EXHIBIT D

STORMWATER MANAGEMENT PLAN

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Alameda Landing
Backbone Infrastructure
City Permit Number: CB12-0730

CITY OF ALAMEDA
ALAMEDA COUNTY
CALIFORNIA

December, 2012

Prepared By:

BKF
ENGINEERS / SURVEYORS / PLANNERS

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Report prepared for:

Region Water Quality Control Board

Storm Water Management Plan for Alameda Landing Retail Development Phase 1
Alameda, CA

City Permit Number:
BKF Engineers Job No.: 20065092

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STATE OF CALIFORNIA

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Principal

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A. Project Description and Information Summary

Existing Site

The existing site (formerly Fleet Industrial Supply Center (FISC)) is bordered by Stargell Avenue at the south, Mariner Square Loop at the east, existing Coast Guard Housing at the west and the Oakland Estuary at the north (**Figure 1**). At the north the site is generally at elevation 1.5-2.5 adjacent to existing Warehouses 1 and 2. The south elevation is approximately elevation 8.5 at the intersection of Stargell and Fifth Street.

The site receives approximately 19 inches of annual rainfall. The existing site consists of two Naval Air Station support warehouses building 4 and 5 surrounded by pavement and native material stockpiled. The site is roughly 0% impervious and 100% pervious (**Figure 2**). The proposed site will be 96% impervious.

The existing FISC site drains to the north through existing storm drain infrastructure and discharges directly to the Oakland Estuary through an existing outfall to remain. The outfall consists of a weir structure in the Pond connecting to flap gate structure via twin 48-inch siphon pipes; a 72-inch pipe connecting the flap gate to a headwall; and a sheet pile open channel that drains to the estuary.

Project Description

Some of the proposed Backbone Improvements (BBI) includes the following:

1. Proposed streets – Mitchell Ave, Fifth Street
2. Widened existing streets – Stargell Avenue and Mariner Square Loop
3. Utilities – Storm drain, sewer, water and joint trench
4. Traffic signals
5. Bioretention areas
6. Planting areas
7. Street lights

The new backbone infrastructure is approximately 4,400 miles of roadways/utilities or 7.0 acres. The former Alameda Naval Station known as Fleet Industrial Supply Center consist of mainly impervious surfaces (paved roads and buildings); however, all improvements will be removed or demolished per the demolition and leveling construction activities that will be take place per the Alameda Landing contract drawings titled, "Phase 1 Demolition and Site Leveling", prepared by BKF engineers, dated 2/2/2012. As a result of the demolition activities the site will be pervious and leveled. Since we are creating more than 10,000 sf of impervious surface the project is subject to the treatment and flow components referenced in the NPDES permit.

I. PROJECT SETTING

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B. Opportunities and Constraints of Storm Water Management

The Storm Water Management Plan shows the grading and drainage patterns of the BBI, and the methods proposed to remove suspended solids and pollutants from storm water runoff. Treatment of all runoff from the project area is required according to current stormwater C.3 requirements. Storm water treatment requirements are met by implementing bioretention areas throughout the site to treat the proposed improvements.

Opportunities:

The new backbone roads conform to the existing terrain of the site. The public storm drain improvements which will collect the runoff after treatment in roadside bioretention areas and discharge to the existing Oakland Estuary outfall. During non-treatment storm events, runoff will bypass bioretention areas by entering a curb inlet which has a 2" lip at the throat. **(See Figure 6)**

The proposed BBI connects a series of roadside bioretention areas and generally maintains the existing hydrology of the site by directing runoff to the existing Oakland estuary outfall (**Figure 3**). Sidewalks separated from new street by landscape will bypass bioretention areas as they are self treating.

Mariner Square Loop (MSL) is an existing public street in existing public street right-of-way. The Alameda Landing Project is conditioned to improve the public street. Required improvements include the addition of a sidewalk, widening to accommodate bicycle lanes and left turn pockets, and resurfacing/reconstruction to restore its structural integrity. Since MSL is an existing street to which no new traffic lanes are being added, the proposed improvements do not constitute a "Road Project", as defined in section C.3.b.ii.(4) of the MRP, and do not trigger the need for storm water treatment

Constraints:

Infiltration of storm water into the site soils may not be feasible due to low permeability rates reported by the Geotechnical Engineer.

Bioretention areas or Integrated Management Practices (IMPs) with engineered soil are sized to accept stormwater from existing and proposed areas at the bottom of each of the Drainage Management Areas (DMAs).

II. Measures to Limit Imperviousness

A. Pervious Site Improvements

- Roadside Bioretention areas and landscape strips.

- Sidewalks which drain directly to landscape strips.
- Landscape strips which drain directly to bioretention areas.

B. Drainage as a Design Element

- The linear green pedestrian plaza along Fifth Street at the northwesterly portion of the site will integrate Bioretention Areas and meandering paths. Landscape areas drain directly to bioretention areas and are counted as self treating.

- Bioretention Areas treat stormwater by allowing stormwater infiltrate through engineered soil. A perforated pipe collects and conveys the treated subsurface stormwater to outfalls with energy dissipation or storm drain catch basins which drain to the existing watershed.

C. Minimizing Volume of Runoff

- Bioretention areas have been designed and sized per the combination of flow and volume designed criteria indicated on the C.3 Stormwater Technical Guidance handbook.

III. Selection and Primary Design of Storm Water Treatment BMP's

Impervious areas are separated into 43 DMAs. The stormwater runoff from each DMA drains to specific IMPs.

Since the project discharges directly to the Oakland estuary hydrograph modification is not required. Although, the new impervious area has increased, the project's offsite discharge over time does not alter the precondition stormwater peak discharges; therefore, hydrograph modifications do not need to be implemented. Regardless the IMP's were designed for flow control and treatment.

A. General Bioretention Area Characteristics

The bioretention areas are designed to meet the C.3 Stormwater Technical Guidance (Version 3.0) combination of flow and volume design criteria. The bioretention areas are sized such that bioretention area soil mix surface area (not including side slopes) meet the minimum area needed to allow 6 inches of ponding depth for the calculated stormwater inflow volume. The following calculations show a minimum area required to allow for approximately 6" of ponding. The proposed bioretention areas will meet or exceed the calculated required areas as shown in (**Figure 4A**).

The depth of the surface ponding area is sized so that the ponding area functions to retain water prior to it entering the soil at a minimum 5 inches per hour required by MRP provision C.3.c(2)(b)(vi). See (**Figure 4A**). Provision C.3.d of the MRP specifies that treatment measures that use a combination of flow and volume capacity shall be sized to treat at least 80 percent of the total runoff over the life of the project, using local rainfall. A sizing summary of each bioretention area can be found in **(Figure 4B).**

As an example, the square footage calculation and volume required for the bioretention treatment area of DMA #13.1 is shown in the following steps.

a. Determine **Total C*A (sf)**
   For Pervious area use C=0.10
   For Impervious area use C=0.70
   Total C*A = (0.7 * 1,412) + (0.1 *800) = 1,068

b. Determine **C composite**
   Total C*A / Total area = 1,068/2,212 = 0.48

c. Calculate **Unit Basin Storage Volume**
   This number is calculated using Table 5-2 "Unit Basin Storage Volumes in Inches for 80 Percent Capture Using 48-hour Drawdowns".
   Since the project is located in the city of Alameda the corresponding location is Oakland. Using the C composite obtained from step b interpolate values from table 5-2 to obtain the unit basin storage volume in inches.

   (Composite Runoff coefficient, Unit basin storage volume)

   Since the composite C is 0.48 it falls between these two values (0.25, 0.17) and (0.50, 0.34). After interpolating our adjusted Unit Basin Storage volume is 0.33

   (0.34-.17) / (0.5-.25) = 0.68
   0.68 * (0.50-0.48) = 0.136
   0.34-.136 = 0.33

d. Calculate **Project Mean Annual Precipitation (in)**
   Alameda's Annual Precipitation is 19 inches.
   Value is obtained from The Alameda County Flood Control and Water Conservation District Attachment-6 titled "Mean Annual Precipitation".

   Unit basin Storage Volume * (Alameda Annual Mean Precipitation/Oakland Airport - value obtained from table 5-2)

   0.33 * (19/18.35) = 0.34 inches

e. Calculate **I (in)**
   Project Mean Annual Precipitation / C composite
   0.34 / 0.48 = 0.70 inches

f. Calculate the **Duration, T (hr)**
   I (in) / 0.2 (in/hr)

0.70 / 0.2 = 3.52 hr

g. Estimate **Bioretention Treatment Area**
A preliminary estimate of bioretention area is estimated. The estimated area used in combination with the infiltration rate and storm duration to calculate the required treatment volume (see step i.).

31.87 SF is assumed.

h. Compute **Total V inflow (cf)**
$$\frac{(\text{Total } C*A) * (I)}{12} = (1{,}068 * 0.70) / 12 = 62.69 \text{ cf}$$

i. Calculate **Volume Treated (cf)**
Bioretention Treatment Area * Duration T * Infiltration constant

Infiltration constant is 5 in/hr => 0.42 ft/hr

31.87 sf * 3.52 hr * 0.416 ft/hr = 46.75 cf

j. Calculate the **Stored Volume (cf)**
Total Volume Inflow - Volume treated
62.69 cf – 46.75 cf = 15.94 cf

k. Calculate **Required Ponding Depth (ft)**
Stored Volume/ Bioretention Treatment Area

15.94 cf / 31.87 sf = 0.50 ft => 6" required ponding depth

Each bioretention area was designed with the following characteristics:

- Ponding depth is 6 inches minimum. Overflow catch basin shall be 6" from flow line.
- Vegetation selected for viability and to minimize need for fertilizers and pesticides in well-drained soil.
- 18" of engineered biotreatment soil mix per County of Alameda specs. Treatment soil infiltrates at 5 inches per hour.
- 12" class II permeable rock per Caltrans specifications in which perforated pipe is installed.
- 6" Perforated-pipe subdrain connected to storm drainage system.
- Sides of Bioretention Areas can be retained with Vertical/Slotted Curbs or Side slopes that do not exceed 3:1.
- Sloped cobbles for energy dissipation at 18" curb cut inlets will be installed.
- Waterproof liner to be installed at bottom and extend 7 inches up the side of the class II permeable layer.
- Tributary areas which drain to bioretention areas do not exceed 2 acres.

- The project will install purple pipe systems to irrigate the landscaping and bioretention areas. The purple pipe system will be connected to the domestic water system until EBMUD extends recycled water service to the area.

B. Specific descriptions of each DMA and IMP are as follows:

A summary of all proposed, impervious/pervious surface area has been listed in **(Figure 4B)**.

- DMA 1- 6, 14.1, 14, 16-17, 38: Includes drainage from the east half of Fifth Street Road from centerline to flowline. Runoff from these areas discharge into their respective IMP areas which consist of bioretention areas located at low spots. See Figure 4A.
- DMA 7-13.1, 15, 18-19, 40: Includes drainage from the west half of Fifth Street Road from centerline to flowline. Runoff from these areas discharge into their respective IMP areas which consist of bioretention areas located at low spots. See Figure 4A.
- DMA 20-23, 34-37: Includes drainage from the south half of Mitchell Avenue from centerline to flowline. Runoff from these areas discharge into their respective IMP areas which consist of bioretention areas located at low spots. See Figure 4A.
- DMA 24-33, 39: Includes drainage from the north half of Mitchell Avenue from centerline to flowline. Runoff from these areas discharge into their respective IMP areas which consist of bioretention areas located at low spots. See Figure 4A.
- DMA 41-42: Landscape areas within the "linear green" drain directly to bioretention areas and are counted as self-treating.

For road projects, sidewalks which drain directly to vegetated areas are specifically excluded from Provisions C.3.b.ii.(4)(a)-(c). The sidewalk and vegetated areas are not hydrologically separated from the gutter flow therefore these areas are treated the bioretention areas using a factor of 0.1.

IV. Source Control Measures

The following activities occur in areas designated for improvements have potential to allow pollutants to enter runoff:

- Landscape maintenance
- Street sweeping
- Construction/demolition of existing buildings
- Grading

implemented as described in **the Alameda County Integrated Management Practice Summary.**

Table 1. Sources and Source Control BMP's

Potential Source	Permanent BMP's	Operational BMP's
On-site Storm Drain Inlets	• Mark all inlets with the words "No Dumping! Flows to Creek" or similar	• Maintain and periodically repaint or replace inlet markings.
Landscape/outdoor pesticide and fertilizer use.	• Landscaping will be designed to minimize required irrigation and runoff, to promote surface infiltration, and to minimize the use of fertilizers and pesticides that can contribute to storm water pollution. • Plantings for IMP's will be selected to be appropriate to anticipated soil and moisture conditions. • Where possible, pest-resistant plants will be selected, especially for locations adjacent to hardscape. • Plants will be selected appropriate to site soils, slopes, climate, sun, wind, rain, land use, air movement, ecological consistency, and plant interactions.	• Landscaping to be maintained using minimum or no pesticides. • Person or contractor responsible for landscape maintenance to use IPM principles.
Plazas and sidewalks Facility Cleaning Construction and Demolition of Buildings		• Potential sources shall be swept regularly to prevent the accumulation of litter and debris. Debris from pressure washing shall be collected to prevent entry into the storm drain system. Wash water containing any cleaning agent or degreaser shall be collected and discharged to the sanitary sewer and not discharged to a storm drain.

V. Permitting and Code Compliance Issues

There are no known conflicts between the proposed Storm Water Management Plan and Alameda County ordinances or policies. Any conflicts found will be resolved through the design review process or during subsequent permitting.

VI. Construction Plan C.3 Checklist

Table 1. Construction Plan C.3. Checklist

Storm Water Management Plan Reference	**BMP Description**	**Improvement Plan Sheet Number**
DMA (1-42)	Bioretention Areas – Detains runoff in a surface reservoir, filters it through plant roots and a biologically active soil mix, and then infiltrates it into the ground.	
Self Treating Areas (43 to 47)	Landscape areas	

VII. Owner's Certification

The selection, sizing, and preliminary design of treatment BMP's and other control measures in the plan meet the requirements of Regional Water Quality Control Board Order R2-2003-0022

EXHIBIT D

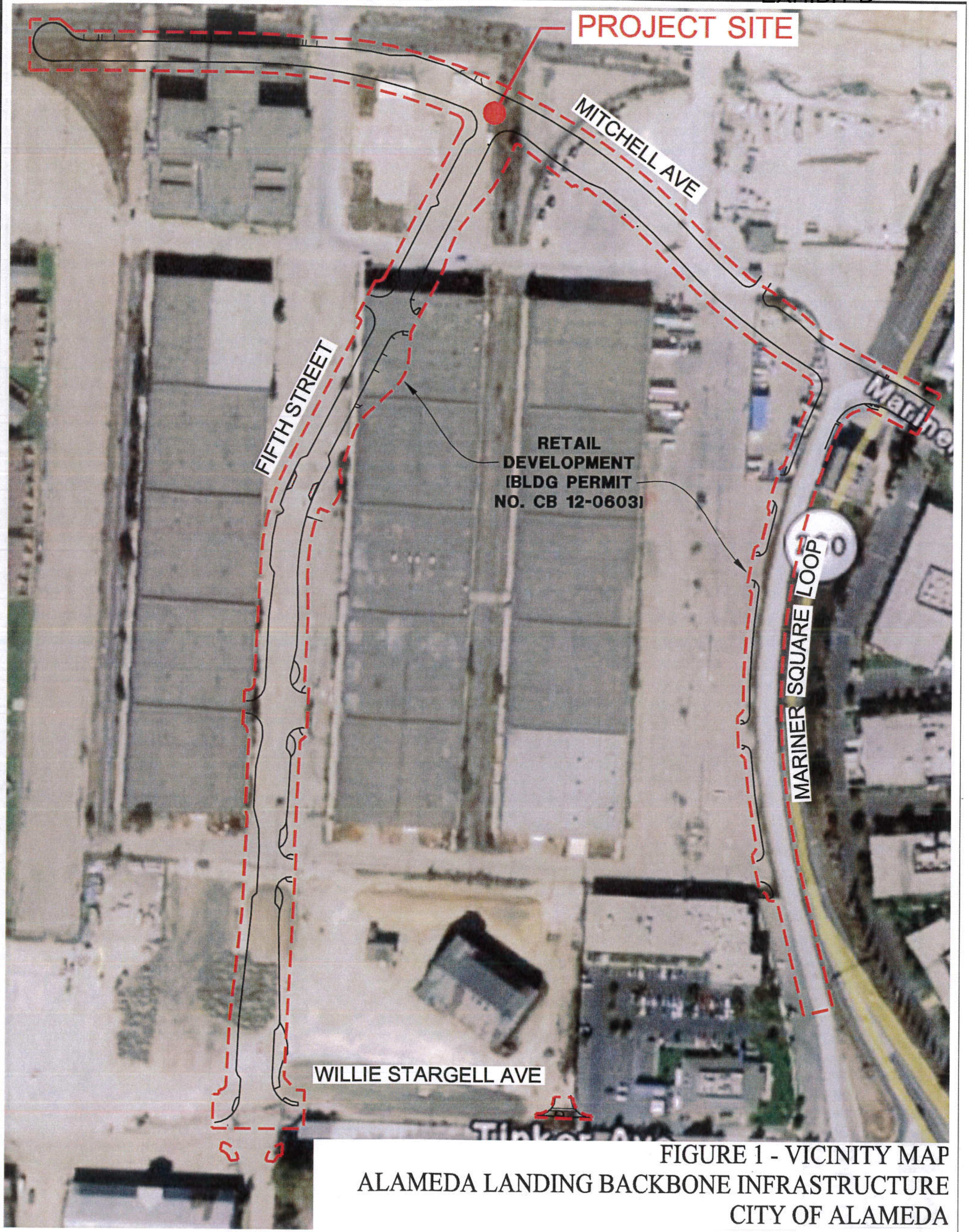

FIGURE 1 - VICINITY MAP
ALAMEDA LANDING BACKBONE INFRASTRUCTURE
CITY OF ALAMEDA

BKF

EXHIBIT D

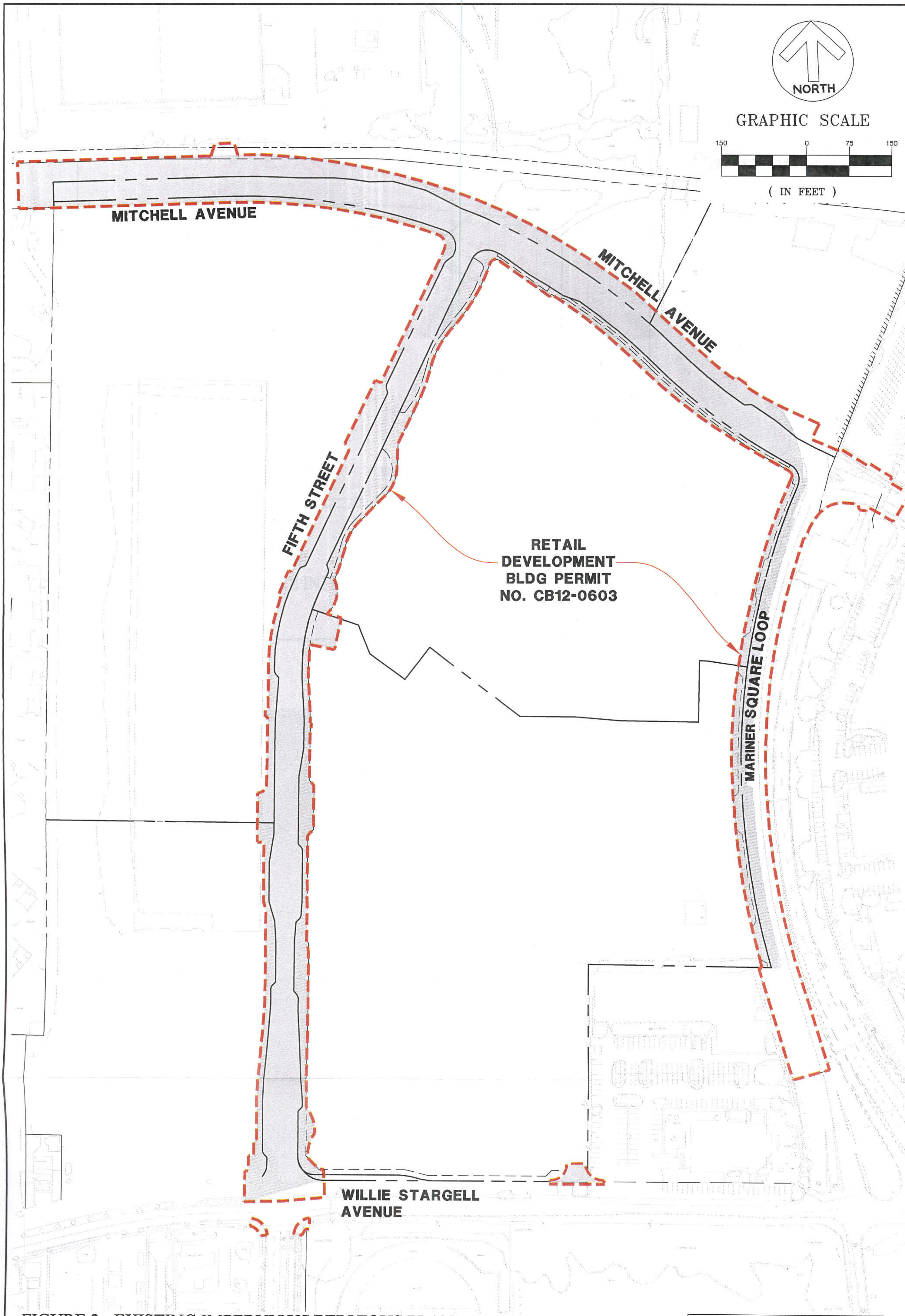

FIGURE 2 - EXISTING IMPERVIOUS/PERVIOUS PLAN
ALAMEDA LANDING BACKBONE INFRASTRUCTURE
CITY OF ALAMEDA

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LEGEND:

- PERVIOUS AREAS [307,870 SF]
- IMPERVIOUS AREA [48,160 SF]
- LIMIT OF WORK

EXHIBIT D

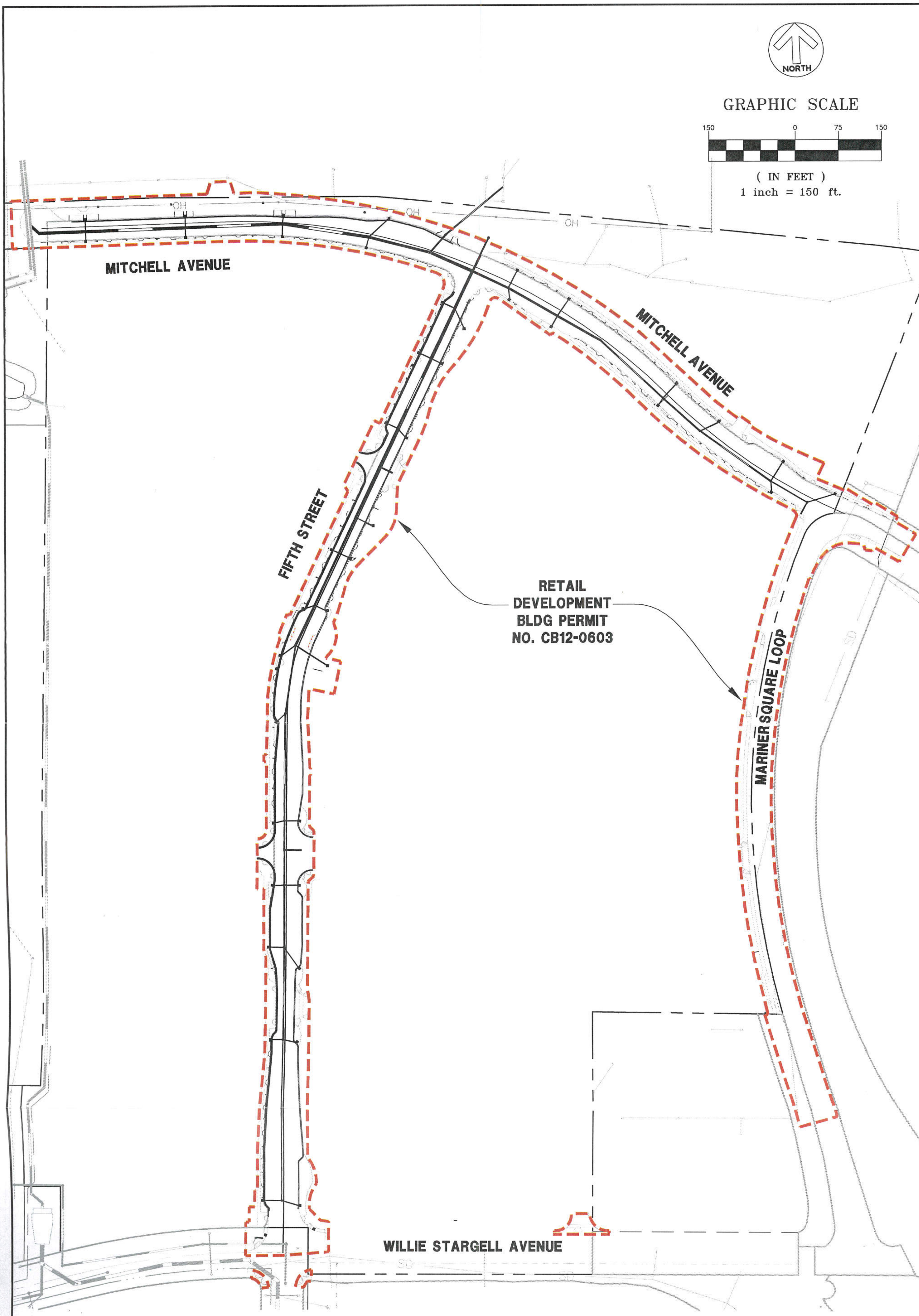

FIGURE 3 PROPOSED CONDITIONS
ALAMEDA LANDING BACKBONE INFRASTRUCTURE
CITY OF ALAMEDA
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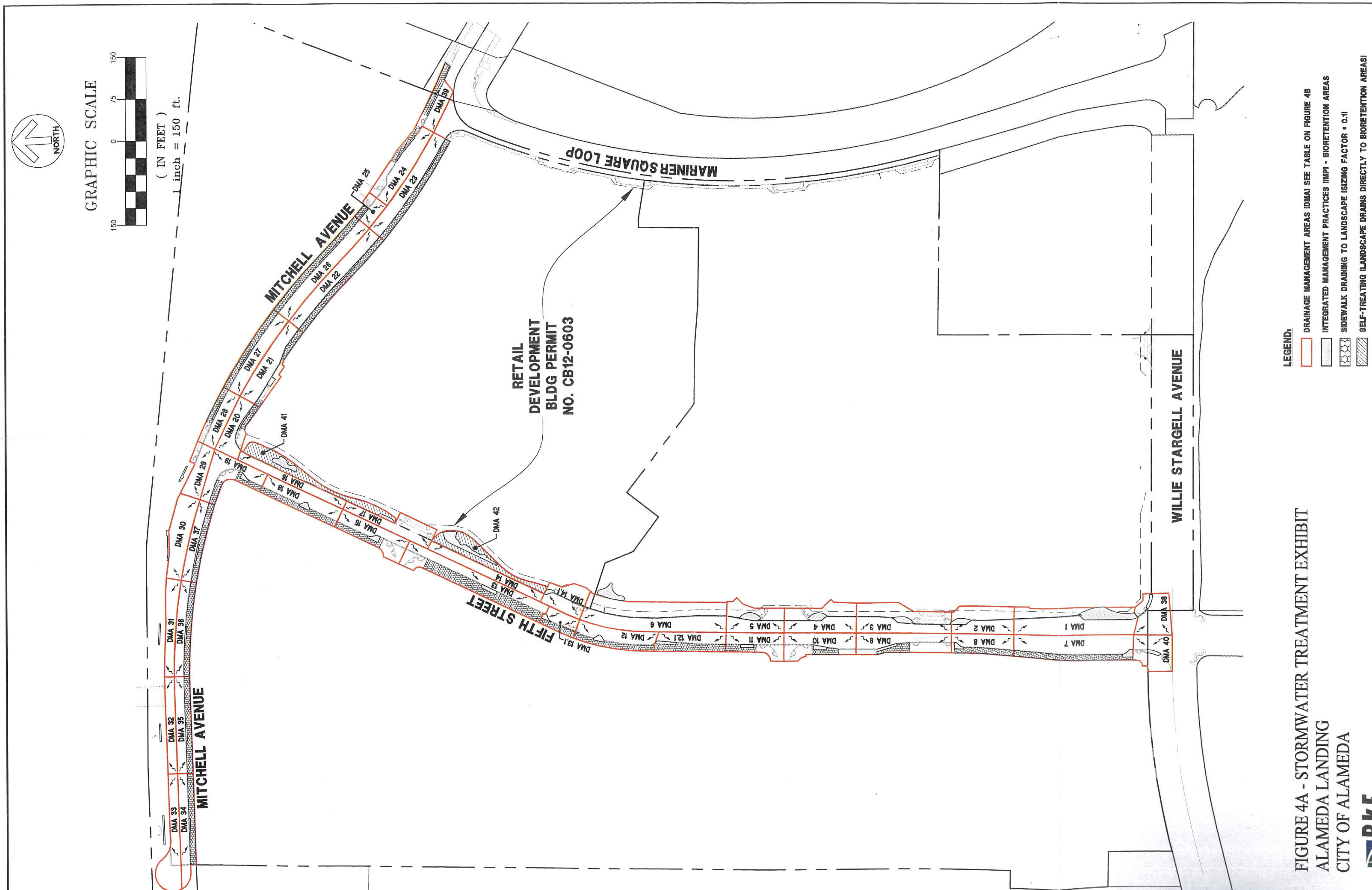
EXHIBIT D


GRAPHIC SCALE
150
75
0
150
(IN FEET)
1 inch = 150 ft.
NORTH
MITCHELL AVENUE
MARINER SQUARE LOOP
RETAIL DEVELOPMENT BLDG PERMIT NO. CB12-0603
FIFTH STREET
WILLIE STARGELL AVENUE
LEGEND:
DRAINAGE MANAGEMENT AREAS (DMA) SEE TABLE ON FIGURE 4B
INTEGRATED MANAGEMENT PRACTICES (IMP) - BIORETENTION AREAS
SIDEWALK DRAINING TO LANDSCAPE (SIZING FACTOR = 0.1)
SELF-TREATING (LANDSCAPE DRAINS DIRECTLY TO BIORETENTION AREAS)
FIGURE 4A - STORMWATER TREATMENT EXHIBIT
ALAMEDA LANDING
CITY OF ALAMEDA
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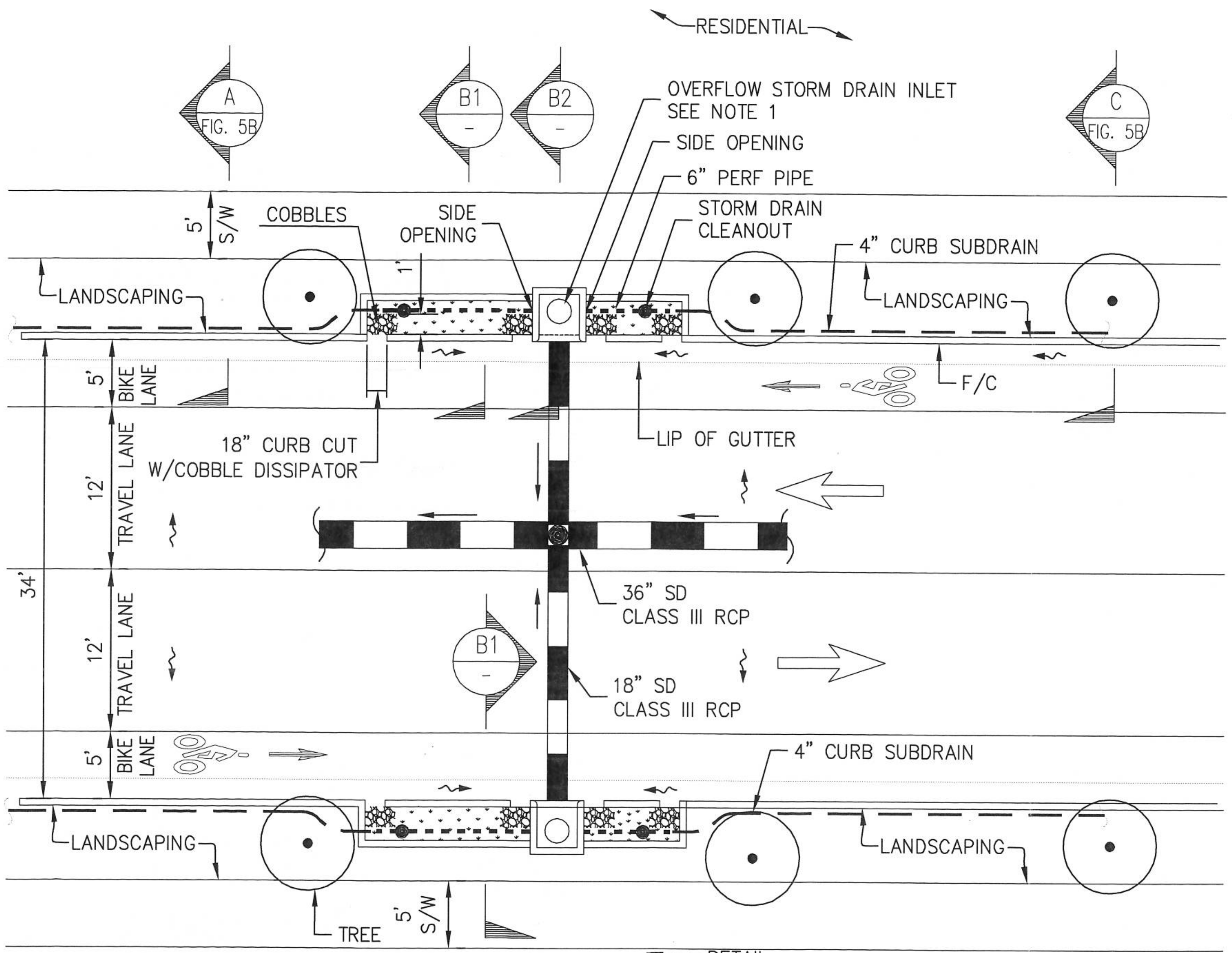
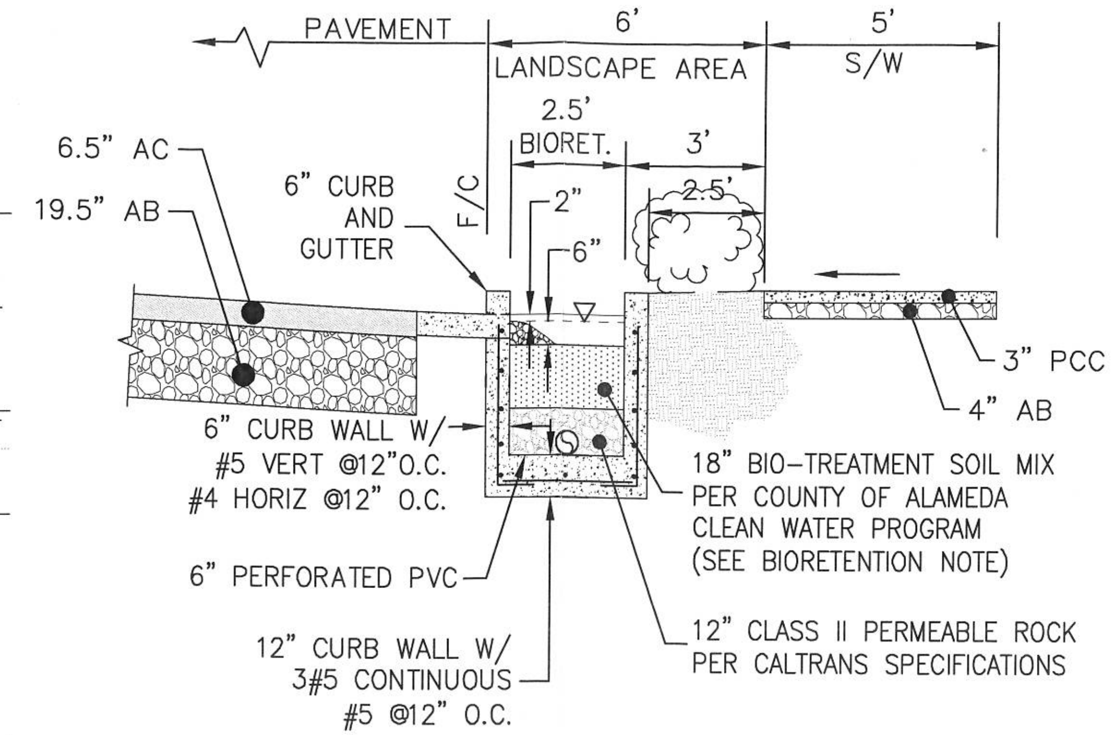
DMA #	TOTAL (SF)	PERVIOUS (SF)	IMPERVIOUS (SF)	BIO-RETENTION (SF) PROVIDED	Total C*A (SF)	C composite	.25-.5	0.5-.75	.75-1	Unit Basin Storage Volume (Table 5-2)	Project Mean Annual Precip. (inches)	I (inch)	Duration, T (hr)	Minimum Bioretention Area	Total V inflow (CF)	Volume treated (CF)	Stored V (CF)	Required depth	
1	11045	1663	9382	1663	6733.7	0.61	0.41	0.41	0.40	0.41	0.42	0.70	3.48	200.33	390.91	290.75	100.16	0.50	
2	5578	305	5273	305	3721.6	0.67	0.45	0.45	0.44	0.45	0.46	0.69	3.47	110.60	215.14	159.84	55.30	0.50	
3	8405	295	8110	295	5706.5	0.68	0.46	0.45	0.45	0.45	0.47	0.69	3.47	169.56	329.63	244.86	84.77	0.50	
4	6768	355	6413	355	4524.6	0.67	0.45	0.45	0.44	0.45	0.46	0.69	3.47	134.46	261.54	194.31	67.23	0.50	
5	5060	387	4673	387	3309.8	0.65	0.44	0.44	0.43	0.44	0.45	0.69	3.47	98.39	191.51	142.32	49.19	0.50	
6	13830	0	13830	680	9681.0	0.70	0.48	0.47	0.47	0.47	0.48	0.69	3.46	287.56	558.48	414.71	143.76	0.50	
7	9729	2399	7330	178	5370.9	0.55	0.38	0.37	0.37	0.37	0.39	0.70	3.50	159.94	313.38	233.31	80.07	0.50	
8	4081	1293	2788	116	2080.9	0.51	0.35	0.35	0.34	0.35	0.36	0.70	3.52	62.05	121.96	90.91	31.04	0.50	
9	6205	814	5391	149	3855.1	0.62	0.42	0.42	0.41	0.42	0.43	0.70	3.48	114.67	223.60	166.27	57.33	0.50	
10	6171	647	5524	142	3931.5	0.64	0.43	0.43	0.42	0.43	0.44	0.70	3.48	116.90	227.76	169.31	58.45	0.50	
11	4125	734	3391	130	2447.1	0.59	0.40	0.40	0.39	0.40	0.41	0.70	3.49	72.83	142.25	105.84	36.41	0.50	
12.1	4440	1953	2487	156	1936.2	0.44	0.30	0.30	0.29	0.30	0.31	0.70	3.52	57.76	113.60	84.72	28.88	0.50	
12	5139	1504	3635	151	2694.9	0.52	0.36	0.36	0.35	0.36	0.37	0.70	3.51	80.32	157.69	117.49	40.19	0.50	
13	9986	4333	5653	164	4390.4	0.44	0.30	0.30	0.29	0.30	0.31	0.70	3.52	130.97	257.60	192.11	65.49	0.50	
13.1	2212	800	1412	105	1068.4	0.48	0.33	0.33	0.32	0.33	0.34	0.70	3.52	31.87	62.69	46.75	15.94	0.50	**SAMPLE CALCULATION**
14	3500	0	3500	982	2450.0	0.70	0.48	0.47	0.47	0.47	0.48	0.69	3.46	72.77	141.34	104.95	36.38	0.50	
14.1	3820	101	3719	85	2613.4	0.68	0.47	0.46	0.46	0.46	0.47	0.69	3.46	77.65	150.91	112.09	38.82	0.50	
15	5082	1107	3975	146	2893.2	0.57	0.39	0.38	0.38	0.38	0.40	0.70	3.50	86.12	168.54	125.41	43.13	0.50	
16	3808	458	3350	458	2390.8	0.63	0.43	0.42	0.42	0.42	0.44	0.70	3.48	71.19	138.60	103.17	35.43	0.50	
17	4730	0	4730	150	3311.0	0.70	0.48	0.47	0.47	0.47	0.48	0.69	3.46	98.35	191.00	141.84	49.17	0.50	
18	5261	1679	3582	150	2675.3	0.51	0.35	0.35	0.34	0.35	0.36	0.70	3.52	79.77	156.82	116.90	39.91	0.50	
19	5380	1057	4323	96	3131.8	0.58	0.40	0.39	0.39	0.39	0.41	0.70	3.49	93.18	182.23	135.55	46.68	0.50	
20	4129	484	3645	80	2599.9	0.63	0.43	0.42	0.42	0.42	0.44	0.70	3.48	77.32	150.70	112.04	38.66	0.50	
21	6167	812	5355	127	3829.7	0.62	0.42	0.42	0.41	0.42	0.43	0.70	3.48	113.91	222.13	165.17	56.95	0.50	
22	7008	1784	5224	115	3835.2	0.55	0.37	0.37	0.36	0.37	0.38	0.70	3.50	114.23	223.88	166.70	57.18	0.50	
23	7173	2235	4938	115	3680.1	0.51	0.35	0.35	0.34	0.35	0.36	0.70	3.52	109.72	215.60	160.70	54.90	0.50	
24	5967	751	5216	120	3726.3	0.62	0.42	0.42	0.41	0.42	0.43	0.70	3.48	110.83	216.07	160.66	55.41	0.50	
25	1778	198	1580	34	1125.8	0.63	0.43	0.43	0.42	0.43	0.44	0.70	3.48	33.48	65.24	48.50	16.74	0.50	
26	7022	1792	5230	117	3840.2	0.55	0.37	0.37	0.36	0.37	0.38	0.70	3.50	114.38	224.18	166.93	57.26	0.50	
27	5583	1743	3840	88	2862.3	0.51	0.35	0.35	0.34	0.35	0.36	0.70	3.52	85.34	167.70	125.00	42.70	0.50	
28	3605	631	2974	75	2144.9	0.59	0.40	0.40	0.39	0.40	0.41	0.70	3.49	63.83	124.67	92.75	31.92	0.50	
29	3238	0	3238	70	2266.6	0.70	0.48	0.47	0.47	0.47	0.48	0.69	3.46	67.33	130.76	97.10	33.66	0.50	
30	5327	0	5327	130	3728.9	0.70	0.48	0.47	0.47	0.47	0.48	0.69	3.46	110.76	215.11	159.74	55.37	0.50	
31	3548	0	3548	95	2483.6	0.70	0.48	0.47	0.47	0.47	0.48	0.69	3.46	73.77	143.27	106.39	36.88	0.50	
32	3050	0	3050	95	2135.0	0.70	0.48	0.47	0.47	0.47	0.48	0.69	3.46	63.42	123.16	91.46	31.71	0.50	
33	5180	0	5180	130	3626.0	0.70	0.48	0.47	0.47	0.47	0.48	0.69	3.46	107.70	209.18	155.33	53.85	0.50	
34	4832	1327	3505	79	2586.2	0.54	0.36	0.36	0.35	0.36	0.38	0.70	3.51	77.05	151.16	112.59	38.57	0.50	
35	4533	1473	3060	70	2289.3	0.51	0.34	0.34	0.33	0.34	0.36	0.70	3.52	68.27	134.24	100.09	34.16	0.50	
36	4421	1331	3090	69	2296.1	0.52	0.35	0.35	0.34	0.35	0.36	0.70	3.51	68.44	134.43	100.18	34.25	0.50	
37	4132	1504	2628	79	1990.0	0.48	0.33	0.33	0.32	0.33	0.34	0.70	3.52	59.36	116.76	87.07	29.69	0.50	
38	4385	0	4385	115	3069.5	0.70	0.48	0.47	0.47	0.47	0.48	0.69	3.46	91.17	177.07	131.49	45.58	0.50	
39	3285	1046	2239	64	1671.9	0.51	0.35	0.35	0.34	0.35	0.36	0.70	3.52	49.85	98.00	73.05	24.94	0.50	
40	8442	4159	4283	124	3414.0	0.40	0.27	0.28	0.26	0.27	0.28	0.70	3.52	101.84	200.31	149.39	50.92	0.50	
41	3980	3980	0	SELF - TREATING															
42	3464	3464	0	SELF - TREATING															

FIGURE 4B - STORMWATER TREATMENT TABLE
ALAMEDA LANDING BACKBONE INFRASTRUCTURE
CITY OF ALAMEDA

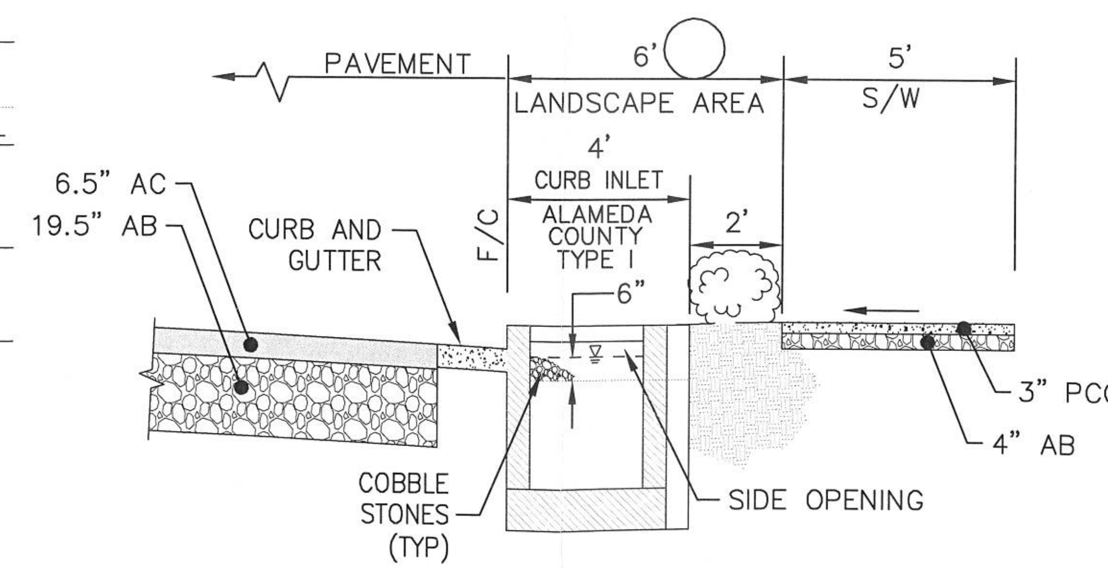
RKF



1 **PLAN VIEW** 1" = 10'



B1 **SECTION B1-B1**
1" = 4'



B2 **SECTION B2-B2**
1" = 4'

NOTE

1. LIP FROM GUTTER FLOWLINE TO CURB INLET THROAT. LOW FLOWS DRAIN THROUGH CURB CUT INTO BIORETENTION. HIGH FLOW IN BIORETENTION POND AND DRAIN INTO SIDE OPENING. CURB INLET PROVIDES EMERGENCY DRAIN IN CURB CUTS ARE BLOCKED.

FIGURE 5A - MITCHELL AVE. TYPICAL BIORETENTION DETAIL
ALAMEDA LANDING BACKBONE INFRASTRUCTURE
CITY OF ALAMEDA

BKF

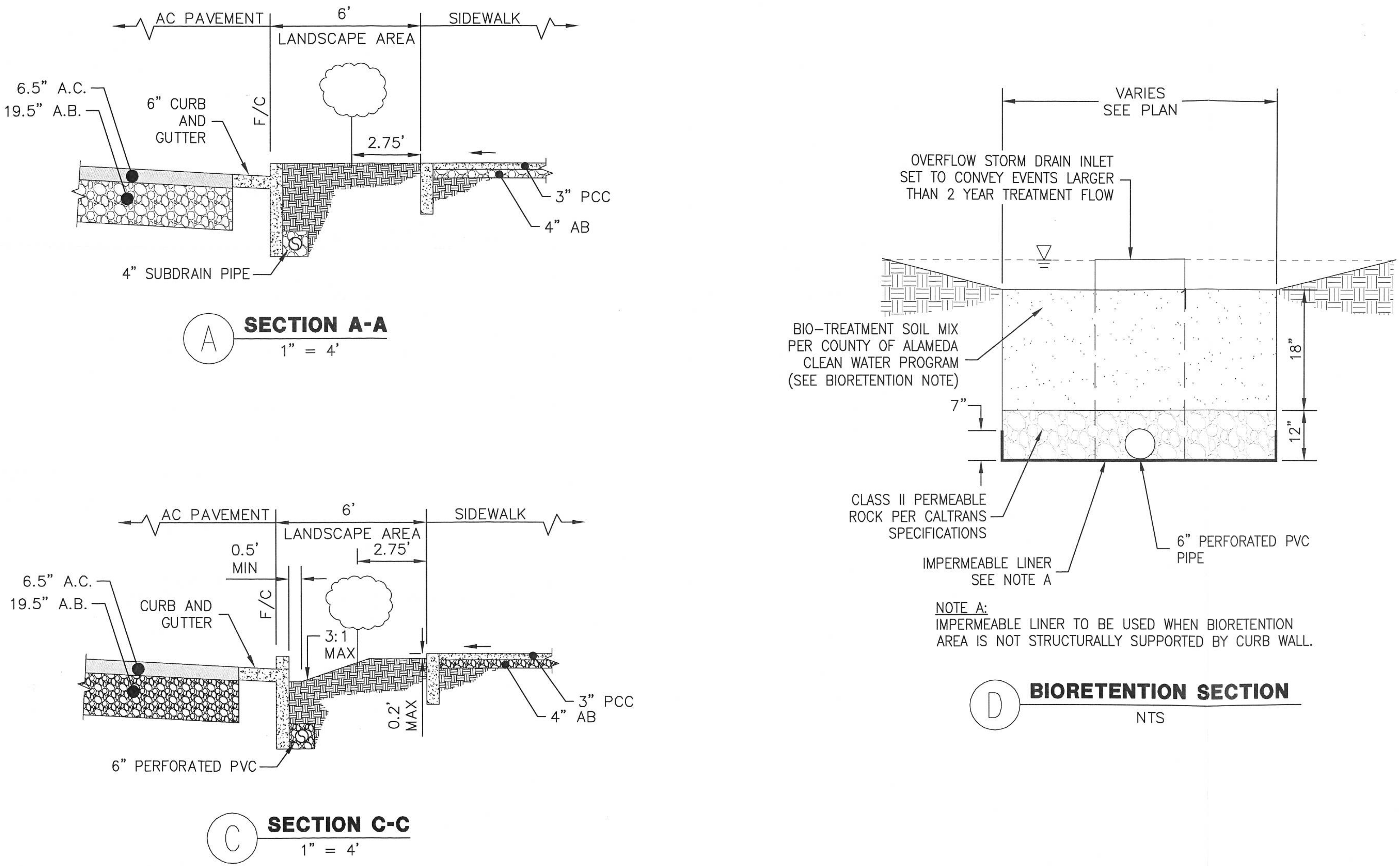


FIGURE 5B - MITCHELL AVE. TYPICAL BIORETENTION DETAIL
ALAMEDA LANDING BACKBONE INFRASTRUCTURE
CITY OF ALAMEDA

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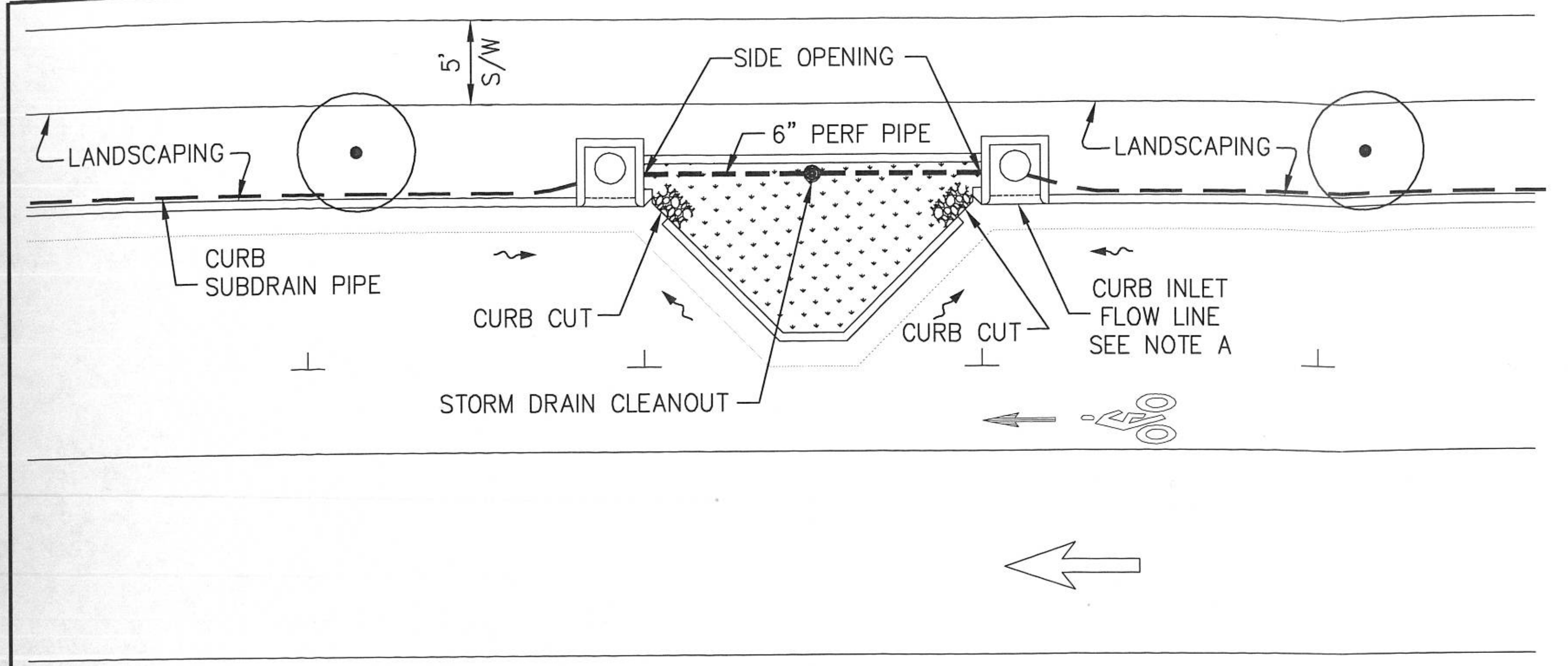
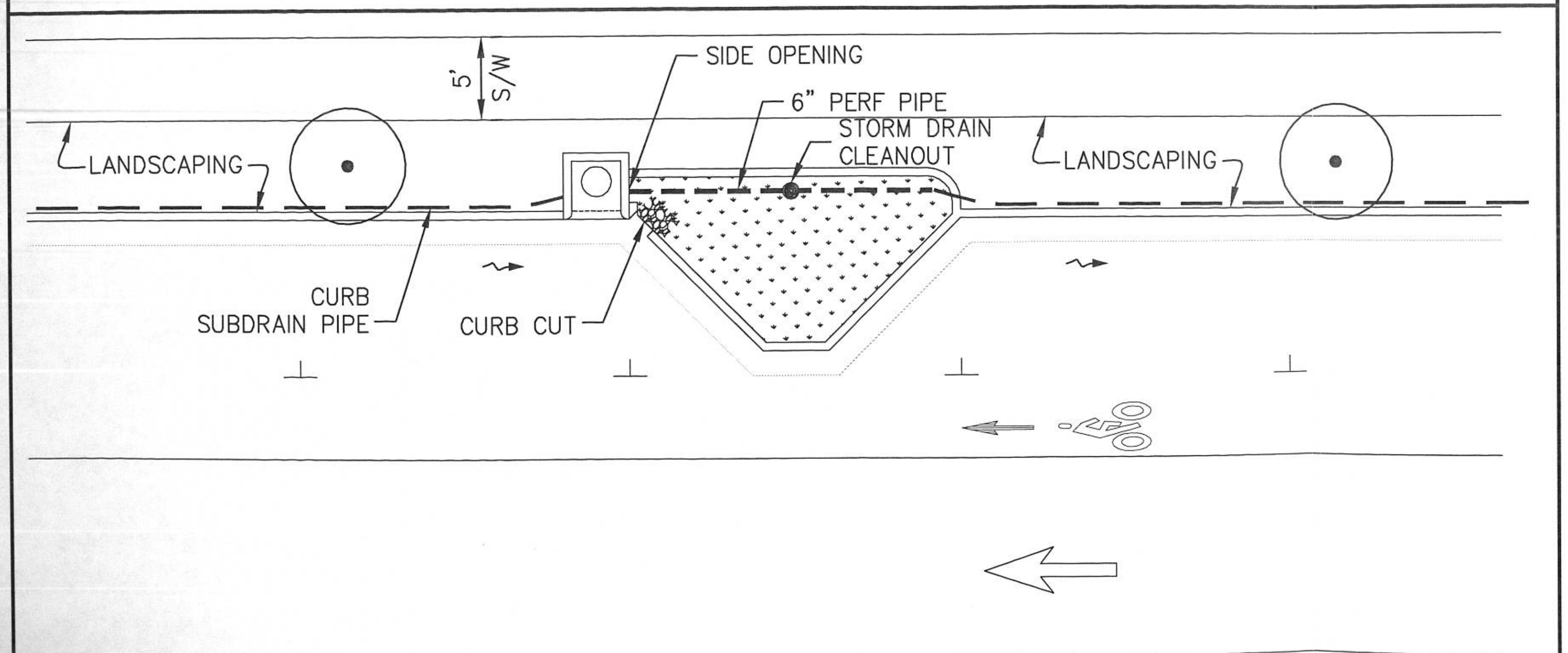


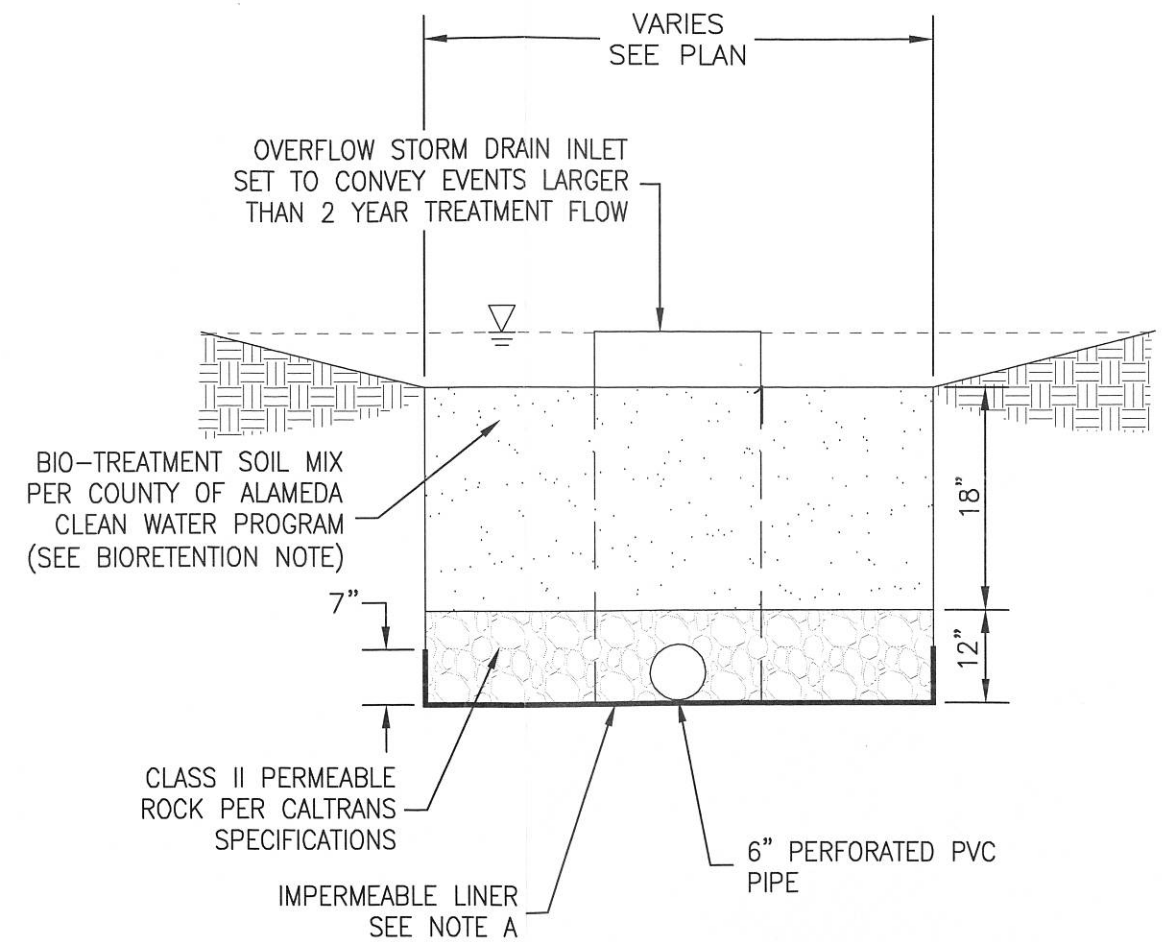
① PLAN VIEW
1" = 10'



② PLAN VIEW
1" = 10'

NOTE

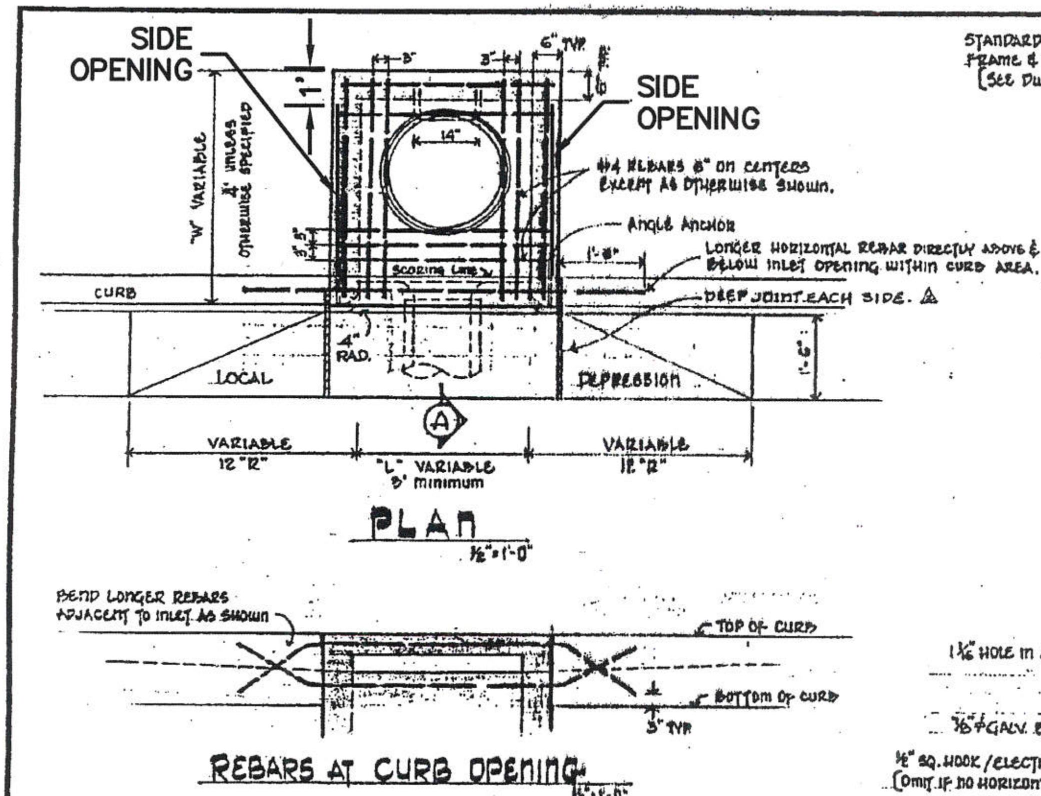
① LIP FROM GUTTER FLOWLINE TO CURB INLET THROAT. LOW FLOWS DRAIN THROUGH CURB CUT INTO BIORETENTION. HIGH FLOW IN BIORETENTION POND AND DRAIN INTO SIDE OPENING. CURB INLET PROVIDES EMERGENCY DRAIN IN CURB CUTS ARE BLOCKED.

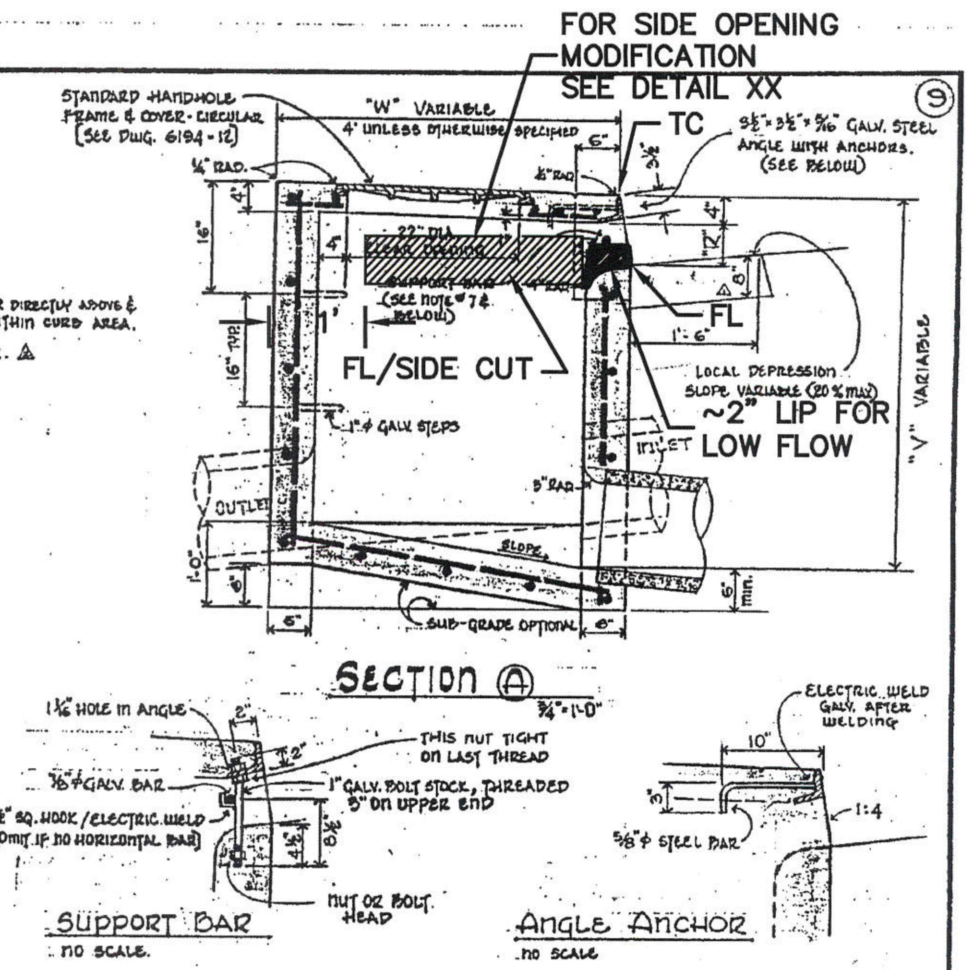


NOTE A:
IMPERMEABLE LINER TO BE USED WHEN BIORETENTION AREA IS NOT STRUCTURALLY SUPPORTED BY CURB WALL.

③ BIORETENTION SECTION
NTS

FIGURE 5C - FIFTH STREET BULB OUT BIORETENTION DETAIL
ALAMEDA LANDING
CITY OF ALAMEDA
BKF





NOTES:

1. "L", "V", "W", AND "R" AS SPECIFIED; MIN. "L" = 5', MIN. "W" = 4' & MIN. "R" = 4".
2. WHEN BOTH "L" AND "W" EXCEED THE MINIMUM VALUES (5' AND 4' RESPECTIVELY), USE A TYPE 6 CATCH BASIN (SEE DWG. NO. 6197-14).
3. INLET AND OUTLET LOCATIONS AS SPECIFIED.
4. CONCRETE SHALL BE CLASS "A".
5. REINFORCING: #4 BARS, 12" C-C EXCEPT AS SHOWN OTHERWISE.
6. ALL SPLICES IN REINFORCING SHALL HAVE 10" MIN. LAP (INCLUDING AT CORNERS)
7. HORIZONTAL PROTECTION BAR SHALL BE USED WHEN CURBFACE IS 10 INCHES OR MORE.
8. WHEN "L" EXCEEDS 5½', VERTICAL SUPPORT BARS SHALL BE USED AT 42" MAX. SPACING.
9. PIPE TO BE PLACED THROUGH CATCH BASIN WHENEVER POSSIBLE.
10. STEPS TO BE USED WHEN "V" IS GREATER THAN 3'-6".
11. EXPOSED SURFACES TO CONFORM TO ADJOINING CURB & WALK IN GRADE AND FINISH.

NO.	REVISED	BY	APP.
△	11-24-82	ALM	
△	1-21-74	AM°	

COMPILED H. WONG
DRAWN WONG / MCRORY
CHECKED T.D. EDWARDS
DATE JAN. 1974
SCALE AS NOTED

CITY OF ALAMEDA
CALIFORNIA
ENGINEERING DEPARTMENT
STANDARD
CATCH BASIN
TYPE 1

SHEET 1 OF 1
APPROVED BY M.J. Hanna
CITY ENGINEER
REG. C. E. NO. 7061
DATE 12-10-73
DWG. 6980
CASE 14

FIGURE 6 - BIORETENTION STORMDRAIN CURB INLET
ALAMEDA LANDING BACKBONE INFRASTRUCTURE
CITY OF ALAMEDA

BKF

Appendix A

EXHIBIT D

Treadwell&Rollo
A LANGAN COMPANY

13 August 2012
Project 731584101

Mr. Bill Kennedy
Catellus Alameda Landing Development, LLC
66 Franklin Street, Suite 200
Oakland, California 94607

Subject: Geotechnical Consultation
Alameda Landing Backbone Infrastructure
Alameda, California

Dear Mr. Kennedy:

This letter presents updated recommendations for the design and construction of the proposed backbone infrastructure (Backbone) improvements at the Alameda Landing Redevelopment project site. We understand that the Backbone improvements consist of extending Mitchell Avenue to the east, 5th Street to the north through the site, and re-constructing and widening Mariners Square Loop. The approximate locations of the proposed Backbone improvements are shown on Figure 1. We recently completed a geotechnical investigation of Mariners Square Loop, and presented the results of our investigation, conclusions and recommendations in our report titled *Geotechnical Evaluation Mariner Square Loop Improvements, Alameda Landing, Alameda, California,* dated 5 July 2012. In addition we have recently completed supplemental subsurface investigations for the planned retail center and residential developments. The approximate locations of the available borings and Cone Penetration Tests (CPTs) performed at the site are shown on Figure 2.

Preliminary recommendations were presented in a report prepared by Treadwell & Rollo Inc. titled *Preliminary Geotechnical Investigation Report Alameda Landing, Alameda California*, dated 21 June 2007. This letter presents updated recommendations for the Backbone improvements considering the results of the recently completed additional field and laboratory testing completed as part of the more recent geotechnical investigations at the site.

1.0 SUBSURFACE CONDITIONS

Available subsurface data indicate the site is blanketed by 4.5 to 23 feet of fill. The fill generally consists of loose to medium dense clayey sand and sand with varying amounts of gravel, and expansive very soft to soft clay and silt. The fill is underlain by about 15 to over 90 feet of weak, compressible Bay Mud. The upper several feet of Bay Mud is generally medium-stiff to stiff, presumably from past desiccation. Layers of loose to medium dense sand have been encountered within the Bay Mud deposit. The approximate thickness of the Bay Mud across the site is presented on Figure 2. The Bay Mud is underlain by Older Marine deposits generally consisting of medium dense to very dense sand with varying amounts of silt and clay, and stiff to very stiff clay interbedded with thin discontinuous silty sand layers to the maximum depth explored [156.0 feet below the existing ground surface (bgs), Elevation -153 feet].

The groundwater level was previously measured in the borings between 2.5 and 12.5 feet bgs, and pore pressure dissipation tests performed indicate that the phreatic surface at the time of the tests ranged from approximately 5 to 11.5 feet bgs. These depths correspond to elevations ranging from about 3.5 and -3.0 feet. Groundwater was encountered in the borings during our supplemental investigations at depths ranging from of 4.5 to 4.75 feet bgs (Elevations 0.5 to -1.2 Feet). Groundwater levels are expected to fluctuate seasonally and with the tides in the nearby channel.

EXHIBIT D

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2.0 CONCLUSIONS

The primary geotechnical issues that should be addressed during design are: 1) settlement behavior of new roadways and utilities as the Bay Mud consolidates under the weight of existing and new fill, 2) variable thickness of the Bay Mud, 3) seismic hazards, including the potential for liquefaction-induced settlement, 4) the presence of existing pile foundations, 5) variability and strength of the soil subgrade, and 6) the impact of Bay Mud at shallow depths below the ground surface on site grading and installation of foundations and utilities. Our updated conclusions and recommendations for design and construction of the proposed improvements are presented in the following sections.

2.1 Settlement Considerations

The results of our studies indicate that the primary consolidation of the Bay Mud layer due to the existing fill at the site is essentially complete. We estimate that the ground surface at the site left in its current condition over the next 50 years could settle from less than ½ inch where the Bay Mud layer is 30 feet thick to approximately four inches where the Bay Mud layer is 90 feet thick. This settlement is primarily due to the long term secondary compression of the Bay Mud.

Constructing new structures and/or placement of new fill at the site will begin a new cycle of consolidation of the Bay Mud and resulting ground surface settlement. The amount and rate of consolidation settlement depends upon: 1) the weight of any new fill and/or structural loads, 2) the thickness of the existing fill, 3) the thickness of the Bay Mud deposit (including the dredged Bay Mud fill), 4) the degree to which desiccation has overconsolidated the upper portion of the Bay Mud deposit, and 5) the presence of sand layers within the Bay Mud deposit. These factors vary significantly across the site making it difficult to generalize the amount of total and differential settlement expected beneath improvements. We have estimated settlements for certain conditions and the results are discussed in the following sections.

2.1.1 Settlement from New Fill

New fill placed at the project site will cause additional settlement due to compression of the existing fill above the Bay Mud and consolidation of the Bay Mud layer. Settlement of the existing fill should occur soon after placement of new fill and the magnitude of settlement is generally much less than the settlement due to consolidation of the Bay Mud. Therefore, for the purpose of this discussion, we have ignored the contribution of fill compression to the total settlement.

We have estimated consolidation settlements at the site considering various thicknesses of new fill and existing Bay Mud thicknesses. The results of our settlement analyses are shown in Figures 3 through 6. As shown in these figures the estimated rate and magnitude of settlement vary significantly. Differential settlements due to the new fill can be estimated by using the estimated settlements in Figures 3 through 6 and the Bay mud thicknesses shown on Figure 2.

Our analyses consider the generalized conditions beneath the site, however because of the complexity of the subsurface conditions, and because the data is from widely spaced borings and CPTs, the curves should be considered as approximate. The magnitude of the settlement estimates, however, provides a qualitative indication that significant ground settlement will have to be accommodated during design.

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2.1.2 Seismic Hazards

Strong shaking during an earthquake can result in ground failures such as those associated with soil liquefaction,[1] lateral spreading,[2] and cyclic densification.[3] These hazards are discussed in the following paragraphs.

2.1.2.1 Cyclic Densification

Seismically-induced compaction or cyclic densification of non-saturated sand (sand above the groundwater table) caused by earthquake vibrations may result in ground surface settlement. The fill encountered above the groundwater table generally consists of mixtures of sand and clay and is relatively thin. We conclude the granular portion of the existing fill is sufficiently dense and is relatively thin, therefore, we conclude that the risk of cyclic densification is low and if it occurs its contribution to the overall seismically induced-settlement will be small.

2.1.2.2 Liquefaction-Induced Settlement

A report prepared by Tejima & Associates (1989) indicated that liquefaction occurred during the 1989 Loma Prieta Earthquake in localized portions of the Coast Guard Housing (CGH) complex to the west of the Alameda Redevelopment project. Liquefaction was also documented at the Alameda Naval Air Station (NAS). The evidence of liquefaction consisted of ground surface cracking and the formation of sand boils. Sand boils were observed in a landscaped area adjacent to an existing day care center and at the location of a backfilled boring near the day care center. Medium dense fine sand was encountered between depths of 7 and 10 feet in the boring where the sand boil was observed.

Our liquefaction analyses were performed in general accordance with the methodology presented in NCEER and Youd et al. (2001) using data obtained from our CPTs, and laboratory testing. We considered peak ground accelerations (PGA) of 0.36 times gravity (g[4]) in our liquefaction analyses. This PGA corresponds to the 2010 CBC Design Earthquake (DE) for an S_E site classification. Based on the results of our subsurface explorations and laboratory testing programs, we identified layers of loose to medium dense sand with varying amounts of silt that may be susceptible to liquefaction during a strong seismic event.

---

1 Liquefaction is a transformation of soil from a solid to a liquefied state during which saturated soil temporarily loses strength resulting from the buildup of excess pore water pressure, especially during earthquake-induced cyclic loading. Soil susceptible to liquefaction includes loose to medium dense sand and gravel, low-plasticity silt, and some low-plasticity clay deposits.

2 Lateral spreading is a phenomenon in which surficial soil displaces along a shear zone that has formed within an underlying liquefied layer. Upon reaching mobilization, the surficial blocks are transported downslope or in the direction of a free face by earthquake and gravitational forces.

3 Cyclic densification is a phenomenon in which non-saturated, cohesionless soil is densified by earthquake vibrations, causing ground-surface settlement.

4 g refers to the force of gravity. Gravity is equal to the acceleration of objects under its influence, which at the earth's surface is approximately 32.2 feet per second squared (ft/sec^2).

We used the method developed by Tokimatsu and Seed (1987) to estimate the amount of settlement that can occur based on the CPT results. We estimate liquefaction-induced settlements ranging from approximately 2/3-inch to 5-inches for DE level of ground shaking. In general, the majority of the potentially liquefiable layers are within the existing fill and Bay Mud, or just below the Bay Mud. Improvements and foundations bearing above these layers may lose support and settle. The liquefiable layers encountered below the Bay Mud appear to be relatively thin and discontinuous.

Hazards associated with liquefaction of soil layers relatively close to the ground surface include formation of sand boils, lurch cracking, and loss of bearing capacity for shallow foundations. The potential for these phenomena to occur depends on the thickness of the liquefiable soil layer relative to the thickness of the overlying non-liquefiable material. Ishihara (1985) developed an empirical relation that provides approximate boundaries for liquefaction-induced surface damage for soil profiles consisting of a liquefiable layer overlain by a liquefaction resistant, or protective, surface layer. Using the Ishihara method, we conclude the potential exists for liquefaction-induced ground surface damage to occur at the site when the peak ground acceleration during an earthquake exceeds 0.3g.

2.2 Subgrade Soil Characteristics

Previous Soil Resistance Tests (R-value) have been performed on numerous samples of the existing fill on and adjacent to the site. In tests were performed on samples of the existing fill materials collected within five feet of the existing ground surface. The R-values of the existing fill material tested range from 14 to 71. The higher R-values were obtained from samples of sandy soil near the existing Webster Tube and are not considered representative of the general near surface soil conditions at the site.

2.3 Construction Considerations

Excavation for utilities may be difficult because of the presence of granular fill, weak Bay Mud, and a high groundwater table. We judge excavation cuts will generally not stand vertically. Gently sloping, open cuts and/or shoring will be required. Because of the high groundwater table, dewatering may be required to facilitate utility installation.

In general, the material excavated from utility trenches will be wet and will require considerable drying before it can be reused as compacted fill. Aeration and discing will likely be necessary to dry the material. Trench spoils other than Bay Mud should be spread out on other parts of the site to allow them to dry. From past experience, we conclude it is generally impractical to reuse Bay Mud as trench backfill because of the significant effort required to reduce its moisture content so that compaction can be achieved. Therefore, we recommend that excavated Bay Mud be removed from the site or processed (dried) for use as fill in landscape areas. Moisture conditioned existing granular fill (not Bay Mud) or imported granular material should be used to backfill utility trenches.

Grading in areas where poorly compacted fill or Bay Mud is within a few feet of the existing ground surface is expected to be difficult. Based on our experience; repeated construction traffic on thin fill overlying soft clay generally results in excessive deflections ("pumping") and rutting of the ground surface. Recommended measures for mitigating poor quality subgrade materials, and/or wet weather construction are provided in subsequent sections of this letter.

EXHIBIT D

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3.0 RECOMMENDATIONS

3.1 Subgrade Preparation and Fill Placement

Prior to grading, demolition of the former improvements on the site, particularly underground utilities will be required. Former improvements such as pavements, underground utilities, old foundations, or other obstructions should be removed when encountered. An exception are existing pile foundations, which may be cut off at least five feet below: 1) finished grade (top of pavements, or slabs of grade); or 2) the bottom of excavations for new utilities, whichever is deeper. If an excavation extends below the groundwater during demolition activities, the portion of the resulting excavation below the groundwater level should be filled with ¾-inch crushed rock. If fine grained soil (clay or Bay Mud) is exposed at the base of the excavation, it may be necessary to place a geotextile fabric (Mirafi 500X or equivalent) over the base of the excavation prior to placement of the rock to prevent the rock from being pushed into the fine grained soil. Once a firm base is established above the groundwater level, compacted fill can be placed on the crushed rock. A layer of filter fabric, such as Mirafi 140N, should be placed between the crushed rock and compacted fill to reduce the potential fines infiltrating into the voids between the crushed rock particles. If sandy soil is encountered below the groundwater table it may be necessary to wrap the crushed rock in the filter fabric to prevent "piping" of the sandy soil into the voids in the rock, which could result in ground surface settlement.

Where existing utilities underlie areas to receive new improvements, they should be removed or abandoned in-place by filling them with grout. The procedure for in-place abandonment of utilities should be evaluated on a case-by-case basis, and will depend on the locations of existing utilities in relation to the proposed improvements. However, in general, we recommend that existing utilities within four feet of final grades be removed and the resulting excavations properly backfilled. Concrete and asphalt generated by demolition of the existing improvements may be reused as engineered fill provided they are broken into pieces smaller than four inches in maximum diameter with no more than 50 percent of the particles (by dry weight) being larger than two inches and are acceptable from an environmental standpoint. These materials should be mixed with sufficient fine-grained material to minimize the presence of voids.

Areas to receive fill should be stripped of vegetation and organic topsoil. The stripped soil may be stockpiled for later use as fill in landscaped areas; organic topsoil should not be used as compacted fill. The subgrade exposed at the bottoms of the proposed building pad excavations, as well as other portions of the site that will receive new fill or site improvements, should be scarified to a depth of at least eight inches, moisture-conditioned to above optimum moisture content, and compacted to at least 90 percent relative compaction[5]. For pavement areas the upper six inches of the pavement subgrade should be compacted to at least 95 percent relative compaction.

If areas of weak soil are encountered during subgrade preparation and/or grading is performed during wet weather, we recommend these areas be repaired/protected using one of the subgrade repair options presented in Section 3.2 of this report.

---

5 Relative compaction refers to the in-place dry density of soil expressed as a percentage of the maximum dry density of the same material, as determined by the ASTM D1557-07 laboratory compaction procedure.

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In general excavated materials, with the exception of Bay Mud, can generally be reused as fill at the site. Any imported fill placed during grading should meet the following criteria:

- be non-hazardous
- be free of organic matter
- contain no rocks or lumps larger than three inches in greatest dimension
- have a low expansion potential (defined by a liquid limit of less than 40 and Plasticity Index lower than 12)
- be non-corrosive
- be approved by the geotechnical engineer.

All fill should be moisture-conditioned to above optimum moisture content, placed in horizontal lifts not exceeding eight inches in loose thickness, and compacted to at least 90 percent relative compaction, except fill placed within proposed pavement areas. In these areas the upper six inches of the soil subgrade and all aggregate base materials should be compacted to at least 95 percent relative compaction. Where used, sand containing less than 10 percent fines (particles passing the No. 200 sieve) should also be compacted to at least 95 percent relative compaction.

Samples of proposed import fill materials should be submitted to the geotechnical engineer for approval at least three business days prior to use at the site. The grading subcontractor should also provide analytical test results or other suitable environmental documentation to the project environmental engineer for approval prior to importing fill to the site.

3.2 Wet Weather Grading and Subgrade Stabilization

This section presents alternatives to mitigate wet and/or weak subgrade soil, or for grading during wet weather. They are:

1) Scarify and aerate the upper 12 to 24 inches of soil to reduce its moisture content so that it can be compacted to meet the compaction requirements. For this alternative, several weeks of dry, warm weather may be required, and up to 12 inches of soil may need to be removed to allow deeper aeration and then placed back and compacted.

2) Mix and compact the upper 12 to 18 inches of the weak soil with lime or high alkali cement whichever is most appropriate for the soil encountered. Typically a minimum of 5 percent (by dry weight) of lime or cement is required to stabilize weak soil. It should be noted that lime- or cement-admixtures will raise the pH of the soil, which could adversely impact plants; therefore, we recommend that the landscape architect be consulted prior to the selection of this subgrade repair alternative.

3) Over excavate the upper 12 to 18 inches of the weak soil, and backfill with a lean concrete backfill.

4) Over excavate the upper 12 to 24 inches of the weak soil, place a geotextile (Mirafi 500X or equivalent) over the sides and bottoms of the over-excavated areas, and place and compact granular fill, such as ½- to ¾-inch crushed rock or Class 2 aggregate base, over the geotextile fabric.

We recommend a non-vibratory roller be used to compact weak and/or wet subgrade soil. The most appropriate alternative will depend on the time of year that site grading commences and how much time is available to allow for drying of the soil as well as the size of the area to be treated.

3.3 Underground Utilities

We anticipate that excavations for utility trenches can be readily made with a backhoe; however, debris may be encountered in the fill. All trenches should conform to the current CAL-OSHA requirements.

The thickness and type of bedding material required for utility conduits will depend on the soil conditions at the utility trench bottom. As a minimum, bedding should have a thickness of at least D/4 (with D equal to the outside pipe diameter) below the bottom of the pipe, and a minimum thickness of four inches. Clean sand, rod mill, or pea gravel bedding material are acceptable for use as bedding materials in shallow trenches above the groundwater level.

In general, soil backfill for utility trenches should be compacted according to the recommendations presented in Section 3.1 except for the upper three feet of utility trench backfill (measured below the top of pavement) should be compacted to at least 95 percent relative compaction per City of Alameda requirements. Jetting and flooding of trench backfill should not be allowed. Special care should be taken when backfilling utility trenches in pavement areas. Poor compaction may cause excessive settlements, resulting in damage to the pavement section.

3.4 Concrete Flatwork

In areas to receive sidewalks or other flatwork, the subgrade should be scarified to a depth of at least 12 inches, moisture-conditioned to above optimum moisture content, and compacted to at least 90 percent relative compaction. Exterior concrete flatwork should be underlain by at least four inches of Class 2 aggregate base compacted to at least 90 percent relative compaction.

3.5 Flexible Pavement Design

The State of California flexible pavement design method was used to develop a pavement section for the roadway widening, where new pavement is planned. The near-surface fill generally consists of sand with varying amounts of silt, clay, and gravel, and sandy clay with varying amounts of silt and gravel. We used a resistance value of 14 for design which is the minimum R-value of the soil samples tested previous investigations. Our updated recommendations for new flexible pavements are presented in Table 1.

TABLE 1
Recommended New Flexible Pavement Sections for Subgrade R-Value of 14

Design TI	Asphalt Concrete (inches)	Class II Aggregate Base (R=78) (inches)	Total Thickness (inches)
7	11.0 (deep lift)	0	11.0
	4.0	14.0	18.0
8	11.5 (deep lift)	0	11.5
	5.0	15.0	20.0
9	13.5 (deep lift)	0	13.5
	5.5	18.0	23.5
10	14.5 (deep lift)	0	14.5
	6.5	19.5	26.0

All pavement materials (asphalt concrete, aggregate base, etc.) should conform to the current State of California (Caltrans) Standard Specifications.

3.6 Drainage and Landscaping

Positive surface drainage should be provided direct surface water away from foundations, and/or towards appropriate collection and disposal facilities. To reduce the potential for water ponding we recommend the ground surface be designed to slope with a surface gradient of at least two percent in unpaved (landscape, unimproved, etc.) areas and one percent in paved (sidewalks, roadways etc.) areas. These preliminary gradients should be checked once final grading plans and anticipated cut/fill thicknesses are known.

To reduce the potential for irrigation water infiltrating below concrete flatwork (sidewalks and patios) or entering the pavement sections (flexible and/or rigid), vertical curbs adjacent to landscaped areas should extend at least six inches below the bottom of the baserock. Where heavily watered areas (lawns and/or unlined storm water retention facilities, etc.) are located adjacent to paved areas, it may also be necessary to install a subdrain behind the curb or within the pavement to intercept excess water.

Drainage below pavements, exterior concrete, or around or below catch basins to collect subsurface or perched groundwater water are not anticipated. If catch basins are to be located below the groundwater additional weight may be required to resist hydrostatic uplift pressures.

EXHIBIT D

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4.0 LIMITATIONS

The conclusions and recommendations presented in this report apply to the site and construction conditions as we have described them, and are the result of engineering studies and our interpretations of the existing geotechnical conditions. Actual subsurface conditions may vary. Should conditions substantially differ from those anticipated, some modifications to our conclusions and recommendations may be necessary.

We trust that this letter provides the information you require at this time. If you have any questions, please call.

Sincerely yours,
TREADWELL & ROLLO, A LANGAN COMPANY

REGISTERED PROFESSIONAL ENGINEER
HAZE M. RODGERS
NO. 2818
Exp. 06/30/14
GEOTECHNICAL
STATE OF CALIFORNIA

Haze M. Rodgers, GE
Senior Project Engineer

Richard D. Rodgers, GE
Senior Principal

REGISTERED PROFESSIONAL ENGINEER
RICHARD D. RODGERS
NO. 732
EXP 12/31/13
GEOTECHNICAL
STATE OF CALIFORNIA

731584101.13_HMR_Geotechnical Consultation

Attachments: Figure 1 – Conceptual Development Plan
Figure 2 –Bay Mud Thickness
Figure 3 – Estimated Consolidation Settlement vs. Time 1 foot New Fill
Figure 4 – Estimated Consolidation Settlement vs. Time 2 feet New Fill
Figure 5 – Estimated Consolidation Settlement vs. Time 3 feet New Fill
Figure 6 – Estimated Consolidation Settlement vs. Time 4 feet New Fill