APPENDIX E

PRELIMINARY WATER QUALITY MANAGEMENT PLAN AND DRAINAGE REPORT

E-1: PRELIMINARY WATER QUALITY MANAGEMENT PLAN (WQMP)
E-2: PRELIMINARY HYDROLOGIC AND HYDRAULIC DRAINAGE REPORT

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E-1: Preliminary Water Quality Management Plan (WQMP)

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Preliminary Water Quality Management Plan (WQMP)

Project Name:

Enterprise Business Center

26200 Enterprise Way

Prepared for:

Ares Management

4675 MacArthur Court, Suite 625

Newport Beach, California, 92660

(949) 892-4911

Prepared by:

Kier + Wright

April 19, 2023

Engineer <u>Garrett Readler</u> **Registration No.** <u>76867</u>

8955 Research Drive

Irvine, California, 92618

(949) 508-0202

Project **Owner's Certification**			
Permit/Application No.	06-21-5437	Grading Permit No.	
Tract/Parcel Map No.	APN: 610-401-06	Building Permit No.	
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract)			

This Water Quality Management Plan (WQMP) has been prepared for Ares Management by Kier & Wright. The WQMP is intended to comply with the requirements of the local NPDES Stormwater Program requiring the preparation of the plan.

The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with the current Orange County Drainage Area Management Plan (DAMP) and the intent of the non-point source NPDES Permit for Waste Discharge Requirements for the County of Orange, Orange County Flood Control District and the incorporated Cities of Orange County within the Santa Ana Region. Once the undersigned transfers its interest in the property, its successors-in-interest shall bear the aforementioned responsibility to implement and amend the WQMP. An appropriate number of approved and signed copies of this document shall be available on the subject site in perpetuity.

Owner: Black Creek Group			
Name	Christopher Sanford		
Company	Ares Management		
Address	4675 MacArthur Court, Suite 625, Newport Beach, CA 92660		
Email	Chris.sanford@aresmgmt.com		
Telephone #	(949) 892-4911		
Signature		Date	

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Appendices

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B .... BMP Maintenance Manual
C .... Geotechnical Soils Report
D .... Infiltration Report
E .... Web Soil Survey
F .... Hydrology Report
G .... Request of Flow Reduction

Section I Discretionary Permit(s) and Water Quality Conditions

Project Information			
Permit/Application No.	06-21-5437	Tract/Parcel Map No.	APN: 610-401-06
Additional Information/ Comments:			
Water Quality Conditions			
Water Quality Conditions (list verbatim)	• Project that create 10,000 square feet or more of impervious surface • Parking lot area of 5,000 square feet or more, or with 15 of more parking spaces, and potentially urban runoff. • All significant redevelopement projects, where significant redevelopment is defined as the addition or replacement of 5,000 or more square feet of impervious surface on an already developed site. • WQMP must be approved prior to issuance of grading permit.		
Watershed-Based Plan Conditions			
Provide applicable conditions from watershed - based plans including WIHMPs and TMDLS.	Newport Bay Watershed WIHMP		

Section II Project Description

II.1 Project Description

The proposed project includes the demolition and removal of one two-story building of 74,960 sf footprint with 144,906 total square footage, as well a majority of the parking lot. The existing parking lot area was 265,897 sf. The existing site drained to various curb inlets thoughout the parking lot where it then was routed out to the public network. The proposed building will be 160,810 sf and the proposed parking area will be 160,400 sf. The proposed landscape for the site will be 35,196 sf. The proposed site will flow to various new inlets and one existing inlet where they will be treated by linear modular wetland systems. After treatment, the stormwater will exit the site using the existing connections to the public network. The peak flow leaving the site will be reduced by 40% by the use of an underground detention system and orifice. The total disturbed soil area is 366,687 square feet.

Description of Proposed Project				
Development Category (Verbatim from WQMP):	All significant redevelopment projects, where significant redevelopment is defined as the addition or replacement of 5,000 or more square feet of impervious surface on an already developed site. Redevelopment does not include routine maintenance activities that are conducted to maintain original line and grade, hydraulic capacity, original purpose of the facility, or emergency redevelopment activity required to protect public health and safety			
Project Area (ft_2): 366,687	Number of Dwelling Units: 0		SIC Code: 4226	
Narrative Project Description:	Single story spec warehouse with parking, landscaping, and two floors of office space. Existing site to be demolished.			
Project Area	Pervious		Impervious	
	Area (acres or sq ft)	Percentage	Area (acres or sq ft)	Percentage
Pre-Project Conditions	62,365 sf	17%	304,774 sf	83%
Post-Project Conditions	35,196 sf	9.6%	331,410 sf	90.4%
Drainage Patterns/Connections	The existing drainage patterns will be preserved.			

II.2 Potential Stormwater Pollutants

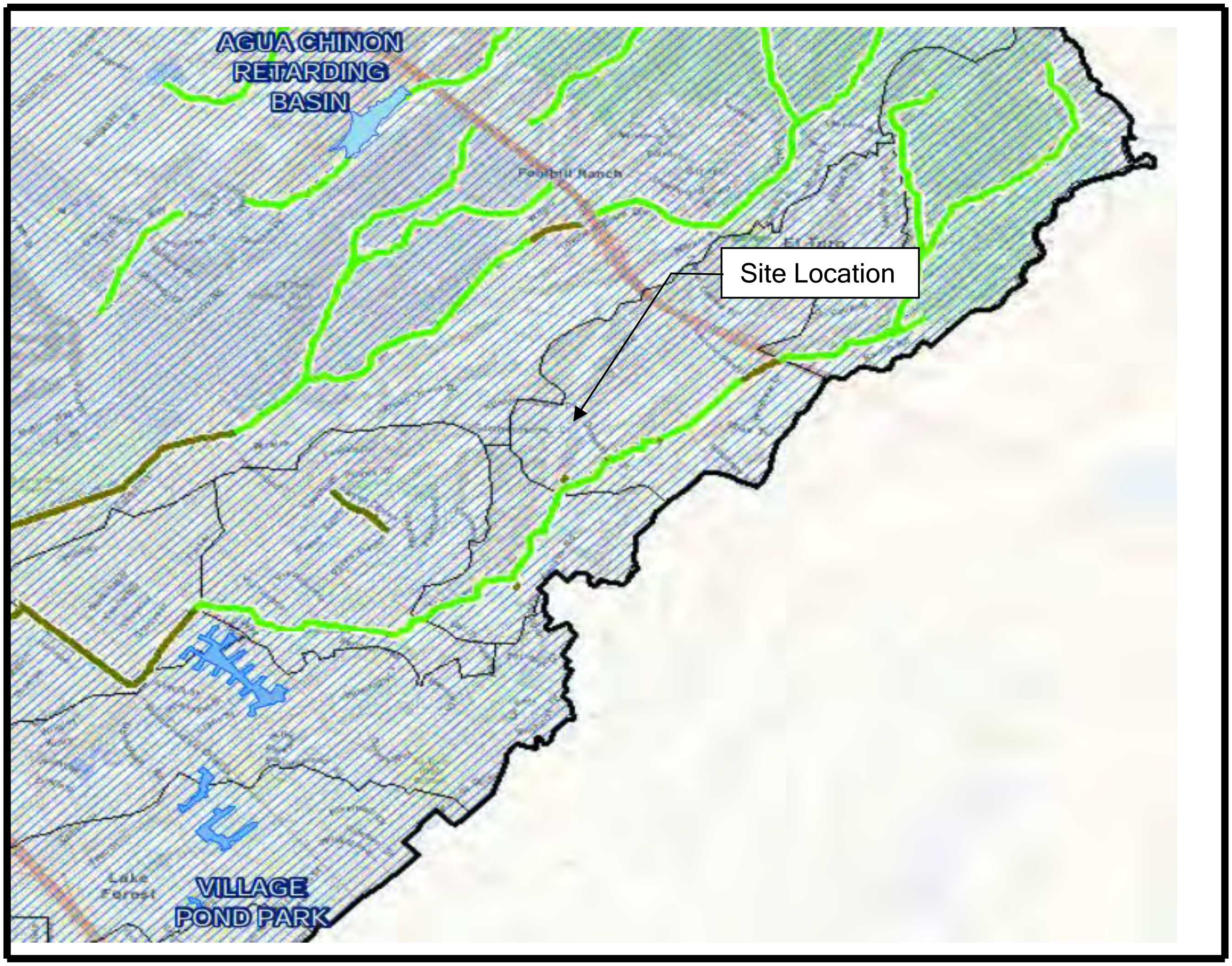
Pollutants of Concern			
Pollutant	Circle One: E=Expected to be of concern N=Not Expected to be of concern		Additional Information and Comments
Suspended-Solid/ Sediment	E	N	Erosion control to be provided. Runoff will be treated before being discharged.
Nutrients	E	N	Runoff will be treated before being discharged.
Heavy Metals	E	N	No manufacturing taking place.
Pathogens (Bacteria/Virus)	E	N	No onsite septic, discharge to public sewer.
Pesticides	E	N	Minimum use of pesticides on landscaping. Runoff will be treated before being discharged.
Oil and Grease	E	N	From parked vehicles and trucks. Runoff will be treated before being discharged.
Toxic Organic Compounds	E	N	No toxic substances used.
Trash and Debris	E	N	Trash will be disposed of within dumpsters. Site maintenance will be provided by local congregations on a weekly basis.

II.3 Hydrologic Conditions of Concern

☐ No

☒ Yes

Figure XVI-3 from the TGD indicates the site is in an area with downstream streams that are susceptible to potential erosion.



II.4 Post Development Drainage Characteristics

The proposed site will be split into seven drainage areas where the runoff will be treated and then discharged into the public system. Drainage will be routed to underground detention chambers before treatment to reduce the peak flow leaving. Since the existing parking is being demolished and removed, new curb and gutter will be utilized to flow runoff to these curb inlets. We will utilize the two existing connections to the public storm drain network to convey the flow off the site. The site has little offsite flow as the developed areas around it contain their own runoff. The existing public storm drain outfalls to Serrano Creek southwest of our site at the end Prism Place.

II.5 Property Ownership/Management

Describe property ownership/management. *Refer to Section 2.2.5 in the TGD.*

The owner of the property is Black Creek Group.

Section III Site Description

III.1 Physical Setting

Planning Area/ Community Name	Pacific Commercentre Planned Community
Location/Address	26200 Enterprise Way
	Lake Forest, CA, 92630
Land Use	Office Space / Industrial
Zoning	LI – Light Industrial
Acreage	8.43
Predominant Soil Type	Group D Soils/Dense Silty Sands with varying clay content

III.2 Site Characteristics

Precipitation Zone	Type I rainfall distribution
Topography	The terrain slopes northeast to southwest with slopes generally less than 6%.
Drainage Patterns/Connections	The existing parking lot utilizes gutters to convey flow to catch basins throughout the lot
Soil Type, Geology, and Infiltration Properties	Soil Type D/ Dense Silty Sand with 0.1-0.3 in/hr Infiltration (See Appendix E – Web Soil Survey, Appendix C – Geotechnical Soils Report, and Appendix D – Infiltration Report)

Site Characteristics (continued)	
Hydrogeologic (Groundwater) Conditions	Groundwater was not encountered during any drilling of any of the bores. Due to this, the static groundwater table is considered to have existed at a depth in excess of 30 feet at the time.
Geotechnical Conditions (relevant to infiltration)	The majority of the site is silty sands and clayey sands with a very slow infiltration rate.
Off-Site Drainage	No offsite drainage is entering or crossing the site.
Utility and Infrastructure Information	Electrical, sanitary, and water will be supplied to the building.

III.3 Watershed Description

Receiving Waters	Serrano Creek to San Diego Creek to the Pacific Ocean
303(d) Listed Impairments	Ammonia (unionized), benthic community effects, indicator bacteria, pH, toxicity
Applicable TMDLs	Sediment, Nutrient, Toxic
Pollutants of Concern for the Project	Metals
Environmentally Sensitive and Special Biological Significant Areas	Serrano Creek susceptible to erosion due to high flows leaving the site. See Appendix I

Section IV Best Management Practices (BMPs)

IV. 1 Project Performance Criteria

Describe project performance criteria. Several steps must be followed in order to determine what performance criteria will apply to a project. These steps include:

- If the project has an approved WIHMP or equivalent, then any watershed specific criteria must be used, and the project can evaluate participation in the approved regional or sub- regional opportunities. The local Permittee planning or NPDES staff should be consulted regarding the existence of an approved WIHMP or equivalent.
- Determine applicable hydromodification control performance criteria. *Refer to Section 7.II- 2.4.2.2 of the Model WQMP.*
- Determine applicable LID performance criteria. *Refer to Section 7.II-2.4.3 of the Model WQMP.*
- Determine applicable treatment control BMP performance criteria. *Refer to Section 7.II*-3.2.2 *of the Model WQMP.*
- Calculate the LID design storm capture volume for the project. *Refer to Section 7.II-2.4.3 of the Model WQMP.*

(NOC Permit Area only) Is there an approved WIHMP or equivalent for the project area that includes more stringent LID feasibility criteria or if there are opportunities identified for implementing LID on regional or sub-regional basis?	YES ☐	NO ☒
If yes, describe WIHMP feasibility criteria or regional/sub-regional LID opportunities.		

Project Performance Criteria (continued)	
If HCOC exists, list applicable hydromodification control performance criteria (Section 7.II-2.4.2.2 in MWQMP)	Hydrologic Condition of Concern does exist in the discharge to Serrano Creek. The 100-year peak flow contributing to Serrano Creek must be reduced by 40%
List applicable LID performance criteria (Section 7.II-2.4.3 from MWQMP)	Underground pipe storage system is being used to reduce the discharge by 40% as requested.
List applicable treatment control BMP performance criteria (Section 7.II-3.2.2 from MWQMP)	Modular Wetland Systems for treatment of runoff.
Calculate LID design storm capture volume for Project.	N/A. Proposed drainage improvements are to reduce the flow leaving our site by 40% as requested.

IV.2. SITE DESIGN AND DRAINAGE PLAN

Describe site design and drainage plan including

- The site will be split into seven drainage areas where flow will be directed to curb inlets and treated. Parts of the existing curb and gutter will be utilized to convey flow towards proposed catch basins. The roof drains will discharge to the treatment area before being sent to an underground pipe storage system for detention and outflow control.
- Seven DMA's have been designed with catch basins and treatment systems to capture flow
- WQMP plot plan: see sheets PG-GP and PG-SWMP for the conceptual grading and drainage plan.
- Flow based design was used to size the DMB's for each drainage area:

DMA No.	Area (SF)	Area (AC)	Landscape (SF)	Landscape (AC)	Imperv. (SF)	Imper. (AC)	Treatment Flow (CFS)	Total Treatment Flow (CFS)	Bioclean Model Number
A1	58999	1.354	10,723	0.246	48,276	1.108	0.27	1.31	MWS-L-8-8
A2	48903	1.123	2,330	0.053	46,573	1.069	0.25		
A3	141302	3.244	2,504	0.057	138,798	3.186	0.75		
A4	7784	0.179	2,178	0.050	5,606	0.129	0.03		
B1	21200	0.487	4,482	0.103	16,718	0.384	0.09	0.21	MWS-L-8-12
B2	14416	0.331	2,761	0.063	11,655	0.268	0.06		
B3	10207	0.234	977	0.022	9,230	0.212	0.05		
C1	8292	0.190	419	0.010	7,873	0.181	0.04	0.30	MWS-L-4-8
C2	30796	0.707	2,789	0.064	28,007	0.643	0.15		
C3	24708	0.567	6,034	0.139	18,674	0.429	0.10		

IV.3 LID BMP SELECTION AND PROJECT CONFORMANCE ANALYSIS

IV.3.1 Hydrologic Source Controls

Hydrological source control BMPs are not used on our project as we are treating all of the stormwater on site and controlling the flow once it has been treated to meet a 40% reduction in total flow leaving the site. We are treating the site's stormwater with modular wetland systems placed throughout the site where runoff will be treated before being released. We are achieving the reduction in flow by storing a large portion of the runoff and releasing it at a controlled rate.

Name	Included?
Localized on-lot infiltration	☐
Impervious area dispersion (e.g. roof top disconnection)	☐
Street trees (canopy interception)	☐
Residential rain barrels (not actively managed)	☐
Green roofs/Brown roofs	☐
Blue roofs	☐
Impervious area reduction (e.g. permeable pavers, site design)	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐

IV.3.2 Infiltration BMPs

Infiltration BMPs are not to be used on this project. From the Infiltration Report found in Appendix D, “Based on the results of the infiltration testing at the subject site, infiltration is not considered feasible at this site due to the presence of dense engineered fill soils, comprised of silty sands and clayey sands, which possess very poor infiltration characteristics.”

Name	Included?
Bioretention without underdrains	☐
Rain gardens	☐
Porous landscaping	☐
Infiltration planters	☐
Retention swales	☐
Infiltration trenches	☐
Infiltration basins	☐
Drywells	☐
Subsurface infiltration galleries	☐
French drains	☐
Permeable asphalt	☐
Permeable concrete	☐
Permeable concrete pavers	☐
Other:	☐
Other:	☐

IV.3.3 Evapotranspiration, Rainwater Harvesting BMPs

If the full Design Storm Capture Volume cannot be met with infiltration BMPs, describe any evapotranspiration, rainwater harvesting BMPs.

Name	Included?
All HSCs; *See Section IV.3.1*	☐
Surface-based infiltration BMPs	☐
Biotreatment BMPs	☒
Above-ground cisterns and basins	☐
Underground detention	☒
Other:	☐
Other:	☐
Other:	☐

Underground detention system is to reduce the overall flow leaving the site by 40%.

IV.3.4 Biotreatment BMPs

If the full Design Storm Capture Volume cannot be met with infiltration BMPs, and/or evapotranspiration and rainwater harvesting BMPs, describe biotreatment BMPs. Include sections for selection, suitability, sizing, and infeasibility, as applicable.

Name	Included?
Bioretention with underdrains	☐
Stormwater planter boxes with underdrains	☐
Rain gardens with underdrains	☐
Constructed wetlands	☐
Vegetated swales	☐
Vegetated filter strips	☐
Proprietary vegetated biotreatment systems	☒
Wet extended detention basin	☐
Dry extended detention basins	☐
Other:	☐
Other:	☐

IV.3.5 Hydromodification Control BMPs

Flow leaving the site must be reduced by 40%. This is achieved by having the largest DMA flow to an underground pipe storage system and controlling the outflow.

Hydromodification Control BMPs	
BMP Name	BMP Description
Underground pipe storage system	Flow is sent here after being treated and the outlet is controlled to allow for a 40% reduction in overall flow leaving the site.

IV.3.6 Treatment Control BMPs

Modular wetland systems will be used to treat stormwater on site.

Treatment Control BMPs	
BMP Name	BMP Description
Modular Wetland Systems	Modular wetland systems will be utilized in three treatment drainage areas (A, B, & C) to treat incoming flow. Prior to being treated, flow will be routed to the underground detention system where the peak flow leaving the system will be reduced. The two existing connections to the public storm drain network will be utilized to convey flow off our the site after treatment.

IV.3.7 Non-structural Source Control BMPs

Fill out non-structural source control check box forms or provide a brief narrative explaining if non- structural source controls were not used.

Non-Structural Source Control BMPs				
Identifier	Name	Check One		If not applicable, state brief reason
		Included	Not Applicable	
N1	Education for Property Owners, Tenants and Occupants	☒	☐	
N2	Activity Restrictions	☒	☐	
N3	Common Area Landscape Management	☒	☐	
N4	BMP Maintenance	☒	☐	
N5	Title 22 CCR Compliance (How development will comply)	☒	☐	
N6	Local Industrial Permit Compliance	☒	☐	
N7	Spill Contingency Plan	☐	☒	No storage tanks on site.
N8	Underground Storage Tank Compliance	☒	☐	
N9	Hazardous Materials Disclosure Compliance	☐	☒	No hazardous materials.
N10	Uniform Fire Code Implementation	☒	☐	
N11	Common Area Litter Control	☒	☐	
N12	Employee Training	☒	☐	
N13	Housekeeping of Loading Docks	☒	☐	
N14	Common Area Catch Basin Inspection	☒	☐	
N15	Street Sweeping Private Streets and Parking Lots	☒	☐	
N16	Retail Gasoline Outlets	☐	☒	N/A

IV.3.8 Structural Source Control BMPs

Fill out structural source control check box forms or provide a brief narrative explaining if Structural source controls were not used.

Structural Source Control BMPs				
Identifier	Name	Check One		If not applicable, state brief reason
		Included	Not Applicable	
S1	Provide storm drain system stenciling and signage	☒	☐	
S2	Design and construct outdoor material storage areas to reduce pollution introduction	☐	☒	No material stored outside.
S3	Design and construct trash and waste storage areas to reduce pollution introduction	☒	☐	
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	☒	☐	
S5	Protect slopes and channels and provide energy dissipation	☒	☐	
	Incorporate requirements applicable to individual priority project categories (from SDRWQCB NPDES Permit)	☐	☒	No dewatering on site.
S6	Dock areas	☒	☐	
S7	Maintenance bays	☐	☒	No maintenance bays.
S8	Vehicle wash areas	☐	☒	No vehicle wash areas.
S9	Outdoor processing areas	☐	☒	No outdoor processing areas.
S10	Equipment wash areas	☐	☒	No equipment wash areas,
S11	Fueling areas	☐	☒	No fueling areas
S12	Hillside landscaping	☒	☐	
S13	Wash water control for food preparation areas	☐	☒	No food prep areas.
S14	Community car wash racks	☐	☒	No car wash racks.

IV.4 ALTERNATIVE COMPLIANCE PLAN (IF APPLICABLE)

IV.4.1 Water Quality Credits

Water quality credits are not applicable.

Description of Proposed Project		
Project Types that Qualify for Water Quality Credits (Select all that apply):		
☐ Redevelopment projects that reduce the overall impervious footprint of the project site.	☐ Brownfield redevelopment, meaning redevelopment, expansion, or reuse of real property which may be complicated by the presence or potential presence of hazardous substances, pollutants or contaminants, and which have the potential to contribute to adverse ground or surface WQ if not redeveloped.	☐ Higher density development projects which include two distinct categories (credits can only be taken for one category): those with more than seven units per acre of development (lower credit allowance); vertical density developments, for example, those with a Floor to Area Ratio (FAR) of 2 or those having more than 18 units per acre (greater credit allowance).
☐ Mixed use development, such as a combination of residential, commercial, industrial, office, institutional, or other land uses which incorporate design principles that can demonstrate environmental benefits that would not be realized through single use projects (e.g. reduced vehicle trip traffic with the potential to reduce sources of water or air pollution).	☐ Transit-oriented developments, such as a mixed use residential or commercial area designed to maximize access to public transportation; similar to above criterion, but where the development center is within one half mile of a mass transit center (e.g. bus, rail, light rail or commuter train station). Such projects would not be able to take credit for both categories, but may have greater credit assigned	☐ Redevelopment projects in an established historic district, historic preservation area, or similar significant city area including core City Center areas (to be defined through mapping).

☐ Developments with dedication of undeveloped portions to parks, preservation areas and other pervious uses.	☐ Developments in a city center area.	☐ Developments in historic districts or historic preservation areas.	☐ Live-work developments, a variety of developments designed to support residential and vocational needs together - similar to criteria to mixed use development; would not be able to take credit for both categories.	☐ In-fill projects, the conversion of empty lots and other underused spaces into more beneficially used spaces, such as residential or commercial areas.

Calculation of Water Quality Credits (if applicable)	

IV.4.2 Alternative Compliance Plan Information

Alternative compliance plan is not applicable.

Section V Inspection/Maintenance Responsibility for BMPs

Fill out information in table below. Prepare and attach an Operation and Maintenance Plan. Identify the mechanism through which BMPs will be maintained. Inspection and maintenance records must be kept for a minimum of five years for inspection by the regulatory agencies. *Refer to Section 7.II 4.0 in the Model WQMP.*

BMP Inspection/Maintenance			
BMP	Reponsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
Modular Wetland System	Owner	Remove trash	Remove trash every 6-12 months
Modular Wetland System	Owner	Remove sediment	Remove sediment every 12-24 months
Modular Wetland System	Owner	Replace cartridge filter,	Replace cartridge filter every 12-24 months
Modular Wetland System	Owner	Replace drain down filter.	Replace drain down filter every 12-24 months
Education of property owners, tenants, and occupants	Owner	Distribute practical information materials that contribute to the protection of stormwater quality.	Prior to construction and as needed
Activity restrictions	Owner	Restricts activities that compromise the surface water quality	As needed
Common area landscape management	Owner	Refer to CASQA BMP Handbook (SC-73)	Weekly and as needed
Tittle 22 CCR compliance	Owner	If hazardous waste is encountered, the management of the waste will comply with Title 22	As needed

BMP Inspection/Maintenance			
BMP	Reponsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
Local industrial permit compliance	Owner	Ensure that clean stormwater is discharged from the site	As needed
Underground storage tank compliance	Owner	Ensure that underground storage tanks comply with state regulations	As needed
Uniform fire code implementation	Owner	Compliance with Article 80 of the Uniform Fire Code	During construction and as needed
Common area litter control	Owner	Refer to CASQA BMP Handbook (SC-60)	Weekly and as needed
Employee training	Owner	Training employees of businesses on practical information materials that contribute to the protection of stormwater quality	At hire and as needed
Houekeeping of loading docks	Owner	Refer to CASQA BMP Handbook (S-31)	Weekly and as needed
Common area catch basin inspection	Owner	Refer to CASQA BMP Handbook (SC-74)	80% of the area inspected, cleaned, and maintained annually with 100% of the facilities included in a two-year period
Street sweeping private streets and parking lots	Owner	Refer to CASQA BMP Handbook (SC-43 and SC-70)	Swept prior to the storm season and prior of the rainy season
Provide storm drain system stenciling and signange	Owner	Refer to CASQA BMP Handbook (SD-13)	Prior to construction and as needed

BMP Inspection/Maintenance			
BMP	Reponsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
Design and construct trash and waste storage areas to reduce pollution introduction	Owner	Refer to CASQA BMP Handbook (SD-32)	During design and construction phase
Use efficient irrigation systems and landscape design, water conservation, smart controllers, and source control	Owner	Refer to CASQA BMP Handbook (SD-12)	During design and construction phase
Protect slopes and channels and provide energy dissipation	Owner	Install permanent stabilization BMP's on disturbed slopes and inspect for large debris that would disrupt flow	Prior to a rain event and as needed, check monthly.
Dock areas	Owner	Refer to CASQA BMP Handbook (SD-31)	Weekly and as needed
Hillside landscaping	Owner	Refer to CASQA BMP Handbook (SD-10)	Prior to a rain event and as needed

Section VI Site Plan and Drainage Plan

VI.1 SITE PLAN AND DRAINAGE PLAN

- See appendix for drainage plan.

VI.2 ELECTRONIC DATA SUBMITTAL

The minimum requirement is to provide submittal of PDF exhibits in addition to hard copies. Format must not require specialized software to open.

If the local jurisdiction requires specialized electronic document formats (CAD, GIS) to be submitted, this section will be used to describe the contents (e.g., layering, nomenclature, georeferencing, etc.) of these documents so that they may be interpreted efficiently and accurately.

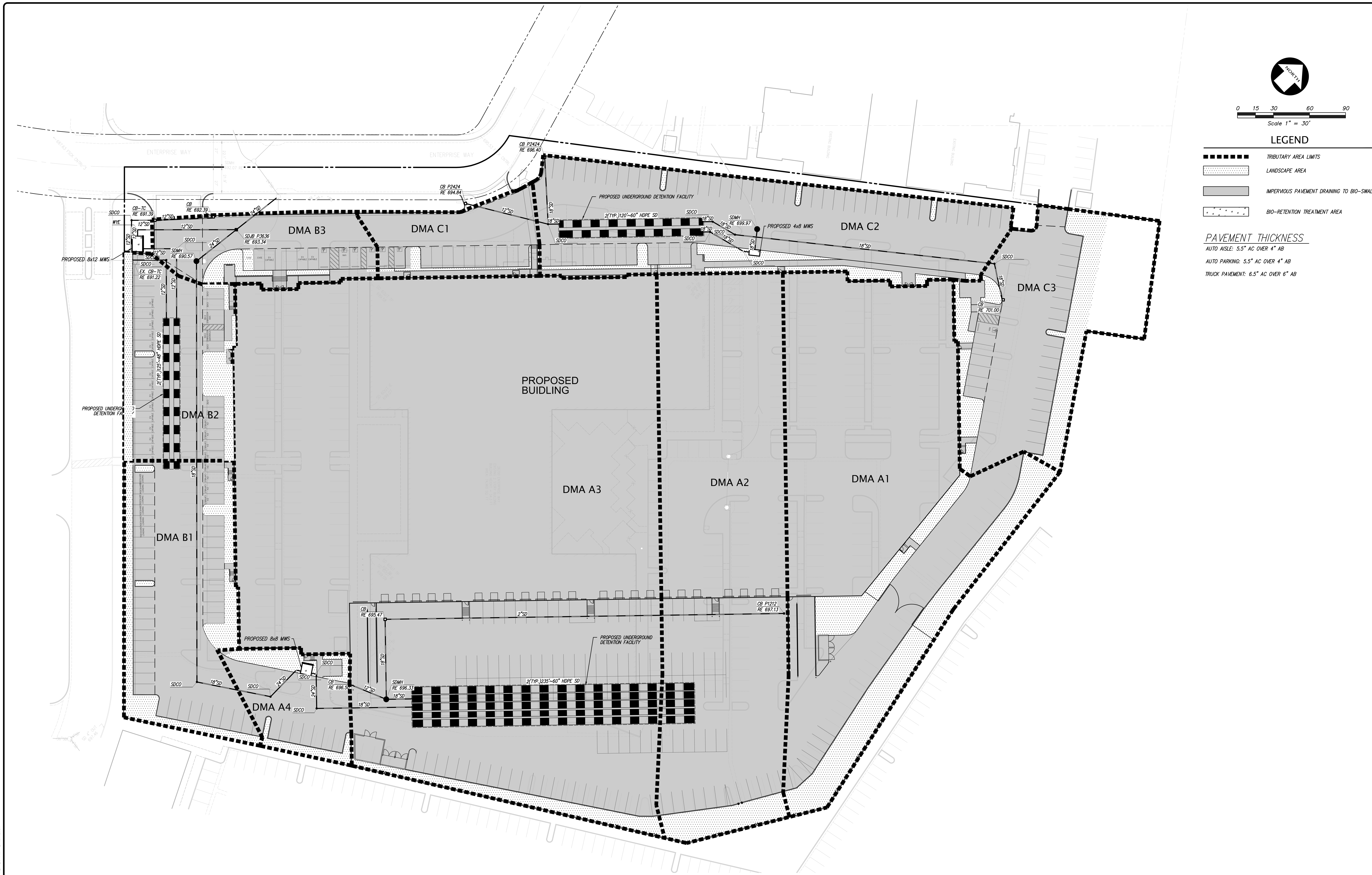
Section VII Educational Materials

Refer to the Orange County Stormwater Program (ocwatersheds.com) for a library of materials available. For the copy submitted to the Permittee, only attach the educational materials specifically applicable to the project. Other materials specific to the project may be included as well and must be attached.

Education Materials			
Residential Material (http://www.ocwatersheds.com)	Check If Applicable	Business Material (http://www.ocwatersheds.com)	Check If Applicable
The Ocean Begins at Your Front Door	☐	Tips for the Automotive Industry	☐
Tips for Car Wash Fund-raisers	☐	Tips for Using Concrete and Mortar	☒
Tips for the Home Mechanic	☐	Tips for the Food Service Industry	☐
Homeowners Guide for Sustainable Water Use	☐	Proper Maintenance Practices for Your Business	☒
Household Tips	☐	Other Material	Check If Attached
Proper Disposal of Household Hazardous Waste	☐		
Recycle at Your Local Used Oil Collection Center (North County)	☐		☐
Recycle at Your Local Used Oil Collection Center (Central County)	☐		☐
Recycle at Your Local Used Oil Collection Center (South County)	☐		☐
Tips for Maintaining a Septic Tank System	☐		☐
Responsible Pest Control	☐		☐
Sewer Spill	☐		☐
Tips for the Home Improvement Projects	☐		☐
Tips for Horse Care	☐		☐
Tips for Landscaping and Gardening	☒		☐
Tips for Pet Care	☐		☐
Tips for Pool Maintenance	☐		☐
Tips for Residential Pool, Landscape and Hardscape Drains	☐		☐
Tips for Projects Using Paint	☐		☐

Appendix A

Preliminary BMP Plan



DMA No.	Area (SF)	Area (AC)	Landscape (SF)	Landscape (AC)	Imperv. (SF)	Imper. (AC)	Treatment Flow (CFS)	Treatment Flow (CFS)	Bioclean Model Number
A1	58999	1.354	10,723	0.246	48,276	1.108	0.20	1.00	MWS-L-8-8
A2	48903	1.123	2,330	0.053	46,573	1.069	0.19		
A3	141302	3.244	2,504	0.057	138,798	3.186	0.57		
A4	7784	0.179	2,178	0.050	5,606	0.129	0.02		
B1	21200	0.487	4,482	0.103	16,718	0.384	0.07	0.16	MWS-L-8-12
B2	14416	0.331	2,761	0.063	11,655	0.268	0.05		
B3	10207	0.234	977	0.022	9,230	0.212	0.04		
C1	8292	0.190	419	0.010	7,873	0.181	0.03	0.23	MWS-L-4-8
C2	30796	0.707	2,789	0.064	28,007	0.643	0.12		
C3	24708	0.567	6,034	0.139	18,674	0.429	0.08		

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Phone: (949) 508-0202
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PRELIMINARY SWQCP OF 26200 ENTERPRISE WAY FOR BLACK CREEK GROUP

LAKE FOREST, CALIFORNIA

DATE	APRIL, 2023
SCALE	1" = 30'
DESIGNER	EK
DRAWN BY	MRF
JOB NO.	A21532
SHEET	C4.0
OF	6 SHEETS

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Appendix B

BMP Maintenance Manual

Modular Wetlands® Linear

A Stormwater Biofiltration Solution

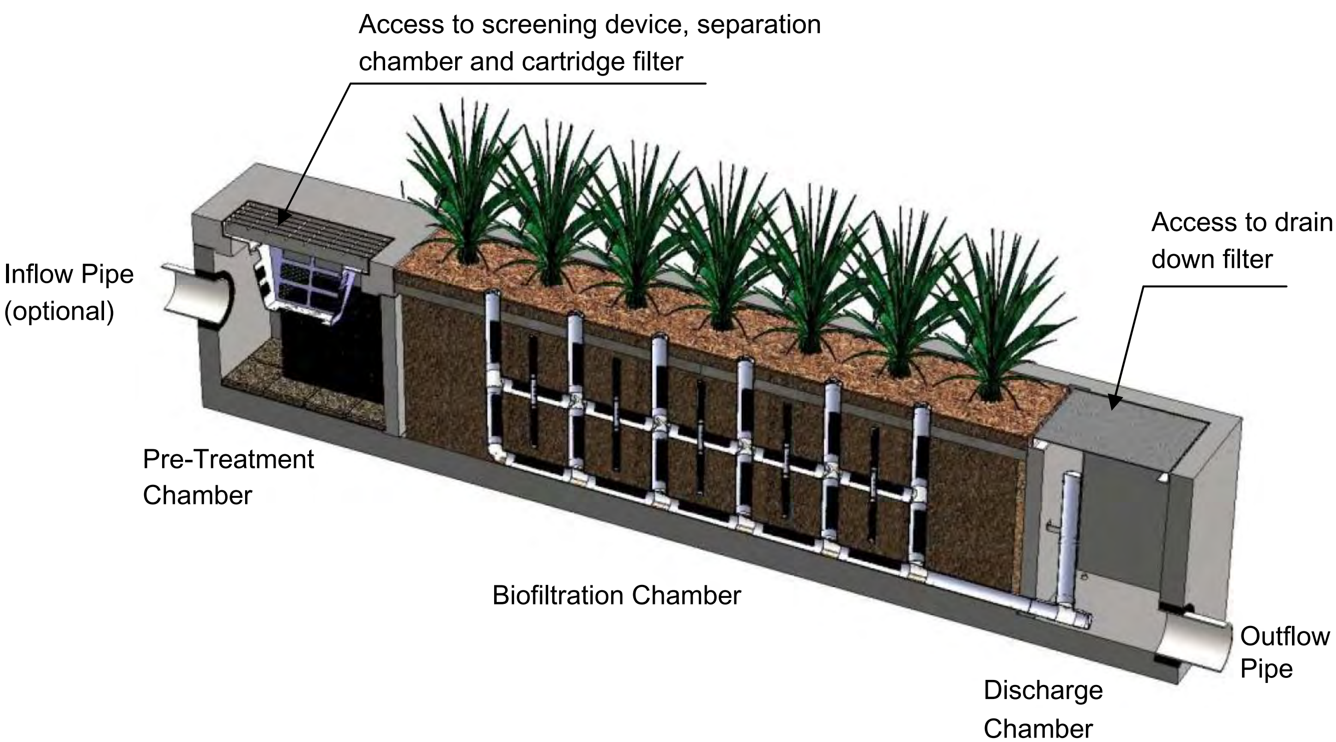
OPERATION & MAINTENANCE MANUAL

Maintenance Guidelines for Modular Wetlands Linear

Maintenance Summary

- Remove Trash from Screening Device – average maintenance interval is 6 to 12 months.
    - (*5 minute average service time*).
- Remove Sediment from Separation Chamber – average maintenance interval is 12 to 24 months.
    - (*10 minute average service time*).
- Replace Cartridge Filter Media – average maintenance interval 12 to 24 months.
    - (*10-15 minute per cartridge average service time*).
- Replace Drain Down Filter Media – average maintenance interval is 12 to 24 months.
    - (*5 minute average service time*).
- Trim Vegetation – average maintenance interval is 6 to 12 months.
    - (*Service time varies*).

System Diagram



Maintenance Procedures

Screening Device

1. Remove grate or manhole cover to gain access to the screening device in the Pre-Treatment Chamber. Vault type units do not have screening device. Maintenance can be performed without entry.
2. Remove all pollutants collected by the screening device. Removal can be done manually or with the use of a vacuum truck. The hose of the vacuum truck will not damage the screening device.
3. Screening device can easily be removed from the Pre-Treatment Chamber to gain access to separation chamber and media filters below. Replace grate or manhole cover when completed.

Separation Chamber

1. Perform maintenance procedures of screening device listed above before maintaining the separation chamber.
2. With a pressure washer spray down pollutants accumulated on walls and cartridge filters.
3. Vacuum out Separation Chamber and remove all accumulated pollutants. Replace screening device, grate or manhole cover when completed.

Cartridge Filters

1. Perform maintenance procedures on screening device and separation chamber before maintaining cartridge filters.
2. Enter separation chamber.
3. Unscrew the two bolts holding the lid on each cartridge filter and remove lid.
4. Remove each of 4 to 8 media cages holding the media in place.
5. Spray down the cartridge filter to remove any accumulated pollutants.
6. Vacuum out old media and accumulated pollutants.
7. Reinstall media cages and fill with new media from manufacturer or outside supplier. Manufacturer will provide specification of media and sources to purchase.
8. Replace the lid and tighten down bolts. Replace screening device, grate or manhole cover when completed.

Drain Down Filter

1. Remove hatch or manhole cover over discharge chamber and enter chamber.
2. Unlock and lift drain down filter housing and remove old media block. Replace with new media block. Lower drain down filter housing and lock into place.
3. Exit chamber and replace hatch or manhole cover.

Maintenance Notes

1. Following maintenance and/or inspection, it is recommended the maintenance operator prepare a maintenance/inspection record. The record should include any maintenance activities performed, amount and description of debris collected, and condition of the system and its various filter mechanisms.

2. The owner should keep maintenance/inspection record(s) for a minimum of five years from the date of maintenance. These records should be made available to the governing municipality for inspection upon request at any time.

3. Transport all debris, trash, organics and sediments to approved facility for disposal in accordance with local and state requirements.

4. Entry into chambers may require confined space training based on state and local regulations.

5. No fertilizer shall be used in the Biofiltration Chamber.

6. Irrigation should be provided as recommended by manufacturer and/or landscape architect. Amount of irrigation required is dependent on plant species. Some plants may require irrigation.

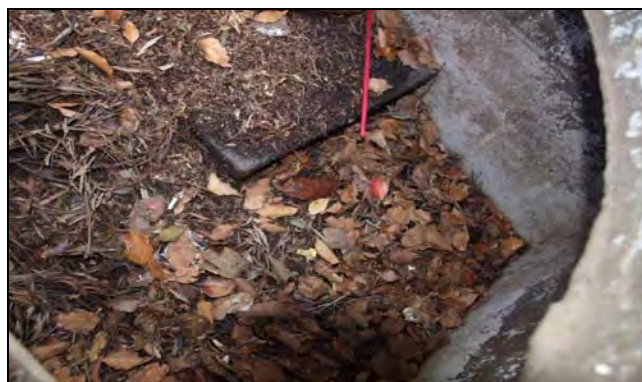
Maintenance Procedure Illustration

Screening Device

The screening device is located directly under the manhole or grate over the Pre-Treatment Chamber. It's mounted directly underneath for easy access and cleaning. Device can be cleaned by hand or with a vacuum truck.

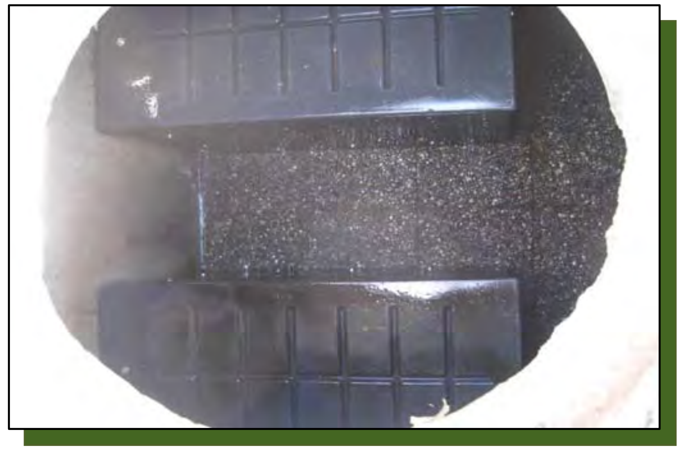
Separation Chamber

The separation chamber is located directly beneath the screening device. It can be quickly cleaned using a vacuum truck or by hand. A pressure washer is useful to assist in the cleaning process.



Cartridge Filters

The cartridge filters are located in the Pre-Treatment chamber connected to the wall adjacent to the biofiltration chamber. The cartridges have removable tops to access the individual media filters. Once the cartridge is open media can be easily removed and replaced by hand or a vacuum truck.



Drain Down Filter

The drain down filter is located in the Discharge Chamber. The drain filter unlocks from the wall mount and hinges up. Remove filter block and replace with new block.

Trim Vegetation

Vegetation should be maintained in the same manner as surrounding vegetation and trimmed as needed. No fertilizer shall be used on the plants. Irrigation per the recommendation of the manufacturer and or landscape architect. Different types of vegetation requires different amounts of irrigation.

Inspection Report
Modular Wetlands Linear

Project Name ______________________________

Project Address ______________________________
(city) (Zip Code)

Owner / Management Company ______________________________

Contact ______________________ Phone ( ) –

Inspector Name ______________________ Date ____/____/______ Time __________ AM / PM

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint ☐ Storm Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition ______________________ Additional Notes ______________________

For Office Use Only
(Reviewed By)
(Date) Office personnel to complete section to the left.

Inspection Checklist

Modular Wetland System Type (Curb, Grate or UG Vault): __________ Size (22', 14' or etc.): __________

Structural Integrity:	**Yes**	**No**	**Comments**
Damage to pre-treatment access cover (manhole cover/grate) or cannot be opened using normal lifting pressure?			
Damage to discharge chamber access cover (manhole cover/grate) or cannot be opened using normal lifting pressure?			
Does the MWS unit show signs of structural deterioration (cracks in the wall, damage to frame)?			
Is the inlet/outlet pipe or drain down pipe damaged or otherwise not functioning properly?			
Working Condition:			
Is there evidence of illicit discharge or excessive oil, grease, or other automobile fluids entering and clogging the unit?			
Is there standing water in inappropriate areas after a dry period?			
Is the filter insert (if applicable) at capacity and/or is there an accumulation of debris/trash on the shelf system?			
Does the depth of sediment/trash/debris suggest a blockage of the inflow pipe, bypass or cartridge filter? If yes specify which one in the comments section. Note depth of accumulation in in pre-treatment chamber.			Depth:
Does the cartridge filter media need replacement in pre-treatment chamber and/or discharge chamber?			Chamber:
Any signs of improper functioning in the discharge chamber? Note issues in comments section.			
Other Inspection Items:			
Is there an accumulation of sediment/trash/debris in the wetland media (if applicable)?			
Is it evident that the plants are alive and healthy (if applicable)? Please note Plant Information below.			
Is there a septic or foul odor coming from inside the system?			

Waste:	**Yes**	**No**
Sediment / Silt / Clay		
Trash / Bags / Bottles		
Green Waste / Leaves / Foliage		

Recommended Maintenance	
No Cleaning Needed	
Schedule Maintenance as Planned	
Needs Immediate Maintenance	

Plant Information	
Damage to Plants	
Plant Replacement	
Plant Trimming	

Additional Notes: ______________________________

Cleaning and Maintenance Report
Modular Wetlands Linear

Bio Clean
A Forterra Company

For Office Use Only	
(Reviewed By)	
(Date)	
Office personnel to complete section to the left.	

Project Name ______________________________

Project Address ______________________________ (city) (Zip Code)

Owner / Management Company ______________________________

Contact ______________________________ Phone ( ) –

Inspector Name ______________________________ Date ___/___/_____ Time ________ AM / PM

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint ☐ Storm   Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition ______________________________ Additional Notes ______________________________

Site Map #	GPS Coordinates of Insert	Manufacturer / Description / Sizing	Trash Accumulation	Foliage Accumulation	Sediment Accumulation	Total Debris Accumulation	Condition of Media 25/50/75/100 (will be changed @ 75%)	Operational Per Manufactures' Specifications (If not, why?)
	Lat: Long:	MWS Catch Basins						
		MWS Sedimentation Basin						
		Media Filter Condition						
		Plant Condition						
		Drain Down Media Condition						
		Discharge Chamber Condition						
		Drain Down Pipe Condition						
		Inlet and Outlet Pipe Condition						

Comments:

Appendix C

Geotechnical Soils Report

GEOTECHNICAL INVESTIGATION
PROPOSED WAREHOUSE
26200 Enterprise Way
Lake Forest, California
for
Black Creek Group

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

April 7, 2021

Black Creek Group
4675 MacArthur Court, Suite 625
Newport Beach, California 92660

Attention: Mr. Chris Sanford
Senior Vice President, Development

Project No.: 21G135-1

Subject: Geotechnical Investigation
Proposed Warehouse
26200 Enterprise Way
Lake Forest, California

Dear Mr. Sanford:

In accordance with your request, we have conducted a geotechnical investigation at the subject site. We are pleased to present this report summarizing the conclusions and recommendations developed from our investigation.

We sincerely appreciate the opportunity to be of service on this project. We look forward to providing additional consulting services during the course of the project. If we may be of further assistance in any manner, please contact our office.

Respectfully Submitted,

SOUTHERN CALIFORNIA GEOTECHNICAL, INC.

Gregory K. Mitchell, GE 2364
Principal Engineer

REGISTERED PROFESSIONAL ENGINEER GREGORY K. MITCHELL No. 2364 GEOTECHNICAL STATE OF CALIFORNIA

Robert G. Trazo, GE 2655

REGISTERED PROFESSIONAL ENGINEER ROBERT TRAZO No. 2655 GEOTECHNICAL STATE OF CALIFORNIA

Distribution: (1) Addressee

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Plate 2: Boring Location Plan
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D Grading Guide Specifications
E Seismic Design Parameters

1.0 EXECUTIVE SUMMARY

Presented below is a brief summary of the conclusions and recommendations of this investigation. Since this summary is not all inclusive, it should be read in complete context with the entire report.

Geotechnical Design Considerations

- The site is underlain by engineered fill soils and Capistrano formation sandstone bedrock. The bedrock generally consists of medium dense to very dense, poorly consolidated fine-grained sandstone. The fill soils possess relatively high strengths and favorable consolidation/collapse characteristics, indicate of engineered fill. We performed research at the City of Lake Forest in an attempt to obtain reports documenting the placement and compaction of any such fill soils. The City has no such records.
- The existing conditions will create a bedrock/fill transition within the proposed building area. It is also expected that the upper 3± feet of soils will be disturbed during demolition of the existing development. Based on these conditions, remedial grading will be necessary within the proposed building area to provide a pad suitable for support of the proposed structure.
- The existing pavements are in fair to good condition, and consideration may be given to reusing some of the existing pavements with the new development. However, the existing pavement thicknesses are not adequate to support any significant volume of truck traffic.
- The on-site soils possess a very low expansion potential.

Site Preparation Recommendations

- Demolition of the existing development should include foundations, floor slabs, utilities, pavements and any other subsurface improvements that will not remain in place with the new development. Debris resultant from demolition should be disposed of off-site. Concrete and asphalt debris may be crushed to a maximum 2-inch particle size, well-mixed with on-site soils, and reused in new structural fills.
- Initial site preparation should include stripping of any surficial vegetation within the landscaped planters that are demolished. The surficial vegetation, and any organic soils should be properly disposed of off-site.
- Remedial grading is recommended to be performed within the proposed building area in order to mitigate the bedrock/fill transitions, and to remove all soils disturbed during demolition of the existing building. The soils within the proposed building area should be overexcavated to a depth of 5 feet below existing grade and to a depth of at least 3 feet below proposed building pad subgrade elevations, whichever is greater.
- The proposed foundation influence zones should be overexcavated to a depth of at least 3 feet below proposed foundation bearing grade.
- Additional overexcavation should be performed in the southeastern region of the building pad to mitigate the bedrock/fill transition. This area of the pad should be overexcavated to a depth of 5 feet below foundation bearing grade.
- Following completion of the overexcavation, the exposed soils should be scarified to a depth of at least 12 inches and moisture treated to 0 to 4 percent above optimum moisture content. The subgrade soils should then be recompacted to at least 90 percent of the ASTM D-1557 maximum dry density. The previously excavated soils may then be replaced as compacted structural fill.

- The new pavement and flatwork subgrade soils are recommended to be scarified to a depth of 12± inches, thoroughly moisture conditioned and recompacted to at least 90 percent of the ASTM D-1557 maximum dry density.

Foundation Design Recommendations

- Conventional shallow foundations, supported in newly placed compacted fill.
- 3,000 lbs/ft^2 maximum allowable soil bearing pressure.
- Reinforcement consisting of at least four (4) No. 5 rebars (2 top and 2 bottom) in strip footings. Additional reinforcement may be necessary for structural considerations.

Building Floor Slab Design Recommendations

- Conventional Slab-on-Grade: minimum 6 inches thick.
- Modulus of Subgrade Reaction: k = 150 psi/in.
- Reinforcement is not expected to be necessary for geotechnical considerations. The actual thickness and reinforcement of the floor slab should be determined by the structural engineer.

Pavement Design Recommendations

ASPHALT PAVEMENTS (R = 40)					
Materials	Thickness (inches)				
	Parking Stalls (TI = 4.0)	Auto Drive Lanes (TI = 5.0)	Truck Traffic		
			(TI = 6.0)	(TI = 7.0)	(TI = 8.0)
Asphalt Concrete	3	3	3½	4	5
Aggregate Base	3	4	6	7	8
Compacted Subgrade (90% minimum compaction)	12	12	12	12	12

PORTLAND CEMENT CONCRETE PAVEMENTS (R = 40)				
Materials	Thickness (inches)			
	Automobile Parking and Drive Areas (TI = 5.0)	Truck Traffic		
		(TI =6.0)	(TI =7.0)	(TI =8.0)
PCC	5	5	5½	6½
Compacted Subgrade (95% minimum compaction)	12	12	12	12

2.0 SCOPE OF SERVICES

The scope of services performed for this project was in accordance with our Proposal No. 21P170, dated February 25, 2021. The scope of services included a visual site reconnaissance, subsurface exploration, field and laboratory testing, and geotechnical engineering analysis to provide criteria for preparing the design of the building foundations, building floor slab, and parking lot pavements along with site preparation recommendations and construction considerations for the proposed development. The evaluation of the environmental aspects of this site was beyond the scope of services for this geotechnical investigation.

3.0 SITE AND PROJECT DESCRIPTION

3.1 Site Conditions

The site is located at 26200 Enterprise Way in Lake Forest, California. The site is bounded to the north by Enterprise Way and existing commercial/industrial buildings, to the east and south by existing commercial/industrial developments, and to the west by Enterprise Court. The general location of the site is illustrated on the Site Location Map, enclosed as Plate 1 in Appendix A of this report.

The site is an irregular-shaped parcel, 8.83± acres in size. The site is presently developed with one (1) commercial office building, 75,000± ft^2 in size, located in the central area of the site. The development is a two-story building of concrete tilt up construction. A series of Bloomenergy servers, are located on concrete pads along the southern property line, behind the building. The building is surrounded by asphaltic concrete pavements and limited areas of Portland cement concrete pavements. The pavements are in good condition with minor cracking throughout. Landscape planters are present throughout the site and possesses small shrubs, bushes and medium to large trees. The eastern and southern boundaries of the site possess north and west facing slopes. These slopes ascend 10 to 15 feet from the subject site to the adjacent property. A concrete-lined drainage swale is located near the midpoint of the slope. The remaining areas of the slopes are covered with dense vegetation.

Detailed topographic information was obtained from the preliminary grading and drainage plan, prepared by Kier + Wright. Based on this plan, the overall site slopes downward to the west at a gradient of 3± percent. As mentioned above, the eastern and southern boundaries of the site possess a north and west facing ascending slopes, with a gradient of approximately 3h:1v. The minimum site elevation is 690± feet mean sea level (msl), located at the west corner of the site. The maximum site elevation is 710± feet msl, located along the eastern property line.

3.2 Proposed Development

A preliminary site plan has been provided to our office by the client. Based on this plan, the site will be developed with one (1) new commercial industrial building, 161,979± ft^2 in size, located in the central region of the site. Dock-high doors will be constructed along a portion of the southern building wall. The proposed building is expected to be surrounded by asphaltic concrete pavements in the parking and drive areas, Portland cement concrete pavements in the loading dock areas, and concrete flatwork and landscaped planters throughout the site.

Detailed structural information has not been provided. It is assumed that the new building will be a single-story structure of tilt-up concrete construction, typically supported on conventional shallow foundations with a concrete slab-on-grade floor. Based on the assumed construction, maximum column and wall loads are expected to be on the order of 100 kips and 4 to 7 kips per linear foot, respectively.

No significant amounts of below-grade construction, such as basements or crawl spaces, are expected to be included in the proposed development. Based on the assumed topography, cuts and fills of 4 to 6± feet are expected to be necessary to achieve the proposed site grades.

4.0 SUBSURFACE EXPLORATION

4.1 Scope of Exploration/Sampling Methods

The subsurface exploration conducted for this project consisted of six (6) borings advanced to depths of 20 to 30± feet below the existing site grades. All of the borings were logged during drilling by a member of our staff.

The borings were advanced with hollow-stem augers, by a conventional truck-mounted drilling rig. Representative bulk and relatively undisturbed soil samples were taken during drilling. Relatively undisturbed soil samples were taken with a split barrel "California Sampler" containing a series of one inch long, 2.416± inch diameter brass rings. This sampling method is described in ASTM Test Method D-3550. In-situ samples were also taken using a 1.4± inch inside diameter split spoon sampler, in general accordance with ASTM D-1586. Both of these samplers are driven into the ground with successive blows of a 140-pound weight falling 30 inches. The blow counts obtained during driving are recorded for further analysis. Bulk samples were collected in plastic bags to retain their original moisture content. The relatively undisturbed ring samples were placed in molded plastic sleeves that were then sealed and transported to our laboratory.

The approximate locations of the borings are indicated on the Boring Location Plan, included as Plate 2 in Appendix A of this report. The Boring Logs, which illustrate the conditions encountered at the boring locations, as well as the results of some of the laboratory testing, are included in Appendix B.

4.2 Geotechnical Conditions

Pavements

Asphaltic concrete pavement was encountered at the ground surface of all boring locations. The pavement sections generally consisted of 3½ to 4½± inches of asphaltic concrete, underlain by 2½ to 7± inches of aggregate base.

Engineered Fill (Afe)

Engineered fill soils were encountered at Boring Nos. B-1 and B-4 through B-6, extending to depths of 12 to more than 30± feet. Boring Nos. B-1 and B-5 were terminated in the engineered fill soils. These fill materials consist of medium dense to very dense silty sands with varying clay content. Many samples of the fill soils possess variable coloration and variable strength, indicative of their classification as fill.

Capistrano Formation – Oso member (Tco)

Capistrano Formation bedrock was encountered beneath the pavements and/or beneath the fill soils at most of the boring locations, extending to at least the maximum depth explored of 30± feet below the existing site grades. The bedrock generally consists of light gray to dark gray fine-grained poorly consolidated silty sandstone and sandstone. The samples occasionally possess trace amounts of clay, organics and iron oxide staining.

Groundwater

Free water was not encountered during the drilling of any of the borings. Based on the lack of any water within the borings, and the moisture contents of the recovered soil samples, the static groundwater table is considered to have existed at a depth in excess of 30± feet at the time of the subsurface exploration.

As a part of our research, we reviewed available groundwater data in order to determine groundwater levels for the site. The primary reference used to determine the groundwater depths in the subject site area is the California State Water Resources Control Board website, GeoTracker, https://geotracker.waterboards.ca.gov. The nearest monitoring well on record is located 1.37± miles west of the site. Water level readings within this monitoring well indicate a groundwater level of 72± feet below the ground surface in September 2017.

4.3 Geologic Conditions

Geologic research indicates that the majority of the site is underlain by white to bluish-white, silty, marine, fine- to medium-grained, thick bedded to massive, poorly sorted arkosic sandstone. mapped as late Miocene to early Pliocene Capistrano Formation, Oso Member (Map Symbol Tco). The Holocene to Pleistocene age Slopewash (Map Symbol Qsw) is mapped in the northwestern and southeastern property lines of the site. The bedding within the Capistrano Formation is indicated to trend northwest-southeast with a dip of 14 degrees to the north, on the geologic map. The primary available reference applicable to the subject site is the Geologic Map and Sections of the South Half El Toro Quadrangle, Orange County, California, by Donald Fife, 1974. A portion of this map indicating the location of the subject site is included herein as Plate 3 in Appendix A.

Based on the materials encountered in the exploratory borings, the site is underlain by sandstone, and silty sandstone of the Capistrano Formation.

5.0 LABORATORY TESTING

The soil samples recovered from the subsurface exploration were returned to our laboratory for further testing to determine selected physical and engineering properties of the soils. The tests are briefly discussed below. It should be noted that the test results are specific to the actual samples tested, and variations could be expected at other locations and depths.

Classification

All recovered soil samples were classified using the Unified Soil Classification System (USCS), in accordance with ASTM D-2488. The field identifications were then supplemented with additional visual classifications and/or by laboratory testing. The USCS classifications are shown on the Boring Logs and are periodically referenced throughout this report.

Density and Moisture Content

The density has been determined for selected relatively undisturbed ring samples. These densities were determined in general accordance with the method presented in ASTM D-2937. The results are recorded as dry unit weight in pounds per cubic foot. The moisture contents are determined in accordance with ASTM D-2216, and are expressed as a percentage of the dry weight. These test results are presented on the Boring Logs.

Consolidation

Selected soil samples were tested to determine their consolidation potential, in accordance with ASTM D-2435. The testing apparatus is designed to accept either natural or remolded samples in a one-inch high ring, approximately 2.416 inches in diameter. Each sample is then loaded incrementally in a geometric progression and the resulting deflection is recorded at selected time intervals. Porous stones are in contact with the top and bottom of the sample to permit the addition or release of pore water. The samples are typically inundated with water at an intermediate load to determine their potential for collapse or heave. The results of the consolidation testing are plotted on Plates C-1 through C-4 in Appendix C of this report.

Maximum Dry Density and Optimum Moisture Content

A representative bulk sample has been tested for its maximum dry density and optimum moisture content. The results have been obtained using the Modified Proctor procedure, per ASTM D-1557 and are presented on Plate C-5 in Appendix C of this report. This test is generally used to compare the in-situ densities of undisturbed field samples, and for later compaction testing. Additional testing of other soil types or soil mixes may be necessary at a later date.

Soluble Sulfates

A representative sample of the near-surface soil was submitted to a subcontracted analytical laboratory for determination of soluble sulfate content. Soluble sulfates are naturally present in soils, and if the concentration is high enough, can result in degradation of concrete which comes into contact with these soils. The results of the soluble sulfate testing are presented below, and are discussed further in a subsequent section of this report.

Sample Identification	Soluble Sulfates (%)	Sulfate Classification
B-1 @ 0 to 5 feet	0.005	Not Applicable (S0)

Corrosivity Testing

One representative sample of the near-surface soils was submitted to a subcontracted corrosion engineering laboratory to identify potentially corrosive characteristics with respect to common construction materials. The corrosivity testing included a determination of the electrical resistivity, pH, and chloride and nitrate concentrations of the soils, as well as other tests. The results of some of these tests are presented below.

Sample Identification	Saturated Resistivity (ohm-cm)	pH	Chlorides (mg/kg)	Nitrates (mg/kg)
B-1 @ 0 to 5 feet	3,000	9.2	5.3	3.4

Expansion Index (EI)

The expansion potential of the on-site soils was determined in general accordance with ASTM D-4829. The testing apparatus is designed to accept a 4-inch diameter, 1-in high, remolded sample. The sample is initially remolded to 50± 1 percent saturation and then loaded with a surcharge equivalent to 144 pounds per square foot. The sample is then inundated with water, and allowed to swell against the surcharge. The resultant swell or consolidation is recorded after a 24-hour period. The result of the EI testing is as follows:

Sample Identification	Expansion Index	Expansive Potential
B-1 @ 0 to 5 feet	12	Very Low

6.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of our review, field exploration, laboratory testing and geotechnical analysis, the proposed development is considered feasible from a geotechnical standpoint. The recommendations contained in this report should be taken into the design, construction, and grading considerations.

The recommendations are contingent upon all grading and foundation construction activities being monitored by the geotechnical engineer of record. The recommendations are provided with the assumption that an adequate program of client consultation, construction monitoring, and testing will be performed during the final design and construction phases to verify compliance with these recommendations. Maintaining Southern California Geotechnical, Inc., (SCG) as the geotechnical consultant from the beginning to the end of the project will provide continuity of services. The geotechnical engineering firm providing testing and observation services shall assume the responsibility of Geotechnical Engineer of Record.

The Grading Guide Specifications, included as Appendix D, should be considered part of this report, and should be incorporated into the project specifications. The contractor and/or owner of the development should bring to the attention of the geotechnical engineer any conditions that differ from those stated in this report, or which may be detrimental for the development.

6.1 Seismic Design Considerations

The subject site is located in an area which is subject to strong ground motions due to earthquakes. The performance of a site-specific seismic hazards analysis was beyond the scope of this investigation. However, numerous faults capable of producing significant ground motions are located near the subject site. Due to economic considerations, it is not generally considered reasonable to design a structure that is not susceptible to earthquake damage. Therefore, significant damage to structures may be unavoidable during large earthquakes. The proposed structure should, however, be designed to resist structural collapse and thereby provide reasonable protection from serious injury, catastrophic property damage and loss of life.

Faulting and Seismicity

Research of available maps indicates that the subject site is not located within an Alquist-Priolo Earthquake Fault Zone. Furthermore, SCG did not identify any evidence of faulting during the geotechnical investigations. Therefore, the possibility of significant fault rupture on the site is considered to be low.

The potential for other geologic hazards such as seismically induced settlement, lateral spreading, tsunamis, inundation, seiches, flooding, and subsidence affecting the site is considered low.

Seismic Design Parameters

The 2019 California Building Code (CBC) provides procedures for earthquake resistant structural design that include considerations for on-site soil conditions, occupancy, and the configuration of the structure including the structural system and height. The seismic design parameters presented below are based on the soil profile and the proximity of known faults with respect to the subject site.

Based on standards in place at the time of this report, the proposed development is expected to be designed in accordance with the requirements of the 2019 edition of the California Building Code (CBC), which was adopted on January 1, 2020.

The 2019 CBC Seismic Design Parameters have been generated using the SEAOC/OSHPD Seismic Design Maps Tool, a web-based software application available at the website www.seismicmaps.org. This software application calculates seismic design parameters in accordance with several building code reference documents, including ASCE 7-16, upon which the 2019 CBC is based. The application utilizes a database of risk-targeted maximum considered earthquake (MCE_R) site accelerations at 0.01-degree intervals for each of the code documents. The table below was created using data obtained from the application. The output generated from this program is included as Plate E-1 in Appendix E of this report.

The 2019 CBC requires that a site-specific ground motion study be performed in accordance with Section 11.4.8 of ASCE 7-16 for Site Class D sites with a mapped S_1 value greater than 0.2. However, Section 11.4.8 of ASCE 7-16 also indicates an exception to the requirement for a site-specific ground motion hazard analysis for certain structures on Site Class D sites. The commentary for Section 11 of ASCE 7-16 (Page 534 of Section C11 of ASCE 7-16) indicates that "In general, this exception effectively limits the requirements for site-specific hazard analysis to very tall and or flexible structures at Site Class D sites." Based on our understanding of the proposed development, the seismic design parameters presented below were calculated assuming that the exception in Section 11.4.8 applies to the proposed structures at this site. However, the structural engineer should verify that this exception is applicable to the proposed structures. Based on the exception, the spectral response accelerations presented below were calculated using the site coefficients (F_a and F_v) from Tables 1613.2.3(1) and 1613.2.3(2) presented in Section 16.4.4 of the 2019 CBC.

2019 CBC SEISMIC DESIGN PARAMETERS

Parameter		Value
Mapped Spectral Acceleration at 0.2 sec Period	S_S	1.261
Mapped Spectral Acceleration at 1.0 sec Period	S_1	0.450
Site Class	---	D
Site Modified Spectral Acceleration at 0.2 sec Period	S_{MS}	1.261
Site Modified Spectral Acceleration at 1.0 sec Period	S_{M1}	0.833
Design Spectral Acceleration at 0.2 sec Period	S_{DS}	0.841
Design Spectral Acceleration at 1.0 sec Period	S_{D1}	0.555

It should be noted that the site coefficient F_v and the parameters S_{M1} and S_{D1} were not included in the SEAOC/OSHPD Seismic Design Maps Tool output for the 2019 CBC. We calculated these parameters-based on Table 1613.2.3(2) in Section 16.4.4 of the 2019 CBC using the value of S_1

obtained from the Seismic Design Maps Tool, assuming that a site-specific ground motion hazards analysis is not required for the proposed building at this site.

Liquefaction

Liquefaction is the loss of strength in generally cohesionless, saturated soils when the pore-water pressure induced in the soil by a seismic event becomes equal to or exceeds the overburden pressure. The primary factors which influence the potential for liquefaction include groundwater table elevation, soil type and grain size characteristics, relative density of the soil, initial confining pressure, and intensity and duration of ground shaking. The depth within which the occurrence of liquefaction may impact surface improvements is generally identified as the upper 50 feet below the existing ground surface. Liquefaction potential is greater in saturated, loose, poorly graded fine sands with a mean (d_{50}) grain size in the range of 0.075 to 0.2 mm (Seed and Idriss, 1971). Clayey (cohesive) soils or soils which possess clay particles (d<0.005mm) in excess of 20 percent (Seed and Idriss, 1982) are generally not considered to be susceptible to liquefaction, nor are those soils which are above the historic static groundwater table.

The Earthquake Zones of Required Investigation, El Toro Quadrangle map, published by the California Geological Survey (CGS), indicates that the subject site is not located within a designated liquefaction hazard zone. In addition, the subsurface conditions encountered at the subject site are not considered to be conducive to liquefaction. Based on the conditions encountered at the boring locations, and the mapping performed by the CGS, liquefaction is not considered to be a significant design concern for this project. This map also indicates that the site is not located with an Earthquake Induced Landslide Zone.

6.2 Geotechnical Design Considerations

General

The subsurface conditions at this site consist of engineered fill soils and moderate to high strength Capistrano formation sandstone at all of the boring locations. The engineered fill soils possess relatively high strengths and favorable consolidation and collapse characteristics. We performed research at the City of Lake Forest in an attempt to obtain reports documenting the placement and compaction of any such fill soils. The City has no such records. We did, however, obtain a copy of a previous geotechnical map for the site, prepared by Petra Geotechnical, which indicates that the site is underlain by engineered fill soils and Capistrano formation bedrock. However, he precise fill depths could not be determined from this plan. All of the data collected by SCG indicates that the existing fill soils represent engineered fill, generally suitable for support of new structures.

As a result of the previous grading, a portion of the proposed warehouse will be underlain by engineered fill soils, whereas the southeastern area of the new building will be underlain by sandstone bedrock. These existing conditions will create a bedrock/fill transition within the proposed building area. It is also expected that the upper 3± feet of soils will be disturbed during demolition of the existing development. Based on these conditions, remedial grading will be necessary within the proposed building area to provide a pad suitable for support of the proposed structure.

The existing pavements are in fair to good condition, and consideration may be given to reusing some of the existing pavements with the new development. However, the existing pavement thicknesses are not adequate to support any significant volume of truck traffic.

Settlement

The recommended remedial grading will remove a portion of the near-surface native bedrock materials and replace these materials as compacted structural fill. Disturbed soils created during demolition of the existing development will also be removed to a stable soil subgrade. The engineered fill soils and bedrock materials that will remain in place below the recommended depth of overexcavation possess relatively high strengths. Therefore, following completion of the recommended grading, post-construction settlements are expected to be within tolerable limits.

Expansion

The near-surface soils consist of silty sandstone with no appreciable clay content. The results of expansion index testing indicate that these materials are very low expansive (EI = 12). Therefore, no design considerations related to expansive soils are considered warranted for this site.

Soluble Sulfates

The results of the soluble sulfate testing indicate that the selected sample of the on-site soils contains a sulfate concentration that corresponds to Class S0 with respect to the American Concrete Institute (ACI) Publication 318-05 Building Code Requirements for Structural Concrete and Commentary, Section 4.3. Therefore, specialized concrete mix designs are not considered to be necessary, with regard to sulfate protection purposes. It is, however, recommended that additional soluble sulfate testing be conducted at the completion of rough grading to verify the soluble sulfate concentrations of the soils which are present at pad grade within the building areas.

Corrosion Potential

The results of laboratory testing indicate that the tested sample of the on-site soils possesses a saturated resistivity value of 3,000 ohm-cm, and a pH value of 9.2. These test results have been evaluated in accordance with guidelines published by the Ductile Iron Pipe Research Association (DIPRA). The DIPRA guidelines consist of a point system by which characteristics of the soils are used to quantify the corrosivity characteristics of the site. Resistivity and pH are two of the five factors that enter into the evaluation procedure. Redox potential, relative soil moisture content and sulfides are also included. Although sulfide testing was not part of the scope of services for this project, we have evaluated the corrosivity characteristics of the on-site soils using resistivity, pH and moisture content. Based on these factors, and utilizing the DIPRA procedure, the on-site soils are considered to be moderately corrosive to ductile iron pipe. Therefore, polyethylene protection may be required for cast iron or ductile iron pipes.

A relatively low concentration (5.3 mg/kg) of chlorides was detected in the sample submitted for corrosivity testing. In general, soils possessing chloride concentrations in excess of 500 parts per million (ppm) are considered to be corrosive with respect to steel reinforcement within reinforced concrete. Based on the lack of any significant chlorides in the tested sample, the site is considered to have a C1 chloride exposure in accordance with the American Concrete Institute (ACI) Publication 318 Building Code Requirements for Structural Concrete and Commentary. Therefore, a specialized concrete mix design for reinforced concrete for protection against chloride exposure is not considered warranted.

Nitrates present in soil can be corrosive to copper tubing at concentrations greater than 50 mg/kg. The tested sample possesses a nitrate concentration of 3.4 mg/kg. Based on this test result, the on-site soils are not considered to be corrosive to copper pipe. Since SCG does not practice in the area of corrosion engineering, the client may wish to contact a corrosion engineer to provide a more thorough evaluation.

It should be noted that SCG does not practice in the field of corrosion engineering. Therefore, the client may wish to contact a corrosion engineer to provide a more thorough evaluation.

Shrinkage/Subsidence

Removal and recompaction of the existing fill soils is estimated to result in an average shrinkage of 3 to 10 percent. Bedrock materials are expected to result in less than 5% shrinkage or bulking when removed and replaced as compacted fill. These shrinkage/bulking estimates are based on the assumption that the onsite soils will be compacted to about 92 percent of the ASTM D-1557 maximum dry density. It should be noted that these estimates are based on the results of dry density testing performed on small-diameter samples of the existing soils taken at the boring locations. If a more accurate and precise shrinkage estimate is desired, SCG can perform a shrinkage study involving several excavated test-pits where in-place densities are determined using in-situ testing methods instead of laboratory density testing on small-diameter samples. Please contact SCG for details and a cost estimate regarding a shrinkage study, if desired.

Minor ground subsidence is expected to occur in the soils below the zone of removal, due to settlement and machinery working. The subsidence is estimated to be 0.1 feet. This estimate may be used for grading in areas that are underlain by existing engineered fill soils.

These estimates are based on previous experience and the subsurface conditions encountered at the boring locations. The actual amount of subsidence is expected to be variable and will be dependent on the type of machinery used, repetitions of use, and dynamic effects, all of which are difficult to assess precisely.

Grading and Foundation Plan Review

Detailed grading and foundation plans were not available at the time of this report. It is therefore recommended that we be provided with copies of the preliminary grading and foundation plans, when they become available, for review with regard to the conclusions, recommendations, and assumptions contained within this report.

6.3 Site Grading Recommendations

The grading recommendations presented below are based on the subsurface conditions encountered at the boring locations, and our understanding of the proposed development. We recommend that all grading activities be completed in accordance with the Grading Guide Specifications included as Appendix D of this report, unless superseded by site-specific recommendations presented below.

Site Stripping and Demolition

Demolition of the existing structure should include any improvements that will not remain in place for use with the new development, including foundations, floor slabs, and utilities. Any pavements that will be reused with the new development should be protected from damage by construction traffic. Debris resultant from demolition should be disposed of off-site. All applicable federal, state and local specifications and regulations should be followed in demolition, abandonment, and disposal of the resulting debris. Concrete and asphalt debris may be crushed to a maximum 2-inch particle size, well-mixed with the on-site soils, and incorporated into new structural fills.

Initial site stripping should include removal of any vegetation, as well as any underlying topsoil or other organic materials from landscaped areas. Based on conditions observed at the time of the subsurface exploration, stripping of grass, shrubs, and trees will be required. Root masses associated with the trees should be removed in their entirety, and the resultant excavations should be backfilled with compacted structural fill soils. Any organic materials should be removed and disposed of off-site, or in non-structural areas of the property. The actual extent of site stripping should be determined in the field by the geotechnical engineer, based on the organic content and stability of the materials encountered.

Treatment of Existing Soils: Building Pad

Remedial grading should be performed within the proposed building area in order to remove the soils disturbed during demolition and to mitigate the bedrock/fill transitions that would otherwise exist. Based on conditions encountered at the boring locations, the existing soils/bedrock within the proposed building area are recommended to be overexcavated to a depth of at least 5 feet below existing grades and to a depth of at least 3 feet below proposed building pad subgrade elevations, whichever is greater. The depth of the overexcavation should also extend to a depth sufficient to remove all undocumented fill soils and soils disturbed during demolition. Within the influence zones of the new foundations, the overexcavation should extend to a depth of at least 3 feet below proposed foundation bearing grade.

Additional overexcavation should be performed in the southeastern area of the proposed building pad, in the area of Boring Nos. B-2 and B-3, to soften the bedrock/fill transition that will exist in this area of the site. This area of the pad should be overexcavated to a depth of 5 feet below foundation bearing grade. The extent of the shallow bedrock in this area should be confirmed during grading.

The overexcavation areas should extend at least 5 feet beyond the building and foundation perimeters, and to an extent equal to the depth of fill placed below the foundation bearing grade, whichever is greater. If the proposed structure incorporates any exterior columns (such as for a canopy or overhang) the overexcavation should also encompass these areas.

Following completion of the overexcavation, the subgrade soils within the overexcavation areas should be evaluated by the geotechnical engineer to verify their suitability to serve as the structural fill subgrade, as well as to support the foundation loads of the new structure. This evaluation should include proofrolling and probing to identify any soft, loose or otherwise unstable soils that must be removed. Some localized areas of deeper excavation may be required if additional fill materials or loose, porous, or low-density native soils are encountered at the base of the overexcavation.

After a suitable overexcavation subgrade has been achieved, the exposed soils/bedrock should be scarified to a depth of at least 12 inches and moisture treated to 0 to 4 percent above optimum moisture content. The subgrade soils should then be recompacted to at least 90 percent of the ASTM D-1557 maximum dry density. The building pad area may then be raised to grade with previously excavated soils or imported structural fill.

Treatment of Existing Soils: Retaining Walls and Site Walls

The existing soils within the areas of any proposed retaining walls and site walls should be overexcavated to a depth of 3 feet below foundation bearing grade and replaced as compacted structural fill as discussed above for the proposed building pad. Retaining wall or site wall foundations may also be supported within sandstone bedrock materials with no further overexcavation. Any disturbed or low strength fill soils within any of these foundation areas should be removed in their entirety. The overexcavation areas should extend at least 3 feet beyond the foundation perimeters, and to an extent equal to the depth of fill below the new foundations. Any erection pads for tilt-up concrete walls are considered to be part of the foundation system. Therefore, these overexcavation recommendations are applicable to erection pads. The overexcavation subgrade soils should be evaluated by the geotechnical engineer prior to scarifying, moisture conditioning to within 0 to 4 percent above the optimum moisture content, and recompacting the upper 12 inches of exposed subgrade soils. The previously excavated soils may then be replaced as compacted structural fill.

If the full lateral recommended remedial grading cannot be completed for the proposed retaining walls and site walls located along property lines, the foundations for those walls should be designed using a reduced allowable bearing pressure. Furthermore, the contractor should take necessary precautions to protect the adjacent improvements during rough grading. Specialized grading techniques, such as A-B-C slot cuts, will likely be required during remedial grading. The geotechnical engineer of record should be contacted if additional recommendations, such as shoring design recommendations, are required during grading.

Treatment of Existing Soils: Flatwork, Parking and Drive Areas

Based on economic considerations, overexcavation of the existing near-surface existing soils in the new flatwork, parking and drive areas is not considered warranted, with the exception of areas where lower strength or unstable soils are identified by the geotechnical engineer during grading. Subgrade preparation in the new flatwork, parking and drive areas should initially consist of removal of all soils disturbed during stripping and demolition operations.

The geotechnical engineer should then evaluate the subgrade to identify any areas of additional unsuitable soils. Any such materials should be removed to a level of firm and unyielding soil. The exposed subgrade soils should then be scarified to a depth of 12± inches, moisture conditioned to 0 to 4 percent above the optimum moisture content, and recompacted to at least 90 percent of the ASTM D-1557 maximum dry density. Based on the presence of variable strength surficial soils throughout the site, it is expected that some isolated areas of additional overexcavation may be required to remove zones of lower strength, unsuitable soils.

Fill Placement

- Fill soils should be placed in thin (6± inches), near-horizontal lifts, moisture conditioned to 0 to 4 percent above the optimum moisture content, and compacted.
- On-site soils may be used for fill provided they are cleaned of any debris to the satisfaction of the geotechnical engineer.
- All grading and fill placement activities should be completed in accordance with the requirements of the 2019 CBC and the grading code of the city of Lake Forest.
- All fill soils should be compacted to at least 90 percent of the ASTM D-1557 maximum dry density.
- Compaction tests should be performed periodically by the geotechnical engineer as random verification of compaction and moisture content. These tests are intended to aid the contractor. Since the tests are taken at discrete locations and depths, they may not be indicative of the entire fill and therefore should not relieve the contractor of his responsibility to meet the job specifications.

Imported Structural Fill

All imported structural fill should consist of very low expansive (EI < 20), well graded soils possessing at least 10 percent fines (that portion of the sample passing the No. 200 sieve). Additional specifications for structural fill are presented in the Grading Guide Specifications, included as Appendix D.

Utility Trench Backfill

In general, all utility trench backfill should be compacted to at least 90 percent of the ASTM D-1557 maximum dry density. As an alternative, a clean sand (minimum Sand Equivalent of 30) may be placed within trenches and compacted in place (jetting or flooding is not recommended). Compacted trench backfill should conform to the requirements of the local grading code, and more restrictive requirements may be indicated by the city of Lake Forest. All utility trench backfills should be witnessed by the geotechnical engineer. The trench backfill soils should be compaction tested where possible; probed and visually evaluated elsewhere.

Utility trenches which parallel a footing, and extending below a 1h:1v (horizontal to vertical) plane projected from the outside edge of the footing should be backfilled with structural fill soils, compacted to at least 90 percent of the ASTM D-1557 standard. Pea gravel backfill should not be used for these trenches.

Any soils used to backfill voids around subsurface utility structures, such as manholes or vaults, should be placed as compacted structural fill. If it is not practical to place compacted fill in these areas, then such void spaces may be backfilled with lean concrete slurry. Uncompacted pea gravel or sand is not recommended for backfilling these voids since these materials have a potential to settle and thereby cause distress of pavements placed around these subterranean structures.

6.4 Construction Considerations

Excavation Considerations

The near-surface soils generally consist of sands and silty sands. These materials may be subject to moderate caving within shallow excavations. Where caving does occur, flattened excavation slopes may be sufficient to provide excavation stability. On a preliminary basis, the inclination of temporary slopes should not exceed 2h:1v. Deeper excavations may require some form of external stabilization such as shoring or bracing. Maintaining adequate moisture content within the near-surface soils will improve excavation stability. All excavation activities on this site should be conducted in accordance with Cal-OSHA regulations.

Groundwater

The static groundwater table is considered to have existed at a depth in excess of 30± feet at the time of the subsurface exploration. Therefore, groundwater is not expected to impact grading or foundation construction activities.

6.5 Foundation Design and Construction

Based on the preceding grading recommendations, it is assumed that the new building pad will be underlain by structural fill soils used to replace a portion of the existing fill soils, and the existing sandstone bedrock. These new structural fill soils are expected to extend to depths of at least 3 to 5 feet below proposed foundation bearing grade, underlain by 1± foot of additional soil that has been densified and moisture conditioned in place. Based on this subsurface profile, the proposed structure may be supported on conventional shallow foundations.

Foundation Design Parameters

New square and rectangular footings may be designed as follows:

- Maximum, net allowable soil bearing pressure: 3,000 lbs/ft^2.
- Minimum wall/column footing width: 14 inches/24 inches.
- Minimum longitudinal steel reinforcement within strip footings: Four (4) No. 5 rebars (2 top and 2 bottom).
- Minimum foundation embedment: 12 inches into suitable structural fill soils, and at least 18 inches below adjacent exterior grade. Interior column footings may be placed immediately beneath the floor slab.
- It is recommended that the perimeter building foundations be continuous across all exterior doorways. Any flatwork adjacent to the exterior doors should be doweled into the perimeter foundations in a manner determined by the structural engineer.

The allowable bearing pressures presented above may be increased by 1/3 when considering short duration wind or seismic loads. The minimum steel reinforcement recommended above is based on geotechnical considerations; additional reinforcement may be necessary for structural considerations. The actual design of the foundations should be determined by the structural engineer.

Foundation Construction

The foundation subgrade soils should be evaluated at the time of overexcavation, as discussed in Section 6.3 of this report. It is further recommended that the foundation subgrade soils be evaluated by the geotechnical engineer immediately prior to steel or concrete placement. Soils suitable for direct foundation support should consist of newly placed structural fill, compacted to at least 90 percent of the ASTM D-1557 maximum dry density. Any unsuitable materials should be removed to a depth of suitable bearing compacted structural fill or suitable native alluvium (where reduced bearing pressures are utilized), with the resulting excavations backfilled with compacted fill soils. As an alternative, lean concrete slurry (500 to 1,500 psi) may be used to backfill such isolated overexcavations.

The foundation subgrade soils should also be properly moisture conditioned to 0 to 4 percent above the Modified Proctor optimum, to a depth of at least 12 inches below bearing grade. Since it is typically not feasible to increase the moisture content of the floor slab and foundation subgrade soils once rough grading has been completed, care should be taken to maintain the moisture content of the building pad subgrade soils throughout the construction process.

Estimated Foundation Settlements

Post-construction total and differential settlements of shallow foundations designed and constructed in accordance with the previously presented recommendations are estimated to be less than 1.0 and 0.5 inches, respectively. Differential movements are expected to occur over a 30-foot span, thereby resulting in an angular distortion of less than 0.002 inches per inch.

Lateral Load Resistance

Lateral load resistance will be developed by a combination of friction acting at the base of foundations and slab and the passive earth pressure developed by footings below grade. The following friction and passive pressure may be used to resist lateral forces:

- Passive Earth Pressure: 300 lbs/ft^3
- Friction Coefficient: 0.30

These are allowable values, and include a factor of safety. When combining friction and passive resistance, the passive pressure component should be reduced by one-third. These values assume that footings will be poured directly against compacted structural fill soils. The maximum allowable passive pressure is 3,000 lbs/ft^2.

6.6 Floor Slab Design and Construction

Subgrades which will support the new floor slabs should be prepared in accordance with the recommendations contained in the *Site Grading Recommendations* section of this report. Based on the anticipated grading which will occur at this site, the floor of the proposed structure may be constructed as a conventional slab-on-grade supported on newly placed structural fill (or densified existing soils), extending to a depth of at least 3 feet below finished pad grades. Based on geotechnical considerations, the floor slab may be designed as follows:

- Minimum slab thickness: 6 inches.
- Modulus of Subgrade Reaction: k = 150 psi/in.
- Minimum slab reinforcement: Reinforcement is not considered necessary from a geotechnical standpoint. The actual floor slab reinforcement should be determined by the structural engineer, based on the imposed slab loading.
- Slab underlayment: If moisture sensitive floor coverings will be used then minimum slab underlayment should consist of a moisture vapor barrier constructed below the entire area of the proposed slab where such moisture sensitive floor coverings are anticipated. The moisture vapor barrier should meet or exceed the Class A rating as defined by ASTM E 1745-97 and have a permeance rating less than 0.01 perms as described in ASTM E 96-95 and ASTM E 154-88. A polyolefin material such as Stego® Wrap Vapor Barrier or equivalent will meet these specifications. The moisture vapor barrier should be properly constructed in accordance with all applicable manufacturer specifications. Given that a rock free subgrade is anticipated and that a capillary break is not required, sand below the barrier is not required. The need for sand and/or the amount of sand above the moisture vapor barrier should be specified by the structural engineer or concrete contractor. The selection of sand above the barrier is not a geotechnical engineering issue and hence outside our purview. Where moisture sensitive floor coverings are not anticipated, the vapor barrier may be eliminated.
- Moisture condition the floor slab subgrade soils to 0 to 4 percent above the Modified Proctor optimum moisture content, to a depth of 12 inches. The moisture content of the floor slab subgrade soils should be verified by the geotechnical engineer within 24 hours prior to concrete placement.
- Proper concrete curing techniques should be utilized to reduce the potential for slab curling or the formation of excessive shrinkage cracks.

The actual design of the floor slab should be completed by the structural engineer to verify adequate thickness and reinforcement.

6.7 Exterior Flatwork Design and Construction

Subgrades which will support new exterior slabs-on-grade for sidewalks, patios, and other concrete flatwork, should be prepared in accordance with the recommendations contained in the

Grading Recommendations section of this report. Assuming that the flatwork is supported on the existing soils, exterior slabs-on-grade may be designed as follows:

- Minimum slab thickness: 4½ inches.
- Minimum slab reinforcement: No. 3 bars at 18 inches on center, in both directions.
- The flatwork at building entry areas should be structurally connected to the perimeter foundation that is recommended to span across the door opening. This recommendation is designed to reduce the potential for differential movement at this joint.
- Moisture condition the slab subgrade soils to within 0 to 4 percent of optimum moisture content, to a depth of at least 12 inches. Adequate moisture conditioning should be verified by the geotechnical engineer 24 hours prior to concrete placement.
- Proper concrete curing techniques should be utilized to reduce the potential for slab curling or the formation of excessive shrinkage cracks.
- Control joints should be provided at a maximum spacing of 8 feet on center in two directions for slabs and at 6 feet on center for sidewalks. Control joints are intended to direct cracking. Minor cracking of exterior concrete slabs on grade should be expected.

Expansion or felt joints should be used at the interface of exterior slabs on grade and any fixed structures to permit relative movement.

6.8 Retaining Wall Design and Construction

Although not indicated on the site plans, some small (less than 6 feet in height) retaining walls may be required to facilitate the new site grades. The parameters recommended for use in the design of these walls are presented below.

Retaining Wall Design Parameters

Based on the soil conditions encountered at the boring locations, the following parameters may be used in the design of new retaining walls for this site. The following parameters assume that only the on-site soils will be utilized for retaining wall backfill. The near-surface soils generally consist of sands and silty sands. Based on their classification, these materials are expected to possess a friction angle of at least 30 degrees when compacted to at least 90 percent of the ASTM D-1557 maximum dry density.

If desired, SCG could provide design parameters for an alternative select backfill material behind the retaining walls. The use of select backfill material could result in lower lateral earth pressures. In order to use the design parameters for the imported select fill, this material must be placed within the entire active failure wedge. This wedge is defined as extending from the heel of the retaining wall upwards at an angle of approximately 60° from horizontal. If select backfill material behind the retaining wall is desired, SCG should be contacted for supplementary recommendations.

RETAINING WALL DESIGN PARAMETERS

Design Parameter		Soil Type: On-site Sands and Silty Sands
Internal Friction Angle (ϕ)		30°
Unit Weight		128 lbs/ft^3
Equivalent Fluid Pressure:	Active Condition (level backfill)	43 lbs/ft^3
	Active Condition (2h:1v backfill)	69 lbs/ft^3
	At-Rest Condition (level backfill)	64 lbs/ft^3

The walls should be designed using a soil-footing coefficient of friction of 0.30 and an equivalent passive pressure of 300 lbs/ft^3. The structural engineer should incorporate appropriate factors of safety in the design of the retaining walls.

The active earth pressure may be used for the design of retaining walls that do not directly support structures or support soils that in turn support structures and which will be allowed to deflect. The at-rest earth pressure should be used for walls that will not be allowed to deflect such as those which will support foundation bearing soils, or which will support foundation loads directly.

Where the soils on the toe side of the retaining wall are not covered by a "hard" surface such as a structure or pavement, the upper 1 foot of soil should be neglected when calculating passive resistance due to the potential for the material to become disturbed or degraded during the life of the structure.

Seismic Lateral Earth Pressures

In accordance with the 2019 CBC, any retaining walls more than 6 feet in height must be designed for seismic lateral earth pressures. If walls 6 feet or more are required for this site, the geotechnical engineer should be contacted for supplementary seismic lateral earth pressure recommendations.

Retaining Wall Foundation Design

The retaining wall foundations should be underlain by at least 3 feet of newly placed structural fill, or undisturbed Capistrano formation bedrock. Foundations to support new retaining walls should be designed in accordance with the general Foundation Design Parameters presented in a previous section of this report.

Backfill Material

On-site soils may be used to backfill the retaining walls. However, all backfill material placed within 3 feet of the back wall face should have a particle size no greater than 3 inches. Some sorting and/or crushing operations may be required. The retaining wall backfill materials should be well graded.

It is recommended that a minimum 1-foot thick layer of free-draining granular material (less than 5 percent passing the No. 200 sieve) be placed against the face of the retaining walls. This material should extend from the top of the retaining wall footing to within 1 foot of the ground surface on the back side of the retaining wall. This material should be approved by the geotechnical engineer. In lieu of the 1-foot thick layer of free-draining material, a properly installed prefabricated drainage composite such as the MiraDRAIN 6000XL (or approved equivalent), which is specifically designed for use behind retaining walls, may be used. If the layer of free-draining material is not covered by an impermeable surface, such as a structure or pavement, a 12-inch thick layer of a low permeability soil should be placed over the backfill to reduce surface water migration to the underlying soils. The layer of free draining granular material should be separated from the backfill soils by a suitable geotextile, approved by the geotechnical engineer.

All retaining wall backfill should be placed and compacted under engineering controlled conditions in the necessary layer thicknesses to ensure an in-place density between 90 and 93 percent of the maximum dry density as determined by the Modified Proctor test (ASTM D1557-91). Care should be taken to avoid over-compaction of the soils behind the retaining walls, and the use of heavy compaction equipment should be avoided.

Subsurface Drainage

As previously indicated, the retaining wall design parameters are based upon drained backfill conditions. Consequently, some form of permanent drainage system will be necessary in conjunction with the appropriate backfill material. Subsurface drainage may consist of either:

- A weep hole drainage system typically consisting of a series of 4-inch diameter holes in the wall situated slightly above the ground surface elevation on the exposed side of the wall and at an approximate 8-foot on-center spacing. The weep holes should include a 2 cubic foot pocket of open graded gravel, surrounded by an approved geotextile fabric, at each weep hole location.

- A 4-inch diameter perforated pipe surrounded by 2 cubic feet of gravel per linear foot of drain placed behind the wall, above the retaining wall footing. The gravel layer should be wrapped in a suitable geotextile fabric to reduce the potential for migration of fines. The footing drain should be extended to daylight or tied into a storm drainage system.

6.9 Pavement Design Parameters

Site preparation in the pavement area should be completed as previously recommended in the *Site Grading Recommendations* section of this report. The subsequent pavement recommendations assume proper drainage and construction monitoring, and are based on either PCA or CALTRANS design parameters for a twenty (20) year design period. However, these designs also assume a routine pavement maintenance program to obtain the anticipated 20-year pavement service life.

Existing Pavements

The existing pavements are generally in good condition and are suitable for reuse with the new development. However, these pavements were designed for the traffic associated with the existing office building and are consequently relatively thin sections. The pavements consist of 3½ to 4½ inches of AC over 2½ to 7 inches of AB. These pavements are only considered suitable for reuse in auto and light truck traffic areas. If these pavements are subjected to significant heavy truck traffic, they will likely experience a short service life.

Pavement Subgrades

It is anticipated that the new pavements will be primarily supported on a layer of compacted structural fill, consisting of scarified, thoroughly moisture conditioned and recompacted existing soils. The near-surface soils generally consist of sands and silty sands. These soils are generally considered to possess good to excellent pavement support characteristics, with R-values in the range of 40 to 60. The subsequent pavement design is therefore based upon an assumed R-value of 40. Any fill material imported to the site should have support characteristics equal to or greater than that of the on-site soils and be placed and compacted under engineering controlled conditions. It is recommended that R-value testing be performed after completion of rough grading to verify that the pavement design recommendations presented herein are valid.

Asphaltic Concrete

Presented below are the recommended thicknesses for new flexible pavement structures consisting of asphaltic concrete over a granular base. The pavement designs are based on the traffic indices (TI's) indicated. The client and/or civil engineer should verify that these TI's are representative of the anticipated traffic volumes. If the client and/or civil engineer determine that the expected traffic volume will exceed the applicable traffic index, we should be contacted for supplementary recommendations. The design traffic indices equate to the following approximate daily traffic volumes over a 20-year design life, assuming six operational traffic days per week.

Traffic Index	No. of Heavy Trucks per Day
4.0	0
5.0	1
6.0	3
7.0	11
8.0	35

For the purpose of the traffic volumes indicated above, a truck is defined as a 5-axle tractor trailer unit with one 8-kip axle and two 32-kip tandem axles. All of the traffic indices allow for 1,000 automobiles per day.

ASPHALT PAVEMENTS (R = 40)					
Materials	Thickness (inches)				
	Parking Stalls (TI = 4.0)	Auto Drive Lanes (TI = 5.0)	Truck Traffic		
			(TI = 6.0)	(TI = 7.0)	(TI = 8.0)
Asphalt Concrete	3	3	3½	4	5
Aggregate Base	3	4	6	7	8
Compacted Subgrade (90% minimum compaction)	12	12	12	12	12

The aggregate base course should be compacted to at least 95 percent of the ASTM D-1557 maximum dry density. The asphaltic concrete should be compacted to at least 95 percent of the batch plant-reported maximum density. The aggregate base course may consist of crushed aggregate base (CAB) or crushed miscellaneous base (CMB), which is a recycled gravel, asphalt and concrete material. The gradation, R-Value, Sand Equivalent, and Percentage Wear of the CAB or CMB should comply with appropriate specifications contained in the current edition of the "Greenbook" Standard Specifications for Public Works Construction.

Portland Cement Concrete

The preparation of the subgrade soils within concrete pavement areas should be performed as previously described for proposed asphalt pavement areas. The minimum recommended thicknesses for the Portland Cement Concrete pavement sections are as follows:

PORTLAND CEMENT CONCRETE PAVEMENTS (R = 40)				
Materials	Thickness (inches)			
	Automobile Parking and Drive Areas (TI = 5.0)	Truck Traffic		
		(TI =6.0)	(TI =7.0)	(TI =8.0)
PCC	5	5	5½	6½
Compacted Subgrade (95% minimum compaction)	12	12	12	12

The concrete should have a 28-day compressive strength of at least 3,000 psi. The maximum joint spacing within all of the PCC pavements is recommended to be equal to or less than 30 times the pavement thickness. Any reinforcement within the PCC pavements should be determined by the project structural engineer.

7.0 GENERAL COMMENTS

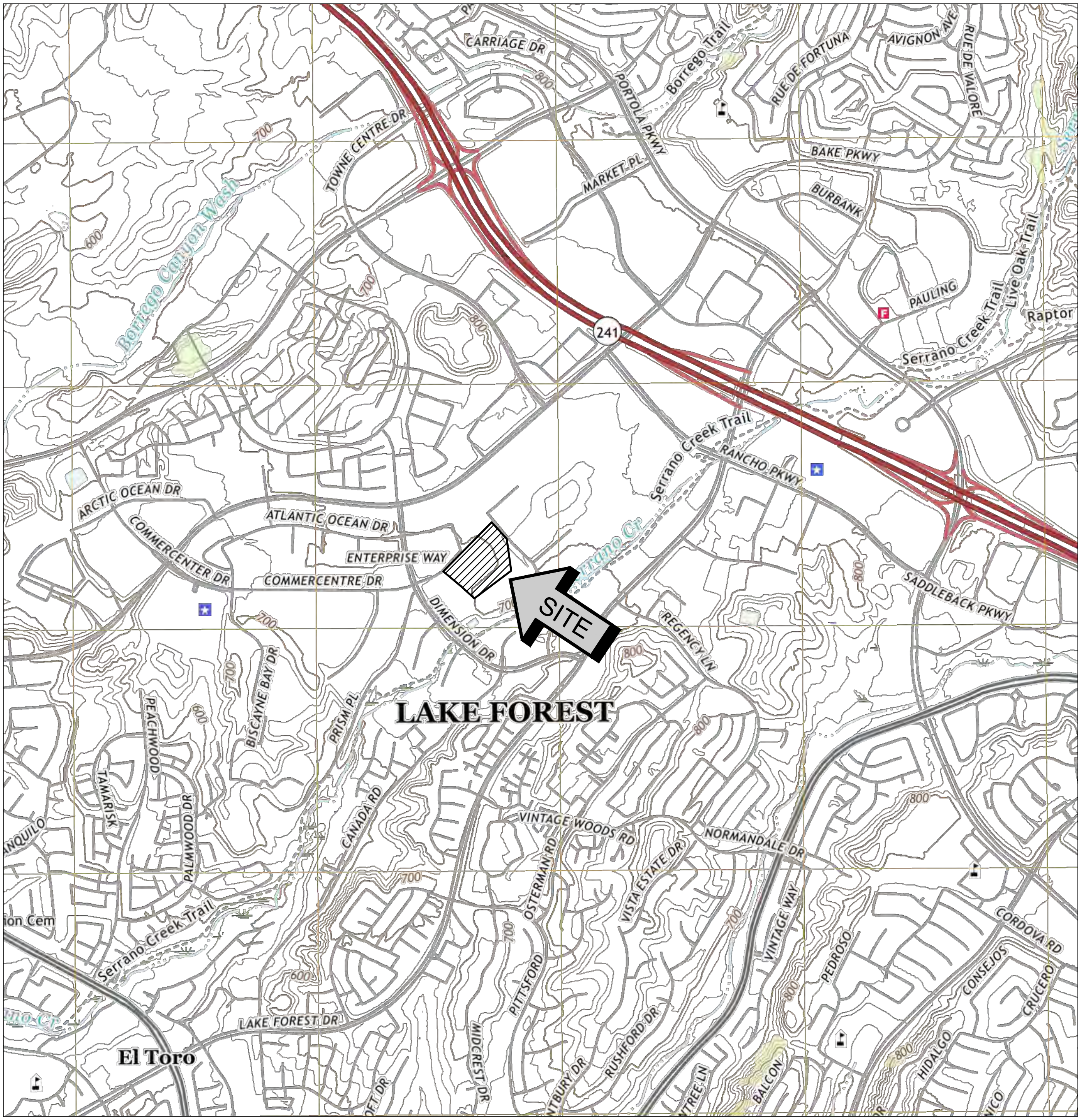
This report has been prepared as an instrument of service for use by the client, in order to aid in the evaluation of this property and to assist the architects and engineers in the design and preparation of the project plans and specifications. This report may be provided to the contractor(s) and other design consultants to disclose information relative to the project. However, this report is not intended to be utilized as a specification in and of itself, without appropriate interpretation by the project architect, civil engineer, and/or structural engineer. The reproduction and distribution of this report must be authorized by the client and Southern California Geotechnical, Inc. Furthermore, any reliance on this report by an unauthorized third party is at such party's sole risk, and we accept no responsibility for damage or loss which may occur. The client(s)' reliance upon this report is subject to the Engineering Services Agreement, incorporated into our proposal for this project.

The analysis of this site was based on a subsurface profile interpolated from limited discrete soil samples. While the materials encountered in the project area are considered to be representative of the total area, some variations should be expected between boring locations and sample depths. If the conditions encountered during construction vary significantly from those detailed herein, we should be contacted immediately to determine if the conditions alter the recommendations contained herein.

This report has been based on assumed or provided characteristics of the proposed development. It is recommended that the owner, client, architect, structural engineer, and civil engineer carefully review these assumptions to ensure that they are consistent with the characteristics of the proposed development. If discrepancies exist, they should be brought to our attention to verify that they do not affect the conclusions and recommendations contained herein. We also recommend that the project plans and specifications be submitted to our office for review to verify that our recommendations have been correctly interpreted.

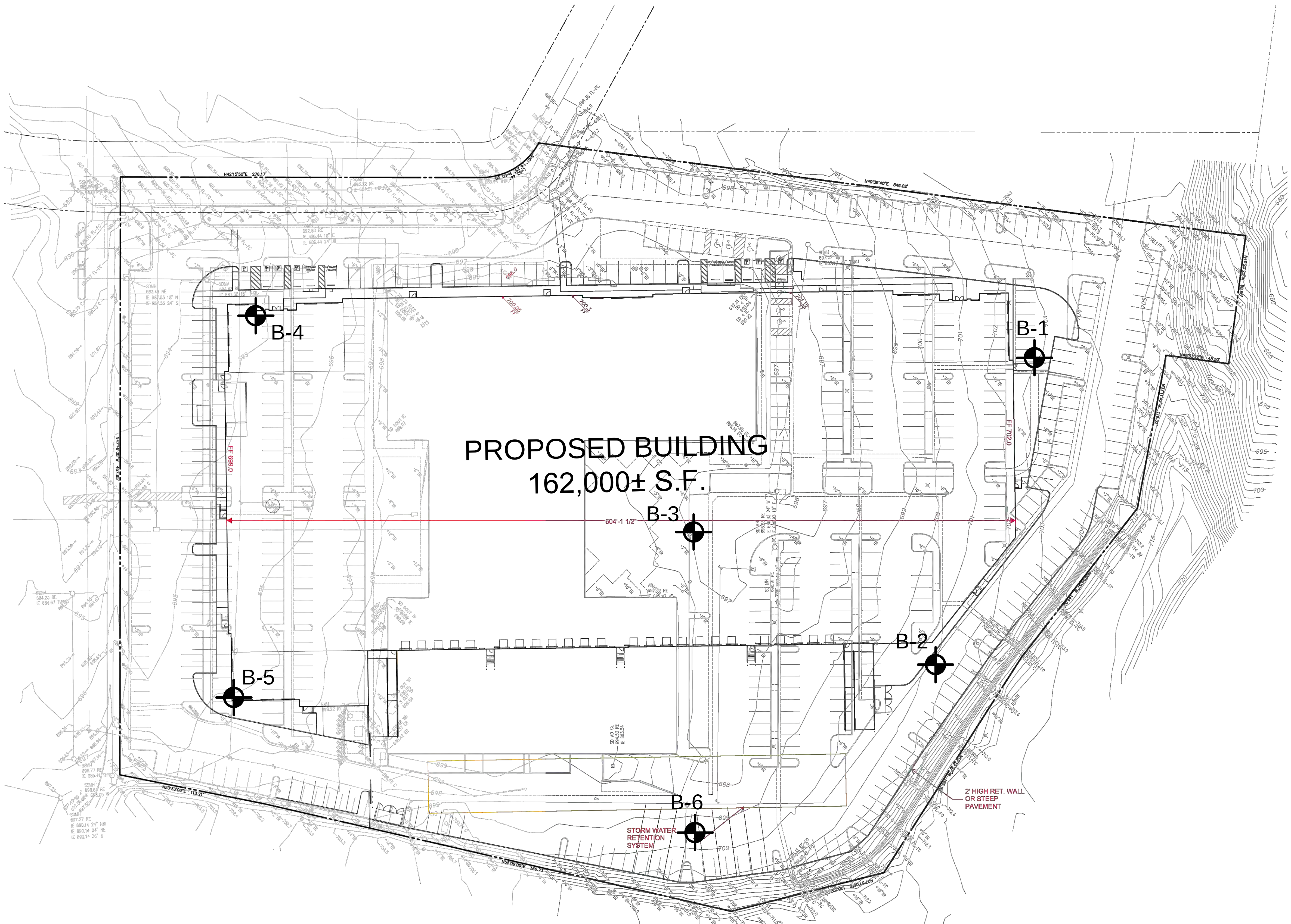
The analysis, conclusions, and recommendations contained within this report have been promulgated in accordance with generally accepted professional geotechnical engineering practice. No other warranty is implied or expressed.

APPENDIX A



SOURCE: USGS TOPOGRAPHIC MAP OF LAKE FOREST QUADRANGLE, ORANGE COUNTY, CALIFORNIA, 2018

SITE LOCATION MAP	
PROPOSED WAREHOUSE	
LAKE FOREST, CALIFORNIA	
SCALE: 1" = 2000'	SOUTHERN CALIFORNIA GEOTECHNICAL (SoCalGeo)
DRAWN: MD CHKD: RGT	
SCG PROJECT 21G135-1	
PLATE 1	



GEOTECHNICAL LEGEND

APPROXIMATE BORING LOCATION

NOTE: BASE MAP PREPARED BY KIER + WRIGHT

BORING LOCATION PLAN	
PROPOSED WAREHOUSE	
LAKE FOREST, CALIFORNIA	
SCALE: 1" = 80'	
DRAWN: JAH CHKD: RGT	
SCG PROJECT 21G135-1	
PLATE 2	

LEGEND

Qsw

SLOPEWASH. (Holocene to Pleistocene(?))

Lithology: Varies with parent materials. In general consists of light olive-gray to olive-gray, silty to clayey, organicly rich soil which is plastic when wet and hard when dry. Consists of detrital materials resulting from debris flows or creep aided by rill wash, ground water, and unchanneled surficial drainage. Accumulates near the base of slopes and at the mouths of small canyons. Includes colluvium and minor residu soils. It is commonly transitional with adjacent soils or alluvial deposits. Mapped where estimated to exceed three feet in thickness.

Tco

CAPISTRANO FORMATION, OSO MEMBER. (late Miocene to early Pliocene)

Lithology: Marine, white to bluish-white, silty, fine-to medium-grained, thick bedded to massive, poorly sorted arkosic sandstone. Commonly cross-bedded. Locally contains calcareous concretions as much as two feet in diameter. Concretionary zones commonly are found in association with marine vertebrate fossils, but locally friable sand lenses are encountered. Bentonite beds 1 to 2 inches thick, were observed in an anticline on the east flank of Aliso Creek.

SOURCE: "GEOLOGY MAP OF THE SOUTH HALF OF THE EL TORO QUADRANGLE, ORANGE COUNTY, CALIFORNIA" BY DONALD L. FIFE, 1974

GEOLOGIC MAP

PROPOSED WAREHOUSE

LAKE FOREST, CALIFORNIA

SCALE: 1" = 2000'

DRAWN: JAH
CHKD: GKM

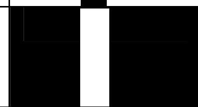
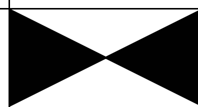
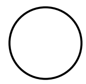
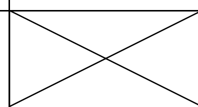
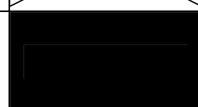
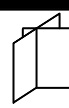
SCG PROJECT
21G135-1

PLATE 3

SOUTHERN CALIFORNIA GEOTECHNICAL

APPENDIX B

BORING LOG LEGEND

SAMPLE TYPE	GRAPHICAL SYMBOL	SAMPLE DESCRIPTION
AUGER		SAMPLE COLLECTED FROM AUGER CUTTINGS, NO FIELD MEASUREMENT OF SOIL STRENGTH. (DISTURBED)
CORE		ROCK CORE SAMPLE: TYPICALLY TAKEN WITH A DIAMOND-TIPPED CORE BARREL. TYPICALLY USED ONLY IN HIGHLY CONSOLIDATED BEDROCK.
GRAB		SOIL SAMPLE TAKEN WITH NO SPECIALIZED EQUIPMENT, SUCH AS FROM A STOCKPILE OR THE GROUND SURFACE. (DISTURBED)
CS		CALIFORNIA SAMPLER: 2-1/2 INCH I.D. SPLIT BARREL SAMPLER, LINED WITH 1-INCH HIGH BRASS RINGS. DRIVEN WITH SPT HAMMER. (RELATIVELY UNDISTURBED)
NSR		NO RECOVERY: THE SAMPLING ATTEMPT DID NOT RESULT IN RECOVERY OF ANY SIGNIFICANT SOIL OR ROCK MATERIAL.
SPT		STANDARD PENETRATION TEST: SAMPLER IS A 1.4 INCH INSIDE DIAMETER SPLIT BARREL, DRIVEN 18 INCHES WITH THE SPT HAMMER. (DISTURBED)
SH		SHELBY TUBE: TAKEN WITH A THIN WALL SAMPLE TUBE, PUSHED INTO THE SOIL AND THEN EXTRACTED. (UNDISTURBED)
VANE		VANE SHEAR TEST: SOIL STRENGTH OBTAINED USING A 4 BLADED SHEAR DEVICE. TYPICALLY USED IN SOFT CLAYS-NO SAMPLE RECOVERED.

COLUMN DESCRIPTIONS

DEPTH:	Distance in feet below the ground surface.
SAMPLE:	Sample Type as depicted above.
BLOW COUNT:	Number of blows required to advance the sampler 12 inches using a 140 lb hammer with a 30-inch drop. 50/3” indicates penetration refusal (>50 blows) at 3 inches. WH indicates that the weight of the hammer was sufficient to push the sampler 6 inches or more.
POCKET PEN.:	Approximate shear strength of a cohesive soil sample as measured by pocket penetrometer.
GRAPHIC LOG:	Graphic Soil Symbol as depicted on the following page.
DRY DENSITY:	Dry density of an undisturbed or relatively undisturbed sample in lbs/ft^3.
MOISTURE CONTENT:	Moisture content of a soil sample, expressed as a percentage of the dry weight.
LIQUID LIMIT:	The moisture content above which a soil behaves as a liquid.
PLASTIC LIMIT:	The moisture content above which a soil behaves as a plastic.
PASSING #200 SIEVE:	The percentage of the sample finer than the #200 standard sieve.
UNCONFINED SHEAR:	The shear strength of a cohesive soil sample, as measured in the unconfined state.

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		(LITTLE OR NO FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SANDS		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		(LITTLE OR NO FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES		SM	SILTY SANDS, SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

BORING NO. B-1

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

JOB NO.: 21G135-1	DRILLING DATE: 3/12/21	WATER DEPTH: Dry
PROJECT: Proposed Warehouse	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: 28 feet
LOCATION: Lake Forest, California	LOGGED BY: Jamie Hayward	READING TAKEN: At Completion

SURFACE ELEVATION: 702.5 feet MSL

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
					3½± inches Asphaltic Concrete; 3½± inches Aggregate Base							
	X	21			ENGINEERED FILL (Afe): Light Gray to Gray Brown Silty fine Sand, little Iron oxide staining, medium dense to dense-moist to very moist		15					EI = 12 @ 0 to 5 feet
	X	29					15					
5												
	X	25					12					
	X	30					12					
10												
	X	29					14					
15												
					ENGINEERED FILL (Afe): Dark Gray Silty fine Sand, little Clay, medium dense-moist to very moist							
	X	23					15					
20												
	X	18					15					
25												
					@ 28 to 30 feet, Dark Gray Brown, some Clay, dense							
	X	31					14					
30												
					Boring Terminated at 30'							

TBL 21G135-1.GPJ SOCALGEO.GDT 4/8/21

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-2

JOB NO.: 21G135-1
PROJECT: Proposed Warehouse
LOCATION: Lake Forest, California

DRILLING DATE: 3/12/21
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jamie Hayward

WATER DEPTH: Dry
CAVE DEPTH: 23 feet
READING TAKEN: At Completion

SURFACE ELEVATION: 701.5 feet MSL

DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
					4½± inches Asphaltic Concrete; 7± inches Aggregate Base							
	X	78/10"			CAPISTRANO FORMATION (Tco): Light Gray fine-grained Sandstone, very dense-damp to moist	108	10					
	X	93/9"			@ 3 feet, little medium Sand	111	7					
5	X	50/5"				101	8					
	X	50/5"				98	8					
10	X	50/5"				99	6					
15	X	88/9"					10					
20	X	76/10"					13					
25	X	90/11"			@ 23½ feet, little Iron oxide staining		7					
					Boring Terminated at 25'							

TBL 21G135-1.GPJ SOCALGEO.GDT 4/8/21

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-3

JOB NO.: 21G135-1
PROJECT: Proposed Warehouse
LOCATION: Lake Forest, California

DRILLING DATE: 3/12/21
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jamie Hayward

WATER DEPTH: Dry
CAVE DEPTH: 17 feet
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: 697 feet MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
					3½± inches Asphaltic Concrete; 3± inches Aggregate Base							
		77/10"			CAPISTRANO FORMATION (Tco): Light Gray fine-grained Sandstone, very dense-damp to moist	110	4					
		50/5"				98	6					
5		50/5.5"				104	5					
		50/5"				100	7					
10		50/5"				96	7					
		83/9"					8					
15												
		91/10"			@ 18½ feet, Gray Brown, trace Silt		10					
20												

Boring Terminated at 20'

TBL 21G135-1.GPJ SOCALGEO.GDT 4/8/21

SOUTHERN CALIFORNIA GEOTECHNICAL

A California Corporation

BORING NO. B-4

JOB NO.: 21G135-1
PROJECT: Proposed Warehouse
LOCATION: Lake Forest, California

DRILLING DATE: 3/12/21
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jamie Hayward

WATER DEPTH: Dry
CAVE DEPTH: 23 feet
READING TAKEN: At Completion

SURFACE ELEVATION: 695 feet MSL

FIELD RESULTS: DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	LABORATORY RESULTS: DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
					4± inches Asphaltic Concrete; 2½± inches Aggregate Base							
		47			ENGINEERED FILL (Afe): Gray Brown Silty fine Sand, little Iron oxide staining, medium dense to dense-moist to very moist	113	14					
		36				109	12					
5		43				110	11					
		40				109	14					
		77/11"			@ 9 feet, trace Clay, very dense	118	13					
10												
					ENGINEERED FILL (Afe): Gray to Gray Brown Silty fine Sand, trace Clay, varied coloration, dense-very moist							
		33					17					
15												
		33					16 13					
20												
					CAPISTRANO FORMATION (Tco): Light Gray Brown fine-grained Sandstone, very dense-moist							
		75/11"					10					
25												

Boring Terminated at 25'

TBL 21G135-1.GPJ SOCALGEO.GDT 4/8/21

TEST BORING LOG

BORING NO. B-5

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

JOB NO.: 21G135-1
PROJECT: Proposed Warehouse
LOCATION: Lake Forest, California

DRILLING DATE: 3/12/21
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jamie Hayward

WATER DEPTH: Dry
CAVE DEPTH: 26 feet
READING TAKEN: At Completion

SURFACE ELEVATION: 696 feet MSL

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
0					3½± inches Asphaltic Concrete; 3± inches Aggregate Base							
					ENGINEERED FILL (Afe): Light Gray Brown to Gray Brown Silty fine Sand, trace Clay, little Iron oxide staining, varied coloration, medium dense to dense-moist to very moist							
	X	37					13					
	X	20					12					
5												
	X	35					14					
					ENGINEERED FILL (Afe): Light Gray Brown Silty fine Sand, little Clay, little Iron oxide staining, varied coloration, medium dense to very dense-moist to very moist							
	X	26					12					
10												
	X	33					13					
15												
	X	61/9"					15					
20												
	X	28					14					
25												
					ENGINEERED FILL (Afe): Dark Brown to Gray Brown Clayey fine Sand, varied coloration, dense-moist							
	X	36					14					
30					Boring Terminated at 30'							

SOUTHERN CALIFORNIA GEOTECHNICAL

A California Corporation

BORING NO. B-6

JOB NO.: 21G135-1
PROJECT: Proposed Warehouse
LOCATION: Lake Forest, California

DRILLING DATE: 3/12/21
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jamie Hayward

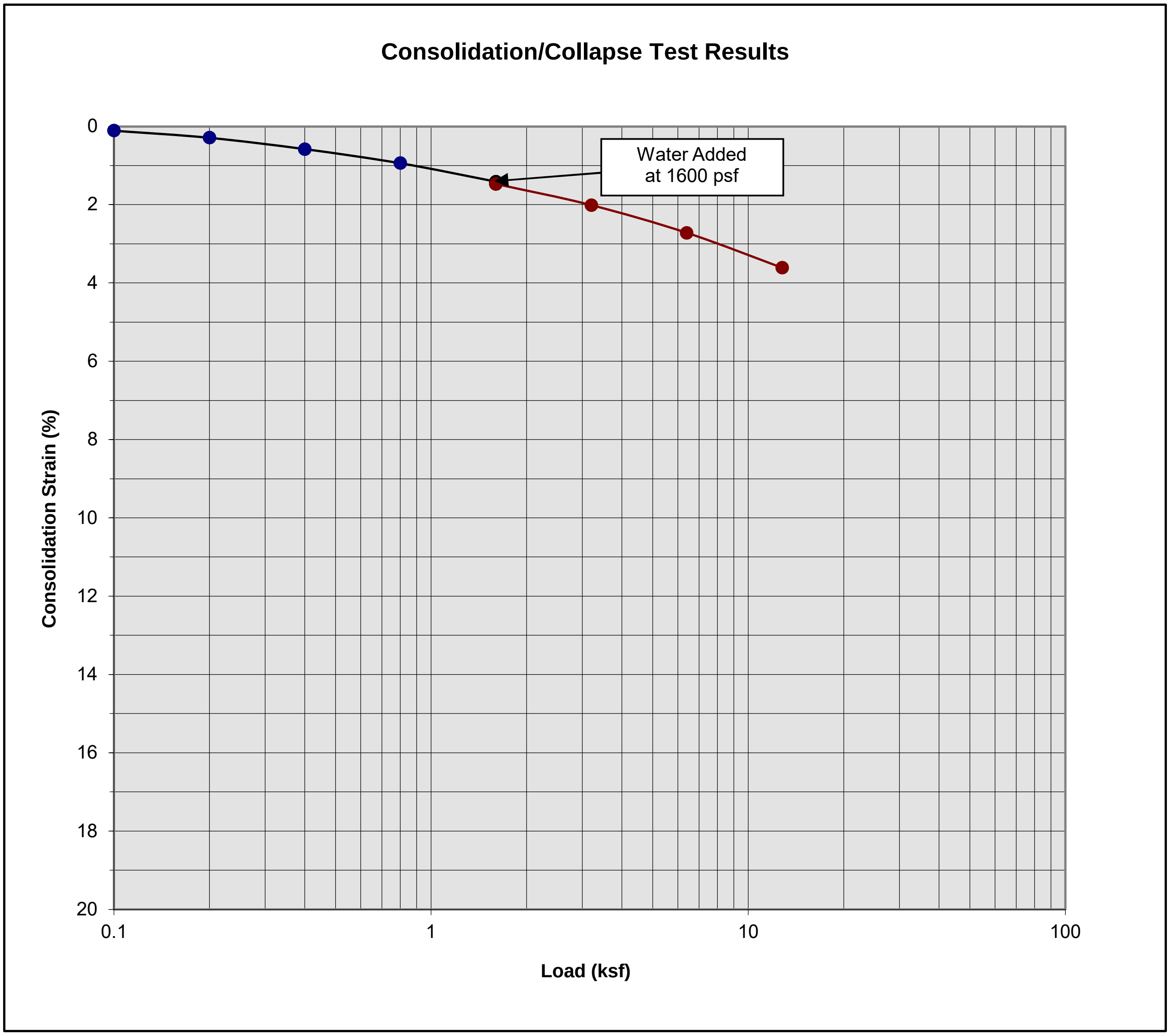
WATER DEPTH: Dry
CAVE DEPTH: 17 feet
READING TAKEN: At Completion

SURFACE ELEVATION: 699.5 feet MSL

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
0					4½± inches Asphaltic Concrete; 4½± inches Aggregate Base							
1	Hand				ENGINEERED FILL (Afe): Light Gray Brown Silty fine Sand, trace medium Sand, trace Clay, medium dense to very dense-moist to very moist		12					Hand Augered 0 to 5 feet due to Existing Utility
4	Hand						10					
6	Drive	50			@ 6 to 8½ feet, trace to little Iron oxide staining		14					
8.5	Drive	36					13					
12					CAPISTRANO FORMATION (Tco): Gray Brown fine-grained Silty Sandstone, little Iron oxide staining, poorly consolidated, dense to very dense-moist							
13.5	Drive	39					11					
18.5	Drive	56					12					
20					Boring Terminated at 20'							

TBL 21G135-1.GPJ SOCALGEO.GDT 4/8/21

APPENDIX C

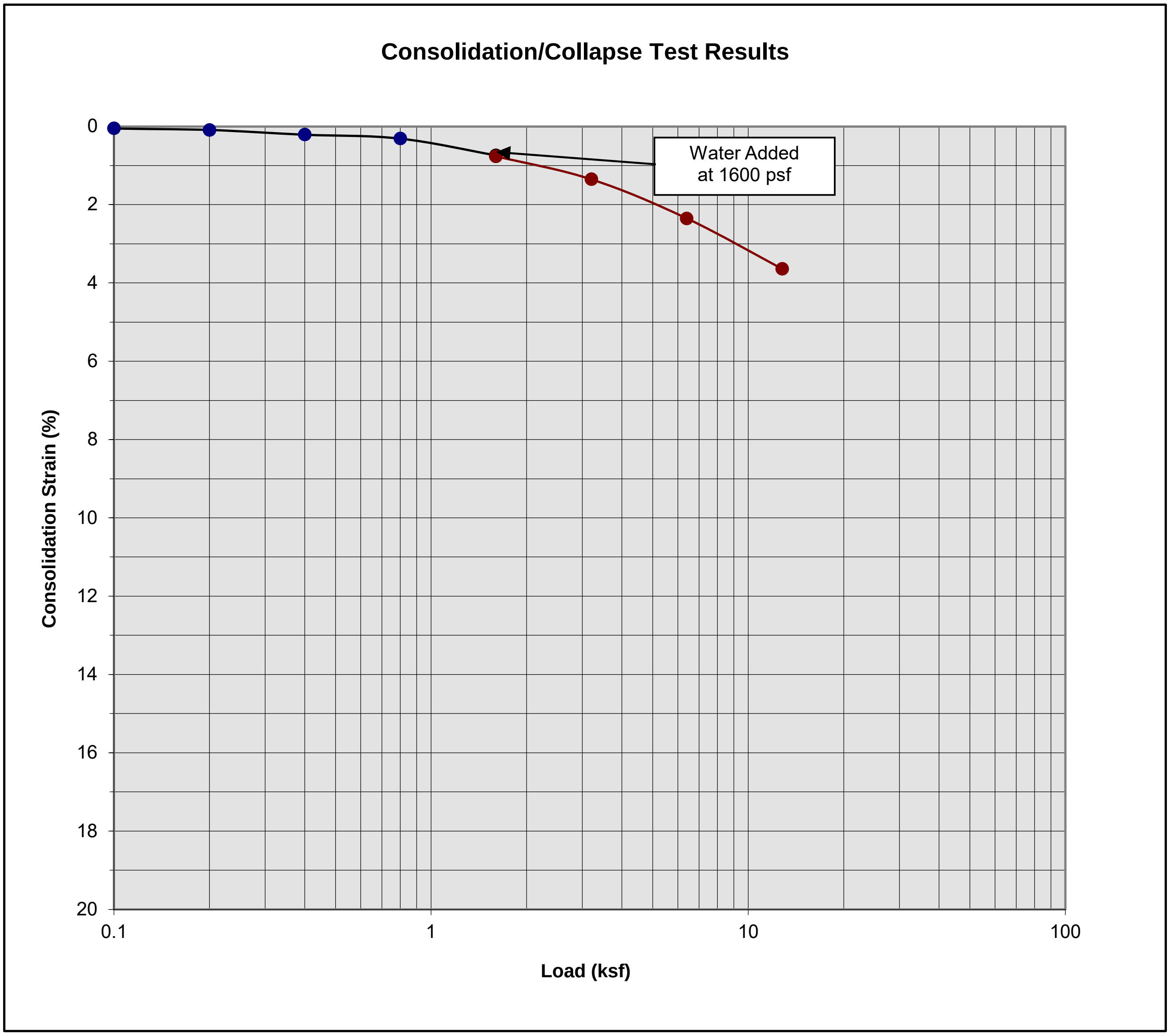


Classification: FILL: Gray Brown Silty fine Sand, trace Clay

Boring Number:	B-4		Initial Moisture Content (%)	12
Sample Number:	---		Final Moisture Content (%)	14
Depth (ft)	3 to 4		Initial Dry Density (pcf)	109.6
Specimen Diameter (in)	2.4		Final Dry Density (pcf)	114.2
Specimen Thickness (in)	1.0		Percent Collapse (%)	0.06

Proposed Warehouse
Lake Forest, California
Project No. 21G135-1
PLATE C- 1

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

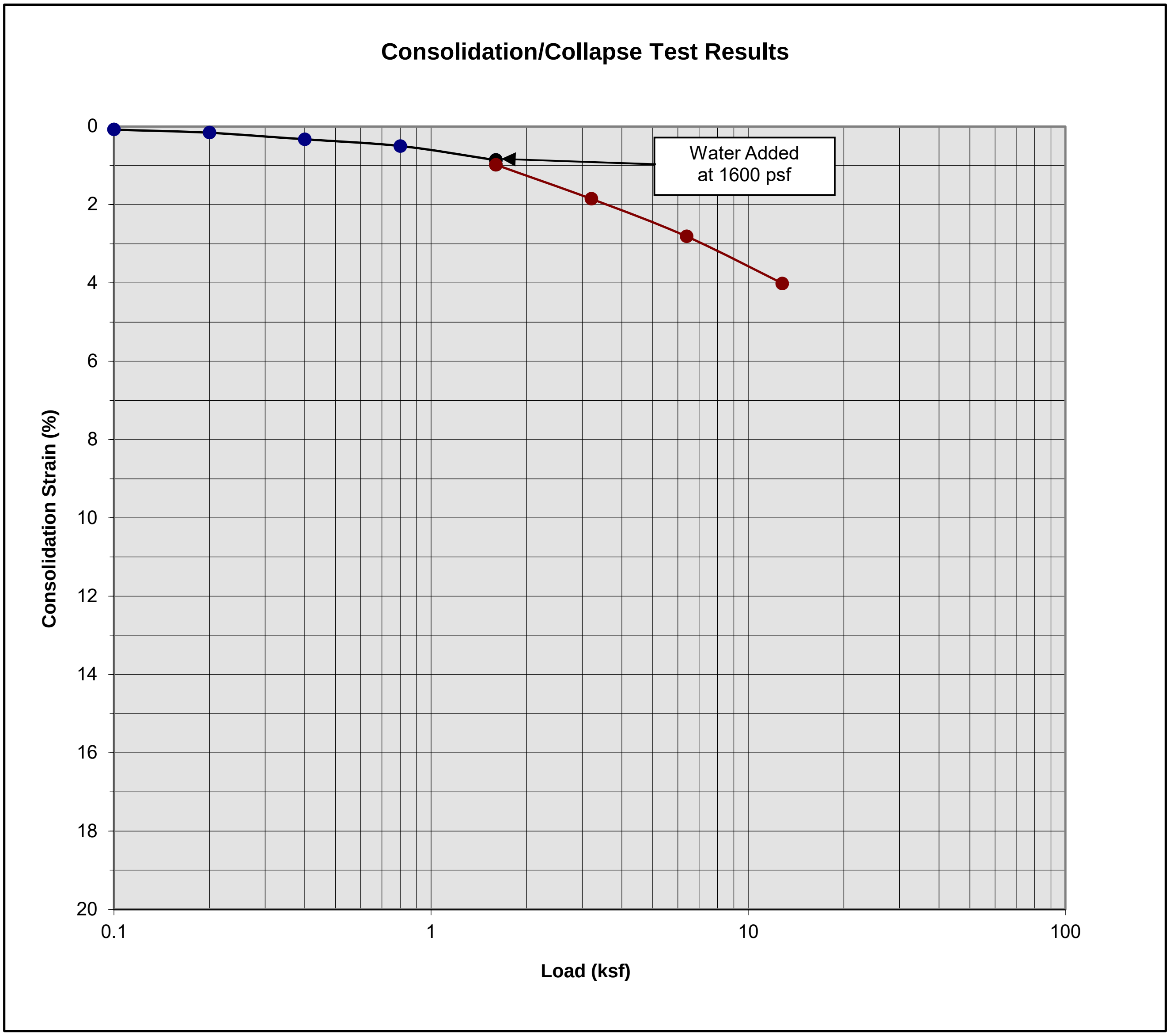


Classification: FILL: Gray Brown Silty fine Sand, trace Clay

Boring Number:	B-4	Initial Moisture Content (%)	11
Sample Number:	---	Final Moisture Content (%)	16
Depth (ft)	5 to 6	Initial Dry Density (pcf)	109.9
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	114.7
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.02

Proposed Warehouse
Lake Forest, California
Project No. 21G135-1
PLATE C- 2

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation



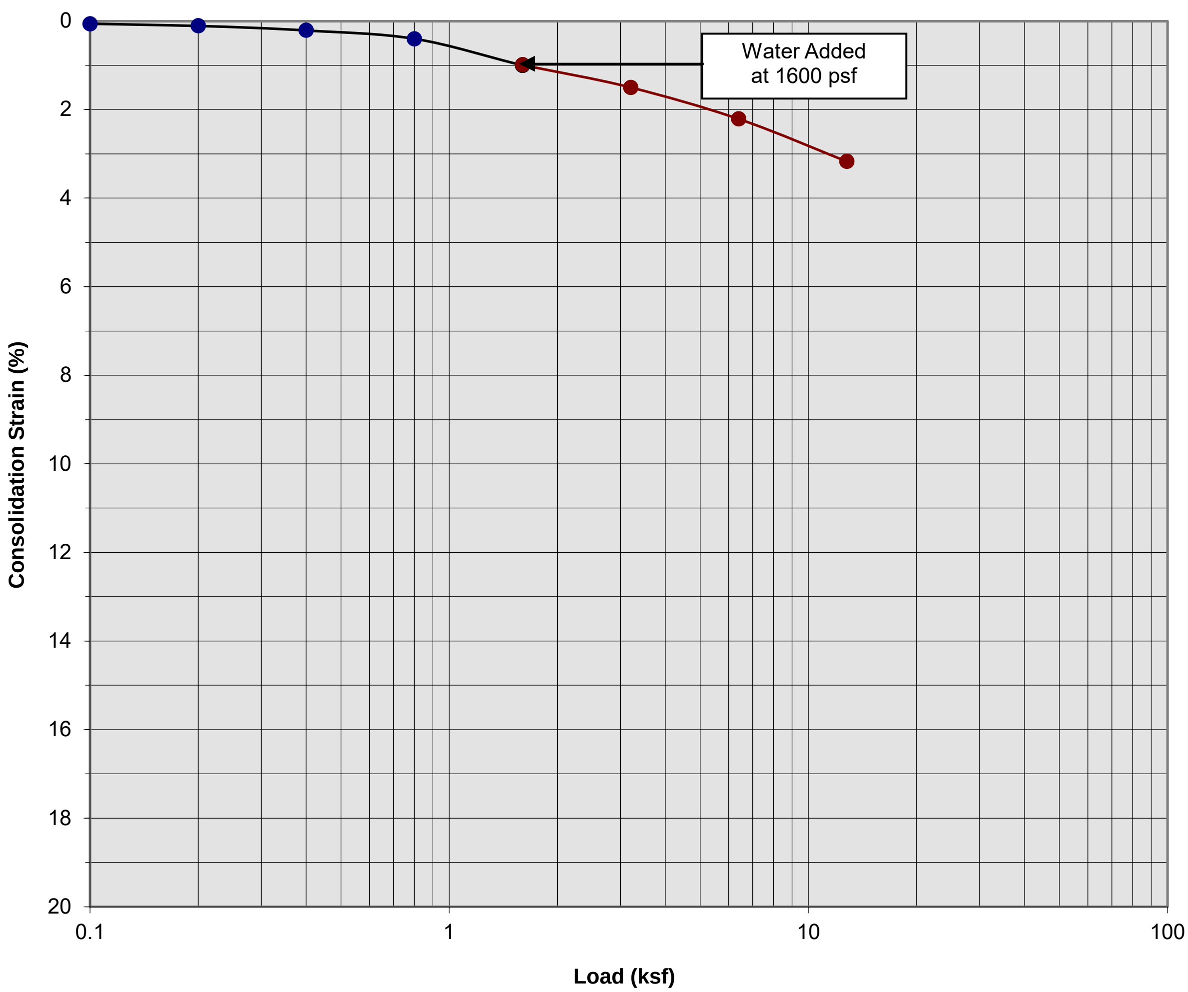
Classification: FILL: Gray Brown Silty fine Sand, trace Clay

Boring Number:	B-4	Initial Moisture Content (%)	13
Sample Number:	---	Final Moisture Content (%)	17
Depth (ft)	7 to 8	Initial Dry Density (pcf)	108.8
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	113.2
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.12

Proposed Warehouse
Lake Forest, California
Project No. 21G135-1
PLATE C- 3

SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

Consolidation/Collapse Test Results

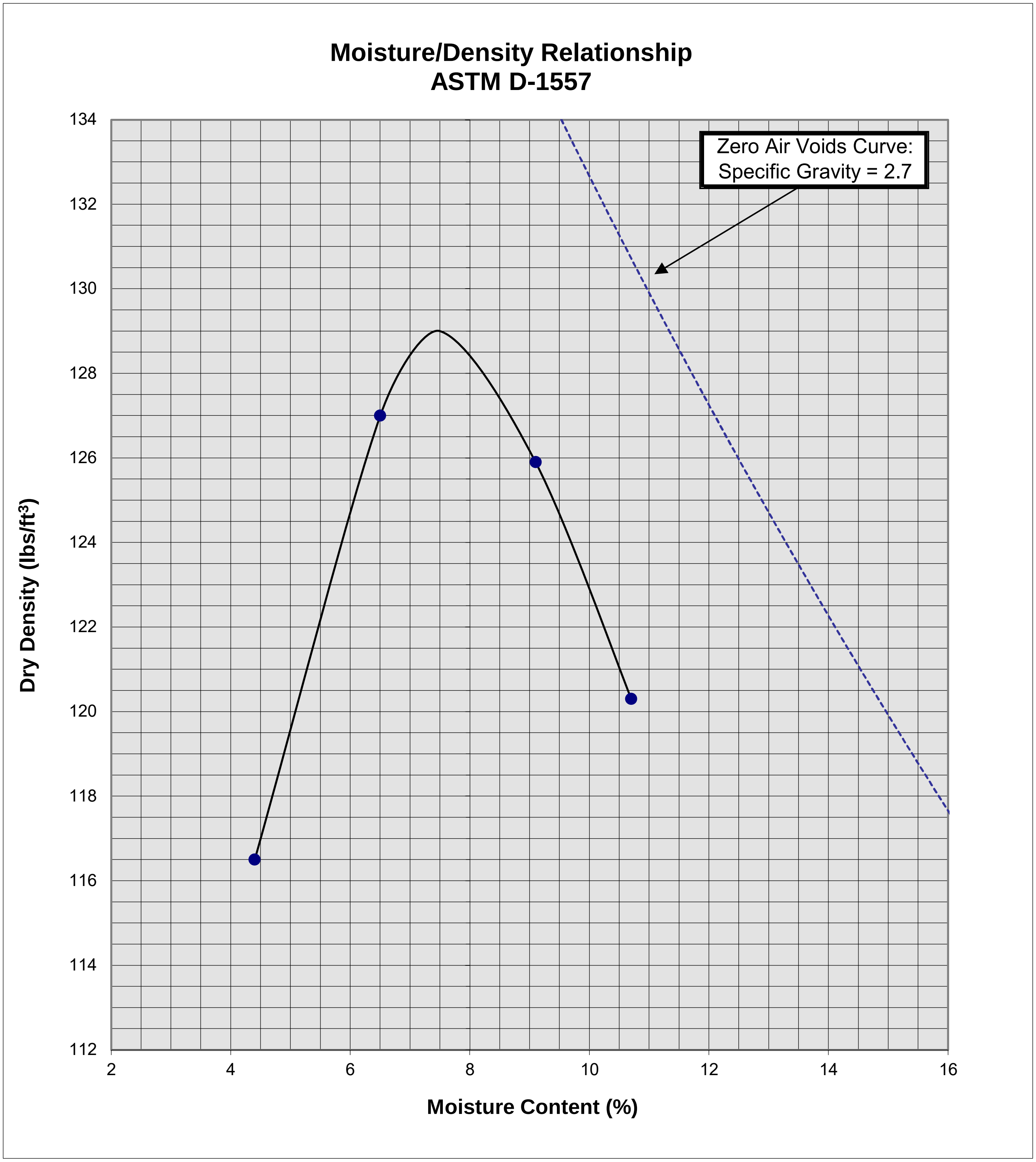


Classification: FILL: Gray Brown Silty fine Sand, trace Clay

Boring Number:	B-4	Initial Moisture Content (%)	13
Sample Number:	---	Final Moisture Content (%)	16
Depth (ft)	9 to 10	Initial Dry Density (pcf)	117.9
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	122.2
Specimen Thickness (in)	1.0	Percent Collapse (%)	-0.01

Proposed Warehouse
Lake Forest, California
Project No. 21G135-1
PLATE C- 4

SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation



Soil ID Number	B-1 @ 0-5'
Optimum Moisture (%)	7.5
Maximum Dry Density (pcf)	130
Soil Classification	Light Gray to Gray Brown Silty fine Sand

Proposed Warehouse
Lake Forest, California
Project No. 21G135-1
PLATE C-5

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

APPENDIX D

GRADING GUIDE SPECIFICATIONS

These grading guide specifications are intended to provide typical procedures for grading operations. They are intended to supplement the recommendations contained in the geotechnical investigation report for this project. Should the recommendations in the geotechnical investigation report conflict with the grading guide specifications, the more site specific recommendations in the geotechnical investigation report will govern.

General

- The Earthwork Contractor is responsible for the satisfactory completion of all earthwork in accordance with the plans and geotechnical reports, and in accordance with city, county, and applicable building codes.

- The Geotechnical Engineer is the representative of the Owner/Builder for the purpose of implementing the report recommendations and guidelines. These duties are not intended to relieve the Earthwork Contractor of any responsibility to perform in a workman-like manner, nor is the Geotechnical Engineer to direct the grading equipment or personnel employed by the Contractor.

- The Earthwork Contractor is required to notify the Geotechnical Engineer of the anticipated work and schedule so that testing and inspections can be provided. If necessary, work may be stopped and redone if personnel have not been scheduled in advance.

- The Earthwork Contractor is required to have suitable and sufficient equipment on the job-site to process, moisture condition, mix and compact the amount of fill being placed to the approved compaction. In addition, suitable support equipment should be available to conform with recommendations and guidelines in this report.

- Canyon cleanouts, overexcavation areas, processed ground to receive fill, key excavations, subdrains and benches should be observed by the Geotechnical Engineer prior to placement of any fill. It is the Earthwork Contractor's responsibility to notify the Geotechnical Engineer of areas that are ready for inspection.

- Excavation, filling, and subgrade preparation should be performed in a manner and sequence that will provide drainage at all times and proper control of erosion. Precipitation, springs, and seepage water encountered shall be pumped or drained to provide a suitable working surface. The Geotechnical Engineer must be informed of springs or water seepage encountered during grading or foundation construction for possible revision to the recommended construction procedures and/or installation of subdrains.

Site Preparation

- The Earthwork Contractor is responsible for all clearing, grubbing, stripping and site preparation for the project in accordance with the recommendations of the Geotechnical Engineer.

- If any materials or areas are encountered by the Earthwork Contractor which are suspected of having toxic or environmentally sensitive contamination, the Geotechnical Engineer and Owner/Builder should be notified immediately.

- Major vegetation should be stripped and disposed of off-site. This includes trees, brush, heavy grasses and any materials considered unsuitable by the Geotechnical Engineer.

- Underground structures such as basements, cesspools or septic disposal systems, mining shafts, tunnels, wells and pipelines should be removed under the inspection of the Geotechnical Engineer and recommendations provided by the Geotechnical Engineer and/or city, county or state agencies. If such structures are known or found, the Geotechnical Engineer should be notified as soon as possible so that recommendations can be formulated.

- Any topsoil, slopewash, colluvium, alluvium and rock materials which are considered unsuitable by the Geotechnical Engineer should be removed prior to fill placement.

- Remaining voids created during site clearing caused by removal of trees, foundations basements, irrigation facilities, etc., should be excavated and filled with compacted fill.

- Subsequent to clearing and removals, areas to receive fill should be scarified to a depth of 10 to 12 inches, moisture conditioned and compacted

- The moisture condition of the processed ground should be at or slightly above the optimum moisture content as determined by the Geotechnical Engineer. Depending upon field conditions, this may require air drying or watering together with mixing and/or discing.

<u>Compacted Fills</u>

- Soil materials imported to or excavated on the property may be utilized in the fill, provided each material has been determined to be suitable in the opinion of the Geotechnical Engineer. Unless otherwise approved by the Geotechnical Engineer, all fill materials shall be free of deleterious, organic, or frozen matter, shall contain no chemicals that may result in the material being classified as "contaminated," and shall be very low to non-expansive with a maximum expansion index (EI) of 50. The top 12 inches of the compacted fill should have a maximum particle size of 3 inches, and all underlying compacted fill material a maximum 6-inch particle size, except as noted below.

- All soils should be evaluated and tested by the Geotechnical Engineer. Materials with high expansion potential, low strength, poor gradation or containing organic materials may require removal from the site or selective placement and/or mixing to the satisfaction of the Geotechnical Engineer.

- Rock fragments or rocks less than 6 inches in their largest dimensions, or as otherwise determined by the Geotechnical Engineer, may be used in compacted fill, provided the distribution and placement is satisfactory in the opinion of the Geotechnical Engineer.

- Rock fragments or rocks greater than 12 inches should be taken off-site or placed in accordance with recommendations and in areas designated as suitable by the Geotechnical Engineer. These materials should be placed in accordance with Plate D-8 of these Grading Guide Specifications and in accordance with the following recommendations:

    - Rocks 12 inches or more in diameter should be placed in rows at least 15 feet apart, 15 feet from the edge of the fill, and 10 feet or more below subgrade. Spaces should be left between each rock fragment to provide for placement and compaction of soil around the fragments.

    - Fill materials consisting of soil meeting the minimum moisture content requirements and free of oversize material should be placed between and over the rows of rock or concrete. Ample water and compactive effort should be applied to the fill materials as they are placed in order that all of the voids between each of the fragments are filled and compacted to the specified density.

- Subsequent rows of rocks should be placed such that they are not directly above a row placed in the previous lift of fill. A minimum 5-foot offset between rows is recommended.

- To facilitate future trenching, oversized material should not be placed within the range of foundation excavations, future utilities or other underground construction unless specifically approved by the soil engineer and the developer/owner representative.

- Fill materials approved by the Geotechnical Engineer should be placed in areas previously prepared to receive fill and in evenly placed, near horizontal layers at about 6 to 8 inches in loose thickness, or as otherwise determined by the Geotechnical Engineer for the project.

- Each layer should be moisture conditioned to optimum moisture content, or slightly above, as directed by the Geotechnical Engineer. After proper mixing and/or drying, to evenly distribute the moisture, the layers should be compacted to at least 90 percent of the maximum dry density in compliance with ASTM D-1557-78 unless otherwise indicated.

- Density and moisture content testing should be performed by the Geotechnical Engineer at random intervals and locations as determined by the Geotechnical Engineer. These tests are intended as an aid to the Earthwork Contractor, so he can evaluate his workmanship, equipment effectiveness and site conditions. The Earthwork Contractor is responsible for compaction as required by the Geotechnical Report(s) and governmental agencies.

- Fill areas unused for a period of time may require moisture conditioning, processing and recompaction prior to the start of additional filling. The Earthwork Contractor should notify the Geotechnical Engineer of his intent so that an evaluation can be made.

- Fill placed on ground sloping at a 5-to-1 inclination (horizontal-to-vertical) or steeper should be benched into bedrock or other suitable materials, as directed by the Geotechnical Engineer. Typical details of benching are illustrated on Plates D-2, D-4, and D-5.

- Cut/fill transition lots should have the cut portion overexcavated to a depth of at least 3 feet and rebuilt with fill (see Plate D-1), as determined by the Geotechnical Engineer.

- All cut lots should be inspected by the Geotechnical Engineer for fracturing and other bedrock conditions. If necessary, the pads should be overexcavated to a depth of 3 feet and rebuilt with a uniform, more cohesive soil type to impede moisture penetration.

- Cut portions of pad areas above buttresses or stabilizations should be overexcavated to a depth of 3 feet and rebuilt with uniform, more cohesive compacted fill to impede moisture penetration.

- Non-structural fill adjacent to structural fill should typically be placed in unison to provide lateral support. Backfill along walls must be placed and compacted with care to ensure that excessive unbalanced lateral pressures do not develop. The type of fill material placed adjacent to below grade walls must be properly tested and approved by the Geotechnical Engineer with consideration of the lateral earth pressure used in the design.

Foundations

- The foundation influence zone is defined as extending one foot horizontally from the outside edge of a footing, and proceeding downward at a ½ horizontal to 1 vertical (0.5:1) inclination.

- Where overexcavation beneath a footing subgrade is necessary, it should be conducted so as to encompass the entire foundation influence zone, as described above.

- Compacted fill adjacent to exterior footings should extend at least 12 inches above foundation bearing grade. Compacted fill within the interior of structures should extend to the floor subgrade elevation.

Fill Slopes

- The placement and compaction of fill described above applies to all fill slopes. Slope compaction should be accomplished by overfilling the slope, adequately compacting the fill in even layers, including the overfilled zone and cutting the slope back to expose the compacted core

- Slope compaction may also be achieved by backrolling the slope adequately every 2 to 4 vertical feet during the filling process as well as requiring the earth moving and compaction equipment to work close to the top of the slope. Upon completion of slope construction, the slope face should be compacted with a sheepsfoot connected to a sideboom and then grid rolled. This method of slope compaction should only be used if approved by the Geotechnical Engineer.

- Sandy soils lacking in adequate cohesion may be unstable for a finished slope condition and therefore should not be placed within 15 horizontal feet of the slope face.

- All fill slopes should be keyed into bedrock or other suitable material. Fill keys should be at least 15 feet wide and inclined at 2 percent into the slope. For slopes higher than 30 feet, the fill key width should be equal to one-half the height of the slope (see Plate D-5).

- All fill keys should be cleared of loose slough material prior to geotechnical inspection and should be approved by the Geotechnical Engineer and governmental agencies prior to filling.

- The cut portion of fill over cut slopes should be made first and inspected by the Geotechnical Engineer for possible stabilization requirements. The fill portion should be adequately keyed through all surficial soils and into bedrock or suitable material. Soils should be removed from the transition zone between the cut and fill portions (see Plate D-2).

Cut Slopes

- All cut slopes should be inspected by the Geotechnical Engineer to determine the need for stabilization. The Earthwork Contractor should notify the Geotechnical Engineer when slope cutting is in progress at intervals of 10 vertical feet. Failure to notify may result in a delay in recommendations.

- Cut slopes exposing loose, cohesionless sands should be reported to the Geotechnical Engineer for possible stabilization recommendations.

- All stabilization excavations should be cleared of loose slough material prior to geotechnical inspection. Stakes should be provided by the Civil Engineer to verify the location and dimensions of the key. A typical stabilization fill detail is shown on Plate D-5.

- Stabilization key excavations should be provided with subdrains. Typical subdrain details are shown on Plates D-6.

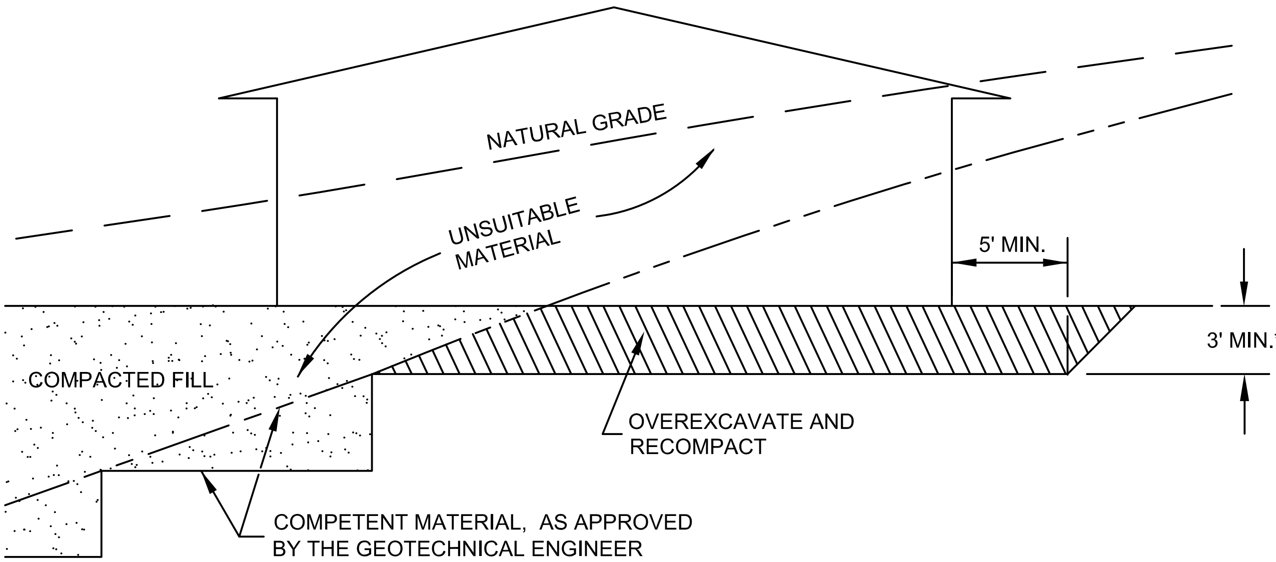
Subdrains

- Subdrains may be required in canyons and swales where fill placement is proposed. Typical subdrain details for canyons are shown on Plate D-3. Subdrains should be installed after approval of removals and before filling, as determined by the Soils Engineer.

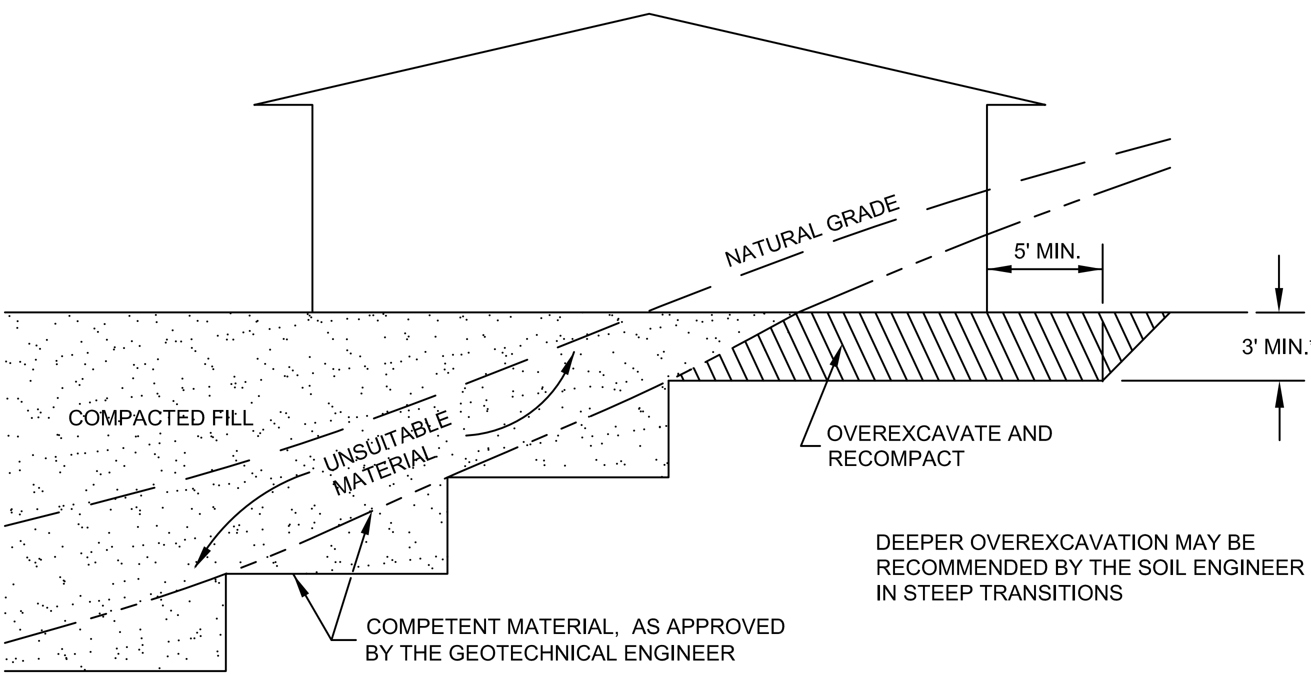
- Plastic pipe may be used for subdrains provided it is Schedule 40 or SDR 35 or equivalent. Pipe should be protected against breakage, typically by placement in a square-cut (backhoe) trench or as recommended by the manufacturer.

- Filter material for subdrains should conform to CALTRANS Specification 68-1.025 or as approved by the Geotechnical Engineer for the specific site conditions. Clean ¾-inch crushed rock may be used provided it is wrapped in an acceptable filter cloth and approved by the Geotechnical Engineer. Pipe diameters should be 6 inches for runs up to 500 feet and 8 inches for the downstream continuations of longer runs. Four-inch diameter pipe may be used in buttress and stabilization fills.

CUT LOT



CUT/FILL LOT (TRANSITION)



*SEE TEXT OF REPORT FOR SPECIFIC RECOMMENDATION.
ACTUAL DEPTH OF OVEREXCAVATION MAY BE GREATER.

TRANSITION LOT DETAIL

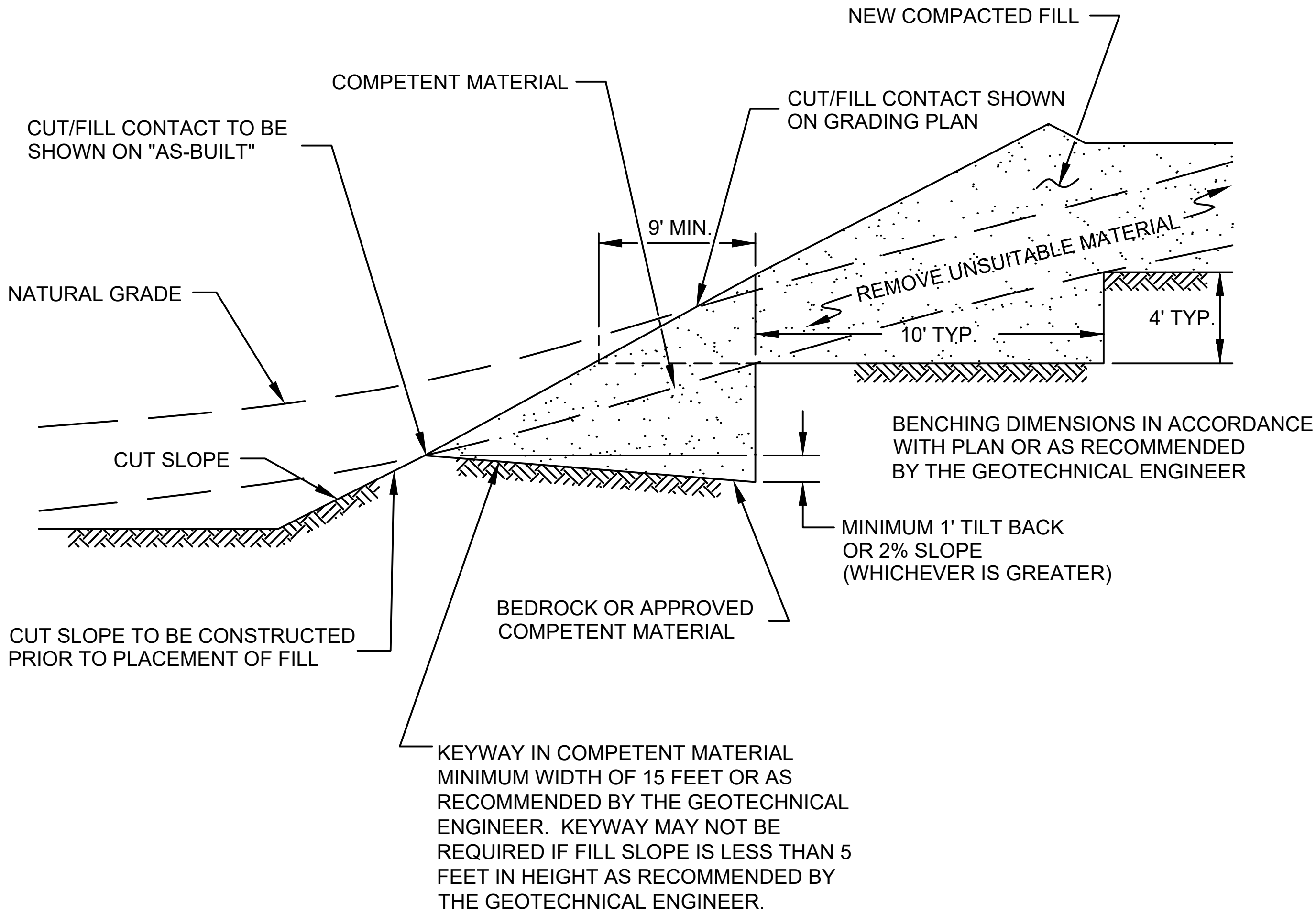
GRADING GUIDE SPECIFICATIONS

NOT TO SCALE

DRAWN: JAS
CHKD: GKM

PLATE D-1

SOUTHERN CALIFORNIA GEOTECHNICAL



FILL ABOVE CUT SLOPE DETAIL

GRADING GUIDE SPECIFICATIONS

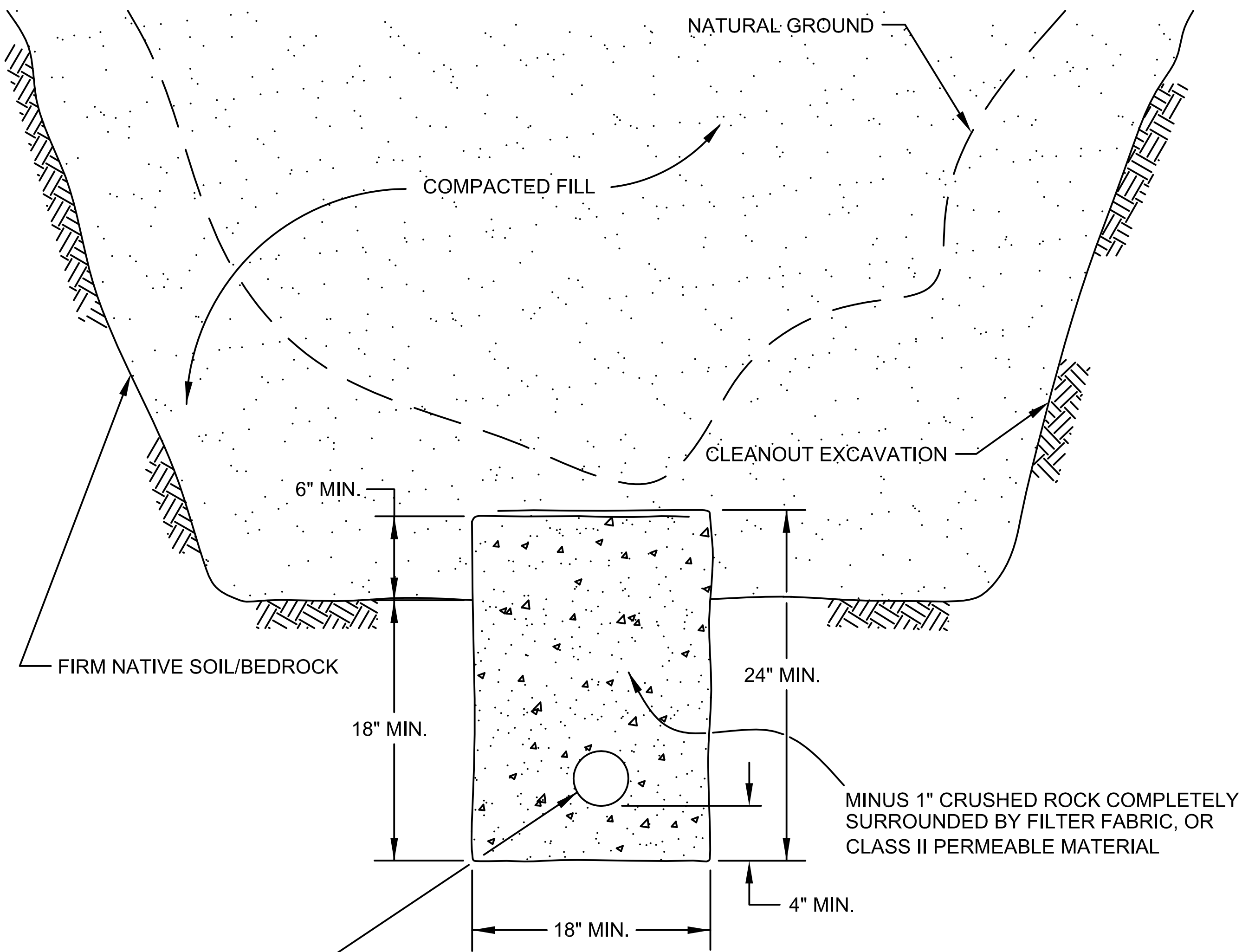
NOT TO SCALE

DRAWN: JAS
CHKD: GKM

PLATE D-2

SoCalGeo

SOUTHERN CALIFORNIA GEOTECHNICAL



PIPE MATERIAL	DEPTH OF FILL OVER SUBDRAIN
ADS (CORRUGATED POLETHYLENE)	8
TRANSITE UNDERDRAIN	20
PVC OR ABS: SDR 35	35
SDR 21	100

SCHEMATIC ONLY
NOT TO SCALE

CANYON SUBDRAIN DETAIL

GRADING GUIDE SPECIFICATIONS

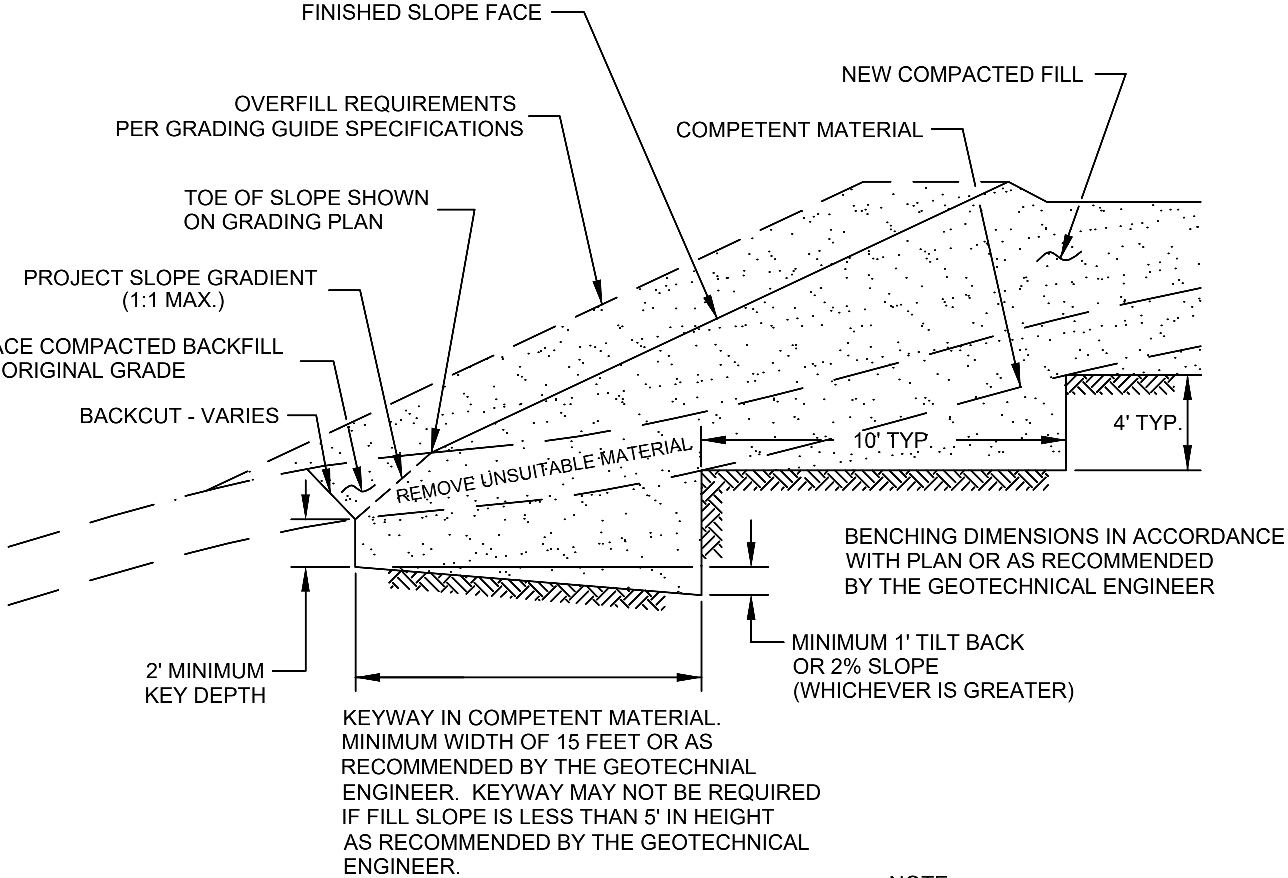
NOT TO SCALE

DRAWN: JAS
CHKD: GKM

PLATE D-3

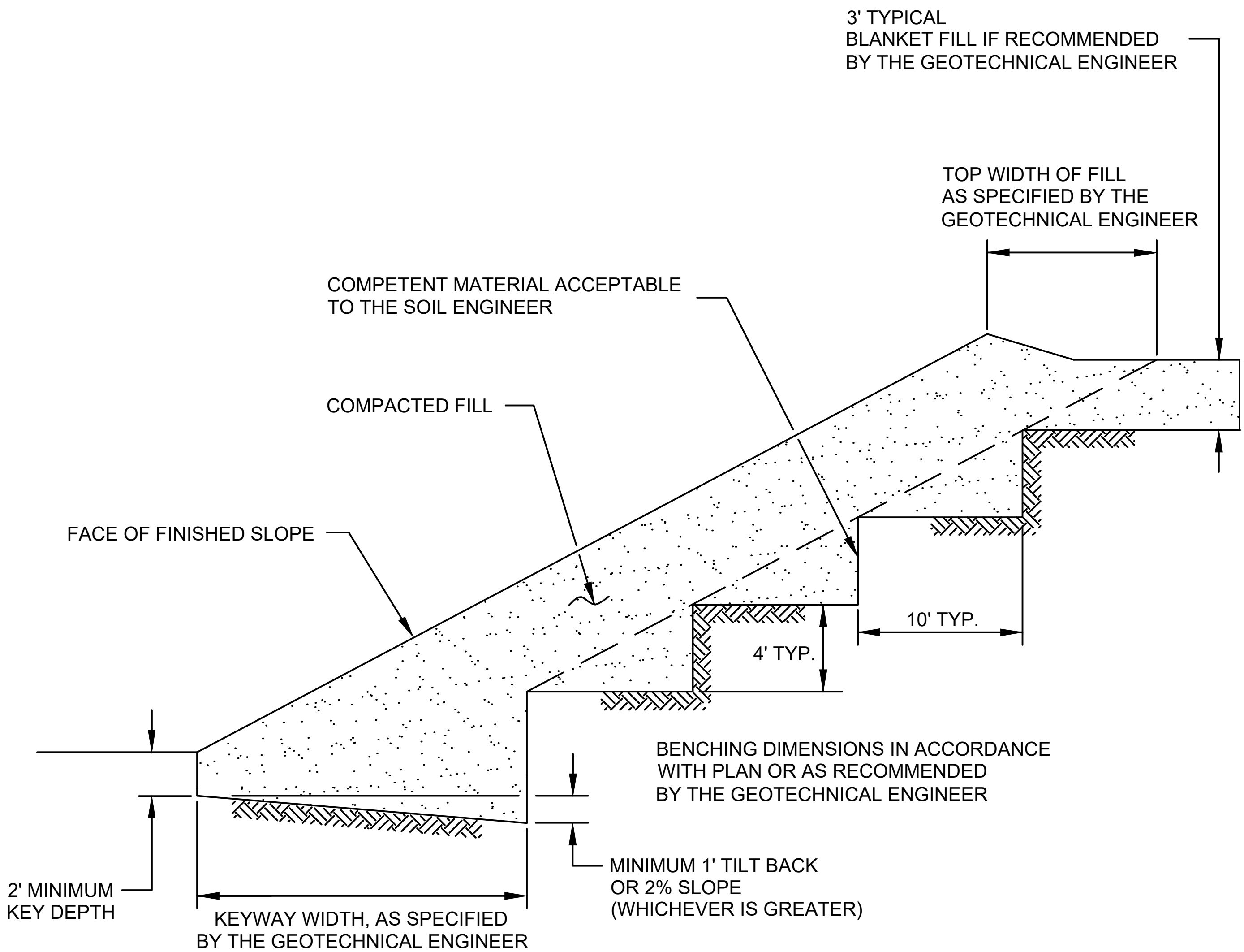
SoCalGeo

SOUTHERN CALIFORNIA GEOTECHNICAL



NOTE:
BENCHING SHALL BE REQUIRED
WHEN NATURAL SLOPES ARE
EQUAL TO OR STEEPER THAN 5:1
OR WHEN RECOMMENDED BY
THE GEOTECHNICAL ENGINEER.

FILL ABOVE NATURAL SLOPE DETAIL	
GRADING GUIDE SPECIFICATIONS	
NOT TO SCALE	SOUTHERN CALIFORNIA GEOTECHNICAL
DRAWN: JAS CHKD: GKM	
PLATE D-4	



STABILIZATION FILL DETAIL

GRADING GUIDE SPECIFICATIONS

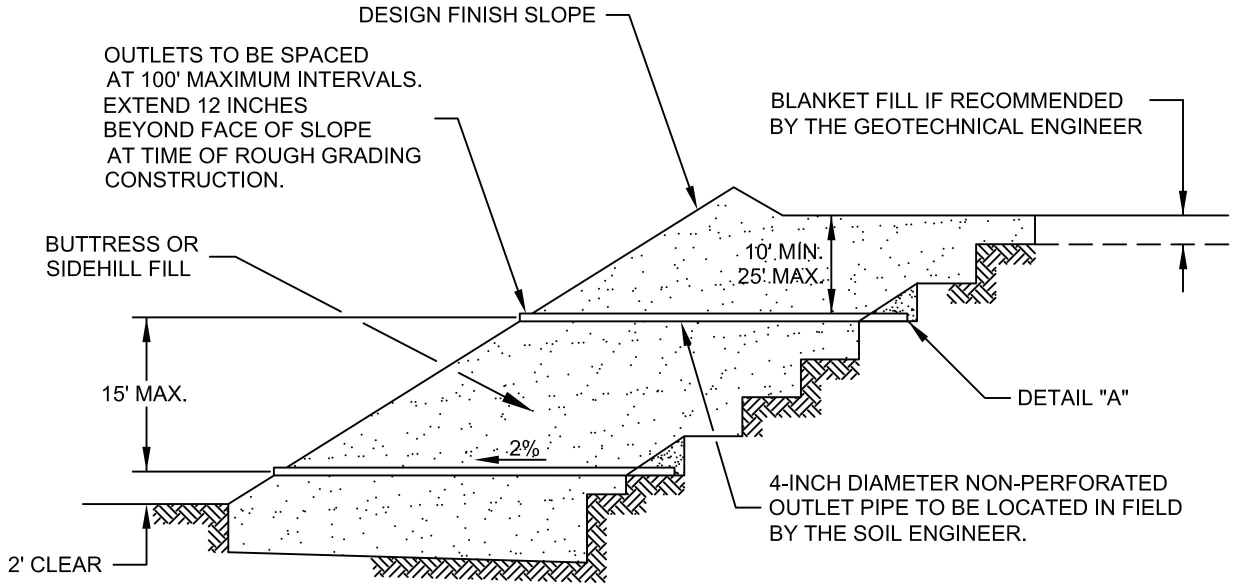
NOT TO SCALE

DRAWN: JAS
CHKD: GKM

PLATE D-5

SoCalGeo

SOUTHERN CALIFORNIA GEOTECHNICAL



"FILTER MATERIAL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT: (CONFORMS TO EMA STD. PLAN 323)

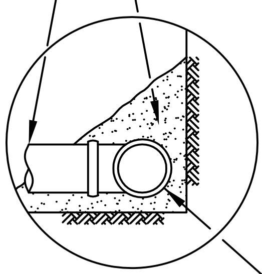
SIEVE SIZE	PERCENTAGE PASSING
1"	100
3/4"	90-100
3/8"	40-100
NO. 4	25-40
NO. 8	18-33
NO. 30	5-15
NO. 50	0-7
NO. 200	0-3

"GRAVEL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT:

SIEVE SIZE	MAXIMUM PERCENTAGE PASSING
1 1/2"	100
NO. 4	50
NO. 200	8

SAND EQUIVALENT = MINIMUM OF 50

OUTLET PIPE TO BE CONNECTED TO SUBDRAIN PIPE WITH TEE OR ELBOW



FILTER MATERIAL - MINIMUM OF FIVE CUBIC FEET PER FOOT OF PIPE. SEE ABOVE FOR FILTER MATERIAL SPECIFICATION.

ALTERNATIVE: IN LIEU OF FILTER MATERIAL FIVE CUBIC FEET OF GRAVEL PER FOOT OF PIPE MAY BE ENCASED IN FILTER FABRIC. SEE ABOVE FOR GRAVEL SPECIFICATION.

FILTER FABRIC SHALL BE MIRAFI 140 OR EQUIVALENT. FILTER FABRIC SHALL BE LAPPED A MINIMUM OF 12 INCHES ON ALL JOINTS.

MINIMUM 4-INCH DIAMETER PVC SCH 40 OR ABS CLASS SDR 35 WITH A CRUSHING STRENGTH OF AT LEAST 1,000 POUNDS, WITH A MINIMUM OF 8 UNIFORMLY SPACED PERFORATIONS PER FOOT OF PIPE INSTALLED WITH PERFORATIONS ON BOTTOM OF PIPE. PROVIDE CAP AT UPSTREAM END OF PIPE. SLOPE AT 2 PERCENT TO OUTLET PIPE.

DETAIL "A"

NOTES:
1. TRENCH FOR OUTLET PIPES TO BE BACKFILLED WITH ON-SITE SOIL.

SLOPE FILL SUBDRAINS

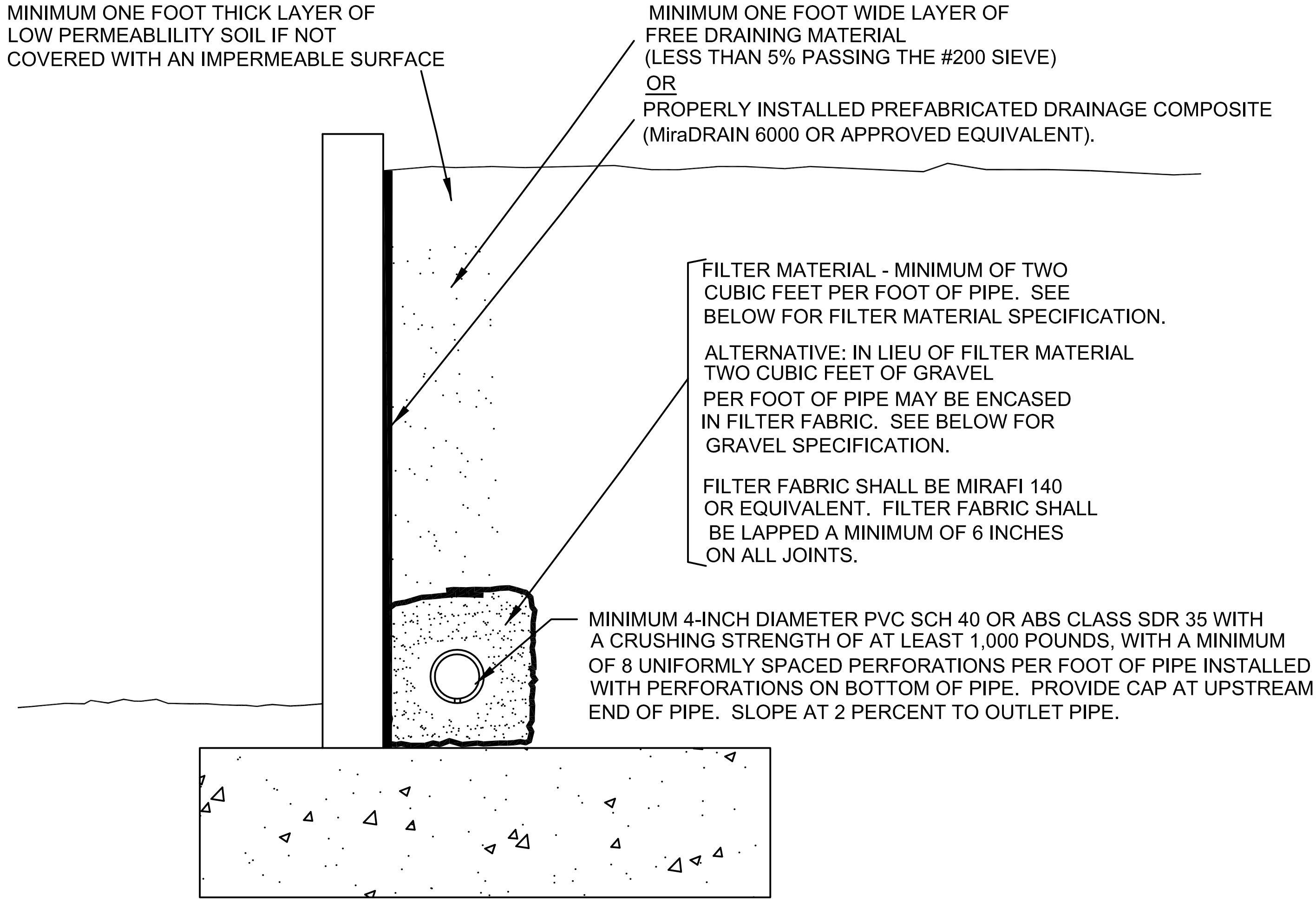
GRADING GUIDE SPECIFICATIONS

NOT TO SCALE

DRAWN: JAS
CHKD: GKM

PLATE D-6

SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL



"FILTER MATERIAL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT: (CONFORMS TO EMA STD. PLAN 323)

SIEVE SIZE	PERCENTAGE PASSING
1"	100
3/4"	90-100
3/8"	40-100
NO. 4	25-40
NO. 8	18-33
NO. 30	5-15
NO. 50	0-7
NO. 200	0-3

"GRAVEL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT:

SIEVE SIZE	MAXIMUM PERCENTAGE PASSING
1 1/2"	100
NO. 4	50
NO. 200	8

SAND EQUIVALENT = MINIMUM OF 50

RETAINING WALL BACKDRAINS

GRADING GUIDE SPECIFICATIONS

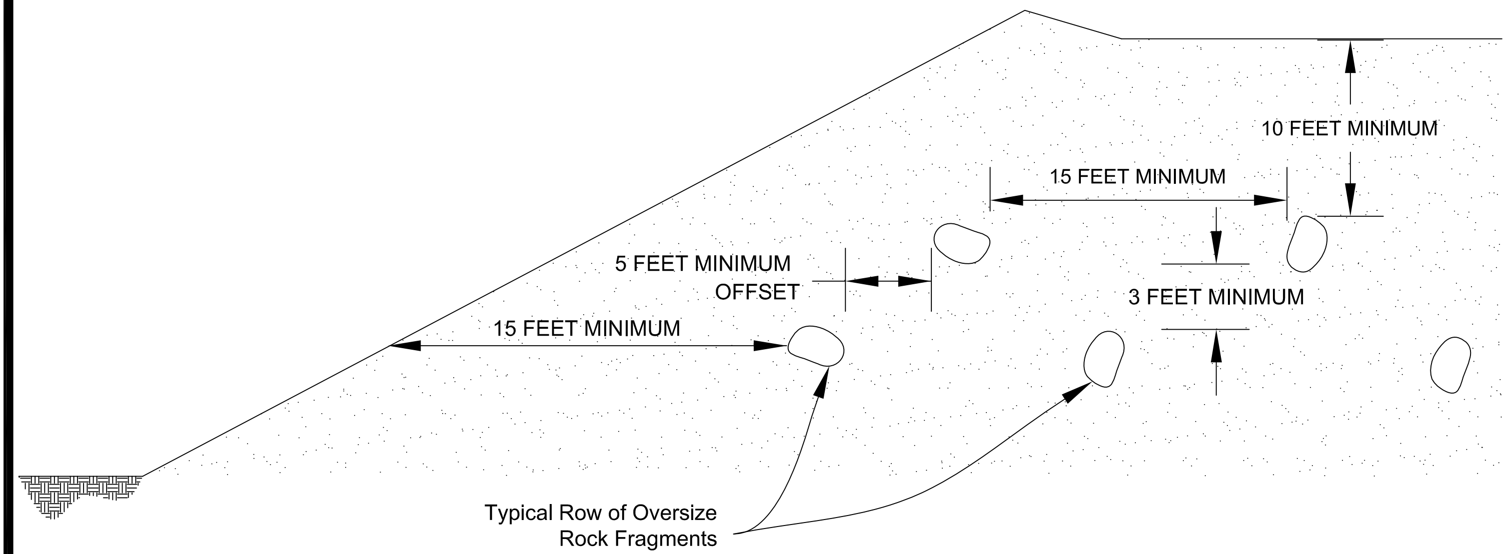
NOT TO SCALE

DRAWN: JAS
CHKD: GKM

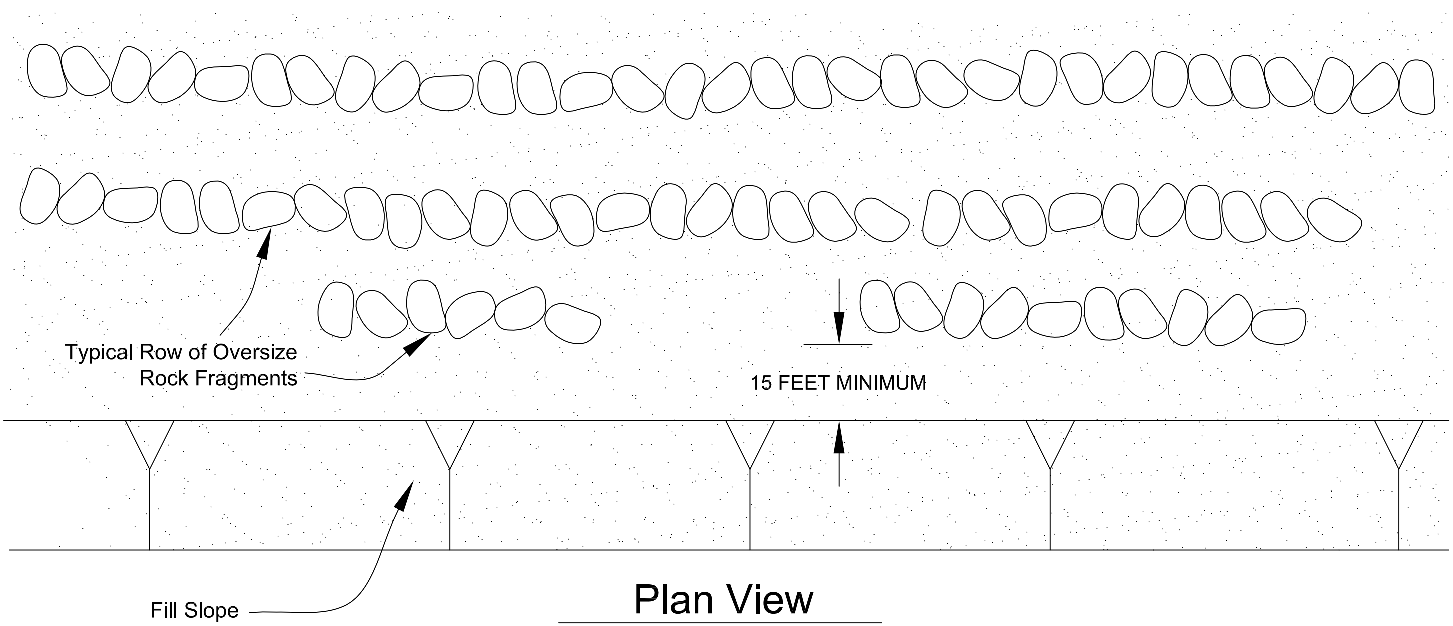
PLATE D-7

SoCalGeo

SOUTHERN CALIFORNIA GEOTECHNICAL



Section View



Plan View

PLACEMENT OF OVERSIZED MATERIAL

GRADING GUIDE SPECIFICATIONS

NOT TO SCALE

DRAWN: PM
CHKD: GKM

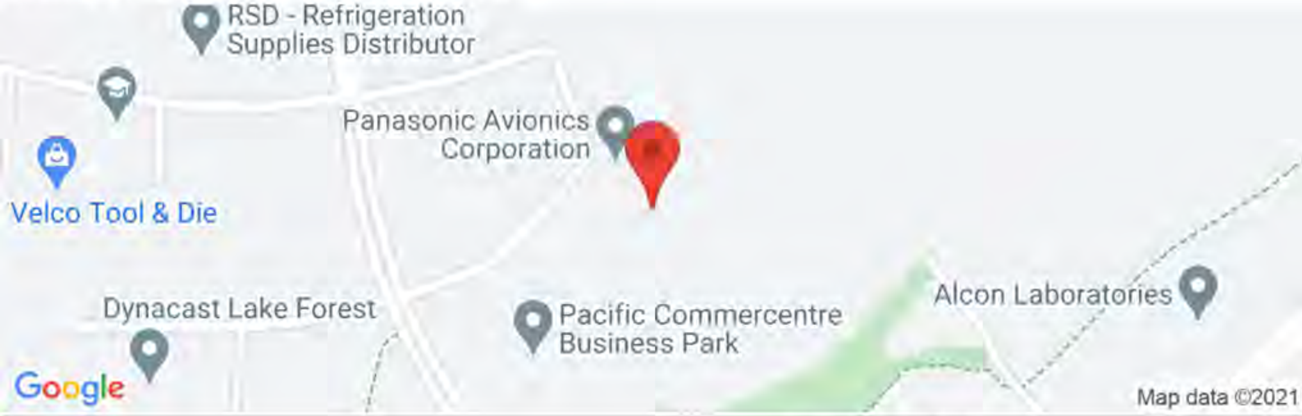
PLATE D-8

SoCalGeo

SOUTHERN
CALIFORNIA
GEOTECHNICAL

APPENDIX E

Latitude, Longitude: 33.665477, -117.672504



Date	3/24/2021, 1:51:33 PM
Design Code Reference Document	ASCE7-16
Risk Category	III
Site Class	D - Stiff Soil

Type	Value	Description
S_S	1.261	MCE_R ground motion. (for 0.2 second period)
S_1	0.45	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.261	Site-modified spectral acceleration value
S_{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S_{DS}	0.841	Numeric seismic design value at 0.2 second SA
S_{D1}	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	null -See Section 11.4.8	Seismic design category
F_a	1	Site amplification factor at 0.2 second
F_v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.522	MCE_G peak ground acceleration
F_{PGA}	1.1	Site amplification factor at PGA
PGA_M	0.575	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.261	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.342	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.5	Factored deterministic acceleration value. (0.2 second)
S1RT	0.45	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.483	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.58	Factored deterministic acceleration value. (Peak Ground Acceleration)
C_{RS}	0.94	Mapped value of the risk coefficient at short periods
C_{R1}	0.932	Mapped value of the risk coefficient at a period of 1 s

SOURCE: SEAOC/OSHPD Seismic Design Maps Tool
<https://seismicmaps.org/>

SEISMIC DESIGN PARAMETERS - 2019 CBC
PROPOSED WAREHOUSE
LAKE FOREST, CALIFORNIA

DRAWN: JAH
CHKD: RGT
SCG PROJECT
21G135-1
PLATE E-1

SOUTHERN CALIFORNIA GEOTECHNICAL

Appendix D

Infiltration Report

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

April 8, 2021

Black Creek Group
4675 MacArthur Court, Suite 625
Newport Beach, California 92660

Attention: Mr. Chris Sanford
Senior Vice President, Development

Project No.: 21G135-2

Subject: Results of Infiltration Testing
Proposed Warehouse
26200 Enterprise Way
Lake Forest, California

Reference: Geotechnical Investigation, Proposed Warehouse, 26200 Enterprise Way, Lake Forest, California, prepared by Southern California Geotechnical (SCG) for Black Creek Group, SCG Project No. 21G135-1, dated April 7, 2021.

Dear Mr. Sanford:

In accordance with your request, we have conducted infiltration testing at the subject site. We are pleased to present this report summarizing the results of the infiltration testing and our design recommendations.

Scope of Services

The scope of services performed for this project was in accordance with our Proposal No. 21P170, dated February 25, 2021. The scope of services included site reconnaissance, subsurface exploration, field testing, and engineering analysis to determine the infiltration rates of the onsite soils. The infiltration testing was performed in general accordance with the guidelines published by Orange County: Technical Guidance Document for the Preparation of Conceptual/Preliminary and/or Project Water Quality Management Plans (WQMPs) in South Orange County, Appendix D. These guidelines were most recently updated December 21, 2018.

Site and Project Description

The site is located at 26200 Enterprise Way in Lake Forest, California. The site is bounded to the north by Enterprise Way and existing commercial/industrial buildings, to the east and south by existing commercial/industrial developments, and to the west by Enterprise Court. The general location of the site is illustrated on the Site Location Map, included as Plate 1 of this report.

The site is an irregular-shaped parcel, 8.83± acres in size. The site is presently developed with one (1) commercial office building, 75,000± ft^2 in size, located in the central area of the site. The development is a two-story building of concrete tilt up construction. A series of Bloomenergy servers, are located on concrete pads along the southern property line, behind the building. The building is surrounded by asphaltic concrete pavements and limited areas of

Portland cement concrete pavements. The pavements are in good condition with minor cracking throughout. Landscape planters are present throughout the site and possesses small shrubs, bushes and medium to large trees. The eastern and southern boundaries of the site possess north and west facing slopes. These slopes ascend 10 to 15 feet from the subject site to the adjacent property. A concrete-lined drainage swale is located near the midpoints of the slopes. The remaining areas of the slopes are covered with dense vegetation.

Proposed Development

A preliminary site plan has been provided to our office by the client. Based on this plan, the site will be developed with one (1) new commercial industrial building, 162,000± ft² in size, located in the central region of the site. Dock-high doors will be constructed along a portion of the southern building wall. The proposed building is expected to be surrounded by asphaltic concrete pavements in the parking and drive areas, Portland cement concrete pavements in the loading dock areas, and concrete flatwork and landscaped planters throughout the site.

The use of on-site storm water infiltration systems has been proposed for the new development at the site. We understand that the infiltration system may consist of below-grade chambers located in the southeastern corner of the site. The bottom of the infiltration system will be approximately 10± feet below the existing site grades.

Concurrent Study

SCG recently conducted a geotechnical investigation for this project, referred above. The subsurface exploration for this project consisted of six (6) borings advanced to depths of 20 to 30± feet below the existing site grades. Asphaltic concrete pavement was encountered at the ground surface of all boring locations. The pavement sections generally consisted of 3½ to 4½± inches of asphaltic concrete, underlain by 2½ to 7± inches of aggregate base. Engineered fill soils were encountered at Boring Nos. B-1 and B-4 through B-6, extending to depths of 12 to more than 30± feet. Boring Nos. B-1 and B-5 were terminated in the engineered fill soils. These fill materials consist of medium dense to very dense silty sands with varying clay content. Many samples of the fill soils possess variable coloration and variable strength, indicative of their classification as fill. Capistrano Formation bedrock was encountered beneath the pavements and/or beneath the fill soils at most of the boring locations, extending to at least the maximum depth explored of 30± feet below the existing site grades. The bedrock generally consists of light gray to dark gray fine-grained poorly consolidated silty sandstone. The samples occasionally possess trace amounts of clay, organics and iron oxide staining. Free water was not encountered during the drilling of any of the borings.

Geologic Conditions

Geologic research indicates that the majority of the site is underlain by white to bluish-white, silty, marine, fine- to medium-grained, thick bedded to massive, poorly sorted arkosic sandstone. mapped as late Miocene to early Pliocene Capistrano Formation, Oso Member (Map Symbol Tco). The Holocene to Pleistocene age Slopewash (Map Symbol Qsw) is mapped in the northwestern and southeastern property lines of the site. The bedding within the Capistrano Formation is indicated to trend northwest-southeast with a dip of 14 degrees to the north, on the geologic map. The primary available reference applicable to the subject site is the Geologic

Map and Sections of the South Half El Toro Quadrangle, Orange County, California, by Donald Fife, 1974. A portion of this map indicating the location of the subject site is included herein as Plate 3 in Appendix A.

Based on the materials encountered in the exploratory borings, the site is underlain by sandstone, and silty sandstone of the Capistrano Formation.

Subsurface Exploration

Scope of Exploration

The subsurface exploration conducted for the infiltration testing consisted of two (2) infiltration test borings, advanced to depths of 10± feet below the existing site grades. The infiltration borings were advanced using a conventional truck-mounted drilling rig, equipped with 8-inch-diameter hollow stem augers, and were logged during drilling by a member of our staff. The approximate locations of the infiltration test borings (identified as I-1 and I-2) are indicated on the Infiltration Test Location Plan, enclosed as Plate 2 of this report.

Upon the completion of the infiltration borings, the bottom of each test boring was covered with 2± inches of clean ¾-inch gravel. A sufficient length of 3-inch-diameter perforated PVC casing was then placed into each test hole so that the PVC casing extended from the bottom of the test hole to the ground surface. Clean ¾-inch gravel was then installed in the annulus surrounding the PVC casing.

Geotechnical Conditions

Pavements

Asphaltic Concrete (AC) pavements were encountered at the ground surface of both infiltration test locations. The pavements consisted of 2½ to 3½± inches of AC with 5± inches of Aggregate Base (AB) at each location.

Engineered Fill (Afe)

Engineered fill soils were encountered beneath the pavements at both infiltration test locations, extending to at least the maximum depth explored of 10± feet below ground surface. These fill materials consist of medium dense to dense silty fine sands and clayey sands. Some samples of the fill soils possess variable coloration and variable strength, indicative of their classification as fill.

Infiltration Testing

As previously mentioned, the infiltration testing was performed in general accordance with the Orange County guidelines: Technical Guidance Document for the Preparation of Conceptual/Preliminary and/or Project Water Quality Management Plans (WQMPs) in South Orange County, Appendix D.

Pre-soaking

In accordance with the county infiltration standards, all of the infiltration test borings were pre-soaked prior to the infiltration testing. The pre-soaking process consisted of filling the test borings by inverting a full 5-gallon bottle of clear water supported over each hole so that the water level reaches a level of at least 5 times the hole's radius above the gravel at the bottom of each hole. The pre-soaking was completed after all of the water had percolated through each test hole or after 15 hours since initiating the pre-soak.

Infiltration Testing

Following the pre-soaking process of the infiltration test borings, SCG performed the infiltration testing. Each test hole was filled with water to a depth of at least 5 times the hole's radius above the gravel at the bottom of each test hole, and less than or equal to the water level used during the pre-soaking process. In accordance with the Orange County guidelines, since "non-sandy soils" were encountered at the bottom of both infiltration borings, readings were taken at 30-minute intervals for a total of 6 hours. After each reading, the borings were refilled to the correct water level above the gravel at the bottom of each test hole. The water level readings are presented on the spreadsheets enclosed with this report. The infiltration rates for each of the timed intervals are also tabulated on the spreadsheets.

The infiltration rates from the test are tabulated in inches per hour. In accordance with the typically accepted practice, it is recommended that the most conservative reading from the latter part of the infiltration tests be used as the design infiltration rate. The rates are summarized below:

Infiltration Test No.	Depth (feet)	Soil Description	Infiltration Rate (inches/hour)
I-1	10	ENGINEERED FILL: Light Gray to Brown Silty fine Sand	0.1
I-2	10	ENGINEERED FILL: Gray Brown Clayey fine Sand	0.3

Laboratory Testing

Moisture Content

The moisture contents for the recovered soil samples within the borings were determined in accordance with ASTM D-2216 and are expressed as a percentage of the dry weight. These test results are presented on the Boring Logs.

Grain Size Analysis

The grain size distribution of selected soils collected from the bottom of each infiltration test boring have been determined using a range of wire mesh screens. These tests were performed in general accordance with ASTM D-422 and/or ASTM D-1140. The weight of the portion of the sample retained on each screen is recorded and the percentage finer or coarser of the total weight is calculated. The results of these tests are presented on Plates C-1 through C-2 of this report.

Design Recommendations

Two (2) infiltration tests were performed at the subject site. As noted above, the infiltration rates at these locations range from 0.1 to 0.3 inches per hour.

Based on the results of the infiltration testing at the subject site, infiltration is not considered feasible at this site due to the presence of dense engineered fill soils, comprised of silty sands and clayey sands, which possess very poor infiltration characteristics.

General Comments

This report has been prepared as an instrument of service for use by the client in order to aid in the evaluation of this property and to assist the architects and engineers in the design and preparation of the project plans and specifications. This report may be provided to the contractor(s) and other design consultants to disclose information relative to the project. However, this report is not intended to be utilized as a specification in and of itself, without appropriate interpretation by the project architect, structural engineer, and/or civil engineer. The design of the infiltration system is the responsibility of the civil engineer. The role of the geotechnical engineer is limited to determination of infiltration rate only. By using the design infiltration rates contained herein, the civil engineer agrees to indemnify, defend, and hold harmless the geotechnical engineer for all aspects of the design and performance of the infiltration system. The reproduction and distribution of this report must be authorized by the client and Southern California Geotechnical, Inc. Furthermore, any reliance on this report by an unauthorized third party is at such party's sole risk, and we accept no responsibility for damage or loss which may occur. The analysis of this site was based on a subsurface profile interpolated from limited discrete soil samples. While the materials encountered in the project area are considered to be representative of the total area, some variations should be expected between trench locations and testing depths. If the conditions encountered during construction vary significantly from those detailed herein, we should be contacted immediately to determine if the conditions alter the recommendations contained herein.

This report has been based on assumed or provided characteristics of the proposed development. It is recommended that the owner, client, architect, structural engineer, and civil engineer carefully review these assumptions to ensure that they are consistent with the characteristics of the proposed development. If discrepancies exist, they should be brought to our attention to verify that they do not affect the conclusions and recommendations contained herein. We also recommend that the project plans and specifications be submitted to our office for review to verify that our recommendations have been correctly interpreted. The analysis, conclusions, and recommendations contained within this report have been promulgated in accordance with generally accepted professional geotechnical engineering practice. No other warranty is implied or expressed.

Closure

We sincerely appreciate the opportunity to be of service on this project. We look forward to providing additional consulting services during the course of the project. If we may be of further assistance in any manner, please contact our office.

Respectfully Submitted,

SOUTHERN CALIFORNIA GEOTECHNICAL, INC.

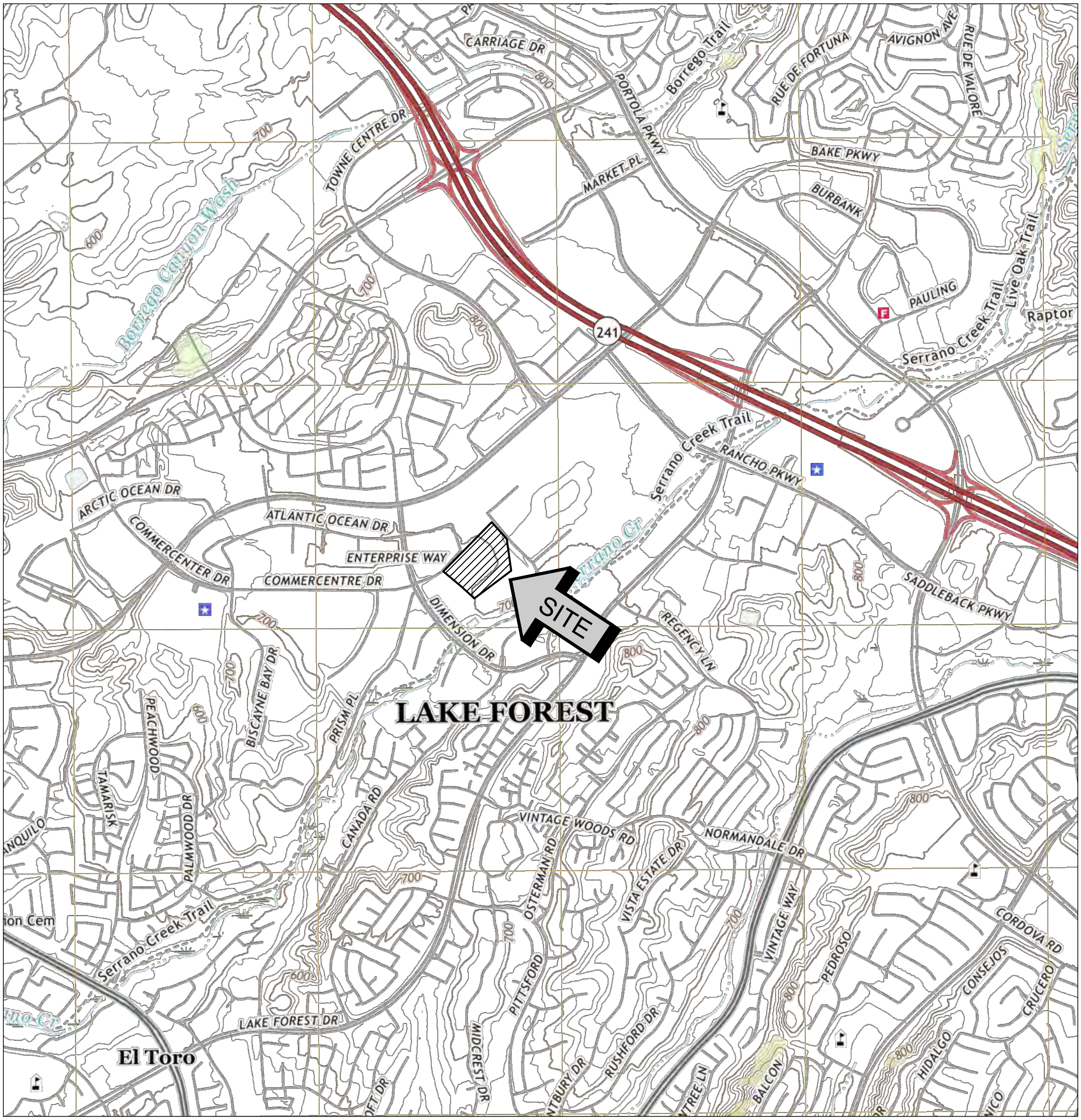
Jose Zuniga
Staff Engineer

Gregory K. Mitchell, GE 2364
Principal Engineer

REGISTERED PROFESSIONAL ENGINEER
GREGORY K. MITCHELL
No. 2364
GEOTECHNICAL
STATE OF CALIFORNIA

Distribution: (1) Addressee

Enclosures: Plate 1 - Site Location Map
Plate 2 - Infiltration Test Location Plan
Plate 3 – Geologic Map
Boring Log Legend and Logs (4 pages)
Infiltration Test Results Spreadsheets (2 pages)
Grain Size Distribution Graphs (2 pages)



SOURCE: USGS TOPOGRAPHIC MAP OF LAKE FOREST QUADRANGLE, ORANGE COUNTY, CALIFORNIA, 2018

SITE LOCATION MAP

PROPOSED WAREHOUSE

LAKE FOREST, CALIFORNIA

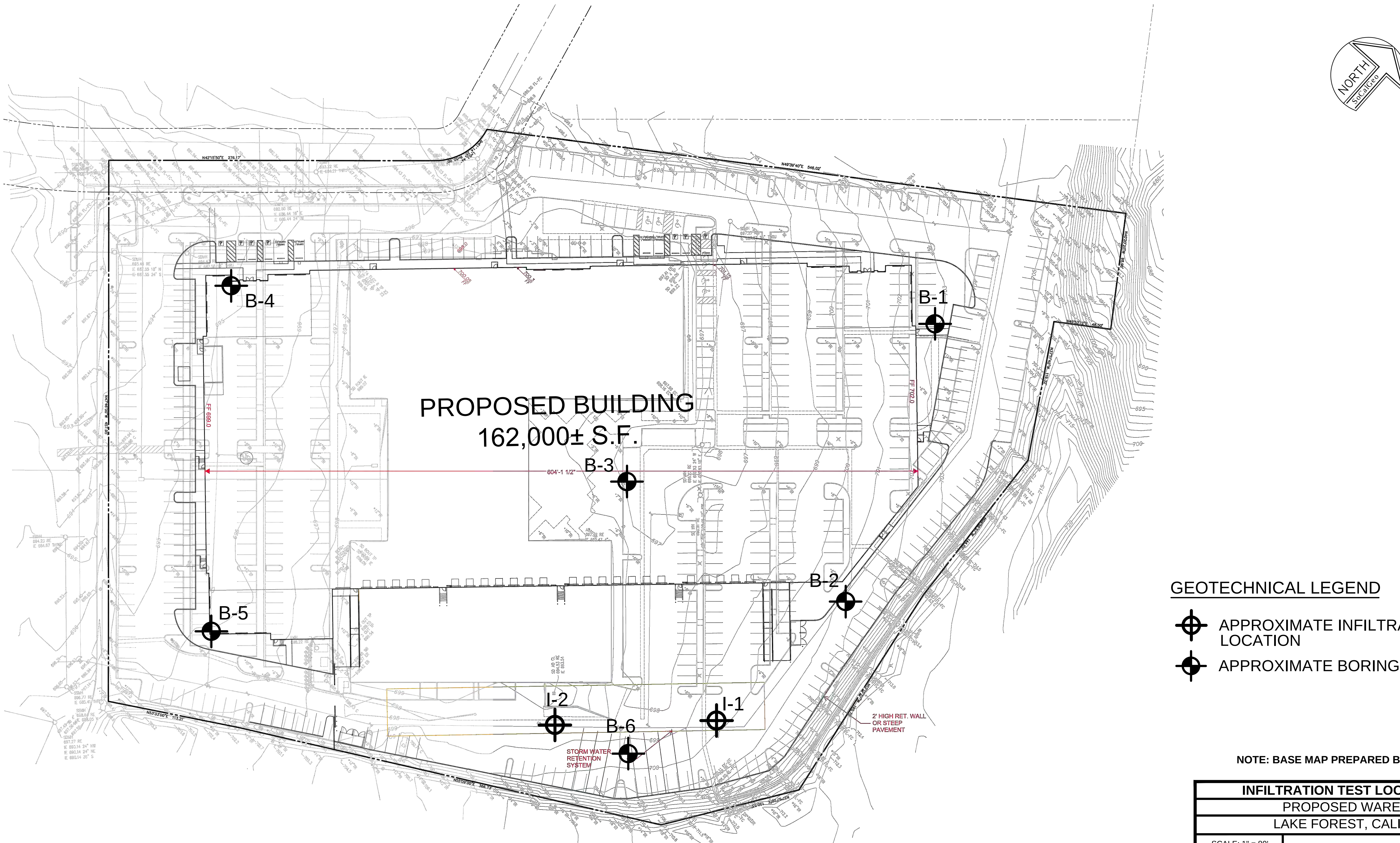
SCALE: 1" = 2000'

DRAWN: MD
CHKD: RGT

SCG PROJECT
21G135-2

PLATE 1

SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL



GEOTECHNICAL LEGEND

- APPROXIMATE INFILTRATION TEST LOCATION
- APPROXIMATE BORING LOCATION

NOTE: BASE MAP PREPARED BY KIER + WRIGHT

INFILTRATION TEST LOCATION PLAN	
PROPOSED WAREHOUSE	
LAKE FOREST, CALIFORNIA	
SCALE: 1" = 80'	
DRAWN: JAH CHKD: GKM	
SCG PROJECT 21G135-2	
PLATE 2	

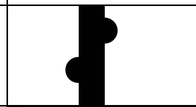
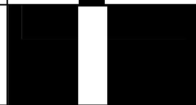
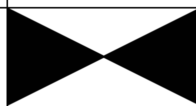
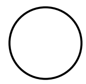
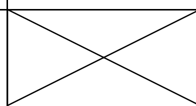
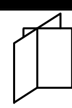
LEGEND

Qsw	SLOPEWASH. (Holocene to Pleistocene(?)) *Lithology*: Varies with parent materials. In general consists of light olive-gray to olive-gray, silty to clayey, organicly rich soil which is plastic when wet and hard when dry. Consists of detrital materials resulting from debris flows or creep aided by rill wash, ground water, and unchanneled surficial drainage. Accumulates near the base of slopes and at the mouths of small canyons. Includes colluvium and minor residu soils. It is commonly transitional with adjacent soils or alluvial deposits. Mapped where estimated to exceed three feet in thickness.
Tco	CAPISTRANO FORMATION, OSO MEMBER. (late Miocene to early Pliocene) *Lithology*: Marine, white to bluish-white, silty, fine-to medium-grained, thick bedded to massive, poorly sorted arkosic sandstone. Commonly cross-bedded. Locally contains calcareous concretions as much as two feet in diameter. Concretionary zones commonly are found in association with marine vertebrate fossils, but locally friable sand lenses are encountered. Bentonite beds 1 to 2 inches thick, were observed in an anticline on the east flank of Aliso Creek.

SOURCE: "GEOLOGY MAP OF THE SOUTH HALF OF THE EL TORO QUADRANGLE, ORANGE COUNTY, CALIFORNIA" BY DONALD L. FIFE, 1974

GEOLOGIC MAP	
PROPOSED WAREHOUSE	
LAKE FOREST, CALIFORNIA	
SCALE: 1" = 2000'	SOUTHERN CALIFORNIA GEOTECHNICAL
DRAWN: JAH CHKD: GKM	
SCG PROJECT 21G135-2	
PLATE 3	

BORING LOG LEGEND

SAMPLE TYPE	GRAPHICAL SYMBOL	SAMPLE DESCRIPTION
AUGER		SAMPLE COLLECTED FROM AUGER CUTTINGS, NO FIELD MEASUREMENT OF SOIL STRENGTH. (DISTURBED)
CORE		ROCK CORE SAMPLE: TYPICALLY TAKEN WITH A DIAMOND-TIPPED CORE BARREL. TYPICALLY USED ONLY IN HIGHLY CONSOLIDATED BEDROCK.
GRAB		SOIL SAMPLE TAKEN WITH NO SPECIALIZED EQUIPMENT, SUCH AS FROM A STOCKPILE OR THE GROUND SURFACE. (DISTURBED)
CS		CALIFORNIA SAMPLER: 2-1/2 INCH I.D. SPLIT BARREL SAMPLER, LINED WITH 1-INCH HIGH BRASS RINGS. DRIVEN WITH SPT HAMMER. (RELATIVELY UNDISTURBED)
NSR		NO RECOVERY: THE SAMPLING ATTEMPT DID NOT RESULT IN RECOVERY OF ANY SIGNIFICANT SOIL OR ROCK MATERIAL.
SPT		STANDARD PENETRATION TEST: SAMPLER IS A 1.4 INCH INSIDE DIAMETER SPLIT BARREL, DRIVEN 18 INCHES WITH THE SPT HAMMER. (DISTURBED)
SH		SHELBY TUBE: TAKEN WITH A THIN WALL SAMPLE TUBE, PUSHED INTO THE SOIL AND THEN EXTRACTED. (UNDISTURBED)
VANE		VANE SHEAR TEST: SOIL STRENGTH OBTAINED USING A 4 BLADED SHEAR DEVICE. TYPICALLY USED IN SOFT CLAYS-NO SAMPLE RECOVERED.

COLUMN DESCRIPTIONS

DEPTH: Distance in feet below the ground surface.

SAMPLE: Sample Type as depicted above.

BLOW COUNT: Number of blows required to advance the sampler 12 inches using a 140 lb hammer with a 30-inch drop. 50/3” indicates penetration refusal (>50 blows) at 3 inches. WH indicates that the weight of the hammer was sufficient to push the sampler 6 inches or more.

POCKET PEN.: Approximate shear strength of a cohesive soil sample as measured by pocket penetrometer.

GRAPHIC LOG: Graphic Soil Symbol as depicted on the following page.

DRY DENSITY: Dry density of an undisturbed or relatively undisturbed sample in lbs/ft^3.

MOISTURE CONTENT: Moisture content of a soil sample, expressed as a percentage of the dry weight.

LIQUID LIMIT: The moisture content above which a soil behaves as a liquid.

PLASTIC LIMIT: The moisture content above which a soil behaves as a plastic.

PASSING #200 SIEVE: The percentage of the sample finer than the #200 standard sieve.

UNCONFINED SHEAR: The shear strength of a cohesive soil sample, as measured in the unconfined state.

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

JOB NO.: 21G135-2	DRILLING DATE: 3/12/21	WATER DEPTH: Dry
PROJECT: Proposed Warehouse	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: ---
LOCATION: Lake Forest, California	LOGGED BY: Jamie Hayward	READING TAKEN: At Completion

SURFACE ELEVATION: 689.5 feet MSL

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
					3½± Inches Asphaltic Concrete, 5± Inches Aggregate Base							
	X	31			ENGINEERED FILL (Afe): Light Gray Silty fine Sand, trace Iron oxide staining, dense-moist		12					
	X	35			@ 3 feet, moist to very moist		9					
5												
	X	39					20					
					ENIGEERED FILL (Afe): Light Gray to Brown Silty fine Sand, dense-moist to very moist		10					
	X	36					15			27		
10												

Boring Terminated at 10'

BORING NO. I-2

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

JOB NO.: 21G135-2	DRILLING DATE: 3/12/21	WATER DEPTH: Dry
PROJECT: Proposed Warehouse	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: ---
LOCATION: Lake Forest, California	LOGGED BY: Jamie Hayward	READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: 670 feet MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
					2½± Inches Asphaltic Concrete, 5± Inches Aggregate Base							
	X	38			ENIGEERED FILL (Afe): Light Gray Silty fine Sand, trace Iron oxide staining, dense-moist		8					
	X	40			@ 3 feet, moist to very moist		11					
5												
	X	32					10					
	X	16			ENIGEERED FILL (Afe): Gray Brown Clayey fine Sand, trace Silt, medium dense-moist		9			29		
10												

Boring Terminated at 10'

TBL 21G135-2.GPJ SOCALGEO.GDT 4/9/21

INFILTRATION CALCULATIONS

Project Name	Proposed Warehouse
Project Location	Lake Forest, California
Project Number	21G135-2
Engineer	Oscar Sandoval

Test Hole Radius	4	(in)
Test Depth	10.2	(ft)

Infiltration Test Hole	I-1

Interval Number		Time	Time Interval (min)	Water Depth (ft)	Change in Water Level (ft)	Average Head Height (ft)	Infiltration Rate Q (in/hr)
1	Initial	8:30 AM	30.0	8.20	0.15	1.93	0.29
	Final	9:00 AM		8.35			
2	Initial	9:02 AM	30.0	8.20	0.20	1.90	0.39
	Final	9:32 AM		8.40			
3	Initial	9:34 AM	30.0	8.20	0.20	1.90	0.39
	Final	10:04 AM		8.40			
4	Initial	10:04 AM	30.0	8.20	0.20	1.90	0.39
	Final	10:34 AM		8.40			
5	Initial	10:36 AM	30.0	8.20	0.16	1.92	0.31
	Final	11:06 AM		8.36			
6	Initial	11:08 AM	30.0	8.20	0.16	1.92	0.31
	Final	11:38 AM		8.36			
7	Initial	11:40 AM	30.0	8.20	0.16	1.92	0.31
	Final	12:10 PM		8.36			
8	Initial	12:13 PM	30.0	8.20	0.16	1.92	0.31
	Final	12:43 PM		8.36			
9	Initial	12:45 PM	30.0	8.20	0.15	1.93	0.29
	Final	1:15 PM		8.35			
10	Initial	1:20 PM	30.0	8.20	0.15	1.93	0.29
	Final	1:50 PM		8.35			
11	Initial	1:52 PM	30.0	8.20	0.15	1.93	0.29
	Final	2:22 PM		8.35			
12	Initial	2:26 PM	30.0	8.20	0.15	1.93	0.29
	Final	2:56 PM		8.35			

Per County Standards, Infiltration Rate calculated as follows:

$$Q = \frac{\Delta H(60r)}{\Delta t(r + 2H_{avg})}$$

Where: Q = Infiltration Rate (in inches per hour)

ΔH = Change in Height (Water Level) over the time interval

r = Test Hole (Borehole) Radius

Δt = Time Interval

H_{avg} = Average Head Height over the time interval

INFILTRATION CALCULATIONS

Project Name	Proposed Warehouse
Project Location	Lake Forest, California
Project Number	21G135-2
Engineer	Oscar Sandoval

Test Hole Radius	4	(in)
Test Depth	10.2	(ft)

Infiltration Test Hole	I-1

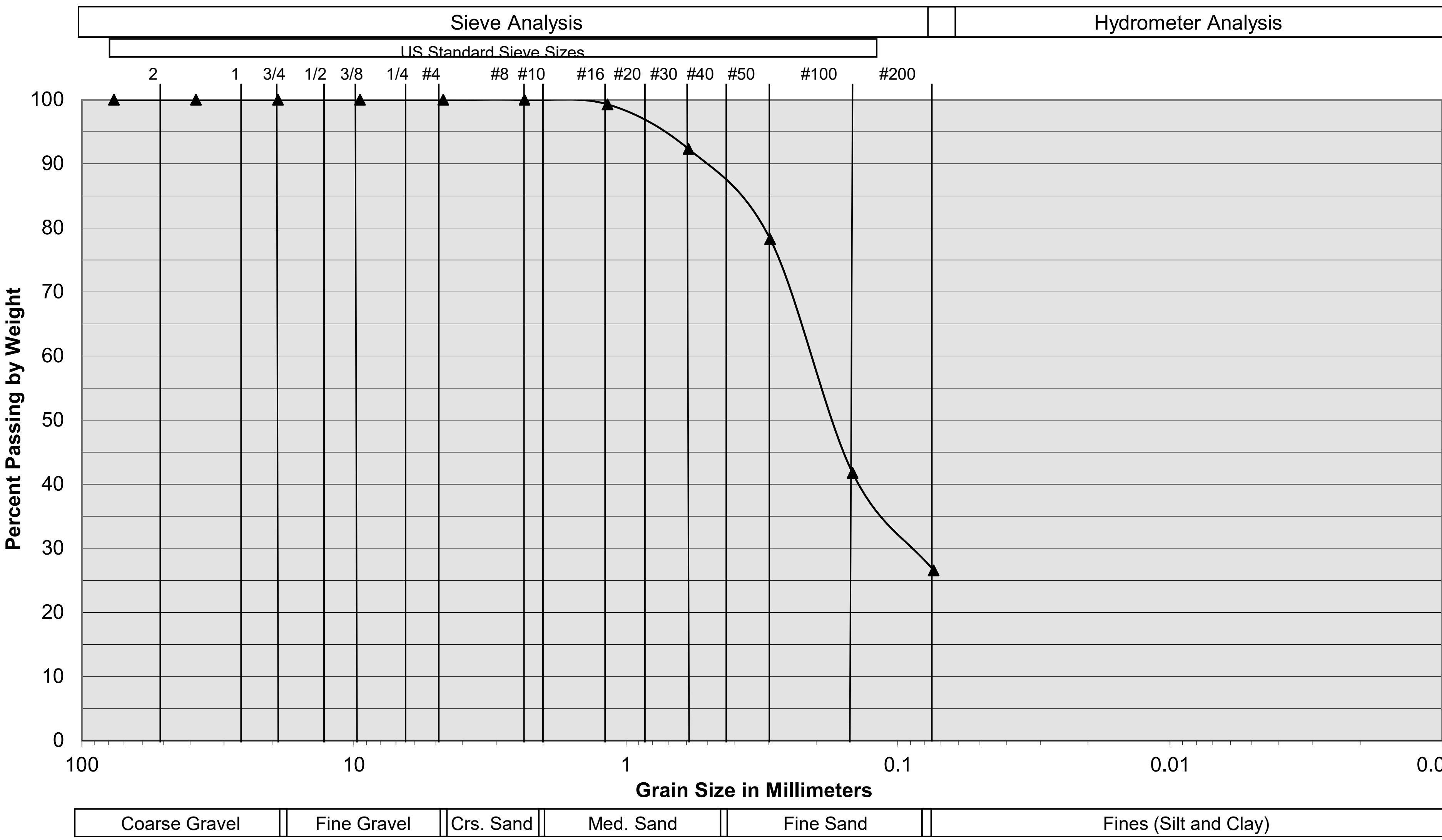
Interval Number		Time	Time Interval (min)	Water Depth (ft)	Change in Water Level (ft)	Average Head Height (ft)	Infiltration Rate Q (in/hr)
1	Initial	7:55 AM	30.0	8.20	0.05	1.98	0.09
	Final	8:25 AM		8.25			
2	Initial	8:25 AM	30.0	8.20	0.05	1.98	0.09
	Final	8:55 AM		8.25			
3	Initial	8:55 AM	30.0	8.20	0.07	1.97	0.13
	Final	9:25 AM		8.27			
4	Initial	9:25 AM	30.0	8.20	0.07	1.97	0.13
	Final	9:55 AM		8.27			
5	Initial	9:55 AM	30.0	8.20	0.06	1.97	0.11
	Final	10:25 AM		8.26			
6	Initial	10:25 AM	30.0	8.20	0.06	1.97	0.11
	Final	10:55 AM		8.26			
7	Initial	10:55 AM	30.0	8.20	0.06	1.97	0.11
	Final	11:25 AM		8.26			
8	Initial	11:25 AM	30.0	8.20	0.06	1.97	0.11
	Final	11:55 AM		8.26			
9	Initial	11:55 AM	30.0	8.20	0.06	1.97	0.11
	Final	12:25 PM		8.26			
10	Initial	12:25 PM	30.0	8.20	0.05	1.98	0.09
	Final	12:55 PM		8.25			
11	Initial	12:55 PM	30.0	8.20	0.05	1.98	0.09
	Final	1:25 PM		8.25			
12	Initial	1:25 PM	30.0	8.20	0.05	1.98	0.09
	Final	1:55 PM		8.25			

Per County Standards, Infiltration Rate calculated as follows:

$$Q = \frac{\Delta H(60r)}{\Delta t(r + 2H_{avg})}$$

Where: Q = Infiltration Rate (in inches per hour)
ΔH = Change in Height (Water Level) over the time interval
r = Test Hole (Borehole) Radius
Δt = Time Interval
H_{avg} = Average Head Height over the time interval

Grain Size Distribution

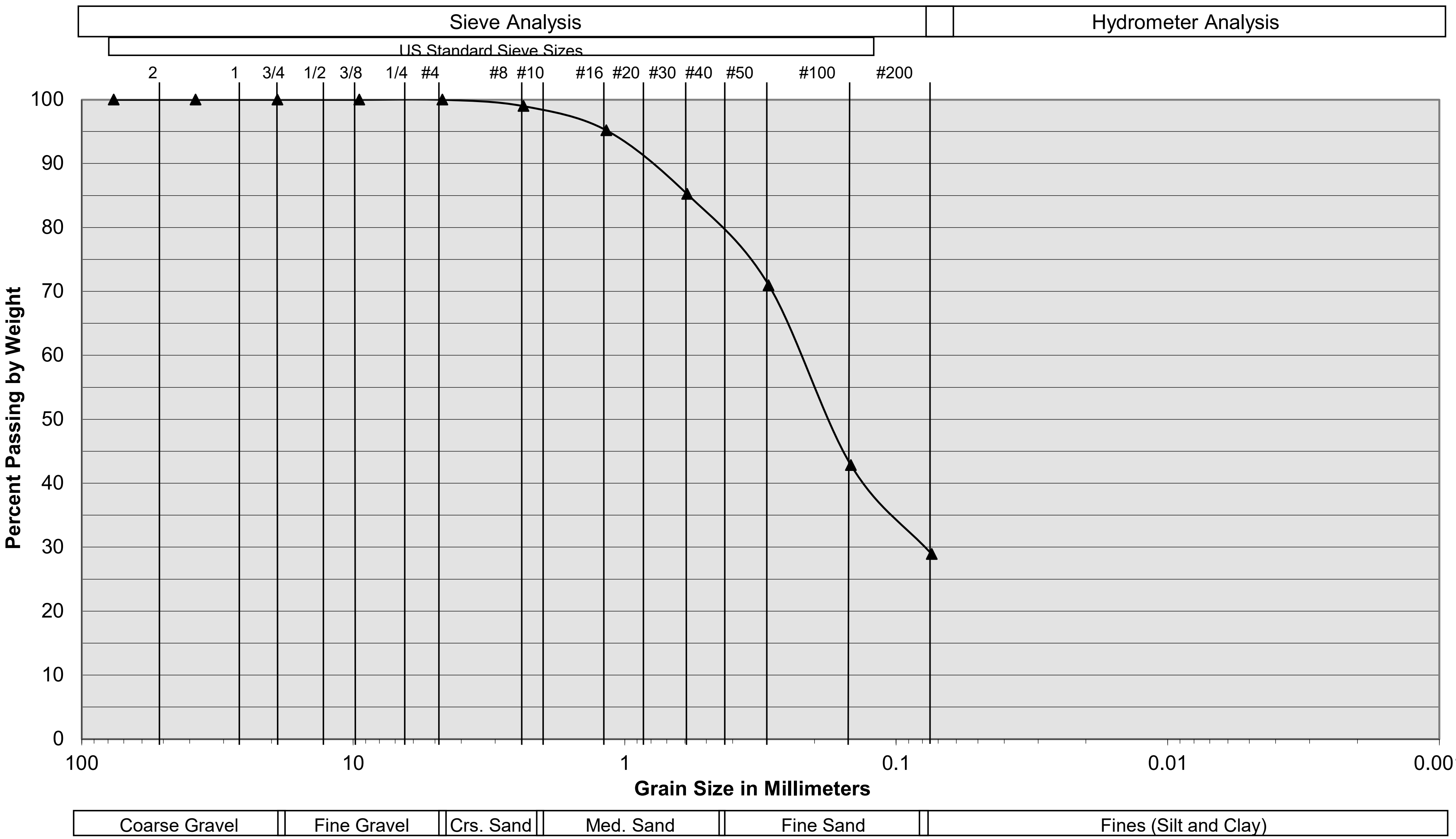


Sample Description	I-1 @ 8.5'
Soil Classification	Light Gray to Brown Silty fine Sand

Proposed Warehouse
Lake Forest, California
Project No. 21G135-2
PLATE C- 1

SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL A California Corporation

Grain Size Distribution



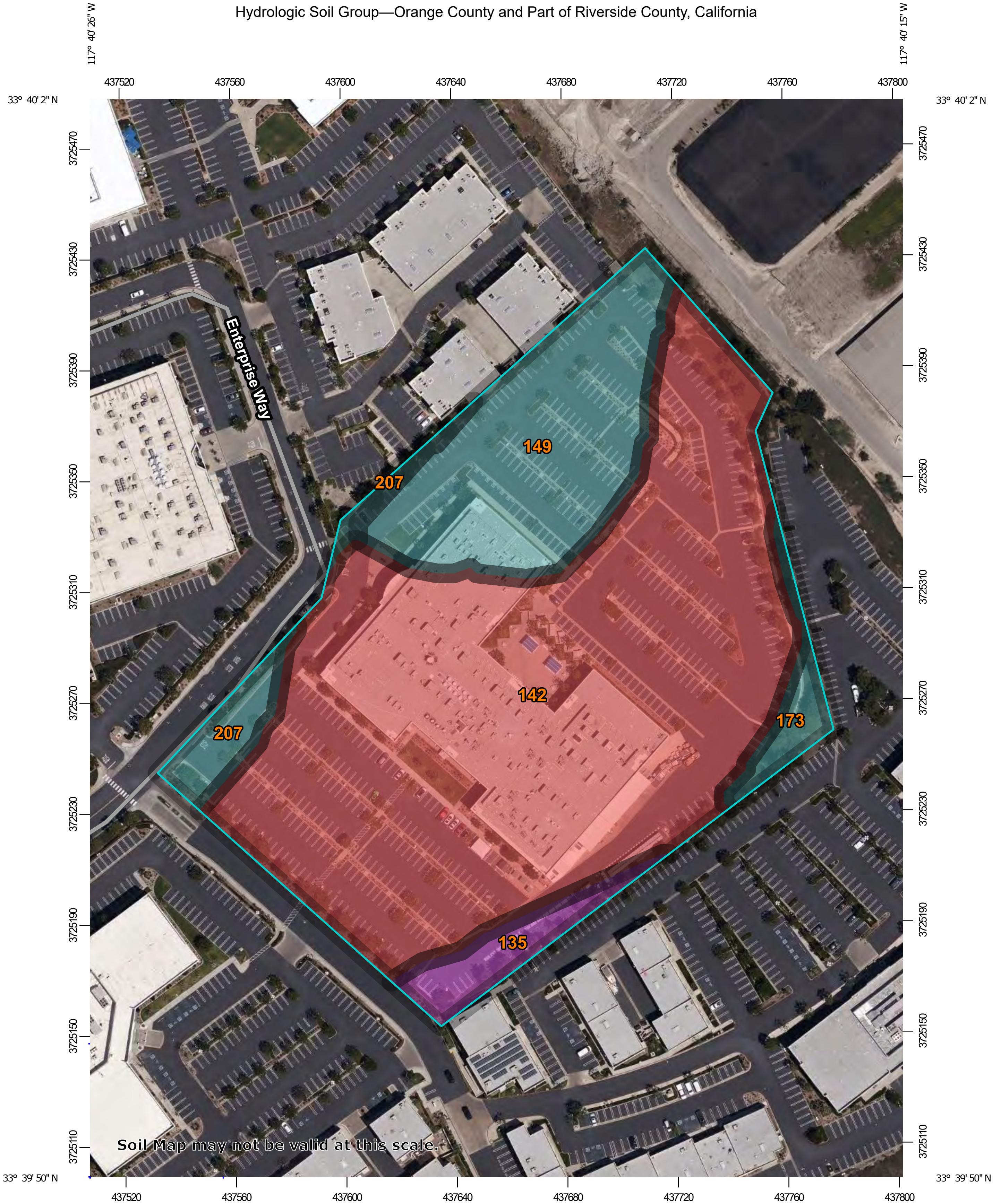
Sample Description	I-2 @ 8.5'
Soil Classification	Gray Brown Clayey fine Sand

Proposed Warehouse
Lake Forest, California
Project No. 21G135-2
PLATE C- 2

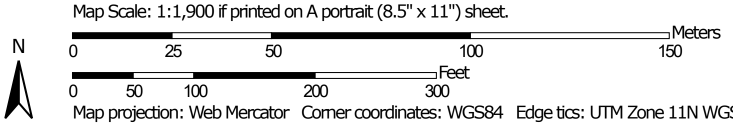
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

Appendix E

Web Soil Survey



Map Scale: 1:1,900 if printed on A portrait (8.5" x 11") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Orange County and Part of Riverside County, California
Survey Area Data: Version 14, May 27, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 11, 2018—May 5, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
135	Capistrano sandy loam, 2 to 9 percent slopes	A	0.3	3.7%
142	Cieneba sandy loam, 30 to 75 percent slopes, eroded	D	6.5	71.4%
149	Cropley clay, 2 to 9 percent slopes, warm MAAT, MLRA 19	C	1.7	18.8%
173	Myford sandy loam, 2 to 9 percent slopes	C	0.2	2.5%
207	Sorrento loam, 2 to 9 percent slopes, warm MAAT, MLRA 19	C	0.3	3.5%
Totals for Area of Interest			**9.1**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Appendix F

Hydrology Report

Preliminary Hydrologic & Hydraulic Drainage Report

For

26200 Enterprise Way
Lake Forest, California, 92630

April 19, 2023

Prepared For:

BLACK CREEK GROUP

4675 MacArthur Court, Suite 625
Newport Beach, California, 92660

Prepared By:

KIER & WRIGHT
CIVIL ENGINEERS & SURVEYORS, INC.

8955 Research Dr.
Irvine, CA, 92618
Phone 949.508.0202

Preliminary Hydrologic & Hydraulic Report

for

26200 Enterprise Way
Irvine, California

Date: May 28, 2021

Project Manager:	D. Garrett Readler, P.E. RCE No. 76867
Job Number:	A21532

Prepared By: ________________________________05/28/21_______

D. Garrett Readler, P.E. Date
Kier & Wright

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1. Introduction 4
1.1 Project Description 4
1.2 Report Objectives 4
1.3 Criteria, Procedure, and Methodology 4
2. Discussion/Calculations 5
2.1 Hydrology 5
2.2 Hydraulics 6
2.3 Stormwater Quality 6
3. Conclusion 6
4. Attachments 7

1. Introduction

1.1 PROJECT DESCRIPTION

This report has been prepared to provide an analysis of drainage patterns and improvements related to the 26200 Enterprise Way development, which is located within the City of Lake Forest, CA. The proposed project is a redevelopment of an existing office space. Once completed, this site will contain one new warehouse with truck docks, surrounded by site parking, landscape, and hardscape, with modular wetland systems for treatment and an underground pipe storage system for outflow control.

The site consists currently of one two-story building and parking lot. The property is bounded more commercial and industrial buildings on the north, south, and west. The northeastern property is currently undeveloped. All existing onsite drainage facilities drain to the storm drain in the public right of way, which drains to nearby Serrano Creek.

The project proposes to surface drain all runoff to curb inlets where it will be treated prior to discharging into the public system. Treated runoff from the largest drainage area will be routed to the underground storage system where the discharge will be controlled to the public storm drain. The purpose of this is to reduce the overall discharge from the site by 40% as requested by the city of Lake Forest.

1.2 REPORT OBJECTIVES

The objective of this report is to outline an orderly drainage system for the site in accordance with the Orange County Hydrology and Hydraulics Manual. Objectives of this report are as follows:

- Determine the developed, or proposed, site hydrologic conditions, including overland runoff rates expected from the 100-year storm event.
- Validate the design of the proposed underground storm drain conveyance systems and provide hydraulic calculations.
- Storm water quality treatment in accordance with MRP NPDES Permit dated November 19, 2015 will be provided. See separate project WQMP.

1.3 CRITERIA, PROCEDURE, AND METHODOLOGY

Calculations and design criteria contained within this report are consistent with the Orange County Hydrology requirements. The hydrology and storage calculations are per SCS runoff equations and are in accordance with County design criteria as performed in the Hydro Cad software. It should be noted that Hydro Cad was utilized to calculate the storage and ponding capacity in the proposed pipes.

2. Discussion/Calculations

2.1 HYDROLOGY

In order to determine expected peak runoff rates from the site, the overall project watershed was divided into ten tributary areas, or Drainage Management Areas (DMA's), based on area draining to proposed treatment devices. A table of the DMA's and their corresponding detention system and area can be found in the table below.

DETENTION SYSTEM	DMA AREA	AREA (AC)
DENTENTION SYSTEM A	1	1.36
	2	1.12
	3	3.24
	4	0.18
DETENTION SYSTEM B	5	0.49
	6	0.33
	7	0.23
DETENTION SYSTEM C	8	0.19
	9	0.71
	10	0.56

Site hydrology was determined using CivilD software utilizing a 100 year storm event.

Using the inputs as described above, the expected 100-year, 24-hour peak runoff rate for listed in the table below:

100-year	TOTAL
Pre-Development (cfs)	40.5
Post-Development (Pre-Mitigation) (cfs)	38.1
Post-Development (Post-Mitigation) (cfs)	19.0

The existing peak flow leaving the site was 40.5 cfs. The proposed peak flow leaving the site before outlet control is 38.1 cfs. With outlet control, the total flow leaving the site is 19.0 cfs, a reduction of 53%. In the hydrology report, the final link contains a flow of 19.0 cfs. The lower value is due to the peak flow of DMA 3 occurring at a different time than the others due to having to flow through the chambers, thus the software will account for the sub-areas having different peak flow times. To be conservative in our approach, we designed the reduction with the individual peak flows of each DMA to maximize flow.

See Attachment 1 of this report for the proposed Hydrology Map and DMA areas and see Attachment 2 of this report for hydrologic calculations as contained within the CivlD and HydroCAD results.

2.2 HYDRAULICS

The storm drain system compliments the watershed area drainage pattern with an underground storm drain collecting each bio-retention planter. The storm drainage ultimately exits the site at two locations, an existing manhole at the northwest of the site to the main in Enterprise Way and to an existing manhole at the northeast of the building that carries flow to the public system.

Results from the HydroCAD analysis support the sizing and functionality of the proposed onsite underground storm drain system. See Attachment 2 of this report for detailed analysis.

2.3 STORMWATER QUALITY

The storm water quality treatment was designed in accordance with the MRP NPDES Permit dated November 19, 2015. Three onsite modular wetland systems are proposed to meet treatment requirements. For more information, see the separate Water Quality Management Plan (WQMP).

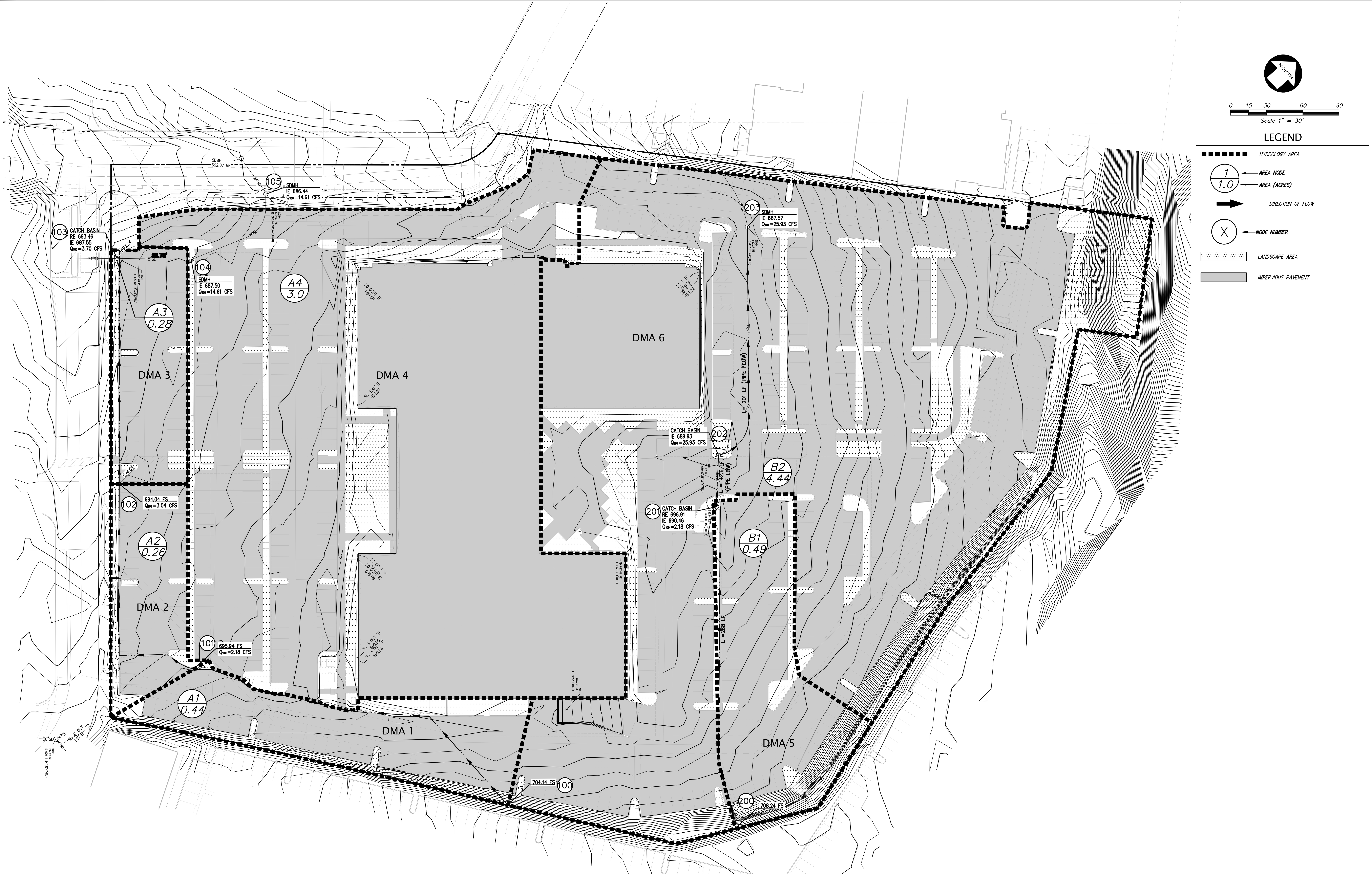
3. Conclusion

The overall hydrology and hydraulics are consistent with City of Lake Forest and County of Orange guidelines for the 100-year, 24-hour storm event. Treatment criteria is being met by the inclusion of three modular wetland systems onsite. All calculations supporting the design of proposed storm drain conveyance are contained within the Attachments of this report.

4. Attachments

Attachment 1	Hydrology Map
Attachment 2	CIVILD & HydroCAD Analysis

Attachment 1
Hydrology Map



DMA No.	Area (SF)	Area (AC)	Landscape (SF)	Landscape (AC)	Imperv. (SF)	Imper. (AC)
1	19,217	0.441	5,253	0.121	13,963	0.321
2	11,262	0.259	2,109	0.048	9,153	0.210
3	12,363	0.284	319	0.007	12,045	0.277
4	131,156	3.011	17,193	0.395	113,963	2.616
5	21,463	0.493	5,994	0.138	15,469	0.355
6	193,240	4.436	73,178	1.680	120,062	2.756

REVISION | BY
REVISION | BY | NO.

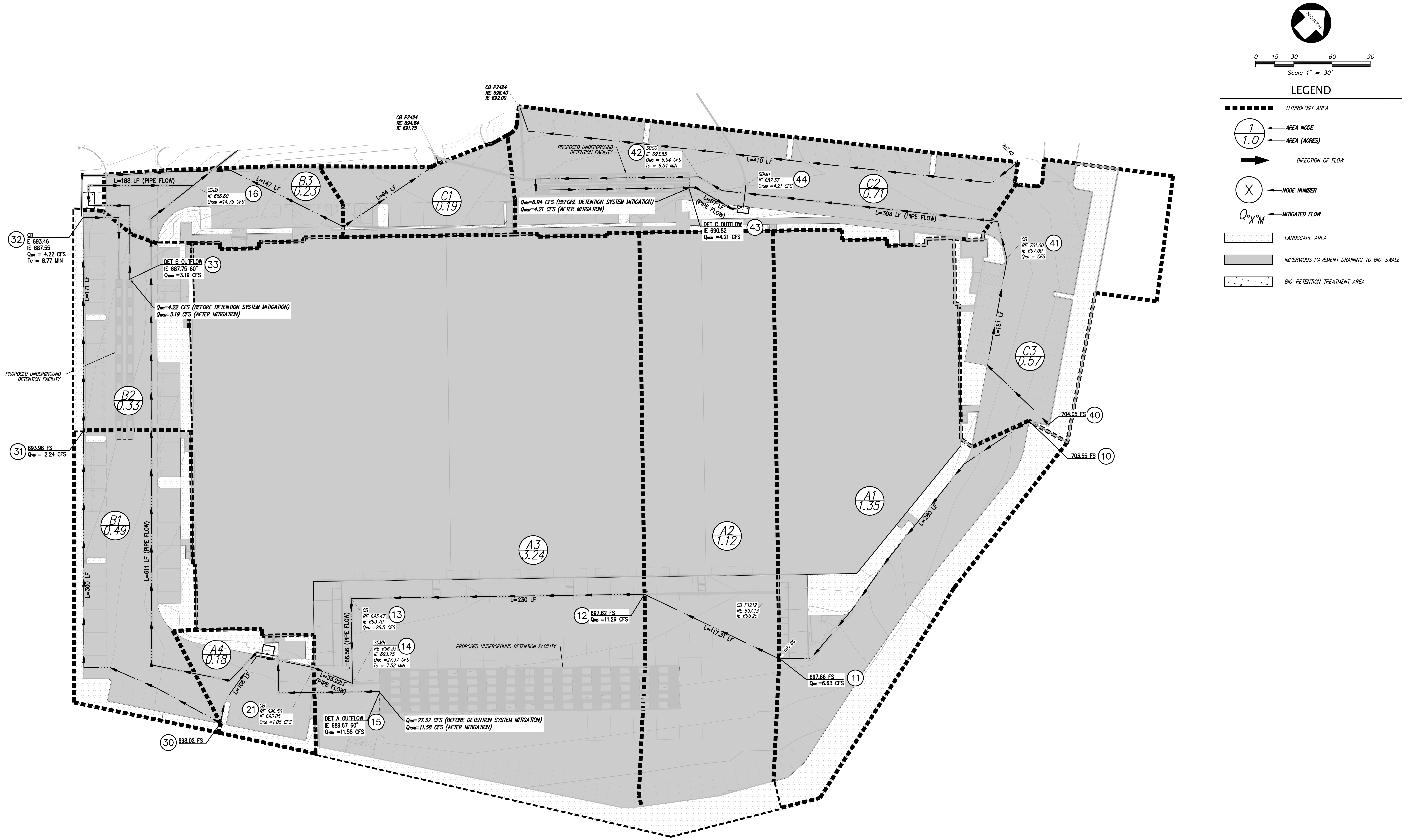
KIER+WRIGHT
163 Technology Drive
Irvine, CA 92620
Phone: (949) 508-0202
www.kierwright.com

EXISTING HYDROLOGY MAP
OF
26200 ENTERPRISE WAY
FOR
BLACK CREEK GROUP

LAKE FOREST, CALIFORNIA

DATE	APRIL, 2021
SCALE	1" = 30'
DESIGNER	EK
DRAWN BY	MRF
JOB NO.	A21532
SHEET	C4.0
OF 6	SHEETS

Z:\2021\A21532\DWG\ENTITLEMENTS\EXHIBITS\HYDROLOGY\A21532 EXISTING HYDROLOGY MAP.dwg 4-19-23 01:16:33 PM



DMA No.	Area (SF)	Area (AC)	Landscape (SF)	Landscape (AC)	Imperv. (SF)	Imper. (AC)
A1	58999	1.354	10,723	0.246	48,276	1.108
A2	48903	1.123	2,330	0.053	46,573	1.069
A3	141302	3.244	2,504	0.057	138,798	3.186
A4	7784	0.179	2,178	0.050	5,606	0.129
B1	21200	0.487	4,482	0.103	16,718	0.384
B2	14416	0.331	2,761	0.063	11,655	0.268
B3	10207	0.234	977	0.022	9,230	0.212
C1	8292	0.190	419	0.010	7,873	0.181
C2	30796	0.707	2,789	0.064	28,007	0.643
C3	24708	0.567	6,034	0.139	18,674	0.429

PROPOSED HYDROLOGY MAP
OF
26200 ENTERPRISE WAY
FOR
BLACK CREEK GROUP

LAKE FOREST, CALIFORNIA

KIER+WRIGHT
163 Technology Drive
Irvine, CA 92620
Phone: (949) 508-0202
www.kierwright.com

DATE	APRIL, 2023
SCALE	1" = 30'
DESIGNER	EK
DRAWN BY	MRF
JOB NO.	A21532
SHEET	C4.0
OF	6 SHEETS

NO. | REVISION | BY

Attachment 2
CIVILD & HydroCAD Analysis

```
                    Orange County Rational Hydrology Program

                (Hydrology Manual Date(s) October 1986 & November 1996)

   CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2018 Version 9.0
          Rational Hydrology Study, Date: 04/19/23  File Name:
A21532EXQ10.roc
------------------------------------------------------------------------
A21532 EXISTING CONDITION
Q100


------------------------------------------------------------------------


Program License Serial Number 6509

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------

Rational hydrology study storm event year is   100.0

Decimal fraction of study above 2000 ft., 600M  =     0.0000
English Units Used for input data


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      100.000 to Point/Station      101.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   299.360(Ft.)
Top (of initial area) elevation =   704.140(Ft.)
Bottom (of initial area) elevation =   695.940(Ft.)
Difference in elevation =     8.200(Ft.)
Slope =    0.02739  s(%)=       2.74
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
```

```
Initial area time of concentration =    6.107 min.
Rainfall intensity =      5.517(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.897
Subarea runoff =      2.177(CFS)
Total initial stream area =       0.440(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      101.000 to Point/Station     102.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =   695.940(Ft.)
End of street segment elevation =   694.040(Ft.)
Length of street segment  =   207.470(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  35.000(Ft.)
Distance from crown to crossfall grade break  =  10.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   7.000(Ft.)
Slope from curb to property line (v/hz) =   0.025
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      2.634(CFS)
Depth of flow =   0.333(Ft.), Average velocity =   2.202(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  10.341(Ft.)
Flow velocity =   2.20(Ft/s)
Travel time =    1.57 min.     TC =    7.68  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Rainfall intensity =      4.839(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.896
Subarea runoff =      0.859(CFS) for    0.260(Ac.)
Total runoff =      3.036(CFS)  Total area =       0.70(Ac.)
Area averaged Fm value =    0.020(In/Hr)
```

```
Street flow at end of street =      3.036(CFS)
Half street flow at end of street =      3.036(CFS)
Depth of flow =   0.346(Ft.), Average velocity =   2.276(Ft/s)
Flow width (from curb towards crown)=  10.989(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      102.000 to Point/Station      103.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =   694.040(Ft.)
End of street segment elevation =   693.460(Ft.)
Length of street segment  =   193.140(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  32.000(Ft.)
Distance from crown to crossfall grade break  =  10.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   7.000(Ft.)
Slope from curb to property line (v/hz) =   0.025
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      3.402(CFS)
Depth of flow =   0.429(Ft.), Average velocity =   1.523(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  14.600(Ft.)
Flow velocity =   1.52(Ft/s)
Travel time =    2.11 min.     TC =    9.79  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Rainfall intensity =      4.210(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.896
Subarea runoff =      0.659(CFS) for    0.280(Ac.)
Total runoff =      3.695(CFS)  Total area =       0.98(Ac.)
Area averaged Fm value =    0.020(In/Hr)
Street flow at end of street =      3.695(CFS)
```

```
Half street flow at end of street =      3.695(CFS)
Depth of flow =   0.438(Ft.), Average velocity =   1.554(Ft/s)
Flow width (from curb towards crown)=  15.087(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station     104.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   687.550(Ft.)
Downstream point/station elevation =   687.500(Ft.)
Pipe length  =    58.78(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.695(CFS)
Given pipe size =     18.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     0.125(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      0.073(Ft.)
 Minor friction loss =      0.102(Ft.)  K-factor =   1.50
Pipe flow velocity =      2.09(Ft/s)
Travel time through pipe =    0.47 min.
Time of concentration (TC) =    10.26 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      104.000 to Point/Station     104.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Time of concentration =    10.26 min.
Rainfall intensity =      4.099(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.896
Subarea runoff =     10.914(CFS) for    3.000(Ac.)
Total runoff =     14.609(CFS)  Total area =        3.98(Ac.)
Area averaged Fm value =    0.020(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      104.000 to Point/Station     105.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
```

```
Upstream point/station elevation =   687.500(Ft.)
Downstream point/station elevation =   686.440(Ft.)
Pipe length  =    90.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    14.609(CFS)
Given pipe size =     18.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     2.272(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      1.740(Ft.)
 Minor friction loss =      1.592(Ft.)  K-factor =   1.50
Pipe flow velocity =      8.27(Ft/s)
Travel time through pipe =    0.18 min.
Time of concentration (TC) =    10.44 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      200.000 to Point/Station      201.000
**** INITIAL AREA EVALUATION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   268.000(Ft.)
Top (of initial area) elevation =   708.240(Ft.)
Bottom (of initial area) elevation =   696.910(Ft.)
Difference in elevation =    11.330(Ft.)
Slope =    0.04228  s(%)=       4.23
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    5.357 min.
Rainfall intensity =      5.948(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.897
Subarea runoff =      2.614(CFS)
Total initial stream area =        0.490(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      201.000 to Point/Station      202.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation =   690.460(Ft.)
Downstream point/station elevation =   689.930(Ft.)
```

```
Pipe length  =    42.62(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.614(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =     2.614(CFS)
Normal flow depth in pipe =    5.78(In.)
Flow top width inside pipe =   16.81(In.)
Critical Depth =    7.35(In.)
Pipe flow velocity =      5.34(Ft/s)
Travel time through pipe =    0.13 min.
Time of concentration (TC) =     5.49 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      202.000 to Point/Station      202.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Time of concentration =     5.49 min.
Rainfall intensity =      5.865(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.897
Subarea runoff =     23.318(CFS) for    4.440(Ac.)
Total runoff =     25.933(CFS)  Total area =        4.93(Ac.)
Area averaged Fm value =    0.020(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      202.000 to Point/Station      203.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   689.930(Ft.)
Downstream point/station elevation =   687.570(Ft.)
Pipe length  =   201.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    25.933(CFS)
Given pipe size =     24.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     1.867(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      2.640(Ft.)
 Minor friction loss =      1.587(Ft.)  K-factor =   1.50
Pipe flow velocity =      8.25(Ft/s)
```

```
Travel time through pipe =    0.41 min.
Time of concentration (TC) =     5.90 min.
End of computations, total study area =            8.91 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged SCS curve number (AMC 2) =  75.0
```

```
                   Orange County Rational Hydrology Program

               (Hydrology Manual Date(s) October 1986 & November 1996)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2018 Version 9.0
        Rational Hydrology Study, Date: 04/14/23  File Name: A21532PROP.roc
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A21532 PROPOSED CONDITION
Q100
PRE-MITIGATION


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Program License Serial Number 6509

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 *********   Hydrology Study Control Information **********

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Rational hydrology study storm event year is   100.0

Decimal fraction of study above 2000 ft., 600M  =     0.0000
English Units Used for input data


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Process from Point/Station       10.000 to Point/Station      11.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   280.000(Ft.)
Top (of initial area) elevation =   703.550(Ft.)
Bottom (of initial area) elevation =   697.660(Ft.)
Difference in elevation =     5.890(Ft.)
Slope =    0.02104  s(%)=       2.10
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
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Initial area time of concentration =    6.268 min.
Rainfall intensity =      5.436(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.897
Subarea runoff =      6.629(CFS)
Total initial stream area =       1.360(Ac.)


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Process from Point/Station       11.000 to Point/Station      12.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =   697.660(Ft.)
End of street segment elevation =   696.620(Ft.)
Length of street segment  =   117.310(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  59.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(Ft.)
Slope from gutter to grade break (v/hz) =  -0.020
Slope from grade break to crown (v/hz)  =  -0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.025
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      9.008(CFS)
Depth of flow =   0.271(Ft.), Average velocity =   2.459(Ft/s)
Note:  depth of flow exceeds top of street crown.
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  59.000(Ft.)
Flow velocity =   2.46(Ft/s)
Travel time =    0.80 min.     TC =    7.06  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Rainfall intensity =      5.076(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.896
Subarea runoff =      4.656(CFS) for    1.120(Ac.)
Total runoff =     11.285(CFS)  Total area =       2.48(Ac.)
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Area averaged Fm value =    0.020(In/Hr)
Street flow at end of street =     11.285(CFS)
Half street flow at end of street =      5.643(CFS)
Depth of flow =   0.295(Ft.), Average velocity =   2.601(Ft/s)
Note:  depth of flow exceeds top of street crown.
Flow width (from curb towards crown)=  59.000(Ft.)


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Process from Point/Station       12.000 to Point/Station      13.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Covered channel
Upstream point elevation =   696.620(Ft.)
Downstream point elevation =   695.470(Ft.)
Channel length thru subarea  =   230.000(Ft.)
Channel base width      =    0.670(Ft.)
Slope or 'Z' of left channel bank =   0.000
Slope or 'Z' of right channel bank =   0.000
Estimated mean flow rate at midpoint of channel =     18.608(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    0.670(Ft.)
Flow(q) thru subarea =     18.608(CFS)
Pressure flow condition in covered channel:
Wetted perimeter =    2.68(Ft.)  Flow area =    0.45(Sq.Ft)
Hydraulic grade line required at box inlet =    705.390(Ft.)
Friction loss =    706.540(Ft.)
Minor Friction loss =      0.000(Ft.)   K-Factor =  0.000
Flow Velocity =   41.45(Ft/s)
Travel time  =    0.09 min.
Time of concentration =    6.84 min.
 Adding area flow to channel
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Rainfall intensity =      5.170(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.897
Subarea runoff =     15.229(CFS) for    3.240(Ac.)
Total runoff =     26.514(CFS)  Total area =        5.72(Ac.)
Area averaged Fm value =    0.020(In/Hr)
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Process from Point/Station       13.000 to Point/Station      14.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   693.700(Ft.)
Downstream point/station elevation =   693.500(Ft.)
Pipe length  =    66.56(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    26.514(CFS)
Given pipe size =     18.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     9.282(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      4.239(Ft.)
 Minor friction loss =      5.243(Ft.)  K-factor =   1.50
Pipe flow velocity =     15.00(Ft/s)
Travel time through pipe =    0.07 min.
Time of concentration (TC) =     6.91 min.


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Process from Point/Station       14.000 to Point/Station      14.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      5.720(Ac.)
Runoff from this stream =     26.514(CFS)
Time of concentration =    6.91 min.
Rainfall intensity =     5.139(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


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Process from Point/Station       20.000 to Point/Station      21.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   106.000(Ft.)
Top (of initial area) elevation =   698.020(Ft.)
Bottom (of initial area) elevation =   696.500(Ft.)
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Difference in elevation =     1.520(Ft.)
Slope =    0.01434  s(%)=       1.43
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    4.589 min.
Rainfall intensity =      6.499(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.897
Subarea runoff =      1.050(CFS)
Total initial stream area =        0.180(Ac.)


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Process from Point/Station       21.000 to Point/Station      14.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   693.850(Ft.)
Downstream point/station elevation =   693.750(Ft.)
Pipe length  =    33.22(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.050(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     1.050(CFS)
Normal flow depth in pipe =    6.26(In.)
Flow top width inside pipe =   11.99(In.)
Critical Depth =    5.17(In.)
Pipe flow velocity =      2.53(Ft/s)
Travel time through pipe =    0.22 min.
Time of concentration (TC) =     4.81 min.


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Process from Point/Station       21.000 to Point/Station      14.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.180(Ac.)
Runoff from this stream =      1.050(CFS)
Time of concentration =    4.81 min.
Rainfall intensity =     6.328(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream  Area  Flow rate      TC     Fm       Rainfall Intensity
 No.    (Ac.)   (CFS)       (min) (In/Hr)     (In/Hr)


1      5.72    26.514      6.91    0.020      5.139
2      0.18     1.050      4.81    0.020      6.328
Qmax(1) =
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           1.000 *    1.000 *    26.514) +
           0.811 *    1.000 *     1.050) + =      27.366
Qmax(2) =
           1.232 *    0.695 *    26.514) +
           1.000 *    1.000 *     1.050) + =      23.769

Total of 2 streams to confluence:
Flow rates before confluence point:
      26.514       1.050
Maximum flow rates at confluence using above data:
       27.366       23.769
Area of streams before confluence:
        5.720        0.180
Effective area values after confluence:
        5.900        4.157
Results of confluence:
Total flow rate =     27.366(CFS)
Time of concentration =     6.914 min.
Effective stream area after confluence =      5.900(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.020(In/Hr)
Study area total (this main stream) =       5.90(Ac.)


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Process from Point/Station       14.000 to Point/Station      15.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   693.750(Ft.)
Downstream point/station elevation =   686.700(Ft.)
Pipe length  =   560.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    27.366(CFS)
Given pipe size =     18.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
    36.530(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =     37.994(Ft.)
 Minor friction loss =      5.586(Ft.)  K-factor =   1.50
Pipe flow velocity =     15.49(Ft/s)
Travel time through pipe =    0.60 min.
Time of concentration (TC) =     7.52 min.


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Process from Point/Station       15.000 to Point/Station      15.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
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Stream flow area =      5.900(Ac.)
Runoff from this stream =     27.366(CFS)
Time of concentration =    7.52 min.
Rainfall intensity =     4.898(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


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Process from Point/Station       30.000 to Point/Station      31.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   299.600(Ft.)
Top (of initial area) elevation =   698.020(Ft.)
Bottom (of initial area) elevation =   693.960(Ft.)
Difference in elevation =     4.060(Ft.)
Slope =    0.01355  s(%)=       1.36
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.032 min.
Rainfall intensity =      5.089(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.896
Subarea runoff =      2.235(CFS)
Total initial stream area =        0.490(Ac.)


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Process from Point/Station       31.000 to Point/Station      32.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =   693.960(Ft.)
End of street segment elevation =   693.460(Ft.)
Length of street segment  =   170.760(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  56.500(Ft.)
Distance from crown to crossfall grade break  =  18.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.035
Slope from grade break to crown (v/hz)  =   0.035
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   7.500(Ft.)
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Slope from curb to property line (v/hz) =   0.050
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      2.794(CFS)
Depth of flow =   0.451(Ft.), Average velocity =   1.639(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   9.619(Ft.)
Flow velocity =   1.64(Ft/s)
Travel time =    1.74 min.     TC =    8.77  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Rainfall intensity =      4.484(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.896
Subarea runoff =      1.059(CFS) for    0.330(Ac.)
Total runoff =      3.295(CFS)  Total area =        0.82(Ac.)
Area averaged Fm value =    0.020(In/Hr)
Street flow at end of street =      3.295(CFS)
Half street flow at end of street =      3.295(CFS)
Depth of flow =   0.474(Ft.), Average velocity =   1.706(Ft/s)
Flow width (from curb towards crown)=  10.270(Ft.)


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Process from Point/Station      32.000 to Point/Station      32.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Time of concentration =     8.77 min.
Rainfall intensity =      4.484(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
```

rational method)(Q=KCIA) is C = 0.896
Subarea runoff = 0.924(CFS) for 0.230(Ac.)
Total runoff = 4.219(CFS) Total area = 1.05(Ac.)
Area averaged Fm value = 0.020(In/Hr)

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Process from Point/Station 32.000 to Point/Station 15.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 687.550(Ft.)
Downstream point/station elevation = 686.600(Ft.)
Pipe length = 273.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 4.219(CFS)
Given pipe size = 12.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
3.549(Ft.) at the headworks or inlet of the pipe(s)
Pipe friction loss = 3.827(Ft.)
Minor friction loss = 0.672(Ft.) K-factor = 1.50
Pipe flow velocity = 5.37(Ft/s)
Travel time through pipe = 0.85 min.
Time of concentration (TC) = 9.62 min.

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Process from Point/Station 32.000 to Point/Station 15.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 1.050(Ac.)
Runoff from this stream = 4.219(CFS)
Time of concentration = 9.62 min.
Rainfall intensity = 4.254(In/Hr)
Area averaged loss rate (Fm) = 0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream No.	Area (Ac.)	Flow rate (CFS)	TC (min)	Fm (In/Hr)	Rainfall Intensity (In/Hr)
1	5.90	27.366	7.52	0.020	4.898
2	1.05	4.219	9.62	0.020	4.254

Qmax(1) =
1.000 * 1.000 * 27.366) +
1.152 * 0.782 * 4.219) + = 31.166
Qmax(2) =

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           0.868 *    1.000 *    27.366) +
           1.000 *    1.000 *     4.219) + =      27.968

Total of 2 streams to confluence:
Flow rates before confluence point:
      27.366       4.219
Maximum flow rates at confluence using above data:
       31.166       27.968
Area of streams before confluence:
        5.900        1.050
Effective area values after confluence:
        6.721        6.950
Results of confluence:
Total flow rate =     31.166(CFS)
Time of concentration =     7.517 min.
Effective stream area after confluence =      6.721(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.020(In/Hr)
Study area total (this main stream) =       6.95(Ac.)


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Process from Point/Station      15.000 to Point/Station      16.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   686.600(Ft.)
Downstream point/station elevation =   686.440(Ft.)
Pipe length  =    45.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    31.166(CFS)
Given pipe size =     24.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     2.986(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      0.854(Ft.)
 Minor friction loss =      2.292(Ft.)  K-factor =   1.50
Pipe flow velocity =      9.92(Ft/s)
Travel time through pipe =    0.08 min.
Time of concentration (TC) =     7.59 min.


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Process from Point/Station      40.000 to Point/Station      41.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
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Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   151.100(Ft.)
Top (of initial area) elevation =   704.050(Ft.)
Bottom (of initial area) elevation =   701.000(Ft.)
Difference in elevation =     3.050(Ft.)
Slope =    0.02019  s(%)=       2.02
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    4.938 min.
Rainfall intensity =      6.232(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.897
Subarea runoff =      3.131(CFS)
Total initial stream area =       0.560(Ac.)


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Process from Point/Station       41.000 to Point/Station      42.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   697.000(Ft.)
Downstream point/station elevation =   687.570(Ft.)
Pipe length  =   591.25(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.131(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =     3.131(CFS)
Normal flow depth in pipe =    5.95(In.)
Flow top width inside pipe =   16.94(In.)
Critical Depth =    8.10(In.)
Pipe flow velocity =      6.14(Ft/s)
Travel time through pipe =    1.60 min.
Time of concentration (TC) =     6.54 min.


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Process from Point/Station       42.000 to Point/Station      42.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
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Time of concentration =     6.54 min.
Rainfall intensity =      5.304(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.897
Subarea runoff =      3.812(CFS) for    0.900(Ac.)
Total runoff =      6.943(CFS)  Total area =        1.46(Ac.)
Area averaged Fm value =    0.020(In/Hr)
End of computations, total study area =           8.41 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged SCS curve number (AMC 2) =  75.0
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                    Orange County Rational Hydrology Program

                (Hydrology Manual Date(s) October 1986 & November 1996)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2018 Version 9.0
        Rational Hydrology Study, Date: 04/18/23  File Name: A21532POST.roc
------------------------------------------------------------------------
A21532 PROPOSED CONDITION
Q100
POST MITIGATION/DETENTION


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Program License Serial Number 6509

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 *********   Hydrology Study Control Information **********

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Rational hydrology study storm event year is   100.0

Decimal fraction of study above 2000 ft., 600M  =     0.0000
English Units Used for input data


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       15.000 to Point/Station      15.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Rainfall intensity =      4.897(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =   7.52 min.  Rain intensity =       4.90(In/Hr)
Total area =         5.91(Ac.)  Total runoff =     11.58(CFS)


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Process from Point/Station       15.000 to Point/Station       16.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   689.670(Ft.)
Downstream point/station elevation =   686.700(Ft.)
Pipe length  =   610.55(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    11.580(CFS)
Given pipe size =     24.00(In.)
Calculated individual pipe flow  =    11.580(CFS)
Normal flow depth in pipe =   15.28(In.)
Flow top width inside pipe =   23.09(In.)
Critical Depth =   14.64(In.)
Pipe flow velocity =      5.49(Ft/s)
Travel time through pipe =    1.85 min.
Time of concentration (TC) =     9.37 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       15.000 to Point/Station       16.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      5.910(Ac.)
Runoff from this stream =     11.580(CFS)
Time of concentration =    9.37 min.
Rainfall intensity =     4.316(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       33.000 to Point/Station       33.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Rainfall intensity =      4.484(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =   8.77 min.  Rain intensity =       4.48(In/Hr)
Total area =         1.05(Ac.)  Total runoff =      3.19(CFS)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       33.000 to Point/Station      16.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   687.750(Ft.)
Downstream point/station elevation =   686.600(Ft.)
Pipe length  =   188.30(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.190(CFS)
Given pipe size =     12.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     0.743(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      1.509(Ft.)
 Minor friction loss =      0.384(Ft.)  K-factor =   1.50
Pipe flow velocity =      4.06(Ft/s)
Travel time through pipe =    0.77 min.
Time of concentration (TC) =     9.54 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       33.000 to Point/Station      16.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.050(Ac.)
Runoff from this stream =      3.190(CFS)
Time of concentration =    9.54 min.
Rainfall intensity =     4.272(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream  Area  Flow rate      TC     Fm       Rainfall Intensity
 No.    (Ac.)   (CFS)       (min) (In/Hr)     (In/Hr)


1      5.91    11.580      9.37    0.020      4.316
2      1.05     3.190      9.54    0.020      4.272
Qmax(1) =
           1.000 *    1.000 *    11.580) +
           1.010 *    0.982 *     3.190) + =      14.746
Qmax(2) =
           0.990 *    1.000 *    11.580) +
           1.000 *    1.000 *     3.190) + =      14.652

Total of 2 streams to confluence:
Flow rates before confluence point:
      11.580       3.190
```

```
Maximum flow rates at confluence using above data:
       14.746       14.652
Area of streams before confluence:
        5.910        1.050
Effective area values after confluence:
        6.941        6.960
Results of confluence:
Total flow rate =     14.746(CFS)
Time of concentration =     9.374 min.
Effective stream area after confluence =      6.941(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.020(In/Hr)
Study area total (this main stream) =      6.96(Ac.)

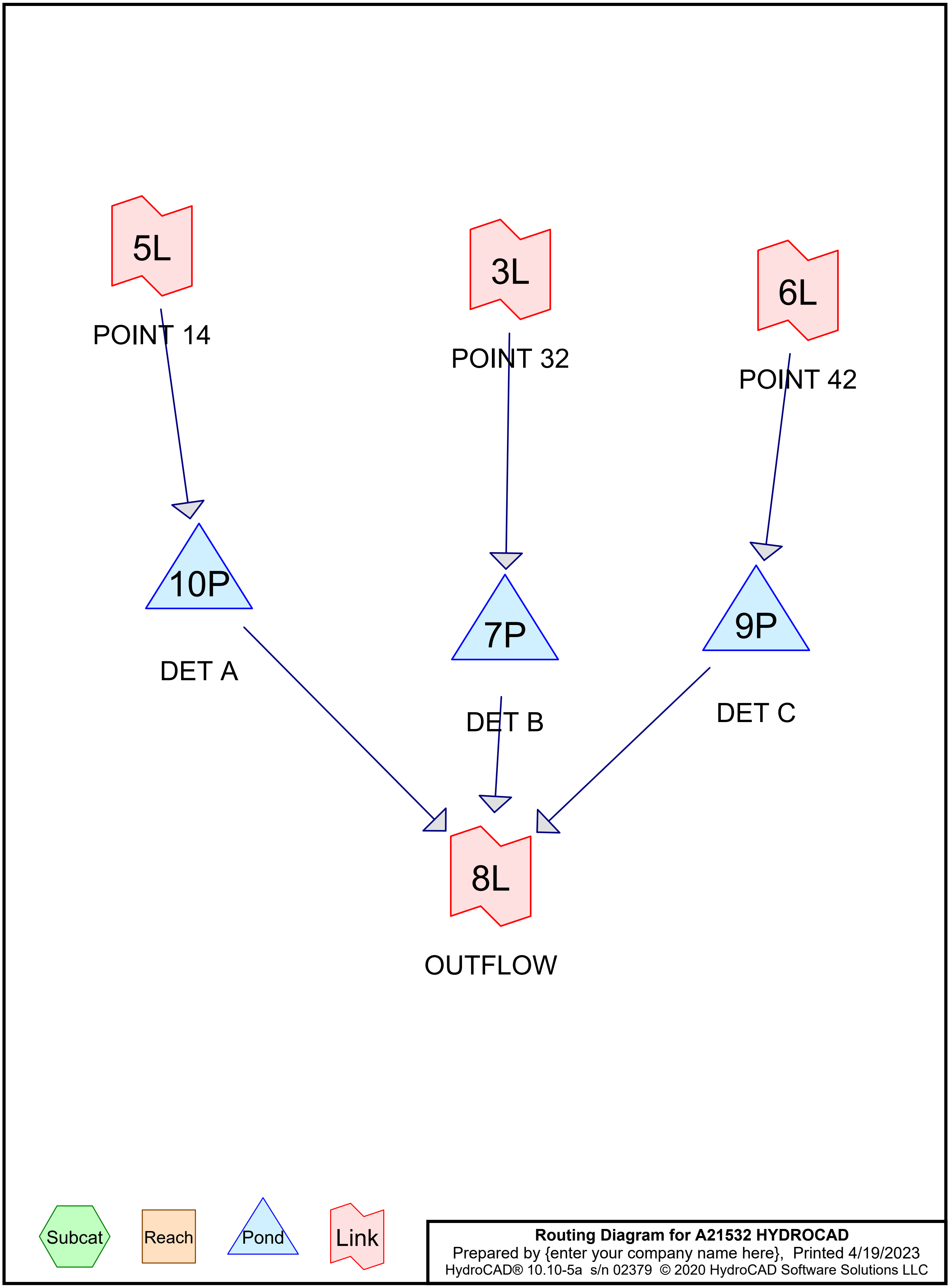

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       16.000 to Point/Station      17.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   686.600(Ft.)
Downstream point/station elevation =   686.440(Ft.)
Pipe length  =    44.60(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    14.746(CFS)
Given pipe size =     24.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     0.543(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      0.189(Ft.)
 Minor friction loss =      0.513(Ft.)  K-factor =   1.50
Pipe flow velocity =      4.69(Ft/s)
Travel time through pipe =    0.16 min.
Time of concentration (TC) =     9.53 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       42.000 to Point/Station      43.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Rainfall intensity =      5.305(In/Hr) for a   100.0 year storm
User specified values are as follows:
```

```
TC =   6.54 min.  Rain intensity =       5.30(In/Hr)
Total area =         1.46(Ac.)  Total runoff =      4.21(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      43.000 to Point/Station      44.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   690.820(Ft.)
Downstream point/station elevation =   687.570(Ft.)
Pipe length  =    66.66(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.210(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =     4.210(CFS)
Normal flow depth in pipe =    5.19(In.)
Flow top width inside pipe =   16.31(In.)
Critical Depth =    9.44(In.)
Pipe flow velocity =      9.97(Ft/s)
Travel time through pipe =    0.11 min.
Time of concentration (TC) =     6.65 min.
End of computations, total study area =           8.42 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged SCS curve number (AMC 2) =  75.0
```



Routing Diagram for A21532 HYDROCAD
Prepared by {enter your company name here}, Printed 4/19/2023
HydroCAD® 10.10-5a s/n 02379 © 2020 HydroCAD Software Solutions LLC

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Pond 7P: DET B Peak Elev=688.96' Storage=0.017 af Inflow=3.75 cfs 0.392 af
Outflow=3.19 cfs 0.391 af

Pond 9P: DET C Peak Elev=691.81' Storage=0.014 af Inflow=4.49 cfs 0.545 af
Outflow=4.21 cfs 0.544 af

Pond 10P: DET A Peak Elev=692.27' Storage=0.263 af Inflow=23.19 cfs 2.247 af
Outflow=11.58 cfs 2.235 af

Link 3L: POINT 32 CFS Imported from DETB.csv Inflow=3.75 cfs 0.392 af
Primary=3.75 cfs 0.392 af

Link 5L: POINT 14 CFS Imported from DETA.csv Inflow=23.19 cfs 2.247 af
Primary=23.19 cfs 2.247 af

Link 6L: POINT 42 CFS Imported from DETC.csv Inflow=4.49 cfs 0.545 af
Primary=4.49 cfs 0.545 af

Link 8L: OUTFLOW Inflow=18.13 cfs 3.170 af
Primary=18.13 cfs 3.170 af

Summary for Pond 10P: DET A

[82] Warning: Early inflow requires earlier time span

Inflow	=	23.19 cfs @	16.17 hrs,	Volume=	2.247 af
Outflow	=	11.58 cfs @	16.29 hrs,	Volume=	2.235 af, Atten= 50%, Lag= 7.6 min
Primary	=	11.58 cfs @	16.29 hrs,	Volume=	2.235 af

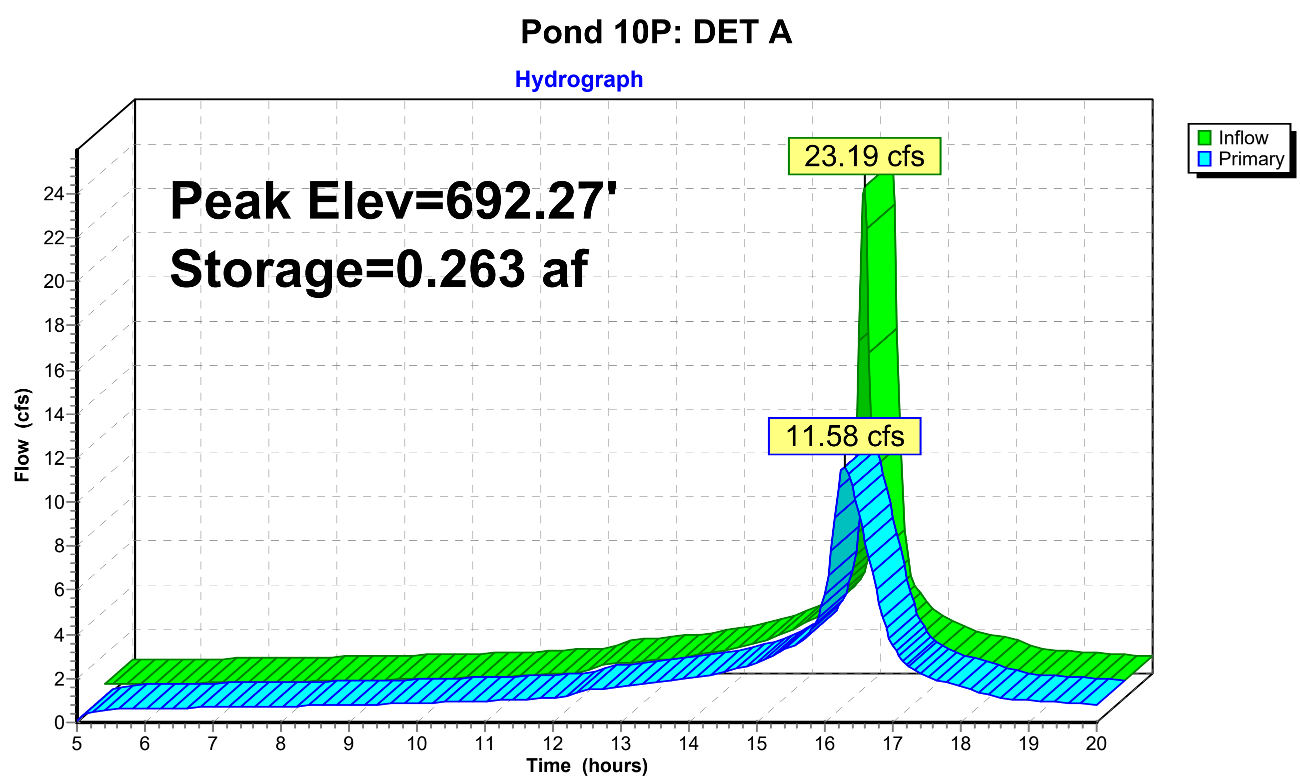
Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 692.27' @ 16.29 hrs Surf.Area= 0.135 ac Storage= 0.263 af

Plug-Flow detention time= 12.0 min calculated for 2.226 af (99% of inflow)
Center-of-Mass det. time= 9.8 min (870.2 - 860.4)

Volume	Invert	Avail.Storage	Storage Description
#1	689.67'	0.530 af	**60.0" Round Pipe Storage** x 5 L= 235.0' S= 0.0010 '/'

Device	Routing	Invert	Outlet Devices
#1	Primary	689.67'	**18.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=11.55 cfs @ 16.29 hrs HW=692.26' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 11.55 cfs @ 6.54 fps)



Summary for Pond 7P: DET B

[82] Warning: Early inflow requires earlier time span

Inflow	=	3.75 cfs @	16.18 hrs, Volume=	0.392 af
Outflow	=	3.19 cfs @	16.25 hrs, Volume=	0.391 af, Atten= 15%, Lag= 4.2 min
Primary	=	3.19 cfs @	16.25 hrs, Volume=	0.391 af

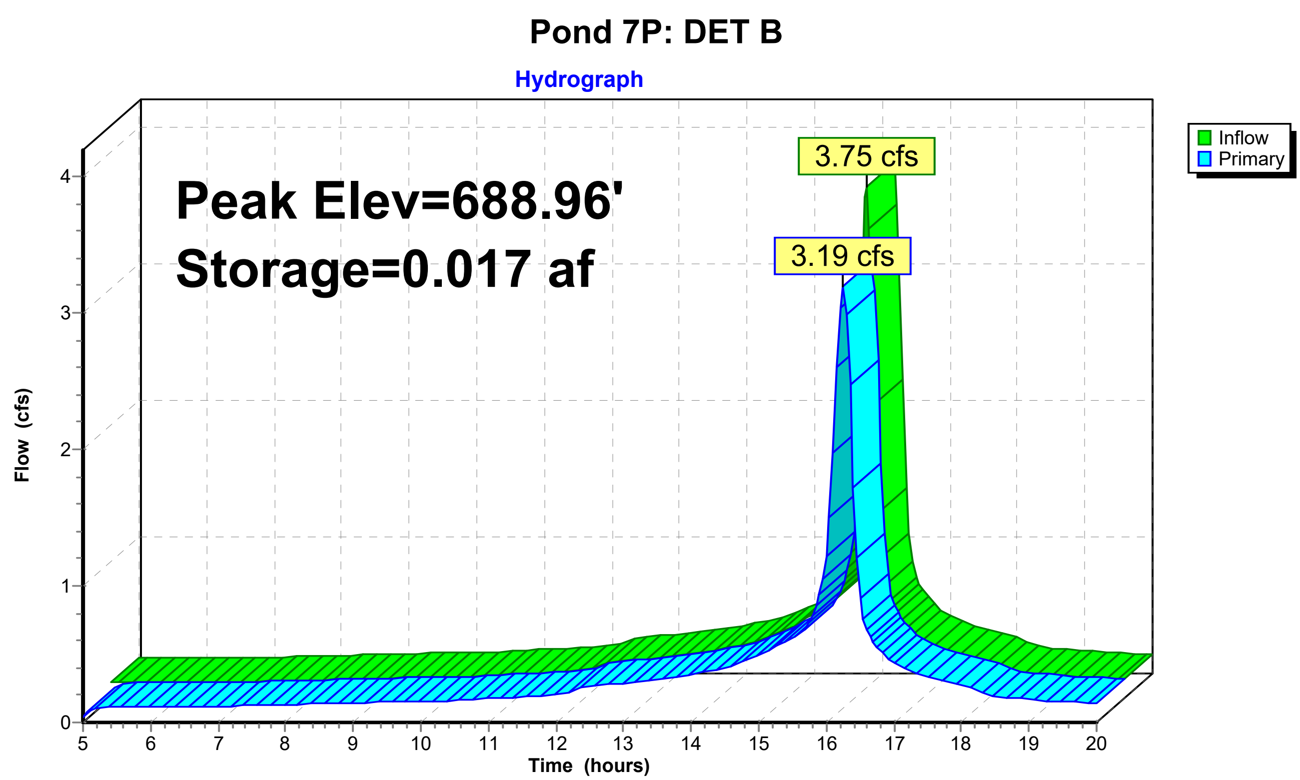
Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 688.96' @ 16.25 hrs Surf.Area= 0.021 ac Storage= 0.017 af

Plug-Flow detention time= 3.7 min calculated for 0.391 af (100% of inflow)
Center-of-Mass det. time= 2.9 min (863.7 - 860.8)

Volume	Invert	Avail.Storage	Storage Description
#1	687.75'	0.072 af	**48.0" Round Pipe Storage** x 2 L= 125.0' S= 0.0010 '/'

Device	Routing	Invert	Outlet Devices
#1	Primary	687.75'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.18 cfs @ 16.25 hrs HW=688.96' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 3.18 cfs @ 4.05 fps)



Summary for Pond 9P: DET C

[82] Warning: Early inflow requires earlier time span

Inflow	=	4.49 cfs @	16.15 hrs, Volume=	0.545 af
Outflow	=	4.21 cfs @	16.18 hrs, Volume=	0.544 af, Atten= 6%, Lag= 2.0 min
Primary	=	4.21 cfs @	16.18 hrs, Volume=	0.544 af

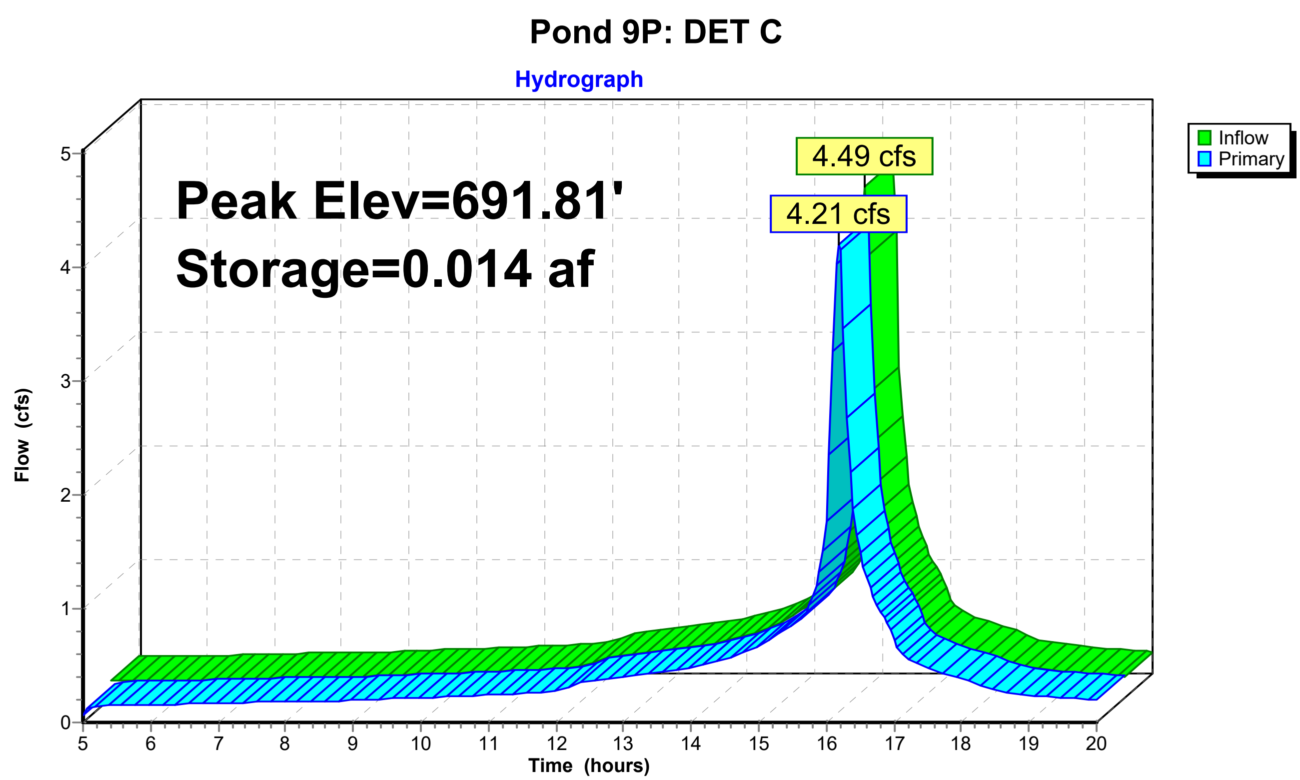
Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 691.81' @ 16.18 hrs Surf.Area= 0.021 ac Storage= 0.014 af

Plug-Flow detention time= 3.1 min calculated for 0.544 af (100% of inflow)
Center-of-Mass det. time= 2.3 min (864.8 - 862.5)

Volume	Invert	Avail.Storage	Storage Description
#1	690.82'	0.108 af	**60.0" Round Pipe Storage** x 2 L= 120.0' S= 0.0010 '/'

Device	Routing	Invert	Outlet Devices
#1	Primary	690.82'	**18.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=4.11 cfs @ 16.18 hrs HW=691.80' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 4.11 cfs @ 3.37 fps)

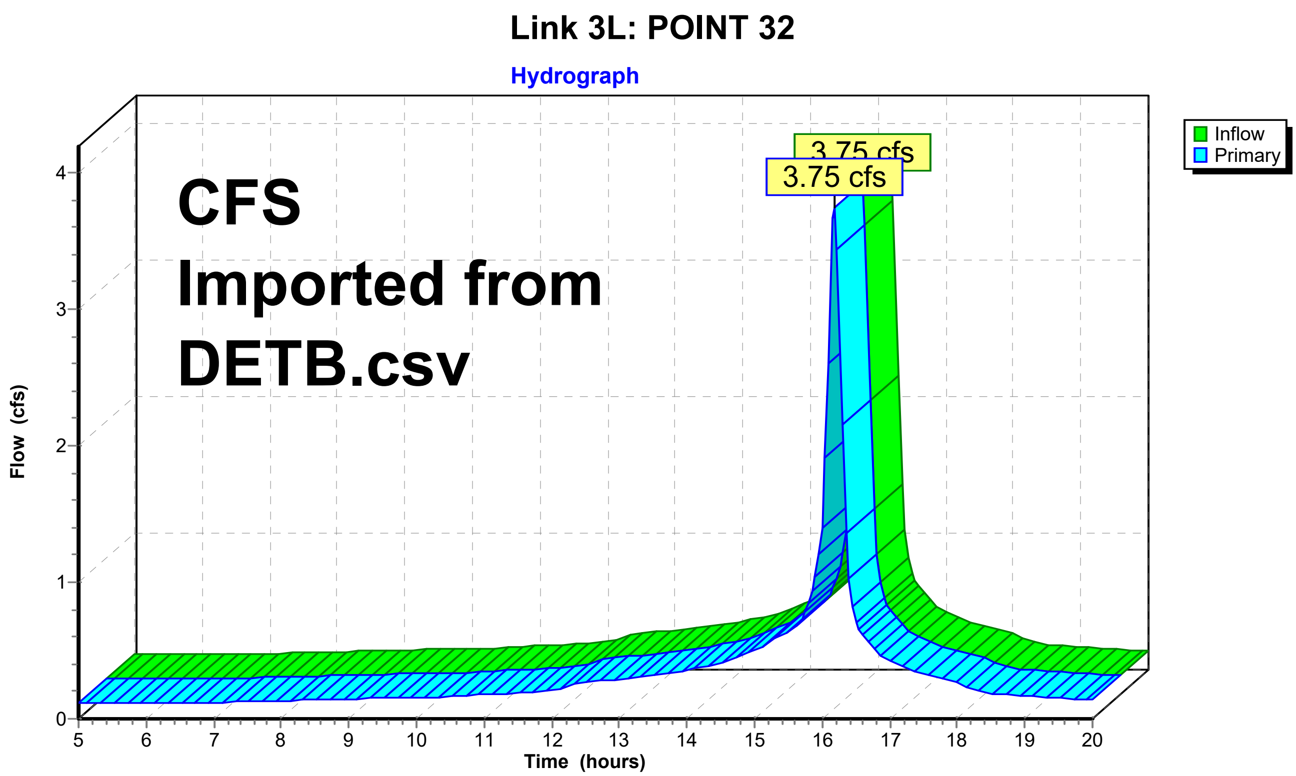


Summary for Link 3L: POINT 32

Inflow	=	3.75 cfs @	16.18 hrs, Volume=	0.392 af
Primary	=	3.75 cfs @	16.18 hrs, Volume=	0.392 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

CFS Imported from DETB.csv

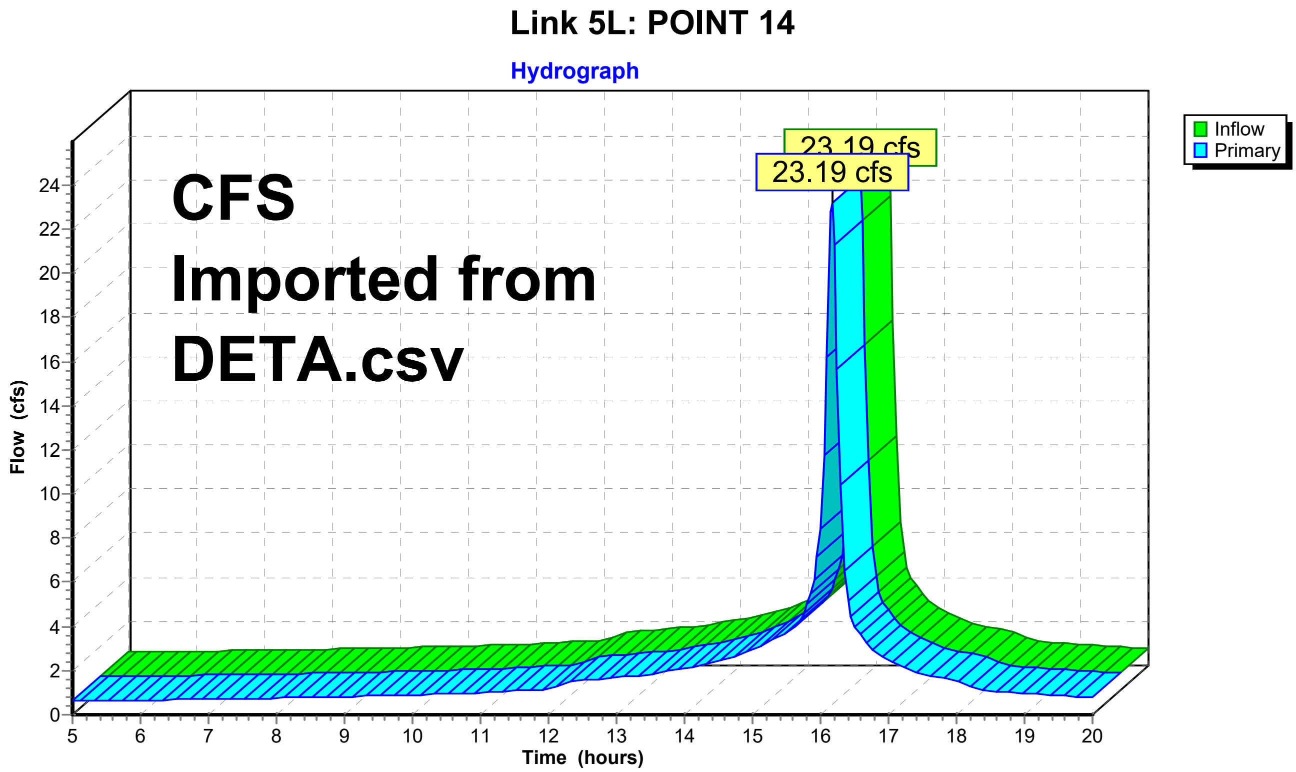


Summary for Link 5L: POINT 14

Inflow	=	23.19 cfs @	16.17 hrs, Volume=	2.247 af
Primary	=	23.19 cfs @	16.17 hrs, Volume=	2.247 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

CFS Imported from DETA.csv

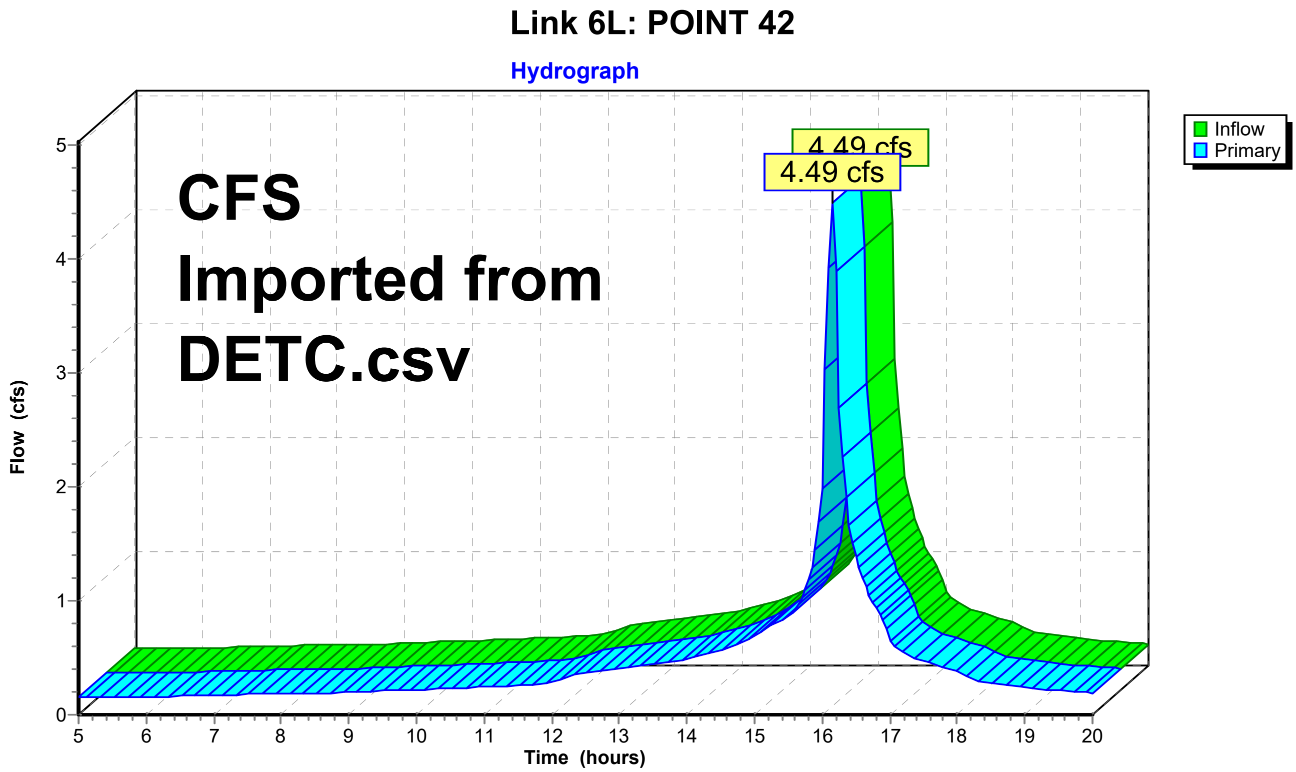


Summary for Link 6L: POINT 42

Inflow	=	4.49 cfs @	16.15 hrs,	Volume=	0.545 af
Primary	=	4.49 cfs @	16.15 hrs,	Volume=	0.545 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

CFS Imported from DETC.csv



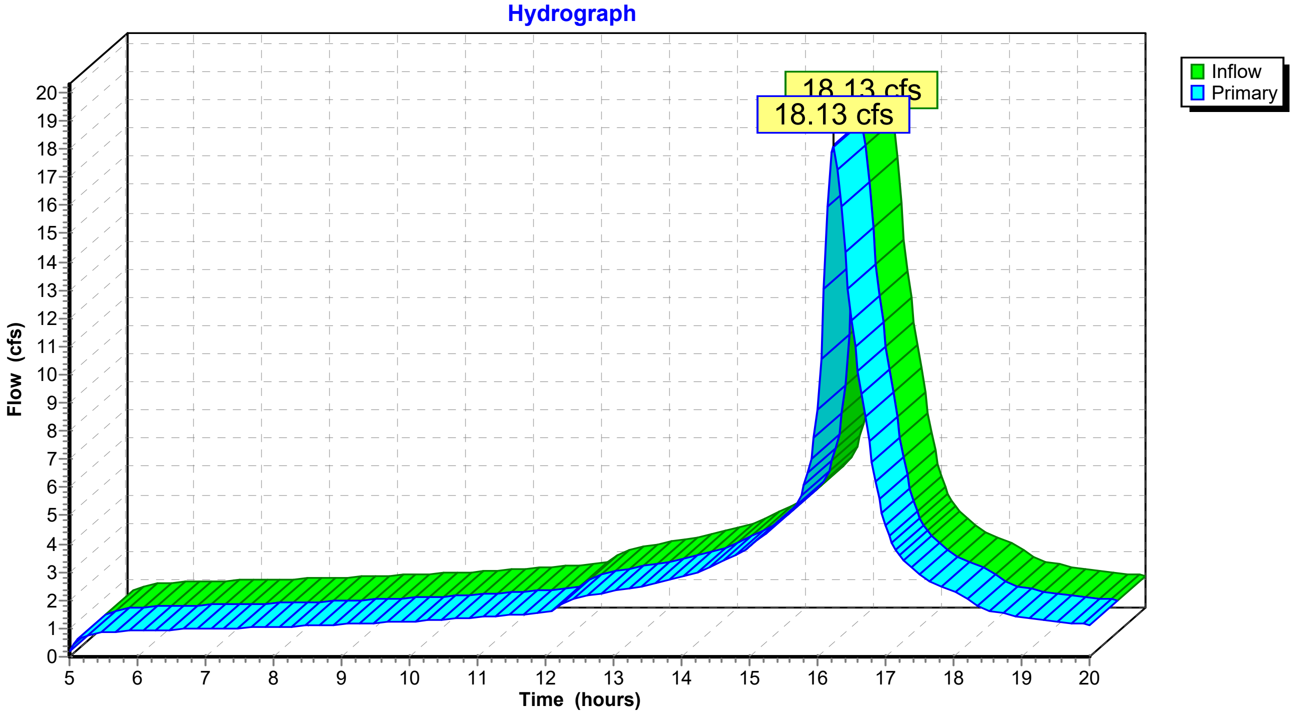
Summary for Link 8L: OUTFLOW

Inflow	=	18.13 cfs @	16.23 hrs, Volume=	3.170 af	
Primary	=	18.13 cfs @	16.23 hrs, Volume=	3.170 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Fixed water surface Elevation= 686.44'

Link 8L: OUTFLOW



Appendix G

Request of Flow Reduction

Memorandum

To: Jennifer Mansur, Associate Planner

Cc: Dennis Jue, Deputy City Engineer

From: Terry Kelley, Engineering Plan Checker, AndersonPenna

Date: March 12, 2021

Subject: PA 03-21-5408, 26200 Enterprise Way, PC#1 Revised 4-23-21

Engineering has performed a preliminary review of the subject project and has the following comments:

1. To determine the Water Quality Management Plan (WQMP) criteria the final use of the property must be established before submitting a Preliminary WQMP during the planning process. The applicant is to review the City's site at https://www.lakeforestca.gov/294/Water-Quality.
2. Initial determination based on the review this will be a Priority WQMP.
3. Grading plans which may require drainage plans must be completed and submitted to Public Works for review.
4. Erosion control plans must be submitted as part of the grading plans for Public Works review.
5. Haul route plans for demolition and grading operations must be completed and submitted to Public Works for review.
6. All existing private drainage facilities must be identified.
7. All existing public drainage facilities must be identified.
8. All access to the property and buildings from and to private and public areas must meet current ADA requirements.
9. The applicant will be required to provide a Preliminary Hydrology report during the planning phase addressing the requirement for a reduction of 38 to 40% in the 100-year flows contributing to Serrano Creek. The Serrano Summit mixed use site (Civic Center and Lennar residential development); the Meadows residential development and other developments have reduced their flows to Serrano Creek by these percentage amounts.

If you have any questions regarding the above comments please contact me.

Teresa (Terry) Kelley, P.E.
Consultant Plan Check Engineer
Ardurra
City Office: (949) 461-3483
Mobile: (949) 371-3223 (Best Contact)
tkelley@lakeforestca.gov

E-2: Preliminary Hydrologic and Hydraulic Drainage Report

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Preliminary Hydrologic & Hydraulic Drainage Report

For

26200 Enterprise Way
Lake Forest, California, 92630

April 19, 2023

Prepared For:

BLACK CREEK® GROUP

4675 MacArthur Court, Suite 625
Newport Beach, California, 92660

Prepared By:

KIER & WRIGHT
CIVIL ENGINEERS & SURVEYORS, INC.

8955 Research Dr.
Irvine, CA, 92618
Phone 949.508.0202

Preliminary Hydrologic & Hydraulic Report

for

26200 Enterprise Way
Irvine, California

Date: May 28, 2021

Project Manager:	D. Garrett Readler, P.E. RCE No. 76867
Job Number:	A21532

Prepared By: ______________________ 05/28/21

D. Garrett Readler, P.E. Date
Kier & Wright

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1.2 Report Objectives 4
1.3 Criteria, Procedure, and Methodology 4
2. Discussion/Calculations 5
2.1 Hydrology 5
2.2 Hydraulics 6
2.3 Stormwater Quality 6
3. Conclusion 6
4. Attachments 7

1. Introduction

1.1 PROJECT DESCRIPTION

This report has been prepared to provide an analysis of drainage patterns and improvements related to the 26200 Enterprise Way development, which is located within the City of Lake Forest, CA. The proposed project is a redevelopment of an existing office space. Once completed, this site will contain one new warehouse with truck docks, surrounded by site parking, landscape, and hardscape, with modular wetland systems for treatment and an underground pipe storage system for outflow control.

The site consists currently of one two-story building and parking lot. The property is bounded more commercial and industrial buildings on the north, south, and west. The northeastern property is currently undeveloped. All existing onsite drainage facilities drain to the storm drain in the public right of way, which drains to nearby Serrano Creek.

The project proposes to surface drain all runoff to curb inlets where it will be treated prior to discharging into the public system. Treated runoff from the largest drainage area will be routed to the underground storage system where the discharge will be controlled to the public storm drain. The purpose of this is to reduce the overall discharge from the site by 40% as requested by the city of Lake Forest.

1.2 REPORT OBJECTIVES

The objective of this report is to outline an orderly drainage system for the site in accordance with the Orange County Hydrology and Hydraulics Manual. Objectives of this report are as follows:

- Determine the developed, or proposed, site hydrologic conditions, including overland runoff rates expected from the 100-year storm event.
- Validate the design of the proposed underground storm drain conveyance systems and provide hydraulic calculations.
- Storm water quality treatment in accordance with MRP NPDES Permit dated November 19, 2015 will be provided. See separate project WQMP.

1.3 CRITERIA, PROCEDURE, AND METHODOLOGY

Calculations and design criteria contained within this report are consistent with the Orange County Hydrology requirements. The hydrology and storage calculations are per SCS runoff equations and are in accordance with County design criteria as performed in the Hydro Cad software. It should be noted that Hydro Cad was utilized to calculate the storage and ponding capacity in the proposed pipes.

2. Discussion/Calculations

2.1 HYDROLOGY

In order to determine expected peak runoff rates from the site, the overall project watershed was divided into ten tributary areas, or Drainage Management Areas (DMA's), based on area draining to proposed treatment devices. A table of the DMA's and their corresponding detention system and area can be found in the table below.

DETENTION SYSTEM	DMA AREA	AREA (AC)
DENTENTION SYSTEM A	1	1.36
	2	1.12
	3	3.24
	4	0.18
DETENTION SYSTEM B	5	0.49
	6	0.33
	7	0.23
DETENTION SYSTEM C	8	0.19
	9	0.71
	10	0.56

Site hydrology was determined using CivilD software utilizing a 100 year storm event.

Using the inputs as described above, the expected 100-year, 24-hour peak runoff rate for listed in the table below:

100-year	TOTAL
Pre-Development (cfs)	40.5
Post-Development (Pre-Mitigation) (cfs)	38.1
Post-Development (Post-Mitigation) (cfs)	19.0

The existing peak flow leaving the site was 40.5 cfs. The proposed peak flow leaving the site before outlet control is 38.1 cfs. With outlet control, the total flow leaving the site is 19.0 cfs, a reduction of 53%. In the hydrology report, the final link contains a flow of 19.0 cfs. The lower value is due to the peak flow of DMA 3 occurring at a different time than the others due to having to flow through the chambers, thus the software will account for the sub-areas having different peak flow times. To be conservative in our approach, we designed the reduction with the individual peak flows of each DMA to maximize flow.

See Attachment 1 of this report for the proposed Hydrology Map and DMA areas and see Attachment 2 of this report for hydrologic calculations as contained within the CivlD and HydroCAD results.

2.2 HYDRAULICS

The storm drain system compliments the watershed area drainage pattern with an underground storm drain collecting each bio-retention planter. The storm drainage ultimately exits the site at two locations, an existing manhole at the northwest of the site to the main in Enterprise Way and to an existing manhole at the northeast of the building that carries flow to the public system.

Results from the HydroCAD analysis support the sizing and functionality of the proposed onsite underground storm drain system. See Attachment 2 of this report for detailed analysis.

2.3 STORMWATER QUALITY

The storm water quality treatment was designed in accordance with the MRP NPDES Permit dated November 19, 2015. Three onsite modular wetland systems are proposed to meet treatment requirements. For more information, see the separate Water Quality Management Plan (WQMP).

3. Conclusion

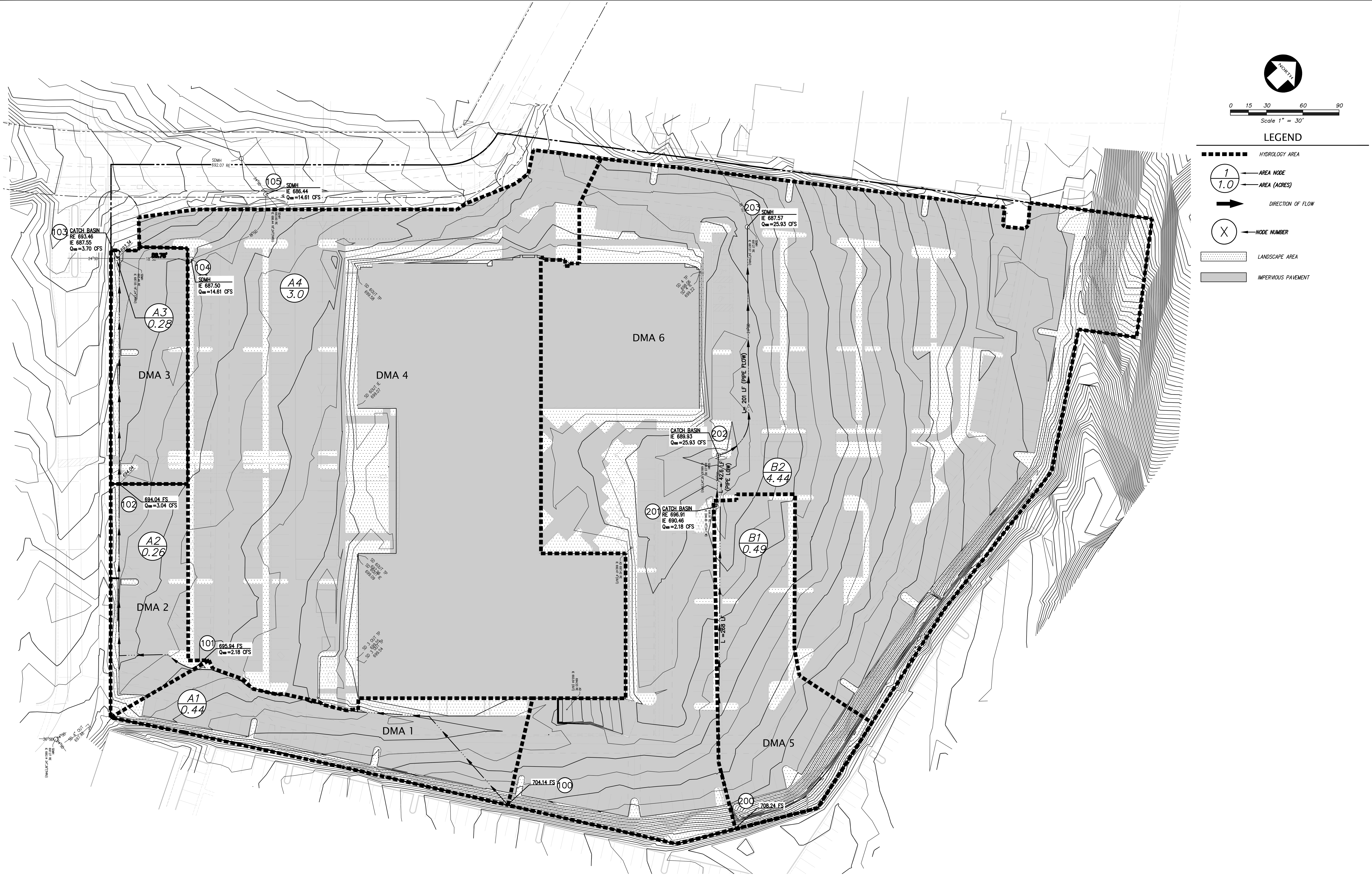
The overall hydrology and hydraulics are consistent with City of Lake Forest and County of Orange guidelines for the 100-year, 24-hour storm event. Treatment criteria is being met by the inclusion of three modular wetland systems onsite. All calculations supporting the design of proposed storm drain conveyance are contained within the Attachments of this report.

4. Attachments

Attachment 1	Hydrology Map
Attachment 2	CIVILD & HydroCAD Analysis

Attachment 1

Hydrology Map



DMA No.	Area (SF)	Area (AC)	Landscape (SF)	Landscape (AC)	Imperv. (SF)	Imper. (AC)
1	19,217	0.441	5,253	0.121	13,963	0.321
2	11,262	0.259	2,109	0.048	9,153	0.210
3	12,363	0.284	319	0.007	12,045	0.277
4	131,156	3.011	17,193	0.395	113,963	2.616
5	21,463	0.493	5,994	0.138	15,469	0.355
6	193,240	4.436	73,178	1.680	120,062	2.756

EXISTING HYDROLOGY MAP
OF
26200 ENTERPRISE WAY
FOR
BLACK CREEK GROUP

LAKE FOREST, CALIFORNIA

KIER+WRIGHT
163 Technology Drive
Irvine, CA 92620
Phone: (949) 508-0202
www.kierwright.com

DATE	APRIL, 2021
SCALE	1" = 30'
DESIGNER	EK
DRAWN BY	MRF
JOB NO.	A21532
SHEET	C4.0
OF 6	SHEETS

REVISION | NO. | BY

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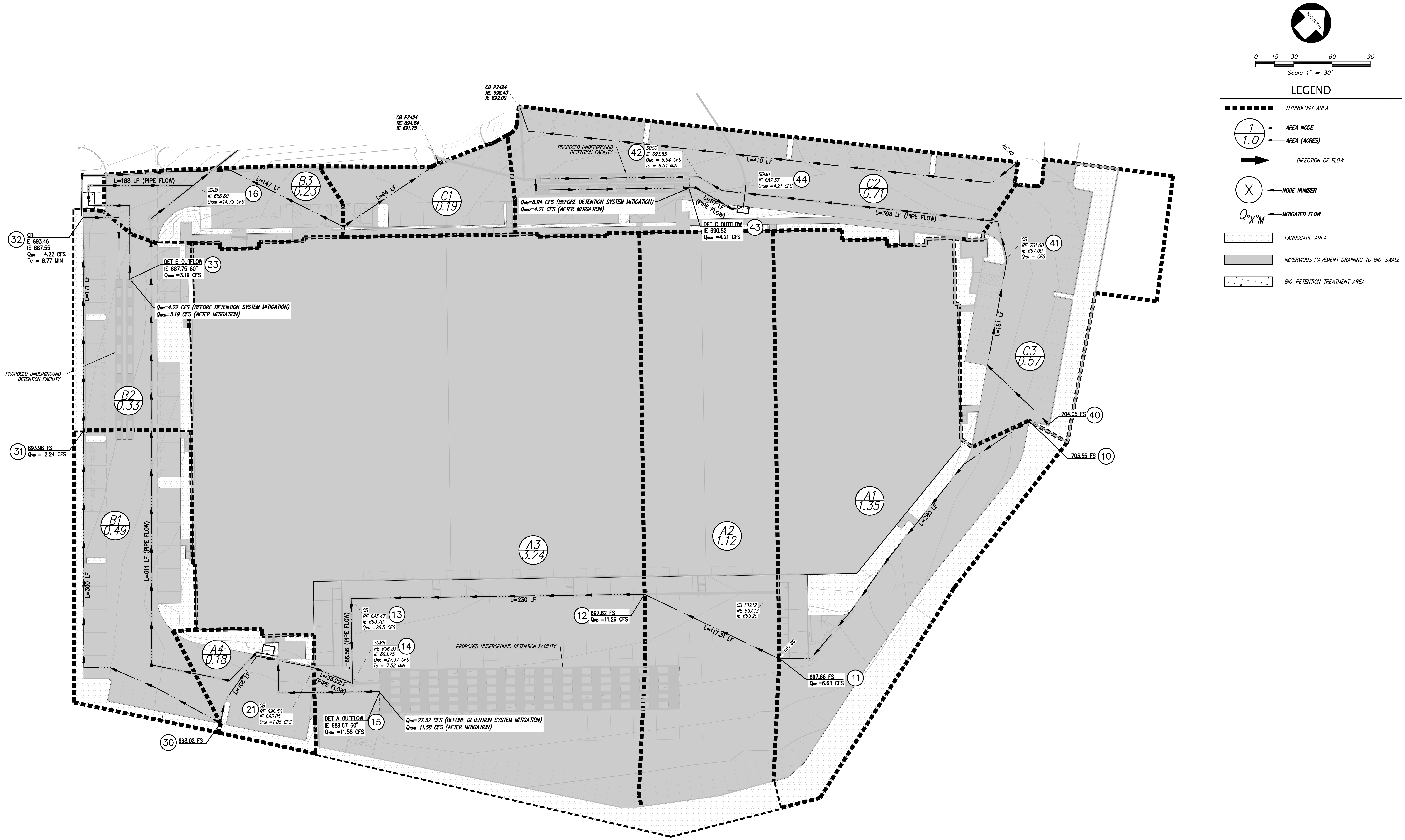

DMA No.	Area (SF)	Area (AC)	Landscape (SF)	Landscape (AC)	Imperv. (SF)	Imper. (AC)
A1	58999	1.354	10,723	0.246	48,276	1.108
A2	48903	1.123	2,330	0.053	46,573	1.069
A3	141302	3.244	2,504	0.057	138,798	3.186
A4	7784	0.179	2,178	0.050	5,606	0.129
B1	21200	0.487	4,482	0.103	16,718	0.384
B2	14416	0.331	2,761	0.063	11,655	0.268
B3	10207	0.234	977	0.022	9,230	0.212
C1	8292	0.190	419	0.010	7,873	0.181
C2	30796	0.707	2,789	0.064	28,007	0.643
C3	24708	0.567	6,034	0.139	18,674	0.429

PROPOSED HYDROLOGY MAP
OF
26200 ENTERPRISE WAY
FOR
BLACK CREEK GROUP

LAKE FOREST, CALIFORNIA

KIER+WRIGHT
163 Technology Drive
Irvine, CA 92620
Phone: (949) 508-0202
www.kierwright.com

DATE	APRIL, 2023
SCALE	1" = 30'
DESIGNER	EK
DRAWN BY	MRF
JOB NO.	A21532
SHEET	C4.0
OF	6 SHEETS

<u>Attachment 2</u>

CIVILD & HydroCAD Analysis

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                    Orange County Rational Hydrology Program

                (Hydrology Manual Date(s) October 1986 & November 1996)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2018 Version 9.0
        Rational Hydrology Study, Date: 04/19/23  File Name:
A21532EXQ10.roc
------------------------------------------------------------------------
A21532 EXISTING CONDITION
Q100


------------------------------------------------------------------------


Program License Serial Number 6509

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------

Rational hydrology study storm event year is   100.0

Decimal fraction of study above 2000 ft., 600M  =     0.0000
English Units Used for input data


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      100.000 to Point/Station      101.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   299.360(Ft.)
Top (of initial area) elevation =   704.140(Ft.)
Bottom (of initial area) elevation =   695.940(Ft.)
Difference in elevation =     8.200(Ft.)
Slope =    0.02739  s(%)=       2.74
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
```

```
Initial area time of concentration =    6.107 min.
Rainfall intensity =      5.517(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.897
Subarea runoff =      2.177(CFS)
Total initial stream area =       0.440(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      101.000 to Point/Station      102.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =   695.940(Ft.)
End of street segment elevation =   694.040(Ft.)
Length of street segment  =   207.470(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  35.000(Ft.)
Distance from crown to crossfall grade break  =  10.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   7.000(Ft.)
Slope from curb to property line (v/hz) =   0.025
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      2.634(CFS)
Depth of flow =   0.333(Ft.), Average velocity =   2.202(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  10.341(Ft.)
Flow velocity =   2.20(Ft/s)
Travel time =    1.57 min.     TC =    7.68  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Rainfall intensity =      4.839(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.896
Subarea runoff =      0.859(CFS) for    0.260(Ac.)
Total runoff =      3.036(CFS)  Total area =       0.70(Ac.)
Area averaged Fm value =    0.020(In/Hr)
```

```
Street flow at end of street =      3.036(CFS)
Half street flow at end of street =      3.036(CFS)
Depth of flow =   0.346(Ft.), Average velocity =   2.276(Ft/s)
Flow width (from curb towards crown)=  10.989(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      102.000 to Point/Station      103.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =   694.040(Ft.)
End of street segment elevation =   693.460(Ft.)
Length of street segment  =   193.140(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  32.000(Ft.)
Distance from crown to crossfall grade break  =  10.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   7.000(Ft.)
Slope from curb to property line (v/hz) =   0.025
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      3.402(CFS)
Depth of flow =   0.429(Ft.), Average velocity =   1.523(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  14.600(Ft.)
Flow velocity =   1.52(Ft/s)
Travel time =    2.11 min.     TC =    9.79  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Rainfall intensity =      4.210(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.896
Subarea runoff =      0.659(CFS) for    0.280(Ac.)
Total runoff =      3.695(CFS)  Total area =        0.98(Ac.)
Area averaged Fm value =    0.020(In/Hr)
Street flow at end of street =      3.695(CFS)
```

```
Half street flow at end of street =      3.695(CFS)
Depth of flow =   0.438(Ft.), Average velocity =   1.554(Ft/s)
Flow width (from curb towards crown)=  15.087(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      104.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   687.550(Ft.)
Downstream point/station elevation =   687.500(Ft.)
Pipe length  =    58.78(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.695(CFS)
Given pipe size =     18.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     0.125(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      0.073(Ft.)
 Minor friction loss =      0.102(Ft.)  K-factor =   1.50
Pipe flow velocity =      2.09(Ft/s)
Travel time through pipe =    0.47 min.
Time of concentration (TC) =    10.26 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      104.000 to Point/Station      104.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Time of concentration =    10.26 min.
Rainfall intensity =      4.099(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.896
Subarea runoff =     10.914(CFS) for    3.000(Ac.)
Total runoff =     14.609(CFS)  Total area =        3.98(Ac.)
Area averaged Fm value =    0.020(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      104.000 to Point/Station      105.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
```

```
____________________________________________________________________
Upstream point/station elevation =   687.500(Ft.)
Downstream point/station elevation =   686.440(Ft.)
Pipe length  =    90.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    14.609(CFS)
Given pipe size =     18.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     2.272(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      1.740(Ft.)
 Minor friction loss =      1.592(Ft.)  K-factor =   1.50
Pipe flow velocity =      8.27(Ft/s)
Travel time through pipe =    0.18 min.
Time of concentration (TC) =    10.44 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      200.000 to Point/Station      201.000
**** INITIAL AREA EVALUATION ****
____________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   268.000(Ft.)
Top (of initial area) elevation =   708.240(Ft.)
Bottom (of initial area) elevation =   696.910(Ft.)
Difference in elevation =    11.330(Ft.)
Slope =    0.04228  s(%)=       4.23
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    5.357 min.
Rainfall intensity =      5.948(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.897
Subarea runoff =      2.614(CFS)
Total initial stream area =        0.490(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      201.000 to Point/Station      202.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
____________________________________________________________________
Upstream point/station elevation =   690.460(Ft.)
Downstream point/station elevation =   689.930(Ft.)
```

```
Pipe length  =    42.62(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.614(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =     2.614(CFS)
Normal flow depth in pipe =    5.78(In.)
Flow top width inside pipe =   16.81(In.)
Critical Depth =    7.35(In.)
Pipe flow velocity =      5.34(Ft/s)
Travel time through pipe =    0.13 min.
Time of concentration (TC) =     5.49 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      202.000 to Point/Station      202.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Time of concentration =     5.49 min.
Rainfall intensity =      5.865(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.897
Subarea runoff =     23.318(CFS) for    4.440(Ac.)
Total runoff =     25.933(CFS)  Total area =       4.93(Ac.)
Area averaged Fm value =    0.020(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      202.000 to Point/Station      203.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   689.930(Ft.)
Downstream point/station elevation =   687.570(Ft.)
Pipe length  =   201.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    25.933(CFS)
Given pipe size =     24.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     1.867(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      2.640(Ft.)
 Minor friction loss =      1.587(Ft.)  K-factor =   1.50
Pipe flow velocity =      8.25(Ft/s)
```

```
Travel time through pipe =    0.41 min.
Time of concentration (TC) =     5.90 min.
End of computations, total study area =            8.91 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged SCS curve number (AMC 2) =  75.0
```

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                    Orange County Rational Hydrology Program

                (Hydrology Manual Date(s) October 1986 & November 1996)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2018 Version 9.0
        Rational Hydrology Study, Date: 04/14/23  File Name: A21532PROP.roc
------------------------------------------------------------------------
A21532 PROPOSED CONDITION
Q100
PRE-MITIGATION


------------------------------------------------------------------------


Program License Serial Number 6509

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------

Rational hydrology study storm event year is   100.0

Decimal fraction of study above 2000 ft., 600M  =     0.0000
English Units Used for input data


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       10.000 to Point/Station      11.000
**** INITIAL AREA EVALUATION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   280.000(Ft.)
Top (of initial area) elevation =   703.550(Ft.)
Bottom (of initial area) elevation =   697.660(Ft.)
Difference in elevation =     5.890(Ft.)
Slope =    0.02104  s(%)=       2.10
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
```

```
Initial area time of concentration =    6.268 min.
Rainfall intensity =      5.436(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.897
Subarea runoff =      6.629(CFS)
Total initial stream area =        1.360(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       11.000 to Point/Station       12.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =   697.660(Ft.)
End of street segment elevation =   696.620(Ft.)
Length of street segment  =   117.310(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  59.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(Ft.)
Slope from gutter to grade break (v/hz) =  -0.020
Slope from grade break to crown (v/hz)  =  -0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.025
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      9.008(CFS)
Depth of flow =   0.271(Ft.), Average velocity =   2.459(Ft/s)
Note:  depth of flow exceeds top of street crown.
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  59.000(Ft.)
Flow velocity =   2.46(Ft/s)
Travel time =    0.80 min.     TC =    7.06  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Rainfall intensity =      5.076(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.896
Subarea runoff =      4.656(CFS) for    1.120(Ac.)
Total runoff =     11.285(CFS)  Total area =        2.48(Ac.)
```

```
Area averaged Fm value =    0.020(In/Hr)
Street flow at end of street =     11.285(CFS)
Half street flow at end of street =      5.643(CFS)
Depth of flow =   0.295(Ft.), Average velocity =   2.601(Ft/s)
Note:  depth of flow exceeds top of street crown.
Flow width (from curb towards crown)=  59.000(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      12.000 to Point/Station      13.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Covered channel
Upstream point elevation =   696.620(Ft.)
Downstream point elevation =   695.470(Ft.)
Channel length thru subarea  =   230.000(Ft.)
Channel base width      =    0.670(Ft.)
Slope or 'Z' of left channel bank =   0.000
Slope or 'Z' of right channel bank =   0.000
Estimated mean flow rate at midpoint of channel =     18.608(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    0.670(Ft.)
Flow(q) thru subarea =     18.608(CFS)
Pressure flow condition in covered channel:
Wetted perimeter =    2.68(Ft.)  Flow area =    0.45(Sq.Ft)
Hydraulic grade line required at box inlet =    705.390(Ft.)
Friction loss =    706.540(Ft.)
Minor Friction loss =      0.000(Ft.)   K-Factor =  0.000
Flow Velocity =   41.45(Ft/s)
Travel time  =    0.09 min.
Time of concentration =    6.84 min.
 Adding area flow to channel
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Rainfall intensity =      5.170(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.897
Subarea runoff =     15.229(CFS) for    3.240(Ac.)
Total runoff =     26.514(CFS)  Total area =        5.72(Ac.)
Area averaged Fm value =    0.020(In/Hr)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       13.000 to Point/Station      14.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   693.700(Ft.)
Downstream point/station elevation =   693.500(Ft.)
Pipe length  =    66.56(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    26.514(CFS)
Given pipe size =     18.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     9.282(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      4.239(Ft.)
 Minor friction loss =      5.243(Ft.)  K-factor =   1.50
Pipe flow velocity =     15.00(Ft/s)
Travel time through pipe =    0.07 min.
Time of concentration (TC) =     6.91 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       14.000 to Point/Station      14.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      5.720(Ac.)
Runoff from this stream =     26.514(CFS)
Time of concentration =    6.91 min.
Rainfall intensity =     5.139(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       20.000 to Point/Station      21.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   106.000(Ft.)
Top (of initial area) elevation =   698.020(Ft.)
Bottom (of initial area) elevation =   696.500(Ft.)
```

```
Difference in elevation =     1.520(Ft.)
Slope =    0.01434  s(%)=       1.43
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    4.589 min.
Rainfall intensity =      6.499(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.897
Subarea runoff =      1.050(CFS)
Total initial stream area =        0.180(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       21.000 to Point/Station      14.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   693.850(Ft.)
Downstream point/station elevation =   693.750(Ft.)
Pipe length  =    33.22(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.050(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     1.050(CFS)
Normal flow depth in pipe =    6.26(In.)
Flow top width inside pipe =   11.99(In.)
Critical Depth =    5.17(In.)
Pipe flow velocity =      2.53(Ft/s)
Travel time through pipe =    0.22 min.
Time of concentration (TC) =     4.81 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       21.000 to Point/Station      14.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.180(Ac.)
Runoff from this stream =      1.050(CFS)
Time of concentration =    4.81 min.
Rainfall intensity =     6.328(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream  Area  Flow rate      TC     Fm       Rainfall Intensity
 No.    (Ac.)   (CFS)       (min) (In/Hr)     (In/Hr)


1      5.72    26.514      6.91    0.020      5.139
2      0.18     1.050      4.81    0.020      6.328
Qmax(1) =
```

```
           1.000 *    1.000 *    26.514) +
           0.811 *    1.000 *     1.050) + =      27.366
Qmax(2) =
           1.232 *    0.695 *    26.514) +
           1.000 *    1.000 *     1.050) + =      23.769

Total of 2 streams to confluence:
Flow rates before confluence point:
      26.514       1.050
Maximum flow rates at confluence using above data:
       27.366       23.769
Area of streams before confluence:
        5.720        0.180
Effective area values after confluence:
        5.900        4.157
Results of confluence:
Total flow rate =     27.366(CFS)
Time of concentration =     6.914 min.
Effective stream area after confluence =      5.900(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.020(In/Hr)
Study area total (this main stream) =       5.90(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       14.000 to Point/Station      15.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   693.750(Ft.)
Downstream point/station elevation =   686.700(Ft.)
Pipe length  =   560.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    27.366(CFS)
Given pipe size =     18.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
    36.530(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =     37.994(Ft.)
 Minor friction loss =      5.586(Ft.)  K-factor =   1.50
Pipe flow velocity =     15.49(Ft/s)
Travel time through pipe =    0.60 min.
Time of concentration (TC) =     7.52 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       15.000 to Point/Station      15.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
```

```
Stream flow area =      5.900(Ac.)
Runoff from this stream =     27.366(CFS)
Time of concentration =    7.52 min.
Rainfall intensity =     4.898(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       30.000 to Point/Station       31.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   299.600(Ft.)
Top (of initial area) elevation =   698.020(Ft.)
Bottom (of initial area) elevation =   693.960(Ft.)
Difference in elevation =     4.060(Ft.)
Slope =    0.01355  s(%)=       1.36
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.032 min.
Rainfall intensity =      5.089(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.896
Subarea runoff =      2.235(CFS)
Total initial stream area =        0.490(Ac.)


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Process from Point/Station       31.000 to Point/Station       32.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =   693.960(Ft.)
End of street segment elevation =   693.460(Ft.)
Length of street segment  =   170.760(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  56.500(Ft.)
Distance from crown to crossfall grade break  =  18.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.035
Slope from grade break to crown (v/hz)  =   0.035
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   7.500(Ft.)
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Slope from curb to property line (v/hz) =   0.050
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      2.794(CFS)
Depth of flow =   0.451(Ft.), Average velocity =   1.639(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   9.619(Ft.)
Flow velocity =   1.64(Ft/s)
Travel time =    1.74 min.     TC =    8.77  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Rainfall intensity =      4.484(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.896
Subarea runoff =      1.059(CFS) for    0.330(Ac.)
Total runoff =      3.295(CFS)  Total area =        0.82(Ac.)
Area averaged Fm value =    0.020(In/Hr)
Street flow at end of street =      3.295(CFS)
Half street flow at end of street =      3.295(CFS)
Depth of flow =   0.474(Ft.), Average velocity =   1.706(Ft/s)
Flow width (from curb towards crown)=  10.270(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      32.000 to Point/Station      32.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Time of concentration =     8.77 min.
Rainfall intensity =      4.484(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
```

```
rational method)(Q=KCIA) is C = 0.896
Subarea runoff =      0.924(CFS) for    0.230(Ac.)
Total runoff =      4.219(CFS)  Total area =       1.05(Ac.)
Area averaged Fm value =    0.020(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       32.000 to Point/Station      15.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   687.550(Ft.)
Downstream point/station elevation =   686.600(Ft.)
Pipe length  =   273.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.219(CFS)
Given pipe size =     12.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     3.549(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      3.827(Ft.)
 Minor friction loss =      0.672(Ft.)  K-factor =   1.50
Pipe flow velocity =      5.37(Ft/s)
Travel time through pipe =    0.85 min.
Time of concentration (TC) =     9.62 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       32.000 to Point/Station      15.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.050(Ac.)
Runoff from this stream =      4.219(CFS)
Time of concentration =    9.62 min.
Rainfall intensity =     4.254(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream  Area  Flow rate      TC     Fm       Rainfall Intensity
 No.    (Ac.)   (CFS)       (min) (In/Hr)     (In/Hr)


1      5.90    27.366      7.52    0.020      4.898
2      1.05     4.219      9.62    0.020      4.254
Qmax(1) =
           1.000 *    1.000 *    27.366) +
           1.152 *    0.782 *     4.219) + =      31.166
Qmax(2) =
```

```
           0.868 *    1.000 *    27.366) +
           1.000 *    1.000 *     4.219) + =      27.968

Total of 2 streams to confluence:
Flow rates before confluence point:
      27.366      4.219
Maximum flow rates at confluence using above data:
       31.166      27.968
Area of streams before confluence:
        5.900       1.050
Effective area values after confluence:
        6.721       6.950
Results of confluence:
Total flow rate =     31.166(CFS)
Time of concentration =     7.517 min.
Effective stream area after confluence =      6.721(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.020(In/Hr)
Study area total (this main stream) =       6.95(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      15.000 to Point/Station      16.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   686.600(Ft.)
Downstream point/station elevation =   686.440(Ft.)
Pipe length  =    45.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    31.166(CFS)
Given pipe size =     24.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     2.986(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      0.854(Ft.)
 Minor friction loss =      2.292(Ft.)  K-factor =   1.50
Pipe flow velocity =      9.92(Ft/s)
Travel time through pipe =    0.08 min.
Time of concentration (TC) =     7.59 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      40.000 to Point/Station      41.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
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Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   151.100(Ft.)
Top (of initial area) elevation =   704.050(Ft.)
Bottom (of initial area) elevation =   701.000(Ft.)
Difference in elevation =     3.050(Ft.)
Slope =    0.02019  s(%)=       2.02
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    4.938 min.
Rainfall intensity =      6.232(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.897
Subarea runoff =      3.131(CFS)
Total initial stream area =       0.560(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      41.000 to Point/Station      42.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   697.000(Ft.)
Downstream point/station elevation =   687.570(Ft.)
Pipe length  =   591.25(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.131(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =     3.131(CFS)
Normal flow depth in pipe =    5.95(In.)
Flow top width inside pipe =   16.94(In.)
Critical Depth =    8.10(In.)
Pipe flow velocity =      6.14(Ft/s)
Travel time through pipe =    1.60 min.
Time of concentration (TC) =     6.54 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      42.000 to Point/Station      42.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
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Time of concentration =     6.54 min.
Rainfall intensity =      5.304(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.897
Subarea runoff =      3.812(CFS) for    0.900(Ac.)
Total runoff =      6.943(CFS)  Total area =        1.46(Ac.)
Area averaged Fm value =    0.020(In/Hr)
End of computations, total study area =           8.41 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged SCS curve number (AMC 2) =  75.0
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                    Orange County Rational Hydrology Program

                (Hydrology Manual Date(s) October 1986 & November 1996)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2018 Version 9.0
        Rational Hydrology Study, Date: 04/18/23  File Name: A21532POST.roc
------------------------------------------------------------------------
A21532 PROPOSED CONDITION
Q100
POST MITIGATION/DETENTION


------------------------------------------------------------------------


Program License Serial Number 6509

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------

Rational hydrology study storm event year is   100.0

Decimal fraction of study above 2000 ft., 600M  =     0.0000
English Units Used for input data


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Process from Point/Station       15.000 to Point/Station       15.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Rainfall intensity =      4.897(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =   7.52 min.  Rain intensity =       4.90(In/Hr)
Total area =         5.91(Ac.)  Total runoff =     11.58(CFS)


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Process from Point/Station       15.000 to Point/Station       16.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   689.670(Ft.)
Downstream point/station elevation =   686.700(Ft.)
Pipe length  =   610.55(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    11.580(CFS)
Given pipe size =     24.00(In.)
Calculated individual pipe flow  =    11.580(CFS)
Normal flow depth in pipe =   15.28(In.)
Flow top width inside pipe =   23.09(In.)
Critical Depth =   14.64(In.)
Pipe flow velocity =      5.49(Ft/s)
Travel time through pipe =    1.85 min.
Time of concentration (TC) =     9.37 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       15.000 to Point/Station       16.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      5.910(Ac.)
Runoff from this stream =     11.580(CFS)
Time of concentration =    9.37 min.
Rainfall intensity =     4.316(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


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Process from Point/Station       33.000 to Point/Station       33.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Rainfall intensity =      4.484(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =   8.77 min.  Rain intensity =       4.48(In/Hr)
Total area =         1.05(Ac.)  Total runoff =      3.19(CFS)
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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       33.000 to Point/Station       16.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   687.750(Ft.)
Downstream point/station elevation =   686.600(Ft.)
Pipe length  =   188.30(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.190(CFS)
Given pipe size =     12.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     0.743(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      1.509(Ft.)
 Minor friction loss =      0.384(Ft.)  K-factor =   1.50
Pipe flow velocity =      4.06(Ft/s)
Travel time through pipe =    0.77 min.
Time of concentration (TC) =     9.54 min.


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Process from Point/Station       33.000 to Point/Station       16.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.050(Ac.)
Runoff from this stream =      3.190(CFS)
Time of concentration =    9.54 min.
Rainfall intensity =     4.272(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream  Area  Flow rate      TC     Fm       Rainfall Intensity
 No.    (Ac.)   (CFS)       (min) (In/Hr)     (In/Hr)


1      5.91    11.580      9.37    0.020      4.316
2      1.05     3.190      9.54    0.020      4.272
Qmax(1) =
           1.000 *    1.000 *    11.580) +
           1.010 *    0.982 *     3.190) + =      14.746
Qmax(2) =
           0.990 *    1.000 *    11.580) +
           1.000 *    1.000 *     3.190) + =      14.652

Total of 2 streams to confluence:
Flow rates before confluence point:
      11.580       3.190
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Maximum flow rates at confluence using above data:
       14.746       14.652
Area of streams before confluence:
        5.910        1.050
Effective area values after confluence:
        6.941        6.960
Results of confluence:
Total flow rate =     14.746(CFS)
Time of concentration =     9.374 min.
Effective stream area after confluence =      6.941(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.020(In/Hr)
Study area total (this main stream) =      6.96(Ac.)


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Process from Point/Station       16.000 to Point/Station      17.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   686.600(Ft.)
Downstream point/station elevation =   686.440(Ft.)
Pipe length  =    44.60(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    14.746(CFS)
Given pipe size =     24.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     0.543(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      0.189(Ft.)
 Minor friction loss =      0.513(Ft.)  K-factor =   1.50
Pipe flow velocity =      4.69(Ft/s)
Travel time through pipe =    0.16 min.
Time of concentration (TC) =     9.53 min.


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Process from Point/Station       42.000 to Point/Station      43.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Rainfall intensity =      5.305(In/Hr) for a   100.0 year storm
User specified values are as follows:
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TC =   6.54 min.  Rain intensity =       5.30(In/Hr)
Total area =         1.46(Ac.)  Total runoff =      4.21(CFS)


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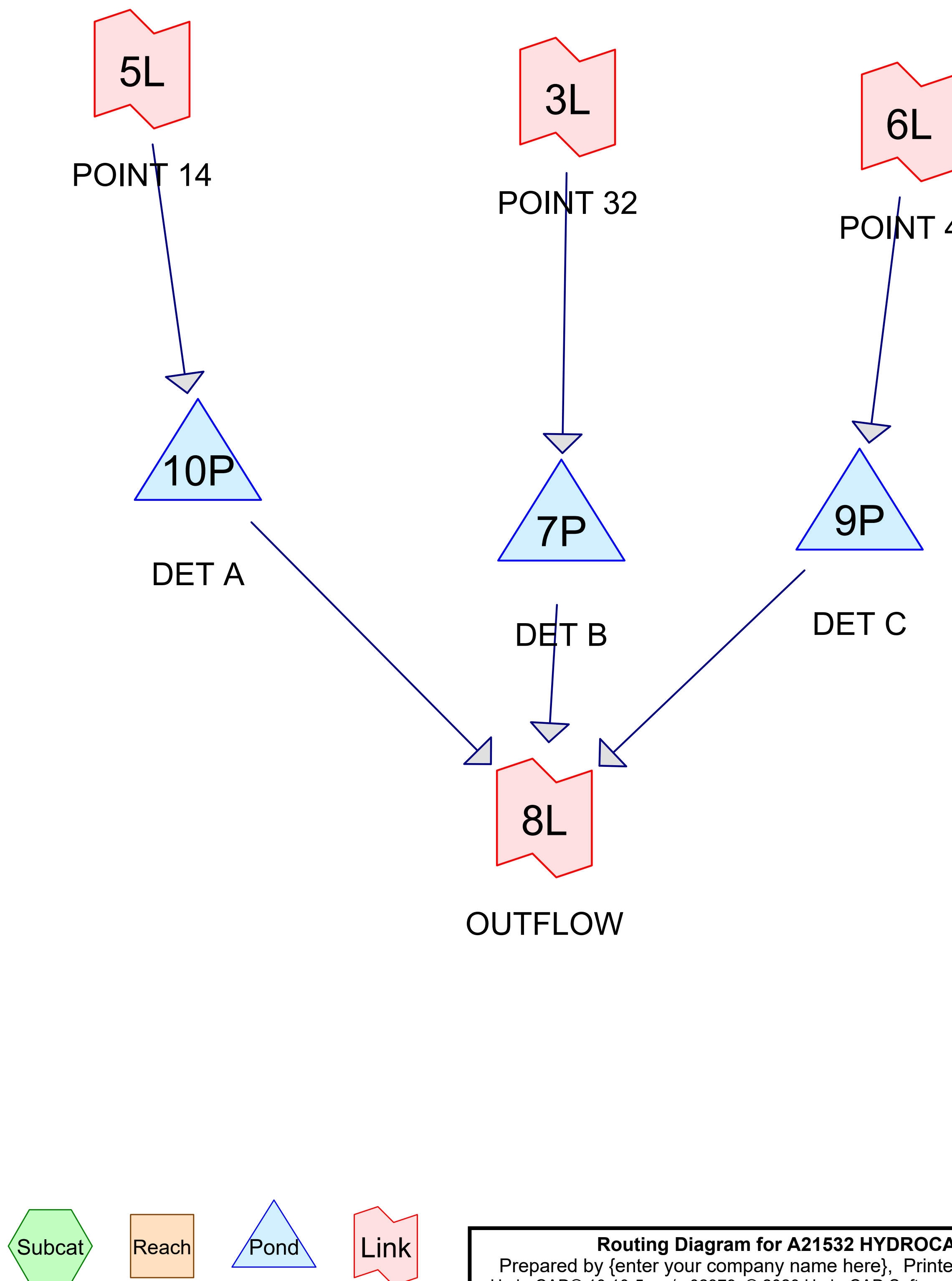
Process from Point/Station       43.000 to Point/Station      44.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   690.820(Ft.)
Downstream point/station elevation =   687.570(Ft.)
Pipe length  =    66.66(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.210(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =     4.210(CFS)
Normal flow depth in pipe =    5.19(In.)
Flow top width inside pipe =   16.31(In.)
Critical Depth =    9.44(In.)
Pipe flow velocity =      9.97(Ft/s)
Travel time through pipe =    0.11 min.
Time of concentration (TC) =     6.65 min.
End of computations, total study area =           8.42 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged SCS curve number (AMC 2) =  75.0
```



Routing Diagram for A21532 HYDROCAD
Prepared by {enter your company name here}, Printed 4/19/2023

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Pond 7P: DET B	Peak Elev=688.96' Storage=0.017 af Inflow=3.75 cfs 0.392 af Outflow=3.19 cfs 0.391 af
Pond 9P: DET C	Peak Elev=691.81' Storage=0.014 af Inflow=4.49 cfs 0.545 af Outflow=4.21 cfs 0.544 af
Pond 10P: DET A	Peak Elev=692.27' Storage=0.263 af Inflow=23.19 cfs 2.247 af Outflow=11.58 cfs 2.235 af
Link 3L: POINT 32	CFS Imported from DETB.csv Inflow=3.75 cfs 0.392 af Primary=3.75 cfs 0.392 af
Link 5L: POINT 14	CFS Imported from DETA.csv Inflow=23.19 cfs 2.247 af Primary=23.19 cfs 2.247 af
Link 6L: POINT 42	CFS Imported from DETC.csv Inflow=4.49 cfs 0.545 af Primary=4.49 cfs 0.545 af
Link 8L: OUTFLOW	Inflow=18.13 cfs 3.170 af Primary=18.13 cfs 3.170 af

Summary for Pond 10P: DET A

[82] Warning: Early inflow requires earlier time span

Inflow	=	23.19 cfs @	16.17 hrs,	Volume=	2.247 af
Outflow	=	11.58 cfs @	16.29 hrs,	Volume=	2.235 af, Atten= 50%, Lag= 7.6 min
Primary	=	11.58 cfs @	16.29 hrs,	Volume=	2.235 af

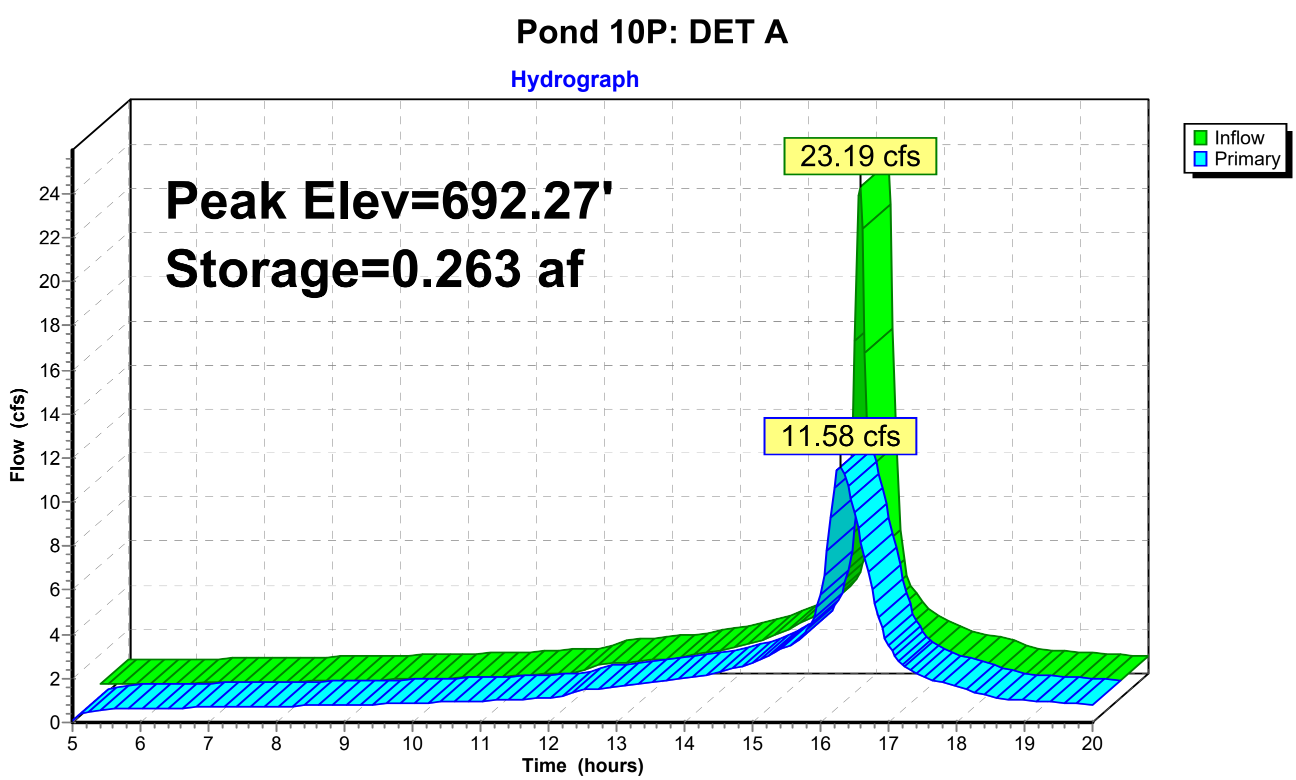
Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 692.27' @ 16.29 hrs Surf.Area= 0.135 ac Storage= 0.263 af

Plug-Flow detention time= 12.0 min calculated for 2.226 af (99% of inflow)
Center-of-Mass det. time= 9.8 min (870.2 - 860.4)

Volume	Invert	Avail.Storage	Storage Description
#1	689.67'	0.530 af	**60.0" Round Pipe Storage** x 5 L= 235.0' S= 0.0010 '/'

Device	Routing	Invert	Outlet Devices
#1	Primary	689.67'	**18.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=11.55 cfs @ 16.29 hrs HW=692.26' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 11.55 cfs @ 6.54 fps)



Summary for Pond 7P: DET B

[82] Warning: Early inflow requires earlier time span

Inflow	=	3.75 cfs @	16.18 hrs, Volume=	0.392 af
Outflow	=	3.19 cfs @	16.25 hrs, Volume=	0.391 af, Atten= 15%, Lag= 4.2 min
Primary	=	3.19 cfs @	16.25 hrs, Volume=	0.391 af

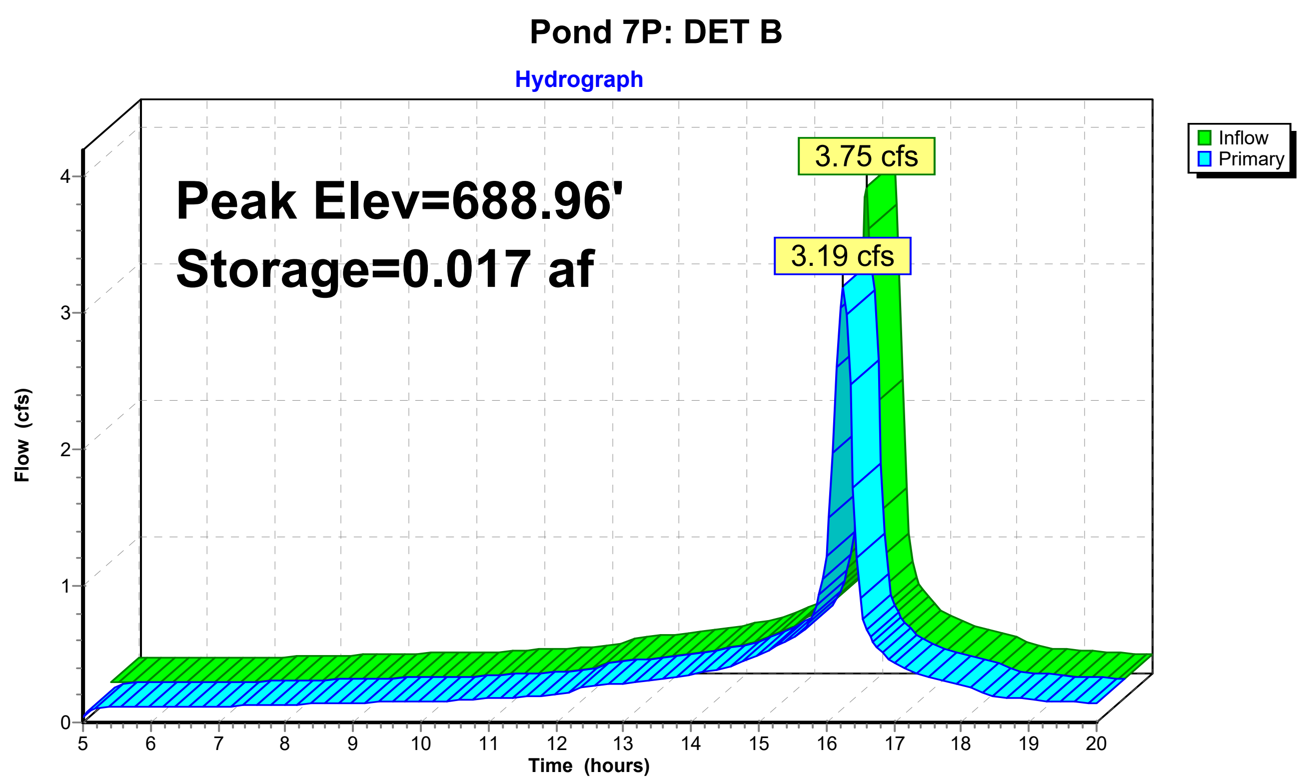
Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 688.96' @ 16.25 hrs Surf.Area= 0.021 ac Storage= 0.017 af

Plug-Flow detention time= 3.7 min calculated for 0.391 af (100% of inflow)
Center-of-Mass det. time= 2.9 min (863.7 - 860.8)

Volume	Invert	Avail.Storage	Storage Description
#1	687.75'	0.072 af	**48.0" Round Pipe Storage** x 2 L= 125.0' S= 0.0010 '/'

Device	Routing	Invert	Outlet Devices
#1	Primary	687.75'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.18 cfs @ 16.25 hrs HW=688.96' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 3.18 cfs @ 4.05 fps)



Summary for Pond 9P: DET C

[82] Warning: Early inflow requires earlier time span

Inflow	=	4.49 cfs @	16.15 hrs, Volume=	0.545 af
Outflow	=	4.21 cfs @	16.18 hrs, Volume=	0.544 af, Atten= 6%, Lag= 2.0 min
Primary	=	4.21 cfs @	16.18 hrs, Volume=	0.544 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 691.81' @ 16.18 hrs Surf.Area= 0.021 ac Storage= 0.014 af

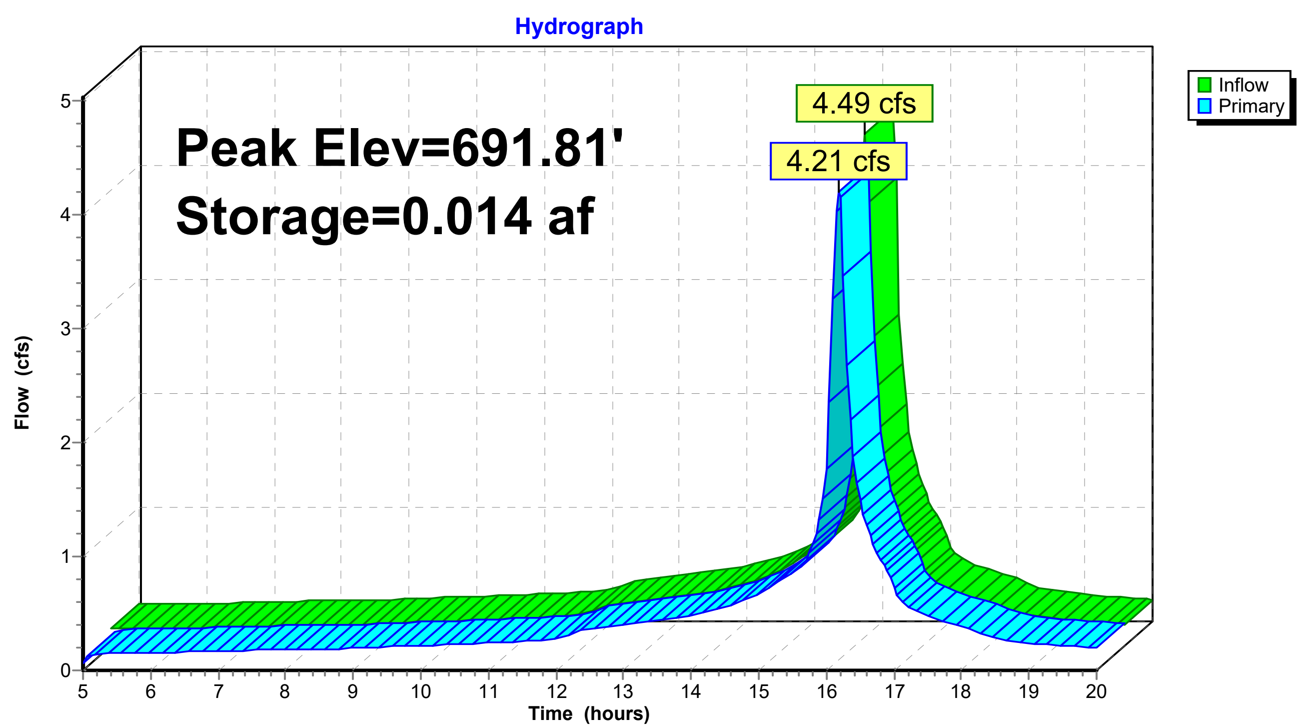
Plug-Flow detention time= 3.1 min calculated for 0.544 af (100% of inflow)
Center-of-Mass det. time= 2.3 min (864.8 - 862.5)

Volume	Invert	Avail.Storage	Storage Description
#1	690.82'	0.108 af	**60.0" Round Pipe Storage** x 2 L= 120.0' S= 0.0010 '/'

Device	Routing	Invert	Outlet Devices
#1	Primary	690.82'	**18.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=4.11 cfs @ 16.18 hrs HW=691.80' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 4.11 cfs @ 3.37 fps)

Pond 9P: DET C

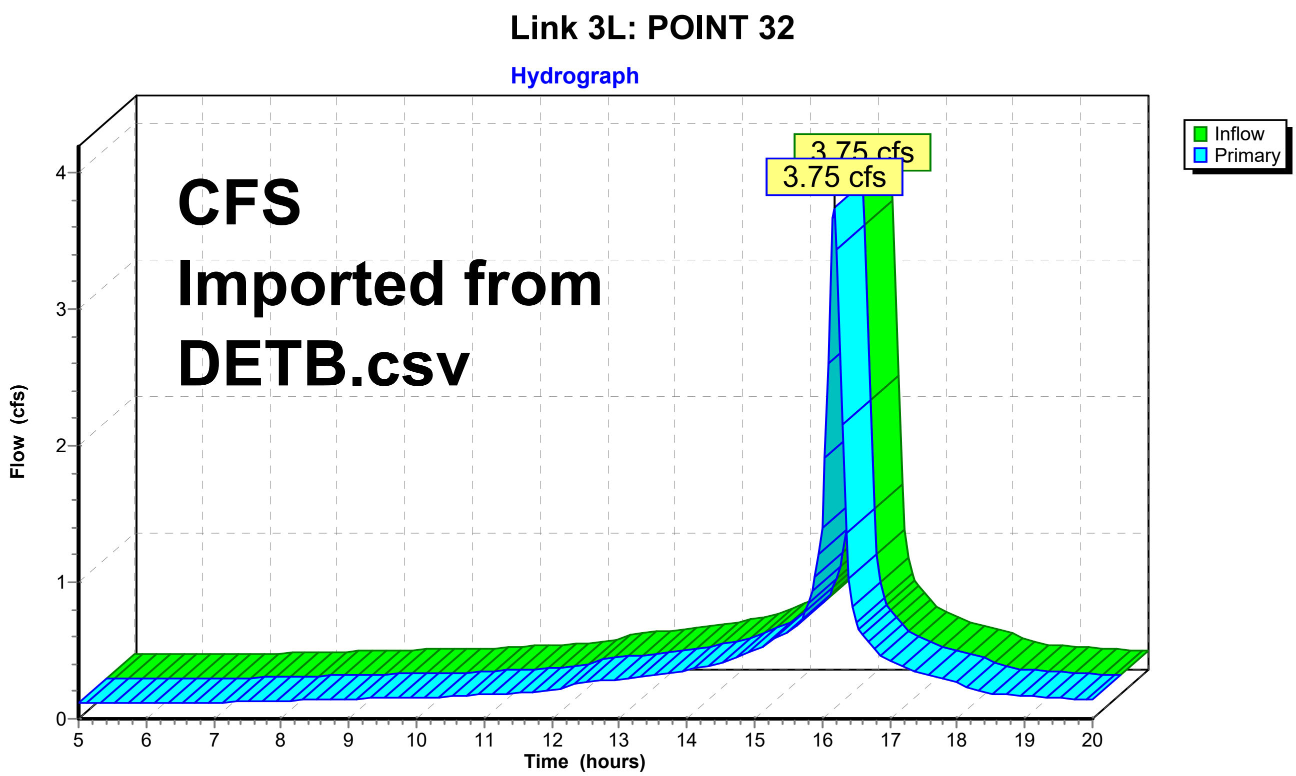


Summary for Link 3L: POINT 32

Inflow	=	3.75 cfs @	16.18 hrs,	Volume=	0.392 af
Primary	=	3.75 cfs @	16.18 hrs,	Volume=	0.392 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

CFS Imported from DETB.csv

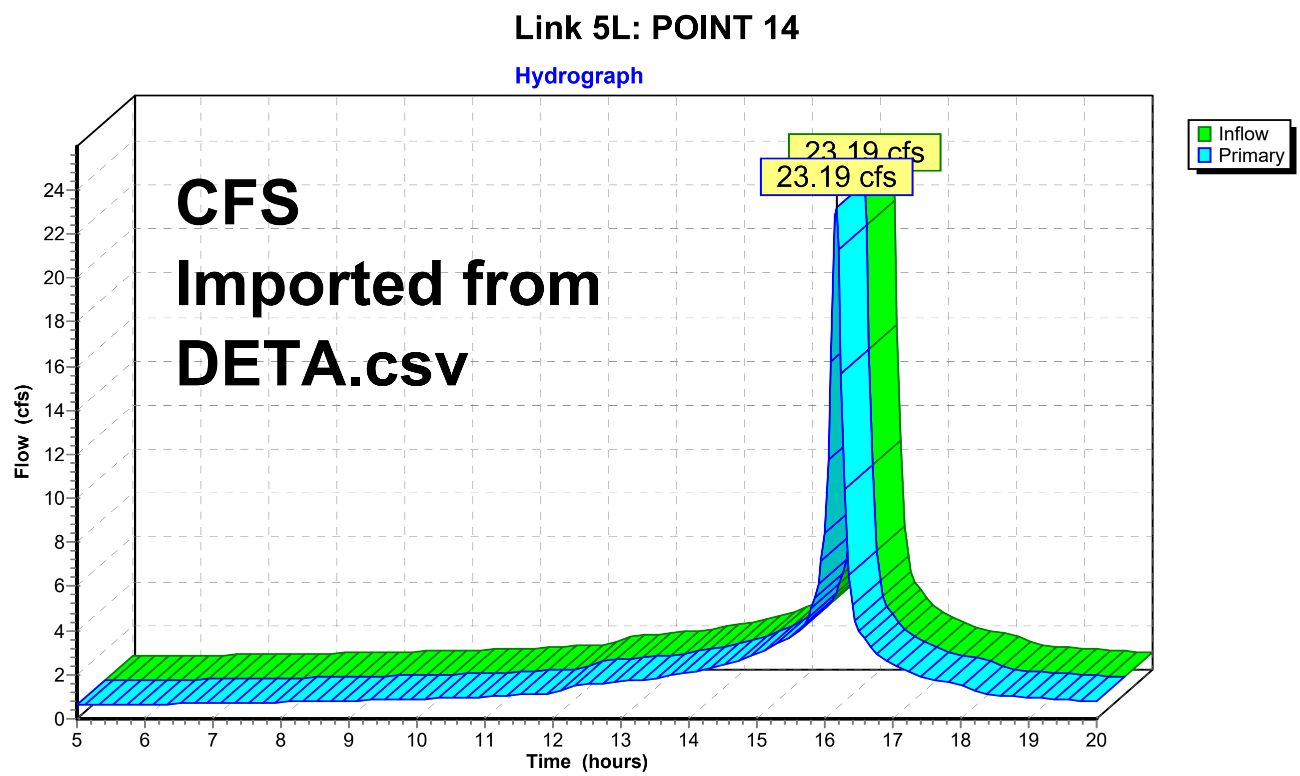


Summary for Link 5L: POINT 14

Inflow	=	23.19 cfs @	16.17 hrs, Volume=	2.247 af
Primary	=	23.19 cfs @	16.17 hrs, Volume=	2.247 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

CFS Imported from DETA.csv

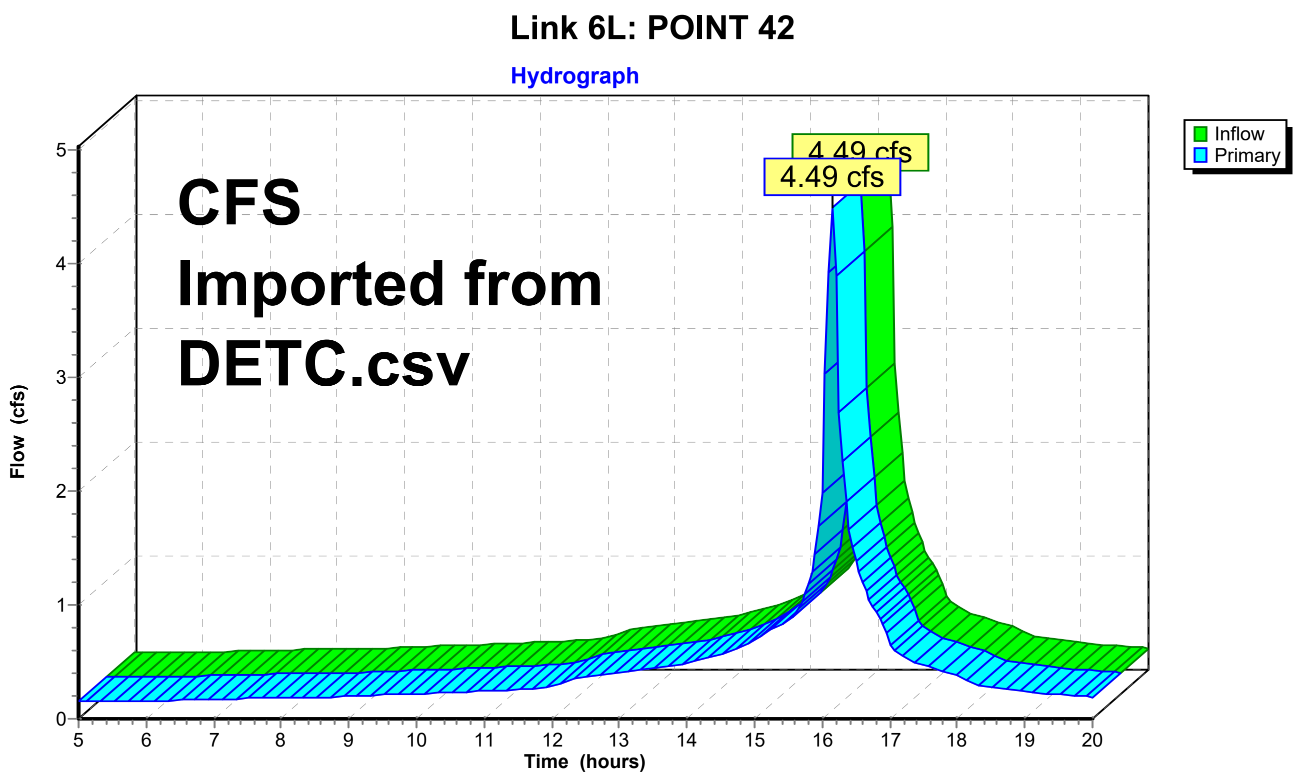


Summary for Link 6L: POINT 42

Inflow	=	4.49 cfs @	16.15 hrs, Volume=	0.545 af
Primary	=	4.49 cfs @	16.15 hrs, Volume=	0.545 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

CFS Imported from DETC.csv



Summary for Link 8L: OUTFLOW

Inflow	=	18.13 cfs @	16.23 hrs,	Volume=	3.170 af
Primary	=	18.13 cfs @	16.23 hrs,	Volume=	3.170 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Fixed water surface Elevation= 686.44'