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September 11, 2023

Mr. Alexander Yuen
Engineer II
City of Daly City
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Daly City, California 94015

160030-002

Subject: Hydraulic Analysis for the 455 Hickey Boulevard Redevelopment Project

Dear Mr. Yuen:

In accordance with the Agreement for Consulting Services dated December 8, 2022, between the City of Daly City (Daly City) and Brown and Caldwell (BC), we are pleased to submit this letter report for your review and use. This report documents the hydraulic analysis performed to determine ability of the water system to deliver domestic and fire flow demands to the proposed 455 Hickey Boulevard Redevelopment Project (Site) in Daly City.

The purpose of this analysis was to answer the following three questions:

1. Can the existing Daly City water system adequately supply the required domestic, irrigation, and fire demand to the Site?
2. What size pipes are necessary to connect the Site to the Daly City water system?
3. How many hydrants are needed to provide fire protection for the Site?

Based on the analysis described later in this report, we can make the following three conclusions:

1. The existing Daly City water system with the proposed upgrades can adequately supply the future building domestic, irrigation, and fire service demands while meeting the pressure, velocity, and head loss criteria.
2. Three new laterals are needed for the domestic, irrigation, and fire service connections between the Site and the Daly City water system. To comply with the minimum pressure and pipe size requirements, upsize approximately 750 ft of the existing 6-inch-diameter water main in Serravista Avenue to an 8-inch-diameter water main (See Figure 1, Table 4, and 6).
3. BC estimated that one new hydrant is needed to meet the fire code requirements based on the reduced fire-flow. The project fire protection engineer shall coordinate and obtain approval from NCFA regarding the actual number, spacing, and location of the new fire hydrants.

City of Daly City
Hydraulic Analysis
455 Hickey Boulevard
Redevelopment Project

Figure 1
Existing and Proposed Water System

455 Hickey Project
Hyd 38
Hyd (New)
FS Lateral
Domestic W (Irrigation Not Shown)
Hyd 39
Upsizing approx. 750' of 6" to 8" W

Legend

Junction
- (All Modeled Facilities)
- (Project Specific Facilities)
- (Inactive Facilities)

Pipe (Diameter, In)
- <=4
- 6
- 8
- 10
- >=12

Project Area

- Pump
- PRV
- Reservoir
- Water Source
- Existing Hydrant
- New Hydrant

* For new hydrants, actual number, spacing, and location as required by North County Fire Authority.

N

0 100 200
Feet

Service Layer Credits: Light Gray Base: Esri Community Maps Contributors, County of San Mateo, California, California State Parks, © OpenStreetMap, Microsoft, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land

Brown AND Caldwell

Author: Kevin Kai Path: \\bc\corp\PW_Exports\154529 - Daly City Water Sys MP 10-year\03 - Engineering\3_3_Model\DalyCity-2023.aprx

This report describes the analysis performed and presents BC's conclusions. It is important to note that our scope did not include the following activities, and therefore, they are not part of this analysis:

- Surge analysis
- Water quality analysis
- Sizing of the proposed automatic fire-suppression sprinklers system

Site Description

Based on the developer's technical memorandum provided to BC by the City on March 20, 2023, BC understands that the property owner plans to redevelop the existing buildings at 455 Hickey Boulevard. The proposed project consists of the following two potential development scenarios:

- Scenario 1: Medical Office Building (5 levels and 180,000 SF).
- Scenario 2: Tech Office Building (8 levels and 280,000 SF).

It is anticipated the Medical Office Building development scenario will be the worst-case for system demand purposes, therefore, Scenario 1 will be the focus of this hydraulic analysis. The proposed project will require the construction of new domestic water, fire water, and irrigation water lines for the Site. The proposed project is situated in Pressure Zone 5/5B near the boundary between Pressure Zones 5/5B and 6/6B.

A portion of the existing 6-inch-diameter water main between Marbly Avenue and Victoria Street will be relocated from under the sidewalk fronting the Site into the Serravista Avenue roadway. The water main will also be upsized to 8-inches to comply with the Daly City pipe size requirements. All new water service connections for the Site will be connected to the new 8-inch-diameter water main in Serravista Avenue.

Domestic Water Demand

BC calculated the domestic average day potable water demands using the sewage generation unit factor provided by the developer. BC estimated that potable water demand is approximately equal to 110% of the sewage generation. Maximum day and peak hour demands (PHD) were also calculated, and the results are shown in Table 1.

Table 1. Domestic Demands for the Proposed Project

Building	Total Area[a] (ft^2)	Approx. No of Occupants	Unit Water Demands[b,c]	Domestic Demand[d] (gpm)		
				Average Day	Maximum Day (1.5X)	Peak Hour (3.0X)
Scenario 1 - Medical Bldg	180,000	800	0.275 gpsfpd	34.4	51.6	103.2
Scenario 2 - Tech Bldg	280,000	1,245	0.11 gpsfpd	21.4	32.1	64.2
Site Irrigation	29,217	-	2.08 gpsfpm	32.7		

a. *Total building areas of all floor levels within the exterior walls per Developer.*
b. *Unit Water Demands (110% of sewage) and occupants per Developer. Medical Office: 0.275 gpsfpd, Tech Bldg: 0.11 gpsfpd. Irrigation demand estimated based on 1-hour of irrigation per day over the proposed landscape areas.*
c. *gpsfpd = gallons per square foot per day, gpsfpm = gallons per square foot per month*
d. *gpm = gallons per minute.*

Fire Water Demand and Hydrants

North County Fire Authority (NCFA) agreed to the following six assumptions after the project review in May 2023:

1. **Building Construction Type.** To estimate the fire flow requirements, BC assumed a building construction type of I-B for the proposed building.
2. **Automatic Sprinklers.** Per Daly City Municipal Code, the proposed building will have approved National Fire Protection Association (NFPA) 13 automatic sprinklers.
3. **Required Fire Flow.** Table 2 shows the required and reduced fireflow and duration per the 2019 California Fire Code (CFC) Appendix B (Table B105.1(2)) for the proposed building. When the building has an automatic fire protection sprinkler system (Section 903.3.1 CFC), the local fire authority can reduce minimum fire-flow by up to 75 percent but not less than 1,000 gpm. NCFA does not permit reduction of fire flow by more than 50 percent and shall not be reduced to less than 1,500 gpm.
4. **Number of Hydrants.** Per CFC Appendix C (Table C102.1), the proposed building requires 1 hydrant based on the reduced fire-flow due to sprinkler related reduction. Existing fire hydrants that meet the City hydrant spacing requirements (within 300 feet [ft]) and are connected to an 8-inch-diameter or larger water main on public streets can be considered as available, however, there is no existing hydrant that meets these criteria near this project. NCFA shall dictate all new hydrant locations.
5. **Hydrant Spacing.** Required hydrant spacing per Daly City Design Standards (Section 6.02.C): 300 ft between hydrants. NCFA shall dictate final hydrant spacing.
6. **Fire Flow Increases.** NCFA may increase required fire flow demand at its discretion to address concerns regarding wild land or other fire protection related issues.
7. **Distance Between Building and Hydrant.** Daly City Municipal Code (Chapter 15.32.080) requires that no portion of the building is more than 150 feet from a hydrant on a fire apparatus access road, as measured by an approved route around the exterior of the building. NCFA shall dictate all new hydrant locations.

Tables 2 and 3 present the fire flow demands and the sprinkler system demands used for this analysis, respectively. Values in Table 2 reflect the fire flow requirements under the 2019 CFC with provisions for automatic fire sprinklers.

Table 2. Fire Flow Demands for the Proposed Project

Building Area	Building Type, per CBC	Fire-flow Calculation Area[a] (ft^2)	Required Fireflow[b] (gpm)	Reduced Fireflow[c] (gpm)	Flow Duration[d] (hours)	Min. No. of Hydrants[e]
Scenario 1 - Medical Bldg	I-B	108,600	3,500	1,750	2	1
Scenario 2 - Tech Bldg	I-B	108,100	3,500	1,750	2	1

a. Total building areas of all floor levels within the exterior walls. For Type I-A/I-B, it shall be the area of the three largest successive floors. Exception: for open parking garages shall be determined by the area of the largest floor.

b. Required fire flow Per the 2019 California Fire Code, Appendix B. (Table B105.1(2)).

c. Reduced fire flow with an approved automatic sprinkler system Per CFC Table B105.2.

d. Required fire flow duration to be based on the reduced fire flow required Per CFC Table B105.1(2).

e. Required minimum number of hydrants are to be based on the reduced fire flow required per CFC Table C102.1.

Table 3. Fire Sprinkler Demands for the Proposed Project							
Building Area	Sprinkler Type	NFPA 13 Occupancy[b]	Sprinkler Area (ft^2)	Density (gpm/ft^2)	Sprinklers Demands[a] (gpm)	Hose Stream Demands (gpm)	Total Sprinklers System Demands (gpm)
Scenario 1 - Medical Bldg	NFPA 13	Ordinary Hazard 1	1,500	0.15	225	250	475
Scenario 2 - Tech Bldg	NFPA 13	Ordinary Hazard 1	1,500	0.15	225	250	475

a. Sprinkler demand based on density/area curves of 2019 NFPA 13, Figure 19.3.3.1.1 in accordance with the density/area method of 19.3.3.2.

b. NFPA 13 Occupancy classification as directed by NCFA, which may be different from the developer provided information.

Lateral Size and System Upgrade

Based on the developer's proposed utilities plans and hydraulic model simulation results, Table 4 presents the estimated quantity and diameter of the new laterals and system upgrade needed for the domestic, irrigation, and fire services connections.

Table 4. Summary of Proposed Pipe Additions			
Service	Diameter	Estimated Public Water System Quantity	Estimated Private Water System Quantity[a]
Domestic	2.5-inch Pipe	50 ft to meter	N/A
Fire Service	6-inch Pipe	50 ft to backflow assembly	N/A
	6-inch Pipe to Hydrants	150 ft (50-ft per hydrant for 1 new and 2 existing hydrants)	N/A
Irrigation	2-inch Pipe	50 ft to meter	N/A
Upsizing	Existing 6-inch Pipe to 8-inch Pipe	750 ft in Serravista Ave between Victoria St and Marbly Ave	N/A

a. Private water system not modeled.

Hydraulic Model Development

BC evaluated the proposed project using the Daly City hydraulic model (model), last updated in June 2023. The Daly City model uses InfoWater by Innovyze, Inc. InfoWater is a commercially available, fully Geographic Information System integrated, water distribution modeling and management software application that calculates and tracks various hydraulic constituents, such as flow, velocity, and pressure of water through the water system.

The existing model only includes distribution mains 8- to 16-inches in diameter, except when those mains are the only local supply. The model was updated with the proposed project shown in Figure 1 and demands listed in Tables 1, 2, and 3.

The hydraulic model consists of the following four elements and assumptions:

1. One new hydrant per Daly City Design Standards (Section 6.02.C) and 2019 CFC.
2. New 2-inch irrigation, 2.5-inch domestic water and 6-inch fire service lateral pipes servicing the proposed building connected to the new 8-inch-diameter public water main in Serravista Avenue.

3. Upsizing approximately 750 ft of the existing 6-inch-diameter asbestos concrete pipe (ACP) in Serravista Avenue to an 8-inch-diameter water pipe to comply with the minimum pipe size requirements listed in Table 6. Upsizing from 6-inch to 8-inch is adequate to provide the required fire flow for the proposed project. The upgraded 8-inch main shall be reconnected to the existing mains on intersecting streets. All existing water services shall be reconnected to the new 8-inch main before abandonment of the existing 6-inch mains.
4. BC simulated new water services to the proposed building using one fire demand node and one domestic demand node per building. However, Daly City may require separate connections/meters for fire, irrigation, and domestic demands. The findings of this water study still apply when proposed building require multiple connections.

Hydrant Test and Model Verification

As described in the American Water Works Association (AWWA) Manual M-32 Computer Modeling of Water Distribution Systems, fire flow testing is a widely used method for estimating the available fire flow from specific fire hydrants within water distribution systems and for validating water models.

Fire flow tests consist of measuring flow from a hydrant (flow hydrant) while measuring the pressure at an adjacent hydrant (residual or pressure hydrant). The flow hydrant causes a pressure drop (AWWA recommends a drop of 10 pound per square inch gauge (psig), or more to create sufficient "stress" on the water system to reveal its characteristics) measured at the residual hydrant.

The modeler simulates the fire flow test in the model by setting the pump/PRV operation and reservoir levels to match the conditions at the time of the test and imposes a demand on the flow hydrant in the model. The modeler then compares the pressure drop at the residual hydrant in the model results to the field data.

Daly City staff conducted a hydrant test near the proposed project along Serravista Avenue in Zone 5 on August 15, 2021. The water system at this test location is supplied with 6-inch-diameter water mains (see Figure 1). Hydrants 39 and 38 were the flow hydrant and pressure hydrant, respectively.

Table 4 lists the fire hydrant test data and the model simulation result for this project. The model static pressure result was 1 psig lower than the field measurement, while the model residual result was 1 psig lower than the field measurement. Typically, a model is considered sufficiently validated when the static and residual pressure predicted by the model are within +/-5 psig of the field measured static and residual pressures.

Table 5. Summary of Fire Hydrant Test and Model Results

Item	BPS Status	Reservoir Level	Pressure Hydrant[a]		Flow Hydrant[b]
	Res 4 BPS	Reservoir 5	Static (psig)	Residual (psig)	Flow (gpm)
Field measurements	Off	13.39	76	74	699
Model results	Off	13.39	75	73	699
Deviation	-	-	1	1	-

a. Pressure Hydrant location: Hydrant 38 on Grid Map D-11.
b. Flow Test Hydrant location: Hydrant 39 on Grid Map D-11.

Evaluation Criteria

BC used 2008 California Waterworks Standard (CCR Title 22, Section 64602) and Daly City's Water Master Plan (BC, June 2022) hydraulic design criteria (Chapter 6) to evaluate the water system performance. Table 6 summarizes the distribution system pressure, velocity, and headloss criteria.

Table 6. Evaluation Criteria

Parameter	Condition	Criterion Value	Notes/Source
Minimum Pressure	Peak hour	40 psig	2008 California Waterworks Standard (CCR Title 22, Section 64602)
	Fire Flow + MDD	20 psig	2008 California Waterworks Standard (CCR Title 22, Section 64602)
	Fire Sprinkler demand + MDD	55 psig	Pressure measured at pad elevation on utility side of water meter per Daly City Recommendation
Maximum Pressure	All conditions	80 psig	Uniform Plumbing Code (Section 608.2)
Maximum Velocity	Maximum day	5 ft/second	Daly City Water Master Plan (BC, June 2022)
Minimum Pipe Size	Serving Hydrants	8-inch diameter	Daly City Water Master Plan (BC, June 2022)
Maximum Headloss	Pipeline diameter < 12 inches	10 ft/1,000 ft	Daly City Water Master Plan (BC, June 2022)
	Pipeline diameter ≥ 12 inches	3 ft/1,000 ft	Daly City Water Master Plan (BC, June 2022)

Model Evaluation Scenarios

BC analyzed the hydraulic network model under four steady-state scenarios:

- **Scenario 1: MDD.** MDD is the theoretical largest demand that occurs during any single day of the year. The day of maximum demand is usually associated with hot weather during the late summer or early fall. The MDD factor for Daly City is 1.5x average day demand. BC applied this global multiplier to all demand nodes in the model to simulate MDD conditions.
- **Scenario 2: PHD.** PHD is the largest demand that occurs on any one single hour during the day of maximum demand and is larger than MDD. BC multiplied average-day demands globally by 3.0 for peak-hour conditions.
- **Scenario 3: MDD + Fire Sprinklers.** BC estimated the project will require 475 gpm fire sprinkler system demand for the proposed building (see Table 3). The project fire protection engineer will address the actual required pressure and number of sprinkler heads for the fire protection system.
- **Scenario 4: MDD + Structure Fire.** BC estimated the project will require a maximum of 1,750 gpm fire hydrant demand for the proposed building (see Table 2). BC analyzed available fire hydrant flow by running the structure fire simulation under the MDD scenario.

Model Evaluation Findings

After analyzing the model output for four model scenarios, BC found that the existing Daly City public water system with the proposed water system expansion shown in Figure 1 would deliver satisfactory pressure and flow to the project. Table 7 shows the hydraulic analysis results for each scenario.

Table 7. Hydraulic Model Analysis Results

Analysis Scenario	Model Inputs			Model Analysis Results at the Site				
	Tank Level	System Demands	Fire Flow/ Sprinkler Demands (gpm)	Minimum Pressure (psig)	Maximum Pressure (psig)	Available Sprinkler/Fire Flow (gpm)	Maximum Velocity (fps)	Maximum Headloss
1	Full -1 ft	MDD	-	-	73	-	<5	<10 ft/1,000 ft
2	Full -10 ft	PHD	-	>40	-	-	-	-
3	Full -1 ft	MDD	475	>55	-	>1,500 at 55 psig	-	-
4	Full -5 ft	MDD	1,750	>20	-	>3,000 at 20 psig	-	-

fps = foot/feet per second

Scenario 1 Findings. The modeled system met the pressure, velocity, and headloss criteria listed in Table 6. The Uniform Plumbing Code limits internal pressures in any structure to 80 psig; therefore, structures with pad elevation lower than approximately 365 ft in Pressure Zone 5/5B will require individual pressure-regulating devices. The proposed building appears to have a Level 1 pad elevation of 374.7 ft at Serravista Avenue and therefore will not require an individual pressure-regulating device.

Scenario 2 Findings. The proposed project junction meets the peak-hour minimum required pressure of 40 psig.

Scenario 3 Findings. The modeled system delivered the estimated sprinkler flow to the proposed building and met the minimum required residual pressure of 55 psig at the pad elevation of the proposed building on the utility side of the water meter. The estimated available sprinkler flow at 55 psig is over 1,500 gpm at the Site.

Scenario 4 Findings. The modeled system delivered the required fire hydrant flows and met the minimum required residual pressure of 20 psig for the Site.

- Daly City's water system would deliver the total maximum fire water volume for the Site (1,750 gpm for 120 minutes equals 210,000 gallons) from Reservoirs 5 and 5B, Reservoir 4 Pump Stations, and pressure reducing stations from adjacent pressure zones.

Because Pressure Zone 5/5B draws water from several sources, BC assumes based on past master planning that these various water sources will have enough available capacity to supply the required fire flow.

BC appreciates the opportunity to assist Daly City with this project. Please call us with any questions.

Very truly yours,

Brown and Caldwell

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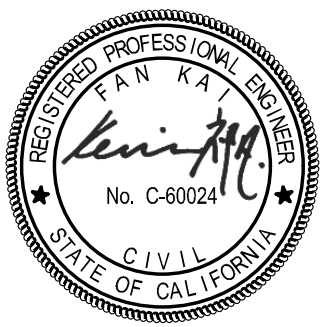
KK/CR



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