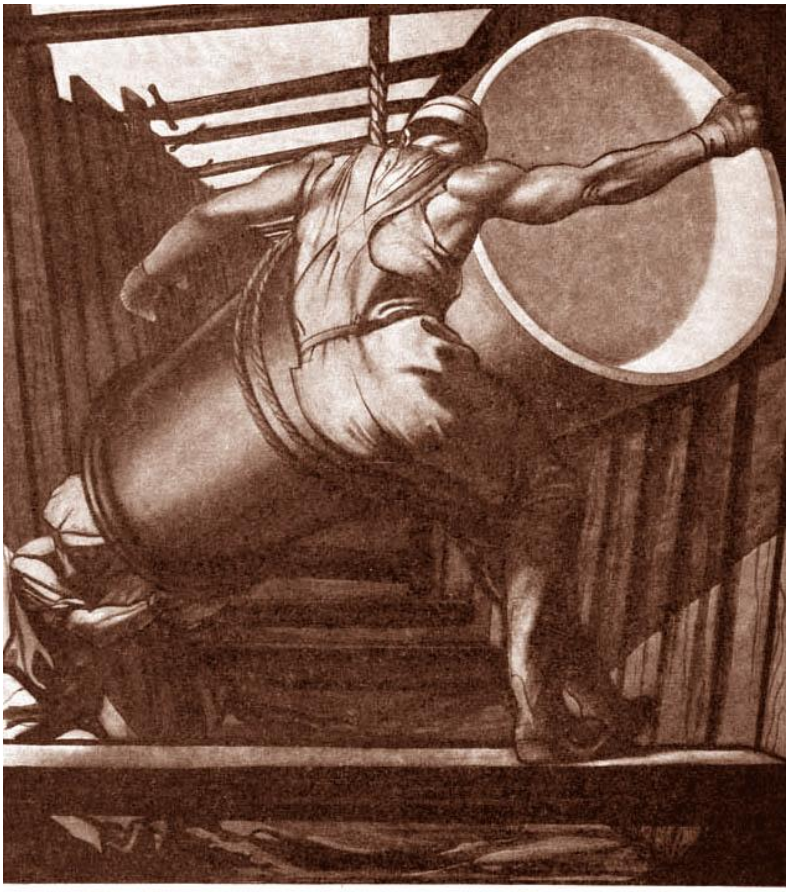
CITY OF ORLAND

SEWER MASTER PLAN



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1.0 Introduction

This section summarizes the results from the Master Wastewater Plan Study and offers several recommendations for future construction projects and system operation.

1.1 Existing Flows and System Capacity

With the completion of the improvements recommended by this master wastewater plan, existing flows into the treatment plant and system capacities are as follow:

- Average Flow = 0.65 MGD (Million Gallons per Day)
- Peak Flow = 1.12 MGD
- Capacity of the Collection System = 3.4 MGD (based on peak flow)
- Capacity of the Wastewater Treatment Plant = 2.1 MGD (based on average flow)

Based on these numbers the system is currently operating at about 31-percent of its capacity.

1.2 Recommended Sewer Main Replacement

Portions of the existing runs of 21 and 24-inch diameter concrete sewer main between the wastewater treatment plant to the intersection of Papst Avenue and South Street are deteriorating. The pipe crown on the section crossing the Tehama-Colusa Canal had been completely deteriorated, leaving no support for the earth above. With no support, debris fell into the pipe, causing other solids in the wastewater flow to get caught. These restrictions in the pipe caused upstream manholes to surcharge and nearly overflow.

To insure safety against possible pipe collapse and overflow, an emergency repair of the outfall main crossing the Tehama-Colusa Canal was completed in October 2004. The remaining portion of the outfall main from County Road MM to the wastewater ponds was bid in late 2004 and constructed in early 2005. It is recommended that the remaining 6670 feet of concrete sanitary sewer main along County Road MM and County Road 200 (South Street) back to Papst Avenue, be replaced with 24-inch diameter PVC Pipe.

The estimated cost to complete this work is $525,000.

1.3 Recommended Sludge Monitoring and Removal Program

As of June 2004, there was 70,000 Cubic yards of sludge within the wastewater treatment plant's stabilization ponds. This is approximately 25-percent of the ponds' volumes. This amount of sludge reduces the ponds' ability to treat wastewater.

Bioremediation was utilized to reduce sludge volume by more than 50%. A program to monitor and remove future sludge from the wastewater stabilization ponds is currently under way. This program continues to utilize the bioremediation process to reduce the build-up of sludge. The program is described in more detail in Section 7.

The continued use of the bioremediation process costs approximately $650.00 a month, or $7,800.00 a year.

1.4 Guidelines for Future Development

Future Sizes:
To insure that the wastewater collection system has enough capacity to serve future development over the entire planning area, recommended future pipe sizes have been calculated. These sizes are listed in Table 5-1.

The intention of Table 5-1 is not to warrant pipe replacement projects, but to serve as a guideline. Any pipe needing replaced for maintenance purposes or to accommodate future development should comply with the sizes in Table 5-1.

Lift Station:
To provide sewer service for future development at the east side of the Planning Area, a lift station location was recommended at the intersection of County Road MM and County Road 200. As a result of two new subdivisions on the east side, a lift station was installed in the northwest corner of the intersection of County Road 17 and County Road N. The lift station was designed for an ultimate peak flow of 1.6-cubic feet per second, and an average flow of 0.83-cubic feet per second.

Sanitary Sewer and Storm Drain Cross Connections:
During rainstorms the flow into the wastewater treatment plant is typically about 25-percent higher than average. With the system currently operating at a fraction of its capacity, these peak flows are not a concern. They will be however, in the future when more capacity is needed.

To reduce the future impact of stormwater inflow, all sanitary sewer and storm drain cross connections should be eliminated. The cross connections should be abandoned as they are encountered during future construction projects.

1.5 Sewer Main Maintenance Program

In addition to the partially clogged 24-inch diameter sewer main crossing the Tehama-Colusa Canal, many of the sanitary sewer manholes within the system have thick layers of scum buildup. H_2S gas in the scum leads to H_2SO_4 (Sulferic Acid) production, which damages/destroys concrete manholes and pipelines. To provide longevity of the collection system and to insure against restriction of pipe capacity, routine cleaning is necessary.

2.0 Purpose

This Sewer System Master Plan was authorized by the Orland City Council to provide planning for current and future development within the Planning Area of the City of Orland. The main objectives of this report are to (1) evaluate the existing sewer infrastructure and its ability to collect and dispose of existing and future sewage flows, (2) determine deficiencies within the system and to evaluate feasible solutions to correct them, (3) select the most economical solutions to correct deficiencies (4) evaluate potential service locations to undeveloped portions of the City, or areas within the City's sphere of influence.

The principal elements of this study include the following:

- Description of the existing wastewater collection system and treatment plant.
- Determination of the existing wastewater flows, and future flow estimates.
- Evaluation of the existing wastewater collection system, and its ability to handle existing and future flows.
- Preparation of guidelines for future pipe sizes and lift station locations within the wastewater collection system.
- Evaluation of the wastewater treatment plant, and its ability to handle existing and future flows.
- Preparation of a Capital Improvement Program that identifies a prioritized schedule of recommended improvements and replacement of facilities.
- Development of cost estimates to complete the recommended Capital Improvement Program to identify the impact on operating and connection fee revenues.

2.1 Sources of Information

Operational data including record sewage flows was obtained from the City of Orland Department of Public Works.

Information about the existing wastewater collection system including pipe sizes, types and grades was collected from "As-Built" Improvement Plans and field surveys conducted by Rolls, Anderson and Rolls.

Information about the existing sewage disposal ponds including cumulative sludge depths and volume was obtained from field measurements by ENNIX Incorporated in June of 2004.

Population projections and planned land use within the Planning Area of the city of Orland were obtained from the Amendment to the City of Orland General Plan prepared by Pacific Municipal Consultants and adopted by the City Council in March of 2003.

2.2 Engineering Analysis

Evaluation of the wastewater collection system included an engineering analysis of several different scenarios that compared current and future flows to the existing capacity of the system. This analysis was conducted using conventional methods for calculating pipe flows. The results of the analysis were confirmed through field observations of current flows at various manholes throughout the system. This procedure is described in greater detail in Section 5.

The existing wastewater treatment plant was analyzed for its ability to treat existing and future flows. This analysis was based on the City of Orland's Wastewater Discharge Permit No. 96-129, which provided water quality requirements.

The sludge volume in the ponds at the wastewater treatment plant was determined from mapping and sludge depth measurements. Future sludge generation was estimated based on population forecasts in the General Plan. Evaluation of the Wastewater Treatment Plant is described in more detail in Section 6.

3.0 Introduction

The City of Orland owns and operates two separate public wastewater systems, both regulated by the California Regional Water Quality Control Board, Central Valley Region – Waste Discharge Requirements Order No. 91-134. The primary system collects and disposes of wastewater generated from residential and commercial properties within the city limits. The secondary system collects and disposes of industrial brine from the two olive producing plants within the city limits.

The industrial brine generated from the olive producing plants is kept separate from the primary wastewater due to its inability to be treated by the same means as the primary wastewater.

Impacts on the brine system due to future industrial growth cannot accurately be estimated. It is anticipated that these impacts will be determined at the time of future industrial development, and that any required upgrades to the system will be the financial responsibility of the developer. Therefore, this report addresses only the primary wastewater system.

3.1 Wastewater Collection System

The wastewater collection system consists of about 30-miles of sanitary sewer main and 400 sanitary sewer manholes. The sewer mains range in size from 6-inch diameter to 24-inch diameter. The sewer mains consist mostly of vitrified clay and concrete pipe, with some PVC in recently developed areas.

There are four sanitary sewer lift stations operating within the collection system. Each lift station currently serves an area of less than 20 acres.

3.2 Wastewater Treatment Plant

The wastewater treatment plant consists of four unlined stabilization ponds and an adjacent 44-acre bermed field. The field is used for wastewater disposal following pond treatment. The field is flood irrigated with wastewater discharged from ponds 3 and 4 which, occurs an average of two times weekly during the winter and every other week during the summer.

4.0 Introduction

This section presents the collection and interpretation of record flow data used by this Master Wastewater Plan to evaluate the primary collection and disposal system. It also describes how the data was forecasted to consider the future impact on the system due to population growth.

4.1 Record Data

All of the wastewater generated within the primary collection system discharges into the stabilization ponds through a Parshall Flume. Flow volumes are calculated from flow depths measured at the Flume. These measurements are tabulated in 2-hour increments-24 hours a day.

In January 2004 the procedure for acquiring flow measurements was reviewed. It was observed that flow volumes could not accurately be measured due to the height of the water level in the ponds. Following the observation, water levels were lowered and reliable flow data was obtained. This report is based on flow data between July 12, 2009 and July 30, 2009. The average daily flows for this period are shown in Table 4-1.

	Average Flow Depth (Measured in Feet)	Average Flow (Million Gallons per Day)
Sunday, July 12, 2009	0.33	0.710
Monday, July 13, 2009	0.30	0.598
Tuesday, July 14, 2009	0.32	0.664
Wednesday, July 15, 2009	0.34	0.724
Thursday, July 16, 2009	0.32	0.680
Friday, July 17, 2009	0.31	0.648
Saturday, July 18, 2009	0.32	0.686
Sunday, July 19, 2009	0.32	0.656
Monday, July 20, 2009	0.32	0.667
Tuesday, July 21, 2009	0.31	0.648
Wednesday, July 22, 2009	0.31	0.630
Thursday, July 23, 2009	0.32	0.663
Friday, July 24, 2009	0.31	0.627
Saturday, July 25, 2009	0.30	0.616
Sunday, July 26, 2009	0.31	0.624
Monday, July 27, 2009	0.30	0.601
Tuesday, July 28, 2009	0.31	0.635
Wednesday, July 29, 2009	0.32	0.667
Thursday, July 30, 2009	0.32	0.669

Average Monthly Flow =	0.65 MGD

Table 4-1
Wastewater Generation

Hourly fluctuation in the record data exhibited peak flows that were generally about 37-percent higher than the average flow in a given day.

In addition to hourly fluctuation, seasonal fluctuation was considered. The data listed in Table 4-1 corresponded to early summer flows. In other wastewater systems, late winter flows are usually about 10-percent lower than seasonal average, and seasonal peek flows are generally about 25-percent higher than seasonal average. Assuming that these approximations characterize the City of Orland, flows are as follow:

1. Average annual flow at the treatment plant = 0.65 MGD (million gallons per day)

2. Annual peak hour flow at the treatment plant = 1.12 MGD

4.2 Peak Hour Factors

The ratio of the average annual flow to annual peak hour flow at the treatment plant was calculated from Equation 4-1.

Equation 4-1
Definition of Peak Hour Factor (PHF)

PHF = Annual Peak Hour Flow / Average Annual Flow

PHF = 1.12 / 0.65 = 1.72

Peak Hour Factors are not the same at all locations within collection system. For a given sanitary sewer main, the PHF is a function of the area and land use being served by that main. Based on record data and information from other sanitary sewer collection systems similar to the City of Orland's system, Equation 4-2 was formulated.

Equation 4-2
To Estimate the Peak Hour Factor

PHF = 8.07 / HE^0.19
4.0 Maximum
1.5 Minimum

The variable "HE" (House Equivalents) in Equation 4-2 is used to express different areas with different types of land use in one consistent unit. One HE is defined as an area that will produce the same amount of wastewater flow as one single-family home within a low-density location.

4.3 Flow Forecasts

The estimated population growth given in the General Plan was used to determine future wastewater flows. It was assumed that flow would increase proportionately to population growth.

A 20-year forecast was conducted using a growth rate of 2.6%. This resulted in the following:

1. Average annual flow at the treatment plant = 1.08 MGD

2. Annual peak hour flow at the treatment plant = 1.87 MGD

A forecast, which assumed ultimate build out of the entire planning area, was conducted using a slightly lower growth rate of 2.3%. This scenario provided 58-years of growth. The resulting flows were as follow:

1. Average annual flow at the treatment plant = 2.57 MGD

2. Annual peak hour flow at the treatment plant = 3.19 MGD

4.4 Stormwater Infiltration

The flow data contained several peaks occurring during rainstorms. The peaks were due to one or both of the following:

1. Stormwater infiltration being introduced into the wastewater collection system through cross-connections with storm drains.

2. Rainwater raises the water level in the ponds, resulting in faulty flow readings at the Parshall Flume.

All of the sewer mains in the City of Orland are relatively shallow and above groundwater. Further, with the high permeability characterized by the soils of Orland, it was unlikely that groundwater or stormwater seepage would have entered the wastewater collection system. The only probable source of stormwater infiltration would have been cross-connections with storm drains.

All existing storm drain connections to the wastewater collection system should be eliminated. This is a simple solution to provide more capacity for future flows.

5.0 Introduction

This section provides the following pertaining to the existing wastewater collection system:

- A description of the methodology used to evaluate the system.
- A comparison between existing capacity, current flows, 20-year forecasted flows and estimated flows at ultimate build-out of the entire planning area.
- Guidelines for future sizes of all the trunk lines within the system.
- The location of a sanitary sewer lift station to serve future development on the east side of the city.
- Identification of maintenance deficiencies and recommended corrective solutions.

5.1 Methodology used to Evaluate the Collection System

An engineering analysis of the existing wastewater collection system was conducted using three different flow scenarios. In the analysis, flows from each scenario were determined for each sanitary sewer trunk line in accordance with Section 4. These flows were compared to actual pipe capacities as calculated by the Manning's Equation. The three flow scenarios are as follow:

1. The first scenario was based on current peak flows. This scenario was used to identify locations where current flows could potentially exceed sewer main capacities.

2. The second scenario was based on 20-year forecasted peak flows. This scenario was used to identify locations where flows could potentially exceed sewer main capacities within the following 20-years.

3. The third scenario was based on resulting peak flows from ultimate build-out of the entire planning area. This scenario was used to determine future sewer main diameters, and would serve as a guideline for future development.

Included in this analysis were sanitary sewer trunk lines 10-inches in diameter and larger. In pipes smaller than 10-inches, estimated flow to capacity ratios were small enough that the pipe sizes were not of concern. Table 5-1 shows the results of calculations from this analysis. Table 5-1 is to be used as a key to Figure 5-1.

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Table 5-1

Sanitary Sewer Flows and Capacities

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Figure 5-1

Wastewater Collection System Map

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5.2 Adequacy of the Existing Collection System

As shown in Table 5-1, all of the existing pipe sizes are large enough to handle current and 20-year forecasted flows. It is good practice for a system to be designed to operate at 50 to 70-percent or less of its capacity. This allows for future growth and unforeseen spikes in the wastewater flow. In comparison, if the City of Orland's collection system could be properly maintained, with current flows it would operate at about 31-percent of its capacity.

5.3 Guidelines for Future Development

Table 5-1 shows replacement pipe sizes. These are not to warrant pipe replacement projects, but rather to serve as guidelines for future construction. If a pipe is required to be replaced for future development or maintenance purposes, it should comply with the size shown in the table. The sizes are based on estimated slopes and are approximate. The sizes should be verified during the design of any pipe replacement project, and be based on actual slopes.

5.4 Maintenance Problems and Recommended Projects

Field observations have identified a few maintenance deficiencies in the collection system. Portions of the existing 24-inch diameter reinforced concrete sanitary sewer main between the treatment plant and the intersection of County Road MM and County Road 20 were deteriorating. They also were coated with a thick layer of scum and contained flow obstructions.

To temporarily insure against over flow or collapse of the sewer main, Emergency repairs were completed in October of 2004.

This section of sewer main is part of a longer stretch that was installed in 1958 from the treatment plant to the intersection of Papst Avenue and South Street. It is recommended that the entire stretch be abandoned, and a parallel 24-inch diameter PVC sewer main be installed. A portion of the line from County Road MM, to the wastewater ponds, was replaced in 2005. The remaining sewer main along County Road MM and County Road 200 to Papst Avenue, still needs to be replaced

In addition to the scum buildup found in the sewer main near the treatment plant, many other manholes throughout the system contained thick coats of buildup. Frequent maintenance and cleaning of the sewer mains throughout the collection system is necessary to assure proper function of the system in the future.

6.0 Introduction

This section provides the following pertaining to the existing wastewater treatment plant:

- A comparison between the capacity and existing flows.
- A summary of the procedures used to determine sludge volume in the stabilization ponds, procedures being implemented to decrease sludge volume and recommended future sludge removal procedures.

6.1 Treatment Plant Capacity Verses Existing Flows

Evaluation of the treatment plant capacity was conducted by a simple comparison between the actual flows into the treatment plant verses the allowable flow given in the Waste Discharge Requirements. These requirements were issued by the California Regional Water Quality Control Board, Central Valley Region - Order No. 96-129.

As previously described in Section 4, the average flow at the treatment plant has been estimated to be 0.65-million gallons per day. The Waste Discharge Requirements allow an average flow of 2.1-million gallons. Therefore, the treatment plant is currently operating at approximately 31-percent of its capacity. Assuming a population growth rate of 2.3-percent, the treatment plant should have adequate capacity for the next 45 to 50-years.

6.2 Sludge Generation and Current Sludge Removal Projects

During field observations at the sewer treatment plant, excessive sludge accumulation in the stabilization ponds was encountered. The existing sludge volume was determined from field measurements to be 70,112 cubic yards, approximately one forth of the volumes of the ponds.

After exploring several options for removing the sludge, ENNIX Incorporated was consulted and began a bioremediation process. With this process microbiological organism were put into the ponds to feed on and decompose the sludge. ENNIX estimated that this process would ultimately reduce the sludge volume by about one-half.

In ponds 1 and 2 sludge was last removed in 1976. The sludge has been accumulating in these two ponds for the last 28 years. In ponds 3 and 4 sludge has never been removed. Sludge in these two ponds has been accumulating for 46 years, since 1958, when the ponds were installed. Some of this sludge was from industrial brine. The industrial brine had been discharged into the ponds with the domestic wastewater up until 1984.

Sludge generation has been projected based on the history of the stabilization ponds, existing sludge volume, and estimated growth rates in the General Plan. It is estimated that the accumulation of 70,000 cubic yards of sludge will take about 20-years. The rate of sludge generation will continue to increase with population growth.

6.3 Recommended Sludge Monitoring and Removal Program

For the stabilization ponds to function properly, they must be kept free of excessive sludge. The accumulated sludge reduces the ponds depth and volume. This decreases the detention time of wastewater flowing through the ponds and impairs the ponds ability to treat the water. Preferably, the sludge volume will not exceed 35,000 cubic yards.

It is recommended that maintenance of the stabilization ponds include a sludge depth-monitoring program. This program would include mapping sludge depths 10-years after bioremediation, and then once every year until the next sludge removal project.

At the end of the bioremediation process, the remaining sludge would be dredged and stockpiled to dry. The dry sludge would then be hauled to a landfill site. This process would begin with dredging the sludge following the bioremediation process currently in progress.

The initial frequency for implementation of this process is estimated to be once every ten years. The frequency will increase as Orland's Population increases. Figure 6-3 shows the sludge generation forecast and estimated dates to begin the sludge removal process as a normal wastewater lagoon system without the utilization of bioremediation.

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Figure 6-3

Forecasted Sludge Generation and Removal

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7.0 Introduction

This section describes and provides cost estimates for all capital projects recommended by this report. The unit prices in the cost estimates are based on recent experience with similar improvements in northern California and actual bids prepared by outside consultants in 2004. Estimated costs should be adjusted annually to reflect the changes in construction costs, based upon the Engineering News Record Construction Cost Index (ENRCCI). The most recent value in the ENRCCI is for August 2009 and equals 8563.

7.1 Sewer Main Replacement

It is recommended that the remaining 6656 feet of concrete sanitary sewer main along County Road MM and County Road 200 (South Street) back to Papst Avenue, be replaced with 24-inch diameter PVC Pipe.

The estimated cost to complete this work is $525,000.

7.2 Sludge Monitoring and Removal Program

A sludge monitoring and removal program should be conducted on each of the four domestic wastewater stabilization ponds. With the introduction of the bioremediation process, the measurable sludge accumulation is too small at this time. This makes it extremely difficult to forecast a potential timeline for sludge removal. This program is summarized as follows:

1. Conduct field measurements and map sludge depths 10-years following the bioremediation project, then once every year until the sludge removal project.

2. At the end of the Bioremediation process, dredge all remaining sludge. Stockpile sludge until dry and hall to a landfill site.

This would begin with the Bioremediation process currently in progress. The next estimated site survey and sludge depth monitoring will begin in 2015 and continue with yearly sludge depth monitoring if warranted.

The estimated cost to complete this work is:

Bioremediation, May 2005 to June 2009	= $32,500.00 (Completed)
Bioremediation, July 2009 to January 2015	= 42,900.00
Site survey / Sludge depth measurements in January, 2015	= $2000.00
Total	= $77,400.00

APPENDIX A

City of Orland

Existing Sewer Main Capacity

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Existing Sewer Main Capacity
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APPENDIX B

City of Orland

Design Sewer Flows at Ultimate Build-Out

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Design Sewer Flows at Ultimate Build-Out
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