SEWER STUDY REPORT

FOR THE

CAMPUS POINT NDP
10290 CAMPUS POINT
SAN DIEGO, CA 92121

June 30, 2020
Rev. April 21, 2021

Prepared by:

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4/20/2021
Date

MBI JN 174310

I. SUMMARY

The purpose of the study is to provide an assessment of the site system's capability to convey the projected project's sewer flow into the City of San Diego's sewer distribution system. The results of the analysis indicate that all proposed sewer mains have enough capacity for the proposed site. All sewer mains experience a depth to diameter ratio (d/D) of less than 50%. Sewer mains were designed to meet the 2-fps cleansing velocity minimum or the minimum slope of 1% as recommended by the City of San Diego Sewer Design guide.

The analysis showed that the proposed onsite wastewater flow analyzed is not less than 10% of the total existing flow of the downstream existing sewer main during peak wet weather flows. Therefore, an upgrade is required for the downstream existing 15" sewer main.

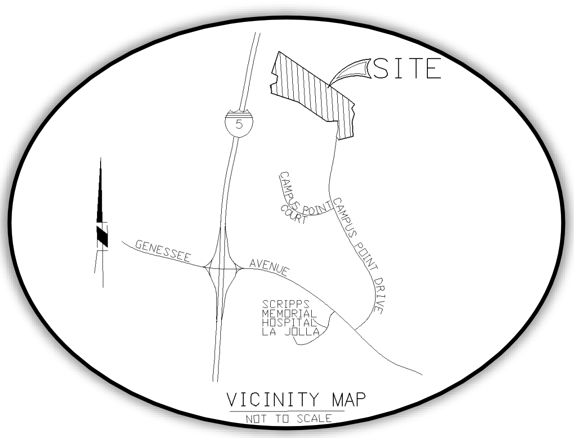
II. Project Description

Project Location

The Campus Point SDP project site is located at 10290 Campus Point Drive, in the Sorento Valley Community of the City of San Diego. The project site consists of approximately 16.7 acres, located west of Campus Point Drive, just east of Interstate 5 and north of Genesee Avenue. The existing site is part of the current Campus Point Business Park and includes buildings with APN numbers 343-230-38, 43, 42, and 14, respectively. The subject property possesses the demolition of two commercial buildings, addressed as 4110 and 4161 Campus Point Court, along with paved surface parking, hardscape, and landscape. A project vicinity map is provided in

Figure 1. The existing site consists of a parking lot, hardscape, and landscape which will be demolished to make room for the construction of five (5) new office/lab buildings, a new parking structure, and new hardscape and landscaping.

Figure 1 -- Vicinity Map



Project Description

The Campus Point NDP project site consists of demolition of existing research and development buildings and the construction of five new office/research and development buildings, various amenity buildings, new hardscape and landscaping, and a parking structure. In addition, the project proposes the construction of new utilities including water, sewer, underground storm drain, and catch basins.

Sewer Study

A hydraulic analysis summary was performed using the Sewer Study Summary from the City of San Diego Sewer Design Guide, Figure 1-2. The spreadsheet will calculate capacity for each of the proposed pipe segments as well as investigate the capacity of the new flows produced to the existing sewer.

The project will include private sewer infrastructure that will be owned, operated, and maintained by Alexandria Real Estate Equities. It will also include making the northern portion of the existing sewer main on Campus Point Court a privately-owned pipe instead of a City owned. The proposed sanitary sewer infrastructure will be 10” and 12” Polyvinyl Chloride (PVC) pipe, intercepting an existing 12” sewer main, and will connect downstream to the City owned existing 12” Vitrified Clay Pipe (VCP) and eventually connecting to the existing 15“ trunk sewer main. This report calculates wastewater generation based on area and equivalent population instead of by fixture units because this project is in its preliminary design state.

III. WASTEWATER GENERATION

Average Dry Weather Flow Generation

The average dry weather flow (ADWF) is generated by calculating the equivalent population based on zoning information. The following equation was used to calculate the ADWF.

Average Dry Weather Flow = 80 gpcd x Equivalent Population

Table III-1 Density Conversions[1]

Zone	Maximum Density (DU/Net Ac)	Population Per DU	Equivalent Population (Pop/Net AC)[2]
Schools/Public	8.9	3.5	31.2
Offices	10.9	3.5	38.2
Commercial/Hotels	12.5	3.5	43.7
Industrial	17.5	3.5	62.5
Hospital	42.9	3.5	150.0

Notes:

1. Excerpt from Table 1-1 *City of San Diego Sewer Design Guide Density Conversions*
2. These values represent equivalent population per floor of the building

Equivalent population was calculated by taking the net square feet of the buildings and converting it to acres and then multiplying the acreage by a 43.7 factor of population/net acres for commercial zones from Table 1-1 of the Sewer Design guide. After multiplying it by 43.7 the new value was then multiplied by the of floors (Table 1-1 of Sewer Design guide) which gave us an equivalent population of the different buildings. Then multiplying the equivalent population by the planning number of 80 gallons per capita day to get the Average Dry Weather Flow.

Example of ADWF calculation for proposed CP4 building

Net acres = 0.967 acres = [210,607 (sf) /43560 (sf/acres)] / 5 (floors)

Eq. Population = 211 people ≈0.967 (acres) x 5 (floors) x 43.7 (pop/net acre)

ADWF = 16,903 gpd ≈ 211 (people) x 80 (gpcd)

ADWF = 11.7 gpm = 16,903 (gpd) / 1440 (minutes/day)

Peak Dry Weather Flow Generation

Peak Dry Weather Flow (PDWF) represents the highest hour flow that will occur during the day. To develop the PDWF for the Project, the City of San Diego Sewer Design Guide, section 1.3.2.2. The peaking factor (PF) was calculated using the Homes & Narver 1960 equation (see below) displayed in Figure 1-1 of the City of San Diego Sewer Design Guide.

Halmes & Narver 1960 → Peak Factor = 6.2945 x $(pop)^{-0.1342}$

Peak Dry Weather Flow Generation = Peak Factor x Average Dry Weather Flow

Example of PDWF calculation for proposed CP4 building

Peaking Factor ≈ 3.07 = 6.2945 x (211) ^ -0.1342

PWDF = 36 gpm = 11.7 (ADWF gpm) x 3.07 (PF)

Peak Wet Weather Flow Generation

Peak Wet Weather Flows (PWWF) is 1.0 based on the recommendation from the City of San Diego of the total PDWF. Peak wet weather flow is the design flow used for the hydraulic analysis of this report.

Peak Wet Weather Flow = Peak Dry Weather Flow x 1.0 (City PWW factor)

Example of PDWF calculation for proposed CP4 building

PWWF = 36 gpm = 36 (gpm) x 1.0

IV. METHODOLOGY

Pipe Sizing

The City of San Diego requires any sewer main servicing a commercial, industrial, or high-rise building area to be at least 10 inches. This development primarily being commercial will require the minimum 10-inch sewer main. Using the PDWF calculated above and manning's equation, the proposed pipeline can accurately be sized. The City of San Diego requires any sewer main 15 inches or smaller to be less than half full during peak wet weather flows.

A new sewer manhole will be placed along the existing sewer main North of the cul-de-sac of Campus Point Court and will intercept the new and existing flows coming from the west and south respectively and divert the flow along the new easterly 12-inch PVC pipe. The proposed pipe alignment upstream of the intercepting manhole will be 10 inches while the proposed pipe realignment downstream will be 12 inches. Using the Peak Wet Weather Flow, calculated in Section III of this report, the pipe size was designed using Manning's equation.

$$Q = k / n * [A * (R_h)^{2/3} * S^{½}]$$

For Manning's equation, the following values and variables are defined.

K (unit conversion factor) = 1.49
n (Manning's coefficient) = 0.013 (Section 1.3.3.1 Sewer Design)
S (slope) = 0.5%, 0.8%, and ≥ 1% where needed
A (Area) = varies with diameter
R_h (hydraulic radius) = varies with depth of flow

Area and hydraulic radius were calculated based on diameter, wetted perimeter and wetted area of the flow. All sewer mains were designed to a minimum 2 fps, if possible. If 2 fps cleansing velocity was not possible then the pipe will be designed to have a minimum 1% slope. OpenFlows FlowMaster was then used to verify the flows for each of the pipe segments calculated through the City of San Diego Sewer Study Summary table.

Impact to Existing Sewer System

According to section 1.7.1 of the City of San Diego Sewer Design Guide 2015, "the downstream shall be studied to the point in the system where the projected peak wet weather flow from the proposed new development is less than 10% of the total flow." The total flow of the existing 15-inch pipe, which is the sewer main that will capture the existing on and off-site sewer flow a s well as the new proposed on-site sewer flow, was used for this analysis. The existing flows were determined in the sewer study previously done for Campus Point SDP revised June 23, 2016. These existing flows were then modified to reflect the changes that Campus NDP is proposing.

V. Hydraulic Analysis

Wastewater Generation per Building

The compiled table of the flow rates for each of the proposed buildings is listed in the Table V-2 below. These calculations were based on the equations presented in Section III of this report.

Table V-2 Wastewater Generation per building

BUILDING	Building Size Square Feet	Net Acres[1]	Number of floors per building	Population per DU[2]	Average Dry Weather flow GPD[3]	Average Dry Weather Flow GPM	Peaking factor[4]	Peak Dry Weather Flow GPM	Wet Weather Flow Factor[5]	Peak Wet Weather Flow GPM
Proposed										
CP3	103559	2.377	4.0	416	33245	23.1	2.80	65	1	65
CP4	210607	0.967	5.0	211	16903	11.7	3.07	36	1	36
CP5	165791	0.761	5.0	166	13306	9.2	3.17	29	1	29
CP6	136500	0.783	4.0	137	10955	7.6	3.25	25	1	25
CP7	211792	0.695	7.0	212	16998	11.8	3.07	36	1	36

Notes:
1 Net Acre here is of the buildings not the drainage basin, streets, or lots.
2 Conversion factor from City of San Diego Sewer Design Guideline May 2015 Table 1-1 " City of San Diego Sewer Design Guide Desnity conversions"
3 80 gpcpd based on City of San Diego Sewer Design Guideline section 1.3.2.2
4 Peaking factor was calculated using the formula found on Figure 1-1 of the sewer design guide. The equation is derived from Holmes & Narver, 1960.
5 City of San Diego recommeded a Wet Weather Factor of 1.0

Pipe Sizing

The sewer main that will capture all the new facilities starting from proposed manhole (MH) 1 was calculated to have a diameter of 10 inches. Then at the proposed intercepting MH, North of Campus Point Court, the proposed pipeline will transition to 12 inches intercepting the existing 12-inch VCP and the proposed 10-inch pipe. All the pipe segments meet or are close to meeting the minimum 2 fps. The sewer study summary table summarizes that none of the proposed pipes will have any fatal issues with their pipe size. All pipes remain under half capacity, not exceeding a d/D of 0.21 for any proposed pipe segment.

Impact to Existing Sewer Mains

The proposed flow rate was compared to the existing system to assess if the flow rate would impact the downstream main by more than 10% of the existing flows. The proposed impact was determined to be the difference between the total flow from the analysis of 2016 and the total flow produced with updates to the existing buildings as some are being either demolished or replaced by parking garages which will not produce a sewer flow. The existing system from the 2016 Study had a peak wet weather flow of 400,294 gpd, while the total dry weather flow for 2020 is 542,322 gpd. The difference between this flow is 142,028 gpd and would be the net impact of the changes to the existing system. This net impact of 142,028 gpd was then compared to the 400,294 gpd of the existing system to give us a percentage. The proposed onsite

PWWF is 35% of the total existing flow. This exceeds the maximum set by the City of San Diego by 25%. Exceeding the 10% requires further investigation of the existing downstream system, through metering, so that the city can determine if the main will need to be upgraded to handle the increase flows. The proposed pipe connects to the existing 12" VC pipe on Campus Point Dr. prior to connecting to the 15" VC pipe. At half full the existing 12" with a 1% slope can have up to 1.78 cfs which is greater than the total proposed peak wet weather flow of 0.837 cfs. At half full, the existing 15" can have up to 3.23 cubic feet per second (cfs) at a 1% slope, while the proposed onsite total peak wet weather flow generates only 0.23 cfs. Sewer flow would need to be metered or received from the City to provide more information on verification of the impacts to the existing system. The metered flow would provide clarification if the 15" sewer main will need to be upgraded or not.

VI. CONCLUSION & RECOMMENDATIONS

All proposed mains will meet either the cleansing velocity of 2 fps or the minimum 1% design slope. However, a design deviation is required for proposed sewer manholes 7, 8, 9, and 10 which are exceeding the maximum depth of 15 feet (ft) below ground surface (bgs) required by section 2.2.1.5 of the Sewer Design Guide. Sewer manholes 7, 8, 9, and 10 are 17.6 ft, 19.6 ft, 19.1 ft, and 15.9 ft respectively. According to Section 2.2.2.3 of the Sewer Design Guide the proposed pipe segments from MH 7 until MH 10 may be constructed using SDR 18 PVC pipe in lieu of a soils report.

The impacts to existing sewer mains portion of the hydraulic analysis show the need of upsizing the downstream 15" VC sewer main. However, metering would be required to confirm if the downstream 15" main would have to be upgraded.

All sewer utilities within public right-of-way shall be designed in accordance with the current City of San Diego Water Design Guide and Standards.

APPENDIX A – Wastewater Generation,
SEWER STUDY SUMMARY
AND EXISTING CAPCACITY ANALYSIS TABLES

Campus Point - Sewer Study Summary

Sheet 1 of 1

Date 6/30/2020

REFER to Sewer Layout - Appendix C

For:

WBS NO.

By:

Line	From	To	Population Per D.U.'s	In-line D.U.'s	Population Served: In-Line	Population Served: Cumulative Total	Sewage Per Capita Per Day (GPD)	Average Dry Weather Flow (GPD)	Dry Weather Peaking Factor	Wet Weather Peaking Factor	Peak Wet Weather (Design Flow) (mgd)	Peak Wet Weather (Design Flow) (cfs)	In-Line Diameter (D) (in)	Upstream Invert	Downstream invert	Pipe Length (ft)	Design Slope (%)	dn (in)	dn (ft)	Ratio (dn/D)	Velocity (ft/s)	Remarks
P-1	MH1	MH2	3.5	0	211	211	80	16903	3.07	1.0	0.05	0.080	10	292.63	290.70	176.00	1.1%	1.30	0.11	0.13	1.93	
P-2	MH2	MH3	3.5	0	166	378	80	30208	2.84	1.0	0.09	0.133	10	290.70	288.00	263.00	1.0%	1.70	0.14	0.17	2.16	
P-3	MH3	MH4	3.5	0	0	378	80	30208	2.84	1.0	0.09	0.133	10	288.00	285.30	258.00	1.0%	1.70	0.14	0.17	2.16	
P-4	MH4	MH5	3.5	0	137	515	80	41164	2.72	1.0	0.11	0.173	10	285.30	282.69	258.00	1.0%	1.90	0.16	0.19	2.40	
P-5	MH5	MH 6	3.5	0	212	727	80	58161	2.60	1.0	0.15	0.234	10	282.69	277.28	98.00	5.5%	1.50	0.13	0.15	4.56	
P-6	MH6	MH7	3.5	0	0	727	80	58161	2.60	1.0	0.15	0.234	12	277.28	276.53	152.00	0.5%	2.50	0.21	0.21	1.97	
P-7	MH7	MH8	3.5	0	0	727	80	58161	2.60	1.0	0.15	0.234	12	276.53	275.08	266.00	0.5%	2.50	0.21	0.21	1.97	
P-9	MH9	MH10	3.5	0	0	727	80	58161	2.60	1.0	0.15	0.234	12	277.28	272.54	189.00	0.5%	2.50	0.21	0.21	1.97	
EX 12" Pipe [1]	MH 10	EX MH	3.5	0	415	2858	80	228641	2.37	1.0	0.54	0.838	12	276.53	273.37	189.00	0.84%	4.10	0.34	0.34	3.54	
EX 15" Pipe [1]	EX MH	UNK	3.5	0	0	2858	80	228641	2.37	1.0	0.54	0.838	15	275.08	274.15	189.00	1.0%	3.60	0.30	0.24	3.70	

Notes

1.) The existing system has an additional existing flow accounted for in a previous report (2015 Tomlinson) which is also included in the cumulative total for population served column.

Comparison of Existing 15" Sewer Main Flow to Additional Proposed Flow					
Source of Flow	**Population per DU**	**Population Served In-Line**	**Population Served Total**	**Sewage Per Capita/Day (gdp)**	**Total Peak Wet Weather Flow (gdp)**
BUILDING A (To be replaced with CP3)	3.5	0	0	80	0
Parking G2 (Building B)	0	0.0	0	80	0
BUILDING C	3.5	101.0	101	80	8080
BUILDING D	3.5	120.0	221	80	17680
BUILDING E	3.5	101.0	322	80	25760
BUILDING F	3.5	123.0	445	80	35600
Parking G3 (Building G)	0	0.0	445	80	35600
Parking G1 (Building H)	0	0.0	445	80	35600
BUILDING I	3.5	72.0	517	80	41360
Planned for Demo (Building J)	0	0	517	80	41360
BUILDING K	3.5	111.0	628	80	50240
BUILDING L	3.5	50.0	678	80	54240
BUILDING M	3.5	266.0	944	80	75520
BUILDING N	3.5	189.0	1133	80	90640
OFFSITE SYSTEM A	3.5	186.0	1319	80	105520
OFFSITE SYSTEM B	3.5	210.8	1530	80	122384
EXISTING ONSITE[1]	3.5	186.0	1716	80	318490
2020 PROPOSED ONSITE[2]	3.5	1142.6	1142	80	223832
				Total Flow (2016)[3]	400294
				Total Flow (2020)	542322
				Net impact to the Existing system	142028

Proposed flow as a percentage of total existing 2016 flow	35%

Notes:

1.) The Existing Onsite flow rate had the peaking factors 1 (PWWF) and 2.32 (PDWF) applied to the average dry weather flow to get the value 318490

2.) The 2020 Proposed Onsite flow rate had the peaking factors 1 (PWWF) and 2.45 (PDWF) applied to the average dry weather flow to get the value 223048

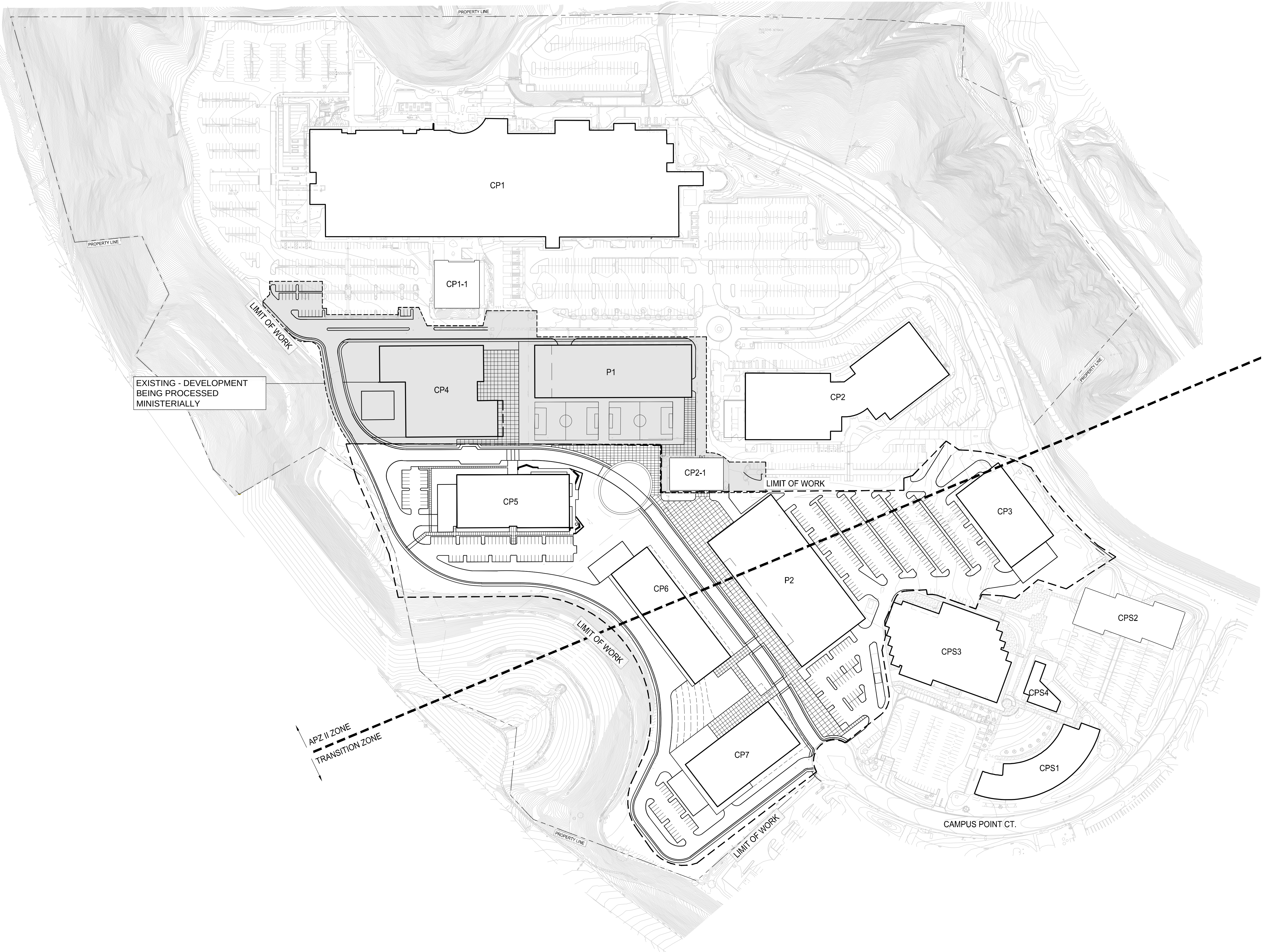
3.) The Total Flow (2016) rate had the peaking factors 1 (PWWF) and 2.23 (PDWF) applied to the average dry weather flow to get the value 400294

Previous Comparison of existing 15" sewer main flow to additional proposed flow					
Source of Flow	**Population per DU**	**Population Served In-Line**	**Population Served Total**	**Sewage Per Capita/Day (gdp)**	**Total Avg. Dry Weather Flow (gdp)**
BUILDING A	3.5	117	117	80	9360
BUILDING B	3.5	155.0	272.0	80	21760
BUILDING C	3.5	101.0	373.0	80	29840
BUILDING D	3.5	120.0	493.0	80	39440
BUILDING E	3.5	101.0	594.0	80	47520
BUILDING F	3.5	123.0	717.0	80	57360
BUILDING G	3.5	88.0	805.0	80	64400
BUILDING H	3.5	92.0	897.0	80	71760
BUILDING I	3.5	72.0	969.0	80	77520
BUILDING J	3.5	76.0	1045.0	80	83600
BUILDING K	3.5	111.0	1156.0	80	92480
BUILDING L	3.5	50.0	1206.0	80	96480
BUILDING M	3.5	266.0	1472.0	80	117760
BUILDING N	3.5	189.0	1661.0	80	132880
OFFSITE SYSTEM A	3.5	186.0	1847.0	80	147760
OFFSITE SYSTEM B	3.5	210.8	2057.8	80	164624
EXISTING ONSITE	3.5	186.0	2243.8	80	179504

2016 PROPOSED ONSITE	3.5	113.5	113.5	80	9080

Proposed flow as a percentage of total existing flow	0.05

APPENDIX B – CAMPUS POINT MASTER PLAN



OVERALL SITE PLAN | 01

LPA

ARCHITECTURE ENGINEERING INTERIORS
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NOT FOR REGULATORY APPROVAL, PERMITTING OR CONSTRUCTION

Campus Point Master Plan
Neighborhood Development Permit

CAMPUS POINT COURT
SAN DIEGO, CA 92121

Developed for:
ALEXANDRIA REAL ESTATE EQUITIES, INC.

Revision	Date

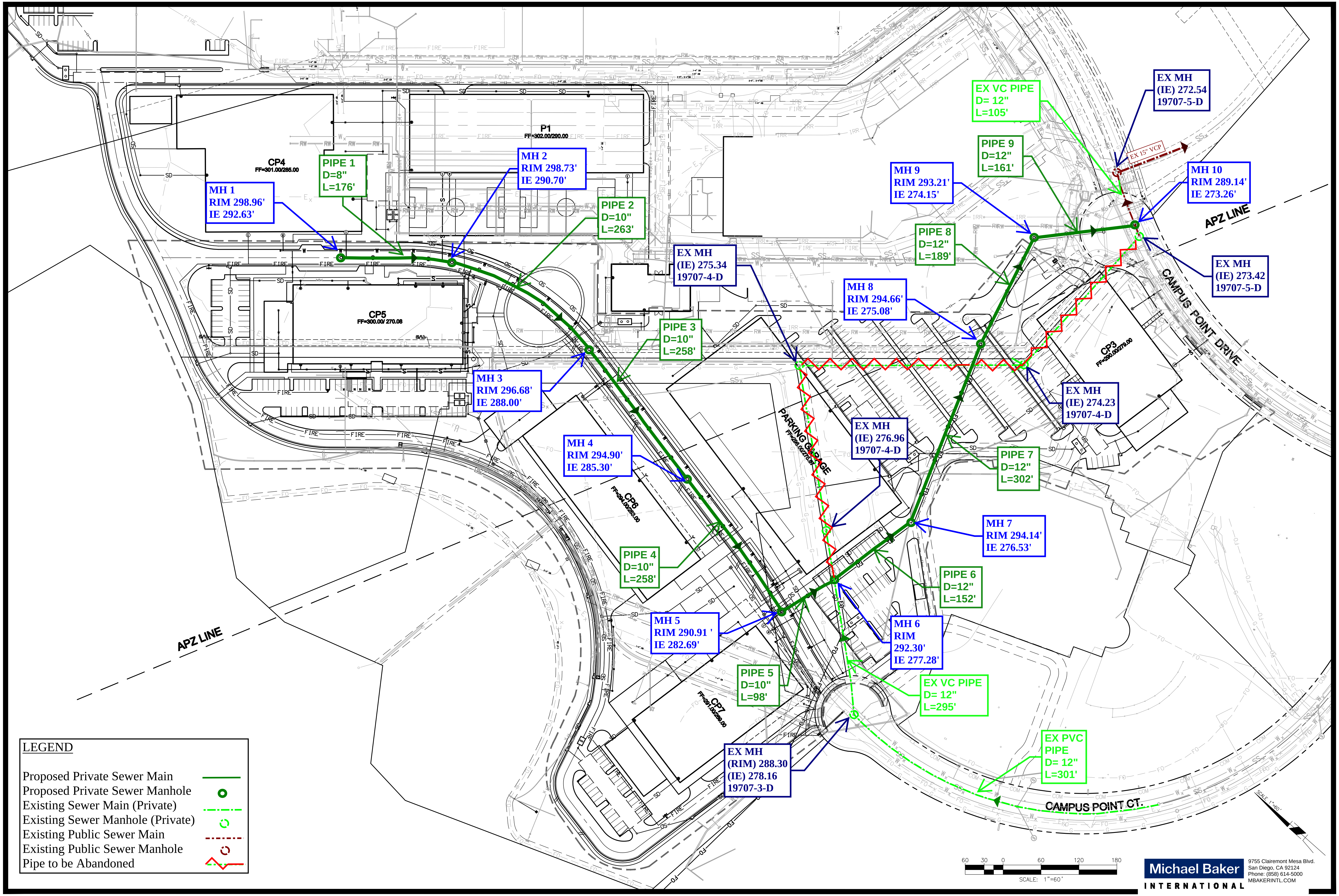
Submittal	Date
NDP - 1ST CITY SUBMITTAL	11/01/2019
NPD - 2ND CITY SUBMITTAL	01/31/2020

Job Number	19125.20
Date Published	01.31.2020
Checked By	AG, CKA
Scale	1" = 80'-0"

OVERALL SITE PLAN

L0.01

APPENDIX C – SEWER LAYOUT



CP4
FF=301.00/285.00
P1
FF=302.00/290.00
CP5
FF=300.00/ 270.08
CP6
CP7
CP3
PARKING GARAGE
MH 1
RIM 298.96'
IE 292.63'
PIPE 1
D=8"
L=176'
MH 2
RIM 298.73'
IE 290.70'
PIPE 2
D=10"
L=263'
MH 3
RIM 296.68'
IE 288.00'
PIPE 3
D=10"
L=258'
MH 4
RIM 294.90'
IE 285.30'
PIPE 4
D=10"
L=258'
MH 5
RIM 290.91 '
IE 282.69'
PIPE 5
D=10"
L=98'
MH 6
RIM
292.30'
IE 277.28'
PIPE 6
D=12"
L=152'
MH 7
RIM 294.14'
IE 276.53'
PIPE 7
D=12"
L=302'
MH 8
RIM 294.66'
IE 275.08'
PIPE 8
D=12"
L=189'
MH 9
RIM 293.21'
IE 274.15'
PIPE 9
D=12"
L=161'
MH 10
RIM 289.14'
IE 273.26'
EX MH
(IE) 275.34
19707-4-D
EX MH
(IE) 276.96
19707-4-D
EX MH
(IE) 274.23
19707-4-D
EX MH
(IE) 273.42
19707-5-D
EX MH
(IE) 272.54
19707-5-D
EX MH
(RIM) 288.30
(IE) 278.16
19707-3-D
EX VC PIPE
D= 12"
L=105'
EX VC PIPE
D= 12"
L=295'
EX PVC
PIPE
D= 12"
L=301'
EX 15" VCP
APZ LINE
APZ LINE
CAMPUS POINT DRIVE
CAMPUS POINT CT.
LEGEND
Proposed Private Sewer Main
Proposed Private Sewer Manhole
Existing Sewer Main (Private)
Existing Sewer Manhole (Private)
Existing Public Sewer Main
Existing Public Sewer Manhole
Pipe to be Abandoned
60 30 0 60 120 180
SCALE: 1"=60'
Michael Baker
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San Diego, CA 92124
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APPENDIX D – CITY OF SAN DIEGO DESIGN GUIDELINES

format shown on Figure 1-2.

Equivalent Population: The equivalent population shall be calculated from zoning information (Ref. Section 1.6). For major new facilities such as high rise apartment buildings, flow rates (assuming one lateral) shall be checked based on the most current, adopted edition of the Uniform Plumbing Code. The most conservative flow rate shall govern.

Daily Per Capita Sewer Flow: The sewer flow for the equivalent population shall be 80 gallons per capita per day (gpcd).

Average Dry Weather Flow (ADWF): Equivalent populations shall be used to calculate the average dry weather flow. The average dry weather flow for each sewer main reach (manhole to manhole) shall be determined by multiplying the total accumulated equivalent population contributing to that reach by 80 gallons per capita per day:

Average Dry Weather Flow = (80 gpcpd) x (Equivalent Population)

Peaking Factor for Dry Weather Flow (PFDWF): The peaking factor is the ratio of peak dry weather flow to average dry weather flow. It is dependent upon the equivalent population within a tributary area. The tributary area is the area upstream of, and including, the current reach for the total flow in each reach of pipe. Figure 1-1, consisting of the table prepared by Holmes and Narver in 1960, shall be used to determine peaking factors for each tributary area. In no instance shall the dry weather flow peaking factor be less than 1.5.

Peak Dry Weather Flow (PDWF): The peak dry weather flow for each sewer main reach shall be determined by multiplying the average dry weather flow by the appropriate peaking factor (Note that peak dry weather flows are not algebraically cumulative as routed through the sewer system, i.e. the peak dry weather flow at any point shall be based on the equivalent population in the basin to that point (Ref. Figure 1-2).

Peak Dry Weather Flow = (Average Dry Weather Flow) x (Dry Weather Flow Peaking Factor)

Peaking Factor for Wet Weather Flow (PFWWF): The peaking factor for wet weather flow is the ratio of peak wet weather flow to peak dry weather flow. It is basin-specific and shall be based on essential information available at the time of the planning study. Information such as historical rainfall/sewage flow data, land use, soil data, pipe/manhole age, materials and conditions, groundwater elevations (post development), inflow and infiltration (I/I) studies, size, slope and densities of the drainage basin, etc., should be utilized in the wet weather analysis to estimate the peaking factor for wet weather. Upward adjustments shall be made in areas with expected high inflow and infiltration (i.e. high ground water or in areas with lush landscaping schemes). Flow meters are installed throughout the City's sewer system. Flow data collected from these meters are available upon request. The objective of this analysis is to quantify the magnitude of peak wet weather flow with a 10-year return period on a statistical basis.

The Senior Civil Engineer overseeing the preparation of the planning study shall coordinate with the City Sewer Modeling Group for approval of the peaking factors to be used for design.

<u>Peak Wet Weather Flow (PWWF)</u>: The peak wet weather flow (or design flow) for a gravity sewer main reach shall be determined by multiplying the peak dry weather flow (ref. Figure 1-2) by the appropriate wet weather peaking factor. The peak wet weather flow is the design flow for a gravity sewer main. It is determined at any point in the system based on the associated upstream average dry weather flow in the basis to that point times the peaking factor for wet weather.

Peak Wet Weather Flow = (Peak Dry Weather Flow) x (Wet Weather Peaking Factor)

1.3.3 Pipe Sizing Criteria

1.3.3.1 Hydraulic Requirements

Manning's formula for open-channel flows shall be used to calculate flows in gravity sewer mains. Manning's coefficient of roughness "n" shall be assumed to be 0.013 for all types of sewer pipe. Sewer grades shall be designed for velocities of 3 to 5 feet per second (fps) where possible. This is extremely important in areas where peak flow will not be achieved for many years. The minimum allowable velocity is 2 fps at calculated peak dry weather flow, excluding infiltration. Sewer mains that do not sustain 2 fps at peak flows shall be designed to have a minimum slope of 1 percent. Additional slope may be required by the Senior Civil Engineer where fill of varied depth is placed below the pipe in order to provide adequate slope after expected settlement occurs. The maximum allowable velocity shall be 10 fps and shall be avoided by adjusting slopes, by increasing the pipe diameter, or by utilizing a vertical curve transition to lower velocities per subsections 2.2.4 and 2.2.9.4. If the Senior Civil Engineer approves a velocity greater than 10 fps, the pipe shall be upgraded to SDR 18 PVC (standard dimension ratio polyvinyl chloride), concrete-encased VC (vitrified clay), or PVC sheet-lined reinforced concrete pipe.

1.3.3.2 Slope

Slope shall be calculated as the difference in elevation at each end of the pipe divided by the horizontal length of the pipe, and shall be a constant value between manholes.

1.3.3.3 Ratio of Depth of Flow to Pipe Diameter (d_n/D)

New sewer mains 15 inches and smaller in diameter shall be sized to carry the projected peak wet weather flow at a depth not greater than half of the inside diameter of the pipe (d_n/D not to exceed 0.5). New sewer mains 18 inches and larger shall be sized to carry the projected peak wet weather flow at a depth of flow not greater than 3/4 of the inside diameter of the pipe (d_n/D not to exceed 0.75).

1.3.3.4 Minimum Pipe Sizes

The size of a sewer pipe is defined as the inside diameter of the pipe. Sewer mains shall be a minimum of 8 inches in diameter in residential areas, and a minimum of 10 inches in commercial, industrial, and high-rise building areas.

1.3.4 Sewer Study Exhibit Criteria

The DESIGN ENGINEER’s sewer study exhibits shall be used to evaluate hydraulics and to establish minimum street and easement widths. Therefore, these documents need to reflect depths and separation of mains from other utilities and improvements. Refer to the Minimum Intake Standards for Sewer Studies in Subsection 1.8.

1.3.5 Private On-Site Wastewater Treatment and Reuse

Refer to Attachment 6 for permitting guidelines of private on-site wastewater treatment and reuse in the City of San Diego.

1.4 SEPARATION OF MAINS

1.4.1 Horizontal Separation

1.4.1.1 Wet Utilities

The separation of water, sewer, reclaimed water mains, and storm drains shall comply with the *State of California Department of Health Services Criteria for the Separation of Water Mains and Sanitary Sewers*. At least 10 feet of horizontal separation shall be maintained between the nearest outer surfaces of sewer lines and potable water mains. More stringent separation requirements population for a given land use. These tabulated figures represent a general case analysis. When more accurate or detailed information, such as fixture unit counts, is available, Table 1-1 shall not be used. For more information on the requirements of the zones shown in Table 1-1, refer to Chapter 13 of the City of San Diego Municipal Code.

1.7 REQUIRED CAPACITY IN EXISTING SEWER SYSTEMS DOWNSTREAM OF NEW FACILITIES

1.7.1 Required Capacity Downstream of New Gravity Sewers

For a new development, the projected peak wet weather flow from the proposed system (ref. Subsection 1.3.2.2) will be added to the field measured maximum flow in the downstream sewer to determine if the projected d_n/D is in compliance with the depth criterion described in Subsection 1.3.3.3. If this criterion is not met, a comprehensive sewer study of the area shall be prepared.

The downstream system shall be studied to the point in the system where the projected peak wet weather flow from the proposed new development is less than 10% of the total flow. All sewers to this point are required to carry the total flow per the depth criterion described in the above paragraph. The existing system to be studied shall not be less than two pipe reaches (i.e. manhole to manhole) from the point of discharge of the new development into the existing system.

1.7.2 Required Capacity Downstream of New Pump Stations

In developed lands, the discharge of the pump station design capacity from the proposed new development will be added to the field measured maximum flow in the existing downstream sewer to determine if the projected d_n/D will comply with the depth criteria described in Subsection 1.3.3.3. If these criteria are not met, a comprehensive sewer study of the area shall be prepared.

The sewer system downstream of the pump station shall be designed for cyclical pumping operation (i.e. on-off pumping). Use the design discharge capacity of the pump station for the tributary area. As a rule of thumb, the cyclical effect in single family residential may be considered negligible when the pump station’s discharge is less than 10% of the total flow. For other density types consult with the Senior Engineer. All sewers to this point are required to carry the total flow per the depth criterion described in the above paragraph. The proposed new system shall discharge at a point not less than two pipe reaches (i.e. manhole to manhole) away the existing system.

TABLE 1-1
CITY OF SAN DIEGO SEWER DESIGN GUIDE
DENSITY CONVERSIONS (Continued)

Zone	Maximum Density (DU / Net Ac)	Population Per DU	Equivalent Population (Pop/Net Ac)
Schools/Public	8.9	3.5	31.2
Offices	10.9	3.5	38.2*
Commercial/Hotels	12.5	3.5	43.7*
Industrial	17.9	3.5	62.5*
Hospital	42.9	3.5	150.0*

Figures with asterisk (*) represent equivalent population per floor of the building.

Definitions:
DU = Dwelling Units
Ac = Acreage
Pop = Population

Net Acreage is the developable lot area excluding areas that are dedicated as public streets in acres. Gross Area is the entire area in acres of the drainage basin, including lots, streets, etc.

For undeveloped areas, assume Net Acreage = 0.8 x Gross Area in Acres

For developed areas, calculate actual Net Acreage.

Tabulated figures are for general case. The tabulated figures shall not be used if more accurate figures are available.

Population is based on actual equivalent dwelling units (EDU) or the maximum estimate obtained from zoning.

Conversion of Fixture Units to Equivalent Dwelling Units (EDU): The Water Meter Data Card, maintained by the Development Services Department, contains a table of plumbing fixtures that should be used for determining the equivalent dwelling units (EDU's) for the purpose of estimating the rate of wastewater generation in residential, commercial, or industrial areas. Currently, the basis for conversion is: 20 fixtures = 1 EDU and 1 EDU = 280 gallons of wastewater per day.

In high rise building areas, flow rates shall be based on the most current, adopted edition of the applicable Plumbing Code, assuming one lateral per area. The most conservative flow rate shall govern.

PUBLIC UTILITIES DEPARTMENT

PEAKING FACTOR FOR SEWER FLOWS
(Dry Weather)

Ratio of Peak to Average Flow*
Versus Tributary Population

Population	Ratio of Peak to Average Flow	Population	Ratio of Peak to Average Flow
200	4.00	4,800	2.01
500	3.00	5,000	2.00
800	2.75	5,200	1.99
900	2.60	5,500	1.97
1,000	2.50	6,000	1.95
1,100	2.47	6,200	1.94
1,200	2.45	6,400	1.93
1,300	2.43	6,900	1.91
1,400	2.40	7,300	1.90
1,500	2.38	7,500	1.89
1,600	2.36	8,100	1.87
1,700	2.34	8,400	1.86
1,750	2.33	9,100	1.84
1,800	2.32	9,600	1.83
1,850	2.31	10,000	1.82
1,900	2.30	11,500	1.80
2,000	2.29	13,000	1.78
2,150	2.27	14,500	1.76
2,225	2.25	15,000	1.75
2,300	2.24	16,000	1.74
2,375	2.23	16,700	1.73
2,425	2.22	17,400	1.72
2,500	2.21	18,000	1.71
2,600	2.20	18,900	1.70
2,625	2.19	19,800	1.69
2,675	2.18	21,500	1.68
2,775	2.17	22,600	1.67
2,850	2.16	25,000	1.65
3,000	2.14	26,500	1.64
3,100	2.13	28,000	1.63
3,200	2.12	32,000	1.61
3,500	2.10	36,000	1.59
3,600	2.09	38,000	1.58
3,700	2.08	42,000	1.57
3,800	2.07	49,000	1.55
3,900	2.06	54,000	1.54
4,000	2.05	60,000	1.53
4,200	2.04	70,000	1.52
4,400	2.03	90,000	1.51
4,600	2.02	100,000+	1.50

***Based on formula:** **Peak Factor = $6.2945 \times (pop)^{-0.1342}$**
(Holmes & Narver, 1960)

FIGURE 1-1

SEWER STUDY SUMMARY

SHEET___OF ___
DATE: _____________
REFER TO PLAN SHEET_____

FOR:_________________________
WBS NO._________________________________ **BY:_________________________**

Line	From	To	Population Per D.U.'s	In-Line D.U.'s	Population Served		Sewage Per Capita Per Day (gpd)	Average Dry Weather Flow	Dry Weather Peaking Factor (1)	Peak Dry Weather Flow	Wet Weather Peaking Factor (2)	Peak Wet Weather Flow (Design Flow)		Line Diameter (D) (in)	Design Slope (%)	dn (ft)	dn/D	Velocity (ft/s)	Remarks
					In-Line	Cumulative Total						mgd	cfs						

Note 1: Sewer Design Guide, Refer to Subsection 1.3.2.2 for definition of Dry Weather Peaking Factor.
Note 2: Sewer Design Guide, Refer to Subsection 1.3.2.2 for definition of Wet Weather Peaking Factor.

SEWER STUDY SUMMARY
FIGURE 1-2

2.2.1.3 Traffic Loads, Dead Loads, and Other Loads

The DESIGN ENGINEER shall pay special attention to the design of sewer pipes from the standpoint of traffic loads, dead loads, embankment loads, and other loads that the pipes may be subjected to during their design life. Pipes that are located in 100-year flood area or below the groundwater table shall be reviewed for hydrostatic uplift.

To avoid adverse effects on pavement sections, deflection of shallow mains (with less than 4 feet cover) shall be minimized by special design as required by the Senior Civil Engineer.

2.2.1.4 Concrete Encasement/Casing

a. Special design including reinforced concrete encasement, casing/outer pipe, or a combination of these methods may be required by the Senior Civil Engineer. (Ref. Subsection 2.2.1.3).

b. Polyvinyl chloride (PVC) pipe shall not be used with concrete encasement or concrete cradle.

c. Reinforced concrete encasement may be required where landscaping may cause root intrusion.

d. Only extra strength vitrified clay pipe or ductile iron pipe shall be used with concrete encasement. However, this does not preclude the placement of “lean” concrete backfill above the limits of the rock envelope when using PVC pipe.

2.2.1.5 Depth of Mains

a. **Cover** is defined as the vertical distance from the finished grade to the top of the sewer main. **Depth** is defined as the distance between invert and finished grade of the sewer main.

b. Sewer pipes shall be designed to achieve a cover of 7 to 9 feet wherever possible.

c. Mains with a depth of 15 feet or greater shall require a Design Deviation Request (ATTACHMENT 2) submitted for approval by the Senior Civil Engineer.

d. In addition, mains deeper than 20 feet, or mains 15 feet deep with laterals, shall require special approval from the Public Utilities Department, Wastewater Collection Division Senior Civil Engineer.

e. Design Deviations for depth will only be approved in exceptional cases and when adequate justification is provided.

f. No lateral connections will be allowed on mains that exceed 15 feet in depth. In those cases where mains are permitted to exceed 15 feet in depth, and lateral connections are necessary, a parallel collector sewer shall be required at standard depths to serve the lots.

g. In open space areas, the standard depth of mains shall be 4 to 5 feet, assuming there are no lateral connections, or as topography allows. Where lateral connections are necessary, the main depth shall be as necessary to accommodate the lateral depths and the contours of the land. The DESIGN ENGINEER shall provide sufficient depth and/or special design at stream bed crossings and other locations to assure protection from erosion.

h. Where a future building will be located adjacent to a new main, the depth of the main shall be coordinated with other utilities so that there will be no conflicts with the future sewer lateral.

2.2.1.6 Shallow Mains

Shallow mains require special designs (refer to Subsection 1.4.2.1). For mains with less than 4 feet of cover, special design shall be required for dead load and linear deflections which shall include evaluation of pavement section deflections.

Lined and coated ductile iron pipe or steel pipe may be used in shallow applications. If concrete encasement is not required for structural purposes, pipe corrosion prevention requirements shall apply. Refer to Chapter 6 - Corrosion Control, for pipe lining and coating requirements.

2.2.1.7 Depth of Dead-End Mains

Dead-end mains with the potential for future extension shall not be less than 7 feet in depth at the dead-end, and shall not preclude any property in the upstream basin from obtaining sewer service. Deviations from such criteria shall require approval by the Senior Civil Engineer. Grades shall be as uniform as practical. For manhole requirements at dead-end mains, refer to Subsection 2.3.1.6.

2.2.1.8 Redundant Sewers

Redundancy in the sewer system shall be provided if a sewer would be located where it would preclude by-pass pumping in the event of a main failure or stoppage. Examples would be where a sewer crosses railroad tracks that

DEVIATION FROM STANDARDS (DESIGN ONLY)

CITY ENGINEER

DRAWING NUMBER(S):	DSD PROJECT NUMBER:	WBS OR IO NUMBER(S):

PROJECT TITLE/DESCRIPTION:

PROJECT LOCATION(S):

PLACE RCE STAMP OF EOR HERE

ENGINEER OF RECORD: ______________________________
(EOR) (Print Name)

______________________ ______________ ______________
(Signature) (RCE NUMBER) (Date)

STANDARDS DEVIATING FROM (e.g. 2018 Greenbook Section; 2018 Standard Drawing SDG-133 Curb Ramps Type A and B):

LOCATIONS OF DEVIATION(S) (Street names/intersections or facility locations):

DESCRIPTION OF DEVIATION(S):

The City of SAN DIEGO	DEVIATION FROM STANDARDS (DESIGN ONLY)	CITY ENGINEER

REASON(S) FOR DEVIATION(S):

MITIGATION MEASURES FOR DEVIATION:

SEE ATTACHED SHEETS (e.g. D sheets, photos or sketches) PROVIDE SHEET NUMBERS WITH DESCRIPTIONS.:

REVIEWED BY:
DESIGN/PLAN CHECK ENGINEER:______________________________
(Print Name)

______________________________ ______________
(Signature) (Date)

APPROVED BY:
DEPUTY CITY ENGINEER (DCE): ______________________________
(Print Name)

______________________________ ______________
(Signature) (Date)