Appendix 'O'

City of West Covina
SEWER SYSTEM CAPACITY EVALUATION
2008-2009, Edited October 2016

The City's previous system capacity analysis was completed in 2009. Since there have been no significant capital improvements since then, the hydraulic model was not updated in this SSMP report. The primary purpose of this Appendix is to capture the methodology that was used in developing the 2009 sewer capacity analysis. The primary update of this Appendix is the cost of the recommended Capital Improvement Projects. The updated (2016 dollars) estimate project costs are provided in Appendix 'P'. These estimates reflect the cost to replace select pipe segments at certain locations as determined by operating condition. Appendix 'P' includes a more detailed list of recommended CIP projects that considers both calculated pipe operating condition as well as feasibility of updating adjacent pipe segments of differing capacity thresholds as part of the same project rather than as separate projects. The exhibits of the recommended project locations provided in Appendix 'O-1' have not been updated in this report as the hydraulic model has not changed.

Introduction and Summary

The City owns and operates its local wastewater collection system consisting of approximately 227 miles of gravity flow sewer pipelines and two segments of force main (varying in size from 4-inch to 18-inch pipe) and 5,187 manholes. The existing sewer system discharges to trunk sewers that are owned and operated by the County Sanitation Districts of Los Angeles County and to the adjacent Cities of Baldwin Park and Covina, and some areas of unincorporated county.

The purpose of this evaluation is to identify deficiencies in the existing sewer mainline system, recommend alternatives to eliminate the deficiencies, prioritize the deficient reaches, and provide the City with a basis on which to build a future infrastructure management system.

The 227 miles of local sewer were modeled using HYDRA® 6.4 by PIZER. Of the total length, approximately 19,096 feet of the existing system were identified as being critically capacity deficient (Greater than 85% full). These are grouped as priority-one projects requiring timely resolution. The deficient reaches of sewer mainlines are located within SMZs 4, 62, 80, 82, 116, 117, 132 and 161. Please refer to exhibit maps A, B, & C in this Appendix 'O-1' for the deficient reach locations. The cost to repair the deficient reaches is estimated to be $8,820,000. Those pipe segments classed as seriously capacity deficient, approximately 30,048 feet of the existing system (between 64% and 85% full), are grouped as priority-two projects requiring resolution in the near future. The deficient reaches of sewer mainlines are located within SMZs 2, 4, 5, 62, 74, 75, 80, 81, 82, 83, 105, 116, 117, 132, 139, 140, 151, 153 and 161. Please refer to exhibit maps A, B, & C in this Appendix 'O-1' for the deficient reach locations. The cost to repair the deficient reaches is estimated to be $11,840,000.

The modeling function was performed utilizing generally accepted sewage generation coefficients in the Los Angeles county region, and land use zoning as shown on a CAD file map identified as: "annZoning CAD Map 04-06" received on December 29, 2008. The zoning map was utilized as representative of the City's current development condition. This map was overlaid on the sewer system map, developed as part of this project, thereby allowing the modeler to apply the sewage generation coefficients for the respective land zoning within each SMZ throughout the City. This method resulted in defining the cumulative sewage generated and carried through the piping within each SMZ and delivered to the receiving system. However, there was no flow monitoring performed to otherwise validate the modeling data result. In months and years ahead, as maintenance inspections are performed, the modeled areas nearing capacity should be closely monitored for signs of exceeding capacity in order to avoid SSOs, and to refine design parameters for replacement.

As future land use changes occur in the General Plan, the model should be updated to reflect consequences of such changes. The model should also be updated to reflect flow monitoring results as well as the construction of new relief facilities, upgrades, and/or the construction of new sewer lines in order to be fully representative of the community sewer system.

Study Approach

The following tasks were performed in the preparation of this Sewer System Capacity Evaluation Report.

1. The City provided copies of existing sewer system as-built construction plans for use in preparing the initial GIS sewer system mapping and attributes base and for the exhibit maps A, B & C of this Appendix 'O-1'.
2. The City provided an electronic CAD file of its land use zoning map for use in creating an overlay map of the parcels and sewer maintenance zones in the city system.
3. Willdan developed a computer model (Pizer Hydra) of the City wastewater collection system utilizing the above data.
4. Analysis of the existing wastewater collection system capacity and determination of any capacity deficiencies (refer to the deficiency criteria section of this report and see the exhibit maps in this Appendix 'O-1').
5. Development of recommendations for system improvements to correct deficiencies.
6. Preparation of cost estimates for the recommended improvements.
7. Preparation of evaluation findings and recommendations to correct identified deficiencies in a Sewer System Capacity Evaluation Report (this Appendix).

System Criteria and Alternatives

In designing or evaluating a wastewater collection system, the engineer must establish certain criteria upon which to base the design. These include such things as available pipe sizes,

materials, slope, bury or cover, connections, etc. Such criteria are established to ensure that the wastewater collection system can operate effectively under all flow conditions. Each pipe segment must be capable of carrying the peak flows without surcharging the system. Surcharging the system occurs when the pipe is flowing under pressure. However, many of the initial design assumptions are unnecessary in the analysis of a collection system when the pipe already exists and its diameter and slope are fixed.

In the analysis of an existing sewer system, the Hydra program compares the capacity of each pipe in the system with the peak wastewater flow projected for that particular link or reach of pipe. If the existing pipe size is surcharged, the Hydra program automatically increases the pipe diameter to the next largest standard pipe size that will carry the design flow without being surcharged. At a minimum, all pipes should be 8 inches or larger in diameter and the velocity of flow in the pipe should be greater than 2 feet per second (ft/s). This velocity will prevent deposition of solids in the sewer and help to re-suspend any materials that may have already settled in the pipe. The minimum corresponding slopes to maintain 2 ft/s for various pipe sizes are shown in Table 1.

Table 1
Minimum Pipe Slopes ft/ft

Sewer Size	Slope
8"	0.0028
10"	0.0021
12"	0.0016
15"	0.0012
18"	0.0010

It is important to note that the slopes listed above assume the depth of flow in the pipe is 0.64 percent full. If there is insufficient flow to create this condition, greater slopes than those shown may be required in order to maintain the minimum self cleaning velocity condition.

The design and analysis of gravity sewer pipes is typically based upon the depth to diameter ratio (d/D). Common design criteria for proposed new sewer design is 0.50 (50% full) for 8 to 15-inch diameter pipes and 0.75 (75% full) for 18-inch and larger pipes. The area above the water surface (residual capacity) helps to keep the sewage aerated, reducing the possibility of septic conditions and odors. Existing wastewater systems are typically allowed to flow with less residual capacity because development and redevelopment has occurred or is foreseeable in the near future.

This report establishes the hydraulic design criteria for existing sewer pipes by classifying "over capacity" pipes as any with a d/D greater than 0.64. This d/D ratio was arrived at by taking 75 percent of the depth to diameter ratio of a pipe having maximum stable flow capacity, which is at a d/D of 0.85 (75% of 85% is 64%). The area above a d/D of 0.85 is considered hydraulically unstable. This reduction results in approximately 35 percent of the pipe's full flow capacity being reserved for variations in discharges, periodic peaking of

flow, seasonal variations and minor or temporary obstructions. Again, this residual capacity helps to keep the sewage aerated, reducing the possibility of septic conditions and odors.

The residual capacity allows for the possibility that actual wastewater flows may be slightly higher than anticipated, especially during the hours when instantaneous or intermittent peaks may occur. These peaks are generally observed between the hours of 6:00 a.m. and 8:00 a.m. Monday thru Friday and between the hours of 9:00 a.m. and 11:00 a.m. Saturday and Sunday. Peak flows may also be observed during rainfall events due to inflow and infiltration conditions.

Exhibit maps A, B, & C in Appendix 'O-1' shows the pipes that are capacity deficient per the 0.64 criteria and also shows the pipes that are deficient per the 0.50 criteria. Only the pipes that exceed the 0.64 criteria are recommended for correction projects.

The design capacity of a gravity pipeline is the calculated capacity of the pipeline based on the Manning formula:

$Q=1.486\ R^{2/3}\ S^{1/2}\ /n$ where, Q = flow in cubic feet per second
R = hydraulic radius in feet = A/ P
A = cross-sectional area of the pipe in square feet
P = wetted perimeter in feet
S = slope of the pipe in feet of rise per foot of length
n = Manning's friction factor

Sewer system capacity is established using a Manning's fiction factor of 0.013 for vitrified clay pipe.

Alternatives

The following alternatives were considered in developing the recommended schedule of deficiency correction projects.

1. Construction of a parallel sewer facility to carry the excess sewage flow is an obvious solution to most of the deficiencies; however, this solution is not necessarily the most economical or practical approach. In some instances rerouting of tributary areas or the construction of a single relief sewer line can be planned in such a way that it will relieve several main sewer lines thereby avoiding the construction of parallel or replacement facilities and the related cost.

2. In other instances, replacement of the existing sewer with a larger size may be the preferred alternative. The replacement or upsizing of the line may include open trench installation or pipe bursting (if surrounding condition are conducive), and the use of temporary bypass pumping. The decision as to which correction alternative to construct is typically made just prior to the design phase after careful consideration of all design constraints such as existing utilities and the costs associated with potential

utility relocation to provide additional space for the construction of a replacement sewer line.

The engineer's opinion of budget figures (See Appendix 'P') was prepared based on the cost to remove and replace the existing sewer with a larger size, as this is the most conservative cost approach.

It is suggested the where the depth of flow exceeds the design criteria of 0.64 d/D, but does not exceed the maximum stable flow capacity of 0.85 d/D, that consideration be given to allowing these sewers to flow in a slightly overloaded condition in lieu of building a more costly relief facility. This overloading occurs only during peak flow conditions that are short in duration. However, the City should frequently monitor these sewers in order to under take a future corrective action as the overloading problem becomes worse.

Analysis of Existing Sewer System

The City's sewer system was modeled using Pizer Hydra Ver. 6.4. The Hydra program is designed to provide analysis of both the existing sewer system and the design of any new sewer lines.

After defining (laying out) the existing sewer system, the network was divided into 179 SMZ's or sewer drainage areas, based upon city sewer records, for input into the computer model. The input data consisted of a numerical designation for each manhole and length of sewer pipe between manholes, the slope of the line, and flow line elevation of each manhole.

Computation of Wastewater Inflows

Once the schematic of the sewer system network was established, data was compiled on each SMZ, General Plan land uses (zoning), and related factors that affect the volume of wastewater generated. Next, it was necessary to compute the area of each type of land use; e.g., low-density residential, medium-density residential, high-density residential, commercial, industrial, schools, etc., within each drainage boundary. The unit flow coefficients (see Table 2) were then applied to the computed areas of land use within each SMZ. The unit flow coefficients, when applied to the land use areas, provide peak flow rates for each particular land use category. The wastewater inflows calculated for the various land use categories within the SMZ were then accumulated to provide the calculated peak flow for the entire drainage area. The accumulation of estimated wastewater flow is accomplished totally within the computer program.

Table 2
Unit Flow Coefficients for Peak Flow Rates

Zone	Cu. Ft. per sec. per acre	Gallons per day per acre
R-1	0.004	2585
R2	0.008	5171
R3	0.012	7756

R-P, Commercial	0.015	9695
Manufacturing	0.021	13573
Institutional	0.015	9695

Flow Monitoring

There was no flow monitoring performed under the contract services for preparation of this SSMP. However, flow confirmation work can be undertaken at any time in the future. Typically, as maintenance inspection findings indicate changed pipeline capacity conditions for those pipe segments near capacity as indicated in the modeling evaluation results. Flow monitoring results can be used to verify and/or calibrate the sewer flow modeling work for a SMZ as affected by changes in development or observed manhole inspections of flow conditions. Also, additional future flow monitoring is recommended at near capacity locations, during periods of rain, to verify or deny potential inflow and infiltration problems, and to refine design parameters, especially for the higher density residential zones.

For each site monitored, the flow data should be reviewed and compared to the contributing SMZ area. The peak monitored flow rate must be compared to the design flow rate and the shape of the outflow curve compared to the SMZ modeled result. An expected difference between the monitored flow and the design flow is between 150 to 250 percent. This difference is expected because the design flow rate includes the maximum flow rate expected from each development type which contains both wet weather inflow/infiltration and design peaking safety factors.

Summary of Findings and Recommendations

Within the initial introduction and summary section, both the critically deficient (> 85% full) and seriously deficient (between 64% and 85% full) pipe segments were described and referenced. Before undertaking design and construction or identifying further project priorities, the performance of select flow monitoring is recommended at crucial locations, especially during periods of rain to verify or deny any potential inflow and infiltration problems. Also to confirm the actual in-system flow conditions which can and do vary do to water usage and customer practices in waste disposal. The findings identified in this evaluation and report are for planning guidance in addressing the sewer system capacity conditions. Further pre-design refinement and analysis will be necessary before initiation of a final design of improvements for the facilities is under taken.

In the event of any land use changes to the General Plan, upon which this study was based, the model should be updated to reflect the consequences of such changes. The model should also be updated to reflect the construction of new sewer lines.

Recommended Deficiency Correction Projects

Presented in the engineer's opinion of cost (Appendix 'P') is a remove and replace approach to correct the identified deficient pipe segments. This is usually a conservative approach to costing and should be refined by thorough engineering evaluation and assessment of the specific conditions and replacement options before proceeding with a specific correction project.

The following criteria for defining and prioritizing relief facility need was used:

Priority 1

Sewers with critical deficiencies of $d/D > 0.85$, are recommended for correction first. Sewers meeting these criteria are ranked highest.

Priority 2

Sewers with critical deficiencies of $0.64 < d/D < 0.85$ are recommended for correction second. Sewers meeting these criteria are ranked lower.

Priority 3

Sewers with a $d/D < 0.64$ are not capacity deficient; therefore, are not ranked here.

Sewer System Improvements Costs

The unit prices shown in the engineer's opinion of cost (see Appendix 'P') represent the anticipated construction cost only as applicable for mid 2016. Bid prices received on jobs of similar nature in Southern California area were one source of information used to derive the cost figure. In addition, manufacturers, suppliers of material and equipment, and local contractors were consulted on various cost items. An additional 35% of construction cost is added to cover the cost of contingencies, design engineering, contract administration and construction observation.

The engineer's opinion of cost does not include an adjustment for inflation. Construction costs can be expected to fluctuate as corresponding changes occur in the national or local economy. One available indicator of these changes is the Engineering News-Record Construction Cost Index for the Los Angeles metropolitan area. This index is compiled from actual construction cost data for materials and labor and is reported in Engineering News-Record magazine. It is suggested that this index be used to update the unit prices presented in Appendix 'P' and in adjusting the estimate from the date of the initial estimates.

Financing of Improvements

General

Funding considerations are often the deciding factor in scoping and implementation of a project. There are, of course, numerous methods or mix of methods, which could be used to finance the implementation of a sewer system capital improvement plan (CIP), and the ongoing operations and maintenance activities. Among these methods are:

1. Pay-as-You-Go Financing (rates, fees and charges based)
2. State Assistance Programs
3. Municipal Securities
4. Improvement Districts
5. Federal Assistance Programs

In the discussion that follows, the above funding options are briefly described and their adaptability to specific circumstances of a sewer system CIP are noted. In evaluating specific funding programs, services of financial and legal experts in such issues are recommended.

Methods of Financing

1. Pay-as-You-Go Financing:

   Development of cash reserves or capital improvement funds, from an agency's revenue base, is often referred to as "pay-as-you-go" funding. This method avoids interest payments on other types of debt financing. Under this form of financing, the initial capital cost of a project must be accumulated in advance of construction, which can cause a delay in project implementation. If delay is not a crucial factor, this is a cost effective method due to the absence of debt financing costs. This method has sometimes been used together with various forms of short-term financing to construct needed sewer infrastructure.

2. State Assistance Programs:

   Under the rules and regulations of the Federal Water Pollution Control Act (Clean Water Act or CWA) and the Federal Safe Drinking Water Act (SDWA), the State has enacted the Clean Water State Revolving Fund (CWSRF) and the Drinking Water Revolving Fund (DWSRF), respectively. These programs are funded by Federal grants, State funds and Revenue bonds. The CWSRF Loan Program provides low-interest loan funding for construction of publicly-owned wastewater treatment facilities, sewers, sewer interceptors, water recycling facilities, as well as implementation of non-point source (NPS) projects or programs. There are different types of funding assistance available under these programs.

www.waterboards.ca.gov/water_issues/programs/grants_loans/srf/

The Department of Water Resources administers the State bond law programs for Water supply/Water quality, Water conservation, Flood management and Regional water management. www.grantsloans.water.ca.gov

The State Water Resources Control Board administers the State revolving fund loans, Water recycling grants & loans, Small community grants, Agricultural drainage loans, Agricultural drainage management loans, Clean beaches initiative grants, Agricultural water quality grants, Areas of special biological significance (ASBS) grants, Storm water grants, and Santa Monica bay restoration commission grants. www.waterboards.ca.gov

The State Department of Public Health administers the DWSRF, Proposition 84 funding for public water systems, and Proposition 50 for the water security, clean drinking water, coastal and beach protection act of 2002 loans. www.cdph.ca.gov

Various types of infrastructure improvement/construction loans can be arranged through the California Infrastructure and Economic Development Bank (IBank)
www.ibank,ca,gov

Limited amounts of public works grant funds have been available to agencies from the State Office of Economic Development. Use of such grant funds must result in the creation of new, permanent jobs in the private sector. In order to ensure that the funds are ultimately assisting those in most need, projects eligible for consideration must be those in areas designated eligible for HUD Urban Development Action Grants (UDAG), EDA Sudden or Long-term Economic Deterioration, or EDA Designated Special Impact Area.

3. Municipal Securities:

Historically, general obligation bonds (GOB's) had been a prevalent method of financing various public works improvements. They are secured by an agency's total assets and payable from ad valorem taxes levied on all taxable properties within the agency's boundary. However, the Jarvis-Gann Amendment (Proposition 13 of 1978) prohibits the levying of ad valorem property taxes beyond pre-existing authorizations and levels (pre-July 1, 1978). Therefore, authorization and issuance of GOB's is not considered feasible under current law.

An option to GOB's is the issuance of a specific type note or bond form, such as a revenue anticipation note (RAN) or a tax anticipation note (TAN) or a certificate of participation (COP) or various combinations of available authorities that can be used to fund public infrastructure needs. These types of municipal securities (Munis) are generally tax-exempt and commonly used to fund public works infrastructure and facilities. Many states also exempt their securities from their own taxes, which makes those securities particularly attractive investments for their own residents.

TAN's and RAN's are instruments backed by anticipated taxes or revenues respectively. When these types of notes are considered for funding of needed infrastructure, a specified source of tax or revenue stream is identified and pledged for repayment of the debt. For example, with sewer facilities, all or a portion of the sewer service revenue fees/charges could be used as backing for the debt instrument selected. Then other local revenue sources could be considered for ongoing operations and maintenance (O&M) or some acceptable mix and match of funds specified to secure the debt and accomplish the O&M.

COP's are another form of municipal funding instrument available. These generally require the facility improvement being funded to be named as security for the investment with a lease back of the facility by the municipality. In turn, the municipality pledges some revenue stream(s) that would be used to repay the investor held notes.

When Munis are being considered for funding of improvements, consultation with an experienced and qualified financing consultant and bond counsel are a must.

4. Improvement Districts:

In general, special assessment district procedures have been established by statute to provide for financing of construction and/or acquisition of public works improvements, such as sewer systems, and for assessing the cost of such improvements to the benefiting properties. Under all assessment proceedings, the cost of the work is assessed against properties within the benefited area. The assessments are levied in specific amounts against each individual property on the basis of the benefit each parcel receives. The property owner may pay the assessment in cash during the cash collection period of 30 days. But, if any assessments are not paid in cash during that period, bonds are usually issued to represent the unpaid assessments and the benefited properties are assessed on their annual property tax bill over a usual period of 10 to 20 years.

The City of West Covina utilizes Government Code Section 38902 to establish sewer service charges. While an assessment district proceeding may be a reasonable and equitable means for financing sewer system improvements, further evaluation and stakeholder involvement is a usual practice to determine the viability and practicality of utilizing such financing method.

5. Federal Assistance Programs:

There are, and have been, a series of federal grant and loan programs which may be applicable to public infrastructure projects. However, the qualification criteria for such programs vary from time to time and their funding or continuation is subject to congressional appropriations. Therefore, such programs should not be considered as a likely source of funds unless a funding commitment letter has been received.

Historically, federal programs administered by the Economic Development Administration (EDA) provide financial and technical assistance to aid the economic development of areas with high unemployment or low family income levels. Communities must make long-range plans for economic growth in order to be eligible for EDA financial assistance, in the form of grants and loans for public works and

development that generates jobs and economic opportunity. Typical public works projects include construction of roads, water and sewer lines, and public facilities. To determine the status requires timely monitoring.

Under the rules and regulations of the Housing and Community Development Act of 1974, the Community Development Block Grant (CDBG) program can fund housing and community development needs. This includes part or all of improvements necessary to upgrade existing sewer facilities. Those qualifying geographic areas within the City that have the greatest overall deficiency in physical infrastructure receive the highest priority according to CDBG criteria. When the sewer system has a defined deficiency, then it is appropriate to use CDBG funds to meet health and safety standards as well as to encourage up-grading of abutting housing and physical environment.

The primary statutory objective of the CDBG program is to develop viable communities by providing decent housing and a suitable living environment and by expanding economic opportunities, principally for persons of low- and moderate-income. Communities receiving CDBG funds through the State may use the funds for many kinds of community development activities including, but not limited to:

- acquisition of property for public purposes;
- construction or reconstruction of streets, water and sewer facilities, neighborhood centers, recreation facilities, and other public works;
- demolition;
- rehabilitation of public and private buildings;
- public services;
- planning activities;
- assistance to nonprofit entities for community development activities; and
- assistance to private, for profit entities to carry out economic development activities (including assistance to micro-enterprises).

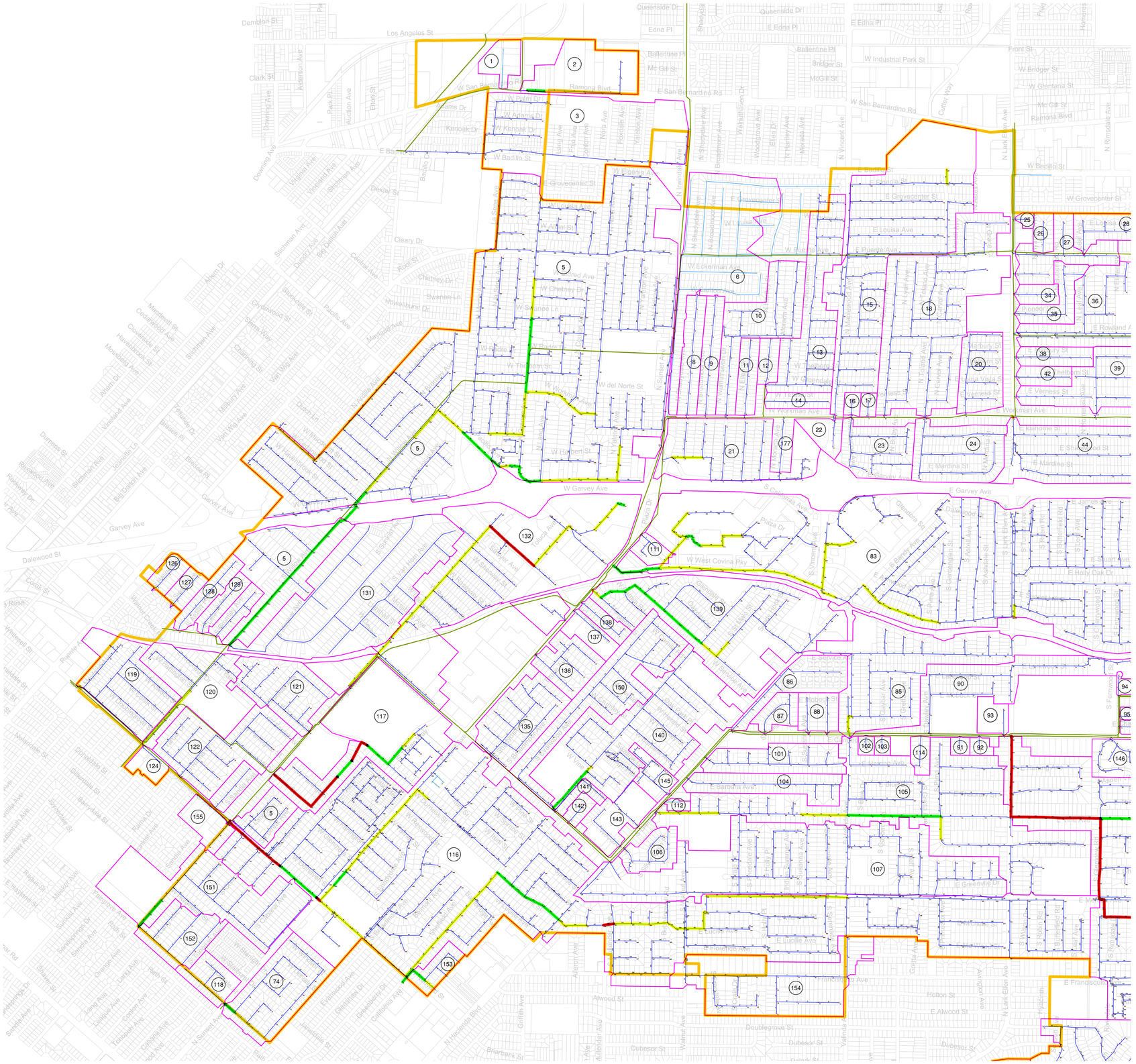
www.hcd.ca.gov/ca/cdbg/about/html

The United State Department of Agriculture Rural Development Program provides communities with population less than 50,000 a variety of direct-guaranteed-loans and /or grants. These include water and wastewater system improvement funding.

www.rurdev.usa.gov/ca

APPENDIX ‘O-1’

Sewer System Capacity Analysis
Deficient Pipes Exhibits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Doublegrove St
Dubesor St
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E Francisquito Ave
E Workman Ave
E Merna St
E Vanessa St
E Rowland Ave
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E Stanley St
E Edna Pl
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Mc Gill St
Bridger St
Holton St
Plaza Dr
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S Citrus St
S Azusa Ave
S Hacienda Blvd
Briarbrook St
Walnut Ave
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Azusa Ave
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Gladstone St
Dalewood St
Garvey Ave
Rosemead Blvd
Del Mar Ave
Temple City Blvd
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Oakdale St
Barranca St
Joyce St
Fairmont Ave
Rubio St
Sunset Ave
Santa Anita Ave
Myrtle Ave
Rosemead Ave
Encanto Ave
Cloverdale St
Sherman Ave
Stickman Ave
Dexter St
Cleary Dr
Rood St
Howellhurst Dr
Swanee Ln
Ahern Dr
Manchester St
Cloverdale Ave
Haverbrook St
Monadnock Ave
Kilarny Dr
Vineland Ave
Millbury Ave
Ivar Way Ave
Chestnut St
Sierra Way
Clearwood St
Shackelford St
Pacific Ave
Maryland Ave
Dutch Ln
Durness St
Rosewood Ave
Rosewood Dr
Joanida Ln
Big Dalton Ave
Brease Pl
Brease Dr
Virginia Ave
Downing Ave
Clark St
Anderson Ave
Bowling Ave
Park Pl
Auction Ave
Elton St
Williams Dr
W Atlanta Dr
Kenbar Dr
Kenoak Dr
Norta Ave
Fedora Ave
Yaldwin Ave
Fido Ave
Ashton Ave
Wang Ave
Santa Ana Ave
Alameda Ave
Sunset Ave
Walnut Ave
Maple Ave
Broadmoor Ave
N Shandrow Pl
N Broadmoor Ave
Woodcrest Ave
Warrington Dr
Ellen Dr
N Hartley Ave
Morado Ave
N Vincent Ave
N Lark Ellen Ave
N Rimsdale Ave
Cutter Way
Glenda Ave
Glenda Dr
Lyell Ave
Ideal Ave
Myrtle Ave
Rosemead Ave
Del Mar Ave
Temple City Blvd

SEE EXHIBIT A

SEE EXHIBIT C

LEGEND:

- EXISTING CSD TRUNK SEWERS
- SANITARY SEWER PIPE
- 0.85 < d/D
- 0.64 < d/D < 0.85
- 0.50 < d/D < 0.64
- CITY BOUNDARY
- SEWER DRAINAGE AREA BORDER
- (108) SEWER MAINTENANCE ZONE

PLAN
SCALE: 1"=600'

600 300 0 600 1200
SCALE FEET

APPENDIX O:

SEWER SYSTEM
CAPACITY ANALYSIS
DEFICIENT PIPES
EXHIBIT B

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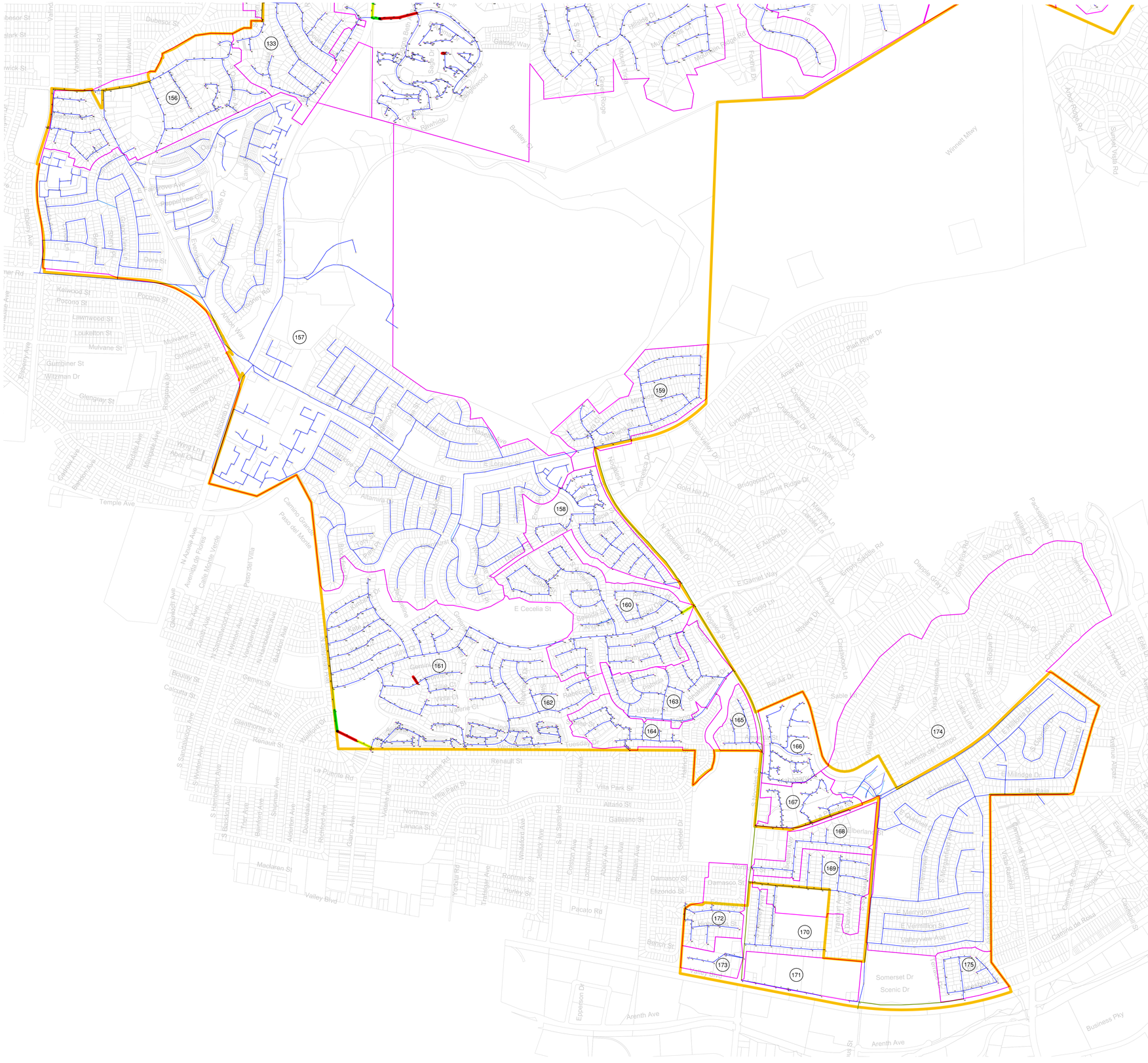
SEE EXHIBIT A

SEE EXHIBIT B



LEGEND:

- EXISTING CSD TRUNK SEWERS
- SANITARY SEWER PIPE
- 0.85 < d/D
- 0.64 < d/D < 0.85
- 0.50 < d/D < 0.64
- CITY BOUNDARY
- SEWER DRAINAGE AREA BORDER
- (108) SEWER MAINTENANCE ZONE

PLAN

SCALE: 1"=600'

600 300 0 600 1200

SCALE FEET

APPENDIX O:

SEWER SYSTEM CAPACITY ANALYSIS DEFICIENT PIPES EXHIBIT C

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