APPENDIX T

Final Wastewater Master Plan Update

Kennedy /Jenks Consultants

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Final Report Wastewater Master Plan Update

July 2007

Prepared for

City of Glendale
633 East Broadway
Glendale, CA 91206

K/J Project No. 0685008

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25 July 2007

Mr. Maurice Oillataguerre
Senior Environmental Program Specialist
City of Glendale
633 East Broadway, Room 209
Glendale, CA 91206

Subject: Final Wastewater Master Plan Update
K/J 0685008

Dear Mr. Oillataguerre:

In accordance with your request, we are pleased to submit five (5) copies and one (1) reproducible original of the Final Wastewater Master Plan Update Report to the City of Glendale (City). This document and the accompanying digital files sent under separate cover constitute our final deliverables for this project.

This Master Plan report is a compilation of the analysis and finding of our study of the City's wastewater system and incorporates the City's comments to the previous draft report submittals. The study included the development of an updated hydraulic model which will be instrumental in the City's self-assessment of future development and "what-if" scenarios.

It has been a pleasure working with you and the other members of the City's staff on this important project and look forward to working with you in the future. Please contact us if you have any questions or need additional information.

Very truly yours,

KENNEDY/JENKS CONSULTANTS

Roger Null, V.P.
Project Manager

Enclosure

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Plate 1 Citywide Pipeline Analysis – Future PWWF Conditions (24" X 36")

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Abbreviations and Definitions

The following abbreviations and definitions are used within the report:

Abbreviation	Definition
AAF	annual average flow
ac	acre
ADD	average day demand
ADWF	average dry weather flow
APN	assessor parcel number
AWWF	average wet weather flow
BMP	Best Management Practices
BOD	biochemical oxygen demand
cf	cubic feet
CFR	Code of Federal Regulations
cfs	cubic feet per second
CIP	Capital Improvement Program
D/d	depth to diameter
dia.	Diameter
DSP	Downtown Specific Plan
DU	dwelling unit
DU/ac	dwelling units per acre
ENR	Engineering News Record
EPA	U.S. Environmental Protection Agency
EADWF	Existing Average Dry Weather Flows
FADWF	Future Average Dry Weather Flows
FEMA	Federal Emergency Management Agency
FPDWF	Future Peak Dry Weather Flows
FPWWF	Future Peak Wet Weather Flows
fps	feet per second
GIS	geographic information system
gpad	gallons per acre day
gpcd	gallons per capita per day
gpm	gallons per minute
hcf	hundred cubic feet
HGL	hydraulic grade line
hp	horsepower
HTP	Hyperion Treatment Plant
I&I	infiltration and inflow
IWPP	industrial waste pretreatment program
JPA	Joint Powers Agreement
K/J	Kennedy/Jenks Consultants
KWH	kilowatt hours
LA	City of Los Angeles

Table of Contents (cont'd)

Abbreviation	Definition
LACSD	Los Angeles County Sanitation Districts
LAGWRP	Los Angeles-Glendale Water Reclamation Plant
LF	linear foot
MFD	multi-family dwelling
MGD	million gallons per day
mg/l	milligrams per liter
NCPI	National Clay Pipe Institute
NOS	North Outfall Sewer
NPDES	National Pollutant Discharge Elimination System
O&M	operations and maintenance
PDWF	peak dry weather flow
population/DU	population per dwelling unit
POTW	publicly owned treatment works
pph	persons per household
PWWF	peak wet weather flow
ROW	right-of-way
RWQCB	Regional Water Quality Control Board
sf	square feet
SFC	sewer facilities charge
SFD	single-family dwelling
SMW	sewer maintenance workers
SRWCB	State Regional Water Control Board
SS	suspended solids
TAZ	traffic area zone
TDH	total dynamic head
VCP	vitrified clay pipe

Executive Summary

BACKGROUND AND OBJECTIVES

The City of Glendale (City or Glendale) is a Charter City located northeast of the City of Los Angeles in the San Gabriel Mountains. Glendale's population of approximately 200,000 resides in over 75,000 dwelling units within a 30.6-square-mile area. The City's current planning efforts estimate that Glendale's population is projected to reach approximately 225,000 by the year 2030. The City performed its last Wastewater Master Plan in 1998.

The City of Glendale's existing wastewater collection system is comprised of four types of facilities. These facilities are wastewater collection system pipelines, permanent wastewater monitoring metering stations, a wastewater pump station, and co-ownership in a wastewater treatment facility. The facility evaluation elements of this Master Plan focus on a hydraulic evaluation of the existing collection system pipelines and a condition/capacity assessment of the existing pump station. The Los Angeles Glendale Water Reclamation Plant (LAGWRP) is not included in this Master Plan as it is operated and maintained by the City of Los Angeles and its capacity and upgrade requirements are handled under a separate Joint Powers Agreement.

The existing wastewater collection system within Glendale contains approximately 360 miles of underground wastewater pipelines. These pipelines range from 8 inches to 36 inches in diameter, with approximately 87% of the system being 8-inch. Wastewater is collected in these facilities and is conveyed primarily by gravity through a "trunk" wastewater pipeline system to regional interceptors for treatment at the Hyperion Treatment Plant (HTP) or the LAGWRP, with sludge discharged to the Hyperion System.

Wastewater flows are accumulated by the wastewater pipeline system in seven district drainage basins and then measured at prescribed locations prior to final discharge to the North Outfall Sewer (NOS), the primary trunk line owned and operated by the City of Los Angeles to convey flow to the HTP. In the last few years, the City installed permanent inline flow metering facilities to replace the permanent flume facilities that had served the City for 30 to 40 years. These metering stations provide ongoing flow data for billing considerations with the City of Los Angeles and are used as the basis of existing flow conditions in this Master Plan. (See Figure 2-2 for basin designations and outfall locations)

Given the projection of additional growth and newly allowable mixed use development in much of the downtown area, the City has established a focused need to assess the hydraulic capacity of the wastewater system. Accordingly, the focus of this Wastewater Master Plan Update is to perform a hydraulic evaluation of Glendale's wastewater facilities to establish a prioritized capital improvement program. The hydraulic evaluation is conducted through the development and calibration of a computerized hydraulic model. The model is used to evaluate the capacity of the existing and future system so that a comprehensive capital improvement program can be prepared. This activity has been necessitated by recent downtown development and the associated Downtown Specific Plan developed by the City.

The objectives of this Master Plan are to:

- Develop a calibrated hydraulic model of the wastewater system.
- Input the anticipated future land use conditions on the wastewater system, and evaluate the existing system's capability to convey existing and ultimate flows.
- In concert with City staff, develop appropriate design criteria for the evaluation of the system.
- Prepare cost estimates of the necessary improvements.
- Document this information in a letter report of findings in the form of a 2007 Wastewater Master Plan Update.

Through the conduct of these objectives, the general purpose for this planning effort is to asses those areas within the City that may be capacity limited facilities and provide a methodical plan for the improvement of these identified areas.

WASTEWATER SYSTEM FINDINGS AND RECOMMENDATIONS

The findings of this study are based on a comprehensive evaluation of available data and an analysis of the existing wastewater system's ability to meet existing and ultimate flows. These primary findings and recommendations are summarized herein to address the key elements of the Wastewater Master Plan Update. Additional minor recommendations are presented within this Master Plan document. The primary findings and recommendations are summarized as follows:

General System Findings and Recommendations

Through the conduct of the Master Plan, there are a number of general system findings and recommendations identified. A few of these key elements are provided in this section.

- Existing wastewater flows were derived by utilizing utility billing data to attach monthly waster consumption to each individual parcel within the City. Return-to-sewer ratios (RTS) were applied based upon land use to determine sewer flows. These flows were calibrated to the flow monitoring information derived from the City's ongoing flow monitoring program.
- Several discussions were held with City staff regarding both the process and results of development of future wastewater flow projections. Based upon these discussions, future planning projections were developed based primarily on the recently completed Traffic Zone Analysis (TAZ) whereby future population and employment factors were developed for approximately 500 areas in the City. This baseline data was further modified to integrate additional development implications of the Disney Grand Central Creative Campus (GC3) project tributary to the Doran Pump Station and a decision to

calculate the loadings for all parcels in the DSP under both the TAZ and General Plan criteria and utilize the greater of the two values for future parcel level loadings in the downtown area.

- The results of this analysis projects the City's ultimate wastewater flows will increase to approximately 22 MGD, an increase of approximately 27% under ultimate buildout conditions.

- In addition to the projection of future increases in dry weather flows, the measured increase in flows during the rain storm event of February 23, 2005 was used to project future wet weather flows in the City's wastewater system. This event, classified as a 5-year storm, indicates that the City's collection system should be able to convey approximately 11 MGD of additional flow during a similar wet weather.

- Through the conduct of the Master Plan Update, it is recommended the City adopt new sewer design criteria. The two components of the new criteria are: a) depth to diameter criteria (d/D) - all pipelines greater than 15-inches should not exceed .67 d/D under future peak wet weather conditions, and pipelines less than or equal to 15-inch should not exceed .5 d/D, and b) wet weather criteria - the peak wet weather response factor is based on a 5-year storm, as measured in February 2005. These recommendations are based on the need to meet new State regulations for the use of a wet weather design criteria, the goal to minimize potential sanitary sewer overflows (SSO's), and discussions with City staff related to the cost and benefit of additional conveyance capacity.

- Given the magnitude of potential growth, the development and adoption of a revised Sewer Facility Charge is desirable to generate revenues commensurate with new development's impact on existing system capacity and provide for capital reinvestment. This new charge should also consider the cost implications of new capacity costs assessed to the City by the City of Los Angeles' through its Sewer Facility Charge program.

Collection and Pumping System Findings and Recommendations

The evaluation of the City's wastewater collection and pumping system is the foundation of the City's Wastewater Master Plan Update. The findings and recommendations provided herein are based on the results of the computerized hydraulic model, available information on system age/condition, and discussions with City staff. These findings and recommendations are summarized in this section.

- The City has an ongoing video inspection program that is designed to assess the condition of the wastewater collection system. In general, most of the City's collection system appears to be in generally good condition because of the City's strong maintenance, repair, replacement, and rehabilitation efforts.

- The majority of the City's wastewater collection system is composed of VCP sewer lines. VCP is a commonly used sewer pipeline material and is generally considered to provide reliable service for over 80 years. As one of the older municipalities in its region, the City's wastewater system contains many older pipelines. In fact, approximately half of the wastewater system is over 75 years old. While facility age in and of itself does not constitute a significantly deteriorated condition, it is an important factor in the development of a facility repair and replacement program. Accordingly, the City should correlate this information with a proactive video inspection program and the ongoing street resurfacing/reconstruction program to plan for the rehabilitation or replacement of these in the coming years.

- The results of the hydraulic evaluation indicate that the majority of the City's collection system has adequate capacity. However, under various current and future peak dry and peak wet weather conditions, approximately 74,400 feet was identified to have insufficient capacity to meet the City's design criteria. While the determination of actual footage to be improved may vary during pre-design when other pipe improvement considerations are included, the projection provides a framework for the magnitude of the City's potential pipeline improvement program requirements.

- The resulting pipelines with potential capacity limitations were segregated by drainage basin for subsequent prioritization, grouping, and final pre-design evaluation by the City during plan implementation. Table ES-1 reflects the estimated cost of these improvements to be approximately $31 million. The general location of these facilities is depicted graphically in Figure ES-1.

- The City owns, operates, and maintains one wastewater pumping station, the Doran Street Wastewater Pumping Plant (lift station) that lifts sewage from an existing 18" trunk sewer passing under the Verdugo Wash Flood Control Channel. This facility was originally constructed sometime around 1930 as a below ground, bi-level facility. The last major reconstruction of this lift station was in 1982 when upper level and ground level structures were added. Capacity analysis of this facility indicated that future development north of the lift station will generate a peak flow of approximately 3 MGD. This flow value exceeds the estimated 2.5 MGD firm capacity for this facility, as well as the capacity of the existing 18" pipe beneath the Verdugo Channel feeding the lift station. These projected flows will also exceed the operational capacity of the existing wet well configuration.

- Given these capacity issues, future improvements will need to consider upsizing the 18" influent piping to 27", increasing wet well operational and emergency storage capacity by lowering the wet well invert elevation several feet, and upgrading the pump capacities. Implementation of these improvements to the existing facility does not appear to be practical or feasible. As such, this finding suggests that construction of a new, properly equipped and technically current lift station is a better alternative. Based on these factors and discussions with City staff, it is recommended that this facility be scheduled for replacement. The estimated costs of these improvements are approximately $7.7 million, as shown in Table ES-1.

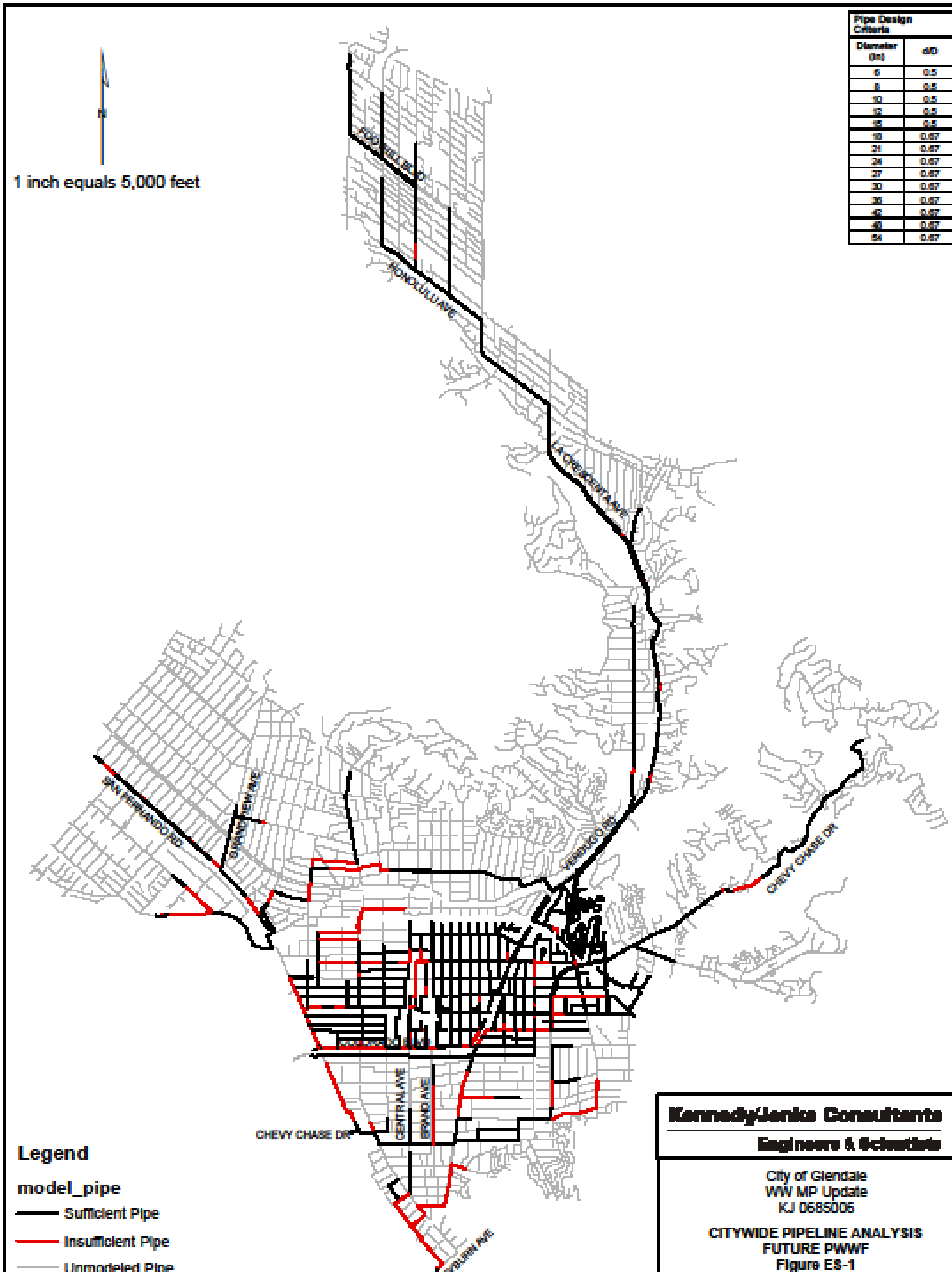
- Given the magnitude of these costs, discussions with City staff suggest that there are a number of factors still outstanding with the long-term strategy for this facility that may affect the final costs and disposition of this facility. These factors include: a) timing and magnitude of the additional flows from the Disney GC3 complex, b) ability to rehabilitate or replace Doran and the associated 18-inch influent pipeline at its exiting location to meet the ultimate demands, and c) potential relocation of this facility northwest of the Verdugo Wash on the Power Plant site and the construction of a new pipeline over the wash to eliminate the current 18-inch siphon under the wash. In consideration of these factors the City has programmed for the pre-design evaluation of this facility in the coming months. This evaluation, in conjunction with the resolution of the other institutional elements, will provide additional input in the final improvement plan and cost considerations for this important wastewater facility.

TABLE ES-1
SUMMARY OF SYSTEM IMPROVEMENT COSTS

PIPELINE IMPROVEMENT COSTS	FPWWF (ft.) [a]	FPWWF ($'s) [a]
Colorado Flume	28,456	11,667,400
Chevy Chase Flume	12,512	4,978,800
Doran Pump Station Basin	3,178	1,439,000
Doran Flume	10,315	4,594,600
Elk Flume	3,781	1,447,700
Salem/San Fernando Flume	7,319	2,824,100
Tyburn Flume	8,846	3,856,500
Total Length & Cost of Deficient Pipelines – Future Conditions	**74,407**	**$30,808,000**

DORAN PUMP STATION IMPROVEMENT COSTS	Estimated Cost ($'s)
New Doran Pump Station	7,000,000
New 27" Pipeline Under the Verdugo Wash	700,000
Total New Doran Pump Station Improvement Costs	**$7,700,000**

(a) FPWWF means future peak wet weather flow conditions.



Pipe Design Criteria	
Diameter (in)	d/D
6	0.5
8	0.5
10	0.5
12	0.5
15	0.5
18	0.67
21	0.67
24	0.67
27	0.67
30	0.67
36	0.67
42	0.67
48	0.67
54	0.67

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CITYWIDE PIPELINE ANALYSIS
FUTURE PWWF
Figure ES-1

Section 1: Introduction

1.1 Background

The City of Glendale is a Charter City located northeast of the City of Los Angeles in the San Gabriel Mountains. Glendale's population of approximately 200,000 resides in over 75,000 dwelling units within a 30.6-square-mile area. The City's current planning efforts estimate that Glendale's population is projected to reach approximately 225,000 by the year 2030.

Wastewater generated by Glendale residents and businesses is collected and conveyed by the City of Glendale's 360 miles of sewer infrastructure and discharged to either the City of Los Angeles's Hyperion Treatment Plant or to the Los Angeles-Glendale Water Reclamation Plant (LAGWRP), with sludge discharged to the Hyperion System. The LAGWRP exists under a series of joint powers agreements between the two cities and was constructed in 1976 with 80 percent grant funding. This facility is operated by the City of Los Angeles, with plant expenditures for the 20-million gallon per day (MGD) facility shared equally. Prior to the LAGWRP facility, the cities have had various contracts regarding wastewater treatment.

Given the projection of additional growth and newly allowable mixed use development in much of the downtown area, the City has established a focused need to assess the hydraulic capacity of the wastewater system. An overview of the objectives for this project is provided in the following section.

1.2 Project Objectives

The focus of this Wastewater Master Plan Update is to perform a hydraulic evaluation of Glendale's wastewater facilities to establish a prioritized capital improvement program. The hydraulic evaluation is conducted through the development and calibration of a computerized hydraulic model. The model is used to evaluate the capacity of the existing and future system so that a comprehensive capital improvement program can be prepared. This activity has been necessitated by recent downtown development and the associated Downtown Specific Plan developed by the City. The objectives of this Master Plan are to:

A. Develop a calibrated hydraulic model of the wastewater system.

B. Input the anticipated future land use conditions on the wastewater system, and evaluate the existing system's capability to convey existing and ultimate flows.

C. In concert with City staff, develop appropriate design criteria for the evaluation of the system.

D. Prepare cost estimates of the necessary improvements.

E. Document this information in a letter report of findings in the form of a 2007 Wastewater Master Plan Update.

Through the conduct of these objectives, the general purpose for this planning effort is to asses those areas within the City that may be capacity limited facilities and provide a methodical plan for the improvement of these identified areas.

1.3 Prior Studies

There have been several prior studies that are pertinent to this Wastewater Master Plan Update. The most pertinent are:

A. "***Wastewater System Master Plan,***" January 1998 by Kennedy/Jenks Consultants. This report established the basis for much of the Master Plan Update. Through this project, the City's base geographic information system (GIS) of the sewer system and land base was developed. The system was analyzed at that time for capacity and condition constraints and deficiencies identified. Many of these areas have been improved.

B. "***Glendale Downtown Specific Plan,***" November 2006 by City staff. This specific plan was developed to integrate the allowable densities and mixed use development opportunities in the downtown area. The plan has gone through a number of iterations since March 2005 and the Final Draft plan was adopted by the City Council on November 7, 2006. This plan is an integral component in deriving future densities and wastewater loadings in the downtown area.

C. "***Traffic Area Zone (TAZ) Analysis***" 2005 by City staff. This analysis is instrumental to the assessment of future wastewater demands in the downtown area. This analysis established the 2025 demands within all city block areas of future population and employment conditions. These conditions were correlated to wastewater discharges to impose future wastewater flows on the wastewater system pipeline network and derive pipeline capacity deficiencies.

D. "**Grand Central Creative Campus Environmental Impact Report**" October 2000 by Glendale Redevelopment Agency. This comprehensive EIR documented the nature of the projected development of this site and established the basis for future wastewater to be generated under buildout conditions.

These documents have been integral to the development of this Wastewater Master Plan Update.

1.4 Project Team

The preparation of this report by Kennedy/Jenks Consultants was under the overall leadership of Roger Null, V.P. and Project Manager. Kennedy/Jenks Consultants (Kennedy/Jenks) received valuable assistance from the City of Glendale Public Works and Engineering staff through its Project Manager, Maurice Oillataguerre.

Section 2: Existing Wastewater System

2.1 Existing Service Area and Study Boundaries

The City of Glendale is largely a residential community, with over 75,000 housing units. Approximately 25,000 of these are single-family dwellings while 50,000 are multi-family units. Various types of commercial establishments provide local services and regional employment opportunities for a strong local economic base.

Over the next several decades, City planners anticipate that the greatest growth will be the intensification of commercial land use in the downtown area. There also is an expected increase in mixed-use development (i.e., residential/commercial/retail) along transportation corridors and transportation nodes and in the downtown area. The study area for this project is defined as the entire City of Glendale boundary.

2.2 Land Use and Planning Projections

An important consideration in the conduct on utility system master planning projects is the integration or development of a community's existing and ultimate land use. It is this transition of land and population-related demographics that alters the demands on local infrastructure. For this reason, the identification of land use is central to the process of quantifying existing and future wastewater flows generated within the City's service area.

Integrating the "best available" vision of this transition is a critical element of the Master Plan. To identify and obtain concurrence on the best available data and City vision, a meeting was held with the City's Planning, Engineering, and Public Works Departments. This meeting discussed:

- identification of vacant land,
- existence of legally non-conforming parcels,
- status of the adopted General Plan,
- general development trends,
- current and pending specific plans,
- development of recent traffic analysis information, and
- availability of digital data for these data sets.

Based on the discussions of this meeting, it was agreed that the recent traffic area zone (TAZ) data was the most current and comprehensive data to represent the City's adopted vision of the future land use and zoning conditions. As such, at the direction of City staff, this data is used in this Master Plan as the primary basis for future land use, population, and densification decision. The data divides the City into approximately 500 city-block areas for ongoing planning considerations. The data within each TAZ includes a documentation of existing and projected population and employment values for the year 2005 and 2030.

Although the City is largely developed, recent trends and opportunities for redevelopment with high rise commercial and/or mixed-use structures has resulted in the need for a focused plan for infrastructure development. Foremost among this development/redevelopment activity is the growth opportunities in downtown Glendale. Based on the need to document and approve the long-range planning of this activity, the City developed the Downtown Specific Plan (DSP). This urban design oriented plan covers downtown Glendale and provides the standards and requirements for redevelopment activity. The final draft of the DSP was adopted by the City Council on November 7, 2006.

From a Master Plan perspective, it is important to note that the projected impact of the DSP on future population and employment values has been integrated in the TAZ data and will be instrumental in the development of future flows in the downtown area. The TAZ boundaries for the Colorado basin are shown in Figure 2-1 to demonstrate the level of detail in this analysis. The current and projected planning data associated with the Colorado basin is also provided for reference as an Appendix.

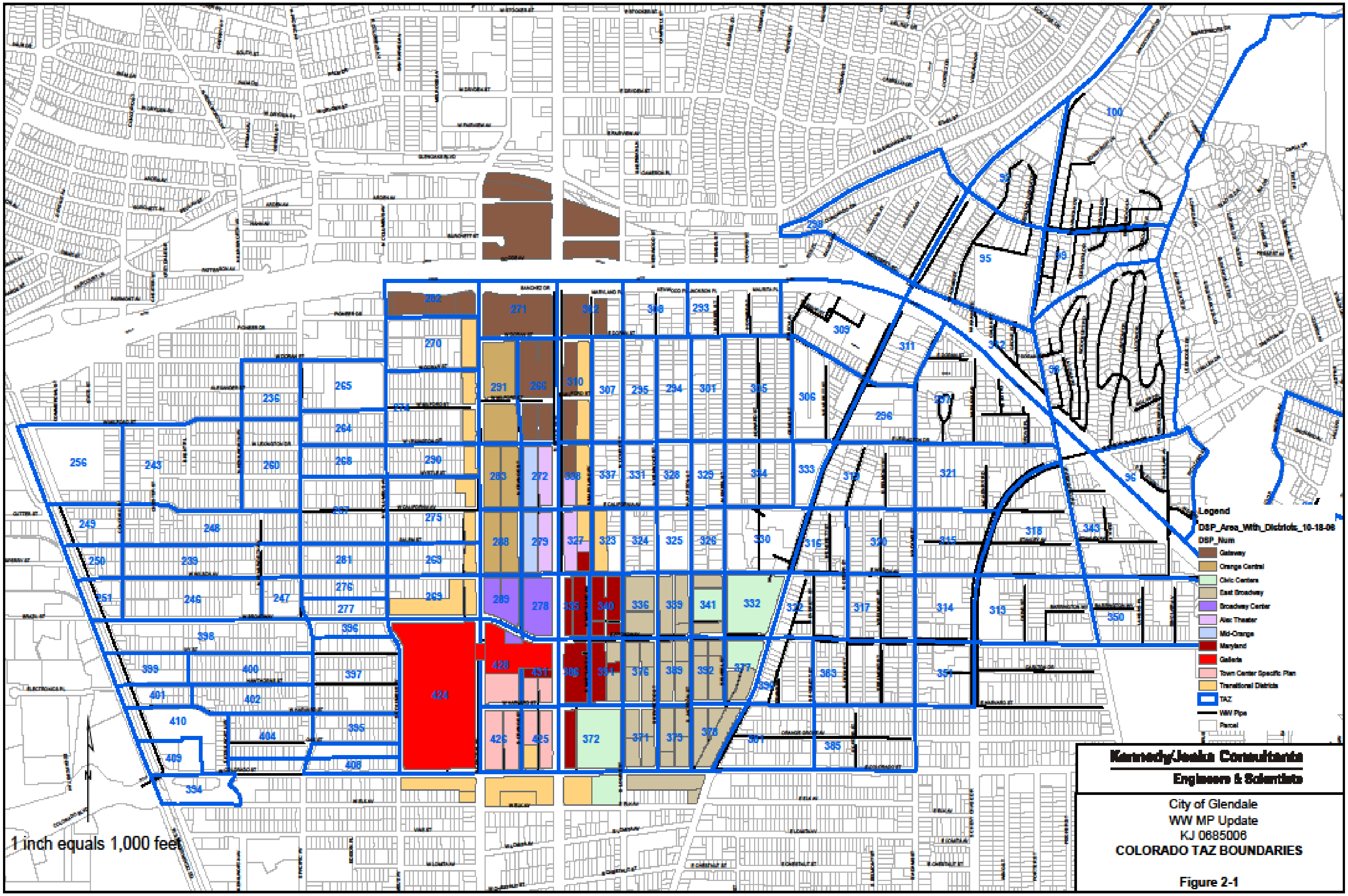
In addition to the DSP, two growth components that warrant documentation are the Disney Grand Central Creative Campus (GC3) project and the development/conversion of low level parking lots in the downtown area. Based on discussions with City staff, each of these two development/redevelopment opportunities were to be added to the TAZ data to provide for the eventuality of this activity. The projection of future wastewater flows associated with these components and the City's total projected wastewater flows are provided in Section 3.

2.3 Existing Wastewater Facilities

The City of Glendale's existing wastewater collection system is comprised of four types of facilities. These facilities are wastewater collection system pipelines, permanent wastewater monitoring metering stations, a wastewater pump station, and co-ownership in a wastewater treatment facility. The facility evaluation elements of this Master Plan focus on a hydraulic evaluation of the existing collection system pipelines and a condition/capacity assessment of the existing pump station. The Los Angeles Glendale Water Reclamation Plant (LAGWRP) is not included in this Master Plan as it is operated and maintained by the City of Los Angeles and its capacity and upgrade requirements are handled under a separate Joint Powers Agreement. The evaluation of wastewater collection and pumping system facilities to meet future system loads is provided in Section 4.

2.3.1 Collection Facilities and Drainage Areas

The City of Glendale's existing wastewater system collects sewage at its point of origin and conveys wastewater in a southerly and southwesterly direction to the Los Angeles North Outfall Sewer (NOS), located along the Los Angeles River. Glendale's topography, in combination with the physical configuration of the piping and pumping system, has divided the City into seven major drainage basins or tributary areas.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DSP_Num
Gateway
Orange Central
Civic Centers
East Broadway
Broadway Center
Alex Theater
Mid-Orange
Maryland
Galleria
Town Center Specific Plan
Transitional Districts
TAZ
WW Pipe
Parcel
1 inch equals 1,000 feet
N
Kennedy/Jenks Consultants
Engineers & Scientists
City of Glendale
WW MP Update
KJ 0685006
COLORADO TAZ BOUNDARIES
Figure 2-1

Wastewater flows are accumulated within each drainage basin's wastewater pipeline system and measured at prescribed locations prior to final discharge to the NOS. In the last few years, the City installed permanent inline flow metering facilities to replace the permanent flume facilities that had served the City for 30 to 40 years. These metering stations provide ongoing flow data for billing considerations with the City of Los Angeles and are used as the basis of existing flow conditions in this Master Plan. The location of these facilities and the associated drainage basin pipeline network is shown on Figure 2-2.

The existing wastewater collection system within Glendale contains approximately 360 miles of underground wastewater pipelines. These pipelines range from 8 inches to 36 inches in diameter. Wastewater is collected in these facilities and is conveyed primarily by gravity through a "trunk" wastewater pipeline system to regional interceptors for treatment at the Hyperion Treatment Plant or the LAGWRP. The predominant material of these pipelines is vitrified clay pipe (VCP).

A comprehensive assessment of the length, diameter, and age of the City of Glendale's underground wastewater collection system was provided in the 1998 Wastewater Master Plan. While there has been ongoing repair and replacement activity, the general pipeline inventory findings in 1998 are applicable today. Of these findings, the most important are:

- approximately 87 percent of all underground facilities are 8 inches in diameter, and
- essentially half of the system is over 75 years old.

While facility age in and of itself does not constitute a significantly deteriorated condition, it is an important factor in the development of a facility repair and replacement program. Accordingly, the City should plan for the rehabilitation of these older facilities.

2.3.2 Doran Pump Station

The City of Glendale owns, operates, and maintains one wastewater pumping station, the Doran Street Wastewater Pumping Plant (lift station) that lifts sewage from an existing 18" trunk sewer passing under the Verdugo Wash Flood Control Channel to a maintenance manhole adjacent to the lift station that allows gravity flow from the lift station to the southeast for discharge into the existing 48" NOS line. This lift station was originally constructed sometime around 1930 as a below ground, bi-level facility. The last major reconstruction of this lift station was in 1982 when upper level and ground level structures were added.

During this upgrade a lower hoist room and an upper level (above ground) hoist room were added including an emergency generator/control room, new pumps, associated piping and valves, a ventilation system, overflow/by pass piping and modifications that allow the dry well to operate as an alternate wet well for maintenance and repair of the wet well. The lower well section, a circular concrete wet well/dry well structure, is 20 feet in diameter and approximately 24 feet in height. The total depth of the facility below ground surface is 38 feet. The lift station is located at 967 W. Doran Street on the western edge of Glendale City limits and adjacent to the southeast corner of the confluence of the Verdugo Wash Flood Control Channel and the Los Angeles River.

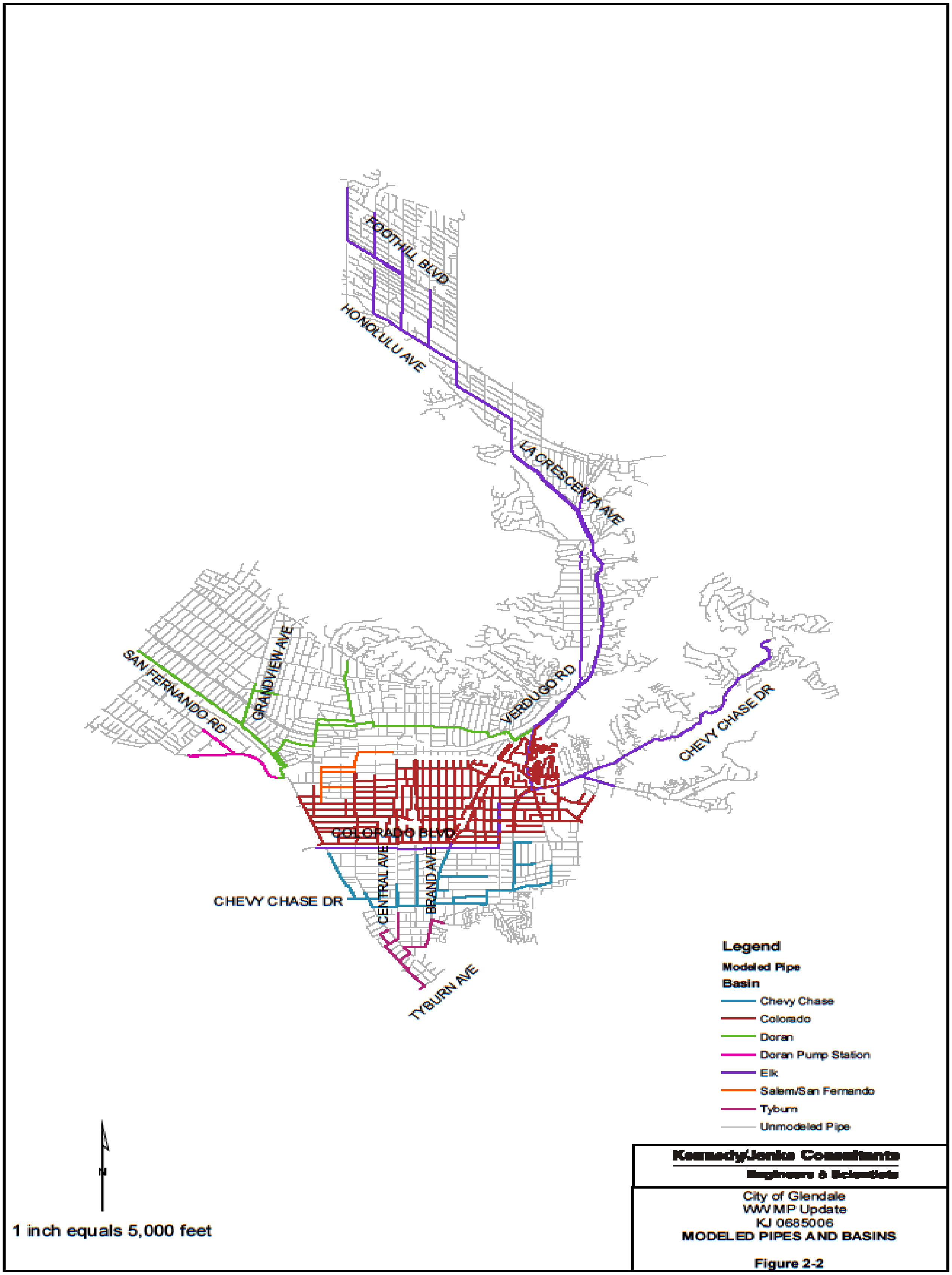

FOOTHILL BLVD
HONOLULU AVE
LA CRESCENTA AVE
VERDUGO RD
CHEVY CHASE DR
SAN FERNANDO RD
GRANDVIEW AVE
COLORADO BLVD
CENTRAL AVE
BRAND AVE
CHEVY CHASE DR
TYBURN AVE
Legend
Modeled Pipe
Basin
Chevy Chase
Colorado
Doran
Doran Pump Station
Elk
Salem/San Fernando
Tyburn
Unmodeled Pipe
N
1 inch equals 5,000 feet
Kennedy/Jenks Consultants
Engineers & Scientists
City of Glendale
WWMP Update
KJ 0665006
MODELED PIPES AND BASINS

Figure 2-2

The lift station is equipped with three 1,150 gallon per minute (gpm), 25-horsepower, ESSCO model 6 x 12 submersible pumps (P101, P102, and P103), one 1,150-gpm, 25-horsepower, ESSCO model 6 x 12 submersible pump for alternative wet well operations (P104), and one 3-horsepower, ESSCO model 3S2 sump pump (P105). Pumps P101, P102, and P103 are located in the wet well and operate on an alternating lead-lag basis with two of the pumps designed for normal operations with the third pump to be available as a standby for emergency flows. Pumps P104 and P105 are located in the dry well, with P104 acting as an alternate by-pass pump when the dry well is utilized as an alterative wet well, and P105 as a submersible sump pump used for the removal of incidental flow from the wet well during wet well shut down. These pumps are all located on the lowest level of the facility, level three, at approximately 38 feet below ground surface. Based on a firm capacity with only two pumps running, the pump design capacity for this facility is approximately 2.5 MGD.

Level two contains access to level three, a pedestal base slide gate operator, and provides entry staging to the lower wet well in accordance with Health and Safety Code requirements. Level one, the above-ground level, contains the facility's electrical control panel, engine driven generator, fuel storage day tank, and an overhead crane system in support of pump removal for repair/replacement. Standby power is provided by the 75 kW engine-driven, generator set. A 550-gallon dual-contained underground fuel storage tank (UST) located adjacent to the lift station between the structure and the Los Angeles River channel wall has recently been replaced with an above ground tank, dual walled tank in the same location.

Section 3: Wastewater Flows and Design Criteria

This section outlines the development of wastewater flows and the design criteria used to evaluate the City's wastewater system. These parameters are based primarily on information provided by the City, other surrounding municipalities, and engineering practices. The data developed and evaluated herein was used to establish current flows in the City. It subsequently provides support for the calibration of the sewer system hydraulic model, and the projection of future system flows within the City's service area. The future flows are used in subsequent sections to evaluate the adequacy of existing collection/pumping system facilities and to identify the need for additional facilities to meet future loading conditions.

To perform the evaluation of wastewater facilities, several key design criteria must be established. These criteria provide the basis by which existing facilities are evaluated for adequate capacity and are used to establish the appropriate size of new facilities needed to meet future system demands. The development of wastewater flows and design criteria to be used in this Master Plan are provided in the following sections.

3.1 Existing Wastewater Flows

As previously discussed, the City has installed seven permanent flow meters at locations in the collection system to measure the volume of wastewater at it leaves the City and is collected by facilities owned and operated by the City of Los Angeles. Wastewater flows and rainfall data captured at these metering stations is instrumental in the development of flow conditions for this Master Plan, including average dry weather flow (ADWF), peak dry weather flow (PDWF), and peak wet weather flow (PWWF) factors for each metering station and drainage basin.

Through these metering facilities, wastewater values are measured at fifteen minute intervals, and daily, monthly and annual average and peak conditions calculated for each basin and for the City of Glendale as a whole. A summary of the flow measurement findings for early 2006 is provided in Table 3-1. Given that flows vary throughout the year, Table 3-1 suggests that the City's existing average annual flow is approximately 17 MGD. The existing peak wet weather flows are also shown herein for reference and used in subsequent section of this report.

TABLE 3-1
EXISTING MEASURED WASTEWATER FLOWS

	ADWF (MGD)	PDWF (MGD)	PWWF (MGD)[a]
Colorado Flume	4.07	6.06	8.56
Chevy Chase Flume	3.25	5.14	6.54
Doran Pump Station Basin	0.62	1.15	1.35
Doran Flume	4.00	6.04	7.74
Elk Flume	3.50	5.39	9.09
Salem/San Fernando Flume	1.10	1.47	2.07
Tyburn Flume	0.76	1.38	2.18
Total Flows	17.30	26.62	37.52

Notes: (a) Flow value measured on February 23, 2005 (5-year storm). Source: City of Glendale flume data, average dry weather flows only, for December 2005 through February 2006 flume data.

3.2 Future Wastewater Flows

Future wastewater flow projections are derived by developing unit wastewater flow factors under current conditions and applying these factors to the population and employment projections developed by the City, provided in the TAZ analysis data set, and included in the zoning (DSP and General Plan). A discussion of this process follows.

3.2.1 Development of Wastewater Flow Factors

Existing average dry weather flow factors are developed by integrating GIS, water billing, and flow monitoring data available during this Master Plan. Wastewater flow factors are derived by correlating the measured wastewater flows provided by the basin metering stations with the water billing data provided by Glendale Water and Power's billing department for December 2005, and January/February 2006. This account-level water billing data is attached spatially to the parcel it serves and subsequently grouped together based on their location in each drainage basin in the City. Each parcel's water usage is converted to wastewater by applying the water to wastewater return-to-sewer ratios associated with its assigned land use type or water billing customer classification. The total calculated total wastewater per basin is then contrasted with the metered flow measurements and return to sewer factors adjusted to balance these values. The return-to-sewer ratios utilized in this process is provided with other supporting tables in Appendix A.

This calibration process is also a key element of the hydraulic model development approach and is further discussed in Section 4 of this study. The resulting parcel level flows are consolidated into the existing TAZ population and employment categories and wastewater factors for each category created for each basin in the City.

3.2.2 Development of Future Wastewater Flows

Once the current wastewater flow factors have been developed on a population and employment basis for each basin, these factors can be applied to the 2030 TAZ values to estimate the total wastewater within each TAZ. The TAZ loadings for each basin are subsequently summed and a baseline estimate of future wastewater basin flows derived.

Several discussions were held with City staff regarding both the process and results of this planning endeavor. Upon review of the findings, Engineering and Public Works staff suggested several adjustments to the TAZ data to integrate additional potential build-out opportunities based on the zoning. As discussed in Section 2, the TAZ data did not seem to fully integrate the development implications of the Disney Grand Central Creative Campus (GC3) project tributary to the Doran Pump Station and there were some concerns that the buildout assumptions used in the development of the TAZ area downtown may not be sufficient for future infrastructure needs. Accordingly, the original City-provided TAZ data was modified as follows:

- increase the wastewater loads discharging from the GC3 project area to 1.08 MGD in conformance with the Final Environmental Impact Report, resulting in an additional 800,000 gpd in the Doran Pump Station basin,
- the loads for the DSP were increased by calculating the loadings for all parcels in the DSP under both the TAZ and General Plan criteria and utilizing the greater of the two values for the future parcel level loadings, and assigning additional future flows to a

number of City-identified parking lots resulting in an additional 300,000 gpd in the Colorado basin and an additional 110,000 gpd in the Salem basin, and

- to account for additional flows generated from the Rockfield area in the Chevy Chase basin, an additional .15 MGD ADWF and .65 MGD PWWF was injected as non-city generated point loads in the hydraulic model.

Integration of these incremental loads with the TAZ generated wastewater values results in the development of the City's projected wastewater flows for the year 2030. The results are summarized for each of the City's drainage basins and are provided in Table 3-2.

TABLE 3-2
PROJECTED WASTEWATER FLOWS

	Existing WW		Future WW	
	ADWF (MGD)	PDWF (MGD)	ADWF (MGD/%)	PDWF (MGD/%)
Colorado Flume	4.07	6.06	6.01 (148%)	8.60 (142%)
Chevy Chase Flume	3.25	5.14	3.61 (111%)	5.52 (107%)
Doran Pump Station Basin	0.62	1.15	1.76 (284%)	2.94 (255%)
Doran Flume	4.00	6.04	4.29 (107%)	6.48 (107%)
Elk Flume	3.50	5.39	3.76 (107%)	5.73 (106%)
Salem/San Fernando Flume	1.10	1.47	1.60 (146%)	2.29 (156%)
Tyburn Flume	0.76	1.38	0.84 (110%)	1.51 (109%)
Total Flows	17.30	26.62	21.87 (126%)	33.07 (124%)

Notes: Percent increase is the increase in flow per basin going from existing to future conditions.

As shown, the City's total average annual wastewater is projected to increase to approximately 22 MGD, an increase of approximately 26%. Closer scrutiny of the table indicates that the increase in most basins is generally consistent with the 1998 Master Plan and current planning expectations for overall development in the City at approximately 10%. The difference in the increase is derived from the substantial projected increases in the Colorado, Salem, and Doran Pump Station drainage basins, as these basins are affected by the Downtown Specific Plan and the Disney GC3 Project, respectively. The incorporation of these flows in the hydraulic model is discussed in Section 4.

3.3 Wastewater Peaking Factors

As described above, average flows entering the collection system are assessed by correlating land use types with associated flow generation factors that have been calibrated to flows measured at the City's permanent flow monitoring facilities. However, further determination of the adequacy of the wastewater system is based upon the ability of the system to convey peak wastewater flows. Peak flows include both peak dry weather and peak wet weather flows. The development of the peak factors that relate average flows to peak flows within the City is described in the following sections.

3.3.1 Peak Dry Weather Flow Factors

Peak dry weather flow results from the natural patterns of wastewater system usage indicated in typical residential and non-residential dischargers to the collection system. These patterns result in a diurnal discharge curve for each user; the combination of these diurnal discharge curves developed throughout a drainage basin result in a characteristic diurnal flow curve at the monitor that measures basin flow.

In the 1998 Master Plan, a comprehensive temporary flow monitoring program was conducted at various locations in the City to supplement the measurement data obtained from the City's flumes. This data, in conjunction with the flume data, was used to create a peaking equation of the City's wastewater system. Since additional flow monitoring is not performed during this study and a single flow value at the point of basin discharge is inadequate to create a new peaking curve, the 1998 curve was evaluated for appropriateness in this Master Plan Update.

Applying the 1998 curve to the flow generation values of each basin was found to provide a reasonable match with the measured peak dry weather flows obtained at the basin discharge points. This condition was further evaluated in the Colorado basin as the City provided additional local flow studies at several locations upstream of the flume. Given this high correlation, the 1998 peaking factor equation is recommended for continued use in this update. The peaking factor equation for this Master Plan is shown graphically on Figure 3-1 and provided as follows:

$$\text{Peaking Factor (PF)} = -0.1815\ \text{Ln}(Q_{avg}) + 1.76, \text{ (Q in mgd)}$$

3.3.2 Peak Wet Weather Flow Factors

Peak wet weather flow factors measure a collection system's response to Rain Dependent Inflow and Infiltration (RDII). Such precipitation enters the collection system through inflow (direct connections such as manhole covers and illegal storm connections) and infiltration (broken and cracked pipes and leaky joints). The amount of RDII that enters a wastewater collection system during any given wet weather event depends both on the total amount of precipitation that falls over the collection system and on the "leakiness" of that system.

Thus, quantification of peak wet weather flow factors for a given wastewater collection system requires the integration of two elements: the identification of a "design" amount of precipitation ("design storm") to use in the calculations, and the calculation of the amount of precipitation from the design storm that will enter the collection system. The selection of a design storm is a process that combines the analysis of probabilistic risk of a given storm to the collection system (in terms of surcharge and/or flooding) with the balancing factor of the economic consequences of over designing the collection system to minimize the risk of spills. The calculation of flow entering the collection system is made using the measured response to specific rainfall events at each of the City's permanent metering facilities.

To begin the process, the City chose as a baseline design storm, a precipitation event with a 5-year recurrence interval. Statistically, there is a 20% chance any given year that a storm of this intensity will take place. The intensity and recurrence interval of the storm were determined from the *Precipitation-Frequency Atlas of the Western United States* (NOAA Atlas 2, Volume XI. 1973). The intensity of the 5 year design storm corresponds to 1.15 inches per hour sustained for 1 hour, or 0.67 inches per hour sustained for 6 hours.

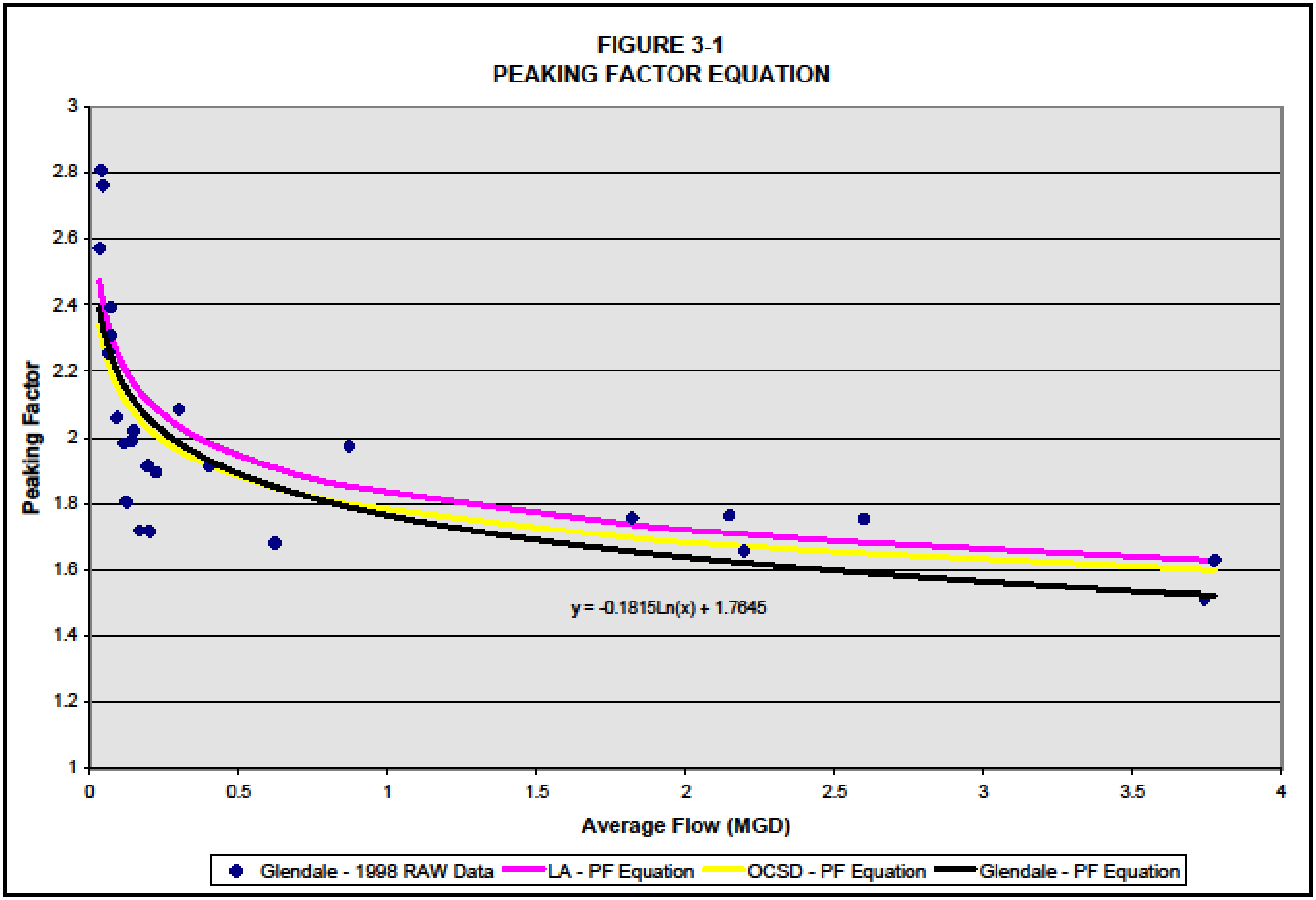


FIGURE 3-1
PEAKING FACTOR EQUATION
Peaking Factor
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0
0.5
1
1.5
2
2.5
3
3.5
4
y = -0.1815Ln(x) + 1.7645
Average Flow (MGD)
Glendale - 1998 RAW Data
LA - PF Equation
OCSD - PF Equation
Glendale - PF Equation

Since the storm event on February 23, 2005 was classified as a 5-year storm, the response to this event is readily available for each basin through the ongoing permanent flow metering program. As expected, some basins within the City showed more response to precipitation.

To incorporate the incremental increase in flow within the basins, the response was quantified by unitizing the amount of precipitation entering a basin by the amount of modeled pipeline in each basin. The result is a wet weather flow factor, calculated in gpd/linear foot of pipe, which describes the amount of precipitation entering a specific area of the collection system.

It should be noted that the resulting wet weather loading factors do not provide an equitable means of comparing the leakiness of one basin to another, as the factors are only unitized by the length of modeled pipeline in each basin. To equitably compare one basin to another, the wet weather response in each basin would have to be normalized by the total footage per basin. This assessment was not performed herein, but rather a unit factor approach was taken to support the data loading requirement of the hydraulic model.

Table 3-3 shows each basin's actual increase to the 5-year storm and the associated unit response factors for each basin. To assess the implications of a more significant storm, the City requested that a 10-year design storm also be considered. The NOAA data suggests that the intensity of an event of this nature would be approximately 20% greater than a 5-year event. In the absence of additional data, each basins response was proportionally increased to account for this additional flow. Both of these peak wet weather loading conditions are shown in Table 3-3.

TABLE 3-3
PEAK WET WEATHER LOADING CRITERIA

	Linear Feet Per Basin (a)	5 Yr I&I (MGD)(b)	10 Yr I&I (MGD)	Gallons/ Day Per Ft - 5 Yr (c)	Gallons/ Day Per Ft - 10 Yr (c)
Colorado Flume	233,248	2.50	3.00	10.72	12.86
Chevy Chase Flume (d)	34,396	1.40	1.68	40.70	48.84
Doran Pump Station Basin	6,883	0.20	0.24	29.06	34.87
Doran Flume	35,573	1.70	2.04	47.79	57.35
Elk Flume	115,588	3.70	4.44	32.01	38.41
Salem/San Fernando Flume	10,337	0.60	0.72	58.04	69.65
Tyburn Flume	11,653	0.80	0.96	68.65	82.38

Notes: (a) Footage indicated is only for modeled pipe per basin.
(b) 5-year I&I PDWF & PWWF values are from Table 3-1; 10-Year I&I is estimated.
(c) The gpd/ft factors are not normalized for total feet/basin & do not reflect degree of basin leakage.

3.4 Wastewater System Design/Capacity Criteria

In analyzing a wastewater system, it is necessary to derive standards regarding the amount of flow that may be efficiently conveyed by any given component: gravity main, pump station, force main, etc. At the time of collection system design and/or evaluation, there is often some uncertainty as to future development patterns within the area to be served. To deal with this uncertainty, provision is usually made for some extra capacity to allow for the possibility of actual system flows being slightly higher than the anticipated flows. The following sections describe the design/capacity criteria used on the evaluation of the City's collection and pumping system as part of this Master Plan.

3.4.1 Gravity Pipeline Design Criteria

As previously discussed, the basins in the City's collection system have a varying response to dry weather and wet weather conditions. Because of this, the City desires to consider design and capacity factors that incorporate both dry and wet flow scenarios. Table 3-4 presents the controlling depth over diameter criteria for pipeline capacity considerations.

TABLE 3-4
SYSTEM DESIGN CRITERIA - PIPELINES

Diameter (in)	d/D
6	0.5
8	0.5
10	0.5
12	0.5
15	0.5
18	0.67
21	0.67
24	0.67
27	0.67
30	0.67
36	0.67
42	0.67
45	0.67
48	0.67

It is important to note that current federal and state regulations require sewer agencies to accommodate the impact of wet weather events on their sewer system through the development and use of a wet weather analysis. This analysis should be based on a particular design storm. To provide the City with the necessary information to make an appropriate decision, both five and ten-year design storms were developed, analyzed, and discussed with the City. Based on these findings and discussions, the City has decided to utilize the 5-year storm as its wet weather design storm criteria at this time, although this criteria may change based on future regulatory requirements and other pipeline sizing and cost considerations. The design criteria shown above are based on conveying peak wet weather flows within acceptable depths for each basin in the City.

In addition to these capacity considerations, from an operational perspective, a minimum peak flow velocity of 2.0 fps at PDWF is desirable to adequately scour the pipeline and prevent significant solids deposition. Pipelines in the system that do not develop adequate cleansing velocity (flat pipelines, low spots, or pipelines with low flow) should be given priority status in the City's pipeline cleaning program.

3.4.2 Pump Station Design Criteria

The evaluation of a wastewater pump station is based on two primary criteria. These criteria include the ability of the pump station to reliably pump the PWWF and wet well adequacy for pump cycling.

3.4.2.1 Capacity

The design pump capacity requirement is consistent with methodology used in the collection system model. A pump station will be considered over capacity if it cannot pump the PWWF with one pump out of service and the remaining pumps operating at 75% of the station's rated capacity. The remaining 25% capacity is allocated for I&I predicted from the applicable design storm, reserve capacity contingency, and variation in daily wastewater flow. Standby power provisions are also an integral element of the pump station reliability.

3.4.2.2 Cycling

Wet well adequacy is analyzed in terms of maximum pump cycles per hour. A typical pump motor is designed for a maximum of six starts or cycles per hour. If the motor is started more than six times in an hour, it may overheat the motor starters, causing them to wear prematurely and fail. The maximum number of cycles per hour corresponds to the minimum cycle time, which is calculated using the pumping rate, the wet well dimensions, and the pump on/off control points. The cross-sectional area of the wet well and the pump control points determine the operational wet well volume. For example, when the wastewater in the wet well reaches the pump's upper control point, the pump turns on and draws down the wet well wastewater level. When the wastewater level reaches the pump's lower control point, the pump turns off and the wet well begins to refill.

The time between pump starts is the cycle time. The minimum cycle time occurs when the flow rate into the wet well is half the pumping rate. Under these conditions, the water level in the wet well rises between pump control points in x minutes, would be pumped down in x minutes, and the cycle time would be 2x minutes.

3.4.2.3 Force Main Maximum Velocity Design Criteria

In addition to the pump station capacity and wet well cycling considerations, the potential construction of new force mains in the system also requires the need for a force main maximum velocity design criteria. The suggested criterion to be used by the City for the evaluation or design of a new sewer force main is for the velocity to not exceed 5 feet per second.

3.5 Wastewater System Unit Costs

Collection system pipeline unit costs were developed based upon costs compiled from recent projects in the City and its surrounding areas and are checked against industry values. These unit costs are displayed in Table 3-5. These costs apply to new and replacement construction of VCP pipelines completed in place under normal working conditions.

TABLE 3-5
PIPELINE UNIT COSTS

Pipe Diameter in Inches	2007 Costs/LF
8	$324
10	$359
12	$391
15	$450
18	$463
21	$475
24	$490
27	$565
30	$610
36	$650
45	$735
48	$864

Note: These unit costs include approximately 35% for engineering, administration, and contingency and reflect current values experienced by City of Glendale Engineering Section.

In contrast to the development of defined unit costs for new replacement pipeline projects, the costs associated with improvements to pumping facilities requires the development of an engineer's estimate of probable costs on a case-by-case basis. The estimated costs for the Doran Lift Station improvements are provided in Section 5.

Section 4: Wastewater System Evaluation

This section evaluates the City's existing wastewater collection system's ability to convey existing peak dry and peak wet weather flows from current land uses; and future peak dry and peak wet weather flows associated with redevelopment and new development of vacant lands in accordance with City planning projections, as discussed above.

4.1 Overview

The wastewater collection system was evaluated for existing and future conditions using a hydraulic model called H20Map Sewer, a computer simulation model developed by MWH Soft, Inc. The model is developed using the wastewater pipeline data obtained from the City's GIS and further reconciled and updated through the conduct of this study. Land use type and flow tributary to system manholes are then linked, and average flows are calculated using the general and specific flow generation criteria presented in Section 3. Collection pipelines and pump stations are evaluated based on their ability to convey the projected peak dry and peak wet weather flow.

Potential hydraulic concerns or deficiencies within the existing system are identified under current and future flow conditions and recommendations are provided for the potential remediation of these facilities. Although the City's pump station is included in the wastewater hydraulic model, it is evaluated separately, using the flow information developed in the model and data collected in the field.

As discussed, a system-wide design capacity contingency is established in the model to provide flexibility for variations in flows and to accommodate future redevelopment projects. The concept of a capacity contingency is a common consideration to account for the undefined size and location of future redevelopment projects and should provide some flexibility for undefined redevelopment within the City. Actual redevelopment projects should be evaluated by the City on a case-by case basis. As such, some especially large or high density projects may require specific capacity improvements to provide adequate service.

4.2 Collection System Evaluation

An integral component of the collection system evaluation is the use and development of a sewer system hydraulic model. The H20Map Sewer modeling program transforms physical system information, flow generation criteria, and analytical criteria into a mathematical model that simulates hydraulic conditions in the sewer system. H20Map Sewer is a dynamic computer model that simulates the hydraulic conditions of the gravity flow collection system. Flows are loaded into the model at each manhole and are summed along each flow path. In addition, the model calculates the capacity of each pipeline within the system and compares the pipeline capacity with the calculated flow to identify potentially hydraulically deficient conditions and to size possible future improvements.

The construction of a hydraulic model in H20Map Sewer requires the development and integration of two separate system elements. These elements include the sewer facility data files and the sewer flow loading data file. H20Map Sewer is designed to read the appropriate characteristics of each system file, integrate the unique linkage among the data elements, and develop the hydraulic simulation of the wastewater conveyed throughout the collection system. Each of these modeling data files are discussed in the following sections.

4.2.1 Wastewater Facilities Data Sets

The facility data file is comprised of the physical elements of the sewer system to be modeled. Physical elements include pipeline diameter, roughness, length, slope, and invert elevations in the collection system, and operations data for the pump station. In H20Map Sewer, these physical elements are stored spatially in native shapefile format. The non-spatial attributes are stored in a linked H20Map Sewer (.hsw file). As previously discussed, these physical elements were imported from pipeline and manhole GIS shapefiles. The shapefiles were provided by the City and updated in this study to integrate those wastewater facilities that had not been updated in the City's GIS wastewater utility layer. This updated digital dataset is delivered to the City under separate cover.

The facilities to be modeled included all pipelines in the downtown area and the primary trunk lines in other City areas. This analysis is an expanded data set from the 1998 Master Plan and provides additional analysis of areas of the City with a high potential for redevelopment implications. The resulting analysis fell within the limits of what could be computed efficiently by H20Map Sewer 2000 link network version. Developing the model in this manner provided for a highly accurate model, because wastewater flows are loaded into the model near their actual physical location of connection, rather than being aggregated into manholes on a downstream trunk line. An original licensed version of the modeling software has been purchased for the City under this agreement and training on its use provided to City staff.

4.2.2 Wastewater Model Loading Data Files

The H20Map Sewer hydraulic modeling platform loads base and peak dry weather flow at the manholes throughout the modeled system. The loading data files consist of a Microsoft Excel spreadsheet that lists the ID number of each manhole in the system and the wastewater load to be assigned to that manhole in the model. A GIS overlay analysis was used to assign each pipeline and manhole in the City's system to a basin.

The ADWF load assigned to each manhole in the Excel file is calculated using spatial relationship functions in the GIS. The wastewater load for each parcel in the City is calculated using water billing records, return-to-sewer ratios, and flow monitoring based calibration adjustment factors. The load from each parcel is uniquely assigned to the appropriate manhole by using the lateral layer's pipe-to-parcel network connectivity. Several loads were also added to the model separate from this GIS-based process. These loads include flow from the conversion of existing low level parking lot facilities to future commercial properties generating wastewater and a point load in the Chevy Chase basin to simulate additional flows from the City of Los Angeles in the Rockfield area.

Peak dry weather loads in the City are calculated by multiplying the base average loads by the peaking factor equation provided in Section 3. The applicable peak factors are based on the flow characteristics in each pipeline. The resulting peak load is incorporated in the wastewater system hydraulic model.

The City's permanent flow metering program is also used to develop peak wet weather flow factors for the wastewater loading data files. The metered wet weather response data is used to calculate an inflow and infiltration value based upon linear feet of pipeline in each basin, as shown in Table 3-3. Since the inflow and infiltration (I&I) value are developed per basin, GIS analysis is used to assign a basin to each modeled pipeline within the City's system, thereby applying the appropriate basin I&I factor to each pipeline. This factor, when multiplied by the total length of the pipe, produces the total amount of I&I experienced by the pipe under peak wet weather conditions. The resulting total projected peak wet weather wastewater flows is derived by adding the incremental wet weather flow values from Table 3-3 to the projected peak dry weather flows shown in table 3-2, and adding the Rockfield area tributary flows. The resulting projected future peak wet weather wastewater flows are shown in Table 4-1.

TABLE 4-1
PROJECTED WET WEATHER WASTEWATER FLOWS

	FADWF	FPDWF	5-Year I&I	FPWWF
Colorado Flume	6.01	8.60	2.5	11.10
Chevy Chase Flume [a]	3.61	5.52	2.2 [a]	7.72
Doran Pump Station Basin	1.76	2.94	.20	3.14
Doran Flume	4.29	6.48	1.7	8.18
Elk Flume	3.76	5.73	3.7	9.43
Salem/San Fernando Flume	1.60	2.29	.60	2.89
Tyburn Flume	0.84	1.51	.80	2.31
Total Flows	21.87	33.07	10.9	44.77

Notes: (a) An additional 0.8 MGD has been added for Rockfield tributary flows.

4.2.3 Hydraulic Modeling Scenarios

Six separate hydraulic modeling evaluations were developed and hydraulic simulations performed to assess the capacity of the City's collection system. These include:

1. Existing Average Dry Weather Flow (EADWF)
2. Existing Peak Dry Weather Flow (EPDWF)
3. Existing Peak Wet Weather Flow (EPWWF) – 5 Yr. Storm
4. Future Average Dry Weather Flow (FADWF)
5. Future Peak Dry Weather Flow (FPDWF)
6. Future Peak Wet Weather Flow (FPWWF) – 5 Year Storm

As previously discussed, the future scenarios correspond to flows projected to the planning horizon of the City's Comprehensive General Plan, Downtown Specific Plan, and the associated 2030 Traffic Zone Analysis that integrates the projection of both population and employment values. While tabular output data from each of these analyses are available, graphical results of the existing ADWF (Scenario 1), future PDWF (Scenario 5), and the future PWWF evaluation

(Scenario 6) are shown herein as they provide the greatest information to support management decisions related to system performance and project prioritization.

4.2.4 Hydraulic Model Calibration

Hydraulic model calibration is the process by which the system's average/peak flow factors, model connectivity, and physical characteristics are adjusted such that modeled flow under the various scenarios matches measured flows recorded during the measured corresponding flow conditions. Results that are well-calibrated for existing flow scenarios indicate that the hydraulic model represents field conditions to a high degree of accuracy. Such a model will give accurate output as future scenarios are run and will provide meaningful results to "what-if" development questions that arise as the demands on the collection system change.

Table 4-2 shows the results of the hydraulic model calibration findings. A model that estimates flows within +/- 5 to 10% is generally considered to be well calibrated. As shown, the City's model provides a reasonable simulation of the average values measured at each of the flume facilities and for the City as a whole.

TABLE 4-2
MODEL CALIBRATION FINDINGS

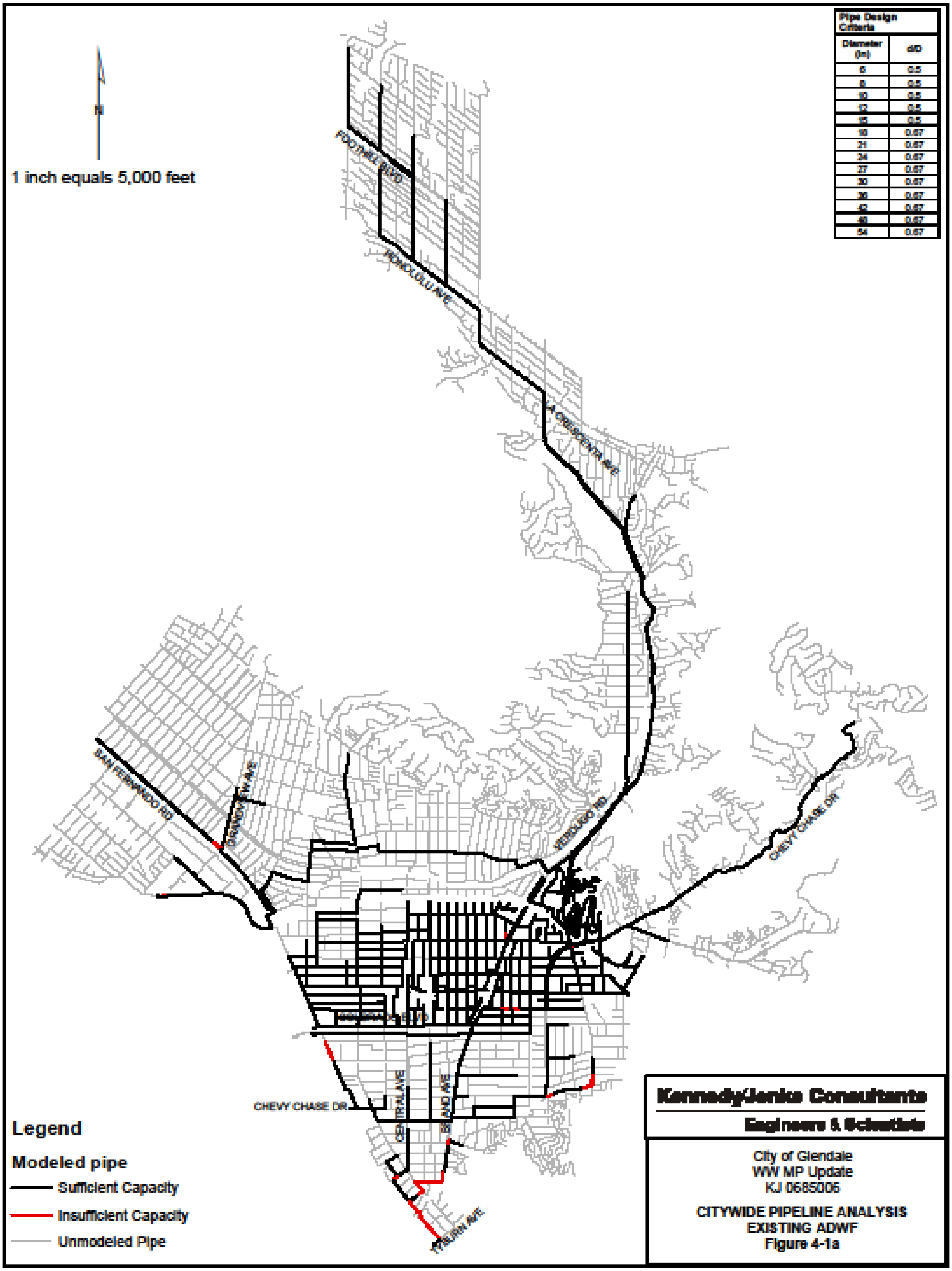
	EADWF (metered) MGD	EADWF (modeled) MGD	Percent Difference (%)
Colorado Flume	4.07	4.12	101.3%
Chevy Chase Flume	3.25	3.33	102.4%
Doran Pump Station Basin	0.62	0.62	100.0%
Doran Flume	4.00	3.96	99.0%
Elk Flume	3.50	3.51	100.1%
Salem/San Fernando Flume	1.10	1.06	96.7%
Tyburn Flume	0.76	0.76	100.0%
Totals	17.30	17.36	100.3%

Note: EADWF means Existing Average Dry Weather Flows

4.3 Collection System Capacity Insufficiencies

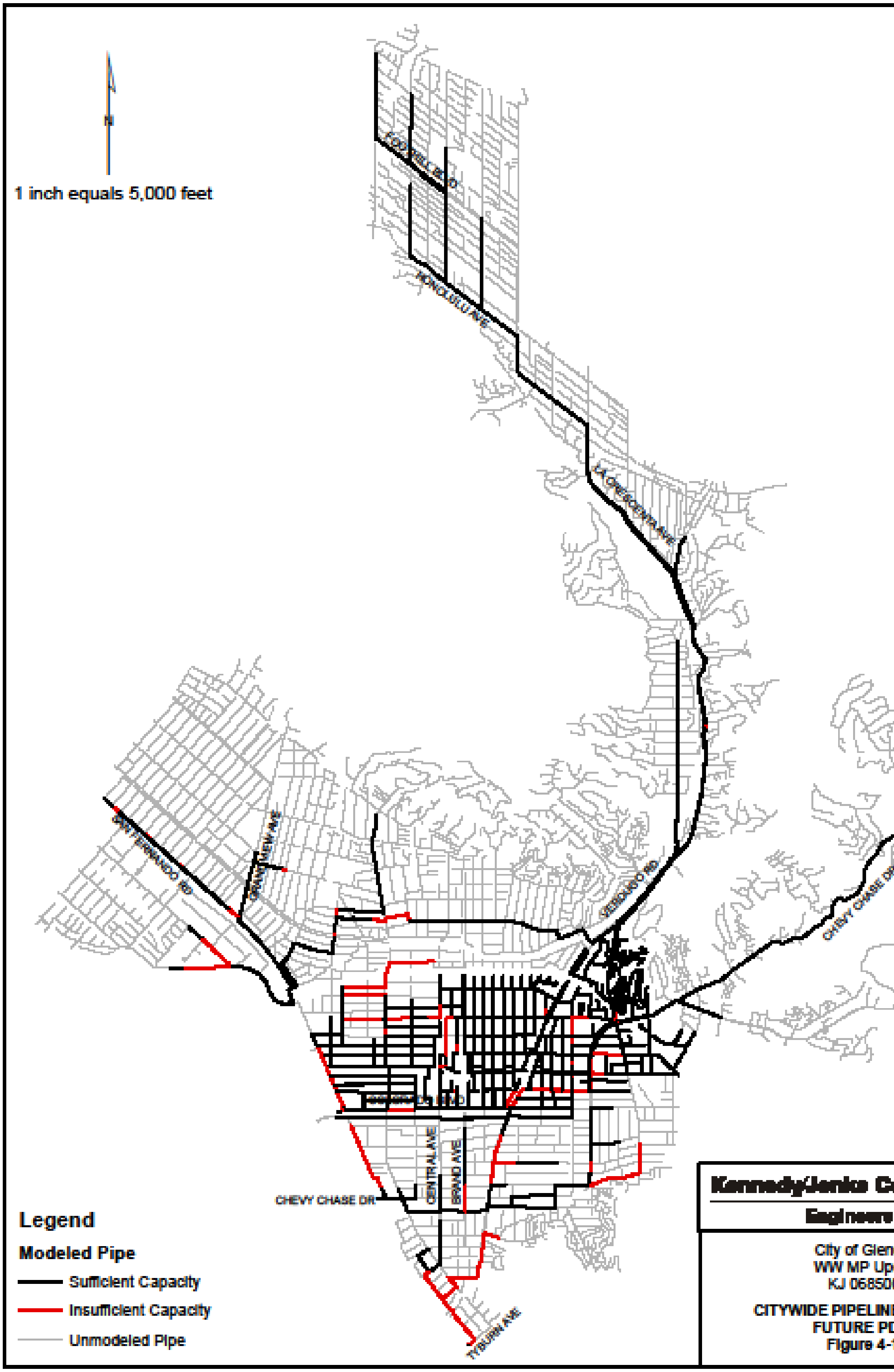
Based upon the output from the collection system model, pipelines with insufficient capacity are identified for the scenarios identified above. These facilities are noted in the modeling file and linked to the City's GIS for graphical display purposes. The results of the hydraulic analysis identify those facilities that have inadequate hydraulic capacity for each scenario.

The existing ADWF and the future PDWF and future PWWF findings are graphically depicted for the citywide analysis on Figures 4-1 a, b, and c respectively. Due to the significant level of future flows and ongoing redevelopment activity in the downtown area/Colorado basin, the analysis results for this basin are shown separately on Figures 4-2 a, b, and c. The linear feet of pipe that does not meet the design criteria developed in Section 3 is summarized for each scenario and separated by basin in Table 4-3. The cost of improving these facilities is discussed in Section 5.



Pipe Design Criteria

Diameter (in)	d/D
6	0.5
8	0.5
10	0.5
12	0.5
15	0.5
18	0.67
21	0.67
24	0.67
27	0.67
30	0.67
36	0.67
42	0.67
48	0.67
54	0.67



Pipe Design Criteria	
Diameter (in)	d/D
6	0.5
8	0.5
10	0.5
12	0.5
15	0.5
18	0.67
21	0.67
24	0.67
27	0.67
30	0.67
36	0.67
42	0.67
48	0.67
54	0.67

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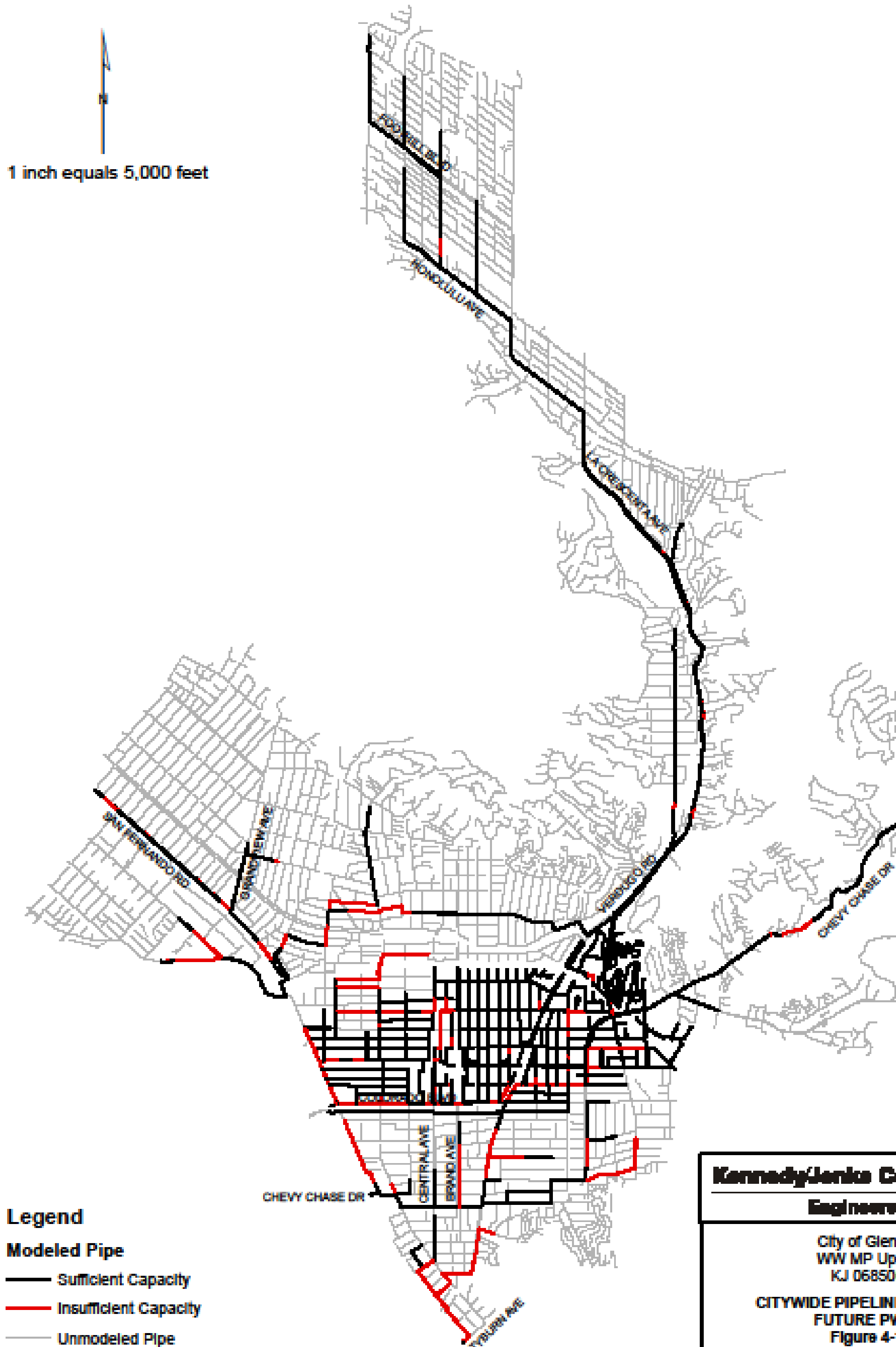
CITYWIDE PIPELINE ANALYSIS
FUTURE PDWF
Figure 4-1b



Pipe Design Criteria

Diameter (In)	d/D
6	0.5
8	0.5
10	0.5
12	0.5
15	0.5
18	0.67
21	0.67
24	0.67
27	0.67
30	0.67
36	0.67
42	0.67
48	0.67
54	0.67

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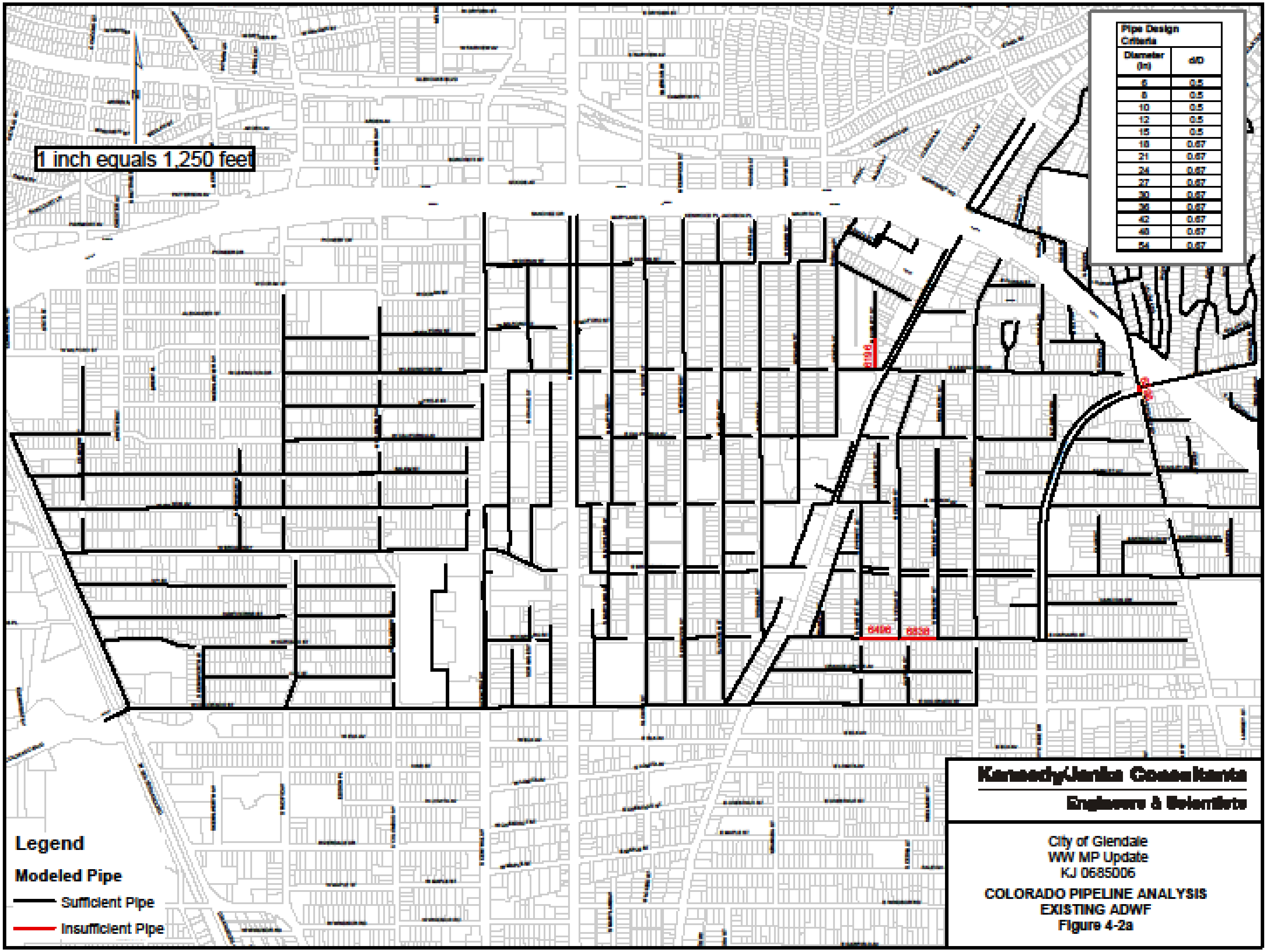
CITYWIDE PIPELINE ANALYSIS
FUTURE PWWF
Figure 4-1c



Pipe Design Criteria	
Diameter (in)	d/D
6	0.5
8	0.5
10	0.5
12	0.5
15	0.5
18	0.67
21	0.67
24	0.67
27	0.67
30	0.67
36	0.67
42	0.67
48	0.67
54	0.67

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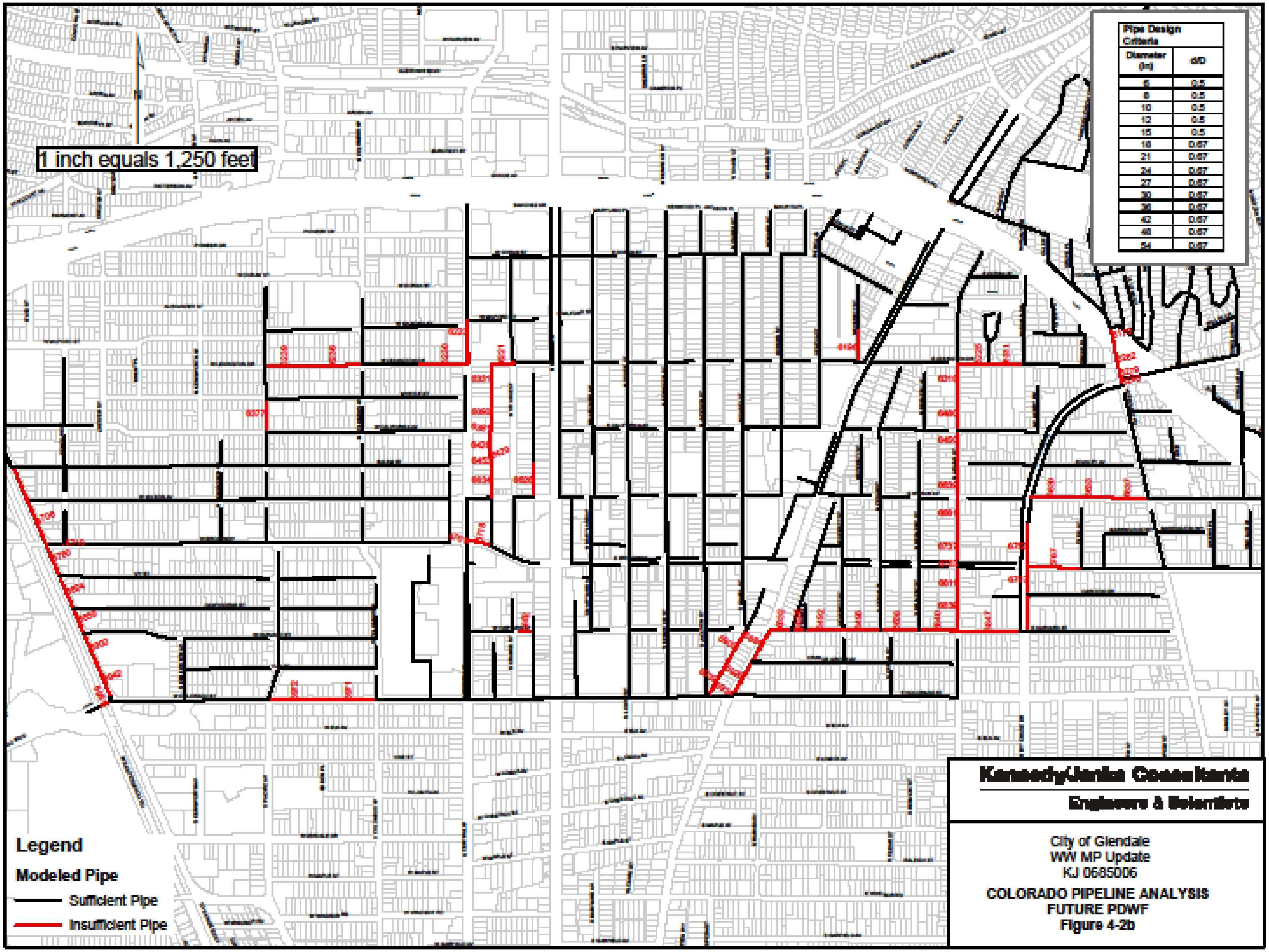
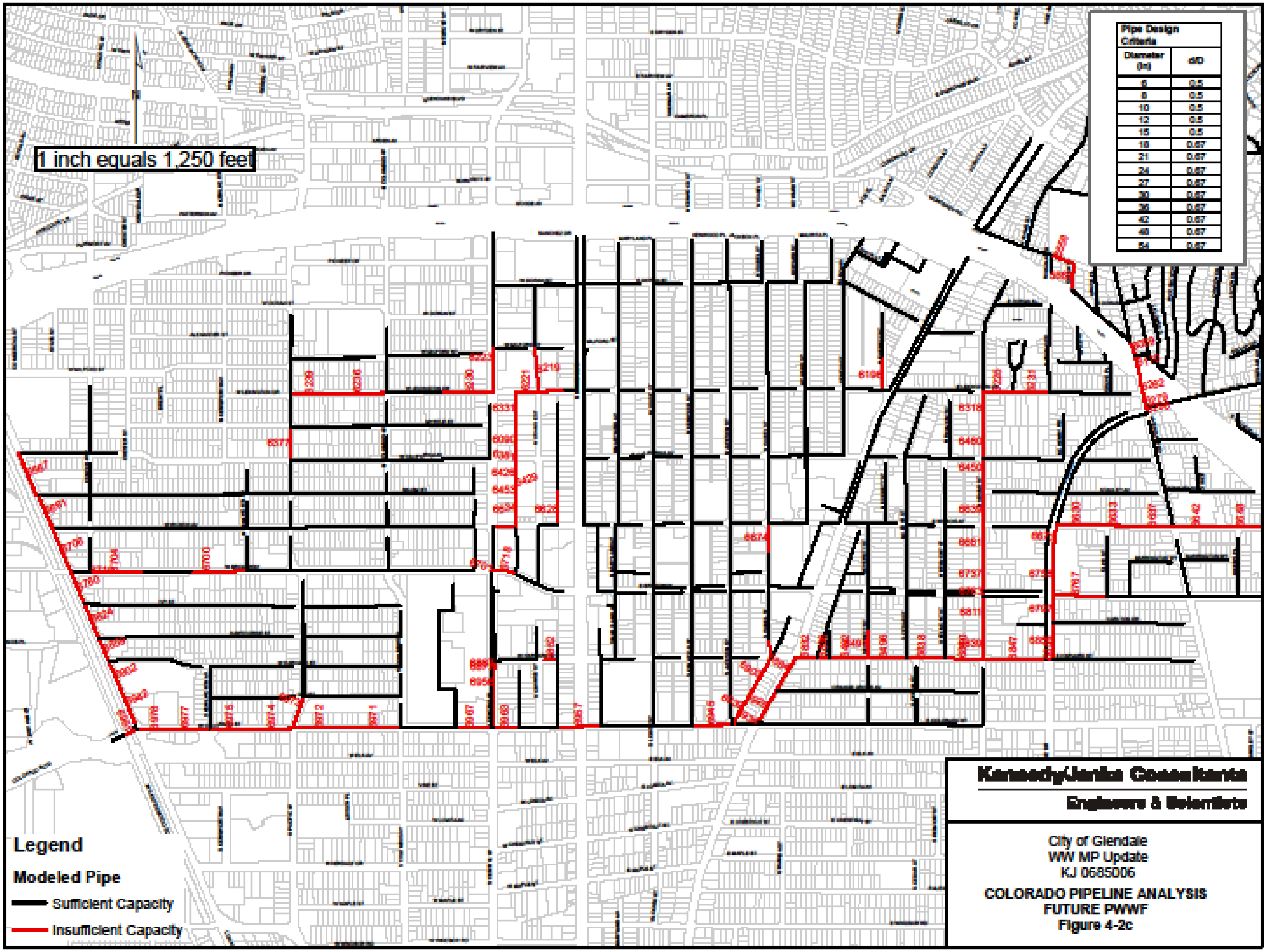
COLORADO PIPELINE ANALYSIS
EXISTING ADWF
Figure 4-2a



Pipe Design Criteria	
Diameter (in)	d/D
6	0.5
8	0.5
10	0.5
12	0.5
15	0.5
18	0.67
21	0.67
24	0.67
27	0.67
30	0.67
36	0.67
42	0.67
48	0.67
54	0.67



Pipe Design Criteria	
Diameter (in)	d/D
6	0.5
8	0.5
10	0.5
12	0.5
15	0.5
18	0.67
21	0.67
24	0.67
27	0.67
30	0.67
36	0.67
42	0.67
48	0.67
54	0.67

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COLORADO PIPELINE ANALYSIS
FUTURE PWWF
Figure 4-2c

TABLE 4-3
SUMMARY OF POTENTIAL PIPELINE IMPROVEMENTS

	ADWF (ft)	PDWF (ft)	PWWF 5 - Yr (ft)
Existing Flow Conditions			
Colorado Flume	1,119	11,979	17,121
Chevy Chase Flume	1,934	8,667	12,109
Doran Pump Station Basin	74	979	1,756
Doran Flume	532	3,068	8,881
Elk Flume	0	0	2,878
Salem/San Fernando Flume	0	4,561	5,686
Tyburn Flume	5,083	8,393	8,846
Feet of Existing Deficient Pipe	**8,741**	**37,648**	**57,278**
Future Flow Conditions			
Colorado Flume	3,611	19,291	28,456
Chevy Chase Flume	2,104	9,525	12,512
Doran Pump Station Basin	967	3,178	3,178
Doran Flume	532	4,270	10,315
Elk Flume	0	112	3,781
Salem/San Fernando Flume	2,541	7,319	7,319
Tyburn Flume	5,494	8,393	8,846
Feet of Future Deficient Pipe	**18,351**	**52,088**	**74,407**

Note: Criteria is per Table 3-4: 0.67 d/D for 18" and greater, 0.5 d/D for < 18". Length of potentially deficient pipe per scenario is the total length that does not meet the design criteria under each scenario's loading conditions.

As shown, there is a substantial increase in the length of pipe that does not meet the design criteria under both existing and future peak wet weather conditions, with a high percentage of these facilities located in the Colorado basin. Since this basin is projected to incur a substantial increase in additional future flows, these facilities should be of high priority. While the determination of actual footage to be improved may vary during pre-design when other pipe improvement considerations are included, the projection provides a framework for the magnitude of the City's potential pipeline improvement program requirements.

4.4 Doran Pump Station Evaluation

To assess the configuration, condition, and capacity of the existing pumping station, Kennedy/Jenks conducted a field assessment of the lift station on 6 December 2006. This assessment was performed during a scheduled shutdown related to replacement of the 18" Fairmont Avenue Sewer Main with a new 27" main north of the Verdugo Wash. Interviews with the City of Glendale's operations staff were conducted and additional information to support the evaluation included construction drawings of the 1982 upgrade, schematics of the lift station operations provided by the City, and information provided by Flo-Systems, Inc., the contractor to the City of Glendale for the maintenance of the lift station.

4.4.1 Lift Station Capacity

As discussed in the accompanying pipeline evaluation, future development north of the lift station will generate a peak flow of approximately 3 MGD. This flow value exceeds the estimated 2.5 MGD firm capacity for this facility, as well as the capacity of the existing 18" pipe beneath the Verdugo Channel feeding the lift station. These projected flows will also exceed the operational capacity of the existing wet well configuration, not because of the wet well's size, but because of the limited relative elevations between the bottom of wet well and the invert of the 18" influent pipe. This differential does not provide the required active volume in the wet well without immersing the influent line and backing up flow in the 18-inch line, and the manhole and Fairmont Avenue sewer main north of the Verdugo Channel. The minimum depth between the influent pipe invert and the bottom of the wet well also restricts the emergency storage capacity of the wet well which, by some operational criteria, requires wet well emergency storage of an hour or more of flow without submerging upstream facilities.

In addition to the impact on the influent and wet well facilities, the capacity of the existing wet well pumps will also be exceeded when these projected future flows are realized, requiring that the pump capacities be increased to approximately 1,500 gpm rather than the existing 1,150 gpm. Flo-Systems reports that the existing pump capacities can not be increased with new impellers.

Because of these capacity issues, future improvements will need to consider upsizing the 18" influent piping, increasing wet well operational and emergency storage capacity by lowering the wet well invert elevation several feet, and upgrading the pump capacities. Implementation of these improvements to the existing facility, especially the increase in storage capacity, does not appear to be practical or feasible. As such, this finding suggests that a better alternative would be to construct a new, properly equipped and technically current lift station. Upsizing the 18" influent will require significant excavation and work on both sides of the Verdugo Channel providing additional rational for the construction of a new lift station at that time.

4.4.2 General Observations

During the shut down, the City conducted miscellaneous improvement projects at the lift station such as wet well cleaning, check valve replacements, replacement of electric seals in lower level fixtures, and other miscellaneous maintenance activities that can only be completed when the wet well is drained. During this shut down, flow was being bypassed around the lift station. Due to this shutdown however, it was not possible to observe the pumps in operational mode. A magnetic flow meter, previously metering discharge flow from the wet well pumps, has been removed from the pump station piping. As a result, there are no recent records of pump flows from the lift station itself.

The lift station is generally in good structural condition, the mechanical ventilation systems meets the required 12 air changes per hour, the emergency power system is operational though not as reliable as would be expected, the pumps are all operational and were recently (2004) rebuilt and underwent impeller replacements, and the motor control center is working but antiquated. Several deficiencies addressed in the 1998 Wastewater Master Plan have been corrected or improved yet there are certain features that need to be considered to improve safety issues, operational efficiencies, and the long term life and operation of the station. The construction schedule for construction of a new lift station, if selected by the City, will impact the extent and need of some of the following, suggested improvements.

4.4.3 Safety and Security

Significant safety issues exist in the lift station that should be addressed regardless of the timing of major lift station improvements or replacement in the future.

1. Replace ladders accessing the dry well. While these ladders are hinged to provide clear access the entire depth of the stair well for planned equipment removal, they are not all connected or adequately designed for emergency rescue. Unless the ladders are moved by hand to clear the stairwell structure, which would not be appropriate during an emergency situation, these ladders block clear removal via safety hoist of anyone needing rescue from the lower levels of the dry well.

2. Install gas detection system and alarm including sensors for methane, oxygen deficiency and hydrogen sulfide (H_2S).

3. Connect new gas detection system to ventilation system controls.

4. Install 7 foot high chain link fence and double gate with helical razor ribbon topping at south property line and along top of Los Angeles River and Verdugo Channel walls. Existing fencing along the flood channel walls is not secure due to existing climbing rungs in the wall of the Los Angeles River channel. Moreover, the low, dilapidated condition of the existing fence provides additional site security and safety issues.

5. Install removable railings around access hatches in dry well for use when hatches are open for the removal of equipment.

6. Install permanent ladder and access hatch to building roof from inside the secured building to avoid the use of portable, temporary ladders when accessing ventilation equipment on the roof.

4.4.4 Structure

Though the pump station is structurally in reasonably good condition, the following improvements should be considered:

1. Remove and replace the wet well floor and wall liner that has bubbled up in several locations, repair damaged wet well tiles at several locations by filling broken areas with non-shrink grout to a smooth, level surface, and line the wet well walls and floor with Sancon 100 or equal.

2. Reseal wall around overflow pipe penetration.

4.4.5 Piping

During the recent shut down the check-valves were replaced in the lift station. The plug valves have not been replaced since their original installation in 1982. The following improvements should be implemented to improve operations and maintenance.

1. Install a flow meter on pump discharge header so that pumps can be more closely monitored. This will be more critical as flows increase to the lift station and these pumps continue to age.
2. Install 12-inch plug valve in bypass turndown at approximate elevation 424. Currently, if dry well is to be flooded in an emergency, it has to be accomplished from below by working overhead to remove the 12-inch blind flange on this overflow turndown.
3. Install 12-inch plug valves in each of the wet well discharge lines above the existing check valves at approximate elevation 424. This installation will require the raising of the discharge header at this level to allow enough height above the floor for installation of the valves.
4. Install 12-inch plug valves in wet well discharge line at approximate elevation 440.

4.4.6 Mechanical, Electrical and Controls

Much of the mechanical, electrical and control systems were installed with the 1982 improvements and therefore have experienced some loss of operational effectiveness due to their 25 plus years of operation. The equipment is antiquated and in some cases parts are not very accessible.

1. The four submersible pumps are in good operating condition and normally one pump handles the load to the lift station. These pumps are still being manufactured making replacement parts available. Due to a relatively high level of grit in the inflow, these pump impellers require replacement every three to five years. The wet well pumps were provided with special fabrication features for the original installation in the existing wet well. Increasing the flow capacity of these existing pumps would not be possible according to Flo-Systems.
2. The breaker for the sump pump in the dry well has experienced breaker overloading and shut down.
3. The ventilation system is sized to accommodate the required 12 air changes per hour and reportedly works well in keeping the lower levels well ventilated. The system is controlled manually by a hand-on switch. The noise level is high in the lower levels of the station from the air ducting which makes communications through the existing intercom system difficult.
4. Level control in the wet well is accomplished by an air bubbler system that works reliably but is limited in its range of settings.
5. The Motor Control Center is old technology and therefore replacement parts are sometimes not available.

6. The emergency generator is also 25 plus years old. It is exercised approximately four times a year. They have had problems shutting the generator off in the past and the automatic transfer switch does not work properly.

4.4.7 Conclusions and Recommendations

Making the identified improvements and corrections as discussed above will keep the lift station operating for some period of time and improve the safety for those responsible for the facility's operations and maintenance. The capacity of the lift station, however, is limited and even at current flows does not provide adequate emergency storage in the wet well without backing up flow in the 18" Verdugo Channel crossing and the manhole on the north side of the channel. While future pump replacement could increase the facilities pumping capacity, it would not accommodate the emergency storage or influent piping submersion issues.

Additionally, since replacement of the 18" piping beneath the Verdugo Channel with a new 27" pipe (or larger) will be necessary, the depth between the influent invert and the bottom of the wet well will be even less than existing due to the depth required beneath the Verdugo Channel bottom. The construction of the new influent line will require major excavation and work on both sides of the Verdugo Channel and around the existing lift station providing an opportunity for complete replacement of the facility. Based on these factors and discussions with City staff, it is recommended that this facility be scheduled for replacement.

Section 5: Wastewater System Improvement Costs

This section incorporates the findings of the previous sections and outlines the estimated costs of the potential collection system and pumping station improvements. Identified improvements are typically prioritized into a capital improvement program based on the assessment of facility condition, the hydraulic analysis under current and future loading conditions, and geographic implications for construction as well as proximity to near-term development projects. The potential capital improvement costs of the identified facilities are contained herein.

5.1 Pipeline Project Prioritization

The most common criteria used to prioritize individual pipelines showing insufficient capacity is the scenario(s) under which the insufficiency was identified. Using this criterion, a facility is essentially prioritized for replacement based on the degree of deficiency and its implicit potential for sanitary sewer overflows if not improved. Using this capacity basis, the City would prioritize the deficiencies from 1 (highest priority) to 5 (lowest priority) using a typical capacity prioritization criterion. Below are the typical criteria used for to prioritize system improvements based on capacity considerations.

Pipeline Capacity Considerations

- Pipelines identified under Existing ADWF should receive the highest priority.
- Pipelines identified under Existing PDWF should be prioritized higher than those identified only under Existing PWWF.
- Pipelines identified under future scenarios should be prioritized in the same hierarchy as above, albeit with a lower priority than those pipes that were identified in existing scenarios.
- While not specifically a capacity concern, upsizing facilities to create a common pipe diameter is often an element of the pipeline capacity design consideration within a particular pipeline service area.

In addition to the pipeline's physical capacity factors derived above, the City should consider integrating several additional economic, environmental, and social criteria in the prioritization process to more effectively manage its wastewater system. These additional considerations often include both the risk and consequences of facility failure and could include:

Asset Management Considerations

- Pipeline Material - Non-VCP pipelines should be prioritized higher than VCP pipes because of the shorter useful life estimated for non-VCP facilities.
- Pipeline Condition/Age - Pipelines with known inferior conditions or limited remaining useful life should be prioritized higher than facilities in good condition.

- Operation and Maintenance Considerations – While this element may be implicitly integrated in the pipeline material or condition factors, the need to include a factor for those facilities requiring frequent maintenance is often integrated to account for excessive maintenance costs. These facilities may also be more apt to cause a sanitary sewer overflow (SSO) event if maintenance is neglected. Safety consideration may also be integrated in this factor.

- New Development Considerations – This element of facility planning is also capacity related, without a pipeline specific new development trigger. As such, additional weighting should be considered for facilities subject to capacity constraints from development upstream. The financial obligations of the City and/or the new development should also be a component of the prioritization process.

- Infrastructure Coordination - Pipelines in City streets that are scheduled for resurfacing and/or are scheduled for other infrastructure improvements should be prioritized to minimize community disruption and save overall City costs.

- Environmental/Social – Facilities whose failure or potential for sanitary sewer overflows would cause substantial environmental damages, adverse public sentiment, and/or other local social consequences should be included as criticality factors that may influence the prioritization of limited capital funds. These criticality factors can have both an economic and non-economic component.

While these asset management considerations are important strategies in the development and implementation of a prioritized capital improvement program, the breadth of this Master Plan Update is limited to the capacity considerations derived above. The pipeline improvements reflected in the following section are limited to the cost of improvement. If appropriate, the prioritization criteria can be modified and integrated in the Final Master Plan Report or in subsequent ongoing in-house infrastructure planning efforts.

5.2 Prioritized Capital Improvement Program

Pipeline improvement costs are derived by correlating the unit cost derived in Section 3 with the length and upsized diameter of each facility with potential insufficient capacity to be improved. The summary of pipeline improvement costs for each scenario is shown in Table 5-1. Upon acceptance of final capacity criteria derived in Section 5.1, pipeline segments can be prioritized and projects created for final pre-design, design and effective construction management.

In addition to these pipeline improvements, the evaluation in Section 4 indicated a general need to schedule for the replacement of the Doran Lift Station. The estimated cost for the replacement of this facility is estimated at approximately $6 to 7 million, depending on existing foundation conditions and other factors at the time of construction. Additionally, the estimated cost to construct a new 27-inch pipeline under the wash is estimated to cost an additional $700,000.

As discussed with City staff, there are a number of factors still outstanding with the long-term strategy for this facility that may affect the final costs and disposition of this facility. These factors include:

- timing and magnitude of the additional flows from the Disney GC3 complex,
- ability to rehabilitate or replace Doran and the associated 18-inch influent pipeline at its exiting location to meet the ultimate demands, and
- potential relocation of this facility northwest of the Verdugo Wash on the Power Plant site and the construction of a new pipeline over the wash to eliminate the current 18-inch siphon under the wash.

In consideration of these factors the City has programmed for the pre-design evaluation of this facility in the coming months. This evaluation, in conjunction with the resolution of the other institutional elements, will provide additional input in the final improvement plan and cost considerations for this important wastewater facility.

TABLE 5-1
SUMMARY OF SYSTEM IMPROVEMENT COSTS

PIPELINE IMPROVEMENT COSTS	FPWWF (ft.) [a]	FPWWF ($'s) [a]
Colorado Flume	28,456	11,667,400
Chevy Chase Flume	12,512	4,978,800
Doran Pump Station Basin	3,178	1,439,000
Doran Flume	10,315	4,594,600
Elk Flume	3,781	1,447,700
Salem/San Fernando Flume	7,319	2,824,100
Tyburn Flume	8,846	3,856,500
Total Length & Cost of Deficient Pipelines – Future Conditions	**74,407**	**$30,808,000**

DORAN PUMP STATION IMPROVEMENT COSTS	Estimated Cost ($'s)
New Doran Pump Station	7,000,000
New 27" Pipeline Under the Verdugo Wash	700,000
Total New Doran Pump Station Improvement Costs	**$7,700,000**

(a) FPWWF means future peak wet weather flow conditions.