LAWRENCE STATION AREA PLAN

PROPOSED INTUITIVE SURGICAL CORPORATE CAMPUS PROJECT AT 932, 945, 950, AND 955 KIFER ROAD (OFFICE EXPANSION BUILDOUT) INFRASTRUCTURE IMPACT STUDY

June 22, 2020

BKF 100+ YEARS
ENGINEERS . SURVEYORS . PLANNERS

255 Shoreline Drive, Suite 200
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SECTION 1: INTRODUCTION AND PROJECT DESCRIPTION

1.1 Project Overview

The proposed Lawrence Station Area Plan (LSAP) Amendment Project (Project) is generally centered around a ½ mile radius of the existing Lawrence Caltrain Station at 137 San Zeno Way in Sunnyvale, California and is approximately 252.09 acres. For the purposes of the infrastructure studies, the LSAP Update project is divided into two study areas: the Housing Expansion Study Area and the Proposed Intuitive Surgical Corporate Campus Project at 932, 945, 950, and 955 Kifer Road (herein referred to as the Office Expansion) Study Area. This Infrastructure Study will address the Office Expansion Study Area which composes of two parcels south of Kifer Road and one parcel north of Kifer Road. The north parcel is bounded by Central Expressway to the north, Texas Instruments campus to the east, Kifer Road to the south, and numerous commercial offices to the west. The south parcel is bounded by Kifer Road to the north, the proposed LSAP Housing Expansion to the east, railroad right of way (ROW) to the south, and two large commercial offices to the west. The project site is located in the far eastern area of the City of Sunnyvale northwest of the Lawrence Caltrain station.

The Office Expansion Study Area site is approximately 32.39 acres of industrial land owned by Intuitive Surgical, Inc. (ISI) that is proposed for redevelopment as office/research and development.

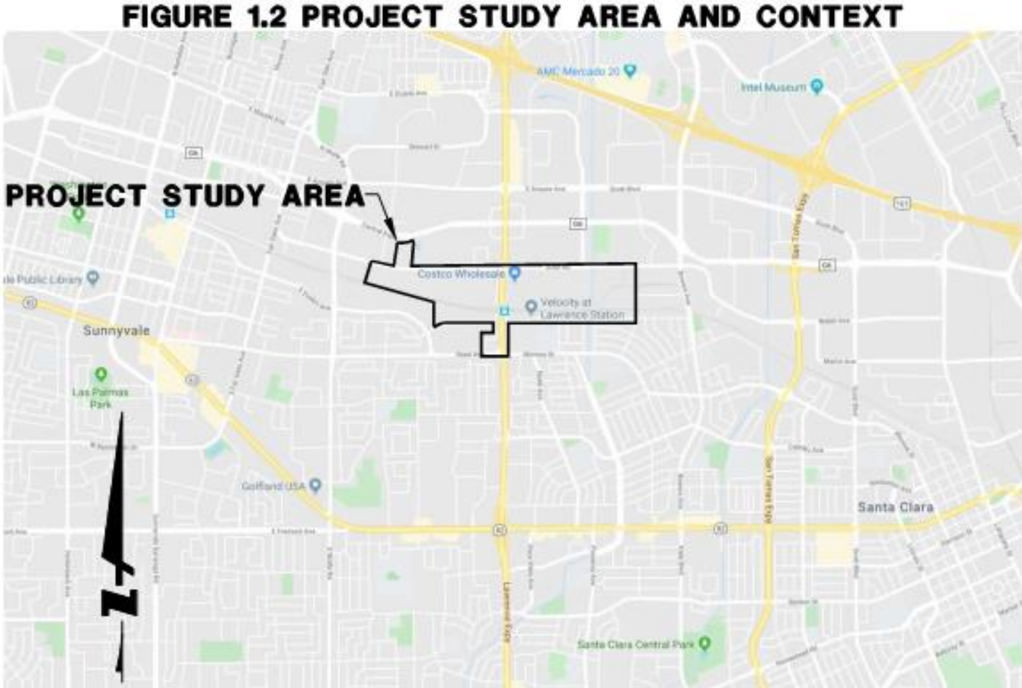
The Housing Expansion Study Area is approximately 219.70 acres encompassing existing developments, railroad ROW, and public ROW. The residential LSAP is bounded by the City of Santa Clara to the north and east, Reed Avenue, Aster Avenue, and the railroad ROW to the south, and the Intuitive Surgical offices to the west. Please refer to the Housing Expansion Buildout Infrastructure Impact Study for the infrastructure analysis associated with the proposed increase of allowable housing potential within the LSAP.

Figure 1.1 - Project Location - illustrates the regional location of the Project.

FIGURE 1.1 PROJECT LOCATION

Figure 1.2 - Project Site and Context - illustrates the Study Area Boundaries and the location of the Project within the City.

FIGURE 1.2 PROJECT STUDY AREA AND CONTEXT



This study will discuss the office expansion located across three parcels. The Project includes two office/R&D buildings, a parking structure, an amenities building, and two central utility plants. Existing utility infrastructure requiring upgrades to serve the Project will be identified in this study.

1.2 Lawrence Station

1.2.1 Existing Conditions and Land Use

Existing conditions and Land Uses within the 32.39 acre office expansion LSAP includes an office/research building, an industrial building, a fitness center, an equipment enclosure, and a recreational park for employees. The ISI project site is currently designated for industrial uses in the City's General Plan.

1.2.2 Proposed ISI Project Component of the LSAP Update

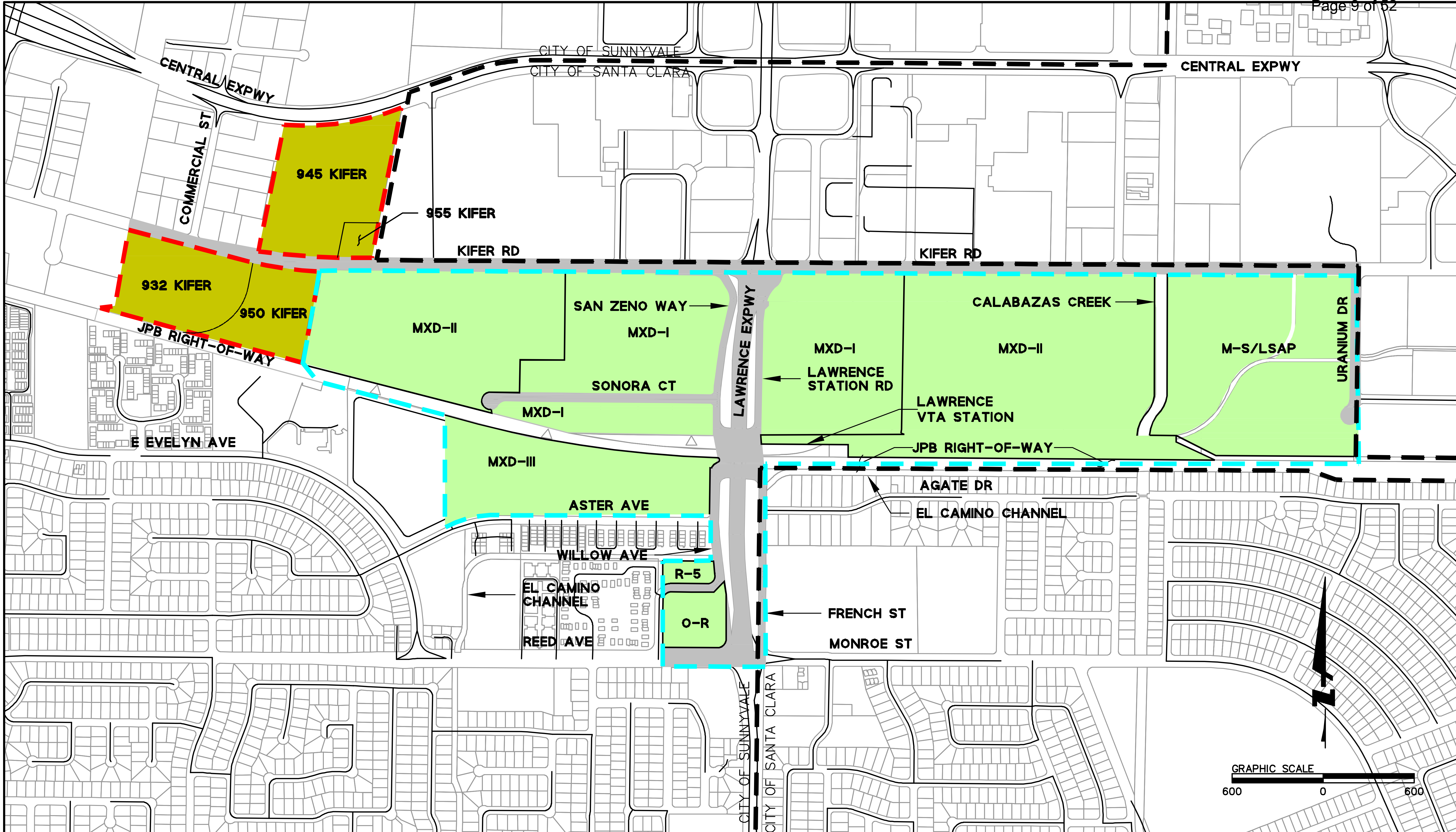
The LSAP Update consists of two primary components: (1) modifications to the adopted LSAP (i.e. an increase in housing potential within the LSAP, expansion of the western LSAP boundary, and a Sense of Place Plan that would function as a policy document for LSAP area circulation, open space, and streetscape improvements) and (2) an office/research development (R&D) and manufacturing redevelopment project in the western LSAP boundary expansion area for the ISI project. This infrastructure study analyzes the second component of the LSAP update: the ISI project. A detailed breakdown of the land uses are shown in Table 2.4 – Office Expansion Study LSAP Potable Water Demand Summary (ADD). The proposed LSAP layout is shown in Figure 1.3 – Proposed Site Layout.

1.3 Project Datum

All elevations referenced herein are based on the following:

- Vertical datum used in the City of Sunnyvale's Utility and GIS Maps.

- Record drawings provided by the City for Aster Avenue and Willow Avenue
- Manhole survey data provided by the City for Lawrence Expressway



LEGEND

- CITY BOUNDARY
- HOUSING EXPANSION STUDY AREA
- OFFICE EXPANSION STUDY AREA
- PUBLIC RIGHT-OF-WAY

DATE:	06/22/2020
SCALE:	1"=600'
DESIGN:	BPB
DRAWN BY:	NRF
APPROVED:	TRM
JOB NO:	20180080

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LSAP HOUSING EXPANSION BUILDOUT INFRASTRUCTURE IMPACT STUDY

FIGURE 1.3 – PROPOSED LSAP STUDY AREA LAYOUT

DRAWING NAME: \\bkf-rc\VOL4\2018\180080_LSAP_Housing\ENG\EXHIBITS\Master Plan\Figure 1.3 - Proposed Site Layout.dwg
PLOT DATE: 06-19-20 PLOTTED BY: lnou

SECTION 2: POTABLE WATER SYSTEM

2.1 Potable Water System Design Criteria

The design criteria used for the office expansion development of the potable water model is based upon established industry operations standards and regulatory agency requirements. The potable water system will be designed in accordance to the City of Sunnyvale's Standard Plans and Specifications and to applicable City, State, and Federal water and fire codes and standards unless otherwise permitted. Since the City of Sunnyvale does not have written standards for water generation, this report will use Redwood City's Design Standards to estimate project water demands. The intent of this study is to identify which existing City water mains will need to be upgraded in order to provide adequate water supply to the LSAP. All existing water mains are located within the City Right-of-Way.

The design criteria are dependent on the demand scenario. Table 2.1 – Potable Water System Demand and Peaking Factor presents the potable water system demand and peaking factor for the demand scenario. Assumed peaking factors for max day demand and peak hour demand scenarios are based on correspondence between BKF and the City of Sunnyvale.

Table 2.1
Potable Water System Demand and Peaking Factor

Parameter	Value
Average Day Demand (ADD)	262,812 gpd
Fire Flow Demands (FF)	4,500 gpm
Maximum Day Demand (MDD)	MDD = 2.0 ADD
Peak Hour Demand (PHD)	PHD = 3.0 ADD

Notes:
1. Fire flow demand based on an assumed R-2 Occupancy type building and construction Type III-A, assuming 25% fire flow reduction for sprinkling.
2. gpd = gallons per day
3. gpm = gallons per minute

Table 2.2 – Potable Water System Design Criteria presents the potable water system design criteria.

Table 2.2
Potable Water System Design Criteria

Parameter	Value
Pipe size	Pipe diameters of 8, 10, 12, and 16 inches shall be used for all distribution and feeder mains.
Pipe Material	For water mains 12-inches and smaller shall be C900 DR14 PVC pipe or AWWA C-151/A21.51 ductile iron pipe (DIP). Water mains larger than 12-inches shall be C905 DR14 PVC or AWWA C-151/A21.51 DIP.
Hazen Williams C-value for recommended pipes	140 for DIP, 150 for PVC
Maximum static pressure	120 psi
Maximum velocity during PHD	7 fps
Maximum velocity during MDD+FF	15 fps
Minimum system pressure during MDD+FF	20 psi

Notes:
fps = feet per second
psi = pounds per square inch

2.2 Potable Water System Layout

Potable water is supplied to the LSAP by the City of Sunnyvale through an existing 12-inch diameter cast iron pipe (CIP) in Kifer Road. Commercial Street also contains an existing 8-inch diameter CIP. Existing potable water system layout is shown on Figure 2.1 – LSAP Existing Potable Water System.

2.3 Upgraded Potable Water System

2.3.1 Proposed Water Demand Factors

The potable water demand factors used for the Project's various land uses are shown in Table 2.3 – LSAP Potable Water Demand Factors (ADD). The total estimated water demands for the Project land uses are shown on Table 2.4 – Office Expansion Study LSAP Potable Water Demand Summary (ADD). Water demands are derived from Redwood City's Design Standards.

Table 2.3
LSAP Potable Water Demand Factors (ADD)

Land Use	Indoor Potable Water Demand Factors (ADD)	Outdoor Potable Water Demand Factors (ADD)	Total Water Demand (ADD)
Office/R&D	0.13 gpd/sf	0.072 gpd/sf	0.202 gpd/sf
Industrial	0.21 gpd/sf	0 gpd/sf	0.21 gpd/sf
Restaurant	30 gpd/seat	0 gpd/seat	30 gpd/seat

Note:
sf = square feet

2.3.2 Model Results Discussion

The existing potable water system is sufficient to supply the potable water demands as well as provide fire flow to the site. Under the scenario of max day demand and fire flow, the water model analysis determined that the flow demand would be at its highest of any scenario at 4,820 gpm as seen in Appendix C-3 – Model Scenario 3: Max Day Demand + Fire Flow. However, the existing potable water system is able to provide a flow of 6,000 gpm, which is well above the necessary flow to meet the demands in this scenario. Refer to Appendix C-3 – Model Scenario 3: Max Day Demand + Fire Flow for water model results. The overall proposed ISI development indicates that no improvements are required for the City's potable water system.

2.4 Potable Water System Model Water Demands

2.4.1 Sources of Land Use Water Demand Data

Potable water demand factors for the model analyses are shown in Table 2.3 – LSAP Potable Water Demand Factors (ADD) and were applied to the project program to develop the project potable water demand total. Table 2.4 – Office Expansion Study LSAP Potable Water Demand Summary (ADD) provides water demands by land use.

See Appendix E – Potable Water System Demand Calculations, for model demand calculations on a block by block basis. Total project development will not exceed the demands presented in Table 2.4 – Office Expansion Study LSAP Potable Water Demand Summary (ADD).

2.4.2 Average Day Demand

The demand factors presented in Table 2.3 – LSAP Potable Water Demand Factors (ADD) and the demand summaries presented in Table 2.4 – Office Expansion Study LSAP Potable Water Demand Summary (ADD) reflect average day demand (ADD) for the Office Expansion Study.

Table 2.4
Office Expansion Study LSAP Potable Water Demand Summary (ADD)

Land Use	Number	Unit	Demand/Unit (gpd)	Total (gpd)
Office/R&D	351,000	sf	0.202	70,902
Industrial	831,000	sf	0.21	174,510
Restaurant[1,3]	580	seat	30	17,400
			Total	262,812

Notes:

1. Total restaurant seating is assumed to be 580 seats. This is based on the assumption that 50% of restaurant space (29,000 sf total) is for patrons and one 10'x10' table has seating for 4 people. The calculation is as follows:
$$(29{,}000\ sf \times 0.5) \times \left(\frac{4\ seats}{100\ sf}\right) = 580\ seats$$
2. Block by block water demand calculations shown in Appendix E – Potable Water System Demand Calculations.
3. Restaurant is defined as employee amenity space.

2.4.3 Maximum Day Demand

Maximum Day Demand (MDD) represents the maximum volume of water used in a 24-hour period for the entire year. A water system is typically evaluated under a maximum day plus fire flow demand condition as this condition allows the system to be stressed at a higher demand rate to ascertain if pipeline carrying capacities are adequate in a fire emergency. As identified in Table 2.1 – Potable Water System Demand and Peaking Factor, a peaking factor of 2 was applied to ADD.

2.4.4 Peak Hour Demand

Peak Hour Demand (PHD) represents the highest hourly demand for the entire system, and simulates the highest flow rate expected. To determine the PHD, a peaking factor was applied to increase the ADD. Peaking factors represent the increase above ADD and are a statistical concept typically obtained from historical data. As identified in Table 2.1 – Potable Water System Demand and Peaking Factor, a peaking factor of 3 was applied to ADD.

2.4.5 Fire Flow Demand

The fire flow (FF) demand is assumed to be 4,500 gallons per minute (gpm) as noted in correspondence between the City of Sunnyvale, Ascent Environmental, and BKF Engineers.

2.5 Potable Water System Model Boundary Conditions

The recommended potable water system is modeled based on calibrated boundary conditions and fire hydrant flow data received from the City completed for the LSAP Project. Since the LSAP Project is redeveloping existing lots, the recommended water model is analyzing existing City water mains and identifying which water mains will need to be upgraded in order to provide adequate water supply for the redevelopment.

2.6 Potable Water System Model Scenario

The LSAP water model was created in Bentley Water CAD V8i SELECT series 1. A series of model scenarios were created to reflect the range of demand usage patterns and confirm conformance to the Potable Water System Design Criteria outline in Table 2.2 – Potable Water System Design Criteria. Three model runs are prepared for the ISI Project and are shown in Table 2.5 – LSAP Project Model Runs – Office Expansion Study.

Table 2.5
LSAP Project Model Runs – Office Expansion Study

Run	Description
1	Static Pressures
2	Peak Hour Demand
3	Maximum Day Demand + Fire Flow

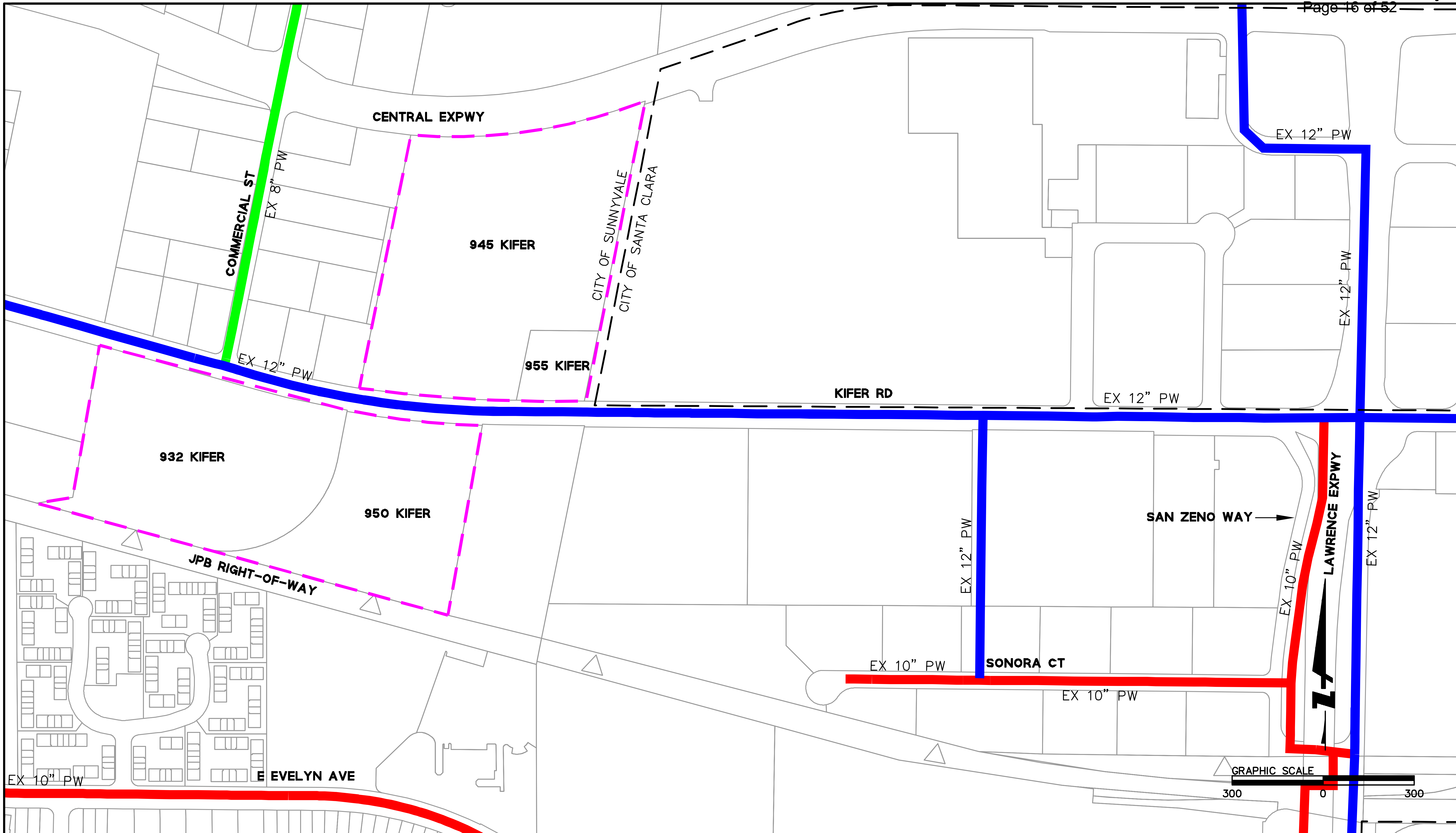
See Appendix C – LSAP Potable Water Model Reports for model run results.

2.7 Potable Water System Recommendations

The existing potable water system, as shown in Appendix C – LSAP Potable Water Model Reports, is designed to meet the design criteria outlined in Table 2.2 – Potable Water System Design Criteria. Table 2.6 – Potable Water System Results for Office Expansion Study summarizes the pressure and velocity results for the referenced model scenarios listed in Table 2.5 – LSAP Project Model Runs – Office Expansion Study. Refer to Appendix C – LSAP Potable Water Demand Results for detailed results of model scenarios. In conclusion, no upgrades to the existing potable water system are required since the water model reflects the system being adequately supplied during maximum daily demand plus fire flow. A water supply analysis memorandum prepared by Ascent Environmental will follow this report and will similarly state that the existing potable water system is sufficient to meet proposed water and fire flow demands.

Table 2.6
Potable Water System Results for Office Expansion Study

Parameter	Requirement	Minimum	Maximum
Static ADD Pressure (psi)	120 max	75	77
PHD Velocity (fps)	7 max	-	1.73
MDD+FF Pressure (calculated system lower limit at total flow available) (psi)	20 min	73	-
MDD+FF Velocity (fps)	15 max	-	10.40



LEGEND

- CITY BOUNDARY
- OFFICE EXPANSION STUDY AREA
- EX 8" PW
- EX 10" PW
- EX 12" PW

DATE:	06/22/2020
SCALE:	1"=300'
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APPROVED:	TRM
JOB NO:	20180080

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LSAP OFFICE EXPANSION BUILDOUT INFRASTRUCTURE REPORT

FIGURE 2.1 – EXISTING POTABLE WATER SYSTEM

DRAWING NAME: \\bkf-rc\VOL4\2018\180080_LSAP_Housing\ENG\EXHIBITS\Master Plan\Water\Office\Figure 2.1 – LSAP Existing Potable Water System.dwg
PLOT DATE: 06-19-20 PLOTTED BY: lnou

SECTION 3: SANITARY SEWER SYSTEM

3.1 Sanitary Sewer System Design Criteria

The design criteria used for the office expansion development of the sanitary sewer model is based upon established industry operations standards and regulatory agency requirements. The sanitary sewer system will be designed in accordance to the City of Sunnyvale's Standard Plans and Specifications and to applicable City, State, and Federal water and fire codes and standards unless otherwise permitted. At certain locations within the project area, City design guidelines were supplemented with updated pipe slope and invert information provided by the City. Sanitary sewer generation is assumed to be 95% of indoor potable water demands. This infrastructure study will identify which existing City sewer mains will need to be upgraded in order to support the anticipated sewer flows from the development within Office Expansion Study Area. All existing sewer mains are located within the City ROW. The pipe material of existing sewer mains is vitrified clay pipe (VCP). The design criteria are dependent on the demand scenario. Table 3.1 – Sanitary Sewer System Design Criteria presents the sanitary sewer system design criteria based on the supplemental information from the City.

Table 3.1
Sanitary Sewer System Design Criteria

Parameter	Value
Minimum pipe size	8-inch inside diameter
Pipe Material	PVC SDR-26 or better
Manning's coefficient, n, for recommended PVC pipes	0.01
Minimum Slope	0.5% (0.005 feet/feet) for sewer diameters 8-inches and smaller, 0.4% (0.004 feet/feet) for sewer diameters 10-inches and larger.
Maximum Slope	14.0% (0.14 feet/feet)
PWWF Maximum Pipe Flow Depth Ratio, *d/D*	0.5 for sewer diameters 10-inches and smaller, 0.75 for sewer diameters 12-inches and larger
Minimum Depth of Cover	5 feet below finished grade
Sewer Generation	95% of indoor potable water demand

Notes:
ADWF = Average Dry Weather Flow
PDWF = Peak Dry Weather Flow
PDWF = Peak Wet Weather Flow
d/D = ratio of depth of flow (*d*) to the pipe inside diameter (*D*)
fps = feet per second
PWWF = Peak Wet Weather Flow

Four flow conditions were analyzed:

1. ADWF in Existing City Sewer System
2. ADWF in Recommended City Sewer System
3. PWWF in Existing City Sewer System
4. PWWF in Recommended City Sewer System

The ADWF is based on the potable water average daily demand described in Section 2.4.2. To account for existing flows entering the project area from other areas of the City, existing sewer flows collected from flow monitoring sites at Lawrence Road north of Warburton Avenue, Kifer Road west of Lawrence Expressway, and Aster Avenue west of Willow Avenue were incorporated into the sanitary sewer model analysis. Existing sewer flow data collected from the flow monitoring cites were received from the City on February 6, 2020. According to the City of

Sunnyvale's Sanitary Sewer Systems Design Standards, the PDWF peaking factor is dependent upon ADWF. We have assumed a PDWF peaking factor that varies between 2.5 and 2.75 which is based on individual parcel demands. PWWF is based on PDWF and a design inflow and infiltration rate based on a 10-year storm event that is 65% of the ADWF. Table 3.2 – Sanitary Sewer System Peaking Factor summarizes the peaking factor to achieve PWWF based on the supplemental information from the City.

Table 3.2
Sanitary Sewer System Peaking Factor

Parameter	Value
Average Dry Weather Flow	225,663 gpd
PDWF[1]	PDWF = (varies between 2.5 and 2.75) * ADWF
PWWF	PWWF = ADWF * (PDWF peaking factor + 0.65)

Note:
PDWF peaking factor is dependent upon ADWF for each parcel.

3.2 Sanitary Sewer Collection System

3.2.1 Existing Sanitary Sewer Collection System

The existing sanitary sewer collection system within the vicinity of the LSAP consists of sewer mains that vary in size between 8-inches to 18-inches. Pipe material of the existing sewer mains is VCP. The existing sanitary sewer system within the LSAP boundary consists of a single drainage area. Sanitary sewer flows generally drain by gravity and ultimately drain to the existing 27-inch sanitary sewer main in Lawrence Expressway. All existing sewer mains are assumed to have adequate slope and that the pipe velocity can meet the minimum 2 fps. For 8-inch pipes, pipe slope was assumed to be 0.4%. Additional record drawings, manhole survey data, and construction documents were provided by the City to update pipe invert and slope information used in this sewer analysis model. Existing sanitary sewer system layout is shown on Figure 3.1 – LSAP Existing Sanitary Sewer System and existing manholes shown on Figure 3.2 – LSAP Existing Sanitary Sewer Manholes.

3.3 Sanitary Sewer System Model Sewer Flows

3.3.1 Land Use Sewer Generation Data

The sanitary sewer flows used are based on the indoor potable water for each land use. Outdoor water demands are not included in sanitary sewer flows because outdoor drains connect to the storm drain system.

3.3.2 Average Dry Weather Flow

The sanitary sewer ADWF is intended to be representative of the average day sanitary sewer generation. The sanitary sewer ADWF is a function of the indoor water use ADD. Table 3.3 – Office Expansion Study LSAP Sanitary Sewer Demand Summary represents indoor water use ADD for each land use shown in Table 2.4 – Office Expansion Study LSAP Potable Water Demand Summary (ADD). The sanitary sewer ADWF is based on 95% of the indoor potable water ADD. Total sewer demand use for each development is detailed in Appendix F – Sanitary Sewer System Demand Calculations. Sewer generation (gpm) that was calculated for each parcel was applied to each sewer line in the street that was adjacent to that particular parcel. This allows an even distribution of sewer generated for a particular parcel to account for existing sanitary sewer lines in the street.

Table 3.3
Office Expansion Study LSAP Sanitary Sewer Demand Summary

Land Use	Number	Unit	Indoor Domestic Water Demand (gpd)	Sanitary Sewer Demand (gpd)
Office/R&D	351,000	sf	45,630	43,349
Industrial	831,000	sf	174,510	165,784
Restaurant[1,2]	580	seat	17,400	16,530
Total	-	-	237,540	225,663

Notes:

1. Total restaurant seating is assumed to be 580 seats. This is based on the assumption that 50% of restaurant (29,000 sf total) is for patrons and one 10'x10' table has seating for 4 people. The calculation is as follows:

$$(29{,}000\ sf \times 0.5) \times \left(\frac{4\ seats}{100\ sf}\right) = 580\ seats$$

2. Restaurant is defined as employee amenity space.

3.3.3 Peak Dry Weather Flow (PDWF)

The sanitary sewer PDWF is the highest sanitary sewer generation during the day due to diurnal peaks associated with higher water usage in the morning and early evening hours. PDWF is determined by applying a peaking factor to ADWF. City of Sunnyvale has varying peaking factors for PDWF which is dependent upon ADWF for each parcel. Peaking factors for the LSAP vary between 2.5 and 2.75.

3.3.4 Peak Wet Weather Flow (PWWF)

The sanitary sewer PWWF incorporates infiltration and inflow rate at 65% of the ADWF. This rate is added to the PDWF peaking factor.

Inflow is surface water that enters the wastewater system from yards, roof drains, downspouts, storm drain cross connections, or through manhole covers due to overland flow runoff. Similar to infiltration, inflow is a result of storm events, and peak inflow typically occurs during heavy storm events or prolonged periods of precipitation.

Infiltration is groundwater that enters sewer facilities such as pipelines, laterals, and manholes through holes, breaks, joint/connection failures, and other openings. Infiltration is directly correlated to the total amount of piping and appurtenances in the ground. Infiltration quantities vary due to seasonal variation in the groundwater levels influenced by storm events, surface and soil conditions, condition of sanitary sewer systems, and type of pipe joints. The highest infiltration flows are typically observed following significant storm events and during the winter or peak precipitation months, when groundwater levels are high.

3.4 Sanitary Sewer Flow Distribution

Each parcel's total sanitary sewer generation was determined by reviewing the planned parcel land use and applying applicable land use sanitary sewer generation rate to it. The parcel land use summary is included in Appendix F – Sanitary Sewer System Demand Calculations for reference.

Each parcel's total sanitary sewer flow was divided equally amongst the sanitary sewer manholes bordering the parcel as shown in Figure 3.2 – Existing Sanitary Sewer Manholes. The parcel flow entering a manhole represents a sanitary sewer lateral point of connection.

3.5 Hydraulic Grade Line Considerations

The analysis of the sanitary sewer system is assumed to be a free outfall condition.

3.6 Sanitary Sewer Boundary Conditions

In addition to the flow monitoring survey data provided by the City, the recommended sanitary sewer system is modeled based on boundary conditions taken from Technical Memorandum 7 attached to the City of Sunnyvale's 2015 Wastewater Collection System Master Plan. Since the LSAP Project is redeveloping existing lots, the recommended sewer model is analyzing existing City sewer mains and identifying which sewer mains will need to be upgraded in order to abide by City sanitary sewer standards.

3.7 Model Scenario Results and Analysis

The LSAP sanitary sewer model was created in Bentley StormCAD V8i SELECT series 5. The following sanitary sewer model flow conditions were developed:

1. Average Dry Weather Flow (ADWF) in Existing City Sewer System
2. ADWF in Recommended City Sewer System
3. Peak Wet Weather Flow (PWWF) in Existing City Sewer System
4. PWWF in Recommended City Sewer System

Sanitary sewer model inside diameters were based on JM Eagle PVC Pipe Size for SDR 26 (160 psi).

3.7.1 Pipe Diameter

The sewer systems were modelled with the inside pipe diameters. Pipe diameters were reviewed based on the d/D exceeding the allowable depth of flow of 0.50 for pipe sizes 10-inches and smaller, and 0.75 for pipe sizes greater than 12-inches per the supplemental information from the City.

3.7.2 Flow Velocity

The flow velocities through the pipes were calculated using the Manning's equation. The Manning's equation calculates the flow velocities using the pipe's roughness coefficient, the hydraulic radius, and the slope of the pipe.

3.7.2.1 Average Dry Weather Flow (ADWF)

Figure 3.3 – LSAP Average Dry Weather Flow Pipe Velocity illustrates the ADWF pipe velocities for the sanitary sewer system. The sanitary sewer system ADWF pipe velocity results are detailed in Appendix D – LSAP Sewer Model Reports. The results shown in this appendix account for flows from the overall LSAP area including the office and housing expansion areas. The recommended system described falls under the housing expansion infrastructure impact study. The results of the analysis show LSAP ADWF velocities ranging from approximately 2.39 fps to 5.67 fps in the City's existing sewer system. ADWF velocities in the recommended City sewer system range from approximately 2.39 fps to 6.24 fps.

3.7.2.2 Peak Wet Weather Flow (PWWF)

Figure 3.4 – LSAP Peak Wet Weather Flow Pipe Velocity illustrates the PWWF pipe velocities for the sanitary sewer system. The sanitary sewer system PWWF pipe velocity results are detailed in Appendix D – LSAP Sewer Model Reports. The results shown in this appendix account for flows from the overall LSAP area including the office and housing expansion areas. The recommended system described falls under the housing expansion infrastructure impact study. The

results of the analysis show LSAP PWWF velocities ranging from approximately fps 3.21 to 7.84 fps in the City's existing sewer system. PWWF velocities in the recommended City sewer system range from approximately 3.21 fps to 8.20 fps.

3.8 Sanitary Sewer System Recommendations

The existing sanitary sewer system, as shown in Appendix D – LSAP Sewer Model Reports, is designed to meet the design criteria outlined in Table 3.1 – Sanitary Sewer System Design Criteria. Refer to Appendix D – LSAP Sewer Model Reports for detailed results of model scenarios. In conclusion, no upgrades to the existing sanitary sewer system are required since the model results display no issues with pipe capacity and flow under various demand scenarios and the existing pipe system abides by City design standards.

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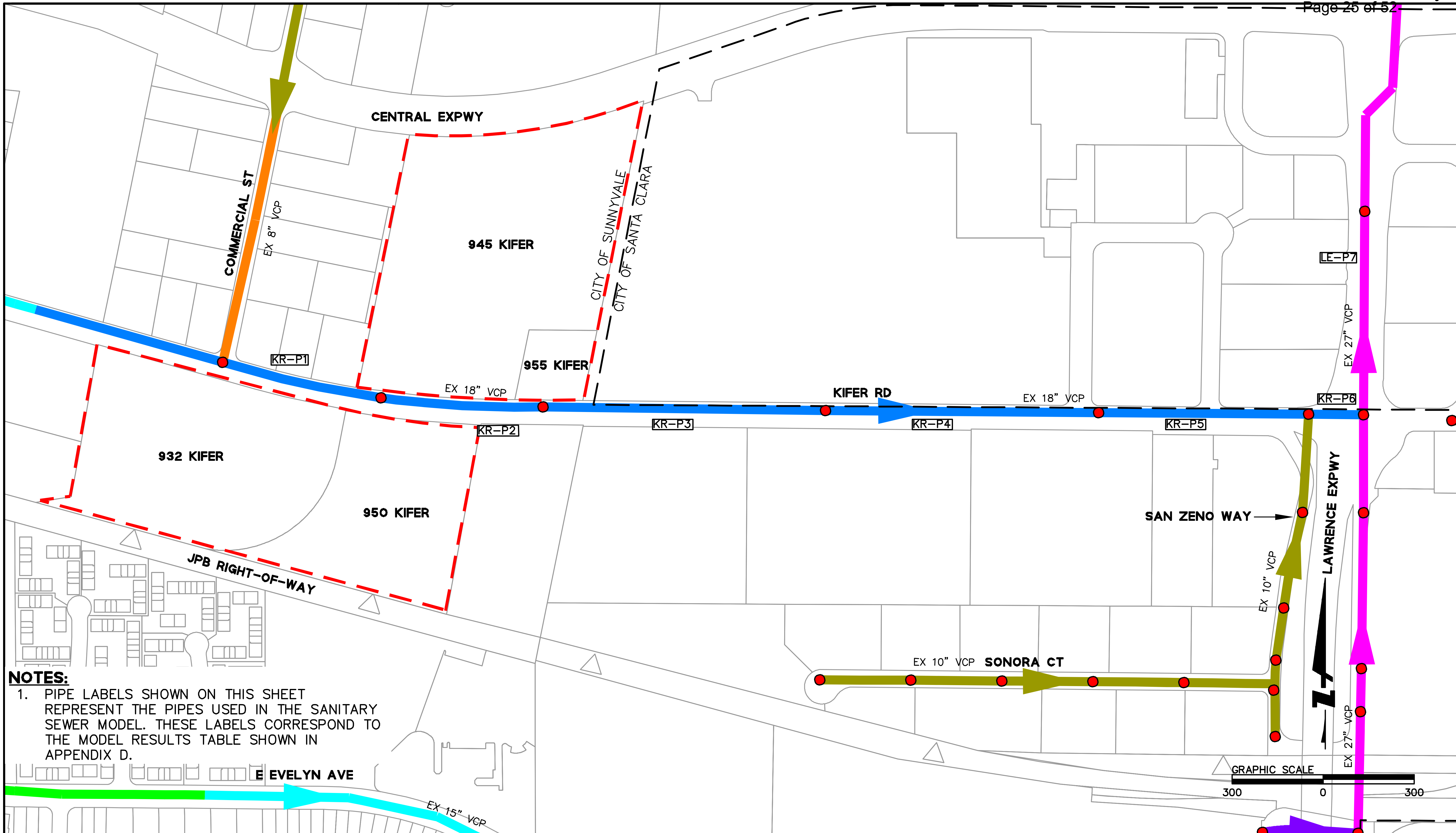

NOTES:

1. PIPE LABELS SHOWN ON THIS SHEET REPRESENT THE PIPES USED IN THE SANITARY SEWER MODEL. THESE LABELS CORRESPOND TO THE MODEL RESULTS TABLE SHOWN IN APPENDIX D.

LEGEND

- CITY BOUNDARY
- OFFICE EXPANSION STUDY AREA
- EX 8" SEWER
- EX 10" SEWER
- EX 12" SEWER
- EX 15" SEWER
- EX 18" SEWER
- EX 24" SEWER
- EX 27" SEWER
- MANHOLE
- KR–P1 ← PIPE NUMBER
- STREET LOCATION

DATE:	06/22/2020
SCALE:	1"=300'
DESIGN:	BPB
DRAWN BY:	EYS
APPROVED:	TRM
JOB NO:	20180080

BKF ENGINEERS / SURVEYORS / PLANNERS
255 SHORELINE DRIVE SUITE 200
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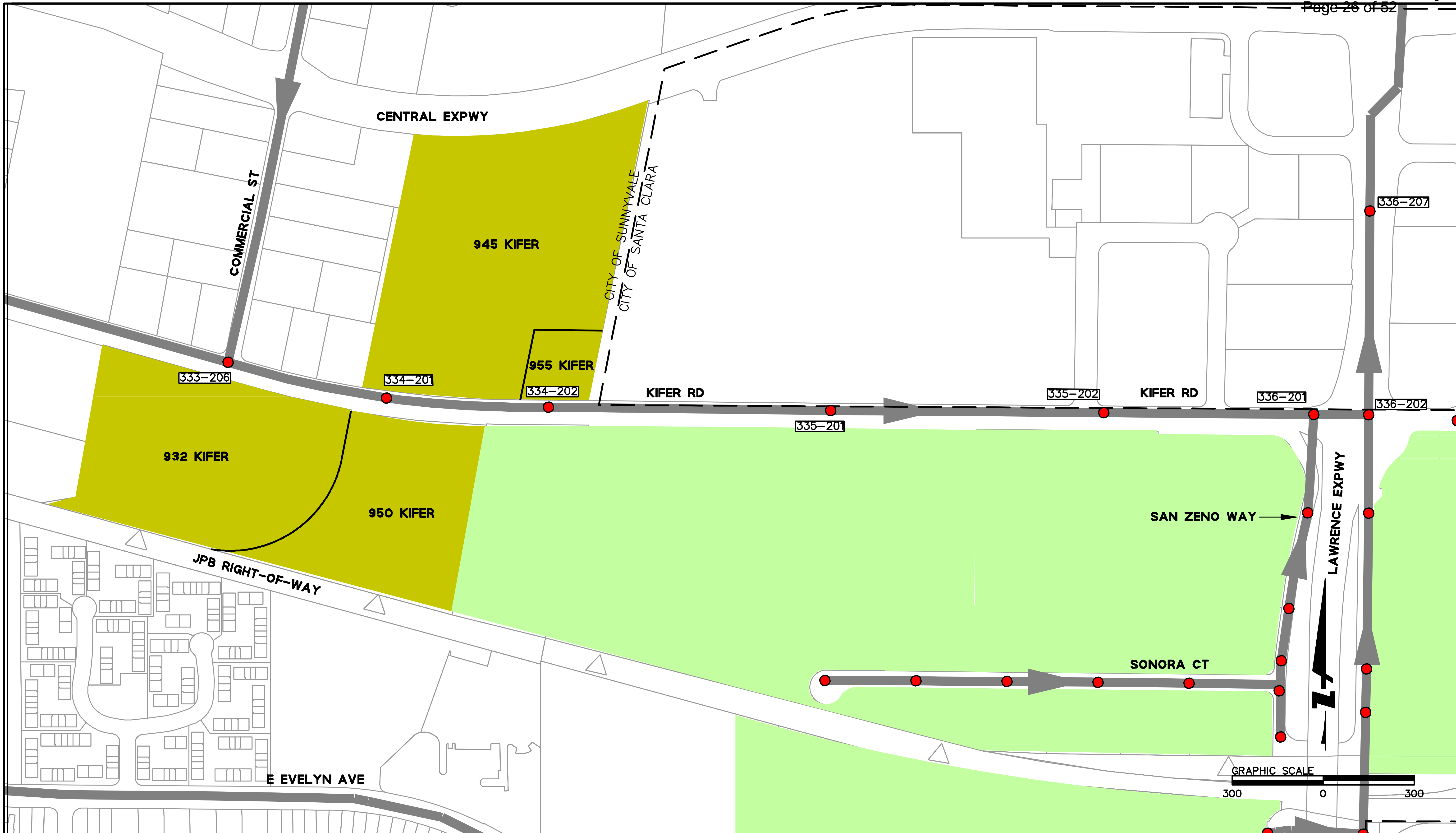
650/482-6300
650/482-6399 (FAX)

LSAP OFFICE EXPANSION BUILDOUT INFRASTRUCTURE REPORT

FIGURE 3.1 – EXISTING SANITARY SEWER SYSTEM

DRAWING NAME: \\bkf-rc\VOL4\2018\180080_LSAP_Housing\ENG\EXHIBITS\Master Plan\Sewer\Office\Figure 3.1 - LSAP Existing Sanitary Sewer System - Office.dwg
PLOT DATE: 06-19-20 PLOTTED BY: lnou



LEGEND

- CITY BOUNDARY
- HOUSING EXPANSION STUDY AREA
- OFFICE EXPANSION STUDY AREA
- EX SEWER
- EX MANHOLE

DATE:	06/22/2020
SCALE:	1"=300'
DESIGN:	BPB
DRAWN BY:	NRF
APPROVED:	TRM
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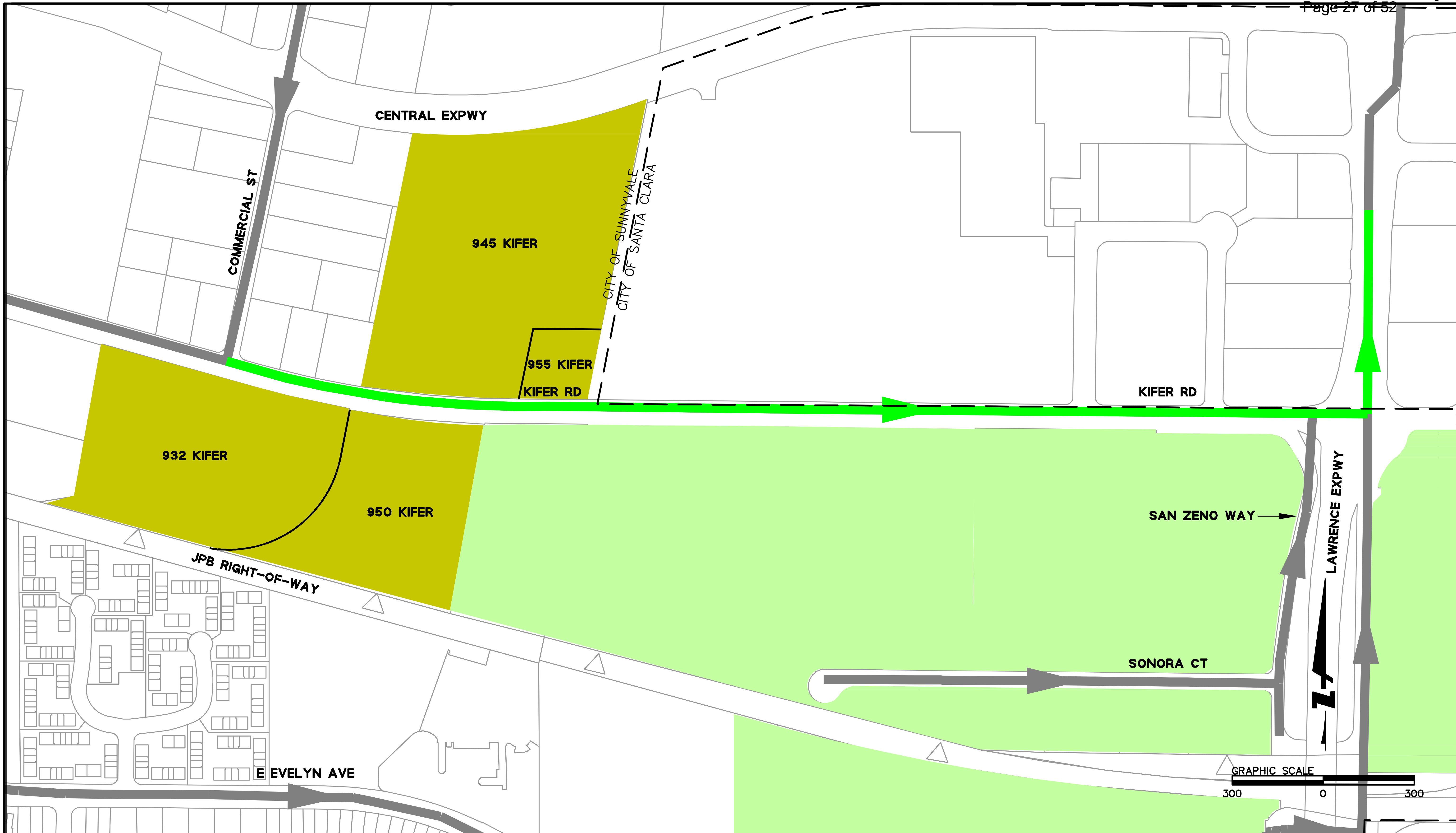
LSAP OFFICE EXPANSION BUILDOUT INFRASTRUCTURE REPORT

FIGURE 3.2 – EXISTING SANITARY SEWER MANHOLES

DRAWING NAME: \\bkf-rc\VOL4\2018\180080_LSAP_Housing\ENG\EXHIBITS\Master Plan\Sewer\Office\Figure 3.2 - LSAP Existing Sanitary Sewer Manholes - Office.dwg
PLOT DATE: 06-19-20 PLOTTED BY: lnou

© BKF Engineers



LEGEND

- CITY BOUNDARY
- HOUSING EXPANSION STUDY AREA
- OFFICE EXPANSION STUDY AREA
- EX SEWER

SS GRAVITY MAIN VELOCITY

- 2.00 FT/S TO 9.99 FT/S

DATE:	06/22/2020
SCALE:	1"=300'
DESIGN:	BPB
DRAWN BY:	NRF
APPROVED:	TRM
JOB NO:	20180080

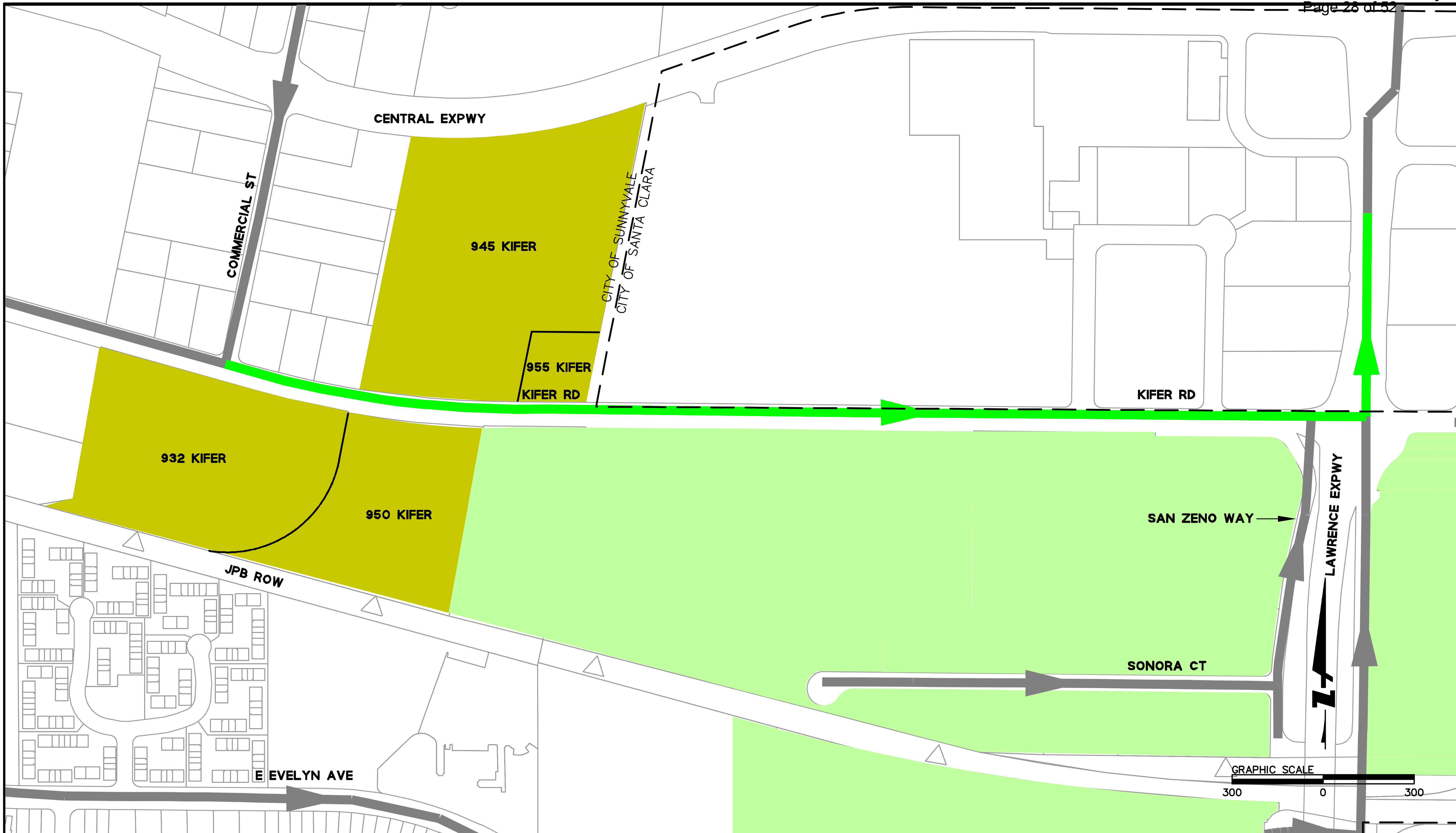
BKF ENGINEERS / SURVEYORS / PLANNERS
255 SHORELINE DRIVE SUITE 200
REDWOOD CITY, CA 94065
650/482-6300
650/482-6399 (FAX)

LSAP OFFICE EXPANSION BUILDOUT INFRASTRUCTURE REPORT

FIGURE 3.3 – LSAP AVERAGE DRY WEATHER FLOW PIPE VELOCITY

DRAWING NAME: \\bkf-rc\VOL4\2018\180080_LSAP_Housing\ENG\EXHIBITS\Master Plan\Sewer\Office\Figure 3.3 - LSAP Average Dry Weather Flow Pipe Velocity - Office.dwg
PLOT DATE: 06-19-20 PLOTTED BY: lnou

©BKF Engineers



LEGEND

- CITY BOUNDARY
- HOUSING EXPANSION STUDY AREA
- OFFICE EXPANSION STUDY AREA
- EX SEWER

SS GRAVITY MAIN VELOCITY

- 2.00 FT/S TO 9.99 FT/S

DATE:	06/22/2020
SCALE:	1"=300'
DESIGN:	BPB
DRAWN BY:	NRF
APPROVED:	TRM
JOB NO:	20180080

BKF
ENGINEERS / SURVEYORS / PLANNERS
255 SHORELINE DRIVE SUITE 200
REDWOOD CITY, CA 94065
650/482-6300
650/482-6399 (FAX)

LSAP OFFICE EXPANSION BUILDOUT INFRASTRUCTURE REPORT

FIGURE 3.4 – LSAP PEAK WET WEATHER FLOW PIPE VELOCITY

DRAWING NAME: \\bkf-rc\VOL4\2018\180080_LSAP_Housing\ENG\EXHIBITS\Master Plan\Sewer\Office\Figure 3.4 – LSAP Peak Wet Weather Flow Pipe Velocity – Office.dwg
PLOT DATE: 06-19-20 PLOTTED BY: lnou

SECTION 4: STORM DRAIN SYSTEM

4.1 Existing Storm Drain Layout

The existing storm drain for LSAP is shown on Figure 4.1 – LSAP Existing Storm Drain System. Existing storm drain mains are maintained by the City of Sunnyvale. The LSAP area is currently served by existing storm drain mains that vary in size between 18-inches to 30-inches.

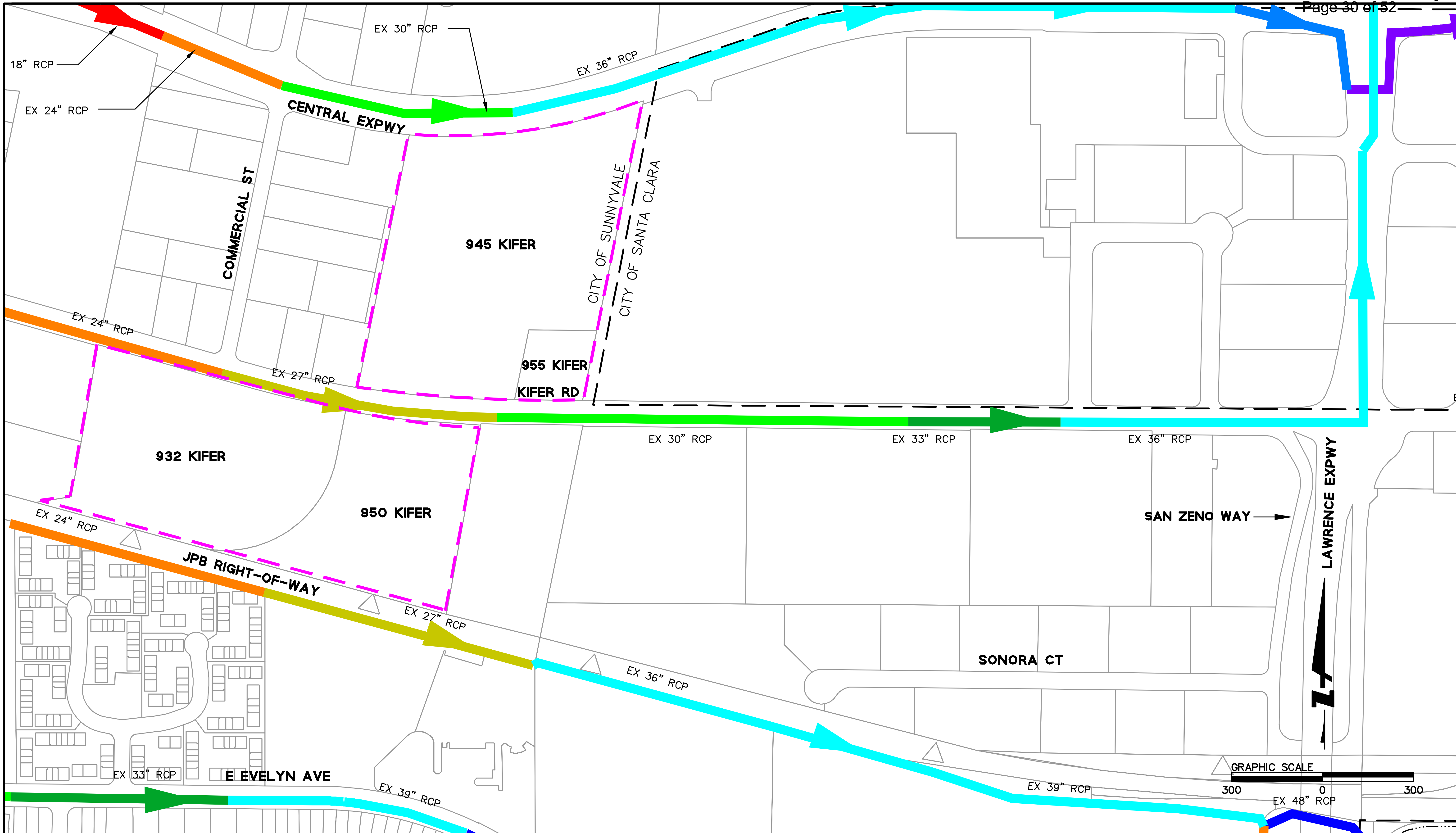
4.2 Storm Drain System for Developed Projects

The existing site is approximately 719,000 sf (51%) of impervious surfaces and 692,100 sf (49%) of pervious surfaces. The north site, located at 945/955 Kifer Road, composes of 447,500 sf (66%) of pervious surfaces and 230,600 sf (34%) of impervious surface. The south site, located at 932/950 Kifer Road, composes of 244,600 sf (33%) of pervious surfaces and 488,400 sf (67%) of impervious surface.

The office expansion LSAP is proposed to have approximately 862,900 sf (61%) of impervious surfaces and 548,100 sf (39%) of pervious surface. The north site proposes 371,600 sf (55%) of pervious surfaces and 306,400 sf (45%) of impervious surface. The south site proposes 176,500 sf (24%) of pervious surfaces and 556,500 sf (76%) of impervious surface. The proposed developments abide by the City of Sunnyvale's Municipal Code requirements for a minimum of 20% landscaped surfaces for each development parcel. The north and south sites proposes bio-treatment areas on-site to treat impervious surfaces. The remainder of the pervious surfaces are assumed to be self-treating and infiltrate within their own development site.

4.3 Storm Drain System Recommendations

With on-site treatment areas for impervious surfaces and self-treating pervious surfaces elsewhere throughout the site, the proposed developments would abide by the City of Sunnyvale's Municipial Code requirements for a minimum of 20% landscaped surfaces for each parcel. Therefore, the proposed Office Expansion Study Area project assumes no increase in stormwater runoff to the existing storm drain system.



LEGEND

- CITY BOUNDARY
- OFFICE EXPANSION STUDY AREA
- EX 18" STORM
- EX 24" STORM
- EX 27" STORM
- EX 30" STORM
- EX 36" STORM

DATE:	06/22/2020
SCALE:	1"=200'
DESIGN:	BPB
DRAWN BY:	EYS
APPROVED:	TRM
JOB NO:	20180080

BKF
ENGINEERS / SURVEYORS / PLANNERS
255 SHORELINE DRIVE SUITE 200
REDWOOD CITY, CA 94065
650/482-6300
650/482-6399 (FAX)

LSAP OFFICE EXPANSION BUILDOUT INFRASTRUCTURE REPORT

FIGURE 4.1 – EXISTING STORM DRAIN SYSTEM

DRAWING NAME: \\bkf-rc\VOL4\2018\180080_LSAP_Housing\ENG\EXHIBITS\Master Plan\Storm\Office\Figure 4.1 – Existing Storm System – Office.dwg
PLOT DATE: 06-19-20 PLOTTED BY: lnou

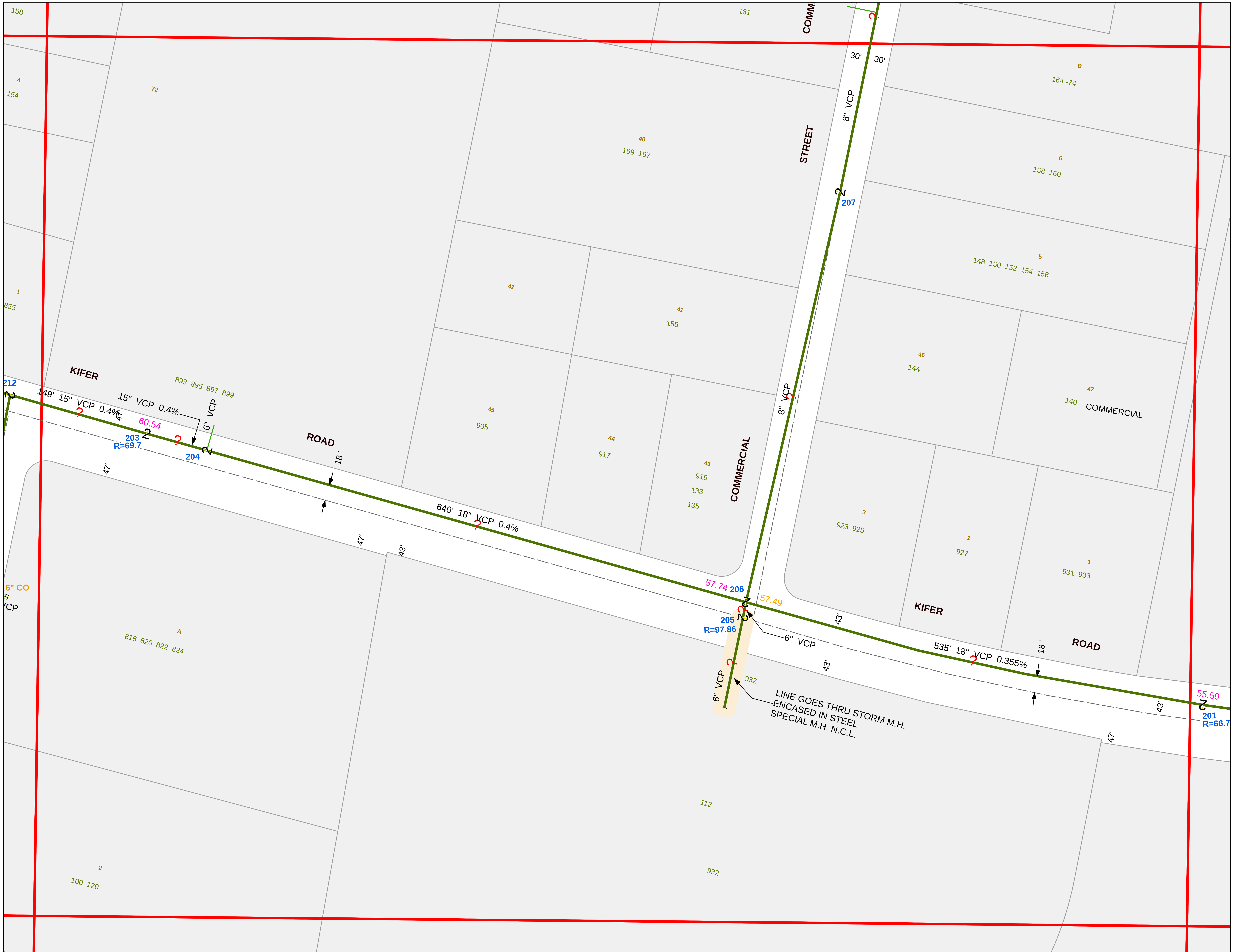
APPENDIX A

Block Book Pages for Lawrence Station Area Plan

APPENDIX A

Block Book Pages for Lawrence Station Area Plan

SUNNYVALE - SEWER
Appendix A



Legend

Lines

- Active Sunnyvale Main
- Abandoned Sunnyvale Main
- Active Private Main
- Others Main
- Active Sunnyvale Lateral
- Abandoned Sunnyvale Lateral
- Active Private Lateral
- Active Force Main
- Abandoned Force Main
- Active Santa Clara Main
- Active Cupertino Main

Points

- Flushing Inlet
- Active Manhole
- Abandoned Manhole
- Active Drop Manhole
- Diversion Structure
- Grade Break
- Main Line Clean Out
- Network Structure
- Clean Out
- Active Plug
- Abandoned Plug
- Meter
- Pump Station
- Lift Station
- Riser
- Drain Inlet

Polygons

- Easement
- Concrete Casing
- Steel Casing
- Detail Polygon
- Blockgrid
- City Boundary

Basemap

- Constructed Centerline
- Street Centerline
- Parcel

Annotation

365'	- Pipe Length
6"	- Diameter
VCP	- Material
0.2%	- Slope
US=19.48	- Upstream Elevation
DS=18.48	- Downstream Elevation
209	- Manhole Number
R=23.58	- Rim Elevation
6" CO	- Clean Out Annotation
F.I.	- Flushing Inlet Annotation
10' P.U.E	- Easement Annotation
80'-42" Steel Casing	- Casing Annotation
BORREGAS AVENUE	- Street Name
129	- Lot Number
1405	- Address Number
ONSITE PRIVATE SYSTEM	- Miscellaneous Annotation

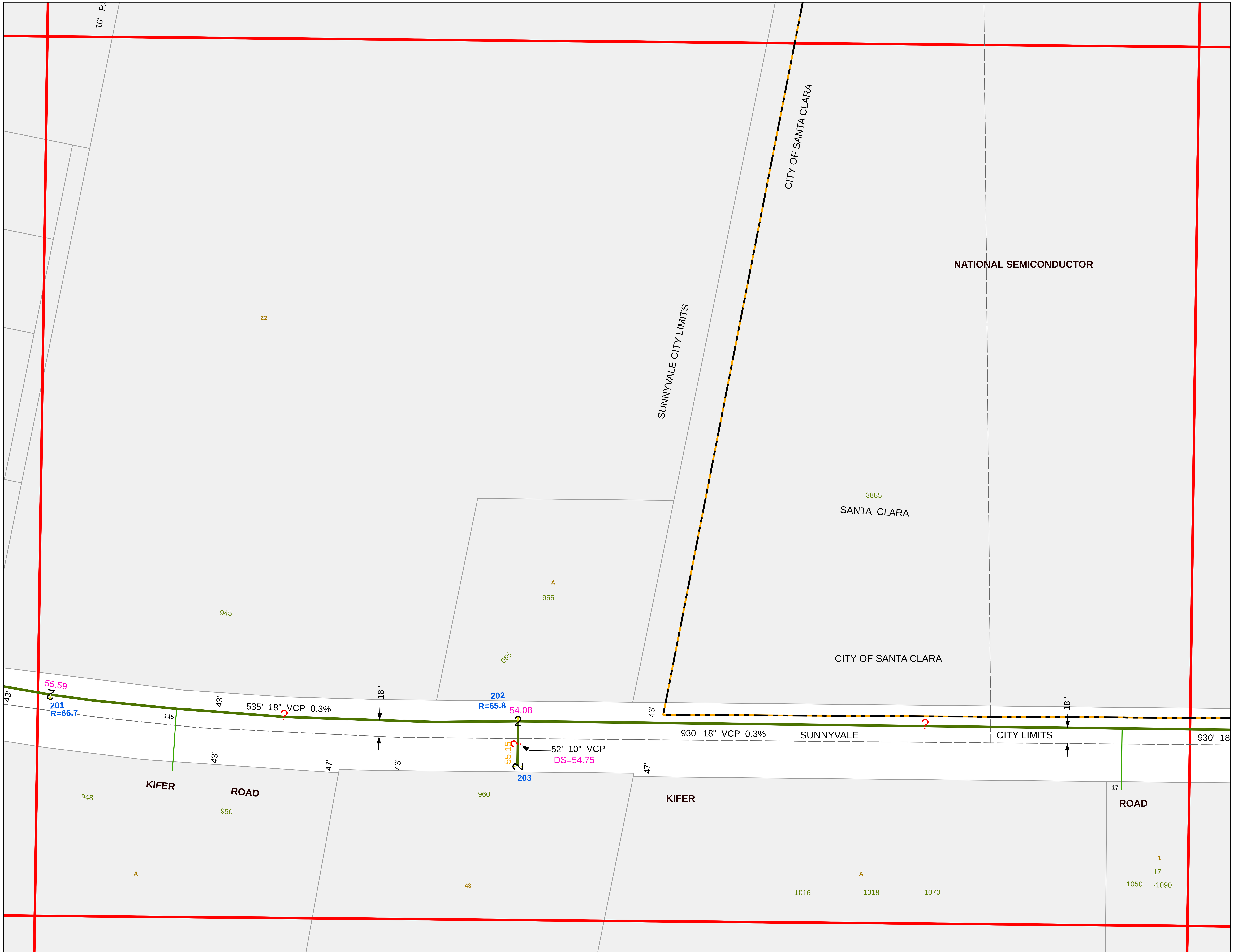
349	348	347
332	333	334
309	308	307

333

0 50 Feet

Nov 11, 2019

SUNNYVALE - SEWER Appendix A



Legend

Lines

- Active Sunnyvale Main
- Abandoned Sunnyvale Main
- Active Private Main
- Others Main
- Active Sunnyvale Lateral
- Abandoned Sunnyvale Lateral
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Polygons

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- City Boundary
- Concrete Casing
- Steel Casing
- Detail Polygon
- Blockgrid

Basemap

- Constructed Centerline
- Street Centerline
- Parcel

Annotation

365'	- Pipe Length	BORREGAS AVENUE	- Street Name
6"	- Diameter	129	- Lot Number
VCP	- Material	1405	- Address Number
0.2%	- Slope	ONSITE PRIVATE SYSTEM	- Miscellaneous Annotation
US=19.48	- Upstream Elevation		
DS=18.48	- Downstream Elevation		
209	- Manhole Number		
R=23.58	- Rim Elevation		
6" CO	- Clean Out Annotation		
F.I.	- Flushing Inlet Annotation		
10' P.U.E	- Easement Annotation		
80'-42" Steel Casing	- Casing Annotation		

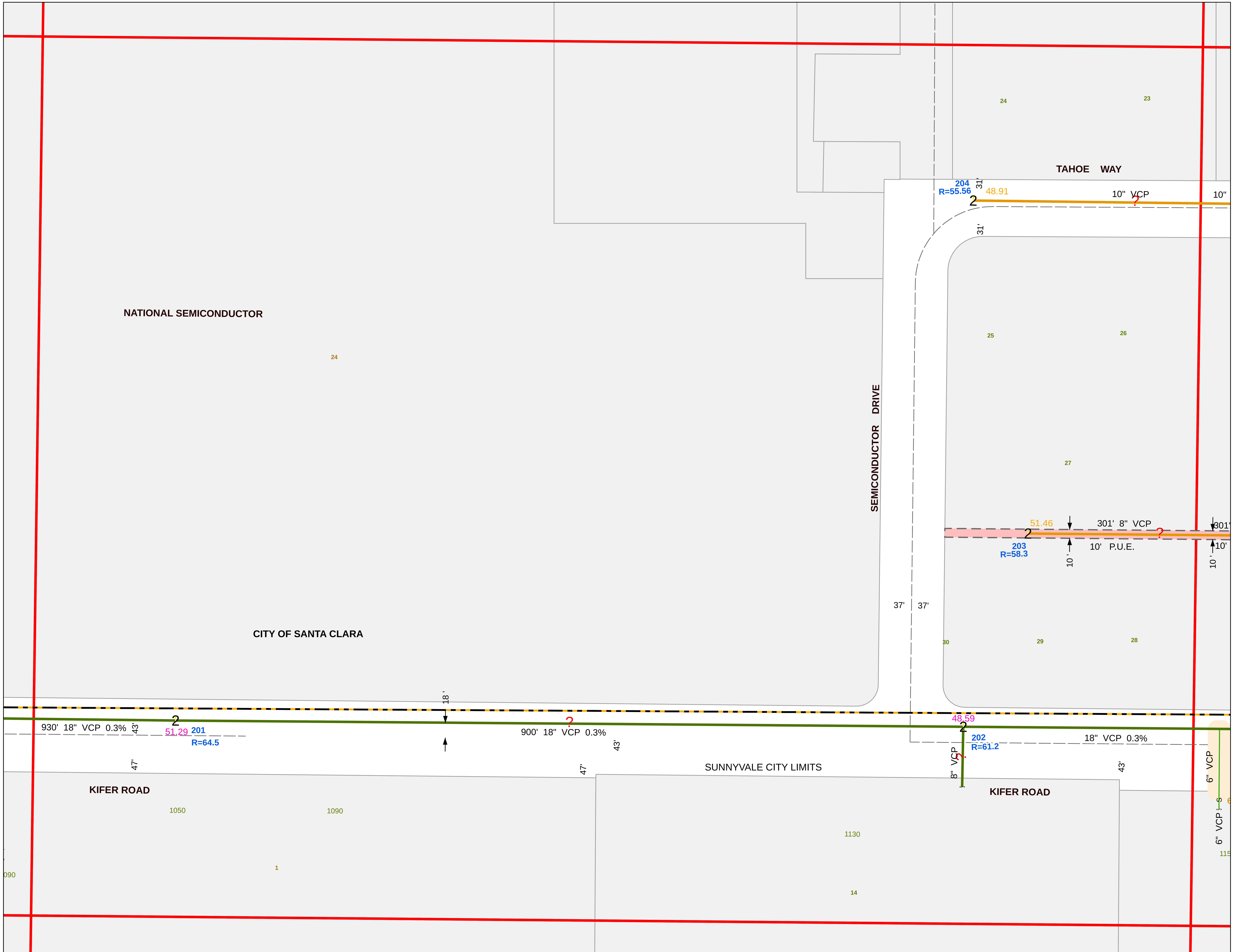
348	347	346
333	334	335
308	307	306

334

0 50 Feet

Nov 11, 2019

SUNNYVALE - SEWER Appendix A



Legend

Lines

- Active Sunnyvale Main
- Abandoned Sunnyvale Main
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- Abandoned Sunnyvale Lateral
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- Clean Out
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- Drain Inlet

Polygons

- Easement
- City Boundary
- Concrete Casing
- Steel Casing
- Detail Polygon
- Blockgrid

Basemap

- Constructed Centerline
- Street Centerline
- Parcel

Annotation

365'	- Pipe Length	BORREGAS AVENUE	- Street Name
6"	- Diameter	129	- Lot Number
VCP	- Material	1405	- Address Number
0.2%	- Slope	ONSITE PRIVATE SYSTEM	- Miscellaneous Annotation
US=19.48	- Upstream Elevation		
DS=18.48	- Downstream Elevation		
209	- Manhole Number		
R=23.58	- Rim Elevation		
6" CO	- Clean Out Annotation		
F.I.	- Flushing Inlet Annotation		
10' P.U.E	- Easement Annotation		
80'-42" Steel Casing	- Casing Annotation		

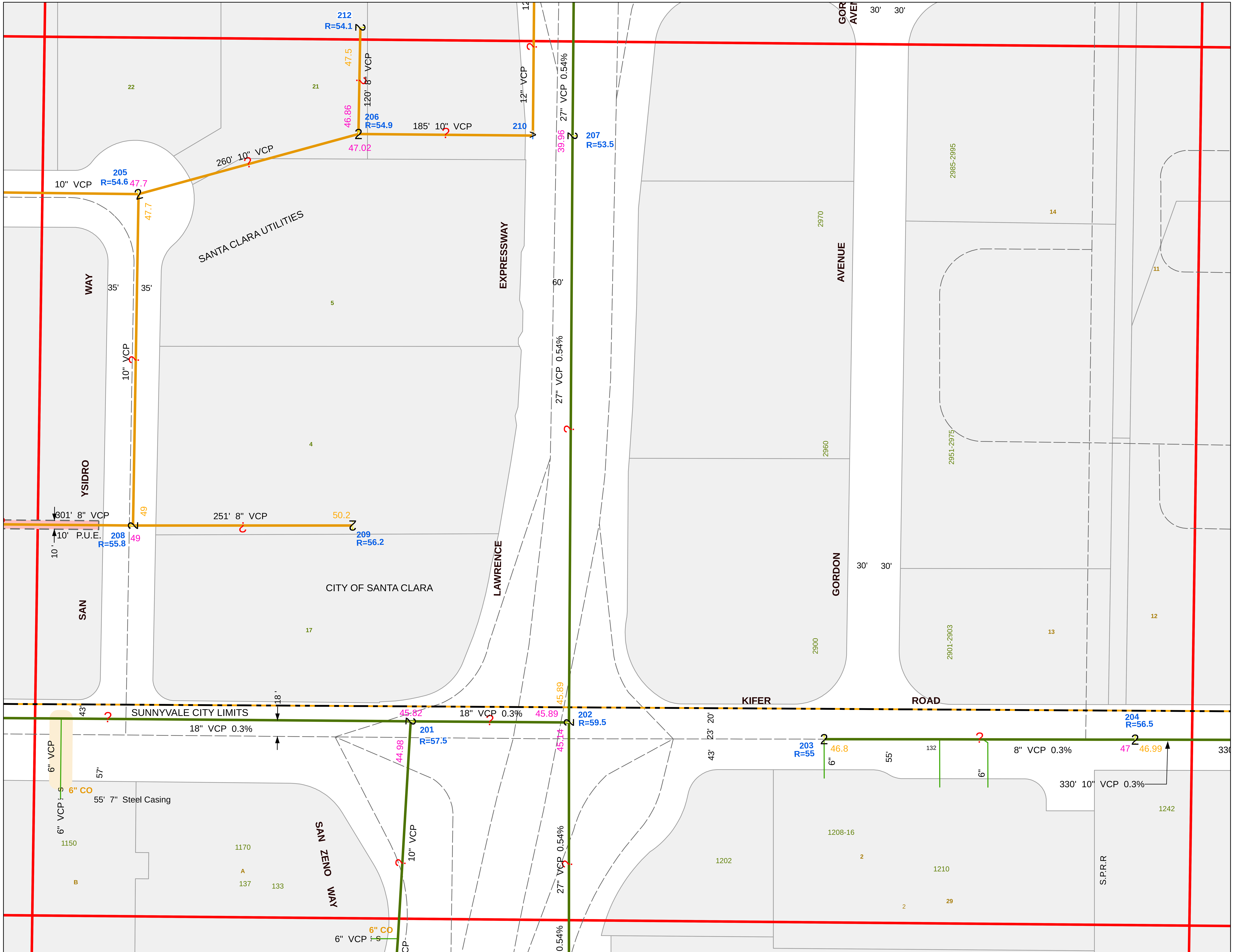
347	346	345
334	335	336
307	306	305

335

0 50 Feet

Nov 11, 2019

SUNNYVALE - SEWER
Appendix A



Legend

Lines
- Active Sunnyvale Main
- Abandoned Sunnyvale Main
- Active Private Main
- Others Main
- Active Sunnyvale Lateral
- Abandoned Sunnyvale Lateral
- Active Private Lateral
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Points
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Polygons
- Easement
- City Boundary
- Concrete Casing
- Steel Casing
- Detail Polygon
- Blockgrid

Basemap
- Constructed Centerline
- Street Centerline
- Parcel

Annotation

365'	- Pipe Length	BORREGAS AVENUE	- Street Name
6"	- Diameter	129	- Lot Number
VCP	- Material	1405	- Address Number
0.2%	- Slope	ONSITE PRIVATE SYSTEM	- Miscellaneous Annotation
US=19.48	- Upstream Elevation		
DS=18.48	- Downstream Elevation		
209	- Manhole Number		
R=23.58	- Rim Elevation		
6" CO	- Clean Out Annotation		
F.I.	- Flushing Inlet Annotation		
10' P.U.E	- Easement Annotation		
80'-42" Steel Casing	- Casing Annotation		

346	345	344
335	336	337
306	305	304

336

0 50 Feet

Nov 11, 2019

APPENDIX B

LSAP Parcels with Development Assumptions

Appendix B
Lawrence Station Area Plan
LSAP Parcels with Devleopment Assumptions
Received from George Schroeder of the City of Sunnyvale on March 16, 2020

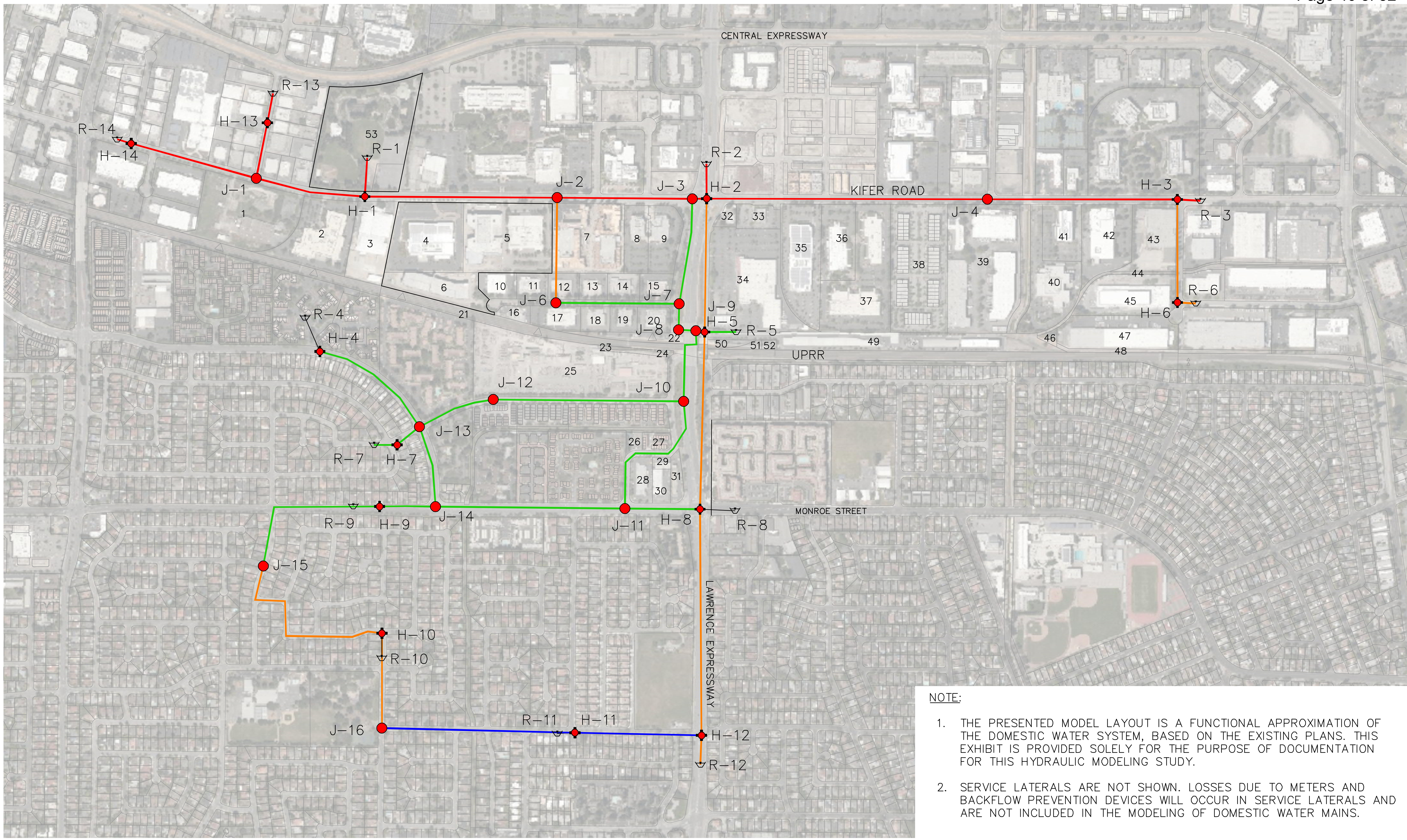
Existing		Parcels highlighted in green will be analyzed as the existing condition.
Proposed		Parcels highlighted in blue will be analyzed as the proposed condition.

Proposed Intuitive Surgical Properties to add to LSAP Boundaries - nonresidential only. See GPA/RZ 2018-7723

APN	Addr #	Street	St. Type	Lot Sq. Ft.	Lot Acres	Existing FAR	Proposed Bldg Sq. Ft.
20540001, 20540002	945-955	Kifer	Rd	678048	15.57	2%	364,000
20549005, 20549012	932-950	Kifer	Rd	732897	16.83	22%	847,000
			Totals	**1410945**	**32.39**		

APPENDIX C

LSAP Potable Water Model Reports



NOTE:

1. THE PRESENTED MODEL LAYOUT IS A FUNCTIONAL APPROXIMATION OF THE DOMESTIC WATER SYSTEM, BASED ON THE EXISTING PLANS. THIS EXHIBIT IS PROVIDED SOLELY FOR THE PURPOSE OF DOCUMENTATION FOR THIS HYDRAULIC MODELING STUDY.

2. SERVICE LATERALS ARE NOT SHOWN. LOSSES DUE TO METERS AND BACKFLOW PREVENTION DEVICES WILL OCCUR IN SERVICE LATERALS AND ARE NOT INCLUDED IN THE MODELING OF DOMESTIC WATER MAINS.

EXHIBIT 1. WaterCAD Model Layout

Lawrence Station Area Plan
Office Study Project
SCALE 1" = 800'
BKF No. 20180080-10

GRAPHIC SCALE
800 0 800 1600

LEGEND

- MODEL NODE
- MODEL RESERVOIR
- J-00 NODE ID
- H-00 HYDRANT ID
- HYDRANT LOCATION

- 12" CAST IRON PIPE (EXISTING)
- 12" DUCTILE IRON PIPE (EXISTING)
- 10" DUCTILE IRON PIPE (EXISTING)
- 8" DUCTILE IRON PIPE (EXISTING)

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APPENDIX C-1

Model Demand Scenario 1: Static

Node Report

Node ID	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)
J-1	63.00	240.00	77
H-1	63.00	240.00	77
H-13	63.00	240.00	77
H-14	67.00	240.00	75

APPENDIX C-2

Model Demand Scenario 2: Peak Hour Demand

Node Report

Label	Demand (gpm)	Available Flow with System-wide Constraint * (gpm)	Minimum Residual Pressure @ PHD (psi)	Maximum Pipe Velocity (ft/s)	Satisfies Criteria?
J-1	500	1,000	76	1.73	TRUE
H-1	500	1,000	77	0.18	TRUE
H-13	500	1,000	77	0.29	TRUE
H-14	500	1,000	75	0.10	TRUE

* Available flow reported is based on system-wide constraint of 20 psi and 15 fps applied every where in the system. During simulation, if the pressure were to drop below 20 psi or velocity exceed 15 fps at any location system-wide due to demand placed at that specific node in question, then the simulation ends and the resulting flow calculated at the end of that simulation is reported for that node in question.

APPENDIX C-3

Model Demand Scenario 3: Max Day Demand + Fire Flow

Node Report

Label	Demand (gpm)	Available Flow with System-wide Constraint * (gpm)	Minimum Residual Pressure @ MDD (psi)	Maximum Pipe Velocity (ft/s)	Satisfies Criteria?
J-1	4,820	6,000	73	10.40	TRUE
H-1	4,820	6,000	76	1.06	TRUE
H-13	4,820	6,000	76	1.77	TRUE
H-14	4,820	6,000	75	0.59	TRUE

* Available flow reported is based on system-wide constraint of 20 psi and 15 fps applied every where in the system. During simulation, if the pressure were to drop below 20 psi or velocity exceed 15 fps at any location system-wide due to demand placed at that specific node in question, then the simulation ends and the resulting flow calculated at the end of that simulation is reported for that node in question.

APPENDIX D

LSAP Sewer Model Reports

Appendix D
Lawrence Station Area Plan
Sanitary Sewer - Average Dry Weather Flow (ADWF) Hydraulics - Existing System

Pipe [5] #	Upstream Node	Downstream Node	Total Flow (gpm)	Capacity @ Constructed Slope (gpm)	Pipe Size (inches)	Length (feet)	Constructed Slope (ft/ft)	Pipe Roughness (Mannings n)	Invert Elevation		Ground/Rim Elevation		HGL Elevation		Upstream Freeboard [2] (feet)	Upstream Cover (feet)	Velocity (ft/s)	**d/D**
									Upstream	Downstream	Upstream	Downstream	Upstream	Downstream				
EX-KR-P1	333-206	334-201	**336.11**	2809.64	18	534.90	0.004	0.013	57.49	55.59	67.86	66.70	57.84	56.04	10.02	8.87	2.39	**0.23**
EX-KR-P2	334-201	334-202	**492.82**	2505.53	18	534.60	0.003	0.013	55.59	54.08	66.70	65.80	56.04	54.54	10.66	9.61	2.45	**0.30**
EX-KR-P3	334-202	335-201	**519.37**	2582.18	18	930.00	0.003	0.013	54.08	51.29	65.80	64.50	54.54	51.77	11.26	10.22	2.55	**0.31**
EX-KR-P4	335-201	335-202	**571.01**	2582.16	18	900.00	0.003	0.013	51.29	48.59	64.50	61.20	51.77	49.06	12.73	11.71	2.61	**0.32**
EX-KR-P5	335-202	336-201	**634.28**	2982.83	18	692.00	0.004	0.013	48.59	45.82	61.20	57.50	49.06	46.30	12.14	11.11	2.99	**0.31**
EX-KR-P6	336-201	336-202	**733.54**	6905.33	18	180.90	0.021	0.013	45.82	41.94	57.50	57.04	46.30	42.90	11.20	10.18	5.67	**0.32**
EX-LE-P7	336-202	336-207 (EX)	**3533.54**	10208.70	27	671.10	0.005	0.013	41.94	38.32	57.04	54.28	42.90	39.23	14.14	12.85	5.20	**0.43**

Note: EX-LE-P7 pipe segment is not within the office expansion scope. It is analyzed as part of the housing expansion scope.

Appendix D
Lawrence Station Area Plan
Sanitary Sewer - Average Dry Weather Flow (ADWF) Hydraulics - Proposed System

Pipe [5] #	Upstream Node	Downstream Node	Total Flow (gpm)	Capacity @ Constructed Slope (gpm)	Pipe Size (inches)	Length (feet)	Constructed Slope (ft/ft)	Pipe Roughness (Mannings n)	Invert Elevation Upstream	Invert Elevation Downstream	Ground/Rim Elevation Upstream	Ground/Rim Elevation Downstream	HGL Elevation Upstream	HGL Elevation Downstream	Upstream Freeboard [2] (feet)	Upstream Cover (feet)	Velocity (ft/s)	d/D
PR-KR-P1	333-206 (P)	334-201 (P)	**336.11**	2809.84	18.00	534.90	0.004	0.013	57.49	55.59	67.86	66.70	57.84	56.04	10.02	8.87	2.39	**0.23**
PR-KR-P2	334-201 (P)	334-202 (P)	**492.82**	2505.44	18.00	534.60	0.003	0.013	55.59	54.08	66.70	65.80	56.04	54.54	10.66	9.61	2.45	**0.30**
PR-KR-P3	334-202 (P)	335-201 (P)	**519.37**	2582.15	18.00	930.00	0.003	0.013	54.08	51.29	65.80	64.50	54.54	51.77	11.26	10.22	2.55	**0.31**
PR-KR-P4	335-201 (P)	335-202 (P)	**571.01**	2582.22	18.00	900.00	0.003	0.013	51.29	48.59	64.50	61.20	51.77	49.06	12.73	11.71	2.62	**0.32**
PR-KR-P5	335-202 (P)	336-201 (P)	**634.28**	2981.31	18.00	692.70	0.004	0.013	48.59	45.82	61.20	57.50	49.06	46.30	12.14	11.11	2.99	**0.31**
PR-KR-P6	336-201 (P)	336-202 (P)	**733.54**	6904.37	18.00	180.90	0.021	0.013	45.82	41.94	57.50	57.04	46.30	42.87	11.20	10.18	5.67	**0.32**
PR-LE-P7	336-202 (P)	336-207 (P)	**3533.54**	17889.16	30.19	670.50	0.005	0.010	41.94	38.32	57.04	54.28	42.87	39.08	14.17	12.58	6.24	**0.37**

Note: EX-LE-P7 pipe segment is not within the office expansion scope. It is analyzed as part of the housing expansion scope.

Appendix D
Lawrence Station Area Plan
Sanitary Sewer - Peak Wet Weather Flow (PWWF) Hydraulics - Existing System

Pipe [5] #	Upstream Node	Downstream Node	Total Flow (gpm)	Capacity @ Constructed Slope (gpm)	Pipe Size (inches)	Length (feet)	Constructed Slope (ft/ft)	Pipe Roughness (Mannings n)	Invert Elevation		Ground/Rim Elevation		HGL Elevation		Upstream Freeboard [2] (feet)	Upstream Cover (feet)	Velocity (ft/s)	d/D
									Upstream	Downstream	Upstream	Downstream	Upstream	Downstream				
EX-KR-P1	333-206	334-201	**957.91**	2809.64	18	534.90	0.004	0.013	57.49	55.59	67.86	66.70	58.09	56.41	9.77	8.87	3.21	**0.40**
EX-KR-P2	334-201	334-202	**1460.66**	2505.53	18	534.60	0.003	0.013	55.59	54.08	66.70	65.80	56.41	54.92	10.29	9.61	3.28	**0.55**
EX-KR-P3	334-202	335-201	**1557.58**	2582.18	18	930.00	0.003	0.013	54.08	51.29	65.80	64.50	54.92	52.19	10.88	10.22	3.41	**0.56**
EX-KR-P4	335-201	335-202	**1720.26**	2582.16	18	900.00	0.003	0.013	51.29	48.59	64.50	61.20	52.19	49.47	12.31	11.71	3.48	**0.60**
EX-KR-P5	335-202	336-201	**1940.67**	2982.83	18	692.00	0.004	0.013	48.59	45.82	61.20	57.50	49.47	46.69	11.73	11.11	4.00	**0.59**
EX-KR-P6	336-201	336-202	**2314.89**	6905.33	18	180.90	0.021	0.013	45.82	41.94	57.50	57.04	46.69	43.71	10.81	10.18	7.84	**0.58**
EX-LE-P7	336-202	336-207 (EX)	**9798.29**	10208.70	27	671.10	0.005	0.013	41.94	38.32	57.04	54.28	43.71	39.96	13.33	12.85	6.51	**0.79**

Note: EX-LE-P7 pipe segment is not within the office expansion scope. It is analyzed as part of the housing expansion scope.

Appendix D
Lawrence Station Area Plan
Sanitary Sewer - Peak Wet Weather Flow (PWWF) Hydraulics - Proposed System

Pipe [5] #	Upstream Node	Downstream Node	Total Flow (gpm)	Capacity @ Constructed Slope (gpm)	Pipe Size (inches)	Length (feet)	Constructed Slope (ft/ft)	Pipe Roughness (Mannings n)	Invert Elevation		Ground/Rim Elevation		HGL Elevation		Upstream Freeboard [2] (feet)	Upstream Cover (feet)	Velocity (ft/s)	**d/D**
									Upstream	Downstream	Upstream	Downstream	Upstream	Downstream				
PR-KR-P1	333-206 (P)	334-201 (P)	**957.91**	2809.84	18.00	534.90	0.004	0.013	57.49	55.59	67.86	66.70	58.09	56.41	9.77	8.87	3.21	**0.40**
PR-KR-P2	334-201 (P)	334-202 (P)	**1460.66**	2505.44	18.00	534.60	0.003	0.013	55.59	54.08	66.70	65.80	56.41	54.92	10.29	9.61	3.28	**0.55**
PR-KR-P3	334-202 (P)	335-201 (P)	**1557.58**	2582.15	18.00	930.00	0.003	0.013	54.08	51.29	65.80	64.50	54.92	52.19	10.88	10.22	3.41	**0.56**
PR-KR-P4	335-201 (P)	335-202 (P)	**1720.26**	2582.22	18.00	900.00	0.003	0.013	51.29	48.59	64.50	61.20	52.19	49.47	12.31	11.71	3.48	**0.60**
PR-KR-P5	335-202 (P)	336-201 (P)	**1940.67**	2981.31	18.00	692.70	0.004	0.013	48.59	45.82	61.20	57.50	49.47	46.69	11.73	11.11	4.00	**0.59**
PR-KR-P6	336-201 (P)	336-202 (P)	**2314.89**	6904.37	18.00	180.90	0.021	0.013	45.82	41.94	57.50	57.04	46.69	43.53	10.81	10.18	7.84	**0.58**
PR-LE-P7	336-202 (P)	336-207 (P)	**9798.29**	17889.16	30.19	670.50	0.005	0.010	41.94	38.32	57.04	54.28	43.53	39.65	13.51	12.58	8.20	**0.63**

Note: EX-LE-P7 pipe segment is not within the office expansion scope. It is analyzed as part of the housing expansion scope.

APPENDIX E

Potable Water System Demand Calculations

Appendix E
Lawrence Station Area Plan
Potable Water System Demand Calculations

LSAP Office Expansion Study

Lot	Residential Units	Commercial/Office/Retail (sf)	Industrial (sf)	Restaurant (sf)	Storage Facility (sf)	LPW (GPD)	LPW (GPM)
1 & 2	--	351,000	--	13,000	--	78,702	54.65
53	--	--	831,000	16,000	--	184,110	127.85
Subtotal	--	351,000	831,000	29,000	--	262,812	182.51

APPENDIX F

Sanitary Sewer System Demand Calculations

Appendix F
Lawrence Station Area Plan
Sanitary Sewer System Demand Calculations

LSAP Office Expansion Study

Lot	Residential Units	Commercial/Office/ Retail (sf)	Industrial (sf)	Restaurant (sf)	Storage Facility (sf)	SS (GPD)	SS (GPM)	SS PDWF (GPM)	SS PWWF (GPM)
1 & 2	--	351,000	--	13,000	--	50,759	35.25	96.93	119.85
53	--	--	831,000	16,000	--	174,905	121.46	303.65	382.60
Subtotal	--	351,000	831,000	29,000	--	225,663	156.71	400.59	502.45