Facebook @ Menlo Park

West Campus

Hydrology Report

November 21, 2011

LUCE FORWARD Gensler BKF CMG CONGER MOSS GUILLARD landscape architecture KEMA FEHR PEERS

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Appendix A: Hamilton Park Development Storm Drain Report

Appendix B: Facebook Menlo Park, West Campus Flood Zone Description

1. INTRODUCTION

Facebook proposes to construct 440,000 square feet of office space on the 22 acre site at the southwest corner of the Willow Road/Bayfront Expressway intersection. The site was previously part of the adjacent Raychem (currently TE Connectivity) site. The parcel was sold to General Motors circa 2005. Because of the down turn in the economy General Motors did not develop the site and it was purchased by Facebook for the expansion of the recently purchase campus on the north side of Bayfront Expressway.

This report documents the impact development of the 22 acre site will have on the Willow Road storm drain system. Approximately 7 acres of the east end of the adjacent TE Connectivity property currently shares storm drain facilities with the site and drains east toward Willow Road. This report will also document impact to the TE Connectivity parcel.

This report will reference a previous storm drainage study that was prepared by BKF Engineers for the Clarum Homes Hamilton Park Development further west on Hamilton Avenue. The analysis prepared for the Hamilton Park Development report included an analysis of the Willow Road storm drainage system for the 10-year and 100-year storm event from Hamilton Avenue to its termination point at the Caltrans pump station on the Bayfront Expressway.

2. BACKGROUND

The portion of the Willow Road storm drain system that the project connects to was evaluated in 2004 for the Hamilton Park Development. This is documented in the report prepared by BKF titled, “Off-Site Storm Drainage System, Hamilton Park Development.” The Hamilton Park Development storm drain report will be used as the basis for the current analysis.

3. BASIS OF DESIGN

The following summarizes the basis of design.

Rational Method: The project area drainage facilities area evaluated using the Rational Method. The Rational Method is defined as Q = C I A, where:

Q = peak flow (cfs)

C = runoff coefficient factor

I = rainfall intensity (in/hr)

A = area (acres)

Design Storm Event: The storm drain system is evaluated using the 10-year and 100-year storm events.

Datum: The calculations are based on a datum from 1978 Caltrans calculation that show rim elevations at Hamilton Avenue and Willow Road at elevation 4.5 (Caltrans datum).

Computer Program: StormCAD V8i by Haestad Methods is used to evaluate the performance of the existing system. This program is a Rational Method based program with hydraulic analysis for both free flow and pressure flow conditions.

Time of Concentration: The initial time of concentration is based on the overland flow formula from the City of Menlo Park Requirements for the Preparation of Hydrology Reports. Additional time of concentration for flow duration in the pipes is calculated by the StormCAD program.

Runoff Coefficient: Runoff coefficients are developed using Caltrans guidelines (Table 819.2B) in the Highway Design Manual and the City of Menlo Park Hydraulic Guidelines. Based on the Caltrans methodology and consistent with the Hamilton Park Development storm drain analysis runoff coefficients are increased by a factor of 1.25 for the 100 year event, but are not increase to more than 1.0.

Summary of runoff coefficients is included as Tables D-1 through D-6. Runoff Coefficients

Starting Water Level: A starting water of elevation -14 is used at the pump station consistent with Caltrans calculations and the Hamilton Park Development storm drain analysis. The starting water level at the pump station is based on a 30-year storm event in the Belle-Haven storm drain system.

Rainfall Intensity: The rainfall intensities for the 10-year and 100-year design storm are calculated using the following equations in the City of Menlo Park Hydrology Reports Requirements:

$$I_{10-year} = \frac{5.76}{Tc^{0.533}} \qquad \text{(in/hr)}$$

$$I_{100-year} = \frac{8.38}{Tc^{0.526}} \qquad \text{(in/hr)}$$

Roughness Coefficient: A Manning's roughness coefficient of 0.013 is used for all storm drain lines.

Freeboard: The existing system is evaluation based on the 10-year event contained within the storm drain system.

Bend Losses: Bend losses are calculated using the HEC-22 energy method which considers bend angles, change in flow rate and change in pipe size.

Rim Elevations: Rim elevations are based on a combination of site survey by Kier & Wright, storm drain invert survey by Kier & Wright, and rim elevations reported by Caltrans. Caltrans reports a station water elevation 86 (elevation -14 on project datum) and a rim at the intersection of Willow Road and Hamilton Avenue (transition from 66-inch to 78-inch diameter line) at elevation 104.5 (elevation 4.5 on project datum). Project surveyed by Kier & Wright are adjusted to conform to the Caltrans datum to be consistent with the starting water level.

4. SYSTEM EVALUATION

EAST CAMPUS

EXISTING CONDITION

The existing storm drain system evaluation is based on the proposed condition that is included in the Hamilton Park Development storm drain analysis. We have included several hydrology and hydraulic tables from the Hamilton Park Development storm drain report. Tables A-3 and A-4 document the results of the proposed condition with the 10 year storm and Tables A-7 and A-8 document the results of the proposed condition with the 100 year storm. This information is used as the starting point for Facebook West Campus storm drain analysis.

EXISTING CONDITION MODEL VERIFICATION

A model of the Willow Road portion of Hamilton Park Development storm drain system was created using the input data from the Hamilton Park tables. This model includes the storm drain system from the Caltrans pump station node through node HT-05 at the intersection of Willow Road and Hamilton Avenue. We found that there were minor differences in the results of the 2004 model and the current model, with the current model having slightly lower hydraulic grade. We understand that these differences result in refinements that have been made to how the StormCAD program analyzes junction losses. Pipe losses between nodes match the Hamilton Park results.

The results of the 10 year storm analysis are shown in Tables B-1 and B-2. The results of the 100 year storm are shown in Tables C-1 and C-2.

EXISTING CONDITION MODEL MODIFICATION

The Hamilton Park Development model includes flow from the project site as a 24 cfs flow input directly to a system node instead of a hydrological input with associated runoff coefficient, area and time of concentration. The 24 cfs was divided between three nodes. Review of the TE Connectivity record drawings and current survey information indicates that the project site and the eastern portion of the TE Connectivity campus discharge to the Willow Road storm drain system at one node, HT-03.

The Hamilton Park Development model also used a slightly different formula for the 100 year rainfall intensity than that published in the current City of Menlo Park requirements for preparation of hydrology reports. The formula for the 10 year rainfall intensity is unchanged

The verification model was then run with the revised flow and updated 100 year rain fall intensity to set a base line for comparison. These model runs result in slightly higher HGL since there is a short segment of pipe with additional flow and slightly higher 100 year storm intensity.

The results of the Existing Condition Model Modification are shown in Tables B-3 and B-4 for the 10 year storm and Tables C-3 and C-4 for the 100 year storm. These results are not significantly different from the Hamilton Park Development storm drain analysis.

PROJECT SITE EXISTING CONDITION MODEL

We then created the Project Site Existing Condition Model by adding the on-site storm drain system to the previous model. This includes a portion of the storm drain system that drains the eastern portion of

the TE Connectivity site. The 24 cfs input flow that represented the project site discharge in the Hamilton Park Development analysis was removed and replaced with hydrological input to the section of storm drain line added to the model. The adjacent Swale A located between the site and the railroad tracks was included in the Hamilton Park Development modes as a hydrological input at node HT-03. Based on review of record drawings this input was moved to node CB-3 in the new model.

The results of the Project Site Existing Condition Model are shown in Tables B-5 and B-6 for the 10 year storm. The total flow and associated hydraulic grade line for the 10 year storm in the Willow Road storm drain system is slightly less than what is presented in the Hamilton Park Development storm drain report. This comes from a more detailed calculation of the drainage area, runoff coefficients and time of concentration from the project site. The on-site system has a minimum of 0.7 feet of freeboard. These results are presented in Tables B-5 and B-6.

The same analysis was completed for the 100 year storm and presented in Tables C-5 and C-6. The results show that the on-site storm drain system does not have capacity for 100 year storm and that the site will experience localized ponding. This is illustrated by negative freeboard and HGL above the ground surface for the on-site system. Two existing conditions contribute to this. The first is the existing on-site storm drain system was not originally designed for the 100 year storm. The second is the 100 year contribution from Swale A. As documented in the Hamilton Park Development storm drain report, during the 100 year storm there is an upstream flow reversal that significantly increases the tributary area to Swale A. Swale A drains to Willow Road through a portion of the on-site storm drain system and basically displaces on-site runoff. To model this we reduce the flow at the on-site nodes until the HGL was at or near the ground surface. This is the actual system capacity and shows a reduction in runoff reaching the Willow Road storm drain system. These results are shown in Tables C-5A and C-6A. Because of this constraint, these model results have slightly lower flows in the Willow Road storm drain system than show in the Hamilton Park Development Storm drain analysis.

PROJECT SITE PROPOSED CONDITION MODEL

Based on the land plan prepared for the August 8, 2011 application to the City of Menlo Plan development of the Facebook site will result in a small decrease in the impervious area on the site. The change in the areas and runoff coefficients was incorporated into the Proposed Condition Model.

The results of the Proposed Condition Model with the 10 year storm are shown in Tables B-7 and B-8. Because of the reduction in impervious area there is a decrease in runoff from the project site and benefit to the Willow Road Storm Drain system. The storm water is contained in the existing storm drain system and minimum freeboard increases from 0.7 feet in the existing condition to 0.9 feet.

The results of the Proposed Condition Model with the 100 year storm are shown in Tables C-7 and C-8. This analysis continues to show that, in the proposed condition, the on-site storm drain system does not have capacity to convey the 100 year storm from the site and the adjacent TE Connectivity tributary area. Because of the large contribution of flow from off-site Swale A and on-site storm drain constraints the storm drain flow making its way to the Willow Road storm drain system remains unchanged for the 100 year event and localized flooding will still occur. This is shown in Tables C-7A and C-8A.

Site Run-Off Summary Table

Node	10 Year Storm (cfs)		100 Year Storm (cfs)	
	Existing	Proposed	Existing	Proposed
CB-1	7.6	7.6	3.0	3.0
CB-2	13.4	13.2	4.0	4.0
CB-3	16.5	16.1	5.0	5.0
CB-4	9.7	9.7	46.3	46.3
CB-5	29.3	28.8	43.6	43.6
MH-15	29.1	28.5	43.4	43.4
HT-03	287.7	287.3	352.0	352.0
HT-02	286.7	286.3	350.8	350.8
HT-OUT	282.9	282.6	346.0	346.0

The project site plan is conceptual and will be developed in more detail as the project moves forward. Because of this, the storm drain system analyzed as part of this report is basic. The time of concentration in the Willow Road storm drain system where the on-site system connects is between 30 and 40 minutes depending on the storm event. The time of concentration for the on-site storm drain system is between 10 and 20 minutes and uses a minimum of 10 minutes. The project site is not large compared to the overall Willow Road drainage area and revisions and additions to the storm drain system match future detailed design will not significantly alter the on-site time of concentration. The Willow Road system time of concentration will continue to govern analysis of the off-site storm drain system.

HYDROLOGICAL BENEFIT OF STORM WATER QUALITY IMPLEMENTATION

This analysis does not consider the reduction in runoff that result from the implementation of storm water quality features on the site. The on-site storm water quality features will include rain garden style treatment areas that will treat runoff from the site impervious area. This effectively delays the treatment flow, or approximately 0.2 inches per hour, by minimum of 1.8 hours and up to 3.6 hours depending on the infiltration rate of the treatment soil. In addition, the treatment areas provide 4 to 6 inches of

storage before storm water is bypassed to the storm drain system. This reduction in runoff will be analyzed in the storm drain report prepared as part of the construction documents for the site.

5. STORMWATER QUALITY

CONSTRUCTION PERIOD STORMWATER QUALITY

As part of the West Campus Construction documents, a Stormwater Pollution Prevention Plan (SWPPP) will be prepared in conformance with the Regional Water Quality Control Board (RWQCB) requirements and California's General Permit for Stormwater Discharges Associated with Construction and Land Disturbance Activities. Pursuant to State Water Resources Control Board Order No. 2009-0009DWQW under NPDES No. CAS000002, a SWPPP and Notice of Intent will be submitted and uploaded to the Permit Registration Documents (PRDs) at the RWQCB's web site. Once the Waste Discharge Identification (WDID) number is available from the RWQCB, the PRDs will be filed through the RWQCB SMARTS registration system.

The SWPPP addresses the following objectives:

1. All pollutants and their sources, including sources of sediment associated with construction, construction site erosion and all other activities associated with construction activity are controlled.

2. Where not otherwise required to be under a RWQCB permit, all non-stormwater discharges are identified and either eliminated, controlled, or treated.

3. Effective site BMPs that result in the reduction or elimination of pollutants in stormwater discharges and authorized non-stormwater discharges from construction activity to the Best Available Technology/Best Control Technology (BAT/BCT) standard.

4. Calculations and design details as well as BMP controls for site run-on are complete and correct.

5. Stabilization BMPs installed to reduce or eliminate pollutants after construction are complete.

6. Post-construction BMPs are completed. See Section 3.4 for post-construction BMPs and details.

7. Methods to implement BMP inspections, visual monitoring, and Construction Site Monitoring Program (CSMP) requirements to comply with the General Permit are provided.

The contractor's Qualified SWPPP Practitioner (QSP) will be responsible for implementation of the SWPPP, including the construction site monitoring program, record keeping and reporting requirements of the General Permit.

POST CONSTRUCTION STORMWATER QUALITY

Redevelopment of the West Campus will incorporate post construction storm water quality measures in conformance with the RWQCB, San Francisco Municipal Regional Permit, Order R2-2009-0074. Project design will incorporate biofiltration treatment using either planted areas similar to Section 6.1 of the permit, Bioretention Areas (Section 6.2), Flow Through Planter and Tree planting areas similar to

Section 6.3, or Tree Well Filter as presented in the San Mateo Countywide Water Pollution Prevention Program C.3 Stormwater Technical Guidance document.

Biofiltration areas are sized using the 4 percent rule where a section of soil that infiltrates at a minimum rate of 5 inches per hour can treat the 0.2 inch per hour treatment storm. Because of high ground water and possible soil and ground water contamination the biofiltration areas will incorporate a impermeable liner. The biofiltration areas will function similar to rain garden type planters.

Stormwater quality features will be developed in more detail during preparation of construction documents for the site.

6. FLOOD ZONE

The West Campus site is currently included in the Special Flood Hazard Area (SFHA) AE7 with a flood elevation of 7.5 as defined in the FEMA 1979 Flood Insurance Study (FIS). Review of FIS indicates that flooding in this area of Menlo Park is tidally induced from San Francisco Bay because of an incomplete system of levees built along the bayfront that include numerous low points and openings that allow tides to overtop or bypass the levees. This system of levees is not recognized or certified by FEMA and the SFHA is mapped as if they do not exist. The flood elevation of 7.5 identified in the FIS is the maximum, 100-year still water elevation in the Bay and does not include an upstream, stormwater runoff hydrologic or hydraulic component.

The existing Project site is surrounded by several features that partially protect it from the 100-year tidal flooding event. These include the Bayfront Expressway, portions of Willlow Road and portions of the railroad right of way that have elevations above 7.5. These are all significant facilities with little chance of sudden failure. These facilities limit the approach of flood waters to the site. Tidally influence flood water comes from either the east across a section of Willow Road adjacent to the railroad right of way or from the west across the TE Connectivity site. This means that tide waters impacting the SFHA flow only in the east/west direction. Therefore, tidal flood waters drain either east across Willow Road toward Ravenswood Slough, or west toward Marsh Road and Flood Slough. These features impede the overland flow of potential flood waters in the north/south direction.

To determine if placing fill on the Project site would have an impoundment effect that may impact the extent or elevation of flooding on adjacent neighborhoods. We reviewed the site topography based on an aerial topographic survey prepared for the Project. This topography indicates that the Bayfront Expressway is higher than the BFE of 7.5 along the entire Project frontage. Review of existing topography and proposed grading reveals that the constraints in the proposed condition are very similar to the constraints in the existing conditions. Tidal flood waters would flow generally east/west and the existing features would impede the overland flow of flood waters in the north/south direction.

The Project proposes to place approximately 72,500 cubic yards of fill on the site. In the existing condition there are approximately 18,400 cubic yards of earth between elevation 5.0 and elevation 7.5. In the proposed condition there will be approximately 16,600 cubic yards of earth between elevation 5.0 and elevation 7.5. Therefore, development of the site will remove approximately 1,800 cubic yards of earth below elevation 7.5. Site grading will remove existing earth in some roadway and landscape areas and place fill over a larger area that is only slightly below elevation 7.5. The site earthwork will not significantly alter the entry and receding of tidal waters through the site. As stated previously, flooding requires the breaching or overtopping of existing levee and the location and size of a breach would only be speculative at this point. In the event of a levee breach or overtopping, the Project site is

surrounded by features that limit the site's exposure to potential tidal flooding including the Bayfront Expressway, portions of Willow Road and the adjacent railroad right of way. Similar to the existing condition tidal water could enter and leave the site only in the east/west direction along the southern boundary of the site.

Tidally influenced flooding does not have a retention/detention component that placing fill would impact. It is based on a specific static elevation that fills the available volume and is not based on a specific volume of water. Placing or removing earth on the site does not change the elevation of tidally influenced flooding and would only change the volume of water that enters and leaves the area. As the tide recedes back to the Bay through the levee low points, so do the flood waters. At this point the levees act as a "bathtub" with water trapped behind the levee in areas that are lower than the levee low points or breach point. The remainder of the flood water exits the area through the existing storm drain system that is connected to the Caltrans storm drain pump station at Bayfront Expressway.

Removal of 1,800 cubic yards of earth from the SFHA could potentially allow that volume of additional tidally influenced flood water on to the site an into the SFHA. This additional volume could slightly increase the duration of tidally induced flooding in low laying areas of adjacent neighborhoods. Because the tidal flooding results from a specific water elevation in the Bay, the extent and depth of flooding would not change. We calculated the volume of tidal flood water in the flood study area to be 11,600,000 cubic feet based on the area identified by the City of Menlo Park and an assumed average water depth of 1 foot. The proposed change in earthwork on the site could increase this detained volume and potential flooding duration by approximately 0.4 percent.

Because flooding in the Project vicinity is tidally influence, earthwork to remove portions of the site from the SFHA will not displace flood water and will not increase the extent or depth of flooding in adjacent neighborhoods that could cause and adverse impact. Proposed grading on the site will increase available volume in the flood area by approximately 0.4 percent and could have a proportionate increase in the duration of flooding. Appendix B: Facebook Menlo Park, West Campus Flood Zone Description included a more detailed discussion of the tidally induce flooding

7. CONCLUSION

The proposed development of the Facebook project on the site will provide a small decrease in impervious area and will not have a negative impact on the Willow Road storm drain system or the on-site storm drain system that serves the site and a portion of the eastern end of the TE Connectivity site. During the 10 year event water is contained in the existing storm drain system. The HGL developed during development of construction documents will be used, along with site grades and building finish floor elevations to confirm adequate freeboard is provided for the proposed development. During a 100 year event, the onsite system is constrained by pipe size and additional contribution of off-site flow. In the existing condition there is localized ponding during the 100 year storm. The reduction in impervious area proposed by the project will provide a benefit, however the system constrains will still result in localized ponding. Development of the site will not impact the Willow Road storm drain system during either the 10 year or the 100 year event.

FIGURES

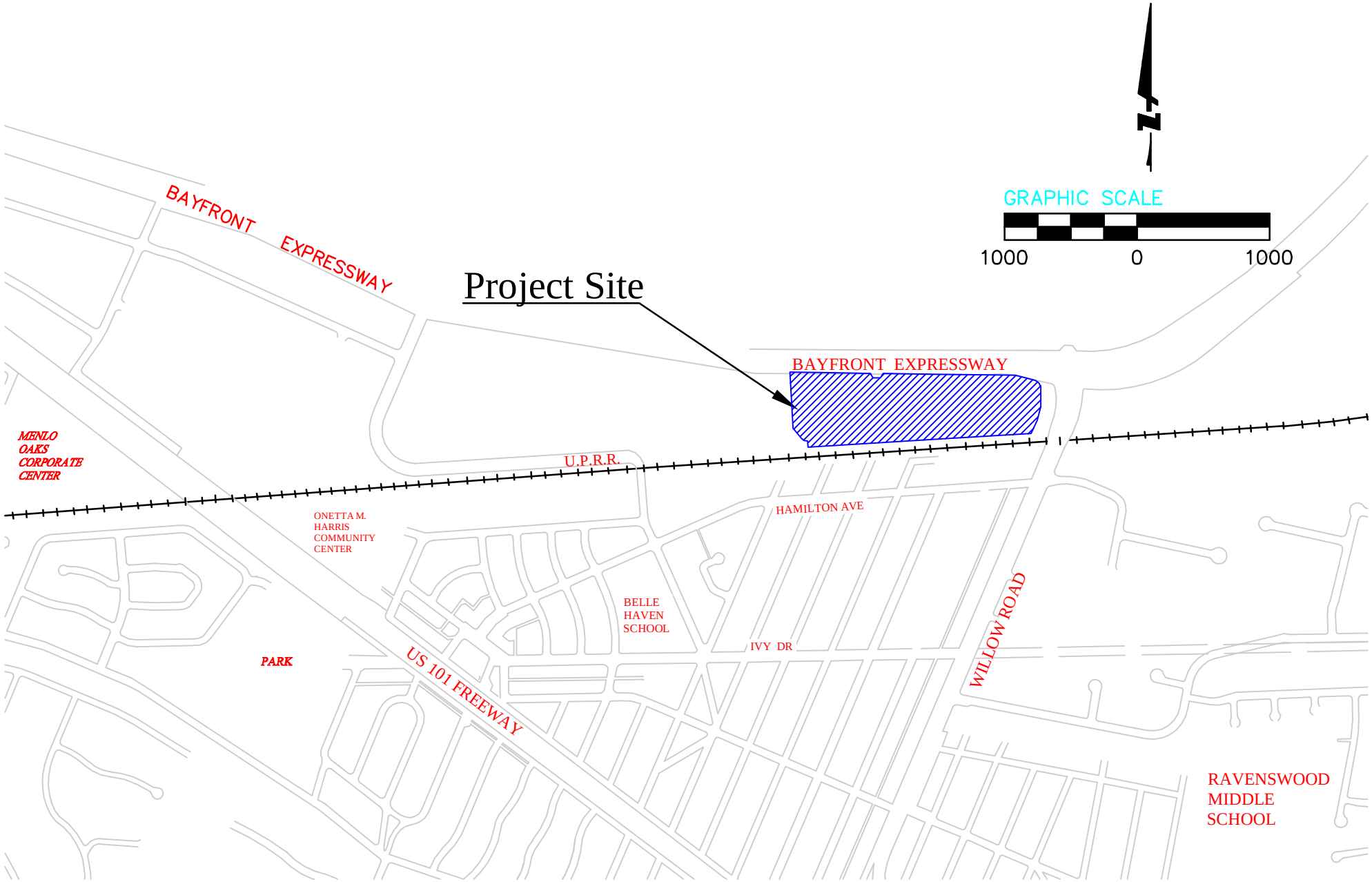

Figure 1
Menlo Park Vicinity Map
Facebook (West Campus) - Menlo Park , CA

BKF

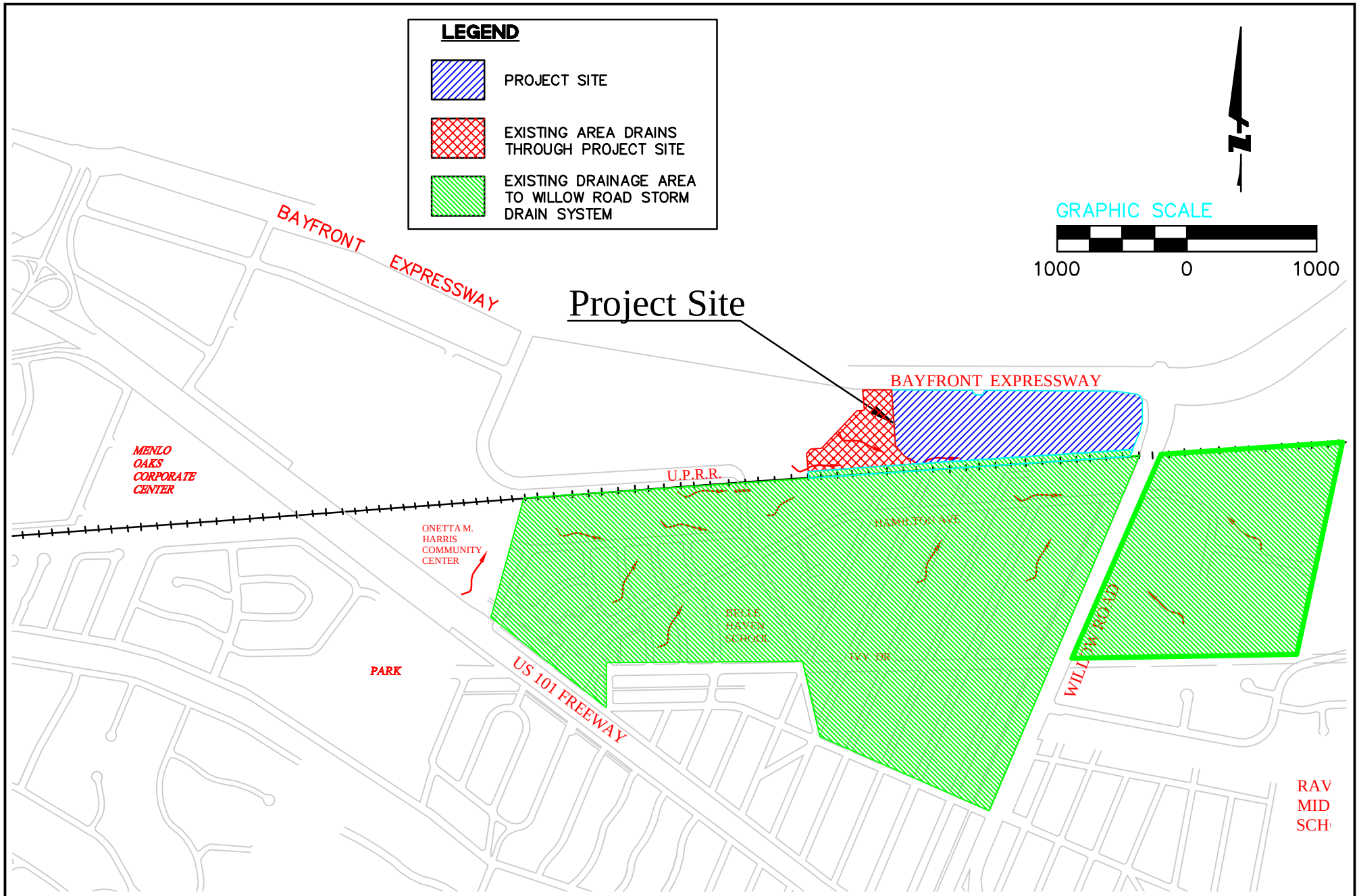

Figure 2
Facebook Drainage System Area
Facebook (West Campus) - Menlo Park , CA

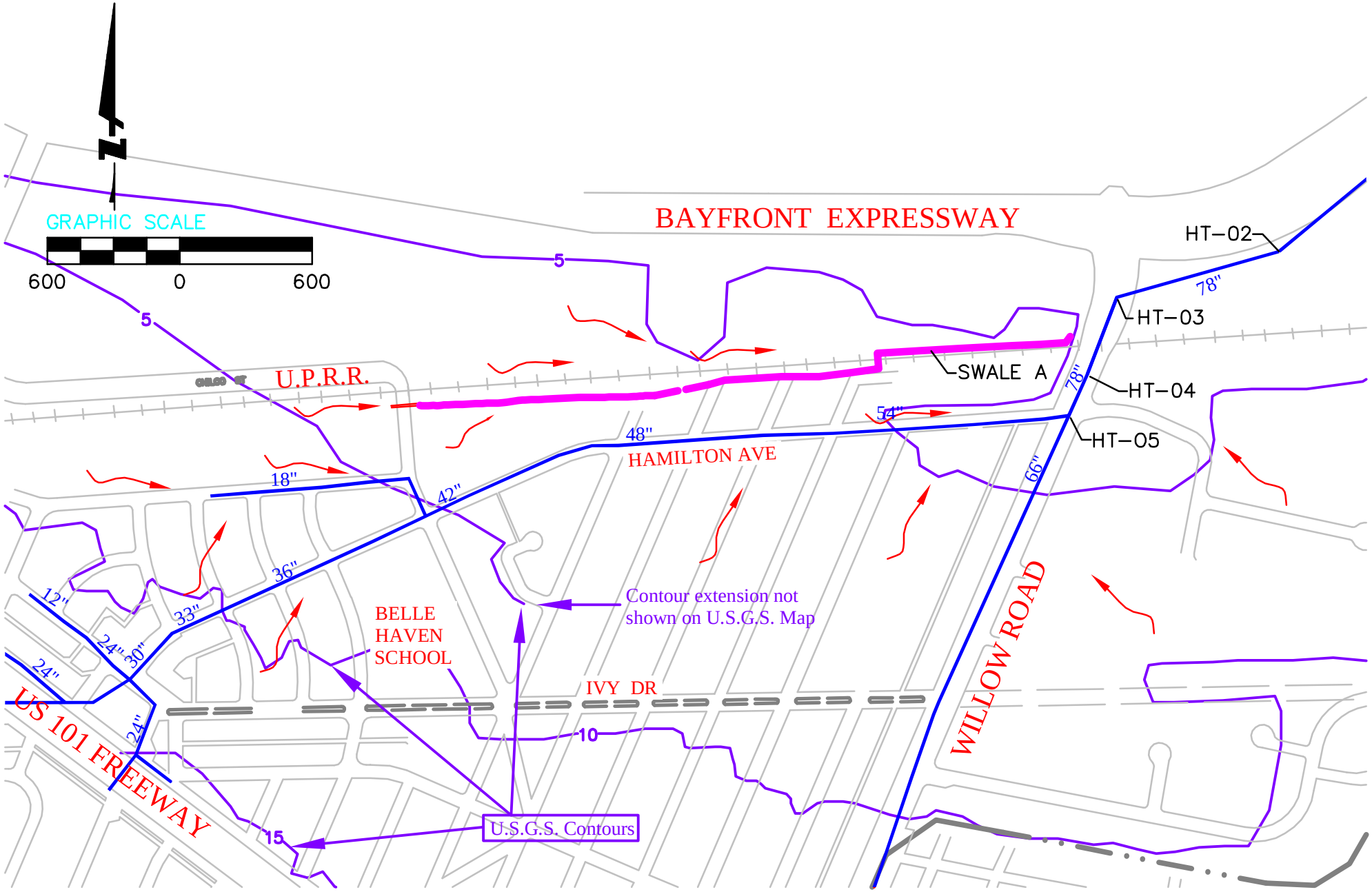

Figure 3

Hamilton Avenue - Willow Road Existing Drainage System

Facebook (West Campus) - Menlo Park , CA

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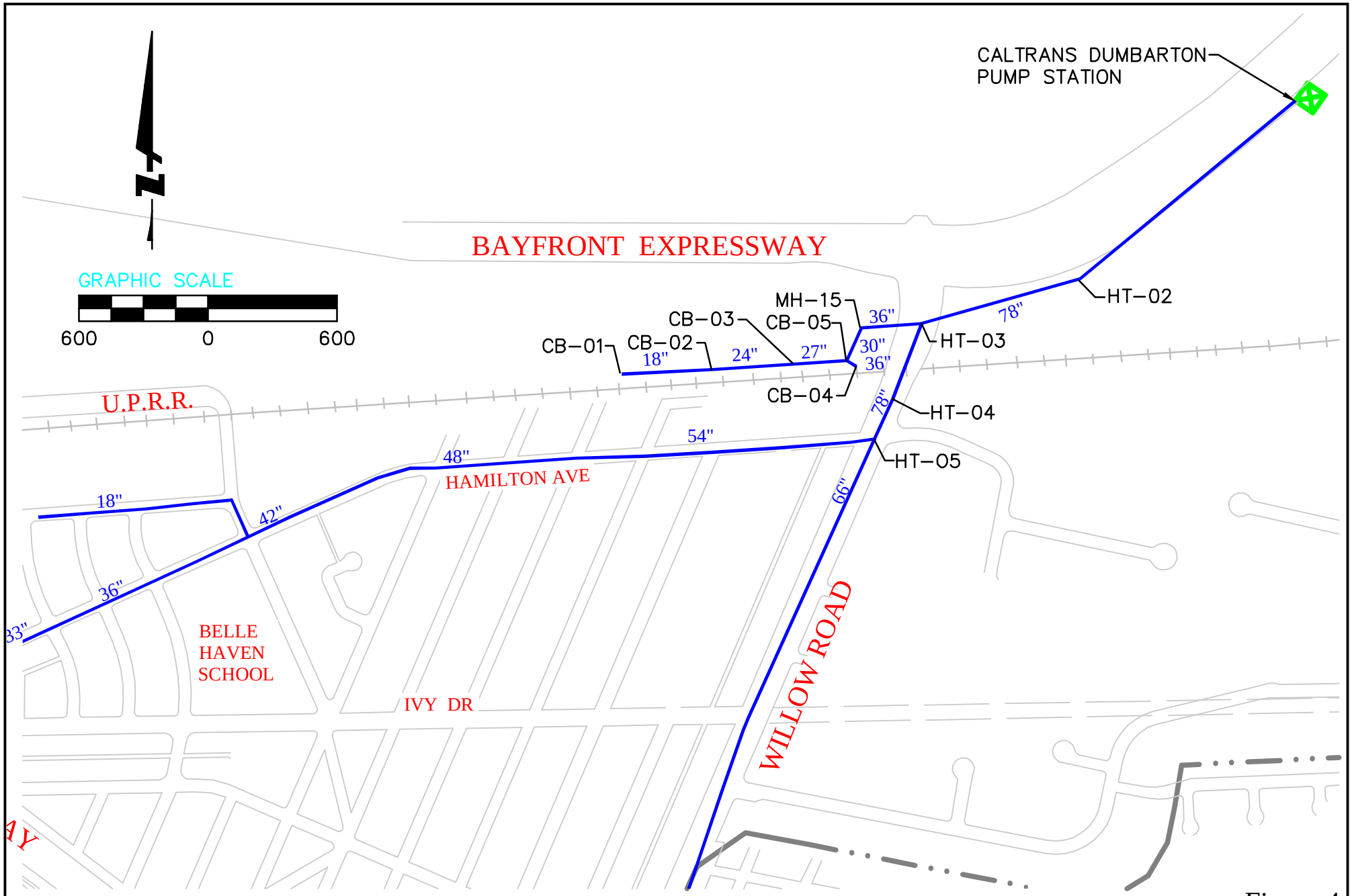
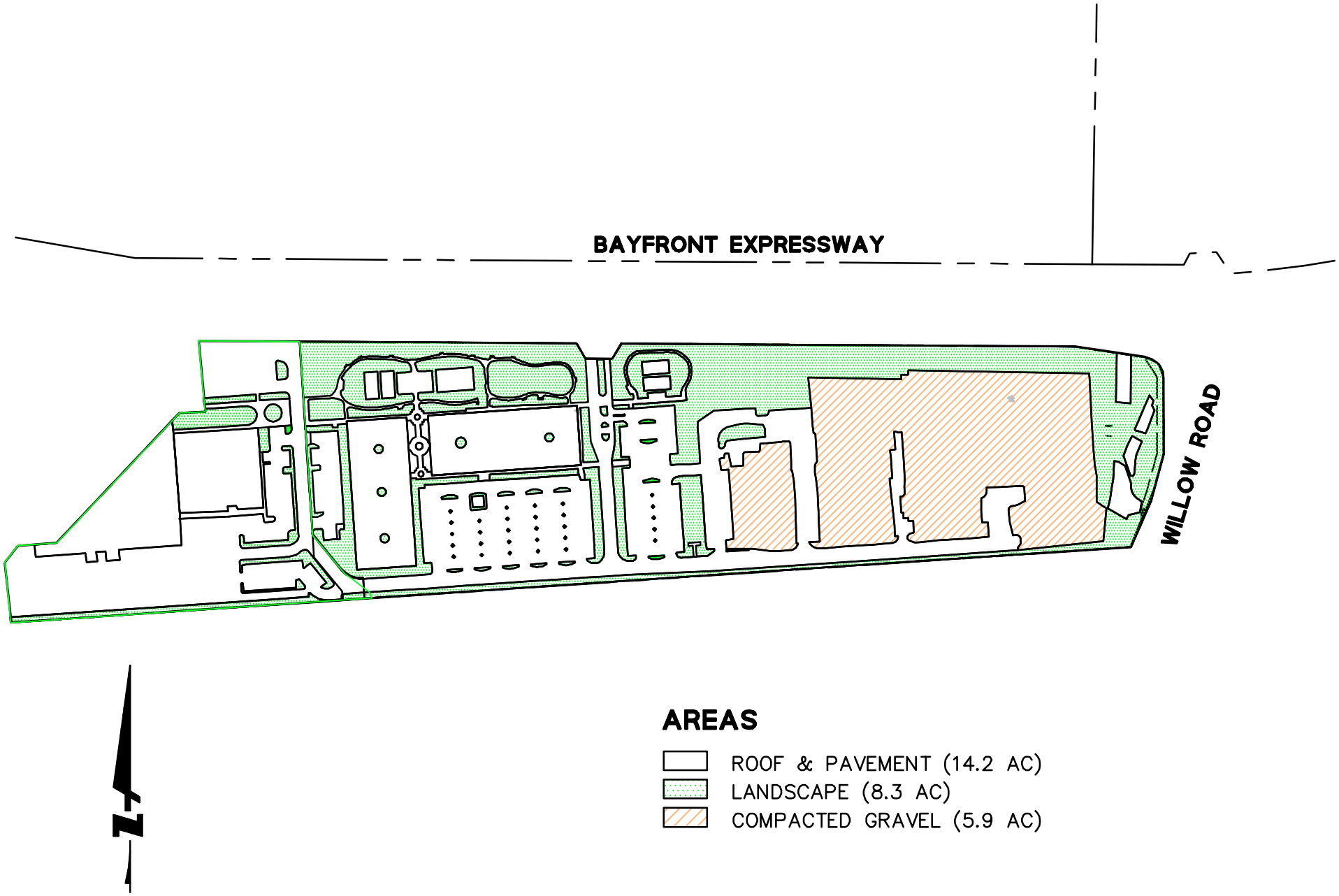


Figure 4
Project Storm Drain System
Facebook (West Campus) - Menlo Park , CA



GRAPHIC SCALE

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Figure 5
Existing Site Area Calculations
Facebook (West Campus) - Menlo Park , CA

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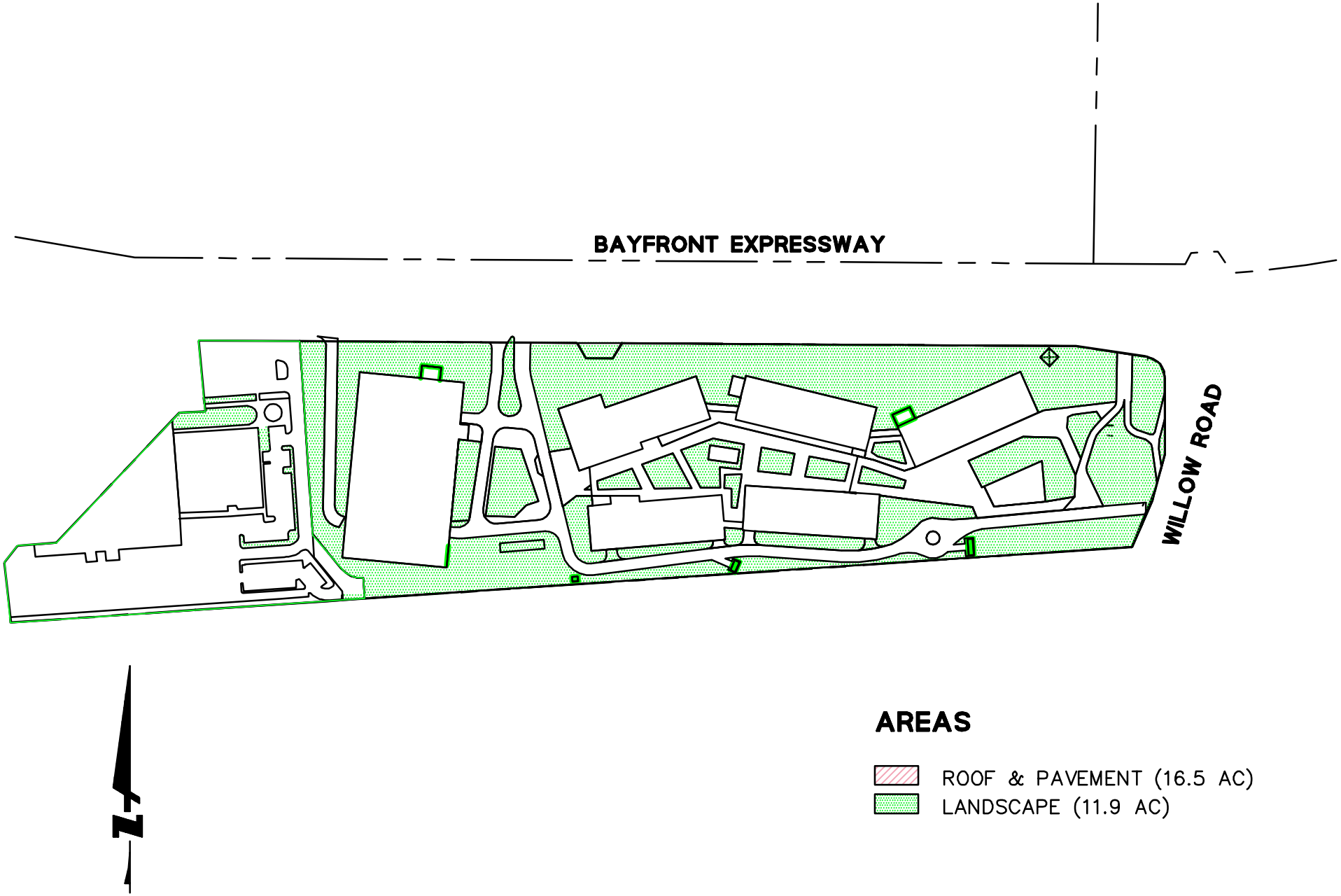

GRAPHIC SCALE

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Figure 6
Proposed Site Area Calculations
Facebook (West Campus) - Menlo Park , CA

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HAMILTON PARK DEVELOPMENT MODEL TABLES

CLARUM HOMES, HAMILTON AVENUE, MENLO PARK STORM DRAINAGE PLAN

Table A-3
Proposed Hydrology: 10-Year Event

Node # (1)	Ground Elevation (ft)	Sump Elevation (ft)	Inlet Area (acres)	Inlet C	Inlet C*A (acres)	Lateral Area	Cumulative Area (acres)	Cumulative C*A (acres)	Inlet Tc (minutes)	System Tc (minutes)	Intensity (in/hr)	Additional Flows	Discharge (cfs)
HL-2406	16.27	12.91	23.50	**0.25**	5.88		23.50	5.9	10.6	10.6	1.60	0	9.5
HL-2405	15.42	12.28	0.00	0.00	0.00		23.50	5.9	0.0	11.2	1.56	0	9.2
HL-2404	14.49	11.59	0.00	0.00	0.00		23.50	5.9	0.0	11.8	1.51	0	9.0
HL-2403	14.13	6.50	0.00	0.00	0.00		23.50	5.9	0.0	12.0	1.50	0	8.9
HL-2402	13.07	5.79	24.10	0.40	9.64		47.60	15.5	11.9	13.4	1.41	0	22.1
HL-2401	12.50	5.41	0.00	0.00	0.00		47.60	15.5	0.0	14.3	1.37	0	21.4
HL-1505	6.98	1.41	9.60	0.40	3.84		9.60	3.8	8.0	8.0	1.84	0	7.1
HL-1504	5.98	0.41	1.10	0.40	0.44		10.70	4.3	7.0	9.0	1.73	0	7.5
HL-1503	4.89	-0.48	0.70	0.40	0.28		11.40	4.6	7.0	10.1	1.64	0	7.5
HL-1502	4.01	-1.36	10.40	0.40	4.16		21.80	8.7	10.0	10.9	1.57	0	13.8
HL-1501	4.24	-3.88	0.00	0.00	0.00		21.80	8.7	0.0	11.3	1.55	0	13.6
HT-25	12.10	5.05	6.60	0.90	5.94		6.60	21.5	10.0	15.2	1.33	0	28.7
HT-24	11.96	3.97	0.00	0.00	0.00	47.6	54.20	21.5	0.0	15.7	1.31	0	28.3
HT-23	11.64	3.74	1.90	0.40	0.76		56.10	22.2	7.2	15.8	1.30	0	29.1
HT-22	10.81	2.74	2.50	0.34	0.85		58.60	23.1	6.7	16.2	1.28	0	29.9
HT-21	11.24	2.34	5.00	0.40	2.00		63.60	25.1	7.6	16.4	1.28	0	32.3
HT-20	10.14	1.07	0.00	0.00	0.00		63.60	25.1	0.0	17.1	1.25	0	31.6
HT-19	9.29	0.09	4.00	0.40	1.60		67.60	26.7	7.8	17.8	1.23	0	32.9
HT-18	8.23	-1.13	4.60	0.40	1.84		72.20	28.5	10.0	18.6	1.20	0	34.4
HT-17	5.99	-2.27	5.00	0.40	2.00		77.20	30.5	10.0	19.5	1.17	0	36.0
HT-16	5.97	-2.50	1.60	0.40	0.64		78.80	31.2	10.0	20.3	1.15	0	36.0
HT-15	5.20	-7.53	9.80	0.32	3.14	21.8	110.40	43.0	10.0	21.2	1.12	0	48.6
HT-14	4.49	-8.29	5.70	0.40	2.28		116.10	45.3	10.0	21.9	1.10	0	50.3
HT-13	3.60	-9.10	20.90	0.38	7.94		137.00	53.2	14.0	23.4	1.07	0	57.2
HT-12	3.40	-10.35	4.50	0.40	1.80		141.50	55.0	10.0	23.8	1.06	0	58.6
HT-11	2.97	-10.72	0.00	0.00	0.00		141.50	55.0	0.0	24.1	1.05	0	58.2
HT-10	3.21	-11.39	0.00	0.00	0.00		141.50	55.0	0.0	25.4	1.02	0	56.7
HT-09	3.16	-12.00	12.70	0.40	5.08		154.20	60.1	10.9	26.8	0.99	0	60.3
HT-08	3.12	-12.10	14.80	0.41	6.07		169.00	66.2	11.9	28.2	0.97	0	64.6
HT-07	3.08	-12.32	22.20	0.42	9.32		191.20	75.5	10.9	29.5	0.95	0	72.1
HT-06	3.75	-15.06	29.20	0.51	14.89		220.40	90.4	10.7	30.7	0.93	0	84.6
HT-5A	.00	-15.80	0.00	0.00	0.00		191.20	0.0	0.0	0.0	0.00	0	0.0
HT-05	4.50	-16.10	0.00	0.00	0.00		220.40	90.4	0.0	32.0	0.91	183	266.0
HT-04	4.00	-17.00	0.00	0.00	0.00		220.40	90.4	0.0	32.6	0.90	184	266.0
HT-03	3.50	-17.50	7.10	0.90	6.39		227.50	96.8	12.7	33.2	0.89	193	279.6
HT-02	3.00	-18.00	0.00	0.00	0.00		227.50	96.8	0.0	34.1	0.88	213	298.5
H-out	2.50	-24.20	0.00	0.00	0.00		227.50	96.8	0.0	37.2	0.84	0	294.8

(1) Node Locations are shown on Figure 4
(2) Outfall is to Pump Station on Willow Road

CLARUM HOMES, HAMILTON AVENUE, MENLO PARK STORM DRAINAGE PLAN

Table A-4
Proposed Hydraulics: 10-Year Event

Pipe #	Upstream Node (1)	Downstream Node	Total Discharge (cfs)	Capacity @ Constructed Slope (cfs)	Pipe Size (inches)	Length (feet)	Constructed Slope (ft/ft)	Invert Elevation Upstream (feet)	Invert Elevation Downstream (feet)	Ground/Rim Elevation Upstream (feet)	Ground/Rim Elevation Downstream (feet)	HGL Elevation Upstream (feet)	HGL Elevation Downstream (feet)	Upstream Freeboard (feet)	Upstream Cover (feet)	Velocity (ft/s)
HL-P2406	HL-2406	HL-2405	9.5	6.3	18 inch	176	0.004	12.91	12.28	16.27	15.42	16.62	15.19	**ABOVE RIM**	1.9	0.0
HL-P2405	HL-2405	HL-2404	9.2	6.3	18 inch	192	0.004	12.28	11.59	15.42	14.49	15.10	13.62	0.3	1.6	0.0
HL-P2404	HL-2404	HL-2403	9.0	26.3	18 inch	81	0.063	11.59	6.50	14.49	14.13	13.32	12.73	1.2	1.4	0.0
HL-P2403	HL-2403	HL-2402	8.9	12.4	24 inch	236	0.003	6.50	5.79	14.13	13.07	12.68	12.31	1.5	5.6	0.0
HL-P2402	HL-2402	HL-2401	22.1	55.0	42 inch	127	0.003	5.79	5.41	13.07	12.50	12.25	12.18	0.8	3.8	0.0
HL-P2401	HL-2401	HT-25	21.4	55.1	42 inch	120	0.003	5.41	5.05	12.50	12.10	12.15	12.10	0.4	3.6	0.0
HL-P1505	HL-1505	HL-1504	7.1	6.7	18 inch	243	0.004	1.41	.41	6.98	5.98	7.10	5.98	**ABOVE RIM**	4.1	0.0
HL-P1504	HL-1504	HL-1503	7.5	6.1	18 inch	265	0.003	.41	-.48	5.98	4.89	6.23	4.89	**ABOVE RIM**	4.1	0.0
HL-P1503	HL-1503	HL-1502	7.5	6.7	18 inch	215	0.004	-.48	-1.36	4.89	4.01	5.12	4.01	**ABOVE RIM**	3.9	0.0
HL-P1502	HL-1502	HL-1501	13.8	12.6	18 inch	176	0.014	-1.36	-3.88	4.01	4.24	7.29	4.24	**ABOVE RIM**	3.9	0.0
HL-P1501	HL-1501	HT-15	13.6	14.3	18 inch	198	0.018	-3.88	-7.53	4.24	5.20	6.48	3.16	**ABOVE RIM**	6.6	0.0
HT-P24	HT-25	HT-24	28.7	14.9	24 inch	248	0.004	5.05	3.97	12.10	11.96	15.95	11.96	**ABOVE RIM**	5.1	0.0
HT-P23	HT-24	HT-23	28.3	13.1	24 inch	69	0.003	3.97	3.74	11.96	11.64	12.72	11.64	**ABOVE RIM**	6.0	0.0
HT-P22	HT-23	HT-22	29.1	14.8	24 inch	233	0.004	3.74	2.74	11.64	10.81	14.67	10.81	**ABOVE RIM**	5.9	0.0
HT-P21	HT-22	HT-21	29.9	14.7	24 inch	95	0.004	2.74	2.34	10.81	11.24	11.86	10.20	**ABOVE RIM**	6.1	0.0
HT-P20	HT-21	HT-20	32.3	27.5	30 inch	282	0.005	2.34	1.07	11.24	10.14	8.55	6.81	2.7	6.4	0.0
HT-P19	HT-20	HT-19	31.6	35.5	33 inch	217	0.005	1.07	.09	10.14	9.29	6.48	5.71	3.7	6.3	0.0
HT-P18	HT-19	HT-18	32.9	35.6	33 inch	270	0.005	.09	-1.13	9.29	8.23	5.60	4.55	3.7	6.5	0.0
HT-P17	HT-18	HT-17	34.4	44.9	36 inch	252	0.005	-1.13	-2.27	8.23	5.99	4.49	3.82	3.7	6.4	0.0
HT-P16	HT-17	HT-16	36.0	19.9	36 inch	258	0.001	-2.27	-2.50	5.99	5.97	3.76	3.01	2.2	5.3	0.0
HT-P15	HT-16	HT-15	36.0	91.9	36 inch	265	0.019	-2.50	-7.53	5.97	5.20	2.96	2.19	3.0	5.5	0.0
HT-P14	HT-15	HT-14	48.6	59.1	42 inch	220	0.003	-7.53	-8.29	5.20	4.49	2.04	1.53	3.2	9.2	0.0
HT-P13	HT-14	HT-13	50.3	42.8	42 inch	448	0.002	-8.29	-9.10	4.49	3.60	1.46	.34	3.0	9.3	0.0
HT-P12	HT-13	HT-12	57.2	89.5	42 inch	158	0.008	-9.10	-10.35	3.60	3.40	.18	-.33	3.4	9.2	0.0
HT-P11	HT-12	HT-11	58.6	56.8	42 inch	116	0.003	-10.35	-10.72	3.40	2.97	-.60	-.99	4.0	10.3	0.0
HT-P10	HT-11	HT-10	58.2	61.3	48 inch	368	0.002	-10.72	-11.39	2.97	3.21	-1.08	-1.69	4.1	9.7	0.0
HT-P09	HT-10	HT-09	56.7	90.3	54 inch	289	0.002	-11.39	-12.00	3.21	3.16	-1.71	-1.95	4.9	10.1	0.0
HT-P08	HT-09	HT-08	60.3	34.7	54 inch	321	0.000	-12.00	-12.10	3.16	3.12	-1.98	-2.28	5.1	10.7	0.0
HT-P07	HT-08	HT-07	64.6	52.4	54 inch	310	0.001	-12.10	-12.32	3.12	3.08	-2.31	-2.65	5.4	10.7	0.0
HT-P06	HT-07	HT-06	72.1	178.4	54 inch	333	0.008	-12.32	-15.06	3.08	3.75	-2.68	-3.13	5.8	10.9	0.0
HT-P5A	HT-5A	HT-05	0.0	247.1	78 inch	135	0.002	-15.80	-16.10	.00	4.50	-4.05	-4.05	4.1	9.3	0.0
HT-P05	HT-06	HT-05	84.6	97.0	54 inch	427	0.002	-15.06	-16.10	3.75	4.50	-3.18	-3.97	6.9	14.3	0.0
HT-P04	HT-05	HT-04	266.0	292.6	78 inch	289	0.003	-16.10	-17.00	4.50	4.00	-4.40	-5.15	8.9	14.1	0.0
HT-P03	HT-04	HT-03	266.0	216.6	78 inch	293	0.002	-17.00	-17.50	4.00	3.50	-5.36	-6.11	9.4	14.5	0.0
HT-P02	HT-03	HT-02	279.6	180.2	78 inch	423	0.001	-17.50	-18.00	3.50	3.00	-7.00	-8.21	10.5	14.5	0.0
HT-P01	HT-02	H-out	298.5	318.8	78 inch	1,677	0.004	-18.00	-24.20	3.00	2.50	-8.56	-14.00	11.6	14.5	0.0

(1) Node Locations are displayed on Figure 4

(2) Outfall: Low flows to pump station, high flows to detention pond.

CLARUM HOMES, HAMILTON AVENUE, MENLO PARK STORM DRAINAGE PLAN

Table A-7
Proposed Hydrology: 100-Year Event with Flow in Street

Node # (1)	Ground Elevation (ft)	Sump Elevation (ft)	Inlet Area (acres)	Inlet C	Inlet C*A (acres)	Lateral Area	Cumulative Area (acres)	Cumulative C*A (acres)	Inlet Tc (minutes)	System Tc (minutes)	Intensity (in/hr)	Additional Flows	Discharge (cfs)
HL-2406	16.27	12.91	23.50	0.31	7.29		23.50	7.3	10.6	10.6	2.23	0	16.4
HL-2405	15.42	12.28	0.00	0.00	0.00		23.50	7.3	0.0	10.9	2.20	0	16.2
HL-2404	14.49	11.59	0.00	0.00	0.00		23.50	7.3	0.0	11.3	2.17	0	15.9
HL-2403	14.13	6.50	0.00	0.00	0.00		23.50	7.3	0.0	11.4	2.15	0	15.8
HL-2402	13.07	5.79	24.10	0.50	12.05		47.60	19.3	11.9	12.2	2.08	0	40.6
HL-2401	12.50	5.41	0.00	0.00	0.00		47.60	19.3	0.0	12.9	2.03	0	39.5
HT-25	12.10	5.05	6.60	0.90	5.94		6.60	25.3	10.0	13.3	1.99	-34	16.6
HT-24	11.96	3.97	0.00	0.00	0.00		6.60	25.3	0.0	14.1	1.93	-34	15.2
HT-23	11.64	3.74	1.90	0.50	0.95	47.60	56.10	26.2	7.2	14.4	1.91	-34	16.6
HT-22	10.81	2.74	2.50	0.42	1.05		58.60	27.3	6.7	15.1	1.87	-34	17.3
HT-21	11.24	2.34	5.00	0.42	2.10		63.60	29.4	7.6	15.4	1.85	-34	20.7
HT-20	10.14	1.07	0.00	0.00	0.00		63.60	29.4	0.0	16.5	1.78	-34	18.8
HT-19	9.29	0.09	4.00	0.50	2.00		67.60	31.4	7.8	17.6	1.72	-34	20.5
HT-18	8.23	-1.13	4.60	0.50	2.30		72.20	33.7	10.0	18.9	1.66	-34	22.4
HT-17	5.99	-2.27	5.00	0.50	2.50		77.20	36.2	10.0	20.3	1.61	-34	24.6
HT-16	5.97	-2.50	1.60	0.50	0.80		78.80	37.0	10.0	21.5	1.56	-34	24.1
HT-15	5.20	-7.53	9.80	0.40	3.92		88.60	40.9	10.0	22.8	1.51	-34	28.3
HT-14	4.49	-8.29	5.70	0.50	2.85		94.30	43.8	10.0	24.0	1.47	-34	30.9
HT-13	3.60	-9.10	14.60	0.50	7.30		108.90	51.1	14.0	26.4	1.40	-34	38.3
HT-12	3.40	-10.35	4.50	0.50	2.25		113.40	53.3	10.0	27.0	1.39	-34	40.5
HT-11	2.97	-10.72	0.00	0.50	0.00		113.40	53.3	10.0	27.5	1.37	-34	39.9
HT-10	3.21	-11.39	0.00	0.50	0.00		113.40	53.3	10.0	29.4	1.33	-34	37.3
HT-09	3.16	-12.00	12.70	0.50	6.35		126.10	59.7	10.9	31.5	1.28	-34	43.1
HT-08	3.12	-12.10	14.80	0.52	7.70		140.90	67.3	11.9	33.4	1.24	-34	50.4
HT-07	3.08	-12.32	22.20	0.52	11.54		163.10	78.9	10.9	35.1	1.21	-34	62.5
HT-06	3.75	-15.06	29.20	0.58	16.94		192.30	95.8	10.7	36.5	1.19	-34	80.9
HT-05A	.00	-15.80	0.00	0.00	0.00		0.00	0.0	0.0	0.0	0.00	235	235.0
HT-05	4.50	-16.10	0.00	0.88	0.00		192.30	95.8	0.0	37.9	1.17	201	313.7
HT-04	4.00	-17.00	0.00	0.00	0.00		192.30	95.8	0.0	38.4	1.16	201	313.0
HT-03	3.50	-17.50	35.20	0.59	20.77		227.50	116.6	12.6	38.9	1.15	205	340.4
HT-02	3.00	-18.00	0.00	0.00	0.00		227.50	116.6	0.0	39.6	1.14	226	360.2
H-out	2.50	-24.20	0.00	0.00	0.00		227.50	116.6	0.0	42.2	1.11	0	356.0

(1) Node Locations are shown on Figure 4
(2) Outfall is to Pump Station on Willow Road

CLARUM HOMES, HAMILTON AVENUE, MENLO PARK STORM DRAINAGE PLAN

Table A-8
Proposed Hydraulics: 100-Year Event with Flow in Street

Pipe #	Upstream Node (1)	Downstream Node	Total Discharge (cfs)	Capacity @ Constructed Slope (cfs)	Pipe Size (inches)	Length (feet)	Constructed Slope (ft/ft)	Invert Elevation		Ground/Rim Elevation		HGL Elevation		Freeboard (feet)	Amount Above Rim (feet)	Amount Flowing in Street (cfs)	Upstream Cover (feet)	Velocity (ft/s)
								Upstream	Downstream	Upstream	Downstream	Upstream	Downstream					
HL-P2406	HL-2406	HL-2405	16.4	6.3	18 inch	176	0.004	12.91	12.28	16.27	15.42	19.72	15.42	**ABOVE RIM**	3.5		1.9	9.3
HL-P2405	HL-2405	HL-2404	16.2	6.3	18 inch	192	0.004	12.28	11.59	15.42	14.49	19.04	14.49	**ABOVE RIM**	3.6		1.6	9.2
HL-P2404	HL-2404	HL-2403	15.9	26.3	18 inch	81	0.063	11.59	6.50	14.49	14.13	15.99	14.13	**ABOVE RIM**	1.5		1.4	9.0
HL-P2403	HL-2403	HL-2402	15.8	12.4	24 inch	236	0.003	6.50	5.79	14.13	13.07	13.77	12.61	0.4	BELOW RIM		5.6	5.0
HL-P2402	HL-2402	HL-2401	40.6	78.6	48 inch	127	0.003	5.79	5.41	13.07	12.50	12.49	12.39	0.6	BELOW RIM		3.3	3.2
HL-P2401	HL-2401	HT-25	39.5	55.1	42 inch	120	0.003	5.41	5.05	12.50	12.10	12.28	12.10	0.2	BELOW RIM		3.6	4.1
HT-P24	HT-25	HT-24	16.6	14.9	24 inch	248	0.004	5.05	3.97	12.10	11.96	12.29	10.95	**ABOVE RIM**	0.2	-34	5.1	5.3
HT-P23	HT-24	HT-23	15.2	13.1	24 inch	69	0.003	3.97	3.74	11.96	11.64	10.67	10.36	1.3	BELOW RIM	-34	6.0	4.8
HT-P22	HT-23	HT-22	16.6	14.8	24 inch	233	0.004	3.74	2.74	11.64	10.81	9.76	8.51	1.9	BELOW RIM	-34	5.9	5.3
HT-P21	HT-22	HT-21	17.3	14.7	24 inch	95	0.004	2.74	2.34	10.81	11.24	7.79	7.23	3.0	BELOW RIM	-34	6.1	5.5
HT-P20	HT-21	HT-20	20.7	27.5	30 inch	282	0.005	2.34	1.07	11.24	10.14	6.82	6.10	4.4	BELOW RIM	-34	6.4	4.2
HT-P19	HT-20	HT-19	18.8	35.5	33 inch	217	0.005	1.07	.09	10.14	9.29	6.02	5.75	4.1	BELOW RIM	-34	6.3	3.2
HT-P18	HT-19	HT-18	20.5	35.6	33 inch	270	0.005	.09	-1.13	9.29	8.23	5.71	5.30	3.6	BELOW RIM	-34	6.5	3.5
HT-P17	HT-18	HT-17	22.4	44.9	36 inch	252	0.005	-1.13	-2.27	8.23	5.99	5.28	4.99	3.0	BELOW RIM	-34	6.4	3.2
HT-P16	HT-17	HT-16	24.6	19.9	36 inch	258	0.001	-2.27	-2.50	5.99	5.97	4.96	4.61	1.0	BELOW RIM	-34	5.3	3.5
HT-P15	HT-16	HT-15	24.1	91.9	36 inch	265	0.019	-2.50	-7.53	5.97	5.20	4.59	4.25	1.4	BELOW RIM	-34	5.5	3.4
HT-P14	HT-15	HT-14	28.3	59.1	42 inch	220	0.003	-7.53	-8.29	5.20	4.49	4.21	4.03	1.0	BELOW RIM	-34	9.2	3.0
HT-P13	HT-14	HT-13	30.9	42.8	42 inch	448	0.002	-8.29	-9.10	4.49	3.60	4.01	3.59	0.5	BELOW RIM	-34	9.3	3.2
HT-P12	HT-13	HT-12	38.3	89.5	42 inch	158	0.008	-9.10	-10.35	3.60	3.40	3.52	3.29	0.1	BELOW RIM	-34	9.2	4.0
HT-P11	HT-12	HT-11	40.5	56.8	42 inch	116	0.003	-10.35	-10.72	3.40	2.97	3.16	2.97	0.2	BELOW RIM	-34	10.3	4.2
HT-P10	HT-11	HT-10	39.9	61.3	48 inch	368	0.002	-10.72	-11.39	2.97	3.21	3.49	3.21	**ABOVE RIM**	0.5	-34	9.7	3.2
HT-P09	HT-10	HT-09	37.3	90.3	54 inch	289	0.002	-11.39	-12.00	3.21	3.16	3.26	3.16	**ABOVE RIM**	0.0	-34	10.1	2.4
HT-P08	HT-09	HT-08	43.1	34.7	54 inch	321	0.000	-12.00	-12.10	3.16	3.12	3.27	3.12	**ABOVE RIM**	0.1	-34	10.7	2.7
HT-P07	HT-08	HT-07	50.4	52.4	54 inch	310	0.001	-12.10	-12.32	3.12	3.08	3.28	3.08	**ABOVE RIM**	0.2	-34	10.7	3.2
HT-P06	HT-07	HT-06	62.5	178.4	54 inch	333	0.008	-12.32	-15.06	3.08	3.75	3.62	3.28	**ABOVE RIM**	0.5	-34	10.9	3.9
HT-P05	HT-06	HT-05	80.9	97.0	54 inch	427	0.002	-15.06	-16.10	3.75	4.50	3.24	2.51	0.5	BELOW RIM	0	14.3	5.1
HT-P05A	HT-05A	HT-05	235.0	152.4	78 inch	355	0.001	-15.80	-16.10	.00	4.50	2.00	1.29	**ABOVE RIM**	2.0		9.3	7.1
HT-P04	HT-05	HT-04	313.7	292.6	78 inch	289	0.003	-16.10	-17.00	4.50	4.00	.49	-.55	4.0	BELOW RIM		14.1	9.5
HT-P03	HT-04	HT-03	313.0	216.6	78 inch	293	0.002	-17.00	-17.50	4.00	3.50	-.90	-1.94	4.9	BELOW RIM		14.5	9.4
HT-P02	HT-03	HT-02	340.4	180.2	78 inch	423	0.001	-17.50	-18.00	3.50	3.00	-3.65	-5.44	7.2	BELOW RIM		14.5	10.3
HT-P01	HT-02	H-out	360.2	318.8	78 inch	1677	0.004	-18.00	-24.20	3.00	2.50	-6.08	-14.00	9.1	BELOW RIM		14.5	10.9

(1) Node Locations are displayed on Figure
(2) Outfall: Low flows to pump station, high flows to detention pond.

10 YEAR STORM TABLES

Table B-1
Existing Hydrology: 10 Year Event - Model Verification

Node	Elevation (Ground) (ft)	Sump Elevation (ft)	Inlet Drainage Area (acres)	Inlet C	Local CA (acres)	System CA (acres)	System Flow Time (min)	System Intensity (in/hr)	Flow (Additional) (ft^3/s)	Flow (ft^3/s)
HT-05	4.5	-16.1	0	0	0.00	90.4	32.0	0.91	183	265.8
HT-04	4.0	-17	0	0	0.00	90.4	32.6	0.90	184	265.9
HT-03	3.5	-17.5	7.1	0.9	6.39	96.8	33.2	0.89	193	279.9
HT-02	3.0	-18	0	0	0.00	96.8	34.0	0.88	213	298.7
H-OUT	2.5	-24.2	0	0	0	96.8	37.2	0.84	0	294.8

Table B-2
Existing Hydraulics:
10 Year Event - Model Verification

Label	Start Node	Stop Node	Flow (ft^3/s)	Capacity (Full Flow) (ft^3/s)	Diameter (in)	Length (Unified) (ft)	Slope (Calculated) (ft/ft)	Invert (Upstream) (ft)	Invert (Downstream) (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Freeboard	Cover (Start) (ft)	Velocity (Average) (ft/s)
P-04	HT-05	HT-04	265.8	292.6	78	289	0.003	-16.10	-17.00	4.50	4.00	-4.69	-5.43	9.2	14.1	8.0
P-03	HT-04	HT-03	265.9	216.6	78	293	0.002	-17.00	-17.50	4.00	3.50	-5.56	-6.31	9.6	14.5	8.0
P-02	HT-03	HT-02	279.9	180.2	78	423	0.001	-17.50	-18.00	3.50	3.00	-7.06	-8.27	10.6	14.5	8.4
P-01	HT-02	OF-1	298.7	318.8	78	1,677	0.004	-18.00	-24.20	3.00	2.50	-8.55	-14.00	11.6	14.5	9.0

Table B-3
Existing Hydrology: 10 Year Event - Model Modification

Node	Elevation (Ground) (ft)	Sump Elevation (ft)	Inlet Drainage Area (acres)	Inlet C	Local CA (acres)	System CA (acres)	System Flow Time (min)	System Intensity (in/hr)	Flow (Additional) (ft^3/s)	Flow (ft^3/s)
HT-05	4.5	-16.1	0	0	0.00	90.4	32.0	0.91	183	265.8
HT-04	4.0	-17	0	0	0.00	90.4	32.6	0.90	183	264.9
HT-03	3.5	-17.5	7.1	0.9	6.39	96.8	33.2	0.89	213	299.9
HT-02	3.0	-18	0	0	0.00	96.8	34.0	0.88	213	298.8
H-OUT	2.5	-24.2	0	0	0	96.8	37.1	0.84	0	294.9

Table B-4
Existing Hydraulics:
10 Year Event - Model Modification

Label	Start Node	Stop Node	Flow (ft^3/s)	Capacity (Full Flow) (ft^3/s)	Diameter (in)	Length (Unified) (ft)	Slope (Calculated) (ft/ft)	Invert (Upstream) (ft)	Invert (Downstream) (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Freeboard	Cover (Start) (ft)	Velocity (Average) (ft/s)
P-04	HT-05	HT-04	265.8	292.6	78	289	0.003	-16.10	-17.00	4.50	4.00	-4.39	-5.13	8.89	14.1	8.0
P-03	HT-04	HT-03	264.9	216.6	78	293	0.002	-17.00	-17.50	4.00	3.50	-5.26	-6.01	9.26	14.5	8.0
P-02	HT-03	HT-02	299.9	180.2	78	423	0.001	-17.50	-18.00	3.50	3.00	-6.88	-8.27	10.38	14.5	9.0
P-01	HT-02	OF-1	298.8	318.8	78	1,677	0.004	-18.00	-24.20	3.00	2.50	-8.55	-14.00	11.55	14.5	9.0

Table B-5
Project Site Existing Conditions Hydrology:
10 Year Event

Node	Elevation (Ground) (ft)	Sump Elevation (ft)	Inlet Drainage Area (acres)	Inlet C	Local CA (acres)	Cumulative CA (acres)	System Flow Time (min)	System Intensity (in/hr)	Flow (Additional) (ft^3/s)	Flow (ft^3/s)
CB-4	-3.89	-3.89	7.1	0.90	6.39	6.4	12.7	1.51	0	9.7
CB-1	2.03	-3.67	6.3	0.83	5.36	5.2	13.7	1.44	0	7.6
CB-2	1.34	-6.17	7.9	0.62	4.90	10.1	16.1	1.31	0	13.4
CB-3	1.94	-7.77	5.55	0.62	3.44	13.6	18.9	1.20	0	16.5
CB-5	2.49	-8.59	8.5	0.62	5.27	25.2	20.33	1.15	0	29.3
MH-15	3.28	-12.3	0	0.00	0.00	25.2	20.73	1.14	0	29.1
HT-05	4.5	-16.1	0	0.00	0.00	90.4	34.0	0.91	183	265.9
HT-04	4	-17	0	0.00	0.00	90.4	34.6	0.90	183	265.4
HT-03	3.5	-17.5	0	0.00	0.00	115.6	35.2	0.90	183	287.7
HT-02	3	-18	0	0.00	0.00	115.6	36.0	0.89	183	286.7
HT-OUT	2.50	-24.2	0	0.00	0.00	115.6	39.3	0.86	0	282.9

Table B-6
Project Site Existing Conditions Hydraulics:
10 Year Event

Label	Start Node	Stop Node	Flow (ft^3/s)	Capacity (Full Flow) (ft^3/s)	Diameter (in)	Length (Unified) (ft)	Slope (Calculated) (ft/ft)	Invert (Upstream) (ft)	Invert (Downstream) (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Freeboard	Cover (Start) (ft)	Velocity (Average) (ft/s)
P-8	CB-4	CB-5	9.7	301.5	36	23	0.204	-3.89	-8.59	-3.89	2.49	-2.90	-5.34	-0.99	-3.0	19.5
P-5	CB-1	CB-2	7.6	6.7	18	616	0.004	-3.67	-6.17	2.03	1.34	1.35	-1.87	0.68	4.2	4.3
P-6	CB-2	CB-3	13.4	10.8	24	709	0.002	-6.17	-7.77	1.34	1.94	-1.87	-4.34	3.21	5.5	4.3
P-7	CB-3	CB-5	16.5	14.7	27	364	0.002	-7.77	-8.59	1.94	2.49	-4.34	-5.37	6.28	7.5	4.1
P-9	CB-5	MH-15	29.3	66.3	30	142	0.026	-8.59	-12.3	2.49	3.28	-5.57	-6.30	8.06	8.6	6.0
P-10	MH-15	HT-03	29.1	104.5	36	212	0.025	-12.3	-17.5	3.28	3.5	-6.57	-6.97	9.85	12.6	4.1
P-04	HT-05	HT-04	265.9	292.6	78	289	0.003	-16.1	-17	4.5	4	-5.13	-5.87	9.63	14.1	8.0
P-03	HT-04	HT-03	265.4	216.6	78	293	0.002	-17	-17.5	4	3.5	-6.00	-6.75	10.00	14.5	8.0
P-02	HT-03	HT-02	287.7	180.2	78	423	0.001	-17.5	-18	3.5	3	-7.45	-8.73	10.95	14.5	8.7
P-01	HT-02	OF-1	286.7	318.8	78	1677	0.004	-18	-24.2	3	2.5	-8.98	-14.00	11.98	14.5	8.6

Table B-7
Project Site Proposed Conditions Hydrology:
10 Year Event

Node	Elevation (Ground) (ft)	Sump Elevation (ft)	Inlet Drainage Area (acres)	Inlet C	Local CA (acres)	Cumulative CA (acres)	System Flow Time (min)	System Intensity (in/hr)	Flow (Additional) (ft^3/s)	Flow (ft^3/s)
CB-4	-3.89	-3.89	7.1	0.90	6.39	6.4	12.7	1.51	0	9.7
CB-1	2.03	-3.67	6.3	0.83	5.23	5.2	13.7	1.44	0	7.6
CB-2	1.34	-6.17	7.9	0.60	4.74	10.0	16.1	1.31	0	13.2
CB-3	1.94	-7.77	5.6	0.60	3.33	13.3	18.9	1.20	0	16.1
CB-5	2.49	-8.59	8.5	0.60	5.10	24.8	20.4	1.15	0	28.8
MH-15	3.28	-12.3	0	0.00	0.00	24.8	20.8	1.14	0	28.5
HT-05	4.5	-16.1	0	0.00	0.00	90.4	34.0	0.91	183	265.9
HT-04	4	-17	0	0.00	0.00	90.4	34.6	0.90	183	265.4
HT-03	3.5	-17.5	0	0.00	0.00	115.2	35.2	0.90	183	287.3
HT-02	3	-18	0	0.00	0.00	115.2	36.0	0.89	183	286.3
HT-OUT	2.50	-24.2	0	0.00	0.00	115.2	39.3	0.86	0	282.6

Table B-8
Project Site Proposed Condition Hydraulics:
10 Year Event

Label	Start Node	Stop Node	Flow (ft^3/s)	Capacity (Full Flow) (ft^3/s)	Diameter (in)	Length (Unified) (ft)	Slope (Calculated) (ft/ft)	Invert (Upstream) (ft)	Invert (Downstream) (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Freeboard	Cover (Start) (ft)	Velocity (Average) (ft/s)
P-8	CB-4	CB-5	9.7	301.5	36	23	0.204	-3.89	-8.59	-3.89	2.49	-2.90	-5.43	-0.99	-3.0	19.5
P-5	CB-1	CB-2	7.6	6.7	18	616	0.004	-3.67	-6.17	2.03	1.34	1.15	-2.07	0.88	4.2	4.3
P-6	CB-2	CB-3	13.2	10.8	24	709	0.002	-6.17	-7.77	1.34	1.94	-2.07	-4.47	3.41	5.5	4.2
P-7	CB-3	CB-5	16.1	14.7	27	364	0.002	-7.77	-8.59	1.94	2.49	-4.47	-5.45	6.41	7.5	4.1
P-9	CB-5	MH-15	28.8	66.3	30	142	0.026	-8.59	-12.3	2.49	3.28	-5.65	-6.34	8.14	8.6	5.9
P-10	MH-15	HT-03	28.5	104.5	36	212	0.025	-12.3	-17.5	3.28	3.50	-6.60	-6.99	9.88	12.6	4.0
P-04	HT-05	HT-04	265.9	292.6	78	289	0.003	-16.1	-17	4.50	4.00	-5.15	-5.89	9.65	14.1	8.0
P-03	HT-04	HT-03	265.4	216.6	78	293	0.002	-17	-17.5	4.00	3.50	-6.02	-6.77	10.02	14.5	8.0
P-02	HT-03	HT-02	287.3	180.2	78	423	0.001	-17.5	-18	3.50	3.00	-7.47	-8.74	10.97	14.5	8.7
P-01	HT-02	OF-1	286.3	318.8	78	1677	0.004	-18	-24.2	3.00	2.50	-9.00	-14.00	12.00	14.5	8.6

100 YEAR STORM TABLES

Table C-1
Existing Hydrology: 100 Year Event - Model Verification

Node	Elevation (Ground) (ft)	Sump Elevation (ft)	Inlet Drainage Area (acres)	Inlet C	Local CA (acres)	System CA (acres)	System Flow Time (min)	System Intensity (in/hr)	Flow (Additional) (ft^3/s)	Flow (ft^3/s)
HT-05	4.5	-16.1	0	0	0	95.8	37.9	1.17	201	313.7
HT-04	4.0	-17	0	0	0	95.8	38.4	1.16	201	312.9
HT-03	3.5	-17.5	35.2	0.59	20.77	116.6	38.9	1.15	205	340.3
HT-02	3.0	-18	0	0	0	116.6	39.6	1.14	226	360.1
H-OUT	2.5	-24.2	0	0	0	116.6	42.2	1.11	0	355.8

Table C-2
Existing Hydraulics: 100 Year Event - Model Verification

Label	Start Node	Stop Node	Flow (ft^3/s)	Capacity (Full Flow) (ft^3/s)	Diameter (in)	Length (Unified) (ft)	Slope (Calculated) (ft/ft)	Invert (Upstream) (ft)	Invert (Downstream) (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Freeboard	Cover (Start) (ft)	Velocity (Average) (ft/s)
P-04	HT-05	HT-04	313.7	292.6	78	289	0.003	-16.10	-17.00	4.50	4.00	-0.23	-1.26	4.73	14.1	9.5
P-03	HT-04	HT-03	312.9	216.6	78	293	0.002	-17.00	-17.50	4.00	3.50	-1.48	-2.53	5.48	14.5	9.4
P-02	HT-03	HT-02	340.3	180.2	78	423	0.001	-17.50	-18.00	3.50	3.00	-3.83	-5.61	7.33	14.5	10.3
P-01	HT-02	OF-1	360.1	318.8	78	1,677	0.004	-18.00	-24.20	3.00	2.50	-6.09	-14.00	9.09	14.5	10.9

Table C-3
Existing Hydrology: 100 Year Event - Model Modification

Node	Elevation (Ground) (ft)	Sump Elevation (ft)	Inlet Drainage Area (acres)	Inlet C	Local CA (acres)	Cumulative CA (acres)	System Flow Time (min)	System Intensity (in/hr)	Flow (Additional) (ft^3/s)	Flow (ft^3/s)
HT-05	4.5	-16.1	0	0	0	95.8	37.9	1.238	201	320.6
HT-04	4.0	-17.0	0	0	0	95.8	38.399	1.23	201	319.8
HT-03	3.5	-17.5	35.2	0.59	20.77	116.6	38.905	1.222	226	369.5
HT-02	3.0	-18.0	0	0	0	116.6	39.538	1.21	226	368.3
H-OUT	2.5	-24.2	0	0	0	116.6	42.1	1.17	0	363.8

Table C-4
Existing Hydraulics:
100 Year Event - Model Modification

Label	Start Node	Stop Node	Flow (ft^3/s)	Capacity (Full Flow) (ft^3/s)	Diameter (in)	Length (Unified) (ft)	Slope (Calculated) (ft/ft)	Invert (Upstream) (ft)	Invert (Downstream) (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Freeboard	Cover (Start) (ft)	Velocity (Average) (ft/s)
P-04	HT-05	HT-04	320.6	292.6	78	289	0.003	-16.10	-17.00	4.50	4.00	0.88	-0.20	3.62	14.1	9.7
P-03	HT-04	HT-03	319.8	216.6	78	293	0.002	-17.00	-17.50	4.00	3.50	-0.44	-1.53	4.44	14.5	9.6
P-02	HT-03	HT-02	369.5	180.2	78	423	0.001	-17.50	-18.00	3.50	3.00	-3.11	-5.21	6.61	14.5	11.1
P-01	HT-02	OF-1	368.3	318.8	78	1,677	0.004	-18.00	-24.20	3.00	2.50	-5.72	-14.00	8.72	14.5	11.1

Table C-5
Project Site Existing Conditions Hydrology:
100 Year Event

Node	Elevation (Ground) (ft)	Sump Elevation (ft)	Inlet Drainage Area (acres)	Inlet C	Local CA (acres)	Cumulative CA (acres)	System Flow Time (min)	System Intensity (in/hr)	Flow (Additional) (ft^3/s)	Flow (ft^3/s)
CB-4	-3.89	-3.9	35.2	0.59	20.77	20.8	12.6	2.21	0	46.3
CB-1	2.03	-3.7	6.3	1.00	6.30	6.3	13.7	2.12	0	13.4
CB-2	1.34	-6.2	7.9	0.77	6.08	12.4	15.1	2.01	0	25.1
CB-3	1.94	-7.8	5.55	0.77	4.27	16.7	16.5	1.92	0	32.2
CB-5	2.49	-8.6	8.5	0.77	6.55	44.0	17.3	1.87	0	83.0
MH-15	3.28	-12.3	0	0.00	0.00	44.0	17.4	1.86	0	82.6
HT-05	4.5	-16.1	0	0.00	0.00	95.8	37.9	1.24	201	320.6
HT-04	4	-17.0	0	0.00	0.00	95.8	38.4	1.23	201	319.8
HT-03	3.5	-17.5	0	0.00	0.00	139.8	38.9	1.22	201	373.1
HT-02	3	-18.0	0	0.00	0.00	139.8	39.5	1.21	201	371.7
HT-OUT	2.50	-24.2	0	0.00	0.00	139.8	42.0	1.17	0	366.3

Table C-6
Project Site Existing Conditions Hydraulics:
100 Year Event

Label	Start Node	Stop Node	Flow (ft³/s)	Capacity (Full Flow) (ft³/s)	Diameter (in)	Length (Unified) (ft)	Slope (Calculated) (ft/ft)	Invert (Upstream) (ft)	Invert (Downstream) (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Freeboard	Cover (Start) (ft)	Velocity (Average) (ft/s)
P-8	CB-4	CB-5	46.3	301.5	36	23	0.204	-3.89	-8.59	-3.89	2.49	2.60	2.49	-6.49	-3.0	6.6
P-5	CB-1	CB-2	13.4	6.7	18	616	0.004	-3.67	-6.17	2.03	1.34	11.41	1.34	-9.38	4.2	7.6
P-6	CB-2	CB-3	25.1	10.7	24	710	0.002	-6.17	-7.77	1.34	1.94	10.70	1.94	-9.36	5.5	8.0
P-7	CB-3	CB-5	32.2	14.7	27	363	0.002	-7.77	-8.59	1.94	2.49	6.41	2.49	-4.47	7.5	8.1
P-9	CB-5	MH-15	83.0	66.3	30	142	0.026	-8.59	-12.30	2.49	3.28	9.09	3.28	-6.60	8.6	16.9
P-10	MH-15	HT-03	82.6	104.5	36	212	0.025	-12.30	-17.50	3.28	3.50	1.35	-1.90	1.93	12.6	11.7
P-04	HT-05	HT-04	320.6	292.6	78	289	0.003	-16.10	-17.00	4.50	4.00	0.90	-0.18	3.60	14.1	9.7
P-03	HT-04	HT-03	319.8	216.6	78	293	0.002	-17.00	-17.50	4.00	3.50	-0.41	-1.50	4.41	14.5	9.6
P-02	HT-03	HT-02	373.1	180.2	78	423	0.001	-17.50	-18.00	3.50	3.00	-2.91	-5.05	6.41	14.5	11.2
P-01	HT-02	OF-1	371.7	318.8	78	1,677	0.004	-18.00	-24.20	3.00	2.50	-5.57	-14.00	8.57	14.5	11.2

Table C-5a
Project Site Existing Hydrology: 100 Year Event
System Flow Capacity

Node	Elevation (Ground) (ft)	Sump Elevation (ft)	Inlet Drainage Area (acres)	Inlet C	Local CA (acres)	Cumulative CA (acres)	System Flow Time (min)	System Intensity (in/hr)	Flow (Additional) (ft^3/s)	Flow (ft^3/s)
CB-4	-3.89	-3.9	35.2	0.59	20.8	20.8	12.6	2.21	0	46.3
CB-1	2.03	-3.7	0	0.00	0.00	0.0	0	3.594	3	3.0
CB-2	1.34	-6.2	0	0.00	0.00	0.0	6.048	3.252	4	4.0
CB-3	1.94	-7.8	0	0.00	0.00	0.0	15.341	1.993	5	5.0
CB-5	2.49	-8.6	0	0.00	0.00	20.8	20.152	1.727	44	43.6
MH-15	3.28	-12.3	0	0.00	0.00	20.8	20.419	1.715	209	43.4
HT-05	4.5	-16.1	0	0.00	0.00	95.8	37.9	1.238	201	320.6
HT-04	4	-17.0	0	0.00	0.00	95.8	38.399	1.23	201	319.8
HT-03	3.5	-17.5	0	0.00	0.00	116.6	38.905	1.222	209	352.0
HT-02	3	-18.0	0	0.00	0.00	116.6	39.57	1.211	209	350.8
HT-OUT	2.50	-24.2	0	0.00	0.00	116.6	42.2	1.17	209	346.0

Table C-6a
Project Site Existing Conditions Hydraulics:
System Flow Capacity

Label	Start Node	Stop Node	Flow (ft^3/s)	Capacity (Full Flow) (ft^3/s)	Diameter (in)	Length (Unified) (ft)	Slope (Calculated) (ft/ft)	Invert (Upstream) (ft)	Invert (Downstream) (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Freeboard	Cover (Start) (ft)	Velocity (Average) (ft/s)
P-8	CB-4	CB-5	46.3	301.5	36	23	0.204	-3.89	-8.59	-3.89	2.49	1.44	1.33	-5.33	-3.0	6.6
P-5	CB-1	CB-2	3.0	6.7	18	616	0.004	-3.67	-6.17	2.03	1.34	1.71	1.21	0.32	4.2	1.7
P-6	CB-2	CB-3	4.0	10.7	24	710	0.002	-6.17	-7.77	1.34	1.94	1.20	0.98	0.14	5.5	1.3
P-7	CB-3	CB-5	5.0	14.7	27	363	0.002	-7.77	-8.59	1.94	2.49	0.98	0.88	0.96	7.5	1.3
P-9	CB-5	MH-15	43.6	66.3	30	142	0.026	-8.59	-12.3	2.49	3.28	0.64	-0.97	1.85	8.6	8.9
P-10	MH-15	HT-03	43.4	104.5	36	212	0.025	-12.3	-17.5	3.28	3.5	-2.39	-3.29	5.67	12.6	6.1
P-04	HT-05	HT-04	320.6	292.6	78	289	0.003	-16.1	-17	4.5	4	-0.51	-1.59	5.01	14.1	9.7
P-03	HT-04	HT-03	319.8	216.6	78	293	0.002	-17	-17.5	4	3.5	-1.81	-2.90	5.81	14.5	9.6
P-02	HT-03	HT-02	352.0	180.2	78	423	0.001	-17.5	-18	3.5	3	-4.14	-6.05	7.64	14.5	10.6
P-01	HT-02	OF-1	350.8	318.8	78	1677	0.004	-18	-24.2	3	2.5	-6.49	-14.00	9.49	14.5	10.6

Table C-7
Project Site Proposed Conditions Hydrology:
100 Year Event

Node	Elevation (Ground) (ft)	Sump Elevation (ft)	Inlet Drainage Area (acres)	Inlet C	Local CA (acres)	Cumulative CA (acres)	System Flow Time (min)	System Intensity (in/hr)	Flow (Additional) (ft^3/s)	Flow (ft^3/s)
CB-4	-3.89	-3.9	35.2	0.59	20.77	20.8	12.6	2.21	0	46.3
CB-1	2.03	-3.7	6.3	1.00	6.30	6.3	13.7	2.12	0	13.4
CB-2	1.34	-6.2	7.9	0.77	6.08	11.8	15.1	2.01	0	24.0
CB-3	1.94	-7.8	5.55	0.77	4.27	15.7	16.6	1.91	0	30.3
CB-5	2.49	-8.6	8.5	0.77	6.55	42.4	17.4	1.87	0	79.8
MH-15	3.28	-12.3	0	0.00	0.00	42.4	17.5	1.86	0	79.4
HT-05	4.5	-16.1	0	0.00	0.00	95.8	37.9	1.24	201	320.6
HT-04	4	-17.0	0	0.00	0.00	95.8	38.4	1.23	201	319.8
HT-03	3.5	-17.5	0	0.00	0.00	138.2	38.9	1.22	201	371.2
HT-02	3	-18.0	0	0.00	0.00	138.2	39.5	1.21	201	369.8
HT-OUT	2.50	-24.2	0	0.00	0.00	138.2	42.0	1.17	0	364.4

Table C-8
Project Site Proposed Conditions Hydraulics:
100 Year Event

Label	Start Node	Stop Node	Flow (ft^3/s)	Capacity (Full Flow) (ft^3/s)	Diameter (in)	Length (Unified) (ft)	Slope (Calculated) (ft/ft)	Invert (Upstream) (ft)	Invert (Downstream) (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Freeboard	Cover (Start) (ft)	Velocity (Average) (ft/s)
P-8	CB-4	CB-5	46.27	301.5	36	23	0.204	-3.89	-8.59	-3.89	2.49	2.60	2.49	-6.49	-3.0	6.6
P-5	CB-1	CB-2	13.43	6.7	18	616	0.004	-3.67	-6.17	2.03	1.34	11.41	1.34	-9.38	4.2	7.6
P-6	CB-2	CB-3	24	10.7	24	710	0.002	-6.17	-7.77	1.34	1.94	9.93	1.94	-8.59	5.5	7.6
P-7	CB-3	CB-5	30.29	14.7	27	363	0.002	-7.77	-8.59	1.94	2.49	5.96	2.49	-4.02	7.5	7.6
P-9	CB-5	MH-15	79.79	66.3	30	142	0.026	-8.59	-12.3	2.49	3.28	8.65	3.28	-6.16	8.6	16.3
P-10	MH-15	HT-03	79.44	104.5	36	212	0.025	-12.3	-17.5	3.28	3.5	0.98	-2.03	2.30	12.6	11.2
P-04	HT-05	HT-04	320.59	292.6	78	289	0.003	-16.1	-17	4.5	4	0.77	-0.31	3.73	14.1	9.7
P-03	HT-04	HT-03	319.77	216.6	78	293	0.002	-17	-17.5	4	3.5	-0.54	-1.63	4.54	14.5	9.6
P-02	HT-03	HT-02	371.2	180.2	78	423	0.001	-17.5	-18	3.5	3	-3.02	-5.14	6.52	14.5	11.2
P-01	HT-02	OF-1	369.77	318.8	78	1,677	0.004	-18	-24.2	3	2.5	-5.66	-14.00	8.66	14.5	11.1

Table C-7a
Project Site Proposed Hydrology: 100 Year Event
System Flow Capacity

Node	Elevation (Ground) (ft)	Sump Elevation (ft)	Inlet Drainage Area (acres)	Inlet C	Local CA (acres)	Cumulative CA (acres)	System Flow Time (min)	System Intensity (in/hr)	Flow (Additional) (ft^3/s)	Flow (ft^3/s)
CB-4	-3.89	-3.9	35.2	0.59	20.8	20.8	12.6	2.21	0	46.3
CB-1	2.03	-3.7	0	0.00	0.00	0.0	0	3.594	3	3.0
CB-2	1.34	-6.2	0	0.00	0.00	0.0	6.048	3.252	4	4.0
CB-3	1.94	-7.8	0	0.00	0.00	0.0	15.341	1.993	5	5.0
CB-5	2.49	-8.6	0	0.00	0.00	20.8	20.152	1.727	44	43.6
MH-15	3.28	-12.3	0	0.00	0.00	20.8	20.419	1.715	209	43.4
HT-05	4.5	-16.1	0	0.00	0.00	95.8	37.9	1.238	201	320.6
HT-04	4	-17.0	0	0.00	0.00	95.8	38.399	1.23	201	319.8
HT-03	3.5	-17.5	0	0.00	0.00	116.6	38.905	1.222	209	352.0
HT-02	3	-18.0	0	0.00	0.00	116.6	39.57	1.211	209	350.8
HT-OUT	2.50	-24.2	0	0.00	0.00	116.6	42.2	1.17	209	346.0

Table C-8a
Project Site Proposed Conditions Hydraulics:
System Flow Capacity

Label	Start Node	Stop Node	Flow (ft^3/s)	Capacity (Full Flow) (ft^3/s)	Diameter (in)	Length (Unified) (ft)	Slope (Calculated) (ft/ft)	Invert (Upstream) (ft)	Invert (Downstream) (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Freeboard	Cover (Start) (ft)	Velocity (Average) (ft/s)
P-8	CB-4	CB-5	46.3	301.5	36	23	0.204	-3.89	-8.59	-3.89	2.49	1.44	1.33	-5.33	-3.0	6.6
P-5	CB-1	CB-2	3.0	6.7	18	616	0.004	-3.67	-6.17	2.03	1.34	1.71	1.21	0.32	4.2	1.7
P-6	CB-2	CB-3	4.0	10.7	24	710	0.002	-6.17	-7.77	1.34	1.94	1.20	0.98	0.14	5.5	1.3
P-7	CB-3	CB-5	5.0	14.7	27	363	0.002	-7.77	-8.59	1.94	2.49	0.98	0.88	0.96	7.5	1.3
P-9	CB-5	MH-15	43.6	66.3	30	142	0.026	-8.59	-12.3	2.49	3.28	0.64	-0.97	1.85	8.6	8.9
P-10	MH-15	HT-03	43.4	104.5	36	212	0.025	-12.3	-17.5	3.28	3.5	-2.39	-3.29	5.67	12.6	6.1
P-04	HT-05	HT-04	320.6	292.6	78	289	0.003	-16.1	-17	4.5	4	-0.51	-1.59	5.01	14.1	9.7
P-03	HT-04	HT-03	319.8	216.6	78	293	0.002	-17	-17.5	4	3.5	-1.81	-2.90	5.81	14.5	9.6
P-02	HT-03	HT-02	352.0	180.2	78	423	0.001	-17.5	-18	3.5	3	-4.14	-6.05	7.64	14.5	10.6
P-01	HT-02	OF-1	350.8	318.8	78	1677	0.004	-18	-24.2	3	2.5	-6.49	-14.00	9.49	14.5	10.6

RUN OFF COEFFICIENT CALCULATIONS

Table D-1
Existing Condition 10 Year Event Run-Off Coefficient Calculation - TE Connectivity Site

Runoff Coefficient Table: 10-year			
	C_{runoff}	Area (acres)	Weight
Roof & Pavement	0.90	5.6	5.04
Landscape	0.30	0.7	0.21
	*Subtotal	6.3	5.25
	Total Site Composite Run-off Coefficient		0.83

*TE Connectivity Area Only

Table D-2
Existing Condition 10 Year Event Run-Off Coefficient Calculation - Project Site

Runoff Coefficient Table: 10-year			
	C_{runoff}	Area (acres)	Weight
Roof & Pavement	0.90	8.7	7.80
Compacted Gravel	0.60	5.9	3.52
Landscape	0.30	7.6	2.27
	Subtotal	22.1	13.59
Total Site Composite Run-off Coefficient			0.62

Table D-3
Proposed Condition 10 Year Event Run-Off Coefficient Calculation - Project Site

Runoff Coefficient Table: 10-year			
	C_{runoff}	Area (acres)	Weight
Roof & Pavement	0.90	10.9	9.84
Landscape	0.30	11.2	3.36
	Subtotal	22.1	13.19
	Total Site Composite Run-off Coefficient		0.60

Table D-4
Existing Condition 100 Year Event Run-Off Coefficient Calculation - TE Connectivity Site

Runoff Coefficient Table: 100-year			
	C_{runoff}	Area (acres)	Weight
Roof & Pavement	0.90	5.6	5.04
Landscape	0.30	0.7	0.21
	*Subtotal	6.3	5.25
Total Site Composite Run-off Coefficient			0.83
Adjusted Site Composite Run-off Coefficient			1

*TE Connectivity Area Only

$C_{100\text{-year}} = C_{10\text{-year}} * 1.25$

Table D-5
Existing Condition 100 Year Event Run-Off Coefficient Calculation - Project Site

Runoff Coefficient Table: 100-year			
	C_{runoff}	Area (acres)	Weight
Roof & Pavement	0.90	8.7	7.80
Compacted Gravel	0.60	5.9	3.52
Lawn	0.30	7.6	2.27
	*Subtotal	22.1	13.59
Total Site Composite Run-off Coefficient			0.62
Adjusted Site Composite Run-off Coefficient			0.77

*Total Site without TE Connectivity Area

$C_{100\text{-year}} = C_{10\text{-year}} * 1.25$

Table D-6
Proposed Condition 100 Year Event Run-Off Coefficient Calculation - Project Site

Runoff Coefficient Table: 100-year			
	C_{runoff}	Area (acres)	Weight
Roof & Pavement	0.90	10.9	9.88
Landscape	0.30	11.2	3.40
	*Subtotal	22.1	13.28
Total Site Composite Run-off Coefficient			0.60
Adjusted Composite Run-off Coefficient			0.75

*Project Area Only

$C_{100\text{-year}} = C_{10\text{-year}} * 1.25$

APPENDIX A:

HAMILTON PARK DEVELOPMENT STORM DRAIN REPORT

OFF-SITE STORM DRAINAGE SYSTEM
HAMILTON PARK DEVELOPMENT

For:

Clarum Homes

MEMLO PARK, CALIFORNIA

Prepared by: Brian Kangas Foulk
BKF Job No.: 20040093

October 8, 2004

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APPENDIX A

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Table A8	Proposed Hydraulics, 100-year Event – with Flow in Streets
Table A9	Flow in Concrete Bypass Channel

APPENDIX B

Table B1	Runoff Coefficient Calculations
Table B2	Area Calculations
Table B3	Calculation of Peak Flow, 100-year Event, to Chilco Street
Table B4	Calculation of Gutter Flow
Table B5	Table 5 of Belle Haven Storm Drain System, November 14, 1995

I. INTRODUCTION

Clarum Homes proposes construction of the Hamilton Park development in Menlo Park. The project vicinity is shown on Figure 1. The proposed development will discharge storm water runoff to the existing Hamilton Avenue storm drain system. The following report documents the off-site flow capacity available in the Hamilton Avenue storm drain system to serve the proposed Hamilton Park development.

The proposed Hamilton Park development will discharge to an existing 42-inch storm drain line on Hamilton Avenue. Currently, the Hamilton Park site is undeveloped. The portion of the site fronting Hamilton Avenue drains to the Hamilton Avenue Storm Drainage System. The rear portion of the site drains to an un-named swale that conveys flows to the Willow Road storm drain system downstream of Hamilton Avenue (Swale A). Figures 2 and 3 show Swale A, along with on- and off-site areas that drain to Swale A. For the purpose of this report, Swale A is divided into two reaches, reaches A1 and A2.

The Hamilton Avenue Storm Drainage System is evaluated using information provided by the City of Menlo Park, supplemented with survey information collected by Kier and Wright. The analyses are for the 10-year storm event, with expected street water levels presented for a 100-year storm event.

II. SUMMARY

The Project site is in the northern portion of Menlo Park near the Southern Pacific Railroad lines. The drainage area to the Hamilton Avenue storm drain system is shown in Figure 2. The existing storm drainage facilities serving the project area are shown in Figures 3 and 4. Runoff from the project area is conveyed to a Caltrans pump station located adjacent to the Bayfront Expressway.

Local drainage facilities in the project area are sized for development of the project area. As a part of the project, an existing swale, Swale A on Figure 3, will be redirected to the Hamilton Avenue storm drain system. Swale A currently conveys 6.3 acres of off-site runoff and 3.5 acres of on-site runoff through the project site. Swale A discharges to the Belle-Haven storm drainage system at Willow Road at node HT-03, downstream of the project site. With proposed development, Reach A1 of Swale A will be directed to the Hamilton Avenue Storm Drain System in the vicinity of Inlet HT-13.

Currently, the peak flow rate in the Hamilton Avenue system at Inlet HT-13 is 53 cfs during the 10-year event and 69 cfs during the 100-year event. Downstream of the site, the Hamilton Avenue storm drain line has adequate flow capacity to convey the 10-year event with freeboard below the rims for both existing and proposed conditions. The Hamilton Avenue system discharges to the Belle-Haven storm drain system at the intersection of Willow Road and Hamilton Avenue at Inlet HT-05.

With proposed development of Hamilton Park and direction of flow from Reach A1 of Swale A to Hamilton Avenue, the peak flow to the downstream system will increase by 4 cfs and there will be an increase in water levels of up to 0.3 feet during the 10-year event. Currently, the

system downstream of the site has adequate freeboard, with the minimum freeboard of 3.3 feet occurring at the connection point, Inlet HT-13. For proposed conditions, the freeboard at this location is reduced to 3.0 feet. Table 1 presents added areas, flows, and changes in freeboard to the Hamilton Avenue storm drain system from Hamilton Park addition. Upstream of the project, the system will overtop at Inlet HT-21, located at Ivy Drive and Hamilton Avenue. This overtopping at HT-21 will occur regardless of the project.

100-year event - With the Hamilton Park project, development will be placed over the location of the existing Swale A. The project proposes a Relocated Swale A that will be concrete-lined, 5.5-feet wide and will slope at 0.1 percent. The proposed slope is consistent with the existing slope of Swale A through the project site.

The relocated Swale A will convey 24 cfs flow from Chilco Street to an existing 24-inch diameter culvert under a Church parking lot to the east of the site. In addition, the following drainage improvements are recommended: (1) install a flap gate on the Chilco Street storm drain line to prevent reverse flow from the Hamilton Avenue storm drain line, and (2) install a parallel 30-inch diameter storm drain line adjacent to the existing 24-inch storm drain line at the east end of the site.

III. BACKGROUND

The project is located in the City of Menlo Park. The project is within the Belle-Haven drainage area. The area was evaluated as a part of the Belle Haven Storm Drain System. Analyses are presented in the Belle-Haven Master Plan by Wilsey & Ham dated 1970. BKF was not able to find a full copy of this report, but did locate Tables that provided information on the downstream storm drainage system.

The Belle-Haven trunk line to the Dumbarton Pump Station was evaluated by California Department of Transportation (Caltrans) in 1978-79. Calculations show a 30-year event peak flow rate of 320 cfs to the storm drain system downstream of Willow Road at Hamilton Avenue. Based on our review, there are discrepancies in lengths of storm drain lines between the site and the discharge. BKF has revised these calculations to correspond to the location of the existing pump station. These calculations were revised to incorporate flows from the Sun Campus.

BKF Engineers evaluated the Belle Haven Storm Drain System in November 1995 as a part of the review of drainage improvements west of Highway 101.

Drainage within the City of Menlo Park was evaluated as a part of the *City-wide Storm Drainage City Study, City of Menlo Park*, by BKF Engineers dated May 2003 (2003 Drainage Study). The project area is excluded from this study. The methodology used in the 2003 Drainage Study is used for these analyses.

IV. BASIS OF DESIGN

The project area drainage facilities are evaluated using the Rational Method. The following summarizes key criteria.

Design Storm Event - The Hamilton Avenue system is evaluated using a 10-year event contained in the storm drain system and the 100-year storm event with flow through the streets.

Datum – The calculations are based on a datum from 1978 Caltrans calculations that show the rim elevation at Hamilton Avenue and Willow Road at elevation 4.5 (Caltrans Datum). All site topography is adjusted to this elevation. The Hamilton Park project datum is 1.68 feet higher than the Caltrans Datum. The Hamilton Park topography shows the storm drain manhole at the intersection of Hamilton Avenue and Chilco at elevation 6.88. The datum for the 1978 Caltrans calculations shows this location at elevation 5.20.

Computer Program - StormCAD by Haestad Methods is used to evaluate the performance of the existing system. This program is a Rational Method based program, with hydraulic analyses for both free-flow and pressure-flow conditions. The methodology used is consistent with the 2003 Drainage Study.

Time of Concentration – An initial time of concentration of 10 minutes is used for flow to the initial inlet, based on an inlet within about 500 feet of the upstream discharge point. Where the gutter flow distance is longer than 500 feet, a longer initial time of concentration is used. The initial time of concentration is calculated as:

Tc = 10 minutes + (Length to first inlet – 500 feet) / (2 feet per second * 60 seconds/minute)

The time of concentration is increased based on flow through the pipe system. There is an existing large diameter under Highway 101 that is over-sized. With the reported velocities in the line, the time of concentration to the downstream system is larger than would be reasonably expected. For modeling purposes, the diameter of this line is reduced to provide a flow velocity greater than two feet per second.

Runoff Coefficient - Runoff coefficients are developed using Caltrans guidelines presented in the Highway Design Manual. A runoff coefficient of 0.40 is used for residential development, 0.7 is used for commercial areas. Runoff coefficients for open space areas are presented in Table B1 and are developed based on slope, soil infiltration, vegetal cover and storage. Runoff coefficients are increased by a factor of 1.25 for the 100-year event.

Starting Water Level – A starting water level of elevation -14 is used at the pump station consistent with the Caltrans calculations. The starting water level at the pump station is based on a 30-year storm event in the Belle-Haven storm drain system. For the 100-year events, a tailwater of about elevation 2.5 is used at the intersection of Willow Road and

Hamilton Avenue. Elevation 2.5 is slightly below the lowest rim elevation of the Hamilton Avenue storm drain system. With a higher tailwater in the Belle-Haven system, reverse flow will occur from the Belle-Haven system to low points along the Hamilton Avenue system.

Rainfall Intensity - The rainfall-intensity is from Menlo Park precipitation intensity-duration-frequency value and published in California Department of Water Resources Bulletin 195. This bulletin was updated in November 1982 and again in August 1986. The precipitation curve for the intensity-duration-frequency values used is from the August 1986 update. The Intensity equation for the 10-year event is based on a best fit for the precipitation values presented for 15 and 30 minutes. The equation used is:

$I_{10\text{-year}} = 5.76 / \text{Time of Concentration}^{.533}$
$I_{100\text{-year}} = 7.45 / \text{Time of Concentration}^{.51}$

Roughness Coefficient – A Manning's roughness coefficient of 0.013 is used for all storm drain lines. For the purposes of this study, detailed offsite investigation was not conducted to verify pipe materials.

Freeboard – The existing system is evaluated based on the 10-year event contained within the storm drain system.

Bend Losses – Bend losses are calculated using the HEC-22 energy method which considers bend angles, change in flow rate and change in pipe size.

Flow above rim elevation – Where the analyses show that the water level is above the rim elevation, flows are removed from the system and allowed to travel as overland flow to the next downstream inlet with flow capacity. Flows are then returned to the system.

Downstream Flow Rates – Flow rates for the Belle-Haven system are from analyses by Caltrans dated August and October of 1978. The 10-year flow rate at Hamilton Avenue and Willow Road is 275 cfs. In February of 1980, the peak flow rate for the final segment of storm drain was increase to 299 cfs to account for additional flow from property that was then owned by Raychem. For the 100-year event, runoff is added to the downstream system to provide a water level of elevation 2.5 at the intersection of Willow Road and Hamilton Avenue. With additional flows in the Belle-Haven system, there will be reverse flow from the Belle-Haven system to the low point of the Hamilton Avenue system. At this time, it is anticipated that the Belle-Haven storm drain under Highway 101 will limit flow to the downstream to about the 25-year event peak flow rate, and the added flows are reasonable. The 100-year event flows through the Belle-Haven system were not evaluated as a part of this study.

Rim Elevations – Rim Elevations are based on a combination of site survey by Kier & Wright, storm drain invert survey by Kier & Wright, and rim elevations reported by Caltrans. Caltrans reports a starting water level at elevation 86 (elevation -14 on project datum) and a rim at the intersection of Willow Road and Hamilton Avenue (transition from 66-inch to 78-inch diameter line) at elevation 104.5 (elevation 4.5 on project

datum). Project survey by Kier & Wright are adjusted to conform to the Caltrans datum to be consistent with the starting water level.

V. SYSTEM EVALUATION

Upstream and Downstream Storm Drain System

The existing trunk line serving the project area was evaluated for the purpose of establishing the change in water level of the system with the proposed modification to the Hamilton Park drainage. Results are presented in Table 1 for the 10-year storm event for existing conditions and with the proposed project.

During a 10-year event, flows downstream of the site are contained within the storm drain system. Upstream of the site, flows are above the rim elevation at Inlet HT-21 at the intersection of Hamilton Avenue and Ivy Drive. Analyses of the existing storm drainage system are presented in Tables A1 and A2 in the Appendix for the 10-year storm events.

The lowest freeboard in the project vicinity is on Chilco, south of the Fire Station. The rim is shown on project drawings at elevation 4.98 (elevation 3.3 drainage datum). This line currently discharges to Reach A1 of Swale A.

There is an existing swale through the site, shown as Reach A1 of Swale A on Figure 3. The Reach A1 of Swale A drainage area is 10.8 acres. Reach A1 of Swale A discharge easterly to Reach A2 of Swale A through a 24-inch diameter culvert as shown on Figure 3.

Proposed Project

The proposed Hamilton Park project includes installation of proposed on-site storm drain lines that discharge to the Hamilton Avenue Storm Drain line. The on-site system will collect off-site runoff that currently flows into Reach A1 of Swale A. The proposed site runoff will be conveyed to Hamilton Avenue in the vicinity of Inlet HT-13. The water level at inlet HT-13 is elevation 1.5 Drainage Datum (elevation 3.2 Project Datum). At inlet HT-14, the water level is elevation 2.0 Drainage Datum (elevation 3.7 Project Datum). The on-site system should be sized to convey flows from the low point on Chilco Street (rim elevation 4.48 Project Datum) to the Hamilton Park storm drain.

With the proposed connection to Hamilton Avenue, there will be a 4 cfs increase in the peak flow rate of the Hamilton Avenue system during the 10-year event. See Table 1 for changes to the Hamilton Avenue Storm Drain System. The additional flow causes a 0.3 foot increase in the water level along the Hamilton Avenue storm drain line at the Hamilton Park connection point, Inlet HT-13. The increased water levels are contained in the storm drain system for the 10-year event.

Expected Street Water Levels During a 100-year Storm Event

Belle-Haven Storm Drain System

With no storage in low-lying areas, during the 100-year storm event, the Belle-Haven storm drain system on Willow Road is at capacity. During the 100-year storm event, overflow and reverse flow will occur within the Belle-Haven system. Inundation of low-lying areas may cause storage to occur that would decrease system flow, increasing the available flow capacity. A detailed study of unintentional off-site flood storage is outside the scope of this study. For this study, a 100-year water level of about elevation 2.5 is used for the Belle-Haven storm drain system. This is consistent with the low point of the Hamilton Avenue system, and reserve flow from the Belle-Haven system to the Hamilton Avenue system would occur with higher water levels in the Belle-Haven system.

Significant portions of the Hamilton Avenue drainage area are lower than the rim elevation at the intersection of Willow Road and Hamilton Avenue. When the Willow Road storm drain is at capacity, flow will back up into the Hamilton Avenue system. Reverse flow could occur. There is a low-lying area in the vicinity of Windermere Avenue, Hollyburne Avenue and Sevier Avenue that will pond to a level where ponded flows will overtop into Reach A2 of Swale A.

Surface Flows in Hamilton Avenue

Upstream of this low-lying area, the storm drainage system does not have flow capacity for a 100-year event. In the vicinity of Highway 101, the storm drain system has a flow deficiency of about 34 cfs at the peak of the 100-year storm event. The excess flow will be conveyed in the street. A portion of the excess flow is stored within the street, while the remaining flows downstream. With about 21 cfs conveyed in the street (10.5 cfs on each side of the street) about 13 cfs will go to filling the gutter flow. The total depth of flow is about 0.5 feet.

At the intersection of Hamilton Avenue and Chilco Street, a flow split will occur with a portion of the flow directed toward Chilco Street and the remainder staying on Hamilton Avenue. For purposes of this study, the flow in the two gutters on Hamilton Avenue is about the same (10.5 cfs per gutter). The flow in the gutter on the north side of Hamilton Avenue splits, with approximately equal water levels in each of the gutters on Chilco Street and on the north side of Hamilton Avenue. For this condition, about 6.7 cfs will flow to the north on Chilco Street and the remainder will flow easterly on Hamilton Avenue.

Runoff from Terminal Avenue Vicinity

A total of about 30 acres drain to Chilco Avenue from the vicinity of Terminal Avenue. During a 100-year event, the water level in the Hamilton Avenue storm drain at Chilco Street is higher than the ground elevation of Terminal Avenue at Chilco Street. During this peak period, the Terminal Avenue storm drain will have no outlet and all runoff must be conveyed as surface flow. The peak flow from this source to relocated Reach A1 of Swale A is 24.6 cfs.

Direct runoff from Railroad

A total of 2.5 acres will drain directly from the railroad to the site. This runoff from this area to relocated Swale A is about 1.6 cfs.

Require Measures at Site

Currently, runoff in excess of the flow capacity of the Hamilton Avenue storm drain line flows to Swale A. Reach A2 of Swale A discharges to an inlet near Willow Road and the Railroad tracks. The following drainage improvements are recommended:

> **Relocated Swale A –** Relocated Swale A will be a concrete-lined ditch along the property line adjacent to the railroad. Relocated Swale A will slope at 0.1 percent. This is consistent with the slope of the existing Swale A. The swale will be 5.5 feet wide.
>
> **Chilco Street Flap Gate –** A flap gate is proposed on Chilco Street to prevent reverse flow from the Hamilton Avenue storm drain from flowing to the Relocated Swale A.
>
> **Parallel Storm Drain –** The existing 24-inch diameter storm drain line at the east end of Swale A is undersized. For existing conditions, the culvert backs flow into Swale A. For proposed conditions, a parallel 30-inch diameter culvert or equivalent capacity open channel extension is proposed to convey flow to the railroad ditch downstream of the property.

Total Runoff to Relocated Swale A, 100-year Event

During a 100-year event, runoff from Hamilton Avenue surface flows, Terminal Avenue vicinity and the railroad property will flow into the Relocated Swale A. The total inflow is about 33 cfs. The Relocated Swale A will act as a detention basin that will attenuate the runoff by about 9 cfs. The peak flow through the Relocated Swale A is 24 cfs. Water levels along Relocated Swale A are presented in Table A-9. With the proposed Relocated Swale A, the 100-year event is fully contained on the Hamilton Park parcel, and no inundation of the adjacent railroad property is anticipated. At Chilco Street, the water level is elevation 4.8, (project datum) and is below the top of curb elevation of 4.98 (project datum).

VI. CONCLUSIONS

The proposed Hamilton Park project will increase water levels in the Hamilton Avenue Storm Drain system during the 10-year event by up to 0.3 feet. The peak increase in water level is at the proposed connection point, in the vicinity of Inlet HT-13. Where there is an increase in water level, there is adequate freeboard to contain the 10-year storm event.

During a 100-year event, the water level in the storm drain system serving the area north of Hamilton Avenue and east of Chilco Street will be at a lower elevation than the water level in the Hamilton Park system. Under existing conditions, reverse flow will occur from the Hamilton Avenue storm drain to Terminal Avenue, at which point the flow will bubble out of manholes

and gravity flow to Reach A1 of Swale A. The tailwater will prevent flow from occurring in the Terminal Avenue storm drain system, and runoff to Terminal Avenue will surface flow to Chilco Street, then to Reach A1 of Swale A.

For proposed conditions, a Relocated Swale A is proposed that will be concrete-lined, 5.5-feet wide and will convey from Chilco Street to the headwall for the existing 24-inch diameter culvert on the east side of the parcel. A parallel 30-inch diameter culvert is proposed to convey flows from the Relocated Swale A to Reach A2 of Swale A. As an alternative, an open channel can be used to convey flows parallel to the existing 24-inch diameter culvert to Reach A2 of Swale A.

A flap gate is recommended on the Chilco Street storm drain line to prevent reverse flow from occurring from the Hamilton Avenue storm drain line to the line to the low-lying area on Chilco Street.

VII. LIMITATIONS

These analyses are based on a drainage system layout data provided by the City of Menlo Park, Kier and Wright, and not verified by BKF. BKF used depth to invert elevations (“dips”) provided by Kier and Wright and rim elevations from 400-scale San Mateo County contour maps. Pipe materials are considered smooth walled unless field verified. Evaluation of unintentional storage that occurs during flooding conditions is not included in this report. Unintentional storage affects factors such as time of concentration and peak flow rates.

VIII. REFERENCES

California Department of Transportation Highway Design Manual

USGS, 2,000-scale Contours Map

San Mateo County 400-scale Contour Maps

Manual of Standards for Erosion & Sediment Control Measures, Association of Bay Area Governments

AE View for Aerial Map of Site

APPENDIX A

Table A1 Existing Hydrology, 10-year Event
Table A2 Existing Hydraulics, 10-year Event
Table A3 Proposed Hydrology, 10-year Event
Table A4 Proposed Hydraulics, 10-year Event
Table A5 Existing Hydrology, 100-year Event – with Flow in Streets
Table A6 Existing Hydraulics, 100-year Event – with Flow in Streets
Table A7 Proposed Hydrology, 100-year Event – with Flow in Streets
Table A8 Proposed Hydraulics, 100-year Event – with Flow in Streets
Table A9 Flow in Concrete Bypass Channel

APPENDIX B

Table B1 Runoff Coefficient Calculations
Table B2 Area Calculations
Table B3 Calculation of Peak Flow, 100-year Event, to Chilco Street
Table B4 Calculation of Gutter Flow
Table B5 Table 5 of Belle Haven Storm Drain System, November 14, 1995

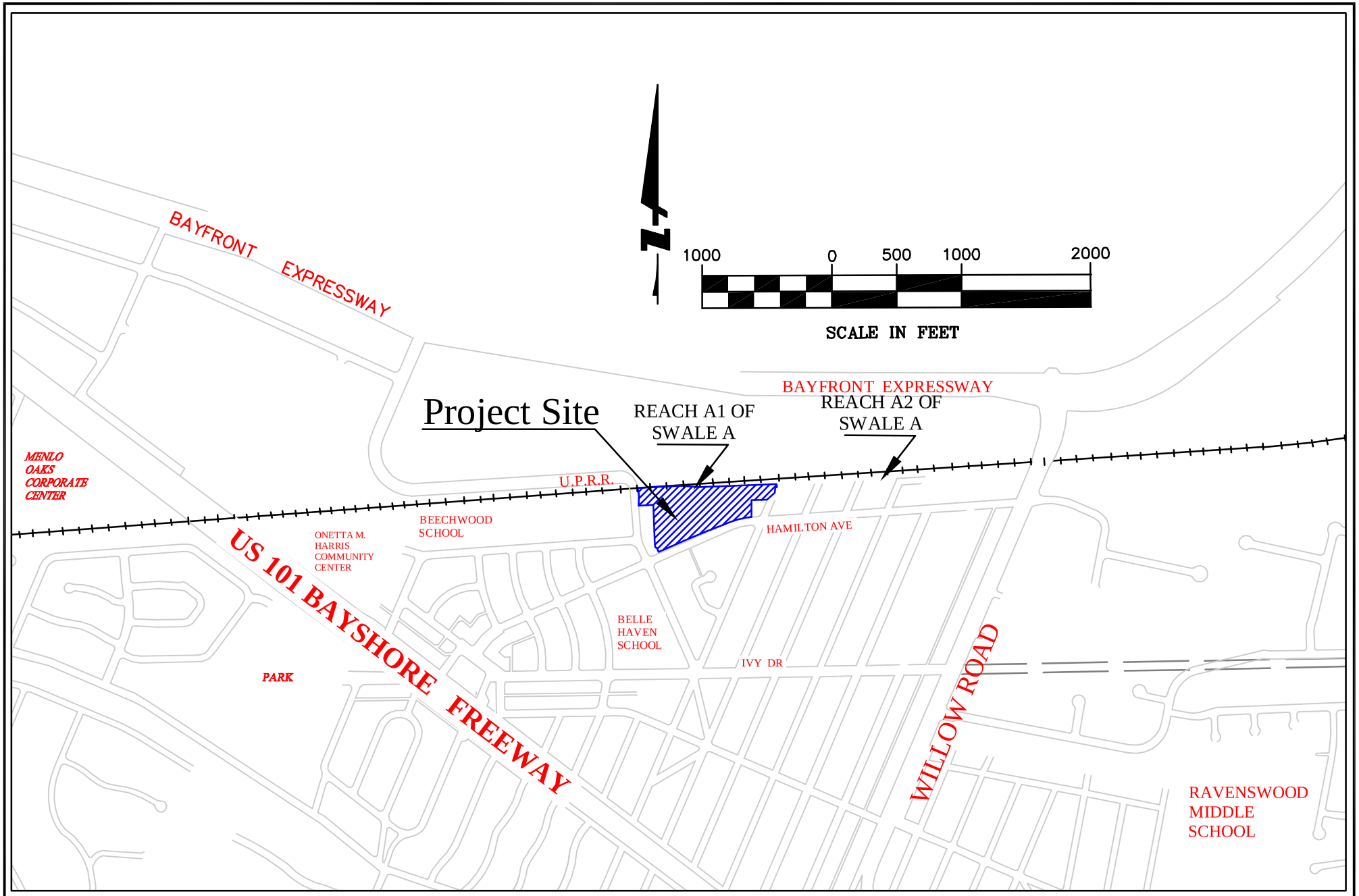

Figure 1
Menlo Park Vicinity Map
Clarum Homes - Menlo Park , CA

BkF

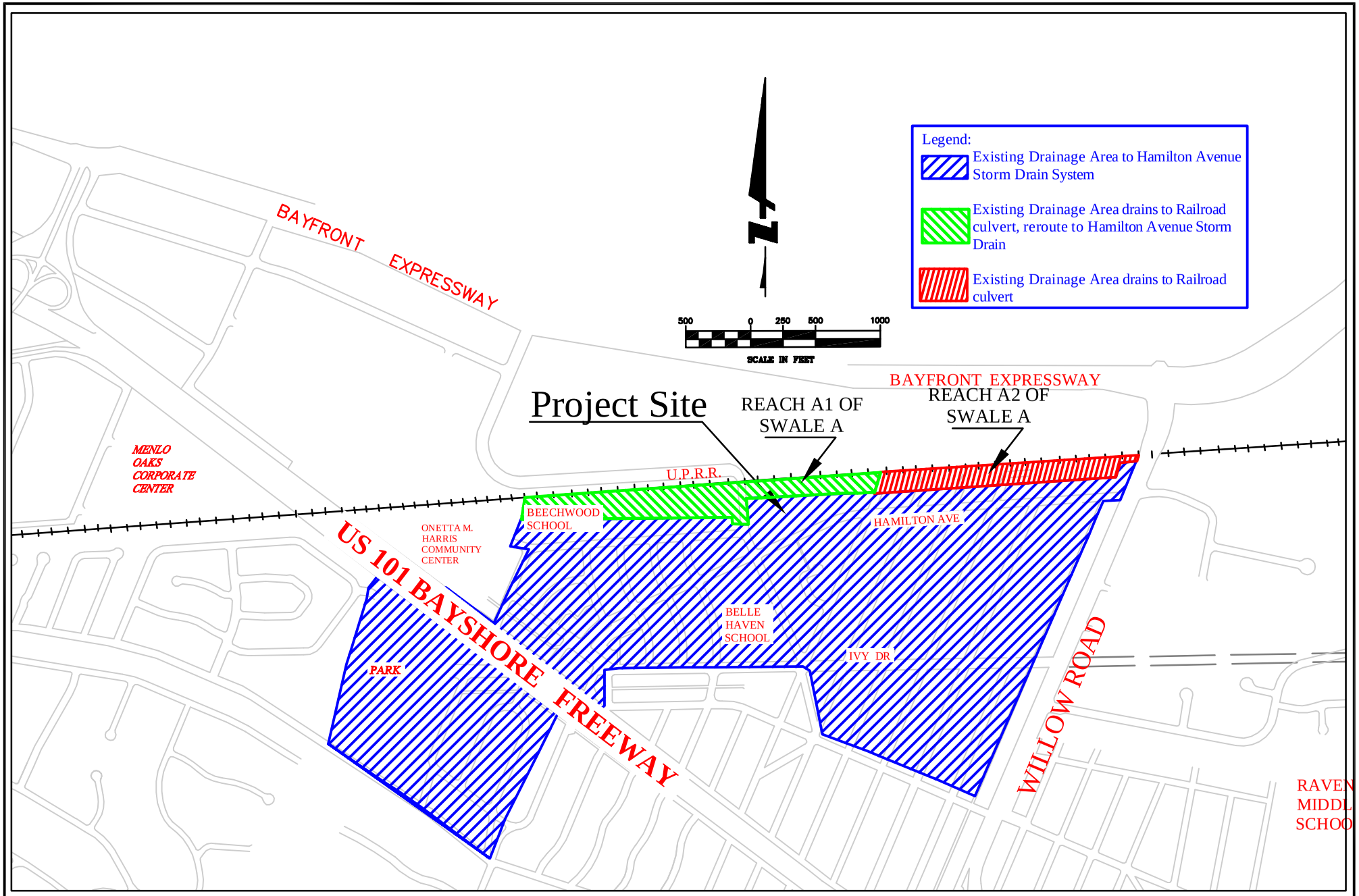

Figure 2
Hamilton Avenue Drainage System Area
Clarum Homes - Menlo Park , CA

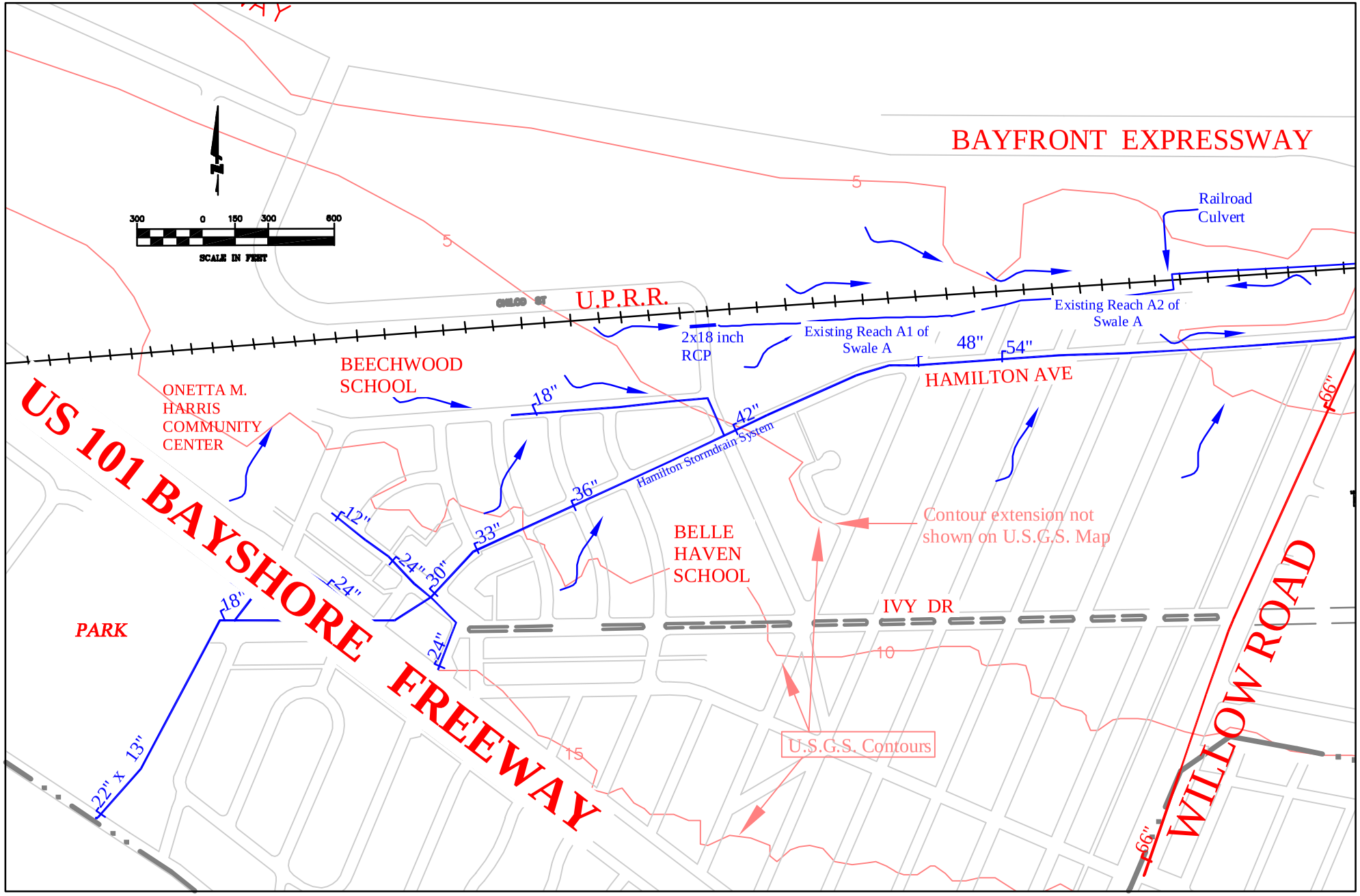

Figure 3
Existing Drainage Systems
Clarum Homes - Menlo Park , CA

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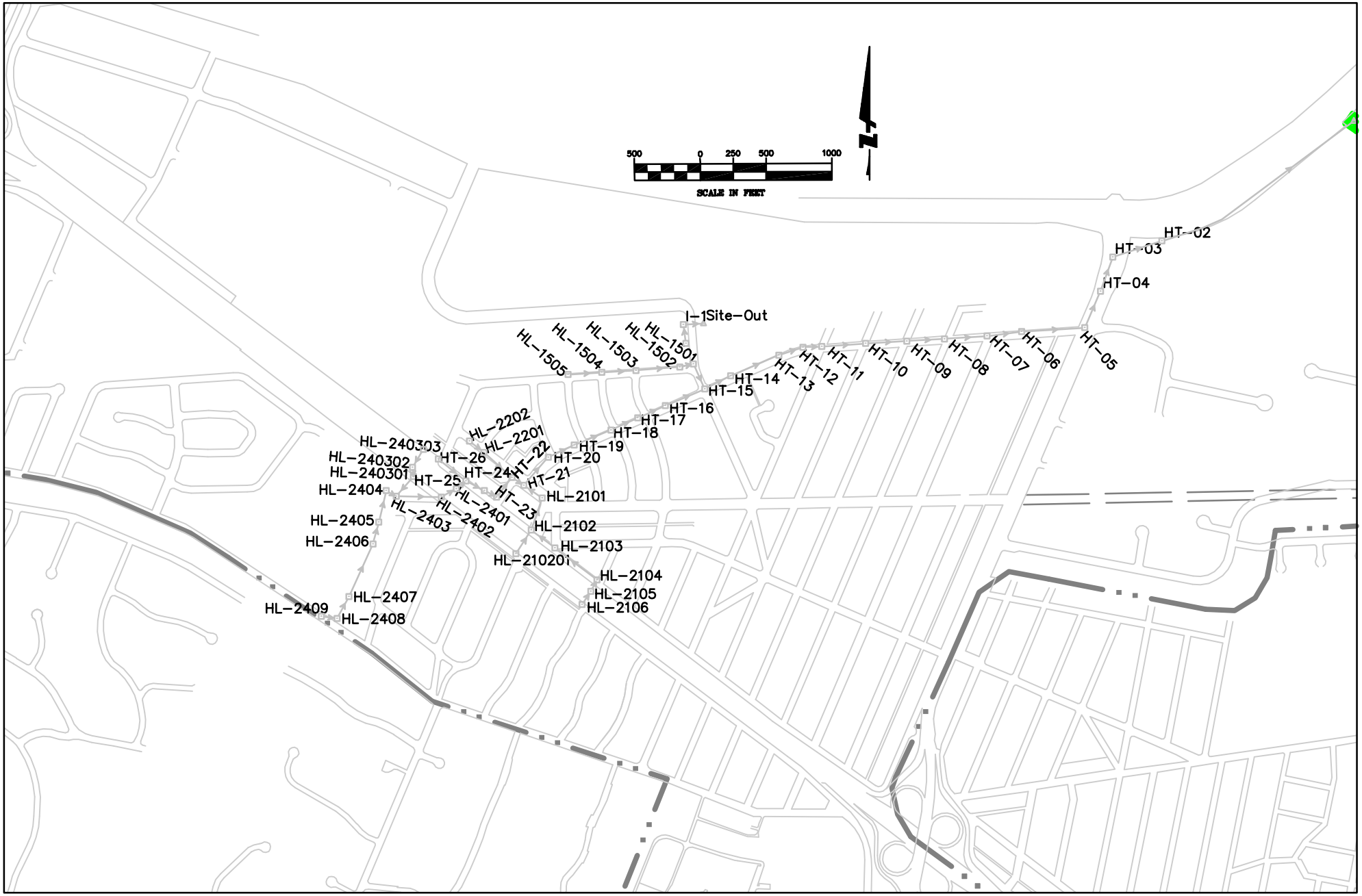

Figure 4
Inlet Numbers and Locations
Clarum Homes - Menlo Park , CA

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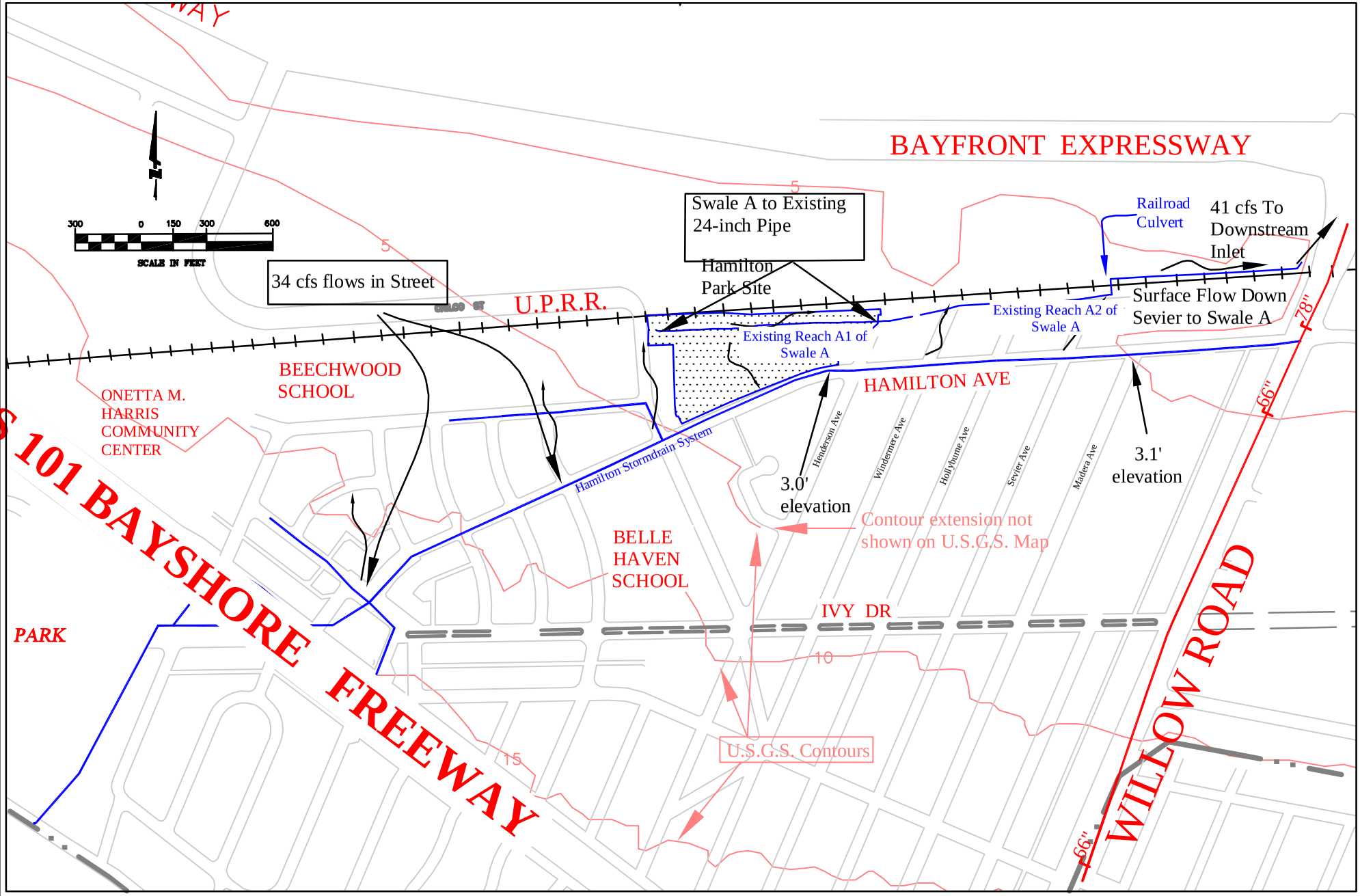


Figure 5
Existing 100-year Surface Flow Direction
Clarum Homes - Menlo Park , CA

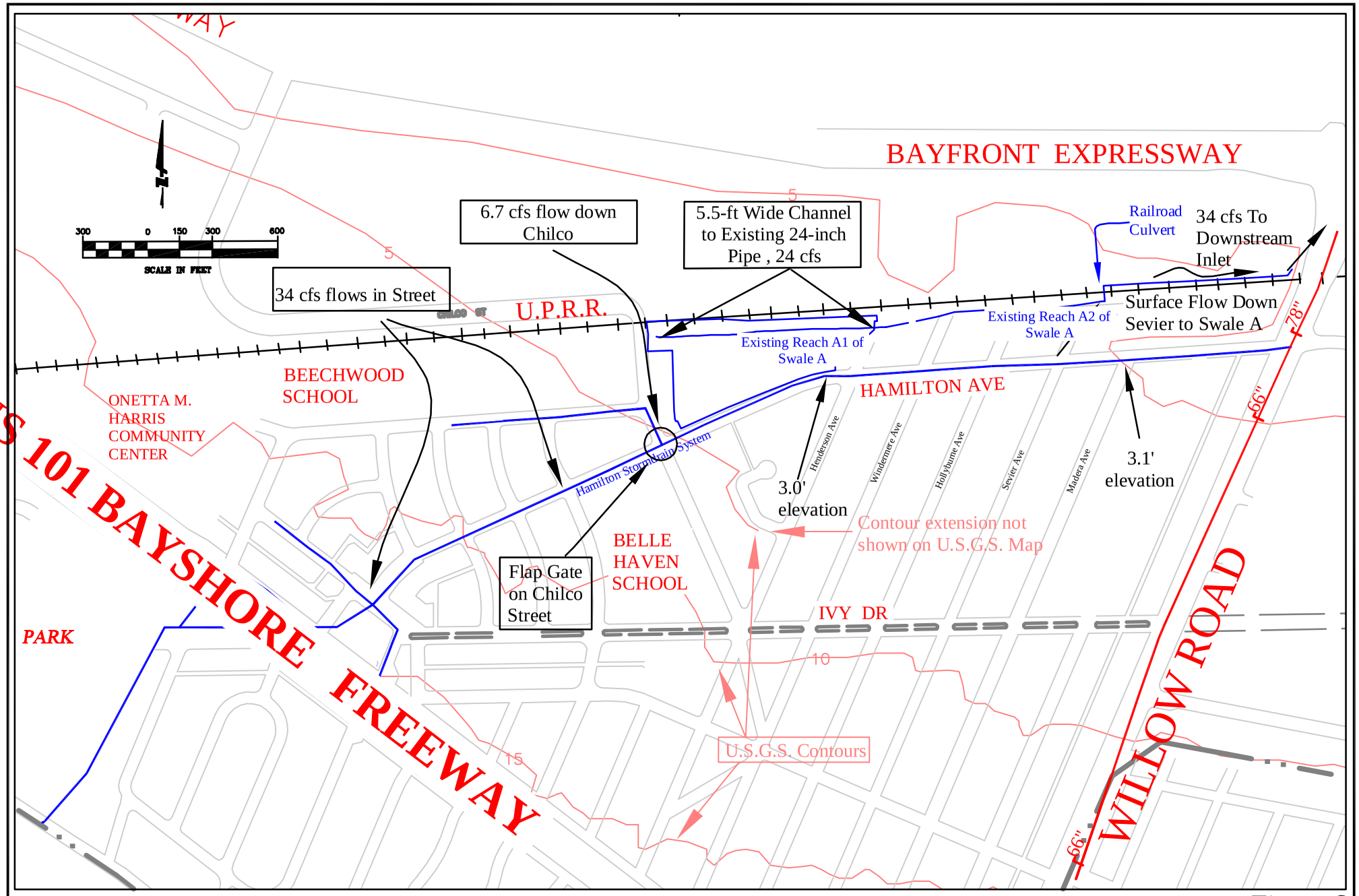


Figure 6
Propsoed 100-year Surface Flow Direction
Clarum Homes - Menlo Park , CA

Clarum Homes - Hamilton Avenue, Menlo Park

Table 1
Proposed Changes Due to Stream Addtion to Hamilton Storm Drain System, 10-year event

Area to Hamilton Avenue Storm Drain System at Inlet HT-13

Existing (acres)	Proposed (acres)	Change[(2)] (acres)
127	137	9.8

Flows to Hamilton Avenue Storm Drain System at Site

Existing (cfs)	Proposed (cfs)	Change (cfs)
53.3	57.2	4.0

Change to Water Surface Levels within the Hamilton Storm Drain System

Node Identification[1]	Pipe Size (inches)	Existing Freeboard (feet)	Proposed Freeboard (feet)	Change Freeboard (feet)	Existing Surface (feet)	Proposed Surface (feet)	Change Surface (feet)	Incremental Change In Flows Downstream of Addition (cfs)
HT-P21	24 inch	ABOVE RIM	**ABOVE RIM**		11.6	11.9	0.3	0.0
HT-P20	30 inch	3.0	2.7	0.3	8.3	8.6	0.3	0.0
HT-P19	33 inch	3.9	3.7	0.3	6.2	6.5	0.3	0.0
HT-P18	33 inch	4.0	3.7	0.3	5.3	5.6	0.3	0.0
HT-P17	36 inch	4.0	3.7	0.3	4.2	4.5	0.3	0.0
HT-P16	36 inch	2.5	2.2	0.3	3.5	3.8	0.3	0.0
HT-P15	36 inch	3.3	3.0	0.3	2.7	3.0	0.3	0.0
HT-P14	42 inch	3.4	3.2	0.3	1.8	2.0	0.3	0.2
HT-P13	42 inch	3.3	3.0	0.3	1.2	1.5	0.3	0.2
HT-P12	42 inch	3.7	3.4	0.2	-0.1	0.2	0.2	4.0
HT-P11	42 inch	4.1	4.0	0.1	-0.7	-0.6	0.1	4.0
HT-P10	48 inch	4.1	4.1	0.1	-1.2	-1.1	0.1	4.0
HT-P09	54 inch	4.9	4.9	0.0	-1.7	-1.7	0.0	4.0
HT-P08	54 inch	5.1	5.1	-0.1	-1.9	-2.0	-0.1	4.0
HT-P07	54 inch	5.3	5.4	-0.1	-2.2	-2.3	-0.1	4.0
HT-P06	54 inch	5.6	5.8	-0.1	-2.5	-2.7	-0.1	4.1
HT-P05	54 inch	6.7	6.9	-0.2	-3.0	-3.2	-0.2	4.2
HT-P04	78 inch	8.6	8.9	-0.3	-4.1	-4.4	-0.3	-3.2
HT-P03	78 inch	9.1	9.4	-0.3	-5.1	-5.4	-0.3	-2.5
HT-P02	78 inch	10.3	10.5	-0.2	-6.8	-7.0	-0.2	-3.6
HT-P01	78 inch	11.4	11.6	-0.2	-8.4	-8.6	-0.2	-4.0

See Table A-1 and A-2 for values
(1) Pipe HT-P12 was used as the connection point for existing Swale A with Hamilton Storm Drain System.
(2) The 19.6 acres added to total area drainage to Hamilton is shown on Figure 2 in green.
(3) In existing conditions all flows in swale A re-enter system at inlet HT-03
(4) In proposed conditions flows in swale A east of the project site remain conveyed by Inlet HT-03

CLARUM HOMES, HAMILTON AVENUE, MENLO PARK STORM DRAINAGE PLAN

Table A-1
Existing Hydrology: 10-Year Event

Node # (1)	Ground Elevation (ft)	Sump Elevation (ft)	Inlet Area (acres)	Inlet C	Inlet C*A (acres)	Lateral Area	Cumulative Area (acres)	Cumulative C*A (acres)	Inlet Tc (minutes)	System Tc (minutes)	Intensity (in/hr)	Additional Flows	Discharge (cfs)
HL-2406	16.27	12.91	23.50	0.25	5.88		23.50	5.9	10.6	10.6	1.60	0	9.5
HL-2405	15.42	12.28	0.00	0.00	0.00		23.50	5.9	0.0	11.2	1.56	0	9.2
HL-2404	14.49	11.59	0.00	0.00	0.00		23.50	5.9	0.0	11.8	1.51	0	9.0
HL-2403	14.13	6.50	0.00	0.00	0.00		23.50	5.9	0.0	12.0	1.50	0	8.9
HL-2402	13.07	5.79	24.10	0.40	9.64		47.60	15.5	11.9	13.4	1.42	0	22.1
HL-2401	12.50	5.41	0.00	0.00	0.00		47.60	15.5	0.0	14.3	1.37	0	21.4
HL-1505	6.98	1.41	9.60	0.40	3.84		9.60	3.8	8.0	8.0	1.84	0	7.1
HL-1504	5.98	0.41	1.10	0.40	0.44		10.70	4.3	7.0	9.0	1.73	0	7.5
HL-1503	4.89	-0.48	0.70	0.40	0.28		11.40	4.6	7.0	10.1	1.64	0	7.5
HL-1502	4.01	-1.36	10.40	0.40	4.16		21.80	8.7	10.0	10.9	1.57	0	13.8
HL-1501	4.24	-3.88	0.00	0.00	0.00		21.80	8.7	0.0	11.3	1.55	0	13.6
HT-25	12.10	5.05	6.60	0.90	5.94		6.60	21.5	10.0	15.2	1.33	0	28.7
HT-24	11.96	3.97	0.00	0.00	0.00	47.6	54.20	21.5	0.0	15.7	1.31	0	28.3
HT-23	11.64	3.74	1.90	0.40	0.76		56.10	22.2	7.2	15.8	1.30	0	29.1
HT-22	10.81	2.74	2.50	0.34	0.85		58.60	23.1	6.7	16.2	1.28	0	29.9
HT-21	11.24	2.34	5.00	0.40	2.00		63.60	25.1	7.6	16.4	1.28	0	32.3
HT-20	10.14	1.07	0.00	0.00	0.00		63.60	25.1	0.0	17.1	1.25	0	31.6
HT-19	9.29	0.09	4.00	0.40	1.60		67.60	26.7	7.8	17.8	1.23	0	32.9
HT-18	8.23	-1.13	4.60	0.40	1.84		72.20	28.5	10.0	18.6	1.20	0	34.4
HT-17	5.99	-2.27	5.00	0.40	2.00		77.20	30.5	10.0	19.5	1.17	0	36.0
HT-16	5.97	-2.50	1.60	0.40	0.64		78.80	31.2	10.0	20.3	1.15	0	36.0
HT-15	5.20	-7.53	9.80	0.30	2.94	21.8	110.40	42.8	10.0	21.2	1.12	0	48.4
HT-14	4.49	-8.29	5.70	0.40	2.28		116.10	45.1	10.0	21.9	1.10	0	50.1
HT-13	3.60	-9.10	11.10	0.40	4.44		127.20	49.5	14.0	23.4	1.07	0	53.3
HT-12	3.40	-10.35	4.50	0.40	1.80		131.70	51.3	10.0	23.8	1.06	0	54.6
HT-11	2.97	-10.72	0.00	0.00	0.00		131.70	51.3	0.0	24.2	1.05	0	54.2
HT-10	3.21	-11.39	0.00	0.00	0.00		131.70	51.3	0.0	25.6	1.02	0	52.7
HT-09	3.16	-12.00	12.70	0.40	5.08		144.40	56.4	10.0	27.1	0.99	0	56.3
HT-08	3.12	-12.10	14.80	0.41	6.07		159.20	62.5	11.9	28.6	0.96	0	60.6
HT-07	3.08	-12.32	22.20	0.42	9.32		181.40	71.8	10.9	29.9	0.94	0	68.0
HT-06	3.75	-15.06	29.20	0.51	14.89		210.60	86.7	10.7	31.2	0.92	0	80.4
HT-05A	.00	-15.80	0.00	0.00	0.00		0.00	0.0	0.0	0.0	0.00	0	0.0
HT-05	4.50	-16.10	0.00	0.00	0.00		210.60	86.7	0.0	32.6	0.90	**191**	269.2
HT-04	4.00	-17.00	0.00	0.00	0.00		210.60	86.7	0.0	33.2	0.89	191	268.5
HT-03	3.50	-17.50	26.70	0.47	12.55		237.30	99.2	12.7	33.8	0.88	195	283.2
HT-02	3.00	-18.00	0.00	0.00	0.00		237.30	99.2	0.0	34.6	0.87	215	302.6
H-out	2.50	-24.20	0.00	0.00	0.00		237.30	99.2	0.0	37.7	0.84	0	298.9

(1) Node Locations are shown on Figure 4
(2) Outfall is to Pump Station on Willow Road
(3) Existing project has existing warehouses and existing storm drain systems. Storm drains for warehouses empty into Hamilton Storm Drain System.

CLARUM HOMES, HAMILTON AVENUE, MENLO PARK STORM DRAINAGE PLAN

Table A-2
Existing Hydraulics: 10-Year Event

Pipe #	Upstream Node (1)	Downstream Node	Total Discharge (cfs)	Capacity @ Constructed Slope (cfs)	Pipe Size (inches)	Length (feet)	Constructed Slope (ft/ft)	Invert Elevation Upstream (feet)	Invert Elevation Downstream (feet)	Ground/Rim Elevation Upstream (feet)	Ground/Rim Elevation Downstream (feet)	HGL Elevation Upstream (feet)	HGL Elevation Downstream (feet)	Upstream Freeboard (feet)	Upstream Cover (feet)	Velocity (ft/s)
HL-P2406	HL-2406	HL-2405	9.5	6.3	18 inch	176	0.004	12.91	12.28	16.27	15.42	16.62	15.19	**ABOVE RIM**	1.9	0.0
HL-P2405	HL-2405	HL-2404	9.2	6.3	18 inch	192	0.004	12.28	11.59	15.42	14.49	15.10	13.62	0.3	1.6	0.0
HL-P2404	HL-2404	HL-2403	9.0	26.3	18 inch	81	0.063	11.59	6.50	14.49	14.13	13.32	12.73	1.2	1.4	0.0
HL-P2403	HL-2403	HL-2402	8.9	12.4	24 inch	236	0.003	6.50	5.79	14.13	13.07	12.68	12.31	1.5	5.6	0.0
HL-P2402	HL-2402	HL-2401	22.1	55.0	42 inch	127	0.003	5.79	5.41	13.07	12.50	12.25	12.18	0.8	3.8	0.0
HL-P2401	HL-2401	HT-25	21.4	55.1	42 inch	120	0.003	5.41	5.05	12.50	12.10	12.15	12.10	0.4	3.6	0.0
HL-P1505	HL-1505	HL-1504	7.1	6.7	18 inch	243	0.004	1.41	.41	6.98	5.98	7.10	5.98	**ABOVE RIM**	4.1	0.0
HL-P1504	HL-1504	HL-1503	7.5	6.1	18 inch	265	0.003	.41	-.48	5.98	4.89	6.23	4.89	**ABOVE RIM**	4.1	0.0
HL-P1503	HL-1503	HL-1502	7.5	6.7	18 inch	215	0.004	-.48	-1.36	4.89	4.01	5.12	4.01	**ABOVE RIM**	3.9	0.0
HL-P1502	HL-1502	HL-1501	13.8	12.6	18 inch	176	0.014	-1.36	-3.88	4.01	4.24	7.29	4.24	**ABOVE RIM**	3.9	0.0
HL-P1501	HL-1501	HT-15	13.6	14.3	18 inch	198	0.018	-3.88	-7.53	4.24	5.20	6.20	2.88	**ABOVE RIM**	6.6	0.0
HT-P24	HT-25	HT-24	28.7	14.9	24 inch	248	0.004	5.05	3.97	12.10	11.96	15.95	11.96	**ABOVE RIM**	5.1	0.0
HT-P23	HT-24	HT-23	28.3	13.1	24 inch	69	0.003	3.97	3.74	11.96	11.64	12.72	11.64	**ABOVE RIM**	6.0	0.0
HT-P22	HT-23	HT-22	29.1	14.8	24 inch	233	0.004	3.74	2.74	11.64	10.81	14.67	10.81	**ABOVE RIM**	5.9	0.0
HT-P21	HT-22	HT-21	29.9	14.7	24 inch	95	0.004	2.74	2.34	10.81	11.24	11.58	9.93	**ABOVE RIM**	6.1	0.0
HT-P20	HT-21	HT-20	32.3	27.5	30 inch	282	0.005	2.34	1.07	11.24	10.14	8.28	6.53	3.0	6.4	0.0
HT-P19	HT-20	HT-19	31.6	35.5	33 inch	217	0.005	1.07	.09	10.14	9.29	6.21	5.43	3.9	6.3	0.0
HT-P18	HT-19	HT-18	32.9	35.6	33 inch	270	0.005	.09	-1.13	9.29	8.23	5.32	4.28	4.0	6.5	0.0
HT-P17	HT-18	HT-17	34.4	44.9	36 inch	252	0.005	-1.13	-2.27	8.23	5.99	4.22	3.55	4.0	6.4	0.0
HT-P16	HT-17	HT-16	36.0	19.9	36 inch	258	0.001	-2.27	-2.50	5.99	5.97	3.48	2.73	2.5	5.3	0.0
HT-P15	HT-16	HT-15	36.0	91.9	36 inch	265	0.019	-2.50	-7.53	5.97	5.20	2.68	1.91	3.3	5.5	0.0
HT-P14	HT-15	HT-14	48.4	59.1	42 inch	220	0.003	-7.53	-8.29	5.20	4.49	1.77	1.26	3.4	9.2	0.0
HT-P13	HT-14	HT-13	50.1	42.8	42 inch	448	0.002	-8.29	-9.10	4.49	3.60	1.19	.08	3.3	9.3	0.0
HT-P12	HT-13	HT-12	53.3	89.5	42 inch	158	0.008	-9.10	-10.35	3.60	3.40	-.05	-.49	3.7	9.2	0.0
HT-P11	HT-12	HT-11	54.6	56.8	42 inch	116	0.003	-10.35	-10.72	3.40	2.97	-.73	-1.07	4.1	10.3	0.0
HT-P10	HT-11	HT-10	54.2	61.3	48 inch	368	0.002	-10.72	-11.39	2.97	3.21	-1.15	-1.67	4.1	9.7	0.0
HT-P09	HT-10	HT-09	52.7	90.3	54 inch	289	0.002	-11.39	-12.00	3.21	3.16	-1.69	-1.90	4.9	10.1	0.0
HT-P08	HT-09	HT-08	56.3	34.7	54 inch	321	0.000	-12.00	-12.10	3.16	3.12	-1.93	-2.19	5.1	10.7	0.0
HT-P07	HT-08	HT-07	60.6	52.4	54 inch	310	0.001	-12.10	-12.32	3.12	3.08	-2.22	-2.51	5.3	10.7	0.0
HT-P06	HT-07	HT-06	68.0	178.4	54 inch	333	0.008	-12.32	-15.06	3.08	3.75	-2.54	-2.94	5.6	10.9	0.0
HT-P5A	HT-05A	HT-05	0.0	247.1	78 inch	135	0.002	-15.80	-16.10	.00	4.50	-3.90	-3.90	3.9	9.3	0.0
HT-P05	HT-06	HT-05	80.4	97.0	54 inch	427	0.002	-15.06	-16.10	3.75	4.50	-2.98	-3.70	6.7	14.3	0.0
HT-P04	HT-05	HT-04	269.2	292.6	78 inch	289	0.003	-16.10	-17.00	4.50	4.00	-4.14	-4.90	8.6	14.1	0.0
HT-P03	HT-04	HT-03	268.5	216.6	78 inch	293	0.002	-17.00	-17.50	4.00	3.50	-5.11	-5.88	9.1	14.5	0.0
HT-P02	HT-03	HT-02	283.2	180.2	78 inch	423	0.001	-17.50	-18.00	3.50	3.00	-6.81	-8.05	10.3	14.5	0.0
HT-P01	HT-02	H-out	302.6	318.8	78 inch	1677	0.004	-18.00	-24.20	3.00	2.50	-8.41	-14.00	11.4	14.5	0.0

(1) Node Locations are displayed on Figure 4

(2) Outfall: Low flows to pump station, high flows to detention pond.

CLARUM HOMES, HAMILTON AVENUE, MENLO PARK STORM DRAINAGE PLAN

Table A-3
Proposed Hydrology: 10-Year Event

Node # (1)	Ground Elevation (ft)	Sump Elevation (ft)	Inlet Area (acres)	Inlet C	Inlet C*A (acres)	Lateral Area	Cumulative Area (acres)	Cumulative C*A (acres)	Inlet Tc (minutes)	System Tc (minutes)	Intensity (in/hr)	Additional Flows	Discharge (cfs)
HL-2406	16.27	12.91	23.50	**0.25**	5.88		23.50	5.9	10.6	10.6	1.60	0	9.5
HL-2405	15.42	12.28	0.00	0.00	0.00		23.50	5.9	0.0	11.2	1.56	0	9.2
HL-2404	14.49	11.59	0.00	0.00	0.00		23.50	5.9	0.0	11.8	1.51	0	9.0
HL-2403	14.13	6.50	0.00	0.00	0.00		23.50	5.9	0.0	12.0	1.50	0	8.9
HL-2402	13.07	5.79	24.10	0.40	9.64		47.60	15.5	11.9	13.4	1.41	0	22.1
HL-2401	12.50	5.41	0.00	0.00	0.00		47.60	15.5	0.0	14.3	1.37	0	21.4
HL-1505	6.98	1.41	9.60	0.40	3.84		9.60	3.8	8.0	8.0	1.84	0	7.1
HL-1504	5.98	0.41	1.10	0.40	0.44		10.70	4.3	7.0	9.0	1.73	0	7.5
HL-1503	4.89	-0.48	0.70	0.40	0.28		11.40	4.6	7.0	10.1	1.64	0	7.5
HL-1502	4.01	-1.36	10.40	0.40	4.16		21.80	8.7	10.0	10.9	1.57	0	13.8
HL-1501	4.24	-3.88	0.00	0.00	0.00		21.80	8.7	0.0	11.3	1.55	0	13.6
HT-25	12.10	5.05	6.60	0.90	5.94		6.60	21.5	10.0	15.2	1.33	0	28.7
HT-24	11.96	3.97	0.00	0.00	0.00	47.6	54.20	21.5	0.0	15.7	1.31	0	28.3
HT-23	11.64	3.74	1.90	0.40	0.76		56.10	22.2	7.2	15.8	1.30	0	29.1
HT-22	10.81	2.74	2.50	0.34	0.85		58.60	23.1	6.7	16.2	1.28	0	29.9
HT-21	11.24	2.34	5.00	0.40	2.00		63.60	25.1	7.6	16.4	1.28	0	32.3
HT-20	10.14	1.07	0.00	0.00	0.00		63.60	25.1	0.0	17.1	1.25	0	31.6
HT-19	9.29	0.09	4.00	0.40	1.60		67.60	26.7	7.8	17.8	1.23	0	32.9
HT-18	8.23	-1.13	4.60	0.40	1.84		72.20	28.5	10.0	18.6	1.20	0	34.4
HT-17	5.99	-2.27	5.00	0.40	2.00		77.20	30.5	10.0	19.5	1.17	0	36.0
HT-16	5.97	-2.50	1.60	0.40	0.64		78.80	31.2	10.0	20.3	1.15	0	36.0
HT-15	5.20	-7.53	9.80	0.32	3.14	21.8	110.40	43.0	10.0	21.2	1.12	0	48.6
HT-14	4.49	-8.29	5.70	0.40	2.28		116.10	45.3	10.0	21.9	1.10	0	50.3
HT-13	3.60	-9.10	20.90	0.38	7.94		137.00	53.2	14.0	23.4	1.07	0	57.2
HT-12	3.40	-10.35	4.50	0.40	1.80		141.50	55.0	10.0	23.8	1.06	0	58.6
HT-11	2.97	-10.72	0.00	0.00	0.00		141.50	55.0	0.0	24.1	1.05	0	58.2
HT-10	3.21	-11.39	0.00	0.00	0.00		141.50	55.0	0.0	25.4	1.02	0	56.7
HT-09	3.16	-12.00	12.70	0.40	5.08		154.20	60.1	10.9	26.8	0.99	0	60.3
HT-08	3.12	-12.10	14.80	0.41	6.07		169.00	66.2	11.9	28.2	0.97	0	64.6
HT-07	3.08	-12.32	22.20	0.42	9.32		191.20	75.5	10.9	29.5	0.95	0	72.1
HT-06	3.75	-15.06	29.20	0.51	14.89		220.40	90.4	10.7	30.7	0.93	0	84.6
HT-5A	.00	-15.80	0.00	0.00	0.00		191.20	0.0	0.0	0.0	0.00	0	0.0
HT-05	4.50	-16.10	0.00	0.00	0.00		220.40	90.4	0.0	32.0	0.91	183	266.0
HT-04	4.00	-17.00	0.00	0.00	0.00		220.40	90.4	0.0	32.6	0.90	184	266.0
HT-03	3.50	-17.50	7.10	0.90	6.39		227.50	96.8	12.7	33.2	0.89	193	279.6
HT-02	3.00	-18.00	0.00	0.00	0.00		227.50	96.8	0.0	34.1	0.88	213	298.5
H-out	2.50	-24.20	0.00	0.00	0.00		227.50	96.8	0.0	37.2	0.84	0	294.8

(1) Node Locations are shown on Figure 4
(2) Outfall is to Pump Station on Willow Road

CLARUM HOMES, HAMILTON AVENUE, MENLO PARK STORM DRAINAGE PLAN

Table A-4
Proposed Hydraulics: 10-Year Event

Pipe #	Upstream Node (1)	Downstream Node	Total Discharge (cfs)	Capacity @ Constructed Slope (cfs)	Pipe Size (inches)	Length (feet)	Constructed Slope (ft/ft)	Invert Elevation Upstream (feet)	Invert Elevation Downstream (feet)	Ground/Rim Elevation Upstream (feet)	Ground/Rim Elevation Downstream (feet)	HGL Elevation Upstream (feet)	HGL Elevation Downstream (feet)	Upstream Freeboard (feet)	Upstream Cover (feet)	Velocity (ft/s)
HL-P2406	HL-2406	HL-2405	9.5	6.3	18 inch	176	0.004	12.91	12.28	16.27	15.42	16.62	15.19	**ABOVE RIM**	1.9	0.0
HL-P2405	HL-2405	HL-2404	9.2	6.3	18 inch	192	0.004	12.28	11.59	15.42	14.49	15.10	13.62	0.3	1.6	0.0
HL-P2404	HL-2404	HL-2403	9.0	26.3	18 inch	81	0.063	11.59	6.50	14.49	14.13	13.32	12.73	1.2	1.4	0.0
HL-P2403	HL-2403	HL-2402	8.9	12.4	24 inch	236	0.003	6.50	5.79	14.13	13.07	12.68	12.31	1.5	5.6	0.0
HL-P2402	HL-2402	HL-2401	22.1	55.0	42 inch	127	0.003	5.79	5.41	13.07	12.50	12.25	12.18	0.8	3.8	0.0
HL-P2401	HL-2401	HT-25	21.4	55.1	42 inch	120	0.003	5.41	5.05	12.50	12.10	12.15	12.10	0.4	3.6	0.0
HL-P1505	HL-1505	HL-1504	7.1	6.7	18 inch	243	0.004	1.41	.41	6.98	5.98	7.10	5.98	**ABOVE RIM**	4.1	0.0
HL-P1504	HL-1504	HL-1503	7.5	6.1	18 inch	265	0.003	.41	-.48	5.98	4.89	6.23	4.89	**ABOVE RIM**	4.1	0.0
HL-P1503	HL-1503	HL-1502	7.5	6.7	18 inch	215	0.004	-.48	-1.36	4.89	4.01	5.12	4.01	**ABOVE RIM**	3.9	0.0
HL-P1502	HL-1502	HL-1501	13.8	12.6	18 inch	176	0.014	-1.36	-3.88	4.01	4.24	7.29	4.24	**ABOVE RIM**	3.9	0.0
HL-P1501	HL-1501	HT-15	13.6	14.3	18 inch	198	0.018	-3.88	-7.53	4.24	5.20	6.48	3.16	**ABOVE RIM**	6.6	0.0
HT-P24	HT-25	HT-24	28.7	14.9	24 inch	248	0.004	5.05	3.97	12.10	11.96	15.95	11.96	**ABOVE RIM**	5.1	0.0
HT-P23	HT-24	HT-23	28.3	13.1	24 inch	69	0.003	3.97	3.74	11.96	11.64	12.72	11.64	**ABOVE RIM**	6.0	0.0
HT-P22	HT-23	HT-22	29.1	14.8	24 inch	233	0.004	3.74	2.74	11.64	10.81	14.67	10.81	**ABOVE RIM**	5.9	0.0
HT-P21	HT-22	HT-21	29.9	14.7	24 inch	95	0.004	2.74	2.34	10.81	11.24	11.86	10.20	**ABOVE RIM**	6.1	0.0
HT-P20	HT-21	HT-20	32.3	27.5	30 inch	282	0.005	2.34	1.07	11.24	10.14	8.55	6.81	2.7	6.4	0.0
HT-P19	HT-20	HT-19	31.6	35.5	33 inch	217	0.005	1.07	.09	10.14	9.29	6.48	5.71	3.7	6.3	0.0
HT-P18	HT-19	HT-18	32.9	35.6	33 inch	270	0.005	.09	-1.13	9.29	8.23	5.60	4.55	3.7	6.5	0.0
HT-P17	HT-18	HT-17	34.4	44.9	36 inch	252	0.005	-1.13	-2.27	8.23	5.99	4.49	3.82	3.7	6.4	0.0
HT-P16	HT-17	HT-16	36.0	19.9	36 inch	258	0.001	-2.27	-2.50	5.99	5.97	3.76	3.01	2.2	5.3	0.0
HT-P15	HT-16	HT-15	36.0	91.9	36 inch	265	0.019	-2.50	-7.53	5.97	5.20	2.96	2.19	3.0	5.5	0.0
HT-P14	HT-15	HT-14	48.6	59.1	42 inch	220	0.003	-7.53	-8.29	5.20	4.49	2.04	1.53	3.2	9.2	0.0
HT-P13	HT-14	HT-13	50.3	42.8	42 inch	448	0.002	-8.29	-9.10	4.49	3.60	1.46	.34	3.0	9.3	0.0
HT-P12	HT-13	HT-12	57.2	89.5	42 inch	158	0.008	-9.10	-10.35	3.60	3.40	.18	-.33	3.4	9.2	0.0
HT-P11	HT-12	HT-11	58.6	56.8	42 inch	116	0.003	-10.35	-10.72	3.40	2.97	-.60	-.99	4.0	10.3	0.0
HT-P10	HT-11	HT-10	58.2	61.3	48 inch	368	0.002	-10.72	-11.39	2.97	3.21	-1.08	-1.69	4.1	9.7	0.0
HT-P09	HT-10	HT-09	56.7	90.3	54 inch	289	0.002	-11.39	-12.00	3.21	3.16	-1.71	-1.95	4.9	10.1	0.0
HT-P08	HT-09	HT-08	60.3	34.7	54 inch	321	0.000	-12.00	-12.10	3.16	3.12	-1.98	-2.28	5.1	10.7	0.0
HT-P07	HT-08	HT-07	64.6	52.4	54 inch	310	0.001	-12.10	-12.32	3.12	3.08	-2.31	-2.65	5.4	10.7	0.0
HT-P06	HT-07	HT-06	72.1	178.4	54 inch	333	0.008	-12.32	-15.06	3.08	3.75	-2.68	-3.13	5.8	10.9	0.0
HT-P5A	HT-5A	HT-05	0.0	247.1	78 inch	135	0.002	-15.80	-16.10	.00	4.50	-4.05	-4.05	4.1	9.3	0.0
HT-P05	HT-06	HT-05	84.6	97.0	54 inch	427	0.002	-15.06	-16.10	3.75	4.50	-3.18	-3.97	6.9	14.3	0.0
HT-P04	HT-05	HT-04	266.0	292.6	78 inch	289	0.003	-16.10	-17.00	4.50	4.00	-4.40	-5.15	8.9	14.1	0.0
HT-P03	HT-04	HT-03	266.0	216.6	78 inch	293	0.002	-17.00	-17.50	4.00	3.50	-5.36	-6.11	9.4	14.5	0.0
HT-P02	HT-03	HT-02	279.6	180.2	78 inch	423	0.001	-17.50	-18.00	3.50	3.00	-7.00	-8.21	10.5	14.5	0.0
HT-P01	HT-02	H-out	298.5	318.8	78 inch	1,677	0.004	-18.00	-24.20	3.00	2.50	-8.56	-14.00	11.6	14.5	0.0

(1) Node Locations are displayed on Figure 4

(2) Outfall: Low flows to pump station, high flows to detention pond.

CLARUM HOMES, HAMILTON AVENUE, MENLO PARK STORM DRAINAGE PLAN

Table A-5
Existing Hydrology: 100-Year Event with Flow in Street

Node # (1)	Ground Elevation (ft)	Sump Elevation (ft)	Inlet Area (acres)	Inlet C	Inlet C*A (acres)	Lateral Area	Cumulative Area (acres)	Cumulative C*A (acres)	Inlet Tc (minutes)	System Tc (minutes)	Intensity (in/hr)	Additional Flows	Discharge (cfs)
HL-2406	16.27	12.91	23.50	0.31	7.29		23.50	7.3	10.6	10.6	2.24	0	16.4
HL-2405	15.42	12.28	0.00	0.00	0.00		23.50	7.3	0.0	10.9	2.20	0	16.2
HL-2404	14.49	11.59	0.00	0.00	0.00		23.50	7.3	0.0	11.3	2.17	0	15.9
HL-2403	14.13	6.50	0.00	0.00	0.00		23.50	7.3	0.0	11.4	2.15	0	15.8
HL-2402	13.07	5.79	24.10	0.50	12.05		47.60	19.3	11.9	12.2	2.08	0	40.6
HL-2401	12.50	5.41	0.00	0.00	0.00		47.60	19.3	0.0	12.9	2.03	0	39.5
HT-25	12.10	5.05	6.60	0.90	5.94		6.60	25.3	10.0	13.3	1.99	-34	16.9
HT-24	11.96	3.97	0.00	0.00	0.00	47.60	54.20	25.3	0.0	14.1	1.93	-34	15.5
HT-23	11.64	3.74	1.90	0.50	0.95		56.10	26.2	7.2	14.3	1.92	-34	16.9
HT-22	10.81	2.74	2.50	0.42	1.05		58.60	27.3	6.7	15.1	1.87	-34	17.7
HT-21	11.24	2.34	5.00	0.42	2.10		63.60	29.4	7.6	15.3	1.85	-34	21.1
HT-20	10.14	1.07	0.00	0.00	0.00		63.60	29.4	0.0	16.4	1.79	-34	19.2
HT-19	9.29	0.09	4.00	0.50	2.00		67.60	31.4	7.8	17.6	1.73	-34	21.0
HT-18	8.23	-1.13	4.60	0.50	2.30		72.20	33.7	10.0	18.8	1.67	-34	22.9
HT-17	5.99	-2.27	5.00	0.50	2.50		77.20	36.2	10.0	20.1	1.61	-34	25.1
HT-16	5.97	-2.50	1.60	0.50	0.80		78.80	37.0	10.0	21.3	1.56	-34	24.6
HT-15	5.20	-7.53	9.80	0.40	3.92		88.60	40.9	10.0	22.6	1.52	-41	21.9
HT-14	4.49	-8.29	5.70	0.50	2.85		94.30	43.8	10.0	24.2	1.47	-41	24.0
HT-13	3.60	-9.10	11.10	0.50	5.55		105.40	49.3	14.0	27.2	1.38	-41	28.0
HT-12	3.40	-10.35	4.50	0.50	2.25		109.90	51.6	10.0	28.1	1.36	-41	29.9
HT-11	2.97	-10.72	0.00	0.50	0.00		109.90	51.6	0.0	28.8	1.34	-41	29.1
HT-10	3.21	-11.39	0.00	0.50	0.00		109.90	51.6	0.0	31.4	1.29	-41	26.0
HT-09	3.16	-12.00	12.70	0.50	6.35		122.60	57.9	10.9	34.3	1.23	-41	30.9
HT-08	3.12	-12.10	14.80	0.52	7.70		137.40	65.6	11.9	37.1	1.18	-41	37.3
HT-07	3.08	-12.32	22.20	0.52	11.54		159.60	77.1	10.9	39.3	1.15	-41	48.4
HT-06	3.75	-15.06	29.20	0.58	16.94		188.80	94.1	10.7	41.1	1.12	-41	65.5
HT-05A	.00	-15.80	0.00	0.00	0.00		0.00	0.0	0.0	0.0	0.00	244	243.7
HT-05	4.50	-16.10	0.00	0.88	0.00		188.80	94.1	0.0	42.8	1.10	203	307.0
HT-04	4.00	-17.00	0.00	0.00	0.00		188.80	94.1	0.0	43.4	1.09	203	306.3
HT-03	3.50	-17.50	38.70	0.59	22.83		227.50	116.9	12.7	43.9	1.08	207	334.9
HT-02	3.00	-18.00	0.00	0.00	0.00		227.50	116.9	0.0	44.6	1.07	228	354.3
H-out	2.50	-24.20	0.00	0.00	0.00		227.50	116.9	0.0	47.2	1.04	0	350.6

(1) Node Locations are shown on Figure 4
(2) Outfall is to Pump Station on Willow Road

CLARUM HOMES, HAMILTON AVENUE, MENLO PARK STORM DRAINAGE PLAN

Table A-6
Existing Hydraulics: 100-Year Event with Flow in Street

Pipe #	Upstream Node (1)	Downstream Node	Total Discharge (cfs)	Capacity @ Constructed Slope (cfs)	Pipe Size (inches)	Length (feet)	Constructed Slope (ft/ft)	Invert Elevation		Ground/Rim Elevation		HGL Elevation		Freeboard (feet)	Amount Above Rim (feet)	Amount Flowing in Street (cfs)	Upstream Cover (feet)	Velocity (ft/s)
								Upstream	Downstream	Upstream	Downstream	Upstream	Downstream					
HL-P2406	HL-2406	HL-2405	16.4	6.3	18 inch	176	0.004	12.91	12.28	16.27	15.42	19.72	15.42	**ABOVE RIM**	3.5		1.9	9.3
HL-P2405	HL-2405	HL-2404	16.2	6.3	18 inch	192	0.004	12.28	11.59	15.42	14.49	19.04	14.49	**ABOVE RIM**	3.6		1.6	9.2
HL-P2404	HL-2404	HL-2403	15.9	26.3	18 inch	81	0.063	11.59	6.50	14.49	14.13	15.99	14.13	**ABOVE RIM**	1.5		1.4	9.0
HL-P2403	HL-2403	HL-2402	15.8	12.4	24 inch	236	0.003	6.50	5.79	14.13	13.07	13.77	12.61	0.4	BELOW RIM		5.6	5.0
HL-P2402	HL-2402	HL-2401	40.6	78.6	48 inch	127	0.003	5.79	5.41	13.07	12.50	12.49	12.39	0.6	BELOW RIM		3.3	3.2
HL-P2401	HL-2401	HT-25	39.5	55.1	42 inch	120	0.003	5.41	5.05	12.50	12.10	12.28	12.10	0.2	BELOW RIM		3.6	4.1
HT-P24	HT-25	HT-24	16.9	14.9	24 inch	248	0.004	5.05	3.97	12.10	11.96	12.07	10.68	0.0	BELOW RIM	34	5.1	5.4
HT-P23	HT-24	HT-23	15.5	13.1	24 inch	69	0.003	3.97	3.74	11.96	11.64	10.39	10.06	1.6	BELOW RIM	34	6.0	4.9
HT-P22	HT-23	HT-22	16.9	14.8	24 inch	233	0.004	3.74	2.74	11.64	10.81	9.44	8.13	2.2	BELOW RIM	34	5.9	5.4
HT-P21	HT-22	HT-21	17.7	14.7	24 inch	95	0.004	2.74	2.34	10.81	11.24	7.38	6.80	3.4	BELOW RIM	34	6.1	5.6
HT-P20	HT-21	HT-20	21.1	27.5	30 inch	282	0.005	2.34	1.07	11.24	10.14	6.38	5.63	4.9	BELOW RIM	34	6.4	4.3
HT-P19	HT-20	HT-19	19.2	35.5	33 inch	217	0.005	1.07	.09	10.14	9.29	5.55	5.26	4.6	BELOW RIM	34	6.3	3.2
HT-P18	HT-19	HT-18	21.0	35.6	33 inch	270	0.005	.09	-1.13	9.29	8.23	5.22	4.80	4.1	BELOW RIM	34	6.5	3.5
HT-P17	HT-18	HT-17	22.9	44.9	36 inch	252	0.005	-1.13	-2.27	8.23	5.99	4.77	4.48	3.5	BELOW RIM	34	6.4	3.2
HT-P16	HT-17	HT-16	25.1	19.9	36 inch	258	0.001	-2.27	-2.50	5.99	5.97	4.45	4.08	1.5	BELOW RIM	34	5.3	3.6
HT-P15	HT-16	HT-15	24.6	91.9	36 inch	265	0.019	-2.50	-7.53	5.97	5.20	4.06	3.70	1.9	BELOW RIM	34	5.5	3.5
HT-P14	HT-15	HT-14	21.9	59.1	42 inch	220	0.003	-7.53	-8.29	5.20	4.49	3.68	3.57	1.5	BELOW RIM	41	9.2	2.3
HT-P13	HT-14	HT-13	24.0	42.8	42 inch	448	0.002	-8.29	-9.10	4.49	3.60	3.56	3.30	0.9	BELOW RIM	41	9.3	2.5
HT-P12	HT-13	HT-12	28.0	89.5	42 inch	158	0.008	-9.10	-10.35	3.60	3.40	3.27	3.14	0.3	BELOW RIM	41	9.2	2.9
HT-P11	HT-12	HT-11	29.9	56.8	42 inch	116	0.003	-10.35	-10.72	3.40	2.97	3.07	2.97	0.3	BELOW RIM	41	10.3	3.1
HT-P10	HT-11	HT-10	29.1	61.3	48 inch	368	0.002	-10.72	-11.39	2.97	3.21	2.96	2.81	0.0	BELOW RIM	41	9.7	2.3
HT-P09	HT-10	HT-09	26.0	90.3	54 inch	289	0.002	-11.39	-12.00	3.21	3.16	2.81	2.76	0.4	BELOW RIM	41	10.1	1.6
HT-P08	HT-09	HT-08	30.9	34.7	54 inch	321	0.000	-12.00	-12.10	3.16	3.12	2.75	2.67	0.4	BELOW RIM	41	10.7	1.9
HT-P07	HT-08	HT-07	37.3	52.4	54 inch	310	0.001	-12.10	-12.32	3.12	3.08	2.66	2.55	0.5	BELOW RIM	41	10.7	2.4
HT-P06	HT-07	HT-06	48.4	178.4	54 inch	333	0.008	-12.32	-15.06	3.08	3.75	2.53	2.33	0.6	BELOW RIM	41	10.9	3.0
HT-P05A	HT-05A	HT-05	243.7	247.1	78 inch	135	0.002	-15.80	-16.10	.00	4.50	1.00	.71	**ABOVE RIM**	1.0	0	9.3	7.3
HT-P05	HT-06	HT-05	65.5	97.0	54 inch	427	0.002	-15.06	-16.10	3.75	4.50	2.30	1.83	1.5	BELOW RIM		14.3	4.1
HT-P04	HT-05	HT-04	307.0	292.6	78 inch	289	0.003	-16.10	-17.00	4.50	4.00	.00	-.99	4.5	BELOW RIM		14.1	9.3
HT-P03	HT-04	HT-03	306.3	216.6	78 inch	293	0.002	-17.00	-17.50	4.00	3.50	-1.33	-2.33	5.3	BELOW RIM		14.5	9.2
HT-P02	HT-03	HT-02	334.9	180.2	78 inch	423	0.001	-17.50	-18.00	3.50	3.00	-3.99	-5.72	7.5	BELOW RIM		14.5	10.1
HT-P01	HT-02	H-out	354.3	318.8	78 inch	1677	0.004	-18.00	-24.20	3.00	2.50	-6.34	-14.00	9.3	BELOW RIM		14.5	10.7

(1) Node Locations are displayed on Figure 4
(2) Outfall: Low flows to pump station, high flows to detention pond.

CLARUM HOMES, HAMILTON AVENUE, MENLO PARK STORM DRAINAGE PLAN

Table A-7
Proposed Hydrology: 100-Year Event with Flow in Street

Node # (1)	Ground Elevation (ft)	Sump Elevation (ft)	Inlet Area (acres)	Inlet C	Inlet C*A (acres)	Lateral Area	Cumulative Area (acres)	Cumulative C*A (acres)	Inlet Tc (minutes)	System Tc (minutes)	Intensity (in/hr)	Additional Flows	Discharge (cfs)
HL-2406	16.27	12.91	23.50	0.31	7.29		23.50	7.3	10.6	10.6	2.23	0	16.4
HL-2405	15.42	12.28	0.00	0.00	0.00		23.50	7.3	0.0	10.9	2.20	0	16.2
HL-2404	14.49	11.59	0.00	0.00	0.00		23.50	7.3	0.0	11.3	2.17	0	15.9
HL-2403	14.13	6.50	0.00	0.00	0.00		23.50	7.3	0.0	11.4	2.15	0	15.8
HL-2402	13.07	5.79	24.10	0.50	12.05		47.60	19.3	11.9	12.2	2.08	0	40.6
HL-2401	12.50	5.41	0.00	0.00	0.00		47.60	19.3	0.0	12.9	2.03	0	39.5
HT-25	12.10	5.05	6.60	0.90	5.94		6.60	25.3	10.0	13.3	1.99	-34	16.6
HT-24	11.96	3.97	0.00	0.00	0.00		6.60	25.3	0.0	14.1	1.93	-34	15.2
HT-23	11.64	3.74	1.90	0.50	0.95	47.60	56.10	26.2	7.2	14.4	1.91	-34	16.6
HT-22	10.81	2.74	2.50	0.42	1.05		58.60	27.3	6.7	15.1	1.87	-34	17.3
HT-21	11.24	2.34	5.00	0.42	2.10		63.60	29.4	7.6	15.4	1.85	-34	20.7
HT-20	10.14	1.07	0.00	0.00	0.00		63.60	29.4	0.0	16.5	1.78	-34	18.8
HT-19	9.29	0.09	4.00	0.50	2.00		67.60	31.4	7.8	17.6	1.72	-34	20.5
HT-18	8.23	-1.13	4.60	0.50	2.30		72.20	33.7	10.0	18.9	1.66	-34	22.4
HT-17	5.99	-2.27	5.00	0.50	2.50		77.20	36.2	10.0	20.3	1.61	-34	24.6
HT-16	5.97	-2.50	1.60	0.50	0.80		78.80	37.0	10.0	21.5	1.56	-34	24.1
HT-15	5.20	-7.53	9.80	0.40	3.92		88.60	40.9	10.0	22.8	1.51	-34	28.3
HT-14	4.49	-8.29	5.70	0.50	2.85		94.30	43.8	10.0	24.0	1.47	-34	30.9
HT-13	3.60	-9.10	14.60	0.50	7.30		108.90	51.1	14.0	26.4	1.40	-34	38.3
HT-12	3.40	-10.35	4.50	0.50	2.25		113.40	53.3	10.0	27.0	1.39	-34	40.5
HT-11	2.97	-10.72	0.00	0.50	0.00		113.40	53.3	10.0	27.5	1.37	-34	39.9
HT-10	3.21	-11.39	0.00	0.50	0.00		113.40	53.3	10.0	29.4	1.33	-34	37.3
HT-09	3.16	-12.00	12.70	0.50	6.35		126.10	59.7	10.9	31.5	1.28	-34	43.1
HT-08	3.12	-12.10	14.80	0.52	7.70		140.90	67.3	11.9	33.4	1.24	-34	50.4
HT-07	3.08	-12.32	22.20	0.52	11.54		163.10	78.9	10.9	35.1	1.21	-34	62.5
HT-06	3.75	-15.06	29.20	0.58	16.94		192.30	95.8	10.7	36.5	1.19	-34	80.9
HT-05A	.00	-15.80	0.00	0.00	0.00		0.00	0.0	0.0	0.0	0.00	235	235.0
HT-05	4.50	-16.10	0.00	0.88	0.00		192.30	95.8	0.0	37.9	1.17	201	313.7
HT-04	4.00	-17.00	0.00	0.00	0.00		192.30	95.8	0.0	38.4	1.16	201	313.0
HT-03	3.50	-17.50	35.20	0.59	20.77		227.50	116.6	12.6	38.9	1.15	205	340.4
HT-02	3.00	-18.00	0.00	0.00	0.00		227.50	116.6	0.0	39.6	1.14	226	360.2
H-out	2.50	-24.20	0.00	0.00	0.00		227.50	116.6	0.0	42.2	1.11	0	356.0

(1) Node Locations are shown on Figure 4
(2) Outfall is to Pump Station on Willow Road

CLARUM HOMES, HAMILTON AVENUE, MENLO PARK STORM DRAINAGE PLAN

Table A-8
Proposed Hydraulics: 100-Year Event with Flow in Street

Pipe #	Upstream Node (1)	Downstream Node	Total Discharge (cfs)	Capacity @ Constructed Slope (cfs)	Pipe Size (inches)	Length (feet)	Constructed Slope (ft/ft)	Invert Elevation		Ground/Rim Elevation		HGL Elevation		Freeboard (feet)	Amount Above Rim (feet)	Amount Flowing in Street (cfs)	Upstream Cover (feet)	Velocity (ft/s)
								Upstream	Downstream	Upstream	Downstream	Upstream	Downstream					
HL-P2406	HL-2406	HL-2405	16.4	6.3	18 inch	176	0.004	12.91	12.28	16.27	15.42	19.72	15.42	**ABOVE RIM**	3.5		1.9	9.3
HL-P2405	HL-2405	HL-2404	16.2	6.3	18 inch	192	0.004	12.28	11.59	15.42	14.49	19.04	14.49	**ABOVE RIM**	3.6		1.6	9.2
HL-P2404	HL-2404	HL-2403	15.9	26.3	18 inch	81	0.063	11.59	6.50	14.49	14.13	15.99	14.13	**ABOVE RIM**	1.5		1.4	9.0
HL-P2403	HL-2403	HL-2402	15.8	12.4	24 inch	236	0.003	6.50	5.79	14.13	13.07	13.77	12.61	0.4	BELOW RIM		5.6	5.0
HL-P2402	HL-2402	HL-2401	40.6	78.6	48 inch	127	0.003	5.79	5.41	13.07	12.50	12.49	12.39	0.6	BELOW RIM		3.3	3.2
HL-P2401	HL-2401	HT-25	39.5	55.1	42 inch	120	0.003	5.41	5.05	12.50	12.10	12.28	12.10	0.2	BELOW RIM		3.6	4.1
HT-P24	HT-25	HT-24	16.6	14.9	24 inch	248	0.004	5.05	3.97	12.10	11.96	12.29	10.95	**ABOVE RIM**	0.2	-34	5.1	5.3
HT-P23	HT-24	HT-23	15.2	13.1	24 inch	69	0.003	3.97	3.74	11.96	11.64	10.67	10.36	1.3	BELOW RIM	-34	6.0	4.8
HT-P22	HT-23	HT-22	16.6	14.8	24 inch	233	0.004	3.74	2.74	11.64	10.81	9.76	8.51	1.9	BELOW RIM	-34	5.9	5.3
HT-P21	HT-22	HT-21	17.3	14.7	24 inch	95	0.004	2.74	2.34	10.81	11.24	7.79	7.23	3.0	BELOW RIM	-34	6.1	5.5
HT-P20	HT-21	HT-20	20.7	27.5	30 inch	282	0.005	2.34	1.07	11.24	10.14	6.82	6.10	4.4	BELOW RIM	-34	6.4	4.2
HT-P19	HT-20	HT-19	18.8	35.5	33 inch	217	0.005	1.07	.09	10.14	9.29	6.02	5.75	4.1	BELOW RIM	-34	6.3	3.2
HT-P18	HT-19	HT-18	20.5	35.6	33 inch	270	0.005	.09	-1.13	9.29	8.23	5.71	5.30	3.6	BELOW RIM	-34	6.5	3.5
HT-P17	HT-18	HT-17	22.4	44.9	36 inch	252	0.005	-1.13	-2.27	8.23	5.99	5.28	4.99	3.0	BELOW RIM	-34	6.4	3.2
HT-P16	HT-17	HT-16	24.6	19.9	36 inch	258	0.001	-2.27	-2.50	5.99	5.97	4.96	4.61	1.0	BELOW RIM	-34	5.3	3.5
HT-P15	HT-16	HT-15	24.1	91.9	36 inch	265	0.019	-2.50	-7.53	5.97	5.20	4.59	4.25	1.4	BELOW RIM	-34	5.5	3.4
HT-P14	HT-15	HT-14	28.3	59.1	42 inch	220	0.003	-7.53	-8.29	5.20	4.49	4.21	4.03	1.0	BELOW RIM	-34	9.2	3.0
HT-P13	HT-14	HT-13	30.9	42.8	42 inch	448	0.002	-8.29	-9.10	4.49	3.60	4.01	3.59	0.5	BELOW RIM	-34	9.3	3.2
HT-P12	HT-13	HT-12	38.3	89.5	42 inch	158	0.008	-9.10	-10.35	3.60	3.40	3.52	3.29	0.1	BELOW RIM	-34	9.2	4.0
HT-P11	HT-12	HT-11	40.5	56.8	42 inch	116	0.003	-10.35	-10.72	3.40	2.97	3.16	2.97	0.2	BELOW RIM	-34	10.3	4.2
HT-P10	HT-11	HT-10	39.9	61.3	48 inch	368	0.002	-10.72	-11.39	2.97	3.21	3.49	3.21	**ABOVE RIM**	0.5	-34	9.7	3.2
HT-P09	HT-10	HT-09	37.3	90.3	54 inch	289	0.002	-11.39	-12.00	3.21	3.16	3.26	3.16	**ABOVE RIM**	0.0	-34	10.1	2.4
HT-P08	HT-09	HT-08	43.1	34.7	54 inch	321	0.000	-12.00	-12.10	3.16	3.12	3.27	3.12	**ABOVE RIM**	0.1	-34	10.7	2.7
HT-P07	HT-08	HT-07	50.4	52.4	54 inch	310	0.001	-12.10	-12.32	3.12	3.08	3.28	3.08	**ABOVE RIM**	0.2	-34	10.7	3.2
HT-P06	HT-07	HT-06	62.5	178.4	54 inch	333	0.008	-12.32	-15.06	3.08	3.75	3.62	3.28	**ABOVE RIM**	0.5	-34	10.9	3.9
HT-P05	HT-06	HT-05	80.9	97.0	54 inch	427	0.002	-15.06	-16.10	3.75	4.50	3.24	2.51	0.5	BELOW RIM	0	14.3	5.1
HT-P05A	HT-05A	HT-05	235.0	152.4	78 inch	355	0.001	-15.80	-16.10	.00	4.50	2.00	1.29	**ABOVE RIM**	2.0		9.3	7.1
HT-P04	HT-05	HT-04	313.7	292.6	78 inch	289	0.003	-16.10	-17.00	4.50	4.00	.49	-.55	4.0	BELOW RIM		14.1	9.5
HT-P03	HT-04	HT-03	313.0	216.6	78 inch	293	0.002	-17.00	-17.50	4.00	3.50	-.90	-1.94	4.9	BELOW RIM		14.5	9.4
HT-P02	HT-03	HT-02	340.4	180.2	78 inch	423	0.001	-17.50	-18.00	3.50	3.00	-3.65	-5.44	7.2	BELOW RIM		14.5	10.3
HT-P01	HT-02	H-out	360.2	318.8	78 inch	1677	0.004	-18.00	-24.20	3.00	2.50	-6.08	-14.00	9.1	BELOW RIM		14.5	10.9

(1) Node Locations are displayed on Figure
(2) Outfall: Low flows to pump station, high flows to detention pond.

CLARUM HOMES, HAMILTON AVENUE, MENLO PARK STORM DRAINAGE PLAN

Table A-9
Flow in Concrete Bypass Channel

River Station	Flow Total (cfs)	Minimum Channel Elevation (feet)	Water Surface Elevation (feet)	Top of Wall at Railroad (feet)	Critial Water Surface (feet)	Energy Grade Elevation (feet)	Energy Grade Slope (feet/feet)	Channel Velocity (feet/sec)	Flow Area (square feet)	Top Width (feet)	Froude Channel Number
2350	24	3.5	4.8	5.0		5.0	0.0011	3.3	7.4	5.5	0.5
2250	24	3.4	4.7	6.2		4.9	0.0011	3.3	7.3	5.5	0.5
2150	24	3.2	4.6	5.3		4.8	0.0008	3.0	8.0	5.5	0.4
1950	24	3.0	4.5	4.6		4.6	0.0008	2.9	8.3	5.5	0.4
1750	24	2.8	4.3	4.5		4.4	0.0007	2.8	8.6	5.5	0.4
1550	24	2.6	4.2	4.4		4.3	0.0006	2.7	9.0	5.5	0.4
1450	24	2.5	4.1	4.1		4.2	0.0006	2.6	9.3	5.5	0.4
1350	24	2.4	4.1	4.2		4.2	0.0005	2.5	9.5	5.5	0.3
1250	24	2.3	4.0	4.3		4.1	0.0005	2.4	9.8	5.5	0.3
1227	24	2.2	4.0			4.1	0.0005	2.4	9.9	5.5	0.3
1210	24	2.2	4.0			4.1	0.0005	2.4	9.9	5.5	0.3
1200	24	2.2	4.0		3.1	4.1	0.0004	2.7	9.0	5.0	0.4
1156.5	Culvert										
1113	24	2.0	3.0		2.9	3.3	0.0020	4.8	5.0	5.0	0.9

CLARUM HOMES, HAMILTON AVENUE, MENLO PARK STORM DRAINAGE PLAN

Table B1
Runoff Coefficient Calculations

Type of Drainage Area		Runoff Coefficient	
		10-Year	100-Year
Residential Single Family		0.40	0.45
Commercial		0.70	0.88
Parks		0.25	0.31
Playgrounds		0.30	0.38
Railroad Right-of-way near Tracks		0.30	0.38
Open Field:	low relief	0.11	
	normal soil infiltration	0.07	
	fair vegatative cover	0.07	
	low surface storage	0.09	
	Total	0.34	0.43

Cal-Trans Highway Design Manual
Table 819.2B
Runoff Coefficients for Developed Areas
$C_{100\text{-year}} = C_{10\text{-year}} * 1.25$

CLARUM HOMES, HAMILTON PARK, MENLO PARK STORM DRAINAGE PLAN

Table B2
Area Calculations

Drains to Station	existing (acres)	Land Type	Runoff Coefficient For Inlet	C* A
HT-03A	9.8	Residential	0.40	3.9
HT-13	6.2	Project Site	0.40	2.5
HT-03B	3.5	Residential	0.40	1.4
HT-09	1.1	Church	0.40	0.4
HT-08	1.1	Church	0.40	0.4
HT-08	0.5	Commercial	0.70	0.4
HT-07	0.6	Commercial	0.70	0.4
HT-06	4.1	Commercial	0.70	2.8
HT-06	5.2	Residential	0.40	2.1
HT-06	9.2	Residential	0.40	3.7
HT-07	4.9	Residential	0.40	2.0
HT-07	4.0	Residential	0.40	1.6
HT-07	4.5	Residential	0.40	1.8
HT-08	4.4	Residential	0.40	1.7
HT-08	4.4	Residential	0.40	1.8
HT-09	4.1	Residential	0.40	1.6
HT-09	4.2	Residential	0.40	1.7
HT-12	4.5	Residential	0.40	1.8
HT-13	4.9	Residential	0.40	2.0
HT-16	1.6	Residential	0.40	0.6
HL-1502	0.6	Residential	0.40	0.2
HL-1503	0.7	Residential	0.40	0.3
HL-1504	1.1	Residential	0.40	0.4
HL-1505	1.4	Residential	0.40	0.6
HL-1505	8.2	Residential	0.40	3.3
HT-22	1.8	Residential	0.40	0.7
HT-23	1.9	Residential	0.40	0.8
HT-21	2.5	Boys and Girls Club	0.40	1.0
HT-22	0.7	Park	0.18	0.1
HT-21	1.0	Residential	0.40	0.4
HT-21	1.5	Residential	0.40	0.6
HT-19	1.8	Residential	0.40	0.7
HT-18	1.4	Residential	0.40	0.6
HT-17	1.2	Residential	0.40	0.5
HT-19	2.3	Residential	0.40	0.9
HT-18	3.2	Residential	0.40	1.3
HT-17	3.8	Residential	0.40	1.5
HT-15	9.8	School	0.30	2.9
HT-14	5.7	Residential	0.40	2.3
HT-09	1.3		0.40	0.5
HT-09	1.9		0.40	0.7
HT-08	2.0		0.40	0.8
HT-08	2.4		0.40	0.9
HT-07	2.6		0.40	1.0
HT-07	2.6		0.40	1.1
HT-07	3.0		0.40	1.2
HT-06	3.2		0.40	1.3
HT-06	3.7		0.40	1.5
HT-06	3.8		0.40	1.5
HT-03A	2.3	School	0.30	0.7
HT-03A	2.4	Field	0.34	0.8
HT-03A	1.6	Field	0.34	0.6
HL-2402	24.1	Residential	0.40	9.6
HL-2406	23.5	Park	0.18	4.2
HT-25	6.6	US 101	0.90	5.9
HT-03B	7.1	area removed from A8	0.40	2.8
Total	228			

CLARUM HOMES, HAMILTON AVENUE, MENLO PARK STORM DRAINAGE PLAN

Table B3
Calculation of Peak Flow, 100-year Event, to Chilco Street

	Area	**Runoff Coefficient**		Tc		Peak Flow
	(acres)	10-yr	100-yr	(minutes)	(inches/hour)	(cfs)
Railroad to Site	2.5	0.3	0.38	19	1.66	1.6
Terminal and Railroad	29.8	0.4	0.50	19	1.66	24.8
Total	32.4					26.3

CLARUM HOMES, HAMILTON AVENUE, MENLO PARK STORM DRAINAGE PLAN

Table B4
Calculation of Gutter Flow

	Peak Runoff		Gutter Flow									Time of	Runoff
Location	each side (cfs)	n	T (feet)	Sx (ft/ft)	Length (feet)	S (ft/ft)	Depth (feet)	Area (sf)	Velocity (fps)	Time (minutes)	Storage (cf)	Concentration (minutes)	Stored (1) (cfs)
I-101 to Chilco	10.3	0.015	14.9	0.035	2500	0.003	0.52	3.9	2.7	15.7	19434	24	13.5
Flow Split (2)													
Hamilton	3.6	0.015	10.0	0.035		0.003	0.35	1.8	2.0	0.0			
Chilco -1	3.4	0.015	10.1	0.035		0.0025	0.35	1.8	1.9				
Chilco -2	3.4	0.015	10.1	0.035		0.0025	0.35	1.8	1.9				
Total on Chilco	6.7												
Chilco to Willow													
Total Flow to Hamilton (3)	22.9												
Hamilton	7.6	0.015	13.3	0.035	3040	0.003	0.47	3.1	2.5	20.6	18814	40	7.8
Peak Street Flow	15.2												

(1) Runoff volume is required to add to the flow depth in the street.

(2) Flow split occurs at Hamilton and Chilco - 3.6 cfs flows on Hamilton, 6.7 cfs flows to Chilco. The water level at Hamilton Avenue is 0.35 feet.

TABLE 5

BELLE-HAVEN STORM DRAIN SYSTEM
STREET STORM DRAIN DESIGN

LINE OR STREET	STRUCT. I.D.	INPUT TO STRUC (CFS)	DESIGN FLOW (CFS)	REPORTED GROUND ELEV. (FT.)	SURVEYED GROUND ELEV. (FT.)	ENTRANC INV. ELEV. (FT.)	EXIT INV. ELEV. (FT.)	PIPE LENGTH L (FT.)	PIPE DIAM. D (IN.)	PIPE SLOPE S (FT./FT.)	DEPTH OF FLOW IN PIPE (FT)	VEL IN PIPE (FPS)	EGL (FT)	HGL (FT)	FREE-BOARD (FT)	FALL IN PIPE (FT)	FRICT. LOSS (FT.)	VELOCITY MANHOLE LOSSES (FEET)	TOTAL ENERGY LOSS (FEET)	FRICTION SLOPE (FT/FT)
							132.00													
22		36.5	36.5					507	36	0.0040		5.2				2.0	1.5			
	21				141.02	129.97	129.97				4.4		135.0	134.4	6.6			0.1	0.9	0.0049
21		7.5	44.0					181	36	0.0040		6.2				0.7	0.8			
	20				140.90	129.25	129.25				4.3		134.1	133.5	7.4			0.1	0.2	0.0092
20		0.0	44.0					25	36	0.0040		6.2				0.1	0.1			
	19				141.06	129.15	129.15				4.1		133.9	133.3	7.8			0.1	0.6	0.0051
19		0.0	44.0					165	36	0.0040		6.2				0.7	0.7			
	18				140.17	128.49	128.49				3.7		133.1	132.2	7.9			0.1	0.5	0.0083
18		7.5	51.5					61	36	0.0039		7.3				0.2	0.4			
	17				141.00	128.25	128.25				3.5		132.5	131.7	9.3			0.2	2.7	0.0063
17		0.0	51.5					425	36	0.0040		7.3				1.7	2.5			
	16				138.30	126.55	125.55				3.0		129.8	129.5	8.8			0.1	0.7	0.0016
16		4.7	56.2					355	48	0.0040		4.5				1.4	0.5			
	15				137.12	124.13	124.13				4.0		128.4	128.1	9.0			0.0	0.3	0.0016
15		4.7	60.8					184	48	0.0040		4.8				0.7	0.3			
	14				136.28	123.39	123.39				4.0		127.8	127.4	8.9			0.0	0.8	0.0021
14		4.7	65.5					363	48	0.0040		5.2				1.5	0.8			
	13				133.10	121.94	120.44				3.8		126.2	125.8	7.3			0.0	0.1	0.0023
13		1.8	67.3					36	48	0.0016		5.4				0.1	0.1			
	12				133.04	120.38	120.38				5.3		126.1	125.7	7.4			0.0	1.0	0.0022
12		0.0	67.3					435	48	0.0015		5.4				0.6	1.0			
	11				132.01	119.73	119.73				5.0		125.2	124.7	7.3			0.0	1.2	0.0026
11		5.9	73.1					472	48	0.0037		5.8				1.8	1.2			
	10				130.38	117.98	117.98				5.4		123.9	123.4	7.0			0.0	1.6	0.0031
10		6.7	79.8					513	48	0.0030		6.4				1.5	1.6			
	9				127.14	116.44	116.44				5.3		122.3	121.7	5.4			0.0	0.4	0.0037
9		7.1	86.9					114	48	0.0020		6.9				0.2	0.4			
	8				126.92	116.21	116.21				5.0		121.9	121.2	5.7			0.0	0.4	0.0012
8		4.0	90.9					356	60	0.0090		4.6				3.2	0.4			
	7				125.85	113.00	113.00				7.5		120.9	120.5	5.3			0.0	0.2	0.0013
7		2.8	93.7					157	60	0.0020		4.8				0.3	0.2			
	6				123.75	112.69	112.69				7.6		120.7	120.3	3.4			0.0	0.6	0.0014
6		2.0	95.7					469	60	0.0020		4.9				0.9	0.6			
	5				122.60	111.75	111.75				7.9		120.0	119.7	2.9			0.0	0.5	0.0015
5		4.8	100.5					314	60	0.0025		5.1				0.8	0.5			
	4				121.87	110.97	110.97				8.2		119.6	119.2	2.7			0.0	0.6	0.0016
4		2.3	102.8					367	60	0.0025		5.2				0.9	0.6			
	3				120.55	110.05	110.05				8.5		119.0	118.6	2.0			0.0	0.5	0.0016
3		2.3	105.2					290	60	0.0025		5.4				0.7	0.5			
	2				119.50	109.33	109.33				8.7		118.5	118.1	1.4			0.0	1.2	0.0030
2		2.3	107.5					410	54	0.0097		6.8				4.0	1.2			
	1				117.47	105.37	105.37				11.2		117.3	116.6	0.9			0.0	0.6	0.0030
1		0.0	107.5					184	54	0.0020		6.8				0.4	0.5			
	CS1			116.4	115.68	105.00	105.00				11.0		116.7	116.0	0.4			0.0	1.4	0.0037
C1		11.5	119.0					380	54	0.0029		7.5				1.1	1.4			
	CS2			116.0		103.90	103.90				10.5		115.3	114.4	2.2			0.0	1.0	0.0037
C2		3.0	119.0					260	54	0.0023		7.5				0.6	1.0			
	CS3			117.4		103.30	103.30				10.2		114.4	113.5	3.9			0.0	1.5	0.0037
C3		1.0	120.0					400	54	0.0022		7.5				0.9	1.5			

TABLE 5 (cont.)

BELLE-HAVEN STORM DRAIN SYSTEM
STREET STORM DRAIN DESIGN

	CS4			115.7		102.40	102.40				9.6		112.9	112.0	3.7			0.0	3.1	0.0044
C4		10.0	130.0					700	54	0.0020		8.2				1.4	3.1			
	CS5			112.5		101.00	100.10				7.8		109.8	108.8	3.7			0.1	1.0	0.0034
C5		58.0	188.0					300	66	0.0033		7.9				1.0	0.9			
	CS6			113.8		99.10	99.10				6.7		108.8	107.8	6.0			0.0	1.6	0.0033
C6		3.0	191.0					500	66	0.0032		6.0				1.6	1.6			
	CS7			111.1		97.50	97.50				8.6		107.2	106.1	5.0			0.0	1.3	0.0032
C7		-2.0	189.0					400	66	0.0035		6.0				1.4	1.3			
	CS8			109.2		96.10	92.50				6.6		105.9	104.9	4.3			0.0	1.4	0.0040
C8		22.0	211.0					340	66	0.0032		6.9				1.1	1.3			
	CS9			108.5		91.40	88.14				11.9		104.5	103.3	5.2			0.0	2.9	0.0042
C9		5.0	216.0					700	66	0.0021		9.1				1.4	2.9			
	CS10			106.4		86.70	86.70				13.6		101.6	100.3	6.1			0.0	4.6	0.0065
C10		55.0	271.0					700	66	0.0034		11.4				2.4	4.6			
	CS11			104.5		84.30	84.30				10.4		97.0	94.7	9.8			0.0	3.8	0.0076
C11		20.0	291.0					500	66	0.0010		12.2				0.5	3.8			
	CS12			108.5		83.80	83.30				7.1		93.3	90.9	17.6			0.0	5.3	0.0031
C12		0.0	291.0					1720	78	0.0006		8.8				1.0	5.3			
	CS13			102.0		82.30	82.30				4.5		87.9	86.8	15.2			0.0	0.4	0.0041
C13		39.0	330.0					100	78	0.0230		9.9				2.3	0.4			
	CS14					80.00	79.80						87.5	86.0				0.0		

MANNING'S n : 0.0

Junction Loss Factors:

>48" 0.0

<42" 0.2

APPENDIX B:

FACEBOOK MENLO PARK, WEST CAMPUS FLOOD ZONE DESCRIPTION

255 Shoreline Drive, Suite 200
Redwood City, California 94065
(650) 482-6300 (Tel)
(650) 482-6399 (Fax)

MEMORANDUM

Date: November 22, 2011 **BKF No.:** 20100166

To: Justin Murphy, Menlo Park
Jennifer Ng, Menlo Park

Copies To:

From: Thomas Morse

Subject: Menlo Park Facebook Campus Project
West Campus Flood Zone Description

Goal

Review FEMA designated flood elevation for the Facebook West Campus site and determine if development of the project could potentially displace flood water onto adjacent areas currently not included in the 100 year flood zone or potentially increase the depth of flooding in the current flood zone. The goal is to ensure that development of the site will not adversely affect flooding on other properties or result in harm to the public.

Background

Facebook proposes redevelopment of the "West Campus," a 22 acre site at the southwest corner of the Willow Road/Bayfront Expressway intersection with 5 buildings and a parking structure totaling approximately 440,000 square feet of office space (Project). The site is currently included in the Special Flood Hazard Area (SFHA) AE7 as shown on the 1999 FEMA Flood Insurance Rate Map (FIRM) Community Panel Number 060321 0005 D. This flood designation is based on the 1979 Flood Insurance Study (FIS) that provides more detailed information and documents the Base Flood Elevation (BFE) at Willow Road as 7.5 (Datum: NGVD 1929). As stated in the FIS, this flood elevation is static and therefore, does not consider the effects of either wave height or run-up. This is appropriate for the area because of the extent of levee protected salt ponds and marsh between the Bay and the Project that attenuate waves from the Bay.

The City of Menlo Park Municipal Code Chapter 12.42, Flood Damage Prevention states:
"…proposed development [should] not adversely affect the carrying capacity of areas where base flood elevations have been determined but a floodway has not been designated. For purposes of this chapter, "adversely affects" means that the cumulative effect of the proposed development when combined with all other existing and anticipated development will increase the water surface elevation of the base flood more than one (1) foot at any point."

The City of Menlo Park further clarified that the definition of "adversely affect" is not limited to a particular source of flooding or whether the project will increase the depth or extent of the 100-

year flood zone. In addition, the City may consider changes in flood velocity, flow rates, duration of flooding, potential for erosion and sedimentation, degradation of water quality, or increased cost of public services when reviewing whether a project will have an adverse affect.

Review of the FIS also indicates that flooding in this area of Menlo Park is tidally induced from San Francisco Bay because of an incomplete system of levees built along the bayfront that include numerous low points and openings that allow tides to overtop or bypass the levees. Levees in the project vicinity are shown on Exhibit 1: Existing Levees. This system of levees is not recognized or certified by FEMA and the SFHA is mapped as if they do not exist. The flood elevation of 7.5 identified in the FIS is the maximum, 100-year still water elevation in the Bay and does not have an upstream, stormwater runoff hydrologic or hydraulic component. This is illustrated on the FIRMs by a large area of flooding that extends along a significant portion of the Peninsula shoreline with a consistent elevation.

Review of City storm drain block maps indicates direct connection to the Bay under Bayfront Expressway in several locations along the West Campus frontage. Field investigation by BKF could not find evidence of these connections. There are no culverts, inlets, headwalls, flap gates or other visible evidence that these connections exist. We believe that these facilities at one time served Bayfront Expressway when it was a two lane road and that they were removed with construction of the existing Bayfront Expressway. Drainage along this portion of Bayfront Expressway is collected in ditches on each side of the road and conveyed to the City storm drain system at the intersection of Bayfront Expressway and Chilco Street.

As part of the site development process, the Project Sponsor proposes to remove portions of the West Campus from the SFHA by placing fill. The development team will process a Letter of Map Revision – Fill (LOMR-F) for the site with the City and FEMA to document removal of the site from the SFHA. Until FEMA issues the LOMR-F, the City will continue its oversight of the potential for flood displacement on neighboring properties.

Analysis

To determine if placing fill on the project site would impact either the extent or depth of flooding, BKF first looked to understand the cause of flooding in the area. Based on review of the FIS, it is understood that flooding in this area is tidal and directly connected to the static elevation of the Bay. Calculations of the flood elevation are based only on the historic data for tide gauging stations in San Francisco Bay. FEMA determined the extent of flooding shown on the FIRM by applying this elevation to topographic maps. Because there are existing levees that are not recognized by FEMA, including the Bayfront Expressway and portions of Willow Road, the actual extent of flooding during a specific event may not include the entire SFHA. Predicting flood patterns and flood volumes in the SFHA is difficult since the flood patterns are dependent on the number and location of levee failures or overtoppings.

In general, flooding in the vicinity of the Project site occurs when a levee is breached or overtopped. When this happens, Bay water flows to the low points behind the levees and continues to pond behind the levee until the tide recedes. When the tide recedes, flood water flows back to the Bay down to the elevation of the remaining portion of the overtopped or breached levee. The remainder of the water impounded behind the levee makes its way to the

storm drain system. The storm drain in this area does not gravity discharge to the Bay, but rather is pumped to Ravenswood slough by the Caltrans pump station adjacent to the Bayfront Expressway. The remainder of the water that collects in localized low points evaporates or infiltrates.

The existing Project site is surrounded by several features that partially protect it from the 100-year tidal flooding event. These include the Bayfront Expressway, portions of Willlow Road and portions of the railroad right of way that have elevations above 7.5 (See Exhibit 2). These are all significant facilities with little chance of sudden failure. These facilities limit the approach of flood waters to the site. Tidally influenced flood water comes from either the east across a section of Willow Road adjacent to the railroad right of way or from the west across the TE Connectivity site. This means that tide waters impacting the SFHA flow only in the east/west direction. Therefore, tidal flood waters drain either east across Willow Road toward Ravenswood Slough, or west toward Marsh Road and Flood Slough. These protecting features impede the overland flow of potential flood waters in the north/south direction.

To determine if placing fill on the Project site would have an impoundment effect that may impact the extent or elevation of flooding on adjacent neighborhoods. We reviewed the site topography based on an aerial topographic survey prepared for the Project. This topography indicates that the Bayfront Expressway is higher than the BFE of 7.5 along the entire Project frontage. To illustrate this we have attached Exhibit 3: Proposed Areas above BFE 7.5 which shows the adjacent and Project areas that are above elevation 7.5 and above elevation 8.0 in the proposed condition. This illustrates that the constraints in the proposed condition are very similar to the constraints in the existing conditions. Tidal flood waters would flow generally east/west and the existing protecting features would impede the overland flow of flood waters in the north/south direction.

There is a culvert under the railroad tracks that could allow conveyance of tidal flood water from the southern neighbors to the swale adjacent to the Project. However, this water then continues east towards Willow Road and would eventually cross the road where the elevations are lower at the railroad tracks. Water does not continue north across the existing site because significant areas of the existing site along Bayfront Expressway are above elevation 7.5 and the entire length of Bayfront Expressway along the project frontage is above elevation 7.5.

The existing Bayfront Expressway undercross at Willow Road could provide hydraulic connectivity between the north and south sides of the Bayfront Expressway. On the north side of Bayfront Expressway the tunnel entrance is protected by the same existing levee that protects the East Campus. With maintenance of this levee, the undercrossing would not provide a source of flood water that would impact the adjacent neighborhoods.

Tidally influenced flooding does not have a retention/detention component that placing fill would impact. It is based on a specific static elevation that fills the available volume and is not based on a specific volume of water. Placing or removing earth on the site does not change the elevation of tidally influenced flooding and would only change the volume of water that enters and leaves the area. As the tide recedes back to the Bay through the levee low points, so do the flood waters. At this point the levees could act as a “bathtub” with water trapped behind the

levee in areas that are lower than the levee low points or breach point. The remainder of the flood water exits the area through the existing storm drain system that is connected to the Caltrans storm drain pump station at Bayfront Expressway.

The Project proposes to place approximately 72,500 cubic yards of fill on the site. To determine if this volume of fill would impact the volume of tidal flood water potentially trapped behind the levee as the tide recedes back to the Bay, we calculated the volume of earth below the 7.5 static tidal flood elevation for both the existing and proposed conditions. To make these calculations consistent, we chose a starting elevation of 5.0 and used AutoCAD's Earthwork module to calculate the volume of earth between elevation 5.0 and the 100 year tidal flood elevation of 7.5. The starting elevation of 5.0 was chosen because it is slightly below the lowest elevation on either the existing or proposed site. This provides a consistent starting point for comparing existing and proposed earth volumes.

In the existing condition there is approximately 18,400 cubic yards of earth between elevations 5.0 and 7.5 (see Exhibit 2). The proposed condition includes approximately 16,600 cubic yards of earth between elevations 5.0 and 7.5 (see Exhibit 3). Therefore, development of the site will remove approximately 1,800 cubic yards of earth below elevation 7.5. Site grading will remove existing earth in some roadway and landscape areas and place fill over a larger area that is only slightly below elevation 7.5.

Removal of 1,800 cubic yards (48,600 cubic feet) of earth from the SFHA could potentially allow that volume of additional tidally influenced flood water on to the site and into the SFHA. This additional volume could slightly increase the duration of tidally induced flooding in low laying areas of adjacent neighborhoods. Because the tidal flooding results from a specific water elevation in the Bay, the extent and depth of flooding would not change. To put this change in flooding duration in perspective, we calculated the volume of tidal flood water in the flood study area to be 11,600,000 cubic feet based on the area identified by the City of Menlo Park (Shown on Exhibit 4) and an assumed average water depth of 1 foot deep in this area. The proposed change in earthwork on the site could increase this detained volume and potential flood duration by approximately 0.4 percent. The actual volume of tidal flood water remaining after a flood event would be dependent on the elevation of the levee breach or overtopping.

Conclusion

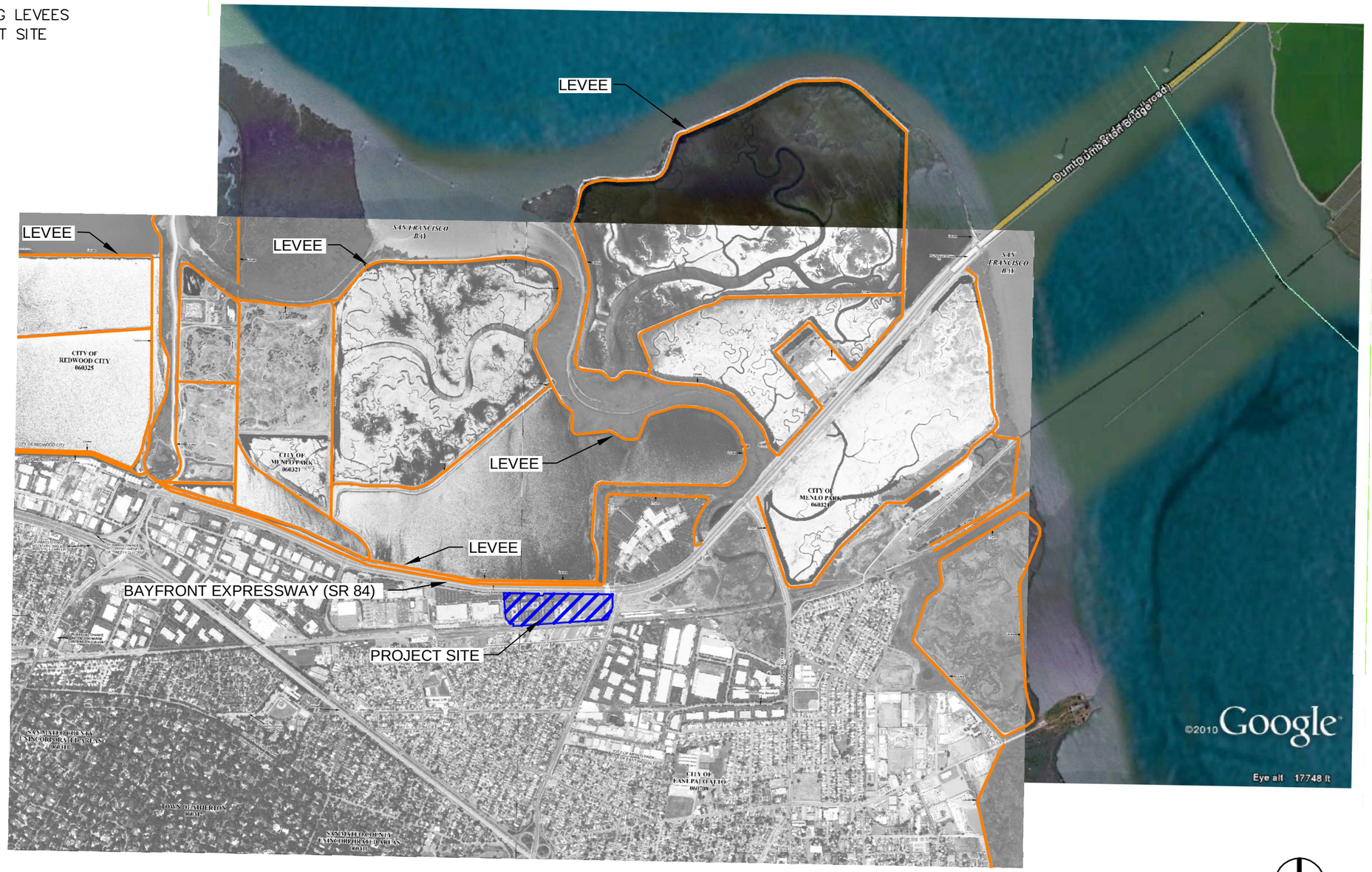
Because flooding in the Project vicinity is tidally influenced, earthwork to remove portions of the site from the SFHA will not displace flood water and will not increase the extent or depth of flooding in adjacent neighborhoods that could cause an adverse impact. Proposed grading on the site will increase available volume in the flood area by approximately 0.4 percent and could have a proportionate increase in the duration of flooding which would not be a significant impact on adjacent neighborhoods.

LEGEND

EXISTING LEVEES

PROJECT SITE

DATUM: NGVD 1929



REF. NORTH

0' 500' 1000' 2000'

FULL SIZE SCALE IS 1"=1000'
11"x17" SIZE SCALE IS 1"=2000'

MENLO PARK FACEBOOK CAMPUS
WEST CAMPUS

312 & 313 CONSTITUTION DR., MENLO PARK, CA

BKF ENGINEERS SURVEYORS PLANNERS

EXHIBIT 1: EXISTING LEVEES

November 22, 2011

LEGEND

- PROPERTY LINE
- PUBLIC RIGHT-OF-WAY
- NON-ACCESS AREA (CALTRANS)
- ELEVATION 8.0
- ELEVATION 7.5 (BFE)

DATUM: NGVD 1929

VOLUME OF EARTH BELOW FINISHED ELEVATION 7.5 – 18,400 CY
VOLUME OF EARTH BELOW FINISHED ELEVATION 8.0 – 29,600 CY

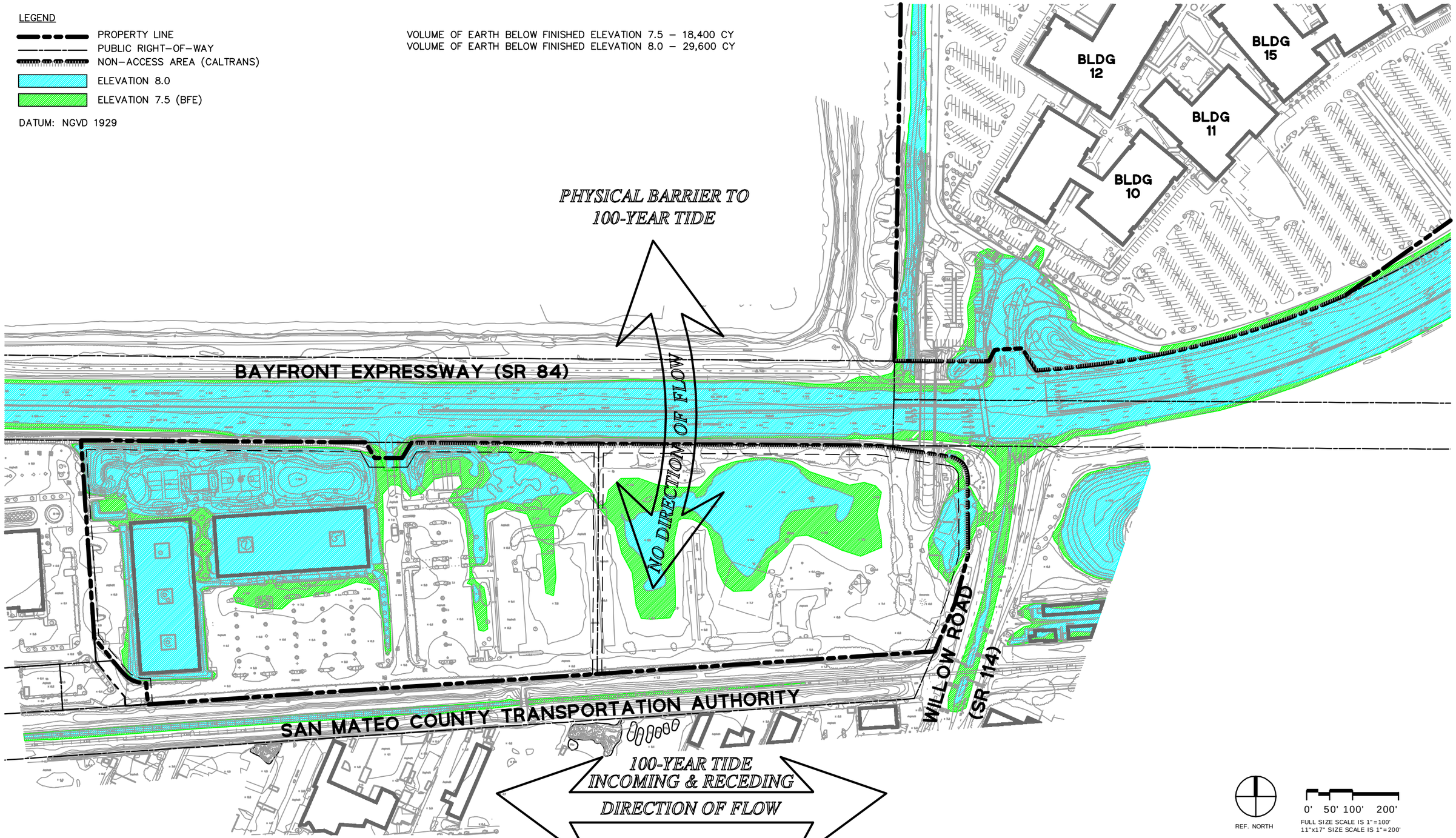


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EXHIBIT 2: EXISTING AREAS ABOVE BFE 7.5

November 22, 2011

DRAWING NAME: K:\Eng10\10016B\DWG\Exhibits\Areas Above BFE-7.5\01-EXISTING AREAS ABOVE BFE-7.5.dwg
PLOT DATE: 11-21-11 PLOTTED BY: yesl

LEGEND

- PROPERTY LINE
- PUBLIC RIGHT-OF-WAY
- NON-ACCESS AREA (CALTRANS)
- ELEVATION 8.0
- ELEVATION 7.5 (BFE)

DATUM: NGVD 1929

VOLUME OF EARTH BELOW FINISHED ELEVATION 7.5 – 16,600 CY
VOLUME OF EARTH BELOW FINISHED ELEVATION 8.0 – 23,800 CY

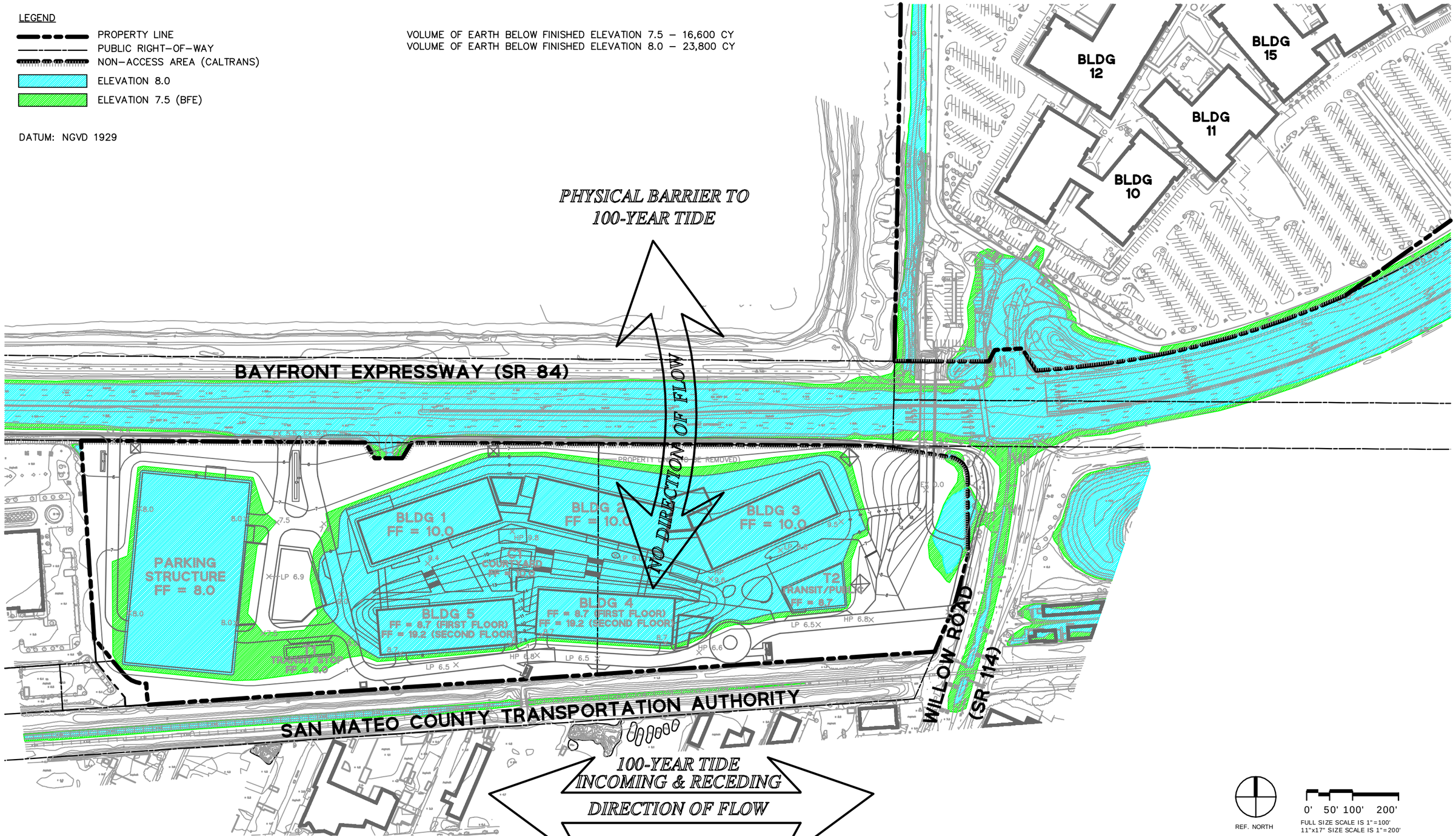

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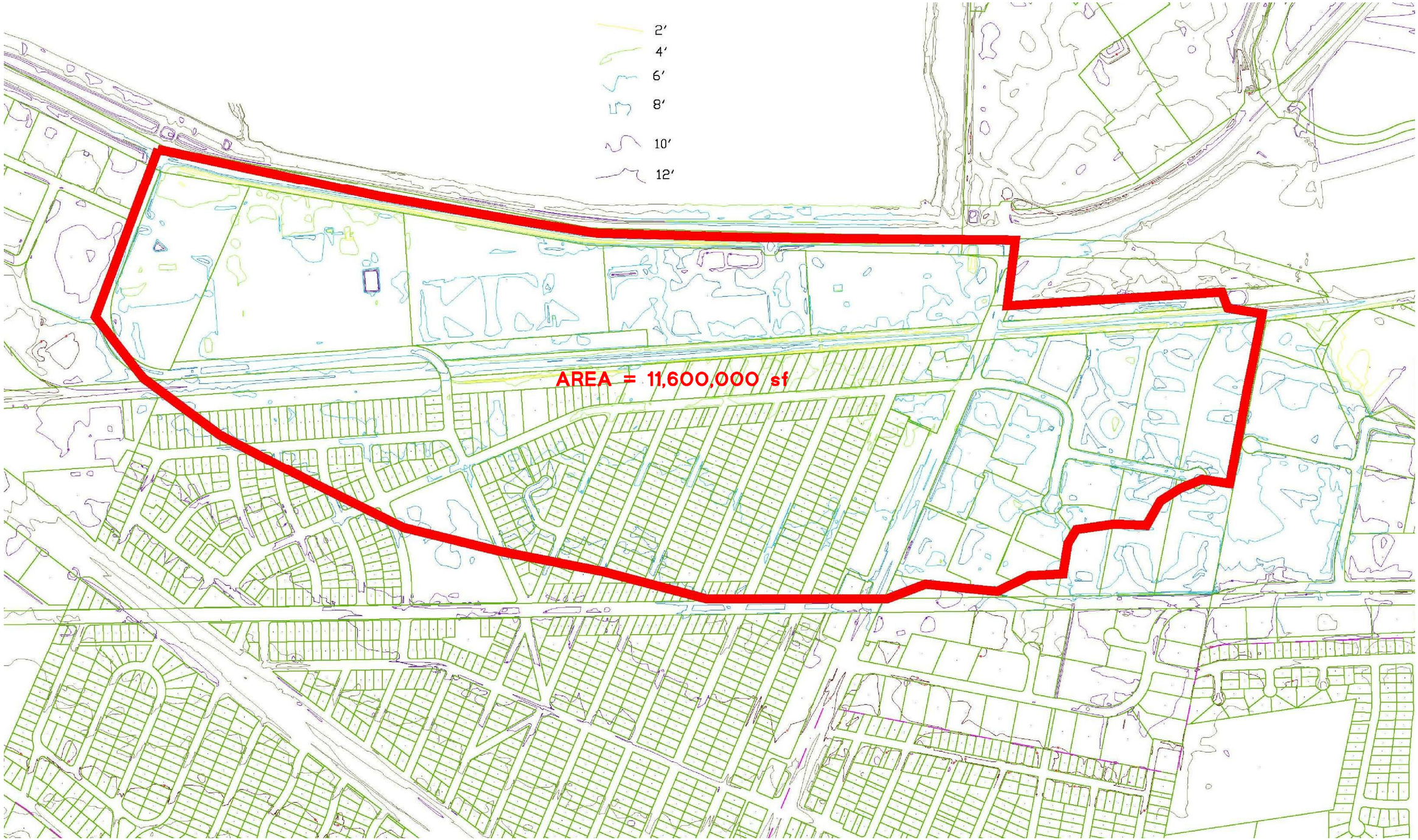
EXHIBIT 3: PROPOSED AREAS ABOVE BFE 7.5

November 22, 2011

DRAWING NAME: K:\Eng10\100166\DWG\Exhibits\Areas Above BFE-7.5\01A-PROPOSED AREAS ABOVE BFE-7.5.dwg
PLOT DATE: 11-21-11 PLOTTED BY: yeel



MENLO PARK FACEBOOK CAMPUS
WEST CAMPUS

312 & 313 CONSTITUTION DR., MENLO PARK, CA

BKF
Engineers
Surveyors
Planners

EXHIBIT 4: STUDY AREA FOR FLOODING ANALYSIS

November 22, 2011

DRAWING NAME: K:\Eng10\100168\DWG\Exhibits\Areas Above BFE-7.5\03-FEMA ANALYSIS.dwg
PLOT DATE: 11-21-11 PLOTTED BY: yael