CITY OF SEBASTOPOL

SANITARY SEWER SYSTEM UTILITY MASTER PLAN

December 2005

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List of Abbreviations

ADDWF	Average Daily Dry Weather Flow
DHS	Department of Health Services
ft	Feet
gpcd	Gallons per capita per day
gpd	Gallons per day
gpm	Gallons per minute
I/I	Inflow and Infiltration
LAFCO	Local Agency Formation Commission
lf	Linear feet
ISO	Insurance Services Office
LOS	Level of Service
MDD	Maximum Daily Demand
Mgpd	Million gallons per day
PHF	Peak Hourly Flow
PVC	polyvinyl chloride
sf	Square feet
SOI	Sphere of Influence

Executive Summary

Coastland Civil Engineering was hired by the City of Sebastopol to complete a *Wastewater System Master Plan*. The Master Plan consists of:

- A study of the existing service area and land use plans;
- An assessment of existing wastewater generation;
- An assessment of existing and future wastewater generation;
- The development of a hydraulic computer model of the existing and future wastewater distribution system;
- An explanation of wastewater system evaluation criteria;
- An evaluation of the existing and future wastewater collection;

This *Wastewater System Master Plan* is intended as an instrument for planning wastewater system improvements necessary to comply with current City zoning ordinances, City Standard Details and Specifications.

A hydraulic model was developed using wastewater generation statistics from 1997 to 2003, the General Plan, the Growth Management Ordinance, Level of Service reports and communication with Public Works and Planning Department staff. The hydraulic model was loaded based on land use densities and adjusted to reflect the City's most recent yearly production data.

The model indicates that the existing wastewater system is adequately designed hydraulically to accommodate current conditions. The City of Sebastopol Public Works Department has identified a few areas where sewer lines are severely deteriorated and require replacement. The priority list and costs to replace these lines is shown in the table below.

Table ES-1
Estimated Costs to Replace Severely Deteriorated Lines

Priority	Location	Estimated Construction Cost	Estimated Total Cost
1	Eastside Ave	$46,875	$60,938
2	Flynn Street	$136,298	$177,187
3	Calder	$147,292	$191,480
4	High Street	$117,283	$152,468
5	Police Station	$129,277	$168,060
	Total	**$577,025**	**$750,133**

These are 2005 costs. Costs should be adjusted for inflation using Engineering News Record 20 City Construction Cost Index, using 7,415 as the basis for 2005.

Future wastewater generation was established based on the Modified General Plan, The City Growth Ordinance and discussions with City Planning and Engineering Departments. Growth in the City includes projects currently in planning and the Northeast Area Specific Plan Option B. Growth also includes annexation of areas in the sphere of influence, including the Gravenstein Highway South Study Area and Belmont Terrace.

This study indicates that for the planned future growth inside the City limits, the existing sanitary sewer collection system is adequate, providing the repairs mentioned above are made.

When the additional growth inside the SOI is included, the existing wastewater collection system was found to be deficient in the South Gravenstein area. Increasing the size of the main in Gravenstein Highway to 10 inches corrects this problem. The project list and cost to replace these lines is shown in the table below.

Table ES-2
Estimated Costs to Replace Undersized Lines

Priority	Location	Estimated Construction Cost	Estimated Total Cost
1	Gravenstein Hwy South	$248,719	$323,334

Since this project is required for the annexation of the South Gravenstein area, the annexation should pay the cost of this work. The new construction should be timed to accommodate expansion of the City into the South Gravenstein area.

Average Daily Dry Weather Flows under future conditions will exceed the City's entitlement for wastewater treatment at the sub-regional plant. Flows generated by modeled growth inside the current city limits will be within the City's entitlement of 0.84 MGD, but if additional areas within the SOI are annexed into the City, the Average Daily Dry Weather Flow is estimated to be about 1.1 MGD. For conservative modeling purposes, this included annexation beyond Growth Management allowances, such as situations that may include compelling public health considerations. Although this is regulated by current policy, should this scenario develop, the City would need to consider that annexation of areas outside the current City limits should be contingent upon the annexation applicant or the City acquiring additional capacity in the Regional Treatment Plant sufficient to accommodate the anticipated flows.

Along with the Master Plan a new electronic Base Map was developed as part of this project. It includes updated information consolidated from several sources and can be overlaid on a digital photo also delivered as part of this project.

Section 1: Introduction

This report provides a comprehensive study of the City of Sebastopol's Wastewater system. It is one of three master plan utility studies conducted by Coastland Civil Engineering analyzing the City's water, sanitary sewer and storm drain facilities. It represents the latest in a series of studies conducted to establish the condition and effectiveness of existing and future wastewater system needs. The following sub-sections provide a brief history of the City's wastewater system and background information regarding development of this report.

1.1 Background

The City of Sebastopol constructed the very basic elements of its present wastewater systems in 1926. The collection system for the central business district and main residential areas had been installed some years prior, but records are not available. Prior to 1967, a few improvements were made to the collection system to accommodate population growth. In 1967[£] a study was undertaken to determine the future wastewater collection requirements of the City and its Sphere of Influence (SOI), and to set criterion for how this was to occur. As a result of the 1967 report, many of the older and undersized wastewater mains were upgraded and extended. The study evaluated the existing condition of the City's wastewater system and provided improvements to the system to meet future collection requirements and to service the growing community.

As the City approaches its ultimate build-out potential, a detailed study including reports, maps and records of the existing wastewater collection systems is again in order, along with a plan for improvements based on the current General Plan and future growth patterns.

1.2 Objectives

The objectives of this study are to evaluate the existing wastewater system collection capacity for residential, commercial, and industrial land use designations, identify system deficiencies, outline existing and future system improvements to meet current and projected demands and provide cost estimates for these improvements.

1.3 Scope of Services

The Scope of Services for this sanitary sewer master plan is as follows:

- Update the 1993 Sanitary Sewer System Base Map to existing conditions.
- Review and update existing wastewater studies, incorporating appropriate areas within the City Sphere of Influence into the study.

[£] M.C. Yoder Associates Consulting Engineers, "Regarding a Study of Domestic and Industrial Wastewater Collection, Treatment, and Disposal", Report to The City of Sebastopol, Sonoma County, California, November 1967.

- Compile and review available wastewater analyses and develop new city-wide analyses.
- Identify needed projects based on existing and future demands.
- Prepare a report outlining recommended improvements to the wastewater system and incorporate preliminary cost estimates for these improvements.
- Prepare a Master Plan Map showing all needed improvements.

1.4 Conduct of Study

The information developed in this report is based on existing demand, production, population figures, reports, as-built drawings, maps, utility information, and improvement plans provided by the City Public Works Department. The Public Works Department staff identified problem areas within the existing wastewater system that they felt required attention.

Orthographic photography with airborne GPS control generated a digital orthographic surface from which photomaps with two foot contours were created. Surface elevations were obtained from these maps. The existing base maps were updated and corrections were made using construction drawings, as-built drawings, field investigations and discussions with the City. The base map information, elevations and engineering assumptions were used to create a computer model of the sanitary sewer system.

The Modified 1998 General Plan, Growth Ordinance and discussions with City Planning were used to determine the projected population densities and wastewater collection needs for the different land use designations within the City.

The projected wastewater system requirements and flows were evaluated to determine the adequacy of wastewater main sizes, pump station sizes, and wet wells for current conditions, as well as full build-out.

Hydraulic modeling of the collection system was performed for the City's wastewater system based on peaking factors. Inflow and Infiltration was distributed over the entire system by length of pipe. This was used to locate areas where lines are deficient or undersized for both current conditions and the future build-out state.

Sections 2, 3 and 4 of this report discuss the study area, the existing wastewater system, the development of projected wastewater generation and the generation of the computer model analysis. Section 5 discusses the results of the hydraulic modeling.

Section 2: Study Area and Existing Wastewater System

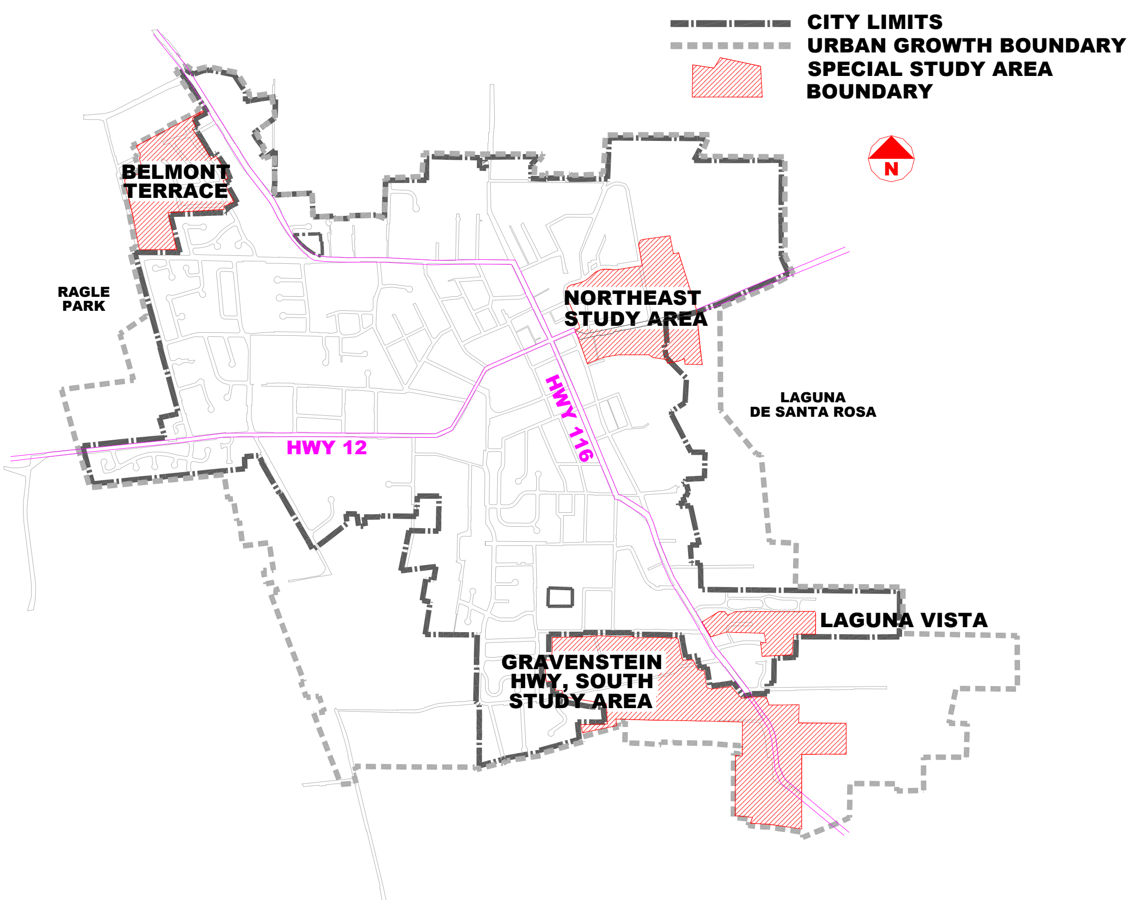
This section describes the Sebastopol Municipal Wastewater System (SMWS) service area, the status of land use planning for the area, and the SMWS collection system.

2.1 Existing Service Area and Land Use Plans

Sebastopol is a semi-urban incorporated community located in western Sonoma County approximately 50 miles north of San Francisco and 7 miles west of Santa Rosa. The area is bounded by the Laguna de Santa Rosa to the east and Atascadero Creek to the west. Highway 12 is the main transportation corridor and bisects the community into north-south quadrants. Highway 116 bisects the community in east-west quadrants.

Figure 2-1 shows neighborhood areas and landmarks that may be referenced on occasion within the report. The commercial areas are generally located along the Hwy 116 corridor with the majority of commercial and industrial space in the northeast quadrant of the City. The remaining areas are primarily residential with a scattering of parks and institutional land use.

FIGURE 2-1
SEBASTOPOL NEIGHBORHOODS AND LANDMARKS



The City of Sebastopol owns, operates and maintains the SSMS collection system and has limited wastewater treatment capacity entitlement in the Sub-regional Sewer Treatment System. Sebastopol's ability to accommodate future development is limited by their capacity entitlement in the Sub-regional Sewer Treatment System.

2.1.1 Status of Area Land Use Plans

Land use planning for the service area is performed under the auspices of the City's Planning Commission, the Design Review Board, citizen committees and the Sonoma County Local Agency Formation Commission (LAFCO), as detailed in the General Plan.

The officially recognized General Plan was adopted in 1994 with updates in 1995, 1996, 1998 and 2003. Consistent with the goals outlined in the General Plan, the City adopted measures to limit urban sprawl by reducing the City's Sphere of Influence (SOI). The community adopted the Urban Growth Boundary Measure (Measure O) in 1996. In essence, Measure O prohibits annexations outside the SOI by the City Council for a period of 20 years unless they are endorsed by voter approval.

The City adopted a Growth Management Ordinance which establishes maximum allowable growth rates based on the community's ability to provide key resources (water, wastewater, roads, and school, for example). Moreover, this ordinance limits the number of new residential units to 25 per year. If the annual limit is not met, the unused allocations become available for future years, for a limited period.

The General Plan establishes level of service (LOS) standards for all utilities including the wastewater system. Each year the City publishes a LOS report that includes annual statistics for wastewater generation and outlines studies and improvements to the system.

2.1.2 Zoning and General Plan Land Use Designation

As mentioned in the previous section, the City of Sebastopol General Plan establishes land use designations for all areas within the SOI. These designations establish the City's zoning regulations as described in the Zoning Ordinance and as illustrated in the Land Use Designations Map. The map in Appendix A reflects current zoning within the City's SOI. The 12 zones identified on this map include Open Space, Parks, Community Facilities, Very Low Density Residential, Medium Density Residential, High Density Residential, General Commercial, Office, Downtown Core, Light Industrial and Office/Light Industrial.

2.1.3 Ultimate Build-out Development Methodology

The City of Sebastopol Growth Ordinance limits the net increase in residences to 575 over the life of the Plan. Second units, commonly known as "Granny Units" are not included in this figure since 1994. As of December 2004, 335 regulated units had been constructed, were under construction, or in the planning process.

The methodology for determining the ultimate growth for this Utility Master Plan is as follows:

- Allow construction of 575 new residential housing units beginning in 1994. Use the existing residential units in 2004 and the planned units in 2004. Fill the remaining units using Alternative B of the Northeast Area Alternative Plan.
- Allow the addition of 100 new second units beginning in 2005. Disperse these throughout the low and medium density housing land use areas.
- Assume the commercial expansion from Alternative B in the Draft Northeast Area Alternative Report.
- Assume an increase of 100,000 sq ft of commercial space along Gravenstein Highway North.
- Assume any remaining capacity to be taken up by growth in the commercial zone in Gravenstein Highway South.

The City also recognizes that there may be expansion of the existing City boundaries to include various areas inside the sphere of influence. These areas include the area south of the City along Gravenstein Highway. In 2000, the City completed a "Gravenstein Highway South Study Area Utility Needs Study" which has been used in this report. Another significant area inside the SOI that may be annexed into the City is the Belmont Terrace Area. This consists of approximately 90 residential homes. In addition to these two major areas, the City Planning envision that about 50 residential units will request to be annexed into the City at various points along the present City boundary and within the SOI.

Consistent with the vision of Urban Growth Boundary measure, future build-out development projects will shift and concentrate land use designations within the City limits, as well as annex areas within the SOI. Table 2-1 shown on the following page, lists locations where City planners estimate this expansion to occur.

All of the above would be constrained and limited by the City's Growth Management policies, but has been modeled herein for conservative analysis purposes.

2.2 Existing Wastewater System

To map a course for future improvements to the City's wastewater system it is vital to evaluate the development and level of service of the existing system, determine existing deficiencies, and develop alternatives to remedy these deficiencies.

2.2.1 Historical Development

The City of Sebastopol was initially formed in the early 1850s serving primarily as a trade center for the predominately agricultural region. In 1902 the City was incorporated and had at that time established businesses such as canneries, mills, and wineries. Most of the original buildings were destroyed in the 1906 earthquake and were later rebuilt. Today, Sebastopol has a population of 7,800 and the hypothetical growth scenario discussed above would allow for the City-wide population to increase to an estimated 9,900.

2.2.2 Existing Wastewater Flows

From the memorandum entitled, "Sewer Flows and Water Usage Statistics for Annual Level of Service Report" prepared by Sebastopol's Engineering Director, dated February 9, 2005, Sebastopol's current entitlement in the Sub-regional Treatment System is 840,000 gallons per

Table 2-1 Build-out Land Use

Residential Build-out	
Location	**Residential Units**
7991 Covert Lane	20
824 Gravenstein Hwy South	4
7385 Healdsburg Avenue	12
7770 Healdsburg Avenue	4
380 Jewell Avenue	1
Laguna Vista (net)	140
840 and 860 Litchfield Avenue	13
791 Norlee Street	3
333 North Main Street	6
501 Petaluma Avenue	39
406 Pitt Avenue	2
501 South Main Street	10
7590 Washington Avenue (net)	3
Northeast Area	78
Second Units spread throughout City	100
Belmont Terrace (In SOI)	90
Belmont Terrace Second Units (In SOI)	27
Gravenstein Hwy South	117
Gravenstein Hwy South Second Units	35
Healdsburg Avenue	8
Bodega Avenue (In SOI)	7
First Street (In SOI)	7
Robinson Road (In SOI)	7
Zimpher Drive (In SOI)	7
South Main Street (In SOI)	7
Jewell Avenue (In SOI)	7

Commercial, Industrial and Community Facilities Build-out	
Location	**area (sq. ft)**
Northeast Area	
light industrial (to be demolished)	150,000
commercial	350,000
community facilities	65,000
Gravenstein Hwy North (in City limits)	
commercial	100,000
Gravenstein Hwy South (in City limits)	
commercial	25,000
Gravenstein Hwy South (in SOI)	
light industrial	939,154
commercial	74,575
Downtown	
commercial	50,000

day (gpd) Average Daily Dry Weather Flow (ADDWF). In 2004, the ADDWF was 0.610 million gallons per day (mgd) or 73% of the City's entitlement. ADDWF for the Morris Street Pump Station from 1997 to 2002 was 0.635 mgd or 76% of the City's entitlement. This amount takes into account residential, commercial and industrial wastewater generation, inflow and infiltration and system losses.

The ADDWF for the Morris Street Pump Station from 1997 to 2002 averaged 0.635 mgd. Flows from 2003 were omitted because they were unusually low when compared to previous years.

Average water use during this period was approximately 1.28 mgd, including approximately 0.03 mgd of high-use irrigation. Disregarding irrigation use, the average water use was 1.25 mgd.

The ratio of ADDWF to average water use in Sebastopol is approximately 51%. The Water Environment Federation Manual of Practice 8 recommends basing wastewater flows on water use and notes that "at least 60% to 90% of the water consumption reaches the sewer system." The ratio of wastewater flow to water use is, therefore, low when compared to national averages.

The Gravenstein Highway South Study Area Utility Needs Study used a factor of 0.58 for residential wastewater flow to water use for average dry weather flows. The Gravenstein Highway South Study Area Utility Needs Study also assumed that all water used by commercial facilities would be discharged into the wastewater collection system and calculated a wastewater flow of 1,000 gallon per day (gpd) per acre for commercial flow.

An examination of the number of existing residential lots, based on the number of homes constructed, a 1994 General Plan Background report, and U.S. Census figures suggests that there are approximately 3,360 residential units within the City. The average current residential water use is approximately 270 gpd per unit. After applying the 0.58 factor calculated from the Gravenstein Highway South Study Area Utility Needs Study, the wastewater flow would be 157 gpd per residential unit.

The Water Master Plan indicated that the average water use for commercial and industrial users is approximately 456,000 gpd dispersed throughout 250 acres of commercial and industrial land. This is an average of 1,816 gpd per acre. Assuming a flow of 1,000 gpd per acre would result in a sewer to water use ratio of about 55%.

Coastland began with these assumed dry weather flows of 157 gpd for residential use and 1,000 gpd for non-residential use.

The ADDWF for the City using the above assumptions is calculated at 731,862 gpd. This is more than the total ADDWF recorded at Morris Street Pump Station. The actual measured ADDWF at the Morris Street Pump Station was divided by the assumed calculated total ADDWF to get a factor for the individual flow components. This percentage factor was then applied to the original assumptions such that the calculated total flow was equal to the measured ADDWF flow at Morris Street. The resulting ADDWF for residential use was 136 gpd per residence and 870 gpd per acre for commercial and industrial flows. A map of existing peak hour flows can be seen in Appendix C.

2.2.3 Peaking Factors and Total Flow for Modeling

Planning future wastewater generation based on current wastewater flows requires making engineering assumptions. To evaluate future wastewater generation and required system upgrades, peaking factors and inflow and infiltration were applied to the average daily dry weather wastewater flow.

A peaking factor of 3.1 was used for Dry Weather sewer flows (peak hour ADWF/ADWF). This is based on Harmon's Peaking Factor; $PF=1+14/(4+P^{1/2})$; where P= the design contributing population in thousands.

Existing residential units have a peak hourly flow of 422 gpd or 0.3 gpm. Existing industrial units have a peak hourly flow of 2690 gpd/acre or 1.9 gpm/acre.

A factor of 4.0 was used for peak weather infiltration (wet weather max day/ADWF). This is the actual measured maximum day inflow/ADWF for the period 1997 to 2003. Since the ADDWF was 0.635 MGD, the infiltration flow is 1.9 mgd or 1,320 gpm.

The wastewater system was modeled to carry the heaviest anticipated flow. For modeling purposes the Peak Hourly Flow was assigned to the residences, commercial and industrial areas. The infiltration for wet weather flow was assigned to pipe lengths.

2.2.4 Existing Infrastructure

City of Sebastopol

The SMSS collection system network is comprised of approximately 152,000 linear feet of pipe ranging in sizes from 6" to 21" and made of various materials including concrete, high-density polyethylene (HDPE), polyvinylchloride (PVC), and vitrified clay pipe (VCP). The existing collection facilities are shown on the Sanitary Sewer System Map in Appendix B. An inventory of the collection system is tabulated in Table 2-2 below.

Table 2-2 Sanitary Sewer Collection System Pipe Inventory

TOTAL PIPE LENGTH (FT)										
Pipe Material / length (ft)	Pipe Diameter (inch)									Length/ Material
	6	8	10	12	14	15	16	18	21	
Asphalt Concrete Pipe	8,781	1,614		1,358						11,753
Ductile Iron Pipe (DI)	2,160	1,643								3,804
Polyvinyl Chloride	72,313	17,979	8,220	2,170	3,201		868			104,751
Vitrified Clay Pipe	18,775	3,129	3,763	3,100		1,424		108	1,428	31,726
Total Length by Diameter (ft)	102,030	24,365	11,983	6,627	3,201	1,424	868	108	1,428	152,034

City of Santa Rosa

The City of Sebastopol contracts with the City of Santa Rosa for wastewater treatment and disposal at the Laguna Subregional Treatment Plant. Sebastopol's entitlement of this treatment/disposal capacity is 0.84 million gallons per day (mgd) ADDWF. In 2004, the City used 73 percent of its entitlement. With a residential building cap of 40 units per year for the first five years of the ordinance and 25 units per year for the next 15 years, provision for affordable housing projects and new commercial and industrial demands, it is estimated that the City will use 96 percent of its wastewater treatment capacity by the year 2013. Increasing Sebastopol's wastewater treatment/disposal capacity is dependent on decreasing existing flow, or purchase of additional treatment capacity, as well as Santa Rosa's ability to expand the wastewater disposal and storage capacity of the subregional treatment plant. To increase its wastewater treatment entitlement, the City would be required to pay a pro-rated share of the expansion of the treatment plant. This could result in increases in user fees for residents of Sebastopol.

Sebastopol's wastewater system flows to an existing lift station known as the Morris Street Lift Station. From the Morris Street Lift Station, wastewater is pumped to the Laguna Treatment Plant through a 14-inch diameter force main. The Morris Street Lift Station includes two wastewater pumps: the first with a rated capacity of 1.7 mgd and the second with a rated capacity of 3.2 mgd. The pumps can be operated individually or in parallel, bringing the total rated capacity of the lift station to approximately 4 mgd. The City's current peak flows through the Morris Street Lift Station are approximately 3 mgd, leaving approximately 1 mgd of available capacity in the pumping and force main system.

2.3 Existing Wastewater System Problem Areas

The City of Sebastopol

The City of Sebastopol has had all sanitary sewer lines inspected over the past several years. Based on the inspection ratings, the types of deterioration noted during the inspections, and the operation problems encountered due to the deterioration the City has listed a few areas where lines need to be replaced. A prioritized list of these severely deteriorated lines is provided in Table 2-3 below.

Table 2-3 Deteriorated Sewer Lines Requiring Replacement

Priority	Location	Up Manhole	Down Manhole	Diameter (in)	Length (ft)
1	Eastside Ave.	S17-009	MAINLINE	6	250
2	Flynn Street	E05-049	E05-009	6	300
2	Flynn Street	E05-009	E05-005	6	660
3	Calder Street	S09-013	S09-009	6	195
3	Calder Ave.	S09-009	S09-005	6	320
3	Calder Ave.	S09-005	S00-005	6	325
4	High Street	S09-025	S09-021	6	220
4	High Street	S09-021	S09-006	6	435
5	Police Station	E05-037	E05-033	6	185
5	Police Station	E05-033	E05-029	6	120
5	Police Station	E05-029	E05-025	6	125
5	Police Station	E05-025	E05-021	6	115

Section 3: Future Wastewater System

3.1 Future Development Potential

Several areas throughout the City of Sebastopol remain undeveloped or not developed to full General Plan "build-out". It is anticipated that these areas will be built with commercial, industrial, or residential development in the future as indicated in the General Plan and as limited by the Sebastopol Growth Ordinance.

These areas, when built according to their Land Use designations will increase the wastewater being generated which may necessitate larger wastewater collection facilities. However, Sebastopol's ability to accommodate future development is limited by its entitlement in the Sub-regional Wastewater Treatment System.

3.2 Future Sewer Flows

New residential units were assumed to have an average dry weather sewer flow of 200 gpd. New commercial and institutional units were assumed to have an average dry weather sewer flow of 0.16 gpd/square feet (sf). For new industrial units we assumed average dry weather sewer flows of 0.26 gpd/sf. A map illustrating peak hour flows for future development is shown in Appendix D.

The above figures were provided by the City Engineering Staff and have been used by them for planning purposes in allocating growth impacts to Sebastopol's wastewater infrastructure. These values are somewhat conservative compared to historical or current flows.

3.3 Peaking Factors and Total Flow for Modeling

A peaking factor of 3.1 was used for Dry Weather sewer flows (peak hour ADWF/ADWF). This is based on Harmon's Peaking Factor; $PF=1+14/(4+P^{1/2})$; where P= the design contributing population in thousands.

Newly constructed residential units have a peak hourly flow of 620 gpd or 0.43 gpm. New commercial and institutional units were assumed to have a peak hourly sewer flow of 0.34 gpm/Ksf. New industrial units were assumed to have peak hourly sewer flows of 0.56 gpm/Ksf.

A factor of 4.0 was used for peak weather infiltration (wet weather max day/ADWF). This is the actual measured maximum day inflow/ADWF for the period 1997 to 2003. Since the ADWF was 0.635 MGD, the infiltration flow is 1.9 mgd or 1,320 gpm.

It is assumed that new construction will not increase the inflow and infiltration flow rate since most construction will be infill and replace existing older collection mains with improved collection mains.

The wastewater system was modeled to carry the heaviest anticipated flow. For modeling purposes the Peak Hourly Flow was assigned to the residences, commercial and industrial areas. The infiltration for wet weather flow was assigned to collection mains on a linear foot basis.

3.4 Future Wastewater Flow Calculations

Using the new construction from Table 2-1 and the values for future sewer flows previously discussed, Table 3-1 below shows the future expected ADDWF for the City of Sebastopol. The City has a current wastewater treatment allotment of 0.840 Mgd of ADDWF. The City has a policy of keeping 5% of sewer treatment capacity in reserve. This reserve is 0.042 Mgd ADDWF.

Table 3-1 indicates that with the planned build-out levels within the City limits, the ADDWF will be below the City's total treatment capacity entitlement, but will have consumed a portion of the reserve, absent flow reductions. With hypothetical development, conservative wastewater generation factors, and annexation of the areas within the SOI, the City would require additional treatment capacity.

Table 3-1 Estimated Future Average Daily Dry Weather Wastewater Flows

Type and Location of Future Construction	New Units or SF	ADDWF (MGD)
Residential in Current City Limits	587	0.117
Commercial, and Community Facilities in Current City Limits	590,000	0.094
Industrial in Current City Limits	-150000	-0.039
Subtotal Growth in City Limits		0.173
Residential in SOI	167	0.033
Commercial, and Community Facilities in SOI	74,575	0.012
Industrial in SOI	939,154	0.244
Subtotal Growth from SOI Annexation		0.290
Total Increase In ADDWF		0.462
Current ADDWF		0.635
Future ADDWF		1.097
ADDWF Capacity		0.840
Calculated Treatment Capacity Shortfall		-0.257

It should be noted that this scenario, in addition to including hypothetical development, does not reflect the metering limits of the Growth Management Ordinance, or regional mitigation of wastewater flows.

3.5 Analysis of the Wastewater System: Build-out

Hydraulic analyses of the wastewater system at build-out conditions were performed using the model development described in Section 2. Refer to Section 2.1.3, "Ultimate Build-out Development Methodology" and Table 2-1, "Build-out Land Use" for the locations and descriptions of future developments and annexations within the SOI. The Area requiring wastewater system improvements is the Gravenstein Highway South area, along Gravenstein Highway.

3.6 Recommended Wastewater System Improvements: Build-out

The wastewater system analyses revealed deficiencies in the existing collection system during periods of high demand as a result of “ultimate build-out” development. Several wastewater system collection pipelines within Gravenstein Highway between Cooper Road and Redwood Avenue must be up-sized as a result of future projected development in the Gravenstein South Study area (Appendix E). The following table lists the pipeline improvements. It is important to note that these deficiencies are the result of increased flow in the SOI in the Gravenstein Highway South Study area. Increases predicted within the current City boundaries do not require increasing pipe capacities.

Table 3-2 Gravenstein Highway South Study Area Wastewater System Improvements

Existing Condition	Length (ft)	Area	Description
8” PVC	329	Gravenstein South	Replace 8” pipe P-1280 from upstream manhole MH-256 to downstream manhole MH-251 with a 10” pipe. (Figure 3-1)
8” PVC	194	Gravenstein South	Replace 8” pipe P-250 from upstream manhole MH-251 to downstream manhole MH-260 with a 10” pipe. (Figure 3-1)
8” PVC	276	Gravenstein South	Replace 8” pipe P-1265 from upstream manhole MH-260 to downstream manhole MH-263 with a 10” pipe. (Figure 3-2)
8” PVC	22	Gravenstein South	Replace 8” pipe P-1576 from upstream manhole MH-263 to downstream manhole MH-264 with a 10” pipe. (Figure 3-2)
8” PVC	359	Gravenstein South	Replace 8” pipe P-1393 from upstream manhole MH-264 to downstream manhole MH-269 with a 10” pipe. (Figure 3-2)

Figure 3-1 Gravenstein Highway Improvements: Cooper to Corline

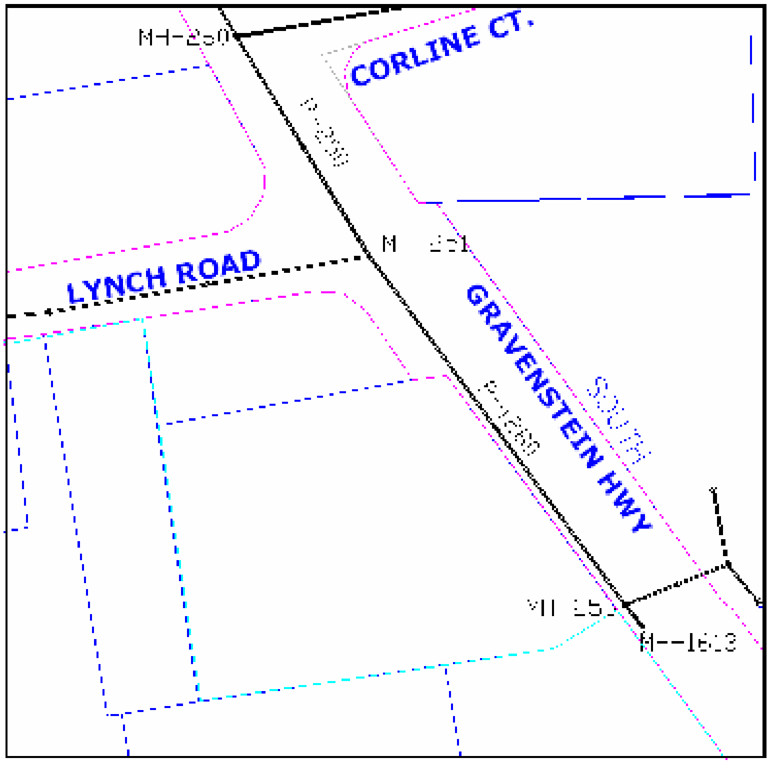
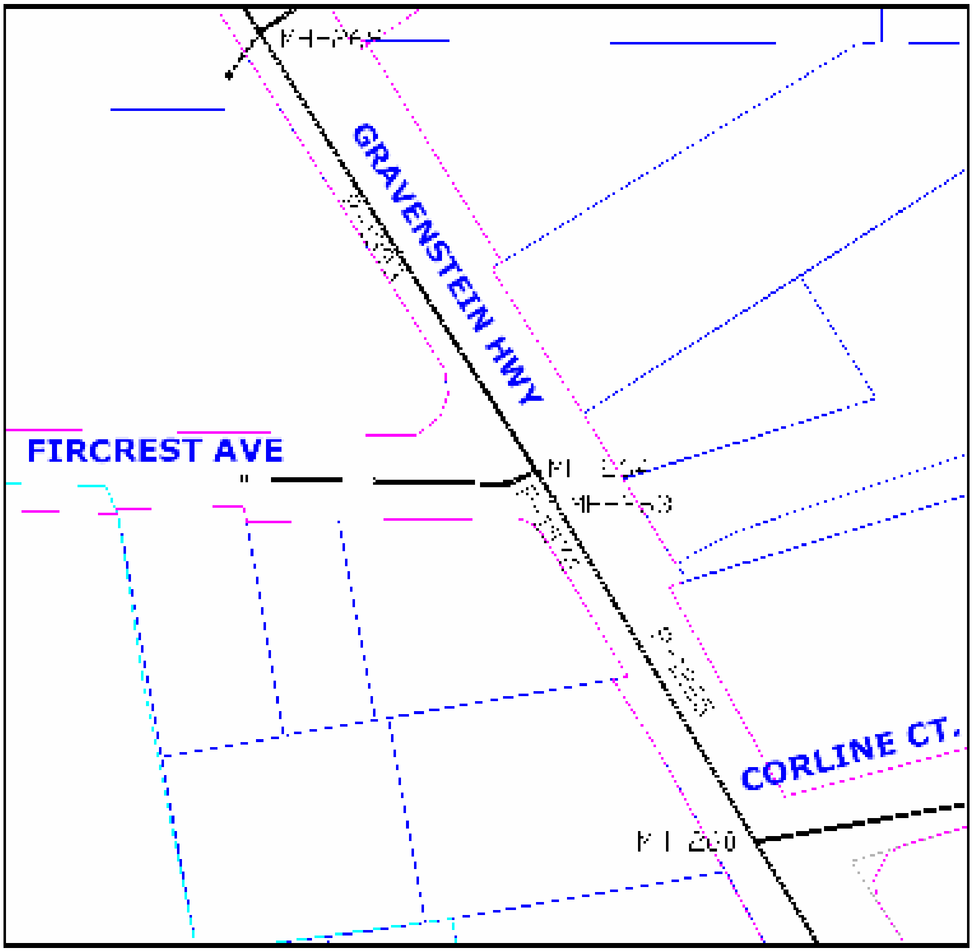


Figure 3-2 Gravenstein Highway Improvements: Corline to Redwood



Section 4: Wastewater System Model Development

4.1 Development of Wastewater System Model

The wastewater system model was created based on the wastewater system base map generated by Coastland Civil Engineering. Utilizing hydraulic modeling software, the base map data was imported to model the peak hour of the peak daily flow for the existing wastewater system and for future system development. The Public Works and Engineering Departments reviewed the base map and provided additional data and corrections to aid in the model calibration. With this information the model was developed based on the following criteria:

- Model calibration was achieved by establishing pipe friction factors (C-factors) for each of the various pipe materials found within the City.

- Nodes were assigned the following attributes:

  - Elevations obtained from orthogonal photographic data with accuracy to the nearest foot

- Pipes were assigned the following attributes:

  - Diameter
  - Length
  - Year constructed
  - Material type
  - Rating (pipe capacity)
  - Hazen Williams friction factor

- Wastewater generation was modeled as:

  - Peak hour dry weather flows for large water users used a ratio of water to sewer use applied to the nearest upstream node. This allowed more accurate distribution of flows than per unit or square foot application.
  - Peak hour dry weather flows for other commercial and industrial units were distributed by square footage and applied to the nearest upstream node.
  - Peak hour dry weather flows for other residential units was applied to the nearest upstream node.
  - Inflow and Infiltration was distributed throughout the system by linear foot of pipe.

4.2 Hydraulic Modeling Methodology

Hydraulic modeling software was used to evaluate the City's existing and future wastewater capacity. The software allows the user to construct graphical representations of pipe networks containing information such as pipe data, pump data, loading, and infiltration. The gravity network is then calculated using the built-in numerical model, which utilizes both the direct step and standard step gradually varied flow methods. In order to most accurately represent the City of Sebastopol's wastewater collection system, the model was created to run a Steady State Analysis on the entire system. Steady State Analyses model a single instant in time and are utilized to model a network under peak loading conditions.

4.3 Calculated Flows and Hydraulic Grade Lines

The Master Plan Model evaluates the entire wastewater system using Steady State Analysis. Loads are the sources of flow in the wastewater system and are categorized as sanitary (dry weather) loads and wet weather loads. The computer program required the input of sanitary loads, corresponding to various residential, commercial, and industrial usages. These loads were adjusted through the use of peaking factors. The program also required the input of wet weather loads, related to rainfall activity such as groundwater infiltration.

4.4 Junction Headlosses and Minor Losses

The losses within the sanitary sewer system were assumed to consist of junction headlosses and minor losses. Junction headlosses were calculated using the HEC-22 Energy Method. There were numerous corrections to the coefficient to take into account structure geometry, pipe diameter, flow depth, relative flow, plunging flow, and benching. The total loss at each structure is the product of the exit pipe's velocity head and the HEC-22 headloss coefficient.

Minor losses or Friction losses were computed based on the average rate of friction loss along a pipe segment. (The average friction slope of a segment multiplied by its length.) Using the direct step method of analysis we were able to generate the gradually varied flow profiles for individual segments of the wastewater system taking friction losses into account.

4.5 Modeling Assumptions

Pipe cover and slopes were found from improvement plans, as-builts, and through field verification where possible. Where elevation and slope information was not known, ground slope was assumed. Where ground slope was less than 0.5% a minimum pipe slope of 0.5% was used. Also, where invert elevations were not available a 0.10' drop across manholes was assumed. The invert information as shown on the Base Maps does not contain any of the calculated values. The Base Maps only contain values from record drawings or field surveys.

Section 5: Results of Wastewater System Analyses

This section describes the criteria used in the analyses of the wastewater system to determine the adequacy of the system as it exists and for future build-out conditions. This section details the results of the analyses.

5.1 Evaluation Criteria

Criteria for evaluating the wastewater collection systems, based on industry standards are described in the following sections.

5.1.1 Collection Pipelines

Pipe capacity depends upon ranges of pressure, velocity and flow specific to pipe types and sizes. Collection pipes were evaluated on their ability to contain anticipated flows generated during the peak hour of the peak average daily dry weather flow.

5.1.2 Pump Stations and Wet Wells

Pump stations serve to provide the system with the required pressure needed to overcome increased elevation. Pumps have been evaluated based on input values of design head and pump discharge. Wet wells were designed based on plans obtained from the City's Public Works Department and were evaluated by active volume.

5.2 Analyses of Existing Wastewater System

Hydraulic analyses of the existing wastewater system were performed using the model development method described in Section 4 of this report. As previously mentioned, the existing wastewater system was analyzed using average peak hourly flow derived from average peak daily dry weather flow data recorded at the Morris Street Pump Station. As a result, the flows utilized to model the existing wastewater system are significantly higher than what is commonly experienced. The maximum day flow at the Morris Street Pump Station between 1997 and 2004 was the equivalent of 1,760 gpm. The Peak Hourly Flow for existing conditions used in this analysis was the equivalent of 2,686 gpm. Based on this flow, the existing wastewater system appears to be adequately sized and designed to accommodate wastewater flows generated due to the current conditions.

5.3 Analyses of Future Wastewater System

Hydraulic analyses of the wastewater system based on future build-out conditions described were performed using the model development method described in Section 4 of this report. Similar to the analysis of the existing system, the system based on future build-out conditions was analyzed using peak hourly flow and wet weather inflow and infiltration. Peak Hourly Flow was derived from average daily dry weather flow data recorded at the Morris Street Pump Station, as well as predicted average daily dry weather flows for future residential, commercial, and industrial units.

Total ADDWF for the future system was calculated at 1.097 Mgd. This is in excess of the City's current entitlement of 0.840 Mgd ADDWF in the Sub-regional Treatment System. The modeled flow rate was 3,681 gpm.

The wastewater system analyses reveal that improvements will need to be made to the existing wastewater system to accommodate future projected wastewater flow generated by development in the Gravenstein Hwy South Study area. Several wastewater system collection lines within South Gravenstein Highway were found to be undersized and will need to be up-sized to 10 inch lines in order for the current system to accommodate future wastewater flows. This is similar to the findings in the Gravenstein Highway South Utility Needs Study. Wastewater system collection lines requiring up-sizing are listed in Table 3-2.

Section 6: Recommended Wastewater System Improvements

The hydraulic analyses of the City of Sebastopol's existing wastewater system presented in the Section 5 indicated no deficiencies. The City has provided us a list of severely deteriorated pipes that need replacement due to damage or structural problems. A list of these lines is provided in Section 2. Estimated costs to replace these lines are provided in Section 7. All of the deteriorated lines can be replaced with 6-inch diameter sewer lines. When replaced, these lines will function both for present and future build-out flows.

The Analysis of the wastewater system based on future "build-out" conditions within the City limits indicate that the pipes are sufficient to accommodate future flows.

When future growth of the area within the SOI is added to furure growth within the City limits, the model indicated that pipes within Gravenstein Highway South must be up-sized in order to accommodate future projected flows coming from the South Gravenstein area. The sewer pipelines in the South Gravenstein area must be increased to 10 inches. This is similar to the findings of the Gravenstein Highway South Study Area Utility Needs Study, Alternatives 1 and 3. Pipes requiring improvement are listed in section 3. Estimated costs to replace these lines are provided in Section 7.

Section 7: Estimated Cost of Recommended Improvements

This section provides the estimated costs for the recommended improvement projects required to meet current and future needs. In this case the projects are those identified by City of Sebastopol Public Works as areas where lines are severely deteriorated and need replacement, as well as lines required to be upsized to meet future developed wastewater generation. The projects below are listed in order of priority. Estimated costs were averaged from a number of actual bid projects from 2003 to 2005, adjusted for inflation. These were compared with other master plan figures, also adjusted for inflation. Future use of this cost data must be adjusted accordingly.

Each project estimate is based on the lineal feet of pipe. Since all deteriorated pipes were 6-inch lines, the material selected for the replacement lines was PVC. The standard cost for a pipe line includes the estimated cost of trenching, shoring, backfilling, paving, valves and connections to water and fire services. Service laterals are assumed to be every 60 feet on each side. Additional costs are added for mobilization, traffic control and miscellaneous work.

Each project estimate includes estimated construction cost, 15% construction contingency and a 30% mark-up for legal, environmental, engineering, inspection and administration services. Estimates do not include land acquisition or right-of-way costs.

These cost estimates are provided at a preliminary planning level of accuracy and do not guarantee that a bid price will be received at or below estimates, as price bids are subject to numerous shifting variables.

These are 2005 costs. Costs should be adjusted for inflation using the Engineering News Record 20 City Construction Costs Index, using 7,415 as the basis for 2005.

7.1 Estimated Capital Cost for Deteriorated Lines

Table 7-1 Eastside Ave

Location	Up Manhole	Down Manhole	Diameter (in)	Length (ft)	Unit Cost	Estimated Cost
Eastside Ave.	S17-009	MAINLINE	6	250	$90	$22,500
Mobilization, Traffic Control and Miscellaneous work						$15,000
Contingency & small project mark-up						$9,375
Construction Cost						$46,875
Total Replacement Cost						**$60,938**

Table 7-2 Flynn Street

Location	Up Manhole	Down Manhole	Diameter (in)	Length (ft)	Unit Cost	Estimated Cost
Flynn Street	E05-049	E05-009	6	300	$87	$36,100
Flynn Street	E05-009	E05-005	6	660	$87	$67,420
Mobilization, Traffic Control and Miscellaneous work						$15,000
Contingency						$17,778
Construction Cost						$136,298
Total Replacement Cost						**$177,187**

Table 7-3 Calder

Location	Up Manhole	Down Manhole	Diameter (in)	Length (ft)	Unit Cost	Estimated Cost
Calder Ave.	S09-013	S09-009	6	195	$87	$26,965
Calder Ave.	S09-009	S09-005	6	320	$87	$37,840
Calder Ave.	S09-005	S00-005	6	325	$87	$38,275
Mobilization, Traffic Control and Miscellaneous work						$25,000
Contingency						$19,212
Construction Cost						$147,292
Total Replacement Cost						**$191,480**

Table 7-4 High Street

Location	Up Manhole	Down Manhole	Diameter (in)	Length (ft)	Unit Cost	Estimated Cost
High Street	S09-025	S09-021	6	220	$87	$29,140
High Street	S09-021	S09-006	6	435	$87	$47,845
Mobilization, Traffic Control and Miscellaneous work						$25,000
Contingency						$15,298
Construction Cost						$117,283
Total Replacement Cost						**$152,468**

Table 7-5 Police Station

Location	Up Manhole	Down Manhole	Diameter (in)	Length (ft)	Unit Cost	Estimated Cost
Police Station	E05-037	E05-033	6	185	$87	$26,095
Police Station	E05-033	E05-029	6	120	$87	$20,440
Police Station	E05-029	E05-025	6	125	$87	$20,875
Police Station	E05-025	E05-021	6	115	$87	$20,005
Mobilization, Traffic Control and Miscellaneous work						$25,000
Contingency						$16,862
Construction Cost						$129,277
Total Replacement Cost						**$168,060**

The estimated construction cost for all these projects is approximately $580K. The total estimated cost to complete all these projects is about $750,000.

7.2 Estimated Capital Cost for Upsizing Lines

The following table provides a cost for upsizing the lines for Gravenstein Highway. This project is necessitated by development in the SOI associated with the South Gravenstein Area. Therefore, the annexation should be responsible for paying the cost of this project. At the time of the annexation, the City should reevaluate the size of the annexation, types of zoning and future demands and increase the size of this replacement line as required to meet the predicted flows.

Note that these costs do not include work to design and constructed needed infrastructure in the South Gravenstein area itself. These estimates were provided by the Gravenstein Highway South Study Area Utility Needs Study (Appendix E). There was no alternative preference for the three sanitary sewer alternatives in the Gravenstein Hwy South Study Area Utility Needs Study. Project costs for sanitary sewer alternatives in the Sebastopol Utility Needs Study varied from $1,675,830 to $1,984,690. Updated for inflation these costs would be from $2,045,141 to $2,427,422.

Table 7-6 Gravenstein Highway

Location	Up Manhole	Down Manhole	Diameter (in)	Length (ft)	Unit Cost	Estimated Cost
Gravenstein Hwy	GOO-129	GOO-125	10	329	$117	$48,493
Gravenstein Hwy	GOO-125	GOO-121	10	194	$117	$32,698
Gravenstein Hwy	GOO-121	GOO-117	10	276	$117	$42,292
Gravenstein Hwy	GOO-117	GOO-113	10	22	$117	$12,574
Gravenstein Hwy	GOO-113	GOO-109	10	359	$117	$52,003
Mobilization, Traffic Control and Miscellaneous work						$35,000
Contingency						$25,659
Construction Cost						$248,719
Total Replacement Cost						**$323,334**

The estimated construction cost for all these projects is approximately $250K. The total estimated cost to complete all these projects is about $323,334.

Appendix A

EXISTING AND FUTURE LAND USE DESIGNATIONS MAP

Appendix B

EXISTING WASTEWATER COLLECTION SYSTEM MAP

Appendix C

EXISTING WASTEWATER PEAK HOUR FLOW MAP

Appendix D

FUTURE “BUILD-OUT” PEAK HOUR FLOW MAP

Appendix E

GRAVENTSTEIN HWY SOUTH UTILITY NEEDS STUDY BY WINZLER & KELLY, 1999