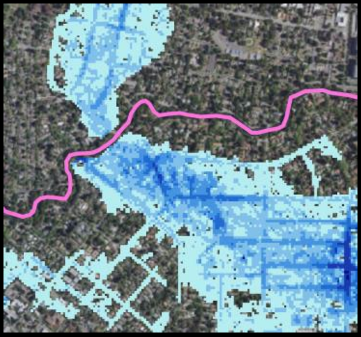
San Francisquito Creek Flood Protection, Ecosystem Restoration, and Recreation Project Upstream of Highway 101

Final Environmental Impact Report – September 2019
Volume 2: Appendices



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PREPARED FOR:
San Francisquito Creek Joint Powers Authority
615 B Menlo Avenue, Menlo Park, CA 94025
sfcjpa.org / jpa@sfcjpa.org / 650-324-1972

VOLUME 2 Appendices

A- Air Quality/Greenhouse Gas Emissions: Analysis of Models and Tools to CorrelateProject-Generated Criteria Pollutant Emissions to Health End Points
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Appendix A

Air Quality/Greenhouse Gas Emissions: Analysis of Models and Tools to Correlate Project-Generated Criteria Pollutant Emissions to Health End Points

Analysis of Models and Tools to Correlate Project-Generated Criteria Pollutant Emissions to Health End Points

Several models and tools capable of translating mass emissions of criteria pollutants to various health endpoints have been developed. Table E-1 summarizes key tools, identifies the analyzed pollutants, describes their intended application and resolution, and analyzes whether they could be used to reasonably correlate project-level emissions to specific health consequences. As shown in Table E-1, almost all tools were designed to be used at the national, state, regional, and/or city-levels. These tools are not well suited to analyze small or localized changes in pollutant concentrations associated with individual projects. Accordingly, they are generally not recommended for CEQA analyses. This attachment may be included in CEQA documents with significant air quality impacts with appropriate modification (i.e., read word-for-word the table and tailor as needed), as shown in the example text in Attachment D.

Table E-1. Analysis of Models and Tools to Correlate Project-Generated Criteria Pollutant Emissions to Health End Points

Tool	Created by	Description	Resolution	Pollutants Analyzed	Project-Level CEQA Applicability
AirCounts[1]	Abt Assoc.	Online tool that helps large and medium-sized cities quickly estimate the health benefits of PM2.5 emission reductions and economic value of those benefits. The tool estimates the number of deaths (mortality) avoided and economic value related to user-specified regional, annual PM2.5 emissions reduction. The modeling year is 2010; avoided deaths are expected to occur over a 20-year period and their present value is shown in 2010 US dollars at a 3% discount rate.	City-level	Primary PM2.5	This tool is only illustrative, as it is limited to certain cities and does not target specific sectors. Given that it was designed as a screening-level tool, is not sector specific, and includes limited California data, the tool is **not recommended** for project-level CEQA analysis.
AP2 (formerly Air Pollution Emission Experiments	Mueller and Mendelsohn, 2006	AP2 is an integrated assessment model developed to assess marginal damage impacts from emissions at the national scale but can be applied at the county-level. The model connects emissions to monetary damages through six modules: emissions (per EPA's	National or county-level	SO_2, ROG, NOx, ozone, PM2.5, PM10	The model operates at the national scale but may be applied at the county-level (although it is not clear how this adjustment should be made). The tool is also not commercially

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[1] https://www.abtassociates.com/tools

Tool	Created by	Description	Resolution	Pollutants Analyzed	Project-Level CEQA Applicability
and Policy [APEEP])[2]		national inventory), air quality modeling, concentrations, exposures, physical effects, and valuation. Damages are presented on a dollar-per-ton basis. Model extends damage assessment beyond human health, and includes assessment on reduced crop and timber yields, reductions in visibility, enhanced depreciation of man-made materials and damages due to lost recreation services.			available. Accordingly, the tool is **not recommended** for project-level CEQA analysis.
Methodology for Estimating Premature Deaths Associated with Long-Term Exposure to Fine Airborne Particulate Matter in California[3]	CARB	The staff report identifies a relative risk of premature death associated with PM2.5 exposure based on a review of all relevant scientific literature, and a new relative risk factor was developed. This new factor is a 10% increase in risk of premature death per 10 μg/m^3 increase in exposure to PM2.5 concentrations (uncertainty interval: 3% to 20%)	National		The primary author of the CARB staff report notes that the analysis method is not suited for small projects and may yield unreliable results due to various uncertainties (SCAQMD 2015). Accordingly, the tool is **not recommended** for project-level CEQA analysis.
Co-Benefits Risk Assessment (COBRA)[4]	US EPA	Preliminary screening tool that contains baseline emission estimates of a variety of air pollutants for a single year (2017). COOBRA is targeted to state and local governments as a screening assessment for clean energy policies. Users specify changes to the baseline emission estimates. COBRA then uses	National, regional, state, or county-levels	PM2.5, SO_2, NOx, NH_3, and ROG	COBRA is a preliminary screening tool only and cannot be used at sub-county resolution. It also does not account for secondary emission changes resulting from market responses. Accordingly, the tool

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[2] Original APEEP: https://www.researchgate.net/publication/253359043_The_Air_Pollution_Emission_Experiments_and_Policy_Analysis_Model_APEEP_Technical_Appendix

[3] https://www.arb.ca.gov/research/health/pm-mort/PMmortalityreportFINALR10-24-08.pdf

[4] https://www.epa.gov/statelocalenergy/co-benefits-risk-assessment-cobra-health-impacts-screening-and-mapping-tool

Tool	Created by	Description	Resolution	Pollutants Analyzed	Project-Level CEQA Applicability
		"canned" source-receptor matrix model to estimate PM changes and resulting health outcomes and monetized values. The results can be mapped to visually represent air quality, human health, and health-related economic benefits. Analysis can be performed across the 14 major emissions categories included in the EPA's National Emissions Inventory. Note that COBRA is based on EPA's BenMAP-CE (discussed in a separate entry).			is **not recommended** for project-level CEQA analysis.
Environmental Benefits and Mapping Program-Community Edition (BenMAP-CE)[5]	US EPA	BenMAP is EPA's detailed model for estimating the health impacts from air pollution. It relies on input concentrations and applies concentration-response (C-R) health impact functions, which relate a change in the concentration of a pollutant with a change in the incidence of a health endpoint, including premature mortality, heart attacks, chronic respiratory illnesses, asthma exacerbation and other adverse health effects. Detailed inputs are required for air quality changes (concentrations from AERMOD), population, baseline incidence rates, and effect estimates.	National, County, City, and sub-regional levels	Ozone, PM, NO_2, SO_2, CO	The smallest default analysis resolution for BenMAP-CE is 144 square kilometers (equivalent to approximately 56 square miles or 36,000 acres). This tool could be used to derive average health incidence/ton estimates that can be used for illustrative purposes only for most projects with proper disclosure of the inherent inaccuracies involved in averaging. It is **not recommended** for individual modeling of smaller projects, however. The tool may be appropriate for certain large-scale planning-level analyses.

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[5] https://www.epa.gov/benmap

Tool	Created by	Description	Resolution	Pollutants Analyzed	Project-Level CEQA Applicability
Fast Scenario Screening Tool (TM5-FASST)[6]	Joint Research Centre (Italy)	Tool allows users to evaluate how air pollutant emissions affect large scale pollutant concentrations and their impact on human health (mortality and years of life lost) and crop yield from national to regional air quality policies, such as climate policies. The tool is web-based and does not require coding or modelling. Users must gain access through publishers.	Global and national-levels	PM2.5, ozone, NOx, NH_3, CO, ROG, EC, CH_4, SO_2	This tool is applicable at national to global scales. Accordingly, the tool is **not recommended** for project-level CEQA analysis.
Long-range Energy Alternatives Planning System--Integrated Benefits Calculator (LEAP-IBC)	Climate and Clean Air Coalit-ion (CCAC)	Allows users to rapidly estimate the impacts of reducing emissions on health, climate, and agriculture. Tool uses sensitivity coefficients that link gridded emissions of air pollutants and precursors to health, climate and agricultural impacts at a national level. The sensitivity coefficients are generated by a chemical transport model, so air quality modeling not necessary. Tool is currently Excel-based and is available through the developers only. A web-based interface is currently under development.	National-level	PM2.5, ozone, NO_2	This tool is applicable at national scale. Accordingly, the tool is **not recommended** for project-level CEQA analysis.
Multi-Pollutant Evaluation Method (MPEM)[7]	BAAQMD	Estimates the impacts of control measures on pollutant concentration, population exposures, and health outcomes for criteria, toxic, and GHG pollutants. Monetizes the value of total health benefits from reductions in PM2.5, ozone, and certain carcinogens, and the social value of GHG reductions. MPEM was designed for development of a Clean Air Plan for the San Francisco Bay Area. The inputs are specific to the SF region and are not appropriate for projects outside BAAQMD.	Regional level in the SFBAAB	Ozone, PM, air toxics, GHG	This tool is designed to support the BAAQMD in regional planning and emissions analysis within the SFBAAB. The model applies changes in pollutant concentrations over a four-square kilometer grid. This tool could be used to derive average health incidence/ton estimates that can be used for illustrative purposes only for

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[6] http://tm5-fasst.jrc.ec.europa.eu/

[7] http://www.baaqmd.gov/~/media/files/planning-and-research/plans/2017-clean-air-plan/mpem_nov_dec_2016-pdf.pdf?la=en

Tool	Created by	Description	Resolution	Pollutants Analyzed	Project-Level CEQA Applicability
					most projects with proper disclosure of the inherent inaccuracies involved in averaging. It is **not recommended** for individual modeling of smaller projects, however. The tool may be appropriate for certain large-scale planning-level analyses in the SFBAAB (with permission of BAAQMD).
Response Surface Model (RSM)-based Benefit-per-Ton Estimates[8]	US EPA	Consists of tables reporting the monetized PM2.5-related health benefits from reducing PM2.5 precursors from certain source types nationally and for 9 US cities/regions. Applying these estimates simply involves multiplying the emissions reduction by the relevant benefit per-ton metric. The resulting value is the PM mortality risk estimate at a 3% discount rate. Note that RSM is based on EPA's BenMAP-CE (discussed in a separate entry).	National or regional (San Joaquin County only) levels	EC, SOx, VOC, NH_3, NOx	While RSM includes regional values specific to San Joaquin County, the metrics only reflect the benefits of reductions in exposure to ambient PM alone and do not include the benefits of reductions in other pollutants. The values are also dated as new sector-based BPT values are more current. Accordingly, the tool is **not recommended** for project-level CEQA analysis (even in San Joaquin County).

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[8] https://www.epa.gov/benmap/response-surface-model-rsm-based-benefit-ton-estimates. Note that the tables with the RSM values shown in this link break down BPT by sector and region and are from Fann's 2009 study, which is now outdated. However, the values in EPA's 2018 Technical Support Document do include updated Values of Statistical Life (United States Environmental Protection Agency 2018).

Tool	Created by	Description	Resolution	Pollutants Analyzed	Project-Level CEQA Applicability
Sector-based Benefit-per-Ton Estimates[9]	US EPA	Two specific sets of BPT estimates for 17 key source categories are available. Both are a reduced-form approach based on BenMAP modeling. The first are based on Fann et al. (2012) values and available from EPA's website. The second is based on updated modeling from Fann et al. (2017) and available in a Technical Support Document (TSD) from EPA. Applying these factors involves multiplying the emissions reduction (in tons) by the relevant benefit (economic value) or incidence (rates of mortality and morbidity) per-ton metric. The resulting value is the economics, mortality, and morbidity of direct and indirect PM2.5 emissions. All values are based on a national-scale study. Local values are preferred, but not available from any existing reduced form model and use of reduced form estimates for another city is unlikely to provide a better-than-national value. Use of the current values from EPA's 2018 TSD represent the most current estimate of monetized or incidence risk. Values from Lepeule et al. (2012) represent the most current estimate of mortality.	National-scale	PM2.5, SO_2, NOx	Due to the complex non-linear chemistry governing ozone formation, EPA was not able to derive ozone or secondary PM BPT values. The BPT estimates provide a rough order-of-magnitude analysis of health consequences from directly-emitted PM and precursors to PM (with no secondary formation). However, the multipliers do not account for project-specific characteristics, receptor locations, or local dispersion characteristics. The resultant health effects are therefore reflective of national averages and may not be exact when applied to the project-level. Nonetheless, the estimates can be used to present an informational and scaled health risk analysis of directly-emitted PM and precursors to PM (with no secondary formation.

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[9] https://www.epa.gov/benmap/sector-based-pm25-benefit-ton-estimates. The updated Technical Support Document (February 2018) is available at: https://www.epa.gov/sites/production/files/2018-02/documents/sourceapportionmentbpttsd_2018.pdf.

Appendix B

San Francisquito Tree Impacts

BARTLETT
HORT SCIENCE
BARTLETT CONSULTING
A Division of The F.A. Bartlett Tree Expert Company

September 26, 2018

Kevin MacKay
ICF
201 Mission St., Suite 1500
San Francisco, CA 94105

Subject: San Francisquito Tree Impacts

Dear Kevin MacKay,

ICF is planning a bank stabilization project along the San Francisquito Creek. You asked HortScience | Bartlett Consulting to assess 15 trees on private property that may be impacted by the construction. You and I were together in the field to identify which trees were included in the assessment.

Summary

In total, I assessed fifteen (15) large trees on five properties that you identified as potentially affected by the bank stabilization project.

Tree impacts are expected to be limited to root damage from shallow excavations near the top of the bank to remove the existing sacked concrete (Sakrete) atop the creek bank and to build a new retaining wall. For most trees this process should result in no or very little injury (Table 1). Some trees growing within 10 feet of the top of bank may have roots at the interface between the soil and the sakrete that would be affected by excavations.

It is difficult to predict impacts to four trees:

- For the property 79 Crescent Drive (trees #8-10) the property boundary and construction plans have not been determined.
- Tree #15 at 63 Cresent Dr. was growing close to a masonry wall. I did not have access to the creek side of the masonry wall to determine the distance from the tree to the top of bank.

Table 1. Tree Disposition Data

Tag #	Species	Diameter (in.)	Disposition	Distance from impact
1	Blue gum	81	Preserve	12 feet from top of bank
2	Blue gum	55	Preserve	4 feet from top of bank
3	Blue gum	64	Preserve	Approx. 10 feet from top of bank
4	Blue gum	41	Preserve	Approx. 10 feet from top of bank
5	Blue gum	53	Preserve	Approx. 10 feet from top of bank
6	Blue gum	64	Preserve	Approx. 10 feet from top of bank
7	Blue gum	112	Preserve	Approx. 20 feet from top of bank
8	Coast live oak	32	Depending on plans	Approx. 10 feet from top of bank
9	Coast redwood	35	Depending on plans	7 feet from top of bank
10	Blue gum	36	Depending on plans	Adjacent to top of bank
11	Coast redwood	45	Preserve	6 feet from masonry wall
12	Coast live oak	14	Preserve	7 feet from masonry wall
13	Coast live oak	13	Preserve	11 feet from masonry wall
14	Coast live oak	34	Preserve	14 feet from masonry wall
15	Coast redwood	48	Depending on plans	1 foot from masonry wall

I recommend an arborist observe excavation and sakrete removal along the top of bank to document root damage and to determine if any trees require removal or further mitigation.

Tree Assessment Methods

Trees were assessed on September 13, 2018. ICF determined which trees were included. The identified trees were primarily large trees, near the top of the creek bank, with a potential to become destabilized due to possible root interference during construction. The assessment procedure consisted of the following steps:

1. Identifying the tree as to species;
2. Tagging each tree with an identifying number and recording its location on a map; off-site trees were not tagged;
3. Measuring the trunk diameter at a point 54" above grade
4. Evaluating the health and structural condition using a scale of 1 – 5 based on a visual inspection from the ground. Portions of trees not visible from the ground could not be assessed and are not included in the rating:

   5 **-** A healthy, vigorous tree, reasonably free of signs and symptom of disease, with good structure and form typical of the species.
   4 **-** Tree with slight decline in vigor, small amount of twig dieback, minor structural defects that could be corrected.
   3 **-** Tree with moderate vigor, moderate twig and small branch dieback, thinning of crown, poor leaf color, moderate structural defects that might be mitigated with regular care.
   2 **-** Tree in decline, epicormic growth, extensive dieback of medium to large branches, significant structural defects that cannot be abated.
   1 **-** Tree in severe decline, dieback of scaffold branches and/or trunk; most of foliage from epicormics; extensive structural defects that cannot be abated.

5. Rating the suitability for preservation as "high", "moderate" or "low". Suitability for preservation considers the health, age and structural condition of the tree, and its potential to remain an asset to the site for years to come.

High:	Trees with good health and structural stability that have the potential for longevity at the site.
Moderate:	Trees with somewhat declining health and/or structural defects that can be abated with treatment. The tree will require more intense management and monitoring, and may have shorter life span than those in 'high' category.
Low:	Tree in poor health or with significant structural defects that cannot be mitigated. Tree is expected to continue to decline, regardless of treatment. The species or individual may have characteristics that are undesirable for landscapes and generally are unsuited for use areas.

Properties Visited

We visited nine properties in Palo Alto, CA. Several smaller trees may be affected as well. In four properties no trees were assessed because no large trees were growing near the creek.

- 1401 Edgewood Drive – Trees #1 and 2
- 1411 Edgewood Drive – Trees #3-6
- 1417 Edgewood Drive – Tree #7
- 1425 Edgewood Drive – No trees assessed

- 87 Crescent Drive – No trees assessed
- 79 Crescent Drive – Trees #8-10
- 75 Crescent Drive – No trees assessed (#10 is near boundary)
- 63 Crescent Drive – Trees #12-15
- 51 Crescent Drive – No trees assessed

Construction Impacts

The majority of the sites that we visited had slopes covered with sakrete that was to be replaced with retaining walls (Figure 1). The sakrete will be removed. Minimal excavation will take place at the top of the bank during sakrete removal. A new near-vertical retaining wall will be built which will require significant excavation lower on the slope. Most of the existing slopes that I observed were steeper than that illustrated in Fig. 1, and so would require less excavation. Twenty-five (25) foot long soil nails will be drilled into the slope at a downward slope angle of 15º. The closest nail to the surface will be five feet below top of slope.

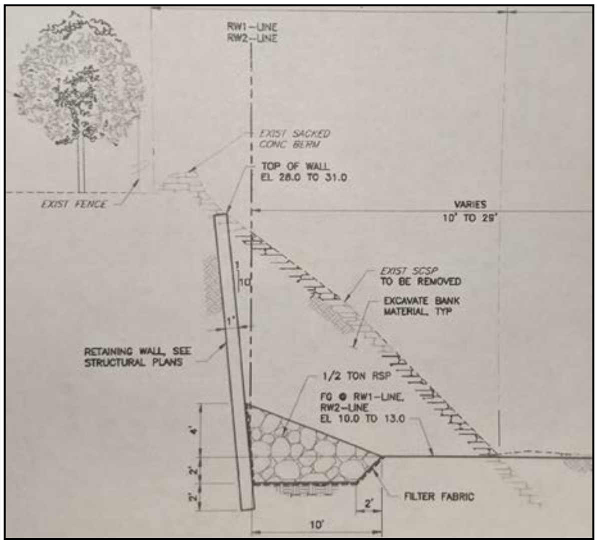


Figure 1. Construction plans showing existing sakrete and future retaining wall.

At 87 Crescent Drive sakrete will be added to the top of the existing sakrete, and no excavation will be required. Rebar will be pounded into the ground to attach the new sakrete to the slope. No trees were identified for assessment at 87 Crescent Drive.

At 79 Crescent Drive a concrete retaining wall already exists rather than sakrete. No construction is planned in this area at this time.

Tree impacts are expected to be limited to root damage from shallow excavations near the top of the bank to remove the sakrete atop the creek bank and to and build the new retaining wall. For most trees this process should result in no or minor injury. Some trees growing within 10 feet of the top of bank may have roots at the interface between the soil and the sakrete that would be affected by excavations.

It is difficult to predict impacts to four trees:

- For the property 79 Crescent Drive (trees #8-10) the property boundary and construction plans have not been determined.
- Tree #15 is growing in close proximity to a masonry wall. I did not have access to the creek side of the masonry wall to determine the distance from the tree to the top of bank.

Installation of the soil nails are of minimal concern because the highest nail will be installed approximately 5 feet below grade. The equipment will drill an 8 inch- diameter hole approximately 25 feet in length into the bank at a downward slope of 15º. The nails will be spaced 5 feet on center in a grid pattern.

Most tree roots are found in the top 3 feet of soil. So, at 5 feet deep, it is unlikely that significant root damage would occur that would destabilize or kill a tree. It is possible that the roots growing near the interface of the soil and sakrete will be within the pathway of a soil nail. I recommend noting these roots during excavation and adjusting soil nails to avoid them.

Equipment access and operations needs to consider surrounding vegetation. I assume that the equipment needed to construct the wall will be working from the creek bed and require no additional clearance or tree removal on private property. Similarly, I was told that the crews will pound rebar at 87 Crescent Drive by hand and require no large equipment, nor tree crown pruning will be needed to complete construction.

Photo 1. Blue gums #1 and 2 were growing in the backyard of 1401 Edgewood Drive.

Site-Specific Trees and Construction

Tree descriptions are provided in the attached Tree Assessment table.

1401 Edgewood Drive

Two mature blue gums (*Eucalyptus globulus*) were assessed at 1401 Edgewood Drive. Tree #1 was 81” in diameter and 12 feet from the top of the bank. Tree #2 was 55” and 4 feet from the top of the bank. Both trees had been topped and were in poor condition with extensive epicormic growth (Photo 1).

Both trees are likely to experience some root loss during excavation near the top of the bank. Because of its close proximity to the creek, tree #2 is of greater concern. I think that both trees will survive construction and will not be destabilized by excavation. I recommend an arborist observe excavation to document root loss and provide mitigation recommendations based on those observations.

Photo 2. Blue gums #7 was the largest tree assessed (112” trunk diameter).

1411 Edgewood Drive

Four mature blue gums were assessed (trees #3-6) at 1411 Edgewood Drive. The four trees had trunk diameters ranging from 41” to 64” and were approximately 10 feet away from the top of creek bank. The trees were in fair condition except for tree #6 with tall, difficult to see crowns and their bases fused together. Tree #6 was in poor condition with a 4 foot wide cavity and large basal flare growing over the pavement.

The four trees will likely have some root loss associated with the construction. I expect root loss of trees #3-6 to be minor; an arborist should monitor excavation to see what root loss does occur.

1417 Edgewood Drive

The largest tree assessed (tree #7) was growing in the backyard of 1417 Edgewood Drive (112” trunk diameter). It appeared to be in good condition, but the upper crown was difficult to see (Photo 2). It was approximately 20 feet from the top of the bank of the creek. If tree #7 loses any roots, I expect it to be minor; an arborist should monitor excavation.

79 Crescent Drive

Three trees were assessed (trees #8-10) at 79 Crescent Drive. Tree #8 was a 32” coast live oak (*Quercus agrifolia*) in poor condition with decay fungus fruiting bodies and a heavy lean and old prop (Photo 3). Tree #9 was a 35” coast redwood (*Sequoia sempervirens*) in good condition. Blue gum #10 had a trunk diameter of approximately 36” and was growing at the corner of the property at the intersection of three fences. The fences were not on the property boundaries, and tree ownership was uncertain in the field. Construction plans are not certain at the time of this writing. Therefore, potential impacts to trees could not be adequately assessed.

63 Crescent Drive

Five trees were assessed (trees #11-15) at 63 Crescent Drive. Coast redwood #11 had a trunk diameter of 45” and was in fair condition with signs of water stress. Tree #11 was 6 feet from the masonry wall. Coast live oaks #12-14 had trunk diameters of 14, 13 and 34” respectively. Tree #12 was the closest to the masonry wall (7 feet) with the others growing in a row behind. The coast live oaks were in fair condition and were heavily bowed either towards the creek (trees #12 and 13) or away from the creek (tree #14). Coast redwood #15 had a trunk diameter of 48” and was in good condition with a dense crown (Photo 4). Tree #15 was 1 foot away from the masonry wall.

Access was not available on the creek side of the masonry wall to see how far the trees are from the top of bank. The two unknowns are:

- How far is the wall from the top of bank?
- What is the footing of the wall and extent of roots growing under it?

Assuming that excavation will take place near the masonry wall and roots can freely grow underneath the wall, impacts to trees will range from none (tree #14) to potentially severe (tree #15). Trees #13 and 14 should not be impacted by construction. Trees #11 and 12 will likely experience minor to severe root loss. Tree #15 may be 1 or 2 feet from the excavation which has the chance of destabilizing or killing the tree.

I recommend an arborist observe excavation near trees #11, 12 and 15 to document root loss and provide mitigation recommendations.

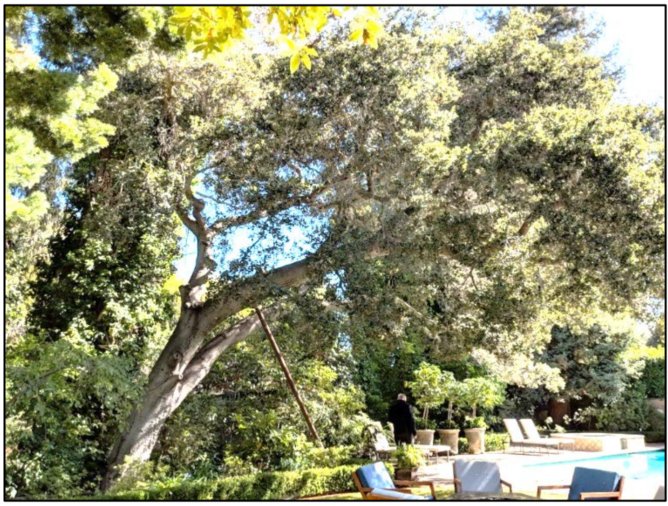


Photo 3 (above). Coast live oak #8 was leaning heavily and being partially supported by a prop.
Photo 4 (right). Coast redwood #15 was 1 foot from the masonry wall and may experience severe root impacts.

Tree Preservation Guidelines

The goal of tree preservation is not merely tree survival during development but maintenance of tree health and beauty for many years. Trees retained on sites that are either subject to extensive injury during construction or are inadequately maintained become a liability rather than an asset. The response of individual trees will depend on the amount of excavation and grading, the care with which demolition is undertaken, and the construction methods. Coordinating any construction activity inside the **TREE PROTECTION ZONE** can minimize these impacts.

The following recommendations will help reduce impacts to trees from development and maintain and improve their health and vitality through the clearing, grading and construction phases.

1. The demolition and construction superintendents shall meet with the Project Arborist before beginning work to review all work procedures, access routes, storage areas, and tree protection measures.
2. The Project Arborist shall monitor excavation and removal of sakrete as well as and drilling for soil nails within 25 feet of the 15 trees included in this assessment.
3. If roots 2” and greater in diameter are encountered during site work and must be cut to complete the construction, the Project Arborist must be consulted to evaluate effects on the health and stability of the tree and recommend treatment.
4. Sakrete within 25 feet of trees shall be removed with equipment that will minimize damage to trees above and below ground, and operate from outside the dripline of the trees.
5. All contractors shall conduct operations in a manner that will prevent damage to trees to be preserved.
6. If injury should occur to any tree during construction, it should be evaluated as soon as possible by the Project Arborist so that appropriate treatments can be applied.
7. No excess soil, chemicals, debris, equipment or other materials shall be dumped or stored within the dripline of any trees.
8. Any additional tree pruning needed for clearance during construction must be performed by a Certified Arborist and not by construction personnel.

This report summarizes my observations and comments which are limited to the planned project work. Tree owners are encouraged to have their trees inspected regularly to assess tree conditions and to provide appropriate treatments to enhance health and structural stability. In particular, owners of large blue gum trees are advised to consider having aerial inspections by a climbing arborist to assess the structure of the tree crown that is not visible from the ground. Where internal decay indicators are present, such as tree #6 at 1411 Edgewood Dr. and tree #8 at 79 Crescent Dr., the owners are advised to have an advanced inspection to assess the extent of decay and its effects on tree stability. Pruning to manage weight distribution on mature trees is an important part of tree management and is the responsibility of the owner.

Our procedures included assessing trees for observable, visible defects. This is not to say that trees without significant defects will not fail. Failure of apparently defect-free trees does occur, especially during storm events. Wind forces, for example, can exceed the strength of defect-free wood causing branches and trunks to break. Wind forces coupled with rain can saturate soils, reducing their ability to hold roots, and blow over defect-free trees.

Furthermore, trees change over time. Our inspections represent the condition of the tree at the time of inspection. Annual tree inspections are recommended to identify changes to tree health and structure. In addition, trees should be inspected after storms of unusual severity to evaluate damage and structural changes. Initiating these inspections is the responsibility of the tree owner.

Please contact me if you have any questions regarding my observations or recommendations.

Sincerely,

Ryan Gilpin
Certified Arborist WE-10268A

Tree Assessment Map

San Francisquito Creek
Palo Alto, CA

Prepared for:
ICF

September 2018

Notes:
1. Tree locations are approximate.

2. Aerial image provided by ESRI.

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Legend

○ Tree

🟥 Parcel

N

100
Feet

HORT SCIENCE
BARTLETT CONSULTING
A Division of The F.A. Bartlett Tree Expert Company

325 Ray Street Phone (925) 484-0211
Pleasanton, CA 94566 Fax (925) 484-0596

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Tree Assessment Map

San Francisquito Creek
Palo Alto, CA

Prepared for:
ICF

September 2018

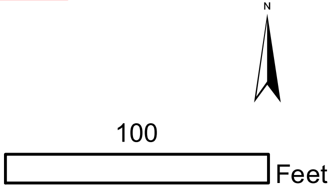
Notes:
1. Tree locations are approximate.

2. Aerial image provided by ESRI.

Legend

○ Tree

🟥 Parcel



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BARTLETT CONSULTING
A Division of The F.A. Bartlett Tree Expert Company

325 Ray Street
Pleasanton, CA 94566
Phone (925) 484-0211
Fax (925) 484-0596

Tree No.	Species	Trunk Diameter (in.)	Protected Tree?	Condition 1=poor 5=excellent	Suitability for Preservation	Comments
			1401 Edgewood Drive			
1	Blue gum	81	No	2	Low	Multiple trunks arise from 5 feet; topped at 25 feet; bushy epicormic regrowth.
2	Blue gum	55	No	2	Low	Multiple trunks arise from 20 feet; topped at 30 feet; bushy epicormic regrowth.
			1411 Edgewood Drive			
3	Blue gum	64	No	3	Moderate	Group of 4 trees; bases fused together with massive burls; branch from adjacent tree pushing against trunk; circling root; upright high crown.
4	Blue gum	41	No	3	Moderate	Group of 4 trees; bases fused together with neighboring trees; codominant trunks arise from 20 feet; tall; upright crown; difficult to see top of tree.
5	Blue gum	53	No	3	Low	Group of 4 trees; bases fused together with neighboring trees; tall; upright crown; difficult to see top of tree; basal flare extends over pavement 1 foot in 3 foot wide.
6	Blue gum	64	No	2	Low	Group of 4 trees; bases fused together with neighboring trees; tall; upright crown; slightly thin; long heavy branches; basal flare extends over pavement 2 feet by 3 foot wide; four foot wide cavity at base from driveway damage.
			1417 Edgewood Drive			
7	Blue gum	112	No	4	High	Huge tree; growing in mounded ivy; root pruning relatively well healed on creek side; bushy lower growth; wide spreading crown slightly one sided towards creek.

Tree No.	Species	Trunk Diameter (in.)	Protected Tree?	Condition 1=poor 5=excellent	Suitability for Preservation	Comments
79 Crescent Drive						
8	Coast live oak	32	Yes	2	Low	Codominant trunks arise from 10 feet; one side propped with growth around it; bleeding; fungal fruiting body (Ganoderma lucidum); crown one sided over pool away from creek; buried and then dug out.
9	Coast redwood	35	Yes	4	High	Good form and structure; dense crown; slightly poor color; slightly thin top; narrow form.
10	Blue gum	36	No	2	Low	At corner of property; multiple trunks arise from 10 feet; bushy; covered in ivy; hard to see much of tree.
63 Crescent Drive						
11	Coast redwood	45	Yes	3	Moderate	Good form and structure; dense foliage; narrow branches; dark green color.
12	Coast live oak	14	Yes	3	Low	Bowed heavily over creek; corrected past other trees crowns; dieback; dense crown.
13	Coast live oak	13	Yes	3	Low	Bowed heavily over creek; dieback; dense crown; growth cracks; interior tree.
14	Coast live oak	34	Yes	3	Low	Bowed heavily away from creek; epicormic growth; dense crown; growth cracks; dominant tree.
15	Coast redwood	48	Yes	4	High	Good form and structure; dense crown; dark green color; epicormic sprouting around base.

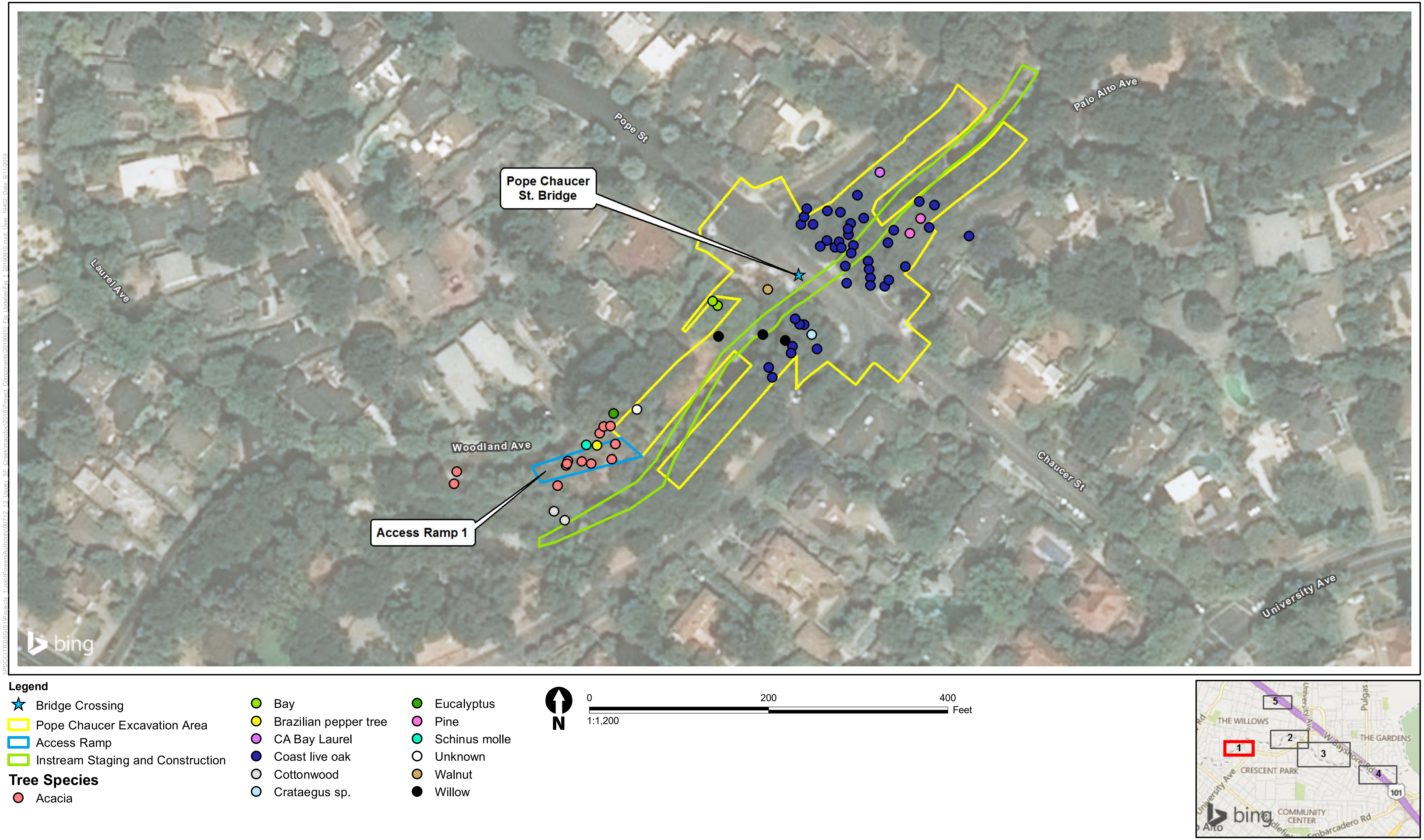

Figure 1
Access Ramp 1

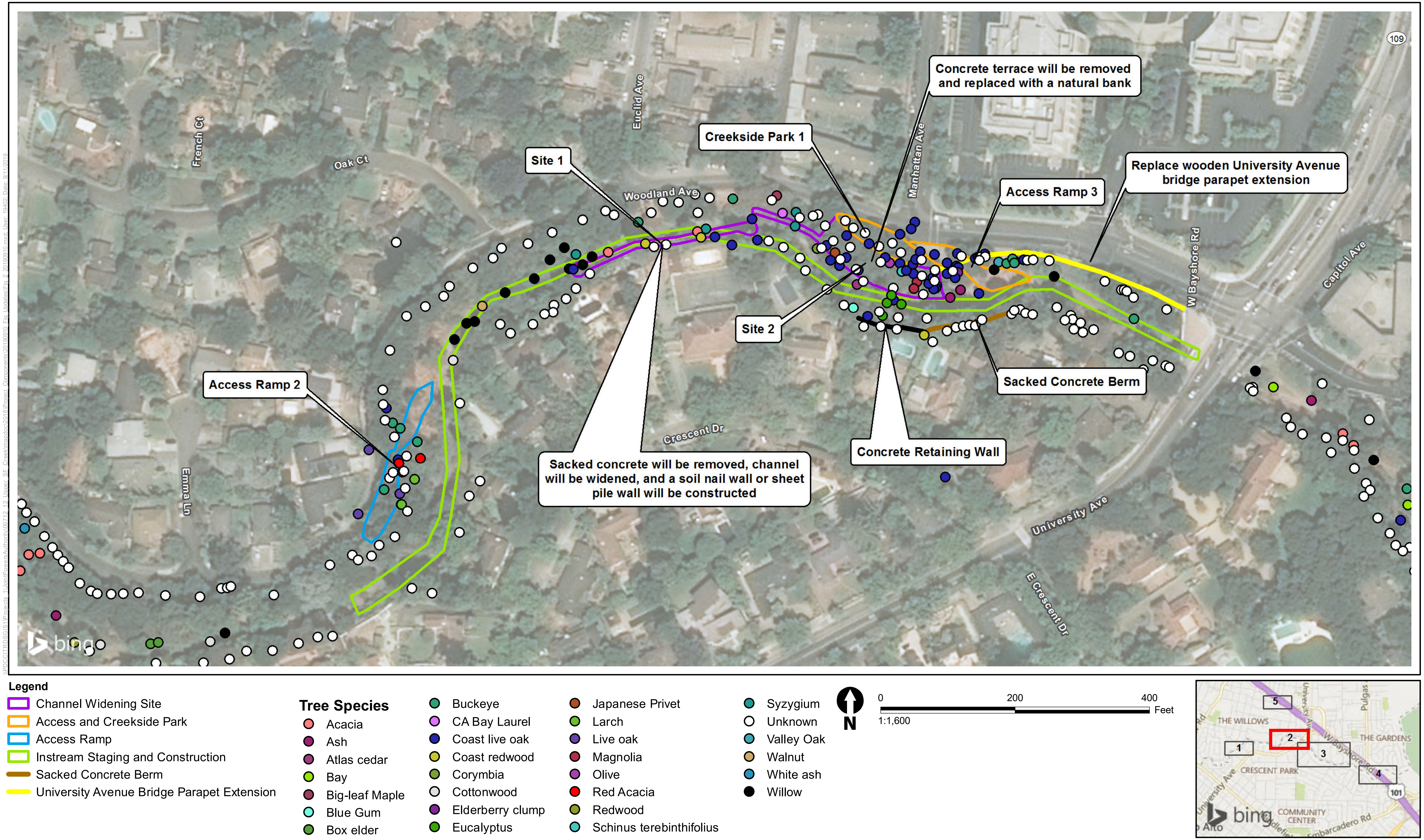

Figure 2
Site 1 and 2 Construction Elements

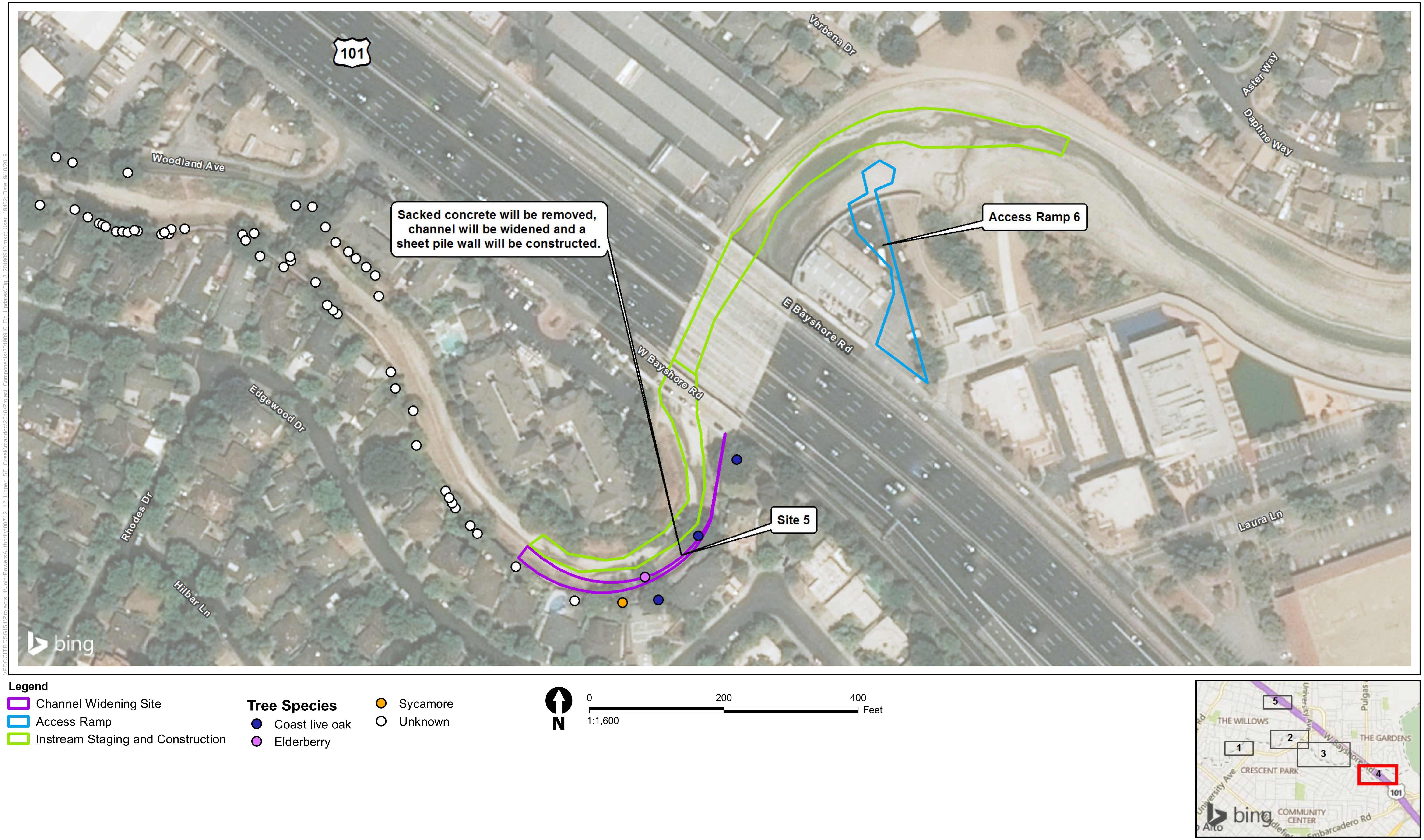

Figure 3
Site 5 Construction Elements

Appendix C

Cultural Resources Pedestrian Survey

Memorandum

To:	Ruzel Ednalino, M.A. Archaeologist USACE San Francisco District
From:	Lily Arias, MA Archaeologist ICF
Date:	February 19, 2019
Re:	**Cultural Resources Pedestrian Survey for the San Francisquito Flood Protection, Ecosystem Restoration, and Recreation Project Upstream of Highway 101**

This memorandum is to document the pedestrian survey conducted as part of the cultural resources review for the Draft Environmental Impact Report (DEIR) of the San Francisquito Creek Joint Powers Authority's (SFCJPA) San Francisquito Flood Protection, Ecosystem Restoration, and Recreation Project Upstream of Highway 101 (project).

For the DEIR, San Francisquito Creek is described in three reaches. Reach 1 extends from San Francisco Bay to the upstream side of U.S. 101. The SFCJPA has completed construction of flood protection improvements in Reach 1; CEQA documentation was completed in 2012 and this Reach 1 is not included in this memorandum. Given program-level improvements are still early in the planning phase and, therefore, conceptual in nature, the reaches are categorized as program-level improvements and project-level improvements. Project-level improvements include construction activities associated with Reach 2, which extends from the upstream side of U.S. 101 to the upstream side of the Pope-Chaucer Bridge. Reach 2 is the subject of this memorandum. Program-level improvements include construction activities associated Reach 3, which begins on the upstream side of the Pope-Chaucer Bridge and extends throughout the upper watershed. Project-level improvements for Reach 3 have not been defined and Reach 3 is not included in this memorandum. Only Reach 2 was subject to pedestrian survey (Figure 1).

Methods

Records Search

A records search was performed at the Northwest Information Center in Rohnert Park, California, on November 28, 2017 (IC#17-1496). The search identified 55 previously recorded resources, with one located within the Reach 2 study area, in an area of proposed channel widening.

P-43-000578 (CA-SCL-583) – This resource was originally identified in the 1960s, and three human burials were removed from the area along with associated funerary items, such as several hundred Olivella beads, several hundred fraction Olivella beads, bird bone whistle, bone awl, and cut and polished bone tube. This material is curated at the Stanford Museum. The resource was revisited in 1985 at which time a formal Department of Parks and Recreation (DPR) 523 form was completed. At this time, houses had been constructed on top of the resource and additional identification was not possible (Bocek and Rutherford 1985). This resource has not been formally evaluated for its eligibility for listing in the CRHR or NRHP.

A three-step process was followed to identify historic built resources and update existing evaluations: (1) undertake background research of previously recorded resources and completed reports within and adjacent to the study area, (2) develop approach and historic context for evaluation, and (3) conduct onsite fieldwork to inspect and record resources. Additional desktop research was conducted at the Palo Alto Historical Association website, newspapers.com, historicaerials.com, state, and national bridge inventories.

Field Survey

A pedestrian survey of the project-level study area was conducted on April 18, 2018, by both an ICF archaeologist and architectural historian, to identify historic age built environment resources, archaeological deposits and surface-exposed features. The archaeological survey consisted of walking across the project-level study area and visually inspecting the ground surface for indicators of surface and subsurface archaeological deposits. The archaeological survey also involved inspecting the local topography to identify areas that have been subject to modern anthropogenic landscape alteration.

The built environment survey consisted of walking the project-level study area and visually inspecting built resources for the potential to be age-eligible (50 years or older). Photographs were taken throughout the course of the survey.

Findings

As discussed above a records search conducted at the NWIC identified one precontact archaeological site within the project-level study area. P-43-000578 (CA-SCL-583) identified within Site 5 of Reach 2. This resource was not accessible during the pedestrian survey.

The pedestrian survey encompassed portions of the project-level study area adjacent to the University Avenue Bridge and the Pope-Chaucer Bridge, as well as 200 meter radius around the bridges.

The project-level study area was inspected for indicators of human activity such as dark midden soils, dietary shell and bone, stone or bone artifacts, and historic artifacts. The area was also examined for any larger, earthen features such as mounds or depressions. The area has been completely developed and consists of residential neighborhoods. The majority of the project-level study area is within the limits of the creek and includes steep banks and heavy vegetation. Any visible ground surface has been disturbed and/or covered in fill and gravel. All visible ground surfaces appear to have been graded, landscaped, or developed.

No archaeological resources were identified during the course of the pedestrian survey.

Two known built environment resources, The University Avenue Bridge and the Pope-Chaucer Street Bridge, were identified and revisited during the pedestrian survey. Photographs were taken of the two structures and a visual inspection of the bridges was conducted to note alterations and existing conditions.

No additional built environment resources were identified during the course of the pedestrian survey.

Conclusions

While no evidence of archaeological deposits was identified during the pedestrian survey, the potential remains that subsurface archaeological deposits are present in the project-level study area. Only a portion of the project-level study area was available for pedestrian survey and the area adjacent to the stream channel was heavily developed and vegetated. As described in Chapter 3.4 *Cultural and Paleontological Resources* of the DEIR over 55 archaeological sites have been identified within overall project area, the majority of which are situated along San Francisquito Creek. Additionally, the areas directly adjacent to the stream contain Holocene-aged alluvium that indicates that the project area has high archaeological sensitivity (Byrd and Meyer 2011; ICF 2018).

Chapter 3.4 *Cultural and Paleontological Resources* of the DEIR states that any ground disturbing activities occurring within Reach 2 have the potential to have significant impacts to documented and as-yet undocumented archaeological resources. The implementation of Mitigation Measures (MM-) CULT-1: *Stop Work if Archaeological Deposits are Encountered During Ground-Disturbing Activities*, MM-Cult-2: *Develop and Implement an Archaeological Testing Plan,* and MM- CULT-3: *Develop and Implement an Archaeological Monitoring Plan* would reduce the impacts to less than significant. Halting work in an area where potential archaeological resources, including human remains, are identified allows the resources to avoid further impact as well as allows for further analysis. All potential archaeological resources should be assessed by a qualified archaeologist to determine its significance under CEQA. If work is to occur within an area where an archaeological site is present, the creation and implementation of an Archaeological Testing Plan before construction activities begin, would allow for understanding of the extent of the resource as well as its significance under CEQA. Due to the highly sensitive nature of Reach 2, the creation and implementation of an

Archaeological Monitoring Plan in areas where project related ground disturbance has the potential to encounter as-yet undocumented archaeological resources would allow for the early identification of archaeological resources by qualified archaeologist and thus avoid destruction of the resource. These mitigation measures are discussed at length in Chapter 3.4 Cultural and Paleontological Resources of the DEIR (ICF 2018).

References

Byrd, F. B., and J. Meyer. 2011. *Initial Cultural Resources Investigation San Francisquito Creek Flood Damage Reduction and Ecosystem Restoration Project, Santa Clara and San Mateo Counties, California.*

ICF. 2018. *DRAFT Environmental Impact Report San Francisquito Flood Protection, Ecosystem Restoration, and Recreation Project Upstream of Highway 101*. Prepared for the San Francisquito Creek Joint Powers Authority.

Photographs

Overview of San Francisquito Creek, directly south of the University Avenue Bridge, view southeast

Overview of San Francisquito Creek, directly south of the University Avenue Bridge, view south

Overview of the north side of the Pope-Chaucer Bridge, view southwest

FIGURE REDACTED

Appendix D

Hydrology Report

Santa Clara Valley
Water District

SAN FRANCISQUITO CREEK HYDROLOGY STUDY

Hydraulics, Hydrology and Geomorphology Unit

FINAL (ADDENDUM #1)

Prepared by:

Jack Xu, PE
Associate Civil Engineer

Under the Direction of:

Liang Xu, Ph.D, PE
Engineering Unit Manager

DECEMBER 2016

ADDENDUM #1

An error was discovered after Corps ATR certification where the incorrect k-value was used to interpolate the 50-yr peak flows in the original report dated November 2015. The k-value was replaced in this addendum, which is dated December 2016. The only changes to the report are in the 50-yr column in Table 15. The changes are documented below.

Table 15: Design Flows (Addendum Updates)

Location	50-Yr Original (2015)	50-Yr Addendum (2016)
Searsville Inflow	3,880	3,700
Searsville Outflow	2,760	2,630
Bear Creek U/S SFC	2,670	2,570
Los Trancos U/S SFC	1,410	1,350
SFC U/S Los Trancos	5,750	5,500
USGS	7,010	6,710
Pope Chaucer	7,490	7,170
US-101	7,730	7,400
K-Value	1.77716	1.72033

The U.S. Army Corps of Engineers San Francisco District Water Resources Section was notified of the change, reviewed the update, and approved the addendum because there was a minimal adjustment to the 50-yr event flows that was determined insignificant.

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APPENDICES

Appendix A: Technical Memorandum - Effect of Searsville Lake on Large Storm Events. SCVWD. March 25, 2015.

Appendix B: US Army Corps of Engineers Agency Technical Review (ATR) Certification background documents.

Attached separately as electronic files

- HEC-RAS v5.0 BETA Searsville 2D Hydraulic Model
- HEC-HMS v4.0 San Francisquito Hydrologic Model
- SFC Flood Frequency Analysis PeakFQSA Output
- Balance Hydrologics Recorded Data Spreadsheet
- Hydrologic Parameters Spreadsheet
- Channel Routing Spreadsheet
- Design Rainfall Spreadsheet
- 2D Model Output Spreadsheet
- Model Plans Spreadsheet

1. INTRODUCTION

1.1. BACKGROUND

San Francisquito Creek forms the boundary of the Santa Clara Valley Water District's (SCVWD) jurisdiction to the north with San Mateo County. The watershed is approximately 45 square miles, with the majority of the watershed in the rural foothills of the San Francisco Peninsula. The Creek's watershed impacts the cities of Palo Alto, East Palo Alto, and Menlo Park. Stanford University is also a major landowner in the region and owns several reservoirs within the watershed.

San Francisquito has three main tributaries that combine to form the creek proper once it leaves the foothills and enters the urbanized valley. Bear Creek is the northernmost tributary and is unimpaired. To the south, Searsville Lake and Dam collect runoff from Alambique, Dennis Martin, Sausal, and Corte Madera Creeks. Searsville Lake offers some attenuation, but has experienced severe sedimentation over time. On the southeastern edge of the watershed, Los Trancos Creek flows unimpaired, passing Felt Lake, a diversion pond owned by Stanford. All three of these tributaries meet before traveling downstream toward the bay through urbanized neighborhoods.

A location map with information about the creek watershed and sub-watersheds is on Figure 1.

1.2. PURPOSE

The purpose of this report is to update the 2007 San Francisquito Hydrology Report[1] by improving the following items from the old report:

1. Upgrading the numerical model from HEC-1 to HEC-HMS v4.0.
2. Characterizing the routing effects of Searsville Lake and dam by using a 2D hydraulic model.
3. Using revised and improved methodology for design storms, loss, and Clark's hydrograph parameters (Tc & R).
4. Calibrating the numerical model to historical storms.
5. Performing a flood frequency analysis (FFA) on the USGS stream gage and validating the hydrologic design model to the FFA.

To do this, a new hydrologic model that reflects the existing San Francisquito Creek watershed was developed. This model will be used to determine revised 1% and 10% design flows for the entire creek.

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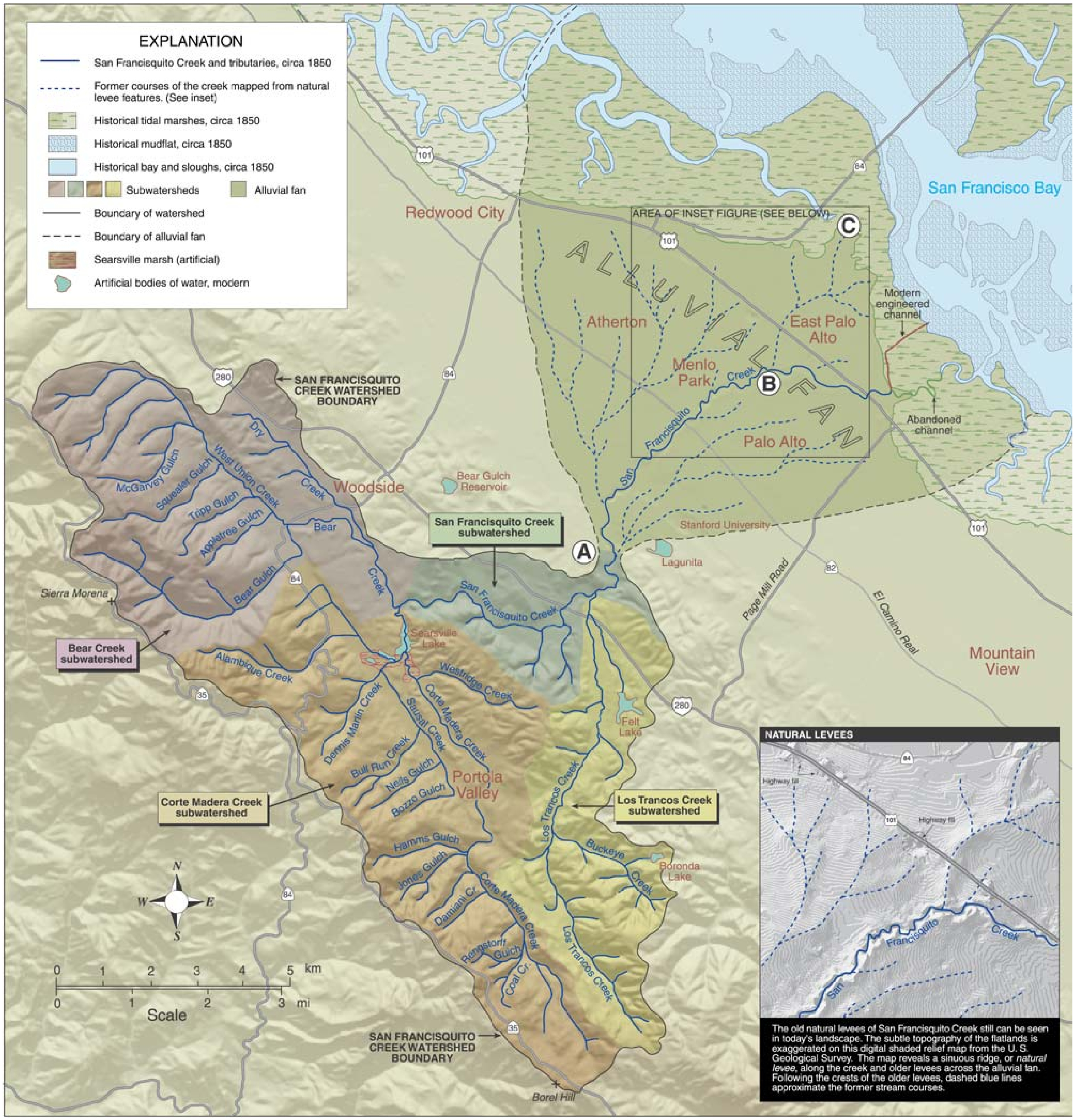
[1] Wang, James et al. SCVWD. San Francisquito Creek Hydrology Report. April 2006, Revised December 2007.



The old natural levees of San Francisquito Creek still can be seen in today's landscape. The subtle topography of the flatlands is exaggerated on this digital shaded relief map from the U. S. Geological Survey. The map reveals a sinuous ridge, or *natural levee*, along the creek and older levees across the alluvial fan. Following the crests of the older levees, dashed blue lines approximate the former stream courses.

Figure 1: San Francisquito Creek Watershed Map

2. MODEL INPUT PARAMETERS

2.1. WATERSHED DELINEATION

Sub-basin watershed delineation was performed by using the ArcHydro add-on to the original ArcGIS software suite. A digital elevation model (DEM) was created from two sources. For Santa Clara County, the 2006 LiDAR data was used, while for San Mateo County, USGS data was used. These elevation datasets were used to determine flow accumulation patterns and ultimately sub-basin delineations. Each sub-basin within an urban area was double checked manually to ensure that terrain features not picked up by the DEM were included, such as walls and levees. In addition, delineations were manually created at stream gage locations and dams.

Two delineated sub-basins were determined not to contribute to San Francisquito Creek flow. The first is the area tributary to Felt Lake. The second is the Stanford golf course.

2.2. SURFACE RUNOFF METHOD

The Army Corp's HEC-HMS hydrologic modeling software was used to perform this study. The Soil Conservation Service (SCS) Curve Number (CN) method was selected as the loss method, and Clark's Unit Hydrograph (CUH) was selected as the transform method. Since the model will primarily be used to determine design flow rates, it will be used as an event-based model, which is appropriate for the SCS loss method. The CUH method is robust for watersheds of different sizes and shapes. Based on previous experiences, the SCS method combined with CUH transform method works well within the Santa Clara Valley Watershed. This method has been used on studies in adjacent Matadero and Steven's Creek watersheds[2], as well as studies in the nearby Saratoga and San Tomas Creek watersheds[3], all of which have drainage areas from 20 to 45 square miles.

2.3. SUB-BASIN PARAMETERS

Six different variables; (2.3.1) Area, (2.3.2) Initial Abstraction, (2.3.3) Curve Number (CN), (2.3.4) Impervious Area, (2.3.5) Time of Concentration, and (2.3.6) Reach Coefficients must be characterized for each sub-basin and are listed below in further detail.

2.3.1. AREA

This is defined as the total area of the sub-basin in square miles. It is determined from area measurements performed in ArcGIS.

2.3.2. INITIAL ABSTRACTION

Initial abstraction represents the initial loss on each sub-basin, and also has bearing on the runoff equation used in HEC-HMS for CN method. The default relationship outlined in the SCS CN loss method is that initial abstraction is 20% of sub-basin storage. However, recent

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[2] SCVWD. Lower Peninsula Watershed Hydrology Report. July 2004, revised December 2007.

[3] SCVWD. Hydrology Report – Saratoga and San Tomas Aquino Creeks. May 8, 2013.

research[4], [5] suggests that 5% is a more appropriate value. Storm calibrations within this model have also supported the 5% value suggested by Hawkins and Lim et al. The initial abstraction used for rural sub-basins is defined by:

$$Initial\ Abstraction = 0.05 \times \left(\frac{1000}{CN} - 10\right)$$

While changing the initial abstraction for the SCS CN method, proper procedure dictates that the CN be modified as well, since HEC-HMS adjusts rainfall excess based on initial abstraction, and initial abstraction is related to the sub-basin storage index (S) that was fixed using a 20% ratio during the development of the SCS method. Since S is directly related to CN, the CN number would need to be adjusted as well if the ratio was changed to 5%. However, calibrations suggested that overall volume was matching observations without adjusting CN.

2.3.3. CURVE NUMBER (CN)

Curve number represents the pervious sub-basin characteristic for surface runoff. Internal parameters of curve number are; soil group, land cover type, and antecedent moisture condition (AMC). Curve number development was performed in accordance with a District memorandum[6] on SCS CN determination.

2.3.4. IMPERVIOUS AREA

Impervious area characterizes the amount of area, in percent, within the sub-basin that will experience negligible loss. These areas are generally considered paved urban areas. This value is based on the 2006 National Land Cover Dataset (NLCD) and is aggregated for each sub-basin in ArcGIS.

For watersheds with large amounts of urban areas, an impervious area reduction is commonly used to account for unconnected impervious areas. However, due to the majority rural makeup of the San Francisquito watershed, a reduction was not used.

---

[4] Kyoung Jae Lim, et al. Effects of Initial Abstraction and Urbanization on Estimated Runoff Using CN Technology. June 2006. Journal of the American Water Resources Association.

[5] Hawkins, Richard H. Woodward, Donald E. Runoff Curve Number Method: Examination of the Initial Abstraction ratio. 2002.

[6] Xu, Jack. SCVWD Technical Memorandum. SCS Curve Number Determination, Update #1. January 10th, 2015.

2.3.5. TIME OF CONCENTRATION (Tc)

Time of concentration is the maximum travel time for each sub-basin. The velocity method described in NEH Chapter 15[7] was used to determine time of concentration. General guidelines used by the District are outlined in a technical memorandum[8] on this subject.

In general, possible collectors and collector combinations were categorized into similar slopes and cross sections. A reiterative process was used to solve manning's equation for velocity, given a certain flow depth. The flow depth was determined from a given flow rate that was selected based on USGS regression equations. The equations serve as a broad estimation of the flow for different recurrence events given the sub-basins characteristics. Therefore, several times of concentrations for each sub-basin were developed, depending on the flow.

2.3.6. STORAGE COEFFCIENT (R)

The storage coefficient represents the amount of storage and attenuation that will not be lost within the sub-basin for the CUH method. This variable will change the shape of the runoff hydrograph. Studies[9] have shown that the storage coefficient ratio remains constant over a large watershed area:

$$Ratio = \frac{R}{R + Tc}$$

A ratio above 0.5 implies more storage and a wider hydrograph with a smaller peak flow. A ratio below 0.5 implies a narrow response with a larger peak flow. This value is held constant for each general topographic area within the Coyote Watershed for all calibration events. For the entire San Francisquito Creek watershed, calibrations supported a storage coefficient ratio of 0.5.

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[7] USDA NRCS. Part 630 Hydrology, National Engineering Handbook. Chapter 15, Time of Concentration.

[8] Xu, Jack. SCVWD Technical Memorandum. Time of Concentration (Tc). November 10, 2014.

[9] USACOE HEC-HMS Users Manual v3.5. August 2010. Chapter 7, pg.141.

2.4. REACH ROUTING PARAMETERS

All reach routing was performed from sub-basin to sub-basin using the Muskingum-Cunge method in the hydrologic model, except for Searsville Reservoir. Muskingum-Cunge is an extension of the Muskingum method, which overcomes difficulty in estimating parameters that are not physically based. According to the HEC-HMS technical reference manual[10], Table 19 lists the Muskingum-Cunge routing method as having the most flexibility. In addition, this routing method has been used successfully in previous studies, similar to CUH as mentioned in Section 2.2.

Slopes were taken using elevations at 10% and 85% of the reach length. Manning's roughness coefficients and channel geometry were estimated using aerial images and field visits. For creek reaches downstream of the Los Trancos Creek confluence, a HEC-RAS existing conditions model is available[11]. Channel geometries and slopes were taken from this model and input into the hydrologic model. These geometric parameters did not change during calibration and are summarized in Table 1.

The following assumptions were made to fit the scope of this report in determining design flows:

- All stream channels contain all the flows. There are no breakouts or spills.
- There are no flows entering or leaving the watershed boundaries from spills.

---

[10] USACOE HEC-HMS Technical Reference Manual. March 2000.

[11] Noble Consultants. Final Report – San Francisquito Creek Hydraulic Modeling and Floodplain Mapping, Existing Condition. Volume I: Channel Hydraulic Modeling. August 2, 2010. Prepared for USACE SF District.

Table 1: Reach Routing Parameters

Reach ID	Length (ft)	Channel n-value	Slope (ft/ft)	Slope/n Determination
SFQ_A1_ChnRT	9596	0.05	0.002111	GIS & Field Visit
SFQ_AA14_Z_ChnRT	5293	0.05	0.003862	GIS & Field Visit
SFQ_E_z_ChnRT	18751	0.043	0.00544	RAS
SFQ_G1_ChnRT	7200	0.05	0.021	GIS & Field Visit
SFQ_G2_Z_ChnRT	11000	0.05	0.0137	GIS & Field Visit
SFQ_G5_Z_ChnRT	2049	0.05	0.007112	GIS & Field Visit
SFQ_G6_Z_ChnRT	6264	0.043	0.00694	RAS
SFQ_H_Z_ChnRT	7062	0.043	0.00565	RAS
SFQ_J2_Z_ChnRT	4971	0.043	0.00322	RAS
SFQ_L_Z_ChnRT	10142	0.043	0.00252	RAS
SFQ_M_Z_ChnRT	9361	0.043	0.00201	RAS
SFQ_N_Z_ChnRT	7761	0.03	0.00045	RAS
SFQ_B1_ChnRT	17495	0.05	0.005323	GIS & Field Visit
SFQ_D_ChnRT	6588	0.06	0.002921	GIS & Field Visit
Reaches only in "No Searsville Lake" Model				
SFQ_BB11_ChnRT	7172	0.05	0.003923	GIS & Field Visit
SFQ_BB13_ChnRT	6616	0.05	0.006561	GIS & Field Visit
SFQ_C6_ChnRT	6197	0.05	0.003009	GIS & Field Visit

2.5. DETENTION FACILITIES

In the San Francisquito Creek watershed, there are three notable detention facilities; Felt Lake, Lake Lagunita, and Searsville Lake.

Felt Lake is used as a water supply source for Stanford University, and generally does not impact the overall flow of the watershed. This is also true for Lake Lagunita, which detains runoff from the campus golf course. Conversations with Stanford facilities revealed that Felt Lake and Lake Lagunita have never overtopped, even during the storm of record in 1998. In addition, a sensitivity study performed by peer review showed very little impact. Therefore, both lakes and the contributing runoff area were taken out of the model.

Searsville Dam is a 68-foot-high concrete gravity dam that is comprised of large concrete blocks. It was built in 1892 by the for-profit Spring Valley Water Company, and was acquired by Stanford University in 1919. Stanford University has not used the reservoir for water supply since 2013[12]. Searsville Lake impounds almost 15 square miles of the watershed behind it.

Due to ongoing sedimentation, at rates that are estimated to vary between 3.6 acre-feet to 23.5 acre-feet per year over the lifespan of the dam[13], the lake only has about four feet of storage before spilling, if empty. This amounts to less than 10% of the original water capacity, which is approximately 90 acre-feet. However, the backwater effect caused by the dam, the wetland behind it, and surrounding low-lying areas, has caused significant attenuation in the past. Observations from historical events suggest that typical volume/discharge methods would not be sufficient. To route the flow from the upland tributaries, through the lake, and out the dam, a 2D hydraulic model was used.

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[12] Stanford University Website. http://news.stanford.edu/searsville/. Updated 5/5/2015. Accessed 10/5/2015.

[13] Northwest Hydraulic Consultants, Balance Hydrologics, HT Harvey Associates, Jones & Stokes, Matt Kondolf, Jerry Smith. Searsville Lake Sediment Impact Study. March 2002. Stanford University, Facilities Operations

2.6. SEARSVILLE LAKE 2-D HYDRAULIC MODEL

HEC-RAS Version 5.0 BETA, October 2014 release, was used to properly model Searsville Lake. A 2D computation mesh was created by using a *.LAS dataset from the 2006 LiDAR survey that generated a digital terrain model with 10' x 10' squares. This dataset was cleaned to remove errant reflectivity data from foliage and buildings by the survey vendor. Relevant hydraulic structures were inputted with data from Balance Hydrology's 1D HEC-RAS model[14] of Searsville that was sent to the District for review in 2014. The outfall of the entire model was modeled as a 2D Boundary Condition Line, whose conditions were determined using a rating curve generated from Balance Hydrology's model. This curve was double checked with recorded stage and flow data from historical events, which was also provided by Balance.

The 2D Boundary Condition Line spans six grid elements, and during simulation, five of those grid elements are wetted. Due to program limitations in the beta, water surface elevations can only be determined on a grid-by-grid basis while in the 2D domain. Conversation with Gary Brunner, lead developer at HEC, revealed that the computational scheme allows for different water surface elevations within each grid at the boundary condition line. Each grid independently uses the rating curve based on its connection at the boundary condition line. Therefore, there are slight variations in the water surface elevations, depending on grid characteristics. To force a singular output for the water surface, the 2D domain would need to be connected to a 1D cross section within the reservoir. Since bathymetry is not available, the five wetted grids will be averaged to determine a single water surface elevation, which will be used to determine flow from the rating curve.

Late in the peer review process, inaccuracies in the terrain data were discovered regarding the resolution of Corte Madera Creek and the Stanford Causeway gap. The former was addressed by using recently surveyed cross sections present in an existing Balance Hydrologics HEC-RAS model. The cross sections were used to adjust the terrain to reflect surveyed conditions. For the Stanford Causeway, the bridge piers in the crossing were added to the terrain. The bridge deck was not modeled since the 100-yr WSEL does not reach the low chord. A sensitivity analysis was performed between the two sets of terrain using both the 24-hr and 72-hr 100-yr design storms. The outcome was a 0.05' difference in WSEL at the dam and a resulting flow change of under 5%. Therefore revised terrain was only used in determining the 10-yr and 100-yr design storms, while the original terrain was still used for calibration and sensitivity studies.

Computational point spacing for the mesh was set at 100' x 100' and 50' x 50', depending on the detail required. A sensitivity analysis that ran the same model at a 10' x 10' mesh showed negligible output difference. The diffusive wave computational method was selected over the full dynamic solution due to the lack of potential energy losses through obstructions. A sensitivity analysis using different methods also yielded negligible difference.

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[14] Sears_US_JPA_052114.prj. Balance Hydrology is Stanford University's consultant.

To properly characterize the lake, several historical calibrations needed to be run to determine if the model is accurate. When available, stream gage data was used as input into the model. HEC-RAS inputs from other tributaries that were not gaged were estimated. Using the following storm events, a final manning's roughness coefficient of 0.1 worked well for all the storms.

- December 2012 (Figure 2)
- March 2011 (Figure 3)
- January 2010 (Figure 4)
- December 2005 (Figure 5)
- February 1998 (Figure 6)

To estimate the HEC-RAS inflow inputs from the Searsville Lake tributaries, several methods were employed. For the 2011 and 2010 events, only one tributary (Corte Madera Creek) was gaged. For 1998, there were no gages upstream of the dam. These events also had reliable gage adjusted radar rainfall data, and were used in the historical calibrations for the hydrologic model. Therefore, outputs from the HEC-HMS hydrology model were used as tributary inflow inputs for the HEC-RAS models. Parameters used in the HMS model were the same as in the model calibrations for the specific event.

For the 2005 event, only Corte Madera Gage was gaged. However, rainfall data was not reliable. Therefore, the remainders of the tributary inflows were determined by scaling the Corte Madera Creek hydrograph based on drainage area.

The 2012 event had two gaged tributaries. Additionally, a third tributary had visual observations for estimated flow. For the remaining tributaries, flow was determined by scaling the hydrographs from the average of the two gaged tributaries, much like in the 2005 event. However, for the tributary with visual observations, the hydrograph was modified so that the observed flow values properly fit within the rising and receding values of the hydrograph.

Using the calibrated 2D hydraulic model and recorded data, a separate technical memorandum[15] was published. This report attempted to quantify the causes of attenuation for Searsville Lake and the effects of the Lake on San Francisquito Creek during significant storm events. This memorandum is included in this report in Appendix A.

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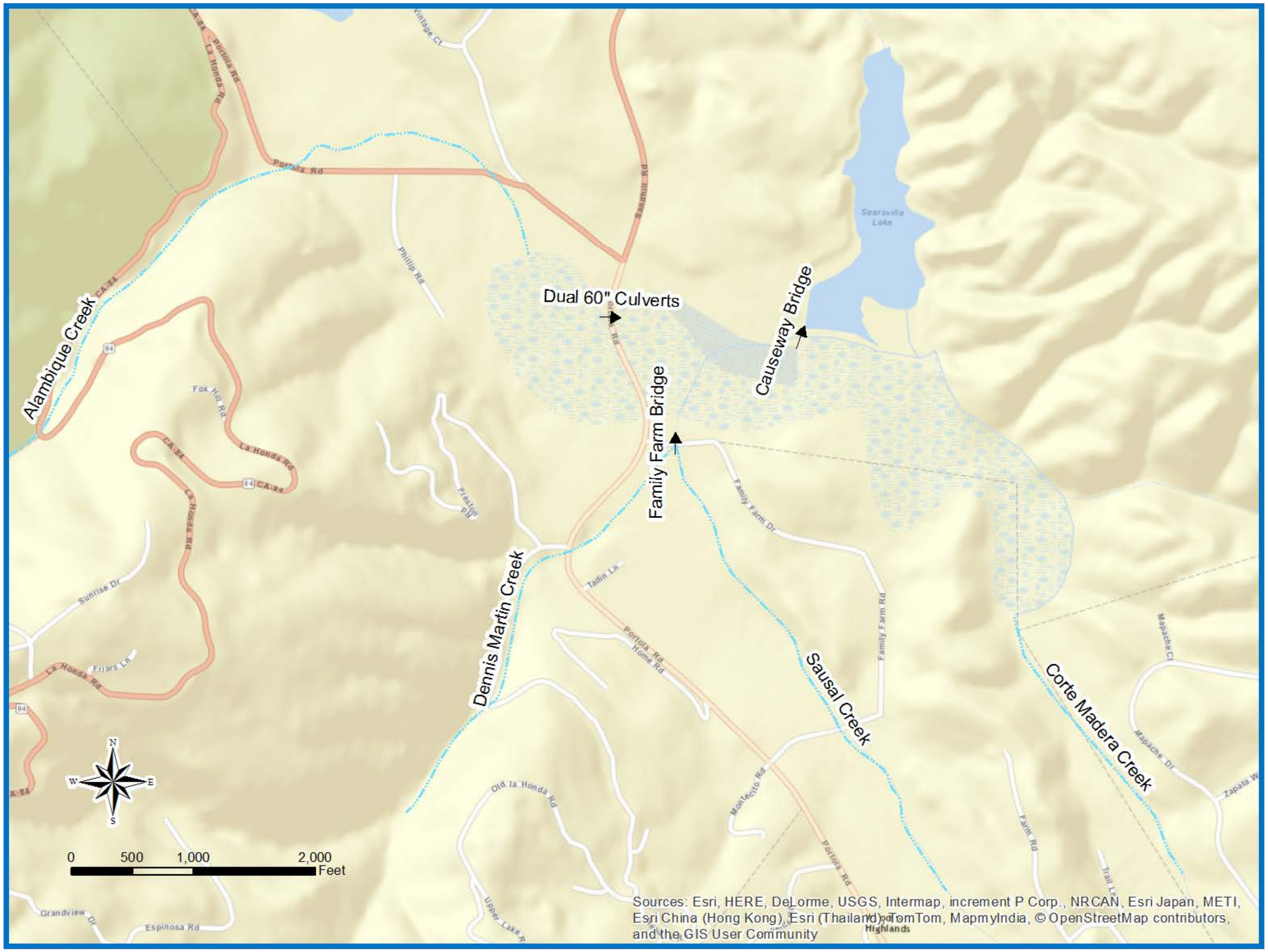
[15] Xu, Jack. SCVWD. Technical Memorandum - Effect of Searsville Lake on Large Storm Events. March 25, 2015.



Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Figure 2: Searsville Lake Detail Map

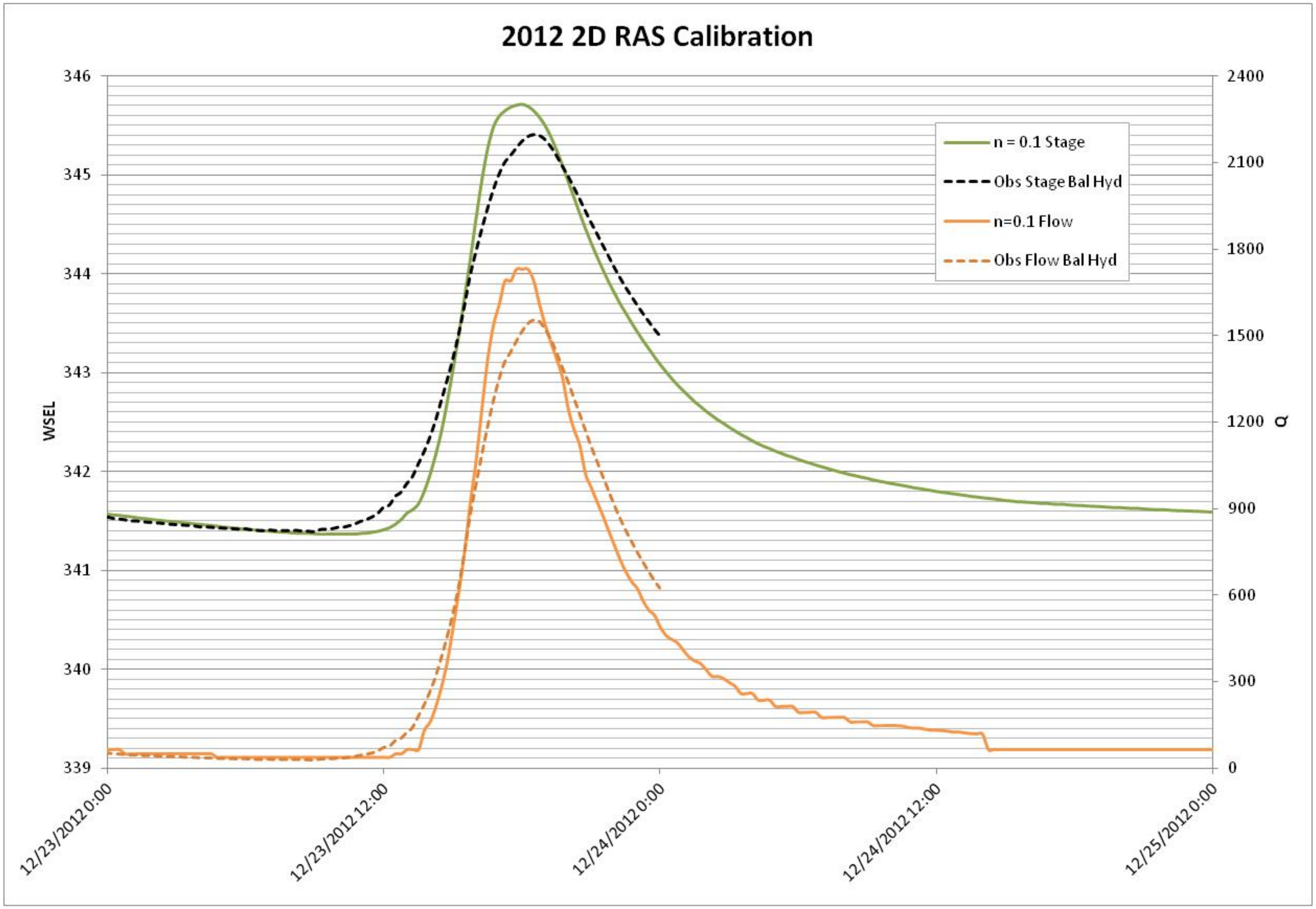


Figure 3: 2012 Searsville 2D Model Calibration

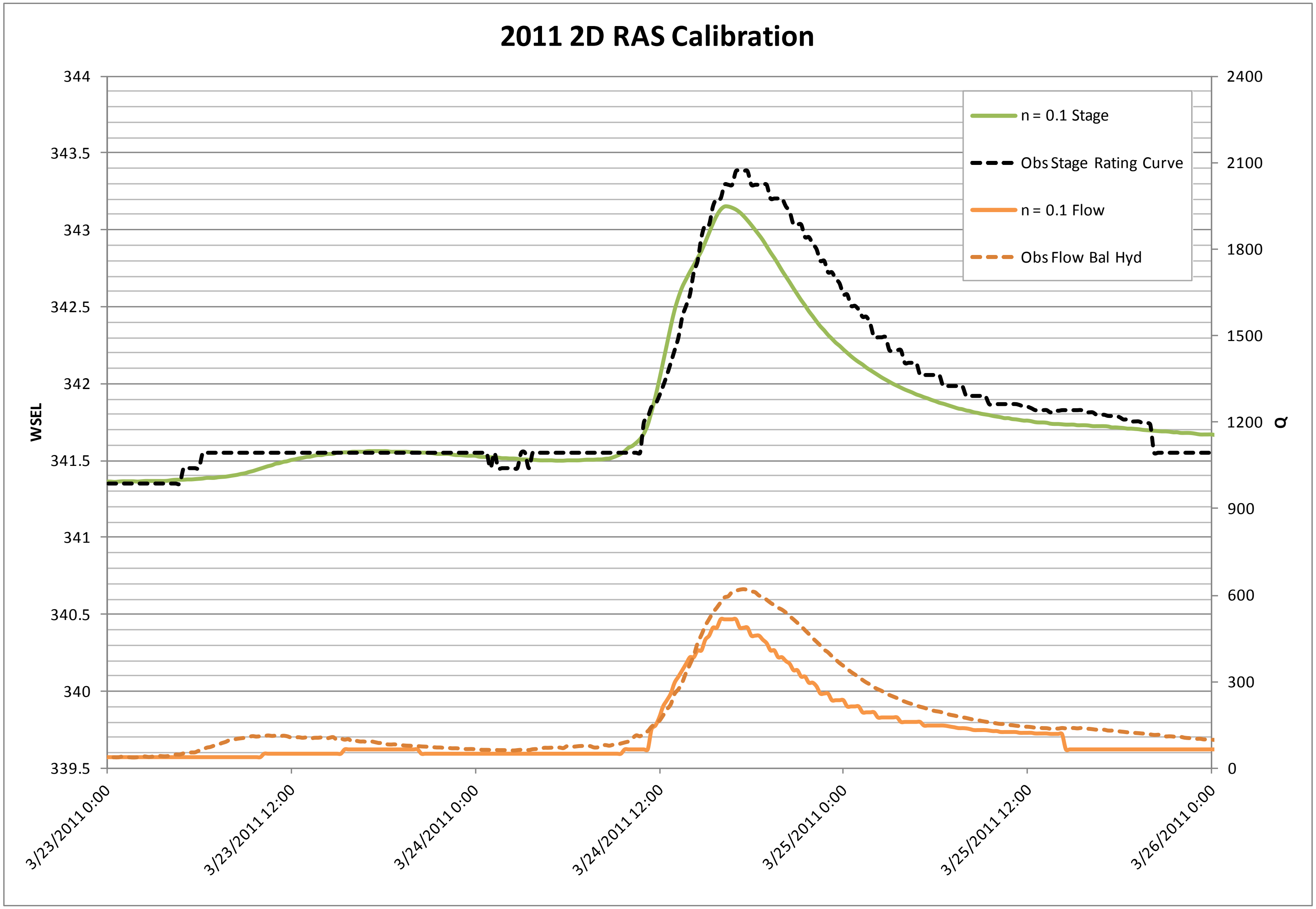


Figure 4: 2011 Searsville 2D Model Calibration

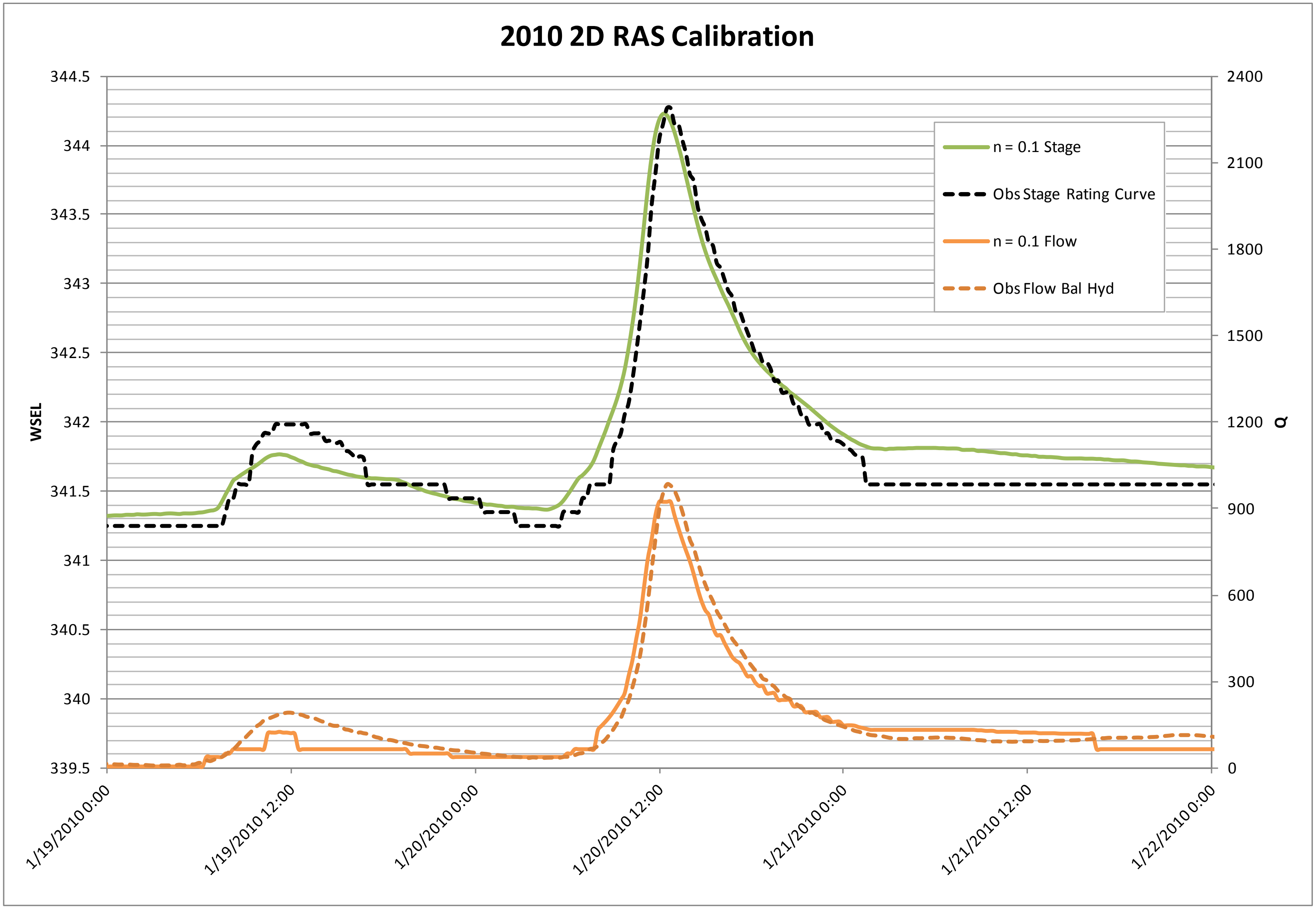


Figure 5: 2010 Searsville 2D Model Calibration

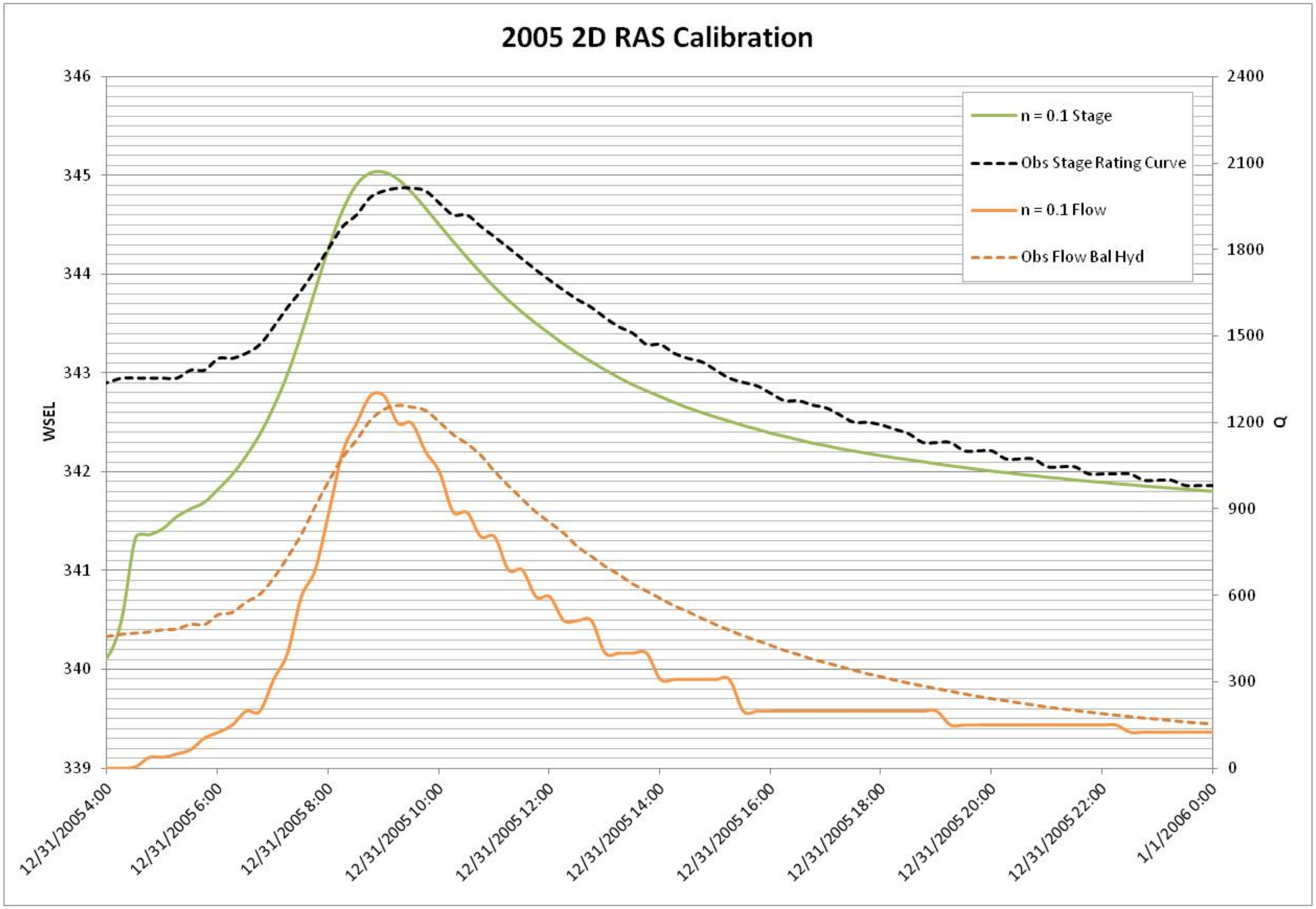


Figure 6: 2005 Searsville 2D Model Calibration

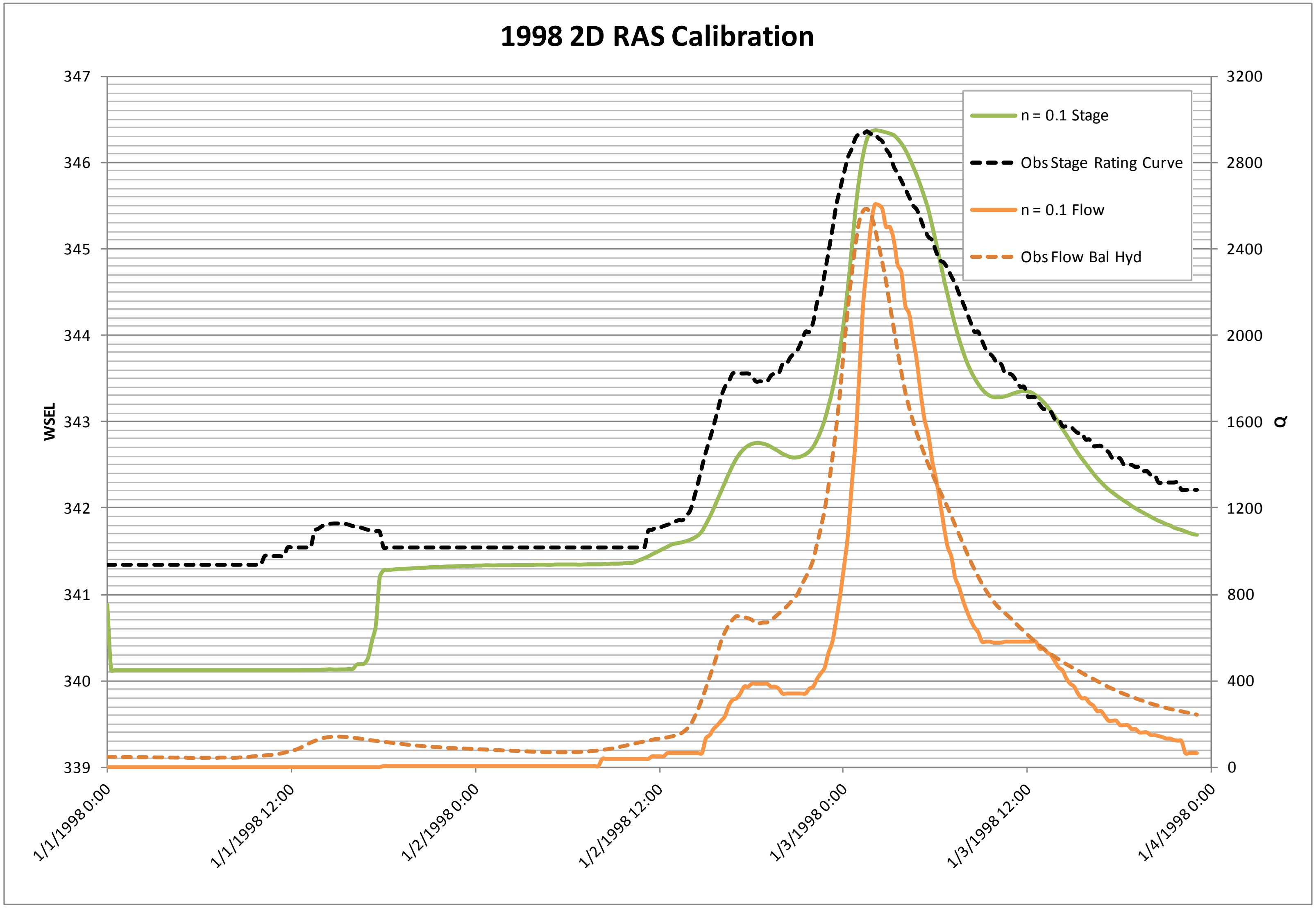


Figure 7: 1998 Searsville 2D Model Calibration

3. MODEL CALIBRATION AND VERIFICATION

3.1. STREAM GAGES

Several stream gages operated by Balance Hydrology (Stanford) have been installed recently on the upstream tributaries of San Francisquito Creek, but data availability for storm events is spotty. There is also a USGS gage, #11164500, near Stanford that has 74 annual maximum observations over 83 years. This gage will be used to determine the flood frequency analysis (FFA).

3.2. CALIBRATION PROCEDURE

The San Francisquito Creek HEC-HMS hydrology model was calibrated and verified to observed stream gage data by using historical gage adjusted rainfall radar data that has been calibrated to observed rain gage data. In short, observed rainfall data was used as input into the hydrologic model for several historic storm events, and the output values compared to observed stream gage data for the same event.

Calibration and verification was done by using the USGS gage recorded flows as the primary gage, since it is considered the most reliable. Gages operated by Balance upstream of the USGS gage were considered suspect for some events. The observed data from these gages were used when evidence did not prove them suspect. However, the observed data was still used as a general reference for suspect events to determine peak timing. Five sub-areas were categorized based on gage catch points to facilitate discussion of model calibration results. The general flowchart is shown in Figure 7.

- Searsville, which includes the area tributary to Searsville Lake and Dam.
- Bear, which includes all of Bear Creek and tributaries up to its confluence to San Francisquito Creek below the Dam.
- Los Trancos, which includes all of Los Trancos Creek and tributaries up to the stream flow gage.
- USGS, which includes all the drainage area from Searsville, Bear, and Los Trancos, to the USGS stream gage
- Urban, which includes the area between the USGS stream gage and the San Francisco Bay.

A map of the five sub-areas, along with the locations of flow measurement stations can be seen in Figure 12.

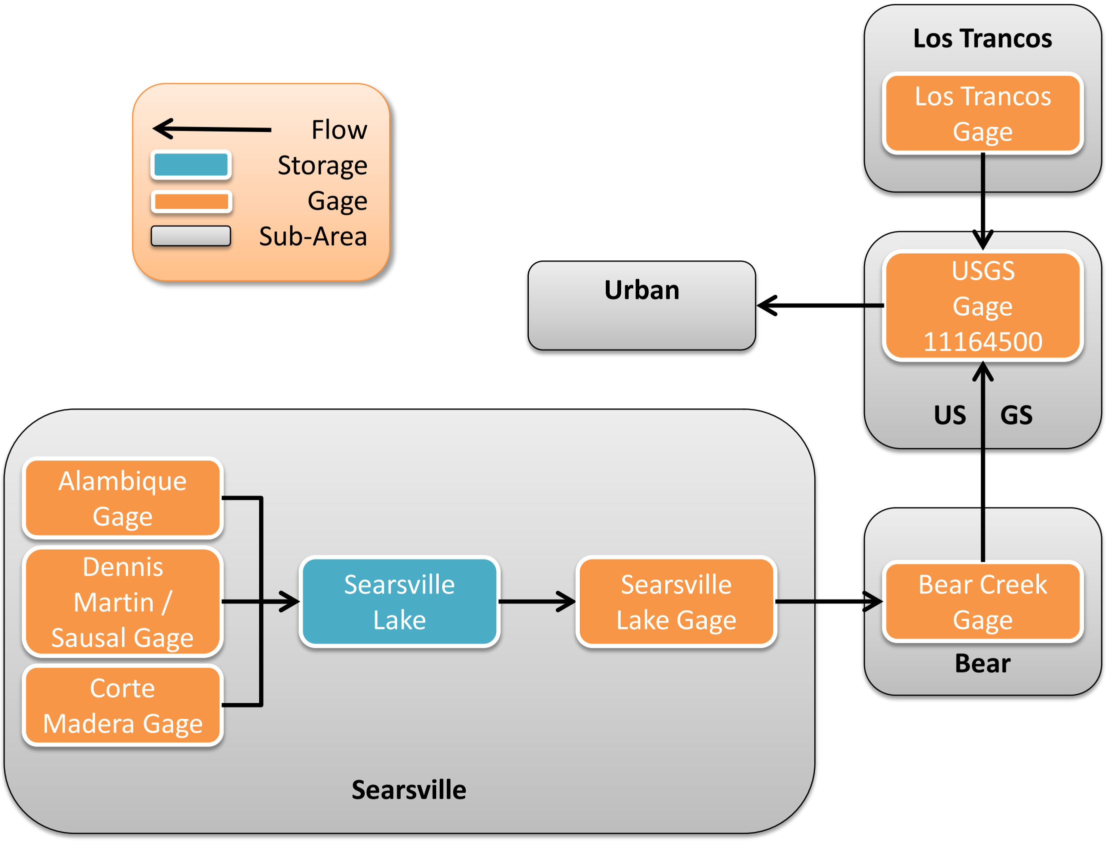


Figure 8: Calibration Sub-Areas

3.3. STREAM GAGE ERRORS

Recorded stream gage data in 2010 and 2011 from Balance are suspiciously low compared to flows measured at the downstream USGS gage. Almost all the runoff is contributed by the majority of the upstream hill watershed, which also gets the most rain. In 2012 and 2006, the total of all the Balance gages was very close to the USGS gage, as shown in Figure 8 and Figure 9. However, in 2011 and 2010, a large amount of flow is missing, shown in Figure 10 and Figure 11. It is likely that there was error in flow measurements from Balance under these circumstances. Therefore, observed Balance stream gate data points for 2011 and 2010 will be used for reference only.

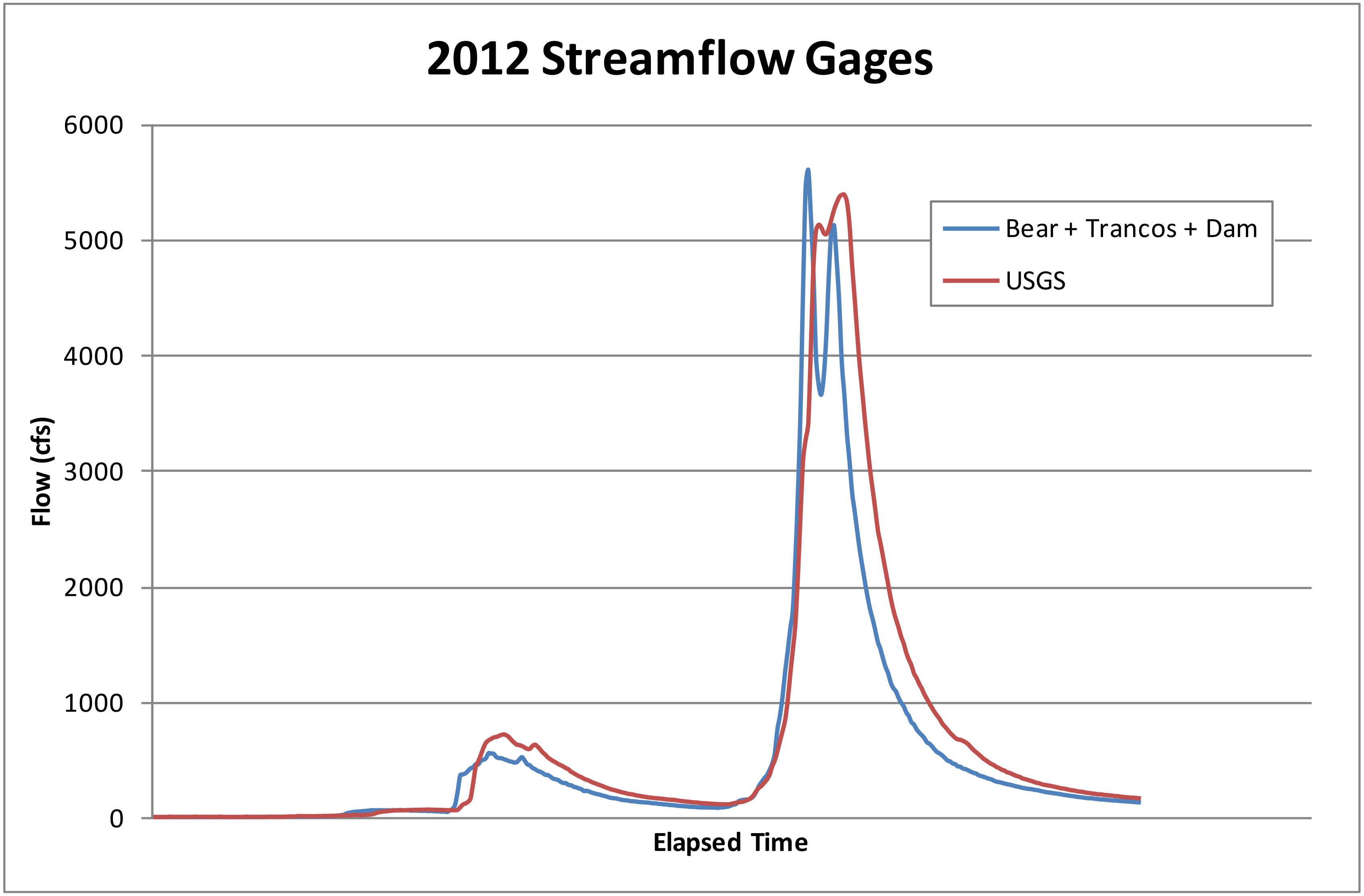


Figure 9: 2012 Streamflow Gage Comparison

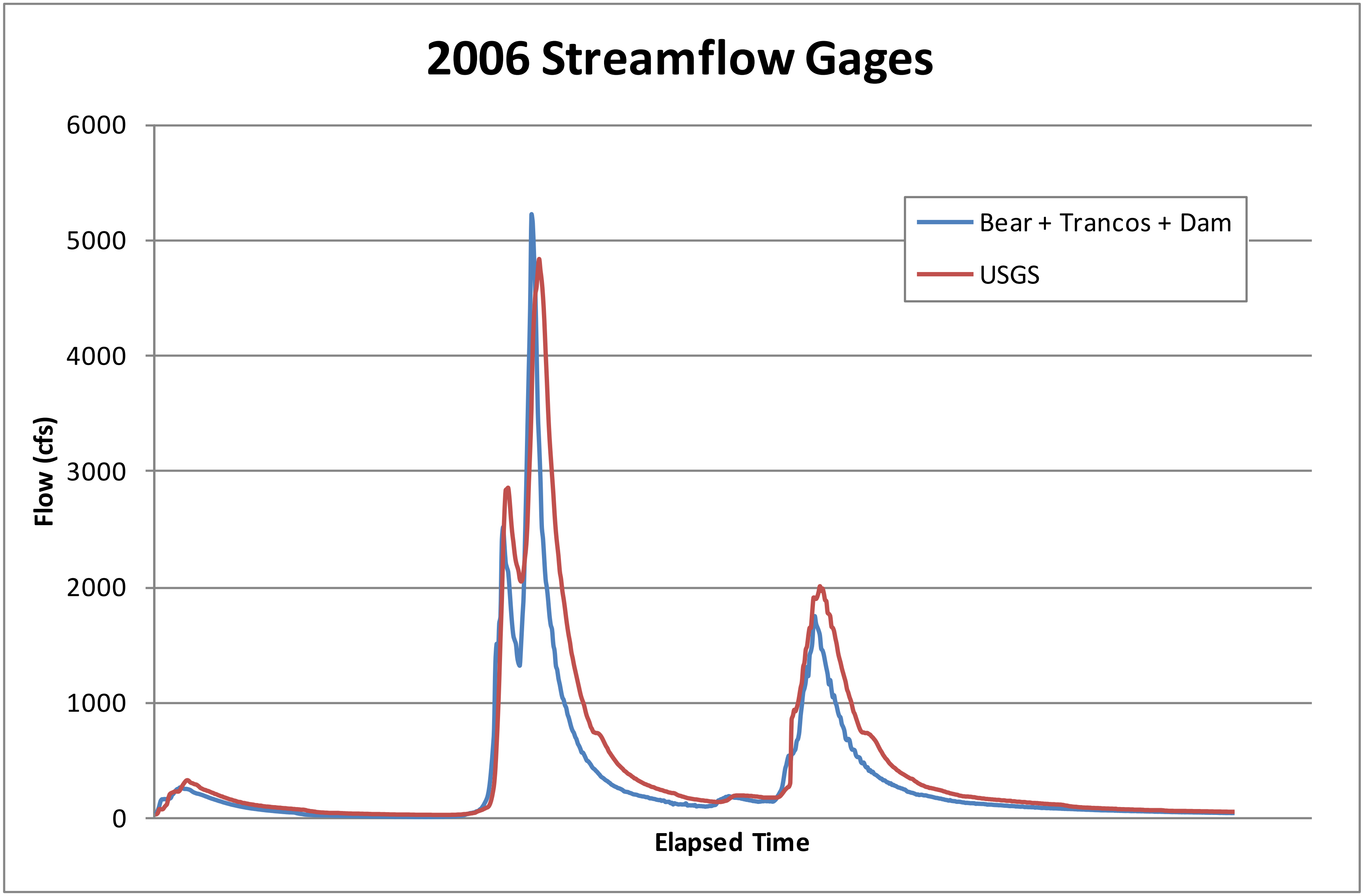


Figure 10: 2006 Streamflow Gage Comparison

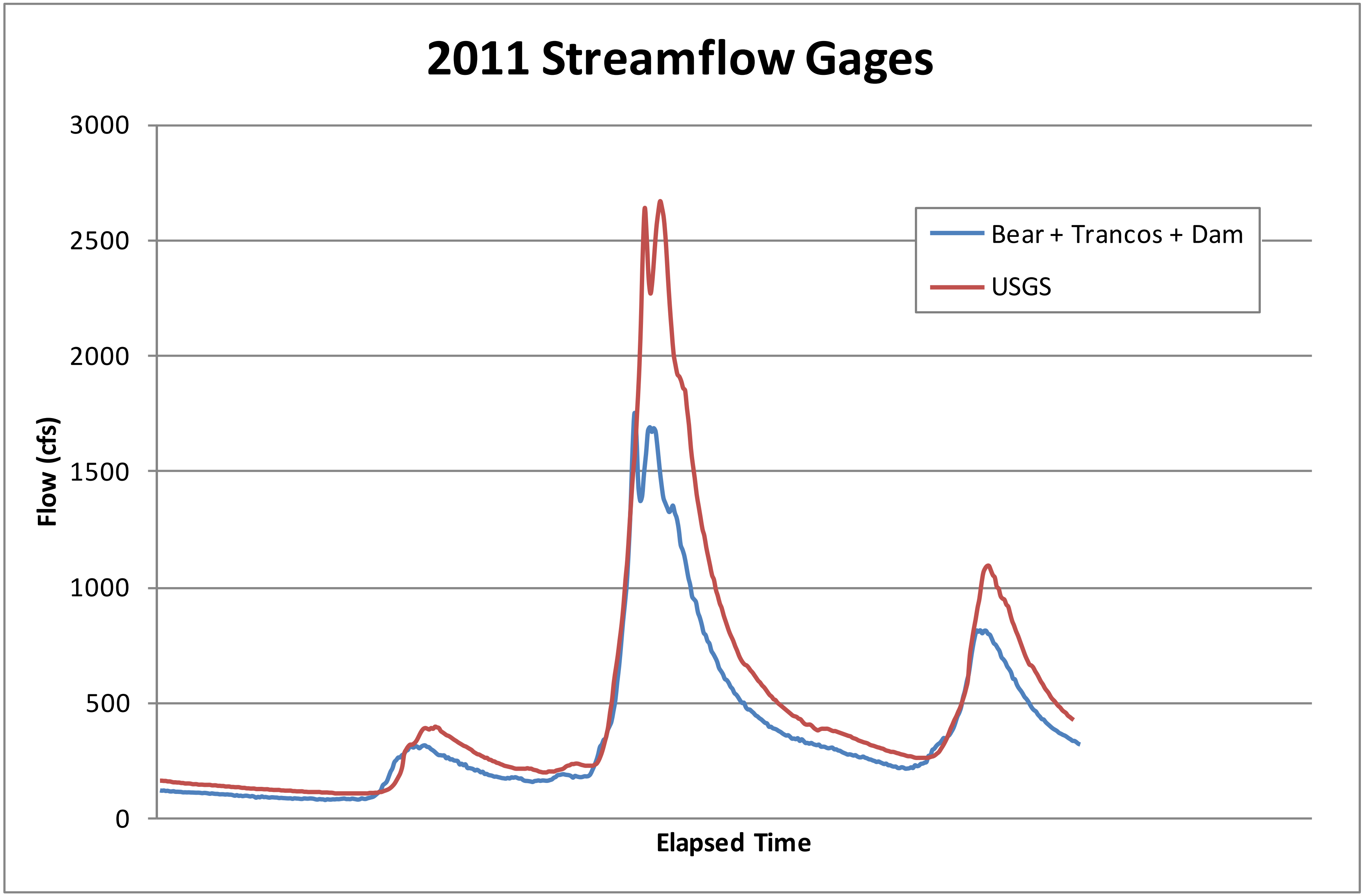


Figure 11: 2011 Streamflow Gage Comparison

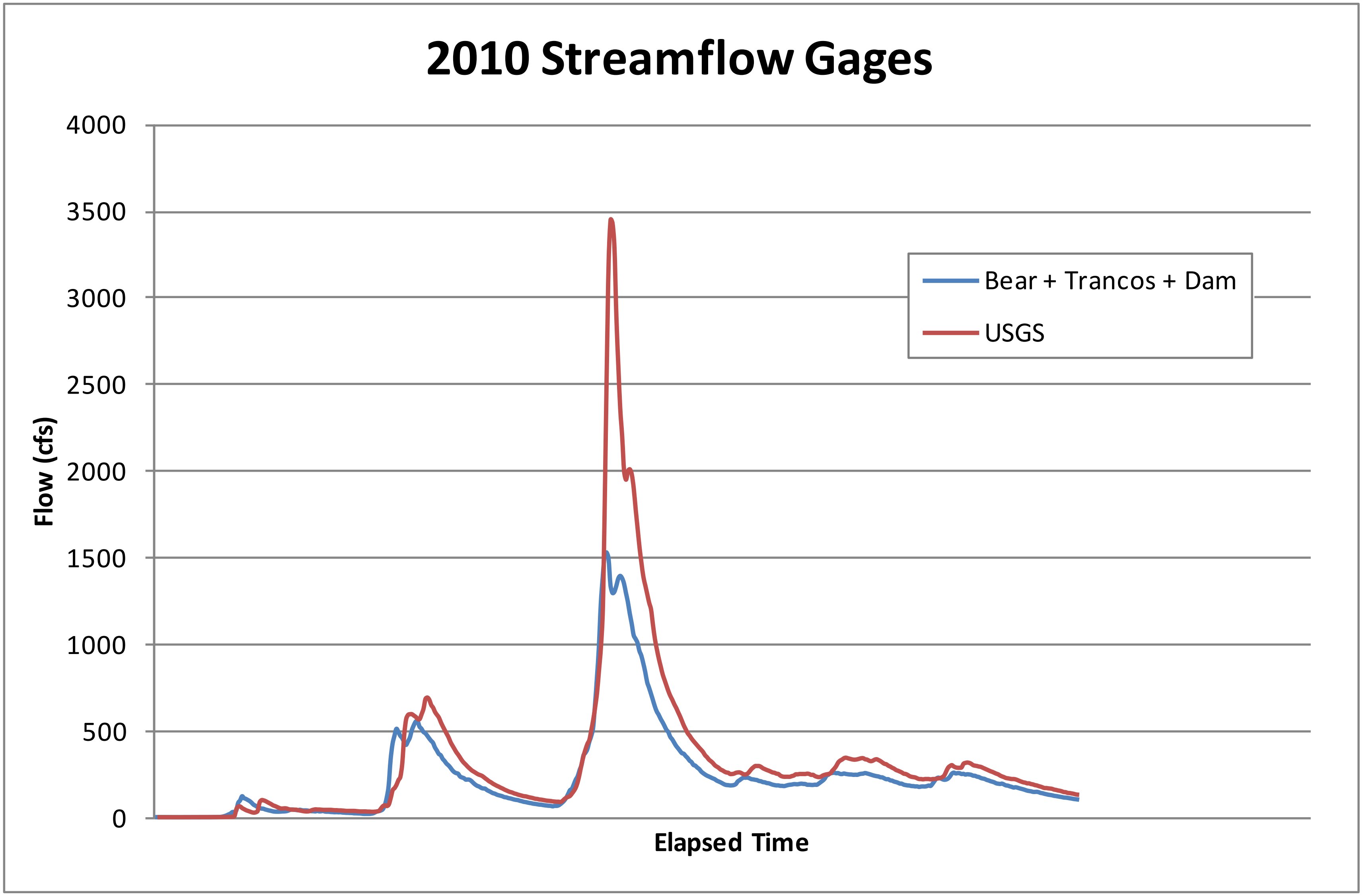


Figure 12: 2010 Streamflow Gage Comparison

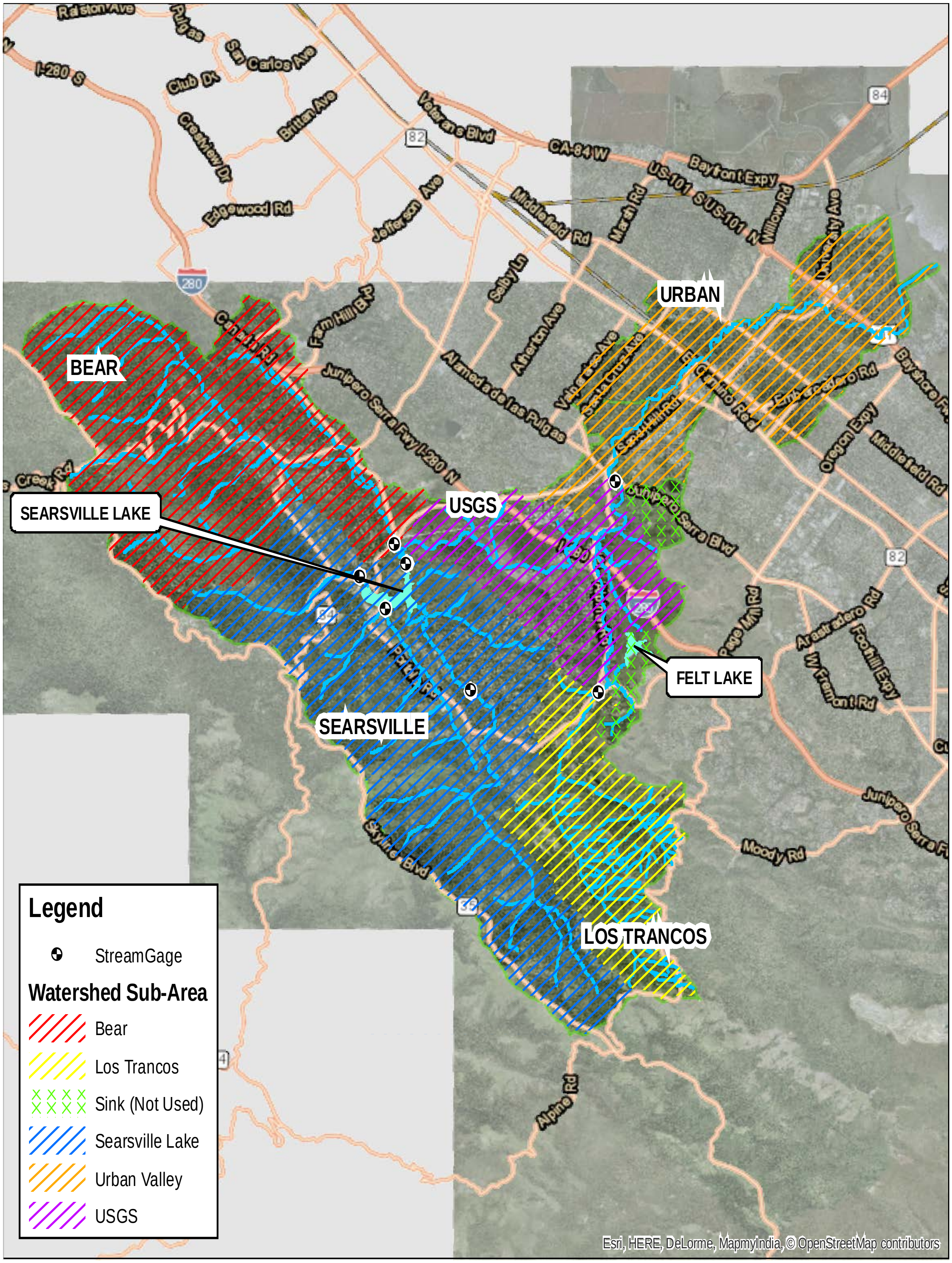


Figure 13: Basin Map

4. CALIBRATION AND VERIFICATION RESULTS

4.1. 02 FEBRUARY 1998

Table 2: February 1998 Model Calibration Parameters

Sub-Area	AMC	Time of Concentration Q*	Storage Coefficient (R) Ratio
Bear	2.25	Q25	0.5
Searsville	1.75	Q10	0.5
Los Trancos	2.0	Q25	0.5
USGS	2.0	Q25	0.5
Urban	2.0	Q25	0.5

**As described in Section 2.3.5 – numbers are based of observed flows at gaging points.*

Three gage locations were in operation for this storm event: USGS, Searsville Lake, and Los Trancos. Since Searsville Lake has already been calibrated, and no gages were in operation upstream of the dam, the observed gage outflow from the dam will be used as input for this calibration event. A 1.75 AMC value for Searsville with a slightly lower time of concentration flow matched well for the 2D model calibration. Flow at the USGS gage matched well.

The peak timing for the Los Trancos gage is slightly later for the modeled result. However, this gage experienced backwater from the downstream fish ladder according to notes by Balance Hydrology. Therefore, this reading serves only as a reference.

The peak timing for the USGS gage is also slightly later for the modeled result and there is slightly less volume in the front end of the hydrograph. However, the calibration results are acceptable. The Bear sub-area antecedent moisture condition (AMC) was increased slightly to 2.25 to bring flows at the USGS gage up to observed values.

Observed flows are in black. Modeled flows are shown in blue. A reference rainfall pattern over Searsville Lake is included under the hydrographs.

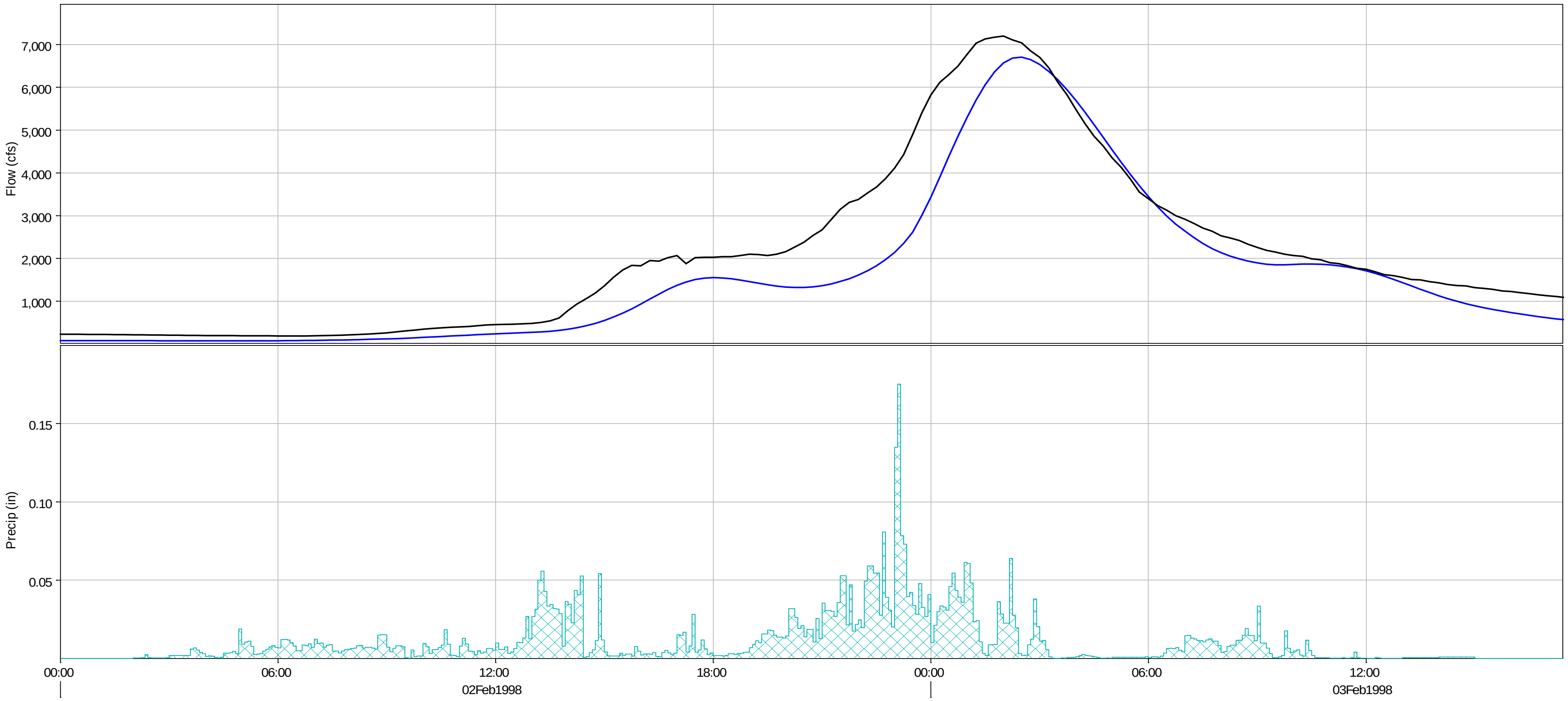


Figure 14: USGS – February 1998

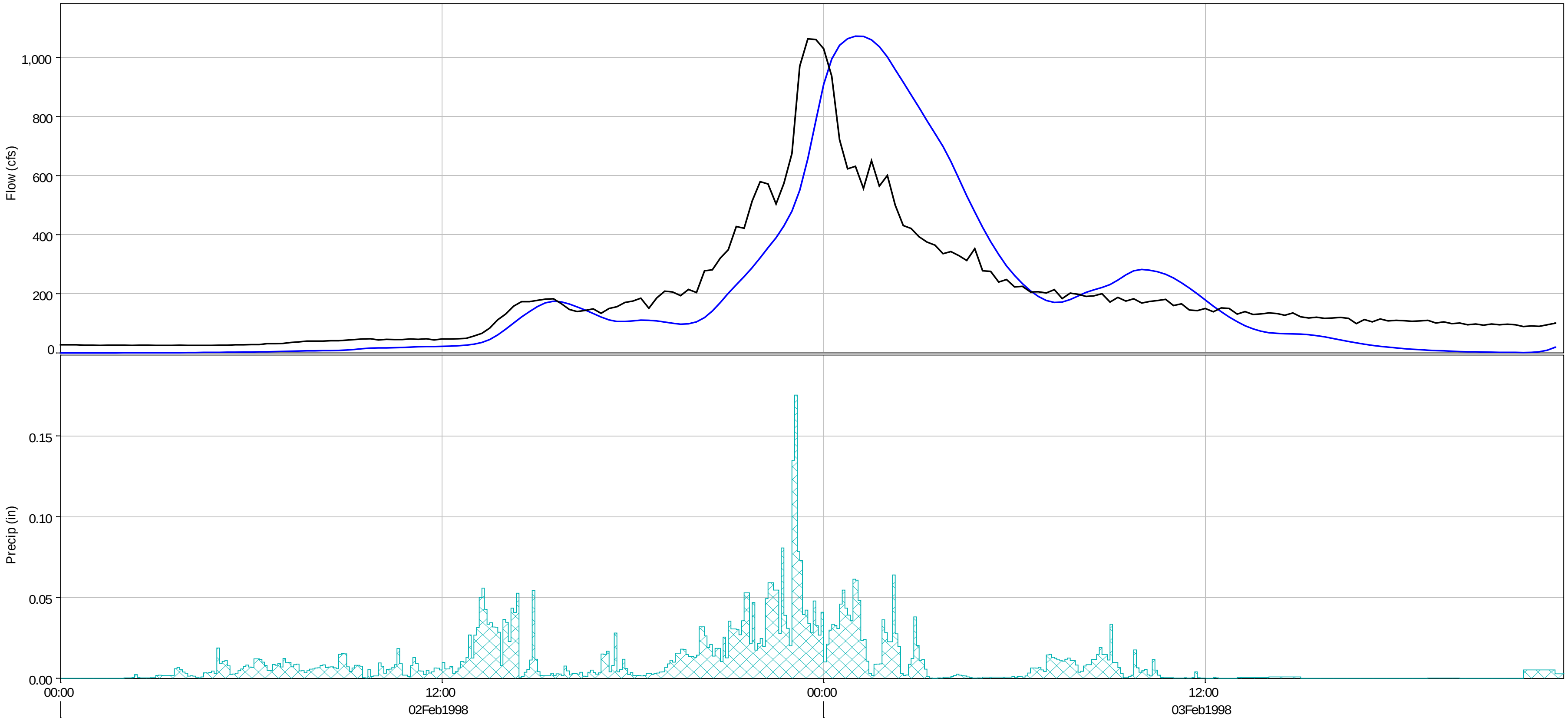


Figure 15: Los Trancos - February 1998

NOTE: *Los Trancos stream flow gage measurements experienced observed backwater from a downstream fish ladder.*

▨ Rainfall
— Model Output
— Observed Data

4.2. 12 FEBRUARY 2000

Table 3: February 2000 Model Calibration Parameters

Sub-Area	AMC	Time of Concentration Q	Storage Coefficient (R) Ratio
Bear	2.75	Q10	0.5
Searsville	2.0	Q10	0.5
Los Trancos	1.75	Q5	0.5
USGS	2.0	Q10	0.5
Urban	2.0	Q10	0.5

**As described in Section 2.3.5 – numbers are based of observed flows at gaging points.*

Three gage locations were in operation for this storm event: USGS, Bear, and Los Trancos. Searsville Lake observed outflow was not available for this date so the 2D hydraulic model was used to supplement. The hydrologic model was run with the parameters shown above, and the output hydrographs upstream of Searsville Lake were used as flow inputs into the 2D model. The resulting 2D spill from Searsville Dam was used as input into the hydrologic model to complete the calibration.

The Bear gage required a very high AMC value of 2.75 to reach the flows observed from the gage. It is suspected that poor rainfall data is to blame. Downstream, observed gage data was used as input. Los Trancos Creek experienced little flow comparatively.

The recorded USGS gage hydrograph has more volume and peak flow than the model. Since most of the flow is controlled by the inputs of Bear, Searsville, and Los Trancos, it is suspected that a combination of low rainfall data affecting runoff volume (evidenced by Bear) and observed stream gage data that is slightly off. Overall, the timing and peak still match well.

Observed flows are in black. Modeled flows are shown in blue. A reference rainfall pattern over Searsville Lake is included under the hydrographs.

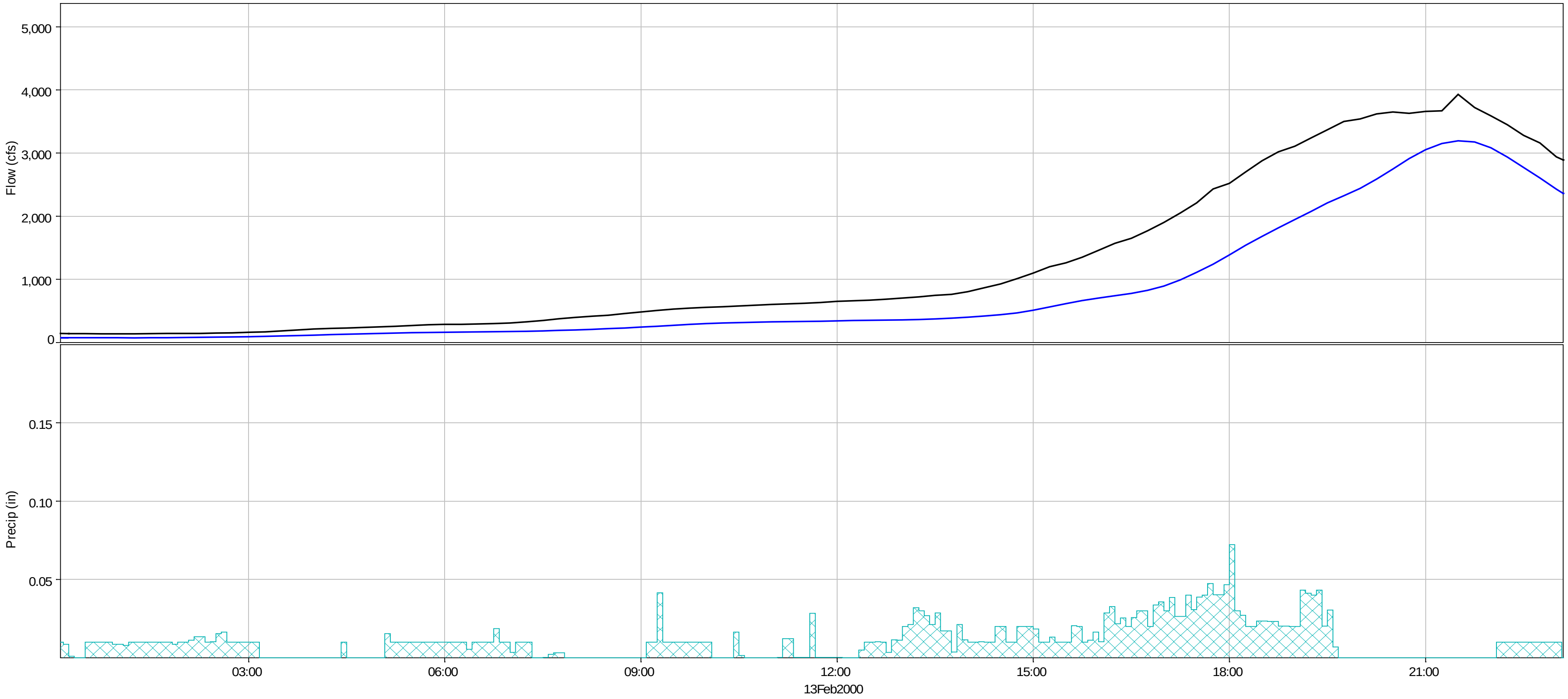
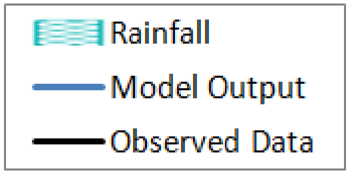


Figure 16: USGS – February 2000

NOTE: *Bear Creek and Los Trancos observed flow data were used as inputs in determining flow at USGS.*



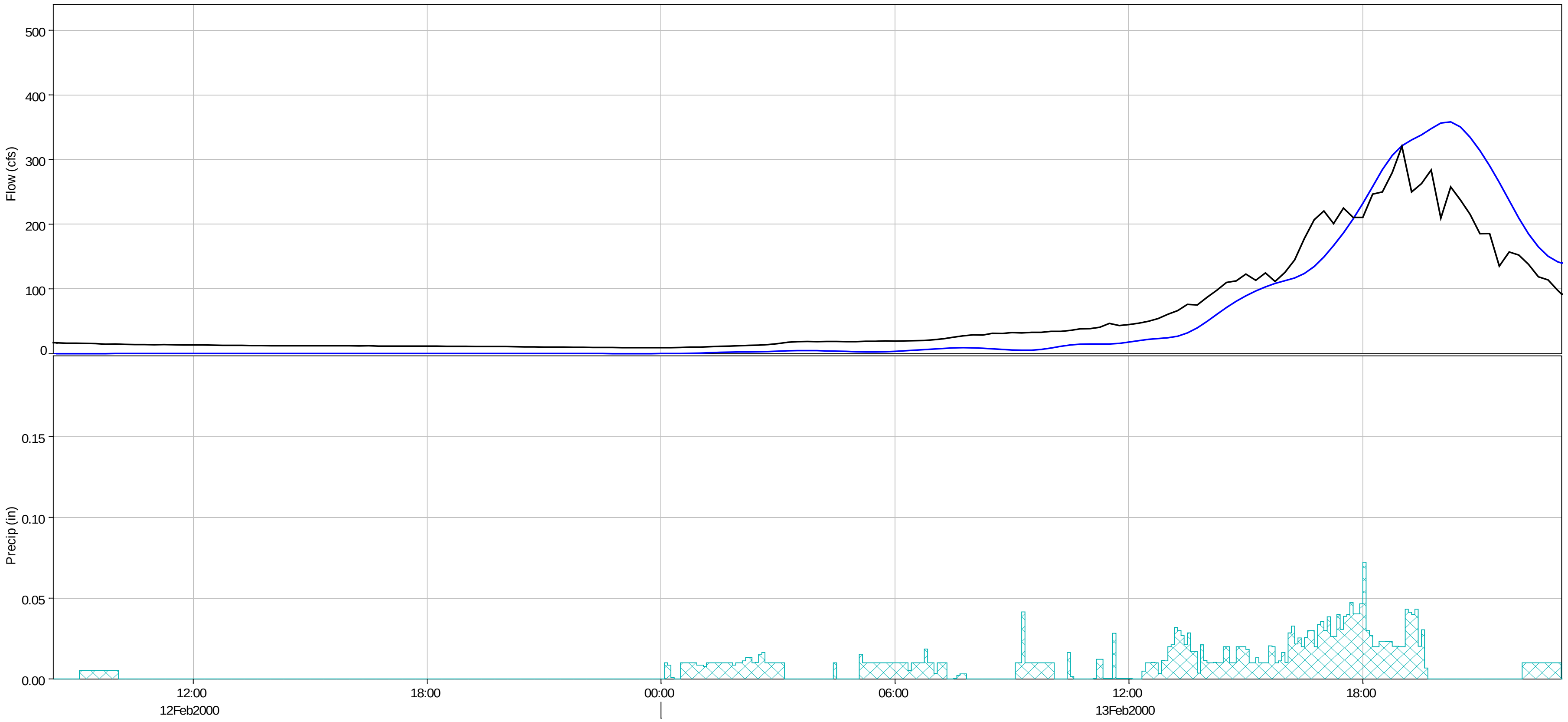


Figure 17: Los Trancos – February 2000

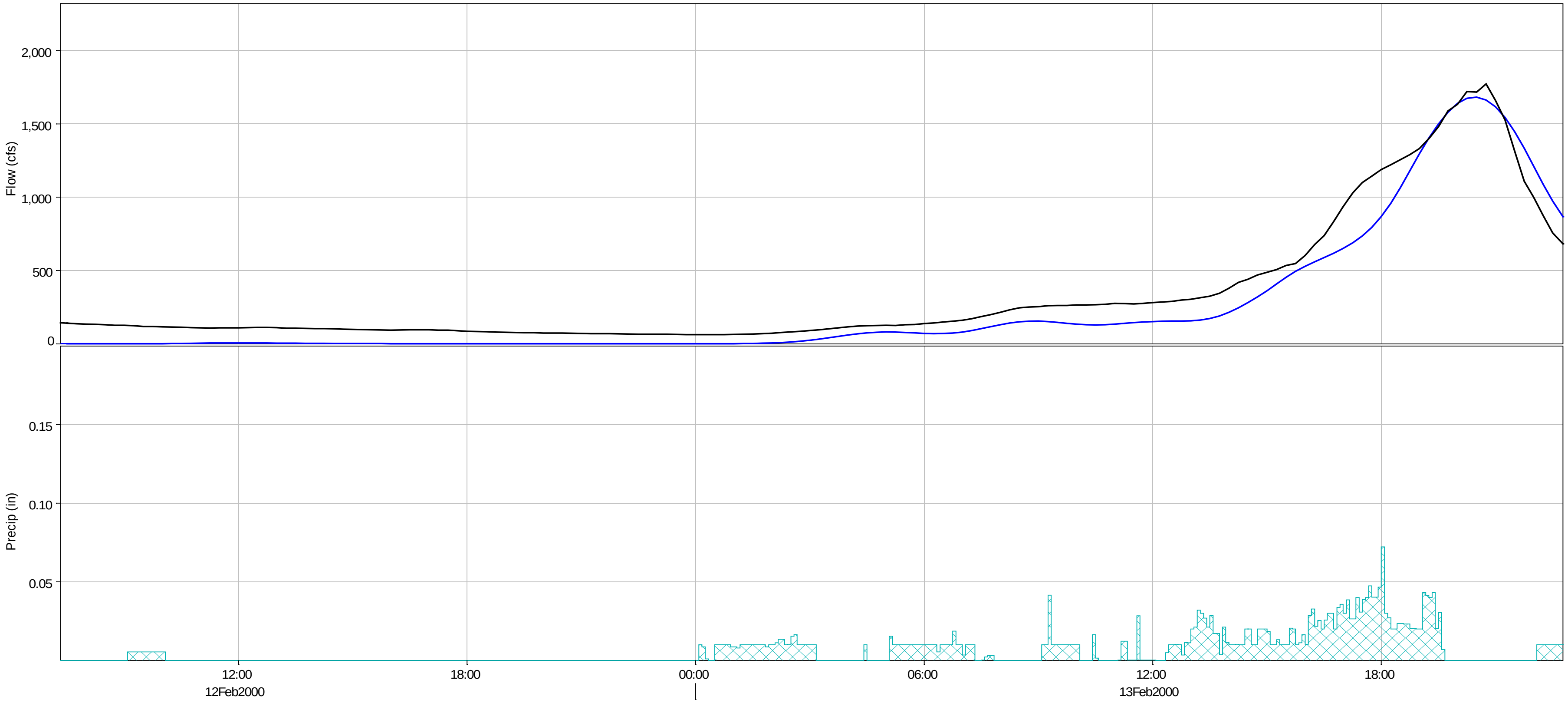


Figure 18: Bear – February 2000

4.3. 18 JANUARY 2010

Table 4: January 2010 Model Calibration Parameters

Sub-Area	AMC	Time of Concentration Q	Storage Coefficient (R) Ratio
Bear	2.0	Q10	0.5
Searsville	1.75	Q10	0.5
Los Trancos	2.0	Q10	0.5
USGS	2.0	Q10	0.5
Urban	2.0	Q10	0.5

**As described in Section 2.3.5 – numbers are based of observed flows at gaging points.*

Five gage locations were in operation for this storm event: USGS, Searsville Dam, Bear, Corte Madera, and Los Trancos. From previous discussion about possible gage errors stemming from Bear and Los Trancos, the observed flow from these gages were not used as inputs. Downstream reference points relied solely on the model.

Using the Searsville recorded outflow, combined with Bear and Los Trancos watersheds at an AMC of 2.0, the modeled flow at the USGS gage matched well with the observed data.
For the Searsville watershed, the only operational gage upstream was Corte Madera. The catch point in the model is downstream of the gage, and therefore a higher modeled flow would be expected. An AMC value of 1.75 computed a flow that is slightly larger than recorded.

Observed flows are in black. Modeled flows are shown in blue. A reference rainfall pattern over Searsville Lake is included under the hydrographs.

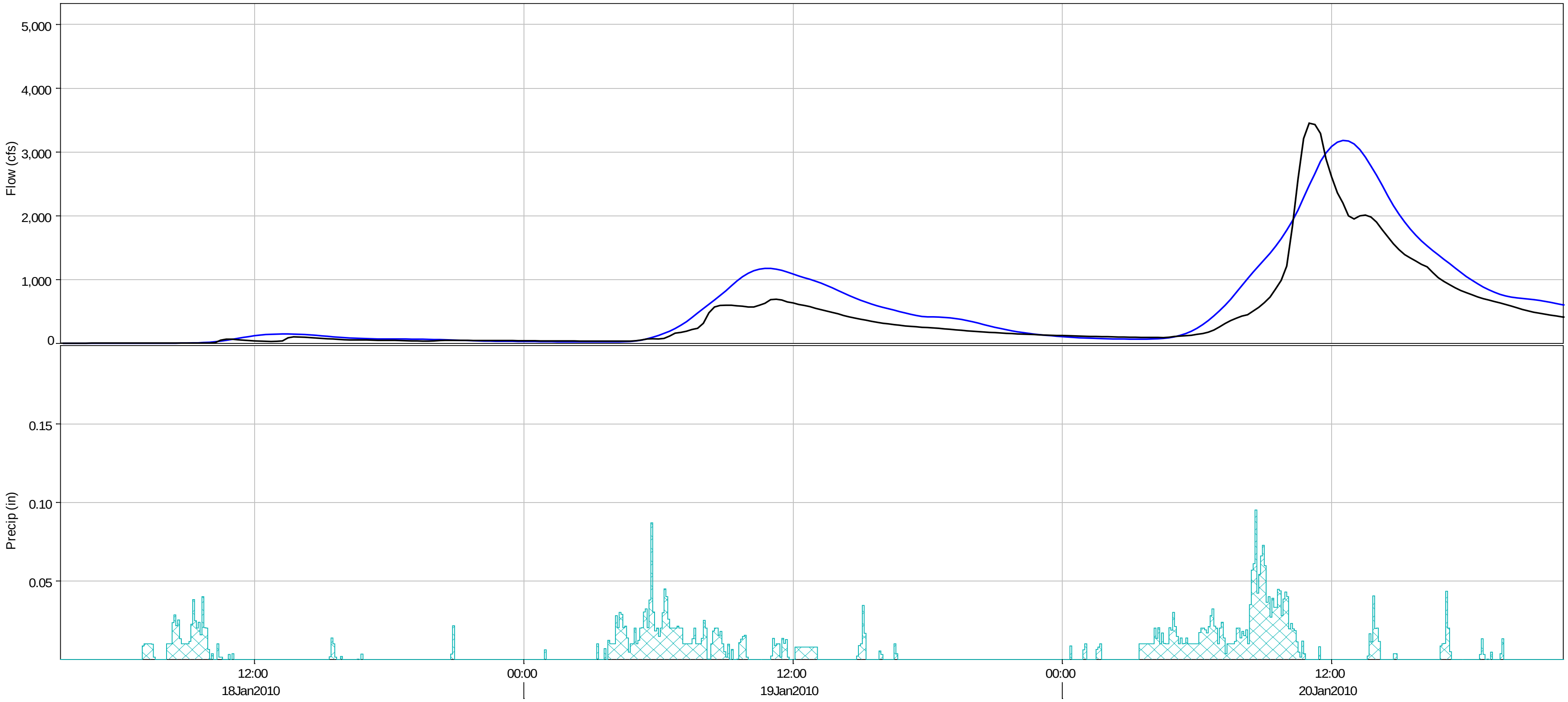


Figure 19: USGS – January 2010

NOTE: *Bear Creek and Los Trancos observed flow data were removed and not used as inputs in determining flow at USGS.*

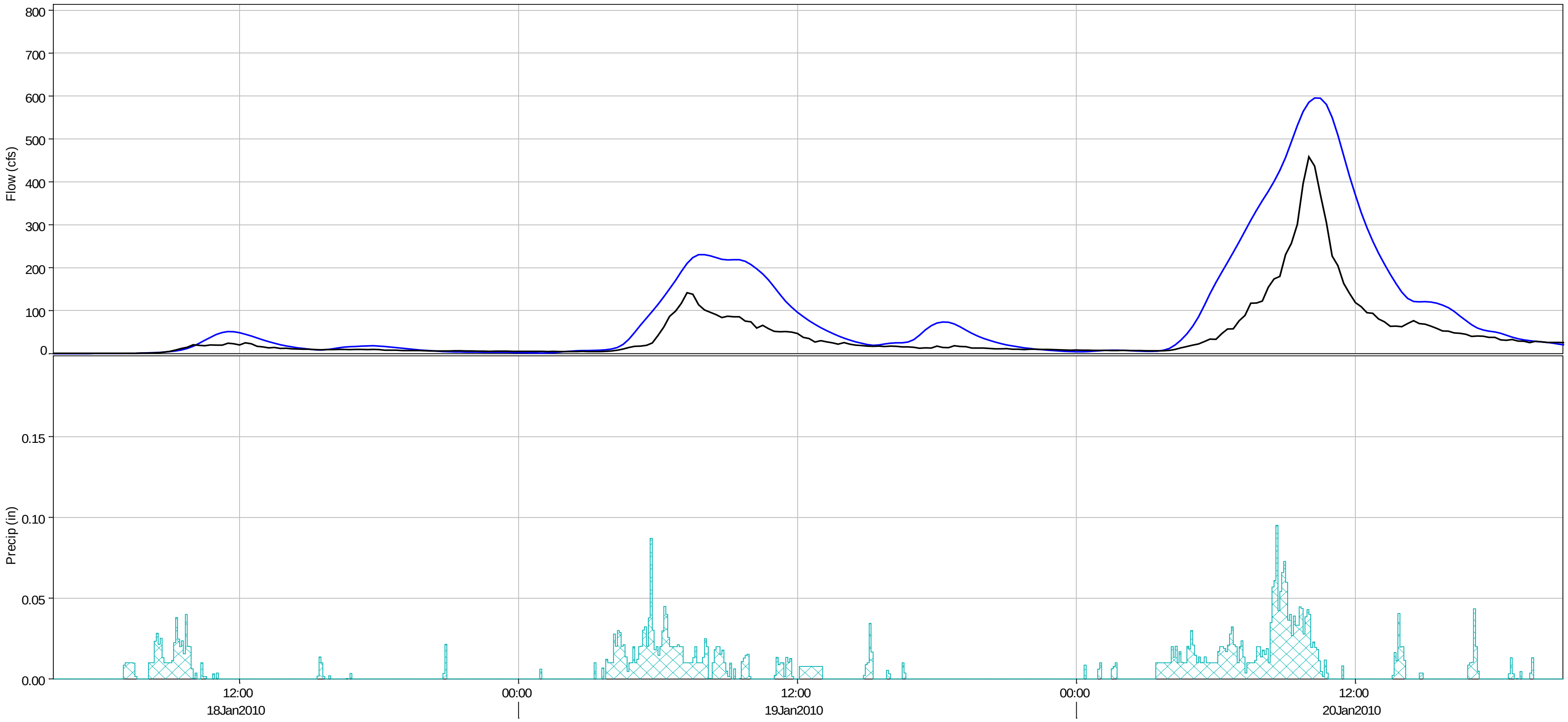


Figure 20: Los Trancos – January 2010

NOTE: *Los Trancos stream flow gage measurements are suspected to be low. Observed data should be used as a rough reference.*

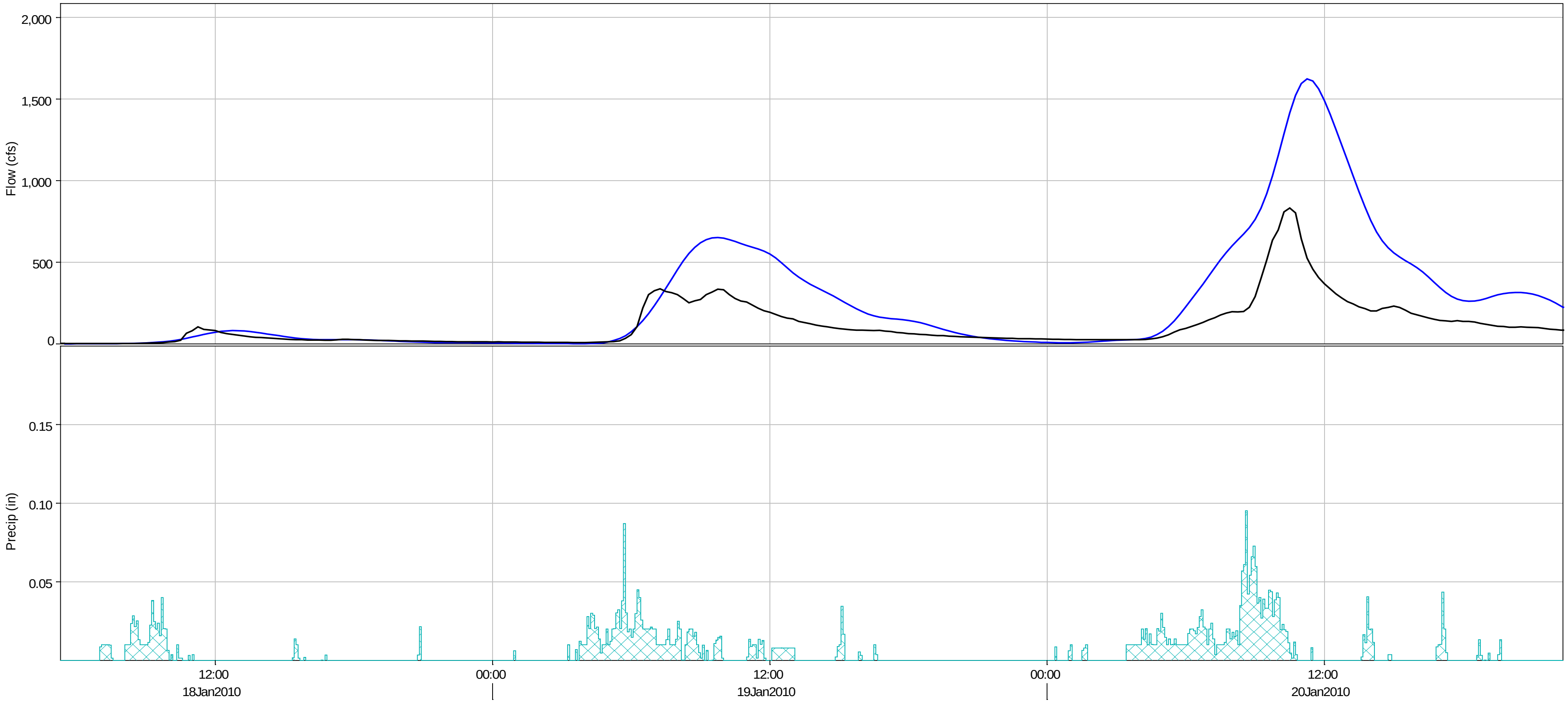


Figure 21: Bear – January 2010

NOTE: *Bear stream flow gage measurements are suspected to be low. Observed data should be used as a rough reference.*

▨	Rainfall
—	Model Output
—	Observed Data

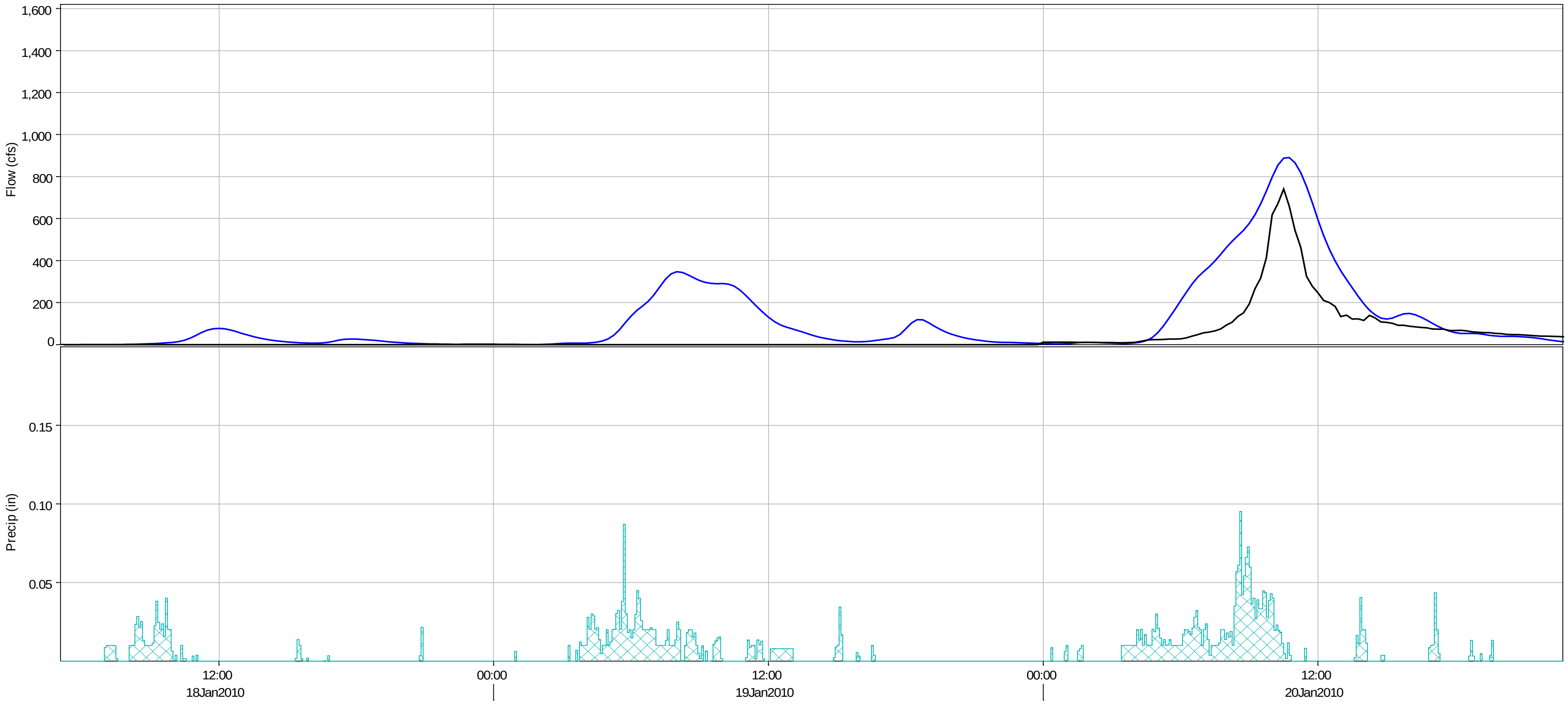
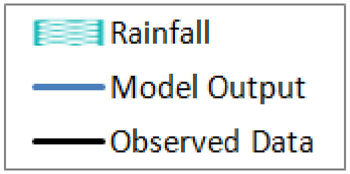


Figure 22: Corte Madera – January 2010

NOTE: *Stream gage located upstream of model catch point. Observed flow should be slightly lower than the model results.*



4.4. 22 MARCH 2011

Table 5: March 2011 Model Calibration Parameters

Sub-Area	AMC	Time of Concentration Q	Storage Coefficient (R) Ratio
Bear	2.0	Q10	0.5
Searsville	1.75	Q10	0.5
Los Trancos	2.0	Q10	0.5
USGS	2.0	Q10	0.5
Urban	2.0	Q10	0.5

**As described in Section 2.3.5 – numbers are based of observed flows at gaging points.*

Five gage locations were in operation for this storm event: USGS, Searsville Dam, Bear, Corte Madera, and Los Trancos. Similar to the 2010 calibration, there are possible gage errors stemming from Bear and Los Trancos. Therefore, the observed flows from these gages were not used as inputs. Downstream reference points relied solely on the model. However, Los Trancos gage matched perfectly with modeled output without any effort, which puts suspicion on the Bear gage.

Using the Searsville outflow, combined with Bear and Los Trancos watersheds at AMC 2.0, the modeled flow at the USGS gage matched very well with the observed data.

For the Searsville watershed, the only operational gage upstream was Corte Madera. The catch point in the model is downstream of the gage, and therefore a higher modeled flow would be expected. An AMC value of 1.75 computed a flow that is slightly larger than observed. Observed flows are in black. Modeled flows are shown in blue. A reference rainfall pattern over Searsville Lake is included under the hydrographs.

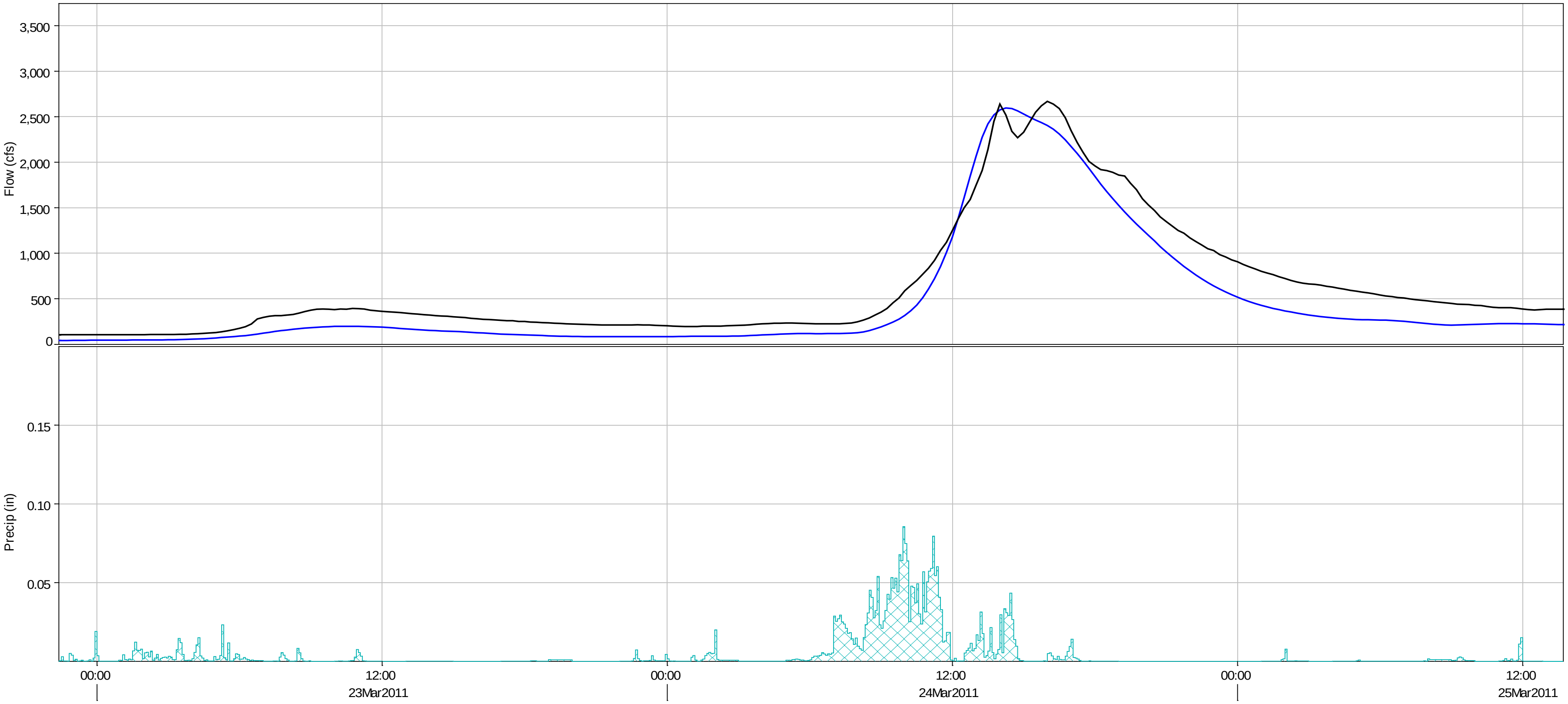
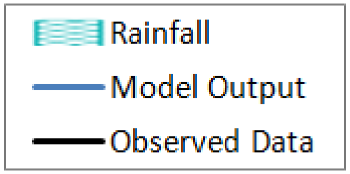


Figure 23: USGS – March 2011

NOTE: *Bear Creek and Los Trancos observed flow data were removed and not used as inputs in determining flow at USGS.*



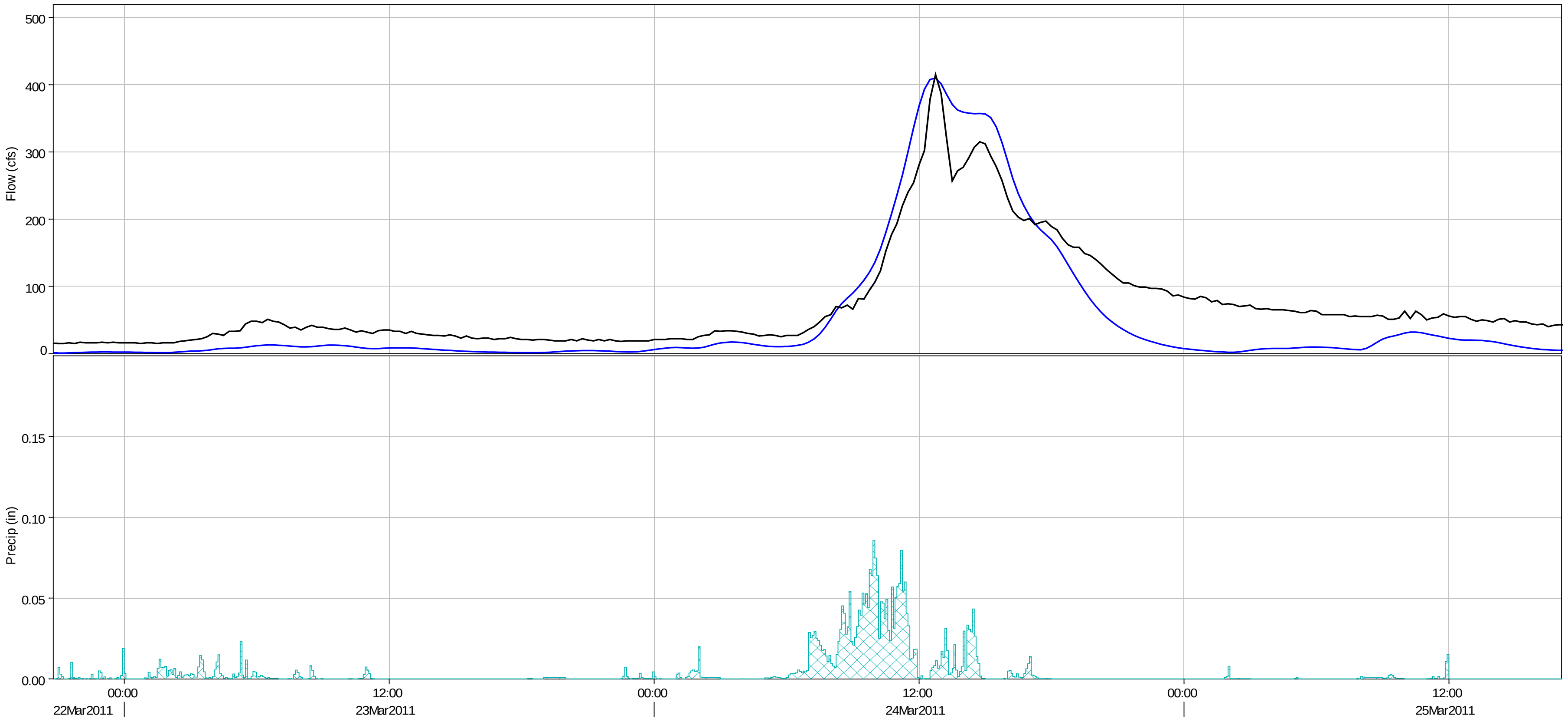


Figure 24: Los Trancos – March 2011

NOTE: *Los Trancos stream flow gage measurements might be suspect, quality unknown.*

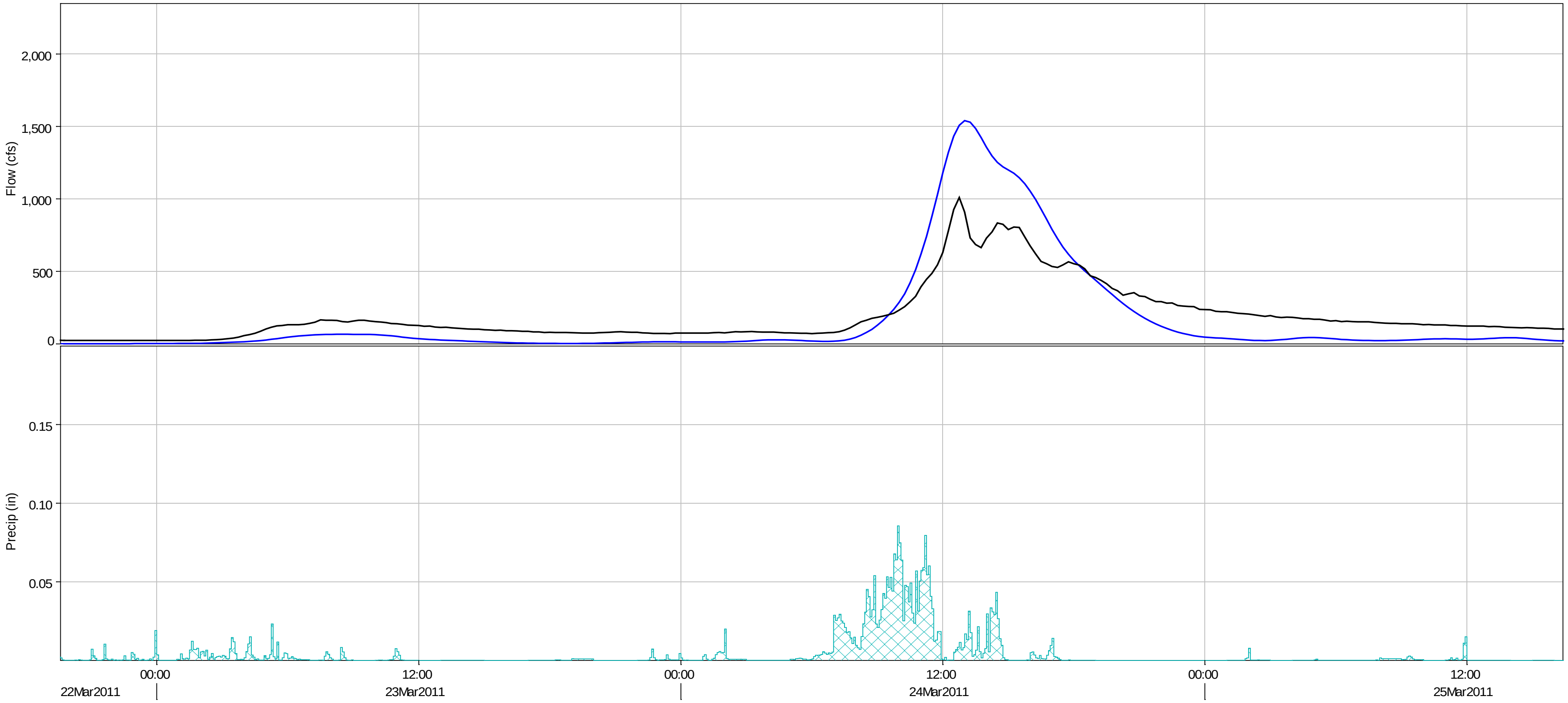


Figure 25: Bear – March 2011

NOTE: *Bear stream flow gage measurements are suspected to be low. Observed data should be used as a rough reference.*

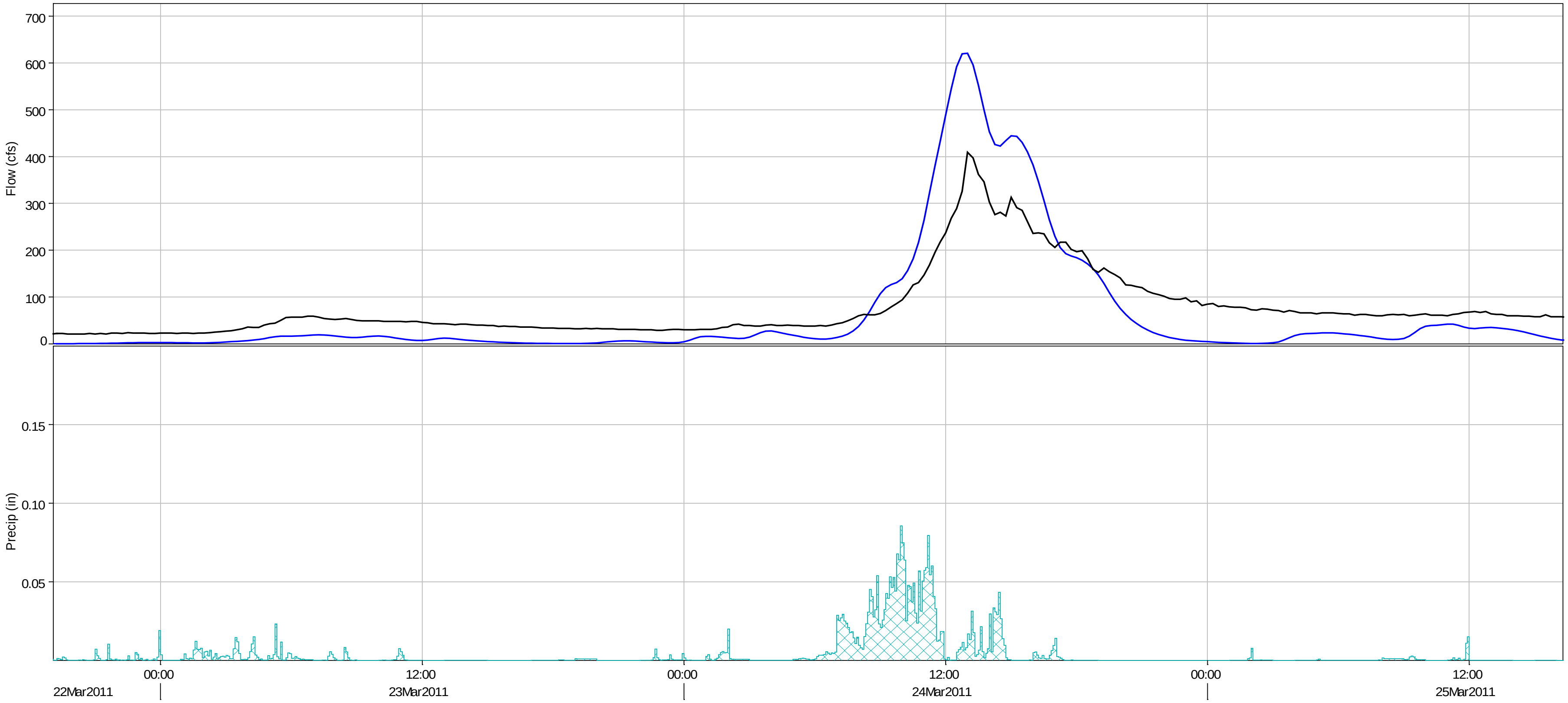


Figure 26: Corte Madera – March 2011

NOTE: *Stream gage located upstream of model catch point. Observed flow should be slightly lower than the model results.*

4.5. 21 DECEMBER 2012

Table 6: December 2012 Model Calibration Parameters

Sub-Area	AMC	Time of Concentration Q	Storage Coefficient (R) Ratio
Bear	2.5	Q200	0.5
Searsville	1.5 – 2.0	Q10	0.5
Los Trancos	1.5	Q10	0.5
USGS	2.0	Q10	0.5
Urban	2.0	Q10	0.5

**As described in Section 2.3.5 – numbers are based of observed flows at gaging points.*

Seven gage locations were in operation for this storm event: USGS, Searsville Dam, Bear, Corte Madera, Alambique, Dennis Martin/Sausal, and Los Trancos. Alambique gage experienced debris and clogged culvert issues, and therefore will only be used as reference. Alambique, Dennis Martin/Sausal, and Corte Madera gages are all upstream of Searsville Dam, and will be used to determine parameters for the Sub-Area Searsville.

For the Searsville watershed, Corte Madera sub-basins were given an AMC value of 2.0, while the rest of the northern sub-basins, including Alambique and Dennis Martin / Sausal, were given an AMC of 1.5 in the Searsville sub-area. This northern sub-area shares a boundary with Bear. It is likely that the rainfall error for Bear is also present in the northern Searsville sub-area as well.

The measured flow at the Bear Creek gage is very high, approaching a 200-year return period when using the USGS gage as a reference. AMC was set at 2.5, but the model could not reproduce the flows that were measured. Erroneous rainfall data is suspected, as a high stream flow at Bear is required to produce the flows seen at USGS. In addition, rainfall discrepancies are seen for sub-basins at higher elevations. This error probably stems from a District rain gage malfunction during this storm, which removed an important calibration point for the radar data. However, there is also a possibility of stream flow gage error, as the peak lasts for much longer, and the volume much higher at the USGS gage.

Using the Searsville outflow, combined with Bear and Los Trancos at an AMC 2.0, the modeled flow at the USGS gage matches the initial rising peak, but is not able to sustain the peak for very long.

Los Trancos is given an AMC of 1.5, and modeled flows are slightly higher than observed. Observed flows are in black. Modeled flows are shown in blue. A reference rainfall pattern over Searsville Lake is included under the hydrographs.

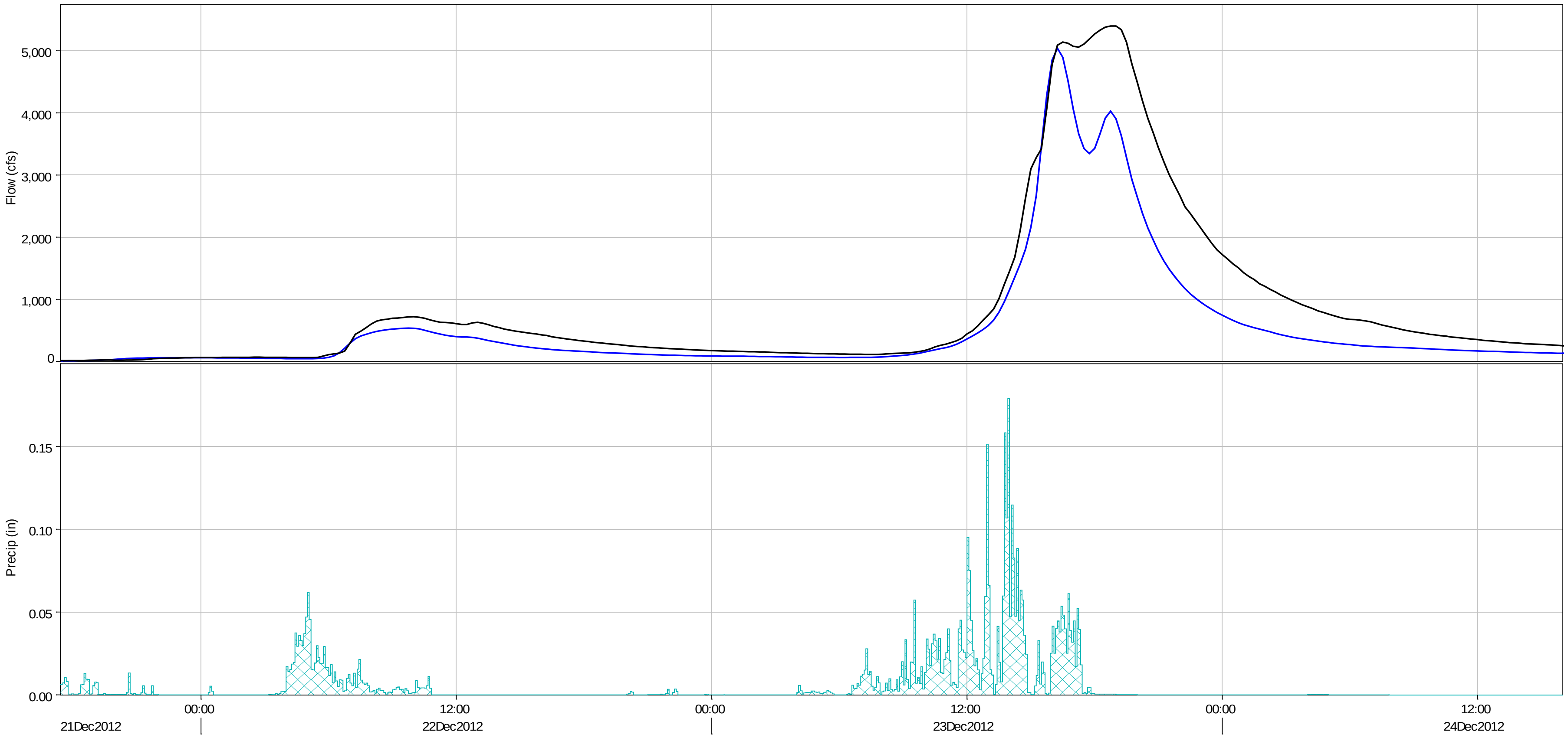


Figure 27: USGS – December 2012

NOTE: *Bear Creek and Los Trancos observed flow data were used as inputs in determining flow at USGS.*

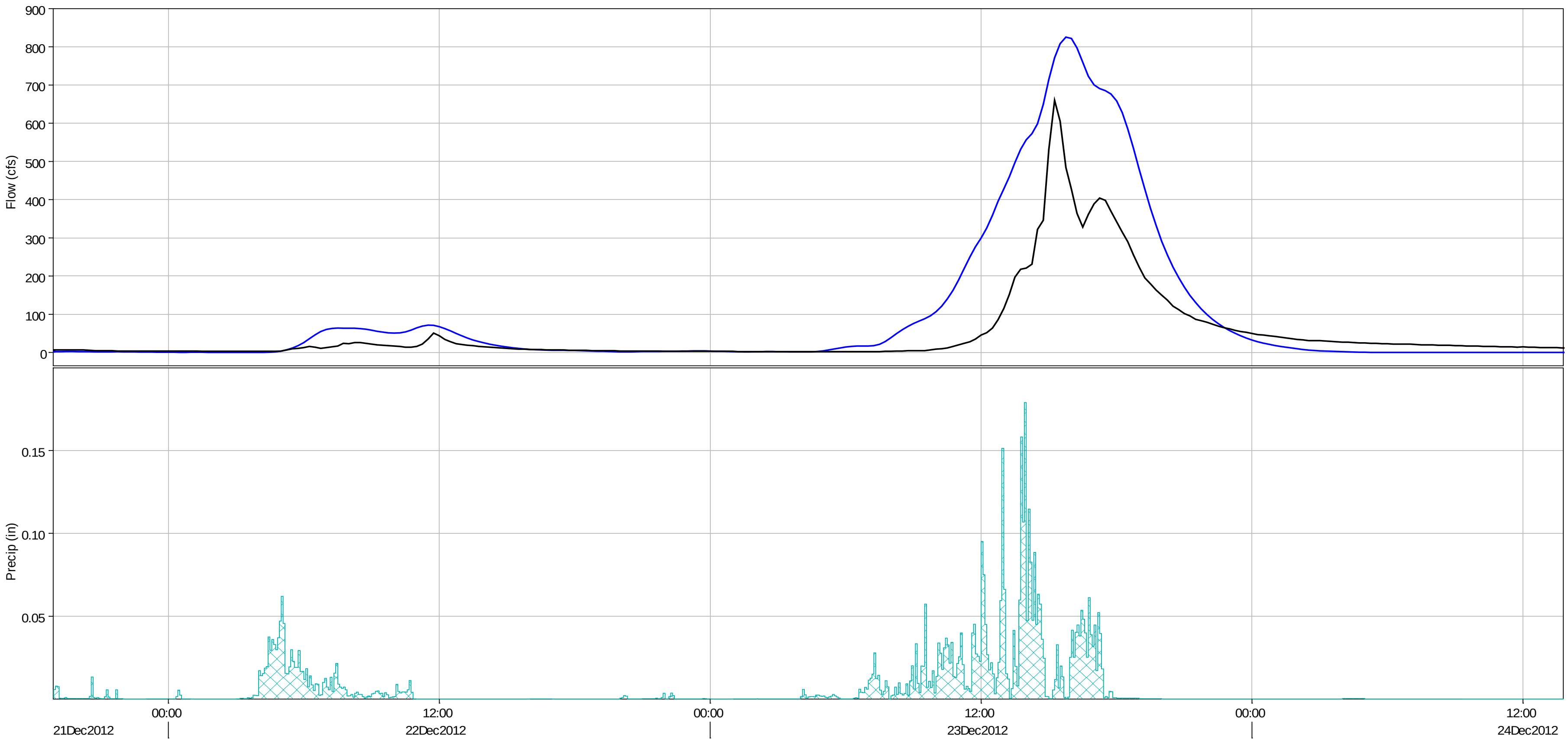


Figure 28: Los Trancos – December 2012

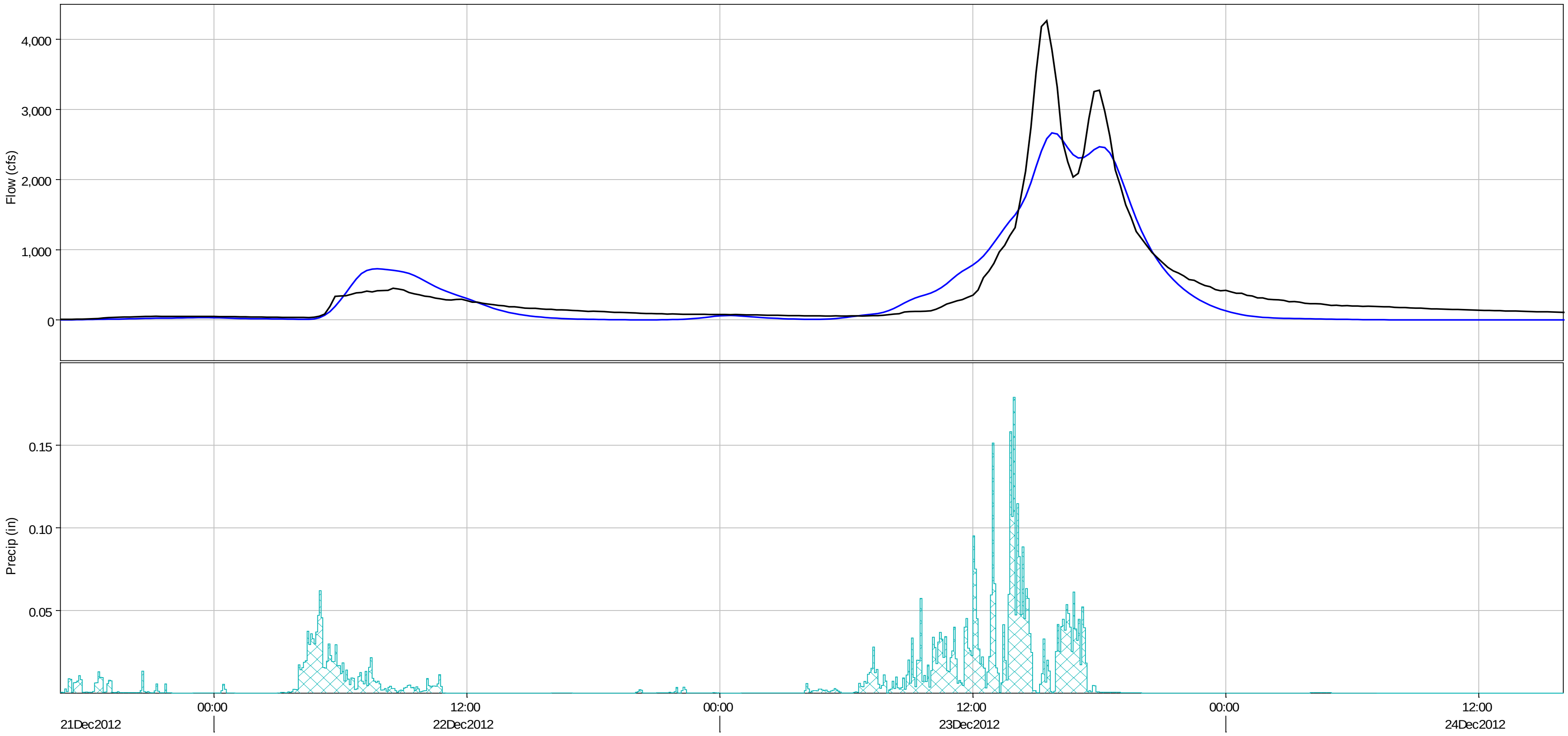


Figure 29: Bear – December 2012

NOTE: *Suspected rainfall data errors.*

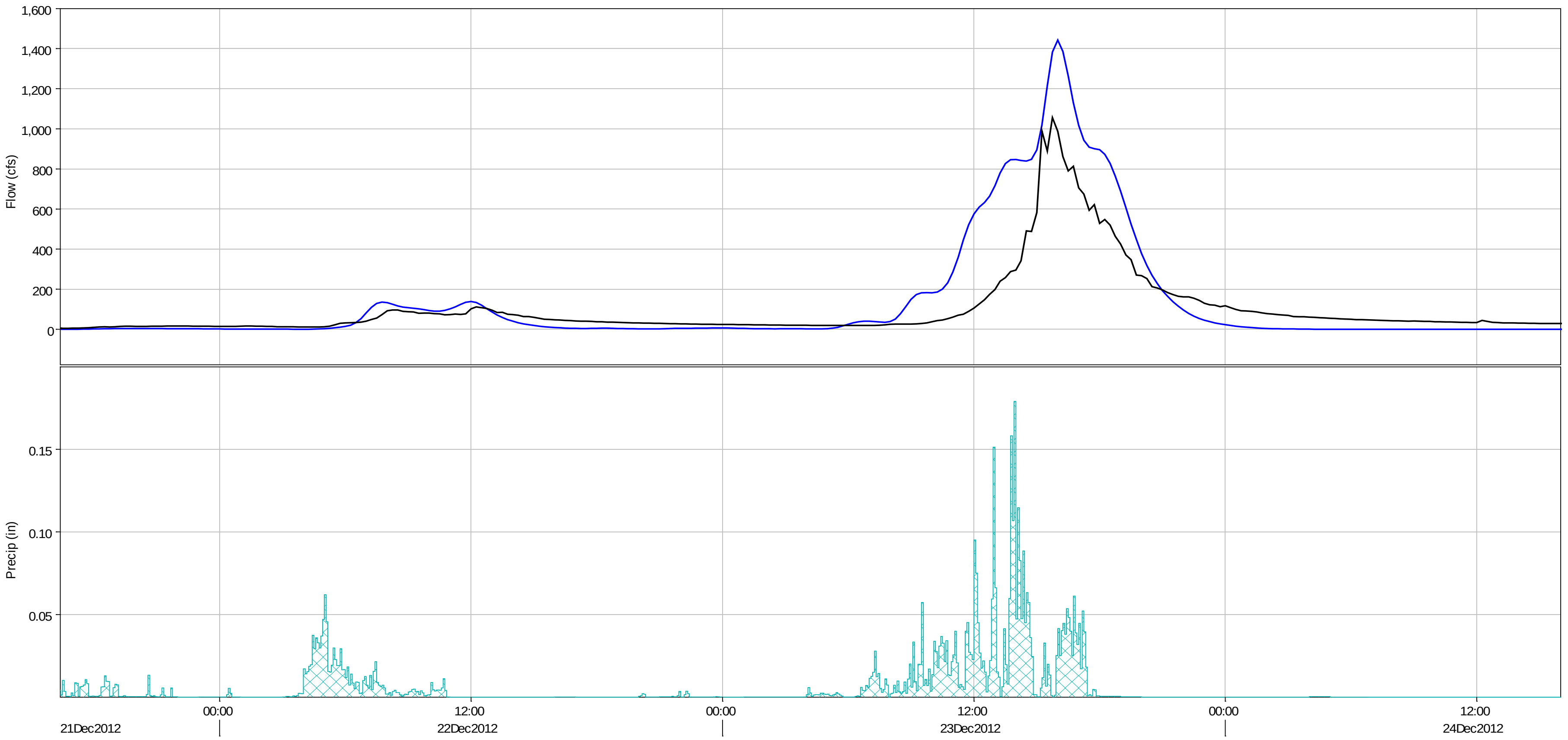
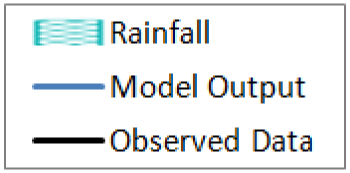


Figure 30: Corte Madera – December 2012

NOTE: *Stream gage located upstream of model catch point. Observed flow should be slightly lower than the model results.*



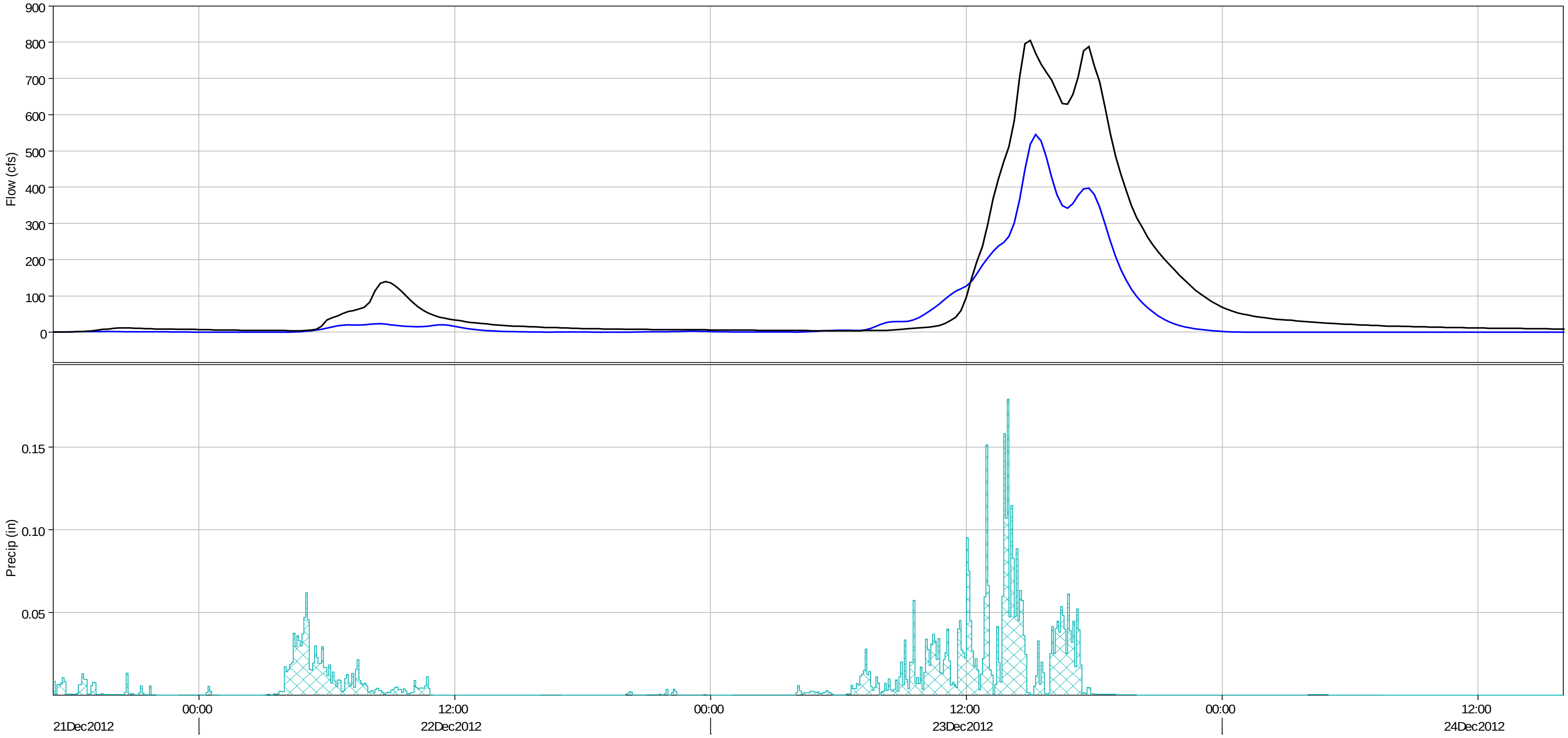
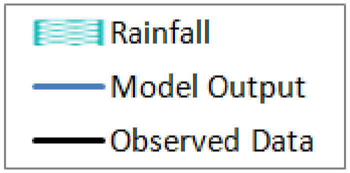


Figure 31: Dennis Martin / Sausal – December 2012

NOTE: *Suspected rainfall data errors.*



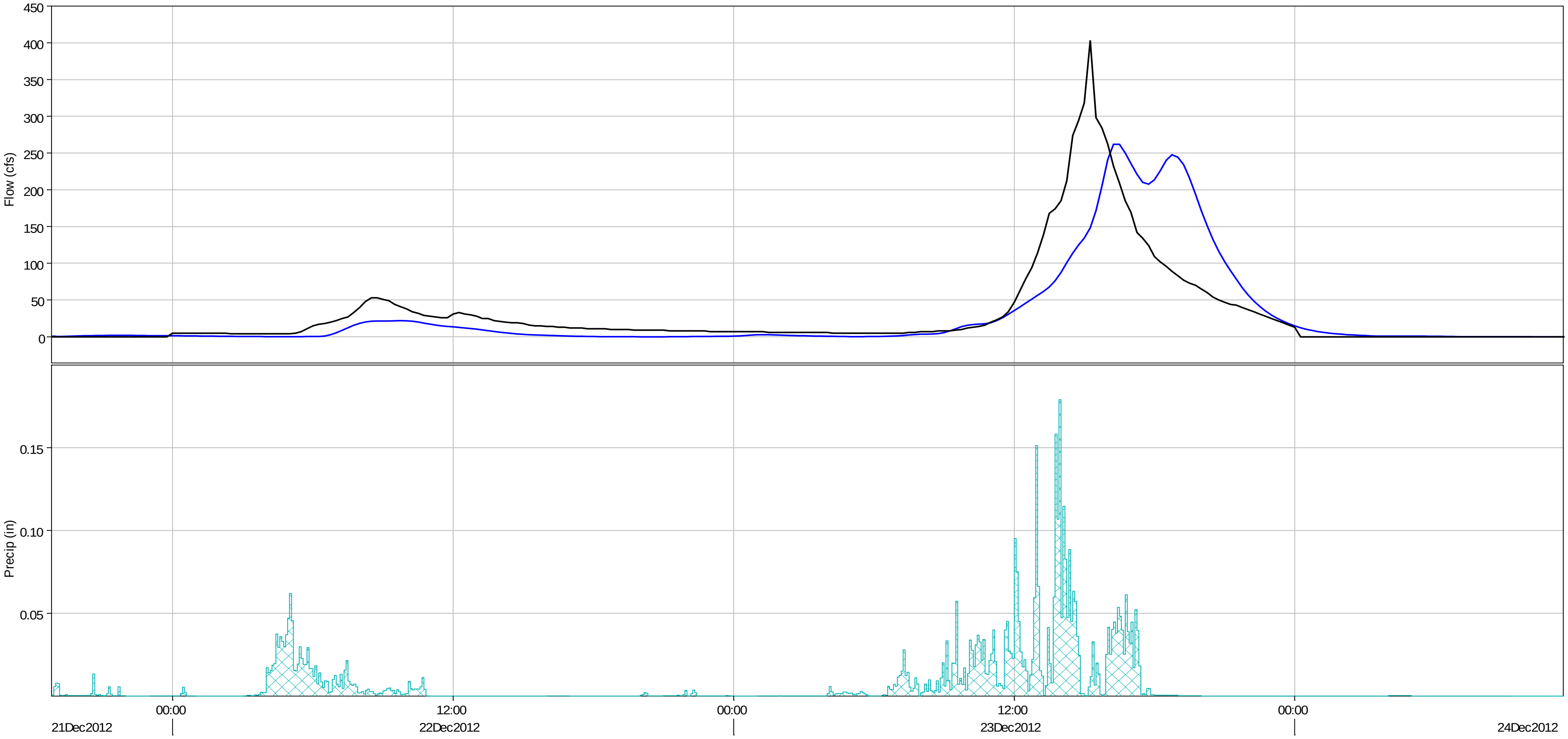
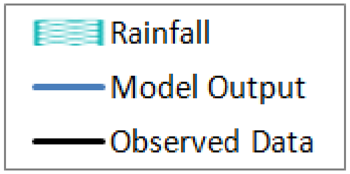


Figure 32: Alambique – December 2012

NOTE: *Culvert near gage clogged during storm. Observed flow data quality is poor at best, and determined from visual inspection. Rainfall data is also suspect.*



5. DESIGN STORM

5.1. PATTERN

Traditionally, the District has used a center-loaded 24-hour storm pattern based on rainfall statistics. This storm pattern is shown in Figure 32. However, a 72-hour storm pattern will also be used to account for the wetting behavior of Searsville Lake.

The storm of record for the entire county was in December 1955, and will be used as the basis for the 72-hr design storm. The storm pattern was modified by using precipitation frequency depths described in below. Depth durations of 1-hr, 2-hr, 3-hr, 6-hr, 12-hr, 24-hr, 48-hr and 72-hrs were used to ensure that within the 1955 pattern, each duration interval inside the design storm represented the statistically determined precipitation depths.

Rainfall depths are contingent upon mean annual precipitation (MAP) when using District rainfall equation, as explained in the next section. In lieu of creating a unique pattern for each sub-basin, the weighted-average MAP was determined for the entire watershed and used in the pattern modification for several reasons:

- The majority of the watershed is in the hills, and therefore does not have such a large variation in MAP compared with the valley.
- The differences in the patterns if each sub-basin was performed individually would be very slight, and from previous experience, not very sensitive.
- The design flow, regardless of rainfall depth and pattern, is calibrated to a gage FFA.

The aforementioned procedure was only done with 100-yr depths. The same pattern used for the 100-yr was adopted for the 10-yr design storm pattern for most of the same reasons listed above. The original 1955 storm pattern, as well as the modified storm pattern, is shown in Figure 33 and Figure 34.

5.2 RAINFALL DEPTH

NOAA-14 depths were not used to characterize the design storm. Previous hydrology studies using NOAA-14 rainfall depths yielded extremely high design flows, in many instances almost double the stream gage flood frequency analysis (FFA) flows. Similarly in this study, attempts to balance the flows by modifying model parameters became unreasonable. Therefore, The District's TDS regional equation is used to calculate the design rainfall depths. The District performed a statistical analysis on all forty rain gages within its jurisdiction to create the regression equation that can estimate precipitation for ungaged watersheds within this hydrometeorologic region.

Table 7 below compares 1% depths for both the 72-hr and 24-hr durations on all the San Francisquito sub-basins, and details the percent increase between the District and NOAA-14, which generally ranges from 20%-35%. Additionally, Table 8 compares the 1% depths between NOAA-14 and District statistical analysis for several durations at a District rain gauge that has been operating since 1966. Not only has the NOAA-14 depth increased for all durations, but the shorter duration depths now represent a higher percentage of the longer duration depths. The second point is important when producing the design storm pattern, and will increase the intensity design storm pattern at the peak, causing more runoff.

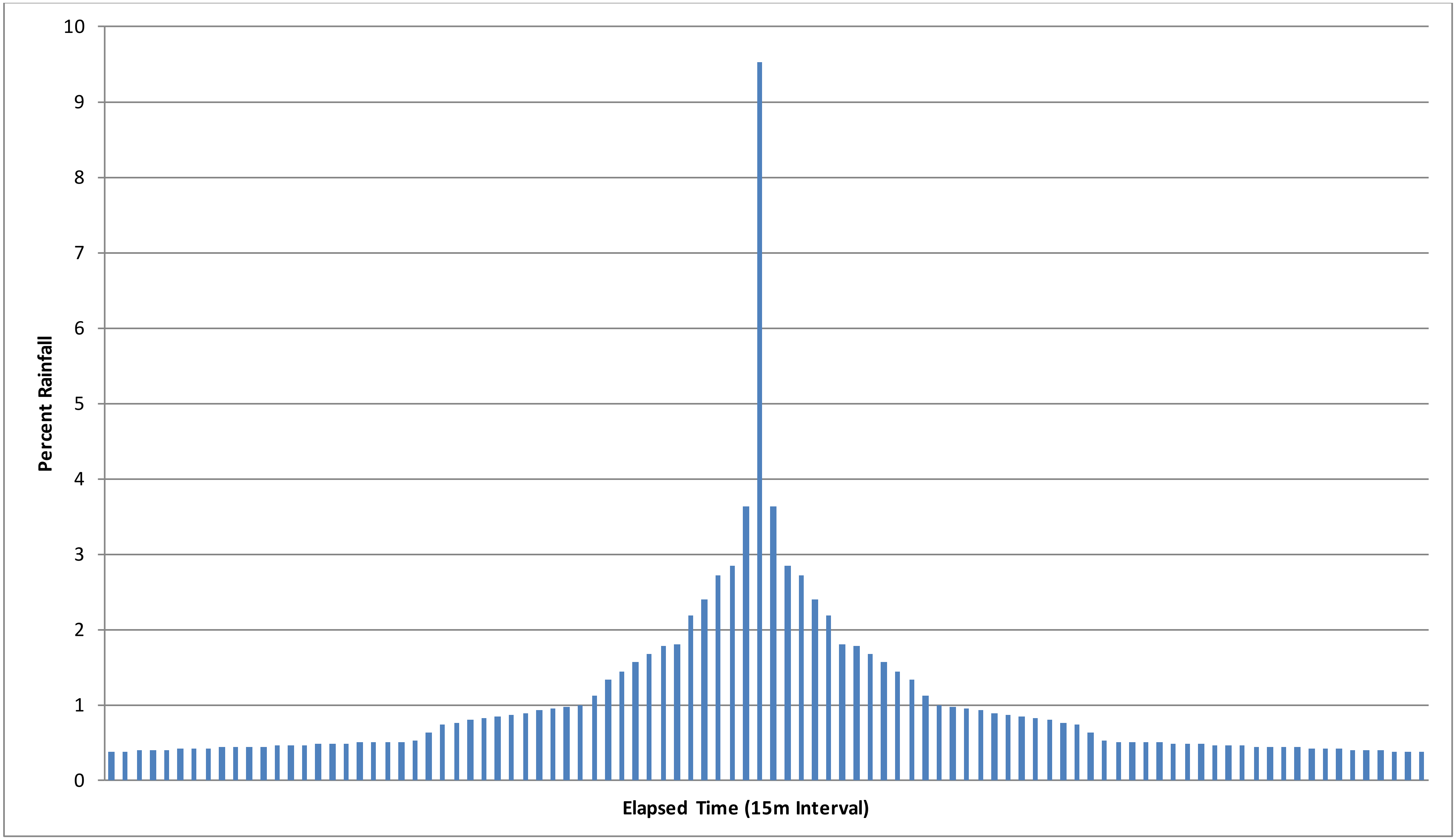


Figure 33: 24-hr Design Storm Pattern

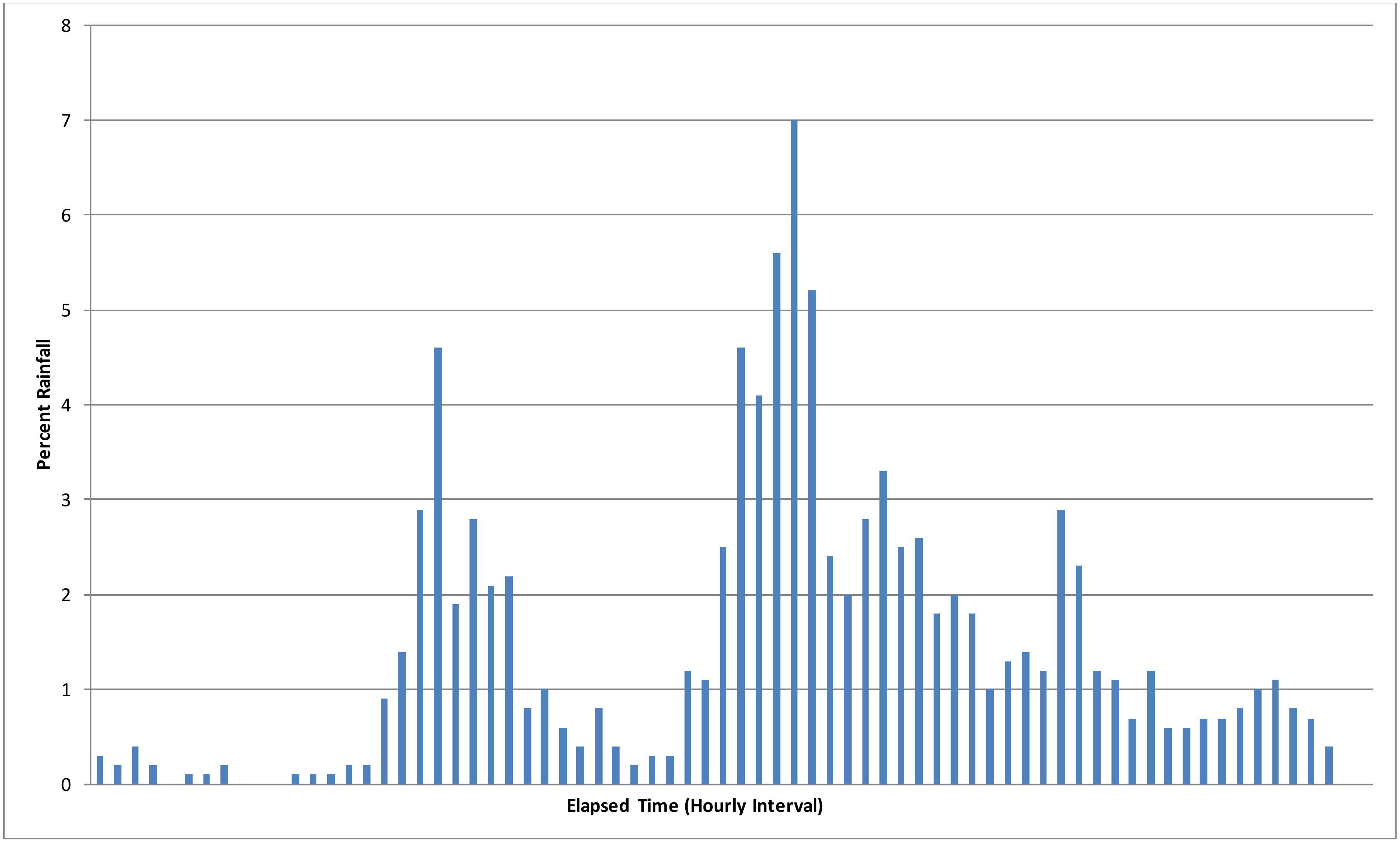


Figure 34: 1955 Storm Pattern

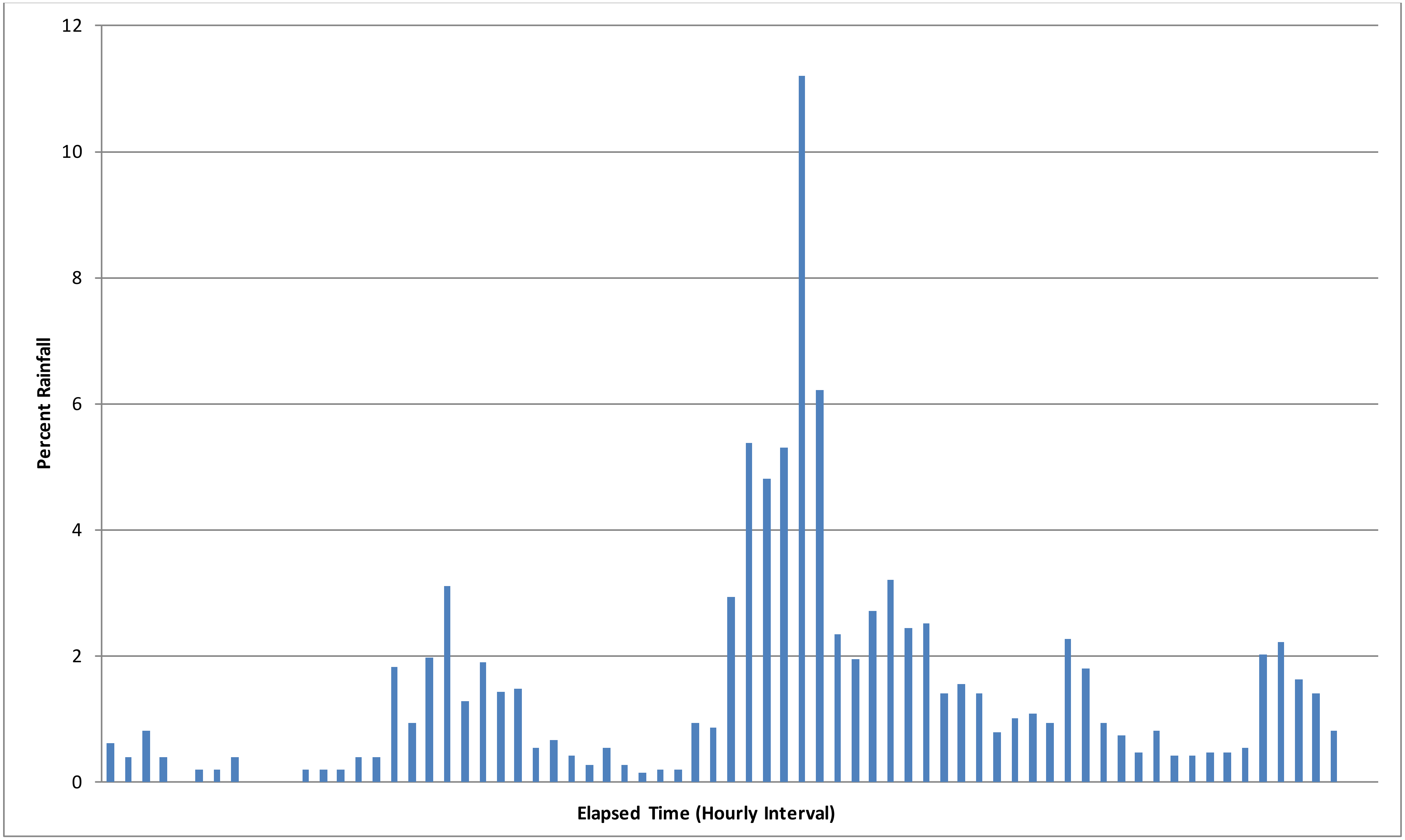


Figure 35: 72-hr Design Pattern

Table 7: Rainfall Depth Comparison

Basin ID	1% 72-hr			1% 24-hr		
	TDS	NOAA-14	% Increase	TDS	NOAA-14	% Increase
SFQ_AA14	8.34	11.4	36.7%	5.504	7.59	37.9%
SFQ_AA15	8.687	11.6	33.5%	5.727	7.58	32.4%
SFQ_A1	10.297	13.97	35.7%	6.76	9.16	35.5%
SFQ_A2	10.73	14.58	35.9%	7.038	9.46	34.4%
SFQ_BB11	9.363	12.27	31%	6.161	7.91	28.4%
SFQ_BB13	8.383	11.43	36.3%	5.532	7.43	34.3%
SFQ_B1	11.053	13.81	24.9%	7.245	8.76	20.9%
SFQ_C1	10.237	13.9	35.8%	6.722	8.89	32.3%
SFQ_C6	10.818	14.9	37.7%	7.095	9.51	34%
SFQ_D	10.677	14.56	36.4%	7.004	9.35	33.5%
SFQ_E	8.974	12.32	37.3%	5.911	7.97	34.8%
SFQ_F	7.676	10.2	32.9%	5.078	6.72	32.3%
SFQ_G1	10.049	12.05	19.9%	6.601	7.71	16.8%
SFQ_G2	9.163	11.1	21.1%	6.033	7.21	19.5%
SFQ_G3	7.649	9.92	29.7%	5.061	6.52	28.8%
SFQ_G4	8.197	9.91	20.9%	5.413	6.5	20.1%
SFQ_G5	7.347	9.14	24.4%	4.867	6.07	24.7%
SFQ_G6	6.784	8.69	28.1%	4.506	5.81	28.9%
SFQ_H	6.343	8.33	31.3%	4.223	5.62	33.1%
SFQ_I	6.226	8.12	30.4%	4.148	5.51	32.8%
SFQ_J1	5.961	7.84	31.5%	3.978	5.32	33.7%
SFQ_J2	5.624	7.52	33.7%	3.762	5.14	36.6%
SFQ_K	5.59	7.13	27.5%	3.74	4.96	32.6%
SFQ_L	5.565	6.87	23.5%	3.724	4.77	28.1%
SFQ_M	5.39	6.43	19.3%	3.612	4.52	25.1%
SFQ_N	5.151	6.06	17.6%	3.459	4.3	24.3%
SFQ_O	4.813	5.89	22.4%	3.242	4.2	29.5%

Table 8: Rainfall Depth and Percentage Comparison for Dahl Ranch Gauge

	1% Depth (and Percent)	
Duration	**SCVWD Gauge Stats**	**NOAA-14**
72-Hr	9.67	11.82
24-Hr	6.27	7.56
6-Hr	3.06	4.47
% of 72-hr	32%	38%
% of 24-hr	49%	59%
1-Hr	1.05	1.69
% of 72-hr	11%	14%
% of 24-hr	17%	22%

The total precipitation for a given storm duration and frequency can be determined from the following TDS equation published by the District[16].

$$P_{f,d} = A_{f,d} + B_{f,d} \times MAP$$

Where:

$P_{f,d}$ = Precipitation depth in inches for a given f, frequency (%) and d, duration (hours).
$A_{f,d}$ & $B_{f,d}$ = Regression constants and coefficients given in the table below
MAP = Mean annual precipitation, in inches, from SCVWD

Table 9: TDS Equation Constants

	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr	48-hr	72-hr
A (1%)	0.5074	0.5317	0.498	0.3228	0.2588	0.1102	0.3239	-0.0876
B (1%)	0.019	0.0389	0.0579	0.1082	0.1613	0.217	0.2751	0.3382
A (10%)	-	-	-	-	-	0.0028	-	-0.1569
B (10%)	-	-	-	-	-	0.1653	-	0.2552

Precipitation depth was calculated individually for each sub-basin in the hydrologic model using the TDS equation shown above due to the variation of MAP. TDS equations for the 10-year recurrence event were only used for the full 24-hr and 72-hr depths, as the other durations were not required since the pattern was already created using the 100-year event.

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[16] SCVWD 2013. Precipitation Gage Data and Depth-Duration-Frequency Analysis. Revised from Saah et al, 2004

5.3 DEPTH AREA REDUCTION FACTOR (DARF)

When accounting for spatial variation in rainfall depth over a large watershed, DARFs are commonly used. As the study area increases in size, there is a decrease in rainfall depth. To properly account for the spatial variation, the depth-area reduction table 13.3 in HMR 59[17] was used. HMR 59 analyzed the largest recorded storms in California to produce the DARFs. Values between the discrete points in the table were interpolated linearly. For San Francisquito, all depths were multiplied by 92.1%, which represents the DARF for a watershed area of 44.95 square miles.

5.4 SEARSVILLE LAKE

To properly model the hydraulic effects of Searsville Lake, a 2D model was used to route flows from the upper lake to the dam spillway. Output from the hydrologic model was used as input to the hydraulic 2D model, and the resulting output used as dam outflow for the hydrologic model.

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[17] NOAA. Hydrometeorological Report No. 59. Probable Maximum Precipitation for California, February 1999.

6. FLOOD FREQUENCY ANALYSIS (FFA)

6.1. DATA

The only stream gage with a significant historical record to perform a FFA is the USGS gage #11164500 at the Stanford golf course. This gage began measuring stream flow in 1932 and has since maintained a continuous length of record, except for a gap from 1942 to 1950. To date, there are 73 annual peak discharges over a period of 83 years.

Stream gage data was downloaded from the USGS National Water Information System[18] (NWIS). Analysis was performed using USGS PeakFQSA[19] software, which also includes an automatic low outlier test improved upon from the original Bulletin 17B, also known as 17C[20]. Gage analysis was performed using a weighted skew, with regional skews determined by USGS SIR 2010-5260[21], which followed the following equation:

$$Regional\ Skew = -0.62 + 1.3\ [\ 1 - \ e^{(-Mean Basin\ Elevation/6500)^2}\ ]$$

Input parameters are listed below in Table 8. Station skew was calculated by the PeakFQSA program and varied depending on the outlier selection.

Table 10: USGS Gage Regional Skew & Mean Square Error

Location	Average Basin Elev	Skew	Mean Square Error
USGS Gage 11164500	953’	-0.60	0.14

6.2 RESULTS

Analysis was performed with two separate low-outlier test methods. The first was the Multiple Grubbs-Beck Test (MGBT) method, which is the default 17C method. The second MGBT method calculated a low-outlier threshold of approximately 1,600cfs. To test sensitivity, a manual low-outlier threshold of 139cfs was used based on visual examination of the data set. Both methods produced similar 100-year flows. 100-yr flows for both methods can be seen in Table 9. Graphs can be seen below in Figure 35 for the MGBT and Figure 36 for the manual threshold. Final FFA results for the MGBT method are in Table 9.

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[18] http://nwis.waterdata.usgs.gov/nwis

[19] Tim Cohn, USGS. PeakFQSA Version 0.998. Flood Frequency Analysis with the Expected Moments Algorithm

[20] Recommended Revisions to Bulletin 17B. June 12, 2013. Subcommittee on Hydrology, Advisory Committee on Water Information. Hydrologic Frequency Analysis Work Group (HFAWG) Memorandum.

[21] Parrett, C., Veilleux, A., Stedinger, J.R., Barth, N.A., Knifong, D.L., and Ferris, J.C., 2011, Regional skew for California, and flood frequency for selected sites in the Sacramento–San Joaquin River Basin, based on data through water year 2006: U.S. Geological Survey Scientific Investigations Report 2010–5260, 94 p.

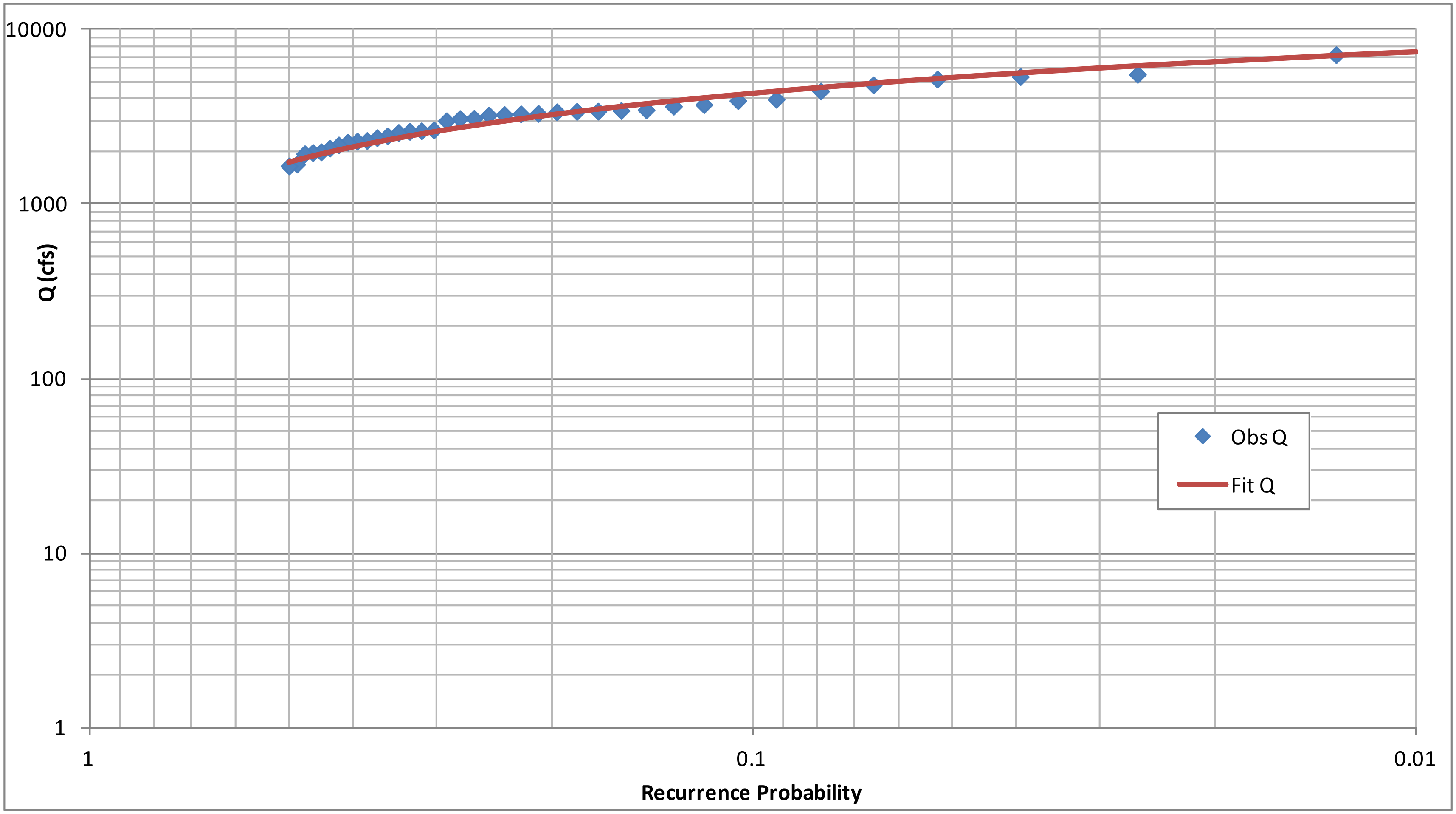

Figure 36: USGS Gage FFA Plot (MGBT)

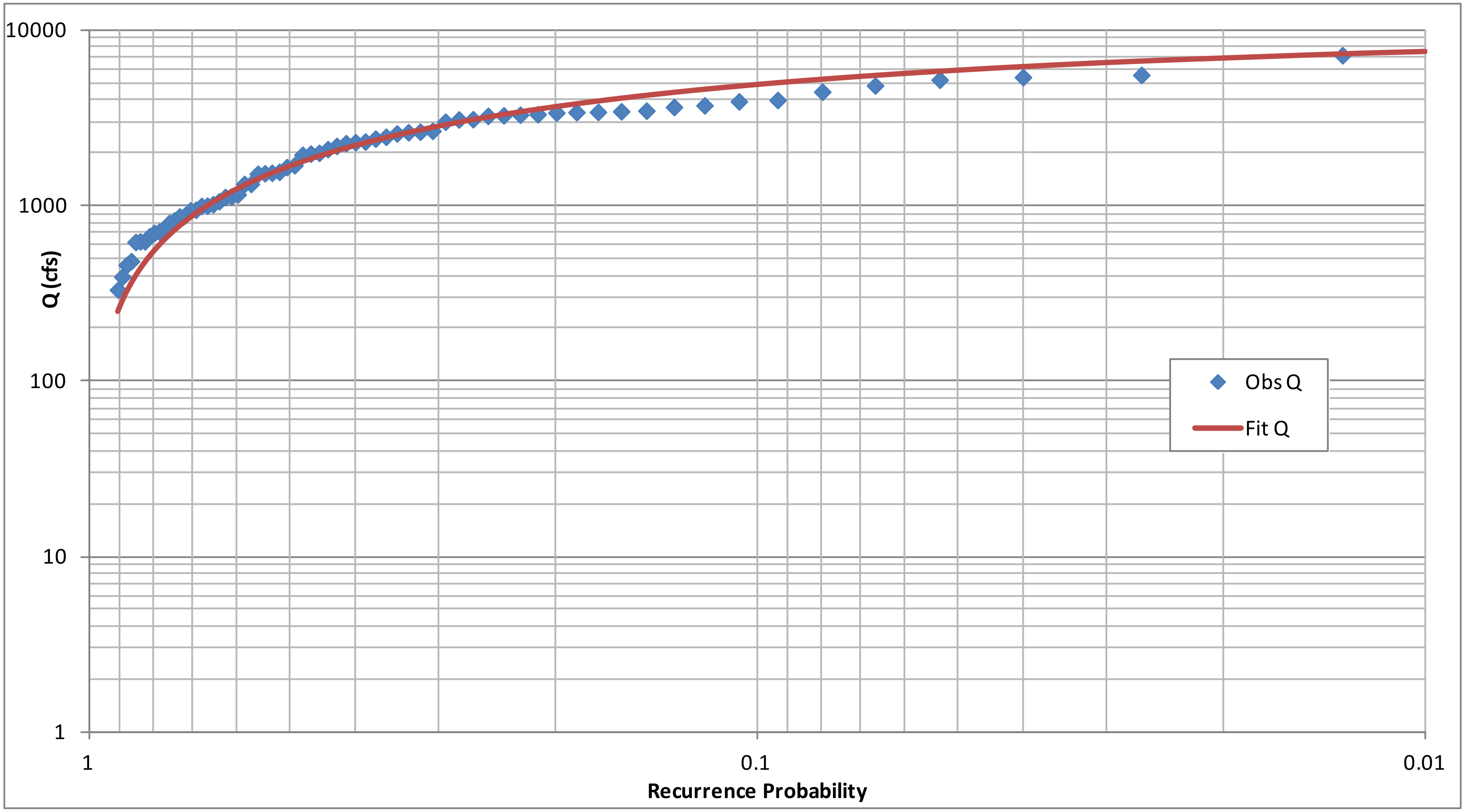

Figure 37: USGS Gage FFA Plot (139cfs Minimum Threshold)

Table 11: USGS Gage 11164500 FFA (MGBT)

Recurrence	Q Flow (cfs)
500yr	9,456cfs
200yr	8,382cfs
100yr	7,519cfs
50yr	6,612cfs
25yr	5,660cfs
10yr	4,330cfs
5yr	3,261cfs
2yr	1,734cfs

6.3 PREVIOUS INDEPENDENT ANALYSES

Two separate independent FFA studies were previously completed for the same gage. The first was a part of the Palo Alto Flood Basin Study by Shaaf and Wheeler in 2014[22]. The second was SIR 2010-5260, a study by the USGS in 2010 on all stream gages within the state of California that presents the most recent regional regression equations. Values vary slightly, due to additional data points, regional skew values, and low-outlier tests. However, all values are reasonably close. Table 10 below compares the different values.

Table 12: USGS Gage 100-yr FFA Comparisons

Study	Q100
Current Study (MGBT)	7,519cfs
Current Study (Manual Threshold)	7,547cfs
USGS SIR 2010-5260	7,690cfs
Shaaf & Wheeler PAFB	7,810cfs

6.4 SEARSVILLE DAM

The historical peak flows recorded by the USGS gage are influenced by the presence of Searsville Dam on the system. It is evident from recent large events that the lake and the dam provide a level of flood protection. However, given the dynamic change of the lake through sedimentation and the resulting topographic change upstream of the lake, it is not clear how the dam has affected the measured flows since the advent of the USGS gage.

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[22] Schaaf & Wheeler. Palo Alto Flood Basin Hydrology. July 2014. Prepared for SCVWD.

The prevailing thought is that as time passed, the lake gradually filled up with sediment, reducing the storage, and thereby increasing runoff downstream. Therefore, it is expected that the annual peak flows measured at the USGS gage would be higher in the past if Searsville Lake and dam, in its current state, was present. This might make our current FFA slightly low given the current conditions. However, this theory has not been verified. To offset this possible uncertainty, the design flow should be set conservatively higher than the results of the FFA.

7. DESIGN FLOWS

7.1. DESIGN MODEL PARAMETERS

Two design storm durations were used to ensure that the most conservative effect of Searsville Lake was captured. Although the design model will be calibrated to FFA value at the USGS gage, other catch points upstream of the gage do not have an index point and might be affected by storm duration.

For the 24-hr design storm pattern, an AMC of 1.65 was used. For the 72-hr design storm pattern, an AMC of 1.4 was used. Time of concentration values were based on a Q100 flows based on USGS regional regression values for each sub-basin, similar to the method used during model calibration. Storage coefficient ratios were left at 0.5 for all sub-basins.

A secondary HEC-HMS basin geometry was created as a “no Searsville lake” option. This model contained a few extra routing reaches to account for the distance in the HEC-RAS 2D model. This basin geometry was used to determine Searsville inflow values, as the Searsville tributaries in the original geometry was disconnected to allow the routing to be performed in the 2D model.

7.2 RESULTS

Model results for both the 24-hr and 72-hr design storms are below. The higher flow value between the two storms will be used as the final design storm.

Table 13: SFC 100-yr Design Model Output

Location	HEC-HMS ID	Q100 (24-hr AMC 1.65)	Q100 (72-hr AMC 1.4)	Final Design Flows
Searsville Inflow	SFQ_E_Lake	4,087	4,261	4,261
Searsville Outflow	Searsville Gage	2,938	3,022	3,022
Bear Creek U/S SFC	SFQ_AA15_Junction	2,863	2,883	2,883
Los Trancos U/S SFC	SFQ_G6_Junction	1,508	1,520	1,520
SFC U/S Los Trancos	SFQ_F_Junction	6,178	6,257	6,257
USGS	SFW_H_USGS_Junction	7,575	7,633	7,633
Pope Chaucer	SFQ_M_Junction	8,146	8,134	8,146
US-101	SFQ_N_Junction	8,404	8,352	8,404

Table 14: SFC 10-yr Design Model Output

Location	HEC-HMS ID	Q10 (24-hr AMC 1.65)	Q10 (72-hr AMC 1.4)	Final Design Flows
Searsville Inflow	SFQ_E_Lake	2,373	2,360	2,373
Searsville Outflow	Searsville Gage	1,690	1,690	1,690
Bear Creek U/S SFC	SFQ_AA15_Junction	1,768	1,784	1,784
Los Trancos U/S SFC	SFQ_G6_Junction	920	934	934
SFC U/S Los Trancos	SFQ_F_Junction	3,606	3,668	3,668
USGS	SFW_H_USGS_Junction	4,434	4,473	4,473
Pope Chaucer	SFQ_M_Junction	4,813	4,802	4,813
US-101	SFQ_N_Junction	4,976	4,943	4,976

7.3 FINAL FLOWS

Using the computed 10-yr and 100-yr design flows, interpolation and extrapolation was performed using Log-Pearson Type III methodology described in Bulletin 17B[23]. The general distribution fit is defined by the following equation:

$$Log\ Q = \bar{X} + K \times S$$

In this case, the flow variable Q is known for the 1% and 10% frequencies, as well as the constant factor K that is obtained from Appendix 3 of Bulletin 17B given a general skew coefficient G, which is determined to be -0.60. That leaves X-bar and S as two unknowns that can be solved.

Final design flows, along with associated K, S, and X-bar values can be seen in Table 13.

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[23] Guidelines for Determining Flood Flow Frequency– Bulletin #17B of the Hydrology Subcommittee. Interagency Advisory Committee on Water Data. Revised 1981. Editorial Corrections March 1982. USGS.

Table 15: Final Design Flows

	Recurrence Interval								Calculated Values	
Location	**2.33-Yr**	**5-Yr**	**10-Yr**	**25-Yr**	**50-Yr**	**100-Yr**	**200-Yr**	**500-Yr**	**S**	**X-bar**
Searsville Inflow	1,080	1,780	2,380	3,140	3,700	4,270	4,760	5,420	0.36963	2.93164
Searsville Outflow	780	1,270	1,690	2,230	2,630	3,030	3,370	3,840	0.36701	2.78738
Bear Creek U/S SFC	940	1,410	1,790	2,250	2,570	2,890	3,160	3,510	0.30309	2.88760
Los Trancos U/S SFC	490	740	940	1,180	1,350	1,520	1,670	1,860	0.30752	2.60124
SFC U/S Los Trancos	1,790	2,820	3,670	4,740	5,500	6,260	6,920	7,790	0.33724	3.15965
USGS	2,180	3,430	4,480	5,780	6,710	7,640	8,440	9,500	0.33747	3.24554
Pope Chaucer	2,370	3,710	4,820	6,190	7,170	8,150	8,990	10,100	0.33228	3.28358
US-101	2,460	3,840	4,980	6,390	7,400	8,410	9,270	10,410	0.33094	3.29966
K-Value	0.27047	0.85718	1.20028	1.5283	1.72033	1.888029	2.01644	2.16884		

8. FUTURE CONDITIONS

8.1. WATERSHED URBANIZATION

In the hills, much of the area is open space preserve and protected from development. In the upper valley, by Searsville Lake, there is very light urbanization on mostly rural tracts of land. In the lower valley, Palo Alto and Menlo Park are essentially fully built out.

Given this information, it is not likely that imperviousness, a measure of urbanization, will change considerably in the next fifty or so years.

8.2. SEARSVILLE DAM

8.2.1. EXISTING CONDITION

Currently the dam provides very little storage in the reservoir proper due to sedimentation. However, there is a definite observed attenuation[24] from historical storms and modeling observations seem to indicate two main factors causing attenuation upstream of the lake:

- For the tributaries feeding into Searsville Lake, the channel capacity is very limited. There is significant usage of floodplains by these tributaries once the low flow channel is exceeded.
- Two constrictions from roadway crossings exist that divide the area upstream of the reservoir. The first is Portola Road crossing Alambique Creek. The second is the Stanford Causeway that spurs off Lakeshore Drive, which is a part of the Stanford Jasper Ridge preserve.

The combination of floodplain usage and roadway constrictions creates artificial detention ponds upstream of Searsville Lake, causing the observed attenuation. Map details can be seen in Figure 2.

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[24] Xu, Jack. SCVWD. Technical Memorandum - Effect of Searsville Lake on Large Storm Events. March 25, 2015.

8.2.2. FUTURE CONDITION

Stanford's Searsville Alternatives Study Committee (SASC) was formed in 2011 by the Stanford University Provost to develop a recommended course of action to address the future of Searsville Dam and Reservoir. SASC is comprised of twelve Stanford University administrators, prominent faculty, including specialists in conservation, land use, environmental sustainability, and water conservation. The results of their findings are published in the Searsville Alternatives Study[25].

SASC has identified not exacerbating flood risk as a primary goal of future Searsville operations. Future Searsville operation is uncertain as Stanford is currently in litigation. However, the Searsville Alternatives Study put forth by SASC recommends two options:

- Let the dam silt in and build a fish ladder passage.
- Create an orifice at the dam base and excavate the sediment inside the lake.

To reflect a the possibility of a silted in dam, a hypothetical condition of a filled in dam was analyzed, where the 1% design storm for both the 24-hr and 72-hr was run with a starting water surface at the invert of the lowest gate in the 2D model to simulate a completely full dam. Results were compared to the existing run and there was no difference in peak flow or timing.

As for the second orifice condition, the details of the orifice size and invert are not known at this point. It is known that the opening needs to facilitate fish passage, but also provide attenuation during high flows.

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[25] Searsville Alternatives Study, Steering Committee Recommendations. Stanford University. April 2015.

APPENDIX A

Santa Clara Valley Water District

TECHNICAL MEMORANDUM

PROJECT: San Francisquito Creek – Searsville Lake **DATE**: March 25, 2015

SUBJECT: Effect of Searsville Lake on Large Storm Events

PREPARED: Jack Xu, PE

1. PURPOSE

The purpose of this report is to quantify the causes of attenuation for Searsville Lake and the effects on San Francisquito Creek flows during significant storm events.

2. BACKGROUND

Searsville Dam is owned and operated by Stanford University, and was constructed in 1892, creating Searsville Lake. The watershed upstream of the dam is approximately 14.5 square miles, which accounts for about a third of the total watershed of San Francisquito Creek. A general map can be seen in Figure 1.

The lake experiences severe sedimentation from upstream sources. According to the Searsville Lake Impact Study[1], varying sedimentation rates averaging about 9 acre-feet per year have occurred over the past 100-plus years. This has significantly decreased the amount of storage that the lake can hold. Currently, from field visits and conversations with Stanford and Balance Hydrologics, the dam will spill through manual gates even during a very minor storm event, and experience uncontrolled overtopping soon thereafter.

However, observations from recent large flood events show that heavy runoff routed through Searsville Lake provided a flood benefit for San Francisquito Creek and communities downstream, either by delaying the timing of the peak flow, or by attenuating the peak flow and releasing the volume over a longer period of time. A case study was performed for the 2012 event to detail the benefits of a lake and no lake scenario in this analysis. Benefits vary widely, and subsequent discussion will focus on determining the behavior of the lake.

3. METHODOLOGY

Analysis focused on using measured data where available. Effort was made to interpret the data to evaluate probable explanations for the attenuation. To augment the dataset where there was missing information, a two-dimensional hydraulic model was constructed, since field visits and general knowledge of the area surrounding the Lake revealed that the attenuation effects were too complicated for a simple model. Using multiple historic events, the 2D model was calibrated and verified. Most of the modeling work and calibration was done for the 2015 San Francisquito Hydrology Study[2]. This study is currently in a draft-review phase, but the calibrated 2D model, along with input data, and historical storms, were utilized for this study used to help analyze the effects of Searsville Lake.

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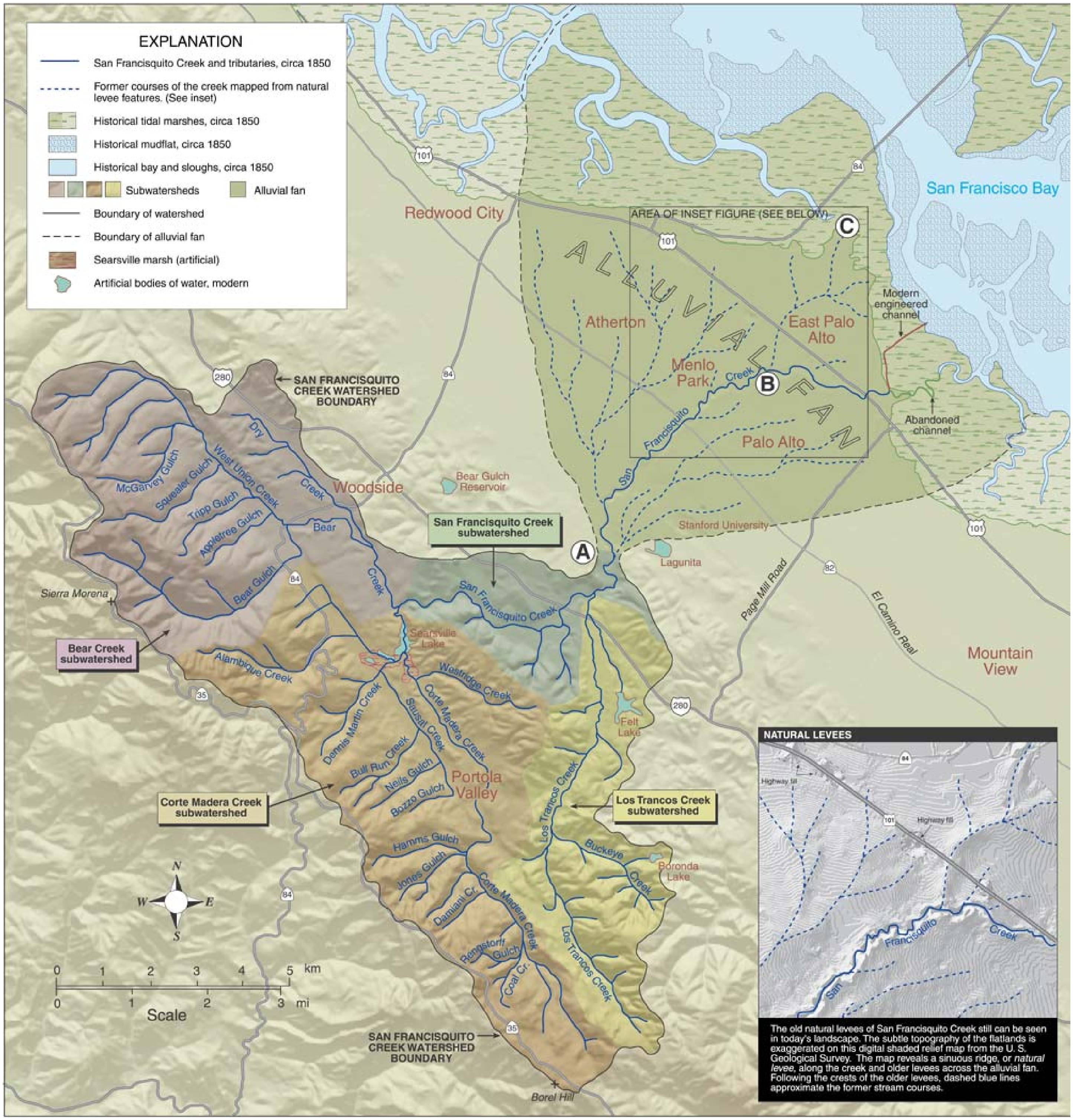
[1] NHC. Balance Hydrologics. HT Harvey & Associates. Jones & Stokes. Kondolf, Matt. Smith, Jerry. Searsville Lake Sediment Impact Study. Stanford University, Facilities Operations. March 2002.

[2] SCVWD. Xu, Jack. San Francisquito Hydrology Study. 2015.



The old natural levees of San Francisquito Creek still can be seen in today's landscape. The subtle topography of the flatlands is exaggerated on this digital shaded relief map from the U. S. Geological Survey. The map reveals a sinuous ridge, or *natural levee*, along the creek and older levees across the alluvial fan. Following the crests of the older levees, dashed blue lines approximate the former stream courses.

Figure 1: San Francisquito Watershed Map

4. HYDROLOGIC DATASET

To analyze the effects of the lake on downstream flows, large historical flow events that had inflow and outflow measurements for Searsville Lake were needed. Upon solicitation, Balance Hydrologics furnished pertinent stream flow data for the events that will be analyzed in this report. However, the data provided was not exhaustive for the events analyzed and missing data was estimated. Several methods were used to fill in the data gaps:

- For the 2011 and 2010 events, only one upstream tributary (Corte Madera Creek) was gaged. These events also had reliable gage adjusted radar rainfall data, and were used in the historical calibrations in the hydrologic model. Therefore, outputs from the HEC-HMS hydrologic model prepared by the 2015 San Francisquito Hydrology Study were used as tributary inflow inputs for the HEC-RAS models.
- For the 2005 event, Corte Madera Gage was the only gaged location as well. However, rainfall data was not reliable. Therefore, the remainders of the tributary inflows were determined by scaling the Corte Madera Creek hydrograph based on drainage area.
- The 2012 event had two gaged tributaries upstream of the Lake. Additionally, a third tributary had visual observations for estimated flow. For the remaining tributaries, flow was determined by scaling the hydrographs from the average of the two gaged tributaries, in the same manner as the 2005 event. However, for the tributary with visual observations, the hydrograph was modified so that the observed flow values properly fit within the rising and receding values of the scaled hydrograph.
- In 1998 and 2000, there were no gaged tributaries upstream of the Lake. Therefore, gage adjusted radar rainfall data was used in the HEC-HMS hydrologic model and the appropriate outflows were used as inputs into the 2D model.
- In 2000, there was no outflow data for Searsville Dam. The 2D model was used to determine the outflow during that time.

Four separate hydrographs were developed based on the different tributary sub-catchments to quantify the 2D model inflow. This was necessary to properly model the attenuation created by different topographic features in the 2D model, such as Portola Road and Family Farm Road.

- Alambique Creek
- Corte Madera Creek
- Dennis Martin & Sausal Creeks
- Additional sub-basin tributary to the Searsville Lake not included in the previous three

5. HYDRAULIC 2D MODEL

HEC-RAS 5.0.0 BETA, released October 2014, will be used to perform the 2D analysis. RAS 5.0 was chosen as the software of choice due to the simplicity of its 2D application, as well as its industry standard use. The October 2014 release is the final BETA release before the final release, and runs very stable with few issues.

A 2D computation mesh was created by using a *.LAS dataset from the 2006 LiDAR survey that generated a digital terrain model with 10’ x 10’ squares. This dataset was cleaned to remove errant reflectivity data from foliage and buildings by the survey vendor. Relevant hydraulic structures were inputted with data from Balance Hydrology’s 1D HEC-RAS model[3] of Searsville that was sent to the District for review in 2014. The outfall of the entire model was modeled as a 2D Boundary Condition Line, which uses a rating curve generated from Balance Hydrology’s model. This curve was double checked with recorded stage and flow data from historical events, which was also provided by Balance.

The 2D Boundary Condition Line spans six grid elements, and during simulation, five of those grid elements are wetted. Due to program limitations in the beta, water surface elevations can only be determined on a grid-by-grid basis while in the 2D domain. Conversation with Gary Brunner, lead developer at HEC, revealed that the computational scheme allows for different water surface elevations within each grid at the boundary condition line. Each grid independently uses the rating curve based on its connection at the boundary condition line. Therefore, there are slight variations in the water surface elevations, depending on grid characteristics. The five wetted grids will be average to determine a single water surface elevation, which will be used to determine flow from the rating curve.

Computational point spacing for the mesh was set at 100’ x 100’ and 50’ x 50’, depending on the detail required. A sensitivity analysis that ran the same model at a 10’ x 10’ mesh showed negligible output difference. The diffusive wave computational method was selected over the full dynamic solution due to the lack of potential energy losses through obstructions. A sensitivity analysis using different methods also yielded negligible difference.

To properly characterize the lake, several historical calibrations were run to determine if the model is accurate. When available, stream gage data was used as input into the model. HEC-RAS inputs from other tributaries that were not gaged were estimated, similar to the methods detailed in Section 4. A final manning’s roughness coefficient of 0.1 worked well for all the historical storms. Results from the calibration and verification process are further detailed in the San Francisquito Hydrology Study.

The 2D model was the same model used in the 2015 San Francisquito Hydrology Study to characterize the effects of the Lake within the hydrologic HEC-HMS model.

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[3] Sears_US_JPA_052114.prj. Balance Hydrology is Stanford University’s consultant.

6. BASELINE OBSERVATIONS

A total of six historical storms were looked at by using the data as described in Section 4. Each storm event was characterized as either being a storm where Searsville Lake had significant attenuation effects (blue), or a storm where the Lake had nuanced attenuation effects (orange). The peak lag time between inflow and outflow, and the overall peak flow reduction, were parameters used to quantify attenuation. Table 1 below documents each storm and the associated attenuation.

Table 1: Historical Lake Attenuation

Historical Event	Peak Inflow (cfs)	Peak Outflow (cfs)	Peak Lag Time (hrs)	Reduced Flow (cfs)	Flow Reduction (%)
2012	2481	1553	3.25	928	37.4%
2011	794	619	3.5	175	22.0%
2010	1429	982	2	447	31.3%
2005	2478	1258	2	1,220	49.2%
2000	1486	1068	1.5	418	28.1%
1998	3023	2588	0.5	435	14.4%

From the table above, there are two events that have parameters that do not necessarily fit the mold. For 2011, there is such a small peak flow reduction, but a large lag time. For 2000, the numbers are very close to the 2010 event. However, it is suspected that the inflow and outflow values for 2000 are less reliable, since there was no gage data for the entire watershed and since all the data was being handled by models.

It is also noted that the attenuation effects of the storm do not seem to follow a trend based on the peak inflow. The 2012 and 2005 events experienced significant attenuations, while the 1998 event experienced very little.

7. ANTECEDENT CONDITIONS

It is well known that the antecedent condition of the watershed can profoundly affect runoff. To analyze this, two datasets were looked at to determine the saturation of the watershed prior to the peak rainfall events for the six storms; antecedent rainfall and baseflow conditions prior to the largest inflow.

For antecedent rainfall, gage adjusted radar rainfall data was looked at one day prior to the peak rainfall intensity for five out of the six events. The 2005 data was extremely suspect and not used. A one day look-back period was used since the gage adjusted radar rainfall data began 24 hours prior to the peak rainfall intensity.

A longer look-back period was not pursued, due to the distance of the nearest rain gage which would provide the data. The nearest rain gage station that was operational during this time frame was at Dahl Ranch. This is a District gage that is on the edge of the entire San Francisquito watershed, just to the east of the Los Trancos Creek tributary area. Due to the observed temporal variation of storms in this area, it was decided not to pursue the use of that gage.

Figure 2 shows a scatter plot of the rainfall percentage that falls during the 24-hr look-back period for the five storm events. Hour zero is the earliest point in time, while hour 23 is the time of highest rainfall intensity. From the plot, the storms in 1998 and 2000 exhibit a higher percentage of rainfall during the earlier hours, while the storms in 2010, 2011, and 2012 have the majority of the rainfall occurring during the immediate hours before the peak rainfall intensity.

Cross referencing the observations from Figure 2 with Table 1, there is a slight trend showing that more attenuation is provided when there is a smaller percentage of antecedent 24-hr rainfall. The 2011 event is an outlier, when looking at peak flow attenuation, but has very large lag time attenuation.

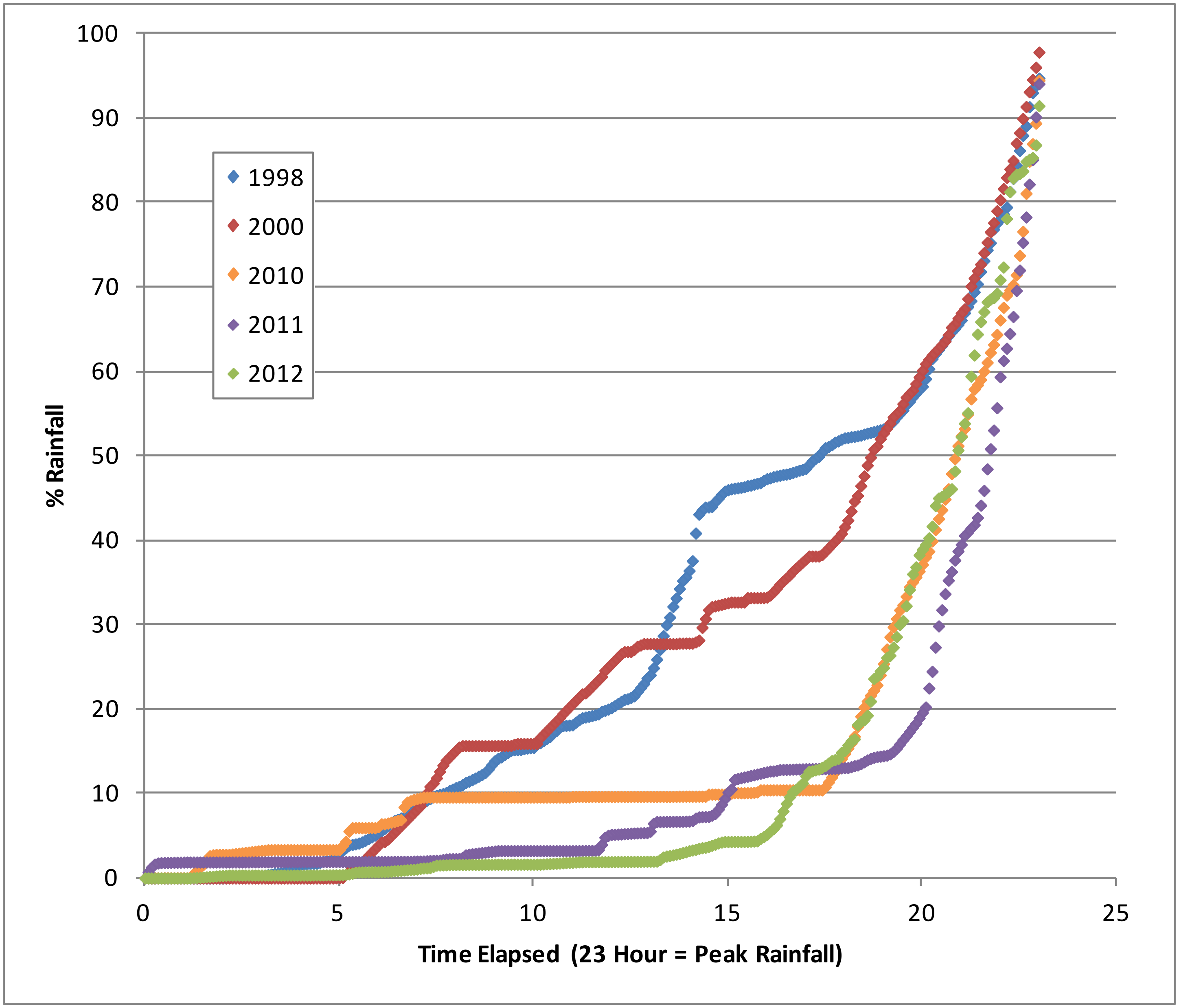

Figure 2: 24-Hr Antecedent Rainfall

The second dataset analyzed was observed baseflow prior to the largest inflow. To determine baseflow, recorded Searsville Lake outflow data was used. The prevailing baseflow was determined to be the lowest flow before the peak hydrograph recorded at Searsville Lake, marked as point B on Figure 3, which was taken from Chow et al[4]. Table 2 summarizes the recorded low flows for five of the six events, as Searsville Lake was not being recorded in 2000. The results suggest that a lower antecedent baseflow produces a larger attenuation. The resulting events are then characterized as having significant attenuation (blue) or nuanced attenuation (orange) based on the antecedent patterns. A graphical representation of the effects of prior low flow to flow reduction is in Figure 4.

Table 2: Prevailing Baseflow

Historical Event	Peak Inflow (cfs)	Peak Outflow (cfs)	Peak Lag Time (hrs)	Flow Reduction (%)	Prior Low Flow (cfs)
2012	2481	1553	3.25	37.4%	30
2011	794	619	3.5	22.0%	65
2010	1429	982	2	31.3%	35
2005	2478	1258	2	49.2%	15
2000	1486	1068	1.5	28.1%	N/A
1998	3023	2588	0.5	14.4%	70

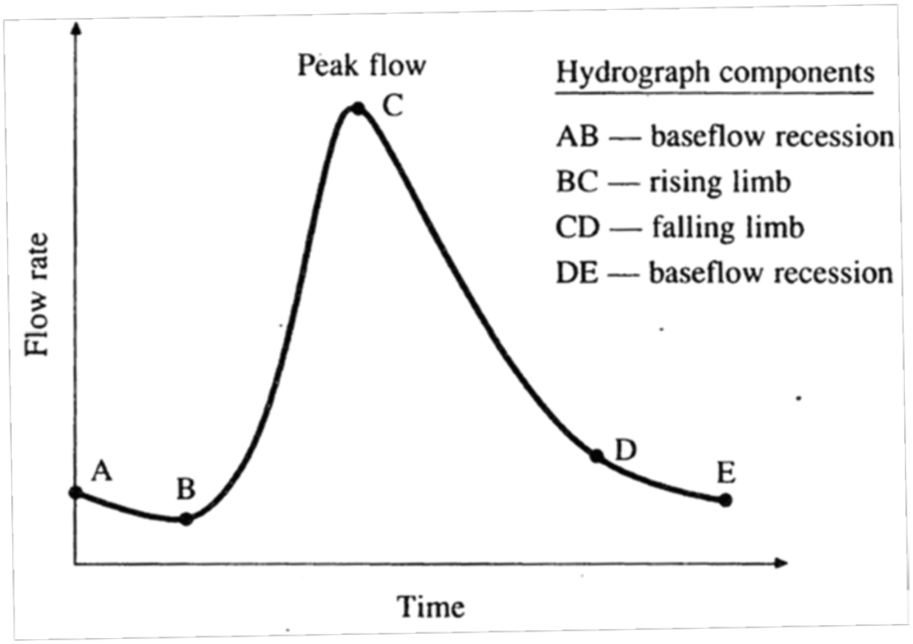

Figure 3: Baseflow Hydrograph Reference

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[4] Chow, Ven Te. Maidment, David R. Mays, Larry W. Applied Hydrology. Published 1988. McGraw-Hill.

8. INFLOW VOLUME

Although a peak flow may help characterize a storm's intensity, an analysis was done to determine the relative inflow volume into the Lake during the rising limb of the hydrograph. The rising limb was used to see the utilization of storage within the Lake in attenuating the peak. Using the inflow data detailed in Section 4, inflow volume was determined for the six hours preceding the peak inflow. Six hours was observed to generally be representative of the rising limb of the hydrograph for these storm events.

The 6-hour total volume during the rising limb was then divided by the observed peak inflow. This ratio helps normalize the volume to the size of the storm, and characterizes the general shape of the inflow hydrograph. A higher ratio of volume/peak would infer a wider hydrograph, while the reverse would be true for a lower ratio. Table 3 summarizes the results from these analyses. In general, the higher volume/peak ratios have less attenuation, while the lower volume/peak ratios exhibit more attenuation. Resulting events are characterized as having significant attenuation (blue) or nuanced attenuation (orange) based the volume/peak ratio. Figure 4 summarizes the effect of 6-hr inflow volume and prior inflow volume to flow reduction.

Table 3: Inflow Volume

Historical Event	Peak Inflow (cfs)	Flow Reduction (%)	6-Hr Inflow Volume (AC-ft)	6-Hr Inflow Volume / Peak Inflow
2012	2481	37.4%	373	15.0%
2011	794	22.0%	204	25.7%
2010	1429	31.3%	246	17.2%
2005	2478	49.2%	381	15.4%
2000	1486	28.1%	439	29.5%
1998	3023	14.4%	638	21.1%

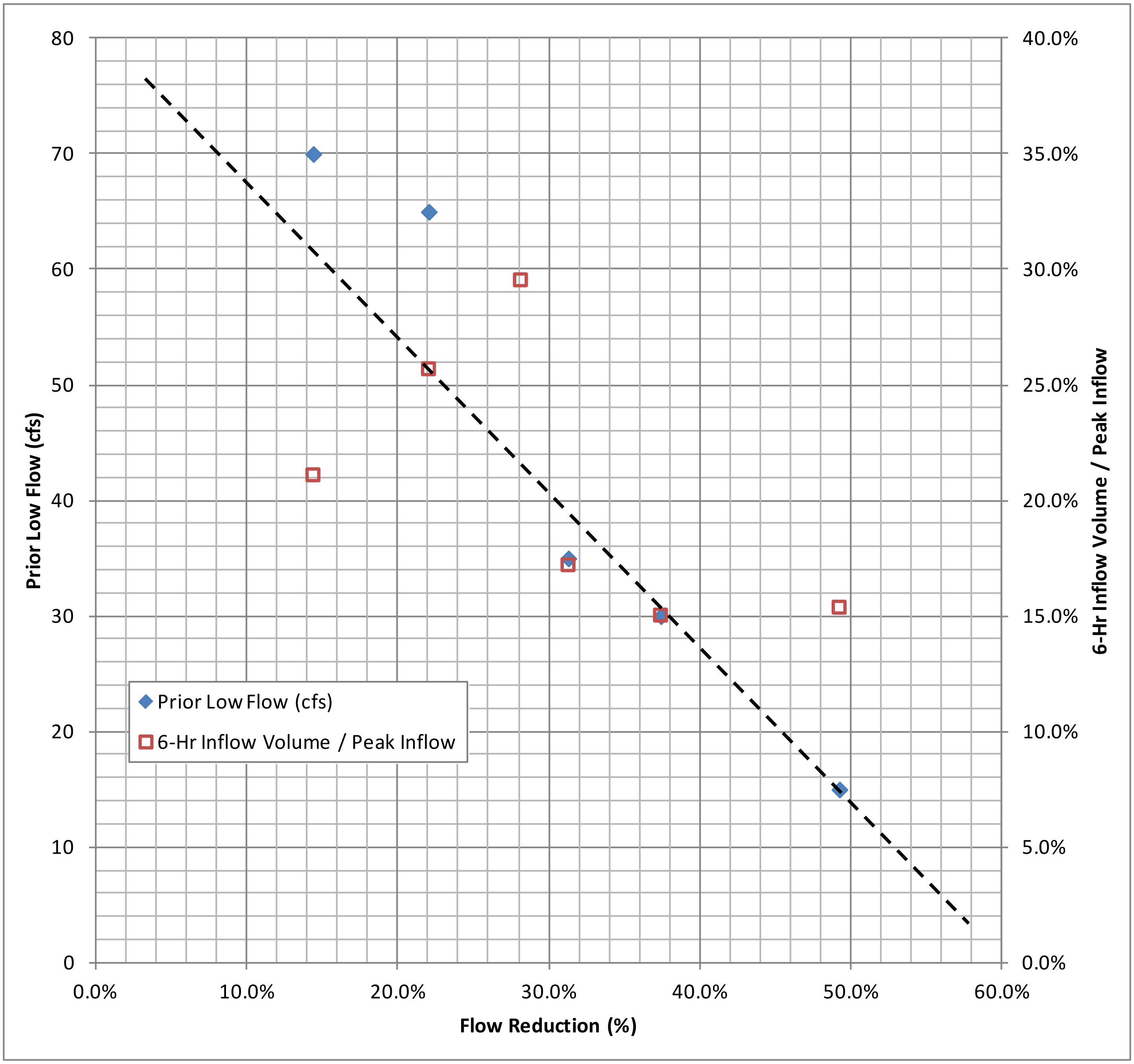

Figure 4: Effects on Flow Reduction

9. DOWNSTREAM EFFECTS

A historical case study was done on the December 2012 event to determine the impacts of Searsville Lake to the downstream reaches of San Francisquito Creek where creek capacity and flooding is an issue. The 2012 event was chosen due to the availability of stream gage data upstream of the Lake to properly estimate the amount of inflow. It is also noted that this event does have one of the highest percentages of flow reduction, and is not representative of every storm event. Due to the high flow reduction, the benefit seen in this case study will likely be on the higher end.

To perform this analysis, the recorded flow downstream will be compared with a hypothetical situation where the lake is not present. No modeling will be performed and measured data will be used. For inflow data into Searsville Lake, the methods outlined in Section 4 was used. Furthermore, two additional stream gages will be used for the study as well. The first is on Bear Creek, and the second is on Los Trancos Creek. Both these creeks join with San Francisquito Creek before entering the valley, as seen in the map in Figure 1. With Searsville, Bear, and Los Trancos, the majority of the runoff producing watershed is accounted for, and additional flows should be negligible for the purposes of this study. To determine the travel time of the flow, analyses will be performed on the recorded data, and the same value will be used for both cases. The USGS gage by the Stanford golf course will be used as the index point to determine impacts to downstream conditions.

For the observed 2012 data, the USGS gage records two peaks, as seen in Figure 5. The first can be attributed to the first Bear Creek peak (4,264cfs), along with smaller flows from Los Trancos and Searsville. Both Bear and Los Trancos peaks occur on the 23rd, at just after 3pm in the afternoon within 15 minutes of each other. This shows that travel times for both Bear and Los Trancos are similar, reaching the USGS gage at 4:30pm, giving a travel time of about 1 hour.

The second and larger peak at the USGS gage occurs at 6:45pm with a flow rate of 5,400cfs. This is attributed, for the most part, to the Searsville Lake spill (1,553cfs) combining with the second Bear Creek peak (3,275cfs). These peaks occur within half an hour, starting at 6pm. The travel time for the Bear and Searsville combined flows is about 45 minutes, slightly faster than the previous travel time. The sum hydrograph of all three of the tributaries is shown in dashed black in Figure 5.

For the hypothetical, no lake scenario, the inflow stream gage data was summed and used as the outflow for Searsville Lake. Travel distance from these stream gages toward the location of the dam was averaged to about 1 mile, which would translate into about a 15 minute travel time at a reasonable velocity of about 6 ft/s, assuming a natural channel in lieu of the lake. Therefore, the summed inflow data was lagged 15 minutes to account for travel time to the dam site. The sum of the three tributaries was then lagged 1 hour to account for the travel time to the USGS gage, which will be considered the hypothetical USGS observed data. Results can be seen in Figure 6.

The estimated peak flow for the no lake scenario is 7,351cfs, which is almost 2,000cfs higher than the observed peak flow value of 5,400cfs. This reduction is a result of a combination of both flow and time attenuation effects from the lake. The largest storm of record on San Francisquito Creek recorded a peak flow of 7,200cfs at the USGS station, which caused significant flooding in the downstream communities in 1998.

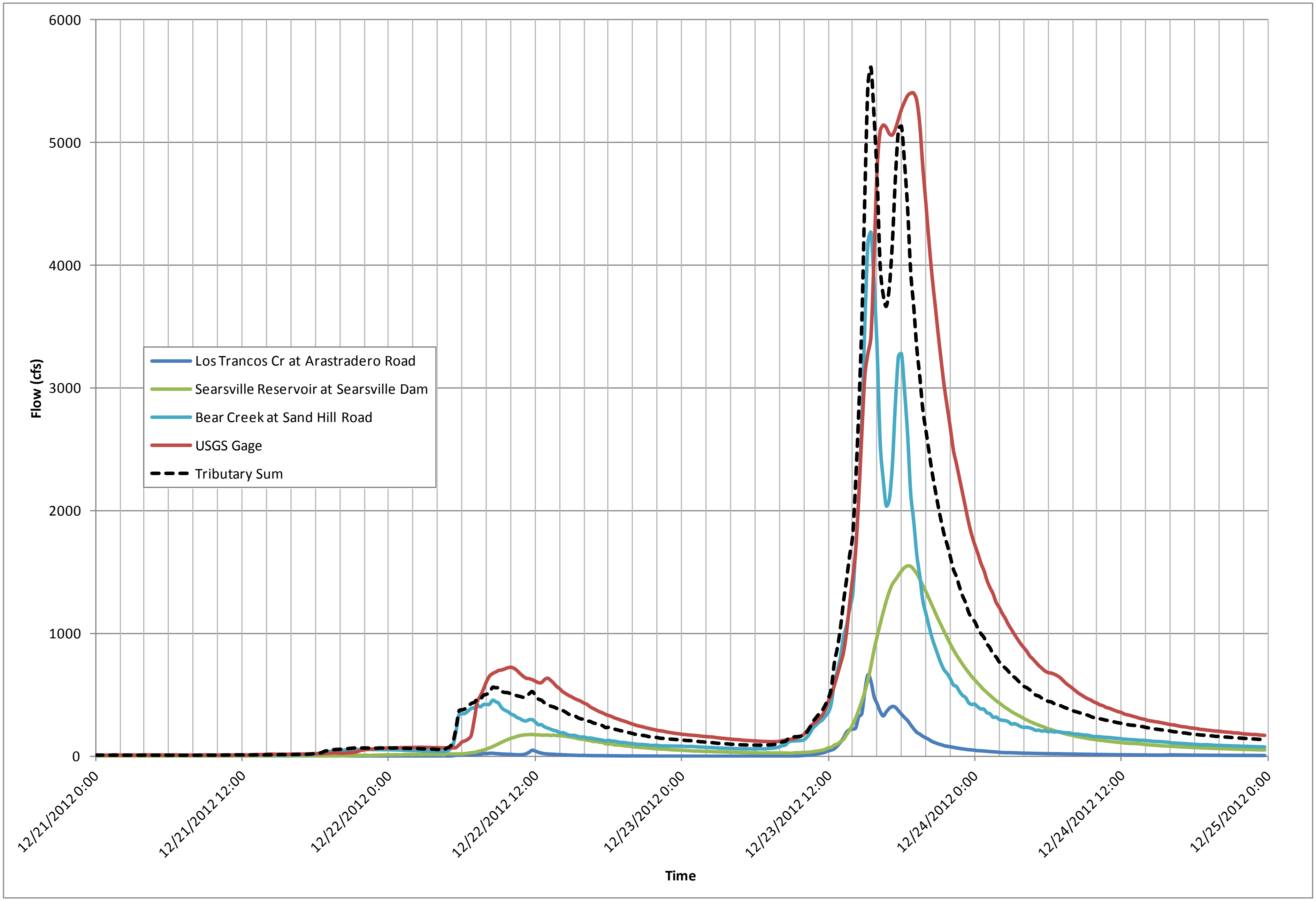

Figure 5: 2012 Observed Stream Flow

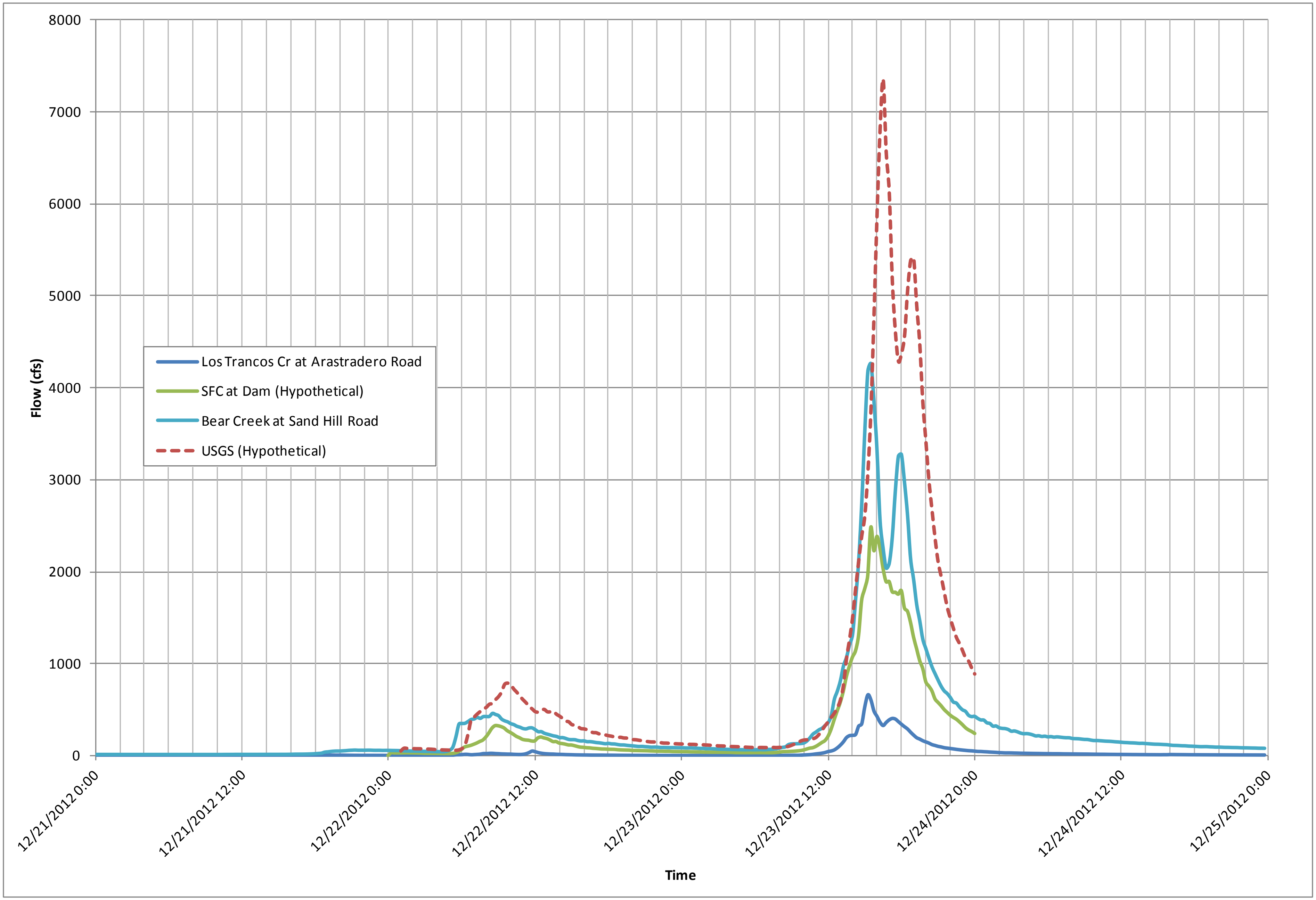

Figure 6: 2012 Hypothetical No Dam Flows

10. CONCLUSIONS

In all six events, three different parameters for each event were then analyzed to quantify the specific characteristics causing the attenuation, including antecedent rainfall, baseflow, and hydrograph shape. General conclusions from the parameters are listed below.

- When the majority (more than 80%-90%) of antecedent rainfall 24-hours before the peak intensity falls within 6 hours of the peak, there is more attenuation.

- When the baseflow prior to the peak inflow is low (less than 30cfs-40cfs), there is more attenuation.

- When the inflow volume / peak inflow is low (less than 18%-20%), meaning a thin and sharp hydrograph, there is more attenuation.

Table 4 below documents how each event performed with respect to all the parameters, and categorizes each event based on the three parameters. Events with significant attenuation are in blue, and events with nuanced attenuation are in orange, with a yes value indicating attenuation.

Table 4: Attenuation Parameter Summary

Historical Event	Flow Reduction (%)	Peak Lag Time (hrs)	24-hr Antecedent Rainfall	Prior Low Flow (cfs)	6-Hr Inflow Volume / Peak Inflow
2012	37.4%	3.25	Y	Y	Y
2011	22.0%	3.5	Y	N	N
2010	31.3%	2	Y	Y	Y
2005	49.2%	2	n/a	Y	Y
2000	28.1%	1.5	N	n/a	N
1998	14.4%	0.5	N	N	N

The results of the analysis show that Searsville Lake has available storage. Storms with the most volume concentrated in the main inflow hydrograph have the most attenuation, while storms that are spread out offer the least attenuation. In addition, the antecedent base flow conditions give a clue to the saturation of the Lake's storage system, showing that an event that occurs during high saturation will not incur much attenuation benefit. The parameters between antecedent rainfall, base flow, and hydrograph shape are likely correlated to some extent, and are probably characteristics of a slow-moving storm system.

The event in 2011 appears to be an outlier, possibly due to the significantly lower peak flow. With a maximum peak inflow to the Lake estimated at around 800cfs, it is almost half the size of the next smallest event.

The exact nature and location of the Searsville Lake storage is not known for certain, but it is hypothesized that the area behind the Lake, identified as the artificial Searsville marsh (Figure 1), is providing the storage. Once the floodplain is utilized, this area has a considerable amount of flow obstructions, as evidenced by a Manning's roughness coefficient of 0.1 in the 2D hydraulic model, and the various culverts used to convey floodwaters under road embankments.

APPENDIX B

DISTRICT'S STATEMENT

CERTIFICATION OF AGENCY TECHNICAL REVIEW
December 2015

Targeted Review

For the:

SAN FRANCISQUITO CREEK HYDROLOGY STUDY
Hydraulics, Hydrology and Geomorphology Unit
DRAFT FINAL USACE DIVISION REVIEW

Prepared by:
Jack Xu, PE Associate Civil Engineer

Under the Direction of:
Liang Xu, Ph. D, PE Engineering Unit Manager

October 2015

San Francisco District

US Army Corps
of Engineers ®

CERTIFICATION OF AGENCY TECHNICAL REVIEW

Subject: Agency Technical Review (ATR) of the **SAN FRANCISQUITO CREEK HYDROLOGY STUDY, Hydraulics, Hydrology and Geomorphology Unit, DRAFT FINAL USACE DIVISION REVIEW, October 2015**, San Francisco District.

Significant concerns and the explanation of the resolution of agency technical review comments for the subject ATR are as follows:

- None

References.

a. ATR guidance: EC 1165-2-214, 15 December 2012, Water Resources Policies and Authorities, CIVIL WORKS REVIEW.
b. The Review Management Organization for this review was the National Flood Risk Management Planning Center of Expertise (FRM-PCX).
c. The ProjnetTM DrChecks Project and Review titles are: Project: (San Francisquito) San Francisquito Creek Flood Risk Management and Review: 2015 Hydrology ATR.
d. The ATR review report is titled: Review Management Organization: National Flood Risk Management Planning Center of Expertise, REVIEW MANAGEMENT ORGANIZATION'S AGENCY TECHNICAL REVIEW REPORT, December 2015, Targeted Review, For the: SAN FRANCISQUITO CREEK HYDROLOGY STUDY, Hydraulics, Hydrology and Geomorphology Unit, DRAFT FINAL USACE DIVISION REVIEW, Prepared by: Jack Xu, PE Associate Civil Engineer, Under the Direction of: Liang Xu, Ph. D, PE Engineering Unit Manager, October 2015, San Francisco District, and contains the ATR Completion Statement.

I certify that all comments resulting from ATR of the subject report have been closed to the satisfaction of the agency technical review team and the project delivery team.

Lyn Gillespie, P.E. Chief, Engineering and Technical Services Division CESPN-ET	Date

Review Management Organization:
National Flood Risk Management
Planning Center of Expertise

REVIEW MANAGEMENT ORGANIZATION'S AGENCY TECHNICAL REVIEW REPORT

December 2015

Targeted Review

For the:

SAN FRANCISQUITO CREEK HYDROLOGY STUDY

Hydraulics, Hydrology and Geomorphology Unit

DRAFT FINAL USACE DIVISION REVIEW

Prepared by:
Jack Xu, PE Associate Civil Engineer

Under the Direction of:
Liang Xu, Ph. D, PE Engineering Unit Manager

October 2015

San Francisco District

US Army Corps
of Engineers ®

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AGENCY TECHNICAL REVIEW REPORT

ENCLOSURE

Agency Technical Review Report

Subject: Targeted review of the **SAN FRANCISQUITO CREEK HYDROLOGY STUDY, Hydraulics, Hydrology and Geomorphology Unit, DRAFT FINAL USACE DIVISION REVIEW, October 2015**, San Francisco District.

1. Scope and Purpose of Review. This review report documents a targeted technical review of the subject report and was conducted pursuant to EC 1165-2-214, 15 December 2012, Water Resources Policies and Authorities, CIVIL WORKS REVIEW. The review was conducted for the San Francisco District. The point of contact for the District was Patrick Sing, Project Engineer, CESPN. The ATR team (ATRT) was lead by Marc L. Masnor, CESWF-PEC-PF (Tulsa, OK). The Review Management Organization with responsibility for managing this ATR was the National Flood Risk Management Planning Center of Expertise (FRM-PCX). The review was conducted between October and November 2015.

2. References.

a. This supplement to the review report was prepared in response to EC 1165-2-214, 15 December 2012, Water Resources Policies and Authorities, CIVIL WORKS REVIEW.
b. The review documents reside online at ProjNet™ (www.projnet.org), DrChecks Project and Review titles: Project: (San Francisquito) San Francisquito Creek Flood Risk Management and Review: 2015 Hydrology ATR.

3. Project Description. San Francisquito Creek forms the boundary of the Santa Clara Valley Water District's (SCVWD) jurisdiction to the north with San Mateo County. The watershed is approximately 45 square miles, with the majority of the watershed in the rural foothills of the San Francisco Peninsula. The Creek's watershed impacts the cities of Palo Alto, East Palo Alto, and Menlo Park. Stanford University is also a major landowner in the region and owns several reservoirs within the watershed.

San Francisquito has three main tributaries that combine to form the creek proper once it leaves the foothills and enters the urbanized valley. Bear Creek is the northernmost tributary and is unimpaired. To the south, Searsville Lake and Dam collect runoff from Alambique, Dennis Martin, Sausal, and Corte Madera Creeks. Searsville Lake offers some attenuation, but has experienced severe sedimentation over time. On the southeastern edge of the watershed, Los Trancos Creek flows unimpaired, passing Felt Lake, a diversion pond owned by Stanford. All three of these tributaries meet before traveling downstream toward the bay through urbanized neighborhoods.

The purpose of the report was to update the 2007 San Francisquito Hydrology Report by improving the following items from the old report:

- Upgrading the numerical model from HEC-1 to HEC-HMS v4.0.
- Characterizing the routing effects of Searsville Lake and dam by using a 2D hydraulic model.
- Using revised and improved methodology for design storms, loss, and Clark’s hydrograph parameters (Tc & R).
- Calibrating the numerical model to historical storms.
- Performing a flood frequency analysis (FFA) on the USGS stream gage and validating the hydrologic design model to the FFA.

A hydrologic model that reflects the existing San Francisquito Creek watershed was developed. This model will be used to determine revised 1% and 10% design flows for the entire creek.

4. Review Team. The following team members met the requirements of the District and RMO for this targeted review.

ATRT Lead – Marc Masnor P.E., Civil Engineer, CESWF-PEC-PF (Tulsa, OK) – 918-669-7349, Marc.L.Masnor@usace.army.mil. Mr. Masnor is a civil works water resources planner in the Plan Formulation Section of the Southwestern Division Office (SWD) Regional Planning and Environmental Center (RPEC), headquartered in the Fort Worth District Office (CESWF) in Fort Worth, TX. He works from the Tulsa District Office (CESWT) in Tulsa, OK, 1645 S. 101st East Ave, Tulsa, OK 74128-4609. He has 37 years of experience with the Corps of Engineers, Tulsa District, Tulsa, OK.

Marc is a SWD regional technical specialist (RTS) for plan formulation and National Environmental Policy Act evaluation of flood risk management (FRM), ecosystem restoration (ECO), and water management and reallocation studies (WMRS). As a senior plan formulation specialist and regional technical specialist, he assists in the development of unique or complex formulation and analysis techniques within the framework of Corps of Engineers guidance; Federal, state, and local laws and regulations; and stakeholder interests. He has been both study manager and project manager for many Tulsa District planning studies that involved flood risk management, ecosystem restoration, comprehensive watershed studies, water supply, reservoir storage reallocation, navigation, hydropower, and chloride control. Mr. Masnor has worked in hydrology, design, project management, and civil works planning offices within the Tulsa District and has completed a wide variety of water resources studies in Kansas, Oklahoma, and Texas. Studies included the evaluation of navigation and hydropower expansion on the McClellan-Kerr Navigation system; a system of 122 small reservoirs in the Grand-Neosho Basin; chloride control evaluations in the Arkansas and Red River Basins; multiple purpose reservoirs system formulation; storage reallocation studies, regional needs studies; watershed ecosystem restoration evaluations; and several local levee, channel, detention, and buyout plans.

He currently provides support for offices within (a) the RPEC and Districts within SWD, (b) three planning centers of expertise (PCX) review management organizations (RMO) for FRM, ECO, and WMRS, and (c) multiple division office RMOs across the Corps. He has participated in or lead roughly 100 ATRs or DQCs.

(a) He supports the RPEC and the SWD as the plan formulation RTS, as an agency technical review (ATR) team member or team lead for continuing authority projects, as a district quality control (DQC) team member, and as a project delivery team (PDT) member.

(b) He supports three PCX RMOs as the ATR Team lead. In that capacity he selects and manages ATR teams to analyze pre-authorization feasibility studies conducted by Districts related to flood risk management, water management and reallocation, ecosystem restoration, and navigation. He has been the Southwestern Division Regional Manager for the FRM PCX National Manager, Eric Thaut (SPD) since 2008 through 2013. Marc participates in a national team that develops tools in support of the PCX RMOs managing body called the PCX Guild. This small team meets at the direction of the Guild to prepare supplemental review tools such as checklists, templates, and training materials for ATR and PDT teams.

(c) He also supports the Division RMOs as the ATR lead. In that capacity he selects and manages ATR teams to analyze post-authorization implementation studies including design documentation reports (DDR) and detailed project reports (DPR), and plans and specifications (P&S), generally for FRM, ECO, and WMRS.

Hydrology and Hydraulics – David Williams, CESWT – 918-669-7091, David.J.Williams@usace.army.mil. David Williams, Hydraulic Engineer, U.S.

Army Corps of Engineers, Tulsa, OK. Dr. Williams graduated Cum Laude from the University of Tulsa in 1999 with a Bachelor of Arts degree in Geology, from the University of Oklahoma in 2001 with a Master of Environmental Science, from Oklahoma State University in 2004 with a Master of Science in Environmental Engineering, and from Oklahoma State University in 2007 with a Doctor of Philosophy in Civil Engineering. He has worked for the U.S. Army Corps of Engineers for 3 years in the Tulsa District office. He currently serves as a Hydraulic Design Engineer for Tulsa District in the areas of flood modeling, flood control structure design, and climate change. Additionally, he serves as a National Hydraulic Modeling Team Lead for the USACE Modeling, Mapping, and Consequences (MC) Production Center and as a representative on the USACE Climate Change and Water Management PDT. Dr. Williams is a member of the USACE Hydrology Committee and of the USACE Extreme Storm Workgroup. He serves on a National Dam Safety Evaluation Team and has conducted several risk-based analyses in the field of Hydrology and Hydraulics. Current work includes modeling of dam break scenarios on multiple structures nationwide as well as levee certification modeling, all based on risk analysis framework. In addition to his employment with USACE, Dr. Williams is an Adjunct Professor of Civil Engineering at Oklahoma State University and a Research Associate (Geosciences) at the University of Tulsa.

5. Charge to Reviewers. A separate charge document was not developed for this targeted review. The District briefed the reviewer. The ATRT Lead’s electronic meeting notice provided the location and description of review documents, review schedule, labor codes, and labor amounts. The notice also identified the District POC and provided contact information, identified the Projnet^{TM} DrChecks project and review, and stated the requirement for four part comments.

6. Summary. The ATR was completed without issues or controversy. The ATRT finding was that the District conducted a thorough peer review. The following paragraphs summarize the status of comments.

a. Critical. None.
b. Unresolved. None.
c. Lessons Learned. None.

7. Dr. Checks Report. The Projnet^{TM} DrChecks report of all comments is attached as Enclosure 1.

8. ATR Completion. Enclosure 2 contains the completion statement of agency technical review. A completion statement for a decision document would be signed by ATRT Lead, the District point of contact, and the RMO representative. Because this was a targeted review the completion statement is only signed by the ATRT Lead and the District point of contact. The District POC should provide a copy of the review report with both signatures for records.

Marc L. Masnor
____
Marc L. Masnor
CESWF-PEC-PF (Tulsa, OK)

Enclosure 1

PROJNET^{TM} DRCHECKS REPORT OF ALL COMMENTS

UNCLASSIFIED\\FOR OFFICIAL USE ONLY

Comment Report: All Comments
Project: San Francisquito Creek Flood Risk Management
Review: 2015 Hydrology ATR
Displaying 4 comments for the criteria specified in this report.

Id	Discipline	Section/Figure	Page Number	Line Number
6284017	Hydrology	n/a	n/a	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

REVIEW CONCERN

Design rainfall values.

BASIS FOR THE CONCERN

It is stated in the report (page 48) that NOAA Atlas 14 was not used to characterize the design storm as previous studies have yielded high flows. There certainly can be value in developing a site-specific analysis in lieu of using a more generalized study such as NOAA Atlas 14, but the discussion on page 48 describing why NOAA Atlas 14 is inappropriate is limited.

SIGNIFICANCE OF THE CONCERN

Medium

ACTION NEEDED TO RESOLVE THE CONCERN

At a minimum, a more complete explanation about why NOAA Atlas 14 was excluded would be helpful on page 48. For example, how do the design values published in NOAA Atlas 14 compare with the TDS design values? How do these compare with TP-40? What factors make NOAA Atlas 14 unsuitable at this location?

Submitted By: David Williams (918-669-7091). Submitted On: Oct 30 2015

1-0 Evaluation **Concurred**

Additional narrative included in section 5.2 RAINFALL DEPTH. In summary, the depths were larger and the percentage short duration/long duration depths were larger too, resulting in higher runoffs. Comparison between NOAA-14 and District TDS equations shown for all sub-basins on new Table 7. Comparison between NOAA-14 at a point rainfall gauge station (ca. 1966) with District statistical numbers done as well in new Table 8. TP-40 shows approximately 6" for 1%, 24-hr storm, and appears closer to the District TDS equations (attachment). However, the 2" contours are rough and difficult to exact.

Submitted By: Jack Xu (4086302913) Submitted On: Nov 05 2015 (Attachment: TP_40_1p_24hr.jpg)

1-1 Backcheck Recommendation **Close Comment**
Closed without comment.

Submitted By: David Williams (918-669-7091) Submitted On: Nov 16 2015
Current Comment Status: **Comment Closed**

6284018	Hydrology	n/a	n/a	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

REVIEW CONCERN

Use of the TDS regional equation.

BASIS FOR THE CONCERN

Without having a detailed knowledge of heavy precipitation events in this basin, it is assumed that they result from onshore flow and occur in part to the local orographic effect of the coastal range. It is also assumed that excessive precipitation results from specific types of weather patterns, e.g. the "Pineapple Express" or some other prevailing flow that brings relatively warm, moist air onshore. Do the storms that were used in the statistical analysis adequately represent the full range of plausible events?

SIGNIFICANCE OF THE CONCERN

Medium

ACTION NEEDED TO RESOLVE THE CONCERN

Please comment.

Submitted By: David Williams (918-669-7091). Submitted On: Oct 30 2015

1-0 Evaluation **For Information Only**
You are correct - all the major moisture that falls in the SFC watershed, and really most of the state for that matter, are from atmospheric river type events, aka pineapple express. There are sometimes very isolated and small convective storms, but these do not occur on the west side of our region, which is where SFC is located.

Our statistical analyses (which produce our TDS equations) rely on recorded rain gauge data that the District has operated - most of which were installed from 1960 to 1980, with an average record length of 30+ years.

Since all the major rain events are atmospheric rivers, the rain gauge data should reflect that as well.

Submitted By: Jack Xu (4086302913) Submitted On: Nov 04 2015

1-1 Backcheck Recommendation **Close Comment**
Closed without comment.

Submitted By: David Williams (918-669-7091) Submitted On: Nov 16 2015
Current Comment Status: **Comment Closed**

6284019	Hydrology	n/a	n/a	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

REVIEW CONCERN

Adopted design rainfall.

BASIS FOR THE CONCERN

Although the TDS equation and coefficients were provided in the report, the adopted design rainfall values were not. Discussion on page 48 would benefit from a table of values.

SIGNIFICANCE OF THE CONCERN

Medium

ACTION NEEDED TO RESOLVE THE CONCERN

Please consider adding a table of TDS design rainfall values to the report. For the sake of comparison, NOAA Atlas 14 design rainfall values would be helpful as well.

Submitted By: David Williams (918-669-7091). Submitted On: Oct 30 2015

1-0 Evaluation **Concurred**
Included new Table 7 to compare 1% 72-hr and 24-hr TDS depths to NOAA-14 depths.

Submitted By: Jack Xu (4086302913) Submitted On: Nov 05 2015

1-1 Backcheck Recommendation **Close Comment**
Closed without comment.

Submitted By: David Williams (918-669-7091) Submitted On: Nov 16 2015
Current Comment Status: **Comment Closed**

6284021	Hydrology	n/a	n/a	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

REVIEW CONCERN

Available storage in Searsville Lake.

BASIS FOR THE CONCERN

On page 13 of the technical memorandum, it is stated that "the exact nature and location of Searsville Lake not known for certain, but is hypothesized that the area behind the lake, identified as the artificial Searsville marsh, is providing the storage." With respect to storage behind the dam, the most critical volume for the hypothetical runoff events is the volume above the normal pool elevation since the additional runoff will be routed on top of this permanent or semi-permanent pool. Since this is the case, a detailed volume-elevation curve can be developed from the DEM, and the areas providing the most storage can be readily identified.

SIGNIFICANCE OF THE CONCERN

Medium

ACTION NEEDED TO RESOLVE THE CONCERN

Consider additional analysis (using the DEM) that will improve knowledge about available flood storage volume behind Searsville Dam. Historical relationships can be developed from topographic quadrangle maps and/or the original design memorandum from the project (if available).

Submitted By: David Williams (918-669-7091). Submitted On: Oct 30 2015

1-0 Evaluation **Concurred**

Additional analysis performed using the DEM, converting it to a TIN file and using a GIS tool to calculate volume at given elevations. Two storage areas were identified, formed by roadway embankments, and one storage area that includes the lake and the marsh upstream.

Since the technical memo is separate from the hydrology study and is already finalized, the data was not added to the technical memo. The design storm and calibration took into account the storage in the 2D model.

Submitted By: Jack Xu (4086302913) Submitted On: Nov 17 2015

1-1 Backcheck Recommendation **Close Comment**

Closed without comment.

Submitted By: David Williams (918-669-7091) Submitted On: Nov 20 2015

Current Comment Status: **Comment Closed**

Enclosure 2

COMPLETION STATEMENT OF AGENCY TECHNICAL REVIEW

COMPLETION OF AGENCY TECHNICAL REVIEW

A targeted agency technical review has been completed for the SAN FRANCISQUITO CREEK HYDROLOGY STUDY, Hydraulics, Hydrology and Geomorphology Unit, DRAFT FINAL USACE DIVISION REVIEW, October 2015, San Francisco District. The review was conducted as defined in the project's Review Plan to comply with the requirements of EC 1165-2-214, 15 December 2012, Water Resources Policies and Authorities, CIVIL WORKS REVIEW. During the review, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of: assumptions, methods, procedures, and material used in analyses, alternatives evaluated, the appropriateness of data used and level obtained, and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing US Army Corps of Engineers policy. The DQC process was found to be thorough. All comments resulting from the ATR have been resolved and the comments have been closed in DrChecks.

Marc L. Masnor, P.E.
ATR Team Leader
CESWF-PEC-PF (Tulsa, OK)

Date

Patrick Sing
Project Engineer
CESPN-ET-EW

Date

Targeted reviews are coordinated with the RMO but do not require signature by the RMO representative. A courtesy copy of the review report and signed completion statement should be provided to the RMO.

DISTRICT QUALITY CONTROL CERTIFICATION COMPLETION OF QUALITY CONTROL ACTIVITIES

The District Quality Control (DQC) of the 2015 hydrology study of the San Francisquito Creek watershed has been completed. A hydrologic model of the entire watershed, hydraulic model characterizing the routing effects of Searsville Dam, main report titled "San Francisquito Creek Hydrology Study, Draft Final, USACE Division Review", and supporting reference documents were reviewed. Certification is hereby given that all quality control activities appropriate to the level of risk and complexity inherent in the product have been completed.

GENERAL FINDINGS

Compliance with clearly established policy principles and procedures, utilizing clearly justified and valid assumptions, has been verified. This includes assumptions; methods, procedures and materials used in analyses; alternatives evaluated; the appropriateness of data used and level of data obtained; and the reasonableness of the results. The undersigned recommends certification of the quality control process for this product.

CERTIFICATION

Certification is hereby given that all quality control activities appropriate to the level of risk and complexity inherent with the completed product.

09 October 2015

Janice M. Lera-Chan, P.E.
Chief, Water Resources Section
CESPN-ET-EW

Date

Harrison S. Sutcliffe, P.E.
Chief, Engineering Branch
CESPN-ET-E

Date

District Quality Control (DQC) Review of the 2015 San Francisquito Hydrologic Study (SCVWD RESPONSE)

Background:

The Water Resources Section of the San Francisco District (SPN) conducted a DQC review of the 2015 hydrologic study of the San Francisquito Creek watershed in September 2015. The 2015 hydrologic study was compiled by the Santa Clara Valley Water District (SCVWD) and includes a HEC-HMS model, a HEC-RAS model, main report, and supporting documentation. SCVWD requests that this hydrologic study be adopted for use in the ongoing San Francisquito Creek General Investigations Feasibility Study. The feasibility study is being conducted by SPN with the San Francisquito Creek Joint Powers Authority (JPA) as the non-federal sponsor. SCVWD is a member of the JPA. A complete list of products included in the 2015 study is presented below.

Products Included in the 2015 Hydrologic Study for DQC Review:

- Main report titled “San Francisquito Creek Hydrology Study, Draft Final USACE DQC Review, September 2015”
- HEC-HMS model “Cal_SFO_2014.hms”
- HEC-RAS model “SearsvilleRAS5.prj”
- Fifteen reference documents for the main report

Prior Coordination Between SCVWD and Water Resources Section:

The Water Resources Section was given the opportunity to review and provide comments on the pre-final draft report in June 2015. At the time of this review, SCVWD had not yet requested a certification of their hydrologic study, so Water Resources Section’s review and comments did not constitute an official DQC review. The Water Resources Section initially had comments about SCVWD’s assumptions regarding the existing and future operations of Searsville Dam, and had concerns that these operations were not being accounted for in their HEC-HMS model. SCVWD attempted to address these concerns by creating Section 8 (“Future Conditions”) in the pre-final draft final report, updating their HEC-HMS model to include a scenario where the lake behind the dam would be full of sediment as a future condition, and by giving a short PowerPoint presentation to Water Resources Section staff regarding the updates to both the pre-final draft report and HEC-HMS model. The Water Resources Section thanks SCVWD for the opportunity to be part of the review process of the 2015 hydrologic study before the official DQC review commenced.

DQC Comments:

Comment #1 (Submitted by: Patrick Sing)

- SCVWD communicated to Water Resources Section that one of the main reasons for conducting this 2015 hydrologic study was to account for attenuation of peak flows caused by the dam at Searsville Lake and that this attenuation was not addressed in SCVWD’s 2007 hydrologic study of the San Francisquito Creek watershed. However, the main report does not include much background information of the dam itself. Background information could include (but not necessarily be limited to): original purpose of the dam, construction date of the dam, current capacity of the dam, and sedimentation rates behind the dam. The only background information provided about the dam is in Section 2.5 (page 6) of the main report regarding the square mileage of the watershed that is behind the dam. Because the attenuation of flows caused by the dam was a driving force for conducting the 2015 hydrologic study, it is recommended that additional background information of the dam be included either in Section 2.5 or Section 8.2 of the main report.

SCVWD Response to Comment #1:

- Concur. Requested background information for Searsville Dam is added to the narrative in section 2.5.

Comment #2 (Submitted by: Janice Lera-Chan)

- SCVWD compiled a technical memorandum, dated March 25, 2015, on the effect of Searsville Lake on large storm events. It is mentioned on page 8 of the main report. It is recommended that the memo either be incorporated in the main report or it be included as attachment, rather than just made as a reference. It is also recommended that a plate (i.e. figure map) be added to the main report that focuses on the Searsville Lake area that shows the roads crossings, culvert restrictions and what is referred to as wetlands/small water bodies.

SCVWD Response to Comment #2:

- Concur. The technical memorandum is added as Appendix A, in addition to being a reference. An additional figure/map was added (now Figure 2) detailing the intricacies of the upstream Searsville Lake area, including the wetlands and culvert crossings. It's worth noting that it was very difficult in finding any sort of map that showed the trails and private roads crossing the Jasper Ridge Preserve in Stanford. However, the figure should have all the pertinent information necessary to understand the operation of the upland area.

Comment #3 (Submitted by: Patrick Sing)

- Section 8.2.2 of the main report refers to a "Stanford steering committee". This is in reference to the steering committee commissioned by Stanford University to address the future of the dam at Searsville Lake. To avoid confusion with other steering committees present at Stanford University, the Water Resources Section recommends referring to this committee as the "Searsville Alternatives Study Committee". This is the same title that is used in the recommendation report that was produced by the committee in April 2015 (and is included as a reference to the main report).

SCVWD Response to Comment #3:

- Concur. Steering committee revised to Searsville Alternatives Study Committee (SASC)

Comment #4 (Submitted by: Patrick Sing)

- The Water Resources Section recommends that Section 8.2.2 of the main report be expanded to include further background information on the Searsville Alternatives Study Committee. Background information could include (but not be limited to): reason for why the committee was founded, who participates on the committee, and responsibilities of the committee.

SCVWD Response to Comment #4:

- Concur. Relevant information added to section 8.2.2, with a more clear reference to the Stanford Alternatives Study report.

Comment #5 (Submitted by: Janice Lera-Chan)

- Section 8.2.2 of the main report briefly states that a comparison was made between a scenario where Searsville Lake is filled in with sediment and a scenario where an orifice at the dam base was created and the sediment inside the lake was excavate. How much sediment would be excavated? Recommend a table showing the existing and future discharges and timing for Searsville these scenarios.

SCVWD Response to Comment #5:

- Additional language clarified the sediment filled scenario and the orifice scenario. However, the orifice details are unknown. The steering report does not specify the size, shape, or invert elevation of the “opening”. Therefore, we are unable to perform any calculations. Discussion was added explaining this as well in 8.2.2.

Comment #6 (Submitted by: Patrick Sing)

- Section 2.2 of the main report notes that the Curve Number method and Clark’s Unit Hydrograph was selected as the loss method and transform method in part because of its successful application to other watersheds within the boundaries of SCVWD. If possible, please provide the names of a couple of these watersheds for comparison of their sizes and shapes to the San Francisquito Creek watershed.

SCVWD Response to Comment #6:

- Added reference to the Lower Peninsula Study (2007) that was also Corps ATR’d, as well as a San Tomas/Saratoga Creek study (2013) that also used Clark’s and CN method. Relative basin areas were added too. Basin sizes are within the range of San Francisquito (20-45 sq mi for the other studies). We feel Lower Peninsula Study would be a good comparison watershed since it is adjacent to San Francisquito. However, given the extensive historical calibration performed, any method would have probably been appropriate.

Comment #7 (Submitted by: Patrick Sing)

- Please provide a short explanation in Section 2.4 of the main report about why the Muskingum-Cunge method was selected as the routing method in the HEC-HMS model. Phone communication between SCVWD and Water Resources Section indicates that Muskingum-Cunge was selected because of its application to other SCVWD projects of similar nature to the San Francisquito Creek watershed - if so, the main report should include this information and further elaborate.

SCVWD Response to Comment #7:

- Muskingum-Cunge further explained. Table 19 in HEC-HMS technical reference manual shows it to be the most robust in performing routing. Other District studies that use Muskingum-Cunge are the same as the reports in Comment #6.

Points of Contact:

Name	Organization	Phone	Email
Janice Lera-Chan	SPN-Water Resources Section (Chief)	(415) 503-6743	janice.m.lera-chan@usace.army.mil
Patrick Sing	SPN-Water Resources Section (Hydraulic Engineer)	(415) 503-6950	patrick.f.sing@usace.army.mil
Patrick Howell	SPN-Project Management	(415) 503-6876	patrick.howell3@usace.army.mil
Liang Xu	SCVWD	(408) 630-2780	lxu@valleywater.org
Jack Xu	SCVWD	(408) 630-2913	jxu@valleywater.org

Appendix E

Traffic Analysis

Final Project Report

Traffic Analysis for the Upstream of Highway 101, San Francisquito Creek Flood Reduction, Ecosystem Restoration and Recreation Project

San Francisquito Creek Joint Powers Authority

October 31, 2018

TJKM

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Appendices

PROJECT OVERVIEW

ICF requested for professional services for Traffic Analysis for San Francisquito Creek Flood Protection, Ecosystem Restoration and Recreational Project Environmental Document. As part of the project, TJKM evaluated the Pope Street/Chaucer Street Bridge and surrounding intersections for existing and bridge closure conditions during weekday a.m. and p.m. peak periods. The objective of the evaluation is to determine impact of the temporary bridge closure within the study area.

Eight study intersections were selected for the project within the study area. The intersections were evaluated under the study scenarios for the weekday a.m. and p.m. peak periods. This report summarizes the results of the analysis including level of service (LOS), delay and 95th percentile queue lengths at all study intersections.

STUDY INTERSECTIONS

The study intersections selected for the project are listed below and illustrated in **Figure 1**.

1. Willow Road/Gilbert Avenue (Signalized)[1]
2. Willow Road/Middlefield Road (Signalized)[1]
3. Middlefield Road/Woodland Avenue-Palo Alto Avenue (Two-Way Stop Control)[1]
4. Middlefield Road/Palo Alto Avenue (One-Way Stop Control)
5. Pope Street/Central Avenue (Yield Control)[1]
6. Pope Street/Woodland Avenue (All-Way Stop Control)[1]
7. Chaucer Street/Palo Alto Avenue (Two-Way Stop Control)
8. Chaucer Street/University Avenue (Signalized)
9. Woodland Avenue/University Avenue (Signalized)

Note:

[1] Intersections fall within the City of Menlo Park jurisdiction. All other intersections fall under City of Palo Alto Jurisdiction.

PROJECT SCENARIOS

The scenarios selected for the study are listed below:

1. Existing Conditions (2018)
2. Existing plus Bridge Closure Conditions

Existing Conditions (2018)

This scenario evaluates all study intersections with existing lane geometry, traffic controls and traffic volumes.

Existing plus Project Conditions

This scenario evaluates all study intersections with existing lane geometry and traffic controls. All inbound and outbound movements at the bridge along Pope Street/Chaucer Street between Pope Street/Woodland Avenue and Chaucer Street/Palo Alto Avenue are restricted to evaluate bridge closure conditions. This includes the eastbound through, northbound right-turn and southbound left-turn movements at Pope Street/Woodland Avenue and the westbound through, northbound left-turn and southbound right-turn movements at Chaucer Street/Palo Alto Avenue intersections. Based on the study area and existing traffic patterns, traffic volumes for the restricted movements were rerouted.

Mitigation Measures

This scenario evaluates potential mitigation measures to reduce impact on traffic operations during bridge closure conditions.

Project Study Area

Legend

X Study Intersections

N

TJKM

STUDY METHODOLOGY

LEVEL OF SERVICE (LOS) ANALYSIS METHODOLOGY

LOS is a standard measure of traffic service along a roadway or at an intersection. It ranges from A to F, with LOS A being best and LOS F being worst. In very general terms, LOS A, B, and C indicate conditions where traffic can move relatively freely. LOS D describes conditions where delay is more noticeable and average travel speeds are more unstable. LOS E indicates significant delays and average travel speeds vary greatly and are unpredictable; traffic volumes are generally at, or close to, capacity. Finally, LOS F characterizes traffic flow at very slow speeds (stop-and-go) and significant delays with queuing at unsignalized intersections, which typically means traffic demand on the roadway exceeds the roadway's capacity.

The *Highway Capacity Manual (HCM), 2000 Edition* is the standard reference published by the Transportation Research Board, and contains the specific criteria and methods to be used in assessing LOS. There are several software packages that have been developed to implement HCM. In this study, Synchro Software was used to calculate the LOS at the study intersections.

Signalized intersection LOS and unsignalized all-way stop controlled LOS is based on the capacity of the intersection as a whole and average delay experienced by a driver. Unsignalized one-way and two-way stop controlled intersection LOS is defined by the average delay experienced by a driver for the minor approach worst movement or major approach critical movement. **Table 1** provides the relationship between LOS rating and delay for signalized and unsignalized intersections.

Table 1: Level of Service Thresholds Based on Intersection Delay

Level of Service	*Signalized Intersection Delay (sec)*	*Unsignalized Intersection Delay (sec)*
A	0 ≤ D ≤ 10	0 ≤ D ≤ 10
B	10 < D ≤ 20	10 < D ≤ 15
C	20 < D ≤ 35	15 < D ≤ 25
D	35 < D ≤ 55	25 < D ≤ 35
E	55 < D ≤ 80	35 < D ≤ 50
F	80 < D	50 < D

Source: Highway Capacity Manual (HCM), 2000 Edition

SIGNIFICANT IMPACT CRITERIA/LEVEL OF SERVICE STANDARDS

City of Palo Alto:

The acceptable LOS in the City of Palo Alto is to maintain a "D" or better for non-Congestion Management Program (CMP) Agency intersections and LOS E for CMP intersections. Based on the City of East Palo Alto 1999 General Plan, the acceptable LOS is also LOS D.

For facilities with an LOS E or LOS F under existing, background, or cumulative conditions before the addition of project traffic, a project is said to have a significant impact per CEQA Guidelines Section 15130 if the TIA shows that the project will cause LOS to deteriorate by the following amounts:

- Addition of the project increases the average control delay for critical movements by four (4) seconds or more, or
- Project traffic increases the Critical V/C (Volume/Capacity) value by 0.01 or more

City of Menlo Park:

Per Policy Circ-3.4 of the City of Menlo Park General Plan adopted in November 2016, the City strives to maintain level of service (LOS) D at all City-controlled signalized intersections during peak hours, except at the intersection of Ravenswood Avenue and Middlefield Road and at intersections along Willow Road from Middlefield Road to US 101.

EXISTING CONDITIONS

ROADWAY NETWORK

The existing Pope-Chaucer Bride is a 40-feet wide, two-lane bridge that connects Woodland Avenue and Palo Alto Avenue along Pope Street/Chaucer Street over the San Francisquito Creek. Surrounding land-uses near the bridge are primarily single-family residential homes with a few small businesses on Gilbert Avenue and Menalto Avenue. Key roadways within the project vicinity are described below:

University Avenue is two lane arterial street that connects from El Camino Real in the south to US 101 in the north.

Middlefield Road is a two to four lane arterial streets that connects from Willow Road in the west and University Avenue in the east within the project vicinity.

Woodland Avenue is primarily a two lane local street that connects from University Avenue to Middlefield Road.

Chaucer Street is a two lane local street that connects from Hamilton Avenue in the east to Woodland Avenue in the west.

Pope Street is a two lane local street that connects from Woodland Avenue in the east to Walnut Street in the west.

Palo Alto Avenue is a two lane local street that connects from University Avenue in the north to Middlefield Road in the south.

Gilbert Avenue a two lane collector street that connects from Willow Road in the west to Menalto Avenue in the east.

Willow Road is primarily a two lane arterial that connects from US 101 in the north to Middlefield Road in the south within the project vicinity.

Figure 2 illustrates the existing lane geometry and traffic controls at the study intersections.

DATA COLLECTION

Intersection Turning Movement Counts (TMC)

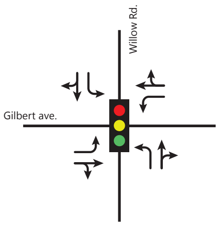
TJKM collected turning movement counts at the study intersections for vehicles, pedestrians, and bicycles on Tuesday, May 22, 2018 on a typical weekday when the schools were in session. The turning movement counts were collected for weekday a.m. (7:00 a.m. - 9:00 a.m.) and p.m. (4:00 p.m. – 6:00 p.m.) peak periods. TJKM obtained Year 2016 turning movement counts for the intersection of Woodland Avenue/University Avenue from the *Newell Bridge Replacement Project Report* dated September 21, 2016. The traffic volumes were projected for existing year 2018 per the report and utilized in this study. **Figure 3** illustrates existing vehicular traffic volumes and **Figure 4** illustrates pedestrian and bicycle volumes for all study intersections. **Appendix A** contains the vehicle, pedestrian, and bicycle counts for the study intersections.

Existing Signal Timing

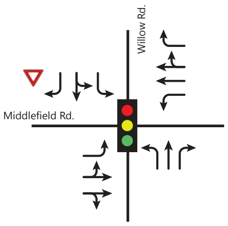
TJKM obtained the existing traffic signal timing sheets and phasing diagrams for the University Avenue/Chaucer Avenue, Willow Road/Gilbert Avenue, Willow Road/Middlefield Road intersections from the City of Palo Alto and the City of Menlo Park for the purpose of this analysis.

Existing Lane Geometry and Traffic Control

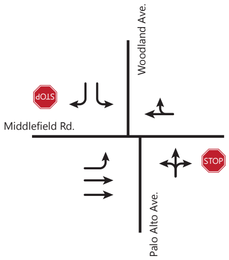
Intersection #1
Willow Rd. / Gilbert Ave.



Intersection #2
Willow Rd. / Middlefield Rd.

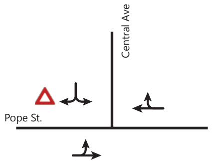


Intersection #3
Palo Alto Ave. / Woodland Ave. / Middlefield Rd.

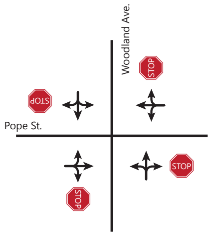


Intersection #4
Palo Alto Ave. / Middlefield Rd.

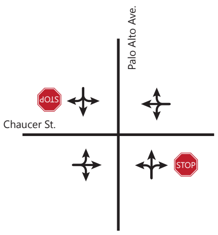
Intersection #5
Central Ave / Pope St.



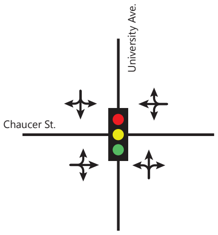
Intersection #6
Woodland Ave. / Pope St.



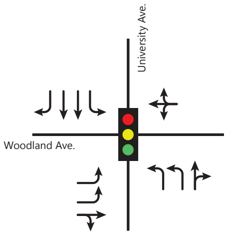
Intersection #7
Palo Alto Ave. / Chaucer St.

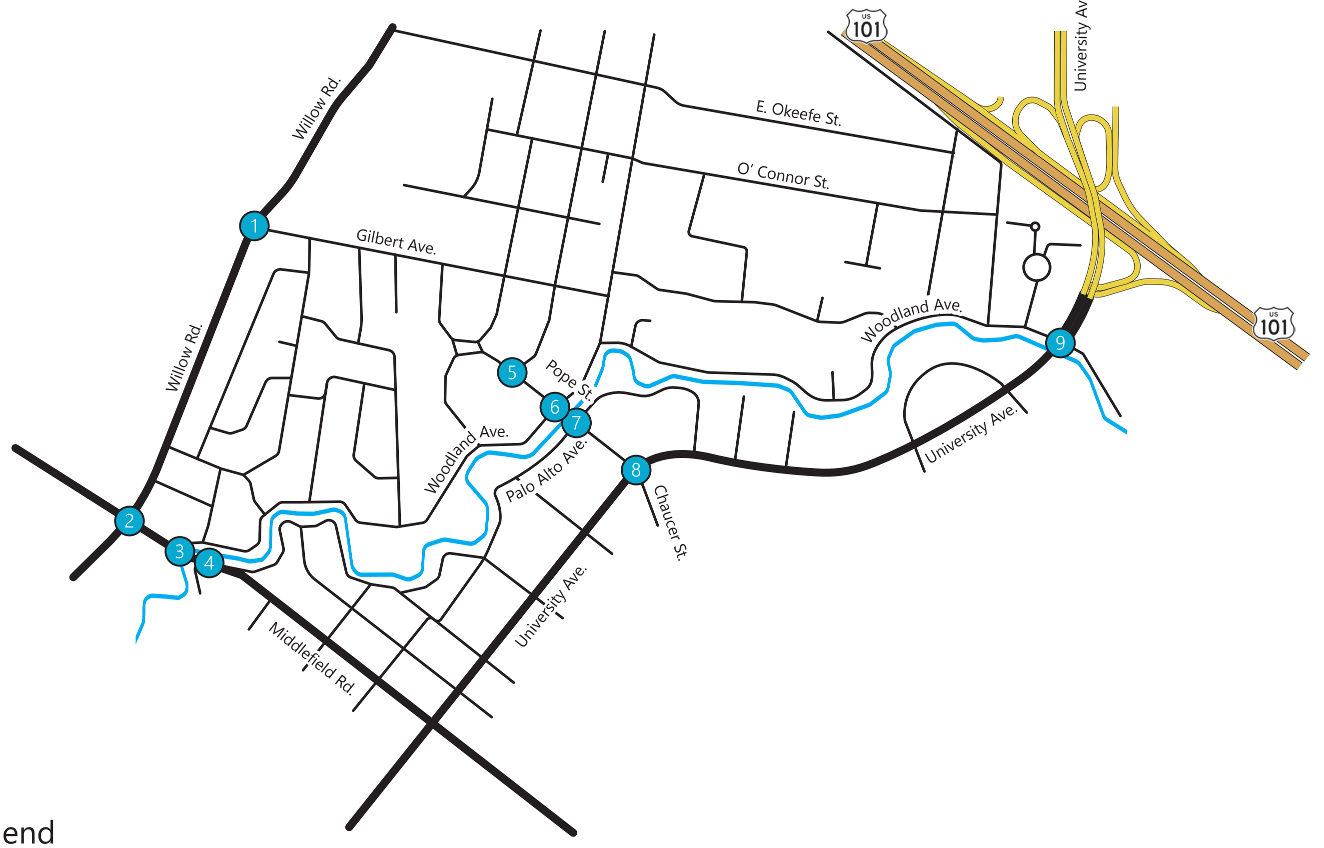


Intersection #8
University Ave. / Chaucer St.



Intersection #9
Woodland Ave. / University Ave.



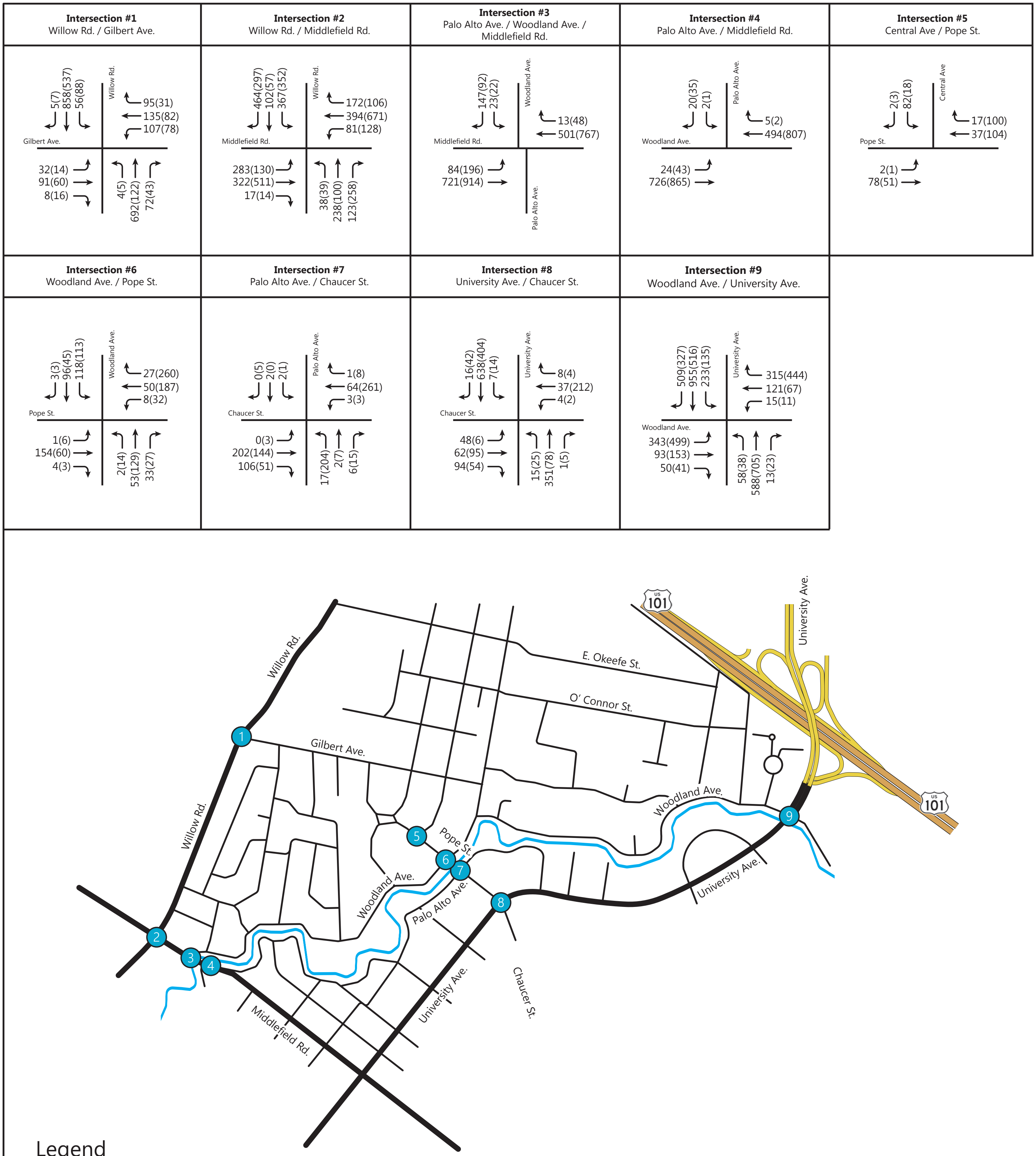


Legend

X	Study Intersections
XX	AM Peak Hour Volumes
(XX)	PM Peak Hour Volumes

N

Existing (2018) Traffic Volumes



Legend

X Study Intersections

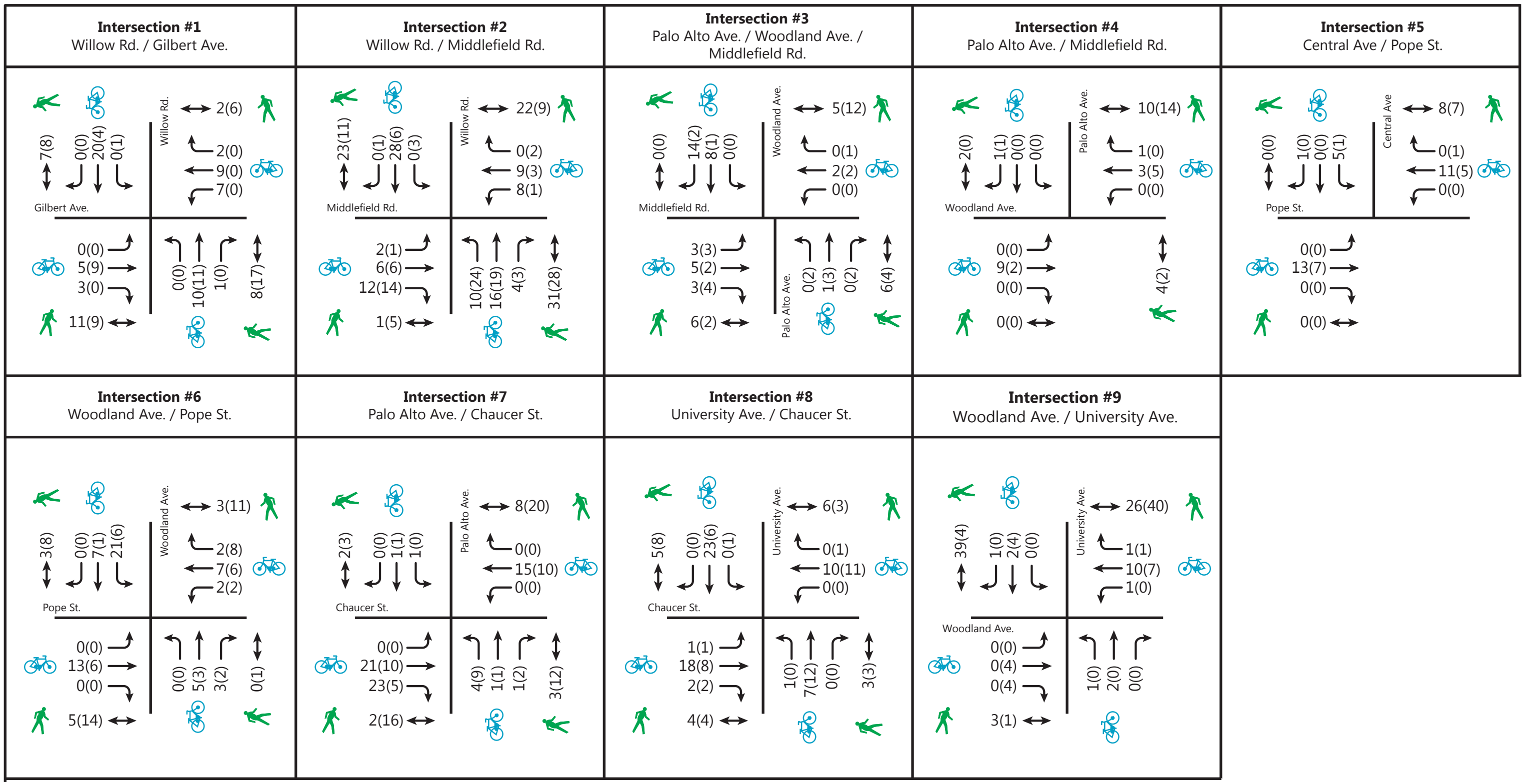
XX AM Peak Hour Volumes

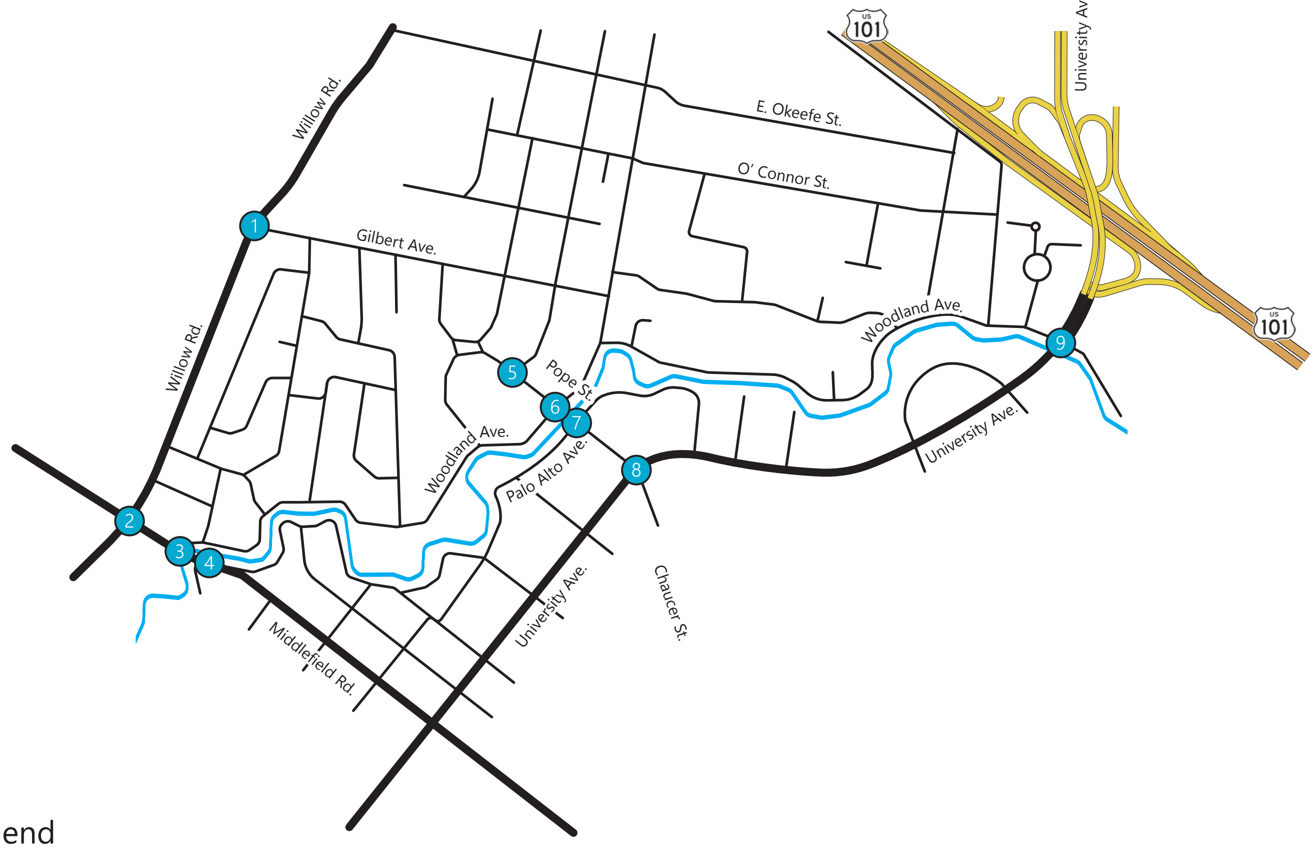
(XX) PM Peak Hour Volumes

042-058

Figure 3

Existing (2018) Pedestrian and Bicycle Volumes





Legend

- X Study Intersections
- XX AM Peak Hour Volumes
- (XX) PM Peak Hour Volumes

N

TJKM

042-058

Figure 4

EXISTING CONDITIONS (2018) LOS AND 95TH PERCENTILE QUEUE LENGTH ANALYSIS

The existing conditions (2018) scenario evaluates all study intersections with existing lane geometry, traffic controls and traffic volumes. The results of the LOS, delay and 95th percentile queue length in feet (ft.) analysis using Synchro software are summarized in **Tables 2** and **3** respectively. **Appendix B** contains Synchro reports for all study intersections.

Under the existing conditions (2018) scenario, all study intersections operate within applicable jurisdictional standards of the City of Palo Alto (LOS D or better) and the City of Menlo Park during the a.m. and p.m. peak hours with the exception of the following:

- Middlefield Road/Woodland Avenue-Palo Alto Avenue – LOS F during p.m. peak hour

Table 2: Existing Conditions LOS and Delay

#	*Study Intersections*	*Control*	*Peak Hour*	*Existing Conditions*	
				Average Delay[1] (sec)	*LOS*
1	Willow Road/Gilbert Avenue	Signalized	AM	29.4	C
			PM	15.1	B
2	Willow Road/Middlefield Road	Signalized	AM	59.7	E
			PM	52.3	D
3	Middlefield Road/Woodland Avenue-Palo Alto Avenue	Two-Way Stop	AM	17.8	C
			PM	**71.5**	**F**
4	Middlefield Road/Palo Alto Avenue	One-Way Stop	AM	12.3	B
			PM	18.4	C
5	Pope Street/Central Avenue	Yield	AM	10.0	A
			PM	10.1	B
6	Pope Street/Woodland Avenue	All-Way Stop	AM	9.4	A
			PM	16.6	C
7	Chaucer Street/Palo Alto Avenue	Two-Way Stop	AM	11.9	B
			PM	26.1	D
8	Chaucer Street/University Avenue	Signalized	AM	10.4	B
			PM	10.3	B
9	Woodland Avenue/University Avenue	Signalized	AM	39.0	D
			PM	39.3	D

Note:

[1] Delay: Overall intersection delay in seconds per vehicle for signalized and unsignalized all-way stop controlled intersections. Delay for minor approach worst movement or major approach critical movements at unsignalized one-way and two-way stop controlled intersections.

Bold indicates unacceptable LOS.

Existing conditions queue length analysis showed several intersections having 95th percentile queue length exceeding existing storage capacity. **Table 5** summarizes 95th percentile queue lengths at the study intersections.

Table 3: Existing Conditions 95th Percentile Queue Lengths (ft.)

#	Study Intersection	Lane Group	Storage Length per lane (feet)	Existing Conditions	
				A.M.	P.M.
1	Willow Road/Gilbert Avenue	EBL	55	**#90**	29
		EBTR	400	147	93
		WBL	90	**#188**	**113**
		WBTR	320	**#333**	137
		NBL	75	m3	3
		NBTR	450	363	44
		SBL	90	31	33
		SBTR	455	**497**	207
2	Willow Road/Middlefield Road	EBL	270	**#346**	210
		EBTR	1025	304	420
		WBL	120	133	**182**
		WBT	330	303	**484**
		WBR	65	175	**80**
		NBL	75	69	**80**
		NBT	1010	#360	172
		NBR	110	101	48
		SBL	150	**m307**	**330**
		SBL	250	**m315**	**331**
		SBR	65	**408**	**309**
3	Middlefield Road/Palo Alto Avenue-Woodland Avenue	EBL	50	7	34
		EBT	350	0	0
		EBT	350	0	0
		WBTR	415	0	0
		SBL	30	11	**75**
		SBR	810	33	52
4	Middlefield Road/Palo Alto Avenue	EBL	40	2	5
		EBT	505	0	0
		WBTR	655	0	0
		SBLR	630	4	14
5	Pope Street/Central Avenue	EBLT	245	0	0
		WBTR	300	0	0
		SBLR	665	10	4
6[1]	Woodland Avenue/Pope Street-Chaucer Street	EBLTR	310	60	53
		WBLTR	110	58	**124**
		NBLTR	595	45	71
		SBLTR	500	76	68

#	*Study Intersection*	*Lane Group*	*Storage Length per lane (feet)*	*Existing Conditions*	
				A.M.	*P.M.*
7	Palo Alto Avenue/Chaucer Street	EBLTR	110	0	0
		WBLTR	470	0	0
		NBLTR	510	3	104
		SBLTR	950	2	1
8	Chaucer Street/University Avenue	EBLTR	470	165	88
		WBLTR	530	46	129
		NBLTR	505	147	46
		SBLTR	365	338	208
9	Woodland Avenue/University Avenue	EBL	580	#162	#235
		EBTR	580	126	178
		WBLTR	500	#442	#419
		NBL	160	68	53
		NBTR	536	231	283
		SBL	210	192	134
		SBT	443	326	167
		SBR	443	66	55

Note:

- 95th percentile volume exceeds capacity, queue maybe longer. Queue shown is maximum after two cycles.

m – Volume for 95th percentile queue is metered by upstream signal.

[1] Synchro does not provide queue lengths for all-way stop control intersections. Queues were obtained from SimTraffic.

Bold indicates 95th Percentile Queue Lengths higher than existing capacity.

EXISTING PLUS BRIDGE CLOSURE CONDITIONS

VEHICULAR LOS, DELAY AND 95TH PERCENTILE QUEUE LENGTH ANALYSIS

The existing plus project conditions scenario evaluates all study intersections with existing lane geometry and traffic controls. All inbound and outbound movements at the bridge along Pope Street/Chaucer Street between Pope Street/Woodland Avenue and Chaucer Street/Palo Alto Avenue are restricted to evaluate bridge closure conditions. This includes restriction of the eastbound through, northbound right-turn and southbound left-turn movements at Pope Street/Woodland Avenue and the westbound through, northbound left-turn and southbound right-turn movements at Chaucer Street/Palo Alto Avenue intersections. Based on the study area and existing traffic patterns, traffic volumes for the restricted movements were rerouted. **Figure 5** illustrates the rerouted trips under bridge closure conditions and **Figure 6** illustrates the total traffic demands under the bridge closure conditions.
Existing signal timings were maintained for signalized intersections under this scenario similar to existing conditions. The results of the LOS, delay and 95th percentile queue length in feet (ft.) analysis using Synchro software are summarized in **Tables 4** and **5** respectively. **Appendix C** contains Synchro reports for all study intersections.

It should be noted that for the purpose of rerouting trips and maintaining reasonable volume balancing at the intersections, all intersections were evaluated with volumes for the same peak hour. The a.m. and p.m. peak hours based on the traffic counts collected are 7:45 a.m. to 8:45 a.m. and 5:00 p.m. to 6:00 p.m. respectively.

Under the existing plus bridge closure conditions scenario, all study intersections operate within applicable jurisdictional standards of the City of Palo Alto (LOS D or better) and City of Menlo Park during the a.m. and p.m. peak hours with the exception of the following:

- Middlefield Road/Woodland Avenue-Palo Alto Avenue – LOS F during a.m. and p.m. peak hours

Middlefield Road/Woodland Avenue-Palo Alto Avenue intersection operates at LOS F during the temporary bridge closure versus LOS C under existing conditions during the a.m. peak period. During the p.m. peak period, this intersection operates at LOS F, however, the delay experienced by Woodland Avenue approach is substantially higher.

Rerouted Trips During Bridge Closure

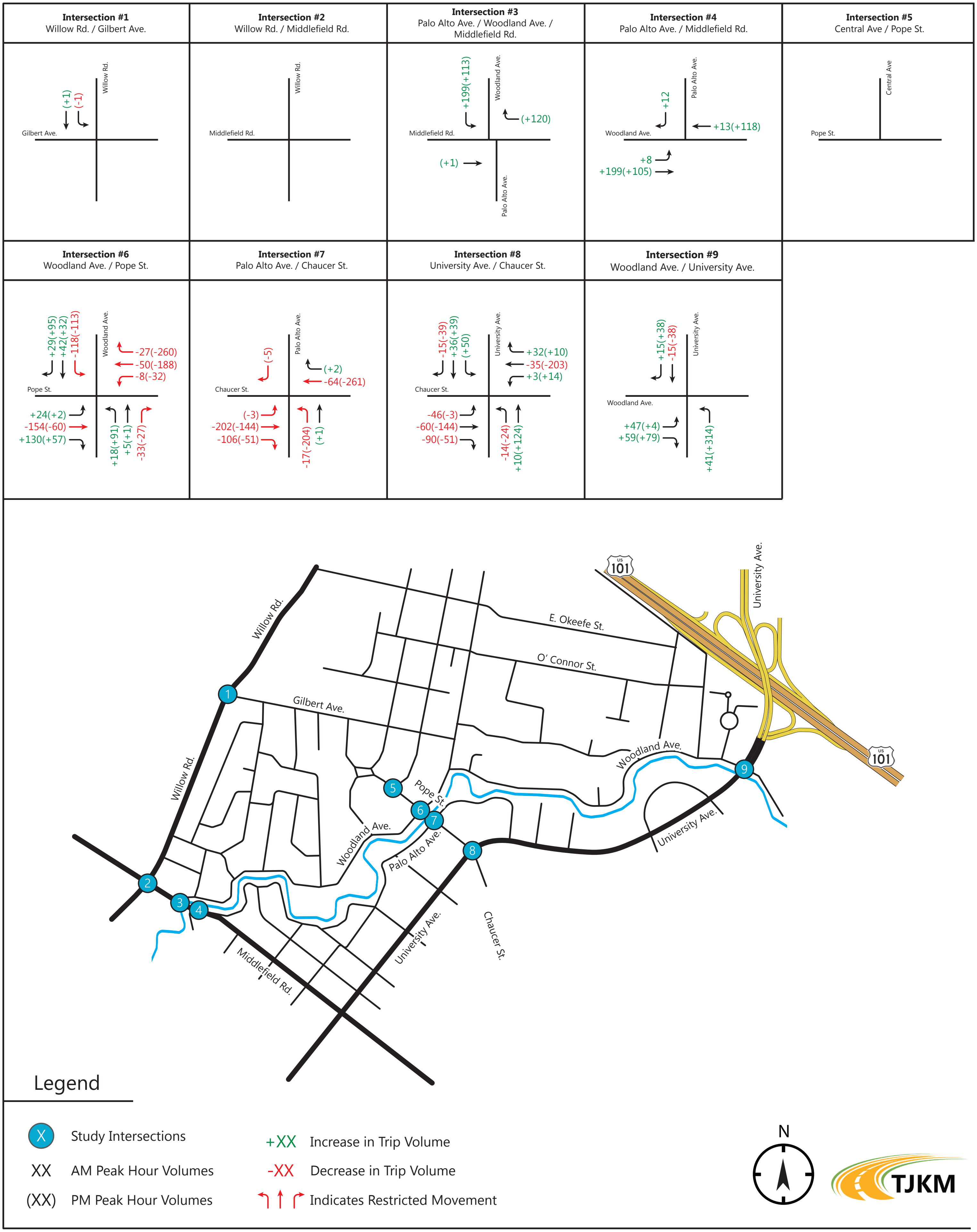


Figure 5

Existing plus Bridge Closure Conditions Traffic Volumes

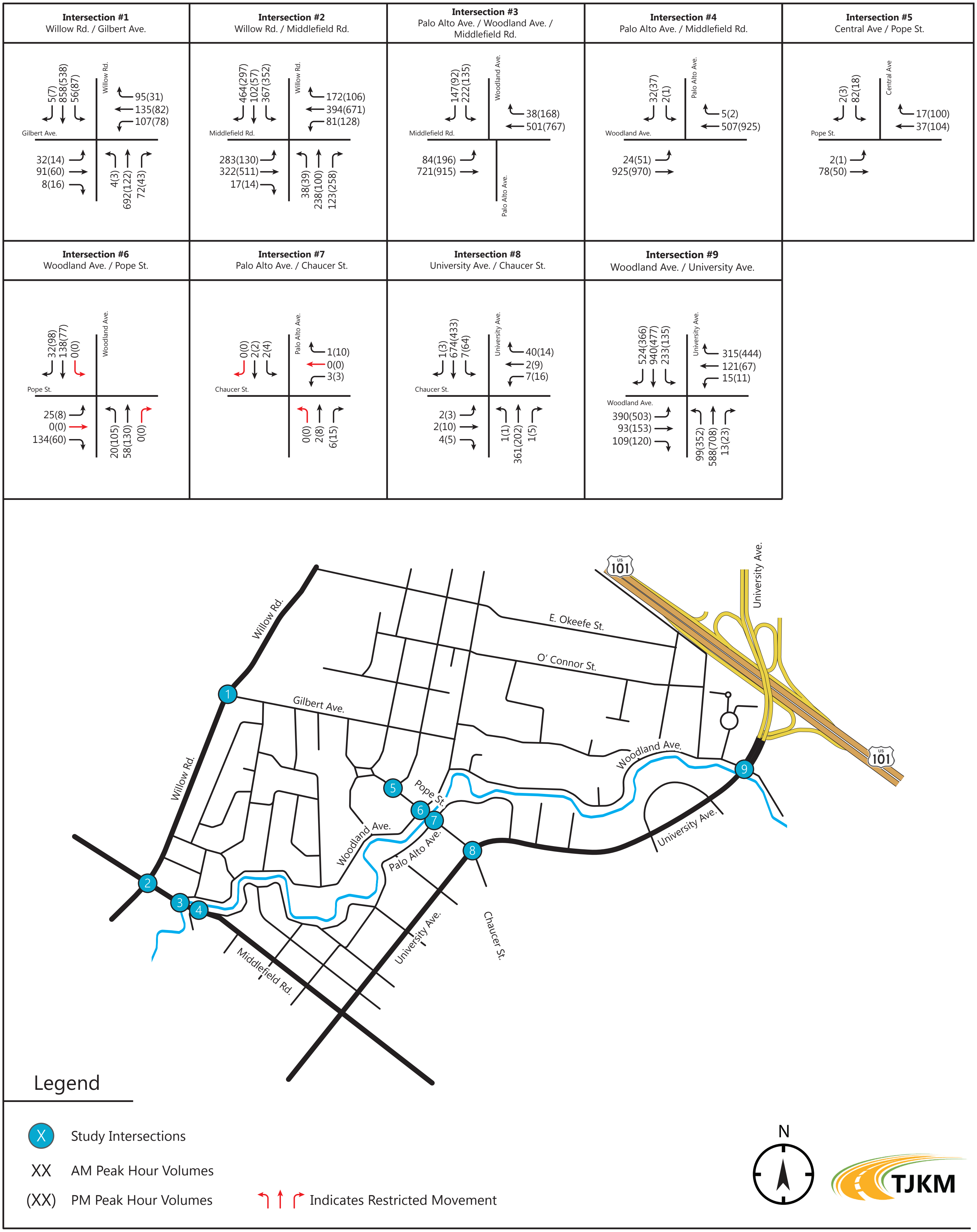


Figure 6

Table 4: Existing plus Project Conditions LOS and Delay

#	Study Intersections	Control	Peak Hour	Existing Conditions		Existing + Bridge Closure Conditions	
				Average Delay[1] (sec)	LOS	Average Delay[1] (sec)	LOS
1	Willow Road/Gilbert Avenue	Signalized	AM	29.4	C	29.4	C
			PM	15.1	B	15.1	B
2	Willow Road/Middlefield Road	Signalized	AM	59.7	E	59.7	E
			PM	52.3	D	52.4	D
3	Middlefield Road/Woodland Avenue-Palo Alto Avenue	Two-Way Stop	AM	17.8	C	**227.4**	**F**
			PM	**71.5**	**F**	**Err[2]**	**F**
4	Middlefield Road/Palo Alto Avenue	One-Way Stop	AM	12.3	B	12.7	B
			PM	18.4	C	21.8	C
5	Pope Street/Central Avenue	Yield	AM	10	A	10.0	A
			PM	10.1	B	10.1	B
6	Pope Street/Woodland Avenue	All-Way Stop	AM	9.4	A	8.3	A
			PM	16.6	C	9.3	A
7	Chaucer Street/Palo Alto Avenue	Two-Way Stop	AM	11.9	B	9.0	A
			PM	26.1	D	9.4	A
8	Chaucer Street/University Avenue	Signalized	AM	10.4	B	4.3	A
			PM	10.3	B	4.8	A
9	Woodland Avenue/University Avenue	Signalized	AM	39.0	D	41.5	D
			PM	39.3	D	51.9	D

Notes:

[1] Delay: Overall intersection delay in seconds per vehicle for signalized and unsignalized all-way stop controlled intersections. Delay for minor approach worst movement or major approach critical movements at unsignalized one-way and two-way stop controlled intersections.

[2] Err indicates error in calculating delay as the volume greatly exceeds capacity.

Bold indicates unacceptable LOS.

The results of the existing plus project conditions queue length analysis was similar to existing conditions analysis at most movements and locations. The queue lengths increased at some locations because of the rerouted trips within the project area, especially at Middlefield Road/Woodland Avenue-Palo Alto Avenue intersection for the Woodland Avenue approach.

Table 5: Existing Plus Bridge Closure Conditions 95th Percentile Queue Lengths (ft.)

#	Study Intersection	Lane Group	Storage Length per lane (feet)	Existing Conditions		Existing + Bridge Closure Conditions	
				A.M.	P.M.	A.M.	P.M.
1	Willow Road/Gilbert Avenue	EBL	55	#90	29	#90	29
		EBTR	400	147	93	147	93
		WBL	90	#188	113	#188	113
		WBTR	320	#333	137	#333	137
		NBL	75	m3	3	m3	3
		NBTR	450	363	44	363	44
		SBL	90	31	33	31	32
		SBTR	455	497	207	497	207
2	Willow Road/Middlefield Road	EBL	270	#346	210	#346	210
		EBTR	1025	304	420	304	420
		WBL	120	133	182	133	182
		WBT	330	303	484	303	484
		WBR	65	175	80	175	80
		NBL	75	69	80	69	80
		NBT	1010	#360	172	#360	172
		NBR	110	101	48	101	48
		SBL	150	m307	330	m307	332
		SBL	250	m315	331	m315	331
		SBR	65	408	309	408	309
3	Middlefield Road/Palo Alto Avenue-Woodland Avenue	EBL	50	7	34	7	40
		EBT	350	0	0	0	0
		EBT	350	0	0	0	0
		WBTR	415	0	0	0	0
		SBL	30	11	75	**327**	**Err**[2]
		SBR	810	33	52	34	61
4	Middlefield Road/Palo Alto Avenue	EBL	40	2	5	2	7
		EBT	505	0	0	0	0
		WBTR	655	0	0	0	0
		SBLR	630	4	14	6	19
5	Pope Street/Central Avenue	EBLT	245	0	0	0	0
		WBTR	300	0	0	0	0
		SBLR	665	10	4	10	4
6	Woodland Avenue/Pope Street-Chaucer Street	EBLTR	310	60	53	59	47
		WBLTR	110	58	124	0	0
		NBLTR	595	45	71	43	74
		SBLTR	500	76	68	67	73

#	*Study Intersection*	*Lane Group*	*Storage Length per lane (feet)*	*Existing Conditions*		*Existing + Bridge Closure Conditions*	
				A.M.	*P.M.*	*A.M.*	*P.M.*
7	Palo Alto Avenue/Chaucer Street	EBLTR	110	0	0	0	0
		WBLTR	470	0	0	0	0
		NBLTR	510	3	104	1	2
		SBLTR	950	2	1	1	1
8	Chaucer Street/University Avenue	EBLTR	470	165	88	14	20
		WBLTR	530	46	129	24	31
		NBLTR	505	147	46	70	80
		SBLTR	365	338	208	174	237
9	Woodland Avenue/University Avenue	EBL	580	#162	#235	#195	#238
		EBTR	580	126	178	#194	#285
		WBLTR	500	#442	#419	#442	#419
		NBL	160	68	53	103	#431
		NBTR	536	231	283	231	284
		SBL	210	192	134	192	134
		SBT	443	326	167	329	178
		SBR	443	66	55	71	71

Notes:

- 95th percentile volume exceeds capacity, queue maybe longer. Queue shown is maximum after two cycles.

m – Volume for 95th percentile queue is metered by upstream signal.

[1] Synchro does not provide queue lengths for all-way stop control intersections. Queues were obtained from SimTraffic.

[2] Err indicates error in calculating delay as the volume greatly exceeds capacity.

Bold indicates 95th Percentile Queue Lengths higher than existing capacity.

PEDESTRIAN AND BICYCLE IMPACTS

With full closure of the Pope St-Chaucer Street Bridge, pedestrians and bicyclists currently using the bridge would experience significant impacts with no alternate routes available within the immediate vicinity of the bridge. Under existing conditions, approximately 13 and 6 bicyclists and 5 and 14 pedestrians cross the bridge in the eastbound direction during the a.m. and p.m. peak hours respectively. Similarly, approximately 15 and 10 bicyclists and 8 and 20 pedestrians cross the bridge in the westbound direction during the a.m. and p.m. peak hours. The intersections of Woodland Avenue/Middlefield Road and Woodland Avenue/University Drive are the closest alternative routes, which are at approximately 0.6 to 0.8 mile distance from the intersection of Woodland Avenue/Pope Street and 0.6 to 0.7 mile distance from the intersection of Palo Alto Avenue/Chaucer Street.

Additionally, there are two bus stops located within close proximity of the bridge, Woodland Avenue & Woodland Court for Routes 83 and 88 and University Avenue & Chaucer Street for Routes 280, 281, 296 and 397. Pedestrians and bicyclists using transit would experience higher delays with the closure of the bridge if they were crossing the bridge to reach their preferred bus stop.

Alternate solutions to mitigate impact faced by pedestrians and bicyclists could include construction staging or constructing temporary pedestrian and bicycle access over the San Francisquito Creek.

MITIGATION MEASURES

Based on the LOS and delay analyses conducted at the eight study intersections, it was observed that under existing year (2018) conditions, all intersections operate with acceptable levels of service during the weekday a.m. and p.m. peak periods with the exception of Middlefield Road/Woodland Avenue-Palo Alto Avenue, which operates at LOS F during the p.m. peak period.

Under existing plus bridge closure conditions, Middlefield Road/Woodland Avenue-Palo Alto Avenue operates at LOS F with significantly higher delay because of the rerouted trips during both a.m. and p.m. peak periods. The 95th percentile queue length analysis conducted provided the same results.

Potential mitigation measures to alleviate the delay experienced at during the bridge closure could include the following:

1. Providing detour signs to divert traffic onto Willow Road rather than Woodland Avenue to get on to Middlefield Road. This would reduce the delay experienced at the intersection because of rerouted trips during commute hours.
2. Providing temporary traffic signal at Middlefield Road/Woodland Avenue-Palo Alto Avenue enabling the intersection to operate with acceptable LOS standards.

TJKM evaluated both options to ascertain the impact on LOS and delay at the study intersections. Under Option 1, traffic that was rerouted to Woodland Avenue/Middlefield Road was rerouted to Willow Road/Gilbert Avenue and traffic signal timings were modified to accommodate the additional traffic. Option 2 does not see any rerouting of traffic; however, traffic signal timings were modified. **Tables 6** and **7** summarize the LOS and delay and 95th percentile queue lengths respectively of the two mitigation measures. **Appendix D** contains the Synchro and SimTraffic analysis reports.

Based on the analysis conducted for the two options, the intersection of Woodland Avenue/Middlefield Road still operates with unacceptable LOS E and F during the a.m. and p.m. peak hours respectively, however, with significantly lower delay under Option 1 scenario. This intersection operates at acceptable LOS for the a.m. and p.m. peak hours under the Option 2 scenario, however, with higher queue lengths for the westbound direction during the p.m. peak period.

Table 6: Mitigation Measures LOS and Delay

#	**Study Intersections**	**Control**	**Peak Hour**	***Existing Conditions***		***Existing + Bridge Closure Conditions***		***Mitigation Measures-Option 1***		***Mitigation Measures-Option 2***	
				Average Delay (sec)	***LOS***	***Average Delay (sec)***	***LOS***	***Average Delay (sec)***	***LOS***	***Average Delay (sec)***	***LOS***
1	Willow Road/Gilbert Avenue	Signalized	AM	29.4	C	29.4	C	32.7	C	29.5	C
			PM	15.1	B	15.1	B	19.5	B	15.1	B
2	Willow Road/Middlefield Road	Signalized	AM	**59.7**	**E**	**59.7**	**E**	**58.6**	**E**	**56.2**	**E**
			PM	52.3	D	52.4	D	54.6	D	52.4	D
3	Middlefield Road/Woodland Avenue-Palo Alto Avenue	Two-Way Stop	AM	17.8	C	**227.4**	**F**	**41.1**	**E**	16.5	B
			PM	**71.5**	**F**	**Err[2]**	**F**	**942.4**	**F**	35.9	D
4	Middlefield Road/Palo Alto Avenue	One-Way Stop	AM	12.3	B	12.7	B	12.7	B	12.8	B
			PM	18.4	C	21.8	C	21.8	C	21.8	C
5	Pope Street/Central Avenue	Yield	AM	10	A	10.0	A	9.0	A	10.0	A
			PM	10.1	B	10.1	B	9.3	A	10.1	B
6	Pope Street/Woodland Avenue	All-Way Stop	AM	9.4	A	8.3	A	7.7	A	8.3	A
			PM	16.6	C	9.3	A	9.1	A	9.3	A
7	Chaucer Street/Palo Alto Avenue	Two-Way Stop	AM	11.9	B	9.0	A	9.0	A	9.0	A
			PM	26.1	D	9.4	A	9.4	A	9.4	A
8	Chaucer Street/University Avenue	Signalized	AM	10.4	B	4.3	A	4.3	A	4.3	A
			PM	10.3	B	4.8	A	4.8	A	4.8	A
9	Woodland Avenue/University Avenue	Signalized	AM	39.0	D	41.5	D	41.5	D	41.5	D
			PM	39.3	D	51.9	D	51.9	D	51.9	D

Notes:

[1] Delay: Overall intersection delay in seconds per vehicle for signalized and unsignalized all-way stop controlled intersections. Delay for minor approach worst movement or major approach critical movements at unsignalized one-way and two-way stop controlled intersections.

[2] Err indicates error in calculating delay as the volume greatly exceeds capacity.

Bold indicates unacceptable LOS.

Table 7: Mitigation Measures 95th Percentile Queue Lengths (ft.)

#	Study Intersection	Lane Group	Storage Length per lane (feet)	Existing Conditions		Existing + Bridge Closure Conditions		Mitigation Measures-Option 1		Mitigation Measures-Option 2	
				A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
1	Willow Road/Gilbert Avenue	EBL	55	#90	29	#90	29	48	26	#90	29
		EBTR	400	147	93	147	93	112	81	147	93
		WBL	90	#188	113	#188	113	378	201	#188	113
		WBTR	320	#333	137	#333	137	237	118	#333	137
		NBL	75	m3	3	m3	3	m2	4	m3	3
		NBTR	450	363	44	363	44	258	67	363	44
		SBL	90	31	33	31	32	81	47	31	32
		SBTR	455	497	207	497	207	953	302	497	207
2	Willow Road/Middlefield Road	EBL	270	#346	210	#346	210	#346	213	#346	210
		EBTR	1025	304	420	304	420	304	423	304	420
		WBL	120	133	182	133	182	133	190	m101	182
		WBT	330	303	484	303	484	303	#508	280	484
		WBR	65	175	80	175	80	175	83	135	80
		NBL	75	69	80	69	80	69	80	69	80
		NBT	1010	#360	172	#360	172	#360	172	#360	172
		NBR	110	101	48	101	48	101	48	101	48
		SBL	150	m307	330	m307	332	m307	390	m307	332
		SBL	250	m315	331	m315	331	m315	392	m315	331
		SBR	65	408	309	408	309	408	323	408	309
3	Middlefield Road/Palo Alto Avenue-Woodland Avenue	EBL	50	7	34	7	40	7	40	m62	#261
		EBT	350	0	0	0	0	0	0	59	141
		EBT	350	0	0	0	0	0	0	59	141
		WBTR	415	0	0	0	0	0	0	347	**#953**
		SBL	30	11	75	**327**	**Err[2]**	36	**198**	**154**	**146**
		SBR	810	33	52	34	61	34	61	38	25
4	Middlefield Road/Palo Alto Avenue	EBL	40	2	5	2	7	2	7	2	7
		EBT	505	0	0	0	0	0	0	0	0
		WBTR	655	0	0	0	0	0	0	0	0
		SBLR	630	4	14	6	19	6	19	6	19
5	Pope Street/Central Avenue	EBLT	245	0	0	0	0	0	0	0	0
		WBTR	300	0	0	0	0	0	0	0	0
		SBLR	665	10	4	10	4	1	1	10	4

#	Study Intersection	Lane Group	Storage Length per lane (feet)	Existing Conditions		Existing + Bridge Closure Conditions		Mitigation Measures-Option 1		Mitigation Measures-Option 2	
				A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
6	Woodland Avenue/Pope Street-Chaucer Street	EBLTR	310	60	53	59	47	43	53	62	49
		WBLTR	110	58	**124**	0	0	0	0	0	0
		NBLTR	595	45	71	43	74	45	77	42	74
		SBLTR	500	76	68	67	73	61	67	67	70
7	Palo Alto Avenue/Chaucer Street	EBLTR	110	0	0	0	0	0	0	0	0
		WBLTR	470	0	0	0	0	0	0	0	0
		NBLTR	510	3	104	1	2	1	2	1	2
		SBLTR	950	2	1	1	1	1	1	1	1
8	Chaucer Street/University Avenue	EBLTR	470	165	88	14	20	14	20	14	20
		WBLTR	530	46	129	24	31	24	31	24	31
		NBLTR	505	147	46	70	80	70	80	70	80
		SBLTR	365	338	208	174	237	174	237	174	237
9	Woodland Avenue/University Avenue	EBL	580	#162	#235	#195	#238	#195	#238	#195	#238
		EBTR	580	126	178	#194	#285	#194	#285	#194	#285
		WBLTR	500	#442	#419	#442	#419	#442	#419	#442	#419
		NBL	160	68	53	103	#431	103	#431	103	#431
		NBTR	536	231	283	231	284	231	284	231	284
		SBL	210	192	134	192	134	192	134	192	134
		SBT	443	326	167	329	178	329	178	329	178
		SBR	443	66	55	71	71	71	71	71	71

Notes:

- 95th percentile volume exceeds capacity, queue maybe longer. Queue shown is maximum after two cycles.

m – Volume for 95th percentile queue is metered by upstream signal.

[1]Synchro does not provide queue lengths for all-way stop control intersections. Queues were obtained from SimTraffic.

[2]Err indicates error in calculating delay as the volume greatly exceeds capacity.

Bold indicates 95th Percentile Queue Lengths higher than existing capacity.

CONCLUSION

Based on the LOS and delay analyses conducted at the eight study intersections, it was observed that under existing year (2018) conditions, all intersections operate with acceptable levels of service during the weekday a.m. and p.m. peak periods with the exception of Middlefield Road/Woodland Avenue-Palo Alto Avenue, which operates at LOS F during the p.m. peak period.

Under existing plus bridge closure conditions, Middlefield Road/Woodland Avenue-Palo Alto Avenue experiences significant impact as a result of the bridge closure and operates at LOS F with significantly higher delay because of the rerouted trips during both a.m. and p.m. peak periods.

TJKM evaluated two potential mitigation measures to mitigate impacts experienced at the intersection of Middlefield Road/Woodland Avenue-Palo Alto Avenue as provided below.

1. Option 1: Providing detour signs and activating real time closures on GPS navigation applications to divert traffic onto Willow Road rather than Woodland Avenue to get on to Middlefield Road. This would reduce the delay experienced at the intersection because of rerouted trips during commute hours.
2. Option 2: Providing temporary traffic signal at Middlefield Road/Woodland Avenue-Palo Alto Avenue enabling the intersection to operate with acceptable LOS standards.

Based on the analysis conducted for the two options, the intersection of Woodland Avenue/Middlefield Road still experiences significant impact and operates with unacceptable LOS E and F during the a.m. and p.m. peak hours respectively, however, with significantly lower delay under Option 1 scenario. This intersection operates at acceptable LOS for the a.m. and p.m. peak hours under the Option 2 scenario, however, with higher queue lengths for the westbound direction during the p.m. peak period.

With full closure of the Pope St-Chaucer Street Bridge, pedestrians and bicyclists currently using the bridge would experience significant impacts with no alternate routes available within the immediate vicinity of the bridge. Additionally, there are two bus stops located within close proximity of the bridge, Woodland Avenue & Woodland Court for Routes 83 and 88 and University Avenue & Chaucer Street for Routes 280, 281, 296 and 397. Pedestrians and bicyclists using transit would experience higher delays with the closure of the bridge if they were crossing the bridge to reach their preferred bus stop.

Alternate solutions to mitigate impact faced by pedestrians and bicyclists could include construction staging or constructing temporary pedestrian and bicycle access over the San Francisquito Creek. Options such as adding crosswalk flashing beacons and green bike lanes at Middlefield Road/Woodland Avenue were considered, however, they were deemed unfeasible due to impacts to traffic operations along Middlefield Road and limitations of right-of-way availability.

Appendix A – Traffic Counts

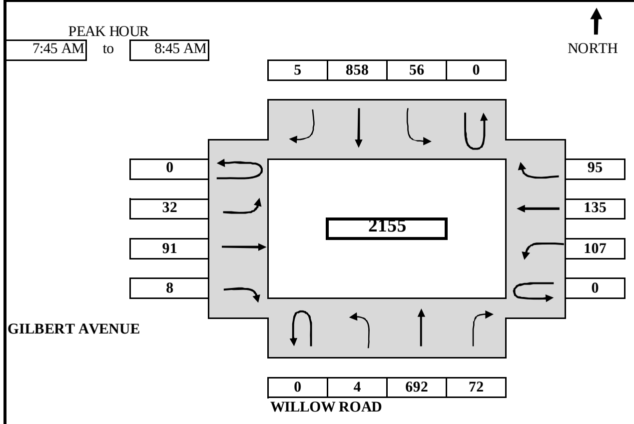
- Turning Movement Vehicles, Bicyclists and Conflicting Pedestrian Counts

B.A.Y.M.E.T.R.I.C.S.

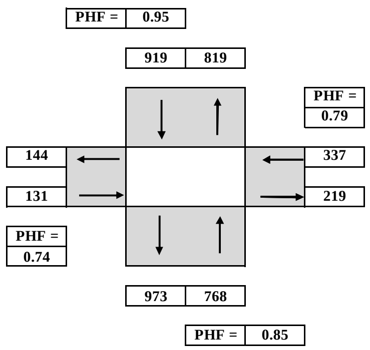
INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**WILLOW ROAD**	**SURVEY TIME:**	**7:00 AM**	**TO**	**9:00 AM**
E-W APPROACH:	**GILBERT AVENUE**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-1AM**

PEAK HOUR
7:45 AM to 8:45 AM



ARRIVAL / DEPARTURE VOLUMES



TIME PERIOD From		To	NORTHBOUND U-TURN	LEFT	THRU	RIGHT	SOUTHBOUND U-TURN	LEFT	THRU	RIGHT	EASTBOUND U-TURN	LEFT	THRU	RIGHT	WESTBOUND U-TURN	LEFT	THRU	RIGHT	TOTAL
SURVEY DATA																			
7:00 AM	to	7:15 AM		1	72	5		3	238	0		5	1	0		6	3	12	**346**
7:15 AM	to	7:30 AM		1	171	9		6	440	1		8	3	4		22	9	23	**697**
7:30 AM	to	7:45 AM		4	312	20		10	653	1		13	9	6		45	38	45	**1156**
7:45 AM	to	8:00 AM		6	451	38		21	882	2		19	22	10		74	58	68	**1651**
8:00 AM	to	8:15 AM		6	660	56		38	1097	3		26	42	10		95	91	92	**2216**
8:15 AM	to	8:30 AM		7	809	75		53	1311	4		31	73	11		125	137	122	**2758**
8:30 AM	to	8:45 AM		8	1004	92		66	1511	6		45	100	14		152	173	140	**3311**
8:45 AM	to	9:00 AM		8	1175	101		82	1711	6		49	113	19		170	196	159	**3789**
TOTAL BY PERIOD																			
7:00 AM	to	7:15 AM	0	1	72	5	0	3	238	0	0	5	1	0	0	6	3	12	**346**
7:15 AM	to	7:30 AM	0	0	99	4	0	3	202	1	0	3	2	4	0	16	6	11	**351**
7:30 AM	to	7:45 AM	0	3	141	11	0	4	213	0	0	5	6	2	0	23	29	22	**459**
7:45 AM	to	8:00 AM	0	2	139	18	0	11	229	1	0	6	13	4	0	29	20	23	**495**
8:00 AM	to	8:15 AM	0	0	209	18	0	17	215	1	0	7	20	0	0	21	33	24	**565**
8:15 AM	to	8:30 AM	0	1	149	19	0	15	214	1	0	5	31	1	0	30	46	30	**542**
8:30 AM	to	8:45 AM	0	1	195	17	0	13	200	2	0	14	27	3	0	27	36	18	**553**
8:45 AM	to	9:00 AM	0	0	171	9	0	16	200	0	0	4	13	5	0	18	23	19	**478**
HOURLY TOTALS																			
7:00 AM	to	8:00 AM	0	6	451	38	0	21	882	2	0	19	22	10	0	74	58	68	**1651**
7:15 AM	to	8:15 AM	0	5	588	51	0	35	859	3	0	21	41	10	0	89	88	80	**1870**
7:30 AM	to	8:30 AM	0	6	638	66	0	47	871	3	0	23	70	7	0	103	128	99	**2061**
7:45 AM	to	8:45 AM	0	4	692	72	0	56	858	5	0	32	91	8	0	107	135	95	**2155**
8:00 AM	to	9:00 AM	0	2	724	63	0	61	829	4	0	30	91	9	0	96	138	91	**2138**

PEAK HOUR SUMMARY

7:45 AM to 8:45 AM	**NORTHBOUND**				**SOUTHBOUND**				**EASTBOUND**				**WESTBOUND**				TOTAL
	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	
VOLUME	0	4	692	72	0	56	858	5	0	32	91	8	0	107	135	95	**2155**
PHF BY MOVEMENT	0.00	0.50	0.83	0.95	0.00	0.82	0.94	0.63	0.00	0.57	0.73	0.50	0.00	0.89	0.73	0.79	OVERALL
PHF BY APPROACH	0.85				0.95				0.74				0.79				0.95
BICYCLE	11				20				8				18				**57**
PEDESTRIAN	10				5				3				10				**28**
	N-LEG				**S-LEG**				**E-LEG**				**W-LEG**				
PEDESTRIAN BY LEG:	2				11				8				7				**28**

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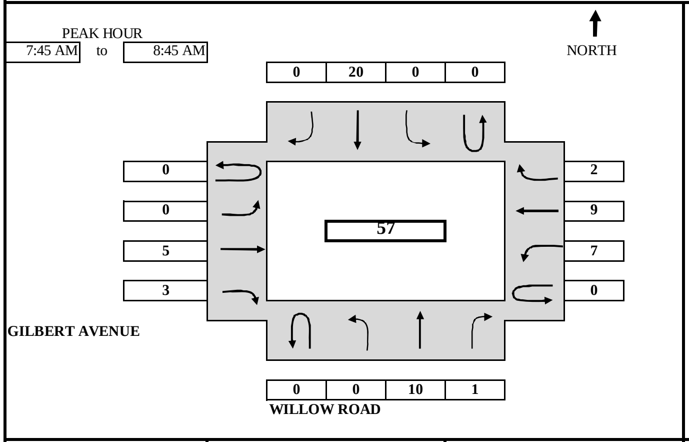
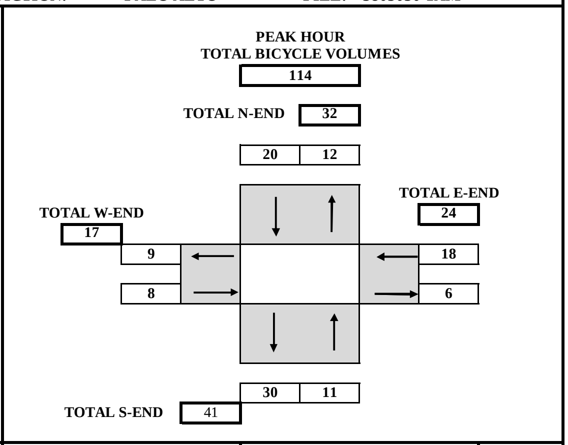
B.A.Y.M.E.T.R.I.C.S.

BICYCLE TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**WILLOW ROAD**	**SURVEY TIME:**	**7:00 AM**	**TO**	**9:00 AM**
E-W APPROACH:	**GILBERT AVENUE**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-1AM**





TIME		PERIOD	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
From		To	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	
SURVEY DATA																			
7:00 AM	to	7:15 AM	0	0	0	0	0	0	2	1	0	0	1	0	0	0	0	0	**4**
7:15 AM	to	7:30 AM	0	0	2	0	0	1	5	1	0	0	1	0	0	2	1	0	**13**
7:30 AM	to	7:45 AM	0	0	5	0	0	1	8	1	0	0	1	0	0	3	4	1	**24**
7:45 AM	to	8:00 AM	0	0	5	0	0	1	18	1	0	0	1	1	0	10	5	1	**43**
8:00 AM	to	8:15 AM	0	0	10	0	0	1	23	1	0	0	3	2	0	10	10	2	**62**
8:15 AM	to	8:30 AM	0	0	12	1	0	1	24	1	0	0	6	2	0	10	12	2	**71**
8:30 AM	to	8:45 AM	0	0	15	1	0	1	28	1	0	0	6	3	0	10	13	3	**81**
8:45 AM	to	9:00 AM	0	0	20	1	0	1	30	1	0	0	6	3	0	10	15	3	**90**
TOTAL BY PERIOD																			
7:00 AM	to	7:15 AM	0	0	0	0	0	0	2	1	0	0	1	0	0	0	0	0	**4**
7:15 AM	to	7:30 AM	0	0	2	0	0	1	3	0	0	0	0	0	0	2	1	0	**9**
7:30 AM	to	7:45 AM	0	0	3	0	0	0	3	0	0	0	0	0	0	1	3	1	**11**
7:45 AM	to	8:00 AM	0	0	0	0	0	0	10	0	0	0	0	1	0	7	1	0	**19**
8:00 AM	to	8:15 AM	0	0	5	0	0	0	5	0	0	0	2	1	0	0	5	1	**19**
8:15 AM	to	8:30 AM	0	0	2	1	0	0	1	0	0	0	3	0	0	0	2	0	**9**
8:30 AM	to	8:45 AM	0	0	3	0	0	0	4	0	0	0	0	1	0	0	1	1	**10**
8:45 AM	to	9:00 AM	0	0	5	0	0	0	2	0	0	0	0	0	0	0	2	0	**9**
HOURLY TOTALS																			
7:00 AM	to	8:00 AM	0	0	5	0	0	1	18	1	0	0	1	1	0	10	5	1	**43**
7:15 AM	to	8:15 AM	0	0	10	0	0	1	21	0	0	0	2	2	0	10	10	2	**58**
7:30 AM	to	8:30 AM	0	0	10	1	0	0	19	0	0	0	5	2	0	8	11	2	**58**
7:45 AM	to	8:45 AM	0	0	10	1	0	0	20	0	0	0	5	3	0	7	9	2	**57**
8:00 AM	to	9:00 AM	0	0	15	1	0	0	12	0	0	0	5	2	0	0	10	2	**47**

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7:45 AM to 8:45 AM					
APPROACH VOLUME	NB	SB	EB	WB	TOTAL
BICYCLE	11	20	8	18	**57**

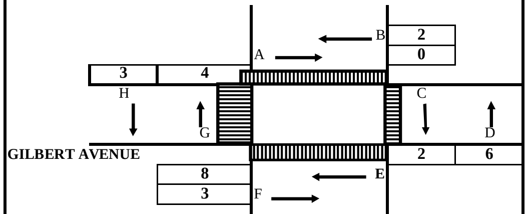
B.A.Y.M.E.T.R.I.C.S.

PEDESTRIAN MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**		**SURVEY DATE:**	**5/22/2018**
N-S APPROACH:	**WILLOW ROAD**		**DAY:**	**TUESDAY**
E-W APPROACH:	**GILBERT AVENUE**		**JURISDICTION:**	**PALO ALTO**
SURVEY PERIOD:	**7:00 AM**	**TO 9:00 AM**	**FILE:**	**3805030-1AM**

PEAK HOUR

07:45 AM TO 08:45 AM



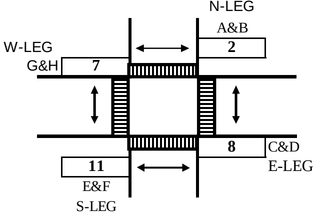
WILLOW ROAD

LEGEND:
- ▥ CROSSWALK
- ▬ SIDEWALK
- — STOP CONTROL LINE
- ● STOP

PEAK HOUR

TOTAL PEDESTRIAN VOLUMES

28



BY LEG:	
N-LEG	2
S-LEG	11
E-LEG	8
W-LEG	7

BY DIRECTION:	
NB(D+G)	**10**
SB(C+H)	**5**
EB(A+F)	**3**
WB(B+E)	**10**

TIME PERIOD			**NORTH X-WALK**		**EAST X-WALK**		**SOUTH X-WALK**		**WEST X-WALK**		
From		**To**	***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***TOTAL***
					S U R V E Y	D A T A					
07:00 AM	---	07:15 AM	0	0	0	0	0	1	0	0	***1***
07:15 AM	---	07:30 AM	0	0	1	0	0	1	1	2	***5***
07:30 AM	---	07:45 AM	1	1	4	0	1	1	1	6	***15***
07:45 AM	---	08:00 AM	1	1	4	0	5	1	2	7	***21***
08:00 AM	---	08:15 AM	1	3	4	2	6	1	2	8	***27***
08:15 AM	---	08:30 AM	1	3	4	5	7	2	2	9	***33***
08:30 AM	---	08:45 AM	1	3	6	6	9	4	5	9	***43***
08:45 AM	---	09:00 AM	2	4	8	7	9	6	7	10	***53***
				T O T A L	B Y	P E R I O D					
07:00 AM	---	07:15 AM	0	0	0	0	0	1	0	0	***1***
07:15 AM	---	07:30 AM	0	0	1	0	0	0	1	2	***4***
07:30 AM	---	07:45 AM	1	1	3	0	1	0	0	4	***10***
07:45 AM	---	08:00 AM	0	0	0	0	4	0	1	1	***6***
08:00 AM	---	08:15 AM	0	2	0	2	1	0	0	1	***6***
08:15 AM	---	08:30 AM	0	0	0	3	1	1	0	1	***6***
08:30 AM	---	08:45 AM	0	0	2	1	2	2	3	0	***10***
08:45 AM	---	09:00 AM	1	1	2	1	0	2	2	1	***10***
				H O U R L Y		T O T A L S					
07:00 AM	---	08:00 AM	1	1	4	0	5	1	2	7	***21***
07:15 AM	---	08:15 AM	1	3	4	2	6	0	2	8	***26***
07:30 AM	---	08:30 AM	1	3	3	5	7	1	1	7	***28***
07:45 AM	---	08:45 AM	0	2	2	6	8	3	4	3	***28***
08:00 AM	---	09:00 AM	1	3	4	7	4	5	5	3	***32***

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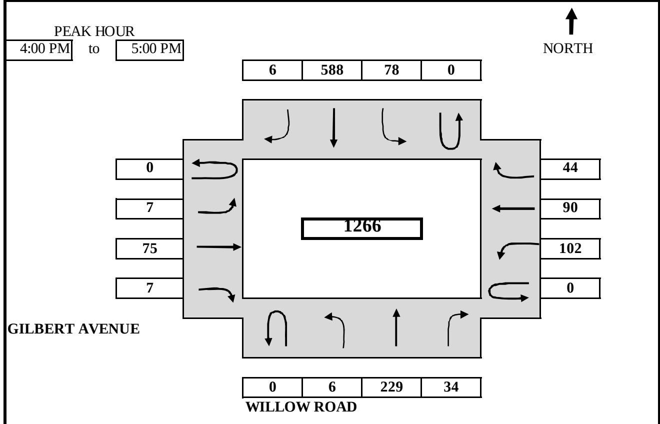
7:45 AM to 8:45 AM					
VOLUME BY DIRECTION	NB	SB	EB	WB	TOTAL
PEDESTRIAN	10	5	3	10	**28**
VOLUME BY LEG	N-LEG	S-LEG	E-LEG	W-LEG	TOTAL
PEDESTRIAN	2	11	8	7	**28**

B.A.Y.M.E.T.R.I.C.S.

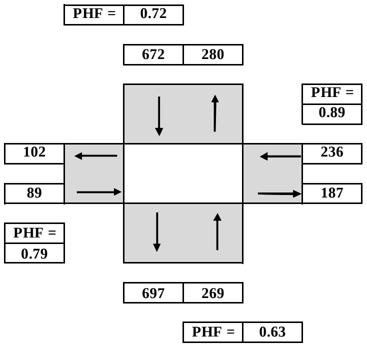
INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**WILLOW ROAD**	**SURVEY TIME:**	**4:00 PM**	**TO**	**6:00 PM**
E-W APPROACH:	**GILBERT AVENUE**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-1PM**

PEAK HOUR
4:00 PM to 5:00 PM



ARRIVAL / DEPARTURE VOLUMES



TIME PERIOD From		To	NB U-TURN	NB LEFT	NB THRU	NB RIGHT	SB U-TURN	SB LEFT	SB THRU	SB RIGHT	EB U-TURN	EB LEFT	EB THRU	EB RIGHT	WB U-TURN	WB LEFT	WB THRU	WB RIGHT	TOTAL
SURVEY DATA																			
4:00 PM	to	4:15 PM		0	97	9		14	156	3		2	17	1		30	18	18	**365**
4:15 PM	to	4:30 PM		4	159	15		31	371	4		5	41	2		59	42	27	**760**
4:30 PM	to	4:45 PM		5	194	28		53	440	4		6	60	5		81	71	34	**981**
4:45 PM	to	5:00 PM		6	229	34		78	588	6		7	75	7		102	90	44	**1266**
5:00 PM	to	5:15 PM		8	267	46		104	704	7		12	90	12		124	107	54	**1535**
5:15 PM	to	5:30 PM		8	311	61		126	859	11		15	101	14		146	138	60	**1850**
5:30 PM	to	5:45 PM		9	330	63		140	992	11		19	123	20		159	156	68	**2090**
5:45 PM	to	6:00 PM		9	351	77		166	1125	13		21	135	23		180	172	75	**2347**
TOTAL BY PERIOD																			
4:00 PM	to	4:15 PM	0	0	97	9	0	14	156	3	0	2	17	1	0	30	18	18	**365**
4:15 PM	to	4:30 PM	0	4	62	6	0	17	215	1	0	3	24	1	0	29	24	9	**395**
4:30 PM	to	4:45 PM	0	1	35	13	0	22	69	0	0	1	19	3	0	22	29	7	**221**
4:45 PM	to	5:00 PM	0	1	35	6	0	25	148	2	0	1	15	2	0	21	19	10	**285**
5:00 PM	to	5:15 PM	0	2	38	12	0	26	116	1	0	5	15	5	0	22	17	10	**269**
5:15 PM	to	5:30 PM	0	0	44	15	0	22	155	4	0	3	11	2	0	22	31	6	**315**
5:30 PM	to	5:45 PM	0	1	19	2	0	14	133	0	0	4	22	6	0	13	18	8	**240**
5:45 PM	to	6:00 PM	0	0	21	14	0	26	133	2	0	2	12	3	0	21	16	7	**257**
HOURLY TOTALS																			
4:00 PM	to	5:00 PM	0	6	229	34	0	78	588	6	0	7	75	7	0	102	90	44	**1266**
4:15 PM	to	5:15 PM	0	8	170	37	0	90	548	4	0	10	73	11	0	94	89	36	**1170**
4:30 PM	to	5:30 PM	0	4	152	46	0	95	488	7	0	10	60	12	0	87	96	33	**1090**
4:45 PM	to	5:45 PM	0	4	136	35	0	87	552	7	0	13	63	15	0	78	85	34	**1109**
5:00 PM	to	6:00 PM	0	3	122	43	0	88	537	7	0	14	60	16	0	78	82	31	**1081**

PEAK HOUR SUMMARY

4:00 PM to 5:00 PM	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	TOTAL
VOLUME	0	6	229	34	0	78	588	6	0	7	75	7	0	102	90	44	**1266**
PHF BY MOVEMENT	0.00	0.38	0.59	0.65	0.00	0.78	0.68	0.50	0.00	0.58	0.78	0.58	0.00	0.85	0.78	0.61	OVERALL
PHF BY APPROACH	0.63				0.72				0.79				0.89				0.80
BICYCLE	11				5				9				0				**25**
PEDESTRIAN	18				7				7				8				**40**
	N-LEG				**S-LEG**				**E-LEG**				**W-LEG**				
PEDESTRIAN BY LEG:	6				9				17				8				**40**

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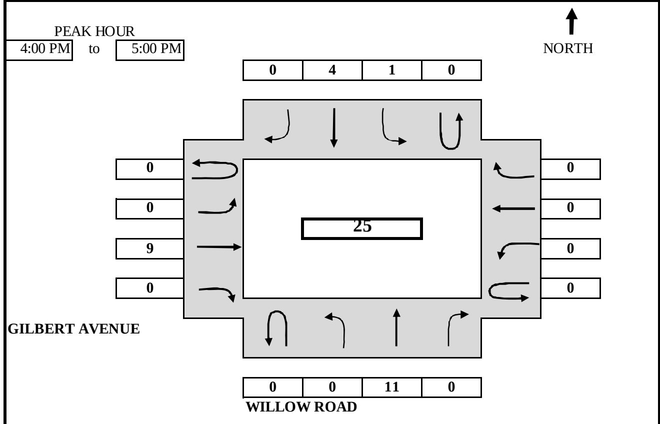
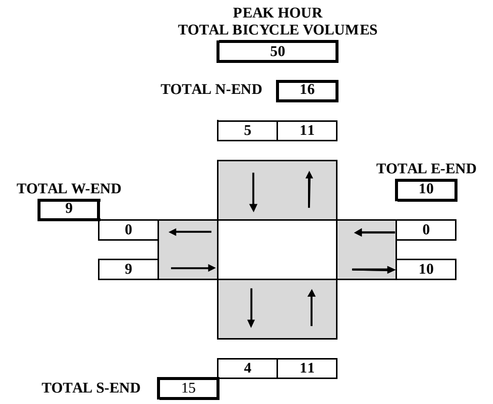
B.A.Y.M.E.T.R.I.C.S.

BICYCLE TURNING MOVEMENT SUMMARY

PROJECT: TRAFFIC COUNTS IN PALO ALTO **SURVEY DATE:** 5/22/2018 **DAY:** TUESDAY
N-S APPROACH: WILLOW ROAD **SURVEY TIME:** 4:00 PM **TO** 6:00 PM
E-W APPROACH: GILBERT AVENUE **JURISDICTION:** PALO ALTO **FILE:** 3805030-1PM





TIME		PERIOD	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
From		To	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	
SURVEY DATA																			
4:00 PM	to	4:15 PM	0	0	1	0	0	0	2	0	0	0	1	0	0	0	0	0	4
4:15 PM	to	4:30 PM	0	0	3	0	0	0	2	0	0	0	5	0	0	0	0	0	10
4:30 PM	to	4:45 PM	0	0	10	0	0	0	3	0	0	0	6	0	0	0	0	0	19
4:45 PM	to	5:00 PM	0	0	11	0	0	1	4	0	0	0	9	0	0	0	0	0	25
5:00 PM	to	5:15 PM	0	0	14	0	0	1	7	0	0	0	11	0	0	0	0	0	33
5:15 PM	to	5:30 PM	0	0	20	0	0	1	10	0	0	0	13	0	0	0	0	0	44
5:30 PM	to	5:45 PM	0	0	22	0	0	1	12	0	0	0	15	0	0	0	0	0	50
5:45 PM	to	6:00 PM	0	0	26	0	0	3	18	0	0	0	17	1	0	1	2	0	68
TOTAL BY PERIOD																			
4:00 PM	to	4:15 PM	0	0	1	0	0	0	2	0	0	0	1	0	0	0	0	0	4
4:15 PM	to	4:30 PM	0	0	2	0	0	0	0	0	0	0	4	0	0	0	0	0	6
4:30 PM	to	4:45 PM	0	0	7	0	0	0	1	0	0	0	1	0	0	0	0	0	9
4:45 PM	to	5:00 PM	0	0	1	0	0	1	1	0	0	0	3	0	0	0	0	0	6
5:00 PM	to	5:15 PM	0	0	3	0	0	0	3	0	0	0	2	0	0	0	0	0	8
5:15 PM	to	5:30 PM	0	0	6	0	0	0	3	0	0	0	2	0	0	0	0	0	11
5:30 PM	to	5:45 PM	0	0	2	0	0	0	2	0	0	0	2	0	0	0	0	0	6
5:45 PM	to	6:00 PM	0	0	4	0	0	2	6	0	0	0	2	1	0	1	2	0	18
HOURLY TOTALS																			
4:00 PM	to	5:00 PM	0	0	11	0	0	1	4	0	0	0	9	0	0	0	0	0	25
4:15 PM	to	5:15 PM	0	0	13	0	0	1	5	0	0	0	10	0	0	0	0	0	29
4:30 PM	to	5:30 PM	0	0	17	0	0	1	8	0	0	0	8	0	0	0	0	0	34
4:45 PM	to	5:45 PM	0	0	12	0	0	1	9	0	0	0	9	0	0	0	0	0	31
5:00 PM	to	6:00 PM	0	0	15	0	0	2	14	0	0	0	8	1	0	1	2	0	43

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4:00 PM to 5:00 PM

APPROACH VOLUME	NB	SB	EB	WB	TOTAL
BICYCLE	11	5	9	0	**25**

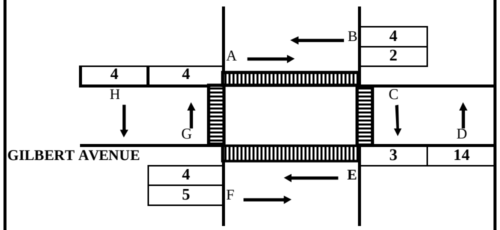
B.A.Y.M.E.T.R.I.C.S.

PEDESTRIAN MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**
N-S APPROACH:	**WILLOW ROAD**	**DAY:**	**TUESDAY**
E-W APPROACH:	**GILBERT AVENUE**	**JURISDICTION:**	**PALO ALTO**
SURVEY PERIOD:	**4:00 PM TO 6:00 PM**	**FILE:**	**3805030-1PM**

PEAK HOUR

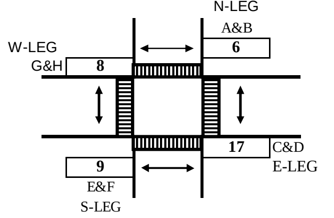
04:00 PM TO 05:00 PM



PEAK HOUR

TOTAL PEDESTRIAN VOLUMES

40



LEGEND:

▥ CROSSWALK

▬ SIDEWALK

— STOP CONTROL LINE

● STOP

BY LEG:	
N-LEG	**6**
S-LEG	**9**
E-LEG	**17**
W-LEG	**8**

BY DIRECTION:	
NB(D+G)	**18**
SB(C+H)	**7**
EB(A+F)	**7**
WB(B+E)	**8**

TIME PERIOD			**NORTH X-WALK**		**EAST X-WALK**		**SOUTH X-WALK**		**WEST X-WALK**		
From		**To**	***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***TOTAL***
SURVEY DATA											
04:00 PM	---	04:15 PM	0	2	0	6	3	1	0	2	***14***
04:15 PM	---	04:30 PM	0	2	2	7	3	3	0	4	***21***
04:30 PM	---	04:45 PM	1	4	2	12	3	5	2	4	***33***
04:45 PM	---	05:00 PM	2	4	3	14	4	5	4	4	***40***
05:00 PM	---	05:15 PM	4	5	4	19	4	5	4	6	***51***
05:15 PM	---	05:30 PM	4	5	10	19	5	8	8	9	***68***
05:30 PM	---	05:45 PM	4	7	13	28	11	11	10	9	***93***
05:45 PM	---	06:00 PM	6	7	13	31	12	11	12	9	***101***
TOTAL BY PERIOD											
04:00 PM	---	04:15 PM	0	2	0	6	3	1	0	2	***14***
04:15 PM	---	04:30 PM	0	0	2	1	0	2	0	2	***7***
04:30 PM	---	04:45 PM	1	2	0	5	0	2	2	0	***12***
04:45 PM	---	05:00 PM	1	0	1	2	1	0	2	0	***7***
05:00 PM	---	05:15 PM	2	1	1	5	0	0	0	2	***11***
05:15 PM	---	05:30 PM	0	0	6	0	1	3	4	3	***17***
05:30 PM	---	05:45 PM	0	2	3	9	6	3	2	0	***25***
05:45 PM	---	06:00 PM	2	0	0	3	1	0	2	0	***8***
HOURLY TOTALS											
04:00 PM	---	05:00 PM	2	4	3	14	4	5	4	4	***40***
04:15 PM	---	05:15 PM	4	3	4	13	1	4	4	4	***37***
04:30 PM	---	05:30 PM	4	3	8	12	2	5	8	5	***47***
04:45 PM	---	05:45 PM	3	3	11	16	8	6	8	5	***60***
05:00 PM	---	06:00 PM	4	3	10	17	8	6	8	5	***61***

Tel : (510) 232-1271 ***Fax: (510) 232-1272***

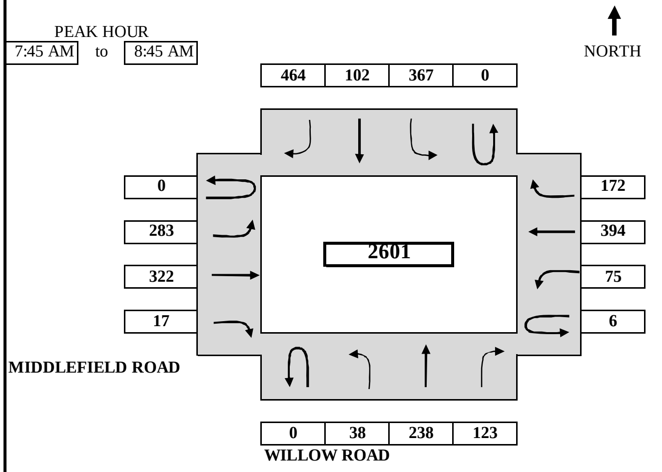
4:00 PM to 5:00 PM					
VOLUME BY DIRECTION	NB	SB	EB	WB	TOTAL
PEDESTRIAN	18	7	7	8	**40**
VOLUME BY LEG	N-LEG	S-LEG	E-LEG	W-LEG	TOTAL
PEDESTRIAN	6	9	17	8	**40**

B.A.Y.M.E.T.R.I.C.S.

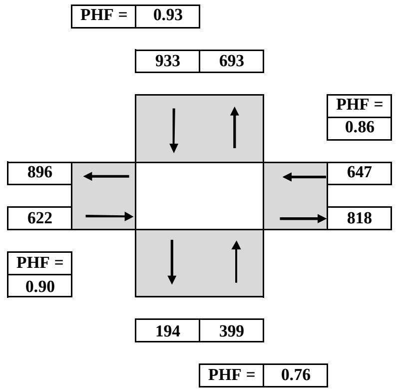
INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**WILLOW ROAD**	**SURVEY TIME:**	**7:00 AM**	**TO**	**9:00 AM**
E-W APPROACH:	**MIDDLEFIELD ROAD**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-2AM**

PEAK HOUR
7:45 AM to 8:45 AM



ARRIVAL / DEPARTURE VOLUMES



TIME PERIOD			NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
From		To	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	
SURVEY DATA																			
7:00 AM	to	7:15 AM		1	20	12		100	14	122		37	43	1	0	7	45	20	**422**
7:15 AM	to	7:30 AM		2	51	27		177	27	217		82	86	1	0	19	117	46	**852**
7:30 AM	to	7:45 AM		5	92	37		266	42	351		134	148	3	1	41	217	86	**1423**
7:45 AM	to	8:00 AM		12	133	57		373	68	468		193	219	7	1	62	318	121	**2032**
8:00 AM	to	8:15 AM		19	215	100		452	93	590		274	286	10	3	82	396	170	**2690**
8:15 AM	to	8:30 AM		33	270	131		541	118	691		338	383	13	5	97	493	208	**3321**
8:30 AM	to	8:45 AM		43	330	160		633	144	815		417	470	20	7	116	611	258	**4024**
8:45 AM	to	9:00 AM		48	382	176		716	164	921		488	585	24	8	131	687	302	**4632**
TOTAL BY PERIOD																			
7:00 AM	to	7:15 AM	0	1	20	12	0	100	14	122	0	37	43	1	0	7	45	20	**422**
7:15 AM	to	7:30 AM	0	1	31	15	0	77	13	95	0	45	43	0	0	12	72	26	**430**
7:30 AM	to	7:45 AM	0	3	41	10	0	89	15	134	0	52	62	2	1	22	100	40	**571**
7:45 AM	to	8:00 AM	0	7	41	20	0	107	26	117	0	59	71	4	0	21	101	35	**609**
8:00 AM	to	8:15 AM	0	7	82	43	0	79	25	122	0	81	67	3	2	20	78	49	**658**
8:15 AM	to	8:30 AM	0	14	55	31	0	89	25	101	0	64	97	3	2	15	97	38	**631**
8:30 AM	to	8:45 AM	0	10	60	29	0	92	26	124	0	79	87	7	2	19	118	50	**703**
8:45 AM	to	9:00 AM	0	5	52	16	0	83	20	106	0	71	115	4	1	15	76	44	**608**
HOURLY TOTALS																			
7:00 AM	to	8:00 AM	0	12	133	57	0	373	68	468	0	193	219	7	1	62	318	121	**2032**
7:15 AM	to	8:15 AM	0	18	195	88	0	352	79	468	0	237	243	9	3	75	351	150	**2268**
7:30 AM	to	8:30 AM	0	31	219	104	0	364	91	474	0	256	297	12	5	78	376	162	**2469**
7:45 AM	to	8:45 AM	0	38	238	123	0	367	102	464	0	283	322	17	6	75	394	172	**2601**
8:00 AM	to	9:00 AM	0	36	249	119	0	343	96	453	0	295	366	17	7	69	369	181	**2600**

PEAK HOUR SUMMARY

7:45 AM to 8:45 AM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	
VOLUME	0	38	238	123	0	367	102	464	0	283	322	17	6	75	394	172	**2601**
PHF BY MOVEMENT	0.00	0.68	0.73	0.72	0.00	0.86	0.98	0.94	0.00	0.87	0.83	0.61	0.75	0.89	0.83	0.86	OVERALL
PHF BY APPROACH	0.76				0.93				0.90				0.86				0.92
BICYCLE	30				28				20				17				**95**
PEDESTRIAN	11				43				6				17				**77**
	N-LEG				**S-LEG**				**E-LEG**				**W-LEG**				
PEDESTRIAN BY LEG:	22				1				31				23				**77**

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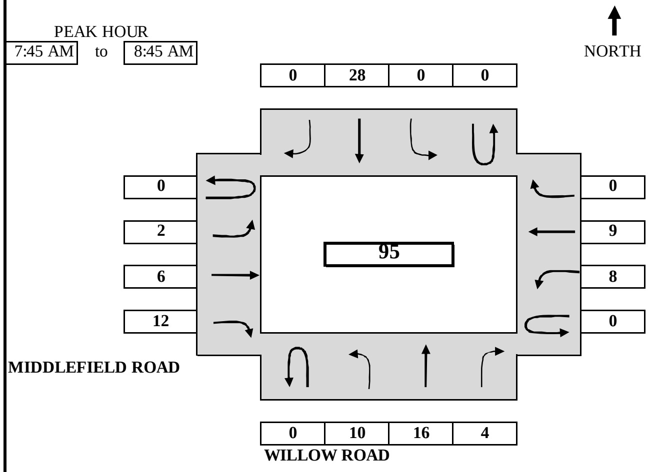
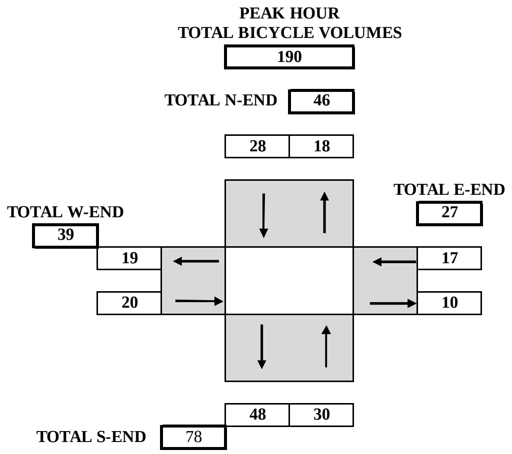
B.A.Y.M.E.T.R.I.C.S.

BICYCLE TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**WILLOW ROAD**	**SURVEY TIME:**	**7:00 AM**	**TO**	**9:00 AM**
E-W APPROACH:	**MIDDLEFIELD ROAD**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-2AM**

PEAK HOUR
7:45 AM to 8:45 AM





TIME		PERIOD	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
From		To	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	
SURVEY DATA																			
7:00 AM	to	7:15 AM	0	1	1	0	0	0	4	0	0	0	1	1	0	0	1	0	**9**
7:15 AM	to	7:30 AM	0	5	3	0	0	0	8	0	0	0	1	2	0	0	3	0	**22**
7:30 AM	to	7:45 AM	0	10	5	3	0	0	13	0	0	0	1	2	0	1	3	1	**39**
7:45 AM	to	8:00 AM	0	12	10	5	0	0	19	0	0	1	1	4	0	6	4	1	**63**
8:00 AM	to	8:15 AM	0	13	13	6	0	0	21	0	0	2	4	9	0	7	4	1	**80**
8:15 AM	to	8:30 AM	0	17	17	7	0	0	28	0	0	2	6	13	0	8	7	1	**106**
8:30 AM	to	8:45 AM	0	20	21	7	0	0	41	0	0	2	7	14	0	9	12	1	**134**
8:45 AM	to	9:00 AM	0	23	23	8	0	0	46	0	0	2	9	14	0	9	13	1	**148**
TOTAL BY PERIOD																			
7:00 AM	to	7:15 AM	0	1	1	0	0	0	4	0	0	0	1	1	0	0	1	0	**9**
7:15 AM	to	7:30 AM	0	4	2	0	0	0	4	0	0	0	0	1	0	0	2	0	**13**
7:30 AM	to	7:45 AM	0	5	2	3	0	0	5	0	0	0	0	0	0	1	0	1	**17**
7:45 AM	to	8:00 AM	0	2	5	2	0	0	6	0	0	1	0	2	0	5	1	0	**24**
8:00 AM	to	8:15 AM	0	1	3	1	0	0	2	0	0	1	3	5	0	1	0	0	**17**
8:15 AM	to	8:30 AM	0	4	4	1	0	0	7	0	0	0	2	4	0	1	3	0	**26**
8:30 AM	to	8:45 AM	0	3	4	0	0	0	13	0	0	0	1	1	0	1	5	0	**28**
8:45 AM	to	9:00 AM	0	3	2	1	0	0	5	0	0	0	2	0	0	0	1	0	**14**
HOURLY TOTALS																			
7:00 AM	to	8:00 AM	0	12	10	5	0	0	19	0	0	1	1	4	0	6	4	1	**63**
7:15 AM	to	8:15 AM	0	12	12	6	0	0	17	0	0	2	3	8	0	7	3	1	**71**
7:30 AM	to	8:30 AM	0	12	14	7	0	0	20	0	0	2	5	11	0	8	4	1	**84**
7:45 AM	to	8:45 AM	0	10	16	4	0	0	28	0	0	2	6	12	0	8	9	0	**95**
8:00 AM	to	9:00 AM	0	11	13	3	0	0	27	0	0	1	8	10	0	3	9	0	**85**

TEL: (510) 232 - 1271 FAX: (510) 232 - 1272

7:45 AM to 8:45 AM					
APPROACH VOLUME	NB	SB	EB	WB	TOTAL
BICYCLE	30	28	20	17	**95**

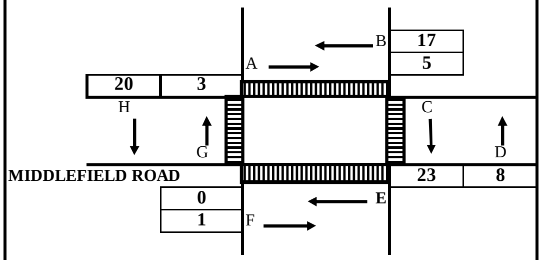
B.A.Y.M.E.T.R.I.C.S.

PEDESTRIAN MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**
N-S APPROACH:	**WILLOW ROAD**	**DAY:**	**TUESDAY**
E-W APPROACH:	**MIDDLEFIELD ROAD**	**JURISDICTION:**	**PALO ALTO**
SURVEY PERIOD	**7:00 AM TO 9:00 AM**	**FILE:**	**3805030-2AM**

PEAK HOUR

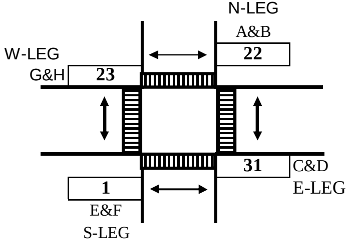
07:45 AM TO 08:45 AM



PEAK HOUR

TOTAL PEDESTRIAN VOLUMES

77



LEGEND: **WILLOW ROAD**

▥ CROSSWALK

▬ SIDEWALK

— STOP CONTROL LINE

● STOP

BY LEG:	
N-LEG	22
S-LEG	1
E-LEG	31
W-LEG	23

BY DIRECTION:	
NB(D+G)	11
SB(C+H)	43
EB(A+F)	6
WB(B+E)	17

TIME PERIOD			**NORTH X-WALK**		**EAST X-WALK**		**SOUTH X-WALK**		**WEST X-WALK**		
From		**To**	***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***TOTAL***
					SURVEY DATA						
07:00 AM	---	07:15 AM	0	0	1	0	0	1	0	0	*2*
07:15 AM	---	07:30 AM	0	0	4	2	0	2	0	1	*9*
07:30 AM	---	07:45 AM	0	0	8	2	0	2	2	1	*15*
07:45 AM	---	08:00 AM	1	8	19	2	0	2	2	16	*50*
08:00 AM	---	08:15 AM	5	9	24	4	0	2	2	16	*62*
08:15 AM	---	08:30 AM	5	15	28	7	0	3	4	19	*81*
08:30 AM	---	08:45 AM	5	17	31	10	0	3	5	21	*92*
08:45 AM	---	09:00 AM	9	19	33	16	0	3	5	23	*108*
					TOTAL BY PERIOD						
07:00 AM	---	07:15 AM	0	0	1	0	0	1	0	0	*2*
07:15 AM	---	07:30 AM	0	0	3	2	0	1	0	1	*7*
07:30 AM	---	07:45 AM	0	0	4	0	0	0	2	0	*6*
07:45 AM	---	08:00 AM	1	8	11	0	0	0	0	15	*35*
08:00 AM	---	08:15 AM	4	1	5	2	0	0	0	0	*12*
08:15 AM	---	08:30 AM	0	6	4	3	0	1	2	3	*19*
08:30 AM	---	08:45 AM	0	2	3	3	0	0	1	2	*11*
08:45 AM	---	09:00 AM	4	2	2	6	0	0	0	2	*16*
					HOURLY TOTALS						
07:00 AM	---	08:00 AM	1	8	19	2	0	2	2	16	*50*
07:15 AM	---	08:15 AM	5	9	23	4	0	1	2	16	*60*
07:30 AM	---	08:30 AM	5	15	24	5	0	1	4	18	*72*
07:45 AM	---	08:45 AM	5	17	23	8	0	1	3	20	*77*
08:00 AM	---	09:00 AM	8	11	14	14	0	1	3	7	*58*

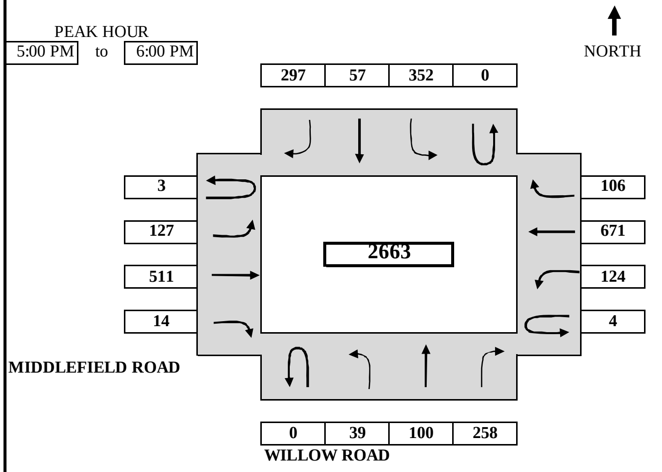
Tel : (510) 232-1271 ***Fax: (510) 232-1272***

7:45 AM to 8:45 AM					
VOLUME BY DIRECTION	NB	SB	EB	WB	TOTAL
PEDESTRIAN	11	43	6	17	77
VOLUME BY LEG	N-LEG	S-LEG	E-LEG	W-LEG	TOTAL
PEDESTRIAN	22	1	31	23	77

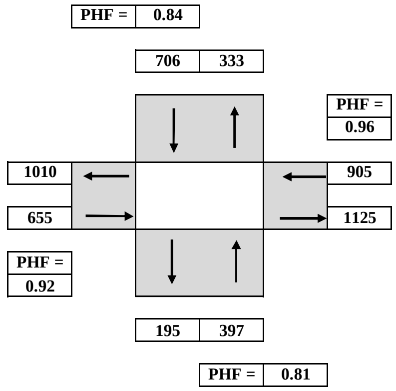
B.A.Y.M.E.T.R.I.C.S.

INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**WILLOW ROAD**	**SURVEY TIME:**	**4:00 PM**	**TO**	**6:00 PM**
E-W APPROACH:	**MIDDLEFIELD ROAD**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-2PM**



ARRIVAL / DEPARTURE VOLUMES



TIME		PERIOD	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
From		To	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	
SURVEY DATA																			
4:00 PM	to	4:15 PM		8	18	51		95	22	75	1	42	128	0	0	13	105	38	**596**
4:15 PM	to	4:30 PM		11	42	100		179	44	161	2	93	262	3	1	32	213	58	**1201**
4:30 PM	to	4:45 PM		28	58	166		251	69	232	2	133	383	6	2	54	340	73	**1797**
4:45 PM	to	5:00 PM		35	79	225		334	85	306	2	160	480	9	2	86	466	94	**2363**
5:00 PM	to	5:15 PM		42	114	306		423	101	375	2	196	620	11	5	116	629	122	**3062**
5:15 PM	to	5:30 PM		52	136	362		484	116	441	2	225	748	16	6	146	782	150	**3666**
5:30 PM	to	5:45 PM		64	164	435		591	134	526	4	259	872	18	6	179	959	176	**4387**
5:45 PM	to	6:00 PM		74	179	483		686	142	603	5	287	991	23	6	210	1137	200	**5026**
TOTAL BY PERIOD																			
4:00 PM	to	4:15 PM	0	8	18	51	0	95	22	75	1	42	128	0	0	13	105	38	**596**
4:15 PM	to	4:30 PM	0	3	24	49	0	84	22	86	1	51	134	3	1	19	108	20	**605**
4:30 PM	to	4:45 PM	0	17	16	66	0	72	25	71	0	40	121	3	1	22	127	15	**596**
4:45 PM	to	5:00 PM	0	7	21	59	0	83	16	74	0	27	97	3	0	32	126	21	**566**
5:00 PM	to	5:15 PM	0	7	35	81	0	89	16	69	0	36	140	2	3	30	163	28	**699**
5:15 PM	to	5:30 PM	0	10	22	56	0	61	15	66	0	29	128	5	1	30	153	28	**604**
5:30 PM	to	5:45 PM	0	12	28	73	0	107	18	85	2	34	124	2	0	33	177	26	**721**
5:45 PM	to	6:00 PM	0	10	15	48	0	95	8	77	1	28	119	5	0	31	178	24	**639**
HOURLY TOTALS																			
4:00 PM	to	5:00 PM	0	35	79	225	0	334	85	306	2	160	480	9	2	86	466	94	**2363**
4:15 PM	to	5:15 PM	0	34	96	255	0	328	79	300	1	154	492	11	5	103	524	84	**2466**
4:30 PM	to	5:30 PM	0	41	94	262	0	305	72	280	0	132	486	13	5	114	569	92	**2465**
4:45 PM	to	5:45 PM	0	36	106	269	0	340	65	294	2	126	489	12	4	125	619	103	**2590**
5:00 PM	to	6:00 PM	0	39	100	258	0	352	57	297	3	127	511	14	4	124	671	106	**2663**

PEAK HOUR SUMMARY

5:00 PM to 6:00 PM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	
VOLUME	0	39	100	258	0	352	57	297	3	127	511	14	4	124	671	106	**2663**
PHF BY MOVEMENT	0.00	0.81	0.71	0.80	0.00	0.82	0.79	0.87	0.38	0.88	0.91	0.70	0.33	0.94	0.94	0.95	OVERALL
PHF BY APPROACH	0.81				0.84				0.92				0.96				0.92
BICYCLE	46				10				21				6				**83**
PEDESTRIAN	16				23				9				5				**53**
	N-LEG				**S-LEG**				**E-LEG**				**W-LEG**				
PEDESTRIAN BY LEG:	9				5				28				11				**53**

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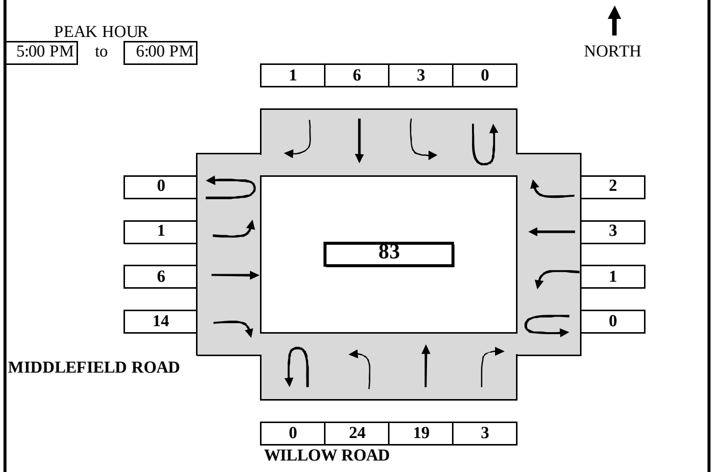
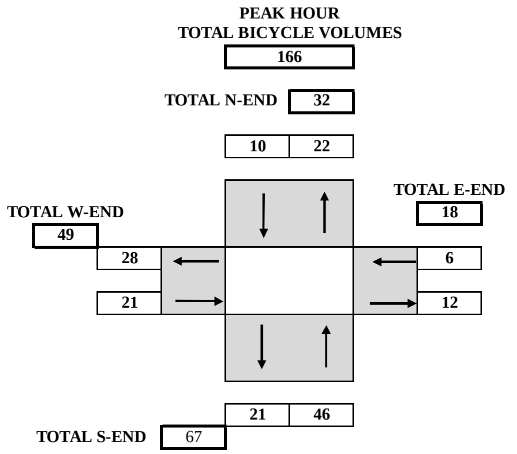
B.A.Y.M.E.T.R.I.C.S.

BICYCLE TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**WILLOW ROAD**	**SURVEY TIME:**	**4:00 PM**	**TO**	**6:00 PM**
E-W APPROACH:	**MIDDLEFIELD ROAD**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-2PM**





TIME		PERIOD	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
From		To	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	
SURVEY DATA																			
4:00 PM	to	4:15 PM	0	3	1	0	0	0	2	1	0	0	0	1	1	0	0	1	**10**
4:15 PM	to	4:30 PM	0	5	4	0	0	1	2	1	0	0	1	1	1	0	0	1	**17**
4:30 PM	to	4:45 PM	0	8	15	0	0	1	2	1	0	1	2	3	1	0	1	1	**36**
4:45 PM	to	5:00 PM	0	11	21	1	0	1	6	2	0	1	3	3	1	0	2	1	**53**
5:00 PM	to	5:15 PM	0	13	24	3	0	1	8	2	0	1	4	9	1	0	3	2	**71**
5:15 PM	to	5:30 PM	0	15	27	3	0	2	8	2	0	1	5	12	1	1	3	3	**83**
5:30 PM	to	5:45 PM	0	26	34	4	0	2	9	2	0	1	7	14	1	1	4	3	**108**
5:45 PM	to	6:00 PM	0	35	40	4	0	4	12	3	0	2	9	17	1	1	5	3	**136**
TOTAL BY PERIOD																			
4:00 PM	to	4:15 PM	0	3	1	0	0	0	2	1	0	0	0	1	1	0	0	1	**10**
4:15 PM	to	4:30 PM	0	2	3	0	0	1	0	0	0	0	1	0	0	0	0	0	**7**
4:30 PM	to	4:45 PM	0	3	11	0	0	0	0	0	0	1	1	2	0	0	1	0	**19**
4:45 PM	to	5:00 PM	0	3	6	1	0	0	4	1	0	0	1	0	0	0	1	0	**17**
5:00 PM	to	5:15 PM	0	2	3	2	0	0	2	0	0	0	1	6	0	0	1	1	**18**
5:15 PM	to	5:30 PM	0	2	3	0	0	1	0	0	0	0	1	3	0	1	0	1	**12**
5:30 PM	to	5:45 PM	0	11	7	1	0	0	1	0	0	0	2	2	0	0	1	0	**25**
5:45 PM	to	6:00 PM	0	9	6	0	0	2	3	1	0	1	2	3	0	0	1	0	**28**
HOURLY TOTALS																			
4:00 PM	to	5:00 PM	0	11	21	1	0	1	6	2	0	1	3	3	1	0	2	1	**53**
4:15 PM	to	5:15 PM	0	10	23	3	0	1	6	1	0	1	4	8	0	0	3	1	**61**
4:30 PM	to	5:30 PM	0	10	23	3	0	1	6	1	0	1	4	11	0	1	3	2	**66**
4:45 PM	to	5:45 PM	0	18	19	4	0	1	7	1	0	0	5	11	0	1	3	2	**72**
5:00 PM	to	6:00 PM	0	24	19	3	0	3	6	1	0	1	6	14	0	1	3	2	**83**

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5:00 PM to 6:00 PM					
APPROACH VOLUME	NB	SB	EB	WB	TOTAL
BICYCLE	46	10	21	6	**83**

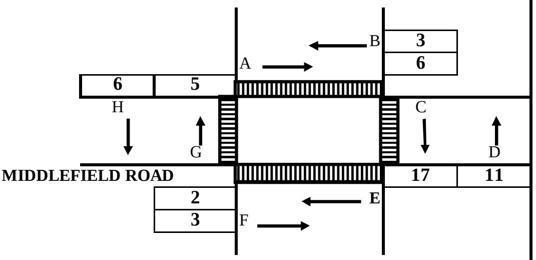
B.A.Y.M.E.T.R.I.C.S.

PEDESTRIAN MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**
N-S APPROACH:	**WILLOW ROAD**	**DAY:**	**TUESDAY**
E-W APPROACH:	**MIDDLEFIELD ROAD**	**JURISDICTION:**	**PALO ALTO**
SURVEY PERIOD	**4:00 PM TO 6:00 PM**	**FILE:**	**3805030-2PM**

PEAK HOUR

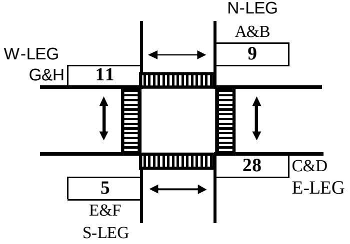
05:00 PM TO 06:00 PM



PEAK HOUR

TOTAL PEDESTRIAN VOLUMES

53



LEGEND: **WILLOW ROAD**

- ▥ CROSSWALK
- ▬ SIDEWALK
- — STOP CONTROL LINE
- ● STOP

BY LEG:	
N-LEG	9
S-LEG	5
E-LEG	28
W-LEG	11

BY DIRECTION:	
NB(D+G)	16
SB(C+H)	23
EB(A+F)	9
WB(B+E)	5

TIME PERIOD			**NORTH X-WALK**		**EAST X-WALK**		**SOUTH X-WALK**		**WEST X-WALK**		
From		**To**	***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***TOTAL***
						SURVEY DATA					
04:00 PM	---	04:15 PM	1	1	0	0	0	0	1	1	***4***
04:15 PM	---	04:30 PM	2	4	1	3	1	0	1	1	***13***
04:30 PM	---	04:45 PM	2	5	2	5	1	0	2	1	***18***
04:45 PM	---	05:00 PM	3	6	4	11	4	0	3	3	***34***
05:00 PM	---	05:15 PM	4	6	8	18	5	1	4	8	***54***
05:15 PM	---	05:30 PM	5	6	16	20	5	1	4	9	***66***
05:30 PM	---	05:45 PM	6	8	20	21	5	3	7	9	***79***
05:45 PM	---	06:00 PM	9	9	21	22	6	3	8	9	***87***
						TOTAL BY PERIOD					
04:00 PM	---	04:15 PM	1	1	0	0	0	0	1	1	***4***
04:15 PM	---	04:30 PM	1	3	1	3	1	0	0	0	***9***
04:30 PM	---	04:45 PM	0	1	1	2	0	0	1	0	***5***
04:45 PM	---	05:00 PM	1	1	2	6	3	0	1	2	***16***
05:00 PM	---	05:15 PM	1	0	4	7	1	1	1	5	***20***
05:15 PM	---	05:30 PM	1	0	8	2	0	0	0	1	***12***
05:30 PM	---	05:45 PM	1	2	4	1	0	2	3	0	***13***
05:45 PM	---	06:00 PM	3	1	1	1	1	0	1	0	***8***
						HOURLY TOTALS					
04:00 PM	---	05:00 PM	3	6	4	11	4	0	3	3	***34***
04:15 PM	---	05:15 PM	3	5	8	18	5	1	3	7	***50***
04:30 PM	---	05:30 PM	3	2	15	17	4	1	3	8	***53***
04:45 PM	---	05:45 PM	4	3	18	16	4	3	5	8	***61***
05:00 PM	---	06:00 PM	6	3	17	11	2	3	5	6	***53***

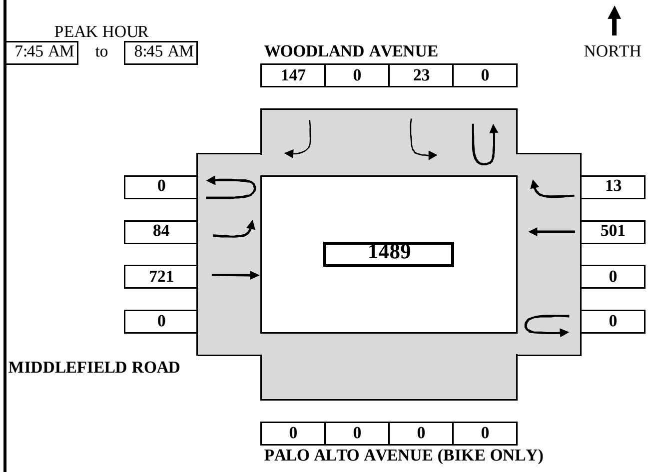
Tel : (510) 232-1271 ***Fax: (510) 232-1272***

5:00 PM to 6:00 PM					
VOLUME BY DIRECTION	NB	SB	EB	WB	TOTAL
PEDESTRIAN	16	23	9	5	**53**
VOLUME BY LEG	N-LEG	S-LEG	E-LEG	W-LEG	TOTAL
PEDESTRIAN	9	5	28	11	**53**

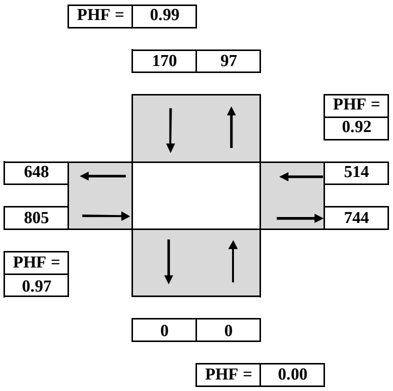
B.A.Y.M.E.T.R.I.C.S.

INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**PALO ALTO AVENUE - WOODLAND AVENUI**	**SURVEY TIME:**	**7:00 AM**	**TO**	**9:00 AM**
E-W APPROACH:	**MIDDLEFIELD ROAD**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-3AM**



ARRIVAL / DEPARTURE VOLUMES



TIME		PERIOD	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
From		To	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	
SURVEY DATA																			
7:00 AM	to	7:15 AM						5		13		3	141				65	1	228
7:15 AM	to	7:30 AM						9		60		7	275				147	2	500
7:30 AM	to	7:45 AM						18		113		12	437				269	5	854
7:45 AM	to	8:00 AM						22		152		24	622				381	11	1212
8:00 AM	to	8:15 AM						30		186		51	790				506	15	1578
8:15 AM	to	8:30 AM						36		222		75	973				632	17	1955
8:30 AM	to	8:45 AM						41		260		96	1158				770	18	2343
8:45 AM	to	9:00 AM						45		275		115	1346				889	19	2689
TOTAL BY PERIOD																			
7:00 AM	to	7:15 AM	0	0	0	0	0	5	0	13	0	3	141	0	0	0	65	1	228
7:15 AM	to	7:30 AM	0	0	0	0	0	4	0	47	0	4	134	0	0	0	82	1	272
7:30 AM	to	7:45 AM	0	0	0	0	0	9	0	53	0	5	162	0	0	0	122	3	354
7:45 AM	to	8:00 AM	0	0	0	0	0	4	0	39	0	12	185	0	0	0	112	6	358
8:00 AM	to	8:15 AM	0	0	0	0	0	8	0	34	0	27	168	0	0	0	125	4	366
8:15 AM	to	8:30 AM	0	0	0	0	0	6	0	36	0	24	183	0	0	0	126	2	377
8:30 AM	to	8:45 AM	0	0	0	0	0	5	0	38	0	21	185	0	0	0	138	1	388
8:45 AM	to	9:00 AM	0	0	0	0	0	4	0	15	0	19	188	0	0	0	119	1	346
HOURLY TOTALS																			
7:00 AM	to	8:00 AM	0	0	0	0	0	22	0	152	0	24	622	0	0	0	381	11	1212
7:15 AM	to	8:15 AM	0	0	0	0	0	25	0	173	0	48	649	0	0	0	441	14	1350
7:30 AM	to	8:30 AM	0	0	0	0	0	27	0	162	0	68	698	0	0	0	485	15	1455
7:45 AM	to	8:45 AM	0	0	0	0	0	23	0	147	0	84	721	0	0	0	501	13	1489
8:00 AM	to	9:00 AM	0	0	0	0	0	23	0	123	0	91	724	0	0	0	508	8	1477

PEAK HOUR SUMMARY

7:45 AM to 8:45 AM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	
VOLUME	0	0	0	0	0	23	0	147	0	84	721	0	0	0	501	13	1489
PHF BY MOVEMENT	0.00	0.00	0.00	0.00	0.00	0.72	0.00	0.94	0.00	0.78	0.97	0.00	0.00	0.00	0.91	0.54	OVERALL
PHF BY APPROACH	0.00				0.99				0.97				0.92				0.96
BICYCLE	1				22				11				2				36
PEDESTRIAN	2				4				8				3				17
	N-LEG				S-LEG				E-LEG				W-LEG				
PEDESTRIAN BY LEG:	5				6				6				0				17

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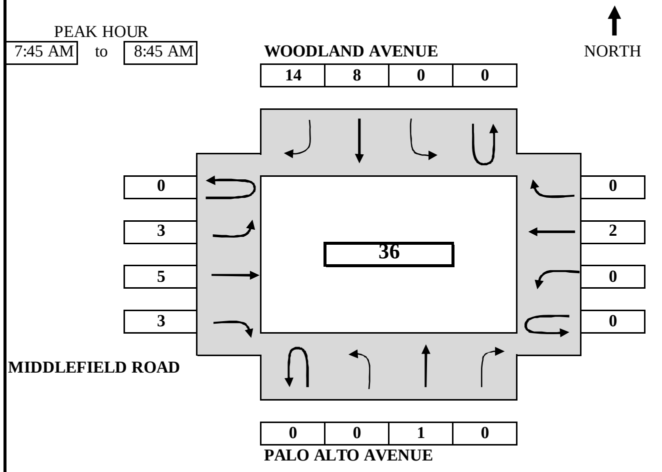
B.A.Y.M.E.T.R.I.C.S.

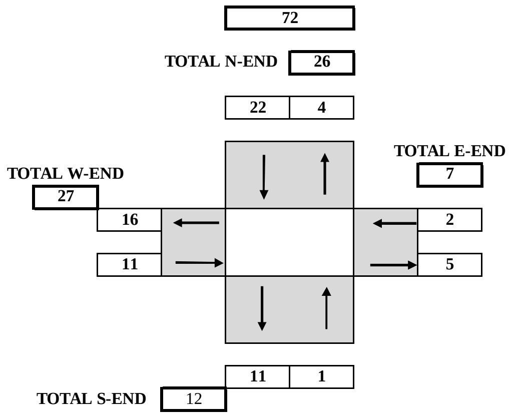
BICYCLE TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**PALO ALTO AVENUE - WOODLAND AVENUI**	**SURVEY TIME:**	**7:00 AM**	**TO**	**9:00 AM**
E-W APPROACH:	**MIDDLEFIELD ROAD**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-3AM**

PEAK HOUR
7:45 AM to 8:45 AM



PEAK HOUR
TOTAL BICYCLE VOLUMES



TIME From		PERIOD To	NB U-TURN	NB LEFT	NB THRU	NB RIGHT	SB U-TURN	SB LEFT	SB THRU	SB RIGHT	EB U-TURN	EB LEFT	EB THRU	EB RIGHT	WB U-TURN	WB LEFT	WB THRU	WB RIGHT	TOTAL
SURVEY DATA																			
7:00 AM	to	7:15 AM	0	0	2	0	0	0	1	0	0	0	1	0	0	0	1	0	**5**
7:15 AM	to	7:30 AM	0	2	3	0	0	0	2	1	0	0	2	0	0	0	1	0	**11**
7:30 AM	to	7:45 AM	0	2	3	0	0	0	5	5	0	1	4	0	0	0	2	0	**22**
7:45 AM	to	8:00 AM	0	2	3	0	0	0	7	16	0	2	5	0	0	0	3	0	**38**
8:00 AM	to	8:15 AM	0	2	3	0	0	0	11	16	0	2	8	1	0	0	3	0	**46**
8:15 AM	to	8:30 AM	0	2	3	0	0	0	12	17	0	3	9	3	0	0	4	0	**53**
8:30 AM	to	8:45 AM	0	2	4	0	0	0	13	19	0	4	9	3	0	0	4	0	**58**
8:45 AM	to	9:00 AM	0	2	4	0	0	0	14	20	0	5	10	3	0	0	5	1	**64**
TOTAL BY PERIOD																			
7:00 AM	to	7:15 AM	0	0	2	0	0	0	1	0	0	0	1	0	0	0	1	0	**5**
7:15 AM	to	7:30 AM	0	2	1	0	0	0	1	1	0	0	1	0	0	0	0	0	**6**
7:30 AM	to	7:45 AM	0	0	0	0	0	0	3	4	0	1	2	0	0	0	1	0	**11**
7:45 AM	to	8:00 AM	0	0	0	0	0	0	2	11	0	1	1	0	0	0	1	0	**16**
8:00 AM	to	8:15 AM	0	0	0	0	0	0	4	0	0	0	3	1	0	0	0	0	**8**
8:15 AM	to	8:30 AM	0	0	0	0	0	0	1	1	0	1	1	2	0	0	1	0	**7**
8:30 AM	to	8:45 AM	0	0	1	0	0	0	1	2	0	1	0	0	0	0	0	0	**5**
8:45 AM	to	9:00 AM	0	0	0	0	0	0	1	1	0	1	1	0	0	0	1	1	**6**
HOURLY TOTALS																			
7:00 AM	to	8:00 AM	0	2	3	0	0	0	7	16	0	2	5	0	0	0	3	0	**38**
7:15 AM	to	8:15 AM	0	2	1	0	0	0	10	16	0	2	7	1	0	0	2	0	**41**
7:30 AM	to	8:30 AM	0	0	0	0	0	0	10	16	0	3	7	3	0	0	3	0	**42**
7:45 AM	to	8:45 AM	0	0	1	0	0	0	8	14	0	3	5	3	0	0	2	0	**36**
8:00 AM	to	9:00 AM	0	0	1	0	0	0	7	4	0	3	5	3	0	0	2	1	**26**

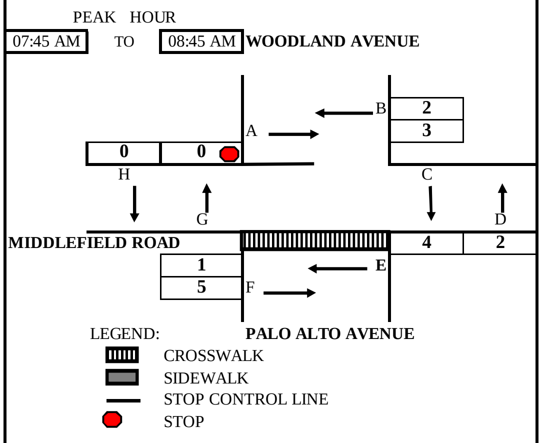
TEL: (510) 232 - 1271 FAX: (510) 232 - 1272

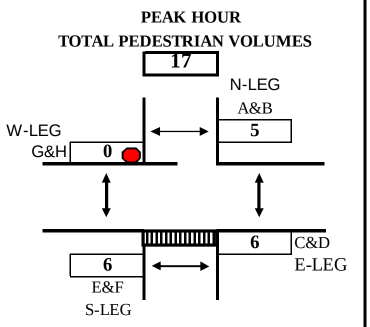
7:45 AM to 8:45 AM					
APPROACH VOLUME	NB	SB	EB	WB	TOTAL
BICYCLE	1	22	11	2	**36**

B.A.Y.M.E.T.R.I.C.S.

PEDESTRIAN MOVEMENT SUMMARY

PROJECT: TRAFFIC COUNTS IN PALO ALTO **SURVEY DATE:** 5/22/2018
N-S APPROACH: PALO ALTO AVENUE WOODLAND AVENUE **DAY:** TUESDAY
E-W APPROACH: MIDDLEFIELD ROAD **JURISDICTION:** PALO ALTO
SURVEY PERIOD 7:00 AM TO 9:00 AM **FILE:** 3805030-3AM





BY LEG:	
N-LEG	5
S-LEG	6
E-LEG	6
W-LEG	0

BY DIRECTION:	
NB(D+G)	2
SB(C+H)	4
EB(A+F)	8
WB(B+E)	3

TIME PERIOD			NORTH X-WALK		EAST X-WALK		SOUTH X-WALK		WEST X-WALK		
From		To	A	B	C	D	E	F	G	H	TOTAL
SURVEY DATA											
07:00 AM	---	07:15 AM	0	0	0	0	0	0	0	0	0
07:15 AM	---	07:30 AM	3	0	1	0	0	0	0	0	4
07:30 AM	---	07:45 AM	4	1	1	0	0	1	0	0	7
07:45 AM	---	08:00 AM	5	1	1	0	0	2	0	0	9
08:00 AM	---	08:15 AM	5	1	2	0	0	2	0	0	10
08:15 AM	---	08:30 AM	5	1	3	2	0	5	0	0	16
08:30 AM	---	08:45 AM	7	3	5	2	1	6	0	0	24
08:45 AM	---	09:00 AM	7	3	5	2	1	7	0	0	25
TOTAL BY PERIOD											
07:00 AM	---	07:15 AM	0	0	0	0	0	0	0	0	0
07:15 AM	---	07:30 AM	3	0	1	0	0	0	0	0	4
07:30 AM	---	07:45 AM	1	1	0	0	0	1	0	0	3
07:45 AM	---	08:00 AM	1	0	0	0	0	1	0	0	2
08:00 AM	---	08:15 AM	0	0	1	0	0	0	0	0	1
08:15 AM	---	08:30 AM	0	0	1	2	0	3	0	0	6
08:30 AM	---	08:45 AM	2	2	2	0	1	1	0	0	8
08:45 AM	---	09:00 AM	0	0	0	0	0	1	0	0	1
HOURLY TOTALS											
07:00 AM	---	08:00 AM	5	1	1	0	0	2	0	0	9
07:15 AM	---	08:15 AM	5	1	2	0	0	2	0	0	10
07:30 AM	---	08:30 AM	2	1	2	2	0	5	0	0	12
07:45 AM	---	08:45 AM	3	2	4	2	1	5	0	0	17
08:00 AM	---	09:00 AM	2	2	4	2	1	5	0	0	16

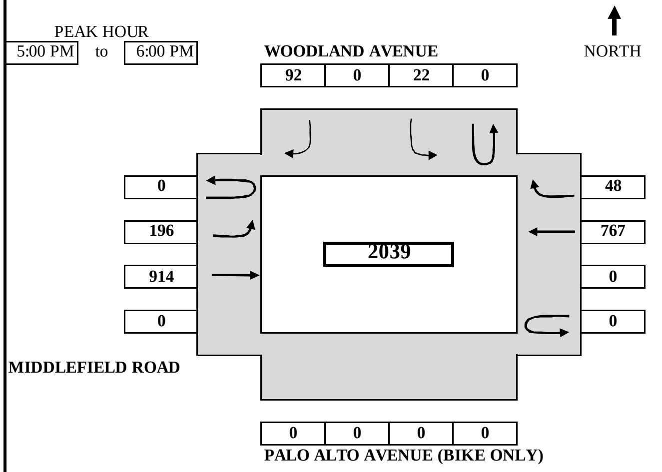
Tel : (510) 232-1271 *Fax: (510) 232-1272*

7:45 AM to 8:45 AM					
VOLUME BY DIRECTION	NB	SB	EB	WB	TOTAL
PEDESTRIAN	2	4	8	3	17
VOLUME BY LEG	N-LEG	S-LEG	E-LEG	W-LEG	TOTAL
PEDESTRIAN	5	6	6	0	17

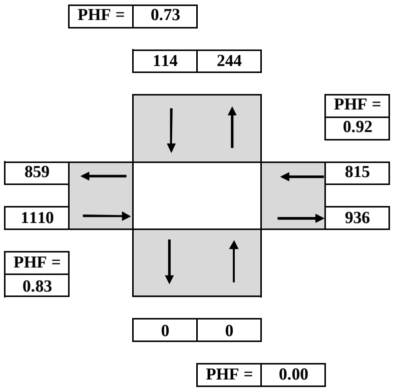
B.A.Y.M.E.T.R.I.C.S.

INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**PALO ALTO AVENUE - WOODLAND AVENUE**	**SURVEY TIME:**	**4:00 PM**	**TO**	**6:00 PM**
E-W APPROACH:	**MIDDLEFIELD ROAD**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-3PM**



ARRIVAL / DEPARTURE VOLUMES



TIME From		PERIOD To	NB U-TURN	NB LEFT	NB THRU	NB RIGHT	SB U-TURN	SB LEFT	SB THRU	SB RIGHT	EB U-TURN	EB LEFT	EB THRU	EB RIGHT	WB U-TURN	WB LEFT	WB THRU	WB RIGHT	TOTAL
SURVEY DATA																			
4:00 PM	to	4:15 PM						6		24		46	208				131	8	**423**
4:15 PM	to	4:30 PM						8		54		101	446				278	22	**909**
4:30 PM	to	4:45 PM						12		85		154	655				412	26	**1344**
4:45 PM	to	5:00 PM						21		125		198	823				583	37	**1787**
5:00 PM	to	5:15 PM						25		142		256	1101				777	48	**2349**
5:15 PM	to	5:30 PM						30		163		299	1314				958	56	**2820**
5:30 PM	to	5:45 PM						40		192		354	1553				1161	75	**3375**
5:45 PM	to	6:00 PM						43		217		394	1737				1350	85	**3826**
TOTAL BY PERIOD																			
4:00 PM	to	4:15 PM	0	0	0	0	0	6	0	24	0	46	208	0	0	0	131	8	**423**
4:15 PM	to	4:30 PM	0	0	0	0	0	2	0	30	0	55	238	0	0	0	147	14	**486**
4:30 PM	to	4:45 PM	0	0	0	0	0	4	0	31	0	53	209	0	0	0	134	4	**435**
4:45 PM	to	5:00 PM	0	0	0	0	0	9	0	40	0	44	168	0	0	0	171	11	**443**
5:00 PM	to	5:15 PM	0	0	0	0	0	4	0	17	0	58	278	0	0	0	194	11	**562**
5:15 PM	to	5:30 PM	0	0	0	0	0	5	0	21	0	43	213	0	0	0	181	8	**471**
5:30 PM	to	5:45 PM	0	0	0	0	0	10	0	29	0	55	239	0	0	0	203	19	**555**
5:45 PM	to	6:00 PM	0	0	0	0	0	3	0	25	0	40	184	0	0	0	189	10	**451**
HOURLY TOTALS																			
4:00 PM	to	5:00 PM	0	0	0	0	0	21	0	125	0	198	823	0	0	0	583	37	**1787**
4:15 PM	to	5:15 PM	0	0	0	0	0	19	0	118	0	210	893	0	0	0	646	40	**1926**
4:30 PM	to	5:30 PM	0	0	0	0	0	22	0	109	0	198	868	0	0	0	680	34	**1911**
4:45 PM	to	5:45 PM	0	0	0	0	0	28	0	107	0	200	898	0	0	0	749	49	**2031**
5:00 PM	to	6:00 PM	0	0	0	0	0	22	0	92	0	196	914	0	0	0	767	48	**2039**

PEAK HOUR SUMMARY

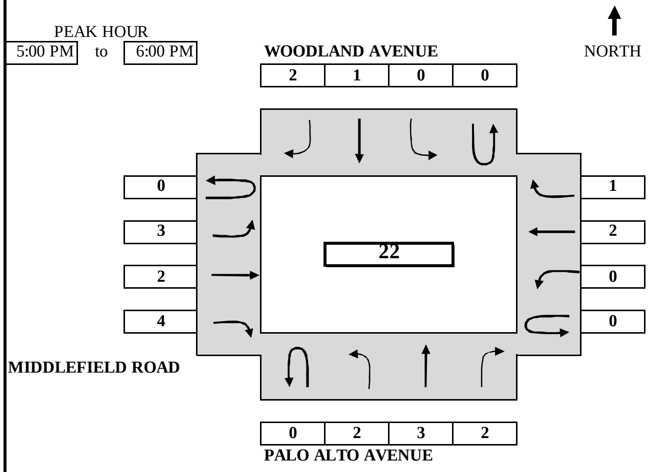
5:00 PM to 6:00 PM	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	TOTAL
VOLUME	0	0	0	0	0	22	0	92	0	196	914	0	0	0	767	48	**2039**
PHF BY MOVEMENT	0.00	0.00	0.00	0.00	0.00	0.55	0.00	0.79	0.00	0.84	0.82	0.00	0.00	0.00	0.94	0.63	OVERALL
PHF BY APPROACH	0.00				0.73				0.83				0.92				0.91
BICYCLE	7				3				9				3				**22**
PEDESTRIAN	1				3				10				4				**18**
	N-LEG				**S-LEG**				**E-LEG**				**W-LEG**				
PEDESTRIAN BY LEG:	12				2				4				0				**18**

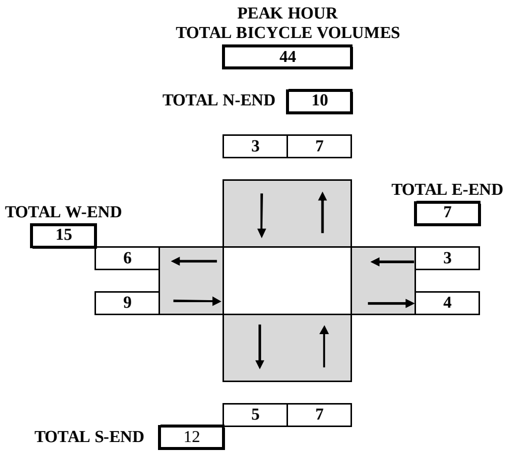
TEL: (510) 232 - 1271 FAX: (510) 232 - 1272

B.A.Y.M.E.T.R.I.C.S.

BICYCLE TURNING MOVEMENT SUMMARY

PROJECT: TRAFFIC COUNTS IN PALO ALTO **SURVEY DATE:** 5/22/2018 **DAY:** TUESDAY
N-S APPROACH: PALO ALTO AVENUE - WOODLAND AVENUE **SURVEY TIME:** 4:00 PM **TO** 6:00 PM
E-W APPROACH: MIDDLEFIELD ROAD **JURISDICTION:** PALO ALTO **FILE:** 3805030-3PM





TIME		PERIOD	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
From		To	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	
SURVEY DATA																			
4:00 PM	to	4:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
4:15 PM	to	4:30 PM	0	0	1	0	0	0	0	1	0	0	2	0	0	0	1	0	**5**
4:30 PM	to	4:45 PM	0	1	3	0	0	0	2	1	0	0	3	0	0	0	1	0	**11**
4:45 PM	to	5:00 PM	0	1	3	0	0	0	2	1	0	2	3	1	0	0	2	0	**15**
5:00 PM	to	5:15 PM	0	2	5	1	0	0	2	1	0	4	3	2	0	0	3	1	**24**
5:15 PM	to	5:30 PM	0	2	5	1	0	0	2	2	0	4	4	4	0	0	3	1	**28**
5:30 PM	to	5:45 PM	0	2	6	2	0	0	2	2	0	5	5	4	0	0	4	1	**33**
5:45 PM	to	6:00 PM	0	3	6	2	0	0	3	3	0	5	5	5	0	0	4	1	**37**
TOTAL BY PERIOD																			
4:00 PM	to	4:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
4:15 PM	to	4:30 PM	0	0	1	0	0	0	0	1	0	0	2	0	0	0	0	0	**4**
4:30 PM	to	4:45 PM	0	1	2	0	0	0	2	0	0	0	1	0	0	0	0	0	**6**
4:45 PM	to	5:00 PM	0	0	0	0	0	0	0	0	0	2	0	1	0	0	1	0	**4**
5:00 PM	to	5:15 PM	0	1	2	1	0	0	0	0	0	2	0	1	0	0	1	1	**9**
5:15 PM	to	5:30 PM	0	0	0	0	0	0	0	1	0	0	1	2	0	0	0	0	**4**
5:30 PM	to	5:45 PM	0	0	1	1	0	0	0	0	0	1	1	0	0	0	1	0	**5**
5:45 PM	to	6:00 PM	0	1	0	0	0	0	1	1	0	0	0	1	0	0	0	0	**4**
HOURLY TOTALS																			
4:00 PM	to	5:00 PM	0	1	3	0	0	0	2	1	0	2	3	1	0	0	2	0	**15**
4:15 PM	to	5:15 PM	0	2	5	1	0	0	2	1	0	4	3	2	0	0	2	1	**23**
4:30 PM	to	5:30 PM	0	2	4	1	0	0	2	1	0	4	2	4	0	0	2	1	**23**
4:45 PM	to	5:45 PM	0	1	3	2	0	0	0	1	0	5	2	4	0	0	3	1	**22**
5:00 PM	to	6:00 PM	0	2	3	2	0	0	1	2	0	3	2	4	0	0	2	1	**22**

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5:00 PM to 6:00 PM					
APPROACH VOLUME	NB	SB	EB	WB	TOTAL
BICYCLE	7	3	9	3	**22**

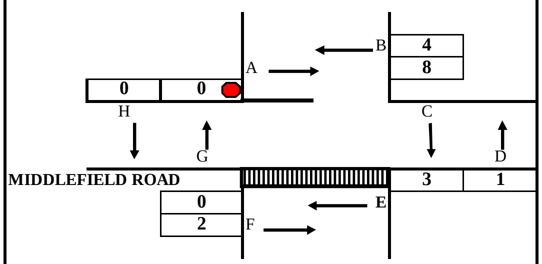
B.A.Y.M.E.T.R.I.C.S.

PEDESTRIAN MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**
N-S APPROACH:	**PALO ALTO AVENUE WOODLAND AVENUE**	**DAY:**	**TUESDAY**
E-W APPROACH:	**MIDDLEFIELD ROAD**	**JURISDICTION:**	**PALO ALTO**
SURVEY PERIOD	**4:00 PM TO 6:00 PM**	**FILE:**	**3805030-3PM**

PEAK HOUR

05:00 PM TO 06:00 PM **WOODLAND AVENUE**



LEGEND: **PALO ALTO AVENUE**

▥ CROSSWALK

▬ SIDEWALK

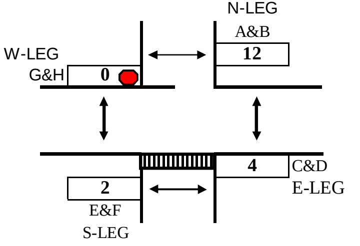
— STOP CONTROL LINE

● STOP

PEAK HOUR

TOTAL PEDESTRIAN VOLUMES

18



BY LEG:		**BY DIRECTION:**	
N-LEG	12	**NB**(D+G)	1
S-LEG	2	**SB**(C+H)	3
E-LEG	4	**EB**(A+F)	10
W-LEG	0	**WB**(B+E)	4

TIME		**PERIOD**	**NORTH X-WALK**		**EAST X-WALK**		**SOUTH X-WALK**		**WEST X-WALK**		
From		**To**	***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***TOTAL***
					SURVEY DATA						
04:00 PM	---	04:15 PM	0	0	1	0	0	0	0	0	*1*
04:15 PM	---	04:30 PM	0	0	3	0	0	0	0	0	*3*
04:30 PM	---	04:45 PM	0	1	3	0	0	0	0	0	*4*
04:45 PM	---	05:00 PM	0	3	3	0	0	0	0	0	*6*
05:00 PM	---	05:15 PM	2	3	4	0	0	0	0	0	*9*
05:15 PM	---	05:30 PM	5	5	4	1	0	0	0	0	*15*
05:30 PM	---	05:45 PM	7	7	6	1	0	2	0	0	*23*
05:45 PM	---	06:00 PM	8	7	6	1	0	2	0	0	*24*
					TOTAL BY PERIOD						
04:00 PM	---	04:15 PM	0	0	1	0	0	0	0	0	*1*
04:15 PM	---	04:30 PM	0	0	2	0	0	0	0	0	*2*
04:30 PM	---	04:45 PM	0	1	0	0	0	0	0	0	*1*
04:45 PM	---	05:00 PM	0	2	0	0	0	0	0	0	*2*
05:00 PM	---	05:15 PM	2	0	1	0	0	0	0	0	*3*
05:15 PM	---	05:30 PM	3	2	0	1	0	0	0	0	*6*
05:30 PM	---	05:45 PM	2	2	2	0	0	2	0	0	*8*
05:45 PM	---	06:00 PM	1	0	0	0	0	0	0	0	*1*
					HOURLY TOTALS						
04:00 PM	---	05:00 PM	0	3	3	0	0	0	0	0	*6*
04:15 PM	---	05:15 PM	2	3	3	0	0	0	0	0	*8*
04:30 PM	---	05:30 PM	5	5	1	1	0	0	0	0	*12*
04:45 PM	---	05:45 PM	7	6	3	1	0	2	0	0	*19*
05:00 PM	---	06:00 PM	8	4	3	1	0	2	0	0	*18*

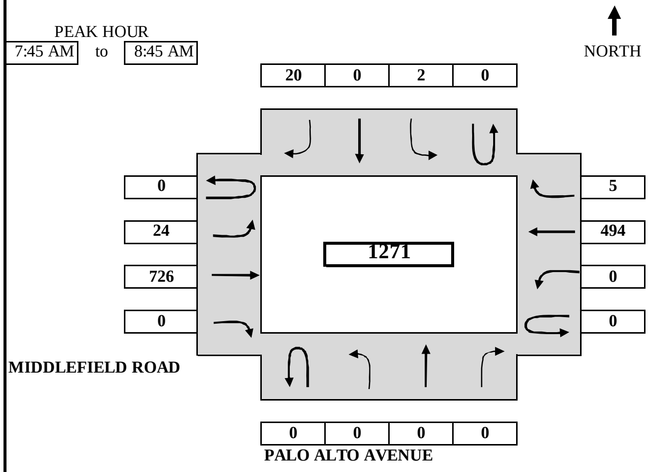
Tel : (510) 232-1271   ***Fax: (510) 232-1272***

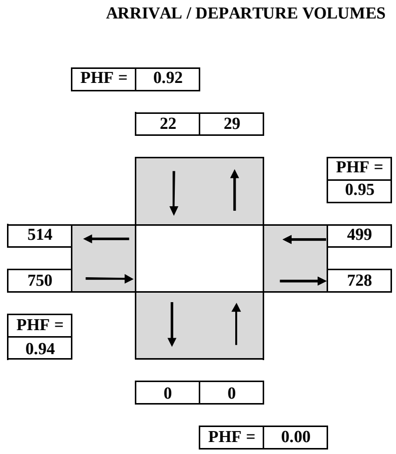
5:00 PM to 6:00 PM					
VOLUME BY DIRECTION	NB	SB	EB	WB	TOTAL
PEDESTRIAN	1	3	10	4	**18**
VOLUME BY LEG	N-LEG	S-LEG	E-LEG	W-LEG	TOTAL
PEDESTRIAN	12	2	4	0	**18**

B.A.Y.M.E.T.R.I.C.S.

INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**PALO ALTO AVENUE**	**SURVEY TIME:**	**7:00 AM**	**TO**	**9:00 AM**
E-W APPROACH:	**MIDDLEFIELD ROAD**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-4AM**





TIME		PERIOD	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
From		To	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	
SURVEY DATA																			
7:00 AM	to	7:15 AM						1		1		1	150				62	0	**215**
7:15 AM	to	7:30 AM						1		2		3	274				135	2	**417**
7:30 AM	to	7:45 AM						1		7		4	445				260	2	**719**
7:45 AM	to	8:00 AM						2		12		8	622				370	4	**1018**
8:00 AM	to	8:15 AM						2		17		12	789				500	6	**1326**
8:15 AM	to	8:30 AM						2		22		19	981				625	6	**1655**
8:30 AM	to	8:45 AM						3		27		28	1171				754	7	**1990**
8:45 AM	to	9:00 AM						3		35		37	1322				866	8	**2271**
TOTAL BY PERIOD																			
7:00 AM	to	7:15 AM	0	0	0	0	0	1	0	1	0	1	150	0	0	0	62	0	**215**
7:15 AM	to	7:30 AM	0	0	0	0	0	0	0	1	0	2	124	0	0	0	73	2	**202**
7:30 AM	to	7:45 AM	0	0	0	0	0	0	0	5	0	1	171	0	0	0	125	0	**302**
7:45 AM	to	8:00 AM	0	0	0	0	0	1	0	5	0	4	177	0	0	0	110	2	**299**
8:00 AM	to	8:15 AM	0	0	0	0	0	0	0	5	0	4	167	0	0	0	130	2	**308**
8:15 AM	to	8:30 AM	0	0	0	0	0	0	0	5	0	7	192	0	0	0	125	0	**329**
8:30 AM	to	8:45 AM	0	0	0	0	0	1	0	5	0	9	190	0	0	0	129	1	**335**
8:45 AM	to	9:00 AM	0	0	0	0	0	0	0	8	0	9	151	0	0	0	112	1	**281**
HOURLY TOTALS																			
7:00 AM	to	8:00 AM	0	0	0	0	0	2	0	12	0	8	622	0	0	0	370	4	**1018**
7:15 AM	to	8:15 AM	0	0	0	0	0	1	0	16	0	11	639	0	0	0	438	6	**1111**
7:30 AM	to	8:30 AM	0	0	0	0	0	1	0	20	0	16	707	0	0	0	490	4	**1238**
7:45 AM	to	8:45 AM	0	0	0	0	0	2	0	20	0	24	726	0	0	0	494	5	**1271**
8:00 AM	to	9:00 AM	0	0	0	0	0	1	0	23	0	29	700	0	0	0	496	4	**1253**

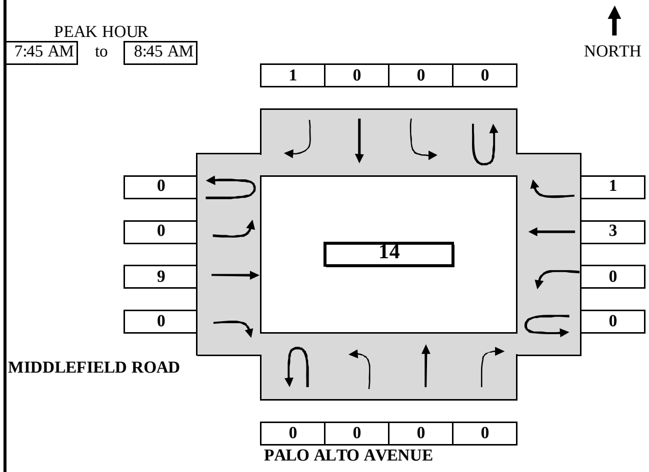
PEAK HOUR SUMMARY

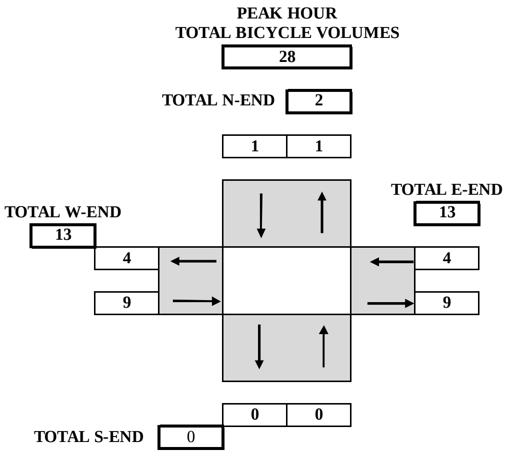
7:45 AM to 8:45 AM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	
VOLUME	0	0	0	0	0	2	0	20	0	24	726	0	0	0	494	5	**1271**
PHF BY MOVEMENT	0.00	0.00	0.00	0.00	0.00	0.50	0.00	1.00	0.00	0.67	0.95	0.00	0.00	0.00	0.95	0.63	OVERALL
PHF BY APPROACH	0.00				0.92				0.94				0.95				0.95
BICYCLE	0				1				9				4				**14**
PEDESTRIAN	4				2				4				6				**16**
	N-LEG				**S-LEG**				**E-LEG**				**W-LEG**				
PEDESTRIAN BY LEG:	10				0				4				2				**16**

B.A.Y.M.E.T.R.I.C.S.

BICYCLE TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**PALO ALTO AVENUE**	**SURVEY TIME:**	**7:00 AM**	**TO**	**9:00 AM**
E-W APPROACH:	**MIDDLEFIELD ROAD**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-4AM**





TIME		**PERIOD**	**NORTHBOUND**				**SOUTHBOUND**				**EASTBOUND**				**WESTBOUND**				TOTAL
From		To	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	
SURVEY DATA																			
7:00 AM	to	7:15 AM	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	**3**
7:15 AM	to	7:30 AM	0	0	0	0	0	0	0	2	0	0	2	0	0	0	1	0	**5**
7:30 AM	to	7:45 AM	0	0	0	0	0	0	0	2	0	0	4	0	0	0	2	0	**8**
7:45 AM	to	8:00 AM	0	0	0	0	0	0	0	3	0	0	6	0	0	0	2	1	**12**
8:00 AM	to	8:15 AM	0	0	0	0	0	0	0	3	0	0	10	0	0	0	3	1	**17**
8:15 AM	to	8:30 AM	0	0	0	0	0	0	0	3	0	0	12	0	0	0	4	1	**20**
8:30 AM	to	8:45 AM	0	0	0	0	0	0	0	3	0	0	13	0	0	0	5	1	**22**
8:45 AM	to	9:00 AM	0	0	0	0	0	0	0	3	0	0	14	0	0	0	6	1	**24**
TOTAL BY PERIOD																			
7:00 AM	to	7:15 AM	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	**3**
7:15 AM	to	7:30 AM	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	**2**
7:30 AM	to	7:45 AM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	**3**
7:45 AM	to	8:00 AM	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0	1	**4**
8:00 AM	to	8:15 AM	0	0	0	0	0	0	0	0	0	0	4	0	0	0	1	0	**5**
8:15 AM	to	8:30 AM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	**3**
8:30 AM	to	8:45 AM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	**2**
8:45 AM	to	9:00 AM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	**2**
HOURLY TOTALS																			
7:00 AM	to	8:00 AM	0	0	0	0	0	0	0	3	0	0	6	0	0	0	2	1	**12**
7:15 AM	to	8:15 AM	0	0	0	0	0	0	0	2	0	0	9	0	0	0	2	1	**14**
7:30 AM	to	8:30 AM	0	0	0	0	0	0	0	1	0	0	10	0	0	0	3	1	**15**
7:45 AM	to	8:45 AM	0	0	0	0	0	0	0	1	0	0	9	0	0	0	3	1	**14**
8:00 AM	to	9:00 AM	0	0	0	0	0	0	0	0	0	0	8	0	0	0	4	0	**12**

TEL: (510) 232 - 1271 FAX: (510) 232 - 1272

7:45 AM to 8:45 AM					
APPROACH VOLUME	NB	SB	EB	WB	TOTAL
BICYCLE	0	1	9	4	**14**

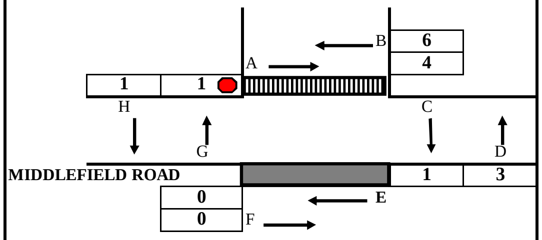
B.A.Y.M.E.T.R.I.C.S.

PEDESTRIAN MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**
N-S APPROACH:	**PALO ALTO AVENUE**	**DAY:**	**TUESDAY**
E-W APPROACH:	**MIDDLEFIELD ROAD**	**JURISDICTION:**	**PALO ALTO**
SURVEY PERIOD	**7:00 AM TO 9:00 AM**	**FILE:**	**3805030-4AM**

PEAK HOUR

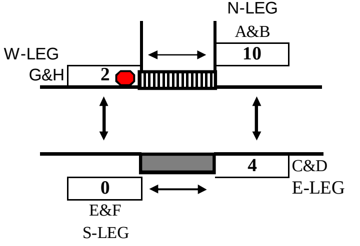
07:45 AM TO 08:45 AM



PEAK HOUR

TOTAL PEDESTRIAN VOLUMES

16



LEGEND: **PALO ALTO AVENUE**

- ▥ CROSSWALK
- ▬ SIDEWALK
- — STOP CONTROL LINE
- ● STOP

BY LEG:		**BY DIRECTION:**	
N-LEG	**10**	**NB**(D+G)	**4**
S-LEG	**0**	**SB**(C+H)	**2**
E-LEG	**4**	**EB**(A+F)	**4**
W-LEG	**2**	**WB**(B+E)	**6**

TIME PERIOD			**NORTH X-WALK**		**EAST X-WALK**		**SOUTH X-WALK**		**WEST X-WALK**		
From		**To**	***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***TOTAL***
SURVEY DATA											
07:00 AM	---	07:15 AM	0	0	0	0	0	0	0	0	*0*
07:15 AM	---	07:30 AM	1	0	0	1	0	0	0	0	*2*
07:30 AM	---	07:45 AM	3	1	0	1	0	0	0	0	*5*
07:45 AM	---	08:00 AM	3	2	0	2	0	0	0	0	*7*
08:00 AM	---	08:15 AM	4	2	1	3	0	0	0	0	*10*
08:15 AM	---	08:30 AM	5	5	1	3	0	0	1	1	*16*
08:30 AM	---	08:45 AM	7	7	1	4	0	0	1	1	*21*
08:45 AM	---	09:00 AM	8	8	1	4	0	0	1	1	*23*
TOTAL BY PERIOD											
07:00 AM	---	07:15 AM	0	0	0	0	0	0	0	0	*0*
07:15 AM	---	07:30 AM	1	0	0	1	0	0	0	0	*2*
07:30 AM	---	07:45 AM	2	1	0	0	0	0	0	0	*3*
07:45 AM	---	08:00 AM	0	1	0	1	0	0	0	0	*2*
08:00 AM	---	08:15 AM	1	0	1	1	0	0	0	0	*3*
08:15 AM	---	08:30 AM	1	3	0	0	0	0	1	1	*6*
08:30 AM	---	08:45 AM	2	2	0	1	0	0	0	0	*5*
08:45 AM	---	09:00 AM	1	1	0	0	0	0	0	0	*2*
HOURLY TOTALS											
07:00 AM	---	08:00 AM	3	2	0	2	0	0	0	0	*7*
07:15 AM	---	08:15 AM	4	2	1	3	0	0	0	0	*10*
07:30 AM	---	08:30 AM	4	5	1	2	0	0	1	1	*14*
07:45 AM	---	08:45 AM	4	6	1	3	0	0	1	1	*16*
08:00 AM	---	09:00 AM	5	6	1	2	0	0	1	1	*16*

Tel : (510) 232-1271 ***Fax: (510) 232-1272***

7:45 AM to 8:45 AM					
VOLUME BY DIRECTION	NB	SB	EB	WB	TOTAL
PEDESTRIAN	4	2	4	6	**16**
VOLUME BY LEG	N-LEG	S-LEG	E-LEG	W-LEG	TOTAL
PEDESTRIAN	10	0	4	2	**16**

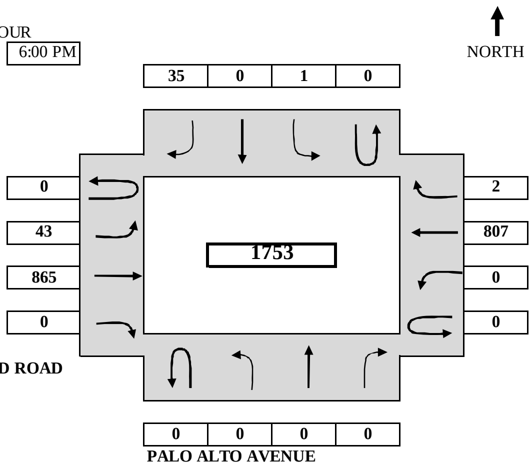
B.A.Y.M.E.T.R.I.C.S.

INTERSECTION TURNING MOVEMENT SUMMARY

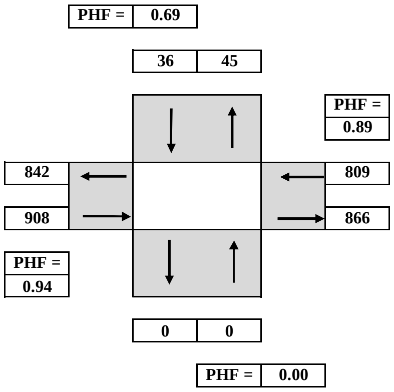
PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**PALO ALTO AVENUE**	**SURVEY TIME:**	**4:00 PM**	**TO**	**6:00 PM**
E-W APPROACH:	**MIDDLEFIELD ROAD**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-4PM**

PEAK HOUR

5:00 PM to 6:00 PM



ARRIVAL / DEPARTURE VOLUMES



TIME From		PERIOD To	NORTHBOUND U-TURN	LEFT	THRU	RIGHT	SOUTHBOUND U-TURN	LEFT	THRU	RIGHT	EASTBOUND U-TURN	LEFT	THRU	RIGHT	WESTBOUND U-TURN	LEFT	THRU	RIGHT	TOTAL
SURVEY DATA																			
4:00 PM	to	4:15 PM						0		9		8	190				132	0	339
4:15 PM	to	4:30 PM						1		14		21	389				268	1	694
4:30 PM	to	4:45 PM						1		18		35	621				422	1	1098
4:45 PM	to	5:00 PM						1		27		47	835				603	1	1514
5:00 PM	to	5:15 PM						2		39		61	1013				773	3	1891
5:15 PM	to	5:30 PM						2		45		73	1239				975	3	2337
5:30 PM	to	5:45 PM						2		55		86	1468				1182	3	2796
5:45 PM	to	6:00 PM						2		62		90	1700				1410	3	3267
TOTAL BY PERIOD																			
4:00 PM	to	4:15 PM	0	0	0	0	0	0	0	9	0	8	190	0	0	0	132	0	339
4:15 PM	to	4:30 PM	0	0	0	0	0	1	0	5	0	13	199	0	0	0	136	1	355
4:30 PM	to	4:45 PM	0	0	0	0	0	0	0	4	0	14	232	0	0	0	154	0	404
4:45 PM	to	5:00 PM	0	0	0	0	0	0	0	9	0	12	214	0	0	0	181	0	416
5:00 PM	to	5:15 PM	0	0	0	0	0	1	0	12	0	14	178	0	0	0	170	2	377
5:15 PM	to	5:30 PM	0	0	0	0	0	0	0	6	0	12	226	0	0	0	202	0	446
5:30 PM	to	5:45 PM	0	0	0	0	0	0	0	10	0	13	229	0	0	0	207	0	459
5:45 PM	to	6:00 PM	0	0	0	0	0	0	0	7	0	4	232	0	0	0	228	0	471
HOURLY TOTALS																			
4:00 PM	to	5:00 PM	0	0	0	0	0	1	0	27	0	47	835	0	0	0	603	1	1514
4:15 PM	to	5:15 PM	0	0	0	0	0	2	0	30	0	53	823	0	0	0	641	3	1552
4:30 PM	to	5:30 PM	0	0	0	0	0	1	0	31	0	52	850	0	0	0	707	2	1643
4:45 PM	to	5:45 PM	0	0	0	0	0	1	0	37	0	51	847	0	0	0	760	2	1698
5:00 PM	to	6:00 PM	0	0	0	0	0	1	0	35	0	43	865	0	0	0	807	2	1753

PEAK HOUR SUMMARY

5:00 PM to 6:00 PM	NORTHBOUND NBU	NBL	NBT	NBR	SOUTHBOUND SBU	SBL	SBT	SBR	EASTBOUND EBU	EBL	EBT	EBR	WESTBOUND WBU	WBL	WBT	WBR	TOTAL
VOLUME	0	0	0	0	0	1	0	35	0	43	865	0	0	0	807	2	1753
PHF BY MOVEMENT	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.73	0.00	0.77	0.93	0.00	0.00	0.00	0.88	0.25	OVERALL
PHF BY APPROACH	0.00				0.69				0.94				0.89				0.93
BICYCLE	0				1				2				5				8
PEDESTRIAN	2				0				6				8				16
	N-LEG				S-LEG				E-LEG				W-LEG				
PEDESTRIAN BY LEG:	14				0				2				0				16

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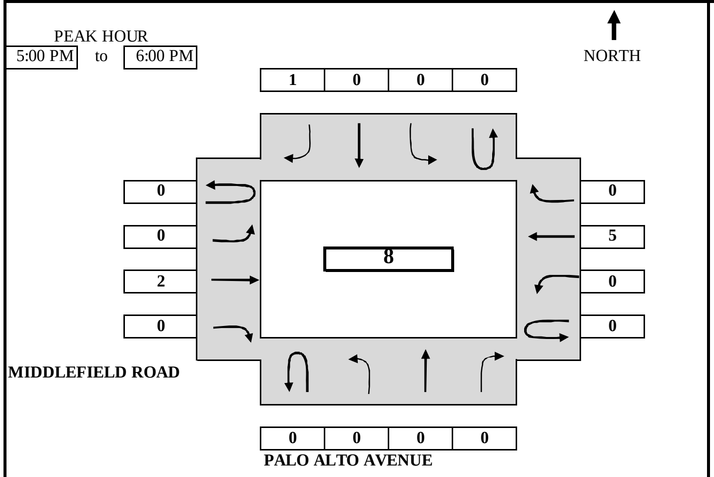
B.A.Y.M.E.T.R.I.C.S.

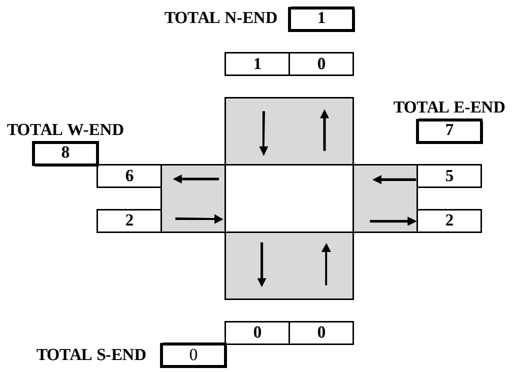
BICYCLE TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**PALO ALTO AVENUE**	**SURVEY TIME:**	**4:00 PM**	**TO**	**6:00 PM**
E-W APPROACH:	**MIDDLEFIELD ROAD**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-4PM**

PEAK HOUR
5:00 PM to 6:00 PM



PEAK HOUR
TOTAL BICYCLE VOLUMES
16



TIME		PERIOD	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
From		To	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	
SURVEY DATA																			
4:00 PM	to	4:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
4:15 PM	to	4:30 PM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	**3**
4:30 PM	to	4:45 PM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	**4**
4:45 PM	to	5:00 PM	0	0	0	0	0	0	0	0	0	0	3	0	0	0	3	0	**6**
5:00 PM	to	5:15 PM	0	0	0	0	0	0	0	1	0	0	3	0	0	0	4	0	**8**
5:15 PM	to	5:30 PM	0	0	0	0	0	0	0	1	0	0	4	0	0	0	5	0	**10**
5:30 PM	to	5:45 PM	0	0	0	0	0	0	0	1	0	0	4	0	0	0	6	0	**11**
5:45 PM	to	6:00 PM	0	0	0	0	0	0	0	1	0	0	5	0	0	0	8	0	**14**
TOTAL BY PERIOD																			
4:00 PM	to	4:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
4:15 PM	to	4:30 PM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	**2**
4:30 PM	to	4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
4:45 PM	to	5:00 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	**2**
5:00 PM	to	5:15 PM	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	**2**
5:15 PM	to	5:30 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	**2**
5:30 PM	to	5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
5:45 PM	to	6:00 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	**3**
HOURLY TOTALS																			
4:00 PM	to	5:00 PM	0	0	0	0	0	0	0	0	0	0	3	0	0	0	3	0	**6**
4:15 PM	to	5:15 PM	0	0	0	0	0	0	0	1	0	0	3	0	0	0	3	0	**7**
4:30 PM	to	5:30 PM	0	0	0	0	0	0	0	1	0	0	2	0	0	0	4	0	**7**
4:45 PM	to	5:45 PM	0	0	0	0	0	0	0	1	0	0	2	0	0	0	4	0	**7**
5:00 PM	to	6:00 PM	0	0	0	0	0	0	0	1	0	0	2	0	0	0	5	0	**8**

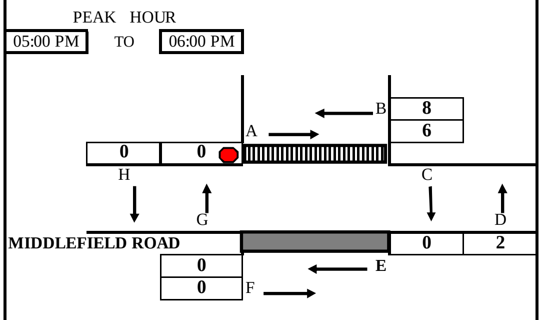
TEL: (510) 232 - 1271 FAX: (510) 232 - 1272

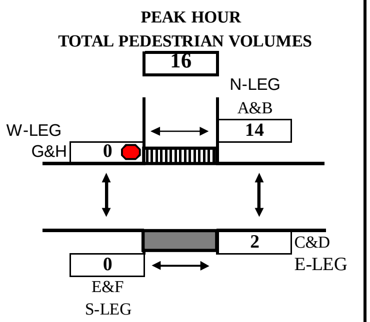
5:00 PM to 6:00 PM					
APPROACH VOLUME	NB	SB	EB	WB	TOTAL
BICYCLE	0	1	2	5	**8**

B.A.Y.M.E.T.R.I.C.S.

PEDESTRIAN MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**
N-S APPROACH:	**PALO ALTO AVENUE**	**DAY:**	**TUESDAY**
E-W APPROACH:	**MIDDLEFIELD ROAD**	**JURISDICTION:**	**PALO ALTO**
SURVEY PERIOD	**4:00 PM TO 6:00 PM**	**FILE:**	**3805030-4PM**





LEGEND:
- ▥ CROSSWALK
- ▬ SIDEWALK
- — STOP CONTROL LINE
- ● STOP

BY LEG:	
N-LEG	14
S-LEG	0
E-LEG	2
W-LEG	0

BY DIRECTION:	
NB(D+G)	2
SB(C+H)	0
EB(A+F)	6
WB(B+E)	8

TIME PERIOD			**NORTH X-WALK**		**EAST X-WALK**		**SOUTH X-WALK**		**WEST X-WALK**		
From		**To**	***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***TOTAL***
SURVEY DATA											
04:00 PM	---	04:15 PM	0	2	0	0	0	0	1	0	*3*
04:15 PM	---	04:30 PM	1	3	0	0	0	0	1	0	*5*
04:30 PM	---	04:45 PM	1	3	0	0	0	0	1	0	*5*
04:45 PM	---	05:00 PM	3	4	0	1	0	0	1	2	*11*
05:00 PM	---	05:15 PM	5	6	0	3	0	0	1	2	*17*
05:15 PM	---	05:30 PM	9	7	0	3	0	0	1	2	*22*
05:30 PM	---	05:45 PM	9	11	0	3	0	0	1	2	*26*
05:45 PM	---	06:00 PM	9	12	0	3	0	0	1	2	*27*
TOTAL BY PERIOD											
04:00 PM	---	04:15 PM	0	2	0	0	0	0	1	0	*3*
04:15 PM	---	04:30 PM	1	1	0	0	0	0	0	0	*2*
04:30 PM	---	04:45 PM	0	0	0	0	0	0	0	0	*0*
04:45 PM	---	05:00 PM	2	1	0	1	0	0	0	2	*6*
05:00 PM	---	05:15 PM	2	2	0	2	0	0	0	0	*6*
05:15 PM	---	05:30 PM	4	1	0	0	0	0	0	0	*5*
05:30 PM	---	05:45 PM	0	4	0	0	0	0	0	0	*4*
05:45 PM	---	06:00 PM	0	1	0	0	0	0	0	0	*1*
HOURLY TOTALS											
04:00 PM	---	05:00 PM	3	4	0	1	0	0	1	2	*11*
04:15 PM	---	05:15 PM	5	4	0	3	0	0	0	2	*14*
04:30 PM	---	05:30 PM	8	4	0	3	0	0	0	2	*17*
04:45 PM	---	05:45 PM	8	8	0	3	0	0	0	2	*21*
05:00 PM	---	06:00 PM	6	8	0	2	0	0	0	0	*16*

Tel : (510) 232-1271 ***Fax: (510) 232-1272***

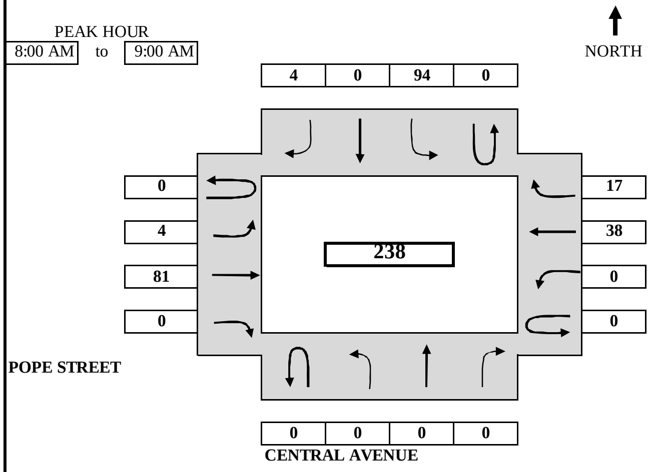
5:00 PM to 6:00 PM					
VOLUME BY DIRECTION	NB	SB	EB	WB	TOTAL
PEDESTRIAN	2	0	6	8	**16**
VOLUME BY LEG	N-LEG	S-LEG	E-LEG	W-LEG	TOTAL
PEDESTRIAN	14	0	2	0	**16**

B.A.Y.M.E.T.R.I.C.S.

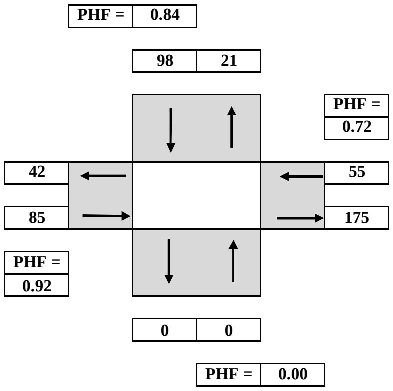
INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**CENTRAL AVENUE**	**SURVEY TIME:**	**7:00 AM**	**TO**	**9:00 AM**
E-W APPROACH:	**POPE STREET**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-5AM**

PEAK HOUR
8:00 AM to 9:00 AM



ARRIVAL / DEPARTURE VOLUMES



TIME		**PERIOD**	**NORTHBOUND**				**SOUTHBOUND**				**EASTBOUND**				**WESTBOUND**				TOTAL
From		To	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	
SURVEY DATA																			
7:00 AM	to	7:15 AM						3		1		0	3				1	3	**11**
7:15 AM	to	7:30 AM						13		1		0	7				3	5	**29**
7:30 AM	to	7:45 AM						25		1		2	11				6	6	**51**
7:45 AM	to	8:00 AM						40		1		2	29				16	10	**98**
8:00 AM	to	8:15 AM						58		2		3	51				31	14	**159**
8:15 AM	to	8:30 AM						84		3		4	67				40	18	**216**
8:30 AM	to	8:45 AM						107		3		4	89				43	23	**269**
8:45 AM	to	9:00 AM						134		5		6	110				54	27	**336**
TOTAL BY PERIOD																			
7:00 AM	to	7:15 AM	0	0	0	0	0	3	0	1	0	0	3	0	0	0	1	3	**11**
7:15 AM	to	7:30 AM	0	0	0	0	0	10	0	0	0	0	4	0	0	0	2	2	**18**
7:30 AM	to	7:45 AM	0	0	0	0	0	12	0	0	0	2	4	0	0	0	3	1	**22**
7:45 AM	to	8:00 AM	0	0	0	0	0	15	0	0	0	0	18	0	0	0	10	4	**47**
8:00 AM	to	8:15 AM	0	0	0	0	0	18	0	1	0	1	22	0	0	0	15	4	**61**
8:15 AM	to	8:30 AM	0	0	0	0	0	26	0	1	0	1	16	0	0	0	9	4	**57**
8:30 AM	to	8:45 AM	0	0	0	0	0	23	0	0	0	0	22	0	0	0	3	5	**53**
8:45 AM	to	9:00 AM	0	0	0	0	0	27	0	2	0	2	21	0	0	0	11	4	**67**
HOURLY TOTALS																			
7:00 AM	to	8:00 AM	0	0	0	0	0	40	0	1	0	2	29	0	0	0	16	10	**98**
7:15 AM	to	8:15 AM	0	0	0	0	0	55	0	1	0	3	48	0	0	0	30	11	**148**
7:30 AM	to	8:30 AM	0	0	0	0	0	71	0	2	0	4	60	0	0	0	37	13	**187**
7:45 AM	to	8:45 AM	0	0	0	0	0	82	0	2	0	2	78	0	0	0	37	17	**218**
8:00 AM	to	9:00 AM	0	0	0	0	0	94	0	4	0	4	81	0	0	0	38	17	**238**

PEAK HOUR SUMMARY

8:00 AM to 9:00 AM	**NORTHBOUND**				**SOUTHBOUND**				**EASTBOUND**				**WESTBOUND**				TOTAL
	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	
VOLUME	0	0	0	0	0	94	0	4	0	4	81	0	0	0	38	17	**238**
PHF BY MOVEMENT	0.00	0.00	0.00	0.00	0.00	0.87	0.00	0.50	0.00	0.50	0.92	0.00	0.00	0.00	0.63	0.85	OVERALL
PHF BY APPROACH	0.00				0.84				0.92				0.72				0.89
BICYCLE	0				6				13				11				**30**
PEDESTRIAN	0				0				8				0				**8**
	N-LEG				**S-LEG**				**E-LEG**				**W-LEG**				
PEDESTRIAN BY LEG:	8				0				0				0				**8**

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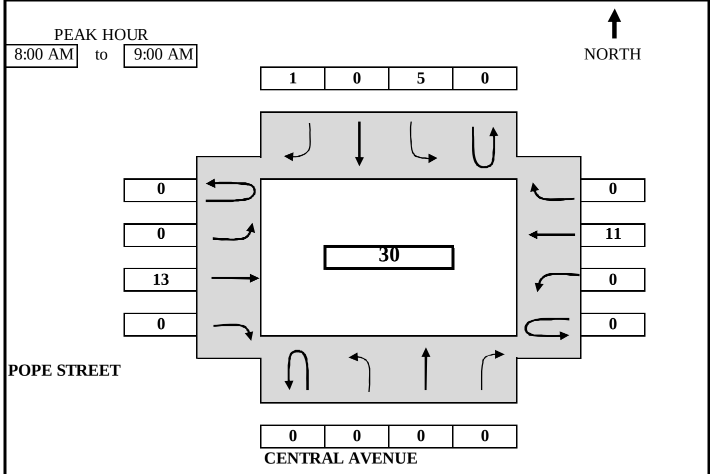
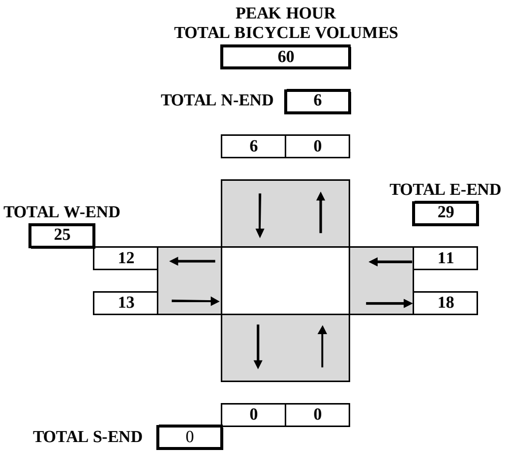
B.A.Y.M.E.T.R.I.C.S.

BICYCLE TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**CENTRAL AVENUE**	**SURVEY TIME:**	**7:00 AM**	**TO**	**9:00 AM**
E-W APPROACH:	**POPE STREET**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-5AM**





TIME		PERIOD	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
From		To	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	
SURVEY DATA																			
7:00 AM	to	7:15 AM	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	**5**
7:15 AM	to	7:30 AM	0	0	0	0	0	0	0	0	0	0	10	0	0	0	1	0	**11**
7:30 AM	to	7:45 AM	0	0	0	0	0	1	0	0	0	0	13	0	0	0	3	0	**17**
7:45 AM	to	8:00 AM	0	0	0	0	0	2	0	0	0	0	15	0	0	0	3	0	**20**
8:00 AM	to	8:15 AM	0	0	0	0	0	3	0	0	0	0	19	0	0	0	6	0	**28**
8:15 AM	to	8:30 AM	0	0	0	0	0	5	0	0	0	0	21	0	0	0	9	0	**35**
8:30 AM	to	8:45 AM	0	0	0	0	0	6	0	1	0	0	26	0	0	0	10	0	**43**
8:45 AM	to	9:00 AM	0	0	0	0	0	7	0	1	0	0	28	0	0	0	14	0	**50**
TOTAL BY PERIOD																			
7:00 AM	to	7:15 AM	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	**5**
7:15 AM	to	7:30 AM	0	0	0	0	0	0	0	0	0	0	5	0	0	0	1	0	**6**
7:30 AM	to	7:45 AM	0	0	0	0	0	1	0	0	0	0	3	0	0	0	2	0	**6**
7:45 AM	to	8:00 AM	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	**3**
8:00 AM	to	8:15 AM	0	0	0	0	0	1	0	0	0	0	4	0	0	0	3	0	**8**
8:15 AM	to	8:30 AM	0	0	0	0	0	2	0	0	0	0	2	0	0	0	3	0	**7**
8:30 AM	to	8:45 AM	0	0	0	0	0	1	0	1	0	0	5	0	0	0	1	0	**8**
8:45 AM	to	9:00 AM	0	0	0	0	0	1	0	0	0	0	2	0	0	0	4	0	**7**
HOURLY TOTALS																			
7:00 AM	to	8:00 AM	0	0	0	0	0	2	0	0	0	0	15	0	0	0	3	0	**20**
7:15 AM	to	8:15 AM	0	0	0	0	0	3	0	0	0	0	14	0	0	0	6	0	**23**
7:30 AM	to	8:30 AM	0	0	0	0	0	5	0	0	0	0	11	0	0	0	8	0	**24**
7:45 AM	to	8:45 AM	0	0	0	0	0	5	0	1	0	0	13	0	0	0	7	0	**26**
8:00 AM	to	9:00 AM	0	0	0	0	0	5	0	1	0	0	13	0	0	0	11	0	**30**

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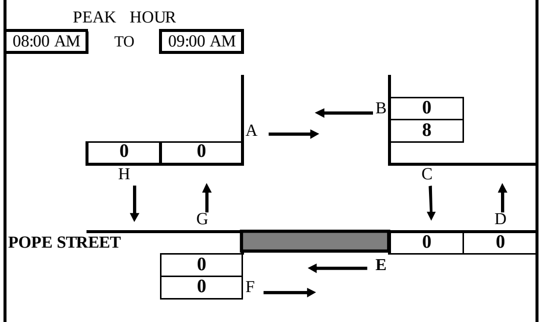
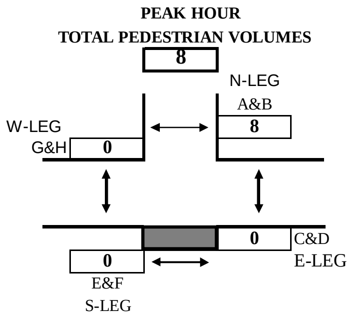
8:00 AM to 9:00 AM					
APPROACH VOLUME	NB	SB	EB	WB	TOTAL
BICYCLE	0	6	13	11	**30**

B.A.Y.M.E.T.R.I.C.S.

PEDESTRIAN MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**
N-S APPROACH:	**CENTRAL AVENUE**	**DAY:**	**TUESDAY**
E-W APPROACH:	**POPE STREET**	**JURISDICTION:**	**PALO ALTO**
SURVEY PERIOD	**7:00 AM TO 9:00 AM**	**FILE:**	**3805030-5AM**





LEGEND: **CENTRAL AVENUE**

- ▥ CROSSWALK
- ▬ SIDEWALK
- — STOP CONTROL LINE
- ● STOP

BY LEG:	
N-LEG	**8**
S-LEG	**0**
E-LEG	**0**
W-LEG	**0**

BY DIRECTION:	
NB(D+G)	**0**
SB(C+H)	**0**
EB(A+F)	**8**
WB(B+E)	**0**

TIME PERIOD			**NORTH X-WALK**		**EAST X-WALK**		**SOUTH X-WALK**		**WEST X-WALK**		
From		**To**	***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***TOTAL***
					SURVEY DATA						
07:00 AM	---	07:15 AM	0	1	0	0	0	0	0	0	*1*
07:15 AM	---	07:30 AM	1	1	0	0	0	0	0	0	*2*
07:30 AM	---	07:45 AM	1	1	0	0	0	0	0	0	*2*
07:45 AM	---	08:00 AM	1	2	0	0	0	0	0	0	*3*
08:00 AM	---	08:15 AM	1	2	0	0	0	0	0	0	*3*
08:15 AM	---	08:30 AM	4	2	0	0	0	0	0	0	*6*
08:30 AM	---	08:45 AM	5	2	0	0	0	0	0	0	*7*
08:45 AM	---	09:00 AM	9	2	0	0	0	0	0	0	*11*
					TOTAL BY PERIOD						
07:00 AM	---	07:15 AM	0	1	0	0	0	0	0	0	*1*
07:15 AM	---	07:30 AM	1	0	0	0	0	0	0	0	*1*
07:30 AM	---	07:45 AM	0	0	0	0	0	0	0	0	*0*
07:45 AM	---	08:00 AM	0	1	0	0	0	0	0	0	*1*
08:00 AM	---	08:15 AM	0	0	0	0	0	0	0	0	*0*
08:15 AM	---	08:30 AM	3	0	0	0	0	0	0	0	*3*
08:30 AM	---	08:45 AM	1	0	0	0	0	0	0	0	*1*
08:45 AM	---	09:00 AM	4	0	0	0	0	0	0	0	*4*
					HOURLY TOTALS						
07:00 AM	---	08:00 AM	1	2	0	0	0	0	0	0	*3*
07:15 AM	---	08:15 AM	1	1	0	0	0	0	0	0	*2*
07:30 AM	---	08:30 AM	3	1	0	0	0	0	0	0	*4*
07:45 AM	---	08:45 AM	4	1	0	0	0	0	0	0	*5*
08:00 AM	---	09:00 AM	8	0	0	0	0	0	0	0	*8*

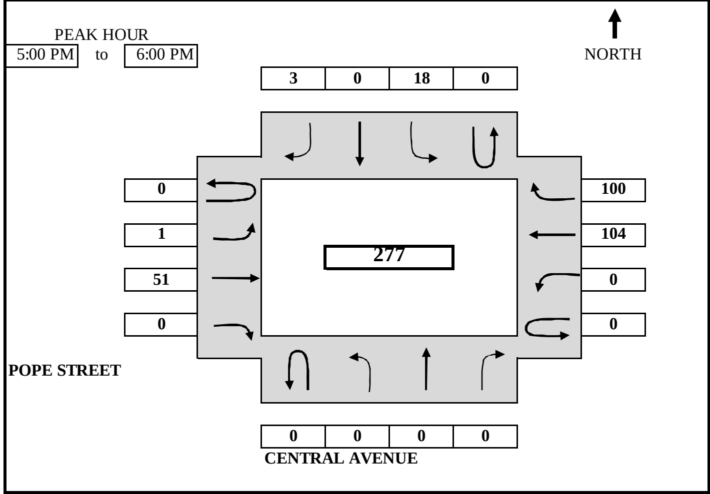
Tel : (510) 232-1271 ***Fax: (510) 232-1272***

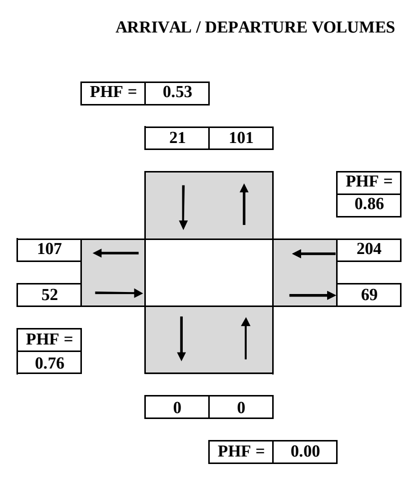
8:00 AM to 9:00 AM					
VOLUME BY DIRECTION	NB	SB	EB	WB	TOTAL
PEDESTRIAN	0	0	8	0	**8**
VOLUME BY LEG	N-LEG	S-LEG	E-LEG	W-LEG	TOTAL
PEDESTRIAN	8	0	0	0	**8**

B.A.Y.M.E.T.R.I.C.S.

INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**CENTRAL AVENUE**	**SURVEY TIME:**	**4:00 PM**	**TO**	**6:00 PM**
E-W APPROACH:	**POPE STREET**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-5PM**





TIME		**PERIOD**	**NORTHBOUND**				**SOUTHBOUND**				**EASTBOUND**				**WESTBOUND**				TOTAL
From		To	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	
SURVEY DATA																			
4:00 PM	to	4:15 PM						7		0		0	22				14	16	**59**
4:15 PM	to	4:30 PM						16		0		0	37				28	38	**119**
4:30 PM	to	4:45 PM						24		1		0	47				37	50	**159**
4:45 PM	to	5:00 PM						26		2		1	58				61	66	**214**
5:00 PM	to	5:15 PM						34		4		1	70				84	102	**295**
5:15 PM	to	5:30 PM						36		5		2	76				111	123	**353**
5:30 PM	to	5:45 PM						41		5		2	92				141	150	**431**
5:45 PM	to	6:00 PM						44		5		2	109				165	166	**491**
TOTAL BY PERIOD																			
4:00 PM	to	4:15 PM	0	0	0	0	0	7	0	0	0	0	22	0	0	0	14	16	**59**
4:15 PM	to	4:30 PM	0	0	0	0	0	9	0	0	0	0	15	0	0	0	14	22	**60**
4:30 PM	to	4:45 PM	0	0	0	0	0	8	0	1	0	0	10	0	0	0	9	12	**40**
4:45 PM	to	5:00 PM	0	0	0	0	0	2	0	1	0	1	11	0	0	0	24	16	**55**
5:00 PM	to	5:15 PM	0	0	0	0	0	8	0	2	0	0	12	0	0	0	23	36	**81**
5:15 PM	to	5:30 PM	0	0	0	0	0	2	0	1	0	1	6	0	0	0	27	21	**58**
5:30 PM	to	5:45 PM	0	0	0	0	0	5	0	0	0	0	16	0	0	0	30	27	**78**
5:45 PM	to	6:00 PM	0	0	0	0	0	3	0	0	0	0	17	0	0	0	24	16	**60**
HOURLY TOTALS																			
4:00 PM	to	5:00 PM	0	0	0	0	0	26	0	2	0	1	58	0	0	0	61	66	**214**
4:15 PM	to	5:15 PM	0	0	0	0	0	27	0	4	0	1	48	0	0	0	70	86	**236**
4:30 PM	to	5:30 PM	0	0	0	0	0	20	0	5	0	2	39	0	0	0	83	85	**234**
4:45 PM	to	5:45 PM	0	0	0	0	0	17	0	4	0	2	45	0	0	0	104	100	**272**
5:00 PM	to	6:00 PM	0	0	0	0	0	18	0	3	0	1	51	0	0	0	104	100	**277**

PEAK HOUR SUMMARY

5:00 PM to 6:00 PM	**NORTHBOUND**				**SOUTHBOUND**				**EASTBOUND**				**WESTBOUND**				TOTAL
	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	
VOLUME	0	0	0	0	0	18	0	3	0	1	51	0	0	0	104	100	**277**
PHF BY MOVEMENT	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.38	0.00	0.25	0.75	0.00	0.00	0.00	0.87	0.69	OVERALL
PHF BY APPROACH	0.00				0.53				0.76				0.86				0.85
BICYCLE	0				1				7				6				**14**
PEDESTRIAN	0				0				2				5				**7**
	N-LEG				**S-LEG**				**E-LEG**				**W-LEG**				
PEDESTRIAN BY LEG:	7				0				0				0				**7**

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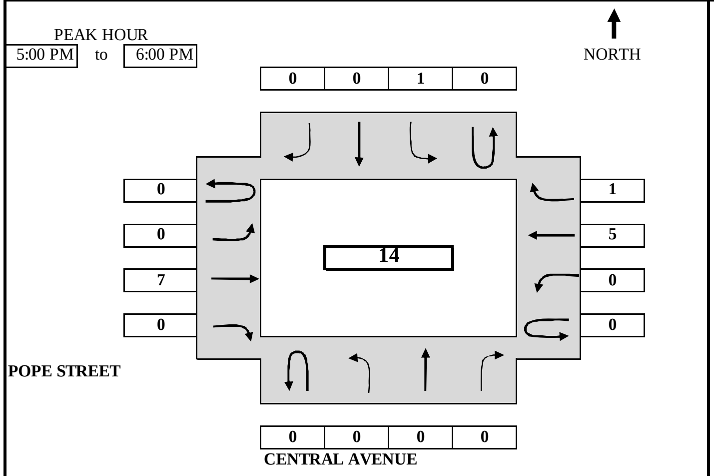
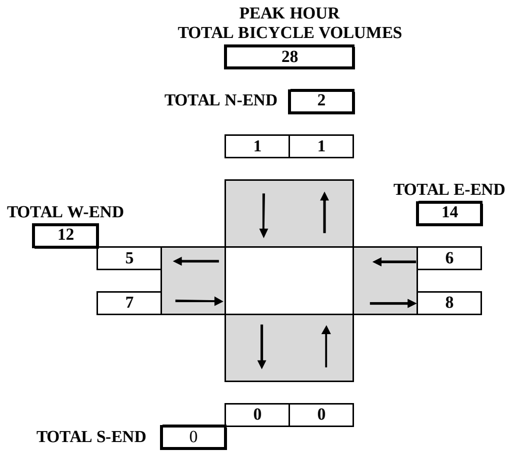
B.A.Y.M.E.T.R.I.C.S.

BICYCLE TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**CENTRAL AVENUE**	**SURVEY TIME:**	**4:00 PM**	**TO**	**6:00 PM**
E-W APPROACH:	**POPE STREET**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-5PM**





TIME		PERIOD	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
From		To	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	
SURVEY DATA																			
4:00 PM	to	4:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
4:15 PM	to	4:30 PM	0	0	0	0	0	1	0	0	0	0	5	0	0	0	3	0	**9**
4:30 PM	to	4:45 PM	0	0	0	0	0	1	0	0	0	0	6	0	0	0	4	1	**12**
4:45 PM	to	5:00 PM	0	0	0	0	0	1	0	0	0	0	7	0	0	0	5	1	**14**
5:00 PM	to	5:15 PM	0	0	0	0	0	1	0	0	0	0	8	0	0	0	6	2	**17**
5:15 PM	to	5:30 PM	0	0	0	0	0	1	0	0	0	0	9	0	0	0	7	2	**19**
5:30 PM	to	5:45 PM	0	0	0	0	0	2	0	0	0	0	12	0	0	0	9	2	**25**
5:45 PM	to	6:00 PM	0	0	0	0	0	2	0	0	0	0	14	0	0	0	10	2	**28**
TOTAL BY PERIOD																			
4:00 PM	to	4:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
4:15 PM	to	4:30 PM	0	0	0	0	0	1	0	0	0	0	5	0	0	0	3	0	**9**
4:30 PM	to	4:45 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	**3**
4:45 PM	to	5:00 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	**2**
5:00 PM	to	5:15 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	**3**
5:15 PM	to	5:30 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	**2**
5:30 PM	to	5:45 PM	0	0	0	0	0	1	0	0	0	0	3	0	0	0	2	0	**6**
5:45 PM	to	6:00 PM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	**3**
HOURLY TOTALS																			
4:00 PM	to	5:00 PM	0	0	0	0	0	1	0	0	0	0	7	0	0	0	5	1	**14**
4:15 PM	to	5:15 PM	0	0	0	0	0	1	0	0	0	0	8	0	0	0	6	2	**17**
4:30 PM	to	5:30 PM	0	0	0	0	0	0	0	0	0	0	4	0	0	0	4	2	**10**
4:45 PM	to	5:45 PM	0	0	0	0	0	1	0	0	0	0	6	0	0	0	5	1	**13**
5:00 PM	to	6:00 PM	0	0	0	0	0	1	0	0	0	0	7	0	0	0	5	1	**14**

TEL: (510) 232 - 1271 FAX: (510) 232 - 1272

5:00 PM to 6:00 PM					
APPROACH VOLUME	NB	SB	EB	WB	TOTAL
BICYCLE	0	1	7	6	**14**

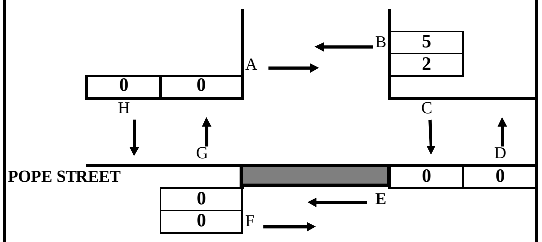
B.A.Y.M.E.T.R.I.C.S.

PEDESTRIAN MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**
N-S APPROACH:	**CENTRAL AVENUE**	**DAY:**	**TUESDAY**
E-W APPROACH:	**POPE STREET**	**JURISDICTION:**	**PALO ALTO**
SURVEY PERIOD	**4:00 PM TO 6:00 PM**	**FILE:**	**3805030-5PM**

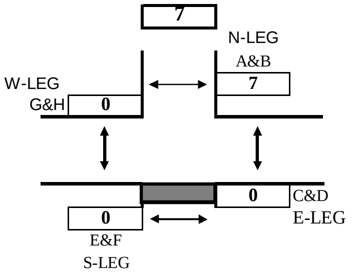
PEAK HOUR

05:00 PM TO 06:00 PM



PEAK HOUR

TOTAL PEDESTRIAN VOLUMES



LEGEND: **CENTRAL AVENUE**

- ▥ CROSSWALK
- ▬ SIDEWALK
- — STOP CONTROL LINE
- ● STOP

BY LEG:		**BY DIRECTION:**	
N-LEG	7	**NB**(D+G)	0
S-LEG	0	**SB**(C+H)	0
E-LEG	0	**EB**(A+F)	2
W-LEG	0	**WB**(B+E)	5

TIME PERIOD			**NORTH X-WALK**		**EAST X-WALK**		**SOUTH X-WALK**		**WEST X-WALK**		
From		**To**	***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***TOTAL***
SURVEY DATA											
04:00 PM	---	04:15 PM	0	0	0	0	0	0	0	0	*0*
04:15 PM	---	04:30 PM	0	0	0	0	0	0	0	0	*0*
04:30 PM	---	04:45 PM	0	1	0	0	0	0	0	0	*1*
04:45 PM	---	05:00 PM	1	1	0	0	0	0	0	0	*2*
05:00 PM	---	05:15 PM	1	3	0	0	0	0	0	0	*4*
05:15 PM	---	05:30 PM	1	4	0	0	0	0	0	0	*5*
05:30 PM	---	05:45 PM	3	5	0	0	0	0	0	0	*8*
05:45 PM	---	06:00 PM	3	6	0	0	0	0	0	0	*9*
TOTAL BY PERIOD											
04:00 PM	---	04:15 PM	0	0	0	0	0	0	0	0	*0*
04:15 PM	---	04:30 PM	0	0	0	0	0	0	0	0	*0*
04:30 PM	---	04:45 PM	0	1	0	0	0	0	0	0	*1*
04:45 PM	---	05:00 PM	1	0	0	0	0	0	0	0	*1*
05:00 PM	---	05:15 PM	0	2	0	0	0	0	0	0	*2*
05:15 PM	---	05:30 PM	0	1	0	0	0	0	0	0	*1*
05:30 PM	---	05:45 PM	2	1	0	0	0	0	0	0	*3*
05:45 PM	---	06:00 PM	0	1	0	0	0	0	0	0	*1*
HOURLY TOTALS											
04:00 PM	---	05:00 PM	1	1	0	0	0	0	0	0	*2*
04:15 PM	---	05:15 PM	1	3	0	0	0	0	0	0	*4*
04:30 PM	---	05:30 PM	1	4	0	0	0	0	0	0	*5*
04:45 PM	---	05:45 PM	3	4	0	0	0	0	0	0	*7*
05:00 PM	---	06:00 PM	2	5	0	0	0	0	0	0	*7*

Tel : (510) 232-1271 ***Fax: (510) 232-1272***

5:00 PM to 6:00 PM					
VOLUME BY DIRECTION	NB	SB	EB	WB	TOTAL
PEDESTRIAN	0	0	2	5	7
VOLUME BY LEG	N-LEG	S-LEG	E-LEG	W-LEG	TOTAL
PEDESTRIAN	7	0	0	0	7

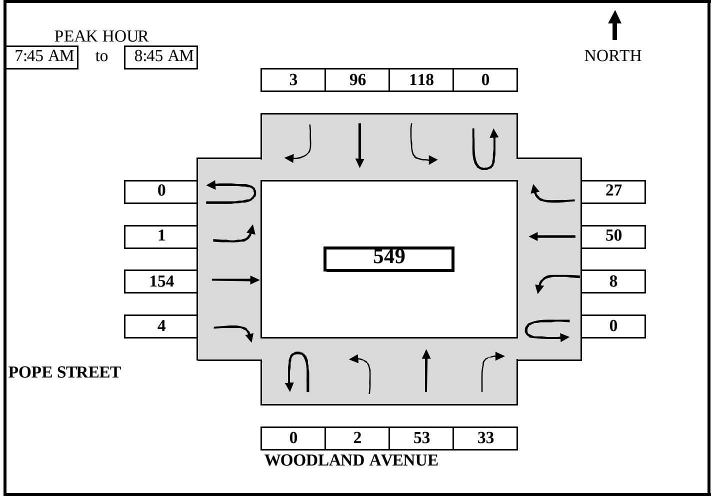
B.A.Y.M.E.T.R.I.C.S.

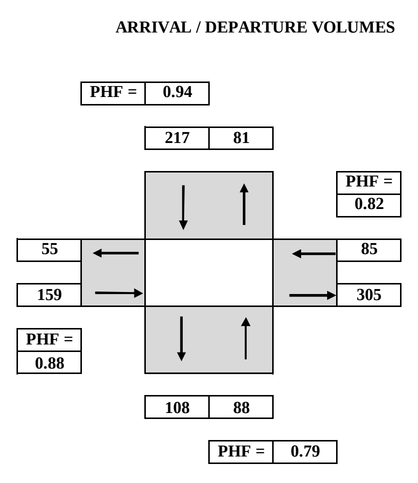
INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT: TRAFFIC COUNTS IN PALO ALTO **SURVEY DATE:** 5/22/2018 **DAY:** TUESDAY

N-S APPROACH: WOODLAND AVENUE **SURVEY TIME:** 7:00 AM **TO** 9:00 AM

E-W APPROACH: POPE STREET **JURISDICTION:** PALO ALTO **FILE:** 3805030-6AM





SURVEY DATA

TIME		PERIOD	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
From		To	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	
7:00 AM	to	7:15 AM		0	2	3		13	13	1		0	7	0		3	3	3	48
7:15 AM	to	7:30 AM		0	2	4		42	48	1		0	20	0		4	7	11	139
7:30 AM	to	7:45 AM		0	5	13		74	98	2		0	36	0		5	9	16	258
7:45 AM	to	8:00 AM		0	12	22		104	124	4		0	68	0		8	22	26	390
8:00 AM	to	8:15 AM		0	26	26		137	141	5		1	107	1		10	41	29	524
8:15 AM	to	8:30 AM		2	42	36		170	165	5		1	145	4		11	52	39	672
8:30 AM	to	8:45 AM		2	58	46		192	194	5		1	190	4		13	59	43	807
8:45 AM	to	9:00 AM		2	70	60		213	206	5		1	238	5		14	74	47	935

TOTAL BY PERIOD

From		To	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	TOTAL
7:00 AM	to	7:15 AM	0	0	2	3	0	13	13	1	0	0	7	0	0	3	3	3	48
7:15 AM	to	7:30 AM	0	0	0	1	0	29	35	0	0	0	13	0	0	1	4	8	91
7:30 AM	to	7:45 AM	0	0	3	9	0	32	50	1	0	0	16	0	0	1	2	5	119
7:45 AM	to	8:00 AM	0	0	7	9	0	30	26	2	0	0	32	0	0	3	13	10	132
8:00 AM	to	8:15 AM	0	0	14	4	0	33	17	1	0	1	39	1	0	2	19	3	134
8:15 AM	to	8:30 AM	0	2	16	10	0	33	24	0	0	0	38	3	0	1	11	10	148
8:30 AM	to	8:45 AM	0	0	16	10	0	22	29	0	0	0	45	0	0	2	7	4	135
8:45 AM	to	9:00 AM	0	0	12	14	0	21	12	0	0	0	48	1	0	1	15	4	128

HOURLY TOTALS

From		To	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	TOTAL
7:00 AM	to	8:00 AM	0	0	12	22	0	104	124	4	0	0	68	0	0	8	22	26	390
7:15 AM	to	8:15 AM	0	0	24	23	0	124	128	4	0	1	100	1	0	7	38	26	476
7:30 AM	to	8:30 AM	0	2	40	32	0	128	117	4	0	1	125	4	0	7	45	28	533
7:45 AM	to	8:45 AM	0	2	53	33	0	118	96	3	0	1	154	4	0	8	50	27	549
8:00 AM	to	9:00 AM	0	2	58	38	0	109	82	1	0	1	170	5	0	6	52	21	545

PEAK HOUR SUMMARY

7:45 AM to 8:45 AM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	
VOLUME	0	2	53	33	0	118	96	3	0	1	154	4	0	8	50	27	549
PHF BY MOVEMENT	0.00	0.25	0.83	0.83	0.00	0.89	0.83	0.38	0.00	0.25	0.86	0.33	0.00	0.67	0.66	0.68	OVERALL
PHF BY APPROACH	0.79				0.94				0.88				0.82				0.93
BICYCLE	8				28				13				11				60
PEDESTRIAN	1				2				6				2				11
	N-LEG				S-LEG				E-LEG				W-LEG				
PEDESTRIAN BY LEG:	3				5				0				3				11

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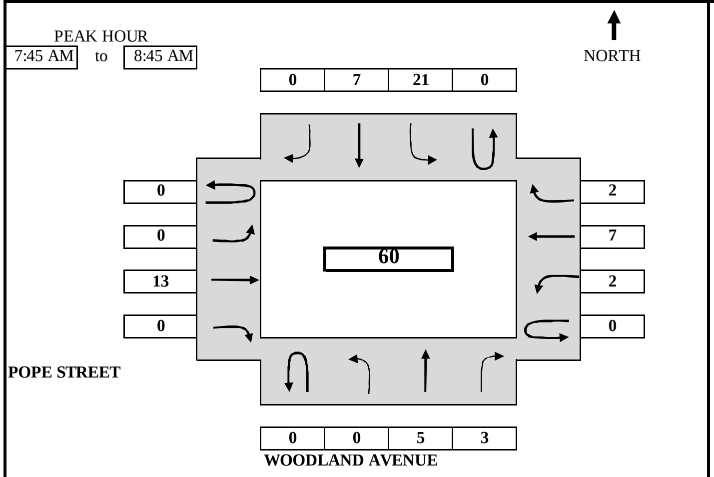
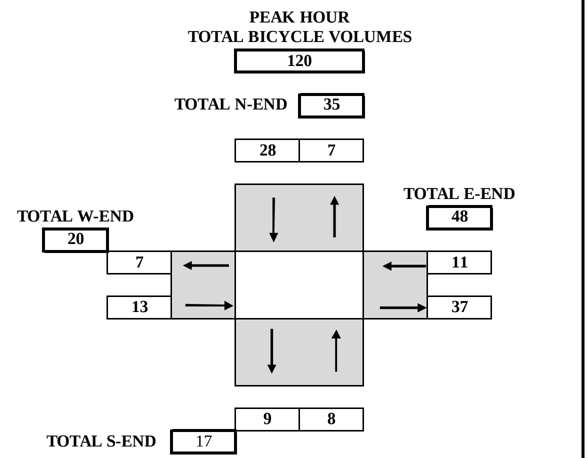
B.A.Y.M.E.T.R.I.C.S.

BICYCLE TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**WOODLAND AVENUE**	**SURVEY TIME:**	**7:00 AM**	**TO**	**9:00 AM**
E-W APPROACH:	**POPE STREET**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-6AM**





TIME From		PERIOD To	NORTHBOUND U-TURN	NORTHBOUND LEFT	NORTHBOUND THRU	NORTHBOUND RIGHT	SOUTHBOUND U-TURN	SOUTHBOUND LEFT	SOUTHBOUND THRU	SOUTHBOUND RIGHT	EASTBOUND U-TURN	EASTBOUND LEFT	EASTBOUND THRU	EASTBOUND RIGHT	WESTBOUND U-TURN	WESTBOUND LEFT	WESTBOUND THRU	WESTBOUND RIGHT	TOTAL
SURVEY DATA																			
7:00 AM	to	7:15 AM	0	0	0	1	0	3	0	0	0	0	5	0	0	0	0	0	**9**
7:15 AM	to	7:30 AM	0	0	0	2	0	6	0	0	0	0	10	0	0	0	1	0	**19**
7:30 AM	to	7:45 AM	0	0	0	3	0	8	2	0	0	0	12	1	0	3	3	1	**33**
7:45 AM	to	8:00 AM	0	0	1	3	0	11	6	0	0	0	14	1	0	4	3	1	**44**
8:00 AM	to	8:15 AM	0	0	3	4	0	18	6	0	0	0	18	1	0	4	6	2	**62**
8:15 AM	to	8:30 AM	0	0	4	4	0	20	8	0	0	0	20	1	0	4	9	2	**72**
8:30 AM	to	8:45 AM	0	0	5	6	0	29	9	0	0	0	25	1	0	5	10	3	**93**
8:45 AM	to	9:00 AM	0	0	6	8	0	38	9	0	0	0	27	1	0	7	14	5	**115**
TOTAL BY PERIOD																			
7:00 AM	to	7:15 AM	0	0	0	1	0	3	0	0	0	0	5	0	0	0	0	0	**9**
7:15 AM	to	7:30 AM	0	0	0	1	0	3	0	0	0	0	5	0	0	0	1	0	**10**
7:30 AM	to	7:45 AM	0	0	0	1	0	2	2	0	0	0	2	1	0	3	2	1	**14**
7:45 AM	to	8:00 AM	0	0	1	0	0	3	4	0	0	0	2	0	0	1	0	0	**11**
8:00 AM	to	8:15 AM	0	0	2	1	0	7	0	0	0	0	4	0	0	0	3	1	**18**
8:15 AM	to	8:30 AM	0	0	1	0	0	2	2	0	0	0	2	0	0	0	3	0	**10**
8:30 AM	to	8:45 AM	0	0	1	2	0	9	1	0	0	0	5	0	0	1	1	1	**21**
8:45 AM	to	9:00 AM	0	0	1	2	0	9	0	0	0	0	2	0	0	2	4	2	**22**
HOURLY TOTALS																			
7:00 AM	to	8:00 AM	0	0	1	3	0	11	6	0	0	0	14	1	0	4	3	1	**44**
7:15 AM	to	8:15 AM	0	0	3	3	0	15	6	0	0	0	13	1	0	4	6	2	**53**
7:30 AM	to	8:30 AM	0	0	4	2	0	14	8	0	0	0	10	1	0	4	8	2	**53**
7:45 AM	to	8:45 AM	0	0	5	3	0	21	7	0	0	0	13	0	0	2	7	2	**60**
8:00 AM	to	9:00 AM	0	0	5	5	0	27	3	0	0	0	13	0	0	3	11	4	**71**

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7:45 AM to 8:45 AM					
APPROACH VOLUME	NB	SB	EB	WB	TOTAL
BICYCLE	8	28	13	11	**60**

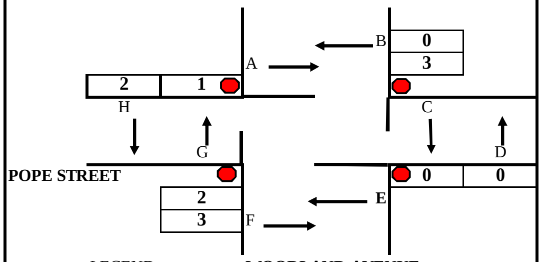
B.A.Y.M.E.T.R.I.C.S.

PEDESTRIAN MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**
N-S APPROACH:	**WOODLAND AVENUE**	**DAY:**	**TUESDAY**
E-W APPROACH:	**POPE STREET**	**JURISDICTION:**	**PALO ALTO**
SURVEY PERIOD	**7:00 AM TO 9:00 AM**	**FILE:**	**3805030-6AM**

PEAK HOUR

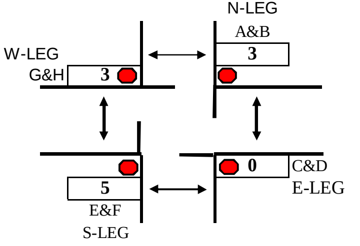
07:45 AM TO 08:45 AM



PEAK HOUR

TOTAL PEDESTRIAN VOLUMES

11



LEGEND:

▥ CROSSWALK

■ SIDEWALK

— STOP CONTROL LINE

● STOP

BY LEG:

N-LEG	**3**
S-LEG	**5**
E-LEG	**0**
W-LEG	**3**

BY DIRECTION:

NB(D+G)	**1**
SB(C+H)	**2**
EB(A+F)	**6**
WB(B+E)	**2**

TIME PERIOD			**NORTH X-WALK**		**EAST X-WALK**		**SOUTH X-WALK**		**WEST X-WALK**		
From		**To**	***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***TOTAL***
SURVEY DATA											
07:00 AM	---	07:15 AM	0	1	0	0	0	2	0	3	*6*
07:15 AM	---	07:30 AM	1	3	0	0	0	2	1	4	*11*
07:30 AM	---	07:45 AM	2	4	0	0	0	4	2	4	*16*
07:45 AM	---	08:00 AM	2	4	0	0	0	4	2	4	*16*
08:00 AM	---	08:15 AM	4	4	0	0	0	5	2	4	*19*
08:15 AM	---	08:30 AM	4	4	0	0	1	6	3	6	*24*
08:30 AM	---	08:45 AM	5	4	0	0	2	7	3	6	*27*
08:45 AM	---	09:00 AM	7	5	0	0	4	7	4	7	*34*
TOTAL BY PERIOD											
07:00 AM	---	07:15 AM	0	1	0	0	0	2	0	3	*6*
07:15 AM	---	07:30 AM	1	2	0	0	0	0	1	1	*5*
07:30 AM	---	07:45 AM	1	1	0	0	0	2	1	0	*5*
07:45 AM	---	08:00 AM	0	0	0	0	0	0	0	0	*0*
08:00 AM	---	08:15 AM	2	0	0	0	0	1	0	0	*3*
08:15 AM	---	08:30 AM	0	0	0	0	1	1	1	2	*5*
08:30 AM	---	08:45 AM	1	0	0	0	1	1	0	0	*3*
08:45 AM	---	09:00 AM	2	1	0	0	2	0	1	1	*7*
HOURLY TOTALS											
07:00 AM	---	08:00 AM	2	4	0	0	0	4	2	4	*16*
07:15 AM	---	08:15 AM	4	3	0	0	0	3	2	1	*13*
07:30 AM	---	08:30 AM	3	1	0	0	1	4	2	2	*13*
07:45 AM	---	08:45 AM	3	0	0	0	2	3	1	2	*11*
08:00 AM	---	09:00 AM	5	1	0	0	4	3	2	3	*18*

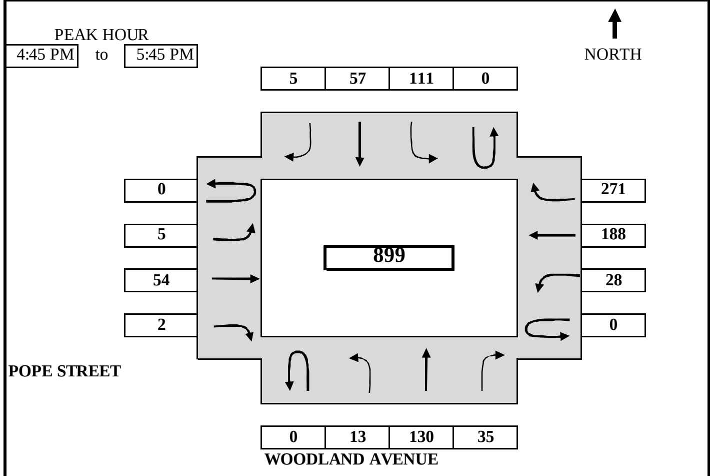
Tel : (510) 232-1271 ***Fax: (510) 232-1272***

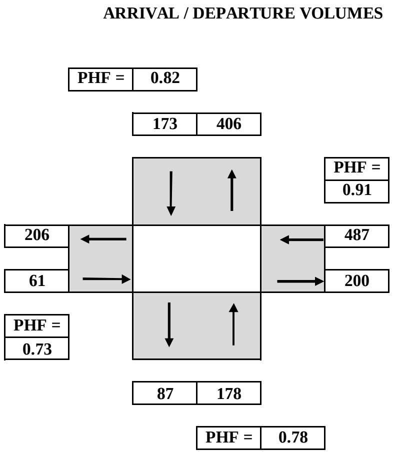
7:45 AM to 8:45 AM					
VOLUME BY DIRECTION	NB	SB	EB	WB	TOTAL
PEDESTRIAN	1	2	6	2	11
VOLUME BY LEG	N-LEG	S-LEG	E-LEG	W-LEG	TOTAL
PEDESTRIAN	3	5	0	3	11

B . A . Y . M . E . T . R . I . C . S .

INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**WOODLAND AVENUE**	**SURVEY TIME:**	**4:00 PM**	**TO**	**6:00 PM**
E-W APPROACH:	**POPE STREET**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-6PM**





TIME From		PERIOD To	NB U-TURN	NB LEFT	NB THRU	NB RIGHT	SB U-TURN	SB LEFT	SB THRU	SB RIGHT	EB U-TURN	EB LEFT	EB THRU	EB RIGHT	WB U-TURN	WB LEFT	WB THRU	WB RIGHT	TOTAL
SURVEY DATA																			
4:00 PM	to	4:15 PM		5	42	12		25	7	1		0	27	3		3	25	44	**194**
4:15 PM	to	4:30 PM		10	80	17		59	22	1		0	50	3		8	56	91	**397**
4:30 PM	to	4:45 PM		13	121	35		80	36	2		0	68	3		14	72	139	**583**
4:45 PM	to	5:00 PM		14	149	51		104	60	4		0	81	3		18	110	197	**791**
5:00 PM	to	5:15 PM		24	186	61		123	68	4		2	99	4		26	159	274	**1030**
5:15 PM	to	5:30 PM		24	221	65		152	80	6		3	103	5		34	205	342	**1240**
5:30 PM	to	5:45 PM		26	251	70		191	93	7		5	122	5		42	260	410	**1482**
5:45 PM	to	6:00 PM		28	278	78		217	105	7		6	141	6		50	297	457	**1670**
TOTAL BY PERIOD																			
4:00 PM	to	4:15 PM	0	5	42	12	0	25	7	1	0	0	27	3	0	3	25	44	**194**
4:15 PM	to	4:30 PM	0	5	38	5	0	34	15	0	0	0	23	0	0	5	31	47	**203**
4:30 PM	to	4:45 PM	0	3	41	18	0	21	14	1	0	0	18	0	0	6	16	48	**186**
4:45 PM	to	5:00 PM	0	1	28	16	0	24	24	2	0	0	13	0	0	4	38	58	**208**
5:00 PM	to	5:15 PM	0	10	37	10	0	19	8	0	0	2	18	1	0	8	49	77	**239**
5:15 PM	to	5:30 PM	0	0	35	4	0	29	12	2	0	1	4	1	0	8	46	68	**210**
5:30 PM	to	5:45 PM	0	2	30	5	0	39	13	1	0	2	19	0	0	8	55	68	**242**
5:45 PM	to	6:00 PM	0	2	27	8	0	26	12	0	0	1	19	1	0	8	37	47	**188**
HOURLY TOTALS																			
4:00 PM	to	5:00 PM	0	14	149	51	0	104	60	4	0	0	81	3	0	18	110	197	**791**
4:15 PM	to	5:15 PM	0	19	144	49	0	98	61	3	0	2	72	1	0	23	134	230	**836**
4:30 PM	to	5:30 PM	0	14	141	48	0	93	58	5	0	3	53	2	0	26	149	251	**843**
4:45 PM	to	5:45 PM	0	13	130	35	0	111	57	5	0	5	54	2	0	28	188	271	**899**
5:00 PM	to	6:00 PM	0	14	129	27	0	113	45	3	0	6	60	3	0	32	187	260	**879**

PEAK HOUR SUMMARY

4:45 PM to 5:45 PM	**NORTHBOUND**				**SOUTHBOUND**				**EASTBOUND**				**WESTBOUND**				TOTAL
	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	
VOLUME	0	13	130	35	0	111	57	5	0	5	54	2	0	28	188	271	**899**
PHF BY MOVEMENT	0.00	0.33	0.88	0.55	0.00	0.71	0.59	0.63	0.00	0.63	0.71	0.50	0.00	0.88	0.85	0.88	OVERALL
PHF BY APPROACH	0.78				0.82				0.73				0.91				0.93
BICYCLE	5				7				6				16				**34**
PEDESTRIAN	6				3				17				8				**34**
	N-LEG				**S-LEG**				**E-LEG**				**W-LEG**				
PEDESTRIAN BY LEG:	11				14				1				8				**34**

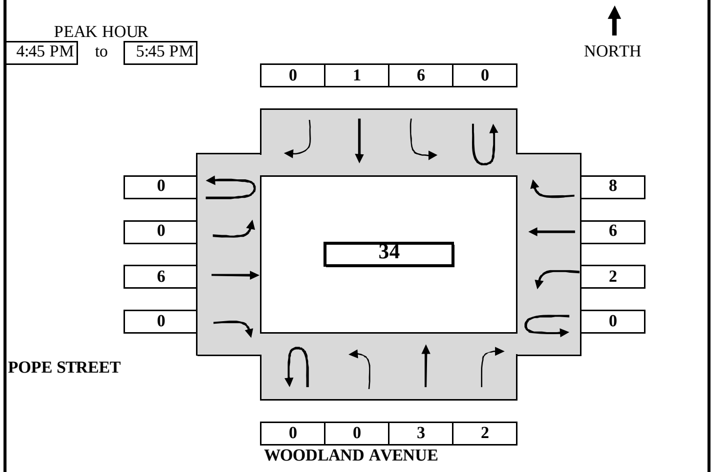
TEL: (510) 232 - 1271 FAX: (510) 232 - 1272

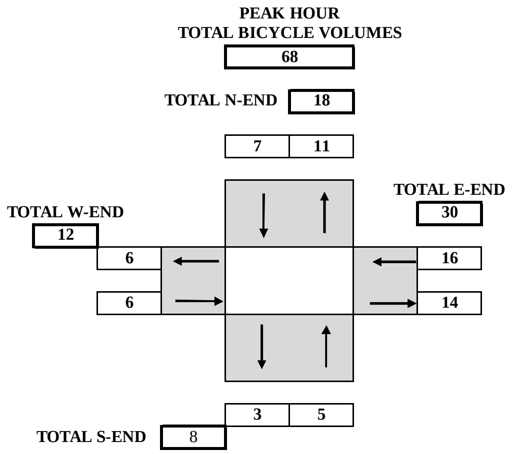
B.A.Y.M.E.T.R.I.C.S.

BICYCLE TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**WOODLAND AVENUE**	**SURVEY TIME:**	**4:00 PM**	**TO**	**6:00 PM**
E-W APPROACH:	**POPE STREET**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-6PM**

PEAK HOUR
4:45 PM to 5:45 PM





TIME		PERIOD	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
From		To	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	
SURVEY DATA																			
4:00 PM	to	4:15 PM	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	1	**4**
4:15 PM	to	4:30 PM	0	0	3	0	0	1	1	0	0	0	5	0	0	0	3	3	**16**
4:30 PM	to	4:45 PM	0	0	4	0	0	3	1	0	0	0	6	0	0	0	5	4	**23**
4:45 PM	to	5:00 PM	0	0	4	1	0	7	2	0	0	0	7	0	0	1	6	5	**33**
5:00 PM	to	5:15 PM	0	0	4	1	0	7	2	0	0	0	8	0	0	2	8	7	**39**
5:15 PM	to	5:30 PM	0	0	7	2	0	8	2	0	0	0	9	0	0	2	9	10	**49**
5:30 PM	to	5:45 PM	0	0	7	2	0	9	2	0	0	0	12	0	0	2	11	12	**57**
5:45 PM	to	6:00 PM	0	0	7	2	0	10	2	0	0	0	13	1	0	4	12	17	**68**
TOTAL BY PERIOD																			
4:00 PM	to	4:15 PM	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	1	**4**
4:15 PM	to	4:30 PM	0	0	0	0	0	1	1	0	0	0	5	0	0	0	3	2	**12**
4:30 PM	to	4:45 PM	0	0	1	0	0	2	0	0	0	0	1	0	0	0	2	1	**7**
4:45 PM	to	5:00 PM	0	0	0	1	0	4	1	0	0	0	1	0	0	1	1	1	**10**
5:00 PM	to	5:15 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	1	2	2	**6**
5:15 PM	to	5:30 PM	0	0	3	1	0	1	0	0	0	0	1	0	0	0	1	3	**10**
5:30 PM	to	5:45 PM	0	0	0	0	0	1	0	0	0	0	3	0	0	0	2	2	**8**
5:45 PM	to	6:00 PM	0	0	0	0	0	1	0	0	0	0	1	1	0	2	1	5	**11**
HOURLY TOTALS																			
4:00 PM	to	5:00 PM	0	0	4	1	0	7	2	0	0	0	7	0	0	1	6	5	**33**
4:15 PM	to	5:15 PM	0	0	1	1	0	7	2	0	0	0	8	0	0	2	8	6	**35**
4:30 PM	to	5:30 PM	0	0	4	2	0	7	1	0	0	0	4	0	0	2	6	7	**33**
4:45 PM	to	5:45 PM	0	0	3	2	0	6	1	0	0	0	6	0	0	2	6	8	**34**
5:00 PM	to	6:00 PM	0	0	3	1	0	3	0	0	0	0	6	1	0	3	6	12	**35**

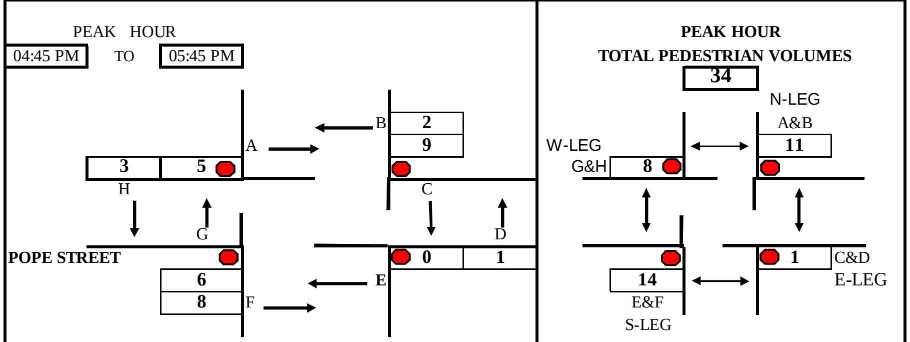
TEL: (510) 232 - 1271 FAX: (510) 232 - 1272

4:45 PM to 5:45 PM					
APPROACH VOLUME	NB	SB	EB	WB	TOTAL
BICYCLE	5	7	6	16	**34**

B.A.Y.M.E.T.R.I.C.S.

PEDESTRIAN MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**
N-S APPROACH:	**WOODLAND AVENUE**	**DAY:**	**TUESDAY**
E-W APPROACH:	**POPE STREET**	**JURISDICTION:**	**PALO ALTO**
SURVEY PERIOD	**4:00 PM TO 6:00 PM**	**FILE:**	**3805030-6PM**



LEGEND:
- ▥ CROSSWALK
- ▬ SIDEWALK
- — STOP CONTROL LINE
- ● STOP

BY LEG:	
N-LEG	**11**
S-LEG	**14**
E-LEG	**1**
W-LEG	**8**

BY DIRECTION:	
NB(D+G)	**6**
SB(C+H)	**3**
EB(A+F)	**17**
WB(B+E)	**8**

TIME PERIOD			**NORTH X-WALK**		**EAST X-WALK**		**SOUTH X-WALK**		**WEST X-WALK**		
From		**To**	***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***TOTAL***
					SURVEY DATA						
04:00 PM	---	04:15 PM	2	0	0	0	1	0	1	0	***4***
04:15 PM	---	04:30 PM	4	1	2	0	2	3	4	5	***21***
04:30 PM	---	04:45 PM	5	1	2	0	3	3	4	6	***24***
04:45 PM	---	05:00 PM	6	1	2	0	7	6	5	7	***34***
05:00 PM	---	05:15 PM	7	2	2	0	7	8	7	7	***40***
05:15 PM	---	05:30 PM	9	2	2	1	7	11	7	8	***47***
05:30 PM	---	05:45 PM	14	3	2	1	9	11	9	9	***58***
05:45 PM	---	06:00 PM	14	3	2	1	13	11	11	9	***64***
					TOTAL BY PERIOD						
04:00 PM	---	04:15 PM	2	0	0	0	1	0	1	0	***4***
04:15 PM	---	04:30 PM	2	1	2	0	1	3	3	5	***17***
04:30 PM	---	04:45 PM	1	0	0	0	1	0	0	1	***3***
04:45 PM	---	05:00 PM	1	0	0	0	4	3	1	1	***10***
05:00 PM	---	05:15 PM	1	1	0	0	0	2	2	0	***6***
05:15 PM	---	05:30 PM	2	0	0	1	0	3	0	1	***7***
05:30 PM	---	05:45 PM	5	1	0	0	2	0	2	1	***11***
05:45 PM	---	06:00 PM	0	0	0	0	4	0	2	0	***6***
					HOURLY TOTALS						
04:00 PM	---	05:00 PM	6	1	2	0	7	6	5	7	***34***
04:15 PM	---	05:15 PM	5	2	2	0	6	8	6	7	***36***
04:30 PM	---	05:30 PM	5	1	0	1	5	8	3	3	***26***
04:45 PM	---	05:45 PM	9	2	0	1	6	8	5	3	***34***
05:00 PM	---	06:00 PM	8	2	0	1	6	5	6	2	***30***

Tel : (510) 232-1271 ***Fax: (510) 232-1272***

4:45 PM	to	5:45 PM			
VOLUME BY DIRECTION	NB	SB	EB	WB	TOTAL
PEDESTRIAN	6	3	17	8	34
VOLUME BY LEG	N-LEG	S-LEG	E-LEG	W-LEG	TOTAL
PEDESTRIAN	11	14	1	8	34

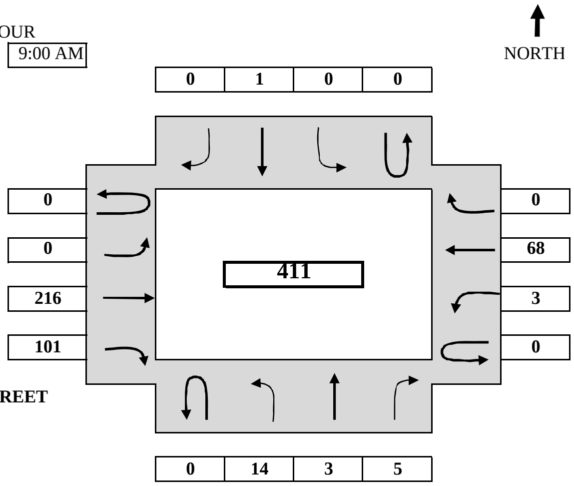
B.A.Y.M.E.T.R.I.C.S.

INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**PALO ALTO AVENUE**	**SURVEY TIME:**	**7:00 AM**	**TO**	**9:00 AM**
E-W APPROACH:	**CHAUCER STREET**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-7AM**

PEAK HOUR

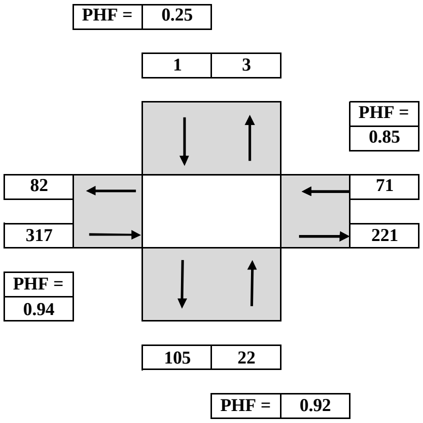
8:00 AM to 9:00 AM



CHAUCER STREET

PALO ALTO AVENUE

ARRIVAL / DEPARTURE VOLUMES



TIME	**PERIOD**		**NORTHBOUND**				**SOUTHBOUND**				**EASTBOUND**				**WESTBOUND**				TOTAL
From		To	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	
SURVEY DATA																			
7:00 AM	to	7:15 AM		2	0	1		0	1	0		0	13	9		1	7	0	**34**
7:15 AM	to	7:30 AM		3	1	2		0	3	1		0	32	36		2	18	0	**98**
7:30 AM	to	7:45 AM		6	4	3		0	3	2		1	59	67		3	26	0	**174**
7:45 AM	to	8:00 AM		13	5	4		2	5	2		1	100	95		3	40	1	**271**
8:00 AM	to	8:15 AM		16	5	7		2	5	2		1	154	125		3	61	1	**382**
8:15 AM	to	8:30 AM		21	5	8		2	5	2		1	203	151		5	79	1	**483**
8:30 AM	to	8:45 AM		23	6	9		2	5	2		1	261	173		6	90	1	**579**
8:45 AM	to	9:00 AM		27	8	9		2	6	2		1	316	196		6	108	1	**682**
TOTAL BY PERIOD																			
7:00 AM	to	7:15 AM	0	2	0	1	0	0	1	0	0	0	13	9	0	1	7	0	**34**
7:15 AM	to	7:30 AM	0	1	1	1	0	0	2	1	0	0	19	27	0	1	11	0	**64**
7:30 AM	to	7:45 AM	0	3	3	1	0	0	0	1	0	1	27	31	0	1	8	0	**76**
7:45 AM	to	8:00 AM	0	7	1	1	0	2	2	0	0	0	41	28	0	0	14	1	**97**
8:00 AM	to	8:15 AM	0	3	0	3	0	0	0	0	0	0	54	30	0	0	21	0	**111**
8:15 AM	to	8:30 AM	0	5	0	1	0	0	0	0	0	0	49	26	0	2	18	0	**101**
8:30 AM	to	8:45 AM	0	2	1	1	0	0	0	0	0	0	58	22	0	1	11	0	**96**
8:45 AM	to	9:00 AM	0	4	2	0	0	0	1	0	0	0	55	23	0	0	18	0	**103**
HOURLY TOTALS																			
7:00 AM	to	8:00 AM	0	13	5	4	0	2	5	2	0	1	100	95	0	3	40	1	**271**
7:15 AM	to	8:15 AM	0	14	5	6	0	2	4	2	0	1	141	116	0	2	54	1	**348**
7:30 AM	to	8:30 AM	0	18	4	6	0	2	2	1	0	1	171	115	0	3	61	1	**385**
7:45 AM	to	8:45 AM	0	17	2	6	0	2	2	0	0	0	202	106	0	3	64	1	**405**
8:00 AM	to	9:00 AM	0	14	3	5	0	0	1	0	0	0	216	101	0	3	68	0	**411**

PEAK HOUR SUMMARY

8:00 AM to 9:00 AM	**NORTHBOUND**				**SOUTHBOUND**				**EASTBOUND**				**WESTBOUND**				TOTAL
	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	
VOLUME	0	14	3	5	0	0	1	0	0	0	216	101	0	3	68	0	**411**
PHF BY MOVEMENT	0.00	0.70	0.38	0.42	0.00	0.00	0.25	0.00	0.00	0.00	0.93	0.84	0.00	0.38	0.81	0.00	OVERALL
PHF BY APPROACH	0.92				0.25				0.94				0.85				0.93
BICYCLE	6				2				44				15				**67**
PEDESTRIAN	3				2				7				3				**15**
	N-LEG				**S-LEG**				**E-LEG**				**W-LEG**				
PEDESTRIAN BY LEG:	8				2				3				2				**15**

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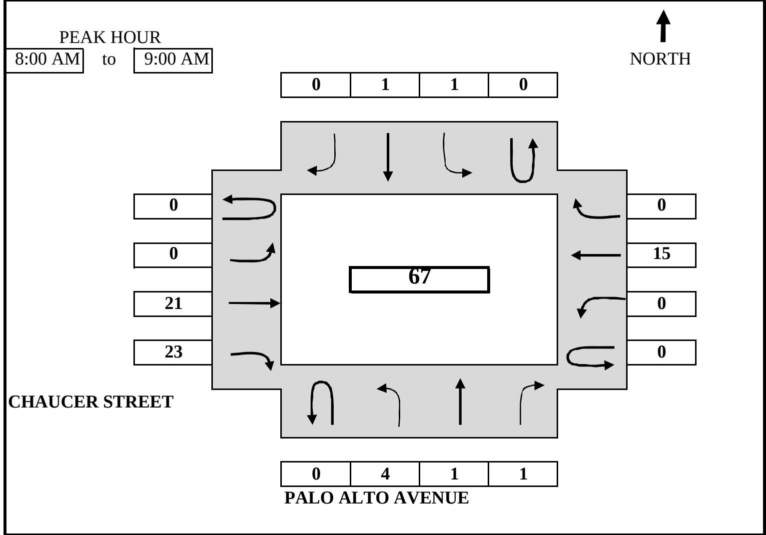
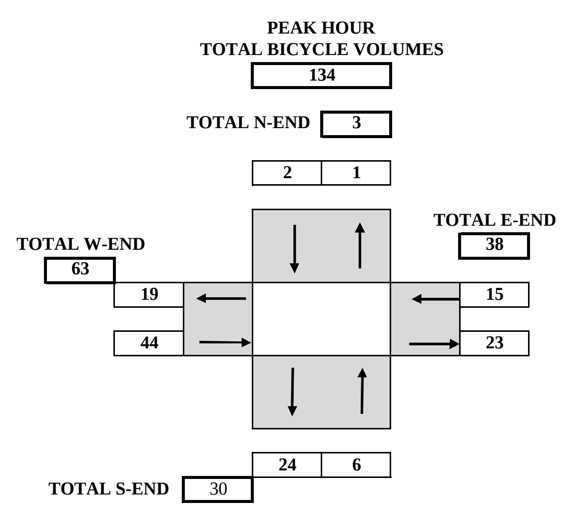
B.A.Y.M.E.T.R.I.C.S.

BICYCLE TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**PALO ALTO AVENUE**	**SURVEY TIME:**	**7:00 AM**	**TO**	**9:00 AM**
E-W APPROACH:	**CHAUCER STREET**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-7AM**





TIME		**PERIOD**	**NORTHBOUND**				**SOUTHBOUND**				**EASTBOUND**				**WESTBOUND**				TOTAL
From		To	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	
SURVEY DATA																			
7:00 AM	to	7:15 AM	0	0	0	0	0	0	0	0	0	0	4	3	0	0	0	0	**7**
7:15 AM	to	7:30 AM	0	0	0	0	0	0	0	0	0	0	8	9	0	0	1	0	**18**
7:30 AM	to	7:45 AM	0	1	0	0	0	0	0	0	0	0	11	12	0	0	5	0	**29**
7:45 AM	to	8:00 AM	0	1	0	0	0	0	0	0	0	0	13	15	0	0	6	0	**35**
8:00 AM	to	8:15 AM	0	1	0	0	0	1	0	0	0	0	16	25	0	0	10	0	**53**
8:15 AM	to	8:30 AM	0	2	0	0	0	1	0	0	0	0	21	29	0	0	14	0	**67**
8:30 AM	to	8:45 AM	0	2	0	0	0	1	0	0	0	0	28	35	0	0	17	0	**83**
8:45 AM	to	9:00 AM	0	5	1	1	0	1	1	0	0	0	34	38	0	0	21	0	**102**
TOTAL BY PERIOD																			
7:00 AM	to	7:15 AM	0	0	0	0	0	0	0	0	0	0	4	3	0	0	0	0	**7**
7:15 AM	to	7:30 AM	0	0	0	0	0	0	0	0	0	0	4	6	0	0	1	0	**11**
7:30 AM	to	7:45 AM	0	1	0	0	0	0	0	0	0	0	3	3	0	0	4	0	**11**
7:45 AM	to	8:00 AM	0	0	0	0	0	0	0	0	0	0	2	3	0	0	1	0	**6**
8:00 AM	to	8:15 AM	0	0	0	0	0	1	0	0	0	0	3	10	0	0	4	0	**18**
8:15 AM	to	8:30 AM	0	1	0	0	0	0	0	0	0	0	5	4	0	0	4	0	**14**
8:30 AM	to	8:45 AM	0	0	0	0	0	0	0	0	0	0	7	6	0	0	3	0	**16**
8:45 AM	to	9:00 AM	0	3	1	1	0	0	1	0	0	0	6	3	0	0	4	0	**19**
HOURLY TOTALS																			
7:00 AM	to	8:00 AM	0	1	0	0	0	0	0	0	0	0	13	15	0	0	6	0	**35**
7:15 AM	to	8:15 AM	0	1	0	0	0	1	0	0	0	0	12	22	0	0	10	0	**46**
7:30 AM	to	8:30 AM	0	2	0	0	0	1	0	0	0	0	13	20	0	0	13	0	**49**
7:45 AM	to	8:45 AM	0	1	0	0	0	1	0	0	0	0	17	23	0	0	12	0	**54**
8:00 AM	to	9:00 AM	0	4	1	1	0	1	1	0	0	0	21	23	0	0	15	0	**67**

TEL: (510) 232 - 1271 FAX: (510) 232 - 1272

8:00 AM to 9:00 AM					
APPROACH VOLUME	NB	SB	EB	WB	TOTAL
BICYCLE	6	2	44	15	**67**

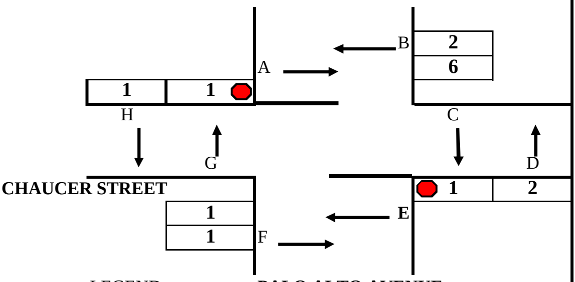
B.A.Y.M.E.T.R.I.C.S.

PEDESTRIAN MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**
N-S APPROACH:	**PALO ALTO AVENUE**	**DAY:**	**TUESDAY**
E-W APPROACH:	**CHAUCER STREET**	**JURISDICTION:**	**PALO ALTO**
SURVEY PERIOD	**7:00 AM TO 9:00 AM**	**FILE:**	**3805030-7AM**

PEAK HOUR

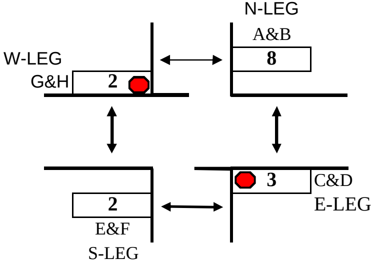
08:00 AM TO 09:00 AM



PEAK HOUR

TOTAL PEDESTRIAN VOLUMES

15



LEGEND: **PALO ALTO AVENUE**

- ▥ CROSSWALK
- ▬ SIDEWALK
- — STOP CONTROL LINE
- ● STOP

BY LEG:	
N-LEG	**8**
S-LEG	**2**
E-LEG	**3**
W-LEG	**2**

BY DIRECTION:	
NB(D+G)	**3**
SB(C+H)	**2**
EB(A+F)	**7**
WB(B+E)	**3**

TIME PERIOD			**NORTH X-WALK**		**EAST X-WALK**		**SOUTH X-WALK**		**WEST X-WALK**		
From		**To**	***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***TOTAL***
SURVEY DATA											
07:00 AM	---	07:15 AM	1	2	0	0	0	0	0	1	***4***
07:15 AM	---	07:30 AM	2	5	0	0	0	0	1	1	***9***
07:30 AM	---	07:45 AM	4	7	1	0	1	1	2	1	***17***
07:45 AM	---	08:00 AM	5	8	1	1	1	1	2	1	***20***
08:00 AM	---	08:15 AM	6	8	1	1	1	2	2	2	***23***
08:15 AM	---	08:30 AM	6	8	1	1	2	2	2	2	***24***
08:30 AM	---	08:45 AM	8	8	2	2	2	2	2	2	***28***
08:45 AM	---	09:00 AM	11	10	2	3	2	2	3	2	***35***
TOTAL BY PERIOD											
07:00 AM	---	07:15 AM	1	2	0	0	0	0	0	1	***4***
07:15 AM	---	07:30 AM	1	3	0	0	0	0	1	0	***5***
07:30 AM	---	07:45 AM	2	2	1	0	1	1	1	0	***8***
07:45 AM	---	08:00 AM	1	1	0	1	0	0	0	0	***3***
08:00 AM	---	08:15 AM	1	0	0	0	0	1	0	1	***3***
08:15 AM	---	08:30 AM	0	0	0	0	1	0	0	0	***1***
08:30 AM	---	08:45 AM	2	0	1	1	0	0	0	0	***4***
08:45 AM	---	09:00 AM	3	2	0	1	0	0	1	0	***7***
HOURLY TOTALS											
07:00 AM	---	08:00 AM	5	8	1	1	1	1	2	1	***20***
07:15 AM	---	08:15 AM	5	6	1	1	1	2	2	1	***19***
07:30 AM	---	08:30 AM	4	3	1	1	2	2	1	1	***15***
07:45 AM	---	08:45 AM	4	1	1	2	1	1	0	1	***11***
08:00 AM	---	09:00 AM	6	2	1	2	1	1	1	1	***15***

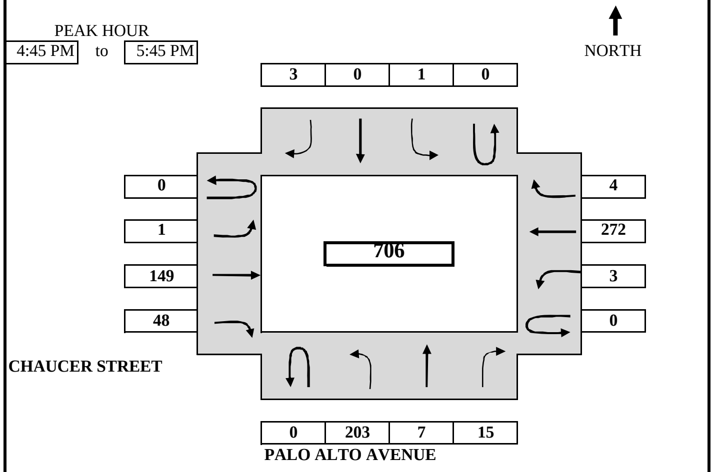
Tel : (510) 232-1271 ***Fax: (510) 232-1272***

8:00 AM to 9:00 AM					
VOLUME BY DIRECTION	NB	SB	EB	WB	TOTAL
PEDESTRIAN	3	2	7	3	**15**
VOLUME BY LEG	N-LEG	S-LEG	E-LEG	W-LEG	TOTAL
PEDESTRIAN	8	2	3	2	**15**

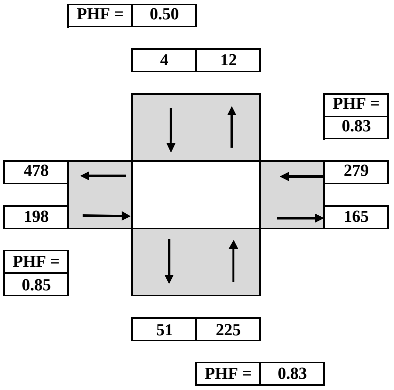
B.A.Y.M.E.T.R.I.C.S.

INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**PALO ALTO AVENUE**	**SURVEY TIME:**	**4:00 PM**	**TO**	**6:00 PM**
E-W APPROACH:	**CHAUCER STREET**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-7PM**



ARRIVAL / DEPARTURE VOLUMES



TIME		PERIOD	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
From		To	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	
SURVEY DATA																			
4:00 PM	to	4:15 PM		36	1	3		1	1	1		1	53	11	1	0	38	0	**147**
4:15 PM	to	4:30 PM		63	4	5		1	2	5		1	90	33	1	0	86	1	**292**
4:30 PM	to	4:45 PM		96	5	8		4	2	9		2	129	47	1	2	125	2	**432**
4:45 PM	to	5:00 PM		138	6	11		5	2	9		2	171	61	1	3	187	2	**598**
5:00 PM	to	5:15 PM		192	7	16		5	2	10		2	207	67	1	3	261	3	**776**
5:15 PM	to	5:30 PM		254	10	19		5	2	10		3	237	78	1	4	316	4	**943**
5:30 PM	to	5:45 PM		299	12	23		5	2	12		3	278	95	1	5	397	6	**1138**
5:45 PM	to	6:00 PM		342	13	26		6	2	14		5	315	112	1	6	448	10	**1300**
TOTAL BY PERIOD																			
4:00 PM	to	4:15 PM	0	36	1	3	0	1	1	1	0	1	53	11	1	0	38	0	**147**
4:15 PM	to	4:30 PM	0	27	3	2	0	0	1	4	0	0	37	22	0	0	48	1	**145**
4:30 PM	to	4:45 PM	0	33	1	3	0	3	0	4	0	1	39	14	0	2	39	1	**140**
4:45 PM	to	5:00 PM	0	42	1	3	0	1	0	0	0	0	42	14	0	1	62	0	**166**
5:00 PM	to	5:15 PM	0	54	1	5	0	0	0	1	0	0	36	6	0	0	74	1	**178**
5:15 PM	to	5:30 PM	0	62	3	3	0	0	0	0	0	1	30	11	0	1	55	1	**167**
5:30 PM	to	5:45 PM	0	45	2	4	0	0	0	2	0	0	41	17	0	1	81	2	**195**
5:45 PM	to	6:00 PM	0	43	1	3	0	1	0	2	0	2	37	17	0	1	51	4	**162**
HOURLY TOTALS																			
4:00 PM	to	5:00 PM	0	138	6	11	0	5	2	9	0	2	171	61	1	3	187	2	**598**
4:15 PM	to	5:15 PM	0	156	6	13	0	4	1	9	0	1	154	56	0	3	223	3	**629**
4:30 PM	to	5:30 PM	0	191	6	14	0	4	0	5	0	2	147	45	0	4	230	3	**651**
4:45 PM	to	5:45 PM	0	203	7	15	0	1	0	3	0	1	149	48	0	3	272	4	**706**
5:00 PM	to	6:00 PM	0	204	7	15	0	1	0	5	0	3	144	51	0	3	261	8	**702**

PEAK HOUR SUMMARY

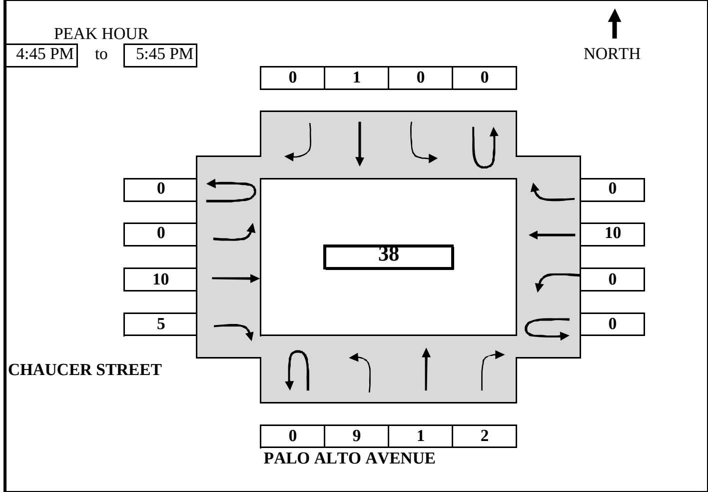
4:45 PM to 5:45 PM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	
VOLUME	0	203	7	15	0	1	0	3	0	1	149	48	0	3	272	4	**706**
PHF BY MOVEMENT	0.00	0.82	0.58	0.75	0.00	0.25	0.00	0.38	0.00	0.25	0.89	0.71	0.00	0.75	0.84	0.50	OVERALL
PHF BY APPROACH	0.83				0.50				0.85				0.83				0.91
BICYCLE	12				1				15				10				**38**
PEDESTRIAN	9				6				23				13				**51**
	N-LEG				**S-LEG**				**E-LEG**				**W-LEG**				
PEDESTRIAN BY LEG:	20				16				12				3				**51**

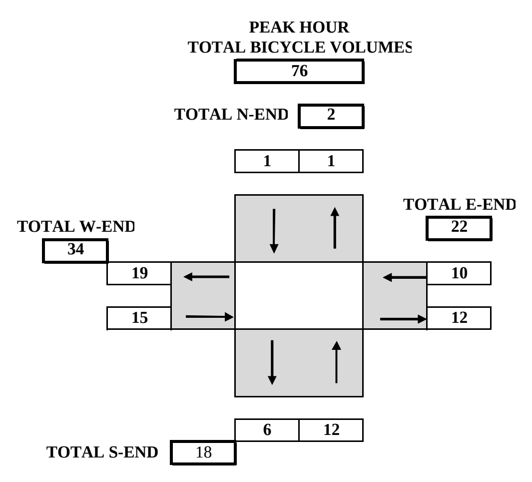
TEL: (510) 232 - 1271 FAX: (510) 232 - 1272

B.A.Y.M.E.T.R.I.C.S.

BICYCLE TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**PALO ALTO AVENUE**	**SURVEY TIME:**	**4:00 PM**	**TO**	**6:00 PM**
E-W APPROACH:	**CHAUCER STREET**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-7PM**





TIME		PERIOD	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
From		To	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	
SURVEY DATA																			
4:00 PM	to	4:15 PM	0	1	0	0	0	0	0	0	0	0	1	0	0	0	5	0	**7**
4:15 PM	to	4:30 PM	0	3	0	0	0	0	0	0	0	0	6	2	0	0	7	0	**18**
4:30 PM	to	4:45 PM	0	5	0	0	0	0	0	0	0	0	7	3	0	0	8	0	**23**
4:45 PM	to	5:00 PM	0	7	0	1	0	0	0	0	0	0	12	5	0	0	11	0	**36**
5:00 PM	to	5:15 PM	0	9	1	2	0	0	1	0	0	0	13	5	0	0	13	0	**44**
5:15 PM	to	5:30 PM	0	11	1	2	0	0	1	0	0	0	16	6	0	0	15	0	**52**
5:30 PM	to	5:45 PM	0	14	1	2	0	0	1	0	0	0	17	8	0	0	18	0	**61**
5:45 PM	to	6:00 PM	0	17	1	2	0	0	1	1	0	0	19	8	0	0	23	0	**72**
TOTAL BY PERIOD																			
4:00 PM	to	4:15 PM	0	1	0	0	0	0	0	0	0	0	1	0	0	0	5	0	**7**
4:15 PM	to	4:30 PM	0	2	0	0	0	0	0	0	0	0	5	2	0	0	2	0	**11**
4:30 PM	to	4:45 PM	0	2	0	0	0	0	0	0	0	0	1	1	0	0	1	0	**5**
4:45 PM	to	5:00 PM	0	2	0	1	0	0	0	0	0	0	5	2	0	0	3	0	**13**
5:00 PM	to	5:15 PM	0	2	1	1	0	0	1	0	0	0	1	0	0	0	2	0	**8**
5:15 PM	to	5:30 PM	0	2	0	0	0	0	0	0	0	0	3	1	0	0	2	0	**8**
5:30 PM	to	5:45 PM	0	3	0	0	0	0	0	0	0	0	1	2	0	0	3	0	**9**
5:45 PM	to	6:00 PM	0	3	0	0	0	0	0	1	0	0	2	0	0	0	5	0	**11**
HOURLY TOTALS																			
4:00 PM	to	5:00 PM	0	7	0	1	0	0	0	0	0	0	12	5	0	0	11	0	**36**
4:15 PM	to	5:15 PM	0	8	1	2	0	0	1	0	0	0	12	5	0	0	8	0	**37**
4:30 PM	to	5:30 PM	0	8	1	2	0	0	1	0	0	0	10	4	0	0	8	0	**34**
4:45 PM	to	5:45 PM	0	9	1	2	0	0	1	0	0	0	10	5	0	0	10	0	**38**
5:00 PM	to	6:00 PM	0	10	1	1	0	0	1	1	0	0	7	3	0	0	12	0	**36**

TEL: (510) 232 - 1271 FAX: (510) 232 - 1272

4:45 PM to 5:45 PM					
APPROACH VOLUME	NB	SB	EB	WB	TOTAL
BICYCLE	12	1	15	10	**38**

B.A.Y.M.E.T.R.I.C.S.

PEDESTRIAN MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**
N-S APPROACH:	**PALO ALTO AVENUE**	**DAY:**	**TUESDAY**
E-W APPROACH:	**CHAUCER STREET**	**JURISDICTION:**	**PALO ALTO**
SURVEY PERIOD	**4:00 PM TO 6:00 PM**	**FILE:**	**3805030-7PM**

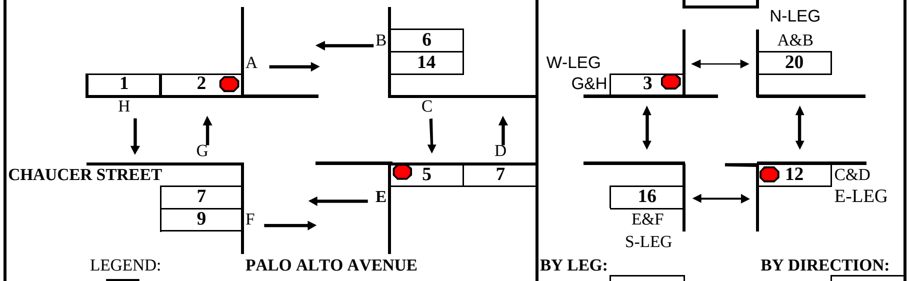
PEAK HOUR

04:45 PM TO 05:45 PM

PEAK HOUR

TOTAL PEDESTRIAN VOLUMES

51



LEGEND:

- ▥ CROSSWALK
- ▬ SIDEWALK
- — STOP CONTROL LINE
- ● STOP

BY LEG:	
N-LEG	**20**
S-LEG	**16**
E-LEG	**12**
W-LEG	**3**

BY DIRECTION:	
NB(D+G)	**9**
SB(C+H)	**6**
EB(A+F)	**23**
WB(B+E)	**13**

TIME PERIOD			**NORTH X-WALK**		**EAST X-WALK**		**SOUTH X-WALK**		**WEST X-WALK**		
From		**To**	***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***TOTAL***
			SURVEY DATA								
04:00 PM	---	04:15 PM	1	0	0	1	1	0	1	1	***5***
04:15 PM	---	04:30 PM	1	1	0	2	2	5	1	3	***15***
04:30 PM	---	04:45 PM	2	3	1	4	3	5	1	3	***22***
04:45 PM	---	05:00 PM	5	5	1	5	6	7	1	3	***33***
05:00 PM	---	05:15 PM	7	7	1	8	6	8	1	3	***41***
05:15 PM	---	05:30 PM	12	7	3	9	7	11	1	3	***53***
05:30 PM	---	05:45 PM	16	9	6	11	10	14	3	4	***73***
05:45 PM	---	06:00 PM	16	9	6	11	12	14	3	4	***75***
			TOTAL BY PERIOD								
04:00 PM	---	04:15 PM	1	0	0	1	1	0	1	1	***5***
04:15 PM	---	04:30 PM	0	1	0	1	1	5	0	2	***10***
04:30 PM	---	04:45 PM	1	2	1	2	1	0	0	0	***7***
04:45 PM	---	05:00 PM	3	2	0	1	3	2	0	0	***11***
05:00 PM	---	05:15 PM	2	2	0	3	0	1	0	0	***8***
05:15 PM	---	05:30 PM	5	0	2	1	1	3	0	0	***12***
05:30 PM	---	05:45 PM	4	2	3	2	3	3	2	1	***20***
05:45 PM	---	06:00 PM	0	0	0	0	2	0	0	0	***2***
			HOURLY TOTALS								
04:00 PM	---	05:00 PM	5	5	1	5	6	7	1	3	***33***
04:15 PM	---	05:15 PM	6	7	1	7	5	8	0	2	***36***
04:30 PM	---	05:30 PM	11	6	3	7	5	6	0	0	***38***
04:45 PM	---	05:45 PM	14	6	5	7	7	9	2	1	***51***
05:00 PM	---	06:00 PM	11	4	5	6	6	7	2	1	***42***

Tel : (510) 232-1271 ***Fax: (510) 232-1272***

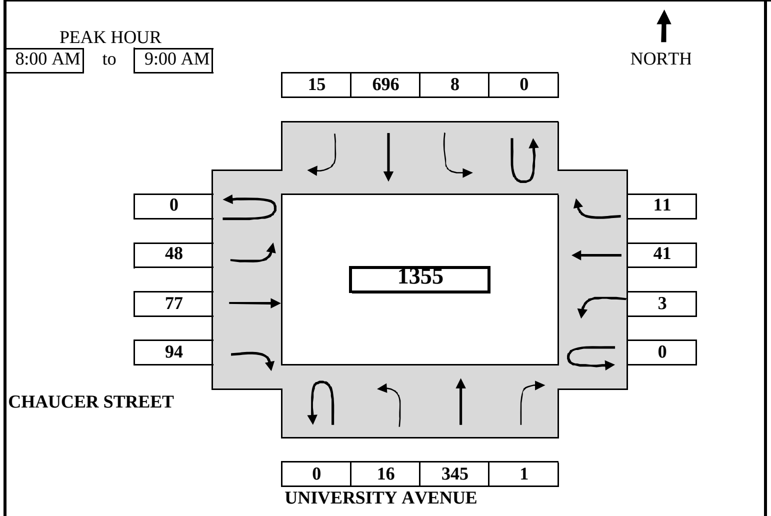
4:45 PM to 5:45 PM

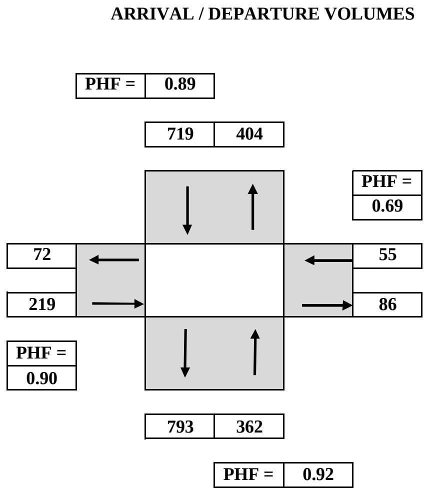
VOLUME BY DIRECTION	NB	SB	EB	WB	TOTAL
PEDESTRIAN	9	6	23	13	**51**
VOLUME BY LEG	N-LEG	S-LEG	E-LEG	W-LEG	TOTAL
PEDESTRIAN	20	16	12	3	**51**

B.A.Y.M.E.T.R.I.C.S.

INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**UNIVERSITY AVENUE**	**SURVEY TIME:**	**7:00 AM**	**TO**	**9:00 AM**
E-W APPROACH:	**CHAUCER STREET**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-8AM**





TIME	PERIOD		NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
From		To	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	
SURVEY DATA																			
7:00 AM	to	7:15 AM		3	61	0		1	163	2		4	5	6		1	3	2	**251**
7:15 AM	to	7:30 AM		4	123	0		2	323	7		6	11	16		1	7	4	**504**
7:30 AM	to	7:45 AM		6	208	0		3	467	13		12	20	31		1	9	6	**776**
7:45 AM	to	8:00 AM		9	308	0		4	603	19		26	32	51		2	16	7	**1077**
8:00 AM	to	8:15 AM		12	397	1		7	755	23		37	45	70		3	31	11	**1392**
8:15 AM	to	8:30 AM		16	480	1		9	914	27		50	65	96		5	42	13	**1718**
8:30 AM	to	8:45 AM		21	559	1		10	1105	29		60	82	125		5	46	14	**2057**
8:45 AM	to	9:00 AM		25	653	1		12	1299	34		74	109	145		5	57	18	**2432**
TOTAL BY PERIOD																			
7:00 AM	to	7:15 AM	0	3	61	0	0	1	163	2	0	4	5	6	0	1	3	2	**251**
7:15 AM	to	7:30 AM	0	1	62	0	0	1	160	5	0	2	6	10	0	0	4	2	**253**
7:30 AM	to	7:45 AM	0	2	85	0	0	1	144	6	0	6	9	15	0	0	2	2	**272**
7:45 AM	to	8:00 AM	0	3	100	0	0	1	136	6	0	14	12	20	0	1	7	1	**301**
8:00 AM	to	8:15 AM	0	3	89	1	0	3	152	4	0	11	13	19	0	1	15	4	**315**
8:15 AM	to	8:30 AM	0	4	83	0	0	2	159	4	0	13	20	26	0	2	11	2	**326**
8:30 AM	to	8:45 AM	0	5	79	0	0	1	191	2	0	10	17	29	0	0	4	1	**339**
8:45 AM	to	9:00 AM	0	4	94	0	0	2	194	5	0	14	27	20	0	0	11	4	**375**
HOURLY TOTALS																			
7:00 AM	to	8:00 AM	0	9	308	0	0	4	603	19	0	26	32	51	0	2	16	7	**1077**
7:15 AM	to	8:15 AM	0	9	336	1	0	6	592	21	0	33	40	64	0	2	28	9	**1141**
7:30 AM	to	8:30 AM	0	12	357	1	0	7	591	20	0	44	54	80	0	4	35	9	**1214**
7:45 AM	to	8:45 AM	0	15	351	1	0	7	638	16	0	48	62	94	0	4	37	8	**1281**
8:00 AM	to	9:00 AM	0	16	345	1	0	8	696	15	0	48	77	94	0	3	41	11	**1355**

PEAK HOUR SUMMARY

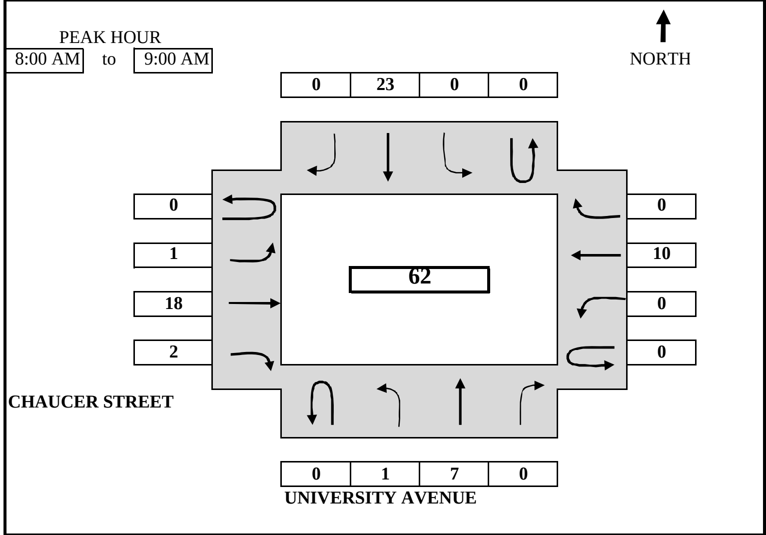
8:00 AM to 9:00 AM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	
VOLUME	0	16	345	1	0	8	696	15	0	48	77	94	0	3	41	11	**1355**
PHF BY MOVEMENT	0.00	0.80	0.92	0.25	0.00	0.67	0.90	0.75	0.00	0.86	0.71	0.81	0.00	0.38	0.68	0.69	OVERALL
PHF BY APPROACH	0.92				0.89				0.90				0.69				0.90
BICYCLE	8				23				21				10				**62**
PEDESTRIAN	5				3				7				3				**18**
	N-LEG				**S-LEG**				**E-LEG**				**W-LEG**				
PEDESTRIAN BY LEG:	6				4				3				5				**18**

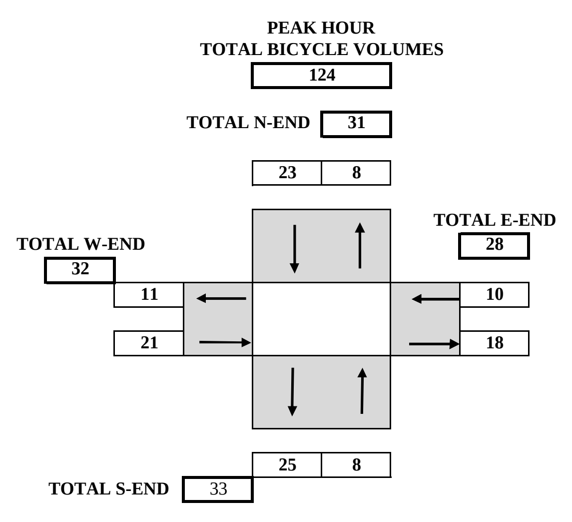
TEL: (510) 232 - 1271 FAX: (510) 232 - 1272

B.A.Y.M.E.T.R.I.C.S.

BICYCLE TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**UNIVERSITY AVENUE**	**SURVEY TIME:**	**7:00 AM**	**TO**	**9:00 AM**
E-W APPROACH:	**CHAUCER STREET**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-8AM**





TIME		**PERIOD**	**NORTHBOUND**				**SOUTHBOUND**				**EASTBOUND**				**WESTBOUND**				TOTAL
From		To	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	
SURVEY DATA																			
7:00 AM	to	7:15 AM	0	0	0	0	0	0	1	0	0	0	5	0	0	0	0	0	**6**
7:15 AM	to	7:30 AM	0	1	0	0	0	0	7	0	0	0	8	1	0	0	0	0	**17**
7:30 AM	to	7:45 AM	0	1	1	0	0	0	15	1	0	0	11	1	0	0	3	0	**33**
7:45 AM	to	8:00 AM	0	1	2	0	0	0	18	1	0	0	14	1	0	0	4	0	**41**
8:00 AM	to	8:15 AM	0	1	2	0	0	0	24	1	0	0	17	1	0	0	7	0	**53**
8:15 AM	to	8:30 AM	0	1	6	0	0	0	26	1	0	0	20	1	0	0	11	0	**66**
8:30 AM	to	8:45 AM	0	2	8	0	0	0	37	1	0	0	29	1	0	0	12	0	**90**
8:45 AM	to	9:00 AM	0	2	9	0	0	0	41	1	0	1	32	3	0	0	14	0	**103**
TOTAL BY PERIOD																			
7:00 AM	to	7:15 AM	0	0	0	0	0	0	1	0	0	0	5	0	0	0	0	0	**6**
7:15 AM	to	7:30 AM	0	1	0	0	0	0	6	0	0	0	3	1	0	0	0	0	**11**
7:30 AM	to	7:45 AM	0	0	1	0	0	0	8	1	0	0	3	0	0	0	3	0	**16**
7:45 AM	to	8:00 AM	0	0	1	0	0	0	3	0	0	0	3	0	0	0	1	0	**8**
8:00 AM	to	8:15 AM	0	0	0	0	0	0	6	0	0	0	3	0	0	0	3	0	**12**
8:15 AM	to	8:30 AM	0	0	4	0	0	0	2	0	0	0	3	0	0	0	4	0	**13**
8:30 AM	to	8:45 AM	0	1	2	0	0	0	11	0	0	0	9	0	0	0	1	0	**24**
8:45 AM	to	9:00 AM	0	0	1	0	0	0	4	0	0	1	3	2	0	0	2	0	**13**
HOURLY TOTALS																			
7:00 AM	to	8:00 AM	0	1	2	0	0	0	18	1	0	0	14	1	0	0	4	0	**41**
7:15 AM	to	8:15 AM	0	1	2	0	0	0	23	1	0	0	12	1	0	0	7	0	**47**
7:30 AM	to	8:30 AM	0	0	6	0	0	0	19	1	0	0	12	0	0	0	11	0	**49**
7:45 AM	to	8:45 AM	0	1	7	0	0	0	22	0	0	0	18	0	0	0	9	0	**57**
8:00 AM	to	9:00 AM	0	1	7	0	0	0	23	0	0	1	18	2	0	0	10	0	**62**

TEL: (510) 232 - 1271 FAX: (510) 232 - 127

8:00 AM to 9:00 AM					
APPROACH VOLUME	NB	SB	EB	WB	TOTAL
BICYCLE	8	23	21	10	**62**

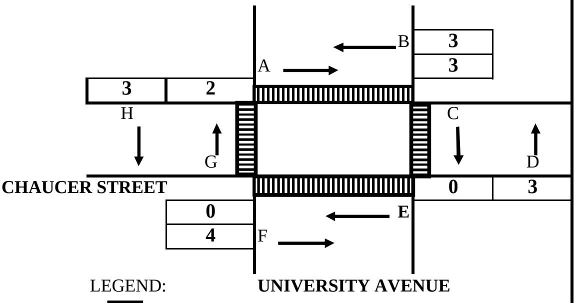
B.A.Y.M.E.T.R.I.C.S.

PEDESTRIAN MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**
N-S APPROACH:	**UNIVERSITY AVENUE**	**DAY:**	**TUESDAY**
E-W APPROACH:	**CHAUCER STREET**	**JURISDICTION:**	**PALO ALTO**
SURVEY PERIOD	**7:00 AM TO 9:00 AM**	**FILE:**	**3805030-8AM**

PEAK HOUR

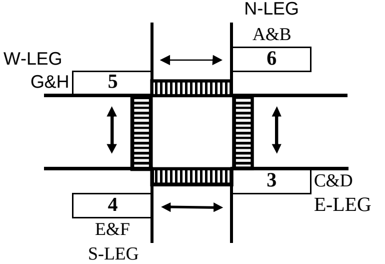
08:00 AM TO 09:00 AM



PEAK HOUR

TOTAL PEDESTRIAN VOLUMES

18



LEGEND:

▥ CROSSWALK

▬ SIDEWALK

— STOP CONTROL LINE

⬢ STOP

BY LEG:

N-LEG	**6**
S-LEG	**4**
E-LEG	**3**
W-LEG	**5**

BY DIRECTION:

NB(D+G)	**5**
SB(C+H)	**3**
EB(A+F)	**7**
WB(B+E)	**3**

TIME PERIOD			**NORTH X-WALK**		**EAST X-WALK**		**SOUTH X-WALK**		**WEST X-WALK**		
From		**To**	***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***TOTAL***
SURVEY DATA											
07:00 AM	---	07:15 AM	2	0	3	0	0	0	0	2	*7*
07:15 AM	---	07:30 AM	3	2	3	0	0	1	0	3	*12*
07:30 AM	---	07:45 AM	3	4	4	0	0	2	2	4	*19*
07:45 AM	---	08:00 AM	3	4	4	1	1	2	2	5	*22*
08:00 AM	---	08:15 AM	4	5	4	2	1	4	2	6	*28*
08:15 AM	---	08:30 AM	4	5	4	3	1	5	3	7	*32*
08:30 AM	---	08:45 AM	4	6	4	3	1	5	3	8	*34*
08:45 AM	---	09:00 AM	6	7	4	4	1	6	4	8	*40*
TOTAL BY PERIOD											
07:00 AM	---	07:15 AM	2	0	3	0	0	0	0	2	*7*
07:15 AM	---	07:30 AM	1	2	0	0	0	1	0	1	*5*
07:30 AM	---	07:45 AM	0	2	1	0	0	1	2	1	*7*
07:45 AM	---	08:00 AM	0	0	0	1	1	0	0	1	*3*
08:00 AM	---	08:15 AM	1	1	0	1	0	2	0	1	*6*
08:15 AM	---	08:30 AM	0	0	0	1	0	1	1	1	*4*
08:30 AM	---	08:45 AM	0	1	0	0	0	0	0	1	*2*
08:45 AM	---	09:00 AM	2	1	0	1	0	1	1	0	*6*
HOURLY TOTALS											
07:00 AM	---	08:00 AM	3	4	4	1	1	2	2	5	*22*
07:15 AM	---	08:15 AM	2	5	1	2	1	4	2	4	*21*
07:30 AM	---	08:30 AM	1	3	1	3	1	4	3	4	*20*
07:45 AM	---	08:45 AM	1	2	0	3	1	3	1	4	*15*
08:00 AM	---	09:00 AM	3	3	0	3	0	4	2	3	*18*

Tel : (510) 232-1271 ***Fax: (510) 232-1272***

8:00 AM to 9:00 AM					
VOLUME BY DIRECTION	NB	SB	EB	WB	TOTAL
PEDESTRIAN	5	3	7	3	**18**
VOLUME BY LEG	N-LEG	S-LEG	E-LEG	W-LEG	TOTAL
PEDESTRIAN	6	4	3	5	**18**

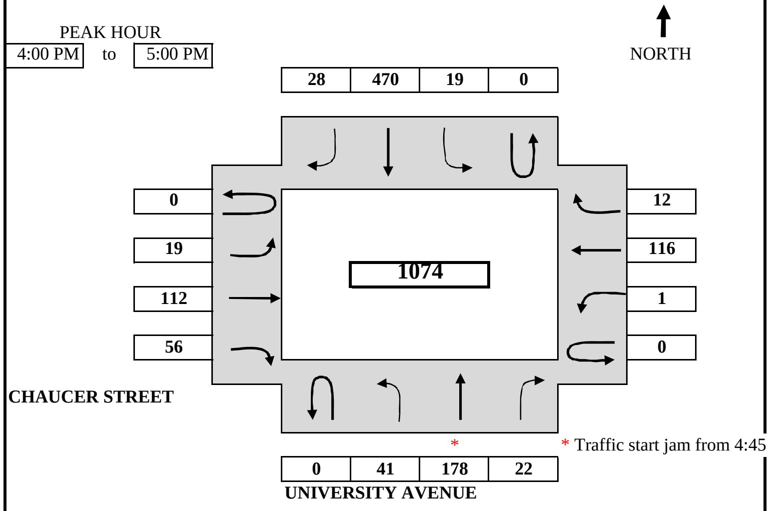
B.A.Y.M.E.T.R.I.C.S.

INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**	**DAY:**	**TUESDAY**
N-S APPROACH:	**UNIVERSITY AVENUE**	**SURVEY TIME:**	**4:00 PM**	**TO**	**6:00 PM**
E-W APPROACH:	**CHAUCER STREET**	**JURISDICTION:**	**PALO ALTO**	**FILE:**	**3805030-8PM**

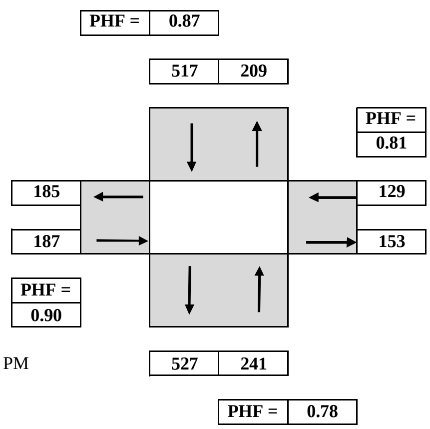
PEAK HOUR

4:00 PM to 5:00 PM



* Traffic start jam from 4:45 to 6:00 PM

ARRIVAL / DEPARTURE VOLUMES



TIME		PERIOD	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
From		To	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	
SURVEY DATA																			
4:00 PM	to	4:15 PM		7	68	2		3	140	6		9	23	20		0	25	1	**304**
4:15 PM	to	4:30 PM		22	124	4		10	218	16		14	52	34		0	54	6	**554**
4:30 PM	to	4:45 PM		32	154	15		16	349	21		18	81	48		1	80	8	**823**
4:45 PM	to	5:00 PM		41	178	22		19	470	28		19	112	56		1	116	12	**1074**
5:00 PM	to	5:15 PM		52	199	25		21	565	36		20	141	69		1	178	14	**1321**
5:15 PM	to	5:30 PM		56	212	25		25	663	41		23	153	82		3	226	14	**1523**
5:30 PM	to	5:45 PM		62	233	27		26	762	56		24	185	96		3	288	15	**1777**
5:45 PM	to	6:00 PM		66	256	27		33	874	70		25	207	110		3	328	16	**2015**
TOTAL BY PERIOD																			
4:00 PM	to	4:15 PM	0	7	68	2	0	3	140	6	0	9	23	20	0	0	25	1	**304**
4:15 PM	to	4:30 PM	0	15	56	2	0	7	78	10	0	5	29	14	0	0	29	5	**250**
4:30 PM	to	4:45 PM	0	10	30	11	0	6	131	5	0	4	29	14	0	1	26	2	**269**
4:45 PM	to	5:00 PM	0	9	24	7	0	3	121	7	0	1	31	8	0	0	36	4	**251**
5:00 PM	to	5:15 PM	0	11	21	3	0	2	95	8	0	1	29	13	0	0	62	2	**247**
5:15 PM	to	5:30 PM	0	4	13	0	0	4	98	5	0	3	12	13	0	2	48	0	**202**
5:30 PM	to	5:45 PM	0	6	21	2	0	1	99	15	0	1	32	14	0	0	62	1	**254**
5:45 PM	to	6:00 PM	0	4	23	0	0	7	112	14	0	1	22	14	0	0	40	1	**238**
HOURLY TOTALS																			
4:00 PM	to	5:00 PM	0	41	178	22	0	19	470	28	0	19	112	56	0	1	116	12	**1074**
4:15 PM	to	5:15 PM	0	45	131	23	0	18	425	30	0	11	118	49	0	1	153	13	**1017**
4:30 PM	to	5:30 PM	0	34	88	21	0	15	445	25	0	9	101	48	0	3	172	8	**969**
4:45 PM	to	5:45 PM	0	30	79	12	0	10	413	35	0	6	104	48	0	2	208	7	**954**
5:00 PM	to	6:00 PM	0	25	78	5	0	14	404	42	0	6	95	54	0	2	212	4	**941**

PEAK HOUR SUMMARY

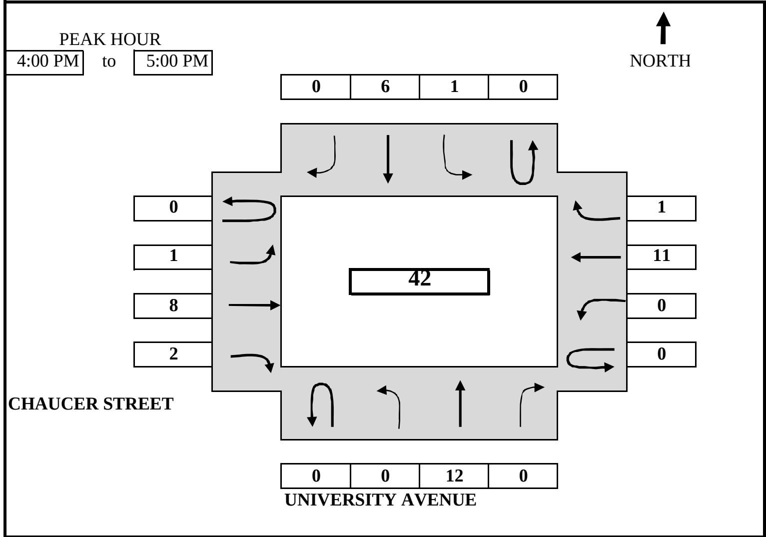
4:00 PM to 5:00 PM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
	NBU	NBL	NBT	NBR	SBU	SBL	SBT	SBR	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	
VOLUME	0	41	178	22	0	19	470	28	0	19	112	56	0	1	116	12	**1074**
PHF BY MOVEMENT	0.00	0.68	0.65	0.50	0.00	0.68	0.84	0.70	0.00	0.53	0.90	0.70	0.00	0.25	0.81	0.60	OVERALL
PHF BY APPROACH	0.78				0.87				0.90				0.81				0.88
BICYCLE	12				7				11				12				**42**
PEDESTRIAN	6				5				2				5				**18**
	N-LEG				**S-LEG**				**E-LEG**				**W-LEG**				
PEDESTRIAN BY LEG:	3				4				3				8				**18**

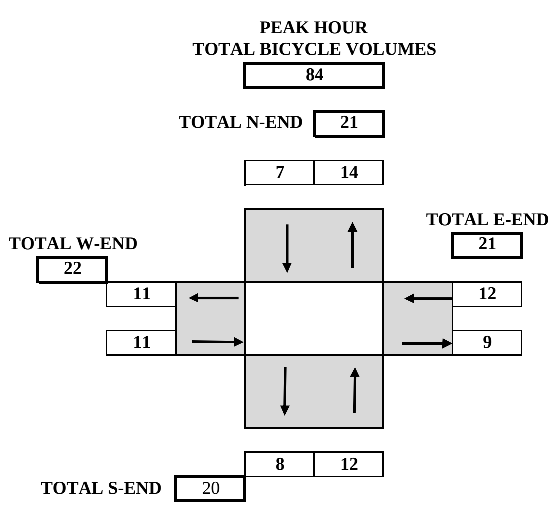
TEL: (510) 232 - 1271 FAX: (510) 232 - 1272

B.A.Y.M.E.T.R.I.C.S.

BICYCLE TURNING MOVEMENT SUMMARY

PROJECT: TRAFFIC COUNTS IN PALO ALTO **SURVEY DATE:** 5/22/2018 **DAY:** TUESDAY
N-S APPROACH: UNIVERSITY AVENUE **SURVEY TIME:** 4:00 PM **TO** 6:00 PM
E-W APPROACH: CHAUCER STREET **JURISDICTION:** PALO ALTO **FILE:** 3805030-8PM





TIME		PERIOD	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
From		To	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	U-TURN	LEFT	THRU	RIGHT	
SURVEY DATA																			
4:00 PM	to	4:15 PM	0	0	3	0	0	1	2	0	0	0	0	0	0	0	4	0	**10**
4:15 PM	to	4:30 PM	0	0	6	0	0	1	3	0	0	0	5	1	0	0	7	0	**23**
4:30 PM	to	4:45 PM	0	0	10	0	0	1	5	0	0	0	5	1	0	0	8	1	**31**
4:45 PM	to	5:00 PM	0	0	12	0	0	1	6	0	0	1	8	2	0	0	11	1	**42**
5:00 PM	to	5:15 PM	0	0	12	0	0	1	10	1	0	1	9	3	0	0	13	2	**52**
5:15 PM	to	5:30 PM	0	0	15	0	0	1	14	1	0	1	10	5	0	0	15	2	**64**
5:30 PM	to	5:45 PM	0	0	17	0	0	1	16	1	0	1	10	5	0	0	15	2	**68**
5:45 PM	to	6:00 PM	0	0	24	0	0	1	17	1	0	1	11	7	0	0	21	2	**85**
TOTAL BY PERIOD																			
4:00 PM	to	4:15 PM	0	0	3	0	0	1	2	0	0	0	0	0	0	0	4	0	**10**
4:15 PM	to	4:30 PM	0	0	3	0	0	0	1	0	0	0	5	1	0	0	3	0	**13**
4:30 PM	to	4:45 PM	0	0	4	0	0	0	2	0	0	0	0	0	0	0	1	1	**8**
4:45 PM	to	5:00 PM	0	0	2	0	0	0	1	0	0	1	3	1	0	0	3	0	**11**
5:00 PM	to	5:15 PM	0	0	0	0	0	0	4	1	0	0	1	1	0	0	2	1	**10**
5:15 PM	to	5:30 PM	0	0	3	0	0	0	4	0	0	0	1	2	0	0	2	0	**12**
5:30 PM	to	5:45 PM	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	**4**
5:45 PM	to	6:00 PM	0	0	7	0	0	0	1	0	0	0	1	2	0	0	6	0	**17**
HOURLY TOTALS																			
4:00 PM	to	5:00 PM	0	0	12	0	0	1	6	0	0	1	8	2	0	0	11	1	**42**
4:15 PM	to	5:15 PM	0	0	9	0	0	0	8	1	0	1	9	3	0	0	9	2	**42**
4:30 PM	to	5:30 PM	0	0	9	0	0	0	11	1	0	1	5	4	0	0	8	2	**41**
4:45 PM	to	5:45 PM	0	0	7	0	0	0	11	1	0	1	5	4	0	0	7	1	**37**
5:00 PM	to	6:00 PM	0	0	12	0	0	0	11	1	0	0	3	5	0	0	10	1	**43**

TEL: (510) 232 - 1271 FAX: (510) 232 - 1272

4:00 PM to 5:00 PM					
APPROACH VOLUME	NB	SB	EB	WB	TOTAL
BICYCLE	12	7	11	12	**42**

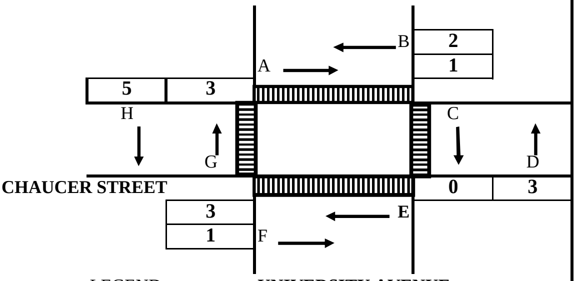
B.A.Y.M.E.T.R.I.C.S.

PEDESTRIAN MOVEMENT SUMMARY

PROJECT:	**TRAFFIC COUNTS IN PALO ALTO**	**SURVEY DATE:**	**5/22/2018**
N-S APPROACH:	**UNIVERSITY AVENUE**	**DAY:**	**TUESDAY**
E-W APPROACH:	**CHAUCER STREET**	**JURISDICTION:**	**PALO ALTO**
SURVEY PERIOD	**4:00 PM TO 6:00 PM**	**FILE:**	**3805030-8PM**

PEAK HOUR

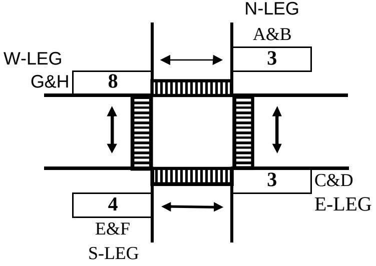
04:00 PM TO 05:00 PM



PEAK HOUR

TOTAL PEDESTRIAN VOLUMES

18



LEGEND:

- ▥ CROSSWALK
- ▬ SIDEWALK
- — STOP CONTROL LINE
- ⬣ STOP

BY LEG:	
N-LEG	**3**
S-LEG	**4**
E-LEG	**3**
W-LEG	**8**

BY DIRECTION:	
NB(D+G)	**6**
SB(C+H)	**5**
EB(A+F)	**2**
WB(B+E)	**5**

TIME PERIOD			**NORTH X-WALK**		**EAST X-WALK**		**SOUTH X-WALK**		**WEST X-WALK**		
From		**To**	***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***TOTAL***
SURVEY DATA											
04:00 PM	---	04:15 PM	1	1	0	1	2	0	0	0	***5***
04:15 PM	---	04:30 PM	1	2	0	2	3	0	2	0	***10***
04:30 PM	---	04:45 PM	1	2	0	3	3	1	2	1	***13***
04:45 PM	---	05:00 PM	1	2	0	3	3	1	3	5	***18***
05:00 PM	---	05:15 PM	2	3	0	3	4	2	5	11	***30***
05:15 PM	---	05:30 PM	4	4	1	3	4	2	9	12	***39***
05:30 PM	---	05:45 PM	6	6	2	12	5	3	10	14	***58***
05:45 PM	---	06:00 PM	6	6	2	15	7	3	11	16	***66***
TOTAL BY PERIOD											
04:00 PM	---	04:15 PM	1	1	0	1	2	0	0	0	***5***
04:15 PM	---	04:30 PM	0	1	0	1	1	0	2	0	***5***
04:30 PM	---	04:45 PM	0	0	0	1	0	1	0	1	***3***
04:45 PM	---	05:00 PM	0	0	0	0	0	0	1	4	***5***
05:00 PM	---	05:15 PM	1	1	0	0	1	1	2	6	***12***
05:15 PM	---	05:30 PM	2	1	1	0	0	0	4	1	***9***
05:30 PM	---	05:45 PM	2	2	1	9	1	1	1	2	***19***
05:45 PM	---	06:00 PM	0	0	0	3	2	0	1	2	***8***
HOURLY TOTALS											
04:00 PM	---	05:00 PM	1	2	0	3	3	1	3	5	***18***
04:15 PM	---	05:15 PM	1	2	0	2	2	2	5	11	***25***
04:30 PM	---	05:30 PM	3	2	1	1	1	2	7	12	***29***
04:45 PM	---	05:45 PM	5	4	2	9	2	2	8	13	***45***
05:00 PM	---	06:00 PM	5	4	2	12	4	2	8	11	***48***

Tel : (510) 232-1271 ***Fax: (510) 232-1272***

4:00 PM to 5:00 PM

VOLUME BY DIRECTION	NB	SB	EB	WB	TOTAL
PEDESTRIAN	6	5	2	5	**18**
VOLUME BY LEG	N-LEG	S-LEG	E-LEG	W-LEG	TOTAL
PEDESTRIAN	3	4	3	8	**18**

Appendix B – Existing Conditions Synchro Reports

- HCM Delay and LOS Reports
- 95th Percentile Queue Length Reports

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	43	134	135	291	5	899	59	908
v/c Ratio	0.86	0.42	0.79	0.92	0.01	0.64	0.17	0.64
Control Delay	150.3	57.7	90.3	89.0	6.2	13.9	6.4	10.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	150.3	57.7	90.3	89.0	6.2	13.9	6.4	10.9
Queue Length 50th (ft)	41	114	127	262	1	302	14	377
Queue Length 95th (ft)	#90	147	#188	#333	m3	363	31	497
Internal Link Dist (ft)		468		521		1923		337
Turn Bay Length (ft)	55		90		75		90	
Base Capacity (vph)	52	336	177	330	337	1398	343	1420
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.83	0.40	0.76	0.88	0.01	0.64	0.17	0.64

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis
1: Willow Rd & Gilbert Ave

Existing Conditions
Timing Plan: A.M. Peak

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱		↰	↱	
Traffic Volume (vph)	32	91	8	107	135	95	4	692	72	56	858	5
Future Volume (vph)	32	91	8	107	135	95	4	692	72	56	858	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	0.99		1.00	0.98		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		0.97	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.94		1.00	0.99		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1765	1830		1721	1715		1770	1828		1770	1861	
Flt Permitted	0.16	1.00		0.53	1.00		0.24	1.00		0.24	1.00	
Satd. Flow (perm)	290	1830		969	1715		443	1828		451	1861	
Peak-hour factor, PHF	0.74	0.74	0.74	0.79	0.79	0.79	0.85	0.85	0.85	0.95	0.95	0.95
Adj. Flow (vph)	43	123	11	135	171	120	5	814	85	59	903	5
RTOR Reduction (vph)	0	2	0	0	17	0	0	2	0	0	0	0
Lane Group Flow (vph)	43	132	0	135	274	0	5	897	0	59	908	0
Confl. Peds. (#/hr)	2		11	11		2	7		8	8		7
Confl. Bikes (#/hr)			5			9			10			20
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			6	
Permitted Phases	4			4			2			6		
Actuated Green, G (s)	26.3	26.3		26.3	26.3		114.5	114.5		114.5	114.5	
Effective Green, g (s)	26.3	26.3		26.3	26.3		114.5	114.5		114.5	114.5	
Actuated g/C Ratio	0.18	0.18		0.18	0.18		0.76	0.76		0.76	0.76	
Clearance Time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	50	320		169	300		338	1395		344	1420	
v/s Ratio Prot		0.07			c0.16			c0.49			0.49	
v/s Ratio Perm	0.15			0.14			0.01			0.13		
v/c Ratio	0.86	0.41		0.80	0.91		0.01	0.64		0.17	0.64	
Uniform Delay, d1	60.1	55.0		59.3	60.7		4.2	8.2		4.8	8.2	
Progression Factor	1.00	1.00		1.00	1.00		1.36	1.42		1.00	1.00	
Incremental Delay, d2	76.1	0.9		22.5	30.2		0.1	1.6		1.1	2.2	
Delay (s)	136.2	55.8		81.9	91.0		5.8	13.3		5.9	10.4	
Level of Service	F	E		F	F		A	B		A	B	
Approach Delay (s)		75.3			88.1			13.3			10.1	
Approach LOS		E			F			B			B	

Intersection Summary			
HCM 2000 Control Delay	29.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	9.2
Intersection Capacity Utilization	75.5%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Queues
2: Willow Rd & Middlefield Rd

Existing Conditions
Timing Plan: A.M. Peak

	⤴	→	⤶	←	↖	↰	↑	↱	↘	↓	↙
Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	226	465	94	478	180	50	313	162	249	256	499
v/c Ratio	0.80	0.79	0.32	0.85	0.61	0.16	0.94	0.49	0.43	0.43	0.74
Control Delay	80.0	69.3	57.9	75.1	39.2	53.3	96.9	30.1	37.5	37.5	24.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	80.0	69.3	57.9	75.1	39.2	53.3	96.9	30.1	37.5	37.5	24.3
Queue Length 50th (ft)	232	237	81	249	94	42	305	63	215	222	258
Queue Length 95th (ft)	#346	304	133	303	175	69	#360	101	m307	m315	408
Internal Link Dist (ft)		465		339			466			185	
Turn Bay Length (ft)	270		120		65	75		110	150		65
Base Capacity (vph)	308	639	305	581	303	322	339	338	580	594	674
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.73	0.73	0.31	0.82	0.59	0.16	0.92	0.48	0.43	0.43	0.74

Intersection Summary

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↰↑↑↱		↰	↑↑↱	↱	↰	↑	↱	↰	↰↑	↱
Traffic Volume (vph)	283	322	17	81	394	172	38	238	123	367	102	464
Future Volume (vph)	283	322	17	81	394	172	38	238	123	367	102	464
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.3	5.3		5.3	5.3	5.3	4.7	4.7	4.7	4.7	4.7	4.7
Lane Util. Factor	0.91	0.91		1.00	0.91	0.91	1.00	1.00	1.00	0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.94	1.00	1.00	0.92	1.00	1.00	0.94
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99		1.00	0.99	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	0.99		0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.97	1.00
Satd. Flow (prot)	1610	3333		1770	3360	1354	1770	1863	1458	1681	1721	1484
Flt Permitted	0.95	0.99		0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.97	1.00
Satd. Flow (perm)	1610	3333		1770	3360	1354	1770	1863	1458	1681	1721	1484
Peak-hour factor, PHF	0.90	0.90	0.90	0.86	0.86	0.86	0.76	0.76	0.76	0.93	0.93	0.93
Adj. Flow (vph)	314	358	19	94	458	200	50	313	162	395	110	499
RTOR Reduction (vph)	0	2	0	0	2	71	0	0	73	0	0	162
Lane Group Flow (vph)	226	463	0	94	476	109	50	313	89	249	256	337
Confl. Peds. (#/hr)			1			22			31			23
Confl. Bikes (#/hr)			6			9			16			28
Turn Type	Split	NA		Split	NA	Perm	Split	NA	Perm	Split	NA	Perm
Protected Phases	2	2		3	3		1	1		4	4	
Permitted Phases						3			1			4
Actuated Green, G (s)	26.3	26.3		25.1	25.1	25.1	26.8	26.8	26.8	51.8	51.8	51.8
Effective Green, g (s)	26.3	26.3		25.1	25.1	25.1	26.8	26.8	26.8	51.8	51.8	51.8
Actuated g/C Ratio	0.18	0.18		0.17	0.17	0.17	0.18	0.18	0.18	0.35	0.35	0.35
Clearance Time (s)	5.3	5.3		5.3	5.3	5.3	4.7	4.7	4.7	4.7	4.7	4.7
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	282	584		296	562	226	316	332	260	580	594	512
v/s Ratio Prot	c0.14	0.14		0.05	c0.14		0.03	c0.17		0.15	0.15	
v/s Ratio Perm						0.08			0.06			c0.23
v/c Ratio	0.80	0.79		0.32	0.85	0.48	0.16	0.94	0.34	0.43	0.43	0.66
Uniform Delay, d1	59.3	59.2		54.9	60.6	56.6	52.1	60.8	53.9	37.7	37.8	41.6
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.91	0.85
Incremental Delay, d2	15.0	7.3		0.6	11.4	1.6	0.2	34.5	0.8	1.7	1.7	4.9
Delay (s)	74.3	66.6		55.5	72.0	58.2	52.3	95.3	54.7	36.0	36.0	40.2
Level of Service	E	E		E	E	E	D	F	D	D	D	D
Approach Delay (s)		69.1			66.6			78.7			38.1	
Approach LOS		E			E			E			D	

Intersection Summary			
HCM 2000 Control Delay	59.7	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	90.8%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
3: Palo Alto Ave/Woodland Ave & Middlefield Rd

Existing Conditions
Timing Plan: A.M. Peak

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↱			✥		↰		↱
Traffic Volume (veh/h)	84	721	0	0	501	13	0	0	0	23	0	147
Future Volume (Veh/h)	84	721	0	0	501	13	0	0	0	23	0	147
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.97	0.97	0.97	0.92	0.92	0.92	0.25	0.25	0.25	0.99	0.99	0.99
Hourly flow rate (vph)	87	743	0	0	545	14	0	0	0	23	0	148
Pedestrians					6			6			5	
Lane Width (ft)					12.0			12.0			12.0	
Walking Speed (ft/s)					3.5			3.5			3.5	
Percent Blockage					1			1			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		398										
pX, platoon unblocked				0.94			0.94	0.94	0.94	0.94	0.94	
vC, conflicting volume	564			749			1623	1487	384	1108	1480	557
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	564			594			1528	1383	204	979	1376	557
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	91			100			100	100	100	87	100	69
cM capacity (veh/h)	999			910			47	120	743	175	122	472

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	NB 1	SB 1	SB 2
Volume Total	87	372	372	559	0	23	148
Volume Left	87	0	0	0	0	23	0
Volume Right	0	0	0	14	0	0	148
cSH	999	1700	1700	1700	1700	175	472
Volume to Capacity	0.09	0.22	0.22	0.33	0.00	0.13	0.31
Queue Length 95th (ft)	7	0	0	0	0	11	33
Control Delay (s)	8.9	0.0	0.0	0.0	0.0	28.6	16.1
Lane LOS	A				A	D	C
Approach Delay (s)	0.9			0.0	0.0	17.8	
Approach LOS					A	C	

Intersection Summary			
Average Delay	2.4		
Intersection Capacity Utilization	47.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↱		Y	
Traffic Volume (veh/h)	24	726	494	5	2	20
Future Volume (Veh/h)	24	726	494	5	2	20
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.94	0.94	0.95	0.95	0.92	0.92
Hourly flow rate (vph)	26	772	520	5	2	22
Pedestrians		2	4		10	
Lane Width (ft)		12.0	12.0		12.0	
Walking Speed (ft/s)		3.5	3.5		3.5	
Percent Blockage		0	0		1	
Right turn flare (veh)						
Median type		None	TWLTL			
Median storage veh)			2			
Upstream signal (ft)		892				
pX, platoon unblocked					0.86	
vC, conflicting volume	535				1360	534
vC1, stage 1 conf vol					532	
vC2, stage 2 conf vol					828	
vCu, unblocked vol	535				1338	534
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)					5.4	
tF (s)	2.2				3.5	3.3
p0 queue free %	97				99	96
cM capacity (veh/h)	1023				347	539

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	26	772	525	24
Volume Left	26	0	0	2
Volume Right	0	0	5	22
cSH	1023	1700	1700	516
Volume to Capacity	0.03	0.45	0.31	0.05
Queue Length 95th (ft)	2	0	0	4
Control Delay (s)	8.6	0.0	0.0	12.3
Lane LOS	A			B
Approach Delay (s)	0.3		0.0	12.3
Approach LOS				B

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	48.9%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
5: Pope St & Central Ave

Existing Conditions
Timing Plan: A.M. Peak

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↱		Y	
Traffic Volume (veh/h)	2	78	37	17	82	2
Future Volume (Veh/h)	2	78	37	17	82	2
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.72	0.72	0.84	0.84
Hourly flow rate (vph)	2	85	51	24	98	2
Pedestrians					8	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					3.5	
Percent Blockage					1	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	83				160	71
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	83				160	71
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				88	100
cM capacity (veh/h)	1503				824	984

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	87	75	100
Volume Left	2	0	98
Volume Right	0	24	2
cSH	1503	1700	826
Volume to Capacity	0.00	0.04	0.12
Queue Length 95th (ft)	0	0	10
Control Delay (s)	0.2	0.0	10.0
Lane LOS	A		A
Approach Delay (s)	0.2	0.0	10.0
Approach LOS			A

Intersection Summary			
Average Delay	3.9		
Intersection Capacity Utilization	17.0%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection: 6: Woodland Ave & Pope St/Chaucer St

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	72	70	54	84
Average Queue (ft)	39	34	26	49
95th Queue (ft)	60	58	45	76
Link Distance (ft)	283	126	395	346
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	1	154	4	8	50	27	2	53	33	118	96	3
Future Volume (vph)	1	154	4	8	50	27	2	53	33	118	96	3
Peak Hour Factor	0.88	0.88	0.88	0.82	0.82	0.82	0.79	0.79	0.79	0.94	0.94	0.94
Hourly flow rate (vph)	1	175	5	10	61	33	3	67	42	126	102	3

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	181	104	112	231
Volume Left (vph)	1	10	3	126
Volume Right (vph)	5	33	42	3
Hadj (s)	0.02	-0.14	-0.19	0.14
Departure Headway (s)	4.9	4.9	4.8	4.9
Degree Utilization, x	0.25	0.14	0.15	0.31
Capacity (veh/h)	679	671	697	690
Control Delay (s)	9.5	8.7	8.6	10.1
Approach Delay (s)	9.5	8.7	8.6	10.1
Approach LOS	A	A	A	B

Intersection Summary			
Delay	9.4		
Level of Service	A		
Intersection Capacity Utilization	35.7%	ICU Level of Service	A
Analysis Period (min)	15		

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Volume (veh/h)	0	202	106	3	64	1	17	2	6	2	2	0
Future Volume (Veh/h)	0	202	106	3	64	1	17	2	6	2	2	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.94	0.94	0.94	0.85	0.85	0.85	0.92	0.92	0.92	0.25	0.25	0.25
Hourly flow rate (vph)	0	215	113	4	75	1	18	2	7	8	8	0
Pedestrians		2			3			2			8	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		0			0			0			1	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					517							
pX, platoon unblocked												
vC, conflicting volume	84			330			363	366	276	374	422	86
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	84			330			363	366	276	374	422	86
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			97	100	99	99	98	100
cM capacity (veh/h)	1501			1227			578	556	759	565	517	964

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	328	80	27	16
Volume Left	0	4	18	8
Volume Right	113	1	7	0
cSH	1501	1227	614	540
Volume to Capacity	0.00	0.00	0.04	0.03
Queue Length 95th (ft)	0	0	3	2
Control Delay (s)	0.0	0.4	11.1	11.9
Lane LOS		A	B	B
Approach Delay (s)	0.0	0.4	11.1	11.9
Approach LOS			B	B

Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	28.1%	ICU Level of Service	A
Analysis Period (min)	15		

8: University Ave & Chaucer St

	→	←	↑	↓
Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	226	72	399	743
v/c Ratio	0.59	0.18	0.37	0.66
Control Delay	26.3	21.4	7.2	11.3
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	26.3	21.4	7.2	11.3
Queue Length 50th (ft)	55	17	56	135
Queue Length 95th (ft)	165	46	147	338
Internal Link Dist (ft)	437	466	382	498
Turn Bay Length (ft)				
Base Capacity (vph)	744	819	1611	1652
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.30	0.09	0.25	0.45

Intersection Summary

8: University Ave & Chaucer St

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Volume (vph)	48	62	94	4	37	8	15	351	1	7	638	16
Future Volume (vph)	48	62	94	4	37	8	15	351	1	7	638	16
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0			5.0			5.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		0.98			0.99			1.00			1.00	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		0.94			0.98			1.00			1.00	
Flt Protected		0.99			1.00			1.00			1.00	
Satd. Flow (prot)		1681			1800			1858			1854	
Flt Permitted		0.91			0.97			0.97			1.00	
Satd. Flow (perm)		1555			1757			1802			1847	
Peak-hour factor, PHF	0.90	0.90	0.90	0.69	0.69	0.69	0.92	0.92	0.92	0.89	0.89	0.89
Adj. Flow (vph)	53	69	104	6	54	12	16	382	1	8	717	18
RTOR Reduction (vph)	0	34	0	0	8	0	0	0	0	0	1	0
Lane Group Flow (vph)	0	192	0	0	64	0	0	399	0	0	742	0
Confl. Peds. (#/hr)	6		4	4		6	5		3	3		5
Confl. Bikes (#/hr)			18			10			7			23
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Actuated Green, G (s)		13.7			13.7			36.8			36.8	
Effective Green, g (s)		13.7			13.7			36.8			36.8	
Actuated g/C Ratio		0.23			0.23			0.62			0.62	
Clearance Time (s)		4.0			4.0			5.0			5.0	
Vehicle Extension (s)		3.0			3.0			4.0			4.0	
Lane Grp Cap (vph)		358			404			1114			1142	
v/s Ratio Prot												
v/s Ratio Perm		c0.12			0.04			0.22			c0.40	
v/c Ratio		0.54			0.16			0.36			0.65	
Uniform Delay, d1		20.1			18.3			5.6			7.2	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		1.5			0.2			0.3			1.4	
Delay (s)		21.7			18.5			5.8			8.7	
Level of Service		C			B			A			A	
Approach Delay (s)		21.7			18.5			5.8			8.7	
Approach LOS		C			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	10.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	59.5	Sum of lost time (s)	9.0
Intersection Capacity Utilization	63.3%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

9: University Ave & Woodland Ave/Scofield Ave

	↗	→	←	↖	↑	↘	↓	↙
Lane Group	EBL	EBT	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	373	155	490	63	653	253	1038	553
v/c Ratio	0.80	0.60	1.07	0.41	0.61	0.75	0.69	0.60
Control Delay	49.6	39.0	89.3	43.8	29.0	45.6	23.6	4.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	49.6	39.0	89.3	43.8	29.0	45.6	23.6	4.8
Queue Length 50th (ft)	100	65	~253	33	153	128	233	0
Queue Length 95th (ft)	#162	126	#442	68	231	192	326	66
Internal Link Dist (ft)		498	512		536		443	
Turn Bay Length (ft)				160		210		
Base Capacity (vph)	484	266	458	249	1064	458	1498	924
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.77	0.58	1.07	0.25	0.61	0.55	0.69	0.60

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↱			✣		↰	↑↱		↰	↑↑	↱
Traffic Volume (vph)	343	93	50	15	121	315	58	588	13	233	955	509
Future Volume (vph)	343	93	50	15	121	315	58	588	13	233	955	509
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0			3.0		3.0	4.0		3.0	4.0	4.0
Lane Util. Factor	0.97	1.00			1.00		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	0.98			0.99		1.00	1.00		1.00	1.00	0.90
Flpb, ped/bikes	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.95			0.91		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	1730			1668		1770	3526		1770	3539	1431
Flt Permitted	0.95	1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	1730			1668		1770	3526		1770	3539	1431
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	373	101	54	16	132	342	63	639	14	253	1038	553
RTOR Reduction (vph)	0	22	0	0	95	0	0	1	0	0	0	323
Lane Group Flow (vph)	373	133	0	0	395	0	63	652	0	253	1038	230
Confl. Peds. (#/hr)			39						3			26
Confl. Bikes (#/hr)			2			2						10
Turn Type	Split	NA		Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	8	8		7	7		1	6		5	2	
Permitted Phases												2
Actuated Green, G (s)	11.6	11.6			18.5		6.5	25.6		16.3	35.4	35.4
Effective Green, g (s)	11.6	11.6			18.5		6.5	25.6		16.3	35.4	35.4
Actuated g/C Ratio	0.14	0.14			0.22		0.08	0.30		0.19	0.42	0.42
Clearance Time (s)	3.0	3.0			3.0		3.0	4.0		3.0	4.0	4.0
Vehicle Extension (s)	2.0	2.0			2.0		2.0	3.0		2.0	3.0	3.0
Lane Grp Cap (vph)	468	236			363		135	1061		339	1473	595
v/s Ratio Prot	c0.11	0.08			c0.24		0.04	0.18		c0.14	c0.29	
v/s Ratio Perm												0.16
v/c Ratio	0.80	0.56			1.09		0.47	0.61		0.75	0.70	0.39
Uniform Delay, d1	35.6	34.3			33.2		37.6	25.5		32.4	20.5	17.3
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	8.6	1.8			72.5		0.9	2.7		7.6	2.9	1.9
Delay (s)	44.1	36.1			105.8		38.5	28.1		40.0	23.3	19.2
Level of Service	D	D			F		D	C		D	C	B
Approach Delay (s)		41.8			105.8			29.0			24.4	
Approach LOS		D			F			C			C	

Intersection Summary			
HCM 2000 Control Delay	39.0	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	85.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	86.2%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Queues
1: Willow Rd & Gilbert Ave

	↗	→	↙	←	↖	↑	↘	↓
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	18	96	88	127	5	262	122	756
v/c Ratio	0.14	0.41	0.59	0.53	0.01	0.19	0.14	0.51
Control Delay	45.6	46.2	63.8	50.1	4.0	3.4	4.0	6.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	45.6	46.2	63.8	50.1	4.0	3.4	4.0	6.5
Queue Length 50th (ft)	13	63	66	84	1	30	16	152
Queue Length 95th (ft)	29	93	113	137	3	44	33	207
Internal Link Dist (ft)		468		521		1923		337
Turn Bay Length (ft)	55		90		75		90	
Base Capacity (vph)	181	340	216	341	480	1406	858	1477
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.28	0.41	0.37	0.01	0.19	0.14	0.51

Intersection Summary

HCM Signalized Intersection Capacity Analysis

1: Willow Rd & Gilbert Ave

Existing Conditions

Timing Plan: P.M. Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱		↰	↱	
Traffic Volume (vph)	14	60	16	78	82	31	3	122	43	88	537	7
Future Volume (vph)	14	60	16	78	82	31	3	122	43	88	537	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	0.98		1.00	1.00	
Flpb, ped/bikes	0.99	1.00		0.98	1.00		0.99	1.00		0.97	1.00	
Frt	1.00	0.97		1.00	0.96		1.00	0.96		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1747	1778		1733	1768		1760	1759		1717	1858	
Flt Permitted	0.53	1.00		0.64	1.00		0.33	1.00		0.60	1.00	
Satd. Flow (perm)	973	1778		1161	1768		604	1759		1080	1858	
Peak-hour factor, PHF	0.79	0.79	0.79	0.89	0.89	0.89	0.63	0.63	0.63	0.72	0.72	0.72
Adj. Flow (vph)	18	76	20	88	92	35	5	194	68	122	746	10
RTOR Reduction (vph)	0	9	0	0	12	0	0	8	0	0	0	0
Lane Group Flow (vph)	18	87	0	88	115	0	5	254	0	122	756	0
Confl. Peds. (#/hr)	6		9	9		6	8		17	17		8
Confl. Bikes (#/hr)			9						11			4
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			6	
Permitted Phases	4			4			2			6		
Actuated Green, G (s)	15.4	15.4		15.4	15.4		95.4	95.4		95.4	95.4	
Effective Green, g (s)	15.4	15.4		15.4	15.4		95.4	95.4		95.4	95.4	
Actuated g/C Ratio	0.13	0.13		0.13	0.13		0.80	0.80		0.80	0.80	
Clearance Time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	124	228		148	226		480	1398		858	1477	
v/s Ratio Prot		0.05			0.06			0.14			c0.41	
v/s Ratio Perm	0.02			c0.08			0.01			0.11		
v/c Ratio	0.15	0.38		0.59	0.51		0.01	0.18		0.14	0.51	
Uniform Delay, d1	46.5	47.9		49.4	48.8		2.5	2.9		2.8	4.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.5	1.1		6.3	1.8		0.0	0.3		0.3	1.3	
Delay (s)	47.0	49.0		55.6	50.6		2.6	3.2		3.2	5.5	
Level of Service	D	D		E	D		A	A		A	A	
Approach Delay (s)		48.7			52.6			3.2			5.2	
Approach LOS		D			D			A			A	

Intersection Summary			
HCM 2000 Control Delay	15.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	9.2
Intersection Capacity Utilization	62.5%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Queues
2: Willow Rd & Middlefield Rd

Existing Conditions
Timing Plan: P.M. Peak

	↗	→	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	127	584	133	710	99	48	123	319	243	244	354
v/c Ratio	0.36	0.79	0.28	0.78	0.23	0.19	0.45	0.66	0.68	0.67	0.81
Control Delay	54.8	62.8	46.2	56.3	16.8	59.5	63.9	13.0	63.3	62.7	47.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	54.8	62.8	46.2	56.3	16.8	59.5	63.9	13.0	63.3	62.7	47.0
Queue Length 50th (ft)	123	313	109	374	20	42	113	0	246	246	216
Queue Length 95th (ft)	210	420	182	484	80	80	172	48	330	331	309
Internal Link Dist (ft)		465		339			466			185	
Turn Bay Length (ft)	270		120		65	75		110	150		65
Base Capacity (vph)	433	907	612	1171	531	408	429	580	517	525	570
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.29	0.64	0.22	0.61	0.19	0.12	0.29	0.55	0.47	0.46	0.62

Intersection Summary

2: Willow Rd & Middlefield Rd

Timing Plan: P.M. Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↰↑↱		↰	↑↑↱	↱	↰	↑	↱	↰	↰↑	↱
Traffic Volume (vph)	130	511	14	128	671	106	39	100	258	352	57	297
Future Volume (vph)	130	511	14	128	671	106	39	100	258	352	57	297
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.3	5.3		5.3	5.3	5.3	4.7	4.7	4.7	4.7	4.7	4.7
Lane Util. Factor	0.91	0.91		1.00	0.91	0.91	1.00	1.00	1.00	0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.97	1.00	1.00	0.92	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.97	1.00
Satd. Flow (prot)	1610	3369		1770	3381	1400	1770	1863	1458	1681	1708	1531
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.97	1.00
Satd. Flow (perm)	1610	3369		1770	3381	1400	1770	1863	1458	1681	1708	1531
Peak-hour factor, PHF	0.92	0.92	0.92	0.96	0.96	0.96	0.81	0.81	0.81	0.84	0.84	0.84
Adj. Flow (vph)	141	555	15	133	699	110	48	123	319	419	68	354
RTOR Reduction (vph)	0	1	0	0	1	55	0	0	272	0	0	114
Lane Group Flow (vph)	127	583	0	133	709	44	48	123	47	243	244	240
Confl. Peds. (#/hr)			5			9			28			11
Confl. Bikes (#/hr)			6			3			19			6
Turn Type	Split	NA		Split	NA	Perm	Split	NA	Perm	Split	NA	Perm
Protected Phases	2	2		3	3		1	1		4	4	
Permitted Phases						3			1			4
Actuated Green, G (s)	30.4	30.4		37.2	37.2	37.2	20.3	20.3	20.3	29.6	29.6	29.6
Effective Green, g (s)	30.4	30.4		37.2	37.2	37.2	20.3	20.3	20.3	29.6	29.6	29.6
Actuated g/C Ratio	0.22	0.22		0.27	0.27	0.27	0.15	0.15	0.15	0.22	0.22	0.22
Clearance Time (s)	5.3	5.3		5.3	5.3	5.3	4.7	4.7	4.7	4.7	4.7	4.7
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	355	744		478	914	378	261	275	215	361	367	329
v/s Ratio Prot	0.08	c0.17		0.08	c0.21		0.03	c0.07		0.14	0.14	
v/s Ratio Perm						0.03			0.03			c0.16
v/c Ratio	0.36	0.78		0.28	0.78	0.12	0.18	0.45	0.22	0.67	0.66	0.73
Uniform Delay, d1	45.3	50.5		39.6	46.3	37.8	51.3	53.5	51.6	49.5	49.4	50.2
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.6	5.4		0.3	4.2	0.1	0.3	1.2	0.5	4.9	4.5	8.1
Delay (s)	45.9	55.9		39.9	50.5	37.9	51.7	54.6	52.1	54.4	53.9	58.3
Level of Service	D	E		D	D	D	D	D	D	D	D	E
Approach Delay (s)		54.1			47.7			52.7			55.9	
Approach LOS		D			D			D			E	

Intersection Summary			
HCM 2000 Control Delay	52.3	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	137.5	Sum of lost time (s)	20.0
Intersection Capacity Utilization	71.1%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
3: Palo Alto Ave/Woodland Ave & Middlefield Rd

Existing Conditions
Timing Plan: P.M. Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↱			✥		↰		↱
Traffic Volume (veh/h)	196	914	0	0	767	48	0	0	0	22	0	92
Future Volume (Veh/h)	196	914	0	0	767	48	0	0	0	22	0	92
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.83	0.83	0.83	0.92	0.92	0.92	0.25	0.25	0.25	0.73	0.73	0.73
Hourly flow rate (vph)	236	1101	0	0	834	52	0	0	0	30	0	126
Pedestrians					4			2			12	
Lane Width (ft)					12.0			12.0			12.0	
Walking Speed (ft/s)					3.5			3.5			3.5	
Percent Blockage					0			0			1	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		398										
pX, platoon unblocked				0.86			0.86	0.86	0.86	0.86	0.86	
vC, conflicting volume	898			1103			2561	2473	556	1898	2447	872
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	898			801			2491	2389	167	1723	2359	872
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	68			100			100	100	100	17	100	57
cM capacity (veh/h)	743			704			5	19	727	36	20	290

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	NB 1	SB 1	SB 2
Volume Total	236	550	550	886	0	30	126
Volume Left	236	0	0	0	0	30	0
Volume Right	0	0	0	52	0	0	126
cSH	743	1700	1700	1700	1700	36	290
Volume to Capacity	0.32	0.32	0.32	0.52	0.00	0.83	0.43
Queue Length 95th (ft)	34	0	0	0	0	75	52
Control Delay (s)	12.1	0.0	0.0	0.0	0.0	260.5	26.6
Lane LOS	B				A	F	D
Approach Delay (s)	2.1			0.0	0.0	71.5	
Approach LOS					A	F	

Intersection Summary			
Average Delay	5.9		
Intersection Capacity Utilization	68.8%	ICU Level of Service	C
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
4: Middlefield Rd & Palo Alto Ave

Existing Conditions
Timing Plan: P.M. Peak

	↗	→	←	↖	↘	↙
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↱		↰↱	
Traffic Volume (veh/h)	43	865	807	2	1	35
Future Volume (Veh/h)	43	865	807	2	1	35
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.94	0.94	0.89	0.89	0.69	0.69
Hourly flow rate (vph)	46	920	907	2	1	51
Pedestrians			2		14	
Lane Width (ft)			12.0		12.0	
Walking Speed (ft/s)			3.5		3.5	
Percent Blockage			0		1	
Right turn flare (veh)						
Median type		None	TWLTL			
Median storage veh)			2			
Upstream signal (ft)		892				
pX, platoon unblocked					0.82	
vC, conflicting volume	923				1936	922
vC1, stage 1 conf vol					922	
vC2, stage 2 conf vol					1014	
vCu, unblocked vol	923				2033	922
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)					5.4	
tF (s)	2.2				3.5	3.3
p0 queue free %	94				100	84
cM capacity (veh/h)	730				233	323

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	46	920	909	52
Volume Left	46	0	0	1
Volume Right	0	0	2	51
cSH	730	1700	1700	321
Volume to Capacity	0.06	0.54	0.53	0.16
Queue Length 95th (ft)	5	0	0	14
Control Delay (s)	10.3	0.0	0.0	18.4
Lane LOS	B			C
Approach Delay (s)	0.5		0.0	18.4
Approach LOS				C

Intersection Summary			
Average Delay	0.7		
Intersection Capacity Utilization	55.5%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↱		Y	
Traffic Volume (veh/h)	1	51	104	100	18	3
Future Volume (Veh/h)	1	51	104	100	18	3
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.76	0.76	0.86	0.86	0.53	0.53
Hourly flow rate (vph)	1	67	121	116	34	6
Pedestrians					7	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					3.5	
Percent Blockage					1	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	244				255	186
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	244				255	186
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				95	99
cM capacity (veh/h)	1313				728	850

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	68	237	40
Volume Left	1	0	34
Volume Right	0	116	6
cSH	1313	1700	744
Volume to Capacity	0.00	0.14	0.05
Queue Length 95th (ft)	0	0	4
Control Delay (s)	0.1	0.0	10.1
Lane LOS	A		B
Approach Delay (s)	0.1	0.0	10.1
Approach LOS			B

Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	22.2%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection: 6: Woodland Ave & Pope St/Chaucer St

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	66	131	86	81
Average Queue (ft)	30	83	43	43
95th Queue (ft)	53	124	71	68
Link Distance (ft)	288	125	400	344
Upstream Blk Time (%)		1		
Queuing Penalty (veh)		3		
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	6	60	3	32	187	260	14	129	27	113	45	3
Future Volume (vph)	6	60	3	32	187	260	14	129	27	113	45	3
Peak Hour Factor	0.73	0.73	0.73	0.91	0.91	0.91	0.78	0.78	0.78	0.82	0.82	0.82
Hourly flow rate (vph)	8	82	4	35	205	286	18	165	35	138	55	4

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	94	526	218	197
Volume Left (vph)	8	35	18	138
Volume Right (vph)	4	286	35	4
Hadj (s)	0.03	-0.28	-0.05	0.16
Departure Headway (s)	6.1	5.1	6.0	6.2
Degree Utilization, x	0.16	0.74	0.36	0.34
Capacity (veh/h)	505	526	542	522
Control Delay (s)	10.3	21.2	12.3	12.3
Approach Delay (s)	10.3	21.2	12.3	12.3
Approach LOS	B	C	B	B

Intersection Summary			
Delay	16.6		
Level of Service	C		
Intersection Capacity Utilization	63.8%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Volume (veh/h)	3	144	51	3	261	8	204	7	15	1	0	5
Future Volume (Veh/h)	3	144	51	3	261	8	204	7	15	1	0	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.85	0.85	0.85	0.83	0.83	0.83	0.83	0.83	0.83	0.50	0.50	0.50
Hourly flow rate (vph)	4	169	60	4	314	10	246	8	18	2	0	10
Pedestrians		3			12			16			20	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		0			1			2			2	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					517							
pX, platoon unblocked	0.94						0.94	0.94		0.94	0.94	0.94
vC, conflicting volume	344			245			563	575	227	588	600	342
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	274			245			506	519	227	533	545	272
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			42	98	98	99	100	99
cM capacity (veh/h)	1192			1301			422	417	791	391	403	707

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	233	328	272	12
Volume Left	4	4	246	2
Volume Right	60	10	18	10
cSH	1192	1301	435	623
Volume to Capacity	0.00	0.00	0.63	0.02
Queue Length 95th (ft)	0	0	104	1
Control Delay (s)	0.2	0.1	26.1	10.9
Lane LOS	A	A	D	B
Approach Delay (s)	0.2	0.1	26.1	10.9
Approach LOS			D	B

Intersection Summary			
Average Delay	8.7		
Intersection Capacity Utilization	41.9%	ICU Level of Service	A
Analysis Period (min)	15		

Queues
8: University Ave & Chaucer St

	→	←	↑	↓
Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	173	269	138	528
v/c Ratio	0.33	0.50	0.18	0.59
Control Delay	14.1	18.3	7.5	11.6
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	14.1	18.3	7.5	11.6
Queue Length 50th (ft)	27	53	16	78
Queue Length 95th (ft)	88	129	46	208
Internal Link Dist (ft)	437	466	382	498
Turn Bay Length (ft)				
Base Capacity (vph)	1040	1105	1535	1767
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.17	0.24	0.09	0.30

Intersection Summary

HCM Signalized Intersection Capacity Analysis
8: University Ave & Chaucer St

Existing Conditions
Timing Plan: P.M. Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Volume (vph)	6	95	54	2	212	4	25	78	5	14	404	42
Future Volume (vph)	6	95	54	2	212	4	25	78	5	14	404	42
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0			5.0			5.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		0.99			1.00			1.00			1.00	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		0.95			1.00			0.99			0.99	
Flt Protected		1.00			1.00			0.99			1.00	
Satd. Flow (prot)		1751			1856			1826			1831	
Flt Permitted		0.98			1.00			0.85			0.99	
Satd. Flow (perm)		1728			1853			1579			1818	
Peak-hour factor, PHF	0.90	0.90	0.90	0.81	0.81	0.81	0.78	0.78	0.78	0.87	0.87	0.87
Adj. Flow (vph)	7	106	60	2	262	5	32	100	6	16	464	48
RTOR Reduction (vph)	0	20	0	0	1	0	0	2	0	0	5	0
Lane Group Flow (vph)	0	153	0	0	268	0	0	136	0	0	523	0
Confl. Peds. (#/hr)	3		4	4		3	8		3	3		8
Confl. Bikes (#/hr)			8			11			12			6
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Actuated Green, G (s)		13.3			13.3			22.6			22.6	
Effective Green, g (s)		13.3			13.3			22.6			22.6	
Actuated g/C Ratio		0.30			0.30			0.50			0.50	
Clearance Time (s)		4.0			4.0			5.0			5.0	
Vehicle Extension (s)		3.0			3.0			4.0			4.0	
Lane Grp Cap (vph)		511			548			794			915	
v/s Ratio Prot												
v/s Ratio Perm		0.09			c0.14			0.09			c0.29	
v/c Ratio		0.30			0.49			0.17			0.57	
Uniform Delay, d1		12.2			13.0			6.1			7.8	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.3			0.7			0.1			1.0	
Delay (s)		12.5			13.7			6.2			8.8	
Level of Service		B			B			A			A	
Approach Delay (s)		12.5			13.7			6.2			8.8	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	10.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	44.9	Sum of lost time (s)	9.0
Intersection Capacity Utilization	46.3%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

9: University Ave & Woodland Ave/Scofield Ave

Timing Plan: P.M. Peak

	↗	→	←	↖	↑	↘	↓	↙
Lane Group	EBL	EBT	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	542	211	568	41	791	147	561	355
v/c Ratio	0.87	0.63	0.99	0.32	0.69	0.64	0.38	0.46
Control Delay	51.4	41.0	56.0	45.3	30.1	48.9	19.5	4.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	51.4	41.0	56.0	45.3	30.1	48.9	19.5	4.3
Queue Length 50th (ft)	154	104	~216	23	195	80	115	0
Queue Length 95th (ft)	#235	178	#419	53	283	134	167	55
Internal Link Dist (ft)		498	512		536		443	
Turn Bay Length (ft)				160		210		
Base Capacity (vph)	648	346	574	334	1154	334	1487	779
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.84	0.61	0.99	0.12	0.69	0.44	0.38	0.46

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↱			✥		↰	↑↱		↰	↑↑	↱
Traffic Volume (vph)	499	153	41	11	67	444	38	705	23	135	516	327
Future Volume (vph)	499	153	41	11	67	444	38	705	23	135	516	327
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0			3.0		3.0	4.0		3.0	4.0	4.0
Lane Util. Factor	0.97	1.00			1.00		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	0.98			1.00		1.00	1.00		1.00	1.00	0.86
Flpb, ped/bikes	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.97			0.89		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	1776			1647		1770	3519		1770	3539	1368
Flt Permitted	0.95	1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	1776			1647		1770	3519		1770	3539	1368
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	542	166	45	12	73	483	41	766	25	147	561	355
RTOR Reduction (vph)	0	11	0	0	220	0	0	3	0	0	0	211
Lane Group Flow (vph)	542	200	0	0	348	0	41	788	0	147	561	144
Confl. Peds. (#/hr)			47						1			40
Confl. Bikes (#/hr)			4						4			7
Turn Type	Split	NA		Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	8	8		7	7		1	6		5	2	
Permitted Phases												2
Actuated Green, G (s)	16.4	16.4			19.4		4.6	29.4		11.8	36.6	36.6
Effective Green, g (s)	16.4	16.4			19.4		4.6	29.4		11.8	36.6	36.6
Actuated g/C Ratio	0.18	0.18			0.22		0.05	0.33		0.13	0.41	0.41
Clearance Time (s)	3.0	3.0			3.0		3.0	4.0		3.0	4.0	4.0
Vehicle Extension (s)	2.0	2.0			2.0		2.0	3.0		2.0	3.0	3.0
Lane Grp Cap (vph)	625	323			355		90	1149		232	1439	556
v/s Ratio Prot	c0.16	0.11			c0.21		0.02	c0.22		c0.08	0.16	
v/s Ratio Perm												0.11
v/c Ratio	0.87	0.62			0.98		0.46	0.69		0.63	0.39	0.26
Uniform Delay, d1	35.7	33.9			35.1		41.5	26.3		37.1	18.8	17.7
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	11.8	2.7			42.4		1.3	3.3		4.1	0.8	1.1
Delay (s)	47.5	36.6			77.6		42.8	29.6		41.2	19.6	18.8
Level of Service	D	D			E		D	C		D	B	B
Approach Delay (s)		44.4			77.6			30.3			22.3	
Approach LOS		D			E			C			C	

Intersection Summary			
HCM 2000 Control Delay	39.3	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	90.7%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Appendix C – Existing Plus Bridge Closure Conditions Synchro Reports

- HCM Delay and LOS Reports
- 95th Percentile Queue Length Reports

	↗	→	↙	←	↖	↑	↘	↓
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	43	134	135	291	5	899	59	908
v/c Ratio	0.86	0.42	0.79	0.92	0.01	0.64	0.17	0.64
Control Delay	150.3	57.7	90.3	89.0	6.2	13.9	6.4	10.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	150.3	57.7	90.3	89.0	6.2	13.9	6.4	10.9
Queue Length 50th (ft)	41	114	127	262	1	302	14	377
Queue Length 95th (ft)	#90	147	#188	#333	m3	363	31	497
Internal Link Dist (ft)		468		521		1923		337
Turn Bay Length (ft)	55		90		75		90	
Base Capacity (vph)	52	336	177	330	337	1398	343	1420
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.83	0.40	0.76	0.88	0.01	0.64	0.17	0.64

Intersection Summary

#	95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.
m	Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑↱		↰	↑↱		↰	↑↱	
Traffic Volume (vph)	32	91	8	107	135	95	4	692	72	56	858	5
Future Volume (vph)	32	91	8	107	135	95	4	692	72	56	858	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	0.99		1.00	0.98		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		0.97	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.94		1.00	0.99		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1765	1830		1721	1715		1770	1828		1770	1861	
Flt Permitted	0.16	1.00		0.53	1.00		0.24	1.00		0.24	1.00	
Satd. Flow (perm)	290	1830		969	1715		443	1828		451	1861	
Peak-hour factor, PHF	0.74	0.74	0.74	0.79	0.79	0.79	0.85	0.85	0.85	0.95	0.95	0.95
Adj. Flow (vph)	43	123	11	135	171	120	5	814	85	59	903	5
RTOR Reduction (vph)	0	2	0	0	17	0	0	2	0	0	0	0
Lane Group Flow (vph)	43	132	0	135	274	0	5	897	0	59	908	0
Confl. Peds. (#/hr)	2		11	11		2	7		8	8		7
Confl. Bikes (#/hr)			5			9			10			20
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			6	
Permitted Phases	4			4			2			6		
Actuated Green, G (s)	26.3	26.3		26.3	26.3		114.5	114.5		114.5	114.5	
Effective Green, g (s)	26.3	26.3		26.3	26.3		114.5	114.5		114.5	114.5	
Actuated g/C Ratio	0.18	0.18		0.18	0.18		0.76	0.76		0.76	0.76	
Clearance Time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	50	320		169	300		338	1395		344	1420	
v/s Ratio Prot		0.07			c0.16			c0.49			0.49	
v/s Ratio Perm	0.15			0.14			0.01			0.13		
v/c Ratio	0.86	0.41		0.80	0.91		0.01	0.64		0.17	0.64	
Uniform Delay, d1	60.1	55.0		59.3	60.7		4.2	8.2		4.8	8.2	
Progression Factor	1.00	1.00		1.00	1.00		1.36	1.42		1.00	1.00	
Incremental Delay, d2	76.1	0.9		22.5	30.2		0.1	1.6		1.1	2.2	
Delay (s)	136.2	55.8		81.9	91.0		5.8	13.3		5.9	10.4	
Level of Service	F	E		F	F		A	B		A	B	
Approach Delay (s)		75.3			88.1			13.3			10.1	
Approach LOS		E			F			B			B	

Intersection Summary			
HCM 2000 Control Delay	29.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	9.2
Intersection Capacity Utilization	75.5%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Queues
2: Willow Rd & Middlefield Rd

Existing + Bridge Closure Conditions

Timing Plan: A.M. Peak

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	226	465	94	478	180	50	313	162	249	256	499
v/c Ratio	0.80	0.79	0.32	0.85	0.61	0.16	0.94	0.49	0.43	0.43	0.74
Control Delay	80.0	69.3	57.9	75.1	39.2	53.3	96.9	30.1	37.5	37.5	24.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	80.0	69.3	57.9	75.1	39.2	53.3	96.9	30.1	37.5	37.5	24.3
Queue Length 50th (ft)	232	237	81	249	94	42	305	63	215	222	258
Queue Length 95th (ft)	#346	304	133	303	175	69	#360	101	m307	m315	408
Internal Link Dist (ft)		465		339			466			185	
Turn Bay Length (ft)	270		120		65	75		110	150		65
Base Capacity (vph)	308	639	305	581	303	322	339	338	580	594	674
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.73	0.73	0.31	0.82	0.59	0.16	0.92	0.48	0.43	0.43	0.74

Intersection Summary

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

2: Willow Rd & Middlefield Rd

Timing Plan: A.M. Peak

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↰↑↑↱		↰	↑↑↱	↱	↰	↑	↱	↰	↰↑	↱
Traffic Volume (vph)	283	322	17	81	394	172	38	238	123	367	102	464
Future Volume (vph)	283	322	17	81	394	172	38	238	123	367	102	464
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.3	5.3		5.3	5.3	5.3	4.7	4.7	4.7	4.7	4.7	4.7
Lane Util. Factor	0.91	0.91		1.00	0.91	0.91	1.00	1.00	1.00	0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.94	1.00	1.00	0.92	1.00	1.00	0.94
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99		1.00	0.99	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	0.99		0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.97	1.00
Satd. Flow (prot)	1610	3333		1770	3360	1354	1770	1863	1458	1681	1721	1484
Flt Permitted	0.95	0.99		0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.97	1.00
Satd. Flow (perm)	1610	3333		1770	3360	1354	1770	1863	1458	1681	1721	1484
Peak-hour factor, PHF	0.90	0.90	0.90	0.86	0.86	0.86	0.76	0.76	0.76	0.93	0.93	0.93
Adj. Flow (vph)	314	358	19	94	458	200	50	313	162	395	110	499
RTOR Reduction (vph)	0	2	0	0	2	71	0	0	73	0	0	162
Lane Group Flow (vph)	226	463	0	94	476	109	50	313	89	249	256	337
Confl. Peds. (#/hr)			1			22			31			23
Confl. Bikes (#/hr)			6			9			16			28
Turn Type	Split	NA		Split	NA	Perm	Split	NA	Perm	Split	NA	Perm
Protected Phases	2	2		3	3		1	1		4	4	
Permitted Phases						3			1			4
Actuated Green, G (s)	26.3	26.3		25.1	25.1	25.1	26.8	26.8	26.8	51.8	51.8	51.8
Effective Green, g (s)	26.3	26.3		25.1	25.1	25.1	26.8	26.8	26.8	51.8	51.8	51.8
Actuated g/C Ratio	0.18	0.18		0.17	0.17	0.17	0.18	0.18	0.18	0.35	0.35	0.35
Clearance Time (s)	5.3	5.3		5.3	5.3	5.3	4.7	4.7	4.7	4.7	4.7	4.7
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	282	584		296	562	226	316	332	260	580	594	512
v/s Ratio Prot	c0.14	0.14		0.05	c0.14		0.03	c0.17		0.15	0.15	
v/s Ratio Perm						0.08			0.06			c0.23
v/c Ratio	0.80	0.79		0.32	0.85	0.48	0.16	0.94	0.34	0.43	0.43	0.66
Uniform Delay, d1	59.3	59.2		54.9	60.6	56.6	52.1	60.8	53.9	37.7	37.8	41.6
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.91	0.85
Incremental Delay, d2	15.0	7.3		0.6	11.4	1.6	0.2	34.5	0.8	1.7	1.7	4.9
Delay (s)	74.3	66.6		55.5	72.0	58.2	52.3	95.3	54.7	36.0	36.0	40.2
Level of Service	E	E		E	E	E	D	F	D	D	D	D
Approach Delay (s)		69.1			66.6			78.7			38.1	
Approach LOS		E			E			E			D	

Intersection Summary			
HCM 2000 Control Delay	59.7	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	90.8%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
3: Palo Alto Ave/Woodland Ave & Middlefield Rd

Existing + Bridge Closure Conditions
Timing Plan: A.M. Peak

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↱			✥		↰		↱
Traffic Volume (veh/h)	84	721	0	0	501	38	0	0	0	222	0	147
Future Volume (Veh/h)	84	721	0	0	501	38	0	0	0	222	0	147
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.97	0.97	0.97	0.92	0.92	0.92	0.25	0.25	0.25	0.99	0.99	0.99
Hourly flow rate (vph)	87	743	0	0	545	41	0	0	0	224	0	148
Pedestrians					6			6			5	
Lane Width (ft)					12.0			12.0			12.0	
Walking Speed (ft/s)					3.5			3.5			3.5	
Percent Blockage					1			1			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		398										
pX, platoon unblocked				0.94			0.94	0.94	0.94	0.94	0.94	
vC, conflicting volume	591			749			1636	1514	384	1122	1494	570
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	591			594			1543	1412	204	993	1390	570
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	91			100			100	100	100	0	100	68
cM capacity (veh/h)	976			910			46	115	743	171	119	462

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	NB 1	SB 1	SB 2
Volume Total	87	372	372	586	0	224	148
Volume Left	87	0	0	0	0	224	0
Volume Right	0	0	0	41	0	0	148
cSH	976	1700	1700	1700	1700	171	462
Volume to Capacity	0.09	0.22	0.22	0.34	0.00	1.31	0.32
Queue Length 95th (ft)	7	0	0	0	0	327	34
Control Delay (s)	9.0	0.0	0.0	0.0	0.0	227.4	16.4
Lane LOS	A				A	F	C
Approach Delay (s)	0.9			0.0	0.0	143.4	
Approach LOS					A	F	

Intersection Summary			
Average Delay	30.3		
Intersection Capacity Utilization	62.3%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↱		↰↱	
Traffic Volume (veh/h)	24	925	507	5	2	32
Future Volume (Veh/h)	24	925	507	5	2	32
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.94	0.94	0.95	0.95	0.92	0.92
Hourly flow rate (vph)	26	984	534	5	2	35
Pedestrians		2	4		10	
Lane Width (ft)		12.0	12.0		12.0	
Walking Speed (ft/s)		3.5	3.5		3.5	
Percent Blockage		0	0		1	
Right turn flare (veh)						
Median type		None	TWLTL			
Median storage veh)			2			
Upstream signal (ft)		892				
pX, platoon unblocked					0.86	
vC, conflicting volume	549				1586	548
vC1, stage 1 conf vol					546	
vC2, stage 2 conf vol					1040	
vCu, unblocked vol	549				1601	548
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)					5.4	
tF (s)	2.2				3.5	3.3
p0 queue free %	97				99	93
cM capacity (veh/h)	1011				276	530

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	26	984	539	37
Volume Left	26	0	0	2
Volume Right	0	0	5	35
cSH	1011	1700	1700	505
Volume to Capacity	0.03	0.58	0.32	0.07
Queue Length 95th (ft)	2	0	0	6
Control Delay (s)	8.7	0.0	0.0	12.7
Lane LOS	A			B
Approach Delay (s)	0.2		0.0	12.7
Approach LOS				B

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	59.3%	ICU Level of Service	B
Analysis Period (min)	15		

5: Pope St & Central Ave

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↱		Y	
Traffic Volume (veh/h)	2	78	37	17	82	2
Future Volume (Veh/h)	2	78	37	17	82	2
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.72	0.72	0.84	0.84
Hourly flow rate (vph)	2	85	51	24	98	2
Pedestrians					8	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					3.5	
Percent Blockage					1	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	83				160	71
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	83				160	71
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				88	100
cM capacity (veh/h)	1503				824	984

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	87	75	100
Volume Left	2	0	98
Volume Right	0	24	2
cSH	1503	1700	826
Volume to Capacity	0.00	0.04	0.12
Queue Length 95th (ft)	0	0	10
Control Delay (s)	0.2	0.0	10.0
Lane LOS	A		A
Approach Delay (s)	0.2	0.0	10.0
Approach LOS			A

Intersection Summary			
Average Delay	3.9		
Intersection Capacity Utilization	17.0%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection: 6: Woodland Ave & Pope St/Chaucer St

Movement	EB	NB	SB
Directions Served	LTR	LTR	LTR
Maximum Queue (ft)	68	54	81
Average Queue (ft)	37	24	43
95th Queue (ft)	59	43	67
Link Distance (ft)	283	395	346
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

HCM Unsignalized Intersection Capacity Analysis
6: Woodland Ave & Pope St/Chaucer St

Existing + Bridge Closure Conditions
Timing Plan: A.M. Peak

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	25	0	134	0	0	0	20	58	0	0	138	32
Future Volume (vph)	25	0	134	0	0	0	20	58	0	0	138	32
Peak Hour Factor	0.88	0.88	0.88	0.82	0.82	0.82	0.79	0.79	0.79	0.94	0.94	0.94
Hourly flow rate (vph)	28	0	152	0	0	0	25	73	0	0	147	34

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	180	0	98	181
Volume Left (vph)	28	0	25	0
Volume Right (vph)	152	0	0	34
Hadj (s)	-0.44	0.00	0.09	-0.08
Departure Headway (s)	4.1	4.7	4.6	4.3
Degree Utilization, x	0.20	0.00	0.12	0.22
Capacity (veh/h)	821	705	744	788
Control Delay (s)	8.1	7.7	8.2	8.5
Approach Delay (s)	8.1	0.0	8.2	8.5
Approach LOS	A	A	A	A

Intersection Summary			
Delay	8.3		
Level of Service	A		
Intersection Capacity Utilization	34.6%	ICU Level of Service	A
Analysis Period (min)	15		

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Volume (veh/h)	0	0	0	3	0	1	0	2	6	2	2	0
Future Volume (Veh/h)	0	0	0	3	0	1	0	2	6	2	2	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.94	0.94	0.94	0.85	0.85	0.85	0.92	0.92	0.92	0.25	0.25	0.25
Hourly flow rate (vph)	0	0	0	4	0	1	0	2	7	8	8	0
Pedestrians		2			3			2			8	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		0			0			0			1	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					517							
pX, platoon unblocked												
vC, conflicting volume	9			2			16	19	5	28	18	10
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	9			2			16	19	5	28	18	10
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	99	99	99	100
cM capacity (veh/h)	1599			1617			979	864	1073	955	865	1060

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	0	5	9	16
Volume Left	0	4	0	8
Volume Right	0	1	7	0
cSH	1700	1617	1018	908
Volume to Capacity	0.00	0.00	0.01	0.02
Queue Length 95th (ft)	0	0	1	1
Control Delay (s)	0.0	5.8	8.6	9.0
Lane LOS		A	A	A
Approach Delay (s)	0.0	5.8	8.6	9.0
Approach LOS			A	A

Intersection Summary			
Average Delay	8.4		
Intersection Capacity Utilization	16.6%	ICU Level of Service	A
Analysis Period (min)	15		

	→	←	↑	↓
Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	8	71	394	766
v/c Ratio	0.03	0.23	0.26	0.50
Control Delay	20.6	13.0	2.8	4.5
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	20.6	13.0	2.8	4.5
Queue Length 50th (ft)	1	3	31	81
Queue Length 95th (ft)	14	24	70	174
Internal Link Dist (ft)	437	466	382	498
Turn Bay Length (ft)				
Base Capacity (vph)	987	986	1787	1781
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.01	0.07	0.22	0.43

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Volume (vph)	2	2	4	7	2	40	1	361	1	7	674	1
Future Volume (vph)	2	2	4	7	2	40	1	361	1	7	674	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0			5.0			5.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		0.94			0.94			1.00			1.00	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		0.93			0.89			1.00			1.00	
Flt Protected		0.99			0.99			1.00			1.00	
Satd. Flow (prot)		1619			1546			1862			1861	
Flt Permitted		0.92			0.95			1.00			1.00	
Satd. Flow (perm)		1500			1476			1860			1855	
Peak-hour factor, PHF	0.90	0.90	0.90	0.69	0.69	0.69	0.92	0.92	0.92	0.89	0.89	0.89
Adj. Flow (vph)	2	2	4	10	3	58	1	392	1	8	757	1
RTOR Reduction (vph)	0	4	0	0	54	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	4	0	0	17	0	0	394	0	0	766	0
Confl. Peds. (#/hr)	6		4	4		6	5		3	3		5
Confl. Bikes (#/hr)			18			10			7			23
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Actuated Green, G (s)		3.5			3.5			33.3			33.3	
Effective Green, g (s)		3.5			3.5			33.3			33.3	
Actuated g/C Ratio		0.08			0.08			0.73			0.73	
Clearance Time (s)		4.0			4.0			5.0			5.0	
Vehicle Extension (s)		3.0			3.0			4.0			4.0	
Lane Grp Cap (vph)		114			112			1352			1348	
v/s Ratio Prot												
v/s Ratio Perm		0.00			c0.01			0.21			c0.41	
v/c Ratio		0.04			0.16			0.29			0.57	
Uniform Delay, d1		19.6			19.8			2.2			2.9	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.1			0.7			0.2			0.7	
Delay (s)		19.7			20.4			2.3			3.6	
Level of Service		B			C			A			A	
Approach Delay (s)		19.7			20.4			2.3			3.6	
Approach LOS		B			C			A			A	

Intersection Summary			
HCM 2000 Control Delay	4.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	45.8	Sum of lost time (s)	9.0
Intersection Capacity Utilization	55.2%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Queues
9: University Ave & Woodland Ave/Scofield Ave

Existing + Bridge Closure Conditions

Timing Plan: A.M. Peak

Lane Group	EBL	EBT	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	424	219	490	108	653	253	1022	570
v/c Ratio	0.88	0.78	1.07	0.57	0.62	0.75	0.72	0.62
Control Delay	57.4	45.9	89.9	47.1	29.3	45.6	25.6	5.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	57.4	45.9	89.9	47.1	29.3	45.6	25.6	5.3
Queue Length 50th (ft)	115	84	~253	56	153	128	239	0
Queue Length 95th (ft)	#195	#194	#442	103	231	192	329	71
Internal Link Dist (ft)		498	512		536		443	
Turn Bay Length (ft)				160		210		
Base Capacity (vph)	484	284	457	249	1051	458	1420	915
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.88	0.77	1.07	0.43	0.62	0.55	0.72	0.62

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

9: University Ave & Woodland Ave/Scofield Ave

Timing Plan: A.M. Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↱			✥		↰	↑↱		↰	↑↑	↱
Traffic Volume (vph)	390	93	109	15	121	315	99	588	13	233	940	524
Future Volume (vph)	390	93	109	15	121	315	99	588	13	233	940	524
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0			3.0		3.0	4.0		3.0	4.0	4.0
Lane Util. Factor	0.97	1.00			1.00		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	0.97			0.99		1.00	1.00		1.00	1.00	0.90
Flpb, ped/bikes	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.92			0.91		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	1659			1668		1770	3526		1770	3539	1431
Flt Permitted	0.95	1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	1659			1668		1770	3526		1770	3539	1431
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	424	101	118	16	132	342	108	639	14	253	1022	570
RTOR Reduction (vph)	0	50	0	0	95	0	0	1	0	0	0	345
Lane Group Flow (vph)	424	169	0	0	395	0	108	652	0	253	1022	225
Confl. Peds. (#/hr)			39						3			26
Confl. Bikes (#/hr)			2			2						10
Turn Type	Split	NA		Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	8	8		7	7		1	6		5	2	
Permitted Phases												2
Actuated Green, G (s)	11.9	11.9			18.5		8.1	25.3		16.3	33.5	33.5
Effective Green, g (s)	11.9	11.9			18.5		8.1	25.3		16.3	33.5	33.5
Actuated g/C Ratio	0.14	0.14			0.22		0.10	0.30		0.19	0.39	0.39
Clearance Time (s)	3.0	3.0			3.0		3.0	4.0		3.0	4.0	4.0
Vehicle Extension (s)	2.0	2.0			2.0		2.0	3.0		2.0	3.0	3.0
Lane Grp Cap (vph)	480	232			363		168	1049		339	1394	563
v/s Ratio Prot	c0.12	0.10			c0.24		0.06	0.18		c0.14	c0.29	
v/s Ratio Perm												0.16
v/c Ratio	0.88	0.73			1.09		0.64	0.62		0.75	0.73	0.40
Uniform Delay, d1	35.9	35.0			33.2		37.1	25.7		32.4	21.9	18.5
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	16.9	9.3			72.5		6.2	2.8		7.6	3.4	2.1
Delay (s)	52.7	44.3			105.8		43.2	28.5		40.0	25.4	20.6
Level of Service	D	D			F		D	C		D	C	C
Approach Delay (s)		49.9			105.8			30.6			25.9	
Approach LOS		D			F			C			C	

Intersection Summary			
HCM 2000 Control Delay	41.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	85.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	88.9%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Queues
1: Willow Rd & Gilbert Ave

Existing + Bridge Closure Conditions
Timing Plan: P.M. Peak

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	18	96	88	127	5	262	121	757
v/c Ratio	0.14	0.41	0.59	0.53	0.01	0.19	0.14	0.51
Control Delay	45.6	46.2	63.8	50.1	4.0	3.4	4.0	6.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	45.6	46.2	63.8	50.1	4.0	3.4	4.0	6.5
Queue Length 50th (ft)	13	63	66	84	1	30	16	152
Queue Length 95th (ft)	29	93	113	137	3	44	32	207
Internal Link Dist (ft)		468		521		1923		337
Turn Bay Length (ft)	55		90		75		90	
Base Capacity (vph)	181	340	216	341	480	1406	858	1477
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.28	0.41	0.37	0.01	0.19	0.14	0.51

Intersection Summary

HCM Signalized Intersection Capacity Analysis
1: Willow Rd & Gilbert Ave

Existing + Bridge Closure Conditions
Timing Plan: P.M. Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱		↰	↱	
Traffic Volume (vph)	14	60	16	78	82	31	3	122	43	87	538	7
Future Volume (vph)	14	60	16	78	82	31	3	122	43	87	538	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	0.98		1.00	1.00	
Flpb, ped/bikes	0.99	1.00		0.98	1.00		0.99	1.00		0.97	1.00	
Frt	1.00	0.97		1.00	0.96		1.00	0.96		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1747	1778		1733	1768		1760	1759		1717	1858	
Flt Permitted	0.53	1.00		0.64	1.00		0.33	1.00		0.60	1.00	
Satd. Flow (perm)	973	1778		1161	1768		603	1759		1080	1858	
Peak-hour factor, PHF	0.79	0.79	0.79	0.89	0.89	0.89	0.63	0.63	0.63	0.72	0.72	0.72
Adj. Flow (vph)	18	76	20	88	92	35	5	194	68	121	747	10
RTOR Reduction (vph)	0	9	0	0	12	0	0	8	0	0	0	0
Lane Group Flow (vph)	18	87	0	88	115	0	5	254	0	121	757	0
Confl. Peds. (#/hr)	6		9	9		6	8		17	17		8
Confl. Bikes (#/hr)			9						11			4
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			6	
Permitted Phases	4			4			2			6		
Actuated Green, G (s)	15.4	15.4		15.4	15.4		95.4	95.4		95.4	95.4	
Effective Green, g (s)	15.4	15.4		15.4	15.4		95.4	95.4		95.4	95.4	
Actuated g/C Ratio	0.13	0.13		0.13	0.13		0.80	0.80		0.80	0.80	
Clearance Time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	124	228		148	226		479	1398		858	1477	
v/s Ratio Prot		0.05			0.06			0.14			c0.41	
v/s Ratio Perm	0.02			c0.08			0.01			0.11		
v/c Ratio	0.15	0.38		0.59	0.51		0.01	0.18		0.14	0.51	
Uniform Delay, d1	46.5	47.9		49.4	48.8		2.5	2.9		2.8	4.3	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.5	1.1		6.3	1.8		0.0	0.3		0.3	1.3	
Delay (s)	47.0	49.0		55.6	50.6		2.6	3.2		3.2	5.5	
Level of Service	D	D		E	D		A	A		A	A	
Approach Delay (s)		48.7			52.6			3.2			5.2	
Approach LOS		D			D			A			A	

Intersection Summary			
HCM 2000 Control Delay	15.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	9.2
Intersection Capacity Utilization	62.6%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	127	584	133	710	99	48	123	319	244	244	354
v/c Ratio	0.36	0.79	0.28	0.78	0.23	0.19	0.45	0.66	0.68	0.67	0.81
Control Delay	54.8	62.8	46.2	56.4	16.8	59.5	63.9	13.0	63.4	62.7	46.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	54.8	62.8	46.2	56.4	16.8	59.5	63.9	13.0	63.4	62.7	46.9
Queue Length 50th (ft)	123	313	109	374	20	42	113	0	247	246	216
Queue Length 95th (ft)	210	420	182	484	80	80	172	48	332	331	309
Internal Link Dist (ft)		465		339			466			185	
Turn Bay Length (ft)	270		120		65	75		110	150		65
Base Capacity (vph)	433	907	612	1170	531	408	429	580	516	525	570
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.29	0.64	0.22	0.61	0.19	0.12	0.29	0.55	0.47	0.46	0.62

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↰↱		↰	↑↱	↱	↰	↑	↱	↰	↰	↱
Traffic Volume (vph)	130	511	14	128	671	106	39	100	258	353	57	297
Future Volume (vph)	130	511	14	128	671	106	39	100	258	353	57	297
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.3	5.3		5.3	5.3	5.3	4.7	4.7	4.7	4.7	4.7	4.7
Lane Util. Factor	0.91	0.91		1.00	0.91	0.91	1.00	1.00	1.00	0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.97	1.00	1.00	0.92	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.97	1.00
Satd. Flow (prot)	1610	3369		1770	3381	1400	1770	1863	1458	1681	1708	1531
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.97	1.00
Satd. Flow (perm)	1610	3369		1770	3381	1400	1770	1863	1458	1681	1708	1531
Peak-hour factor, PHF	0.92	0.92	0.92	0.96	0.96	0.96	0.81	0.81	0.81	0.84	0.84	0.84
Adj. Flow (vph)	141	555	15	133	699	110	48	123	319	420	68	354
RTOR Reduction (vph)	0	1	0	0	1	55	0	0	272	0	0	114
Lane Group Flow (vph)	127	583	0	133	709	44	48	123	47	244	244	240
Confl. Peds. (#/hr)			5			9			28			11
Confl. Bikes (#/hr)			6			3			19			6
Turn Type	Split	NA		Split	NA	Perm	Split	NA	Perm	Split	NA	Perm
Protected Phases	2	2		3	3		1	1		4	4	
Permitted Phases						3			1			4
Actuated Green, G (s)	30.4	30.4		37.2	37.2	37.2	20.3	20.3	20.3	29.6	29.6	29.6
Effective Green, g (s)	30.4	30.4		37.2	37.2	37.2	20.3	20.3	20.3	29.6	29.6	29.6
Actuated g/C Ratio	0.22	0.22		0.27	0.27	0.27	0.15	0.15	0.15	0.22	0.22	0.22
Clearance Time (s)	5.3	5.3		5.3	5.3	5.3	4.7	4.7	4.7	4.7	4.7	4.7
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	355	744		478	914	378	261	275	215	361	367	329
v/s Ratio Prot	0.08	c0.17		0.08	c0.21		0.03	c0.07		0.15	0.14	
v/s Ratio Perm						0.03			0.03			c0.16
v/c Ratio	0.36	0.78		0.28	0.78	0.12	0.18	0.45	0.22	0.68	0.66	0.73
Uniform Delay, d1	45.3	50.5		39.6	46.3	37.8	51.3	53.5	51.6	49.5	49.4	50.2
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.6	5.4		0.3	4.2	0.1	0.3	1.2	0.5	4.9	4.5	8.1
Delay (s)	45.9	55.9		39.9	50.5	37.9	51.7	54.6	52.1	54.5	53.9	58.3
Level of Service	D	E		D	D	D	D	D	D	D	D	E
Approach Delay (s)		54.1			47.7			52.7			55.9	
Approach LOS		D			D			D			E	

Intersection Summary			
HCM 2000 Control Delay	52.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	137.5	Sum of lost time (s)	20.0
Intersection Capacity Utilization	71.1%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
3: Palo Alto Ave/Woodland Ave & Middlefield Rd

Existing + Bridge Closure Conditions

Timing Plan: P.M. Peak

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↱			✥		↰		↱
Traffic Volume (veh/h)	196	915	0	0	767	168	0	0	0	135	0	92
Future Volume (Veh/h)	196	915	0	0	767	168	0	0	0	135	0	92
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.83	0.83	0.83	0.92	0.92	0.92	0.25	0.25	0.25	0.73	0.73	0.73
Hourly flow rate (vph)	236	1102	0	0	834	183	0	0	0	185	0	126
Pedestrians					4			2			12	
Lane Width (ft)					12.0			12.0			12.0	
Walking Speed (ft/s)					3.5			3.5			3.5	
Percent Blockage					0			0			1	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		398										
pX, platoon unblocked				0.86			0.86	0.86	0.86	0.86	0.86	
vC, conflicting volume	1029			1104			2628	2605	557	1964	2514	938
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1029			802			2568	2542	168	1799	2436	938
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	64			100			100	100	100	0	100	52
cM capacity (veh/h)	663			704			4	15	727	31	17	263

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	NB 1	SB 1	SB 2
Volume Total	236	551	551	1017	0	185	126
Volume Left	236	0	0	0	0	185	0
Volume Right	0	0	0	183	0	0	126
cSH	663	1700	1700	1700	1700	31	263
Volume to Capacity	0.36	0.32	0.32	0.60	0.00	6.06	0.48
Queue Length 95th (ft)	40	0	0	0	0	Err	61
Control Delay (s)	13.4	0.0	0.0	0.0	0.0	Err	30.7
Lane LOS	B				A	F	D
Approach Delay (s)	2.4			0.0	0.0	5960.4	
Approach LOS					A	F	

Intersection Summary			
Average Delay	696.5		
Intersection Capacity Utilization	84.9%	ICU Level of Service	E
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis

4: Middlefield Rd & Palo Alto Ave

Existing + Bridge Closure Conditions

Timing Plan: P.M. Peak

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↱		↰↱	
Traffic Volume (veh/h)	51	970	925	2	1	37
Future Volume (Veh/h)	51	970	925	2	1	37
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.94	0.94	0.89	0.89	0.69	0.69
Hourly flow rate (vph)	54	1032	1039	2	1	54
Pedestrians			2		14	
Lane Width (ft)			12.0		12.0	
Walking Speed (ft/s)			3.5		3.5	
Percent Blockage			0		1	
Right turn flare (veh)						
Median type		None	TWLTL			
Median storage veh)			2			
Upstream signal (ft)		892				
pX, platoon unblocked					0.82	
vC, conflicting volume	1055				2196	1054
vC1, stage 1 conf vol					1054	
vC2, stage 2 conf vol					1142	
vCu, unblocked vol	1055				2349	1054
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)					5.4	
tF (s)	2.2				3.5	3.3
p0 queue free %	92				99	80
cM capacity (veh/h)	651				193	271

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	54	1032	1041	55
Volume Left	54	0	0	1
Volume Right	0	0	2	54
cSH	651	1700	1700	269
Volume to Capacity	0.08	0.61	0.61	0.20
Queue Length 95th (ft)	7	0	0	19
Control Delay (s)	11.0	0.0	0.0	21.8
Lane LOS	B			C
Approach Delay (s)	0.5		0.0	21.8
Approach LOS				C

Intersection Summary			
Average Delay	0.8		
Intersection Capacity Utilization	61.1%	ICU Level of Service	B
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
5: Pope St & Central Ave

Existing + Bridge Closure Conditions
Timing Plan: P.M. Peak

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	1	50	104	100	18	3
Future Volume (Veh/h)	1	50	104	100	18	3
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.76	0.76	0.86	0.86	0.53	0.53
Hourly flow rate (vph)	1	66	121	116	34	6
Pedestrians					7	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					3.5	
Percent Blockage					1	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	244				254	186
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	244				254	186
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				95	99
cM capacity (veh/h)	1313				729	850

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	67	237	40
Volume Left	1	0	34
Volume Right	0	116	6
cSH	1313	1700	745
Volume to Capacity	0.00	0.14	0.05
Queue Length 95th (ft)	0	0	4
Control Delay (s)	0.1	0.0	10.1
Lane LOS	A		B
Approach Delay (s)	0.1	0.0	10.1
Approach LOS			B

Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	22.2%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection: 6: Woodland Ave & Pope St/Chaucer St

Movement	EB	NB	SB
Directions Served	LTR	LTR	LTR
Maximum Queue (ft)	55	94	89
Average Queue (ft)	29	46	45
95th Queue (ft)	47	74	73
Link Distance (ft)	288	400	344
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

HCM Unsignalized Intersection Capacity Analysis
6: Woodland Ave & Pope St/Chaucer St

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	8	0	60	0	0	0	105	130	0	0	77	98
Future Volume (vph)	8	0	60	0	0	0	105	130	0	0	77	98
Peak Hour Factor	0.73	0.73	0.73	0.91	0.91	0.91	0.78	0.78	0.78	0.82	0.82	0.82
Hourly flow rate (vph)	11	0	82	0	0	0	135	167	0	0	94	120

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	93	0	302	214
Volume Left (vph)	11	0	135	0
Volume Right (vph)	82	0	0	120
Hadj (s)	-0.47	0.00	0.12	-0.30
Departure Headway (s)	4.6	5.2	4.5	4.2
Degree Utilization, x	0.12	0.00	0.37	0.25
Capacity (veh/h)	708	622	783	830
Control Delay (s)	8.2	8.2	10.1	8.5
Approach Delay (s)	8.2	0.0	10.1	8.5
Approach LOS	A	A	B	A

Intersection Summary			
Delay	9.3		
Level of Service	A		
Intersection Capacity Utilization	42.2%	ICU Level of Service	A
Analysis Period (min)	15		

7: Palo Alto Ave & Chaucer St

Timing Plan: P.M. Peak

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Volume (veh/h)	0	0	0	3	0	10	0	8	15	4	2	0
Future Volume (Veh/h)	0	0	0	3	0	10	0	8	15	4	2	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.85	0.85	0.85	0.83	0.83	0.83	0.83	0.83	0.83	0.50	0.50	0.50
Hourly flow rate (vph)	0	0	0	4	0	12	0	10	18	8	4	0
Pedestrians		3			12			16			20	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		0			1			2			2	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					517							
pX, platoon unblocked												
vC, conflicting volume	32			16			35	56	28	69	50	29
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	32			16			35	56	28	69	50	29
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	99	98	99	100	100
cM capacity (veh/h)	1550			1577			924	805	1019	847	811	1023

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	0	16	28	12
Volume Left	0	4	0	8
Volume Right	0	12	18	0
cSH	1700	1577	931	835
Volume to Capacity	0.00	0.00	0.03	0.01
Queue Length 95th (ft)	0	0	2	1
Control Delay (s)	0.0	1.8	9.0	9.4
Lane LOS		A	A	A
Approach Delay (s)	0.0	1.8	9.0	9.4
Approach LOS			A	A

Intersection Summary			
Average Delay	7.0		
Intersection Capacity Utilization	21.5%	ICU Level of Service	A
Analysis Period (min)	15		

Queues
8: University Ave & Chaucer St

	→	←	↑	↓
Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	20	48	266	575
v/c Ratio	0.05	0.12	0.19	0.44
Control Delay	14.9	13.7	4.9	6.8
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	14.9	13.7	4.9	6.8
Queue Length 50th (ft)	2	5	20	56
Queue Length 95th (ft)	20	31	80	237
Internal Link Dist (ft)	437	466	382	498
Turn Bay Length (ft)				
Base Capacity (vph)	1198	1076	1761	1644
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.02	0.04	0.15	0.35

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Volume (vph)	3	10	5	16	9	14	1	202	5	64	433	3
Future Volume (vph)	3	10	5	16	9	14	1	202	5	64	433	3
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0			5.0			5.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		0.99			0.98			1.00			1.00	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		0.96			0.95			1.00			1.00	
Flt Protected		0.99			0.98			1.00			0.99	
Satd. Flow (prot)		1749			1702			1855			1849	
Flt Permitted		0.94			0.86			1.00			0.93	
Satd. Flow (perm)		1663			1487			1853			1732	
Peak-hour factor, PHF	0.90	0.90	0.90	0.81	0.81	0.81	0.78	0.78	0.78	0.87	0.87	0.87
Adj. Flow (vph)	3	11	6	20	11	17	1	259	6	74	498	3
RTOR Reduction (vph)	0	5	0	0	15	0	0	1	0	0	0	0
Lane Group Flow (vph)	0	15	0	0	33	0	0	265	0	0	575	0
Confl. Peds. (#/hr)	3		4	4		3	8		3	3		8
Confl. Bikes (#/hr)			8			11			12			6
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Actuated Green, G (s)		5.0			5.0			24.8			24.8	
Effective Green, g (s)		5.0			5.0			24.8			24.8	
Actuated g/C Ratio		0.13			0.13			0.64			0.64	
Clearance Time (s)		4.0			4.0			5.0			5.0	
Vehicle Extension (s)		3.0			3.0			4.0			4.0	
Lane Grp Cap (vph)		214			191			1184			1107	
v/s Ratio Prot												
v/s Ratio Perm		0.01			c0.02			0.14			c0.33	
v/c Ratio		0.07			0.17			0.22			0.52	
Uniform Delay, d1		14.9			15.1			2.9			3.8	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.1			0.4			0.1			0.5	
Delay (s)		15.0			15.5			3.1			4.3	
Level of Service		B			B			A			A	
Approach Delay (s)		15.0			15.5			3.1			4.3	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	4.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.46		
Actuated Cycle Length (s)	38.8	Sum of lost time (s)	9.0
Intersection Capacity Utilization	55.8%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

9: University Ave & Woodland Ave/Scofield Ave

Timing Plan: P.M. Peak

	↗	→	←	↖	↑	↘	↓	↙
Lane Group	EBL	EBT	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	547	296	568	383	795	147	518	398
v/c Ratio	0.87	0.87	0.99	1.11	0.69	0.64	0.56	0.61
Control Delay	51.9	57.4	56.4	117.9	30.2	48.9	30.7	7.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	51.9	57.4	56.4	117.9	30.2	48.9	30.7	7.3
Queue Length 50th (ft)	156	143	~216	~258	197	80	128	0
Queue Length 95th (ft)	#238	#285	#419	#431	284	134	178	71
Internal Link Dist (ft)		498	512		536		443	
Turn Bay Length (ft)				160		210		
Base Capacity (vph)	648	350	573	345	1155	334	1022	677
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.84	0.85	0.99	1.11	0.69	0.44	0.51	0.59

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

9: University Ave & Woodland Ave/Scofield Ave

Timing Plan: P.M. Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↱			✥		↰	↑↱		↰	↑↑	↱
Traffic Volume (vph)	503	153	120	11	67	444	352	708	23	135	477	366
Future Volume (vph)	503	153	120	11	67	444	352	708	23	135	477	366
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0			3.0		3.0	4.0		3.0	4.0	4.0
Lane Util. Factor	0.97	1.00			1.00		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	0.97			1.00		1.00	1.00		1.00	1.00	0.86
Flpb, ped/bikes	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.93			0.89		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	1686			1647		1770	3520		1770	3539	1363
Flt Permitted	0.95	1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	1686			1647		1770	3520		1770	3539	1363
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	547	166	130	12	73	483	383	770	25	147	518	398
RTOR Reduction (vph)	0	32	0	0	220	0	0	3	0	0	0	293
Lane Group Flow (vph)	547	264	0	0	348	0	383	792	0	147	518	105
Confl. Peds. (#/hr)			47						1			40
Confl. Bikes (#/hr)			4						4			7
Turn Type	Split	NA		Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	8	8		7	7		1	6		5	2	
Permitted Phases												2
Actuated Green, G (s)	16.4	16.4			19.3		17.6	29.5		11.8	23.7	23.7
Effective Green, g (s)	16.4	16.4			19.3		17.6	29.5		11.8	23.7	23.7
Actuated g/C Ratio	0.18	0.18			0.21		0.20	0.33		0.13	0.26	0.26
Clearance Time (s)	3.0	3.0			3.0		3.0	4.0		3.0	4.0	4.0
Vehicle Extension (s)	2.0	2.0			2.0		2.0	3.0		2.0	3.0	3.0
Lane Grp Cap (vph)	625	307			353		346	1153		232	931	358
v/s Ratio Prot	c0.16	0.16			c0.21		c0.22	c0.23		0.08	0.15	
v/s Ratio Perm												0.08
v/c Ratio	0.88	0.86			0.99		1.11	0.69		0.63	0.56	0.29
Uniform Delay, d1	35.8	35.7			35.2		36.2	26.2		37.1	28.6	26.5
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	12.6	20.4			43.6		80.4	3.3		4.1	2.4	2.1
Delay (s)	48.4	56.1			78.9		116.6	29.6		41.2	31.0	28.5
Level of Service	D	E			E		F	C		D	C	C
Approach Delay (s)		51.1			78.9			57.9			31.5	
Approach LOS		D			E			E			C	

Intersection Summary			
HCM 2000 Control Delay	51.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	96.4%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Appendix D – Mitigation Measures Synchro Reports

- HCM Delay and LOS Reports
- 95th Percentile Queue Length Reports

1: Willow Rd & Gilbert Ave

	↗	→	↙	←	↖	↑	↘	↓
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	43	134	353	291	5	899	59	908
v/c Ratio	0.17	0.22	0.93	0.49	0.04	0.82	0.41	0.81
Control Delay	34.6	34.4	78.0	37.7	11.0	17.9	28.7	31.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	34.6	34.4	78.0	37.7	11.0	17.9	28.7	31.9
Queue Length 50th (ft)	28	88	319	196	1	202	31	712
Queue Length 95th (ft)	48	112	378	237	m2	258	81	953
Internal Link Dist (ft)		468		521		1923		337
Turn Bay Length (ft)	55		90		75		90	
Base Capacity (vph)	284	678	418	653	138	1102	144	1118
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.15	0.20	0.84	0.45	0.04	0.82	0.41	0.81

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

1: Willow Rd & Gilbert Ave

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱		↰	↱	
Traffic Volume (vph)	32	91	8	279	135	95	4	692	72	56	858	5
Future Volume (vph)	32	91	8	279	135	95	4	692	72	56	858	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	0.99		1.00	0.98		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		0.97	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.94		1.00	0.99		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1764	1830		1719	1721		1770	1828		1770	1861	
Flt Permitted	0.41	1.00		0.63	1.00		0.12	1.00		0.13	1.00	
Satd. Flow (perm)	769	1830		1133	1721		230	1828		240	1861	
Peak-hour factor, PHF	0.74	0.74	0.74	0.79	0.79	0.79	0.85	0.85	0.85	0.95	0.95	0.95
Adj. Flow (vph)	43	123	11	353	171	120	5	814	85	59	903	5
RTOR Reduction (vph)	0	2	0	0	18	0	0	2	0	0	0	0
Lane Group Flow (vph)	43	132	0	353	273	0	5	897	0	59	908	0
Confl. Peds. (#/hr)	2		11	11		2	7		8	8		7
Confl. Bikes (#/hr)			5			9			10			20
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			6	
Permitted Phases	4			4			2			6		
Actuated Green, G (s)	50.6	50.6		50.6	50.6		90.2	90.2		90.2	90.2	
Effective Green, g (s)	50.6	50.6		50.6	50.6		90.2	90.2		90.2	90.2	
Actuated g/C Ratio	0.34	0.34		0.34	0.34		0.60	0.60		0.60	0.60	
Clearance Time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	259	617		382	580		138	1099		144	1119	
v/s Ratio Prot		0.07			0.16			c0.49			0.49	
v/s Ratio Perm	0.06			c0.31			0.02			0.25		
v/c Ratio	0.17	0.21		0.92	0.47		0.04	0.82		0.41	0.81	
Uniform Delay, d1	34.9	35.5		47.9	39.2		12.2	23.4		15.8	23.3	
Progression Factor	1.00	1.00		1.00	1.00		0.72	0.50		1.00	1.00	
Incremental Delay, d2	0.3	0.2		27.6	0.6		0.3	4.8		8.4	6.4	
Delay (s)	35.2	35.7		75.5	39.8		9.1	16.6		24.2	29.7	
Level of Service	D	D		E	D		A	B		C	C	
Approach Delay (s)		35.6			59.3			16.6			29.4	
Approach LOS		D			E			B			C	

Intersection Summary			
HCM 2000 Control Delay	32.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	9.2
Intersection Capacity Utilization	80.8%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Queues

2: Willow Rd & Middlefield Rd

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	226	465	94	478	180	50	313	162	342	348	499
v/c Ratio	0.83	0.82	0.31	0.83	0.60	0.15	0.91	0.47	0.60	0.60	0.80
Control Delay	84.2	72.2	57.0	73.0	38.3	51.7	89.4	29.0	41.1	41.1	30.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	84.2	72.2	57.0	73.0	38.3	51.7	89.4	29.0	41.1	41.1	30.8
Queue Length 50th (ft)	234	240	81	247	93	41	300	61	260	264	169
Queue Length 95th (ft)	#371	308	131	300	173	68	340	99	m373	m380	m#467
Internal Link Dist (ft)		465		339			466			185	
Turn Bay Length (ft)	270		120		65	75		110	150		65
Base Capacity (vph)	290	604	318	606	313	345	363	356	572	582	623
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.78	0.77	0.30	0.79	0.58	0.14	0.86	0.46	0.60	0.60	0.80

Intersection Summary

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis
2: Willow Rd & Middlefield Rd

Mitigation Measures - Option 1
Timing Plan: A.M. Peak

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↰↑↱		↰	↑↑↱	↱	↰	↑	↱	↰	↰↑	↱
Traffic Volume (vph)	283	322	17	81	394	172	38	238	123	539	102	464
Future Volume (vph)	283	322	17	81	394	172	38	238	123	539	102	464
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.3	5.3		5.3	5.3	5.3	4.7	4.7	4.7	4.7	4.7	4.7
Lane Util. Factor	0.91	0.91		1.00	0.91	0.91	1.00	1.00	1.00	0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.94	1.00	1.00	0.92	1.00	1.00	0.94
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99		1.00	0.99	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	0.99		0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.97	1.00
Satd. Flow (prot)	1610	3333		1770	3360	1354	1770	1863	1459	1681	1711	1484
Flt Permitted	0.95	0.99		0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.97	1.00
Satd. Flow (perm)	1610	3333		1770	3360	1354	1770	1863	1459	1681	1711	1484
Peak-hour factor, PHF	0.90	0.90	0.90	0.86	0.86	0.86	0.76	0.76	0.76	0.93	0.93	0.93
Adj. Flow (vph)	314	358	19	94	458	200	50	313	162	580	110	499
RTOR Reduction (vph)	0	2	0	0	2	70	0	0	73	0	0	119
Lane Group Flow (vph)	226	463	0	94	476	110	50	313	89	342	348	380
Confl. Peds. (#/hr)			1			22			31			23
Confl. Bikes (#/hr)			6			9			16			28
Turn Type	Split	NA		Split	NA	Perm	Split	NA	Perm	Split	NA	Perm
Protected Phases	2	2		3	3		1	1		4	4	
Permitted Phases						3			1			4
Actuated Green, G (s)	25.5	25.5		25.6	25.6	25.6	27.8	27.8	27.8	51.1	51.1	51.1
Effective Green, g (s)	25.5	25.5		25.6	25.6	25.6	27.8	27.8	27.8	51.1	51.1	51.1
Actuated g/C Ratio	0.17	0.17		0.17	0.17	0.17	0.19	0.19	0.19	0.34	0.34	0.34
Clearance Time (s)	5.3	5.3		5.3	5.3	5.3	4.7	4.7	4.7	4.7	4.7	4.7
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	273	566		302	573	231	328	345	270	572	582	505
v/s Ratio Prot	c0.14	0.14		0.05	c0.14		0.03	c0.17		0.20	0.20	
v/s Ratio Perm						0.08			0.06			c0.26
v/c Ratio	0.83	0.82		0.31	0.83	0.47	0.15	0.91	0.33	0.60	0.60	0.75
Uniform Delay, d1	60.1	60.0		54.5	60.1	56.1	51.2	59.8	53.0	40.9	40.9	43.9
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	0.89	0.89	0.83
Incremental Delay, d2	18.3	9.0		0.6	10.0	1.5	0.2	26.3	0.7	2.6	2.5	5.7
Delay (s)	78.4	69.0		55.1	70.1	57.7	51.4	86.1	53.8	39.2	39.1	42.1
Level of Service	E	E		E	E	E	D	F	D	D	D	D
Approach Delay (s)		72.1			65.2			72.8			40.4	
Approach LOS		E			E			E			D	

Intersection Summary			
HCM 2000 Control Delay	58.6	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	90.8%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

3: Palo Alto Ave/Woodland Ave & Middlefield Rd

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↱			✥		↰		↱
Traffic Volume (veh/h)	84	893	0	0	501	38	0	0	0	51	0	147
Future Volume (Veh/h)	84	893	0	0	501	38	0	0	0	51	0	147
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.97	0.97	0.97	0.92	0.92	0.92	0.25	0.25	0.25	0.99	0.99	0.99
Hourly flow rate (vph)	87	921	0	0	545	41	0	0	0	52	0	148
Pedestrians					6			6			5	
Lane Width (ft)					12.0			12.0			12.0	
Walking Speed (ft/s)					3.5			3.5			3.5	
Percent Blockage					1			1			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		398										
pX, platoon unblocked				0.92			0.92	0.92	0.92	0.92	0.92	
vC, conflicting volume	591			927			1814	1692	472	1211	1672	570
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	591			752			1715	1582	260	1060	1560	570
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	91			100			100	100	100	65	100	68
cM capacity (veh/h)	976			782			34	90	674	150	92	462

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	NB 1	SB 1	SB 2
Volume Total	87	460	460	586	0	52	148
Volume Left	87	0	0	0	0	52	0
Volume Right	0	0	0	41	0	0	148
cSH	976	1700	1700	1700	1700	150	462
Volume to Capacity	0.09	0.27	0.27	0.34	0.00	0.35	0.32
Queue Length 95th (ft)	7	0	0	0	0	36	34
Control Delay (s)	9.0	0.0	0.0	0.0	0.0	41.1	16.4
Lane LOS	A				A	E	C
Approach Delay (s)	0.8			0.0	0.0	22.8	
Approach LOS					A	C	

Intersection Summary			
Average Delay	3.0		
Intersection Capacity Utilization	48.5%	ICU Level of Service	A
Analysis Period (min)	15		

4: Middlefield Rd & Palo Alto Ave

Timing Plan: A.M. Peak

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↱		Y	
Traffic Volume (veh/h)	24	925	507	5	2	32
Future Volume (Veh/h)	24	925	507	5	2	32
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.94	0.94	0.95	0.95	0.92	0.92
Hourly flow rate (vph)	26	984	534	5	2	35
Pedestrians		2	4		10	
Lane Width (ft)		12.0	12.0		12.0	
Walking Speed (ft/s)		3.5	3.5		3.5	
Percent Blockage		0	0		1	
Right turn flare (veh)						
Median type		None	TWLTL			
Median storage veh)			2			
Upstream signal (ft)		892				
pX, platoon unblocked					0.86	
vC, conflicting volume	549				1586	548
vC1, stage 1 conf vol					546	
vC2, stage 2 conf vol					1040	
vCu, unblocked vol	549				1601	548
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)					5.4	
tF (s)	2.2				3.5	3.3
p0 queue free %	97				99	93
cM capacity (veh/h)	1011				276	530

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	26	984	539	37
Volume Left	26	0	0	2
Volume Right	0	0	5	35
cSH	1011	1700	1700	505
Volume to Capacity	0.03	0.58	0.32	0.07
Queue Length 95th (ft)	2	0	0	6
Control Delay (s)	8.7	0.0	0.0	12.7
Lane LOS	A			B
Approach Delay (s)	0.2		0.0	12.7
Approach LOS				B

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	59.3%	ICU Level of Service	B
Analysis Period (min)	15		

5: Pope St & Central Ave

	↗	→	←	↖	↘	↙
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↱		↰↱	
Traffic Volume (veh/h)	2	12	37	17	13	2
Future Volume (Veh/h)	2	12	37	17	13	2
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.72	0.72	0.84	0.84
Hourly flow rate (vph)	2	13	51	24	15	2
Pedestrians					8	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					3.5	
Percent Blockage					1	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	83				88	71
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	83				88	71
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				98	100
cM capacity (veh/h)	1503				905	984

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	15	75	17
Volume Left	2	0	15
Volume Right	0	24	2
cSH	1503	1700	913
Volume to Capacity	0.00	0.04	0.02
Queue Length 95th (ft)	0	0	1
Control Delay (s)	1.0	0.0	9.0
Lane LOS	A		A
Approach Delay (s)	1.0	0.0	9.0
Approach LOS			A

Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	15.7%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection: 6: Woodland Ave & Pope St/Chaucer St

Movement	EB	NB	SB
Directions Served	LTR	LTR	LTR
Maximum Queue (ft)	47	56	72
Average Queue (ft)	18	25	39
95th Queue (ft)	43	45	61
Link Distance (ft)	283	395	346
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	25	0	4	0	0	0	20	58	0	0	96	32
Future Volume (vph)	25	0	4	0	0	0	20	58	0	0	96	32
Peak Hour Factor	0.88	0.88	0.88	0.82	0.82	0.82	0.79	0.79	0.79	0.94	0.94	0.94
Hourly flow rate (vph)	28	0	5	0	0	0	25	73	0	0	102	34

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	33	0	98	136
Volume Left (vph)	28	0	25	0
Volume Right (vph)	5	0	0	34
Hadj (s)	0.11	0.00	0.09	-0.12
Departure Headway (s)	4.5	4.4	4.2	4.0
Degree Utilization, x	0.04	0.00	0.11	0.15
Capacity (veh/h)	756	776	838	895
Control Delay (s)	7.7	7.4	7.7	7.7
Approach Delay (s)	7.7	0.0	7.7	7.7
Approach LOS	A	A	A	A

Intersection Summary			
Delay	7.7		
Level of Service	A		
Intersection Capacity Utilization	26.7%	ICU Level of Service	A
Analysis Period (min)	15		

7: Palo Alto Ave & Chaucer St

Timing Plan: A.M. Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Volume (veh/h)	0	0	0	3	0	1	0	2	6	2	2	0
Future Volume (Veh/h)	0	0	0	3	0	1	0	2	6	2	2	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.94	0.94	0.94	0.85	0.85	0.85	0.92	0.92	0.92	0.25	0.25	0.25
Hourly flow rate (vph)	0	0	0	4	0	1	0	2	7	8	8	0
Pedestrians		2			3			2			8	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		0			0			0			1	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					517							
pX, platoon unblocked												
vC, conflicting volume	9			2			16	19	5	28	18	10
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	9			2			16	19	5	28	18	10
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	99	99	99	100
cM capacity (veh/h)	1599			1617			979	864	1073	955	865	1060

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	0	5	9	16
Volume Left	0	4	0	8
Volume Right	0	1	7	0
cSH	1700	1617	1018	908
Volume to Capacity	0.00	0.00	0.01	0.02
Queue Length 95th (ft)	0	0	1	1
Control Delay (s)	0.0	5.8	8.6	9.0
Lane LOS		A	A	A
Approach Delay (s)	0.0	5.8	8.6	9.0
Approach LOS			A	A

Intersection Summary			
Average Delay	8.4		
Intersection Capacity Utilization	16.6%	ICU Level of Service	A
Analysis Period (min)	15		

8: University Ave & Chaucer St

	→	←	↑	↓
Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	8	71	394	766
v/c Ratio	0.03	0.23	0.26	0.50
Control Delay	20.6	13.0	2.8	4.5
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	20.6	13.0	2.8	4.5
Queue Length 50th (ft)	1	3	31	81
Queue Length 95th (ft)	14	24	70	174
Internal Link Dist (ft)	437	466	382	498
Turn Bay Length (ft)				
Base Capacity (vph)	987	986	1787	1781
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.01	0.07	0.22	0.43

Intersection Summary

HCM Signalized Intersection Capacity Analysis
8: University Ave & Chaucer St

Mitigation Measures - Option 1
Timing Plan: A.M. Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Volume (vph)	2	2	4	7	2	40	1	361	1	7	674	1
Future Volume (vph)	2	2	4	7	2	40	1	361	1	7	674	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0			5.0			5.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		0.94			0.94			1.00			1.00	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		0.93			0.89			1.00			1.00	
Flt Protected		0.99			0.99			1.00			1.00	
Satd. Flow (prot)		1619			1546			1862			1861	
Flt Permitted		0.92			0.95			1.00			1.00	
Satd. Flow (perm)		1500			1476			1860			1855	
Peak-hour factor, PHF	0.90	0.90	0.90	0.69	0.69	0.69	0.92	0.92	0.92	0.89	0.89	0.89
Adj. Flow (vph)	2	2	4	10	3	58	1	392	1	8	757	1
RTOR Reduction (vph)	0	4	0	0	54	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	4	0	0	17	0	0	394	0	0	766	0
Confl. Peds. (#/hr)	6		4	4		6	5		3	3		5
Confl. Bikes (#/hr)			18			10			7			23
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Actuated Green, G (s)		3.5			3.5			33.3			33.3	
Effective Green, g (s)		3.5			3.5			33.3			33.3	
Actuated g/C Ratio		0.08			0.08			0.73			0.73	
Clearance Time (s)		4.0			4.0			5.0			5.0	
Vehicle Extension (s)		3.0			3.0			4.0			4.0	
Lane Grp Cap (vph)		114			112			1352			1348	
v/s Ratio Prot												
v/s Ratio Perm		0.00			c0.01			0.21			c0.41	
v/c Ratio		0.04			0.16			0.29			0.57	
Uniform Delay, d1		19.6			19.8			2.2			2.9	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.1			0.7			0.2			0.7	
Delay (s)		19.7			20.4			2.3			3.6	
Level of Service		B			C			A			A	
Approach Delay (s)		19.7			20.4			2.3			3.6	
Approach LOS		B			C			A			A	

Intersection Summary			
HCM 2000 Control Delay	4.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	45.8	Sum of lost time (s)	9.0
Intersection Capacity Utilization	55.2%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

9: University Ave & Woodland Ave/Scofield Ave

Lane Group	EBL	EBT	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	424	219	490	108	653	253	1022	570
v/c Ratio	0.88	0.78	1.07	0.57	0.62	0.75	0.72	0.62
Control Delay	57.4	45.9	89.9	47.1	29.3	45.6	25.6	5.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	57.4	45.9	89.9	47.1	29.3	45.6	25.6	5.3
Queue Length 50th (ft)	115	84	~253	56	153	128	239	0
Queue Length 95th (ft)	#195	#194	#442	103	231	192	329	71
Internal Link Dist (ft)		498	512		536		443	
Turn Bay Length (ft)				160		210		
Base Capacity (vph)	484	284	457	249	1051	458	1420	915
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.88	0.77	1.07	0.43	0.62	0.55	0.72	0.62

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
9: University Ave & Woodland Ave/Scofield Ave

Mitigation Measures - Option 1
Timing Plan: A.M. Peak

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↱			✥		↰	↑↱		↰	↑↑	↱
Traffic Volume (vph)	390	93	109	15	121	315	99	588	13	233	940	524
Future Volume (vph)	390	93	109	15	121	315	99	588	13	233	940	524
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0			3.0		3.0	4.0		3.0	4.0	4.0
Lane Util. Factor	0.97	1.00			1.00		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	0.97			0.99		1.00	1.00		1.00	1.00	0.90
Flpb, ped/bikes	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.92			0.91		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	1659			1668		1770	3526		1770	3539	1431
Flt Permitted	0.95	1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	1659			1668		1770	3526		1770	3539	1431
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	424	101	118	16	132	342	108	639	14	253	1022	570
RTOR Reduction (vph)	0	50	0	0	95	0	0	1	0	0	0	345
Lane Group Flow (vph)	424	169	0	0	395	0	108	652	0	253	1022	225
Confl. Peds. (#/hr)			39						3			26
Confl. Bikes (#/hr)			2			2						10
Turn Type	Split	NA		Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	8	8		7	7		1	6		5	2	
Permitted Phases												2
Actuated Green, G (s)	11.9	11.9			18.5		8.1	25.3		16.3	33.5	33.5
Effective Green, g (s)	11.9	11.9			18.5		8.1	25.3		16.3	33.5	33.5
Actuated g/C Ratio	0.14	0.14			0.22		0.10	0.30		0.19	0.39	0.39
Clearance Time (s)	3.0	3.0			3.0		3.0	4.0		3.0	4.0	4.0
Vehicle Extension (s)	2.0	2.0			2.0		2.0	3.0		2.0	3.0	3.0
Lane Grp Cap (vph)	480	232			363		168	1049		339	1394	563
v/s Ratio Prot	c0.12	0.10			c0.24		0.06	0.18		c0.14	c0.29	
v/s Ratio Perm												0.16
v/c Ratio	0.88	0.73			1.09		0.64	0.62		0.75	0.73	0.40
Uniform Delay, d1	35.9	35.0			33.2		37.1	25.7		32.4	21.9	18.5
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	16.9	9.3			72.5		6.2	2.8		7.6	3.4	2.1
Delay (s)	52.7	44.3			105.8		43.2	28.5		40.0	25.4	20.6
Level of Service	D	D			F		D	C		D	C	C
Approach Delay (s)		49.9			105.8			30.6			25.9	
Approach LOS		D			F			C			C	

Intersection Summary			
HCM 2000 Control Delay	41.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	85.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	88.9%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Queues
1: Willow Rd & Gilbert Ave

Mitigation Measures - Option 1
Timing Plan: P.M. Peak

	↗	→	↙	←	↖	↑	↘	↓
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	18	96	188	127	5	262	121	757
v/c Ratio	0.08	0.27	0.78	0.35	0.01	0.20	0.16	0.56
Control Delay	36.3	35.6	66.6	37.0	7.0	6.0	6.9	10.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	36.3	35.6	66.6	37.0	7.0	6.0	6.9	10.8
Queue Length 50th (ft)	12	56	140	75	1	49	25	235
Queue Length 95th (ft)	26	81	201	118	4	67	47	302
Internal Link Dist (ft)		468		521		1923		337
Turn Bay Length (ft)	55		90		75		90	
Base Capacity (vph)	315	519	350	518	399	1285	777	1349
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.06	0.18	0.54	0.25	0.01	0.20	0.16	0.56

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱		↰	↱	
Traffic Volume (vph)	14	60	16	167	82	31	3	122	43	87	538	7
Future Volume (vph)	14	60	16	167	82	31	3	122	43	87	538	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	0.98		1.00	1.00	
Flpb, ped/bikes	0.99	1.00		0.98	1.00		1.00	1.00		0.97	1.00	
Frt	1.00	0.97		1.00	0.96		1.00	0.96		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1747	1782		1732	1768		1762	1759		1718	1858	
Flt Permitted	0.60	1.00		0.67	1.00		0.29	1.00		0.59	1.00	
Satd. Flow (perm)	1099	1782		1222	1768		547	1759		1068	1858	
Peak-hour factor, PHF	0.79	0.79	0.79	0.89	0.89	0.89	0.63	0.63	0.63	0.72	0.72	0.72
Adj. Flow (vph)	18	76	20	188	92	35	5	194	68	121	747	10
RTOR Reduction (vph)	0	9	0	0	13	0	0	8	0	0	0	0
Lane Group Flow (vph)	18	87	0	188	114	0	5	254	0	121	757	0
Confl. Peds. (#/hr)	6		9	9		6	8		17	17		8
Confl. Bikes (#/hr)			9						11			4
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			6	
Permitted Phases	4			4			2			6		
Actuated Green, G (s)	23.6	23.6		23.6	23.6		87.2	87.2		87.2	87.2	
Effective Green, g (s)	23.6	23.6		23.6	23.6		87.2	87.2		87.2	87.2	
Actuated g/C Ratio	0.20	0.20		0.20	0.20		0.73	0.73		0.73	0.73	
Clearance Time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	216	350		240	347		397	1278		776	1350	
v/s Ratio Prot		0.05			0.06			0.14			c0.41	
v/s Ratio Perm	0.02			c0.15			0.01			0.11		
v/c Ratio	0.08	0.25		0.78	0.33		0.01	0.20		0.16	0.56	
Uniform Delay, d1	39.4	40.7		45.8	41.4		4.5	5.2		5.1	7.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.2	0.4		15.3	0.6		0.1	0.3		0.4	1.7	
Delay (s)	39.5	41.1		61.1	42.0		4.6	5.6		5.5	9.2	
Level of Service	D	D		E	D		A	A		A	A	
Approach Delay (s)		40.8			53.4			5.6			8.7	
Approach LOS		D			D			A			A	

Intersection Summary			
HCM 2000 Control Delay	19.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	9.2
Intersection Capacity Utilization	66.6%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	127	584	133	710	99	48	123	319	295	299	354
v/c Ratio	0.37	0.81	0.30	0.82	0.24	0.19	0.46	0.66	0.73	0.73	0.77
Control Delay	55.9	64.9	49.3	61.4	17.8	60.2	65.0	13.2	63.8	63.6	46.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	55.9	64.9	49.3	61.4	17.8	60.2	65.0	13.2	63.8	63.6	46.2
Queue Length 50th (ft)	126	322	114	390	20	43	116	0	307	311	238
Queue Length 95th (ft)	213	423	190	#508	83	80	172	48	390	392	323
Internal Link Dist (ft)		465		339			466			185	
Turn Bay Length (ft)	270		120		65	75		110	150		65
Base Capacity (vph)	412	864	532	1017	471	385	406	565	559	567	591
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.31	0.68	0.25	0.70	0.21	0.12	0.30	0.56	0.53	0.53	0.60

Intersection Summary

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↰↑↑↱		↰	↑↑↱	↱	↰	↑	↱	↰	↰↑	↱
Traffic Volume (vph)	130	511	14	128	671	106	39	100	258	442	57	297
Future Volume (vph)	130	511	14	128	671	106	39	100	258	442	57	297
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.3	5.3		5.3	5.3	5.3	4.7	4.7	4.7	4.7	4.7	4.7
Lane Util. Factor	0.91	0.91		1.00	0.91	0.91	1.00	1.00	1.00	0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.97	1.00	1.00	0.92	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.96	1.00
Satd. Flow (prot)	1610	3369		1770	3381	1399	1770	1863	1456	1681	1704	1532
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.96	1.00
Satd. Flow (perm)	1610	3369		1770	3381	1399	1770	1863	1456	1681	1704	1532
Peak-hour factor, PHF	0.92	0.92	0.92	0.96	0.96	0.96	0.81	0.81	0.81	0.84	0.84	0.84
Adj. Flow (vph)	141	555	15	133	699	110	48	123	319	526	68	354
RTOR Reduction (vph)	0	1	0	0	1	56	0	0	273	0	0	93
Lane Group Flow (vph)	127	583	0	133	709	43	48	123	46	295	299	261
Confl. Peds. (#/hr)			5			9			28			11
Confl. Bikes (#/hr)			6			3			19			6
Turn Type	Split	NA		Split	NA	Perm	Split	NA	Perm	Split	NA	Perm
Protected Phases	2	2		3	3		1	1		4	4	
Permitted Phases						3			1			4
Actuated Green, G (s)	30.6	30.6		36.2	36.2	36.2	20.4	20.4	20.4	34.1	34.1	34.1
Effective Green, g (s)	30.6	30.6		36.2	36.2	36.2	20.4	20.4	20.4	34.1	34.1	34.1
Actuated g/C Ratio	0.22	0.22		0.26	0.26	0.26	0.14	0.14	0.14	0.24	0.24	0.24
Clearance Time (s)	5.3	5.3		5.3	5.3	5.3	4.7	4.7	4.7	4.7	4.7	4.7
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	348	729		453	866	358	255	268	210	405	411	369
v/s Ratio Prot	0.08	c0.17		0.08	c0.21		0.03	c0.07		c0.18	0.18	
v/s Ratio Perm						0.03			0.03			0.17
v/c Ratio	0.36	0.80		0.29	0.82	0.12	0.19	0.46	0.22	0.73	0.73	0.71
Uniform Delay, d1	47.1	52.5		42.3	49.5	40.3	53.2	55.4	53.4	49.3	49.3	49.0
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.7	6.3		0.4	6.1	0.2	0.4	1.2	0.5	6.4	6.3	6.1
Delay (s)	47.7	58.7		42.6	55.6	40.5	53.5	56.6	53.9	55.8	55.6	55.1
Level of Service	D	E		D	E	D	D	E	D	E	E	E
Approach Delay (s)		56.8			52.1			54.6			55.5	
Approach LOS		E			D			D			E	

Intersection Summary			
HCM 2000 Control Delay	54.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	141.3	Sum of lost time (s)	20.0
Intersection Capacity Utilization	71.1%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
3: Palo Alto Ave/Woodland Ave & Middlefield Rd

Mitigation Measures - Option 1
Timing Plan: P.M. Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↱			✥		↰		↱
Traffic Volume (veh/h)	196	1004	0	0	767	168	0	0	0	48	0	92
Future Volume (Veh/h)	196	1004	0	0	767	168	0	0	0	48	0	92
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.83	0.83	0.83	0.92	0.92	0.92	0.25	0.25	0.25	0.73	0.73	0.73
Hourly flow rate (vph)	236	1210	0	0	834	183	0	0	0	66	0	126
Pedestrians					4			2			12	
Lane Width (ft)					12.0			12.0			12.0	
Walking Speed (ft/s)					3.5			3.5			3.5	
Percent Blockage					0			0			1	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		398										
pX, platoon unblocked				0.86			0.86	0.86	0.86	0.86	0.86	
vC, conflicting volume	1029			1212			2736	2713	611	2018	2622	938
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1029			919			2692	2666	220	1858	2559	938
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	64			100			100	100	100	0	100	52
cM capacity (veh/h)	663			633			3	12	670	27	14	263

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	NB 1	SB 1	SB 2
Volume Total	236	605	605	1017	0	66	126
Volume Left	236	0	0	0	0	66	0
Volume Right	0	0	0	183	0	0	126
cSH	663	1700	1700	1700	1700	27	263
Volume to Capacity	0.36	0.36	0.36	0.60	0.00	2.40	0.48
Queue Length 95th (ft)	40	0	0	0	0	198	61
Control Delay (s)	13.4	0.0	0.0	0.0	0.0	942.4	30.7
Lane LOS	B				A	F	D
Approach Delay (s)	2.2			0.0	0.0	344.1	
Approach LOS					A	F	

Intersection Summary			
Average Delay	26.1		
Intersection Capacity Utilization	76.3%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↱		↰↱	
Traffic Volume (veh/h)	51	970	925	2	1	37
Future Volume (Veh/h)	51	970	925	2	1	37
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.94	0.94	0.89	0.89	0.69	0.69
Hourly flow rate (vph)	54	1032	1039	2	1	54
Pedestrians			2		14	
Lane Width (ft)			12.0		12.0	
Walking Speed (ft/s)			3.5		3.5	
Percent Blockage			0		1	
Right turn flare (veh)						
Median type		None	TWLTL			
Median storage veh)			2			
Upstream signal (ft)		892				
pX, platoon unblocked					0.82	
vC, conflicting volume	1055				2196	1054
vC1, stage 1 conf vol					1054	
vC2, stage 2 conf vol					1142	
vCu, unblocked vol	1055				2353	1054
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)					5.4	
tF (s)	2.2				3.5	3.3
p0 queue free %	92				99	80
cM capacity (veh/h)	651				192	271

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	54	1032	1041	55
Volume Left	54	0	0	1
Volume Right	0	0	2	54
cSH	651	1700	1700	269
Volume to Capacity	0.08	0.61	0.61	0.20
Queue Length 95th (ft)	7	0	0	19
Control Delay (s)	11.0	0.0	0.0	21.8
Lane LOS	B			C
Approach Delay (s)	0.5		0.0	21.8
Approach LOS				C

Intersection Summary			
Average Delay	0.8		
Intersection Capacity Utilization	61.1%	ICU Level of Service	B
Analysis Period (min)	15		

	↗	→	←	↖	↘	↙
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↱		Y	
Traffic Volume (veh/h)	1	1	104	100	1	3
Future Volume (Veh/h)	1	1	104	100	1	3
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.76	0.76	0.86	0.86	0.53	0.53
Hourly flow rate (vph)	1	1	121	116	2	6
Pedestrians					7	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					3.5	
Percent Blockage					1	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	244				189	186
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	244				189	186
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	99
cM capacity (veh/h)	1313				794	850

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	2	237	8
Volume Left	1	0	2
Volume Right	0	116	6
cSH	1313	1700	836
Volume to Capacity	0.00	0.14	0.01
Queue Length 95th (ft)	0	0	1
Control Delay (s)	3.9	0.0	9.3
Lane LOS	A		A
Approach Delay (s)	3.9	0.0	9.3
Approach LOS			A

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	22.2%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection: 6: Woodland Ave & Pope St/Chaucer St

Movement	EB	NB	SB
Directions Served	LTR	LTR	LTR
Maximum Queue (ft)	64	94	80
Average Queue (ft)	31	46	41
95th Queue (ft)	53	77	67
Link Distance (ft)	288	400	344
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

6: Woodland Ave & Pope St/Chaucer St

Timing Plan: P.M. Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	8	0	60	0	0	0	105	130	0	0	45	98
Future Volume (vph)	8	0	60	0	0	0	105	130	0	0	45	98
Peak Hour Factor	0.73	0.73	0.73	0.91	0.91	0.91	0.78	0.78	0.78	0.82	0.82	0.82
Hourly flow rate (vph)	11	0	82	0	0	0	135	167	0	0	55	120

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	93	0	302	175
Volume Left (vph)	11	0	135	0
Volume Right (vph)	82	0	0	120
Hadj (s)	-0.47	0.00	0.12	-0.38
Departure Headway (s)	4.5	5.1	4.4	4.1
Degree Utilization, x	0.12	0.00	0.37	0.20
Capacity (veh/h)	725	639	793	844
Control Delay (s)	8.1	8.1	10.0	8.1
Approach Delay (s)	8.1	0.0	10.0	8.1
Approach LOS	A	A	B	A

Intersection Summary			
Delay	9.1		
Level of Service	A		
Intersection Capacity Utilization	41.0%	ICU Level of Service	A
Analysis Period (min)	15		

7: Palo Alto Ave & Chaucer St

Timing Plan: P.M. Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Volume (veh/h)	0	0	0	3	0	10	0	8	15	4	2	0
Future Volume (Veh/h)	0	0	0	3	0	10	0	8	15	4	2	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.85	0.85	0.85	0.83	0.83	0.83	0.83	0.83	0.83	0.50	0.50	0.50
Hourly flow rate (vph)	0	0	0	4	0	12	0	10	18	8	4	0
Pedestrians		3			12			16			20	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		0			1			2			2	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					517							
pX, platoon unblocked												
vC, conflicting volume	32			16			35	56	28	69	50	29
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	32			16			35	56	28	69	50	29
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	99	98	99	100	100
cM capacity (veh/h)	1550			1577			924	805	1019	847	811	1023

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	0	16	28	12
Volume Left	0	4	0	8
Volume Right	0	12	18	0
cSH	1700	1577	931	835
Volume to Capacity	0.00	0.00	0.03	0.01
Queue Length 95th (ft)	0	0	2	1
Control Delay (s)	0.0	1.8	9.0	9.4
Lane LOS		A	A	A
Approach Delay (s)	0.0	1.8	9.0	9.4
Approach LOS			A	A

Intersection Summary			
Average Delay	7.0		
Intersection Capacity Utilization	21.5%	ICU Level of Service	A
Analysis Period (min)	15		

Queues

8: University Ave & Chaucer St

	→	←	↑	↓
Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	20	48	266	575
v/c Ratio	0.05	0.12	0.19	0.44
Control Delay	14.9	13.7	4.9	6.8
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	14.9	13.7	4.9	6.8
Queue Length 50th (ft)	2	5	20	56
Queue Length 95th (ft)	20	31	80	237
Internal Link Dist (ft)	437	466	382	498
Turn Bay Length (ft)				
Base Capacity (vph)	1198	1076	1761	1644
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.02	0.04	0.15	0.35

Intersection Summary

HCM Signalized Intersection Capacity Analysis
8: University Ave & Chaucer St

Mitigation Measures - Option 1
Timing Plan: P.M. Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Volume (vph)	3	10	5	16	9	14	1	202	5	64	433	3
Future Volume (vph)	3	10	5	16	9	14	1	202	5	64	433	3
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0			5.0			5.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		0.99			0.98			1.00			1.00	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		0.96			0.95			1.00			1.00	
Flt Protected		0.99			0.98			1.00			0.99	
Satd. Flow (prot)		1749			1702			1855			1849	
Flt Permitted		0.94			0.86			1.00			0.93	
Satd. Flow (perm)		1663			1487			1853			1732	
Peak-hour factor, PHF	0.90	0.90	0.90	0.81	0.81	0.81	0.78	0.78	0.78	0.87	0.87	0.87
Adj. Flow (vph)	3	11	6	20	11	17	1	259	6	74	498	3
RTOR Reduction (vph)	0	5	0	0	15	0	0	1	0	0	0	0
Lane Group Flow (vph)	0	15	0	0	33	0	0	265	0	0	575	0
Confl. Peds. (#/hr)	3		4	4		3	8		3	3		8
Confl. Bikes (#/hr)			8			11			12			6
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Actuated Green, G (s)		5.0			5.0			24.8			24.8	
Effective Green, g (s)		5.0			5.0			24.8			24.8	
Actuated g/C Ratio		0.13			0.13			0.64			0.64	
Clearance Time (s)		4.0			4.0			5.0			5.0	
Vehicle Extension (s)		3.0			3.0			4.0			4.0	
Lane Grp Cap (vph)		214			191			1184			1107	
v/s Ratio Prot												
v/s Ratio Perm		0.01			c0.02			0.14			c0.33	
v/c Ratio		0.07			0.17			0.22			0.52	
Uniform Delay, d1		14.9			15.1			2.9			3.8	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.1			0.4			0.1			0.5	
Delay (s)		15.0			15.5			3.1			4.3	
Level of Service		B			B			A			A	
Approach Delay (s)		15.0			15.5			3.1			4.3	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	4.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.46		
Actuated Cycle Length (s)	38.8	Sum of lost time (s)	9.0
Intersection Capacity Utilization	55.8%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

9: University Ave & Woodland Ave/Scofield Ave

	↗	→	←	↖	↑	↘	↓	↙
Lane Group	EBL	EBT	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	547	296	568	383	795	147	518	398
v/c Ratio	0.87	0.87	0.99	1.11	0.69	0.64	0.56	0.61
Control Delay	51.9	57.4	56.4	117.9	30.2	48.9	30.7	7.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	51.9	57.4	56.4	117.9	30.2	48.9	30.7	7.3
Queue Length 50th (ft)	156	143	~216	~258	197	80	128	0
Queue Length 95th (ft)	#238	#285	#419	#431	284	134	178	71
Internal Link Dist (ft)		498	512		536		443	
Turn Bay Length (ft)				160		210		
Base Capacity (vph)	648	350	573	345	1155	334	1022	677
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.84	0.85	0.99	1.11	0.69	0.44	0.51	0.59

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↱			✥		↰	↑↱		↰	↑↑	↱
Traffic Volume (vph)	503	153	120	11	67	444	352	708	23	135	477	366
Future Volume (vph)	503	153	120	11	67	444	352	708	23	135	477	366
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0			3.0		3.0	4.0		3.0	4.0	4.0
Lane Util. Factor	0.97	1.00			1.00		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	0.97			1.00		1.00	1.00		1.00	1.00	0.86
Flpb, ped/bikes	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.93			0.89		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	1686			1647		1770	3520		1770	3539	1363
Flt Permitted	0.95	1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	1686			1647		1770	3520		1770	3539	1363
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	547	166	130	12	73	483	383	770	25	147	518	398
RTOR Reduction (vph)	0	32	0	0	220	0	0	3	0	0	0	293
Lane Group Flow (vph)	547	264	0	0	348	0	383	792	0	147	518	105
Confl. Peds. (#/hr)			47						1			40
Confl. Bikes (#/hr)			4						4			7
Turn Type	Split	NA		Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	8	8		7	7		1	6		5	2	
Permitted Phases												2
Actuated Green, G (s)	16.4	16.4			19.3		17.6	29.5		11.8	23.7	23.7
Effective Green, g (s)	16.4	16.4			19.3		17.6	29.5		11.8	23.7	23.7
Actuated g/C Ratio	0.18	0.18			0.21		0.20	0.33		0.13	0.26	0.26
Clearance Time (s)	3.0	3.0			3.0		3.0	4.0		3.0	4.0	4.0
Vehicle Extension (s)	2.0	2.0			2.0		2.0	3.0		2.0	3.0	3.0
Lane Grp Cap (vph)	625	307			353		346	1153		232	931	358
v/s Ratio Prot	c0.16	0.16			c0.21		c0.22	c0.23		0.08	0.15	
v/s Ratio Perm												0.08
v/c Ratio	0.88	0.86			0.99		1.11	0.69		0.63	0.56	0.29
Uniform Delay, d1	35.8	35.7			35.2		36.2	26.2		37.1	28.6	26.5
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	12.6	20.4			43.6		80.4	3.3		4.1	2.4	2.1
Delay (s)	48.4	56.1			78.9		116.6	29.6		41.2	31.0	28.5
Level of Service	D	E			E		F	C		D	C	C
Approach Delay (s)		51.1			78.9			57.9			31.5	
Approach LOS		D			E			E			C	

Intersection Summary			
HCM 2000 Control Delay	51.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	96.4%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

	↗	→	↙	←	↖	↑	↘	↓
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	43	134	135	291	5	899	59	908
v/c Ratio	0.86	0.42	0.79	0.92	0.01	0.64	0.17	0.64
Control Delay	150.3	57.7	90.3	89.0	6.5	14.2	6.4	10.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	150.3	57.7	90.3	89.0	6.5	14.2	6.4	10.9
Queue Length 50th (ft)	41	114	127	262	1	310	14	377
Queue Length 95th (ft)	#90	147	#188	#333	m3	363	31	497
Internal Link Dist (ft)		468		521		1923		337
Turn Bay Length (ft)	55		90		75		90	
Base Capacity (vph)	52	336	177	330	337	1398	343	1420
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.83	0.40	0.76	0.88	0.01	0.64	0.17	0.64

Intersection Summary

#	95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.
m	Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis

Mitigation Measures - Option 2

1: Willow Rd & Gilbert Ave

Timing Plan: A.M. Peak

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱		↰	↱	
Traffic Volume (vph)	32	91	8	107	135	95	4	692	72	56	858	5
Future Volume (vph)	32	91	8	107	135	95	4	692	72	56	858	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	0.99		1.00	0.98		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		0.97	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.94		1.00	0.99		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1765	1830		1721	1715		1770	1828		1770	1861	
Flt Permitted	0.16	1.00		0.53	1.00		0.24	1.00		0.24	1.00	
Satd. Flow (perm)	290	1830		969	1715		443	1828		451	1861	
Peak-hour factor, PHF	0.74	0.74	0.74	0.79	0.79	0.79	0.85	0.85	0.85	0.95	0.95	0.95
Adj. Flow (vph)	43	123	11	135	171	120	5	814	85	59	903	5
RTOR Reduction (vph)	0	2	0	0	17	0	0	2	0	0	0	0
Lane Group Flow (vph)	43	132	0	135	274	0	5	897	0	59	908	0
Confl. Peds. (#/hr)	2		11	11		2	7		8	8		7
Confl. Bikes (#/hr)			5			9			10			20
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			6	
Permitted Phases	4			4			2			6		
Actuated Green, G (s)	26.3	26.3		26.3	26.3		114.5	114.5		114.5	114.5	
Effective Green, g (s)	26.3	26.3		26.3	26.3		114.5	114.5		114.5	114.5	
Actuated g/C Ratio	0.18	0.18		0.18	0.18		0.76	0.76		0.76	0.76	
Clearance Time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	50	320		169	300		338	1395		344	1420	
v/s Ratio Prot		0.07			c0.16			c0.49			0.49	
v/s Ratio Perm	0.15			0.14			0.01			0.13		
v/c Ratio	0.86	0.41		0.80	0.91		0.01	0.64		0.17	0.64	
Uniform Delay, d1	60.1	55.0		59.3	60.7		4.2	8.2		4.8	8.2	
Progression Factor	1.00	1.00		1.00	1.00		1.37	1.45		1.00	1.00	
Incremental Delay, d2	76.1	0.9		22.5	30.2		0.1	1.6		1.1	2.2	
Delay (s)	136.2	55.8		81.9	91.0		5.9	13.6		5.9	10.4	
Level of Service	F	E		F	F		A	B		A	B	
Approach Delay (s)		75.3			88.1			13.5			10.1	
Approach LOS		E			F			B			B	

Intersection Summary			
HCM 2000 Control Delay	29.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	9.2
Intersection Capacity Utilization	75.5%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Queues

2: Willow Rd & Middlefield Rd

Timing Plan: A.M. Peak

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	226	465	94	478	180	50	313	162	249	256	499
v/c Ratio	0.80	0.79	0.32	0.85	0.61	0.16	0.94	0.49	0.43	0.43	0.74
Control Delay	80.0	69.3	45.8	61.3	30.1	53.3	96.9	30.1	37.5	37.5	24.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	80.0	69.3	45.8	61.3	30.1	53.3	96.9	30.1	37.5	37.5	24.3
Queue Length 50th (ft)	232	237	63	241	70	42	305	63	215	222	258
Queue Length 95th (ft)	#346	304	m101	280	135	69	#360	101	m307	m315	408
Internal Link Dist (ft)		465		339			466			185	
Turn Bay Length (ft)	270		120		65	75		110	150		65
Base Capacity (vph)	308	639	305	581	303	322	339	338	580	594	674
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.73	0.73	0.31	0.82	0.59	0.16	0.92	0.48	0.43	0.43	0.74

Intersection Summary

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis

Mitigation Measures - Option 2

2: Willow Rd & Middlefield Rd

Timing Plan: A.M. Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↰↑↱		↰	↑↱	↱	↰	↑	↱	↰	↰↑	↱
Traffic Volume (vph)	283	322	17	81	394	172	38	238	123	367	102	464
Future Volume (vph)	283	322	17	81	394	172	38	238	123	367	102	464
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.3	5.3		5.3	5.3	5.3	4.7	4.7	4.7	4.7	4.7	4.7
Lane Util. Factor	0.91	0.91		1.00	0.91	0.91	1.00	1.00	1.00	0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.94	1.00	1.00	0.92	1.00	1.00	0.94
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99		1.00	0.99	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	0.99		0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.97	1.00
Satd. Flow (prot)	1610	3333		1770	3360	1354	1770	1863	1458	1681	1721	1484
Flt Permitted	0.95	0.99		0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.97	1.00
Satd. Flow (perm)	1610	3333		1770	3360	1354	1770	1863	1458	1681	1721	1484
Peak-hour factor, PHF	0.90	0.90	0.90	0.86	0.86	0.86	0.76	0.76	0.76	0.93	0.93	0.93
Adj. Flow (vph)	314	358	19	94	458	200	50	313	162	395	110	499
RTOR Reduction (vph)	0	2	0	0	2	71	0	0	73	0	0	162
Lane Group Flow (vph)	226	463	0	94	476	109	50	313	89	249	256	337
Confl. Peds. (#/hr)			1			22			31			23
Confl. Bikes (#/hr)			6			9			16			28
Turn Type	Split	NA		Split	NA	Perm	Split	NA	Perm	Split	NA	Perm
Protected Phases	2	2		3	3		1	1		4	4	
Permitted Phases						3			1			4
Actuated Green, G (s)	26.3	26.3		25.1	25.1	25.1	26.8	26.8	26.8	51.8	51.8	51.8
Effective Green, g (s)	26.3	26.3		25.1	25.1	25.1	26.8	26.8	26.8	51.8	51.8	51.8
Actuated g/C Ratio	0.18	0.18		0.17	0.17	0.17	0.18	0.18	0.18	0.35	0.35	0.35
Clearance Time (s)	5.3	5.3		5.3	5.3	5.3	4.7	4.7	4.7	4.7	4.7	4.7
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	282	584		296	562	226	316	332	260	580	594	512
v/s Ratio Prot	c0.14	0.14		0.05	c0.14		0.03	c0.17		0.15	0.15	
v/s Ratio Perm						0.08			0.06			c0.23
v/c Ratio	0.80	0.79		0.32	0.85	0.48	0.16	0.94	0.34	0.43	0.43	0.66
Uniform Delay, d1	59.3	59.2		54.9	60.6	56.6	52.1	60.8	53.9	37.7	37.8	41.6
Progression Factor	1.00	1.00		0.79	0.80	0.75	1.00	1.00	1.00	0.91	0.91	0.85
Incremental Delay, d2	15.0	7.3		0.5	9.7	1.4	0.2	34.5	0.8	1.7	1.7	4.9
Delay (s)	74.3	66.6		43.8	58.4	43.5	52.3	95.3	54.7	36.0	36.0	40.2
Level of Service	E	E		D	E	D	D	F	D	D	D	D
Approach Delay (s)		69.1			53.0			78.7			38.1	
Approach LOS		E			D			E			D	

Intersection Summary			
HCM 2000 Control Delay	56.2	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	90.8%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Queues

3: Palo Alto Ave/Woodland Ave & Middlefield Rd

	↗	→	←	↘	↙
Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	87	743	586	224	148
v/c Ratio	0.52	0.36	0.70	0.53	0.26
Control Delay	48.1	4.4	23.2	27.5	5.1
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	48.1	4.4	23.2	27.5	5.1
Queue Length 50th (ft)	39	40	221	86	0
Queue Length 95th (ft)	m62	59	347	154	38
Internal Link Dist (ft)		318	197		
Turn Bay Length (ft)	50			30	
Base Capacity (vph)	177	2052	836	420	570
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.49	0.36	0.70	0.53	0.26

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis
3: Palo Alto Ave/Woodland Ave & Middlefield Rd

Mitigation Measures - Option 2
Timing Plan: A.M. Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↱			✥		↰		↱
Traffic Volume (vph)	84	721	0	0	501	38	0	0	0	222	0	147
Future Volume (vph)	84	721	0	0	501	38	0	0	0	222	0	147
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5			4.5					4.5		4.5
Lane Util. Factor	1.00	0.95			1.00					1.00		1.00
Frpb, ped/bikes	1.00	1.00			1.00					1.00		0.98
Flpb, ped/bikes	1.00	1.00			1.00					0.99		1.00
Frt	1.00	1.00			0.99					1.00		0.85
Flt Protected	0.95	1.00			1.00					0.95		1.00
Satd. Flow (prot)	1770	3539			1841					1756		1555
Flt Permitted	0.95	1.00			1.00					0.76		1.00
Satd. Flow (perm)	1770	3539			1841					1400		1555
Peak-hour factor, PHF	0.97	0.97	0.97	0.92	0.92	0.92	0.25	0.25	0.25	0.99	0.99	0.99
Adj. Flow (vph)	87	743	0	0	545	41	0	0	0	224	0	148
RTOR Reduction (vph)	0	0	0	0	3	0	0	0	0	0	0	104
Lane Group Flow (vph)	87	743	0	0	583	0	0	0	0	224	0	44
Confl. Peds. (#/hr)	5		6	6		5			6	6		
Confl. Bikes (#/hr)			5			2			1			8
Turn Type	Prot	NA			NA					Perm		Perm
Protected Phases	7	4			8			2				
Permitted Phases							2			6		6
Actuated Green, G (s)	6.0	43.5			33.0					22.5		22.5
Effective Green, g (s)	6.0	43.5			33.0					22.5		22.5
Actuated g/C Ratio	0.08	0.58			0.44					0.30		0.30
Clearance Time (s)	4.5	4.5			4.5					4.5		4.5
Vehicle Extension (s)	3.0	3.0			3.0					3.0		3.0
Lane Grp Cap (vph)	141	2052			810					420		466
v/s Ratio Prot	c0.05	0.21			c0.32							
v/s Ratio Perm										c0.16		0.03
v/c Ratio	0.62	0.36			0.72					0.53		0.10
Uniform Delay, d1	33.4	8.4			17.2					21.9		18.9
Progression Factor	1.20	0.48			1.00					1.00		1.00
Incremental Delay, d2	6.6	0.4			5.5					4.8		0.4
Delay (s)	46.6	4.4			22.7					26.7		19.3
Level of Service	D	A			C					C		B
Approach Delay (s)		8.8			22.7			0.0			23.7	
Approach LOS		A			C			A			C	

Intersection Summary			
HCM 2000 Control Delay	16.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	63.2%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

	↗	→	←	↖	↘	↙
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↱		Y	
Traffic Volume (veh/h)	24	925	507	5	2	32
Future Volume (Veh/h)	24	925	507	5	2	32
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.94	0.94	0.95	0.95	0.92	0.92
Hourly flow rate (vph)	26	984	534	5	2	35
Pedestrians		2	4		10	
Lane Width (ft)		12.0	12.0		12.0	
Walking Speed (ft/s)		3.5	3.5		3.5	
Percent Blockage		0	0		1	
Right turn flare (veh)						
Median type		None	TWLTL			
Median storage veh)			2			
Upstream signal (ft)		494				
pX, platoon unblocked					0.71	
vC, conflicting volume	549				1586	548
vC1, stage 1 conf vol					546	
vC2, stage 2 conf vol					1040	
vCu, unblocked vol	549				1622	548
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)					5.4	
tF (s)	2.2				3.5	3.3
p0 queue free %	97				99	93
cM capacity (veh/h)	1011				258	530

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	26	984	539	37
Volume Left	26	0	0	2
Volume Right	0	0	5	35
cSH	1011	1700	1700	501
Volume to Capacity	0.03	0.58	0.32	0.07
Queue Length 95th (ft)	2	0	0	6
Control Delay (s)	8.7	0.0	0.0	12.8
Lane LOS	A			B
Approach Delay (s)	0.2		0.0	12.8
Approach LOS				B

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	59.3%	ICU Level of Service	B
Analysis Period (min)	15		

5: Pope St & Central Ave

	↗	→	←	↖	↘	↙
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↱		Y	
Traffic Volume (veh/h)	2	78	37	17	82	2
Future Volume (Veh/h)	2	78	37	17	82	2
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.72	0.72	0.84	0.84
Hourly flow rate (vph)	2	85	51	24	98	2
Pedestrians					8	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					3.5	
Percent Blockage					1	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	83				160	71
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	83				160	71
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				88	100
cM capacity (veh/h)	1503				824	984

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	87	75	100
Volume Left	2	0	98
Volume Right	0	24	2
cSH	1503	1700	826
Volume to Capacity	0.00	0.04	0.12
Queue Length 95th (ft)	0	0	10
Control Delay (s)	0.2	0.0	10.0
Lane LOS	A		A
Approach Delay (s)	0.2	0.0	10.0
Approach LOS			A

Intersection Summary			
Average Delay	3.9		
Intersection Capacity Utilization	17.0%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection: 6: Woodland Ave & Pope St/Chaucer St

Movement	EB	NB	SB
Directions Served	LTR	LTR	LTR
Maximum Queue (ft)	77	50	77
Average Queue (ft)	38	25	43
95th Queue (ft)	62	42	67
Link Distance (ft)	283	395	346
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

HCM Unsignalized Intersection Capacity Analysis
6: Woodland Ave & Pope St/Chaucer St

Mitigation Measures - Option 2
Timing Plan: A.M. Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	25	0	134	0	0	0	20	58	0	0	138	32
Future Volume (vph)	25	0	134	0	0	0	20	58	0	0	138	32
Peak Hour Factor	0.88	0.88	0.88	0.82	0.82	0.82	0.79	0.79	0.79	0.94	0.94	0.94
Hourly flow rate (vph)	28	0	152	0	0	0	25	73	0	0	147	34

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	180	0	98	181
Volume Left (vph)	28	0	25	0
Volume Right (vph)	152	0	0	34
Hadj (s)	-0.44	0.00	0.09	-0.08
Departure Headway (s)	4.1	4.7	4.6	4.3
Degree Utilization, x	0.20	0.00	0.12	0.22
Capacity (veh/h)	821	705	744	788
Control Delay (s)	8.1	7.7	8.2	8.5
Approach Delay (s)	8.1	0.0	8.2	8.5
Approach LOS	A	A	A	A

Intersection Summary			
Delay	8.3		
Level of Service	A		
Intersection Capacity Utilization	34.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Volume (veh/h)	0	0	0	3	0	1	0	2	6	2	2	0
Future Volume (Veh/h)	0	0	0	3	0	1	0	2	6	2	2	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.94	0.94	0.94	0.85	0.85	0.85	0.92	0.92	0.92	0.25	0.25	0.25
Hourly flow rate (vph)	0	0	0	4	0	1	0	2	7	8	8	0
Pedestrians		2			3			2			8	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		0			0			0			1	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					517							
pX, platoon unblocked												
vC, conflicting volume	9			2			16	19	5	28	18	10
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	9			2			16	19	5	28	18	10
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	99	99	99	100
cM capacity (veh/h)	1599			1617			979	864	1073	955	865	1060

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	0	5	9	16
Volume Left	0	4	0	8
Volume Right	0	1	7	0
cSH	1700	1617	1018	908
Volume to Capacity	0.00	0.00	0.01	0.02
Queue Length 95th (ft)	0	0	1	1
Control Delay (s)	0.0	5.8	8.6	9.0
Lane LOS		A	A	A
Approach Delay (s)	0.0	5.8	8.6	9.0
Approach LOS			A	A

Intersection Summary			
Average Delay	8.4		
Intersection Capacity Utilization	16.6%	ICU Level of Service	A
Analysis Period (min)	15		

8: University Ave & Chaucer St

	→	←	↑	↓
Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	8	71	394	766
v/c Ratio	0.03	0.23	0.26	0.50
Control Delay	20.6	13.0	2.8	4.5
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	20.6	13.0	2.8	4.5
Queue Length 50th (ft)	1	3	31	81
Queue Length 95th (ft)	14	24	70	174
Internal Link Dist (ft)	437	466	382	498
Turn Bay Length (ft)				
Base Capacity (vph)	987	986	1787	1781
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.01	0.07	0.22	0.43

Intersection Summary

HCM Signalized Intersection Capacity Analysis
8: University Ave & Chaucer St

Mitigation Measures - Option 2
Timing Plan: A.M. Peak

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Volume (vph)	2	2	4	7	2	40	1	361	1	7	674	1
Future Volume (vph)	2	2	4	7	2	40	1	361	1	7	674	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0			5.0			5.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		0.94			0.94			1.00			1.00	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		0.93			0.89			1.00			1.00	
Flt Protected		0.99			0.99			1.00			1.00	
Satd. Flow (prot)		1619			1546			1862			1861	
Flt Permitted		0.92			0.95			1.00			1.00	
Satd. Flow (perm)		1500			1476			1860			1855	
Peak-hour factor, PHF	0.90	0.90	0.90	0.69	0.69	0.69	0.92	0.92	0.92	0.89	0.89	0.89
Adj. Flow (vph)	2	2	4	10	3	58	1	392	1	8	757	1
RTOR Reduction (vph)	0	4	0	0	54	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	4	0	0	17	0	0	394	0	0	766	0
Confl. Peds. (#/hr)	6		4	4		6	5		3	3		5
Confl. Bikes (#/hr)			18			10			7			23
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Actuated Green, G (s)		3.5			3.5			33.3			33.3	
Effective Green, g (s)		3.5			3.5			33.3			33.3	
Actuated g/C Ratio		0.08			0.08			0.73			0.73	
Clearance Time (s)		4.0			4.0			5.0			5.0	
Vehicle Extension (s)		3.0			3.0			4.0			4.0	
Lane Grp Cap (vph)		114			112			1352			1348	
v/s Ratio Prot												
v/s Ratio Perm		0.00			c0.01			0.21			c0.41	
v/c Ratio		0.04			0.16			0.29			0.57	
Uniform Delay, d1		19.6			19.8			2.2			2.9	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.1			0.7			0.2			0.7	
Delay (s)		19.7			20.4			2.3			3.6	
Level of Service		B			C			A			A	
Approach Delay (s)		19.7			20.4			2.3			3.6	
Approach LOS		B			C			A			A	

Intersection Summary			
HCM 2000 Control Delay	4.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	45.8	Sum of lost time (s)	9.0
Intersection Capacity Utilization	55.2%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Queues
9: University Ave & Woodland Ave/Scofield Ave

	↗	→	←	↖	↑	↘	↓	↙
Lane Group	EBL	EBT	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	424	219	490	108	653	253	1022	570
v/c Ratio	0.88	0.78	1.07	0.57	0.62	0.75	0.72	0.62
Control Delay	57.4	45.9	89.9	47.1	29.3	45.6	25.6	5.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	57.4	45.9	89.9	47.1	29.3	45.6	25.6	5.3
Queue Length 50th (ft)	115	84	~253	56	153	128	239	0
Queue Length 95th (ft)	#195	#194	#442	103	231	192	329	71
Internal Link Dist (ft)		498	512		536		443	
Turn Bay Length (ft)				160		210		
Base Capacity (vph)	484	284	457	249	1051	458	1420	915
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.88	0.77	1.07	0.43	0.62	0.55	0.72	0.62

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↱			✥		↰	↑↱		↰	↑↑	↱
Traffic Volume (vph)	390	93	109	15	121	315	99	588	13	233	940	524
Future Volume (vph)	390	93	109	15	121	315	99	588	13	233	940	524
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0			3.0		3.0	4.0		3.0	4.0	4.0
Lane Util. Factor	0.97	1.00			1.00		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	0.97			0.99		1.00	1.00		1.00	1.00	0.90
Flpb, ped/bikes	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.92			0.91		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	1659			1668		1770	3526		1770	3539	1431
Flt Permitted	0.95	1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	1659			1668		1770	3526		1770	3539	1431
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	424	101	118	16	132	342	108	639	14	253	1022	570
RTOR Reduction (vph)	0	50	0	0	95	0	0	1	0	0	0	345
Lane Group Flow (vph)	424	169	0	0	395	0	108	652	0	253	1022	225
Confl. Peds. (#/hr)			39						3			26
Confl. Bikes (#/hr)			2			2						10
Turn Type	Split	NA		Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	8	8		7	7		1	6		5	2	
Permitted Phases												2
Actuated Green, G (s)	11.9	11.9			18.5		8.1	25.3		16.3	33.5	33.5
Effective Green, g (s)	11.9	11.9			18.5		8.1	25.3		16.3	33.5	33.5
Actuated g/C Ratio	0.14	0.14			0.22		0.10	0.30		0.19	0.39	0.39
Clearance Time (s)	3.0	3.0			3.0		3.0	4.0		3.0	4.0	4.0
Vehicle Extension (s)	2.0	2.0			2.0		2.0	3.0		2.0	3.0	3.0
Lane Grp Cap (vph)	480	232			363		168	1049		339	1394	563
v/s Ratio Prot	c0.12	0.10			c0.24		0.06	0.18		c0.14	c0.29	
v/s Ratio Perm												0.16
v/c Ratio	0.88	0.73			1.09		0.64	0.62		0.75	0.73	0.40
Uniform Delay, d1	35.9	35.0			33.2		37.1	25.7		32.4	21.9	18.5
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	16.9	9.3			72.5		6.2	2.8		7.6	3.4	2.1
Delay (s)	52.7	44.3			105.8		43.2	28.5		40.0	25.4	20.6
Level of Service	D	D			F		D	C		D	C	C
Approach Delay (s)		49.9			105.8			30.6			25.9	
Approach LOS		D			F			C			C	

Intersection Summary			
HCM 2000 Control Delay	41.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	85.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	88.9%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Queues
1: Willow Rd & Gilbert Ave

	↗	→	↙	←	↖	↑	↘	↓
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	18	96	88	127	5	262	121	757
v/c Ratio	0.14	0.41	0.59	0.53	0.01	0.19	0.14	0.51
Control Delay	45.6	46.2	63.8	50.1	4.0	3.4	4.0	6.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	45.6	46.2	63.8	50.1	4.0	3.4	4.0	6.5
Queue Length 50th (ft)	13	63	66	84	1	30	16	152
Queue Length 95th (ft)	29	93	113	137	3	44	32	207
Internal Link Dist (ft)		468		521		1923		337
Turn Bay Length (ft)	55		90		75		90	
Base Capacity (vph)	181	340	216	341	480	1406	858	1477
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.28	0.41	0.37	0.01	0.19	0.14	0.51

Intersection Summary

1: Willow Rd & Gilbert Ave

Timing Plan: P.M. Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱		↰	↱	
Traffic Volume (vph)	14	60	16	78	82	31	3	122	43	87	538	7
Future Volume (vph)	14	60	16	78	82	31	3	122	43	87	538	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	0.98		1.00	1.00	
Flpb, ped/bikes	0.99	1.00		0.98	1.00		0.99	1.00		0.97	1.00	
Frt	1.00	0.97		1.00	0.96		1.00	0.96		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1747	1778		1733	1768		1760	1759		1717	1858	
Flt Permitted	0.53	1.00		0.64	1.00		0.33	1.00		0.60	1.00	
Satd. Flow (perm)	973	1778		1161	1768		603	1759		1080	1858	
Peak-hour factor, PHF	0.79	0.79	0.79	0.89	0.89	0.89	0.63	0.63	0.63	0.72	0.72	0.72
Adj. Flow (vph)	18	76	20	88	92	35	5	194	68	121	747	10
RTOR Reduction (vph)	0	9	0	0	12	0	0	8	0	0	0	0
Lane Group Flow (vph)	18	87	0	88	115	0	5	254	0	121	757	0
Confl. Peds. (#/hr)	6		9	9		6	8		17	17		8
Confl. Bikes (#/hr)			9						11			4
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			6	
Permitted Phases	4			4			2			6		
Actuated Green, G (s)	15.4	15.4		15.4	15.4		95.4	95.4		95.4	95.4	
Effective Green, g (s)	15.4	15.4		15.4	15.4		95.4	95.4		95.4	95.4	
Actuated g/C Ratio	0.13	0.13		0.13	0.13		0.80	0.80		0.80	0.80	
Clearance Time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	124	228		148	226		479	1398		858	1477	
v/s Ratio Prot		0.05			0.06			0.14			c0.41	
v/s Ratio Perm	0.02			c0.08			0.01			0.11		
v/c Ratio	0.15	0.38		0.59	0.51		0.01	0.18		0.14	0.51	
Uniform Delay, d1	46.5	47.9		49.4	48.8		2.5	2.9		2.8	4.3	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.5	1.1		6.3	1.8		0.0	0.3		0.3	1.3	
Delay (s)	47.0	49.0		55.6	50.6		2.6	3.2		3.2	5.5	
Level of Service	D	D		E	D		A	A		A	A	
Approach Delay (s)		48.7			52.6			3.2			5.2	
Approach LOS		D			D			A			A	

Intersection Summary			
HCM 2000 Control Delay	15.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	9.2
Intersection Capacity Utilization	62.6%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

2: Willow Rd & Middlefield Rd

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	127	584	133	710	99	48	123	319	244	244	354
v/c Ratio	0.36	0.79	0.28	0.78	0.23	0.19	0.45	0.66	0.68	0.67	0.81
Control Delay	54.8	62.8	46.2	56.4	16.8	59.5	63.9	13.0	63.4	62.7	46.9
Queue Delay	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	54.8	62.8	46.2	57.6	16.8	59.5	63.9	13.0	63.4	62.7	46.9
Queue Length 50th (ft)	123	313	109	374	20	42	113	0	247	246	216
Queue Length 95th (ft)	210	420	182	484	80	80	172	48	332	331	309
Internal Link Dist (ft)		465		339			466			185	
Turn Bay Length (ft)	270		120		65	75		110	150		65
Base Capacity (vph)	433	907	612	1170	531	408	429	580	516	525	570
Starvation Cap Reductn	0	0	0	247	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.29	0.64	0.22	0.77	0.19	0.12	0.29	0.55	0.47	0.46	0.62

Intersection Summary

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↰↑↱		↰	↑↑↱	↱	↰	↑	↱	↰	↰↑	↱
Traffic Volume (vph)	130	511	14	128	671	106	39	100	258	353	57	297
Future Volume (vph)	130	511	14	128	671	106	39	100	258	353	57	297
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.3	5.3		5.3	5.3	5.3	4.7	4.7	4.7	4.7	4.7	4.7
Lane Util. Factor	0.91	0.91		1.00	0.91	0.91	1.00	1.00	1.00	0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.97	1.00	1.00	0.92	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.97	1.00
Satd. Flow (prot)	1610	3369		1770	3381	1400	1770	1863	1458	1681	1708	1531
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.97	1.00
Satd. Flow (perm)	1610	3369		1770	3381	1400	1770	1863	1458	1681	1708	1531
Peak-hour factor, PHF	0.92	0.92	0.92	0.96	0.96	0.96	0.81	0.81	0.81	0.84	0.84	0.84
Adj. Flow (vph)	141	555	15	133	699	110	48	123	319	420	68	354
RTOR Reduction (vph)	0	1	0	0	1	55	0	0	272	0	0	114
Lane Group Flow (vph)	127	583	0	133	709	44	48	123	47	244	244	240
Confl. Peds. (#/hr)			5			9			28			11
Confl. Bikes (#/hr)			6			3			19			6
Turn Type	Split	NA		Split	NA	Perm	Split	NA	Perm	Split	NA	Perm
Protected Phases	2	2		3	3		1	1		4	4	
Permitted Phases						3			1			4
Actuated Green, G (s)	30.4	30.4		37.2	37.2	37.2	20.3	20.3	20.3	29.6	29.6	29.6
Effective Green, g (s)	30.4	30.4		37.2	37.2	37.2	20.3	20.3	20.3	29.6	29.6	29.6
Actuated g/C Ratio	0.22	0.22		0.27	0.27	0.27	0.15	0.15	0.15	0.22	0.22	0.22
Clearance Time (s)	5.3	5.3		5.3	5.3	5.3	4.7	4.7	4.7	4.7	4.7	4.7
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	355	744		478	914	378	261	275	215	361	367	329
v/s Ratio Prot	0.08	c0.17		0.08	c0.21		0.03	c0.07		0.15	0.14	
v/s Ratio Perm						0.03			0.03			c0.16
v/c Ratio	0.36	0.78		0.28	0.78	0.12	0.18	0.45	0.22	0.68	0.66	0.73
Uniform Delay, d1	45.3	50.5		39.6	46.3	37.8	51.3	53.5	51.6	49.5	49.4	50.2
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.6	5.4		0.3	4.2	0.1	0.3	1.2	0.5	4.9	4.5	8.1
Delay (s)	45.9	55.9		39.9	50.5	37.9	51.7	54.6	52.1	54.5	53.9	58.3
Level of Service	D	E		D	D	D	D	D	D	D	D	E
Approach Delay (s)		54.1			47.7			52.7			55.9	
Approach LOS		D			D			D			E	

Intersection Summary				
HCM 2000 Control Delay	52.4	HCM 2000 Level of Service	D	
HCM 2000 Volume to Capacity ratio	0.71			
Actuated Cycle Length (s)	137.5	Sum of lost time (s)	20.0	
Intersection Capacity Utilization	71.1%	ICU Level of Service	C	
Analysis Period (min)	15			

c Critical Lane Group

3: Palo Alto Ave/Woodland Ave & Middlefield Rd

	↗	→	←	↘	↙
Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	236	1102	1017	185	126
v/c Ratio	0.91	0.42	1.03	0.79	0.34
Control Delay	80.7	5.6	58.8	62.7	9.3
Queue Delay	0.0	0.9	0.0	0.0	0.0
Total Delay	80.7	6.5	58.8	62.7	9.3
Queue Length 50th (ft)	151	126	~705	111	0
Queue Length 95th (ft)	#261	141	#953	146	25
Internal Link Dist (ft)		318	197		
Turn Bay Length (ft)	50			30	
Base Capacity (vph)	259	2617	992	267	400
Starvation Cap Reductn	0	1127	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.91	0.74	1.03	0.69	0.32

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

3: Palo Alto Ave/Woodland Ave & Middlefield Rd

Timing Plan: P.M. Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↱			✣		↰		↱
Traffic Volume (vph)	196	915	0	0	767	168	0	0	0	135	0	92
Future Volume (vph)	196	915	0	0	767	168	0	0	0	135	0	92
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5			4.5					4.5		4.5
Lane Util. Factor	1.00	0.95			1.00					1.00		1.00
Frpb, ped/bikes	1.00	1.00			0.99					1.00		0.99
Flpb, ped/bikes	1.00	1.00			1.00					0.99		1.00
Frt	1.00	1.00			0.98					1.00		0.85
Flt Protected	0.95	1.00			1.00					0.95		1.00
Satd. Flow (prot)	1770	3539			1800					1758		1562
Flt Permitted	0.95	1.00			1.00					0.76		1.00
Satd. Flow (perm)	1770	3539			1800					1401		1562
Peak-hour factor, PHF	0.83	0.83	0.83	0.92	0.92	0.92	0.25	0.25	0.25	0.73	0.73	0.73
Adj. Flow (vph)	236	1102	0	0	834	183	0	0	0	185	0	126
RTOR Reduction (vph)	0	0	0	0	8	0	0	0	0	0	0	105
Lane Group Flow (vph)	236	1102	0	0	1009	0	0	0	0	185	0	21
Confl. Peds. (#/hr)	12		2	2		12			4	4		
Confl. Bikes (#/hr)			2			2			3			1
Turn Type	Prot	NA			NA					Perm		Perm
Protected Phases	7	4			8			2				
Permitted Phases							2			6		6
Actuated Green, G (s)	14.3	72.4			53.6					16.5		16.5
Effective Green, g (s)	14.3	72.4			53.6					16.5		16.5
Actuated g/C Ratio	0.15	0.74			0.55					0.17		0.17
Clearance Time (s)	4.5	4.5			4.5					4.5		4.5
Vehicle Extension (s)	3.0	3.0			3.0					3.0		3.0
Lane Grp Cap (vph)	258	2617			985					236		263
v/s Ratio Prot	c0.13	0.31			c0.56							
v/s Ratio Perm										c0.13		0.01
v/c Ratio	0.91	0.42			1.02					0.78		0.08
Uniform Delay, d1	41.2	4.8			22.2					39.0		34.3
Progression Factor	1.00	1.00			1.00					1.00		1.00
Incremental Delay, d2	34.0	0.1			35.1					15.6		0.1
Delay (s)	75.2	4.9			57.3					54.5		34.4
Level of Service	E	A			E					D		C
Approach Delay (s)		17.3			57.3			0.0			46.4	
Approach LOS		B			E			A			D	

Intersection Summary			
HCM 2000 Control Delay	35.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	97.9	Sum of lost time (s)	13.5
Intersection Capacity Utilization	85.7%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
	↗	→	←	↖	↘	↙
Lane Configurations	↰	↑	↱		Y	
Traffic Volume (veh/h)	51	970	925	2	1	37
Future Volume (Veh/h)	51	970	925	2	1	37
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.94	0.94	0.89	0.89	0.69	0.69
Hourly flow rate (vph)	54	1032	1039	2	1	54
Pedestrians			2		14	
Lane Width (ft)			12.0		12.0	
Walking Speed (ft/s)			3.5		3.5	
Percent Blockage			0		1	
Right turn flare (veh)						
Median type		None	TWLTL			
Median storage veh)			2			
Upstream signal (ft)		494				
pX, platoon unblocked					0.73	
vC, conflicting volume	1055				2196	1054
vC1, stage 1 conf vol					1054	
vC2, stage 2 conf vol					1142	
vCu, unblocked vol	1055				2458	1054
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)					5.4	
tF (s)	2.2				3.5	3.3
p0 queue free %	92				99	80
cM capacity (veh/h)	651				184	271

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	54	1032	1041	55
Volume Left	54	0	0	1
Volume Right	0	0	2	54
cSH	651	1700	1700	269
Volume to Capacity	0.08	0.61	0.61	0.20
Queue Length 95th (ft)	7	0	0	19
Control Delay (s)	11.0	0.0	0.0	21.8
Lane LOS	B			C
Approach Delay (s)	0.5		0.0	21.8
Approach LOS				C

Intersection Summary			
Average Delay	0.8		
Intersection Capacity Utilization	61.1%	ICU Level of Service	B
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
5: Pope St & Central Ave

Mitigation Measures - Option 2
Timing Plan: P.M. Peak

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↱		⅄	
Traffic Volume (veh/h)	1	50	104	100	18	3
Future Volume (Veh/h)	1	50	104	100	18	3
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.76	0.76	0.86	0.86	0.53	0.53
Hourly flow rate (vph)	1	66	121	116	34	6
Pedestrians					7	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					3.5	
Percent Blockage					1	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	244				254	186
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	244				254	186
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				95	99
cM capacity (veh/h)	1313				729	850

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	67	237	40
Volume Left	1	0	34
Volume Right	0	116	6
cSH	1313	1700	745
Volume to Capacity	0.00	0.14	0.05
Queue Length 95th (ft)	0	0	4
Control Delay (s)	0.1	0.0	10.1
Lane LOS	A		B
Approach Delay (s)	0.1	0.0	10.1
Approach LOS			B

Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	22.2%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection: 6: Woodland Ave & Pope St/Chaucer St

Movement	EB	NB	SB
Directions Served	LTR	LTR	LTR
Maximum Queue (ft)	55	92	85
Average Queue (ft)	30	46	44
95th Queue (ft)	49	74	70
Link Distance (ft)	288	400	344
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	8	0	60	0	0	0	105	130	0	0	77	98
Future Volume (vph)	8	0	60	0	0	0	105	130	0	0	77	98
Peak Hour Factor	0.73	0.73	0.73	0.91	0.91	0.91	0.78	0.78	0.78	0.82	0.82	0.82
Hourly flow rate (vph)	11	0	82	0	0	0	135	167	0	0	94	120

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	93	0	302	214
Volume Left (vph)	11	0	135	0
Volume Right (vph)	82	0	0	120
Hadj (s)	-0.47	0.00	0.12	-0.30
Departure Headway (s)	4.6	5.2	4.5	4.2
Degree Utilization, x	0.12	0.00	0.37	0.25
Capacity (veh/h)	708	622	783	830
Control Delay (s)	8.2	8.2	10.1	8.5
Approach Delay (s)	8.2	0.0	10.1	8.5
Approach LOS	A	A	B	A

Intersection Summary			
Delay	9.3		
Level of Service	A		
Intersection Capacity Utilization	42.2%	ICU Level of Service	A
Analysis Period (min)	15		

7: Palo Alto Ave & Chaucer St

Timing Plan: P.M. Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Volume (veh/h)	0	0	0	3	0	10	0	8	15	4	2	0
Future Volume (Veh/h)	0	0	0	3	0	10	0	8	15	4	2	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.85	0.85	0.85	0.83	0.83	0.83	0.83	0.83	0.83	0.50	0.50	0.50
Hourly flow rate (vph)	0	0	0	4	0	12	0	10	18	8	4	0
Pedestrians		3			12			16			20	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		0			1			2			2	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					517							
pX, platoon unblocked												
vC, conflicting volume	32			16			35	56	28	69	50	29
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	32			16			35	56	28	69	50	29
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	99	98	99	100	100
cM capacity (veh/h)	1550			1577			924	805	1019	847	811	1023

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	0	16	28	12
Volume Left	0	4	0	8
Volume Right	0	12	18	0
cSH	1700	1577	931	835
Volume to Capacity	0.00	0.00	0.03	0.01
Queue Length 95th (ft)	0	0	2	1
Control Delay (s)	0.0	1.8	9.0	9.4
Lane LOS		A	A	A
Approach Delay (s)	0.0	1.8	9.0	9.4
Approach LOS			A	A

Intersection Summary			
Average Delay	7.0		
Intersection Capacity Utilization	21.5%	ICU Level of Service	A
Analysis Period (min)	15		

Queues
8: University Ave & Chaucer St

	→	←	↑	↓
Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	20	48	266	575
v/c Ratio	0.05	0.12	0.19	0.44
Control Delay	14.9	13.7	4.9	6.8
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	14.9	13.7	4.9	6.8
Queue Length 50th (ft)	2	5	20	56
Queue Length 95th (ft)	20	31	80	237
Internal Link Dist (ft)	437	466	382	498
Turn Bay Length (ft)				
Base Capacity (vph)	1198	1076	1761	1644
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.02	0.04	0.15	0.35

Intersection Summary

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Volume (vph)	3	10	5	16	9	14	1	202	5	64	433	3
Future Volume (vph)	3	10	5	16	9	14	1	202	5	64	433	3
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0			5.0			5.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		0.99			0.98			1.00			1.00	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		0.96			0.95			1.00			1.00	
Flt Protected		0.99			0.98			1.00			0.99	
Satd. Flow (prot)		1749			1702			1855			1849	
Flt Permitted		0.94			0.86			1.00			0.93	
Satd. Flow (perm)		1663			1487			1853			1732	
Peak-hour factor, PHF	0.90	0.90	0.90	0.81	0.81	0.81	0.78	0.78	0.78	0.87	0.87	0.87
Adj. Flow (vph)	3	11	6	20	11	17	1	259	6	74	498	3
RTOR Reduction (vph)	0	5	0	0	15	0	0	1	0	0	0	0
Lane Group Flow (vph)	0	15	0	0	33	0	0	265	0	0	575	0
Confl. Peds. (#/hr)	3		4	4		3	8		3	3		8
Confl. Bikes (#/hr)			8			11			12			6
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Actuated Green, G (s)		5.0			5.0			24.8			24.8	
Effective Green, g (s)		5.0			5.0			24.8			24.8	
Actuated g/C Ratio		0.13			0.13			0.64			0.64	
Clearance Time (s)		4.0			4.0			5.0			5.0	
Vehicle Extension (s)		3.0			3.0			4.0			4.0	
Lane Grp Cap (vph)		214			191			1184			1107	
v/s Ratio Prot												
v/s Ratio Perm		0.01			c0.02			0.14			c0.33	
v/c Ratio		0.07			0.17			0.22			0.52	
Uniform Delay, d1		14.9			15.1			2.9			3.8	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.1			0.4			0.1			0.5	
Delay (s)		15.0			15.5			3.1			4.3	
Level of Service		B			B			A			A	
Approach Delay (s)		15.0			15.5			3.1			4.3	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	4.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.46		
Actuated Cycle Length (s)	38.8	Sum of lost time (s)	9.0
Intersection Capacity Utilization	55.8%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

	↗	→	←	↖	↑	↘	↓	↙
Lane Group	EBL	EBT	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	547	296	568	383	795	147	518	398
v/c Ratio	0.87	0.87	0.99	1.11	0.69	0.64	0.56	0.61
Control Delay	51.9	57.4	56.4	117.9	30.2	48.9	30.7	7.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	51.9	57.4	56.4	117.9	30.2	48.9	30.7	7.3
Queue Length 50th (ft)	156	143	~216	~258	197	80	128	0
Queue Length 95th (ft)	#238	#285	#419	#431	284	134	178	71
Internal Link Dist (ft)		498	512		536		443	
Turn Bay Length (ft)				160		210		
Base Capacity (vph)	648	350	573	345	1155	334	1022	677
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.84	0.85	0.99	1.11	0.69	0.44	0.51	0.59

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↱			✥		↰	↑↱		↰	↑↑	↱
Traffic Volume (vph)	503	153	120	11	67	444	352	708	23	135	477	366
Future Volume (vph)	503	153	120	11	67	444	352	708	23	135	477	366
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0			3.0		3.0	4.0		3.0	4.0	4.0
Lane Util. Factor	0.97	1.00			1.00		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	0.97			1.00		1.00	1.00		1.00	1.00	0.86
Flpb, ped/bikes	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.93			0.89		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	1686			1647		1770	3520		1770	3539	1363
Flt Permitted	0.95	1.00			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	1686			1647		1770	3520		1770	3539	1363
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	547	166	130	12	73	483	383	770	25	147	518	398
RTOR Reduction (vph)	0	32	0	0	220	0	0	3	0	0	0	293
Lane Group Flow (vph)	547	264	0	0	348	0	383	792	0	147	518	105
Confl. Peds. (#/hr)			47						1			40
Confl. Bikes (#/hr)			4						4			7
Turn Type	Split	NA		Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	8	8		7	7		1	6		5	2	
Permitted Phases												2
Actuated Green, G (s)	16.4	16.4			19.3		17.6	29.5		11.8	23.7	23.7
Effective Green, g (s)	16.4	16.4			19.3		17.6	29.5		11.8	23.7	23.7
Actuated g/C Ratio	0.18	0.18			0.21		0.20	0.33		0.13	0.26	0.26
Clearance Time (s)	3.0	3.0			3.0		3.0	4.0		3.0	4.0	4.0
Vehicle Extension (s)	2.0	2.0			2.0		2.0	3.0		2.0	3.0	3.0
Lane Grp Cap (vph)	625	307			353		346	1153		232	931	358
v/s Ratio Prot	c0.16	0.16			c0.21		c0.22	c0.23		0.08	0.15	
v/s Ratio Perm												0.08
v/c Ratio	0.88	0.86			0.99		1.11	0.69		0.63	0.56	0.29
Uniform Delay, d1	35.8	35.7			35.2		36.2	26.2		37.1	28.6	26.5
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	12.6	20.4			43.6		80.4	3.3		4.1	2.4	2.1
Delay (s)	48.4	56.1			78.9		116.6	29.6		41.2	31.0	28.5
Level of Service	D	E			E		F	C		D	C	C
Approach Delay (s)		51.1			78.9			57.9			31.5	
Approach LOS		D			E			E			C	

Intersection Summary			
HCM 2000 Control Delay	51.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	96.4%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group