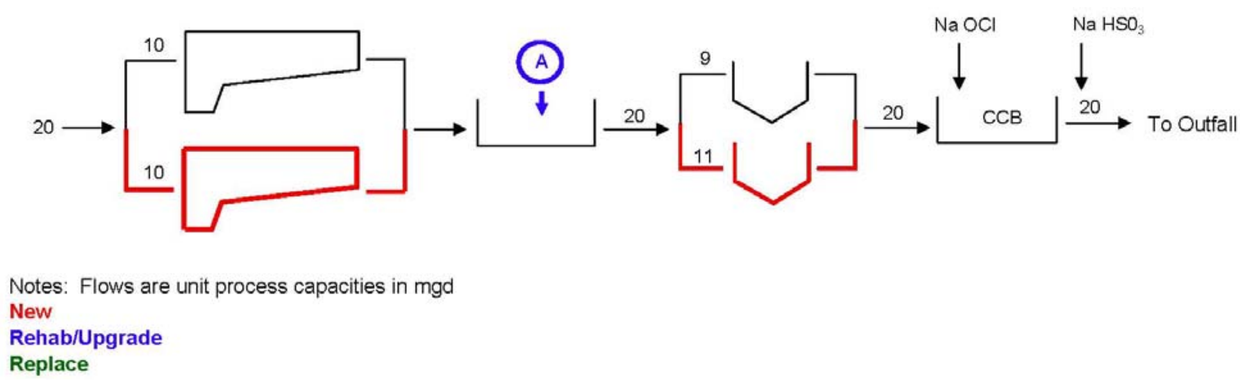


Table 7-4 shows existing and future design data for treatment facilities for Alternative T2.

Table 7-4. Alternative T2 Design Data

Description	Existing Value	New Value
PRIMARY TREATMENT		
Primary Sedimentation		
Circular Primary Sedimentation Basin		
Number	1	-
Diameter, ft	54	-
Overflow rate, PWWF, gpd/sf		
PWWF	2,180	-
Rectangular Primary Sedimentation Basin		
Number	1	2
Width, ft	21.5	21.5
Length, ft	145	145
Overflow rate, gpd/sf		
PWWF	3,200	3,200
SECONDARY TREATMENT		
Aeration Basins		
Number	2	2
Width, ft	34	34
Length, ft	96	96
Sidewater Depth, ft	15.5	15.5
Total Volume, gal	756,000	756,000
MLSS, mg/l	2,000	2,000
Hydraulic Detention Time, hours		
ADWF	11.3	10.7
MMWWF	3.3	3.1
Diffuser Type	Fine Bubble Tubes	Fine Bubble Tubes
Blowers		
Number	3	4
Type	Centrifugal	Centrifugal
Capacity, each, scfm	1,200	1,200
Pressure, psi	8.0	8.0
Secondary Clarifier		

Description	Existing Value	New Value
Existing Clarifier		
Diameter, ft	80	80
Sidewater Depth, ft	16	16
Overflow Rate, gpd/sf		
PDF	1200	1200
PWWF	1800	1800
New Clarifier		
Diameter, ft	-	90
Sidewater Depth, ft	-	18
Overflow Rate, gpd/sf		
PDF	-	1200
PWWF	-	1800
RAS pumps		
Number	2	3
Type	Centrifugal	Centrifugal
Capacity, each, gpm	1,500	1,500
WAS Pump		
Number	1	2
Type	Centrifugal	Centrifugal
Capacity, each, gpm	360	360
Secondary Scum and Tank Drain Pump		
Number	1	1
Capacity, each, gpm	340	340

DISINFECTION

The chlorine contact basin will provide nearly 27 minutes of detention at future peak wet weather flow. Under the current bacterial standard, this detention time is adequate. Baffling modifications to increase the length-to-width ratio of the channels in the basin will improve performance.

Table 7-5. Chlorination and Dechlorination Basic Design Data

Description	Existing Value	New Value
CHLORINATION AND DECHLORINATION		
Chlorination Facilities		
Type	Sodium Hypochlorite	Sodium Hypochlorite
Contact Tank		
Number	1	1
Total volume, gal	370,000	370,000
Hydraulic detention time, minutes		
ADWF	333	313
PWWF	36	27
Sodium Hypochlorite Storage Tanks		
Number	2	2
Total Storage Volume, gal	3,600	3,600
Feed pumps		
Number	3	3
Type	Diaphragm	Diaphragm
Capacity, each, gph	20	20
Dechlorination Facilities		
Type	Sodium bisulfite	Sodium bisulfite
Sodium Bisulfite Storage Tanks		
Number	2	2
Total Storage Volume, gal	3,000	3,000
Feed Pumps		
Number	2	2
Type	Diaphragm	Diaphragm
Capacity, each gph	12.7	12.7
Mixer		
Number	1	1
Type	Vertical	Vertical
Motor, hp	5	5

OUTFALL

The existing 42-inch outfall is currently being replaced due to its deteriorating condition. The cost for replacement of the outfall with a 48-inch pipe slightly north of its current location is included in Table 7-7.

COMPARISON OF ALTERNATIVES

Tables 7-6 and 7-7 present the capital costs for Alternatives G1 and G2, and T1 and T2, respectively. A complete present worth comparison between alternatives will be presented in Chapter 10, Recommended Plan. Non-economic comparisons of alternatives are provided in Tables 7-8 and 7-9.

Table 7-6. Grit Removal Alternatives Capital Cost Comparisons, $1,000

	Alt. G1	Alt. G2
Contractor Profit and Overhead, 15%	$ 92	$ 69
Mobilization, 5%	$ 31	$ 23
New level elements on influent flumes	$ 10	$ 10
Demolish manual bar screen	$ 10	$ 10
New mechanical bar screen	$ 130	$ 130
Replace mechanical bar screen	$ 130	$ 130
Demolish existing stairs	$ 8	$ 8
New grit chamber, channel, gates, appurtenances and pumps	$ 220	-
New grit chamber bypass channel and gate	-	$ 45
New grit cyclone and classifier	$ 97	$ 97
Degritted primary sludge pump	-	$ 18
Site piping	$ 10	$ 10
Electrical/SCADA, 20%	$ 148	$ 110
Subtotal	**$ 886**	**$ 660**
Contingencies, 25%	$ 222	$ 165
Engineering, 20%	$ 222	$ 165
Total	**$1,329**	**$ 990**

Table 7-7. Treatment Alternatives Capital Cost Comparisons, $1,000

	Alt. T1	Alt. T2
Contractor Profit and Overhead, 15%	$ 192	$ 462
Mobilization, 5%	$ 64	$ 154
New Primary Sedimentation Basin	-	$ 1,802
New Blower	$ 24	$ 24
Mixed Liquor Splitter Box	$ 80	$ 80
New Secondary Clarifier	$ 866	$ 866
New RAS Pump	$ 24	$ 24
New WAS Pump	$ 18	$ 18
Site Piping Improvements	$ 50	$ 50
Chlorine Contact Basin Improvements	$ 21	$ 21
Outfall	$ 196	$ 196
Electrical/SCADA, 20%	$ 307	$ 740
Subtotal	**$ 1,842**	**$ 4,437**
Contingencies, 25%	$ 460	$ 1,109
Engineering, 20%	$ 460	$ 1,109
Total	**$ 2,762**	**$ 6,655**

Based on this analysis, the recommended plan for Plant No. 1 is based on the development of Alternatives G2 and T1. These are further developed in Chapter 9.

Table 7-8. Non-Economic Comparison of Grit Removal Alternatives

Evaluation Criteria	Grit Removal Alternative G1	Grit Removal Alternative G2
Capacity – design year for this plan is 2027	Influent pump station and headworks facilities would be sized for design year peak flows.	Influent pump station and headworks facilities would be sized for design year peak flows.
Performance – requirements are guided by DEQ NPDES permit	Screening and grit removal deficiencies would be corrected through proper equipment selection.	Screening and grit removal deficiencies would be corrected through proper equipment selection.
Implementation – feasibility of construction staging to maintain operations of the plant	New aerated grit chamber would be constructed adjacent to existing facilities during the summer season so that existing grit chamber could process influent flow.	The new channel would be constructed first so that flow could be bypassed around the existing aerated grit chamber when the gate in the primary influent channel is installed.
Constructability – outlines any construction concerns or issues	Relatively few uncertainties likely during construction.	Relatively few uncertainties likely during construction.
Reliability – adequate redundancy provided for critical equipment	Complies with Class I reliability requirements	Complies with Class I reliability requirements
Future Capacity Expansion – space available and ease of expansion of new and existing facilities	Future expansion will be considered in the design and placement of new facilities.	Future expansion will be considered in the design and placement of new facilities.
Operational Issues – operational and maintenance ease and flexibility.	Operation will be similar to existing operation. The new aerated grit tank would manually be put on line when flows exceed the capacity of the existing chamber.	Flow in excess of 10 mgd would bypass the aerated grit chamber and primary sludge would be degritted.

Table 7-9. Non-Economic Comparison of Treatment Alternatives

Evaluation Criteria	Treatment Alternative T1	Treatment Alternative T2
Capacity – design year for this plan is 2027	Some raw sewage flows from the headworks directly to the aeration basins during high flows.	All treatment steps have adequate capacity for design year peak flows.
Performance – requirements are guided by DEQ NPDES permit	New facilities will be able to meet the proposed bacteria standards in the new permit.	New facilities will be able to meet the proposed bacteria standards in the new permit.
Implementation – feasibility of construction staging to maintain operations of the plant	Construction staging is possible to keep all facilities in service.	Construction staging is possible to keep all facilities in service.
Constructability – outlines any construction concerns or issues	Few uncertainties are likely during construction.	Few uncertainties are likely during construction.
Regulatory Issues – ease of permit compliance	Permit compliance responsibilities are similar to current situation.	Permit compliance responsibilities are similar to current situation.
Reliability – adequate redundancy provided for critical equipment	Only one primary tank is included in this alternative. Maintenance on that tank would occur during periods of low loading.	All processes have backup facilities.
Future Capacity Expansion – space available and ease of expansion of new and existing facilities	A new secondary clarifier is constructed on currently unoccupied land planned for an additional tank. Area planned for future tanks has been left clear for future expansion.	A new secondary clarifier is constructed on currently unoccupied land planned for an additional tank. Area planned for future tanks has been left clear for future expansion.
Operational Issues – operational and maintenance ease and flexibility.	Pumping of flow from the circular primary basin to the aeration basin is eliminated.	Pumping of flow from the circular primary basin is eliminated.

CHAPTER 8. SOLIDS MANAGEMENT ALTERNATIVES

Solids that are produced as part of the wastewater treatment process must be treated and reused or disposed of in an environmentally acceptable and economically fasible manner. Solids treatment includes reduction of the water content, stabilization of volatile compounds, reduction of pathogens, and storage during wet weather. Following these steps, the biosolids are disposed of in a landfill, or are applied on agricultural land at an agronomic rate. Alternatives for solids management are evaluated in this chapter.

The Department of Environmental Quality (DEQ) encourages the beneficial reuse of biosolids through land application. While incineration has been used at other facilities, air quality concerns and cost have eliminated most of these facilities. Some communities dispose of their dewatered solids in landfills, but the beneficial attributes of the solids as a soil amendment are lost with this approach. In addition, landfill disposal is subject to the discretion of the landfill operator. Some successful solids management programs utilize landfill disposal as a wet-weather or emergency disposal strategy. The City of Coos Bay currently applies solids from Plant Nos. 1 and 2 to private agricultural and forest lands in a manner consistent with regulatory requirements for beneficial reuse.

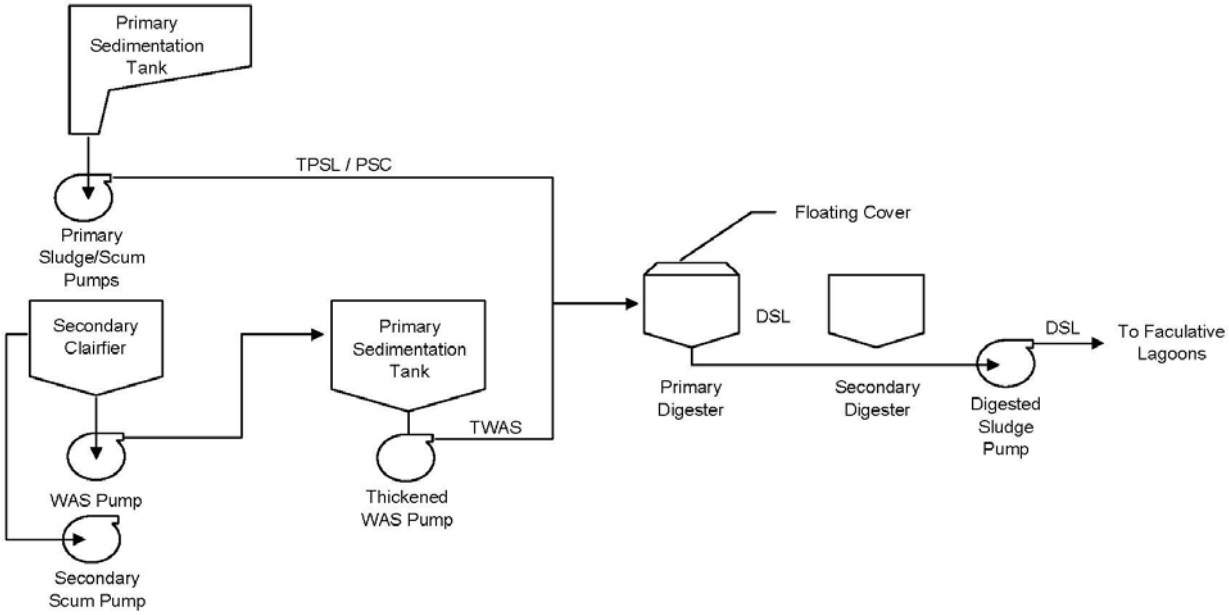
The primary objectives of the solids management program include:

- Ensure adequate capacity is available to process current and projected sludge quantities.
- Comply with applicable state and federal (Code of Federal Regulations, Chapter 40, Part 503) regulations.
- Ensure that biosolids are reused in an environmentally sound and publicly acceptable manner.
- Prevent the creation of nuisance conditions, such as vectors or objectionable odors.
- Minimize costs by using existing facilities to the extent possible.

EXISTING SYSTEM

Solids collected at wastewater treatment plant (WWTP) No. 1 consist of waste activated sludge (WAS), primary sludge, primary scum, and secondary scum. Depending on flow conditions, primary sludge and WAS are either co-thickened in the circular primary sedimentation basin or primary sludge is thickened in the rectangular primary sedimentation basin and WAS is thickened in the circular primary sedimentation basin prior to anaerobic digestion. Digested solids are pumped to the facultative sludge lagoon on the east side of town and combined with digested sludge from WWTP No. 2. The lagoon provides wet weather storage and additional volatile solids reduction. Biosolids are removed from the lagoon and land applied between June and October each year. Figure 8-1 shows the existing sludge processing facilities at WWTP No. 1.

Figure 8-1. Existing Solids Processing Facilities at WWTP No. 1



Solids production rates are estimated to evaluate process options. Under current average loading conditions, the plant generates approximately 3,700 pounds of dry solids per day. Solids production projections are summarized in Table 8-1.

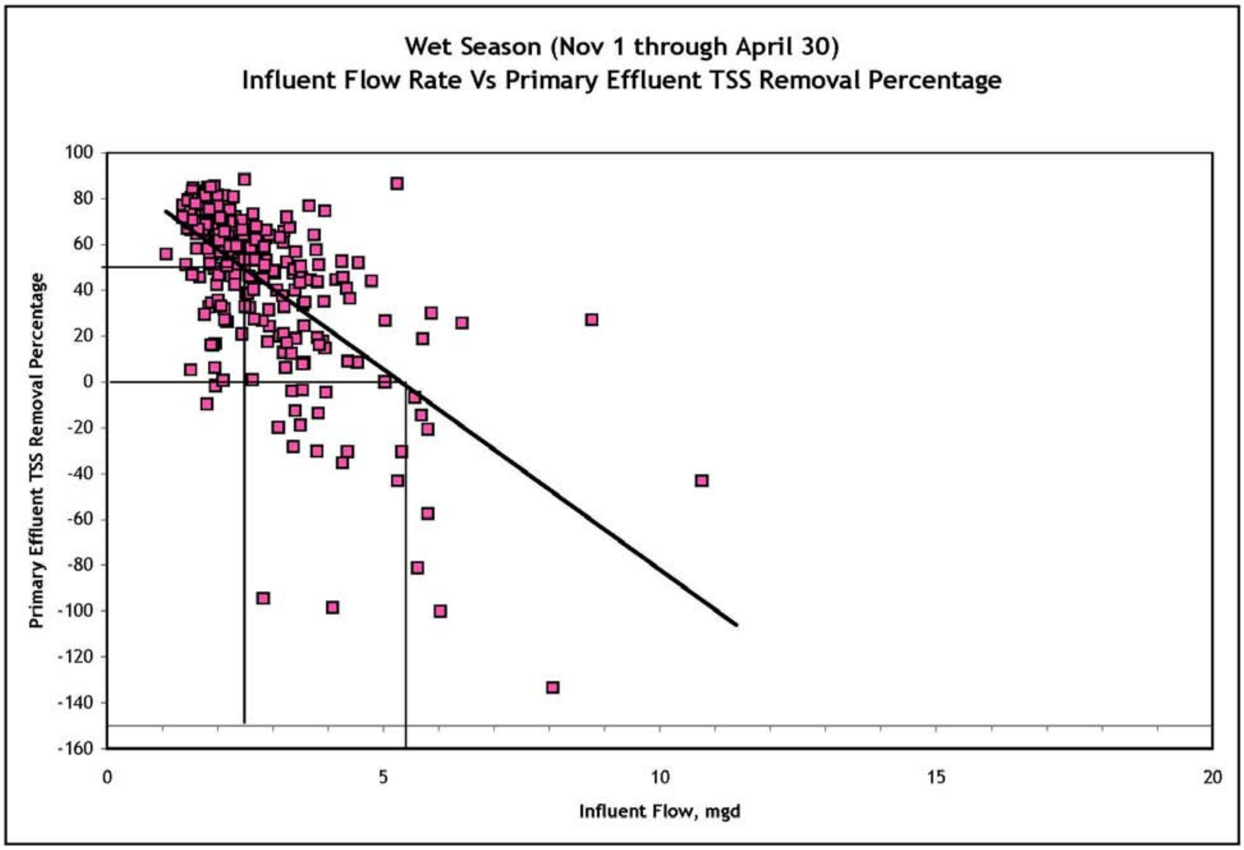
Table 8-1. WWTP No. 1 Average Sludge Production Projections

Year	Sludge Production, lbs/day	Sludge Production, gal/day
2003 Primary Solids	1,980	10,300[a]
WAS Solids	850	7,800[b]
Total Solids	**2,830**	**18,100**
2027 Primary Solids (unthickened)	2,100	11,000[a]
WAS Solids	900	8,300[b]
Total Solids	**3,000**	**19,300**
2027 Primary Solids (thickened)	2,100	6,300[c]
WAS Solids	900	2,700[c]
Total Solids	**3,000**	**9,000**

[a]Based on average thickened sludge pumped to digester at 2 – 2.5 percent solids.
[b]Based on average thickened sludge pumped to digester at 1 – 1.5 percent solids.
[c]Based on average thickened sludge pumped to digester at 4 percent solids.

Primary Sludge. Operations personnel currently maintain a sludge blanket in the rectangular primary sedimentation basin in an effort to thicken primary sludge prior to digestion. While this technique is effective at reducing the volume of sludge produced, the solids are susceptible to wash out during periods of high flow due to hydraulic currents in the primary sedimentation basin. Consequently, the effective capacity of the primary sedimentation basin is reduced compared to an operational approach that does not include in-tank thickening. Figure 8-2 shows the relationship between primary clarifier solids removal efficiency and plant flow. There is a general trend of decreasing efficiency with increased plant flow. As operated, the rectangular primary sedimentation process does not meet its design capacity of 10 mgd.

Figure 8-2. Plant Flow vs. Primary Effluent TSS Removal Percentage



Waste Activated Sludge. WAS solids concentration leaving the circular primary sedimentation basin where it is thickened, currently averages approximately 1 to 1.5 percent. Reducing WAS volume through an alternate thickening method would produce a thicker sludge, increase the capacity of the digesters, and reduce overall solids handling costs.

Anaerobic Digestion. Recommendations in the WWTP No. 2 Facilities Plan propose that thickened sludge from WWTP #2 plant be hauled to WWTP No. 1 for digestion. Table 8-2 summarizes combined sludge quantities from WWTP Nos. 1 and 2.

Table 8-2. Combined WWTP No. 1 and 2 Average Sludge Quantities for Digester Loading

Year	Sludge Production, lbs/day	Sludge Production, gal/day
2003 WWTP No. 1 Solids	2,800	18,100[a]
WWTP No. 2 Solids	2,000	16,300
Total Solids	**4,800**	**34,400**
2027 WWTP No.1 Solids (unthickened)	3,000	19,300[a]
WWTP No. 2 Solids	2,300	6,900
Total Solids	**5,300**	**26,200**
2027 WWTP No. 1 Solids (thickened)	3,000	9,000[c]
WWTP No. 2 Solids	2,300	6,900
Total Solids	**5,300**	**15,900**

[a]Based on average thickened primary sludge pumped to digester at 2 – 2.5 percent solids and thickened WAS pumped to digester at 1 – 1.5 percent solids.
[b]Based on average thickened sludge pumped to digester at 4 percent solids.

Currently, there are two digesters at the WWTP No. 1 site. Digester No. 1 is heated and mixed. Digester No. 2 provides gas storage. Considering only the volume of Digester No. 1, existing capacity is not adequate for current sludge quantities. Alternatives will be evaluated for stabilizing the sludge quantities listed in Table 8-2.

Digested Sludge Pumping. Digested sludge is pumped to the facultative lagoon using a single 450 gpm sludge transfer pump. Operators report the pump is in good condition. Should the pump need repair, there is sludge storage at WWTP No. 2 in the existing digesters which will be converted to storage tanks so that the solids from WWTP No. 2 could be held. Solids from WWTP No. 1 could be held for a short time in the clarifiers. This storage adds a sufficient level of reliability to the system so that a second pump will not be required.

Facultative Lagoon. The City's lagoon has adequate capacity to store current and future loads from WWTP No. 1 and No. 2. Improvement to the lagoon is not needed.

BIOSOLIDS QUALITY

Biosolids produced in the City of Coos Bay meet the Environmental Protection Agency's (EPA) requirements for land application. Table 8-3 shows the general biosolids characteristics, while Table 8-4 summarizes the concentration of heavy metals detected in the biosolids for the year 2004. As shown, the biosolids meet the requirements for exceptional quality biosolids.

Table 8-3. Biosolids Characteristics

Parameter	Average, mg/kg
Total Solids	40,550
Volatile Solids	20,165
VS% / TS%	0.497
Ammonia Nitrogen	12,700
Nitrate Nitrogen	100
Total Kj. Nitrogen	42,150
Phosphorus	31,050
Potassium	2,000

Table 8-4. Biosolids Quality – Metals

Parameter	Measured Average Concentration, mg/kg	Standard, mg/kg	
		Limit	Exceptional Quality
Arsenic	8.9	75	41
Cadmium	2.6	85	39
Chromium	34.2	3,000	1,200
Copper	401.0	4,300	1,500
Lead	105.6	840	300
Mercury	3.6	57	17
Molybdenum	11.4	75	18
Nickel	29.2	420	420
Selenium	5.0	100	36
Zinc	954.5	7,500	2,800

TREATMENT LEVEL

Land application of biosolids is subject to Federal Part 503 regulations. These regulations list two categories of treatment requirements: vector attraction (rodents, birds, and insects) and pathogen reduction. Vector attraction reduction requirements concentrate on reducing the volatile solids content of the sludge. With respect to pathogen reduction requirements, the Regulations recognize two categories of biosolids: Class A and Class B. Class A biosolids have low levels of pathogenic bacteria and are considered safe for public use. Class B biosolids have higher levels of pathogenic bacteria and are not considered appropriate for public use.

The processes required for the production of Class A biosolids have both a significant initial capital cost and ongoing operation and maintenance costs. For this reason, the vast majority of Oregon communities produce Class B biosolids. The sludge management alternatives presented herein assume the City will continue to produce Class B biosolids.

The presence of metals in the sludge is also regulated for land application. Table 8-4 lists the Pollutant Concentration Limits in metals of concern the 503 regulations. The City’s biosolids easily meet the Pollutant Concentration Limits for exceptional quality biosolids.

SOLIDS MANAGEMENT ALTERNATIVES

There are numerous processes available for solids management that (when properly combined) are capable of providing effective solids treatment prior to disposal. Figure 8-3 illustrates a wide range of alternatives that utilize anaerobic or aerobic digestion. In addition to digestion, lime stabilization, pasteurization or thermal drying options could be used to meet the regulatory requirements for pathogen and vector attraction reduction; however, storage options would be reduced if lime stabilization is used.

Prior to analyzing these various options, the three elements of a successful solids management program should be reviewed. A short description of each element as related to the Coos Bay WWTP No. 1 solids management program is presented below.

Disposal. Disposal consists of the final application of the treated solids product. The City currently uses all of their biosolids in a beneficial manner on agricultural and forest lands during the summer months. This method is consistent with DEQ’s promotion of beneficial use and is a program that should have no significant obstacles or limitations in the planning horizon. Other options, as listed in Figure 8-3, either add cost or uncertainty.

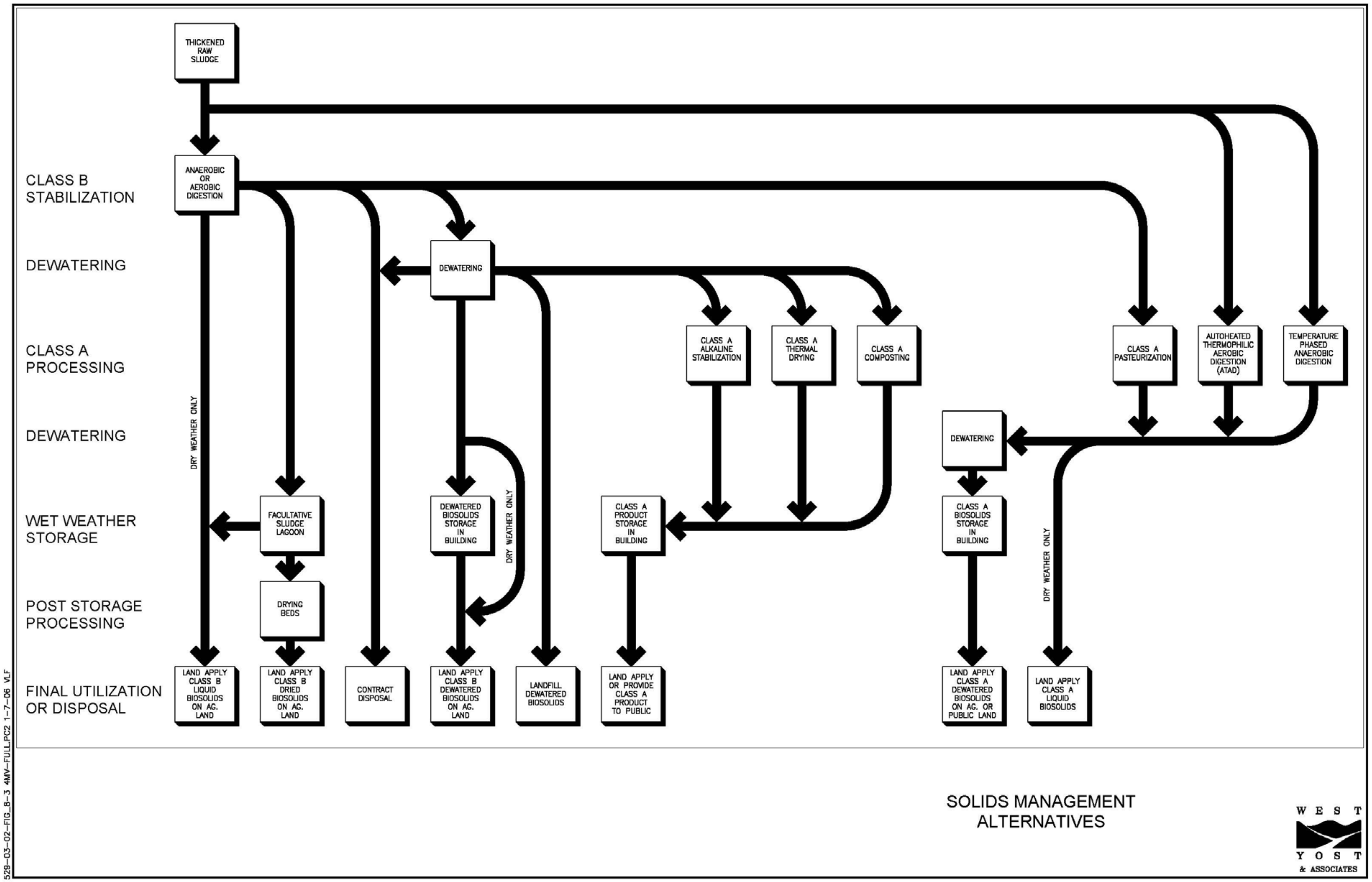
Storage. Most successful solids management programs include some type of wet weather storage of biosolids, because land application is generally achievable only during the summer months when runoff is unlikely and groundwater is generally deeper. The City’s facultative lagoon provides this storage. The lagoon has adequate capacity to accommodate the current and future (projected) sludge quantities from both plants. Therefore, in the interest of maximizing the use of existing facilities, alternative storage methods need not be evaluated.

Treatment. Numerous sludge treatment technologies are available, designed to produce either Class A or Class B biosolids. The primary advantage to Class A biosolids is that they can be distributed with few restrictions due to a higher level of pathogen reduction. However, production of Class A biosolids has significantly higher capital and operation and maintenance (O&M) costs compared to Class B processes. If disposal methods that are compatible with Class B biosolids are available and there is no other compelling reason to convert to a Class A program, the additional expense to achieve a Class A product is not justified.

The City's anaerobic digestion process currently produces Class B biosolids, which is acceptable for application on agricultural and forest land. If additional thickening facilities are included, the existing digesters have enough capacity to accommodate projected future sludge quantities.

Lime stabilization is another common sludge thickening process, but it is not generally compatible with lagoon storage. Converting to Class B lime stabilization would require an alternate approach to storage, and would only be cost-effective if the existing lagoon was inadequate for the design year sludge quantities. A Class B lime stabilization program would require construction of new dewatering and (dewatered biosolids) storage facilities. Aerobic digestion is another acceptable Class B process. While simpler to operate than anaerobic digestion, aerobic digesters require a significant amount of energy and space—additional tank volume would be necessary. In addition, there have been reported cases of odor problems where aerobic digesters are used in combination with facultative sludge lagoons for storage.

Figure 8-3. Solids Management Alternatives



Elements Common to All Alternatives

The following elements are common to all solids management alternatives:

- Digesting thickened sludge from WWTP No. 2 as recommended in the WWTP No. 2 Draft Facilities Plan (February 2005).
- New in-line primary sludge grinder
- New pump for thickened sludge from the circular primary sedimentation basin.
- New boiler, heat exchangers, gas and hot water piping and appurtenances.
- Replacing mixing and recirculating equipment for Digester No. 1. Mechanical mixers are assumed for the purposes of this report.
- Adding mixing, heating and recirculating equipment for Digester No. 2. Automatic sludge transfer between the primary and secondary digesters should be provided.
- New handrails around both digester roofs.
- Replace floating cover on Digester No. 1.
- Improve the cover of Digester No. 2 as required
- General repair on digester control building including replacing broken windows.
- New waste gas burner.
- Replace electrical and SCADA/process control systems. Control system improvements will focus on reducing labor and energy costs.

Solids Management Alternative S1

As shown schematically in Figure 8-4 this alternative includes continuing to thicken primary sludge in the rectangular primary sedimentation basin and thickening WAS in the circular primary clarifier under all flow conditions. The digesters would process WWTP No. 1 sludge along with thickened sludge from WWTP No. 2 until capacity of the digesters is reached at which time Digester No. 1 at WWTP No. 2 will need to be rehabilitated and used to its capacity. A portion of the sludge will be digested at WWTP No. 2 and a portion will be digested at WWTP No. 1. It is recommended that the Digester No. 2 cover be repaired and it be used as the primary digester and Digester No. 1 be equipped with a new floating cover and it be used as a secondary digester.

Major components of Alternative S1 include:

- Upgrading Digester No. 1 at WWTP No. 2 which will be used in the early years as storage tank.
- Resuming hauling of sludge digested at WWTP No. 2 to the lagoon in the later years when sludge is digested at WWTP No. 2.

Figure 8-4. Alternative S1 Process Flow Diagram

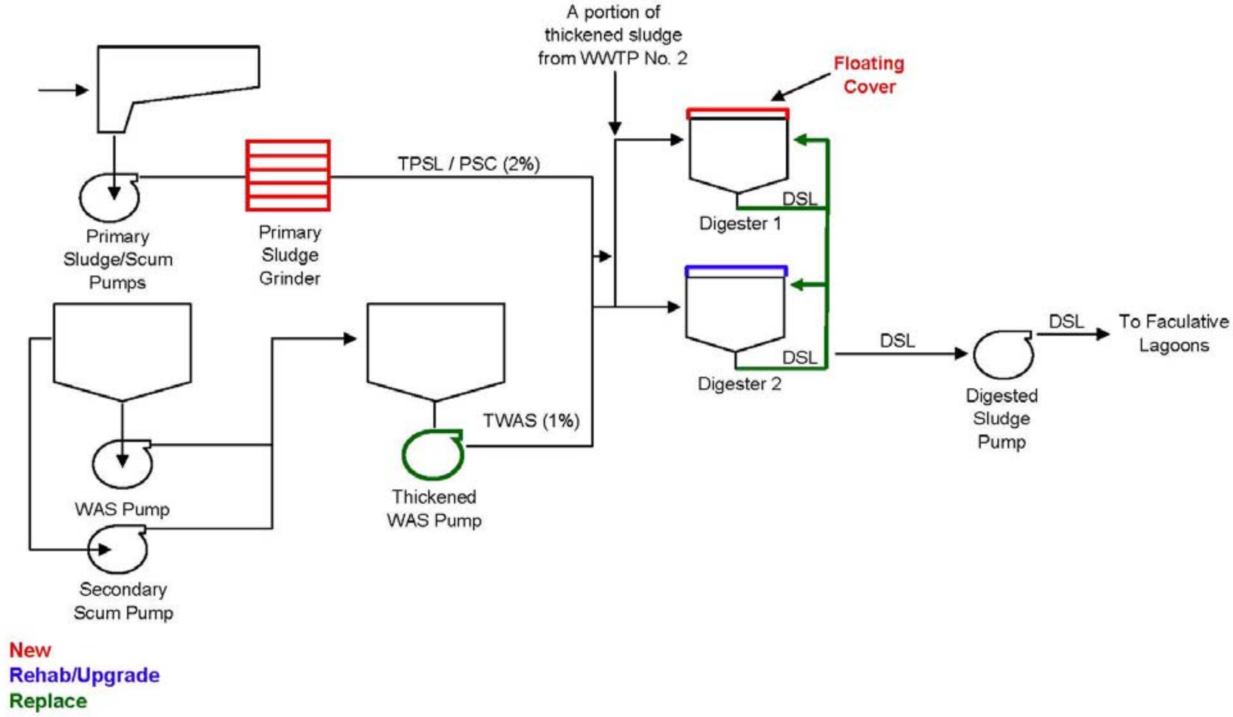


Table 8-5 shows existing and future design data for Alternative S1.

Table 8-5. Solids Management Alternative S1 Design Data

Description	Existing Value	New Value
Primary Sludge		
Primary Sludge Grinder		
Number		1
Type		In-line
Waste Activated Sludge		
Thickened WAS Pump		
Number	1	1
Type	Piston	Rotary Lobe
Capacity, gpm	60	60
Anaerobic Digestion		
Digester No. 1		
Diameter, ft	45	45
Depth, ft	26	26
Volume, gallons	331,150	331,150

Description	Existing Value	New Value
Cover Type	Floating	Floating
Mixer		
Type	Mechanical	Mechanical
Size, Hp	15	15
Digester No. 2		
Diameter, ft	40	40
Depth, ft	26	26
Volume, gallons	253,660	253,660
Cover Type	Fixed	Fixed
Mixer		
Type	Gas Circulation Compressor	Mechanical
Number	1	1
Capacity, cfm	150	
Size, Hp		10
Hydraulic Detention Time, days		
Average	29	27[a]
Maximum Month	21	16[a]
Heat Exchangers		
Number	2	2
Type	Spiral	Spiral
Sludge Recirculation Pumps		
Number	2	2
Type	Recessed Impeller	Recessed Impeller
Capacity, gpm	150	150
Boiler		
Number	1	1
Capacity, Mbtu/h	822	1,000
Waste Gas Burner		
Number	1	1
Capacity, cfh	5,800	5,800
Sludge Transfer Pump		
Number	1	1
Size, gpm	450	450

a. Includes thickened sludge from WWTP No. 2 exceeding the capacity of Digester No. 1 at WWTP No. 2.

Solids Management Alternative S2

As shown schematically in Figure 8-5 this alternative consists of thickening primary sludge in the existing circular primary clarifier under all flow conditions and thickening WAS with a gravity belt thickener, on-site anaerobic digestion with thickened sludge from WWTP No. 2, pumping Class B biosolids to the City's facultative lagoon, and land application. It is recommended that the Digester No. 2 cover be repaired and it be used as the primary digester and Digester No. 1 be equipped with a new floating cover and it be used as a secondary digester.

Major improvements include:

- Converting the existing circular primary sedimentation basin to a gravity thickener and related appurtenances for primary sludge thickening including a new sludge pump.
- Installing a new gravity belt thickener for WAS thickening, a polymer system, a thickened WAS pump and a building to house the equipment.

Figure 8-5. Alternative S2 Process Flow Diagram

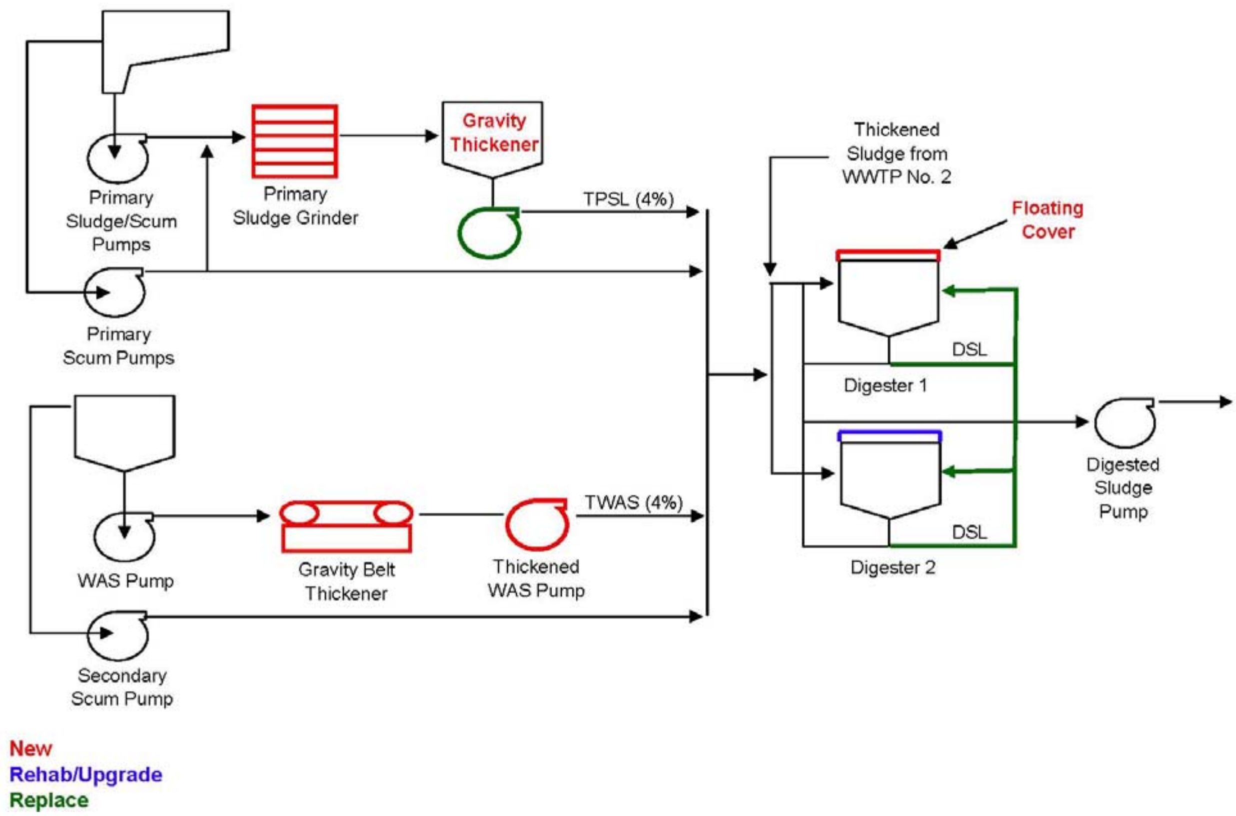


Table 8-6 shows existing and future design data for Alternative S2.

Table 8-6. Solids Management Alternative S2 Design Data

Description	Existing Value	New Value
Primary Sludge		
Thickened Primary Sludge Pump		
Number		1
Type		Rotary Lobe
Capacity, gpm		100
Drive		Constant Speed
Primary Sludge Grinder		
Number		1
Type		In-line
Waste Activated Sludge		
WAS Gravity Belt Thickener		
Number		1
Belt Width, meters		1
Loading Rate, lb/hr-m		500
Thickened WAS Pumps		
Number	1	1
Type	Piston	Rotary Lobe
Capacity, gpm		50
Drive		Constant Speed
Polymer Feed System		
Number		1
Type		Liquid
Anaerobic Digestion		
Digester No. 1		
Diameter, ft	45	45
Depth, ft	26	26
Volume, gallons	331,150	331,150
Cover Type	Floating	Floating
Mixer		
Type	Mechanical	Mechanical
Size, Hp	15	15

Description	Existing Value	New Value
Digester No. 2		
Diameter, ft	40	40
Depth, ft	26	26
Volume, gallons	253,660	253,660
Cover Type	Fixed	Fixed
Mixer		
Type	Gas Circulation Compressor	Mechanical
Number	1	
Capacity, cfm	150	
Size, Hp	15	
Hydraulic Detention Time, days		
Average	29	33[a]
Maximum Month	21	23[a]
Heat Exchangers		
Number	2	2
Type	Spiral	Spiral
Sludge Recirculation Pumps		
Number	2	2
Type	Recessed Impeller	Recessed Impeller
Capacity, gpm	150	150
Boiler		
Number	1	1
Capacity, Mbtu/h	822	1000
Waste Gas Burner		
Number	1	1
Capacity, cfh	5,800	5,800
Sludge Transfer Pump		
Number	1	1
Size, gpm	450	450

a. Includes thickened sludge from WWTP No. 1 and WWTP No. 2

COMPARISON OF ALTERNATIVES

Table 8-7 presents the capital costs for Alternatives S1 and S2. A complete present worth comparison between alternatives will be presented in Chapter 10. A non-economic comparison of the solids management alternatives is provided in Table 8-8.

Although by itself, Alternative S2 has a higher capital cost, it will be implemented in conjunction with liquid treatment alternatives that as a system will result in nearly even costs as other alternatives and the result will be an overall higher level of treatment at the plant. Therefore, Alternative S2 is recommended. A full evaluation of the combined liquid and solids alternatives is given in Chapter 9.

Table 8-7. Solids Management Alternatives Capital Cost Comparisons, $1,000

	Alt. S1	Alt. S2
Contractor Profit and Overhead, 15%	$ 268	$ 283
Mobilization, 5%	$ 89	$ 94
Primary sludge grinder	$ 77	$ 77
Replace piston pump	$ 80	$ 80
New boiler, heat exchangers, gas and hot water piping	$ 237	$ 237
Mixers and recirculation pumps for digesters	$ 328	$ 328
New handrails on digesters	$ 32	$ 32
Demo cover on Digester No. 1	$ 23	$ 23
New fixed cover on Digester No. 1	$ 171	$ 171
Digester building repair	$ 86	$ 86
Improve Digester No. 2 cover	$ 129	$ 129
New waste gas burner	$ 37	$ 37
Yard piping	$ 10	$ 34
Upgrade Digester No. 1 at WWTP No. 2	$ 477	-
New Sludge Truck for WWTP No. 2	$ 100	-
WAS Gravity Belt Thickener	-	$ 473
Thickened WAS Pumping	-	$ 96
Thickening Building	-	$ 86
Electrical/SCADA, 20%	$ 429	$ 453
Subtotal	**$2,573**	**$2,719**
Contingencies, 25%	$ 643	$ 680
Engineering, 20%	$ 643	$ 680
Total	**$3,861**	**$4,079**

Table 8-8. Non-Economic Comparison of Solids Management Alternatives

Evaluation Criteria	Alternative S1	Alternative S2
Capacity – design year for this plan is 2027	Adequate capacity for design year sludge production. Higher ultimate capacity as all three digesters (two at WWTP No. 1 and one at WWTP No. 2) would be used.	Adequate capacity for design year sludge production. Lower ultimate capacity as only the two digesters at WWTP No. 1 would be used.
Performance – requirements are guided by DEQ NPDES permit and Part 503 regulations	Properly designed and operated anaerobic digesters consistently comply with Class B stabilization requirements.	Properly designed and operated anaerobic digesters consistently comply with Class B stabilization requirements.
Implementation – feasibility of construction staging to maintain operations of the plant	Construction staging is possible to keep all facilities in service.	Construction staging is possible to keep all facilities in service.
Constructability – outlines any construction concerns or issues	Few uncertainties are likely during construction.	Few uncertainties are likely during construction.
Regulatory Issues – ease of permit compliance	Complies with Class B biosolids requirements	Complies with Class B biosolids requirements
Reliability – adequate redundancy provided for critical equipment	All digesters will be used to their full capacity toward the end of the planning horizon.	The primary sludge gravity thickener could serve as back-up for the gravity belt thickener. The sludge storage capacity at WWTP No. 2 could provide some relief to digesters at WWTP No. 1.
Future Capacity Expansion – space available and ease of expansion of new and existing facilities	Digester capacity could be increased in the future by adding heating and mixing to Digester No. 1 at WWTP No. 2.	Gravity belt thickening facilities would be constructed on previously unoccupied land.
Operational Issues – operational and maintenance ease and flexibility.	No new processes are added at WWTP No. 1. Primary sedimentation performance will remain poor with sludge thickening remaining the rectangular basin. Thickened WAS concentration will remain low.	Having nearly 30 days of sludge storage at WWPT No. 2 would provide operational flexibility. Thickening facilities will add operations and maintenance activities to WWTP No. 1. Eliminating sludge treatment at WWTP No. 2 consolidates process O&M functions.

CHAPTER 9. RECOMMENDED PLAN

This chapter presents the recommended plan for upgrading Coos Bay Wastewater Treatment Plant No. 1. Liquid treatment alternatives are described in Chapter 7 and solids alternatives are described in Chapter 8.

RECOMMENDED PROCESS IMPROVEMENTS

The recommended improvements are summarized in Table 9-1.

Table 9-1. Summary of Recommended Alternatives

Alternative	Description
G2	New mechanical bar screen, flow meter, grit cyclone and classifier to match existing. Replace existing equipment with new. Each train will treat 10 mgd.
T1	Treat up to 7 mgd with full primary and secondary treatment. A new secondary clarifier will be constructed to provide secondary treatment to all flow up to 13 mgd. One new blower will be added to provide air to the existing aeration basins.
S2	The existing circular primary sedimentation basin will become a gravity thickener for primary sludge. WAS will be thickened with a gravity belt thickener. All equipment and piping for the digesters will be replaced including mixers, heat exchangers and recirculation pumps. Digester No. 1 will get a new floating cover.

PRESENT WORTH ANALYSIS

As noted in Chapters 7 and 8, the grit removal, treatment process and solids management alternatives cannot be compared independently, as some cost savings may be achieved with certain combinations of alternatives. This fact is addressed in the cost summary presented in Table 9-2 which combines the three analyzed processes into complete treatment alternatives. It should be noted that certain combinations were left off this table as they do not provide full treatment if combined. Table 9-2 also compares and ranks the present worth of each alternative. In a present worth analysis, the ongoing operation and maintenance (O&M) costs are converted to an equivalent current value and added to an alternative's capital cost. In this way, alternatives with relatively low capital costs and high O&M costs can be compared to alternatives with high capital and low O&M costs. O&M costs include labor, power and chemicals.

Table 9-2. Present Worth (PW) Cost Comparison of Alternatives, $1000*

Item	G1-T1-S1	G1-T2-S1	G2-T1-S2	G2-T2-S2
Capital	$7,951	$11,844	$7,830	$11,723
Annual O&M	$151	$151	$152	$152
PW of O&M	$1,751	$1,751	$1,758	$1,758
Total PW	$9,701	$13,595	$9,588	$13,481
Rank	2	4	1	3

*Based on a 20 year planning period and a return rate of 5.875 percent as recommended by the Natural Resources Conservation Service.

RECOMMENDED PLAN ELEMENTS

The recommended plan elements include the following:

Liquid Train

Headworks. Headworks improvements include installing new transducers on the influent flumes for reliable influent flow data and replacing the mechanical bar screen and installing a mechanical screen in the bypass channel to meet future flow requirements. The aerated grit basin will remain to treat up to 10 mgd. Flow above 10 mgd will go directly to the rectangular primary sedimentation basin. Dilute primary sludge will be pumped to a new cyclone separator and screw classifier.

Primary Treatment. The existing rectangular primary sedimentation basin will treat flows up to 7 mgd. Flow in excess of 7 mgd will go directly to secondary treatment. The circular primary sedimentation basin will be converted to a gravity thickener for primary sludge. The existing primary sludge pump at the circular tank will be replaced and a sludge grinder will be added.

Aeration Basins. The existing aeration basins have adequate volume to provide secondary treatment to up to 13 mgd of screened raw wastewater. A blower will be added to better meet process oxygen requirements.

Secondary Clarifiers and RAS/WAS Pumping. A new 90-foot diameter clarifier will be added to increase secondary clarification capacity and provide better reliability. RAS and WAS pumping will be added for the new clarifier. A mixed liquor split box will split flow from the aeration basins to the two clarifiers.

Disinfection. Additional baffles will be added in the existing chlorine contact basin to provide improved performance up to 20 mgd.

Solids Train

Primary Sludge and WAS Thickening. Primary sludge will be gravity thickened in the existing circular primary sedimentation basin. Ultimately, WAS will be thickened with a gravity belt thickener.

Anaerobic Digestion. The digesters will stabilize thickened sludge from both WWTPs 1 and 2. Both digesters and the digester control building at WWTP will need to be upgraded to provide adequate digestion capacity. Handrails will be replaced. Equipment including mixers, heat exchangers, recirculation pumps and a boiler will be replaced. Existing Digester No. 2 (with a fixed cover) will be used as the primary digester. The existing floating cover on Digester No. 1 will be replaced and Digester No. 1 will be used as a secondary digester. Sludge can be directly withdrawn from Digester No. 1 for beneficial reuse. During wet-weather months (and any excess solids not used on Agricultural Lands) digested sludge will be pumped to facultative lagoon for storage. The waste gas burner will be replaced so that methane produced in the digesters can be burned.

Biosolids Disposal. Digested sludge will be pumped from the digesters to the City's existing facultative lagoons and ultimately land applied.

Other Improvements

Other improvements needed at the site include the following:

- Site piping improvements.
- Electrical and SCADA/process control improvements. The power distribution system would be upgraded as required to serve new equipment. Control system improvements would focus on improving labor and energy efficiency.
- The recommended plan elements are summarized in Table 9-3. A process flow diagram of the recommended plan is shown in Figure 9-1.

Table 9-3. Recommended Plan Basic Data

Description	New Value
PRELIMINARY TREATMENT	
Flow Measurements	
Parshall Flume	
Number	2
Size, inches	18
Number of Flow Transmitters	2
Headworks	
Mechanical Bar Screen	
Number	2
Type	TBD

Description	New Value
Bar Spacing, in.	3/8
Screenings Compactor	
Number	1
Capacity, cubic feet/hour	34
Upper Screw, HP	1
Lower Screw, HP	1
Aerated Grit Tank	
Number	1
Capacity, each, mgd	10
Grit Pumps	
Number	2
Capacity, each, gpm	270
Degritted Primary Sludge Pump	
Number	1
Capacity, each gpm	270
PRIMARY TREATMENT	
Primary Sedimentation	
Rectangular Primary Sedimentation Basin	
Number	1
Width, ft	21.5
Length, ft	145
Overflow rate, gpd/sf	
PWWF	2,200[a]
SECONDARY TREATMENT	
Aeration Basins	
Number	2
Width, ft	34
Length, ft	96
Sidewater Depth, ft	15.5
Total Volume, gal	756,000
MLSS, mg/l	2,000
Hydraulic Detention Time, hours	

Description	New Value
ADWF	10.7
MMWWF	3.1
Diffuser Type	Fine Bubble Tubes
Blowers	
Number	4
Type	Centrifugal
Capacity, each, scfm	1,200
Pressure, psi	8.0
Secondary Clarifiers	
Existing Clarifier	
Diameter, ft	80
Sidewater Depth, ft	16
Overflow Rate, gpd/sf	
Peak Flow to Secondary Treatment	1200
New Clarifier	
Diameter, ft	90
Sidewater Depth, ft	18
Overflow Rate, gpd/sf	
Peak Flow to Secondary Treatment	1200
RAS pumps	
Number	3
Type	Centrifugal
Capacity, each, gpm	1,500
WAS Pump	
Number	2
Type	Centrifugal
Capacity, each, gpm	360
Secondary Scum and Tank Drain Pump	
Number	1
Capacity, each, gpm	340

Description	New Value
CHLORINATION AND DECHLORINATION	
Chlorination Facilities	
Type	Sodium Hypochlorite
Contact Tank	
Number	1
Total volume, gal	370,000
Hydraulic detention time, minutes	
ADWF	313
PWWF	27
Sodium Hypochlorite Storage Tanks	
Number	2
Total Storage Volume, gal	3,600
Feed pumps	
Number	3
Type	Diaphragm
Capacity, each, gph	20
Dechlorination Facilities	
Type	Sodium bisulfite
Sodium Bisulfite Storage Tanks	
Number	2
Total Storage Volume, gal	3,000
Feed Pumps	
Number	2
Type	Diaphragm
Capacity, each gph	12.7
Mixer	
Number	1
Type	Vertical
Motor, hp	5
OUTFALL	
Length, ft	715
Diameter, in	48

Description	New Value
Diffuser, number of ports	5
SLUDGE PROCESSING	
Primary Sludge	
Thickened Primary Sludge Pump	
Number	1
Type	Rotary Lobe
Capacity, gpm	100
Drive	Constant Speed
Primary Sludge Grinder	
Number	1
Type	In-line
Waste Activated Sludge	
WAS Gravity Belt Thickener	
Number	1
Belt Width, meters	1
Loading Rate, lb/hr-m	500
Thickened WAS Pumps	
Number	1
Type	Rotary Lobe
Capacity, gpm	50
Drive	Constant Speed
Polymer Feed System	
Number	1
Type	Liquid

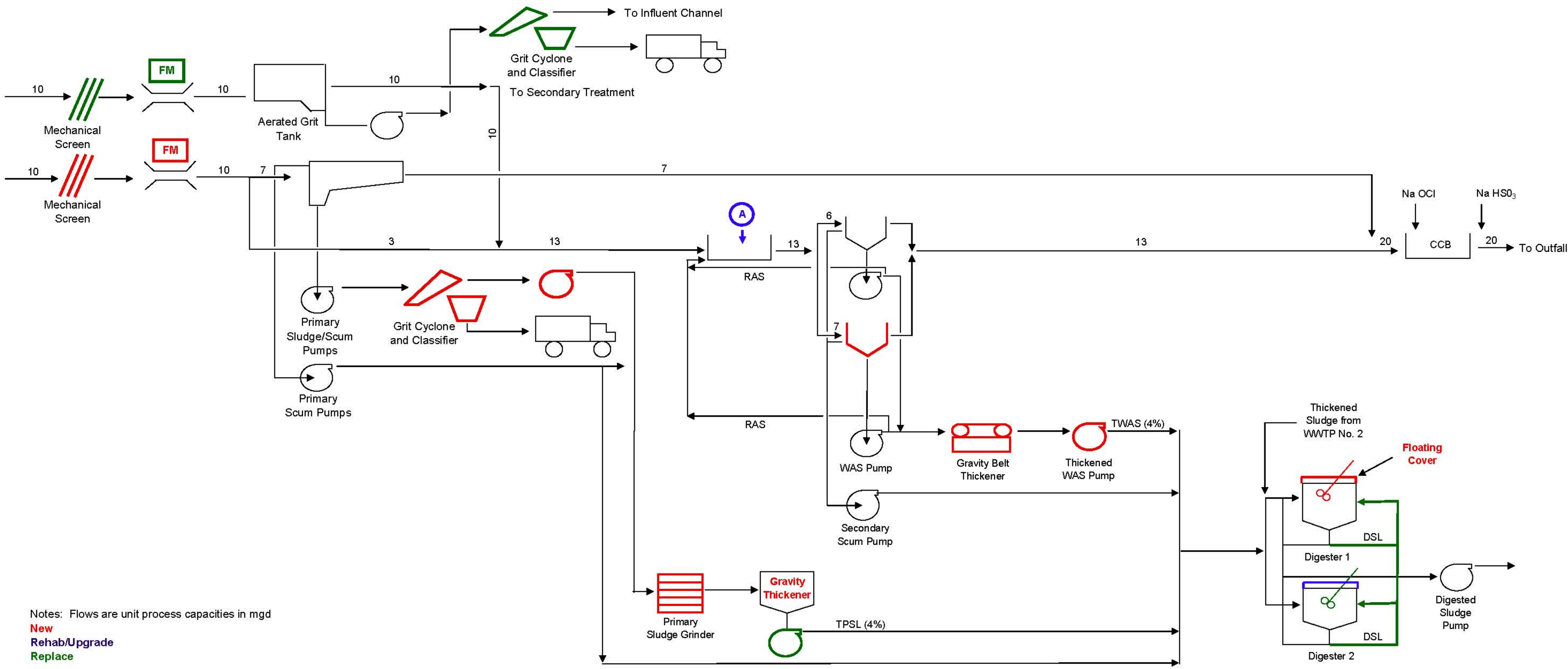
Description	New Value
Anaerobic Digestion	
Digester No. 1	
Diameter, ft	45
Depth, ft	26
Volume, gallons	331,150
Cover Type	Floating
Mixer	
Type	Mechanical
Size, Hp	15
Digester No. 2	
Diameter, ft	40
Depth, ft	26
Volume, gallons	253,660
Cover Type	Fixed
Mixer	
Type	Mechanical
Number	1
Size, Hp	15
Hydraulic Detention Time, days	
Average	33[b]
Maximum Month	23[b]
Heat Exchangers	
Number	2
Type	Spiral
Sludge Recirculation Pumps	
Number	2
Type	Recessed Impeller
Capacity, gpm	150
Boiler	
Number	1
Capacity, Mbtu/h	1000

Description	New Value
Waste Gas Burner	
Number	1
Capacity, cfh	5,800
Sludge Transfer Pump	
Number	1
Size, gpm	450

(a) At peak flow to process, 7 mgd.

(b) Includes thickened sludge from WWTP No. 2.

Figure 9-1. Recommended Plan Process Flow Diagram



IMPLEMENTATION

Improvements will be phased in at the plant over the course of the planning period. These facility improvements are necessary to maintain acceptable performance and reliability at the treatment plant over the next twenty years. The site plan is given in Figure 9-2 and shows the anticipated phasing of improvements.

Phase 1 Facilities

Phase 1 facilities are required to improve reliability, performance and address safety issues. Phase 1 facilities include the following:

- Replace piston pump.
- New level elements on influent flumes.
- Replace floating cover on Digester 1.
- Improve fixed cover on Digester 2.
- Construct new waste gas burner.
- Outfall improvements
- New handrails on digesters.

Phase 2 Facilities

Phase 2 facilities will be implemented to address capacity and reliability issues. Phase 2 facilities include the following:

- New blower.
- Mixed liquor split box.
- New secondary clarifier.
- New RAS pump.
- New WAS pump.
- Site piping.

Phase 3 Facilities

Phase 3 facilities will be needed to accommodate sludge hauled from WWTP No. 2 for digestion at WWTP No. 1. Phase 3 facilities include the following:

- New boiler, heat exchangers, gas and hot water piping.
- Mixing, heating and recirculation pumping for Digester 1.
- Mixing, heating and recirculation pumping for Digester 2.
- Digester building repair.

Phase 4 Facilities

Phase 4 facilities extend digester capacity by thickening sludge. The headworks improvements and grit systems are related and will be constructed simultaneously. Phase 4 Facilities include the following:

- Demolish manual bar screen.
- New mechanical bar screen.
- Replace existing mechanical bar screen.
- Demolish existing stairs.
- New grit chamber bypass channel and gate.
- New grit cyclone and classifier.
- Degritted primary sludge pump.
- Site piping.
- Inline primary sludge grinder.
- WAS Gravity Belt Thickener.
- Thickened WAS pump.
- Thickening Building. (Chemical storage controls)
- Yard piping.

CAPITAL IMPROVEMENT PLAN

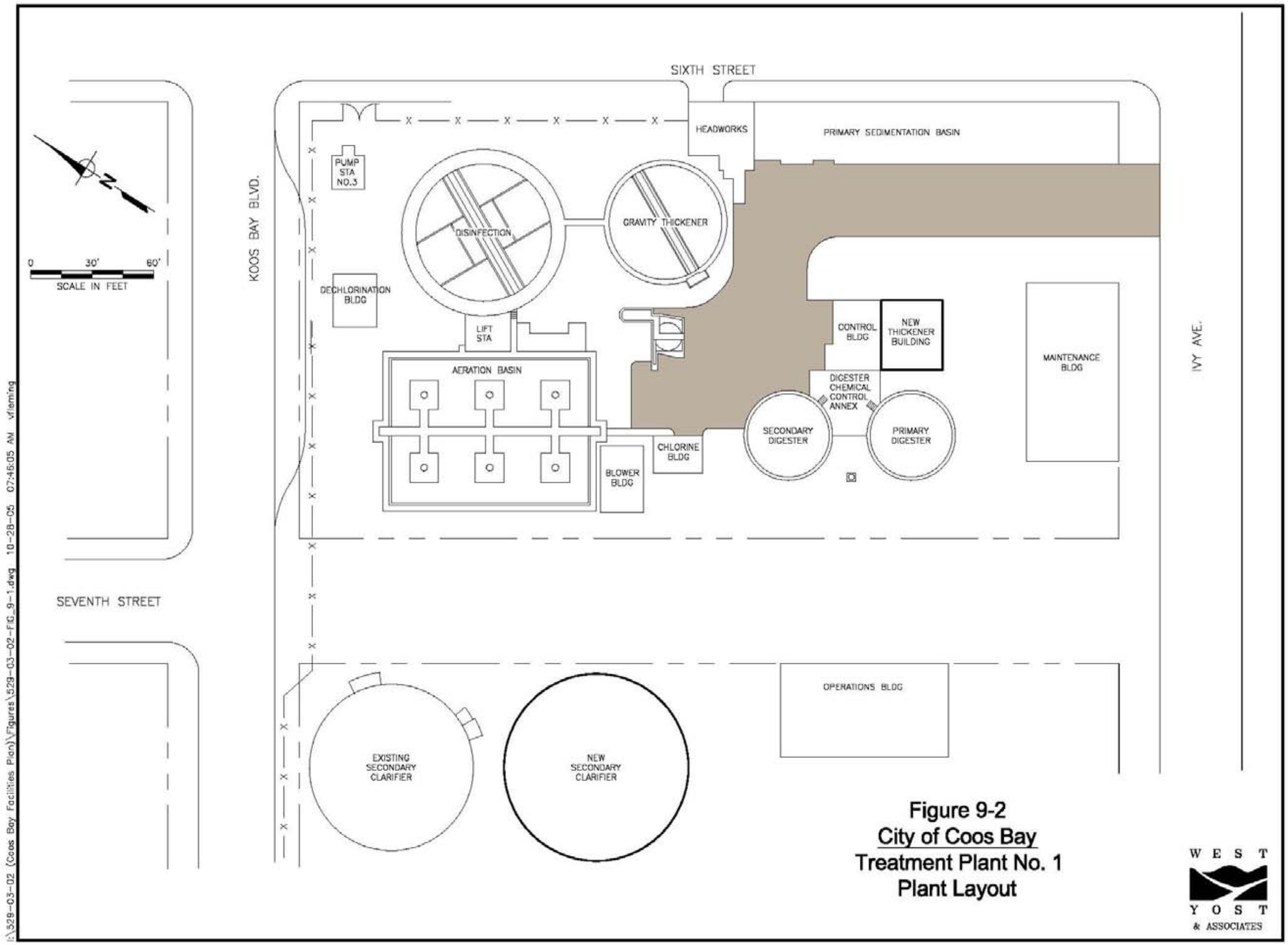
The Capital Improvement Plan (CIP) provides a road map for the City that identifies the location, timing and estimated cost of the recommended improvement projects that are necessary to maintain reliable operation of the wastewater treatment plant. The CIP is based on the recommended plan. The following sections summarize the details of the recommended CIP.

Basis for Cost Estimates

The cost estimates presented in this report are planning level estimates. Such estimates are approximate and made without detailed engineering design data. Construction and operating costs for the recommended plan are based on preliminary layouts. Estimates were prepared using the construction costs of similar plants when possible. When these costs were not available, construction costs were obtained from available cost cures and EPA process design manuals. Since these cost estimates are based on conceptual design data, they may change as more detailed design information is developed.

Costs can be expected to undergo long-term changes in keeping with corresponding changes in the national economy. One of the best available barometers of these changes is the Engineering News-Record (ENR) construction cost index. It is computed from the prices for structural steel, Portland cement, lumber and common labor.

Figure 9-2. Recommended Plan Site Plan



The costs developed in this report are based on the ENR 20-city index of 7314, which was the index in October 2004. The costs presented here may be related to those at any time in the past or future by applying the ratio of the then-prevailing cost index to ENR CCI 7314.

Because of the limitations of cost estimates based on planning information, cost estimates must allow for unanticipated improvements, variation in final quantities, adverse construction conditions, and other unforeseeable difficulties that will increase the final construction cost. Therefore, the total construction cost includes a contingency allowance of 25 percent.

The cost of engineering services for major projects typically includes special investigations, a predesign report, surveying, foundation exploration, preparation of contract drawings and specifications, construction management, start-up services and the preparation of operation and maintenance manuals. Depending on the size and type of project, engineering costs may range from 12 to 20 percent of the construction cost. The lower percentage applies to large projects without complicated mechanical systems. The higher percentage applies to small, complicated projects and to projects that involve extensive remodeling of existing facilities. For Coos Bay WWTP No. 1, where new projects will involve both rehabilitation and expansion of the existing plant, it is assumed that total engineering costs will average 15 percent of the construction cost.

For the cost analysis estates in this report, the City of Coos Bay has internal administrative costs associated with any major construction project. These include internal planning and budgeting, the administration of engineering and construction contracts, legal services, and liaison with regulatory and funding agencies. For a typical project similar in size to the work described in this report, the city's administrative costs are estimated at five percent of the construction cost.

The combination of engineering and administrative cost is assumed to be 20 percent and is applied to the total construction cost.

Capital Cost Summary

Estimated costs for the recommended improvements are summarized in Table 9-4. These costs are all shown in 2004 dollars and need to be adjusted when planning for projects that will be implemented in the future. Projects are organized according to the previously outlined phasing plan.

Based on the general implementation schedule outlined in Table 9-4, Table 9-5 provides a recommended implementation schedule for the capital improvement plan over the full planning period.

Table 9-4. Recommended Plan Cost Summary
(2004 Dollars at ENR CCI 7314)

Description	Cost			
	Construction	Contingency 25%	E&A 20%	Total
Phase 1 Improvement Projects (present to 2010)				
Replace piston pump	115,810	28,953	28,953	173,715
New level elements on influent flumes	20,222	5,056	5,056	30,333
Demo Cover on Digester 1	33,643	8,411	8,411	50,465
Replace floating cover on Digester 1	245,643	61,411	61,411	368,465
Improve roof of Digester 2	35,643	8,911	8,911	53,465
Construct new waste gas burner	53,643	13,411	13,411	80,465
Outfall	1,533,333	383,333	383,333	2,300,000
New handrails on digesters	45,643	11,411	11,411	68,465
Construct standby power	150,000	37,500	37,500	225,000
Total Phase 1 Cost				**3,350,400**
Phase 2 Improvements (2010 to 2014)				
New blower	120,000	30,000	30,000	180,000
Mixed liquor split box	110,000	27,500	27,500	165,000
New secondary clarifier	961,000	240,250	240,250	1,441,500
New RAS pump	120,000	30,000	30,000	180,000
New WAS pump	114,000	28,500	28,500	171,000
Chlorine Contact Basin Improvements	53,000	13,250	13,250	79,500
Site piping	81,000	20,250	20,250	121,500
Total Phase 2 Cost				**2,338,500**
Phase 3 Improvements (2018-2022)				
New boiler, heat exchangers, gas and hot water piping	340,810	85,203	85,203	511,215
Mixing heating and recirc for Digester 1	236,405	59,101	59,101	354,608
Mixing heating and recirc for Digester 2	236,405	59,101	59,101	354,608
Digester building repair	123,643	30,911	30,911	185,465
Total Phase 3 Cost				**1,405,900**

Description	Cost			
	Construction	Contingency 25%	E&A 20%	Total
Phase 4 Improvements (2023-2026)				
Demolish manual bar screen	20,222	5,056	5,056	30,333
New mechanical bar screen	167,722	41,931	41,931	251,583
Replace mechanical bar screen	167,722	41,931	41,931	251,583
Demolish existing stairs	18,222	4,556	4,556	27,333
New grit chamber bypass channel and gate	55,222	13,806	13,806	82,833
New grit cyclone and classifier	134,722	33,681	33,681	202,083
Degritted primary sludge pump	55,722	13,931	13,931	83,583
Site piping	20,222	5,056	5,056	30,333
Inline primary sludge grinder	110,810	27,703	27,703	166,215
WAS Gravity Belt Thickener	680,810	170,203	170,203	1,021,215
Thickened WAS pump	137,810	34,453	34,453	206,715
Thickening Building	123,643	30,911	30,911	185,465
Yard piping	48,643	12,161	12,161	72,965
Total Phase 4 Cost				**2,612,200**
Total Cost				**9,707,000**

Table 9-5. Recommended CIP Implementation Plan
(2004 Dollars at ENR CCI 7314)

	Fiscal Year																					
Project Description	**2005-2006**	**2006-2007**	**2007-2008**	**2008-2009**	**2009-2010**	**2010-2011**	**2011-2012**	**2012-2013**	**2013-2014**	**2014-2015**	**2015-2016**	**2016-2017**	**2017-2018**	**2018-2019**	**2019-2020**	**2020-2021**	**2021-2022**	**2022-2023**	**2023-2024**	**2024-2025**	**2025-2026**	**Total**
PLANT 1																						
Replace piston pump				28,953	43,429	101,334																173,715
New level elements on influent flumes				5,056	7,583	17,694																30,333
Demo Cover on Digester 1				8,411	12,616	29,438																50,465
Replace floating cover on Digester 1				61,411	92,116	214,938																368,465
Improve cover on Digester 2				46,411	69,616	162,438																278,465
Construct new waste gas burner				13,411	20,116	46,938																80,465
Outfall				70,500	105,750	246,750																423,000
New handrails on digesters				11,411	17,116	39,938																68,465
New blower							30,000	50,000	50,000	50,000												180,000
Mixed liquor split box							27,500	45,833	45,833	45,833												165,000
New secondary clarifier							240,250	400,417	400,417	400,417												1,441,500
New RAS pump							30,000	50,000	50,000	50,000												180,000
New WAS pump							28,500	47,500	47,500	47,500												171,000
Chlorine contact basin improvements							13,250	22,083	22,083	22,083												79,500
Site piping							20,250	33,750	33,750	33,750												121,500
New boiler, heat exchangers, gas and hot water piping														85,203	142,004	142,004	142,004					511,215
Mixing heating and recirc for Digester 1														59,101	98,502	98,502	98,502					354,608
Mixing heating and recirc for Digester 2														59,101	98,502	98,502	98,502					354,608
Digester building repair														30,911	51,518	51,518	51,518					185,465
Demolish manual bar screen																			5,056	12,639	12,639	30,333
New mechanical bar screen																			41,931	104,826	104,826	251,583
Replace mechanical bar screen																			41,931	104,826	104,826	251,583
Demolish existing stairs																			4,556	11,389	11,389	27,333
New grit chamber bypass channel and gate																			13,806	34,514	34,514	82,833
New grit cyclone and classifier																			33,681	84,201	84,201	202,083
Degritted primary sludge pump																			13,931	34,826	34,826	83,583
Site piping																			5,056	12,639	12,639	30,333
Inline primary sludge grinder																			27,703	69,256	69,256	166,215
WAS Gravity Belt Thickener																			170,203	425,506	425,506	1,021,215
Thickened WAS pump																			34,453	86,131	86,131	206,715
Thickening Building																			30,911	77,277	77,277	185,465
Yard piping																			12,161	30,402	30,402	72,965
PLANT 2																						11,405,000
	0	0	0	245,562	368,343	859,466	389,750	649,583	649,583	649,583	0	0	0	234,316	390,526	390,526	390,526	0	435,373	1,088,433	1,088,433	19,235,008

COOS BAY WASTEWATER TREATMENT PLANT NO. 1

FACILITIES PLAN

TABLE OF CONTENTS

CHAPTER 1 – EXECUTIVE SUMMARY

CHAPTER 2 – STUDY AREA CHARACTERISTICS

CHAPTER 3 – WASTEWATER COLLECTION SYSTEM

CHAPTER 4 – EXISTING WASTEWATER TREATMENT FACILITIES

CHAPTER 5 – WASTEWATER CHARACTERISTICS

CHAPTER 6 – REGULATORY REQUIREMENTS

CHAPTER 7 – LIQUID STREAM TREATMENT ALTERNATIVES

CHAPTER 8 – SOLIDS MANAGEMENT ALTERNATIVES

CHAPTER 9 – RECOMMENDED PLAN

CHAPTER 10 – FINANCING

COOS BAY WASTEWATER TREATMENT PLANT NO. 1

FACILITIES PLAN

LIST OF TABLES, FIGURES AND APPENDICES

LIST OF TABLES

LIST OF FIGURES

APPENDICES