Appendix I

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MEMORANDUM

DATE: May 24, 2023
TO: Adam Mahoney, K&WI
FROM: B. Shrestha, PE and Dan Schaaf, PE
SUBJECT: SMP 39/40 Drainage Analysis

Introduction

Schaaf & Wheeler performed a hydraulic study to evaluate adequacy of the existing storm drainage system to handle runoff from the SMP 39 development site and the SMP 40 site in Livermore. The study area is shown in **Figure 1**.

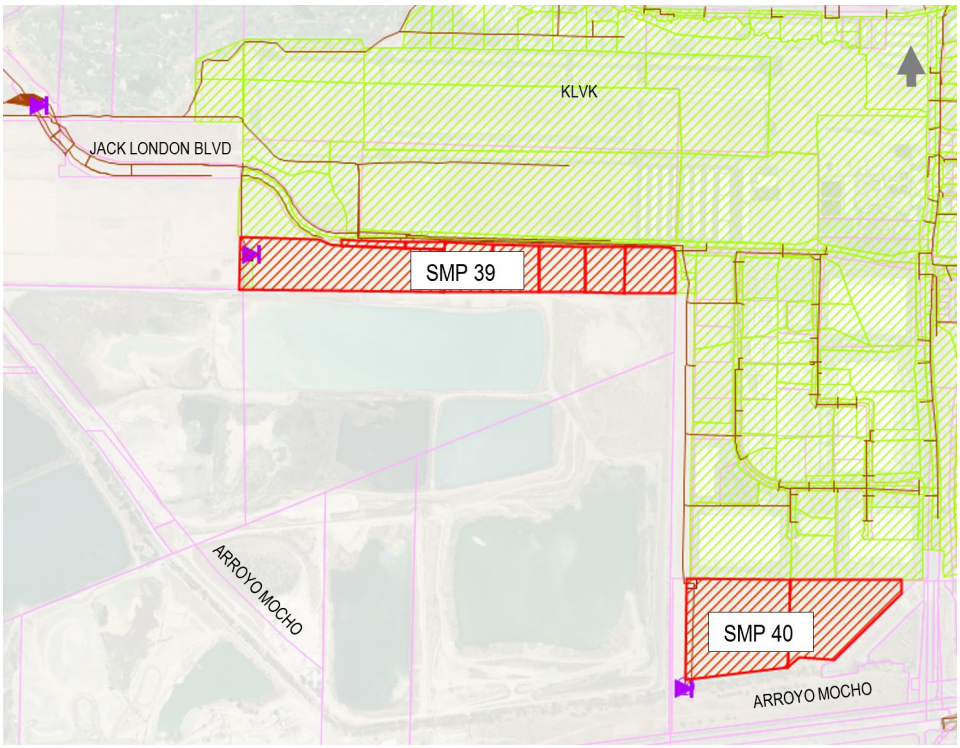

Figure 1: Study Area Overview showing Catchments

The analysis included hydrologic and hydraulic modeling of the runoff from the two sites, and their discharge locations. This analysis relied on information and a hydraulic model prepared for the *City of Livermore Storm Drain Master Plan, 2022.*

The existing land in SMP 39 site will be developed, and runoff from the site will be connected to the existing drainage system facilities along Jack London Boulevard at multiple locations. The capacities of the existing drainage system downstream from the discharge locations were analyzed to determine the impact. Additionally, a proposed SMP 40 site detention system was included in the analysis to evaluate interconnection between existing Oak Basin Detention System with the proposed SMP 40 detention system. The Oak Basin Detention System is shown in **Figure 2**.

Figure 2: Oak Basin Detention (Looking South)

Vertical Datum

The vertical datum used for the report and modeling for the report is in NAVD88 feet. The project elevation data in NGVD29 was converted to NAVD88 by adding 2.64 ft.

Background

The SMP 39 and the SMP 40 development sites are in Livermore, California. The SMP 39 site to the south of Jack London Boulevard is an open agricultural land which is approximately 50 acres. The SMP 40 site which is to the north of Arroyo Mocho is currently open space and approximately 39 acres.

The SMP 39 site is surrounded by Jack London Boulevard to the north, and a quarry site to the south. Existing topographical survey data of the site shows approximately 30 feet of fall in elevation from the east to the west. Any excess runoff from the existing agricultural site is routed through the existing drainage pipes and *modified channels* to the west of the field. *Modified Channel* is a term used in the *Livermore Stream Maintenance Program Manual*, 2015, to distinguish a drainage channel from *engineered channel* or a *natural channel*. The dimensions of the modified channels north of the Jack London Boulevard used in the analysis are approximated based on digital terrain data as topographical survey was not available.

The runoff from the site eventually reaches a large drop structure with multiple culverts under Jack London to the west of Livermore Airport (see **Figure 3**). This drop structure and associated culverts were constructed ten years ago as part of El Charro area improvement and construction of Jack London Boulevard.

Jack London adjacent to SMP 39 site has storm drain of sizes 24-inch to 42-inch running from east to west. This system flows north to the airport channel via two parallel 36-inch pipes. The flow then enters a modified channel parallel to a maintenance access road flowing westerly to the large drop structure.

The SMP 40 site is surrounded by Arroyo Mocho to the south, Isabel Avenue to the east, and a quarry site to the west. Runoff from the site reaches Arroyo Mocho to the southern property line.

Figure 3: Large Drop Structure and Culverts Downstream of Airport

Proposed Improvements

The SMP 39 site will be developed, and runoff will be rerouted to existing drainage system on Jack London Boulevard. The drainage system from the eastern half of the site will be connected to existing storm drains on Jack London Boulevard at multiple locations. This system discharges north into existing modified channels in the airport.

The drainage system from the western half of the site will be routed through a 3 acre-foot detention pond. The outflow from this *SMP 39 West Pond* will flow north through an 18-inch diameter storm drain and 24-inch diameter storm drain under Jack London Boulevard. It will then flow into an existing modified channel immediately along the northern edge of the roadway.

The SMP 40 site will include an underground detention storage system comprised of three parallel 96-inch CMP pipes. Each of these 96-inch CMP will be approximately 1,000 feet long. This detention system will connect to the existing Oak Detention Basin to the north via two orifices. The detention system will also have an overflow connection to the Arroyo Mocho to the south. A flap gate will be included on the outlet to prevent high water level from Arroyo Mocho to backflow into the underground storage system.

Hydrology and Hydraulics

Schaaf & Wheeler utilized a previously developed hydraulic model using InfoWorks ICM software for Storm Drainage Master Plan for Livermore. The hydrologic calculation was based on methods used by Alameda County Flood Control and Drainage District. The scope of this analysis was limited to only 1-D hydraulics, instead of 2-D flood analysis. The runoff used for storm drainage system is calculated using 10-year 24-hour storm. Additional 1-D analysis of the drainage pipe system for 100-yr storm was used for detention systems performance.

The model was further extended by including additional storm drainage components and catchment areas pertinent to the two project sites (see **Figure 4**). The existing modified channels at the northern edge of the Jack London Boulevard, and the existing modified channels in the Livermore Airport were approximately represented in the model based on topographical surface elevation data.

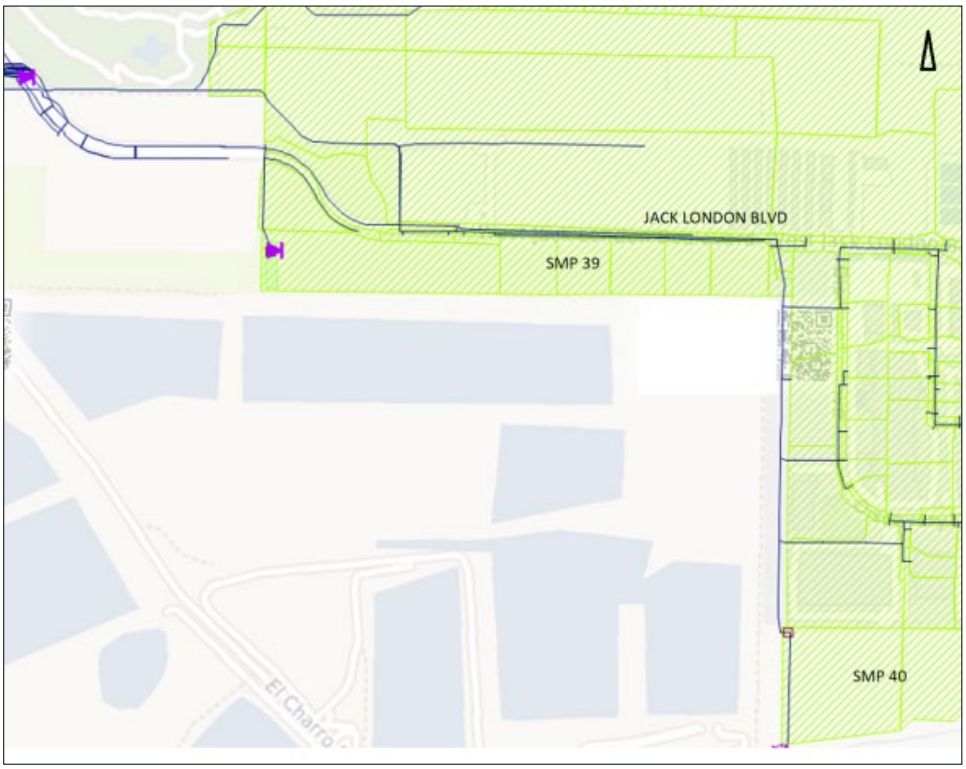

Figure 4: Updated Model Schematics

The catchment areas were delineated based on hydrologic map prepared by K&WI with area take-offs and discharge locations. The runoff from the catchment areas of the site were directed to various manholes along Jack London Boulevard. The runoff surfaces of the project site catchments were changed from pre-project to post-project by modifying imperviousness from 5 percent to 85 percent for hydrologic calculation based on design assumptions.

Discussion of 10-yr Results

The hydraulic analysis of the system shows that the system performs without any issue for the 10-year storm. The eastern half of the SMP 39 site runoff is accommodated by the storm drain on Jack London Boulevard. The western half of the SMP 39 site is effectively attenuated by the new detention pond without causing high flow into downstream system.

The interconnection between the SMP 40 detention system and the existing Oak Detention system performs as designed to allow attenuated flow to the Oak Detention System.

Hydraulic grade lines (HGL) of the system under consideration showed no adverse impact of flooding downstream. The HGL result for Jack London Boulevard is shown in **Figure 6**. The HGL result for Oak Basin interconnected with the SMP 40 system is shown in **Figure 7**.

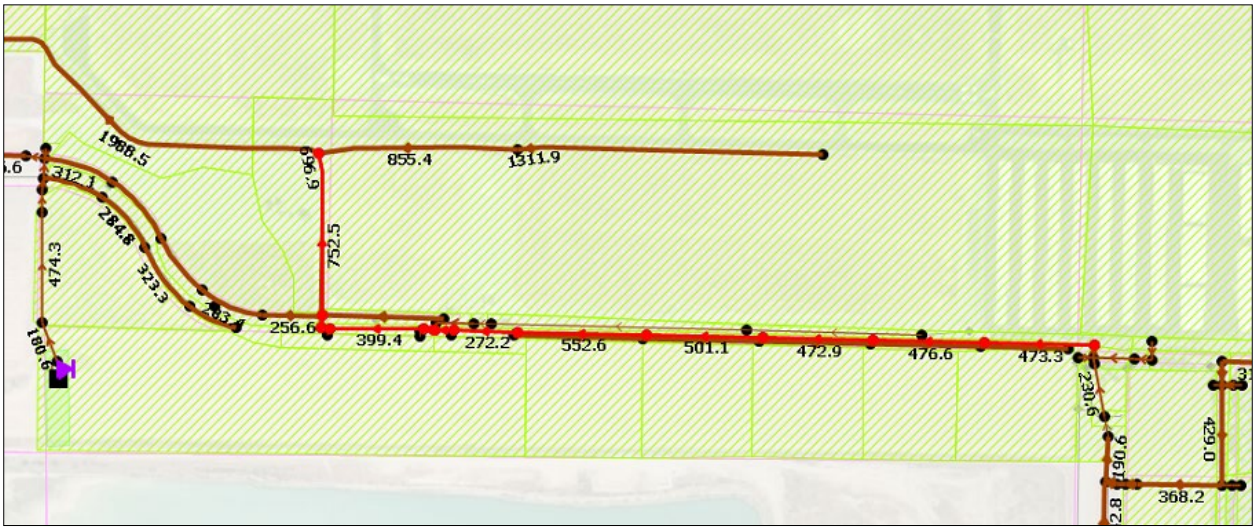

Figure 5 Jack London Boulevard Drains

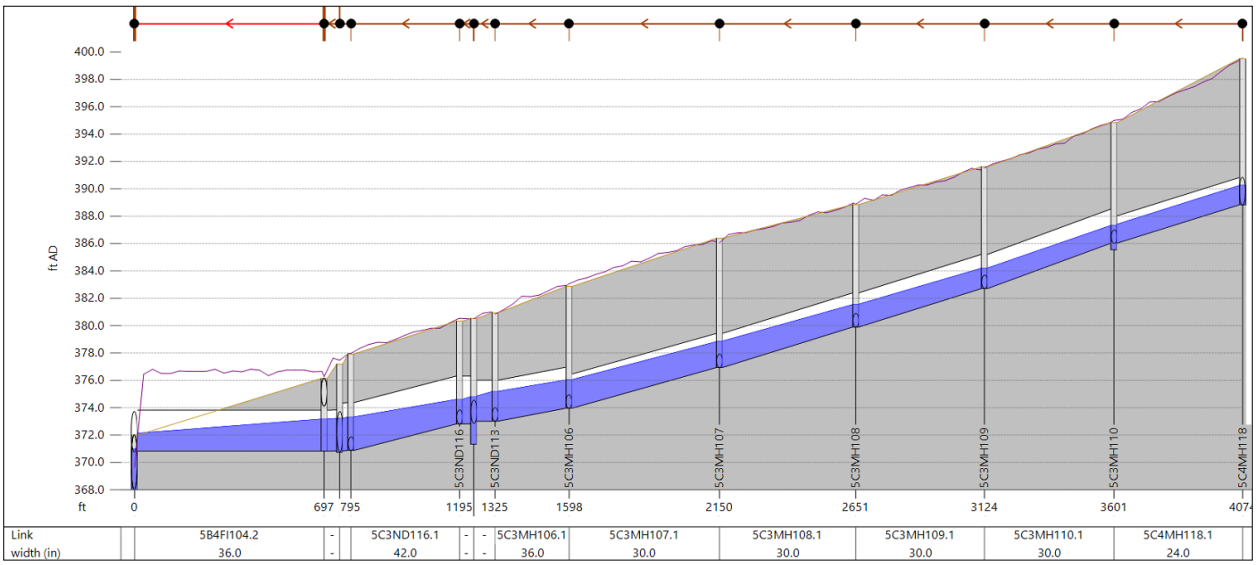

Figure 6 Profile of Jack London Boulevard Pipes showing 10-yr HGL

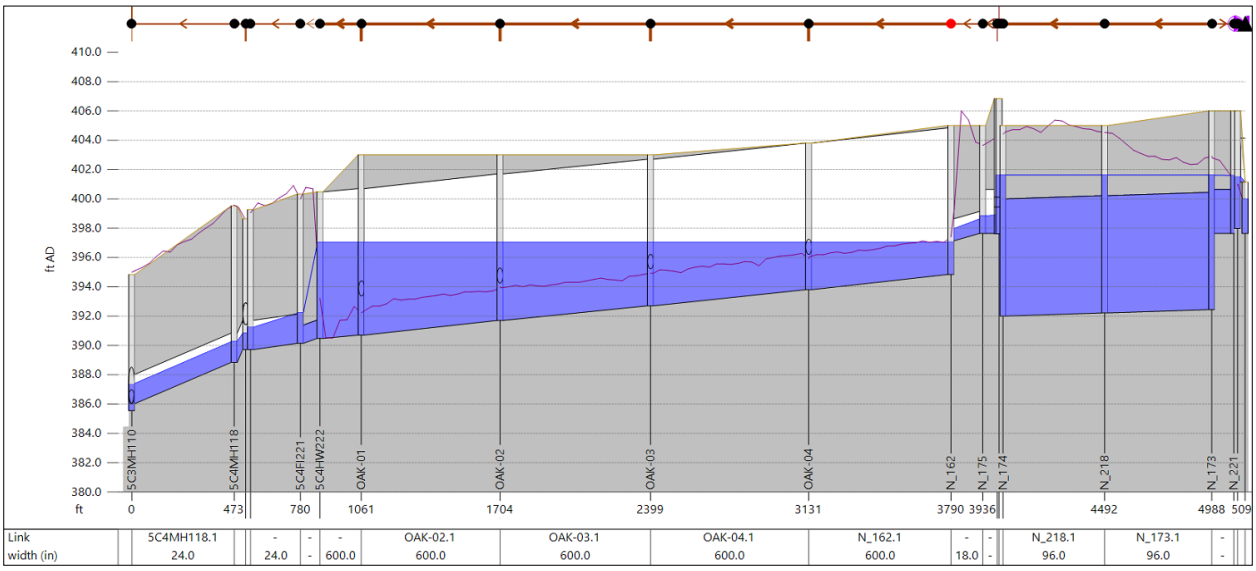

Figure 7 Profile of Oak Basin and SMP 40 Detention System showing 10-yr HGL

Discussion of 100-yr Results

The hydraulic analysis of the system for 100-year storm shows that the system also meets the drainage conveyance capacities. The SMP 39 West Pond detention basin attenuates the flow. The interconnection of existing Oak Basin and the new SMP 40 site underground detention system also performs satisfactorily. The model result shows that the Oak Basin can detain the runoff without overflowing its banks.

Hydraulic grade lines of the system under consideration showed no adverse impact of flooding downstream. The HGL result for Jack London Boulevard is shown in **Figure 8**. The HGL result for Oak Basin interconnected with the SMP 40 detention system is shown in **Figure 9**.

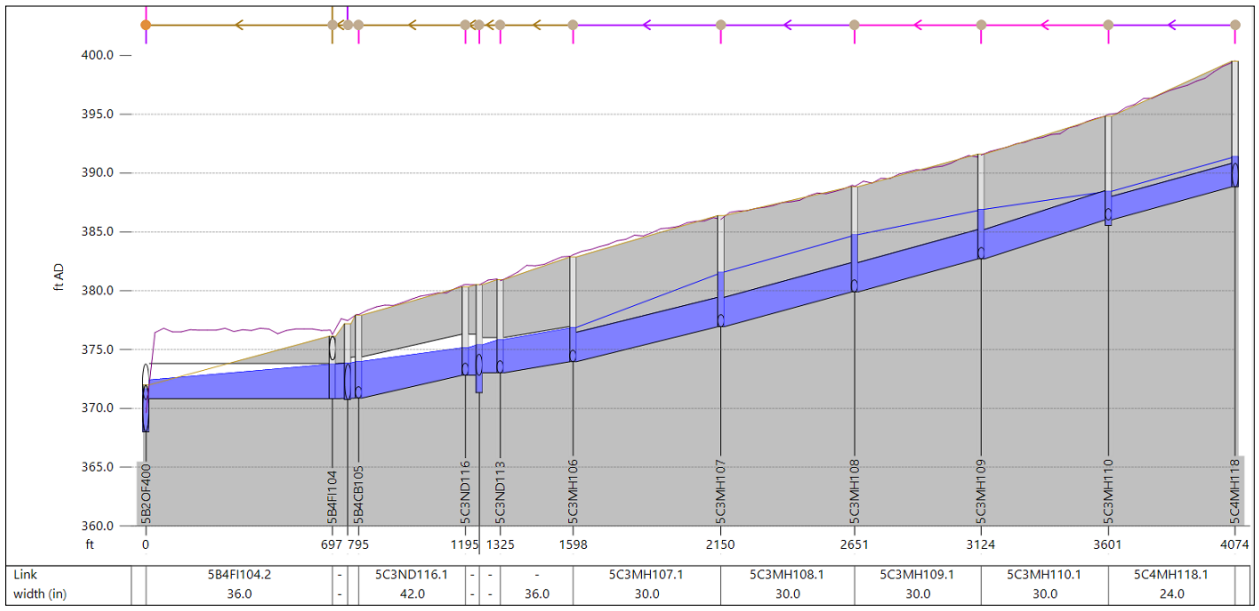

Figure 8 Profile of Jack London Boulevard storm showing 100-yr HGL

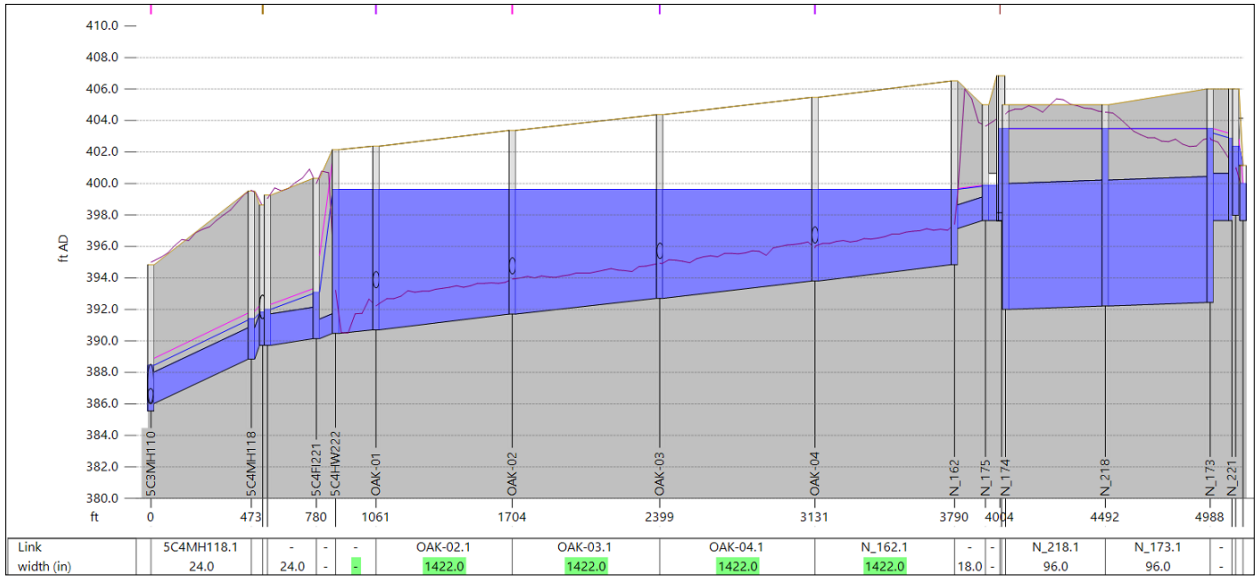

Figure 9 Profile of Oak Basin and SMP 40 Detention System showing 100-yr HGL

Results Summary

Table 1 summarizes the difference in results between various simulations for comparison purpose. Refer to the schematics shown on **Figure 10** for locations.

Table 1 Modeling Results Comparison

Results	Units	10-yr		100-yr	
		Existing	Project	Existing	Project
SMP 40 Detention					
Flow to Oak Basin	cfs	n/a	4.5	n/a	6.1
Oak Basin Detention					
24" to Jack London Boulevard	cfs	14.6	14.8	16.5	16.8
Maximum Level	ft NAVD88	397.4	397.6	399.3	399.6
42-inch on Jack London Boulevard					
Flow	cfs	26.6	34.8	40.7	47.7
HGL	ft NAVD88	372.9	373.3	373.5	373.8
Discharge to Airport Channel					
Two 36" Pipes	cfs	27.1	36	41.5	49.4
SMP 39 West Detention Pond					
Outflow	cfs	n/a	6	n/a	6.9
Maximum Level	ft NAVD88	n/a	370.7	n/a	371.9
Maximum Volume	ac-ft	n/a	1.7	n/a	2.8

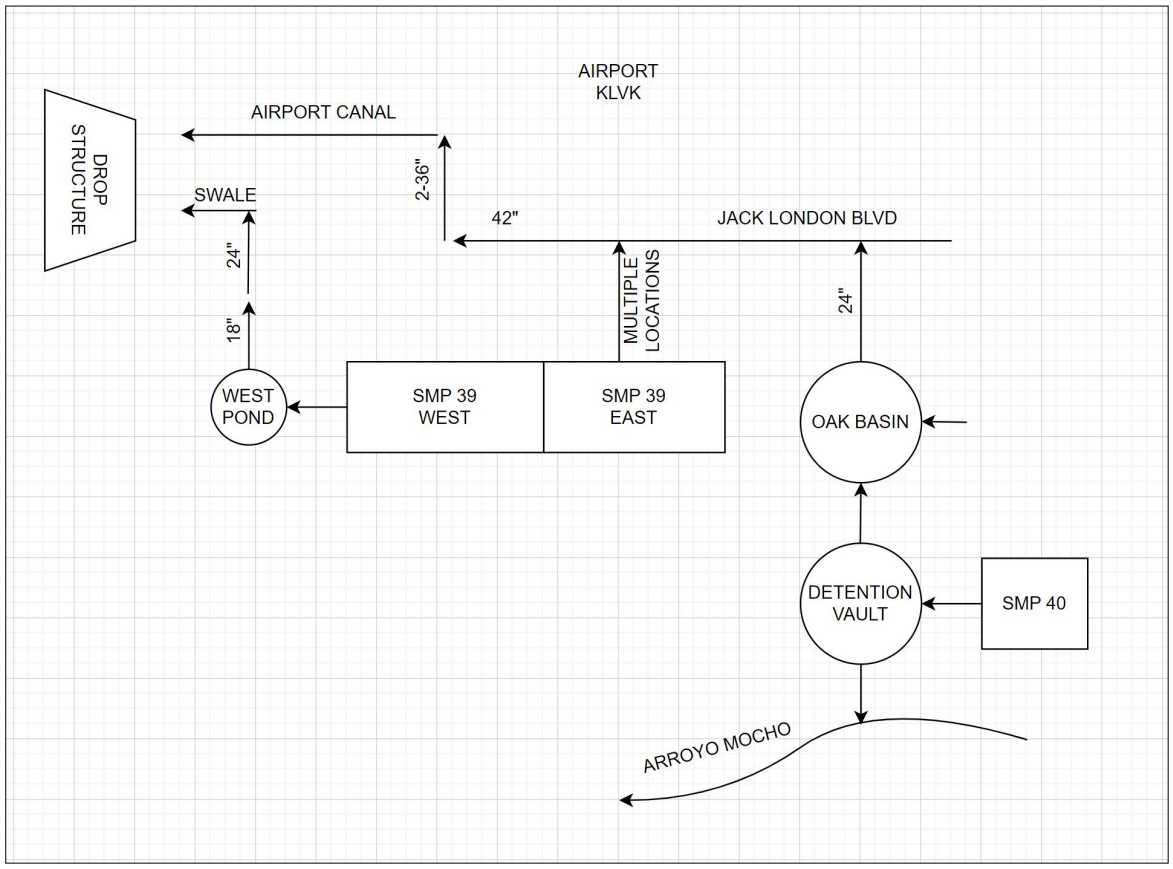

Figure 10 Simplified Schematic Overview of Runoff

Conclusions

Based on the hydraulic and hydrologic analysis of the drainage system for SMP 39 and SMP 40, the existing public drainage system can handle runoff from the new development sites with proposed changes in impervious surface. The new detention basins on SMP 39 site and on SMP 40 site effectively attenuate the flow from these sites. The existing Jack London Boulevard storm drains can convey flow from the eastern half of the SMP 39 site. The open channels in the airport site can convey flow into the drop structure further downstream. The west detention pond on SMP 39 site prevents exacerbating peak runoff in downstream channels.

References

Livermore Storm Drainage Master Plan, 2022

Livermore Stream Maintenance Program Manual, 2015

Preliminary SMP-40 Site Design Drawings