Appendix I

Priority Development Stormwater Quality Management Plan (July 21, 2020)

PDP SWQMP

PRIORITY DEVELOPMENT PROJECT (PDP)
STORM WATER QUALITY MANAGEMENT PLAN (SWQMP)

Project Name Encompass Health Chula Vista Hospital Site

Assessor's Parcel Number(s) 644-040-01-00

Permit Application Number DR19-0028

Drawing Numbers ______________________

CIVIL ENGINEER NAME: Robbie Mahmood ; **PE #** 60421

REGISTERED PROFESSIONAL ENGINEER
RABIH F. MAHMOUD
60421
EXPIRES
6/30/22
CIVIL
STATE OF CALIFORNIA

Wet Signature and Stamp

PREPARED FOR: Applicant Name: Encompass Health

Address: 9001 Liberty Parkway

Birmingham, Alabama 35242

Telephone # (205) 970-5677

PREPARED BY: Company Name: APD Consultants, Inc.

Address: 22362 Gilberto, #245

Rancho Santa Margarita, CA 92688

Telephone # (949) 336-6336

DATE: July 21, 2020

Approved By: City of Chula Vista Date:
(print Name & Sign)

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Project Name/ Encompass Health Chula Vista Hospital Site

TABLE OF CONTENTS

The checklist on this page summarized the table and attachments to be included with this PDP SWQMP Submittal. Tables & attachments with boxes already checked **(√)** are required for all Projects

ACRONYMS

APN	Assessor's Parcel Number
BMP	Best Management Practice
HMP	Hydromodification Management Plan
HSG	Hydrologic Soil Group
MS4	Municipal Separate Storm Sewer System
N/A	Not Applicable
NRCS	Natural Resources Conservation Service
PDP	Priority Development Project
PE	Professional Engineer
SC	Source Control
SD	Site Design
SDRWQCB	San Diego Regional Water Quality Control Board
SIC	Standard Industrial Classification
SWQMP	Storm Water Quality Management Plan

Project Name/ Encompass Health Chula Vista Hospital Site

Certification Page

Project Name: Encompass Health Chula Vista Hospital Site

Permit Application Number: DR19-0028

I hereby declare that I am the Engineer in Responsible Charge of design of storm water best management practices (BMPs) for this project, and that I have exercised responsible charge over the design of the BMPs as defined in Section 6703 of the Business and Professions Code, and that the design is consistent with the PDP requirements of the City of Chula Vista BMP Design Manual, which is based on the requirements of the San Diego Regional Water Quality Control Board Order No. R9-2013-0001 as amended by R9-2015-0001 and R9-2015-0100 (MS4 Permit).

I have read and understand that the City Engineer has adopted minimum requirements for managing urban runoff, including storm water, from land development activities, as described in the BMP Design Manual. I certify that this PDP SWQMP has been completed to the best of my ability and accurately reflects the project being proposed and the applicable BMPs proposed to minimize the potentially negative impacts of this project's land development activities on water quality. I understand and acknowledge that the plan check review of this PDP SWQMP by the City Engineer is confined to a review and does not relieve me, as the Engineer in Responsible Charge of design of storm water BMPs for this project, of my responsibilities for project design.

Engineer of Work's Signature, 07/21/2020 Date

60421 PE #, 06/30/2022 Expiration Date

Robbie Mahmood
Print Name

APD Consultants, Inc.
Company

REGISTERED PROFESSIONAL ENGINEER
RABIH F. MAHMOUD
60421
EXPIRES
6/30/22
CIVIL
STATE OF CALIFORNIA

Engineer's Seal

Project Name/ Encompass Health Chula Vista Hospital Site

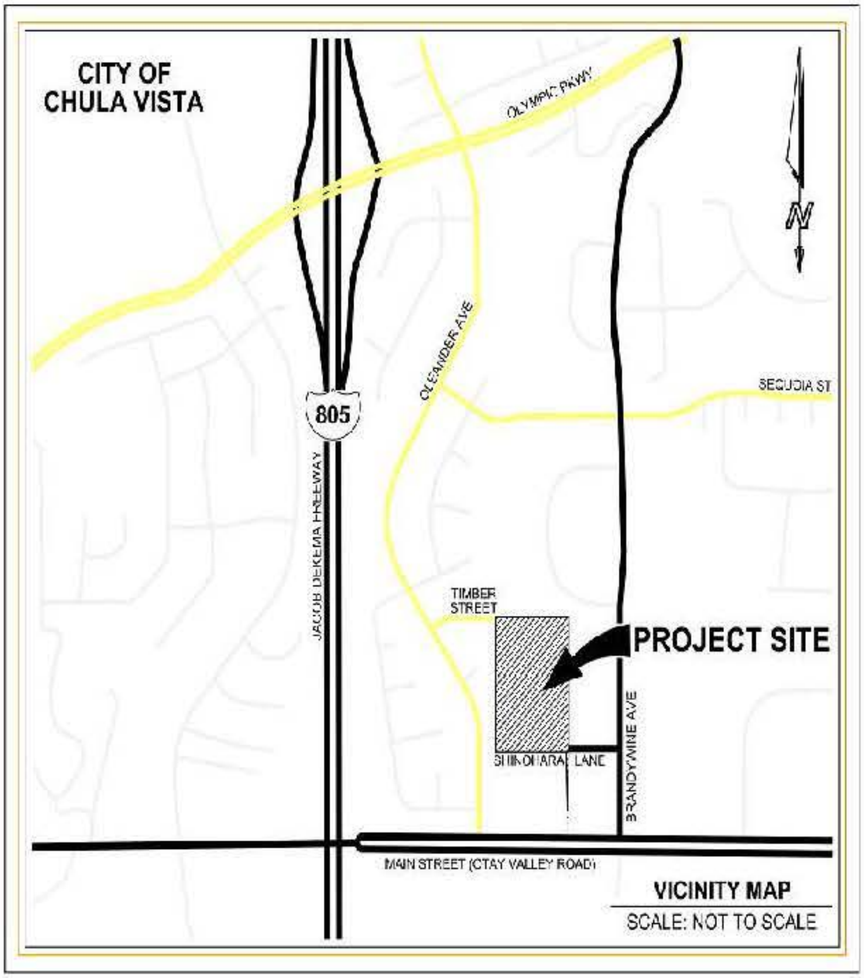
SUBMITTAL RECORD

Use this Table to keep a record of submittals of this PDP SWQMP. Each time the PDP SWQMP is re-submitted, provide the date and status of the project. In column 4 summarize the changes that have been made or indicate if response to plancheck comments is included. When applicable, insert response to plancheck comments behind this page.

Submittal Number	Date	Project Status	Summary of Changes
1		☒ Preliminary Design / Planning/ CEQA ☐ Final Design	Initial Submittal
2		☐ Preliminary Design / Planning/ CEQA ☐ Final Design	
3		☐ Preliminary Design / Planning/ CEQA ☐ Final Design	
4		☐ Preliminary Design / Planning/ CEQA ☐ Final Design	

Project Name/ Encompass Health Chula Vista Hospital Site

Project Vicinity Map



Insert Completed Intake Form (Storm Water Requirements Applicability Checklist)

https://www.chulavistaca.gov/departments/public-works/services/storm-water-pollution-prevention/documents-and-reports

Storm Water Requirements Applicability Checklist for All Permit Applications

CITY OF CHULA VISTA

Intake Form

March 2019 Update

Project Information

Project Address: 517 Shinohara Lane, Chula Vista CA	Project Application # DR19-0028
Project Name: Encompass Health Chula Vista Hospital Site	APN(s) 664-040-01-00

Brief Description of Work Proposed: Construction of Hospital Site, a one story above grade building with approximately 130,000 sf of footprint including parking facilities.

The project is (select one):

☑ New Development Total Impervious Area 188,223 ft²

☐ Redevelopment Total new and/or replaced Impervious Area ____________ ft²
(Redevelopment is the creation and/or replacement of impervious surface on an already developed site).

☐ *Others* ____________

Name of Person Completing this Form: Robbie Mahmood

Role: ☐ Property Owner ☐ Contractor ☐ Architect ☑ Engineer ☐ Other ____________

Email: robbiem@apdcon.com Phone: (949) 336-6336

Signature: [signature] Date Completed: 03/03/2020

Answer each section below, starting with Section 1 and progressing through each section. Additional information for determining the requirements is found in the Chula Vista BMP Design Manual available on the City's website at http://www.chulavistaca.gov/departments/public-works/services/storm-water-pollution-prevention/documents-and-reports.

SECTION 1: Storm Water BMP Requirements

Does the project consist of **one or both** of the following: • Repair or improvements to an existing building or structure that don't alter the size such as: tenant improvements, interior remodeling, electrical work, fire alarm, fire sprinkler system, HVAC work, Gas, plumbing, etc. • Routine maintenance activities such as: roof or exterior structure surface replacement; resurfacing existing roadways and parking lots including dig outs, slurry seal, overlay and restriping; repair damaged sidewalks or pedestrian ramps on existing roads without expanding the impervious footprint; routine replacement of damaged pavement, trenching and resurfacing associated with utility work (i.e. sewer, water, gas or electrical laterals, etc.) and pot holing or geotechnical investigation borings.	☐ **Yes**	**Project is NOT Subject to Permanent Storm Water BMP requirements.** **BUT IS** subject to Construction BMP requirements. Review & sign "Construction Storm Water BMP Certification Statement" on page 2.
	☑ **No**	**Continue to Section 2, page 3.**

Construction Storm Water BMP Certification Statement

The following stormwater quality protection measures are required by City Chula Vista Municipal Code Chapter 14.20 and the City's Jurisdictional Runoff Management Program.

1. All applicable construction BMPs and non-stormwater discharge BMPs shall be installed and maintained for the duration of the project in accordance with the Appendix K "Construction BMP Standards" of the Chula Vista BMP Design Manual.
2. Erosion control BMPs shall be implemented for all portions of the project area in which no work has been done or is planned to be done over a period of 14 or more days. All onsite drainage pathways that convey concentrated flows shall be stabilized to prevent erosion.
3. Run-on from areas outside the project area shall be diverted around work areas to the extent feasible. Run-on that cannot be diverted shall be managed using appropriate erosion and sediment control BMPs.
4. Sediment control BMPs shall be implemented, including providing fiber rolls, gravel bags, or other equally effective BMPs around the perimeter of the project to prevent transport of soil and sediment offsite. Any sediment tracked onto offsite paved areas shall be removed via sweeping at least daily.
5. Trash and other construction wastes shall be placed in a designated area at least daily and shall be disposed of in accordance with applicable requirements.
6. Materials shall be stored to avoid being transported in storm water runoff and non-storm water discharges. Concrete washout shall be directed to a washout area and shall not be washed out to the ground.
7. Stockpiles and other sources of pollutants shall be covered when the chance of rain within the next 48 hours is at least 50%.

I certify that the stormwater quality protection measures listed above will be implemented at the project described on Intake Form. I understand that failure to implement these measures may result in monetary penalties or other enforcement actions. This certification is signed under penalty of perjury and does not require notarization.

Name: Robbie Mahmood Title: Principal

Signature: [signature] Date: 03/03/2020

Section 2: Determine if Project is a Standard Project or Priority Development Project

Is the project in any of the following categories, (a) through (j)?

(a) New development that **creates 10,000 square feet** or more of impervious surfaces (collectively over the entire project site). This includes commercial, industrial, residential, mixed-use, and public development projects on public or private land. ☑ Yes ☐ No

(b) Redevelopment project that **creates and/or replaces 5,000 square feet** or more of impervious surface (collectively over the entire project site on an existing site of 10,000 square feet or more of impervious surfaces). This includes commercial, industrial, residential, mixed-use, and public development projects on public or private land. ☐ Yes ☑ No

(c) New development or redevelopment projects that **creates and/or replaces a combined total of 5,000 square feet** or more of impervious surface (collectively over the entire project site) and support one or more of the following uses: ☐ Yes ☑ No

(i) **Restaurant.** This This category is defined as a facility that sells prepared foods and drinks for consumption, including stationary lunch counters and refreshment stands selling prepared foods and drinks for immediate consumption (Standard Industrial Classification Code 5812).

(ii) **Hillside development projects**. This category includes development on any natural slope that is twenty-five percent or greater.

(iii) **Parking Lots.** This category is defined as a land area or facility for the temporary parking or storage of motor vehicles used personally, for business, or for commerce.

(iv) **Streets, roads, highways, freeways, and driveways**. This category is defined as any paved impervious surface used for the transportation of automobiles, trucks, motorcycles, and other vehicles.

(d) New development or redevelopment project that **creates and/or replaces 2,500 square feet** or more of impervious surface (collectively over the entire project site), discharging directly to an Environmentally Sensitive Area (ESA). "Discharging directly to" includes flow that is conveyed overland a distance of 200 feet or less from the project to the ESA, or conveyed in a pipe or open channel any distance as an isolated flow from the project to the ESA (i.e. not commingled with flows from adjacent lands). ☐ Yes ☑ No

(e) New development or redevelopment project that creates and/or replaces a combined total of 5,000 square feet or more of impervious surface, that support one or more of the following used: ☐ Yes ☑ No

(i) Automotive repair shops. This category is defined as a facility that is categorized in any one of the following Standard Industrial Classification (SIC) codes: 5013, 5014, 5541, 7532-7534, or 7536-7539.

(ii) Retail gasoline outlets. This category includes retail gasoline outlets that meet the meet one of the following criteria: (a) 5,000 square feet or more or (b) a projected Average Daily Traffic (ADT) of 100 or more vehicles per day.

(f) New development or redevelopment that result in the disturbance of **one or more acres** of land and are expected to generate pollutants post construction. This does not include projects creating less than 5,000 sf of impervious surface and where added landscaping does not require regular use of pesticides and fertilizers, such as slope stabilization using native plants. Calculation of the square footage of impervious surface need not include linear pathways that are for infrequent vehicle use, such as emergency maintenance access or bicycle pedestrian use, if they are built with pervious surfaces of if they sheet flow to surrounding pervious surfaces. ☑ Yes ☐ No

The project is (select one):

☐ If "No" is checked for every category in Section 2, **Project is "Standard Development Project"**. Site design and source control BMP requirements apply. **Complete and submit Standard SWQMP** (refer to Chapter 4 & Appendix E of the BMP Design Manual for guidance). Continue to Section 4.

☑ If "Yes" is checked for ANY category in Section 2, **Project is "Priority Development Project (PDP)"**. Complete below, if applicable, and continue to Section 3.

Complete for PDP Redevelopment Projects ONLY:

The total existing (pre-project) impervious area at the project site is: ____ ____ ft² (A)

The total proposed newly created or replaced impervious area is _____ ____ ft² (B)

Percent impervious surface created or replaced (B/A)*100: ____ ___%

The percent impervious surface created or replaced is (select one based on the above calculation):

☐ less than or equal to fifty percent (50%) – **only new impervious areas are considered a PDP**
OR

greater than fifty percent (50%) – **the entire project site is considered a PDP**

☐ **Continue to Section 3**

Section 3: Determine if project is PDP Exempt

1. Does the project ONLY include new or retrofit sidewalk, bicycle lane or trails that:
   - Are designed and constructed to direct storm water runoff to adjacent vegetated areas, or other non-erodible permeable areas? Or;
   - Are designed and constructed to be hydraulically disconnected from paved streets or roads? Or;
   - Are designed and constructed with permeable pavements or surfaces in accordance with USEPA Green Streets guidance?

☐ **Yes. Project is PDP Exempt.**

Complete and submit **Standard SWQMP** (refer to Chapter 4 of the BMP Design Manual for guidance). **Continue to Section 4.**

☐ **No. Next question**

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2. Does the project ONLY include retrofitting or redevelopment of existing paved alleys, streets or roads designed and constructed in accordance with the Green Streets standards?

☐ **Yes.**
Project is PDP Exempt.
Complete and submit Standard SWQMP (refer to Chapter 4 of the BMP Design Manual for guidance). **Continue to Section 4.**

☑ **No.**
Project is PDP.
Site design, source control and structural pollutant control BMPs apply. Complete and submit PDP SWQMP (refer to Chapters 4, 5 & 6 of the BMP Design Manual for guidance). **Continue to Section 4.**

SECTION 4: Construction Storm Water BMP Requirements:

All construction sites are required to implement construction BMPs in accordance with the performance standards in the BMP Design Manual. Some sites are additionally required to obtain coverage under the State Construction General Permit (CGP), which is administered by the State Water Resource Control Board.

1. Does the project include Building/Grading/Construction permits proposing less than 5,000 square feet of ground disturbance and has less than 5-foot elevation change over the entire project area?

☐ Yes; review & sign Construction Storm Water Certification Statement, skip questions 2-4

☑ No; next question

2. Does the project propose construction or demolition activity, including but not limited to, clearing grading, grubbing, excavation, or other activity that results in ground disturbance of less than one acre and more than 5,000 square feet?

☐ Yes. complete & submit Construction Storm Water Pollution Control Plan (CSWPCP), skip questions 3-4

☑ No; next question

3. Does the project results in disturbance of an acre or more of total land area and are considered regular maintenance projects performed to maintain original line and grade, hydraulic capacity, or original purpose of the facility? (Projects such as sewer/storm drain/utility replacement)

☐ Yes. complete & submit Construction Storm Water Pollution Control Plan (CSWPCP), skip question 4

☑ No; next question

4. Is the project proposing land disturbance greater than or equal to one acre OR the project is part of a larger common plan of development disturbing 1 acre or more?

☑ Yes; Storm Water Pollution Prevention Plan (SWPPP) is required. Refer to online CASQA or Caltrans Template. Visit the SWRCB web site at http://www.waterboards.ca.gov/water_issues/programs/stormwater/construction.shtml.

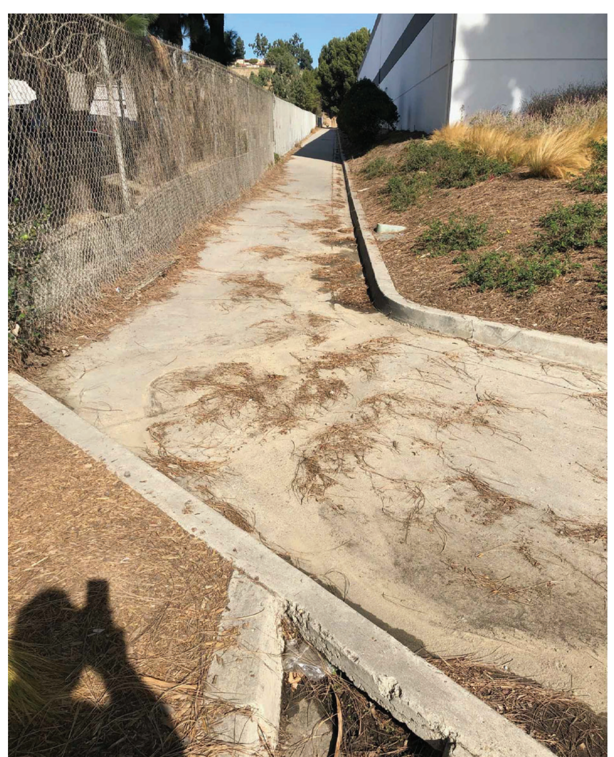
Note: for Projects that result in disturbance of one to five acres of total land area and can demonstrate that there will be no adverse water quality impacts by applying for a Construction Rainfall Erosivity Waiver, may be allowed to submit a CSWPCP in lieu of a SWPPP.

Encompass Health Chula Vista Hospital Site

Project Name/____

HMP Exemption Exhibit

Attach this Exhibit (if Applicable) that shows direct storm water runoff discharge from the project site to HMP exempt area. Include project area, applicable underground storm drains line and/or concrete lined channels, outfall information and exempt waterbody. Reference applicable drawing number(s). **Exhibit must be provided on 11"x17" or larger paper.**



PICTURE 1
CONCRETE CHANNEL

PICTURE 2
CATCH BASIN

800' 400' 0 800' 1600'
SCALE: 1" = 800'

APD CONSULTANTS, INC.
PLANNING . ENGINEERING . CONSTRUCTION MANAGEMENT
188 Technology Dr., Suite B, IRVINE, CA 92618
TEL: (949) 336-6336 FAX: (949) 336-6338 www.apdcon.com

WMAA EXHIBIT
ENCOMPASS HEALTH CHULA VISTA
517 SHINOHARA LANE, CHULA VISTA, CA 91911

Insert Completed Form I-3B: Site Information Checklist for PDPs

https://www.chulavistaca.gov/departments/public-works/services/storm-water-pollution-prevention/documents-and-reports

Project Name: ____

Site Information Checklist	Form I-3B
Project Summary Information	
Project Name	Encompass Health Chula vista Hospital Site
Project Address	517 Shinohara Lane Chula Vista CA, 91911
Assessor's Parcel Number(s) (APN(s))	644-040-01-00
Permit Application Number	DR19-0028
Project Watershed	☒ San Diego Bay
Hydrologic Subarea name with Numeric Identifier up to two decimal places	Select One: ☐ Pueblo San Diego 908 ☐ Sweetwater 909 ☒ Otay 910
Project Area (total area of Assessor's Parcel(s) associated with the project or total area of the right-of-way)	9.730 Acres (423,846 Square Feet)
Area to be Disturbed by the Project (Project Footprint)	9.60 Acres (418,176 Square Feet)
Project Proposed Impervious Area (subset of Project Footprint)	4.32 Acres (188,223 Square Feet)
Project Proposed Pervious Area (subset of Project Footprint)	5.28 Acres (229,953 Square Feet)
Note: Proposed Impervious Area + Proposed Pervious Area = Area to be Disturbed by the Project. This may be less than the Parcel Area.	
The proposed increase or decrease in impervious area in the proposed condition as compared to the pre-project condition	181 %

Form I-3B Page 3 of 10
Description of Existing Site Condition and Drainage Patterns
Current Status of the Site (select all that apply): [ ] Existing development [ ] Previously graded but not built out [ ] Demolition completed without new construction [ ] Agricultural or other non-impervious use [x] Vacant, undeveloped/natural Description / Additional Information:
Existing Land Cover Includes (select all that apply): [ ] Vegetative Cover [x] Non-Vegetated Pervious Areas [ ] Impervious Areas Description / Additional Information:
Underlying Soil belongs to Hydrologic Soil Group (select all that apply): [ ] NRCS Type A [ ] NRCS Type B [ ] NRCS Type C [x] NRCS Type D
Approximate Depth to Groundwater (GW): [ ] GW Depth < 5 feet [ ] 5 feet < GW Depth < 10 feet [ ] 10 feet < GW Depth < 20 feet [x] GW Depth > 20 feet
Existing Natural Hydrologic Features (select all that apply): [ ] Watercourses [ ] Seeps [ ] Springs [ ] Wetlands [x] None Description / Additional Information:

Form I-3B Page 3 of 10
Description of Existing Site Drainage Patterns

How is storm water runoff conveyed from the site? At a minimum, this description should answer:

1. whether existing drainage conveyance is natural or urban;
2. Is runoff from offsite conveyed through the site? if yes, quantify all offsite drainage areas, design flows, and locations where offsite flows enter the project site, and summarize how such flows are conveyed through the site;
3. Provide details regarding existing project site drainage conveyance network, including any existing storm drains, concrete channels, swales, detention facilities, storm water treatment facilities, natural or constructed channels; and
4. Identify all discharge locations from the existing project site along with a summary of conveyance system size and capacity for each of the discharge locations. Provide summary of the pre-project drainage areas and design flows to each of the existing runoff discharge locations.

Describe existing site drainage patterns:

Project site is undeveloped. The Project site generally drains in the southeast direction through surface flow until it reaches Shinohora Lane. There is only one discharge location for the site. The flow from the site will continue to flow south into existing concrete gutters on Shinohora Lane and in turn into existing concrete gutters on Main Street. Evenutally runoff from the site will be conveyed through local storm drain system along Main St., into Otay River until it reaches San Diego Bay.

Form I-3B Page 4 of 10
Description of Proposed Site Development and Drainage Patterns
Project Description / Proposed Land Use and/or Activities: The project will propose to construct a Hospital Site, a one story above grade building with approximately 130,000 sf of footprint. Several parking areas are proposed on the north and south side of the hospital. The project site proposes to construct several landscaped areas and will maintain some aeas with existing vegetation located around the project site. In order to clean the runoff generated from the development, the project proposes to install Modular Wetland System and underground storage chambers.
List/describe proposed impervious features of the project (e.g., buildings, roadways, parking lots, courtyards, athletic courts, other impervious features): Impervious features of the proposed project include hospital building, parking areas, drive aisles, and hardscape.
List/describe proposed pervious features of the project (e.g., landscape areas): Pervious features of the proposed project include landscape areas, plants along the parking area, proposed slopes, and existing open areas.
Does the project include grading and changes to site topography? ☒ Yes ☐ No Description / Additional Information: Intensive grading is anticipated for the site. Project site is still expected to drain southeast of the project site and discharge stormrunoff at the same discharge point as the existing condition. A significant cut up to 20 feet is expected on the north side of the project.

Project Name: Encompass Health Chula Vista Hospital Site

Form I-3B Page 5 of 10

Does the project include changes to site drainage (e.g., installation of new storm water conveyance systems)?

- ☒ Yes
- ☐ No

If yes, provide details regarding the proposed project site drainage conveyance network, including storm drains, concrete channels, swales, detention facilities, storm water treatment facilities, natural or constructed channels, and the method for conveying offsite flows through or around the proposed project site. Identify all discharge locations from the proposed project site along with a summary of the conveyance system size and capacity for each of the discharge locations. Provide a summary of pre- and post-project drainage areas and design flows to each of the runoff discharge locations. Reference the drainage study for detailed calculations.

Describe proposed site drainage patterns:

The project will generally still drain southeast of the project site, discharging to the same existing location. Storm runoff will surface drain into proposed catch basin where runoff will be conveyed via stormdrain pipes. Detention basin chamber sized to 1.5 of the computed stormwater volume will be installed to capture required runoff to be cleansed via proposed Modular Wetland System. The upper underground detention basin chamber will be also utilized to detain flows for drainage purposes. The project will match existing 100-year Peak Flow.

Two (2) general drainage areas are proposed for the developed condition. The Upper and lower drainage area will detain runoff via underground detention chambers and will be be installed each with Modular Wetland System to treat the flow.

Ultimately, both drainage areas will discharge southeast of the project site. The pre-developed condition generates a 100-year peak flow of Q=9.6 cfs and the post-developed condition will generate a 100-year peak flow of Q=32.6 cfs.

Form I-3B Page 6 of 10
Identify whether any of the following features, activities, and/or pollutant source areas will be present (select all that apply): ☒ On-site storm drain inlets ☒ Interior floor drains and elevator shaft sump pumps ☐ Interior parking garages ☐ Need for future indoor & structural pest control ☒ Landscape/Outdoor Pesticide Use ☐ Pools, spas, ponds, decorative fountains, and other water features ☐ Food service ☐ Refuse areas ☐ Industrial processes ☐ Outdoor storage of equipment or materials ☐ Vehicle and Equipment Cleaning ☐ Vehicle/Equipment Repair and Maintenance ☐ Fuel Dispensing Areas ☒ Loading Docks ☐ Fire Sprinkler Test Water ☒ Miscellaneous Drain or Wash Water ☒ Plazas, sidewalks, and parking lots Description / Additional Information:

Encompass Health Chula Vista Hospital Site

Project Name: ____

Form I-3B Page 7 of 10
Identification and Narrative of Receiving Water and Pollutants of Concern
Describe flow path of storm water from the project site discharge location(s), through urban storm conveyance systems as applicable, to receiving creeks, rivers, and lagoons as applicable, and ultimate discharge to the Pacific Ocean (or bay, lagoon, lake or reservoir, as applicable):
The Project site generally drains in the southeast direction through surface flow until it reaches Shinihora Lane. There is only one discharge location for the site. The flow from the site will continue to flow into the concrete gutters on Shinihora Lane and into existing concrete gutters on Brandywine Avenue. Evenutally runoff from the site will be conveyed through local storm drain system along Main St., into Otay River until it reaches San diego Bay.
List any 303(d) impaired water bodies within the path of storm water from the project site to the Pacific Ocean (or bay, lagoon, lake or reservoir, as applicable), identify the pollutant(s)/stressor(s) causing impairment, and identify any TMDLs and/or Highest Priority Pollutants from the WQIP for the impaired water bodies:

303(d) Impaired Water Body	Pollutant(s)/Stressor(s)	TMDLs / WQIP Highest Priority Pollutant
San Diego	Bacteria	Bacteria

Identification of Project Site Pollutants*
*Identification of project site pollutants is only required if flow-thru treatment BMPs are implemented onsite in lieu of retention or biofiltration BMPs (note the project must also participate in an alternative compliance program unless prior lawful approval to meet earlier PDP requirements is demonstrated)
Identify pollutants expected from the project site based on all proposed use(s) of the site (see BMP Design Manual Appendix B.6):

Pollutant	Not Applicable to the Project Site	Expected from the Project Site	Also a Receiving Water Pollutant of Concern
Sediment	☐	☒	☐
Nutrients	☐	☒	☐
Heavy Metals	☐	☒	☐
Organic Compounds	☐	☒	☐
Trash & Debris	☐	☒	☐
Oxygen Demanding Substances	☐	☐	☐
Oil & Grease	☐	☒	☐
Bacteria & Viruses	☐	☒	☐
Pesticides	☐	☒	☐

Project Name: Encompass Health Chula Vista Hospital Site

Form I-3B Page 8 of 10
Hydromodification Management Requirements
Do hydromodification management requirements apply (see Section 1.6)? ☐ Yes, hydromodification management flow control structural BMPs required. ☐ No, the project will discharge runoff directly to existing underground storm drains discharging directly to water storage reservoirs, lakes, enclosed embayments, or the Pacific Ocean. ☐ No, the project will discharge runoff directly to conveyance channels whose bed and bank are concrete-lined all the way from the point of discharge to water storage reservoirs, lakes, enclosed embayments, or the Pacific Ocean. ☒ No, the project will discharge runoff directly to an area identified as appropriate for an exemption by the WMAA for the watershed in which the project resides. Description / Additional Information (to be provided if a 'No' answer has been selected above): See Attached WMAA Exhibit Note: If "No" answer has been selected the SWQMP must include an exhibit that shows the storm water conveyance system from the project site to an exempt water body. The exhibit should include details about the conveyance system and the outfall to the exempt water body.
Critical Coarse Sediment Yield Areas* ***This Section only required if hydromodification management requirements apply**
Based on Section 6.2 and Appendix H does CCSYA exist on the project footprint or in the upstream area draining through the project footprint? ☐ Yes ☐ No Description / Additional Information:

Form I-3B Page 9 of 10
Flow Control for Post-Project Runoff* ***This Section only required if hydromodification management requirements apply**
List and describe point(s) of compliance (POCs) for flow control for hydromodification management (see Section 6.3.1). For each POC, provide a POC identification name or number correlating to the project's HMP Exhibit and a receiving channel identification name or number correlating to the project HMP Exhibit. N/A
Has a geomorphic assessment been performed for the receiving channel(s)? ☐ No, the low flow threshold is 0.1Q2 (default low flow threshold) ☐ Yes, the result is the low flow threshold is 0.1Q2 ☐ Yes, the result is the low flow threshold is 0.3Q2 ☐ Yes, the result is the low flow threshold is 0.5Q2 If a geomorphic assessment has been performed, provide title, date, and preparer: Discussion / Additional Information: (optional)

Encompass Health Chula Vista Hospital Site

Project Name: ____

Form I-3B Page 10 of 10
Other Site Requirements and Constraints
When applicable, list other site requirements or constraints that will influence storm water management design, such as zoning requirements including setbacks and open space, or local codes governing minimum street width, sidewalk construction, allowable pavement types, and drainage requirements. None
Optional Additional Information or Continuation of Previous Sections As Needed
This space provided for additional information or continuation of information from previous sections as needed.

Insert Completed Form I-4: Source Control BMP Checklist for All Development Projects

https://www.chulavistaca.gov/departments/public-works/services/storm-water-pollution-prevention/documents-and-reports

Encompass Health Chula Vista Hospital Site

Project Name:

Source Control BMP Checklist for All Development Projects	Form I-4

All development projects must implement source control BMPs. Refer to **Chapter 4** and **Appendix E** of the BMP Design Manual for information to implement BMPs shown in this checklist.

Note: All selected BMPs must be shown on the site/construction plans.

Answer each category below pursuant to the following:

- "Yes" means the project will implement the source control BMP as described in Chapter 4 and/or Appendix E of the BMP Design Manual. Discussion / justification is not required.
- "No" means the BMP is applicable to the project but it is not feasible to implement. Discussion / justification must be provided.
- "N/A" means the BMP is not applicable at the project site because the project does not include the feature that is addressed by the BMP (e.g., the project has no outdoor materials storage areas). Discussion / justification may be provided.

Source Control Requirement	Applied?		
4.2.1 Prevention of Illicit Discharges into the MS4	☒ Yes	☐ No	☐ N/A
Discussion / justification if 4.2.1 not implemented:			
4.2.2 Storm Drain Stenciling or Signage	☒ Yes	☐ No	☐ N/A
Discussion / justification if 4.2.2 not implemented:			
4.2.3 Protect Outdoor Materials Storage Areas from Rainfall, Run-On, Runoff, and Wind Dispersal	☐ Yes	☐ No	☒ N/A
Discussion / justification if 4.2.3 not implemented:			
4.2.4 Protect Materials Stored in Outdoor Work Areas from Rainfall, Run-On, Runoff, and Wind Dispersal	☐ Yes	☐ No	☒ N/A
Discussion / justification if 4.2.4 not implemented:			
4.2.5 Protect Trash Storage Areas from Rainfall, Run-On, Runoff, and Wind Dispersal	☒ Yes	☐ No	☐ N/A
Discussion / justification if 4.2.5 not implemented:			

Encompass Health Chula Vista Hospital Site

Project Name

Source Control BMP Checklist for All Development Projects			Form I-4 (Page 2 of 2)
4.2.6 Additional BMPs Based on Potential Sources of Runoff Pollutants (must answer for each source listed below)	☐ Yes	☐ No	☐ N/A
SC-A Onsite storm drain inlets	☒ Yes	☐ No	☐ N/A
SC-B Interior floor drains and elevator shaft sump pumps	☒ Yes	☐ No	☐ N/A
SC-C Interior parking garages	☐ Yes	☐ No	☒ N/A
SC-D1 Need for future indoor & structural pest control	☐ Yes	☐ No	☒ N/A
SD-D2 Landscape/outdoor pesticide use	☒ Yes	☐ No	☒ N/A
SC-E Pools, spas, ponds, decorative fountains, and other water features	☐ Yes	☐ No	☒ N/A
SC-F Food Service	☒ Yes	☐ No	☐ N/A
SC-G Refuse areas	☐ Yes	☐ No	☒ N/A
SC-H Industrial processes	☐ Yes	☐ No	☒ N/A
SC-I Outdoor storage of equipment or materials	☐ Yes	☐ No	☒ N/A
SC-J Vehicle and equipment cleaning	☐ Yes	☐ No	☒ N/A
SC-K Vehicle/equipment repair and maintenance	☐ Yes	☐ No	☒ N/A
SC-L Fuel dispensing areas	☐ Yes	☐ No	☒ N/A
SC-M Loading docks	☒ Yes	☐ No	☐ N/A
SC-N Fire sprinkler test water	☒ Yes	☐ No	☐ N/A
SC-O Miscellaneous drain or wash water	☒ Yes	☐ No	☐ N/A
SC-P Plazas, sidewalks, and parking lots	☒ Yes	☐ No	☐ N/A
SC-Q: Large Trash Generating Facilities	☒ Yes	☐ No	☐ N/A
SC-R: Animal Facilities	☐ Yes	☐ No	☒ N/A
SC-S: Plant Nurseries and Garden Centers	☐ Yes	☐ No	☒ N/A
SC-T: Automotive Facilities	☐ Yes	☐ No	☒ N/A
Discussion / justification if 4.2.6 not implemented. Justification must be provided for all "No" answers shown above.			

Insert Completed Form I-5: Site Design BMP Checklist for All Development Projects

https://www.chulavistaca.gov/departments/public-works/services/storm-water-pollution-prevention/documents-and-reports

Encompass Health Chula Vista Hospital Site

Project Name

Site Design BMP Checklist for All Development Projects			Form I-5
All development projects must implement site design BMPs where applicable and feasible. See **Chapter 4 and Appendix E** of the manual for information to implement site design BMPs shown in this checklist. **Note: All selected BMPs must be shown on the site/construction plans.** Answer each category below pursuant to the following. • "Yes" means the project will implement the site design BMP as described in Chapter 4 and/or Appendix E of the manual. Discussion / justification is not required. • "No" means the BMP is applicable to the project but it is not feasible to implement. Discussion / justification must be provided. • "N/A" means the BMP is not applicable at the project site because the project does not include the feature that is addressed by the BMP (e.g., the project site has no existing natural areas to conserve). Discussion / justification may be provided.			
Site Design Requirement	**Applied?**		
4.3.1 Maintain Natural Drainage Pathways and Hydrologic Features	☐Yes	☒No	☐N/A
There are no natural storage, natural swales, permeable soils located on-site. Site will be fully developed.			
4.3.2 Conserve Natural Areas, Soils, and Vegetation	☐Yes	☒No	☐N/A
Project site is fully developed but landscaped natural areas located in the sloping areas will be need to be stabilized with plant materials.			
4.3.3 Minimize Impervious Area	☒Yes	☐No	☐N/A
There is a significant areas of the proposed project site that will remain pervious. Plant materials will be used for a large areas located within the sloping areas.			
4.3.4 Minimize Soil Compaction	☐Yes	☒No	☐N/A
The project site is hill site, there will be cut and fill sites areas. Compaction will be needed in all areas to ensure site stability.			
4.3.5 Impervious Area Dispersion	☐Yes	☒No	☐N/A
Site ' s impervious areas comprise mostly of building foorprint and parking areas located center of the project site. Most of the pervious areas, landscaped areas, are located surrounding the building and parking areas. There is very little opportunity to divert flows from roof, building or parking areas to the sloping landscaped areas. Storm runoff will need to be captured via catchbasins and diverted to underground chambers before			

Project Name/Address: Encompass Health Chula Vista Hospital Site

Site Design BMP Checklist for All Development Projects			Form I-5
Site Design Requirement	**Applied?**		
4.3.6 Runoff Collection	☐Yes	☒No	☐N/A
No opportunity to retain stormwater due to site condition. Proposed project is a hospital and rain barrels are not proposed mostly for residential projects. Permeable parking areas are not feasible since project site has very low infiltration capabilities and front			
4.3.7 Landscaping with Native or Drought Tolerant Species	☒Yes	☐No	☐N/A
4.3.8 Harvesting and Using Precipitation	☐Yes	☐No	☒N/A
Discussion / justification for all "No" answers shown above:			

Insert Completed Form I-6: Summary of PDP Structural BMPs

https://www.chulavistaca.gov/departments/public-works/services/storm-water-pollution-prevention/documents-and-reports

Encompass Health Chula Vista Hospital Site

Project Name: ____

Summary of PDP Structural BMPs	Form I-6
PDP Structural BMPs	
All PDPs must implement structural BMPs for storm water pollutant control (see **Chapter 5 of the manual**). Selection of PDP structural BMPs for storm water pollutant control must be based on the selection process described in **Chapter 5**. PDPs subject to hydromodification management requirements must also implement structural BMPs for flow control for hydromodification management (see **Chapter 6 of the manual**). Both storm water pollutant control and flow control for hydromodification management can be achieved within the same structural BMP(s). PDP structural BMPs must be verified by City at the completion of construction. This may include requiring the project owner or project owner's representative to certify construction of the structural BMPs (see Section 1.12 of the manual). PDP structural BMPs must be maintained into perpetuity (**see Section 7 of the manual**). Use this form to provide narrative description of the general strategy for structural BMP implementation at the project site in the box below. Then complete the PDP structural BMP summary information sheet (page **3 of this form**) for each structural BMP within the project (copy the BMP summary information page as many times as needed to provide summary information for each individual structural BMP).	
Describe the general strategy for structural BMP implementation at the site. This information must describe how the steps for selecting and designing storm water pollutant control BMPs presented in Section 5.1 of the manual were followed, and the results (type of BMPs selected). For projects requiring hydromodification flow control BMPs, indicate whether pollutant control and flow control BMPs are integrated or separate. The project is not feasible for infiltration. DMAs are mostly broken down to two (2) larger Drainage areas draining to two (2) proposed Proprietary Bioretention Systems. BMPs are sized based on the Qbmp and 1.5 times DCV generated on-site. Hydromofication is not required on-site since runoff from site discharges to concreted or lined stormdrains from the project site all the way to the Pacific Ocean. The project site is not feasible for infiltration because the site is "D" soil and the infiltration results yield iniltration rates of as low as 0.06 inches/hr. See Sheet C-11 in the Grading Plans showing locations of all BMPs and underground stormwater storage.	

Project Name: Encompass Health Chula Vista Hospital Site

Form I-6 Page 2 of 3 *(Copy and attach as many as needed)*	
Structural BMP ID No. BMP 1 and BMP 2	
Construction Plan Sheet No DR19-0028	
Type of structural BMP: ☐ Retention by harvest and use (e.g. HU-1, cistern) ☐ Retention by infiltration basin (INF-1) ☐ Retention by bioretention (INF-2) ☐ Retention by permeable pavement (INF-3) ☐ Partial retention by biofiltration with partial retention (PR-1) ☐ Biofiltration (BF-1) ☐ Flow-thru treatment control with prior lawful approval to meet earlier PDP requirements (provide BMP type/description in discussion section below) ☐ Flow-thru treatment control included as pre-treatment/forebay for an onsite retention or biofiltration BMP (provide BMP type/description and indicate which onsite retention or biofiltration BMP it serves in discussion section below) ☐ Flow-thru treatment control with alternative compliance (provide BMP type/description in discussion section below) ☐ Detention pond or vault for hydromodification management ☒ Other (describe in discussion section below)	
Purpose: ☒ Pollutant control only ☐ Hydromodification control only ☐ Combined pollutant control and hydromodification control ☐ Pre-treatment/forebay for another structural BMP ☐ Other (describe in discussion section below)	
Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms if required by the City Engineer (See Section 1.12 of the manual)	APD Consultants, Inc. Robbie Mahmood, P.E. (949) 336-6336
Who will be the final owner of this BMP?	Owner
Who will maintain this BMP into perpetuity?	Owner
What is the funding mechanism for maintenance?	Owner

Project Name: Encompass Health Chula Vista Hospital Site

Form I-6 Page 3 *of* 3 *(Copy and attach as many as needed)*
Structural BMP ID No. BMP 1 and BMP 2
Construction Plan Sheet No. DR19-0028
Discussion (as needed, must include worksheets showing BMP sizing calculations in the SWQMP):   The project is not feasible for any infiltration and proposes to use Modular Wetland System (BF-3) to treat runoff from two drainage areas. The project proposes to install two underground detention chambers to store 1.5 of the required storm volume to be treated before it continues to flow to the Modular Wetland Systems.   See Sheet C-11 in the Grading Plans showing locations of all BMPs and underground stormwater storage.

ATTACHMENT 1

Backup for PDP Pollutant Control BMPs

Project Name/ Encompass Health Chula Vista Hospital Site

Indicate which Items are Included:

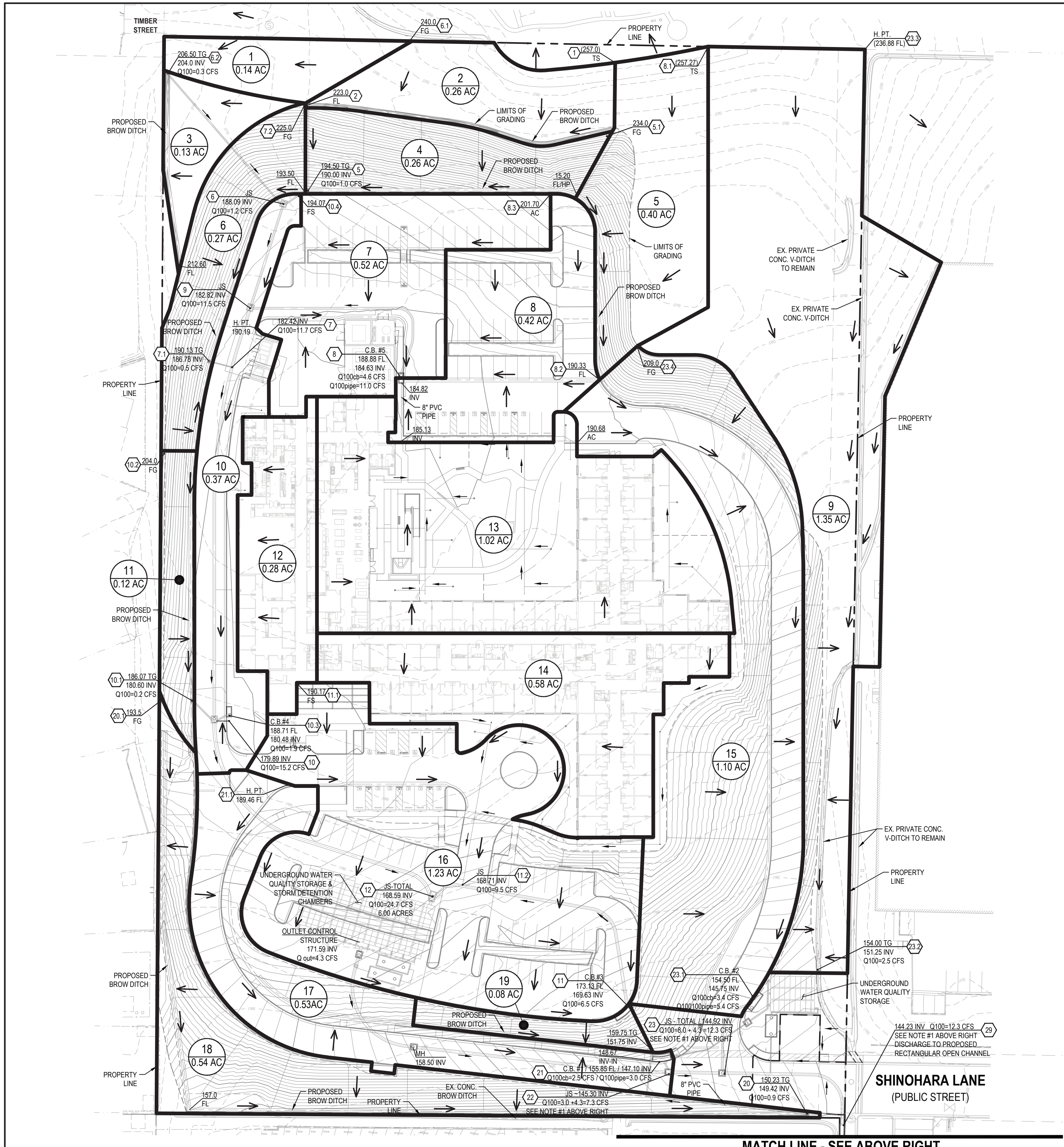
Attachment Sequence	Contents	Checklist
Attachment 1A	**DMA Exhibit (Required)** See DMA Exhibit Checklist.	☒ Included
Attachment 1B	Tabular Summary of DMAs Showing DMA ID matching DMA Exhibit, DMA Area, and DMA Type (Required)* *Provide table in this Attachment OR on DMA Exhibit in Attachment 1a	☒ Included on DMA Exhibit in Attachment 1A ☒ Included as Attachment 1B, separate from DMA Exhibit
Attachment 1C	Form I-7, Harvest and Use Feasibility Screening Checklist (Required unless the entire project will use infiltration BMPs) Refer to Appendix B.3-1 of the BMP Design Manual to complete Form I-7.	☒ Included Not included because the entire project will use infiltration BMPs
Attachment 1D	Infiltration Feasibility Information. Contents of Attachment 1D depend on the infiltration condition: ☒ **No Infiltration Condition**: ☐ Infiltration Feasibility Condition ☐ Letter (***Note: must be stamped & signed by licensed geotechnical engineer***) ☐ Form I-8A (optional) ☐ Form I-8B (optional) ☐ **Partial Infiltration Condition**: ☐ Infiltration Feasibility Condition ☐ Letter (***Note: must be stamped & signed by licensed geotechnical engineer***) ☐ Form I-8A ☐ Form I-8B ☐ **Full Infiltration Condition:** ☐ Form I-8A ☐ Form I-8B ☐ Worksheet C.4-3 ☐ Form I-9 Refer to Appendices C and D of the BMP Design Manual for guidance.	☒ Included Not included because the entire project will use harvest and use BMPs
Attachment 1E	**Pollutant Control BMP Design Worksheets/ Calculations (Required)** Refer to Appendices B and E of the BMP Design Manual for structural pollutant control BMP design guidelines	☒ Included

Project Name/ Encompass Health Chula Vista Hospital Site

Use this checklist to ensure the required information has been included on the DMA Exhibit:

The DMA Exhibit must identify all the following:

- ☒ Underlying hydrologic soil group
- ☐ Approximate depth to groundwater N/A
- ☐ Existing natural hydrologic features (watercourses, seeps, springs, wetlands) N/A
- ☐ Critical coarse sediment yield areas to be protected N/A
- ☒ Existing topography and impervious areas
- ☒ Existing and proposed site drainage network and connections to drainage offsite
- ☒ Proposed grading
- ☒ Proposed impervious features
- ☒ Proposed design features and surface treatments used to minimize imperviousness
- ☒ Drainage management area (DMA) boundaries, DMA ID numbers, and DMA areas (square footage or acreage), and DMA type (i.e., drains to BMP, self-retaining, or self-mitigating)
- ☒ Potential pollutant source areas and corresponding required source controls (see Chapter 4, Appendix E.1, and Form I-3B)
- ☒ Structural BMPs (identify location, type of BMP, and size/detail, and include cross-sections)



DMA NOTES:

1. SOIL GROUP: D SOIL
2. GROUNDWATER DEPTH: 45 FEET TO 85 FEET
3. IMPERVIOUS AREAS: 188,223 SF
4. PERVIOUS AREAS: 229,950 SF
5. LOCATION OF THE POLLUTANT SOURCES;
   - ON-SITE STORM DRAINS
   - INTERIOR FLOOR DRAINS AND ELEVATOR SHAFT SUMP PUMPS
   - LANDSCAPE/OUTDOOR PESTICIDE USE
   - LOADING DOCKS, SIDEWALKS AND PARKING LOTS
   - MISCELLANEOUS DRAIN OR WASH WATER
   - LARGE TRASH GENERATING FACILITIES.
6. REQUIRED SOURCE CONTROLS;
   - PREVENTION OF ILLICIT DISCHARGES INTO MS4
   - STORMDRAIN STENCILING OR SIGNAGE
   - PROTECT TRASH STORAGE AREAS FROM RAINFALL RUN-ON, RUN-OFF AND WIND DISPERSAL

LEGEND:

→	FLOW PATH OF WATER
━━	DRAINAGE AREA BOUNDARY
— —	PROPERTY LINE
1	SUB-AREA NUMBER
0.14 AC	SUB-AREA ACREAGE
AC	ACRES
CB	CATCH BASIN
HP	HIGH POINT
INV	INVERT
JS	JUNCTION STRUCTURE
MH	MANHOLE
L. PT.	LOW POINT
TG	TOP OF GRATE
TS	TOP OF SLOPE
CB	CATCH BASIN
Q100	100-YEAR PEAK FLOW (CFS)
Q100cb	100-YEAR PEAK FLOW IN CATCH BASIN (CFS)
Q100pipe	100-YEAR PEAK FLOW IN PIPE (CFS)

NOTE:

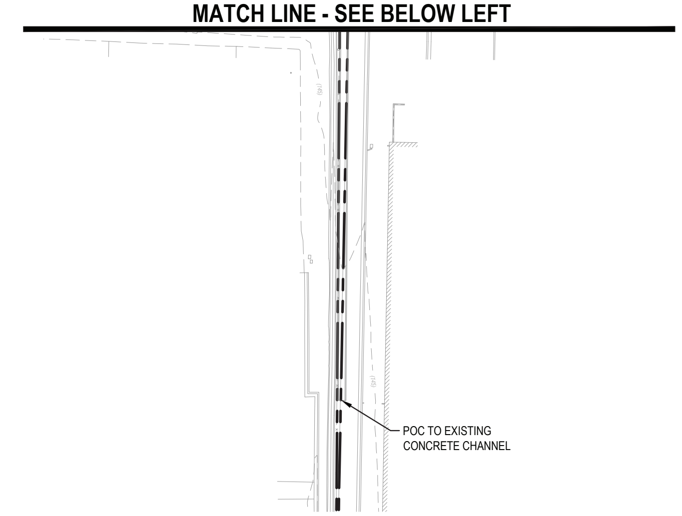
1. THE 4.3 cfs IS THE FLOW DISCHARGING FROM THE UPSTREAM DETENTION CHAMBER.

Project Name: Encompass Health Chula Vista Hospital Site

Tabular Summary of DMAs							Worksheet B-1		
DMA Unique Identifier	Area (acres)	Impervious Area (acres)	% Imp	HSG	Area Weighted Runoff Coefficient	DCV (Cubic feet)	Treated by (BMP ID)	Pollutant Control Type	Drains to (POC ID)
1-4, 6-8	2.00	0.846	42	D	0.53	1997.1	1		1
5, 9	1.75	0	0	D	0.30	991.0	2		1
10	0.37	0.333	90	D	0.9	628.6	1		1
11	0.12	0	0	D	0.3	68.0	2		1
12-14	1.88	0	0	D	0.9	3193.8	1		1
15	1.10	0.275	25	D	0.3	622.9	2		1
16	1.23	0.984	80	D	0.9	2089.6	1		1
17-19	1.15	0.265	23	D	0.28	617.2	2		
Summary of DMA Information (Must match Project description and SWQMP narrative)									
No. of DMAs	Total DMA Area (acres)	Total Impervious Area (acres)	% Impervious		Area Weighted Runoff Coefficient	DCV (Cubic feet)	Total Area Treated (acres)		No. of POCs
19	9.60	4.32	45	D	0.56	10208.1	9.60		1

Where: DMA = Drainage Management Area; HSG = Hydrologic Soil Group; BMP = Best Management Practice; Imp = Imperviousness; DCV = Design Capture Volume; POC = Point of Compliance; ID = identifier; No. = Number

MATCH LINE - SEE BELOW LEFT



SCALE: 1" = 40'

APD CONSULTANTS, INC.
PLANNING . ENGINEERING . CONSTRUCTION MANAGEMENT
22362 GILBERTO, SUITE 245, RANCHO SANTA MARGARITA, CA 92688
TEL: (949) 336-6336 ; (949) 336-6337 www.apdcon.com

REGISTERED PROFESSIONAL ENGINEER RABIH F. MAHMOUD 60421 EXPIRES 6/30/22 CIVIL STATE OF CALIFORNIA

By	REVISIONS	Date	App'd	DATUM	SCALE
				VERTICAL DATUM: NAVD88	HORIZONTAL
					AS SHOWN
				HORIZONTAL DATUM: NAD83	VERTICAL

Designed By:	Drawn By:	Checked By:
V.B.	V.B.	R.M.

Plans Prepared Under Supervision Of: Date:
ROBBIE MAHMOOD, P.E. R.C.E. No. 60421

CITY OF CHULA VISTA DEVELOPMENT SERVICES DEPARTMENT

ENCOMPASS HEALTH CHULA VISTA

DMA EXHIBIT

DRAWING NO. 1

W.O. No.

CV REVISED: 2/13/19

ENCOMPASS HEALTH CHULA VISTA

Project Name: Encompass Health Chula Vista Hospital Site

Tabular Summary of DMAs							Worksheet B-1		
DMA Unique Identifier	Area (acres)	Impervious Area (acres)	% Imp	HSG	Area Weighted Runoff Coefficient	DCV (Cubic feet)	Treated by (BMP ID)	Pollutant Control Type	Drains to (POC ID)
1-4, 6-8	2.00	0.846	42	D	0.53	1997.1	1		1
5, 9	1.75	0	0	D	0.30	991.0	2		1
10	0.37	0.333	90	D	0.9	628.6	1		1
11	0.12	0	0	D	0.3	68.0	2		1
12-14	1.88	0	0	D	0.9	3193.8	1		1
15	1.10	0.275	25	D	0.3	622.9	2		1
16	1.23	0.984	80	D	0.9	2089.6	1		1
17-19	1.15	0.265	23	D	0.28	617.2	2		
Summary of DMA Information (Must match Project description and SWQMP narrative)									
No. of DMAs	Total DMA Area (acres)	Total Impervious Area (acres)	% Impervious		Area Weighted Runoff Coefficient	DCV (Cubic feet)	Total Area Treated (acres)		No. of POCs
19	9.60	4.32	45	D	0.56	10208.1	9.60		1

Where: DMA = Drainage Management Area; HSG = Hydrologic Soil Group; BMP = Best Management Practice; Imp = Imperviousness; DCV= Design Capture Volume; POC = Point of Compliance; ID = identifier; No. = Number

DESIGN CAPTURE VOLUME		Draining to BMP 1		
1	85th percentile 24-hr storm depth	d=	0.52	inches
2	area tributary to BMPs	A=	5.48	acres
3	Area weighted runoff factor	C=	0.76	unitless
4	Street trees volume reduction	TCV=	0	cubic-feet
5	Rain barrels volume reduction	RCV=	0	cubic-feet
6	Calculated DCV= (3630 x C x d x A) - TCV - RCV	DCV=	**7909**	cubic-feet

DESIGN CAPTURE VOLUME		Draining to BMP 2		
1	85th percentile 24-hr storm depth	d=	0.52	inches
2	area tributary to BMPs	A=	4.12	acres
3	Area weighted runoff factor	C=	0.30	unitless
4	Street trees volume reduction	TCV=	0	cubic-feet
5	Rain barrels volume reduction	RCV=	0	cubic-feet
6	Calculated DCV= (3630 x C x d x A) - TCV - RCV	DCV=	**2299**	cubic-feet

Encompass Health Chula Vista Hospital Site

Project Name: ____

Harvest and Use Feasibility Screening			FORM I-7 (Worsksheet B.3-1)
1. Is there a demand for harvested water (check all that apply) at the project site that is reliably present during the wet season? ☒ Toilet and urinal flushing ☒ Landscape irrigation ☐ Other:______________			
2. If there is a demand; estimate the anticipated average wet season demand over a period of 36 hours. Guidance for planning level demand calculations for toilet/urinal flushing and landscape irrigation is provided in Section B.3.2. Toilet / Urinal Flushing (9.3 gal/person-day) x (0.13368 cu-ft / gal) x (1.5 days) = 1.86 cu-ft / person - 36 hr Assume (3 person per house x 1 house) x (1.86 cu-ft / person - 36 hr)= 6 cu-ft/36 hr Landscape Irrigation (0.52 ac irrigated) x (1470 gal/ac-36 hr) x (0.13368 cu-ft/gal) = 102 cu-ft/ 36 hr TOTAL = 6 cu-ft + 102 cu-ft = 108 cu-ft			
3. Calculate the DCV using worksheet B-2.1. [Provide a result here] DCV = 976 cu-ft			
3a. Is the 36-hour demand greater than or equal to the DCV? Yes ⇩ / No ⇨ x	3b. Is the 36-hour demand greater than 0.25DCV but less than the full DCV? Yes ⇩ / No ⇨ x	3c. Is the 36-hour demand less than 0.25DCV? Yes ⇩	
Harvest and use appears to be feasible. Conduct more detailed evaluation and sizing calculations to confirm that DCV can be used at an adequate rate to meet drawdown criteria.	Harvest and use may be feasible. Conduct more detailed evaluation and sizing calculations to determine feasibility. Harvest and use may only be able to be used for a portion of the site, or (optionally) the storage may need to be upsized to meet long term capture targets while draining in longer than 36 hours.	Harvest and use is considered to be infeasible.	

Note: 36-hour demand calculations are for feasibility analysis only, once the feasibility analysis is complete the applicant may be allowed to use a different drawdown time provided they meet the 80 percent of average annual (long term) runoff volume performance standard.

Project Name: Encompass Health Chula Vista Hospital Site

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions	Form I-8A[1] (Worksheet C.4-1)
Part 1 - Full Infiltration Feasibility Screening Criteria	
DMA(s) Being Analyzed:	**Project Phase:**
See DMA Exhibit	Phase 1

Criteria 1: Infiltration Rate Screening	
1A	Is the mapped hydrologic soil group according to the NRCS Web Soil Survey or UC Davis Soil Web Mapper Type A or B and corroborated by available site soil data[2]? ☐ Yes; the DMA may feasibly support full infiltration. Answer "Yes" to Criteria 1 Result or continue to Step 1B if the applicant elects to perform infiltration testing. ☐ No; the mapped soil types are A or B but is not corroborated by available site soil data (continue to Step 1B). ☒ No; the mapped soil types are C, D, or "urban/unclassified" and is corroborated by available site soil data. Answer "No" to Criteria 1 Result. ☐ No; the mapped soil types are C, D, or "urban/unclassified" but is not corroborated by available site soil data (continue to Step 1B).
1B	Is the reliable infiltration rate calculated using planning phase methods from Table D.3-1? ☒ Yes; Continue to Step 1C. ☐ No; Skip to Step 1D.
1C	Is the reliable infiltration rate calculated using planning phase methods from Table D.3-1 greater than 0.5 inches per hour? ☐ Yes; the DMA may feasibly support full infiltration. Answer "Yes" to Criteria 1 Result. ☒ No; full infiltration is not required. Answer "No" to Criteria 1 Result.
1D	**Infiltration Testing Method.** Is the selected infiltration testing method suitable during the design phase (see Appendix D.3)? Note: Alternative testing standards may be allowed with appropriate rationales and documentation. ☐ Yes; continue to Step 1E. ☐ No; select an appropriate infiltration testing method.
1E	**Number of Percolation/Infiltration Tests.** Does the infiltration testing method performed satisfy the minimum number of tests specified in Table D.3-2? ☐ Yes; continue to Step 1F. ☐ No; conduct appropriate number of tests.

[1] This form must be completed each time there is a change to the site layout that would affect the infiltration feasibility condition. Previously completed forms shall be retained to document the evolution of the site storm water design.

[2] Available data includes site-specific sampling or observation of soil types or texture classes, such as obtained from borings or test pits necessary to support other design elements.

Encompass Health Chula Vista Hospital Site

Project Name: ____

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Form I-8A[1] (Worksheet C.4-1)
IF	**Factor of Safety.** Is the suitable Factor of Safety selected for full infiltration design? See guidance in D.5; Tables D.5-1 and D.5-2; and Worksheet D.5-1 (Form I-9). ☐ Yes; continue to Step 1G. ☐ No; select appropriate factor of safety.	
1G	**Full Infiltration Feasibility.** Is the average measured infiltration rate divided by the Factor of Safety greater than 0.5 inches per hour? ☐ Yes; answer "Yes" to Criteria 1 Result. ☐ No; answer "No" to Criteria 1 Result.	
Criteria 1 Result	Is the estimated reliable infiltration rate greater than 0.5 inches per hour within the DMA where runoff can reasonably be routed to a BMP? ☐ Yes; the DMA may feasibly support full infiltration. Continue to Criteria 2. ☒ No; full infiltration is not required. Skip to Part 1 Result.	
Summarize infiltration testing methods, testing locations, replicates, and results and summarize estimates of reliable infiltration rates according to procedures outlined in D.5. Documentation should be included in project geotechnical report.		
Criteria 2: Geologic/Geotechnical Screening		
2A	**If all questions in Step 2A are answered "Yes," continue to Step 2B.** For any "No" answer in Step 2A answer "No" to Criteria 2 and submit an "Infiltration Feasibility Condition Letter" that meets the requirements in Appendix C.1.1. The geologic/geotechnical analyses listed in Appendix C.2.1 do not apply to the DMA because one of the following setbacks cannot be avoided and therefore result in the DMA being in a no infiltration condition. The setbacks must be the closest horizontal radial distance from the surface edge (at the overflow elevation) of the BMP.	

Encompass Health Chula Vista Hospital Site

Project Name: ____

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Form I-8A[1] (Worksheet C.4-1)	
2A-1	Can the proposed full infiltration BMP(s) avoid areas with existing fill materials greater than 5 feet thick below the infiltrating surface?	☐ Yes	☒ No
2A-2	Can the proposed full infiltration BMP(s) avoid placement within 10 feet of existing underground utilities, structures, or retaining walls?	☐ Yes	☐ No
2A-3	Can the proposed full infiltration BMP(s) avoid placement within 50 feet of a natural slope (>25%) or within a distance of 1.5H from fill slopes where H is the height of the fill slope?	☐ Yes	☐ No
2B	When full infiltration is determined to be feasible, a geotechnical investigation report must be prepared that considers the relevant factors identified in Appendix C.2.1. If all questions in Step 2B are answered “Yes,” then answer “Yes” to Criteria 2 Result. If there are “No” answers continue to Step 2C.		
2B-1	**Hydroconsolidation.** Analyze hydroconsolidation potential per approved ASTM standard due to a proposed full infiltration BMP. Can full infiltration BMPs be proposed within the DMA without increasing hydroconsolidation risks?	☐ Yes	☐ No
2B-2	**Expansive Soils.** Identify expansive soils (soils with an expansion index greater than 20) and the extent of such soils due to proposed full infiltration BMPs. Can full infiltration BMPs be proposed within the DMA without increasing expansive soil risks?	☐ Yes	☐ No
2B-3	**Liquefaction**. If applicable, identify mapped liquefaction areas. Evaluate liquefaction hazards in accordance with Section 6.4.2 of the City of San Diego's Guidelines for Geotechnical Reports (2011 or most recent edition). Liquefaction hazard assessment shall take into account any increase in groundwater elevation or groundwater mounding that could occur as a result of proposed infiltration or percolation facilities. Can full infiltration BMPs be proposed within the DMA without increasing liquefaction risks?	☐ Yes	☐ No
2B-4	**Slope Stability**. If applicable, perform a slope stability analysis in accordance with the ASCE and Southern California Earthquake Center (2002) Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Landslide Hazards in California to determine minimum slope setbacks for full infiltration BMPs. See the City of San Diego's Guidelines for Geotechnical Reports (2011) to determine which type of slope stability analysis is required. Can full infiltration BMPs be proposed within the DMA without increasing slope stability risks?	☐ Yes	☐ No
2B-5	**Other Geotechnical Hazards.** Identify site-specific geotechnical hazards not already mentioned (refer to Appendix C.2.1). Can full infiltration BMPs be proposed within the DMA without increasing risk of geologic or geotechnical hazards not already mentioned?	☐ Yes	☐ No

Encompass Health Chula Vista Hospital Site

Project Name: ____

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions	Form I-8A[1] (Worksheet C.4-1)	
2B-6	**Setbacks.** Establish setbacks from underground utilities, structures, and/or retaining walls. Reference applicable ASTM or other recognized standard in the geotechnical report. Can full infiltration BMPs be proposed within the DMA using established setbacks from underground utilities, structures, and/or retaining walls?	☐ Yes	☐ No
2C	**Mitigation Measures.** Propose mitigation measures for each geologic/geotechnical hazard identified in Step 2B. Provide a discussion of geologic/geotechnical hazards that would prevent full infiltration BMPs that cannot be reasonably mitigated in the geotechnical report. See Appendix C.2.1.8 for a list of typically reasonable and typically unreasonable mitigation measures. Can mitigation measures be proposed to allow for full infiltration BMPs? If the question in Step 2 is answered "Yes," then answer "Yes" to Criteria 2 Result. If the question in Step 2C is answered "No," then answer "No" to Criteria 2 Result.	☐ Yes	☐ No
Criteria 2 Result	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of geologic or geotechnical hazards that cannot be reasonably mitigated to an acceptable level?	☐ Yes	☒ No
Summarize findings and basis; provide references to related reports or exhibits.			

Part 1 Result – Full Infiltration Geotechnical Screening [3]	**Result**
If answers to both Criteria 1 and Criteria 2 are "Yes", a full infiltration design is potentially feasible based on Geotechnical conditions only. If either answer to Criteria 1 or Criteria 2 is "No", a full infiltration design is not required.	☐ **Full infiltration Condition** ☒ **Complete Part 2**

[3] To be completed using gathered site information and best professional judgement considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by City Engineer to substantiate findings.

Encompass Health Chula Vista Hospital Site

Project Name: ____

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions	Form I-8A[1] (Worksheet C.4-1)
Part 2 – Partial vs. No Infiltration Feasibility Screening Criteria	
DMA(s) Being Analyzed:	**Project Phase:**
SEE DMA EXHIBIT	PHASE 1
Criteria 3 : Infiltration Rate Screening	

3A	**NRCS Type C, D, or "urban/unclassified":** Is the mapped hydrologic soil group according to the NRCS Web Soil Survey or UC Davis Soil Web Mapper is Type C, D, or "urban/unclassified" and corroborated by available site soil data? ☐ Yes; the site is mapped as C soils and a reliable infiltration rate of 0.15 in/hr. is used to size partial infiltration BMPS. Answer "Yes" to Criteria 3 Result. ☒ Yes; the site is mapped as D soils or "urban/unclassified" and a reliable infiltration rate of 0.05 in/hr. is used to size partial infiltration BMPS. Answer "Yes" to Criteria 3 Result. ☐ No; infiltration testing is conducted (refer to Table D.3-1), continue to Step 3B.
3B	**Infiltration Testing Result:** Is the reliable infiltration rate (i.e. average measured infiltration rate/2) greater than 0.05 in/hr. and less than or equal to 0.5 in/hr? ☒ Yes; the site may support partial infiltration. Answer "Yes" to Criteria 3 Result. ☐ No; the reliable infiltration rate (i.e. average measured rate/2) is less than 0.05 in/hr., partial infiltration is not required. Answer "No" to Criteria 3 Result.
Criteria 3 Result	Is the estimated reliable infiltration rate (i.e., average measured infiltration rate/2) greater than or equal to 0.05 inches/hour and less than or equal to 0.5 inches/hour at any location within each DMA where runoff can reasonably be routed to a BMP? ☒ Yes; Continue to Criteria 4. ☐ No: Skip to Part 2 Result.

Summarize infiltration testing and/or mapping results (i.e. soil maps and series description used for infiltration rate).

Project Name: Encompass Health Chula Vista Hospital Site

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions			Form I-8A[1] (Worksheet C.4-1)
Criteria 4: Geologic/Geotechnical Screening			
4A	If all questions in Step 4A are answered "Yes," continue to Step 2B. For any "No" answer in Step 4A answer "No" to Criteria 4 Result, and submit an "Infiltration Feasibility Condition Letter" that meets the requirements in Appendix C.1.1. The geologic/geotechnical analyses listed in Appendix C.2.1 do not apply to the DMA because one of the following setbacks cannot be avoided and therefore result in the DMA being in a no infiltration condition. The setbacks must be the closest horizontal radial distance from the surface edge (at the overflow elevation) of the BMP.		
4A-1	Can the proposed partial infiltration BMP(s) avoid areas with existing fill materials greater than 5 feet thick?	☐ Yes	☒ No
4A-2	Can the proposed partial infiltration BMP(s) avoid placement within 10 feet of existing underground utilities, structures, or retaining walls?	☐ Yes	☐ No
4A-3	Can the proposed partial infiltration BMP(s) avoid placement within 50 feet of a natural slope (>25%) or within a distance of 1.5H from fill slopes where H is the height of the fill slope?	☐ Yes	☐ No
4B	When full infiltration is determined to be feasible, a geotechnical investigation report must be prepared that considers the relevant factors identified in Appendix C.2.1. If all questions in Step 4B are answered "Yes," then answer "Yes" to Criteria 4 Result. If there are any "No" answers continue to Step 4C.		
4B-1	**Hydroconsolidation.** Analyze hydroconsolidation potential per approved ASTM standard due to a proposed full infiltration BMP. Can partial infiltration BMPs be proposed within the DMA without increasing hydroconsolidation risks?	☐ Yes	☐ No
4B-2	**Expansive Soils.** Identify expansive soils (soils with an expansion index greater than 20) and the extent of such soils due to proposed full infiltration BMPs. Can partial infiltration BMPs be proposed within the DMA without increasing expansive soil risks?	☐ Yes	☐ No
4B-3	**Liquefaction**. If applicable, identify mapped liquefaction areas. Evaluate liquefaction hazards in accordance with Section 6.4.2 of the City of San Diego's Guidelines for Geotechnical Reports (2011). Liquefaction hazard assessment shall take into account any increase in groundwater elevation or groundwater mounding that could occur as a result of proposed infiltration or percolation facilities. Can partial infiltration BMPs be proposed within the DMA without increasing liquefaction risks?	☐ Yes	☐ No

Encompass Health Chula Vista Hospital Site

Project Name: ____

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Form I-8A[1] (Worksheet C.4-1)	
4B-4	**Slope Stability**. If applicable, perform a slope stability analysis in accordance with the ASCE and Southern California Earthquake Center (2002) Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Landslide Hazards in California to determine minimum slope setbacks for full infiltration BMPs. See the City of San Diego's Guidelines for Geotechnical Reports (2011) to determine which type of slope stability analysis is required. Can partial infiltration BMPs be proposed within the DMA without increasing slope stability risks?	☐ Yes	☐ No
4B-5	**Other Geotechnical Hazards.** Identify site-specific geotechnical hazards not already mentioned (refer to Appendix C.2.1). Can partial infiltration BMPs be proposed within the DMA without increasing risk of geologic or geotechnical hazards not already mentioned?	☐ Yes	☐ No
4B-6	**Setbacks.** Establish setbacks from underground utilities, structures, and/or retaining walls. Reference applicable ASTM or other recognized standard in the geotechnical report. Can partial infiltration BMPs be proposed within the DMA using recommended setbacks from underground utilities, structures, and/or retaining walls?	☐ Yes	☐ No
4C	**Mitigation Measures.** Propose mitigation measures for each geologic/geotechnical hazard identified in Step 4B. Provide a discussion on geologic/geotechnical hazards that would prevent partial infiltration BMPs that cannot be reasonably mitigated in the geotechnical report. See Appendix C.2.1.8 for a list of typically reasonable and typically unreasonable mitigation measures. Can mitigation measures be proposed to allow for partial infiltration BMPs? If the question in Step 4C is answered "Yes," then answer "Yes" to Criteria 4 Result. If the question in Step 4C is answered "No," then answer "No" to Criteria 4 Result.	☐ Yes	☐ No
Criteria 4 Result	Can infiltration of greater than or equal to 0.05 inches/hour and less than or equal to 0.5 inches/hour be allowed without increasing the risk of geologic or geotechnical hazards that cannot be reasonably mitigated to an acceptable level?	☐ Yes	☒ No

Project Name: Encompass Health Chula Vista Hospital Site

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions	Form I-8A[1] (Worksheet C.4-1)
Summarize findings and basis; provide references to related reports or exhibits.	
Part 2 – Partial Infiltration Geotechnical Screening Result[4]	**Result**
If answers to both Criteria 3 and Criteria 4 are "Yes", a partial infiltration design is potentially feasible based on geotechnical conditions only. If answers to either Criteria 3 or Criteria 4 is "No", then infiltration of any volume is considered to be infeasible within the site.	☐ **Partial Infiltration Condition** ☒ **No Infiltration Condition**

[4] To be completed using gathered site information and best professional judgement considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by City Engineer to substantiate findings.

Project Name/ Encompass Health Chula Vista Hospital Site

ATTACHMENT 2

Backup for PDP Hydromodification Control Measures

☒ Mark this box if this attachment is empty because the project is exempt from PDP hydromodification management requirements.

Project Name/ Encompass Health Chula Vista Hospital Site

Indicate which Items are Included

Attachment Sequence	Contents	Checklist
Attachment 2A	Hydromodification Management Exhibit (Required)	Included See Hydromodification Management Exhibit Checklist.
Attachment 2B	Management of Critical Coarse Sediment Yield Areas (WMAA Exhibit is required, additional analyses are optional) See Section 6.2 of the BMP Design Manual.	☐ Exhibit showing project drainage boundaries marked on WMAA Critical Coarse Sediment Yield Area Map **(Required)** Optional analyses for Critical Coarse Sediment Yield Area Determination ☐ 6.2.1 Verification of Geomorphic Landscape Units Onsite ☐ 6.2.2 Downstream Systems Sensitivity to Coarse Sediment ☐ 6.2.3 Optional Additional Analysis of Potential Critical Coarse Sediment Yield Areas Onsite
Attachment 2C	Geomorphic Assessment of Receiving Channels (Optional) See Section 6.3.4 of the BMP Design Manual.	☐ Not performed ☐ Included ☐ Submitted as separate stand-alone document
Attachment 2D	Flow Control Facility Design and Structural BMP Drawdown Calculations (Required) Overflow Design Summary for each Structural BMP See Chapter 6 and Appendix G of the BMP Design Manual	☐ Included ☐ Submitted as separate stand-alone document

Project Name/ Encompass Health Chula Vista Hospital Site

Use this checklist to ensure the required information has been included on the Hydromodification Management Exhibit:

The Hydromodification Management Exhibit must identify:

- ☐ Underlying hydrologic soil group
- ☐ Approximate depth to groundwater
- ☐ Existing natural hydrologic features (watercourses, seeps, springs, wetlands)
- ☐ Critical coarse sediment yield areas to be protected
- ☐ Existing topography
- ☐ Existing and proposed site drainage network and connections to drainage offsite
- ☐ Proposed grading
- ☐ Proposed impervious features
- ☐ Proposed design features and surface treatments used to minimize imperviousness
- ☐ Point(s) of Compliance (POC) for Hydromodification Management Hydromodification Management, with a POC at each point of discharge
- ☐ Existing and proposed drainage boundary and drainage area to each POC (when necessary, create separate exhibits for pre-development and post-project conditions)
- ☐ Structural BMPs for hydromodification management (identify location, type of BMP, cross-section and size/detail)

ATTACHMENT 3

Structural BMP Maintenance Information
Hydromodification Control Measures

Encompass Health Chula Vista Hospital Site

Project Name/____

Use this checklist to ensure the required information has been included in the Structural BMP Maintenance Information Attachment:

Attachment 3: For private entity operation and maintenance, Attachment 3 must include a Storm Water Management Facilities Maintenance Agreement with Grant of Access and Covenant's ("Maintenance Agreement") Template can be found at the following link (also refer to Chapter 8.2.1 for more information's):

The following information must be included in the exhibits attached to the Maintenance Agreement:

- ☐ Vicinity map (Depiction of Project Site)
- ☐ Legal Description for Project Site
- ☐ Site design BMPs for which DCV reduction is claimed for meeting the pollutant

  control obligations.
- ☐ BMP and HMP type, location, type, manufacture model, and dimensions, specifications, cross section

  LID features such as (permeable paver and LS location, dim, SF).
- ☐ aintenance recommendations and frequency

ATTACHMENT 4

Copy of Plan Sheets Showing Permanent Storm Water BMPs

Project Name/ Encompass Health Chula Vista Hospital Site

Use this checklist to ensure the required information has been included on the plans:

The plans must identify:

- [x] Structural BMP(s) with ID numbers matching Form I-6 Summary of PDP Structural BMPs
- [x] The grading and drainage design shown on the plans must be consistent with the delineation of DMAs shown on the DMA exhibit
- [x] Details and specifications for construction of structural BMP(s)
- [x] Signage indicating the location and boundary of structural BMP(s) as required by the City Engineer
- [x] How to access the structural BMP(s) to inspect and perform maintenance
- [x] Features that are provided to facilitate inspection (e.g., observation ports, cleanouts, silt posts, or other features that allow the inspector to view necessary components of the structural BMP and compare to maintenance thresholds)
- [x] Manufacturer and part number for proprietary parts of structural BMP(s) when applicable
- [x] Maintenance thresholds specific to the structural BMP(s), with a location-specific frame of reference (e.g., level of accumulated materials that triggers removal of the materials, to be identified based on viewing marks on silt posts or measured with a survey rod with respect to a fixed benchmark within the BMP)
- [x] Recommended equipment to perform maintenance
- [x] When applicable, necessary special training or certification requirements for inspection and maintenance personnel such as confined space entry or hazardous waste management
- [x] Include landscaping plan sheets showing vegetation requirements for vegetated structural BMP(s)
- [ ] All BMPs must be fully dimensioned on the plans
- [ ] When proprietary BMPs are used, site specific cross section with outflow, inflow and model number shall be provided. Broucher photocopies are not allowed.

Encompass Health Chula Vista Hospital Site

Project Name/____

ATTACHMENT 5

Drainage Report

Attach project's drainage report. Refer to the Subdivision Manual to determine the reporting requirements.

PRELIMINARY DRAINAGE REPORT

For

Encompass Health Hospice Site

517 Shinohara Lane

Chula Vista, CA 91911

Prepared for:

Encompass Health

9001 Liberty Parkway

Birmingham, Alabama 35242

Prepared by:

APD Consultants, Inc.

22362 Gilberto, # 245

Rancho Santa Margarita, CA 92688

(949) 336-6336

Robbie Mahmood, P.E.

Principal

Prepared date:

May 30, 2019

Revised date:

July 21, 2020

Page Number

Section 1 – Executive Summary

1.1 Introduction

The proposed Encompass Health Hospital development site is located in an undeveloped parcel in Chula Vista, CA. The property lot is somewhat rectangular in shape and surrounded by existing Commercial buildings to the east and south, and existing residential development to the north and west of the property.

The owner plans to construct a one story Hospital building of roughly 130,000 sf building footprint, parking lots, loading docks, wet and dry utilities and other related construction.

The purpose of this report is to 1) quantify the onsite storm water discharge rate for 100-year storm event, 2) quantify the 100-year 6-hr peak flow and storm volume using the synthetic unit hydrograph, 3) attenuate the peak flow of the developed to that of the existing condition 4) confirm that the storm drain system are capable of intercepting and conveying the 100-year storm.

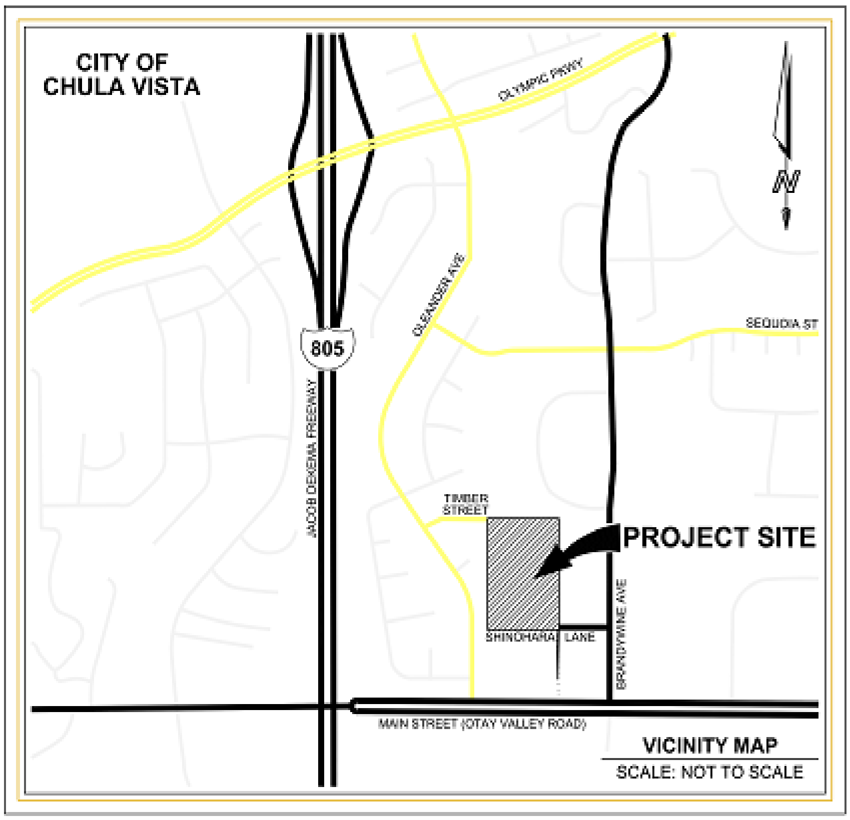
1.2 Summary of Existing Condition

Project site is undeveloped. Figure 1 presents the project site and location of the site. Figure 2 presents the existing condition of the site and the existing site condition surrounding the project site. Historical information gathered as shown in the Geotechnical Report, Page 5, dated March 25, 2019, by Partner Engineering, shows that the property has some site improvements such has grading, drainage and hydroseeding.

The Project site generally drains in the southeast direction. Based on the geotechnical report, page 7, the groundwater is anticipated to be 40-85 feet below ground surface.

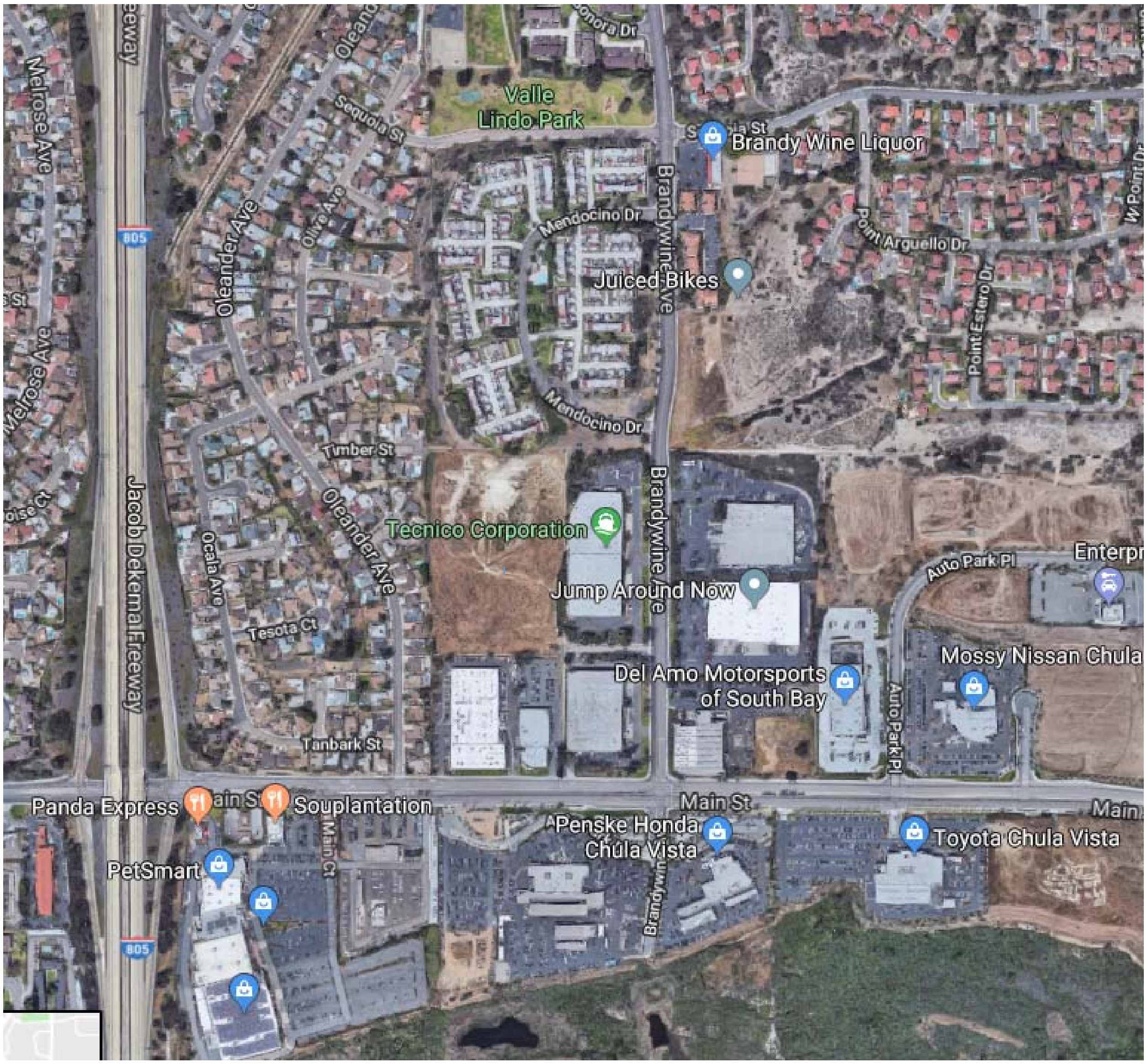
There are 2 existing concrete brow ditch. The 1st brow ditch is located off-site of the southerly boundary. It is a semi-circle about 1foot deep and it presently intercepts on-site flow. The stormwater conveyed in the semi-circle brow ditch will continue to flow to an existing brow ditch running north-south parallel to the alley located south of the project. For the proposed condition of the project, new channels will be constructed to intercept and convey onsite flow. The 2nd brow ditch is located around the middle of the project and will be removed and disposed.

Figure 1



Vicinity Map

Figure 2



LOCATION MAP

1.3 Summary of Proposed Condition

The Developed Condition of the project will generally match the existing drainage condition of the project site. The runoff for the site will discharge southeast of the site through proposed local storm drain system.

In the proposed condition, the off-site brow ditch will not be utilized. Instead, a proposed brow ditch type A SDR SD D-75 will be constructed on-site to intercept and convey flow from the site out to a proposed 176 ft of concrete rectangular channel, 3ft wide x 4.5 ft maximum height, along the alley.

From the proposed channel, the stormwater from the proposed project site will then continue to flow to Main St. An existing catchbasin will capture flow from Main St. and stormwater will be conveyed via Stormdrain pipe until it reaches Otay River.

Per preliminary discussion with the city, the project will match the existing 100 year storm for the site. This will be accomplished through the proposed underground storage which will detail the flow to existing.

The site is found to be not favorable for infiltration structures. The project proposes to treat runoff through proposed Modular Wetland System. A separate report will be submitted to show compliance to Stormwater Treatment requirements.

1.4 Summary of Results

Table 1 below shows the summary of the existing the proposed peak flows from the site.

Table 2 below shows the summary of pre development condition vs routed condition

Table 1 – Summary of 100 –Year Peak Flows and Unit Hydrograph Volumes

	Pre Development	**Post Development**		
		Upper Drainage Area	Lower Drainage Area	Total
Q Peak flow (cfs)	19.4	24.7	8.0	32.7
Storm Volume (cu-ft)	63,501	45,963	27,018	72,981

Table 2 – Summary of 100 –Year Peak flows for pre development and routed flows

	Pre Development	**Post Development**		
		Routed Upper Drainage Area	Lower Drainage Area	Total
Q Peak flow (cfs)	19.4	4.3	8.0	12.3
Storm Volume (cu-ft)	63,501	-	-	-

Section 2 – 100 Year Peak Flow Results (Q_{100})

```
****************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
         (c) Copyright 1982-2003 Advanced Engineering Software (aes)






 ************************** DESCRIPTION OF STUDY **************************
* Encompass Health Chula Vista                                             *
* existing condition                                                       *
* 100 year storm                                                           *
 **************************************************************************

  FILE NAME: VISTAX.DAT
  TIME/DATE OF STUDY: 12:38 07/19/2020
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.500
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: CONSIDER ALL CONFLUENCE STREAM COMBINATIONS
        FOR ALL DOWNSTREAM ANALYSES
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow D00epth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE      2.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  OPEN BRUSH FAIR COVER RUNOFF COEFFICIENT = .3500
  SOIL CLASSIFICATION IS "D"
  S.C.S. CURVE NUMBER (AMC II) =  83
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   998.00
  UPSTREAM ELEVATION(FEET) =    254.00
  DOWNSTREAM ELEVATION(FEET) =    152.00
  ELEVATION DIFFERENCE(FEET) =    102.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.267
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =   100.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.694
  SUBAREA RUNOFF(CFS) =     19.13
  TOTAL AREA(ACRES) =      9.60   TOTAL RUNOFF(CFS) =     19.13
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =      9.60  TC(MIN.) =      6.27
```

```
  PEAK FLOW RATE(CFS)   =     19.13
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
         (c) Copyright 1982-2003 Advanced Engineering Software (aes)



 ************************** DESCRIPTION OF STUDY **************************
* Encompass Health Chula Vista                                             *
* 100-year storm                                                           *
*                                                                          *
 **************************************************************************

  FILE NAME: VISTA.DAT
  TIME/DATE OF STUDY: 19:29 07/18/2020
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.300
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: CONSIDER ALL CONFLUENCE STREAM COMBINATIONS
        FOR ALL DOWNSTREAM ANALYSES
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN- / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE      2.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  OPEN BRUSH FAIR COVER RUNOFF COEFFICIENT = .3500
  SOIL CLASSIFICATION IS "D"
  S.C.S. CURVE NUMBER (AMC II) =  83
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   283.00
  UPSTREAM ELEVATION(FEET) =    257.00
  DOWNSTREAM ELEVATION(FEET) =    223.00
  ELEVATION DIFFERENCE(FEET) =     34.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.267
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =   100.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.239
  SUBAREA RUNOFF(CFS) =      0.48
  TOTAL AREA(ACRES) =      0.26   TOTAL RUNOFF(CFS) =      0.48

****************************************************************************
  FLOW PROCESS FROM NODE      2.00 TO NODE      5.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
```

```
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    223.00  DOWNSTREAM(FEET) =    194.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =    64.00   CHANNEL SLOPE =  0.4453
  CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   2.00
  CHANNEL FLOW THRU SUBAREA(CFS) =      0.48
  FLOW VELOCITY(FEET/SEC.) =  10.91   FLOW DEPTH(FEET) =   0.15
  TRAVEL TIME(MIN.) =   0.10   Tc(MIN.) =   6.36
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      5.00 =   347.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      5.00 TO NODE      5.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   6.36
  RAINFALL INTENSITY(INCH/HR) =   5.19
  TOTAL STREAM AREA(ACRES) =     0.26
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.48

****************************************************************************
  FLOW PROCESS FROM NODE      5.10 TO NODE      5.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  OPEN BRUSH FAIR COVER RUNOFF COEFFICIENT = .3500
  SOIL CLASSIFICATION IS "D"
  S.C.S. CURVE NUMBER (AMC II) =  83
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   253.00
  UPSTREAM ELEVATION(FEET) =    234.00
  DOWNSTREAM ELEVATION(FEET) =    194.50
  ELEVATION DIFFERENCE(FEET) =     39.50
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.267
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =   100.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.239
  SUBAREA RUNOFF(CFS) =      0.48
  TOTAL AREA(ACRES) =      0.26   TOTAL RUNOFF(CFS) =      0.48

****************************************************************************
  FLOW PROCESS FROM NODE      5.00 TO NODE      5.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   6.27
  RAINFALL INTENSITY(INCH/HR) =   5.24
  TOTAL STREAM AREA(ACRES) =     0.26
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.48

  ** CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY      AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)    (ACRE)
      1        0.48     6.36        5.187          0.26
      2        0.48     6.27        5.239          0.26

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1        0.95     6.27       5.239
      2        0.95     6.36       5.187
```

```
  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      0.95   Tc(MIN.) =    6.36
  TOTAL AREA(ACRES) =      0.52
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      5.00 =   347.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      5.00 TO NODE      6.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   190.00  DOWNSTREAM(FEET) =   188.09
  FLOW LENGTH(FEET) =    19.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   2.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.18
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      0.95
  PIPE TRAVEL TIME(MIN.) =   0.04    Tc(MIN.) =    6.40
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      6.00 =   366.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      6.00 TO NODE      6.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   6.40
  RAINFALL INTENSITY(INCH/HR) =   5.17
  TOTAL STREAM AREA(ACRES) =     0.52
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.95

****************************************************************************
  FLOW PROCESS FROM NODE      6.10 TO NODE      6.20 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  OPEN BRUSH FAIR COVER RUNOFF COEFFICIENT = .3500
  SOIL CLASSIFICATION IS "D"
  S.C.S. CURVE NUMBER (AMC II) =  83
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   185.00
  UPSTREAM ELEVATION(FEET) =    240.00
  DOWNSTREAM ELEVATION(FEET) =    206.50
  ELEVATION DIFFERENCE(FEET) =     33.50
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.267
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =   100.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.239
  SUBAREA RUNOFF(CFS) =      0.26
  TOTAL AREA(ACRES) =      0.14   TOTAL RUNOFF(CFS) =      0.26

****************************************************************************
  FLOW PROCESS FROM NODE      6.20 TO NODE      6.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   204.00  DOWNSTREAM(FEET) =   188.09
  FLOW LENGTH(FEET) =   130.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   1.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.92
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      0.26
  PIPE TRAVEL TIME(MIN.) =   0.37    Tc(MIN.) =    6.63
  LONGEST FLOWPATH FROM NODE      6.10 TO NODE      6.00 =   315.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE      6.00 TO NODE      6.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   6.63
  RAINFALL INTENSITY(INCH/HR) =   5.05
  TOTAL STREAM AREA(ACRES) =     0.14
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.26

  ** CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY      AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)    (ACRE)
      1        0.95     6.31        5.218         0.52
      1        0.95     6.40        5.166         0.52
      2        0.26     6.63        5.050         0.14

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1        1.19     6.31       5.218
      2        1.20     6.40       5.166
      3        1.18     6.63       5.050

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      1.20   Tc(MIN.) =    6.40
  TOTAL AREA(ACRES) =      0.66
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      6.00 =   366.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      6.00 TO NODE      9.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   188.09  DOWNSTREAM(FEET) =   182.82
  FLOW LENGTH(FEET) =    78.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   2.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.61
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      1.20
  PIPE TRAVEL TIME(MIN.) =   0.17    Tc(MIN.) =   6.57
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      9.00 =   444.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      9.00 TO NODE      9.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE      8.10 TO NODE      8.20 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  OPEN BRUSH FAIR COVER RUNOFF COEFFICIENT = .3500
  SOIL CLASSIFICATION IS "D"
  S.C.S. CURVE NUMBER (AMC II) =  83
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   275.00
  UPSTREAM ELEVATION(FEET) =    257.27
  DOWNSTREAM ELEVATION(FEET) =    190.33
  ELEVATION DIFFERENCE(FEET) =     66.94
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.267
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
```

```
          THE MAXIMUM OVERLAND FLOW LENGTH =   100.00
          (Reference: Table 3-1B of Hydrology Manual)
          THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.239
  SUBAREA RUNOFF(CFS) =      0.79
  TOTAL AREA(ACRES) =      0.43   TOTAL RUNOFF(CFS) =      0.79

****************************************************************************
  FLOW PROCESS FROM NODE      8.20 TO NODE      8.00 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =    190.33
  DOWNSTREAM NODE ELEVATION(FEET) =    188.88
  CHANNEL LENGTH THRU SUBAREA(FEET) =   147.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.120
  PAVEMENT LIP(FEET) =  0.030   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.01800
  MAXIMUM DEPTH(FEET) =   0.50
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.717
  OFFICE PROFESSIONAL/COMMERCIAL RUNOFF COEFFICIENT = .8500
  SOIL CLASSIFICATION IS "D"
  S.C.S. CURVE NUMBER (AMC II) =  96
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      1.71
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.21
  AVERAGE FLOW DEPTH(FEET) =   0.22   FLOOD WIDTH(FEET) =   10.98
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   1.11   Tc(MIN.) =   7.37
  SUBAREA AREA(ACRES) =    0.46       SUBAREA RUNOFF(CFS) =    1.84
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.608
  TOTAL AREA(ACRES) =      0.89         PEAK FLOW RATE(CFS) =       2.55

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.25   FLOOD WIDTH(FEET) =   14.01
  FLOW VELOCITY(FEET/SEC.) =   2.29   DEPTH*VELOCITY(FT*FT/SEC) =   0.57
  LONGEST FLOWPATH FROM NODE      8.10 TO NODE      8.00 =   422.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      8.00 TO NODE      8.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   7.37
  RAINFALL INTENSITY(INCH/HR) =   4.72
  TOTAL STREAM AREA(ACRES) =     0.89
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.55

****************************************************************************
  FLOW PROCESS FROM NODE      8.30 TO NODE      8.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  OFFICE PROFESSIONAL/COMMERCIAL RUNOFF COEFFICIENT = .8500
  SOIL CLASSIFICATION IS "D"
  S.C.S. CURVE NUMBER (AMC II) =  96
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   235.00
  UPSTREAM ELEVATION(FEET) =    201.70
  DOWNSTREAM ELEVATION(FEET) =    188.88
  ELEVATION DIFFERENCE(FEET) =     12.82
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.437
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
          THE MAXIMUM OVERLAND FLOW LENGTH =    90.91
          (Reference: Table 3-1B of Hydrology Manual)
          THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.060
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      2.68
  TOTAL AREA(ACRES) =      0.52   TOTAL RUNOFF(CFS) =      2.68

****************************************************************************
```

```
 FLOW PROCESS FROM NODE      8.00 TO NODE      8.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =   2.44
 RAINFALL INTENSITY(INCH/HR) =   6.06
 TOTAL STREAM AREA(ACRES) =     0.52
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.68

 ** CONFLUENCE DATA **
 STREAM     RUNOFF      Tc      INTENSITY      AREA
 NUMBER      (CFS)    (MIN.)   (INCH/HOUR)    (ACRE)
    1        2.55     7.37        4.717          0.89
    2        2.68     2.44        6.060          0.52

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
 STREAM     RUNOFF      Tc      INTENSITY
 NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
    1        3.52     2.44       6.060
    2        4.64     7.37       4.717

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      4.64   Tc(MIN.) =    7.37
 TOTAL AREA(ACRES) =      1.41
 LONGEST FLOWPATH FROM NODE      8.10 TO NODE      8.00 =   422.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      8.00 TO NODE      8.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.717
 NEIGHBORHOOD COMMERCIAL RUNOFF COEFFICIENT = .7900
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  94
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.7370
 SUBAREA AREA(ACRES) =    1.05   SUBAREA RUNOFF(CFS) =    3.91
 TOTAL AREA(ACRES) =      2.46   TOTAL RUNOFF(CFS) =    8.55
 TC(MIN.) =   7.37
 ** PEAK FLOW RATE TABLE **
 STREAM   RUNOFF       Tc
 NUMBER    (CFS)     (MIN.)
   1      10.99       2.44
   2        8.55       7.37
 NEW PEAK FLOW DATA ARE:
 PEAK FLOW RATE(CFS) =    10.99  Tc(MIN.) =   2.44

****************************************************************************
 FLOW PROCESS FROM NODE      8.00 TO NODE      9.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   184.63  DOWNSTREAM(FEET) =   182.82
 FLOW LENGTH(FEET) =   167.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  21.0 INCH PIPE IS  12.7 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   7.20
 ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =     10.99
 PIPE TRAVEL TIME(MIN.) =   0.39    Tc(MIN.) =   2.82
 LONGEST FLOWPATH FROM NODE      8.10 TO NODE      9.00 =   589.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      9.00 TO NODE      9.00 IS CODE =  11
----------------------------------------------------------------------------
```

```
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
  STREAM     RUNOFF     Tc      INTENSITY     AREA
  NUMBER      (CFS)   (MIN.)   (INCH/HOUR)   (ACRE)
      1       10.99     2.82       6.060        2.46
      2        8.55     7.79       4.553        2.46
  LONGEST FLOWPATH FROM NODE      8.10 TO NODE      9.00 =   589.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM     RUNOFF     Tc      INTENSITY     AREA
  NUMBER      (CFS)   (MIN.)   (INCH/HOUR)   (ACRE)
      1        1.19     6.48       5.128        0.66
      2        1.20     6.57       5.079        0.66
      3        1.18     6.80       4.967        0.66
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      9.00 =   444.00 FEET.

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
      1      11.51       2.82        6.060
      2      10.49       6.48        5.128
      3      10.41       6.57        5.079
      4      10.19       6.80        4.967
      5       9.64       7.79        4.553

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =     11.51   Tc(MIN.) =    2.82
  TOTAL AREA(ACRES) =      3.12

****************************************************************************
  FLOW PROCESS FROM NODE      9.00 TO NODE      7.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   182.82  DOWNSTREAM(FEET) =   182.42
  FLOW LENGTH(FEET) =    45.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  14.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.71
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     11.51
  PIPE TRAVEL TIME(MIN.) =   0.11    Tc(MIN.) =   2.94
  LONGEST FLOWPATH FROM NODE      8.10 TO NODE      7.00 =   634.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      7.00 TO NODE      7.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   2.94
  RAINFALL INTENSITY(INCH/HR) =   6.06
  TOTAL STREAM AREA(ACRES) =     3.12
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     11.51

****************************************************************************
  FLOW PROCESS FROM NODE      7.20 TO NODE      7.10 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  OPEN BRUSH FAIR COVER RUNOFF COEFFICIENT = .3500
  SOIL CLASSIFICATION IS "D"
  S.C.S. CURVE NUMBER (AMC II) =  83
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   220.00
  UPSTREAM ELEVATION(FEET) =    225.00
  DOWNSTREAM ELEVATION(FEET) =    190.13
  ELEVATION DIFFERENCE(FEET) =     34.87
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.267
```

```
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =   100.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.239
  SUBAREA RUNOFF(CFS) =      0.50
  TOTAL AREA(ACRES) =      0.27   TOTAL RUNOFF(CFS) =      0.50

****************************************************************************
  FLOW PROCESS FROM NODE      7.10 TO NODE      7.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   186.78  DOWNSTREAM(FEET) =   182.42
  FLOW LENGTH(FEET) =    16.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   1.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   9.46
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      0.50
  PIPE TRAVEL TIME(MIN.) =   0.03    Tc(MIN.) =   6.29
  LONGEST FLOWPATH FROM NODE      7.20 TO NODE      7.00 =   236.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      7.00 TO NODE      7.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   6.29
  RAINFALL INTENSITY(INCH/HR) =   5.22
  TOTAL STREAM AREA(ACRES) =     0.27
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.50

  ** CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY      AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)    (ACRE)
      1       11.51     2.94        6.060         3.12
      1       10.49     6.59        5.071         3.12
      1       10.41     6.69        5.023         3.12
      1       10.19     6.92        4.914         3.12
      1        9.64     7.91        4.508         3.12
      2        0.50     6.29        5.223         0.27

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1       11.74     2.94       6.060
      2       10.68     6.29       5.223
      3       10.97     6.59       5.071
      4       10.88     6.69       5.023
      5       10.66     6.92       4.914
      6       10.06     7.91       4.508

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =     11.74   Tc(MIN.) =    2.94
  TOTAL AREA(ACRES) =      3.39
  LONGEST FLOWPATH FROM NODE      8.10 TO NODE      7.00 =   634.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      7.00 TO NODE     10.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
```

```
  ELEVATION DATA: UPSTREAM(FEET) =   182.42  DOWNSTREAM(FEET) =   179.89
  FLOW LENGTH(FEET) =   265.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  13.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.93
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     11.74
  PIPE TRAVEL TIME(MIN.) =   0.64    Tc(MIN.) =   3.57
  LONGEST FLOWPATH FROM NODE      8.10 TO NODE     10.00 =   899.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE     10.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   3.57
  RAINFALL INTENSITY(INCH/HR) =   6.06
  TOTAL STREAM AREA(ACRES) =     3.39
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     11.74

****************************************************************************
  FLOW PROCESS FROM NODE     10.20 TO NODE     10.10 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  OPEN BRUSH FAIR COVER RUNOFF COEFFICIENT = .3500
  SOIL CLASSIFICATION IS "D"
  S.C.S. CURVE NUMBER (AMC II) =  83
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   207.00
  UPSTREAM ELEVATION(FEET) =    204.00
  DOWNSTREAM ELEVATION(FEET) =    186.07
  ELEVATION DIFFERENCE(FEET) =     17.93
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.574
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =   100.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.079
  SUBAREA RUNOFF(CFS) =      0.21
  TOTAL AREA(ACRES) =      0.12   TOTAL RUNOFF(CFS) =      0.21

****************************************************************************
  FLOW PROCESS FROM NODE     10.10 TO NODE     10.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   6.57
  RAINFALL INTENSITY(INCH/HR) =   5.08
  TOTAL STREAM AREA(ACRES) =     0.12
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.21

****************************************************************************
  FLOW PROCESS FROM NODE     10.40 TO NODE     10.30 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  OFFICE PROFESSIONAL/COMMERCIAL RUNOFF COEFFICIENT = .8500
  SOIL CLASSIFICATION IS "D"
  S.C.S. CURVE NUMBER (AMC II) =  96
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   392.00
  UPSTREAM ELEVATION(FEET) =    194.07
  DOWNSTREAM ELEVATION(FEET) =    188.71
  ELEVATION DIFFERENCE(FEET) =      5.36
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.235
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    63.67
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
```

```
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.060
NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
SUBAREA RUNOFF(CFS) =      1.91
TOTAL AREA(ACRES) =      0.37   TOTAL RUNOFF(CFS) =      1.91

****************************************************************************
FLOW PROCESS FROM NODE     10.30 TO NODE     10.30 IS CODE =  81
----------------------------------------------------------------------------
>>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.060
NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
OFFICE PROFESSIONAL/COMMERCIAL RUNOFF COEFFICIENT = .8500
SOIL CLASSIFICATION IS "D"
S.C.S. CURVE NUMBER (AMC II) =  96
AREA-AVERAGE RUNOFF COEFFICIENT = 0.8500
SUBAREA AREA(ACRES) =    0.28   SUBAREA RUNOFF(CFS) =    1.44
TOTAL AREA(ACRES) =      0.65   TOTAL RUNOFF(CFS) =    3.35
TC(MIN.) =   3.24

****************************************************************************
FLOW PROCESS FROM NODE     10.30 TO NODE     10.00 IS CODE =  31
----------------------------------------------------------------------------
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
ELEVATION DATA: UPSTREAM(FEET) =   180.48  DOWNSTREAM(FEET) =   179.89
FLOW LENGTH(FEET) =     9.00   MANNING'S N =  0.013
ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
DEPTH OF FLOW IN  18.0 INCH PIPE IS   4.3 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) =  10.18
ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
PIPE-FLOW(CFS) =      3.35
PIPE TRAVEL TIME(MIN.) =   0.01    Tc(MIN.) =   3.25
LONGEST FLOWPATH FROM NODE     10.40 TO NODE     10.00 =   401.00 FEET.

****************************************************************************
FLOW PROCESS FROM NODE     10.00 TO NODE     10.00 IS CODE =   1
----------------------------------------------------------------------------
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
>>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
TOTAL NUMBER OF STREAMS =  3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  3 ARE:
TIME OF CONCENTRATION(MIN.) =   3.25
RAINFALL INTENSITY(INCH/HR) =   6.06
TOTAL STREAM AREA(ACRES) =     0.65
PEAK FLOW RATE(CFS) AT CONFLUENCE =      3.35
```

** CONFLUENCE DATA **

STREAM NUMBER	RUNOFF (CFS)	Tc (MIN.)	INTENSITY (INCH/HOUR)	AREA (ACRE)
1	11.74	3.57	6.060	3.39
1	10.68	6.94	4.903	3.39
1	10.97	7.24	4.774	3.39
1	10.88	7.33	4.733	3.39
1	10.66	7.57	4.638	3.39
1	10.06	8.57	4.282	3.39
2	0.21	6.57	5.079	0.12
3	3.35	3.25	6.060	0.65

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
CONFLUENCE FORMULA USED FOR 3 STREAMS.

** PEAK FLOW RATE TABLE **

STREAM NUMBER	RUNOFF (CFS)	Tc (MIN.)	INTENSITY (INCH/HOUR)
1	15.19	3.25	6.060
2	15.20	3.57	6.060
3	13.33	6.57	5.079
4	13.59	6.94	4.903

```
     5       13.81     7.24       4.774
     6       13.70     7.33       4.733
     7       13.41     7.57       4.638
     8       12.61     8.57       4.282

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =     15.20   Tc(MIN.) =    3.57
  TOTAL AREA(ACRES) =      4.16
  LONGEST FLOWPATH FROM NODE      8.10 TO NODE     10.00 =   899.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE     12.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   179.89  DOWNSTREAM(FEET) =   168.59
  FLOW LENGTH(FEET) =   228.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  10.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  13.81
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     15.20
  PIPE TRAVEL TIME(MIN.) =   0.28    Tc(MIN.) =   3.85
  LONGEST FLOWPATH FROM NODE      8.10 TO NODE     12.00 =  1127.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     12.00 TO NODE     12.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   3.85
  RAINFALL INTENSITY(INCH/HR) =   6.06
  TOTAL STREAM AREA(ACRES) =     4.16
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     15.20

****************************************************************************
  FLOW PROCESS FROM NODE     11.10 TO NODE     11.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  OFFICE PROFESSIONAL/COMMERCIAL RUNOFF COEFFICIENT = .8500
  SOIL CLASSIFICATION IS "D"
  S.C.S. CURVE NUMBER (AMC II) =  96
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   497.00
  UPSTREAM ELEVATION(FEET) =    190.17
  DOWNSTREAM ELEVATION(FEET) =    173.13
  ELEVATION DIFFERENCE(FEET) =     17.04
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.705
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    82.14
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.060
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      6.49
  TOTAL AREA(ACRES) =      1.26   TOTAL RUNOFF(CFS) =      6.49

****************************************************************************
  FLOW PROCESS FROM NODE     11.00 TO NODE     11.20 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   169.63  DOWNSTREAM(FEET) =   168.71
  FLOW LENGTH(FEET) =   182.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  13.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.65
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      6.49
```

```
  PIPE TRAVEL TIME(MIN.) =   0.65    Tc(MIN.) =   3.36
  LONGEST FLOWPATH FROM NODE     11.10 TO NODE     11.20 =   679.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     11.20 TO NODE     11.20 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.060
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  OFFICE PROFESSIONAL/COMMERCIAL RUNOFF COEFFICIENT = .8500
  SOIL CLASSIFICATION IS "D"
  S.C.S. CURVE NUMBER (AMC II) =  96
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8500
  SUBAREA AREA(ACRES) =    0.58   SUBAREA RUNOFF(CFS) =    2.99
  TOTAL AREA(ACRES) =      1.84   TOTAL RUNOFF(CFS) =    9.48
  TC(MIN.) =   3.36

****************************************************************************
  FLOW PROCESS FROM NODE     11.20 TO NODE     12.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   168.71  DOWNSTREAM(FEET) =   168.59
  FLOW LENGTH(FEET) =    24.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  15.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.11
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      9.48
  PIPE TRAVEL TIME(MIN.) =   0.08    Tc(MIN.) =   3.43
  LONGEST FLOWPATH FROM NODE     11.10 TO NODE     12.00 =   703.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     12.00 TO NODE     12.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   3.43
  RAINFALL INTENSITY(INCH/HR) =   6.06
  TOTAL STREAM AREA(ACRES) =     1.84
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      9.48

  ** CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY      AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)    (ACRE)
      1       15.19     3.53        6.060         4.16
      1       15.20     3.85        6.060         4.16
      1       13.33     6.86        4.943         4.16
      1       13.59     7.23        4.779         4.16
      1       13.81     7.52        4.658         4.16
      1       13.70     7.62        4.619         4.16
      1       13.41     7.85        4.529         4.16
      1       12.61     8.85        4.192         4.16
      2        9.48     3.43        6.060         1.84

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1       24.68     3.43       6.060
      2       24.67     3.53       6.060
      3       24.68     3.85       6.060
      4       21.06     6.86       4.943
      5       21.07     7.23       4.779
      6       21.09     7.52       4.658
```

```
     7       20.92     7.62       4.619
     8       20.50     7.85       4.529
     9       19.17     8.85       4.192

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =     24.68   Tc(MIN.) =    3.85
  TOTAL AREA(ACRES) =      6.00
  LONGEST FLOWPATH FROM NODE      8.10 TO NODE     12.00 =  1127.00 FEET.

+--------------------------------------------------------------------------+
|                                                                          |
|                                                                          |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE     20.10 TO NODE     20.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  LAWNS, GOLF COURSES, ETC. FAIR COVER RUNOFF COEFFICIENT = .3500
  SOIL CLASSIFICATION IS "D"
  S.C.S. CURVE NUMBER (AMC II) =  84
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   776.00
  UPSTREAM ELEVATION(FEET) =    193.50
  DOWNSTREAM ELEVATION(FEET) =    150.23
  ELEVATION DIFFERENCE(FEET) =     43.27
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    7.613
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =   100.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.620
  SUBAREA RUNOFF(CFS) =      0.87
  TOTAL AREA(ACRES) =      0.54   TOTAL RUNOFF(CFS) =      0.87

****************************************************************************
  FLOW PROCESS FROM NODE     20.00 TO NODE     21.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   149.42  DOWNSTREAM(FEET) =   148.67
  FLOW LENGTH(FEET) =   149.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   4.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   2.77
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      0.87
  PIPE TRAVEL TIME(MIN.) =   0.90    Tc(MIN.) =    8.51
  LONGEST FLOWPATH FROM NODE     20.10 TO NODE     21.00 =   925.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     21.00 TO NODE     21.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   8.51
  RAINFALL INTENSITY(INCH/HR) =   4.30
  TOTAL STREAM AREA(ACRES) =     0.54
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.87

****************************************************************************
  FLOW PROCESS FROM NODE     21.10 TO NODE     21.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  NEIGHBORHOOD COMMERCIAL RUNOFF COEFFICIENT = .7900
  SOIL CLASSIFICATION IS "D"
```

```
  S.C.S. CURVE NUMBER (AMC II) =  94
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   490.00
  UPSTREAM ELEVATION(FEET) =    189.46
  DOWNSTREAM ELEVATION(FEET) =    155.85
  ELEVATION DIFFERENCE(FEET) =     33.61
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.891
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    96.86
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.060
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      2.54
  TOTAL AREA(ACRES) =      0.53   TOTAL RUNOFF(CFS) =      2.54

****************************************************************************
  FLOW PROCESS FROM NODE     21.00 TO NODE     21.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.060
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  LAWNS, GOLF COURSES, ETC. FAIR COVER RUNOFF COEFFICIENT = .3500
  SOIL CLASSIFICATION IS "D"
  S.C.S. CURVE NUMBER (AMC II) =  84
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7323
  SUBAREA AREA(ACRES) =    0.08   SUBAREA RUNOFF(CFS) =    0.17
  TOTAL AREA(ACRES) =      0.61   TOTAL RUNOFF(CFS) =    2.71
  TC(MIN.) =   2.89

****************************************************************************
  FLOW PROCESS FROM NODE     21.00 TO NODE     21.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   2.89
  RAINFALL INTENSITY(INCH/HR) =   6.06
  TOTAL STREAM AREA(ACRES) =     0.61
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.71

  ** CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY      AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)    (ACRE)
      1        0.87     8.51        4.300          0.54
      2        2.71     2.89        6.060          0.61

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1        3.00     2.89       6.060
      2        2.79     8.51       4.300

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      3.00   Tc(MIN.) =    2.89
  TOTAL AREA(ACRES) =      1.15
  LONGEST FLOWPATH FROM NODE     20.10 TO NODE     21.00 =   925.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     21.00 TO NODE     22.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   147.10  DOWNSTREAM(FEET) =   145.30
  FLOW LENGTH(FEET) =     8.00   MANNING'S N =  0.013
```

```
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   3.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  15.25
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      3.00
  PIPE TRAVEL TIME(MIN.) =   0.01    Tc(MIN.) =   2.90
  LONGEST FLOWPATH FROM NODE     20.10 TO NODE     22.00 =   933.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     22.00 TO NODE     23.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   145.30  DOWNSTREAM(FEET) =   144.92
  FLOW LENGTH(FEET) =    36.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   6.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.13
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      3.00
  PIPE TRAVEL TIME(MIN.) =   0.12    Tc(MIN.) =   3.02
  LONGEST FLOWPATH FROM NODE     20.10 TO NODE     23.00 =   969.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     23.00 TO NODE     23.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 3 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE     23.30 TO NODE     23.20 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  OPEN BRUSH FAIR COVER RUNOFF COEFFICIENT = .3500
  SOIL CLASSIFICATION IS "D"
  S.C.S. CURVE NUMBER (AMC II) =  83
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   701.00
  UPSTREAM ELEVATION(FEET) =    236.88
  DOWNSTREAM ELEVATION(FEET) =    154.00
  ELEVATION DIFFERENCE(FEET) =     82.88
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.267
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =   100.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.239
  SUBAREA RUNOFF(CFS) =      2.48
  TOTAL AREA(ACRES) =      1.35   TOTAL RUNOFF(CFS) =      2.48

****************************************************************************
  FLOW PROCESS FROM NODE     23.20 TO NODE     23.10 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   151.25  DOWNSTREAM(FEET) =   145.75
  FLOW LENGTH(FEET) =    52.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   3.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  11.05
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      2.48
  PIPE TRAVEL TIME(MIN.) =   0.08    Tc(MIN.) =   6.35
  LONGEST FLOWPATH FROM NODE     23.30 TO NODE     23.10 =   753.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     23.10 TO NODE     23.10 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
```

```
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   6.35
  RAINFALL INTENSITY(INCH/HR) =   5.20
  TOTAL STREAM AREA(ACRES) =     1.35
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.48

****************************************************************************
  FLOW PROCESS FROM NODE     23.40 TO NODE     23.10 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .8700
  SOIL CLASSIFICATION IS "D"
  S.C.S. CURVE NUMBER (AMC II) =  97
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   584.00
  UPSTREAM ELEVATION(FEET) =    209.00
  DOWNSTREAM ELEVATION(FEET) =    154.50
  ELEVATION DIFFERENCE(FEET) =     54.50
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    1.953
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    98.66
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.060
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      1.85
  TOTAL AREA(ACRES) =      0.35   TOTAL RUNOFF(CFS) =      1.85

****************************************************************************
  FLOW PROCESS FROM NODE     23.10 TO NODE     23.10 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.060
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  LAWNS, GOLF COURSES, ETC. FAIR COVER RUNOFF COEFFICIENT = .3500
  SOIL CLASSIFICATION IS "D"
  S.C.S. CURVE NUMBER (AMC II) =  84
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.5155
  SUBAREA AREA(ACRES) =    0.75   SUBAREA RUNOFF(CFS) =    1.59
  TOTAL AREA(ACRES) =      1.10   TOTAL RUNOFF(CFS) =    3.44
  TC(MIN.) =   1.95

****************************************************************************
  FLOW PROCESS FROM NODE     23.10 TO NODE     23.10 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   1.95
  RAINFALL INTENSITY(INCH/HR) =   6.06
  TOTAL STREAM AREA(ACRES) =     1.10
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      3.44

  ** CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY      AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)    (ACRE)
     1        2.48     6.35        5.197          1.35
     2        3.44     1.95        6.060          1.10

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
     1        4.20     1.95       6.060
```

```
    2       5.42     6.35       5.197

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      5.42   Tc(MIN.) =    6.35
  TOTAL AREA(ACRES) =      2.45
  LONGEST FLOWPATH FROM NODE     23.30 TO NODE     23.10 =   753.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     23.10 TO NODE     23.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   145.75  DOWNSTREAM(FEET) =   144.92
  FLOW LENGTH(FEET) =    59.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   8.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.68
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      5.42
  PIPE TRAVEL TIME(MIN.) =   0.15    Tc(MIN.) =    6.49
  LONGEST FLOWPATH FROM NODE     23.30 TO NODE     23.00 =   812.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     23.00 TO NODE     23.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 3 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
  STREAM     RUNOFF     Tc      INTENSITY     AREA
  NUMBER      (CFS)   (MIN.)   (INCH/HOUR)   (ACRE)
    1        4.20     2.11       6.060        2.45
    2        5.42     6.49       5.120        2.45
  LONGEST FLOWPATH FROM NODE     23.30 TO NODE     23.00 =   812.00 FEET.

  ** MEMORY BANK #  3 CONFLUENCE DATA **
  STREAM     RUNOFF     Tc      INTENSITY     AREA
  NUMBER      (CFS)   (MIN.)   (INCH/HOUR)   (ACRE)
    1        3.00     3.02       6.060        1.15
    2        2.79     8.64       4.259        1.15
  LONGEST FLOWPATH FROM NODE     20.10 TO NODE     23.00 =   969.00 FEET.

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF      Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
    1       6.30       2.11        6.060
    2       7.20       3.02        6.060
    3       7.96       6.49        5.120
    4       7.30       8.64        4.259

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      7.96   Tc(MIN.) =    6.49
  TOTAL AREA(ACRES) =      3.60

****************************************************************************
  FLOW PROCESS FROM NODE     23.00 TO NODE     29.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   144.92  DOWNSTREAM(FEET) =   144.23
  FLOW LENGTH(FEET) =   116.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  12.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.30
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      7.96
  PIPE TRAVEL TIME(MIN.) =   0.36    Tc(MIN.) =    6.86
  LONGEST FLOWPATH FROM NODE     20.10 TO NODE     29.00 =  1085.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
```

```
  TOTAL AREA(ACRES)     =      3.60  TC(MIN.) =      6.86
  PEAK FLOW RATE(CFS)   =      7.96
  *** PEAK FLOW RATE TABLE ***
         Q(CFS)   Tc(MIN.)
  1        6.30      2.50
  2        7.20      3.40
  3        7.96      6.86
  4        7.30      9.02
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

Section 3 – Detention Basin Requirements and Calculations

```
        U N I T   H Y D R O G R A P H   A N A L Y S I S

     Copyright (c) CIVILCADD/CIVILDESIGN, 1990 - 2004, Version 7.0

                  Study date  07/19/20  File: vista.out


     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++


     Program License Serial Number 4027

     --------------------------------------------------------------------
     Existing condition
     Encompass Health Chula Vista


     --------------------------------------------------------------------
     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

     Storm Event Year = 100

     Antecedent Moisture Condition = 3

      English (in-lb) Input Units Used

      English Rainfall Data (Inches) Input Values Used

     Area averaged rainfall isohyetal data:
            Sub-Area(Ac.)       Rainfall (In)
                 9.60             2.50

     Rainfall Distribution pattern used in study:
     Type B for SCS (small dam) or San Diego 6 hour storms
     -------------------------------------------------------------------
     +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

     ********* Area-Averaged SCS Curve Number and Fm *********

     Area       Area           SCS CN    SCS CN    Fm      Soil
     (Ac.)      fract          (AMC2)    (AMC3)   (In/Hr)  Group
          9.60   1.000         85.0      97.0     0.000    D

     Area-averaged catchment SCS Curve Number AMC(3) = 97.000
     Area-averaged Fm value using values listed =  0.000(In/Hr)
     +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
     Using SCS formula for calculating lag time
            lag = L(Ft)^0.8 (S+1)^0.7 / 1900 Slope(%)^0.5
     Length to the watershed divide (L) =    1220.00(Ft.)
     Average watershed slope in % =      5.100
     S = (1000 / CN(97.00) - 10) =   0.31
     Watershed area =       9.60(Ac.)
     Catchment Lag time =   0.083 hours
     Unit interval =   5.000 minutes
     Unit interval percentage of lag time = 100.5419
     Hydrograph baseflow =     0.00(CFS)
     Minimum watershed loss rate(Fm) =  0.099(In/Hr)
     Average adjusted SCS Curve Number = 97.000

     Rainfall depth area reduction factors:
     Using a total area of       9.60(Ac.) (Ref: SCS Sup A, Sec.4)

     Pacific Coastal Climate ratio used
     Areal factor ratio (rainfall reduction) = 1.000
     Rainfall entered for study =    2.500(In)
     Adjusted rainfall =    2.500(In)
     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

 The following unit hydrograph was developed using an S-Graph
 interpolated by time percentage of lag time vs. percentage of peak flow.
```

The S-Graphs for Valley, Foothill, and Mountain were developed by the U.S. Army Corps of Engineers for use in the respective type of basins located in Southern California. (Hydrology San Gabrial River ... U.S. Engineer Office, Dec 1944, revised Jul 1946) The Desert S-Graph is from Report ... on ... Tahquitz Creek, California, same U.S. offfice, Corps of Engineers, June 1963. The Valley Developed S-Graph is used by Orange and San Bernardino counties in California to represent the characteristics of valley areas with a large amount of development. Because of the wide variety in topography in Southern California, these synthetic unit hydrographs were included for use as options in any geographic location.

The SCS(Soil Conservation Service Dimensionless S-Graph, SCS handbook, of 1972, applies to a broad cross section of geographic locations and hydrologic regions.

The User Defined hydrograph converts the user Q/Qp vs. T/Tp values into an S-Graph based on lag = Tp/0.9. Then, for the lag time used, the S-Graph in interpolated in time % of lag.

The following S-Graph or S-Graph combination is used in this study:

VALLEY DEVELOPED S-Graph

U N I T H Y D R O G R A P H

(K = 116.16 (CFS))

Time Ratio (t/Lag)	Time (hrs)	Discharge Ratios (Q/Qp)	Q (CFS)	Mass Curve Ratios (Qa/Q)
1.01	0.083	0.279	20.174	0.174
2.01	0.167	1.000	72.392	0.797
3.02	0.250	0.293	21.197	0.979
4.02	0.333	0.033	2.397	1.000

For each time interval of the 6 or 24 hour storm, the total rainfall up to that storm time is calculated. Then the Soil Conservation Service SCS (report 1972, 1975) area averaged Curve Number (CN) is used to determine the amount of direct runoff in (In) using the following equations:

$$Q = \frac{(P - Ia)^2}{P - Ia + S}$$

Where:
Q = direct runoff, P = depth of precipitation, Ia = Initial Abstraction and S is the watershed storage in inches. S and Ia are given by the following equations:

$$S = \frac{1000}{CN} - 10 \quad \text{and} \quad Ia = 0.2\,S$$

Note: If Metric (SI) Units are used, rainfall data is converted by the program internally into inches for these calculations.

Note: In the following printout, the revised runoff column is only used when the minimum soil loss rate, fm, exceeds the normal loss rate of delta P(dP) - delta Q(dQ) then the dP-dQ column equals fm = 0.099(In) (for time interval = 0.008(In)) and the revised runoff is shown in the last column.

Time Period (hours)	Total Rainfall (In) P	Total SCS Runoff (In) Q	Rainfall Amount (In) dP	Runoff Amount (In) dQ	Infiltr-ation (In) dP-dQ	Revised Runoff Min Loss Rate
0.08	0.0146	0.0000	0.0146	0.0000	0.0146	--------
0.17	0.0292	0.0000	0.0146	0.0000	0.0146	--------
0.25	0.0438	0.0000	0.0146	0.0000	0.0146	--------
0.33	0.0583	0.0000	0.0146	0.0000	0.0146	--------
0.42	0.0729	0.0004	0.0146	0.0004	0.0142	--------
0.50	0.0875	0.0020	0.0146	0.0016	0.0130	--------
0.58	0.1071	0.0058	0.0196	0.0038	0.0158	--------
0.67	0.1267	0.0112	0.0196	0.0055	0.0141	--------
0.75	0.1463	0.0181	0.0196	0.0069	0.0127	--------
0.83	0.1658	0.0262	0.0196	0.0081	0.0115	--------
0.92	0.1854	0.0353	0.0196	0.0091	0.0105	--------
1.00	0.2050	0.0453	0.0196	0.0100	0.0096	--------
1.08	0.2292	0.0587	0.0242	0.0134	0.0107	--------
1.17	0.2533	0.0732	0.0242	0.0145	0.0097	--------
1.25	0.2775	0.0886	0.0242	0.0154	0.0088	--------
1.33	0.3017	0.1047	0.0242	--------	0.0083	0.0159
1.42	0.3258	0.1216	0.0242	--------	0.0083	0.0159
1.50	0.3500	0.1390	0.0242	--------	0.0083	0.0159
1.58	0.3875	0.1670	0.0375	0.0280	0.0095	--------
1.67	0.4250	0.1961	0.0375	0.0291	0.0084	--------
1.75	0.4625	0.2261	0.0375	--------	0.0083	0.0292
1.83	0.5000	0.2568	0.0375	--------	0.0083	0.0292
1.92	0.5375	0.2882	0.0375	--------	0.0083	0.0293
2.00	0.5750	0.3202	0.0375	--------	0.0083	0.0292
2.08	0.7292	0.4560	0.1542	0.1358	0.0184	--------
2.17	0.8833	0.5968	0.1542	0.1408	0.0134	--------
2.25	1.0375	0.7408	0.1542	0.1440	0.0101	--------
2.33	1.1917	0.8870	0.1542	--------	0.0083	0.1459
2.42	1.3458	1.0347	0.1542	--------	0.0083	0.1459
2.50	1.5000	1.1836	0.1542	--------	0.0083	0.1459
2.58	1.5417	1.2240	0.0417	--------	0.0083	0.0334
2.67	1.5833	1.2644	0.0417	--------	0.0083	0.0334
2.75	1.6250	1.3050	0.0417	--------	0.0083	0.0334
2.83	1.6667	1.3455	0.0417	--------	0.0083	0.0334
2.92	1.7083	1.3861	0.0417	--------	0.0083	0.0334
3.00	1.7500	1.4268	0.0417	--------	0.0083	0.0334
3.08	1.7837	1.4597	0.0337	--------	0.0083	0.0255
3.17	1.8175	1.4927	0.0337	--------	0.0083	0.0255
3.25	1.8512	1.5257	0.0337	--------	0.0083	0.0255
3.33	1.8850	1.5587	0.0338	--------	0.0083	0.0255
3.42	1.9188	1.5918	0.0338	--------	0.0083	0.0255
3.50	1.9525	1.6248	0.0337	--------	0.0083	0.0255
3.58	1.9750	1.6469	0.0225	--------	0.0083	0.0142
3.67	1.9975	1.6690	0.0225	--------	0.0083	0.0142
3.75	2.0200	1.6911	0.0225	--------	0.0083	0.0142
3.83	2.0425	1.7131	0.0225	--------	0.0083	0.0142
3.92	2.0650	1.7352	0.0225	--------	0.0083	0.0142
4.00	2.0875	1.7573	0.0225	--------	0.0083	0.0142
4.08	2.1063	1.7758	0.0188	--------	0.0083	0.0105
4.17	2.1250	1.7942	0.0187	--------	0.0083	0.0105
4.25	2.1437	1.8126	0.0187	--------	0.0083	0.0105
4.33	2.1625	1.8311	0.0188	--------	0.0083	0.0105
4.42	2.1813	1.8495	0.0188	--------	0.0083	0.0105
4.50	2.2000	1.8679	0.0187	--------	0.0083	0.0105
4.58	2.2179	1.8856	0.0179	--------	0.0083	0.0097
4.67	2.2358	1.9032	0.0179	--------	0.0083	0.0097
4.75	2.2538	1.9209	0.0179	--------	0.0083	0.0097
4.83	2.2717	1.9385	0.0179	--------	0.0083	0.0097
4.92	2.2896	1.9562	0.0179	--------	0.0083	0.0097
5.00	2.3075	1.9738	0.0179	--------	0.0083	0.0097
5.08	2.3229	1.9890	0.0154	--------	0.0083	0.0072
5.17	2.3383	2.0042	0.0154	--------	0.0083	0.0072
5.25	2.3537	2.0194	0.0154	--------	0.0083	0.0072

```
       5.33   2.3692    2.0346    0.0154  --------    0.0083   0.0072
       5.42   2.3846    2.0498    0.0154  --------    0.0083   0.0072
       5.50   2.4000    2.0650    0.0154  --------    0.0083   0.0072
       5.58   2.4167    2.0814    0.0167  --------    0.0083   0.0084
       5.67   2.4333    2.0979    0.0167  --------    0.0083   0.0084
       5.75   2.4500    2.1143    0.0167  --------    0.0083   0.0084
       5.83   2.4667    2.1308    0.0167  --------    0.0083   0.0084
       5.92   2.4833    2.1472    0.0167  --------    0.0083   0.0084
       6.00   2.5000    2.1637    0.0167  --------    0.0083   0.0084
     --------------------------------------------------------------------
     --------------------------------------------------------------------
     Total soil rain loss =      0.68(In)
     Total effective runoff =      1.82(In)
     ---------------------------------------------------------------------
     Peak flow rate this hydrograph =          16.95(CFS)
     Total runoff volume this hydrograph =          63505.9(Ft3)
     ---------------------------------------------------------------------
     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                         6 - H O U R    S T O R M
                    R u n o f f      H y d r o g r a p h
     --------------------------------------------------------------------
                 Hydrograph in   5   Minute intervals ((CFS))

     --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        5.0      10.0      15.0      20.0
-----------------------------------------------------------------------
  0+ 5       0.0000      0.00  Q         |         |         |         |
  0+10       0.0000      0.00  Q         |         |         |         |
  0+15       0.0000      0.00  Q         |         |         |         |
  0+20       0.0000      0.00  Q         |         |         |         |
  0+25       0.0001      0.01  Q         |         |         |         |
  0+30       0.0005      0.06  Q         |         |         |         |
  0+35       0.0018      0.20  Q         |         |         |         |
  0+40       0.0047      0.42  Q         |         |         |         |
  0+45       0.0090      0.62  VQ        |         |         |         |
  0+50       0.0144      0.78  VQ        |         |         |         |
  0+55       0.0208      0.93  VQ        |         |         |         |
  1+ 0       0.0280      1.05  V Q       |         |         |         |
  1+ 5       0.0363      1.21  V Q       |         |         |         |
  1+10       0.0467      1.50  |VQ       |         |         |         |
  1+15       0.0581      1.67  |V Q      |         |         |         |
  1+20       0.0703      1.77  |V Q      |         |         |         |
  1+25       0.0830      1.83  | VQ      |         |         |         |
  1+30       0.0957      1.85  | VQ      |         |         |         |
  1+35       0.1101      2.09  |  VQ     |         |         |         |
  1+40       0.1307      2.99  |  V Q    |         |         |         |
  1+45       0.1537      3.33  |   V Q   |         |         |         |
  1+50       0.1770      3.39  |   V Q   |         |         |         |
  1+55       0.2004      3.40  |    VQ   |         |         |         |
  2+ 0       0.2238      3.40  |     Q   |         |         |         |
  2+ 5       0.2620      5.55  |      V  |Q        |         |         |
  2+10       0.3540     13.36  |        V|         |     Q   |         |
  2+15       0.4646     16.05  |         | V       |         | Q       |
  2+20       0.5794     16.68  |         |    V    |         |  Q      |
  2+25       0.6958     16.90  |         |        V|         |  Q      |
  2+30       0.8125     16.95  |         |         | V       |  Q      |
  2+35       0.9136     14.68  |         |         |    V   Q|         |
  2+40       0.9586      6.54  |         |  Q      |     V   |         |
  2+45       0.9872      4.15  |       Q |         |      V  |         |
  2+50       1.0140      3.88  |      Q  |         |      V  |         |
  2+55       1.0407      3.88  |      Q  |         |       V |         |
  3+ 0       1.0674      3.88  |      Q  |         |        V|         |
  3+ 5       1.0931      3.72  |      Q  |         |        V|         |
  3+10       1.1147      3.15  |     Q   |         |         V         |
  3+15       1.1353      2.98  |    Q    |         |         |V        |
  3+20       1.1557      2.96  |    Q    |         |         |V        |
  3+25       1.1761      2.96  |    Q    |         |         | V       |
  3+30       1.1965      2.96  |    Q    |         |         | V       |
  3+35       1.2153      2.74  |    Q    |         |         |  V      |
  3+40       1.2285      1.92  |  Q      |         |         |  V      |
  3+45       1.2401      1.68  |  Q      |         |         |   V     |
```

```
    3+50       1.2515      1.66  |  Q      |         |         |   V     |
    3+55       1.2629      1.66  |  Q      |         |         |   V     |
    4+ 0       1.2743      1.66  |  Q      |         |         |   V     |
    4+ 5       1.2852      1.58  |  Q      |         |         |    V    |
    4+10       1.2942      1.31  | Q       |         |         |    V    |
    4+15       1.3027      1.23  | Q       |         |         |    V    |
    4+20       1.3111      1.22  | Q       |         |         |    V    |
    4+25       1.3195      1.22  | Q       |         |         |     V   |
    4+30       1.3279      1.22  | Q       |         |         |     V   |
    4+35       1.3362      1.20  | Q       |         |         |     V   |
    4+40       1.3440      1.14  | Q       |         |         |     V   |
    4+45       1.3518      1.12  | Q       |         |         |      V  |
    4+50       1.3595      1.12  | Q       |         |         |      V  |
    4+55       1.3672      1.12  | Q       |         |         |      V  |
    5+ 0       1.3750      1.12  | Q       |         |         |      V  |
    5+ 5       1.3824      1.07  | Q       |         |         |      V  |
    5+10       1.3885      0.89  |Q        |         |         |       V |
    5+15       1.3943      0.84  |Q        |         |         |       V |
    5+20       1.4000      0.83  |Q        |         |         |       V |
    5+25       1.4057      0.83  |Q        |         |         |       V |
    5+30       1.4115      0.83  |Q        |         |         |       V |
    5+35       1.4174      0.86  |Q        |         |         |       V |
    5+40       1.4239      0.95  |Q        |         |         |        V|
    5+45       1.4306      0.97  |Q        |         |         |        V|
    5+50       1.4374      0.98  |Q        |         |         |        V|
    5+55       1.4441      0.98  |Q        |         |         |        V|
    6+ 0       1.4508      0.98  |Q        |         |         |        V|
    6+ 5       1.4564      0.81  |Q        |         |         |        V|
    6+10       1.4578      0.20  Q         |         |         |        V|
    6+15       1.4579      0.02  Q         |         |         |         V
-----------------------------------------------------------------------
```

```
       U N I T  H Y D R O G R A P H  A N A L Y S I S

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               Study date  07/19/20  File: vista1.out


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Program License Serial Number 4027

----------------------------------------------------------------------
Encompass Health
100 yr 6 hr
upper area

----------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

Storm Event Year = 100

Antecedent Moisture Condition = 3

 English (in-lb) Input Units Used

 English Rainfall Data (Inches) Input Values Used

Area averaged rainfall isohyetal data:
       Sub-Area(Ac.)       Rainfall (In)
            6.00             2.50

Rainfall Distribution pattern used in study:
Type B for SCS (small dam) or San Diego 6 hour storms
---------------------------------------------------------------------
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

********* Area-Averaged SCS Curve Number and Fm *********

Area       Area          SCS CN    SCS CN    Fm      Soil
(Ac.)      fract         (AMC2)    (AMC3)   (In/Hr)  Group
     0.03   0.005         85.0      97.0     0.000    D
     2.77   0.462         98.0      98.0

     0.01   0.002         82.0      95.2     0.000    D
     0.99   0.165         98.0      98.0

     1.90   0.317         79.0      93.4     0.000    D

     0.30   0.049         85.0      97.0     0.000    D
     0.00   0.001         98.0      98.0

Area-averaged catchment SCS Curve Number AMC(3) = 96.484
Area-averaged Fm value using values listed =  0.000(In/Hr)
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Using SCS formula for calculating lag time
       lag = L(Ft)^0.8 (S+1)^0.7 / 1900 Slope(%)^0.5
Length to the watershed divide (L) =     955.00(Ft.)
Average watershed slope in % =     10.600
S = (1000 / CN(96.48) - 10) =   0.36
Watershed area =       6.00(Ac.)
Catchment Lag time =   0.049 hours
Unit interval =   5.000 minutes
Unit interval percentage of lag time = 171.3060
Hydrograph baseflow =     0.00(CFS)
Minimum watershed loss rate(Fm) =  0.000(In/Hr)
Average adjusted SCS Curve Number = 96.484

Rainfall depth area reduction factors:
Using a total area of       6.00(Ac.) (Ref: SCS Sup A, Sec.4)
```

Pacific Coastal Climate ratio used
Areal factor ratio (rainfall reduction) = 1.000
Rainfall entered for study = 2.500(In)
Adjusted rainfall = 2.500(In)
++

The following unit hydrograph was developed using an S-Graph interpolated by time percentage of lag time vs. percentage of peak flow. The S-Graphs for Valley, Foothill, and Mountain were developed by the U.S. Army Corps of Engineers for use in the respective type of basins located in Southern California. (Hydrology San Gabrial River ... U.S. Engineer Office, Dec 1944, revised Jul 1946) The Desert S-Graph is from Report ... on ... Tahquitz Creek, California, same U.S. offfice, Corps of Engineers, June 1963. The Valley Developed S-Graph is used by Orange and San Bernardino counties in California to represent the characteristics of valley areas with a large amount of development. Because of the wide variety in topography in Southern California, these synthetic unit hydrographs were included for use as options in any geographic location.

The SCS(Soil Conservation Service Dimensionless S-Graph, SCS handbook, of 1972, applies to a broad cross section of geographic locations and hydrologic regions.

The User Defined hydrograph converts the user Q/Qp vs. T/Tp values into an S-Graph based on lag = Tp/0.9. Then, for the lag time used, the S-Graph in interpolated in time % of lag.

The following S-Graph or S-Graph combination is used in this study:

VALLEY DEVELOPED S-Graph

U N I T H Y D R O G R A P H

++

Time Ratio (t/Lag)	Time (hrs)	Discharge Ratios (Q/Qp)	Q (CFS)	Mass Curve Ratios (Qa/Q)
	(K =	72.60 (CFS))		
1.71	0.083	0.724	29.695	0.409
3.43	0.167	1.000	40.996	0.974
5.14	0.250	0.047	1.909	1.000

++

For each time interval of the 6 or 24 hour storm, the total rainfall up to that storm time is calculated. Then the Soil Conservation Service SCS (report 1972, 1975) area averaged Curve Number (CN) is used to determine the amount of direct runoff in (In) using the following equations:

$$Q = \frac{(P - Ia)^2}{P - Ia + S}$$

Where:
Q = direct runoff, P = depth of precipitation, Ia = Initial Abstraction and S is the watershed storage in inches. S and Ia are given by the following equations:

$$S = \frac{1000}{CN} - 10 \quad \text{and} \quad Ia = 0.2\ S$$

Note: If Metric (SI) Units are used, rainfall data is converted by the program internally into inches for these calculations.

Note: In the following printout, the revised runoff column is only used when the minimum soil loss rate, fm, exceeds the normal loss rate of delta P(dP) - delta Q(dQ) then the dP-dQ column equals fm = 0.000(In) (for time interval = 0.000(In)) and the revised runoff is shown in the last column.

Time Period (hours)	Total Rainfall (In) P	Total SCS Runoff (In) Q	Rainfall Amount (In) dP	Runoff Amount (In) dQ	Infiltr-ation (In) dP-dQ	Revised Runoff Min Loss Rate
0.08	0.0146	0.0000	0.0146	0.0000	0.0146	--------
0.17	0.0292	0.0000	0.0146	0.0000	0.0146	--------
0.25	0.0438	0.0000	0.0146	0.0000	0.0146	--------
0.33	0.0583	0.0000	0.0146	0.0000	0.0146	--------
0.42	0.0729	0.0000	0.0146	0.0000	0.0146	--------
0.50	0.0875	0.0006	0.0146	0.0006	0.0140	--------
0.58	0.1071	0.0029	0.0196	0.0024	0.0172	--------
0.67	0.1267	0.0069	0.0196	0.0040	0.0156	--------
0.75	0.1463	0.0123	0.0196	0.0054	0.0142	--------
0.83	0.1658	0.0189	0.0196	0.0066	0.0130	--------
0.92	0.1854	0.0266	0.0196	0.0077	0.0119	--------
1.00	0.2050	0.0352	0.0196	0.0086	0.0110	--------
1.08	0.2292	0.0469	0.0242	0.0118	0.0124	--------
1.17	0.2533	0.0598	0.0242	0.0129	0.0113	--------
1.25	0.2775	0.0736	0.0242	0.0138	0.0103	--------
1.33	0.3017	0.0883	0.0242	0.0147	0.0095	--------
1.42	0.3258	0.1037	0.0242	0.0154	0.0088	--------
1.50	0.3500	0.1197	0.0242	0.0161	0.0081	--------
1.58	0.3875	0.1458	0.0375	0.0261	0.0114	--------
1.67	0.4250	0.1731	0.0375	0.0273	0.0102	--------
1.75	0.4625	0.2013	0.0375	0.0283	0.0092	--------
1.83	0.5000	0.2305	0.0375	0.0292	0.0083	--------
1.92	0.5375	0.2604	0.0375	0.0299	0.0076	--------
2.00	0.5750	0.2910	0.0375	0.0306	0.0069	--------
2.08	0.7292	0.4220	0.1542	0.1310	0.0231	--------
2.17	0.8833	0.5591	0.1542	0.1371	0.0171	--------
2.25	1.0375	0.7002	0.1542	0.1411	0.0131	--------
2.33	1.1917	0.8439	0.1542	0.1438	0.0104	--------
2.42	1.3458	0.9897	0.1542	0.1457	0.0084	--------
2.50	1.5000	1.1369	0.1542	0.1472	0.0070	--------
2.58	1.5417	1.1769	0.0417	0.0400	0.0017	--------
2.67	1.5833	1.2169	0.0417	0.0401	0.0016	--------
2.75	1.6250	1.2570	0.0417	0.0401	0.0015	--------
2.83	1.6667	1.2972	0.0417	0.0402	0.0015	--------
2.92	1.7083	1.3375	0.0417	0.0403	0.0014	--------
3.00	1.7500	1.3778	0.0417	0.0403	0.0014	--------
3.08	1.7837	1.4105	0.0337	0.0327	0.0011	--------
3.17	1.8175	1.4432	0.0337	0.0327	0.0010	--------
3.25	1.8512	1.4760	0.0337	0.0328	0.0010	--------
3.33	1.8850	1.5088	0.0338	0.0328	0.0010	--------
3.42	1.9188	1.5416	0.0338	0.0328	0.0009	--------
3.50	1.9525	1.5744	0.0337	0.0328	0.0009	--------
3.58	1.9750	1.5963	0.0225	0.0219	0.0006	--------
3.67	1.9975	1.6183	0.0225	0.0219	0.0006	--------
3.75	2.0200	1.6402	0.0225	0.0219	0.0006	--------
3.83	2.0425	1.6621	0.0225	0.0219	0.0006	--------
3.92	2.0650	1.6841	0.0225	0.0220	0.0005	--------
4.00	2.0875	1.7061	0.0225	0.0220	0.0005	--------
4.08	2.1063	1.7244	0.0188	0.0183	0.0004	--------
4.17	2.1250	1.7427	0.0187	0.0183	0.0004	--------
4.25	2.1437	1.7610	0.0187	0.0183	0.0004	--------
4.33	2.1625	1.7794	0.0188	0.0183	0.0004	--------
4.42	2.1813	1.7977	0.0188	0.0183	0.0004	--------
4.50	2.2000	1.8161	0.0187	0.0183	0.0004	--------
4.58	2.2179	1.8336	0.0179	0.0175	0.0004	--------

4.67	2.2358	1.8511	0.0179	0.0175	0.0004	--------
4.75	2.2538	1.8687	0.0179	0.0175	0.0004	--------
4.83	2.2717	1.8862	0.0179	0.0176	0.0004	--------
4.92	2.2896	1.9038	0.0179	0.0176	0.0004	--------
5.00	2.3075	1.9213	0.0179	0.0176	0.0004	--------
5.08	2.3229	1.9365	0.0154	0.0151	0.0003	--------
5.17	2.3383	1.9516	0.0154	0.0151	0.0003	--------
5.25	2.3537	1.9667	0.0154	0.0151	0.0003	--------
5.33	2.3692	1.9818	0.0154	0.0151	0.0003	--------
5.42	2.3846	1.9970	0.0154	0.0151	0.0003	--------
5.50	2.4000	2.0121	0.0154	0.0151	0.0003	--------
5.58	2.4167	2.0285	0.0167	0.0164	0.0003	--------
5.67	2.4333	2.0448	0.0167	0.0164	0.0003	--------
5.75	2.4500	2.0612	0.0167	0.0164	0.0003	--------
5.83	2.4667	2.0776	0.0167	0.0164	0.0003	--------
5.92	2.4833	2.0939	0.0167	0.0164	0.0003	--------
6.00	2.5000	2.1103	0.0167	0.0164	0.0003	--------

```
-------------------------------------------------------------------
-------------------------------------------------------------------
Total soil rain loss =      0.39(In)
Total effective runoff =      2.11(In)
--------------------------------------------------------------------
Peak flow rate this hydrograph =          10.62(CFS)
Total runoff volume this hydrograph =          45962.9(Ft3)
--------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                    6 - H O U R    S T O R M
               R u n o f f      H y d r o g r a p h
-------------------------------------------------------------------
            Hydrograph in   5   Minute intervals ((CFS))

-------------------------------------------------------------------
```

```
Time(h+m) Volume Ac.Ft   Q(CFS)  0        5.0      10.0      15.0      20.0
-----------------------------------------------------------------------
  0+ 5       0.0000      0.00  Q         |         |         |         |
  0+10       0.0000      0.00  Q         |         |         |         |
  0+15       0.0000      0.00  Q         |         |         |         |
  0+20       0.0000      0.00  Q         |         |         |         |
  0+25       0.0000      0.00  Q         |         |         |         |
  0+30       0.0001      0.02  Q         |         |         |         |
  0+35       0.0008      0.09  Q         |         |         |         |
  0+40       0.0023      0.22  Q         |         |         |         |
  0+45       0.0045      0.33  Q         |         |         |         |
  0+50       0.0074      0.42  Q         |         |         |         |
  0+55       0.0109      0.51  VQ        |         |         |         |
  1+ 0       0.0149      0.58  VQ        |         |         |         |
  1+ 5       0.0199      0.72  VQ        |         |         |         |
  1+10       0.0259      0.88  VQ        |         |         |         |
  1+15       0.0325      0.96  |Q        |         |         |         |
  1+20       0.0396      1.03  |VQ       |         |         |         |
  1+25       0.0471      1.08  |VQ       |         |         |         |
  1+30       0.0549      1.14  | Q       |         |         |         |
  1+35       0.0650      1.46  | Q       |         |         |         |
  1+40       0.0781      1.91  | VQ      |         |         |         |
  1+45       0.0920      2.01  |  VQ     |         |         |         |
  1+50       0.1063      2.08  |   Q     |         |         |         |
  1+55       0.1210      2.14  |   Q     |         |         |         |
  2+ 0       0.1361      2.19  |   QV    |         |         |         |
  2+ 5       0.1719      5.20  |     V   Q         |         |         |
  2+10       0.2373      9.50  |       V |        Q|         |         |
  2+15       0.3066     10.06  |         |V        Q         |         |
  2+20       0.3776     10.31  |         |   V     Q         |         |
  2+25       0.4499     10.49  |         |      V  Q         |         |
  2+30       0.5230     10.62  |         |        V|Q        |         |
  2+35       0.5747      7.50  |         |   Q     |V        |         |
  2+40       0.5961      3.11  |     Q   |         | V       |         |
  2+45       0.6161      2.91  |    Q    |         |  V      |         |
  2+50       0.6362      2.92  |    Q    |         |   V     |         |
  2+55       0.6563      2.92  |    Q    |         |   V     |         |
  3+ 0       0.6765      2.92  |    Q    |         |    V    |         |
  3+ 5       0.6951      2.70  |    Q    |         |     V   |         |
```

```
    3+10       0.7115      2.39  |   Q     |         |     V   |         |
    3+15       0.7279      2.38  |   Q     |         |      V  |         |
    3+20       0.7443      2.38  |   Q     |         |       V |         |
    3+25       0.7607      2.38  |   Q     |         |       V |         |
    3+30       0.7771      2.38  |   Q     |         |        V|         |
    3+35       0.7913      2.06  |   Q     |         |        V|         |
    3+40       0.8024      1.61  |  Q      |         |         V         |
    3+45       0.8133      1.59  |  Q      |         |         V         |
    3+50       0.8243      1.59  |  Q      |         |         |V        |
    3+55       0.8353      1.59  |  Q      |         |         |V        |
    4+ 0       0.8463      1.59  |  Q      |         |         | V       |
    4+ 5       0.8565      1.49  | Q       |         |         | V       |
    4+10       0.8657      1.34  | Q       |         |         | V       |
    4+15       0.8749      1.33  | Q       |         |         |  V      |
    4+20       0.8840      1.33  | Q       |         |         |  V      |
    4+25       0.8932      1.33  | Q       |         |         |  V      |
    4+30       0.9024      1.33  | Q       |         |         |   V     |
    4+35       0.9114      1.31  | Q       |         |         |   V     |
    4+40       0.9202      1.27  | Q       |         |         |   V     |
    4+45       0.9289      1.27  | Q       |         |         |    V    |
    4+50       0.9377      1.27  | Q       |         |         |    V    |
    4+55       0.9465      1.27  | Q       |         |         |    V    |
    5+ 0       0.9553      1.27  | Q       |         |         |     V   |
    5+ 5       0.9635      1.20  | Q       |         |         |     V   |
    5+10       0.9711      1.10  | Q       |         |         |     V   |
    5+15       0.9787      1.10  | Q       |         |         |      V  |
    5+20       0.9862      1.10  | Q       |         |         |      V  |
    5+25       0.9938      1.10  | Q       |         |         |      V  |
    5+30       1.0014      1.10  | Q       |         |         |      V  |
    5+35       1.0092      1.14  | Q       |         |         |       V |
    5+40       1.0174      1.19  | Q       |         |         |       V |
    5+45       1.0255      1.19  | Q       |         |         |       V |
    5+50       1.0337      1.19  | Q       |         |         |        V|
    5+55       1.0419      1.19  | Q       |         |         |        V|
    6+ 0       1.0501      1.19  | Q       |         |         |        V|
    6+ 5       1.0549      0.70  |Q        |         |         |        V|
    6+10       1.0552      0.03  Q         |         |         |         V
-----------------------------------------------------------------------
```

```
       U N I T  H Y D R O G R A P H  A N A L Y S I S

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               Study date  07/19/20  File: vista2.out

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Program License Serial Number 4027

---------------------------------------------------------------------
Encompass Health
100 year/6 hour
lower area

---------------------------------------------------------------------
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

Storm Event Year = 100

Antecedent Moisture Condition = 3

 English (in-lb) Input Units Used

 English Rainfall Data (Inches) Input Values Used

Area averaged rainfall isohyetal data:
       Sub-Area(Ac.)       Rainfall (In)
            0.00             2.50
            3.60             2.50

Rainfall Distribution pattern used in study:
Type B for SCS (small dam) or San Diego 6 hour storms
--------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

********* Area-Averaged SCS Curve Number and Fm *********

Area       Area          SCS CN    SCS CN    Fm      Soil
(Ac.)      fract         (AMC2)    (AMC3)   (In/Hr)  Group
     0.01   0.002         82.0      95.2     0.000    D
     0.80   0.223         98.0      98.0

     1.53   0.426         85.0      97.0     0.000    D
     0.02   0.004         98.0      98.0

     1.18   0.327         79.0      93.4     0.000    D
     0.06   0.017         98.0      98.0

Area-averaged catchment SCS Curve Number AMC(3) = 96.062
Area-averaged Fm value using values listed =  0.000(In/Hr)
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Using U.S. Army Corps of Engineers formula for lag time
   lag = 24 n ( L(Mi) Lc(Mi) /Slope(Ft/Mi) ) ^ 0.38
Watercourse length =     870.00(Ft.)
Length from concentration point to centroid =     400.00(Ft.)
Elevation difference along watercourse =     114.00(Ft.)
Mannings friction factor along watercourse (n) =  0.025
Watershed area =       3.60(Ac.)
Catchment Lag time =   0.033 hours
Unit interval =   5.000 minutes
Unit interval percentage of lag time = 254.4913
Hydrograph baseflow =     0.00(CFS)
Minimum watershed loss rate(Fm) =  0.000(In/Hr)
Average adjusted SCS Curve Number = 96.062

Rainfall depth area reduction factors:
Using a total area of       3.60(Ac.) (Ref: SCS Sup A, Sec.4)
```

Pacific Coastal Climate ratio used
Areal factor ratio (rainfall reduction) = 1.000
Rainfall entered for study = 2.500(In)
Adjusted rainfall = 2.500(In)
+++

The following unit hydrograph was developed using an S-Graph interpolated by time percentage of lag time vs. percentage of peak flow. The S-Graphs for Valley, Foothill, and Mountain were developed by the U.S. Army Corps of Engineers for use in the respective type of basins located in Southern California. (Hydrology San Gabrial River ... U.S. Engineer Office, Dec 1944, revised Jul 1946) The Desert S-Graph is from Report ... on ... Tahquitz Creek, California, same U.S. offfice, Corps of Engineers, June 1963. The Valley Developed S-Graph is used by Orange and San Bernardino counties in California to represent the characteristics of valley areas with a large amount of development. Because of the wide variety in topography in Southern California, these synthetic unit hydrographs were included for use as options in any geographic location.

The SCS(Soil Conservation Service Dimensionless S-Graph, SCS handbook, of 1972, applies to a broad cross section of geographic locations and hydrologic regions.

The User Defined hydrograph converts the user Q/Qp vs. T/Tp values into an S-Graph based on lag = Tp/0.9. Then, for the lag time used, the S-Graph in interpolated in time % of lag.

The following S-Graph or S-Graph combination is used in this study:

VALLEY DEVELOPED S-Graph

U N I T H Y D R O G R A P H

+++

(K = 43.56 (CFS))

Time Ratio (t/Lag)	Time (hrs)	Discharge Ratios (Q/Qp)	Q (CFS)	Mass Curve Ratios (Qa/Q)
2.54	0.083	1.000	25.585	0.587
5.09	0.167	0.703	17.975	1.000

+++

For each time interval of the 6 or 24 hour storm, the total rainfall up to that storm time is calculated. Then the Soil Conservation Service SCS (report 1972, 1975) area averaged Curve Number (CN) is used to determine the amount of direct runoff in (In) using the following equations:

$$Q = \frac{(P - Ia)^2}{P - Ia + S}$$

Where:
Q = direct runoff, P = depth of precipitation, Ia = Initial Abstraction and S is the watershed storage in inches. S and Ia are given by the following equations:

$$S = \frac{1000}{CN} - 10 \quad \text{and} \quad Ia = 0.2\,S$$

Note: If Metric (SI) Units are used, rainfall data is converted by the program internally into inches for these calculations.

Note: In the following printout, the revised runoff column is only used when the minimum soil loss rate, fm, exceeds the normal loss rate of delta P(dP) - delta Q(dQ) then the dP-dQ column equals fm = 0.000(In) (for time interval = 0.000(In)) and the revised runoff is shown in the last column.

Time Period (hours)	Total Rainfall (In) P	Total SCS Runoff (In) Q	Rainfall Amount (In) dP	Runoff Amount (In) dQ	Infiltr- ation (In) dP-dQ	Revised Runoff Min Loss Rate
0.08	0.0146	0.0000	0.0146	0.0000	0.0146	--------
0.17	0.0292	0.0000	0.0146	0.0000	0.0146	--------
0.25	0.0438	0.0000	0.0146	0.0000	0.0146	--------
0.33	0.0583	0.0000	0.0146	0.0000	0.0146	--------
0.42	0.0729	0.0000	0.0146	0.0000	0.0146	--------
0.50	0.0875	0.0001	0.0146	0.0001	0.0145	--------
0.58	0.1071	0.0014	0.0196	0.0014	0.0182	--------
0.67	0.1267	0.0044	0.0196	0.0029	0.0166	--------
0.75	0.1463	0.0087	0.0196	0.0043	0.0153	--------
0.83	0.1658	0.0142	0.0196	0.0055	0.0141	--------
0.92	0.1854	0.0208	0.0196	0.0066	0.0130	--------
1.00	0.2050	0.0284	0.0196	0.0076	0.0120	--------
1.08	0.2292	0.0389	0.0242	0.0105	0.0137	--------
1.17	0.2533	0.0505	0.0242	0.0116	0.0125	--------
1.25	0.2775	0.0631	0.0242	0.0126	0.0115	--------
1.33	0.3017	0.0767	0.0242	0.0135	0.0107	--------
1.42	0.3258	0.0910	0.0242	0.0143	0.0099	--------
1.50	0.3500	0.1060	0.0242	0.0150	0.0092	--------
1.58	0.3875	0.1305	0.0375	0.0245	0.0130	--------
1.67	0.4250	0.1563	0.0375	0.0258	0.0117	--------
1.75	0.4625	0.1832	0.0375	0.0269	0.0106	--------
1.83	0.5000	0.2111	0.0375	0.0279	0.0096	--------
1.92	0.5375	0.2398	0.0375	0.0287	0.0088	--------
2.00	0.5750	0.2692	0.0375	0.0294	0.0081	--------
2.08	0.7292	0.3962	0.1542	0.1270	0.0271	--------
2.17	0.8833	0.5302	0.1542	0.1339	0.0202	--------
2.25	1.0375	0.6687	0.1542	0.1385	0.0157	--------
2.33	1.1917	0.8103	0.1542	0.1417	0.0125	--------
2.42	1.3458	0.9543	0.1542	0.1440	0.0102	--------
2.50	1.5000	1.1000	0.1542	0.1457	0.0085	--------
2.58	1.5417	1.1396	0.0417	0.0396	0.0020	--------
2.67	1.5833	1.1793	0.0417	0.0397	0.0020	--------
2.75	1.6250	1.2191	0.0417	0.0398	0.0019	--------
2.83	1.6667	1.2590	0.0417	0.0399	0.0018	--------
2.92	1.7083	1.2990	0.0417	0.0399	0.0017	--------
3.00	1.7500	1.3390	0.0417	0.0400	0.0017	--------
3.08	1.7837	1.3714	0.0337	0.0325	0.0013	--------
3.17	1.8175	1.4039	0.0337	0.0325	0.0013	--------
3.25	1.8512	1.4365	0.0337	0.0325	0.0012	--------
3.33	1.8850	1.4690	0.0338	0.0326	0.0012	--------
3.42	1.9188	1.5016	0.0338	0.0326	0.0011	--------
3.50	1.9525	1.5343	0.0337	0.0326	0.0011	--------
3.58	1.9750	1.5561	0.0225	0.0218	0.0007	--------
3.67	1.9975	1.5779	0.0225	0.0218	0.0007	--------
3.75	2.0200	1.5997	0.0225	0.0218	0.0007	--------
3.83	2.0425	1.6215	0.0225	0.0218	0.0007	--------
3.92	2.0650	1.6433	0.0225	0.0218	0.0007	--------
4.00	2.0875	1.6652	0.0225	0.0218	0.0007	--------
4.08	2.1063	1.6834	0.0188	0.0182	0.0005	--------
4.17	2.1250	1.7016	0.0187	0.0182	0.0005	--------
4.25	2.1437	1.7198	0.0187	0.0182	0.0005	--------
4.33	2.1625	1.7381	0.0188	0.0182	0.0005	--------
4.42	2.1813	1.7563	0.0188	0.0182	0.0005	--------
4.50	2.2000	1.7746	0.0187	0.0183	0.0005	--------
4.58	2.2179	1.7920	0.0179	0.0174	0.0005	--------
4.67	2.2358	1.8095	0.0179	0.0175	0.0005	--------

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        4.75   2.2538    1.8269    0.0179    0.0175    0.0005 --------
        4.83   2.2717    1.8444    0.0179    0.0175    0.0004 --------
        4.92   2.2896    1.8619    0.0179    0.0175    0.0004 --------
        5.00   2.3075    1.8794    0.0179    0.0175    0.0004 --------
        5.08   2.3229    1.8944    0.0154    0.0150    0.0004 --------
        5.17   2.3383    1.9095    0.0154    0.0151    0.0004 --------
        5.25   2.3537    1.9245    0.0154    0.0151    0.0004 --------
        5.33   2.3692    1.9396    0.0154    0.0151    0.0004 --------
        5.42   2.3846    1.9546    0.0154    0.0151    0.0004 --------
        5.50   2.4000    1.9697    0.0154    0.0151    0.0004 --------
        5.58   2.4167    1.9860    0.0167    0.0163    0.0004 --------
        5.67   2.4333    2.0023    0.0167    0.0163    0.0004 --------
        5.75   2.4500    2.0186    0.0167    0.0163    0.0004 --------
        5.83   2.4667    2.0349    0.0167    0.0163    0.0004 --------
        5.92   2.4833    2.0512    0.0167    0.0163    0.0004 --------
        6.00   2.5000    2.0675    0.0167    0.0163    0.0004 --------
      --------------------------------------------------------------------
      --------------------------------------------------------------------
      Total soil rain loss =      0.43(In)
      Total effective runoff =      2.07(In)
      ---------------------------------------------------------------------
      Peak flow rate this hydrograph =          6.32(CFS)
      Total runoff volume this hydrograph =         27018.3(Ft3)
      ---------------------------------------------------------------------
      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                        6 - H O U R   S T O R M
                   R u n o f f     H y d r o g r a p h
      --------------------------------------------------------------------
                Hydrograph in   5   Minute intervals ((CFS))

      --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+ 5       0.0000      0.00  Q         |         |         |         |
  0+10       0.0000      0.00  Q         |         |         |         |
  0+15       0.0000      0.00  Q         |         |         |         |
  0+20       0.0000      0.00  Q         |         |         |         |
  0+25       0.0000      0.00  Q         |         |         |         |
  0+30       0.0000      0.00  Q         |         |         |         |
  0+35       0.0003      0.04  Q         |         |         |         |
  0+40       0.0010      0.10  Q         |         |         |         |
  0+45       0.0021      0.16  Q         |         |         |         |
  0+50       0.0036      0.22  Q         |         |         |         |
  0+55       0.0054      0.27  VQ        |         |         |         |
  1+ 0       0.0076      0.31  VQ        |         |         |         |
  1+ 5       0.0104      0.40  VQ        |         |         |         |
  1+10       0.0137      0.49  VQ        |         |         |         |
  1+15       0.0174      0.53  |VQ       |         |         |         |
  1+20       0.0213      0.57  |VQ       |         |         |         |
  1+25       0.0255      0.61  |VQ       |         |         |         |
  1+30       0.0299      0.64  |VQ       |         |         |         |
  1+35       0.0361      0.90  | VQ      |         |         |         |
  1+40       0.0437      1.10  | V Q     |         |         |         |
  1+45       0.0516      1.15  |  VQ     |         |         |         |
  1+50       0.0599      1.20  |  VQ     |         |         |         |
  1+55       0.0684      1.24  |   Q     |         |         |         |
  2+ 0       0.0771      1.27  |   VQ    |         |         |         |
  2+ 5       0.1031      3.78  |     V   |    Q    |         |         |
  2+10       0.1425      5.71  |        V|         | Q       |         |
  2+15       0.1835      5.95  |         |V        |  Q      |         |
  2+20       0.2256      6.11  |         |   V     |   Q     |         |
  2+25       0.2685      6.23  |         |      V  |   Q     |         |
  2+30       0.3120      6.32  |         |         V    Q    |         |
  2+35       0.3370      3.63  |         |   Q     |V        |         |
  2+40       0.3489      1.73  |     Q   |         | V       |         |
  2+45       0.3608      1.73  |     Q   |         |  V      |         |
  2+50       0.3728      1.74  |     Q   |         |   V     |         |
  2+55       0.3847      1.74  |     Q   |         |   V     |         |
  3+ 0       0.3967      1.74  |     Q   |         |    V    |         |
  3+ 5       0.4074      1.55  |     Q   |         |     V   |         |
  3+10       0.4172      1.41  |    Q    |         |     V   |         |
```

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    3+15       0.4269      1.42  |    Q    |         |      V  |         |
    3+20       0.4367      1.42  |    Q    |         |       V |         |
    3+25       0.4465      1.42  |    Q    |         |       V |         |
    3+30       0.4562      1.42  |    Q    |         |        V|         |
    3+35       0.4641      1.14  |   Q     |         |        V|         |
    3+40       0.4707      0.95  |  Q      |         |         V         |
    3+45       0.4772      0.95  |  Q      |         |         V         |
    3+50       0.4837      0.95  |  Q      |         |         |V        |
    3+55       0.4903      0.95  |  Q      |         |         |V        |
    4+ 0       0.4968      0.95  |  Q      |         |         | V       |
    4+ 5       0.5028      0.86  |  Q      |         |         | V       |
    4+10       0.5082      0.79  |  Q      |         |         | V       |
    4+15       0.5137      0.79  |  Q      |         |         |  V      |
    4+20       0.5192      0.79  |  Q      |         |         |  V      |
    4+25       0.5246      0.79  |  Q      |         |         |  V      |
    4+30       0.5301      0.79  |  Q      |         |         |   V     |
    4+35       0.5354      0.77  |  Q      |         |         |   V     |
    4+40       0.5407      0.76  |  Q      |         |         |   V     |
    4+45       0.5459      0.76  |  Q      |         |         |    V    |
    4+50       0.5512      0.76  |  Q      |         |         |    V    |
    4+55       0.5564      0.76  |  Q      |         |         |    V    |
    5+ 0       0.5616      0.76  |  Q      |         |         |     V   |
    5+ 5       0.5665      0.70  | Q       |         |         |     V   |
    5+10       0.5710      0.66  | Q       |         |         |     V   |
    5+15       0.5755      0.66  | Q       |         |         |      V  |
    5+20       0.5800      0.66  | Q       |         |         |      V  |
    5+25       0.5845      0.66  | Q       |         |         |      V  |
    5+30       0.5890      0.66  | Q       |         |         |      V  |
    5+35       0.5938      0.69  | Q       |         |         |       V |
    5+40       0.5987      0.71  | Q       |         |         |       V |
    5+45       0.6036      0.71  | Q       |         |         |       V |
    5+50       0.6084      0.71  | Q       |         |         |        V|
    5+55       0.6133      0.71  | Q       |         |         |        V|
    6+ 0       0.6182      0.71  | Q       |         |         |        V|
    6+ 5       0.6203      0.29  |Q        |         |         |        V|
-----------------------------------------------------------------------
```

FLOOD HYDROGRAPH ROUTING PROGRAM

Study date: 07/20/20

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underground detention basin routing
upper area, 6.0 acres
100 yr / 6 hr

Program License Serial Number 4027

```
******************** HYDROGRAPH INFORMATION *********************

               From study/file name: vista1.rte
****************************HYDROGRAPH DATA****************************
               Number of intervals =    72
               Time interval =    5.0 (Min.)
               Maximum/Peak flow rate =       10.935 (CFS)
               Total volume =       1.114 (Ac.Ft)
       Status of hydrographs being held in storage
                  Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
       Peak (CFS)      0.000     0.000     0.000     0.000     0.000
       Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
***********************************************************************
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        0.000 to Point/Station        0.000
**** RETARDING BASIN ROUTING ****
```

User entry of depth-outflow-storage data

Total number of inflow hydrograph intervals = 72
Hydrograph time unit = 5.000 (Min.)
Initial depth in storage basin =   0.00(Ft.)

Initial basin depth =   0.00 (Ft.)
Initial basin storage =   0.00 (Ac.Ft)
Initial basin outflow =   0.00 (CFS)

Depth vs. Storage and Depth vs. Discharge data:

Basin Depth (Ft.)	Storage (Ac.Ft)	Outflow (CFS)	(S-O*dt/2) (Ac.Ft)	(S+O*dt/2) (Ac.Ft)
0.000	0.000	0.000	0.000	0.000
1.000	0.041	0.001	0.041	0.041
2.000	0.082	0.002	0.082	0.082
3.000	0.123	0.003	0.123	0.123
4.000	0.210	0.004	0.210	0.210
5.000	0.293	1.160	0.289	0.297
6.000	0.371	2.390	0.363	0.379
7.000	0.440	3.180	0.429	0.451
8.000	0.491	3.800	0.478	0.504
9.000	0.532	4.340	0.517	0.547

Hydrograph Detention Basin Routing

Graph values: 'I'= unit inflow; 'O'=outflow at time shown

```
       -----------------------------------------------------------------------
 Time   Inflow  Outflow    Storage                                      Depth
(Hours)  (CFS)   (CFS)     (Ac.Ft) .0       2.7    5.47    8.20   10.93 (Ft.)
 0.083    0.00    0.00      0.000  O       |       |       |       |     0.00
 0.167    0.00    0.00      0.000  O       |       |       |       |     0.00
 0.250    0.00    0.00      0.000  O       |       |       |       |     0.00
 0.333    0.02    0.00      0.000  O       |       |       |       |     0.00
 0.417    0.13    0.00      0.001  O       |       |       |       |     0.01
 0.500    0.22    0.00      0.002  O       |       |       |       |     0.04
 0.583    0.43    0.00      0.004  OI      |       |       |       |     0.10
 0.667    0.55    0.00      0.007  OI      |       |       |       |     0.18
 0.750    0.65    0.00      0.012  OI      |       |       |       |     0.28
 0.833    0.73    0.00      0.016  O I     |       |       |       |     0.40
 0.917    0.80    0.00      0.022  O I     |       |       |       |     0.53
 1.000    0.86    0.00      0.027  O I     |       |       |       |     0.67
 1.083    1.14    0.00      0.034  O  I    |       |       |       |     0.83
 1.167    1.20    0.00      0.042  O  I    |       |       |       |     1.03
 1.250    1.26    0.00      0.051  O  I    |       |       |       |     1.24
 1.333    1.31    0.00      0.060  O  I    |       |       |       |     1.45
 1.417    1.35    0.00      0.069  O  I    |       |       |       |     1.67
 1.500    1.38    0.00      0.078  O   I   |       |       |       |     1.90
 1.583    2.21    0.00      0.090  O     I |       |       |       |     2.21
 1.667    2.27    0.00      0.106  O     I |       |       |       |     2.58
 1.750    2.32    0.00      0.122  O     I |       |       |       |     2.97
 1.833    2.37    0.00      0.138  O     I |       |       |       |     3.17
 1.917    2.40    0.00      0.154  O      I|       |       |       |     3.36
 2.000    2.43    0.00      0.171  O      I|       |       |       |     3.55
 2.083   10.25    0.06      0.214  O       |       |       |    I  |     4.05
 2.167   10.52    1.01      0.282  | O     |       |       |     I |     4.87
 2.250   10.69    1.98      0.345  |    O  |       |       |      I|     5.66
 2.333   10.80    2.75      0.402  |       O       |       |      I|     6.46
 2.417   10.88    3.37      0.456  |       |O      |       |      I|     7.31
 2.500   10.93    3.99      0.506  |       |  O    |       |       I     8.36
 2.583    2.96    4.25      0.525  |       I   O   |       |       |     8.83
 2.667    2.97    4.14      0.517  |       I   O   |       |       |     8.63
 2.750    2.97    4.04      0.509  |       I  O    |       |       |     8.44
 2.833    2.97    3.94      0.502  |       I  O    |       |       |     8.27
 2.917    2.97    3.86      0.496  |       I  O    |       |       |     8.11
 3.000    2.98    3.78      0.490  |       I  O    |       |       |     7.98
 3.083    2.41    3.70      0.483  |      I| O     |       |       |     7.83
 3.167    2.41    3.59      0.474  |      I| O     |       |       |     7.67
 3.250    2.41    3.50      0.466  |      I| O     |       |       |     7.51
 3.333    2.42    3.41      0.459  |      I|O      |       |       |     7.37
 3.417    2.42    3.33      0.453  |      I|O      |       |       |     7.25
 3.500    2.42    3.26      0.446  |      I|O      |       |       |     7.13
 3.583    1.61    3.16      0.438  |   I   |O      |       |       |     6.97
 3.667    1.61    3.04      0.428  |   I   O       |       |       |     6.83
 3.750    1.61    2.93      0.419  |   I   O       |       |       |     6.69
 3.833    1.61    2.83      0.410  |   I   O       |       |       |     6.56
 3.917    1.61    2.74      0.402  |   I   O       |       |       |     6.44
 4.000    1.61    2.66      0.394  |   I  O|       |       |       |     6.34
 4.083    1.35    2.57      0.386  |  I   O|       |       |       |     6.22
 4.167    1.35    2.47      0.378  |  I   O|       |       |       |     6.11
 4.250    1.35    2.39      0.371  |  I  O |       |       |       |     6.00
 4.333    1.35    2.28      0.364  |  I  O |       |       |       |     5.91
 4.417    1.35    2.18      0.358  |  I  O |       |       |       |     5.83
 4.500    1.35    2.10      0.352  |  I  O |       |       |       |     5.76
 4.583    1.29    2.02      0.347  |  I O  |       |       |       |     5.70
 4.667    1.29    1.94      0.343  |  I O  |       |       |       |     5.64
 4.750    1.29    1.87      0.338  |  I O  |       |       |       |     5.58
 4.833    1.29    1.81      0.335  |  I O  |       |       |       |     5.53
 4.917    1.29    1.76      0.331  |  I O  |       |       |       |     5.49
 5.000    1.29    1.71      0.328  |  I O  |       |       |       |     5.45
 5.083    1.11    1.66      0.325  |  IO   |       |       |       |     5.41
 5.167    1.11    1.60      0.321  |  IO   |       |       |       |     5.36
 5.250    1.11    1.55      0.318  |  IO   |       |       |       |     5.32
 5.333    1.11    1.51      0.315  |  IO   |       |       |       |     5.28
 5.417    1.11    1.46      0.312  |  IO   |       |       |       |     5.25
 5.500    1.11    1.43      0.310  |  IO   |       |       |       |     5.22
 5.583    1.20    1.40      0.308  |  IO   |       |       |       |     5.20
 5.667    1.20    1.38      0.307  |  IO   |       |       |       |     5.18
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5.750    1.20    1.36      0.306  |  O     |       |       |       |      5.16
5.833    1.20    1.34      0.305  |  O     |       |       |       |      5.15
5.917    1.20    1.33      0.304  |  O     |       |       |       |      5.14
6.000    1.20    1.32      0.303  |  O     |       |       |       |      5.13
6.083    0.00    1.24      0.298  I  O     |       |       |       |      5.07
6.167    0.00    1.12      0.290  I  O     |       |       |       |      4.96
6.250    0.00    1.02      0.283  I O      |       |       |       |      4.88
6.333    0.00    0.92      0.276  I O      |       |       |       |      4.80
6.417    0.00    0.84      0.270  I O      |       |       |       |      4.72
6.500    0.00    0.76      0.264  I O      |       |       |       |      4.66
6.583    0.00    0.69      0.259  I O      |       |       |       |      4.60
6.667    0.00    0.63      0.255  IO       |       |       |       |      4.54
6.750    0.00    0.57      0.251  IO       |       |       |       |      4.49
6.833    0.00    0.52      0.247  IO       |       |       |       |      4.45
6.917    0.00    0.47      0.244  IO       |       |       |       |      4.40
7.000    0.00    0.43      0.240  IO       |       |       |       |      4.37
7.083    0.00    0.39      0.238  IO       |       |       |       |      4.33
7.167    0.00    0.35      0.235  IO       |       |       |       |      4.30
7.250    0.00    0.32      0.233  O        |       |       |       |      4.27
7.333    0.00    0.29      0.231  O        |       |       |       |      4.25
7.417    0.00    0.27      0.229  O        |       |       |       |      4.23
7.500    0.00    0.24      0.227  O        |       |       |       |      4.20
7.583    0.00    0.22      0.225  O        |       |       |       |      4.19
7.667    0.00    0.20      0.224  O        |       |       |       |      4.17
7.750    0.00    0.18      0.223  O        |       |       |       |      4.15
7.833    0.00    0.16      0.221  O        |       |       |       |      4.14
7.917    0.00    0.15      0.220  O        |       |       |       |      4.13
8.000    0.00    0.14      0.219  O        |       |       |       |      4.11
8.083    0.00    0.12      0.219  O        |       |       |       |      4.10
8.167    0.00    0.11      0.218  O        |       |       |       |      4.09
8.250    0.00    0.10      0.217  O        |       |       |       |      4.08
8.333    0.00    0.09      0.216  O        |       |       |       |      4.08
```

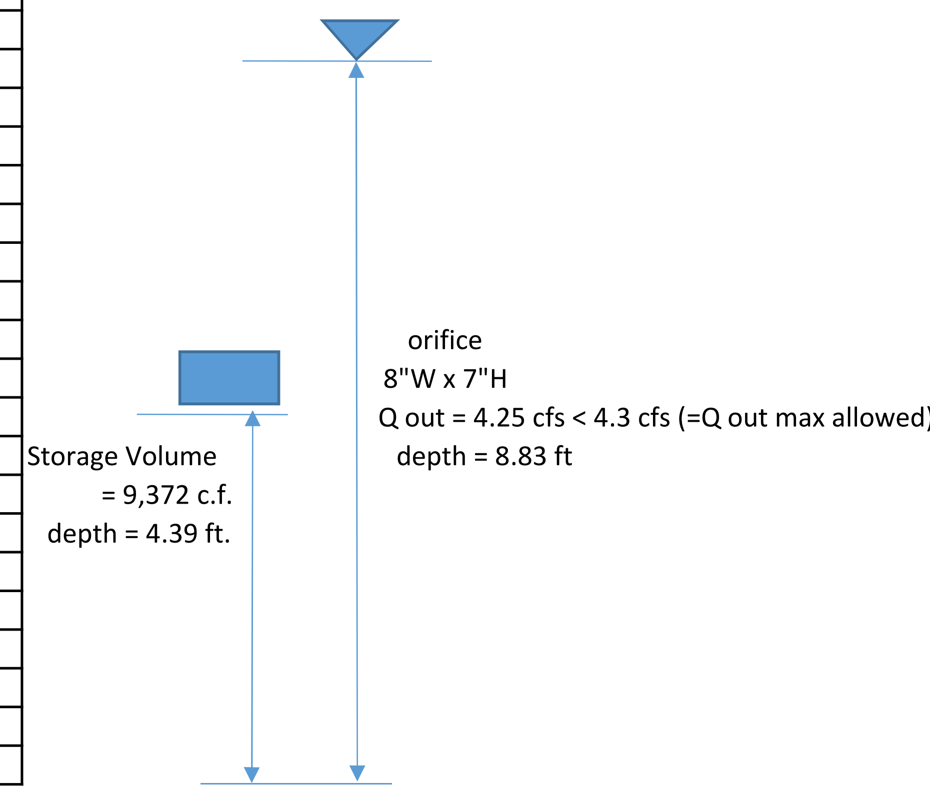
```
     Remaining water in basin =    0.22 (Ac.Ft)


     ****************************HYDROGRAPH DATA****************************
                    Number of intervals =   100
                    Time interval =    5.0 (Min.)
                    Maximum/Peak flow rate =        4.251 (CFS)
                    Total volume =       0.898 (Ac.Ft)
            Status of hydrographs being held in storage
                       Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
            Peak (CFS)      0.000     0.000     0.000     0.000     0.000
            Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
     ***********************************************************************

     --------------------------------------------------------------------
```

Encompass Health Chula Vista
Upper Storm/Water Qulaity Chambers - Stage/Storage/Dischage Relationship

depth	Volume		height	Q out
	Cumulative		h	
(feet)	(cubic feet)	(acre-feet)	(feet)	(cfs)
	103 chambers			
	22 end caps			
	12" rocks above			
	36" rocks below			
9.00	23,171	0.5319	4.51	4.34
8.00	21,380	0.4908	3.51	3.8
top of chambers				
7.00	19,147	0.4396	2.51	3.18
6.00	16,154	0.3708	1.51	2.39
5.00	12,775	0.2933	0.51	1.16
4.00	9,150	0.2101	0	
bottom of chambers				
3.00	5,372	0.1233	0	
2.00	3,582	0.0822	0	
1.00	1,791	0.0411	0	
0.00	0	0.0000	0	



Notes:

1. DCV = 6,248 c.f.
2. Required Storage = DCV x 1.5 = 6,248 x 1.5 = 9,372 c.f.
3. Q out max allowed = 4.3 cfs

Project: **Encompass Health - lower chambers**

Chamber Model -	MC-4500		
Units -	**Imperial**	Click Here for Metric	
Number of Chambers -	21		
Number of End Caps -	6		
Voids in the stone (porosity) -	40	%	
Base of Stone Elevation -	0.00	ft	☑ Include Perimeter Stone in Calculations
Amount of Stone Above Chambers -	12	in	
Amount of Stone Below Chambers -	14	in	
Area of system -	962	sf Min. Area -	962 sf min. area

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StormTech MC-4500 Cumulative Storage Volumes

Height of System *(inches)*	Incremental Single Chamber *(cubic feet)*	Incremental Single End Cap *(cubic feet)*	Incremental Chambers *(cubic feet)*	Incremental End Cap *(cubic feet)*	Incremental Stone *(cubic feet)*	Incremental Ch, EC and Stone *(cubic feet)*	Cumulative System (cubic feet)	Elevation (feet)
86	0.00	0.00	0.00	0.00	32.07	32.07	4228.27	7.17
85	0.00	0.00	0.00	0.00	32.07	32.07	4196.20	7.08
84	0.00	0.00	0.00	0.00	32.07	32.07	4164.13	7.00
83	0.00	0.00	0.00	0.00	32.07	32.07	4132.07	6.92
82	0.00	0.00	0.00	0.00	32.07	32.07	4100.00	6.83
81	0.00	0.00	0.00	0.00	32.07	32.07	4067.93	6.75
80	0.00	0.00	0.00	0.00	32.07	32.07	4035.87	6.67
79	0.00	0.00	0.00	0.00	32.07	32.07	4003.80	6.58
78	0.00	0.00	0.00	0.00	32.07	32.07	3971.73	6.50
77	0.00	0.00	0.00	0.00	32.07	32.07	3939.67	6.42
76	0.00	0.00	0.00	0.00	32.07	32.07	3907.60	6.33
75	0.00	0.00	0.00	0.00	32.07	32.07	3875.53	6.25
74	0.04	0.00	0.86	0.00	31.72	32.58	3843.47	6.17
73	0.12	0.01	2.44	0.06	31.07	33.57	3810.88	6.08
72	0.16	0.03	3.46	0.16	30.62	34.24	3777.32	6.00
71	0.21	0.05	4.38	0.29	30.20	34.87	3743.08	5.92
70	0.27	0.07	5.64	0.41	29.65	35.69	3708.21	5.83
69	0.45	0.09	9.51	0.53	28.05	38.09	3672.52	5.75
68	0.67	0.11	13.97	0.68	26.21	40.86	3634.43	5.67
67	0.80	0.14	16.78	0.85	25.02	42.64	3593.58	5.58
66	0.91	0.17	19.07	1.01	24.04	44.11	3550.94	5.50
65	1.00	0.19	21.06	1.15	23.18	45.39	3506.82	5.42
64	1.09	0.22	22.83	1.29	22.42	46.54	3461.43	5.33
63	1.16	0.24	24.43	1.45	21.71	47.60	3414.89	5.25
62	1.23	0.27	25.91	1.62	21.05	48.59	3367.29	5.17
61	1.30	0.30	27.29	1.79	20.44	49.51	3318.70	5.08
60	1.36	0.32	28.58	1.94	19.86	50.38	3269.19	5.00
59	1.42	0.35	29.79	2.09	19.31	51.19	3218.81	4.92
58	1.47	0.37	30.94	2.23	18.80	51.97	3167.62	4.83
57	1.53	0.39	32.03	2.36	18.31	52.70	3115.65	4.75
56	1.57	0.42	33.06	2.50	17.84	53.41	3062.95	4.67
55	1.62	0.44	34.05	2.64	17.39	54.08	3009.54	4.58
54	1.67	0.46	34.99	2.78	16.96	54.73	2955.46	4.50
53	1.71	0.48	35.89	2.90	16.55	55.34	2900.73	4.42
52	1.75	0.50	36.75	3.03	16.15	55.94	2845.39	4.33
51	1.79	0.53	37.58	3.15	15.78	56.50	2789.45	4.25
50	1.83	0.55	38.37	3.27	15.41	57.05	2732.95	4.17
49	1.86	0.56	39.13	3.39	15.06	57.58	2675.90	4.08
48	1.90	0.58	39.86	3.50	14.72	58.09	2618.32	4.00
47	1.93	0.60	40.57	3.61	14.40	58.57	2560.24	3.92
46	1.96	0.62	41.25	3.72	14.08	59.05	2501.66	3.83
45	2.00	0.64	41.90	3.83	13.78	59.50	2442.62	3.75
44	2.03	0.66	42.53	3.93	13.48	59.94	2383.11	3.67
43	2.05	0.67	43.13	4.04	13.20	60.37	2323.17	3.58
42	2.08	0.69	43.71	4.14	12.93	60.78	2262.80	3.50
41	2.11	0.71	44.27	4.24	12.66	61.17	2202.02	3.42
40	2.13	0.72	44.81	4.34	12.41	61.56	2140.85	3.33
39	2.16	0.74	45.33	4.44	12.16	61.93	2079.29	3.25
38	2.18	0.76	45.83	4.54	11.92	62.29	2017.36	3.17
37	2.21	0.77	46.32	4.63	11.69	62.63	1955.07	3.08
36	2.23	0.79	46.78	4.72	11.47	62.97	1892.44	3.00
35	2.25	0.80	47.23	4.81	11.25	63.29	1829.47	2.92
34	2.27	0.82	47.66	4.92	11.03	63.62	1766.18	2.83
33	2.29	0.84	48.07	5.04	10.82	63.93	1702.57	2.75
32	2.31	0.85	48.46	5.08	10.65	64.19	1638.63	2.67
31	2.33	0.86	48.84	5.15	10.47	64.46	1574.44	2.58
30	2.34	0.87	49.21	5.23	10.29	64.73	1509.98	2.50
29	2.36	0.89	49.56	5.31	10.12	64.99	1445.24	2.42
28	2.38	0.90	49.89	5.39	9.95	65.23	1380.26	2.33
27	2.39	0.91	50.21	5.46	9.80	65.47	1315.02	2.25
26	2.41	0.92	50.51	5.53	9.65	65.70	1249.55	2.17
25	2.42	0.93	50.80	5.61	9.50	65.91	1183.86	2.08
24	2.43	0.95	51.08	5.67	9.37	66.12	1117.94	2.00
23	2.44	0.96	51.34	5.74	9.23	66.32	1051.82	1.92
22	2.46	0.97	51.59	5.80	9.11	66.50	985.51	1.83
21	2.47	0.98	51.82	5.87	8.99	66.68	919.00	1.75
20	2.48	0.99	52.04	5.93	8.88	66.85	852.32	1.67
19	2.49	1.00	52.25	5.99	8.77	67.01	785.47	1.58
18	2.50	1.01	52.45	6.04	8.67	67.16	718.46	1.50
17	2.51	1.02	52.64	6.10	8.57	67.31	651.30	1.42
16	2.51	1.02	52.81	6.15	8.48	67.44	584.00	1.33
15	2.53	1.03	53.07	6.20	8.36	67.62	516.56	1.25
14	0.00	0.00	0.00	0.00	32.07	32.07	448.93	1.17
13	0.00	0.00	0.00	0.00	32.07	32.07	416.87	1.08
12	0.00	0.00	0.00	0.00	32.07	32.07	384.80	1.00
11	0.00	0.00	0.00	0.00	32.07	32.07	352.73	0.92
10	0.00	0.00	0.00	0.00	32.07	32.07	320.67	0.83
9	0.00	0.00	0.00	0.00	32.07	32.07	288.60	0.75
8	0.00	0.00	0.00	0.00	32.07	32.07	256.53	0.67
7	0.00	0.00	0.00	0.00	32.07	32.07	224.47	0.58
6	0.00	0.00	0.00	0.00	32.07	32.07	192.40	0.50
5	0.00	0.00	0.00	0.00	32.07	32.07	160.33	0.42
4	0.00	0.00	0.00	0.00	32.07	32.07	128.27	0.33
3	0.00	0.00	0.00	0.00	32.07	32.07	96.20	0.25
2	0.00	0.00	0.00	0.00	32.07	32.07	64.13	0.17

Project: **Encompass Health - upper chambers**

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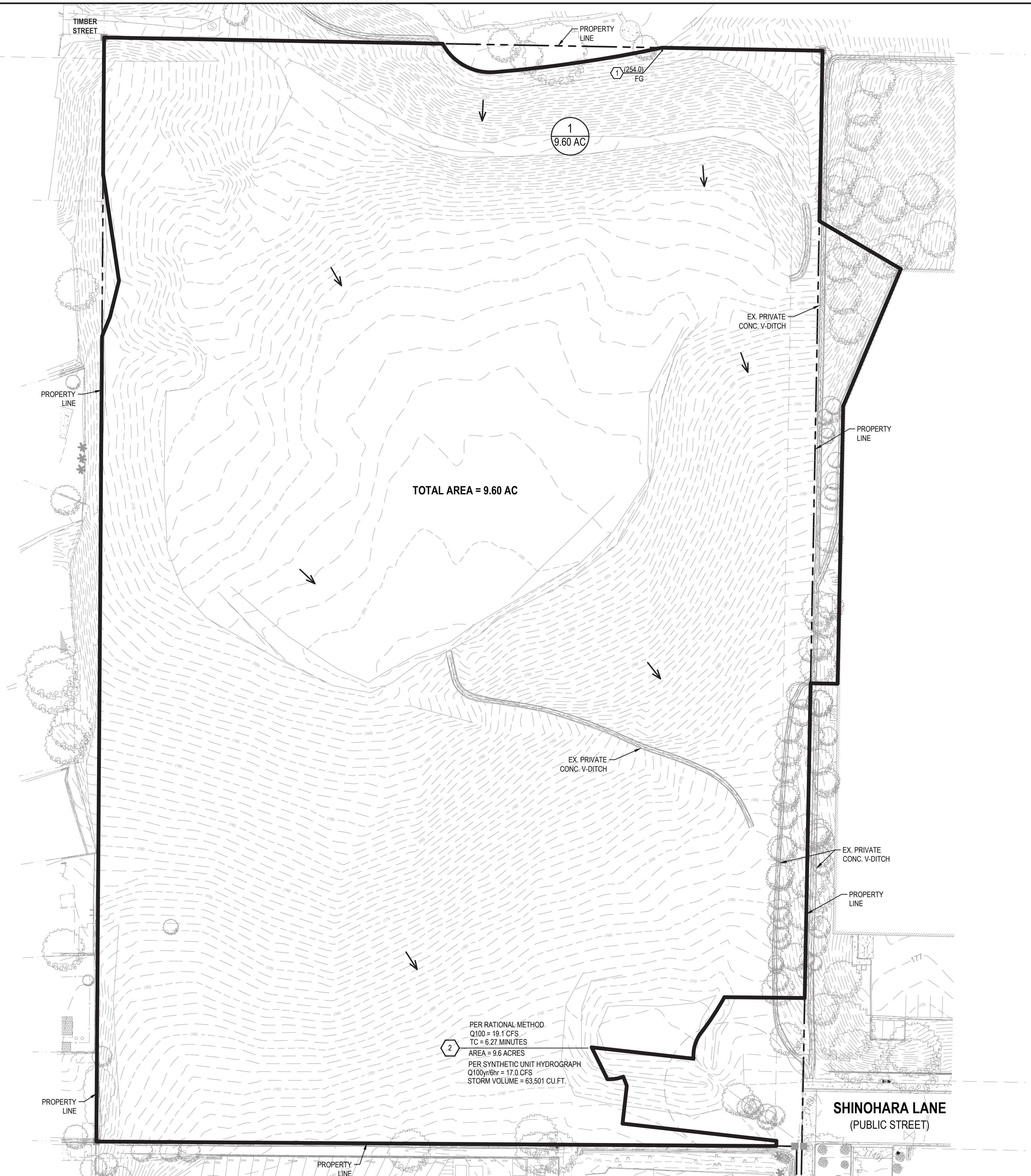
Chamber Model -	MC-4500		
Units -	**Imperial**	Click Here for Metric	
Number of Chambers -	103		
Number of End Caps -	22		
Voids in the stone (porosity) -	40	%	
Base of Stone Elevation -	0.00	ft	☑ Include Perimeter Stone in Calculations
Amount of Stone Above Chambers -	12	in	
Amount of Stone Below Chambers -	36	in	
Area of system -	4477	sf Min. Area -	4477 sf min. area

StormTech MC-4500 Cumulative Storage Volumes

Height of System *(inches)*	Incremental Single Chamber *(cubic feet)*	Incremental Single End Cap *(cubic feet)*	Incremental Chambers *(cubic feet)*	Incremental End Cap *(cubic feet)*	Incremental Stone *(cubic feet)*	Incremental Ch, EC and Stone *(cubic feet)*	Cumulative System (cubic feet)	Elevation (feet)
108	0.00	0.00	0.00	0.00	149.23	149.23	23170.66	9.00
107	0.00	0.00	0.00	0.00	149.23	149.23	23021.43	8.92
106	0.00	0.00	0.00	0.00	149.23	149.23	22872.19	8.83
105	0.00	0.00	0.00	0.00	149.23	149.23	22722.96	8.75
104	0.00	0.00	0.00	0.00	149.23	149.23	22573.73	8.67
103	0.00	0.00	0.00	0.00	149.23	149.23	22424.49	8.58
102	0.00	0.00	0.00	0.00	149.23	149.23	22275.26	8.50
101	0.00	0.00	0.00	0.00	149.23	149.23	22126.03	8.42
100	0.00	0.00	0.00	0.00	149.23	149.23	21976.79	8.33
99	0.00	0.00	0.00	0.00	149.23	149.23	21827.56	8.25
98	0.00	0.00	0.00	0.00	149.23	149.23	21678.33	8.17
97	0.00	0.00	0.00	0.00	149.23	149.23	21529.09	8.08
96	0.04	0.00	4.22	0.00	147.55	151.77	21379.86	8.00
95	0.12	0.01	11.96	0.22	144.36	156.54	21228.09	7.92
94	0.16	0.03	16.97	0.58	142.21	159.76	21071.55	7.83
93	0.21	0.05	21.50	1.05	140.21	162.76	20911.79	7.75
92	0.27	0.07	27.64	1.49	137.58	166.71	20749.03	7.67
91	0.45	0.09	46.64	1.93	129.81	178.37	20582.32	7.58
90	0.67	0.11	68.52	2.49	120.83	191.84	20403.95	7.50
89	0.80	0.14	82.30	3.11	115.07	200.48	20212.11	7.42
88	0.91	0.17	93.54	3.69	110.34	207.57	20011.63	7.33
87	1.00	0.19	103.30	4.22	106.23	213.74	19804.06	7.25
86	1.09	0.22	112.00	4.73	102.54	219.27	19590.32	7.17
85	1.16	0.24	119.84	5.31	99.17	224.32	19371.05	7.08
84	1.23	0.27	127.10	5.94	96.01	229.06	19146.73	7.00
83	1.30	0.30	133.87	6.55	93.07	233.48	18917.67	6.92
82	1.36	0.32	140.19	7.12	90.31	237.61	18684.18	6.83
81	1.42	0.35	146.13	7.65	87.72	241.50	18446.57	6.75
80	1.47	0.37	151.75	8.16	85.27	245.18	18205.07	6.67
79	1.53	0.39	157.09	8.67	82.93	248.69	17959.88	6.58
78	1.57	0.42	162.17	9.18	80.69	252.05	17711.19	6.50
77	1.62	0.44	167.00	9.69	78.56	255.25	17459.15	6.42
76	1.67	0.46	171.62	10.18	76.51	258.31	17203.90	6.33
75	1.71	0.48	176.04	10.65	74.56	261.25	16945.59	6.25
74	1.75	0.50	180.26	11.11	72.69	264.05	16684.35	6.17
73	1.79	0.53	184.30	11.56	70.89	266.74	16420.29	6.08
72	1.83	0.55	188.20	11.99	69.16	269.35	16153.55	6.00
71	1.86	0.56	191.93	12.42	67.49	271.84	15884.20	5.92
70	1.90	0.58	195.53	12.83	65.89	274.25	15612.35	5.83
69	1.93	0.60	198.98	13.24	64.35	276.56	15338.11	5.75
68	1.96	0.62	202.30	13.64	62.86	278.80	15061.54	5.67
67	2.00	0.64	205.50	14.04	61.42	280.95	14782.74	5.58
66	2.03	0.66	208.58	14.43	60.03	283.03	14501.79	5.50
65	2.05	0.67	211.54	14.81	58.69	285.04	14218.76	5.42
64	2.08	0.69	214.39	15.19	57.40	286.98	13933.71	5.33
63	2.11	0.71	217.13	15.56	56.16	288.85	13646.73	5.25
62	2.13	0.72	219.79	15.92	54.95	290.66	13357.88	5.17
61	2.16	0.74	222.34	16.28	53.78	292.41	13067.22	5.08
60	2.18	0.76	224.80	16.63	52.66	294.09	12774.81	5.00
59	2.21	0.77	227.17	16.98	51.58	295.72	12480.72	4.92
58	2.23	0.79	229.45	17.31	50.53	297.29	12185.00	4.83
57	2.25	0.80	231.63	17.64	49.52	298.80	11887.71	4.75
56	2.27	0.82	233.74	18.06	48.51	300.31	11588.91	4.67
55	2.29	0.84	235.77	18.50	47.53	301.79	11288.60	4.58
54	2.31	0.85	237.71	18.61	46.71	303.02	10986.81	4.50
53	2.33	0.86	239.57	18.89	45.85	304.31	10683.79	4.42
52	2.34	0.87	241.36	19.19	45.02	305.56	10379.47	4.33
51	2.36	0.89	243.07	19.47	44.22	306.76	10073.91	4.25
50	2.38	0.90	244.71	19.75	43.45	307.91	9767.15	4.17
49	2.39	0.91	246.27	20.03	42.71	309.01	9459.24	4.08
48	2.41	0.92	247.76	20.29	42.01	310.07	9150.23	4.00
47	2.42	0.93	249.18	20.55	41.34	311.08	8840.16	3.92
46	2.43	0.95	250.54	20.80	40.70	312.04	8529.09	3.83
45	2.44	0.96	251.82	21.05	40.09	312.95	8217.05	3.75
44	2.46	0.97	253.03	21.28	39.51	313.82	7904.10	3.67
43	2.47	0.98	254.18	21.51	38.96	314.65	7590.28	3.58
42	2.48	0.99	255.26	21.73	38.43	315.43	7275.63	3.50
41	2.49	1.00	256.29	21.95	37.94	316.18	6960.19	3.42
40	2.50	1.01	257.26	22.15	37.47	316.88	6644.02	3.33
39	2.51	1.02	258.17	22.35	37.03	317.54	6327.14	3.25
38	2.51	1.02	259.02	22.54	36.61	318.17	6009.59	3.17
37	2.53	1.03	260.27	22.72	36.04	319.03	5691.43	3.08
36	0.00	0.00	0.00	0.00	149.23	149.23	5372.40	3.00
35	0.00	0.00	0.00	0.00	149.23	149.23	5223.17	2.92
34	0.00	0.00	0.00	0.00	149.23	149.23	5073.93	2.83
33	0.00	0.00	0.00	0.00	149.23	149.23	4924.70	2.75
32	0.00	0.00	0.00	0.00	149.23	149.23	4775.47	2.67
31	0.00	0.00	0.00	0.00	149.23	149.23	4626.23	2.58
30	0.00	0.00	0.00	0.00	149.23	149.23	4477.00	2.50
29	0.00	0.00	0.00	0.00	149.23	149.23	4327.77	2.42
28	0.00	0.00	0.00	0.00	149.23	149.23	4178.53	2.33
27	0.00	0.00	0.00	0.00	149.23	149.23	4029.30	2.25
26	0.00	0.00	0.00	0.00	149.23	149.23	3880.07	2.17
25	0.00	0.00	0.00	0.00	149.23	149.23	3730.83	2.08
24	0.00	0.00	0.00	0.00	149.23	149.23	3581.60	2.00

Section 4 – Hydrology Maps

4.1 Existing Development Hydrology Map
4.2 Proposed Development Hydrology Map



ENCOMPASS HEALTH CHULA VISTA

LEGEND:

→	FLOW PATH OF WATER
(heavy line)	DRAINAGE AREA BOUNDARY
(dash line)	PROPERTY LINE
1	SUB-AREA NUMBER
0.14 AC	SUB-AREA ACREAGE
AC	ACRES
CB	CATCH BASIN
HP	HIGH POINT
INV	INVERT
JS	JUNCTION STRUCTURE
MH	MANHOLE
L. PT.	LOW POINT
TG	TOP OF GRATE
TS	TOP OF SLOPE

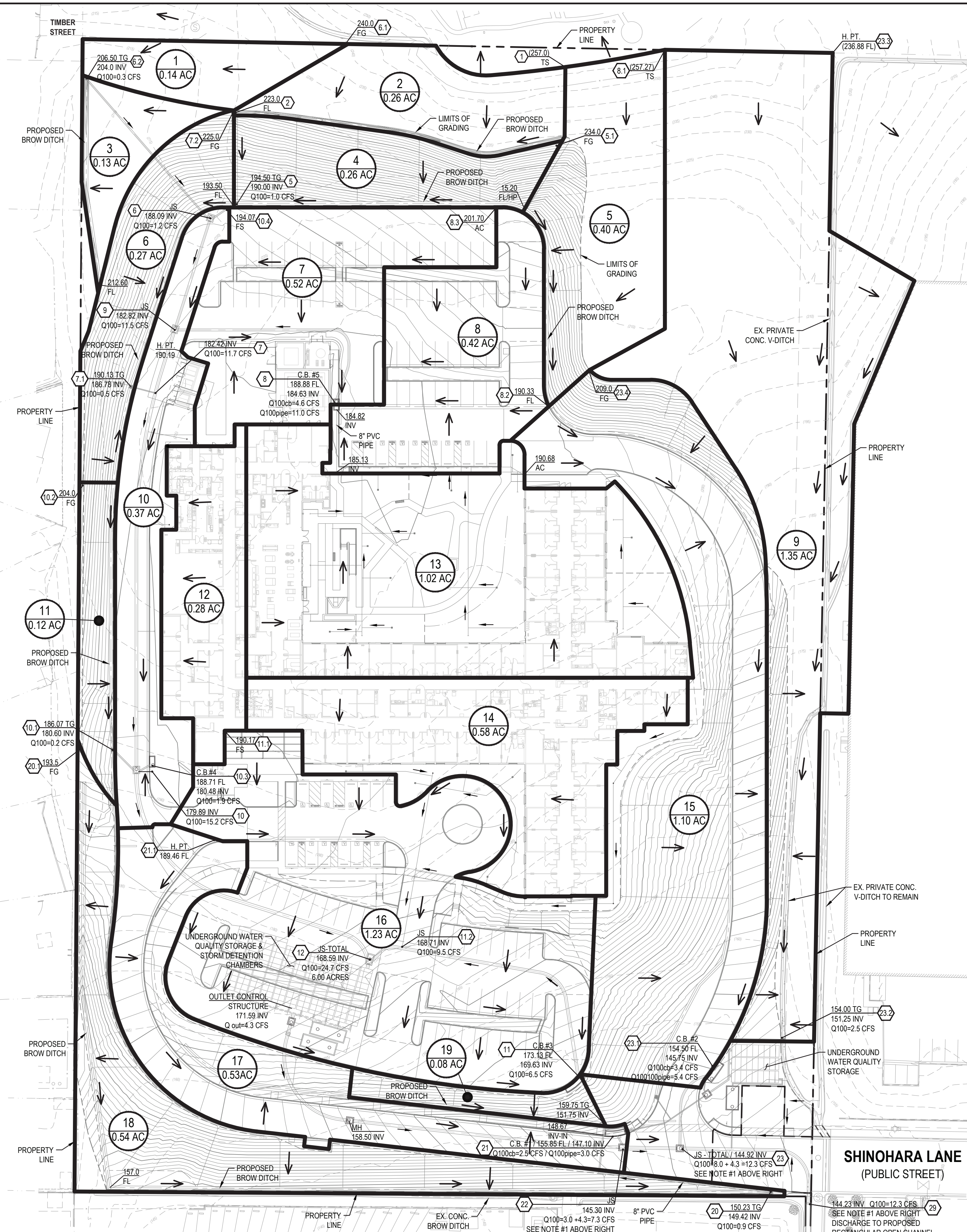
REGISTERED PROFESSIONAL ENGINEER RABIH F. MAHMOUD 60421 EXPIRES 6/30/22 CIVIL STATE OF CALIFORNIA

APD CONSULTANTS, INC.
PLANNING . ENGINEERING . CONSTRUCTION MANAGEMENT
22362 GILBERTO, SUITE 245, RANCHO SANTA MARGARITA, CA 92688
TEL: (949) 336-6336 ; (949) 336-6337 www.apdcon.com

40' 20' 0 40' 80'
SCALE: 1" = 40'

By	REVISIONS	Date	App'd	DATUM	SCALE	Designed By:	Drawn By:	Checked By:	CITY OF CHULA VISTA DEVELOPMENT SERVICES DEPARTMENT	DRAWING NO.
				VERTICAL DATUM: NAVD88	HORIZONTAL	V.B.	V.B.	R.M.	ENCOMPASS HEALTH CHULA VISTA	1
					AS SHOWN	Plans Prepared Under Supervision Of:		Date:		
				HORIZONTAL DATUM: NAD83	VERTICAL	ROBBIE MAHMOOD, P.E.		R.C.E. No. 60421	PRE-DEVELOPMENT CONDITION HYDROLOGY MAP	W.O. No.

CV REVISED: 2/13/19



ENCOMPASS HEALTH CHULA VISTA

LEGEND:

→	FLOW PATH OF WATER
━━	DRAINAGE AREA BOUNDARY
— - —	PROPERTY LINE
1	SUB-AREA NUMBER
0.14 AC	SUB-AREA ACREAGE
AC	ACRES
CB	CATCH BASIN
HP	HIGH POINT
INV	INVERT
JS	JUNCTION STRUCTURE
MH	MANHOLE
L. PT.	LOW POINT
TG	TOP OF GRATE
TS	TOP OF SLOPE
CB	CATCH BASIN
Q100	100-YEAR PEAK FLOW (CFS)
Q100cb	100-YEAR PEAK FLOW IN CATCH BASIN (CFS)
Q100pipe	100-YEAR PEAK FLOW IN PIPE (CFS)

NOTE:

1. The 4.3 cfs is the flow discharging from the upstream detention chamber

REGISTERED PROFESSIONAL ENGINEER RABIH F. MAHMOUD 60421 EXPIRES 6/30/22 CIVIL STATE OF CALIFORNIA

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22362 GILBERTO, SUITE 245, RANCHO SANTA MARGARITA, CA 92688
TEL: (949) 336-6336 ; (949) 336-6337 www.apdcon.com

40' 20' 0 40' 80'
SCALE: 1" = 40'

By	REVISIONS	Date	App'd	DATUM	SCALE	Designed By:	Drawn By:	Checked By:	CITY OF CHULA VISTA DEVELOPMENT SERVICES DEPARTMENT	DRAWING NO.
				VERTICAL DATUM: NAVD88	HORIZONTAL	V.B.	V.B.	R.M.	ENCOMPASS HEALTH CHULA VISTA	1
					AS SHOWN	Plans Prepared Under Supervision Of:		Date:		
				HORIZONTAL DATUM: NAD83	VERTICAL	ROBBIE MAHMOOD, P.E.		R.C.E. No. 60421	HYDROLOGY MAP PROPOSED CONDITION	W.O. No.

CV REVISED: 2/13/19

Section 5 – 3' Wide Concrete Channel Hydraulics

```
****************************************************************************
                 HYDRAULIC ELEMENTS - I  PROGRAM PACKAGE
         (C) Copyright 1982-99 Advanced Engineering Software (aes)
                    Ver. 8.0  Release Date: 01/01/99


----------------------------------------------------------------------------
  TIME/DATE OF STUDY: 15:39   7/22/2020
============================================================================


 ************************** DESCRIPTION OF STUDY **************************
* channel                                                                  *
* Q = attenuated flow                                                      *
*                                                                          *
 **************************************************************************

****************************************************************************
>>>>CHANNEL INPUT INFORMATION<<<<
----------------------------------------------------------------------------
    CHANNEL Z1(HORIZONTAL/VERTICAL) =    0.00
            Z2(HORIZONTAL/VERTICAL) =    0.00
    BASEWIDTH(FEET) =     3.00
    CONSTANT CHANNEL SLOPE(FEET/FEET) = 0.005000
    UNIFORM FLOW(CFS) =       12.30
    MANNINGS FRICTION FACTOR = 0.0140
============================================================================
    NORMAL-DEPTH FLOW INFORMATION:
----------------------------------------------------------------------------
    >>>>> NORMAL DEPTH(FEET) =   0.83
    FLOW TOP-WIDTH(FEET) =         3.00
    FLOW AREA(SQUARE FEET) =           2.49
    HYDRAULIC DEPTH(FEET) =     0.83
    FLOW AVERAGE VELOCITY(FEET/SEC.) =     4.94
    UNIFORM FROUDE NUMBER =    0.956
    PRESSURE + MOMENTUM(POUNDS) =          182.22
    AVERAGED VELOCITY HEAD(FEET) =      0.379
    SPECIFIC ENERGY(FEET) =      1.209
============================================================================
    CRITICAL-DEPTH FLOW INFORMATION:
----------------------------------------------------------------------------
    CRITICAL FLOW TOP-WIDTH(FEET) =         3.00
    CRITICAL FLOW AREA(SQUARE FEET) =           2.41
    CRITICAL FLOW HYDRAULIC DEPTH(FEET) =     0.80
    CRITICAL FLOW AVERAGE VELOCITY(FEET/SEC.) =     5.10
    CRITICAL DEPTH(FEET) =     0.80
    CRITICAL FLOW PRESSURE + MOMENTUM(POUNDS) =         182.06
    AVERAGED CRITICAL FLOW VELOCITY HEAD(FEET) =      0.403
    CRITICAL FLOW SPECIFIC ENERGY(FEET) =      1.208
============================================================================
```

Section 6 – Catch Basin and Piping Hydraulics

```
********************************************************************************
                  PIPE-FLOW HYDRAULICS COMPUTER PROGRAM PACKAGE
            (Reference: LACFCD,LACRD, AND OCEMA HYDRAULICS CRITERION)
           (c) Copyright 1982-2003 Advanced Engineering Software (aes)
                      Ver. 8.0  Release Date: 01/01/2003


  ************************** DESCRIPTION OF STUDY **************************
 * Line "A"                                                                 *
 *                                                                          *
 *                                                                          *
  **************************************************************************

   FILE NAME: VA.DAT
   TIME/DATE OF STUDY: 14:20 07/22/2020
********************************************************************************
                 GRADUALLY VARIED FLOW ANALYSIS FOR PIPE SYSTEM
                           NODAL POINT STATUS TABLE
                  (Note: "*" indicates nodal point data used.)
                        UPSTREAM RUN                     DOWNSTREAM RUN
   NODE    MODEL   PRESSURE      PRESSURE+         FLOW         PRESSURE+
  NUMBER  PROCESS  HEAD(FT)   MOMENTUM(POUNDS)   DEPTH(FT)   MOMENTUM(POUNDS)
   996.50-            2.00*           572.37         1.58             562.93
        } FRICTION
   999.66-            1.92*           561.49         1.75 Dc          554.05
        } JUNCTION
  1003.51-            3.20*           574.48         0.76             433.27
        } FRICTION
  1004.65-            3.15*           563.73         0.76             433.00
        } FRICTION+BEND   } HYDRAULIC JUMP
  1027.63-            2.19            374.91         0.76*            431.64
        } FRICTION
  1115.86-            1.41 Dc         281.26         0.80*            406.63
        } FRICTION+BEND
  1229.91-            1.41 Dc         281.26         1.23*            288.73
        } FRICTION
  1231.27-            1.41*Dc         281.26         1.41*Dc          281.26
        } JUNCTION
  1235.94-            1.82*           250.38         1.06             204.62
        } FRICTION        } HYDRAULIC JUMP
  1396.03-            1.23 Dc         198.32         1.06*            204.52
        } FRICTION+BEND
  1521.43-            1.23 Dc         198.32         1.09*            202.53
        } FRICTION
  1544.97-            1.23*Dc         198.32         1.23*Dc          198.32
        } JUNCTION
  1549.64-            1.96*           135.23         0.23              17.14
        } FRICTION        } HYDRAULIC JUMP
  1627.24-            0.41*Dc          11.25         0.41*Dc           11.25
--------------------------------------------------------------------------------
  MAXIMUM NUMBER OF ENERGY BALANCES USED IN EACH PROFILE =  10
--------------------------------------------------------------------------------
  NOTE: STEADY FLOW HYDRAULIC HEAD-LOSS COMPUTATIONS BASED ON THE MOST
  CONSERVATIVE FORMULAE FROM THE CURRENT LACRD,LACFCD, AND OCEMA
  DESIGN MANUALS.
********************************************************************************
  DOWNSTREAM PIPE FLOW CONTROL DATA:
  NODE NUMBER =   996.50            FLOWLINE ELEVATION =    168.30
  PIPE FLOW =       24.70 CFS       PIPE DIAMETER =  24.00 INCHES
  ASSUMED DOWNSTREAM CONTROL HGL =   170.300 FEET
--------------------------------------------------------------------------------
  NODE   996.50 : HGL = <  170.300>;EGL= <  171.260>;FLOWLINE= <  168.300>

********************************************************************************
  FLOW PROCESS FROM NODE   996.50 TO NODE   999.66 IS CODE =  1
  UPSTREAM NODE   999.66     ELEVATION =   168.39  (FLOW SEALS IN REACH)
--------------------------------------------------------------------------------
  CALCULATE FRICTION LOSSES(LACFCD):
  PIPE FLOW   =      24.70 CFS     PIPE DIAMETER =  24.00 INCHES
  PIPE LENGTH =       3.16 FEET         MANNING'S N  =  0.01300
--------------------------------------------------------------------------------
  NORMAL DEPTH(FT) =      1.17          CRITICAL DEPTH(FT) =      1.75
================================================================================
  DOWNSTREAM CONTROL ASSUMED PRESSURE HEAD(FT) =     2.00
================================================================================
  GRADUALLY VARIED FLOW PROFILE COMPUTED INFORMATION:
--------------------------------------------------------------------------------
  DISTANCE FROM      FLOW DEPTH  VELOCITY      SPECIFIC        PRESSURE+
   CONTROL(FT)          (FT)     (FT/SEC)     ENERGY(FT)    MOMENTUM(POUNDS)
         0.000          2.000      7.860           2.960             572.37
         1.184          1.975      7.878           2.940             568.42
         2.110          1.951      7.911           2.923             565.21
         2.886          1.926      7.955           2.909             562.50
         3.160          1.916      7.975           2.904             561.49
--------------------------------------------------------------------------------
  NODE   999.66 : HGL = <  170.306>;EGL= <  171.294>;FLOWLINE= <  168.390>

********************************************************************************
  FLOW PROCESS FROM NODE   999.66 TO NODE  1003.51 IS CODE =  5
  UPSTREAM NODE  1003.51     ELEVATION =   168.59  (FLOW UNSEALS IN REACH)
```

```
----------------------------------------------------------------------------
  CALCULATE JUNCTION LOSSES:
      PIPE        FLOW    DIAMETER   ANGLE    FLOWLINE   CRITICAL   VELOCITY
                 (CFS)   (INCHES) (DEGREES) ELEVATION  DEPTH(FT.)  (FT/SEC)
    UPSTREAM      15.20    24.00     60.00    168.59      1.41        4.838
   DOWNSTREAM     24.70    24.00       -      168.39      1.75        7.978
   LATERAL #1      9.50    24.00     60.00    168.59      1.10        3.024
   LATERAL #2      0.00     0.00      0.00      0.00      0.00        0.000
      Q5           0.00===Q5 EQUALS BASIN INPUT===

  LACFCD AND OCEMA FLOW JUNCTION FORMULAE USED:
  DY=(Q2*V2-Q1*V1*COS(DELTA1)-Q3*V3*COS(DELTA3)-
      Q4*V4*COS(DELTA4))/((A1+A2)*16.1)+FRICTION LOSSES
  UPSTREAM:    MANNING'S N = 0.01300;  FRICTION SLOPE = 0.00451
  DOWNSTREAM:  MANNING'S N = 0.01300;  FRICTION SLOPE = 0.01037
  AVERAGED FRICTION SLOPE IN JUNCTION ASSUMED AS 0.00744
  JUNCTION LENGTH =   4.67 FEET
  FRICTION LOSSES =  0.035 FEET          ENTRANCE LOSSES =  0.000 FEET
  JUNCTION LOSSES = (DY+HV1-HV2)+(ENTRANCE LOSSES)
  JUNCTION LOSSES = ( 0.863)+( 0.000) =   0.863
----------------------------------------------------------------------------
  NODE  1003.51 : HGL = <  171.794>;EGL= <  172.157>;FLOWLINE= <  168.590>

****************************************************************************
  FLOW PROCESS FROM NODE  1003.51 TO NODE  1004.65 IS CODE =  1
  UPSTREAM NODE  1004.65      ELEVATION =   168.65  (FLOW IS UNDER PRESSURE)
----------------------------------------------------------------------------
  CALCULATE FRICTION LOSSES(LACFCD):
  PIPE FLOW   =      15.20 CFS     PIPE DIAMETER =  24.00 INCHES
  PIPE LENGTH =       1.14 FEET          MANNING'S N  =  0.01300
  SF=(Q/K)**2 = ((     15.20)/(   226.319))**2 = 0.00451
  HF=L*SF = (      1.14)*(0.00451) =      0.005
----------------------------------------------------------------------------
  NODE  1004.65 : HGL = <  171.799>;EGL= <  172.162>;FLOWLINE= <  168.650>

****************************************************************************
  FLOW PROCESS FROM NODE  1004.65 TO NODE  1027.63 IS CODE =  3
  UPSTREAM NODE  1027.63      ELEVATION =   169.79  (HYDRAULIC JUMP OCCURS)
----------------------------------------------------------------------------
  CALCULATE PIPE-BEND LOSSES(OCEMA):
  PIPE FLOW =       15.20 CFS            PIPE DIAMETER =  24.00 INCHES
  CENTRAL ANGLE = 58.200 DEGREES         MANNING'S N = 0.01300
  PIPE LENGTH =       22.98 FEET
----------------------------------------------------------------------------
  HYDRAULIC JUMP: DOWNSTREAM RUN ANALYSIS RESULTS
----------------------------------------------------------------------------
  NORMAL DEPTH(FT) =       0.75          CRITICAL DEPTH(FT) =      1.41
============================================================================
  UPSTREAM CONTROL ASSUMED FLOWDEPTH(FT) =     0.76
============================================================================
  GRADUALLY VARIED FLOW PROFILE COMPUTED INFORMATION:
----------------------------------------------------------------------------
  DISTANCE FROM      FLOW DEPTH  VELOCITY      SPECIFIC        PRESSURE+
   CONTROL(FT)          (FT)    (FT/SEC)     ENERGY(FT)    MOMENTUM(POUNDS)
         0.000          0.758     13.919          3.768           431.64
         4.250          0.758     13.931          3.773           431.96
         9.006          0.757     13.942          3.777           432.27
        14.404          0.757     13.954          3.782           432.58
        20.643          0.756     13.966          3.787           432.90
        22.980          0.756     13.970          3.788           433.00
----------------------------------------------------------------------------
  HYDRAULIC JUMP: UPSTREAM RUN ANALYSIS RESULTS
============================================================================
  DOWNSTREAM CONTROL ASSUMED PRESSURE HEAD(FT) =     3.15
============================================================================
  PRESSURE FLOW PROFILE COMPUTED INFORMATION:
----------------------------------------------------------------------------
  DISTANCE FROM       PRESSURE   VELOCITY      SPECIFIC        PRESSURE+
   CONTROL(FT)        HEAD(FT)   (FT/SEC)     ENERGY(FT)    MOMENTUM(POUNDS)
         0.000          3.149      4.838          3.512           563.73
        22.980          2.185      4.838          2.549           374.91
------------------------END OF HYDRAULIC JUMP ANALYSIS------------------------
| PRESSURE+MOMENTUM BALANCE OCCURS AT    16.02 FEET UPSTREAM OF NODE 1004.65 |
|      DOWNSTREAM DEPTH = 2.477 FEET, UPSTREAM CONJUGATE DEPTH = 0.757 FEET |
----------------------------------------------------------------------------
  NODE  1027.63 : HGL = <  170.548>;EGL= <  173.558>;FLOWLINE= <  169.790>

****************************************************************************
  FLOW PROCESS FROM NODE  1027.63 TO NODE  1115.86 IS CODE =  1
  UPSTREAM NODE  1115.86      ELEVATION =   174.17  (FLOW IS SUPERCRITICAL)
----------------------------------------------------------------------------
  CALCULATE FRICTION LOSSES(LACFCD):
  PIPE FLOW   =      15.20 CFS     PIPE DIAMETER =  24.00 INCHES
  PIPE LENGTH =      88.23 FEET          MANNING'S N  =  0.01300
----------------------------------------------------------------------------
  NORMAL DEPTH(FT) =       0.75          CRITICAL DEPTH(FT) =      1.41
============================================================================
  UPSTREAM CONTROL ASSUMED FLOWDEPTH(FT) =     0.80
============================================================================
  GRADUALLY VARIED FLOW PROFILE COMPUTED INFORMATION:
----------------------------------------------------------------------------
  DISTANCE FROM      FLOW DEPTH  VELOCITY      SPECIFIC        PRESSURE+
   CONTROL(FT)          (FT)    (FT/SEC)     ENERGY(FT)    MOMENTUM(POUNDS)
```

```
          0.000         0.799     12.972          3.414           406.63
          3.872         0.794     13.072          3.449           409.24
          8.248         0.790     13.173          3.486           411.90
         13.265         0.785     13.276          3.524           414.60
         19.120         0.781     13.381          3.563           417.35
         26.122         0.776     13.487          3.602           420.15
         34.787         0.771     13.594          3.643           423.00
         46.081         0.767     13.703          3.685           425.89
         62.176         0.762     13.814          3.727           428.84
         88.230         0.758     13.919          3.768           431.64
------------------------------------------------------------------------------
  NODE  1115.86 : HGL = <  174.969>;EGL= <  177.584>;FLOWLINE= <  174.170>

******************************************************************************
  FLOW PROCESS FROM NODE  1115.86 TO NODE  1229.91 IS CODE =  3
  UPSTREAM NODE  1229.91     ELEVATION =   179.83  (FLOW IS SUPERCRITICAL)
------------------------------------------------------------------------------
  CALCULATE PIPE-BEND LOSSES(OCEMA):
  PIPE FLOW =      15.20 CFS            PIPE DIAMETER =  24.00 INCHES
  CENTRAL ANGLE = 72.200 DEGREES        MANNING'S N = 0.01300
  PIPE LENGTH =     114.05 FEET
------------------------------------------------------------------------------
  NORMAL DEPTH(FT) =      0.75          CRITICAL DEPTH(FT) =      1.41
==============================================================================
  UPSTREAM CONTROL ASSUMED FLOWDEPTH(FT) =     1.23
==============================================================================
  GRADUALLY VARIED FLOW PROFILE COMPUTED INFORMATION:
------------------------------------------------------------------------------
  DISTANCE FROM      FLOW DEPTH  VELOCITY      SPECIFIC        PRESSURE+
   CONTROL(FT)          (FT)    (FT/SEC)     ENERGY(FT)    MOMENTUM(POUNDS)
          0.000         1.226      7.530          2.106           288.73
          0.995         1.178      7.892          2.146           293.58
          2.401         1.131      8.293          2.200           299.89
          4.346         1.084      8.741          2.271           307.82
          7.021         1.037      9.243          2.364           317.61
         10.727         0.989      9.806          2.483           329.50
         15.972         0.942     10.442          2.636           343.82
         23.715         0.895     11.164          2.832           360.95
         36.120         0.848     11.989          3.081           381.38
         60.151         0.800     12.938          3.401           405.75
        114.050         0.799     12.972          3.414           406.63
------------------------------------------------------------------------------
  NODE  1229.91 : HGL = <  181.056>;EGL= <  181.936>;FLOWLINE= <  179.830>

******************************************************************************
  FLOW PROCESS FROM NODE  1229.91 TO NODE  1231.27 IS CODE =  1
  UPSTREAM NODE  1231.27     ELEVATION =   179.90  (FLOW IS SUPERCRITICAL)
------------------------------------------------------------------------------
  CALCULATE FRICTION LOSSES(LACFCD):
  PIPE FLOW   =      15.20 CFS    PIPE DIAMETER =  24.00 INCHES
  PIPE LENGTH =       1.36 FEET         MANNING'S N  =  0.01300
------------------------------------------------------------------------------
  NORMAL DEPTH(FT) =      0.75          CRITICAL DEPTH(FT) =      1.41
==============================================================================
  UPSTREAM CONTROL ASSUMED FLOWDEPTH(FT) =     1.41
==============================================================================
  GRADUALLY VARIED FLOW PROFILE COMPUTED INFORMATION:
------------------------------------------------------------------------------
  DISTANCE FROM      FLOW DEPTH  VELOCITY      SPECIFIC        PRESSURE+
   CONTROL(FT)          (FT)    (FT/SEC)     ENERGY(FT)    MOMENTUM(POUNDS)
          0.000         1.405      6.443          2.050           281.26
          0.148         1.339      6.795          2.057           282.20
          0.651         1.273      7.199          2.079           285.16
          1.360         1.226      7.530          2.106           288.73
------------------------------------------------------------------------------
  NODE  1231.27 : HGL = <  181.305>;EGL= <  181.950>;FLOWLINE= <  179.900>

******************************************************************************
  FLOW PROCESS FROM NODE  1231.27 TO NODE  1235.94 IS CODE =  5
  UPSTREAM NODE  1235.94     ELEVATION =   180.09  (FLOW IS SUBCRITICAL)
------------------------------------------------------------------------------
  CALCULATE JUNCTION LOSSES:
       PIPE       FLOW    DIAMETER   ANGLE    FLOWLINE   CRITICAL   VELOCITY
                 (CFS)   (INCHES) (DEGREES) ELEVATION  DEPTH(FT.)  (FT/SEC)
    UPSTREAM      11.70    24.00      0.00    180.09      1.23        3.892
   DOWNSTREAM     15.20    24.00       -      179.90      1.41        6.445
   LATERAL #1      0.20    18.00     45.00    180.39      0.16        0.130
   LATERAL #2      3.30    18.00     60.00    180.39      0.69        2.145
      Q5           0.00===Q5 EQUALS BASIN INPUT===

  LACFCD AND OCEMA FLOW JUNCTION FORMULAE USED:
  DY=(Q2*V2-Q1*V1*COS(DELTA1)-Q3*V3*COS(DELTA3)-
      Q4*V4*COS(DELTA4))/((A1+A2)*16.1)+FRICTION LOSSES
  UPSTREAM:    MANNING'S N = 0.01300;  FRICTION SLOPE = 0.00233
  DOWNSTREAM:  MANNING'S N = 0.01300;  FRICTION SLOPE = 0.00638
  AVERAGED FRICTION SLOPE IN JUNCTION ASSUMED AS 0.00436
  JUNCTION LENGTH =   4.67 FEET
  FRICTION LOSSES =  0.020 FEET         ENTRANCE LOSSES =  0.000 FEET
  JUNCTION LOSSES = (DY+HV1-HV2)+(ENTRANCE LOSSES)
  JUNCTION LOSSES = ( 0.199)+( 0.000) =   0.199
------------------------------------------------------------------------------
  NODE  1235.94 : HGL = <  181.914>;EGL= <  182.149>;FLOWLINE= <  180.090>
```

```
****************************************************************************
  FLOW PROCESS FROM NODE  1235.94 TO NODE  1396.03 IS CODE =  1
  UPSTREAM NODE  1396.03     ELEVATION =   181.50  (HYDRAULIC JUMP OCCURS)
----------------------------------------------------------------------------
  CALCULATE FRICTION LOSSES(LACFCD):
  PIPE FLOW   =      11.70 CFS     PIPE DIAMETER =  24.00 INCHES
  PIPE LENGTH =     160.09 FEET          MANNING'S N  =  0.01300
----------------------------------------------------------------------------
  HYDRAULIC JUMP: DOWNSTREAM RUN ANALYSIS RESULTS
----------------------------------------------------------------------------
  NORMAL DEPTH(FT) =      1.06          CRITICAL DEPTH(FT) =      1.23
============================================================================
  UPSTREAM CONTROL ASSUMED FLOWDEPTH(FT) =     1.06
============================================================================
  GRADUALLY VARIED FLOW PROFILE COMPUTED INFORMATION:
----------------------------------------------------------------------------
  DISTANCE FROM      FLOW DEPTH  VELOCITY     SPECIFIC       PRESSURE+
   CONTROL(FT)          (FT)    (FT/SEC)     ENERGY(FT)    MOMENTUM(POUNDS)
         0.000          1.061     6.909          1.803          204.52
         2.885          1.061     6.910          1.803          204.53
         6.113          1.061     6.911          1.803          204.54
         9.775          1.061     6.912          1.803          204.55
        14.006          1.061     6.913          1.803          204.56
        19.014          1.060     6.915          1.803          204.57
        25.150          1.060     6.916          1.803          204.58
        33.067          1.060     6.917          1.803          204.59
        44.237          1.060     6.918          1.804          204.60
        63.387          1.060     6.919          1.804          204.61
       160.090          1.060     6.919          1.804          204.62
----------------------------------------------------------------------------
  HYDRAULIC JUMP: UPSTREAM RUN ANALYSIS RESULTS
============================================================================
  DOWNSTREAM CONTROL ASSUMED FLOWDEPTH(FT) =     1.82
============================================================================
  GRADUALLY VARIED FLOW PROFILE COMPUTED INFORMATION:
----------------------------------------------------------------------------
  DISTANCE FROM      FLOW DEPTH  VELOCITY     SPECIFIC       PRESSURE+
   CONTROL(FT)          (FT)    (FT/SEC)     ENERGY(FT)    MOMENTUM(POUNDS)
         0.000          1.824     3.891          2.059          250.38
         7.424          1.764     3.987          2.011          241.51
        14.566          1.705     4.100          1.966          233.31
        21.426          1.645     4.230          1.923          225.81
        27.979          1.586     4.379          1.884          219.08
        34.177          1.526     4.547          1.847          213.15
        39.938          1.466     4.738          1.815          208.10
        45.133          1.407     4.953          1.788          204.00
        49.547          1.347     5.196          1.767          200.93
        52.805          1.288     5.471          1.753          199.00
        54.174          1.228     5.782          1.747          198.32
       160.090          1.228     5.782          1.747          198.32
------------------------END OF HYDRAULIC JUMP ANALYSIS-----------------------
| PRESSURE+MOMENTUM BALANCE OCCURS AT    44.35 FEET UPSTREAM OF NODE 1235.94 |
|       DOWNSTREAM DEPTH = 1.416 FEET, UPSTREAM CONJUGATE DEPTH = 1.060 FEET |
----------------------------------------------------------------------------
  NODE  1396.03 : HGL = <  182.561>;EGL= <  183.303>;FLOWLINE= <  181.500>

****************************************************************************
  FLOW PROCESS FROM NODE  1396.03 TO NODE  1521.43 IS CODE =  3
  UPSTREAM NODE  1521.43     ELEVATION =   182.61  (FLOW IS SUPERCRITICAL)
----------------------------------------------------------------------------
  CALCULATE PIPE-BEND LOSSES(OCEMA):
  PIPE FLOW =      11.70 CFS             PIPE DIAMETER =  24.00 INCHES
  CENTRAL ANGLE = 17.300 DEGREES         MANNING'S N = 0.01300
  PIPE LENGTH =     125.40 FEET
----------------------------------------------------------------------------
  NORMAL DEPTH(FT) =      1.06          CRITICAL DEPTH(FT) =      1.23
============================================================================
  UPSTREAM CONTROL ASSUMED FLOWDEPTH(FT) =     1.09
============================================================================
  GRADUALLY VARIED FLOW PROFILE COMPUTED INFORMATION:
----------------------------------------------------------------------------
  DISTANCE FROM      FLOW DEPTH  VELOCITY     SPECIFIC       PRESSURE+
   CONTROL(FT)          (FT)    (FT/SEC)     ENERGY(FT)    MOMENTUM(POUNDS)
         0.000          1.089     6.689          1.784          202.53
         2.410          1.086     6.713          1.786          202.73
         5.164          1.083     6.736          1.788          202.93
         8.355          1.080     6.760          1.790          203.14
        12.118          1.077     6.784          1.792          203.36
        16.662          1.074     6.809          1.794          203.57
        22.339          1.071     6.833          1.796          203.80
        29.808          1.067     6.858          1.798          204.03
        40.547          1.064     6.883          1.800          204.27
        59.302          1.061     6.908          1.803          204.51
       125.400          1.061     6.909          1.803          204.52
----------------------------------------------------------------------------
  NODE  1521.43 : HGL = <  183.699>;EGL= <  184.394>;FLOWLINE= <  182.610>

****************************************************************************
  FLOW PROCESS FROM NODE  1521.43 TO NODE  1544.97 IS CODE =  1
  UPSTREAM NODE  1544.97     ELEVATION =   182.82  (FLOW IS SUPERCRITICAL)
----------------------------------------------------------------------------
  CALCULATE FRICTION LOSSES(LACFCD):
  PIPE FLOW   =      11.70 CFS     PIPE DIAMETER =  24.00 INCHES
```

```
  PIPE LENGTH =      23.54 FEET          MANNING'S N  =  0.01300
------------------------------------------------------------------------------
  NORMAL DEPTH(FT) =      1.06           CRITICAL DEPTH(FT) =      1.23
==============================================================================
  UPSTREAM CONTROL ASSUMED FLOWDEPTH(FT) =     1.23
==============================================================================
  GRADUALLY VARIED FLOW PROFILE COMPUTED INFORMATION:
------------------------------------------------------------------------------
  DISTANCE FROM      FLOW DEPTH  VELOCITY      SPECIFIC        PRESSURE+
   CONTROL(FT)          (FT)    (FT/SEC)     ENERGY(FT)    MOMENTUM(POUNDS)
          0.000         1.228      5.782          1.747           198.32
          0.147         1.211      5.880          1.748           198.38
          0.635         1.194      5.981          1.749           198.56
          1.558         1.176      6.087          1.752           198.87
          3.051         1.159      6.196          1.756           199.30
          5.326         1.142      6.310          1.761           199.88
          8.737         1.125      6.429          1.767           200.59
         13.949         1.107      6.552          1.774           201.45
         22.454         1.090      6.680          1.784           202.46
         23.540         1.089      6.689          1.784           202.53
------------------------------------------------------------------------------
  NODE  1544.97 : HGL = <  184.048>;EGL= <  184.567>;FLOWLINE= <  182.820>

******************************************************************************
  FLOW PROCESS FROM NODE  1544.97 TO NODE  1549.64 IS CODE =  5
  UPSTREAM NODE  1549.64     ELEVATION =   183.02  (FLOW UNSEALS IN REACH)
------------------------------------------------------------------------------
  CALCULATE JUNCTION LOSSES:
       PIPE        FLOW    DIAMETER   ANGLE    FLOWLINE   CRITICAL   VELOCITY
                   (CFS)   (INCHES) (DEGREES) ELEVATION  DEPTH(FT.)  (FT/SEC)
    UPSTREAM        1.20    18.00      0.00    183.02      0.41        0.679
   DOWNSTREAM      11.70    24.00       -      182.82      1.23        5.784
   LATERAL #1      10.50    24.00     72.30    183.07      1.16        4.320
   LATERAL #2       0.00     0.00      0.00      0.00      0.00        0.000
      Q5            0.00===Q5 EQUALS BASIN INPUT===

  LACFCD AND OCEMA FLOW JUNCTION FORMULAE USED:
  DY=(Q2*V2-Q1*V1*COS(DELTA1)-Q3*V3*COS(DELTA3)-
      Q4*V4*COS(DELTA4))/((A1+A2)*16.1)+FRICTION LOSSES
  UPSTREAM:    MANNING'S N = 0.01300;  FRICTION SLOPE = 0.00013
  DOWNSTREAM:  MANNING'S N = 0.01300;  FRICTION SLOPE = 0.00552
  AVERAGED FRICTION SLOPE IN JUNCTION ASSUMED AS 0.00283
  JUNCTION LENGTH =   4.67 FEET
  FRICTION LOSSES =  0.013 FEET         ENTRANCE LOSSES =  0.000 FEET
  JUNCTION LOSSES = (DY+HV1-HV2)+(ENTRANCE LOSSES)
  JUNCTION LOSSES = ( 0.422)+( 0.000) =   0.422
------------------------------------------------------------------------------
  NODE  1549.64 : HGL = <  184.982>;EGL= <  184.989>;FLOWLINE= <  183.020>

******************************************************************************
  FLOW PROCESS FROM NODE  1549.64 TO NODE  1627.24 IS CODE =  1
  UPSTREAM NODE  1627.24     ELEVATION =   188.09  (HYDRAULIC JUMP OCCURS)
------------------------------------------------------------------------------
  CALCULATE FRICTION LOSSES(LACFCD):
  PIPE FLOW   =       1.20 CFS     PIPE DIAMETER =  18.00 INCHES
  PIPE LENGTH =      77.60 FEET          MANNING'S N  =  0.01300
------------------------------------------------------------------------------
  HYDRAULIC JUMP: DOWNSTREAM RUN ANALYSIS RESULTS
------------------------------------------------------------------------------
  NORMAL DEPTH(FT) =      0.22           CRITICAL DEPTH(FT) =      0.41
==============================================================================
  UPSTREAM CONTROL ASSUMED FLOWDEPTH(FT) =     0.41
==============================================================================
  GRADUALLY VARIED FLOW PROFILE COMPUTED INFORMATION:
------------------------------------------------------------------------------
  DISTANCE FROM      FLOW DEPTH  VELOCITY      SPECIFIC        PRESSURE+
   CONTROL(FT)          (FT)    (FT/SEC)     ENERGY(FT)    MOMENTUM(POUNDS)
          0.000         0.410      3.068          0.556            11.25
          0.032         0.390      3.284          0.558            11.29
          0.142         0.371      3.528          0.564            11.43
          0.357         0.351      3.805          0.576            11.68
          0.718         0.332      4.124          0.596            12.06
          1.289         0.313      4.492          0.626            12.58
          2.180         0.293      4.921          0.670            13.27
          3.600         0.274      5.428          0.732            14.16
          6.026         0.255      6.031          0.820            15.31
         10.990         0.235      6.760          0.946            16.78
         77.600         0.231      6.932          0.978            17.14
------------------------------------------------------------------------------
  HYDRAULIC JUMP: UPSTREAM RUN ANALYSIS RESULTS
==============================================================================
  DOWNSTREAM CONTROL ASSUMED PRESSURE HEAD(FT) =     1.96
==============================================================================
  PRESSURE FLOW PROFILE COMPUTED INFORMATION:
------------------------------------------------------------------------------
  DISTANCE FROM       PRESSURE   VELOCITY      SPECIFIC        PRESSURE+
   CONTROL(FT)        HEAD(FT)  (FT/SEC)     ENERGY(FT)    MOMENTUM(POUNDS)
          0.000         1.962      0.679          1.969           135.23
          7.086         1.500      0.679          1.507            84.28
==============================================================================
  ASSUMED DOWNSTREAM PRESSURE HEAD(FT) =     1.50
==============================================================================
  GRADUALLY VARIED FLOW PROFILE COMPUTED INFORMATION:
```

```
------------------------------------------------------------------------------
  DISTANCE FROM       FLOW DEPTH  VELOCITY      SPECIFIC        PRESSURE+
   CONTROL(FT)           (FT)     (FT/SEC)     ENERGY(FT)    MOMENTUM(POUNDS)
          7.086         1.500      0.679          1.507            84.28
          8.751         1.391      0.702          1.399            72.47
         10.407         1.282      0.746          1.291            61.26
         12.056         1.173      0.809          1.183            50.89
         13.695         1.064      0.895          1.076            41.47
         15.316         0.955      1.011          0.971            33.14
         16.911         0.846      1.168          0.867            25.97
         18.456         0.737      1.389          0.767            20.05
         19.903         0.628      1.712          0.673            15.48
         21.130         0.519      2.213          0.595            12.43
         21.750         0.410      3.068          0.556            11.25
         77.600         0.410      3.068          0.556            11.25
------------------------END OF HYDRAULIC JUMP ANALYSIS-----------------------
| PRESSURE+MOMENTUM BALANCE OCCURS AT    19.41 FEET UPSTREAM OF NODE 1549.64 |
|       DOWNSTREAM DEPTH = 0.665 FEET, UPSTREAM CONJUGATE DEPTH = 0.233 FEET |
------------------------------------------------------------------------------
  NODE  1627.24 : HGL = <  188.500>;EGL= <  188.646>;FLOWLINE= <  188.090>

******************************************************************************
  UPSTREAM PIPE FLOW CONTROL DATA:
  NODE NUMBER =  1627.24           FLOWLINE ELEVATION =   188.09
  ASSUMED UPSTREAM CONTROL HGL =    188.50 FOR DOWNSTREAM RUN ANALYSIS

==============================================================================
  END OF GRADUALLY VARIED FLOW ANALYSIS
```

```
******************************************************************************
                 PIPE-FLOW HYDRAULICS COMPUTER PROGRAM PACKAGE
           (Reference: LACFCD,LACRD, AND OCEMA HYDRAULICS CRITERION)
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                     Ver. 8.0  Release Date: 01/01/2003


  ************************** DESCRIPTION OF STUDY **************************
 * Line "B"                                                                 *
 *                                                                          *
 *                                                                          *
  **************************************************************************

   FILE NAME: VB.DAT
   TIME/DATE OF STUDY: 14:53 07/22/2020

******************************************************************************
                GRADUALLY VARIED FLOW ANALYSIS FOR PIPE SYSTEM
                          NODAL POINT STATUS TABLE
                  (Note: "*" indicates nodal point data used.)
                      UPSTREAM RUN                      DOWNSTREAM RUN
   NODE    MODEL   PRESSURE      PRESSURE+          FLOW         PRESSURE+
  NUMBER  PROCESS  HEAD(FT)   MOMENTUM(POUNDS)   DEPTH(FT)   MOMENTUM(POUNDS)
  2003.53-            3.21*             488.91       1.10 Dc          150.81
        } FRICTION
  2012.50-            3.19*             484.17       1.07             150.96
        } FRICTION+BEND
  2023.18-            3.17*             481.49       1.10 Dc          150.81
        } FRICTION
  2027.95-            3.16*             479.22       1.10 Dc          150.81
        } JUNCTION
  2027.95-            3.31*             479.73       0.88 Dc           92.20
        } FRICTION
  2126.62-            2.90*             397.68       0.89 Dc           92.18
        } FRICTION+BEND
  2154.48-            2.79*             377.62       0.89 Dc           92.17
        } FRICTION
  2210.55-            2.56*             331.81       0.90 Dc           92.13
------------------------------------------------------------------------------
  MAXIMUM NUMBER OF ENERGY BALANCES USED IN EACH PROFILE =  10
------------------------------------------------------------------------------
  NOTE: STEADY FLOW HYDRAULIC HEAD-LOSS COMPUTATIONS BASED ON THE MOST
  CONSERVATIVE FORMULAE FROM THE CURRENT LACRD,LACFCD, AND OCEMA
  DESIGN MANUALS.
******************************************************************************
  DOWNSTREAM PIPE FLOW CONTROL DATA:
  NODE NUMBER =  2003.53            FLOWLINE ELEVATION =   168.59
  PIPE FLOW =        9.50 CFS       PIPE DIAMETER =  24.00 INCHES
  ASSUMED DOWNSTREAM CONTROL HGL =   171.800 FEET
------------------------------------------------------------------------------
  NODE  2003.53 : HGL = <  171.800>;EGL= <  171.942>;FLOWLINE= <  168.590>

******************************************************************************
  FLOW PROCESS FROM NODE  2003.53 TO NODE  2012.50 IS CODE =  1
  UPSTREAM NODE  2012.50     ELEVATION =   168.63  (FLOW IS UNDER PRESSURE)
------------------------------------------------------------------------------
  CALCULATE FRICTION LOSSES(LACFCD):
  PIPE FLOW   =        9.50 CFS      PIPE DIAMETER =  24.00 INCHES
  PIPE LENGTH =        8.97 FEET          MANNING'S N  =  0.01300
  SF=(Q/K)**2 = ((      9.50)/(   226.188))**2 = 0.00176
  HF=L*SF = (      8.97)*(0.00176) =      0.016
------------------------------------------------------------------------------
  NODE  2012.50 : HGL = <  171.816>;EGL= <  171.958>;FLOWLINE= <  168.630>

******************************************************************************
  FLOW PROCESS FROM NODE  2012.50 TO NODE  2023.18 IS CODE =  3
  UPSTREAM NODE  2023.18     ELEVATION =   168.69  (FLOW IS UNDER PRESSURE)
------------------------------------------------------------------------------
  CALCULATE PIPE-BEND LOSSES(OCEMA):
  PIPE FLOW =        9.50 CFS             PIPE DIAMETER =  24.00 INCHES
  CENTRAL ANGLE = 54.100 DEGREES          MANNING'S N = 0.01300
  PIPE LENGTH =      10.68 FEET           BEND COEFFICIENT(KB) = 0.19383
  FLOW VELOCITY =   3.02 FEET/SEC.        VELOCITY HEAD =  0.142 FEET
  HB=KB*(VELOCITY HEAD) = ( 0.194)*( 0.142) =   0.028
  SF=(Q/K)**2 = ((      9.50)/(   226.212))**2 = 0.00176
  HF=L*SF = (     10.68)*(0.00176) =  0.019
  TOTAL HEAD LOSSES = HB + HF = ( 0.028)+( 0.019) =  0.046
------------------------------------------------------------------------------
  NODE  2023.18 : HGL = <  171.862>;EGL= <  172.004>;FLOWLINE= <  168.690>

******************************************************************************
  FLOW PROCESS FROM NODE  2023.18 TO NODE  2027.95 IS CODE =  1
  UPSTREAM NODE  2027.95     ELEVATION =   168.71  (FLOW IS UNDER PRESSURE)
------------------------------------------------------------------------------
  CALCULATE FRICTION LOSSES(LACFCD):
  PIPE FLOW   =        9.50 CFS      PIPE DIAMETER =  24.00 INCHES
  PIPE LENGTH =        4.77 FEET          MANNING'S N  =  0.01300
  SF=(Q/K)**2 = ((      9.50)/(   226.280))**2 = 0.00176
  HF=L*SF = (      4.77)*(0.00176) =      0.008
------------------------------------------------------------------------------
  NODE  2027.95 : HGL = <  171.871>;EGL= <  172.013>;FLOWLINE= <  168.710>
```

```
****************************************************************************
  FLOW PROCESS FROM NODE  2027.95 TO NODE  2027.95 IS CODE =  5
  UPSTREAM NODE  2027.95     ELEVATION =   168.71  (FLOW IS UNDER PRESSURE)
----------------------------------------------------------------------------
  CALCULATE JUNCTION LOSSES:
       PIPE       FLOW    DIAMETER   ANGLE    FLOWLINE   CRITICAL   VELOCITY
                 (CFS)   (INCHES) (DEGREES) ELEVATION  DEPTH(FT.)  (FT/SEC)
     UPSTREAM      6.50    24.00      0.00    168.71      0.90        2.069
    DOWNSTREAM     9.50    24.00       -      168.71      1.10        3.024
    LATERAL #1     3.00     8.00     90.00    169.38      0.66        8.594
    LATERAL #2     0.00     0.00      0.00      0.00      0.00        0.000
       Q5          0.00===Q5 EQUALS BASIN INPUT===

  LACFCD AND OCEMA FLOW JUNCTION FORMULAE USED:
  DY=(Q2*V2-Q1*V1*COS(DELTA1)-Q3*V3*COS(DELTA3)-
      Q4*V4*COS(DELTA4))/((A1+A2)*16.1)+FRICTION LOSSES
  UPSTREAM:    MANNING'S N = 0.01300;  FRICTION SLOPE = 0.00083
  DOWNSTREAM:  MANNING'S N = 0.01300;  FRICTION SLOPE = 0.00176
  AVERAGED FRICTION SLOPE IN JUNCTION ASSUMED AS 0.00129
  JUNCTION LENGTH =   2.00 FEET
  FRICTION LOSSES =  0.003 FEET         ENTRANCE LOSSES =  0.000 FEET
  JUNCTION LOSSES = (DY+HV1-HV2)+(ENTRANCE LOSSES)
  JUNCTION LOSSES = ( 0.078)+( 0.000) =   0.078
----------------------------------------------------------------------------
  NODE  2027.95 : HGL = <  172.024>;EGL= <  172.091>;FLOWLINE= <  168.710>

****************************************************************************
  FLOW PROCESS FROM NODE  2027.95 TO NODE  2126.62 IS CODE =  1
  UPSTREAM NODE  2126.62     ELEVATION =   169.21  (FLOW IS UNDER PRESSURE)
----------------------------------------------------------------------------
  CALCULATE FRICTION LOSSES(LACFCD):
  PIPE FLOW   =       6.50 CFS     PIPE DIAMETER =  24.00 INCHES
  PIPE LENGTH =      98.67 FEET          MANNING'S N  =  0.01300
  SF=(Q/K)**2 = ((      6.50)/(   226.212))**2 = 0.00083
  HF=L*SF = (     98.67)*(0.00083) =      0.081
----------------------------------------------------------------------------
  NODE  2126.62 : HGL = <  172.106>;EGL= <  172.172>;FLOWLINE= <  169.210>

****************************************************************************
  FLOW PROCESS FROM NODE  2126.62 TO NODE  2154.48 IS CODE =  3
  UPSTREAM NODE  2154.48     ELEVATION =   169.35  (FLOW IS UNDER PRESSURE)
----------------------------------------------------------------------------
  CALCULATE PIPE-BEND LOSSES(OCEMA):
  PIPE FLOW =       6.50 CFS             PIPE DIAMETER =  24.00 INCHES
  CENTRAL ANGLE = 70.300 DEGREES         MANNING'S N = 0.01300
  PIPE LENGTH =      27.86 FEET          BEND COEFFICIENT(KB) = 0.22095
  FLOW VELOCITY =   2.07 FEET/SEC.       VELOCITY HEAD =  0.066 FEET
  HB=KB*(VELOCITY HEAD) = ( 0.221)*( 0.066) =   0.015
  SF=(Q/K)**2 = ((      6.50)/(   226.226))**2 = 0.00083
  HF=L*SF = (     27.86)*(0.00083) =  0.023
  TOTAL HEAD LOSSES = HB + HF = ( 0.015)+( 0.023) =  0.038
----------------------------------------------------------------------------
  NODE  2154.48 : HGL = <  172.143>;EGL= <  172.210>;FLOWLINE= <  169.350>

****************************************************************************
  FLOW PROCESS FROM NODE  2154.48 TO NODE  2210.55 IS CODE =  1
  UPSTREAM NODE  2210.55     ELEVATION =   169.63  (FLOW IS UNDER PRESSURE)
----------------------------------------------------------------------------
  CALCULATE FRICTION LOSSES(LACFCD):
  PIPE FLOW   =       6.50 CFS     PIPE DIAMETER =  24.00 INCHES
  PIPE LENGTH =      56.07 FEET          MANNING'S N  =  0.01300
  SF=(Q/K)**2 = ((      6.50)/(   226.247))**2 = 0.00083
  HF=L*SF = (     56.07)*(0.00083) =      0.046
----------------------------------------------------------------------------
  NODE  2210.55 : HGL = <  172.190>;EGL= <  172.256>;FLOWLINE= <  169.630>

****************************************************************************
  UPSTREAM PIPE FLOW CONTROL DATA:
  NODE NUMBER =  2210.55           FLOWLINE ELEVATION =   169.63
  ASSUMED UPSTREAM CONTROL HGL =    170.53 FOR DOWNSTREAM RUN ANALYSIS

============================================================================
  END OF GRADUALLY VARIED FLOW ANALYSIS
```

```
____________________________________________________________________________
****************************************************************************
                 PIPE-FLOW HYDRAULICS COMPUTER PROGRAM PACKAGE
           (Reference: LACFCD,LACRD, AND OCEMA HYDRAULICS CRITERION)
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                       Ver. 8.0  Release Date: 01/01/2003


  ************************** DESCRIPTION OF STUDY **************************
 * Line "C"                                                                 *
 *                                                                          *
 *                                                                          *
  **************************************************************************

   FILE NAME: VC.DAT
   TIME/DATE OF STUDY: 14:47 07/22/2020
____________________________________________________________________________
****************************************************************************
                GRADUALLY VARIED FLOW ANALYSIS FOR PIPE SYSTEM
                          NODAL POINT STATUS TABLE
                 (Note: "*" indicates nodal point data used.)
                       UPSTREAM RUN                  DOWNSTREAM RUN
   NODE    MODEL   PRESSURE      PRESSURE+         FLOW         PRESSURE+
  NUMBER  PROCESS  HEAD(FT)   MOMENTUM(POUNDS)   DEPTH(FT)   MOMENTUM(POUNDS)
  3001.84-              1.93*          257.84        1.00              190.63
         } FRICTION         } HYDRAULIC JUMP
  3111.44-              1.19 Dc        182.81        1.01*             189.89
         } FRICTION+BEND
  3129.11-              1.19 Dc        182.81        1.03*             188.63
         } FRICTION
  3138.71-              1.19 Dc        182.81        1.04*             187.78
         } FRICTION+BEND
  3146.49-              1.19 Dc        182.81        1.05*             187.15
         } FRICTION
  3168.39-              1.19*Dc        182.81        1.19*Dc           182.81
         } CATCH BASIN
  3175.39-              1.61*           89.26        1.19 Dc            62.37
----------------------------------------------------------------------------
  MAXIMUM NUMBER OF ENERGY BALANCES USED IN EACH PROFILE =  10
----------------------------------------------------------------------------
  NOTE: STEADY FLOW HYDRAULIC HEAD-LOSS COMPUTATIONS BASED ON THE MOST
  CONSERVATIVE FORMULAE FROM THE CURRENT LACRD,LACFCD, AND OCEMA
  DESIGN MANUALS.
****************************************************************************
  DOWNSTREAM PIPE FLOW CONTROL DATA:
  NODE NUMBER =  3001.84            FLOWLINE ELEVATION =   183.07
  PIPE FLOW =       11.00 CFS       PIPE DIAMETER =  24.00 INCHES
  ASSUMED DOWNSTREAM CONTROL HGL =   185.000 FEET
----------------------------------------------------------------------------
  NODE  3001.84 : HGL = <  185.000>;EGL= <  185.195>;FLOWLINE= <  183.070>

****************************************************************************
  FLOW PROCESS FROM NODE  3001.84 TO NODE  3111.44 IS CODE =  1
  UPSTREAM NODE  3111.44     ELEVATION =   184.10  (HYDRAULIC JUMP OCCURS)
----------------------------------------------------------------------------
  CALCULATE FRICTION LOSSES(LACFCD):
  PIPE FLOW   =      11.00 CFS     PIPE DIAMETER =  24.00 INCHES
  PIPE LENGTH =     109.60 FEET         MANNING'S N  =  0.01300
----------------------------------------------------------------------------
  HYDRAULIC JUMP: DOWNSTREAM RUN ANALYSIS RESULTS
----------------------------------------------------------------------------
  NORMAL DEPTH(FT) =      1.00          CRITICAL DEPTH(FT) =      1.19
============================================================================
  UPSTREAM CONTROL ASSUMED FLOWDEPTH(FT) =     1.01
============================================================================
  GRADUALLY VARIED FLOW PROFILE COMPUTED INFORMATION:
----------------------------------------------------------------------------
  DISTANCE FROM      FLOW DEPTH  VELOCITY      SPECIFIC        PRESSURE+
   CONTROL(FT)          (FT)     (FT/SEC)     ENERGY(FT)    MOMENTUM(POUNDS)
         0.000         1.011      6.903          1.751            189.89
         2.915         1.010      6.911          1.752            189.97
         6.192         1.009      6.919          1.753            190.05
         9.926         1.008      6.927          1.754            190.13
        14.261         1.007      6.935          1.755            190.21
        19.414         1.006      6.943          1.756            190.29
        25.754         1.006      6.951          1.756            190.38
        33.972         1.005      6.960          1.757            190.46
        45.617         1.004      6.968          1.758            190.54
        65.662         1.003      6.976          1.759            190.62
       109.600         1.003      6.976          1.759            190.63
----------------------------------------------------------------------------
  HYDRAULIC JUMP: UPSTREAM RUN ANALYSIS RESULTS
============================================================================
  DOWNSTREAM CONTROL ASSUMED FLOWDEPTH(FT) =     1.93
============================================================================
  GRADUALLY VARIED FLOW PROFILE COMPUTED INFORMATION:
----------------------------------------------------------------------------
  DISTANCE FROM      FLOW DEPTH  VELOCITY      SPECIFIC        PRESSURE+
   CONTROL(FT)          (FT)     (FT/SEC)     ENERGY(FT)    MOMENTUM(POUNDS)
         0.000         1.930      3.539          2.125            257.84
         8.914         1.856      3.616          2.059            245.27
        17.405         1.782      3.720          1.997            233.62
```

```
       25.541          1.708     3.849          1.938           222.92
       33.323          1.634     4.003          1.883           213.24
       40.711          1.560     4.184          1.832           204.67
       47.621          1.486     4.395          1.786           197.31
       53.905          1.411     4.640          1.746           191.29
       59.307          1.337     4.926          1.714           186.73
       63.361          1.263     5.259          1.693           183.83
       65.102          1.189     5.648          1.685           182.81
      109.600          1.189     5.648          1.685           182.81
------------------------END OF HYDRAULIC JUMP ANALYSIS-----------------------
| PRESSURE+MOMENTUM BALANCE OCCURS AT    54.74 FEET UPSTREAM OF NODE 3001.84 |
|      DOWNSTREAM DEPTH = 1.400 FEET, UPSTREAM CONJUGATE DEPTH = 1.003 FEET |
------------------------------------------------------------------------------
  NODE  3111.44 : HGL = <  185.111>;EGL= <  185.852>;FLOWLINE= <  184.100>

******************************************************************************
  FLOW PROCESS FROM NODE  3111.44 TO NODE  3129.11 IS CODE =  3
  UPSTREAM NODE  3129.11     ELEVATION =   184.27  (FLOW IS SUPERCRITICAL)
------------------------------------------------------------------------------
  CALCULATE PIPE-BEND LOSSES(OCEMA):
  PIPE FLOW =      11.00 CFS             PIPE DIAMETER =  24.00 INCHES
  CENTRAL ANGLE = 90.000 DEGREES         MANNING'S N = 0.01300
  PIPE LENGTH =      17.67 FEET
------------------------------------------------------------------------------
  NORMAL DEPTH(FT) =      0.99           CRITICAL DEPTH(FT) =      1.19
==============================================================================
  UPSTREAM CONTROL ASSUMED FLOWDEPTH(FT) =     1.03
==============================================================================
  GRADUALLY VARIED FLOW PROFILE COMPUTED INFORMATION:
------------------------------------------------------------------------------
  DISTANCE FROM      FLOW DEPTH  VELOCITY      SPECIFIC        PRESSURE+
   CONTROL(FT)           (FT)    (FT/SEC)     ENERGY(FT)    MOMENTUM(POUNDS)
        0.000          1.027     6.770          1.739           188.63
        2.627          1.024     6.797          1.741           188.87
        5.623          1.020     6.823          1.744           189.12
        9.086          1.017     6.851          1.746           189.38
       13.160          1.014     6.878          1.749           189.64
       17.670          1.011     6.903          1.751           189.89
------------------------------------------------------------------------------
  NODE  3129.11 : HGL = <  185.297>;EGL= <  186.009>;FLOWLINE= <  184.270>

******************************************************************************
  FLOW PROCESS FROM NODE  3129.11 TO NODE  3138.71 IS CODE =  1
  UPSTREAM NODE  3138.71     ELEVATION =   184.36  (FLOW IS SUPERCRITICAL)
------------------------------------------------------------------------------
  CALCULATE FRICTION LOSSES(LACFCD):
  PIPE FLOW   =      11.00 CFS     PIPE DIAMETER =  24.00 INCHES
  PIPE LENGTH =       9.60 FEET          MANNING'S N  =  0.01300
------------------------------------------------------------------------------
  NORMAL DEPTH(FT) =      1.00           CRITICAL DEPTH(FT) =      1.19
==============================================================================
  UPSTREAM CONTROL ASSUMED FLOWDEPTH(FT) =     1.04
==============================================================================
  GRADUALLY VARIED FLOW PROFILE COMPUTED INFORMATION:
------------------------------------------------------------------------------
  DISTANCE FROM      FLOW DEPTH  VELOCITY      SPECIFIC        PRESSURE+
   CONTROL(FT)           (FT)    (FT/SEC)     ENERGY(FT)    MOMENTUM(POUNDS)
        0.000          1.038     6.675          1.731           187.78
        2.485          1.035     6.704          1.733           188.03
        5.330          1.031     6.733          1.736           188.29
        8.632          1.028     6.763          1.738           188.56
        9.600          1.027     6.770          1.739           188.63
------------------------------------------------------------------------------
  NODE  3138.71 : HGL = <  185.398>;EGL= <  186.091>;FLOWLINE= <  184.360>

******************************************************************************
  FLOW PROCESS FROM NODE  3138.71 TO NODE  3146.49 IS CODE =  3
  UPSTREAM NODE  3146.49     ELEVATION =   184.43  (FLOW IS SUPERCRITICAL)
------------------------------------------------------------------------------
  CALCULATE PIPE-BEND LOSSES(OCEMA):
  PIPE FLOW =      11.00 CFS             PIPE DIAMETER =  24.00 INCHES
  CENTRAL ANGLE = 19.300 DEGREES         MANNING'S N = 0.01300
  PIPE LENGTH =       7.78 FEET
------------------------------------------------------------------------------
  NORMAL DEPTH(FT) =      1.01           CRITICAL DEPTH(FT) =      1.19
==============================================================================
  UPSTREAM CONTROL ASSUMED FLOWDEPTH(FT) =     1.05
==============================================================================
  GRADUALLY VARIED FLOW PROFILE COMPUTED INFORMATION:
------------------------------------------------------------------------------
  DISTANCE FROM      FLOW DEPTH  VELOCITY      SPECIFIC        PRESSURE+
   CONTROL(FT)           (FT)    (FT/SEC)     ENERGY(FT)    MOMENTUM(POUNDS)
        0.000          1.048     6.600          1.725           187.15
        2.398          1.044     6.626          1.727           187.37
        5.142          1.041     6.653          1.729           187.59
        7.780          1.038     6.675          1.731           187.78
------------------------------------------------------------------------------
  NODE  3146.49 : HGL = <  185.478>;EGL= <  186.155>;FLOWLINE= <  184.430>

******************************************************************************
  FLOW PROCESS FROM NODE  3146.49 TO NODE  3168.39 IS CODE =  1
  UPSTREAM NODE  3168.39     ELEVATION =   184.63  (FLOW IS SUPERCRITICAL)
------------------------------------------------------------------------------
```

```
  CALCULATE FRICTION LOSSES(LACFCD):
  PIPE FLOW   =      11.00 CFS     PIPE DIAMETER =  24.00 INCHES
  PIPE LENGTH =      21.90 FEET          MANNING'S N  =  0.01300
------------------------------------------------------------------------------
  NORMAL DEPTH(FT) =      1.01           CRITICAL DEPTH(FT) =      1.19
==============================================================================
  UPSTREAM CONTROL ASSUMED FLOWDEPTH(FT) =     1.19
==============================================================================
  GRADUALLY VARIED FLOW PROFILE COMPUTED INFORMATION:
------------------------------------------------------------------------------
  DISTANCE FROM      FLOW DEPTH  VELOCITY      SPECIFIC        PRESSURE+
   CONTROL(FT)          (FT)    (FT/SEC)      ENERGY(FT)    MOMENTUM(POUNDS)
         0.000          1.189     5.648          1.685            182.81
         0.148          1.171     5.752          1.685            182.87
         0.639          1.153     5.860          1.687            183.07
         1.567          1.136     5.973          1.690            183.39
         3.070          1.118     6.090          1.694            183.86
         5.362          1.100     6.213          1.699            184.48
         8.799          1.082     6.340          1.706            185.24
        14.053          1.064     6.473          1.715            186.17
        21.900          1.048     6.600          1.725            187.15
------------------------------------------------------------------------------
  NODE  3168.39 : HGL = <  185.819>;EGL= <  186.315>;FLOWLINE= <  184.630>

******************************************************************************
  FLOW PROCESS FROM NODE  3168.39 TO NODE  3175.39 IS CODE =  8
  UPSTREAM NODE  3175.39     ELEVATION =   184.80  (FLOW IS SUBCRITICAL)
------------------------------------------------------------------------------
  CALCULATE CATCH BASIN ENTRANCE LOSSES(LACFCD):
  PIPE FLOW =      11.00 CFS          PIPE DIAMETER =  24.00 INCHES
  FLOW VELOCITY =   5.65 FEET/SEC.    VELOCITY HEAD =  0.496 FEET
  CATCH BASIN ENERGY LOSS = .2*(VELOCITY HEAD) = .2*(  0.496) =  0.099
------------------------------------------------------------------------------
  NODE  3175.39 : HGL = <  186.414>;EGL= <  186.414>;FLOWLINE= <  184.800>

******************************************************************************
  UPSTREAM PIPE FLOW CONTROL DATA:
  NODE NUMBER =  3175.39            FLOWLINE ELEVATION =   184.80
  ASSUMED UPSTREAM CONTROL HGL =    185.99 FOR DOWNSTREAM RUN ANALYSIS

==============================================================================
  END OF GRADUALLY VARIED FLOW ANALYSIS
```

```
****************************************************************************
                PIPE-FLOW HYDRAULICS COMPUTER PROGRAM PACKAGE
          (Reference: LACFCD,LACRD, AND OCEMA HYDRAULICS CRITERION)
          (c) Copyright 1982-2003 Advanced Engineering Software (aes)
                   Ver. 8.0  Release Date: 01/01/2003


  ************************** DESCRIPTION OF STUDY **************************
 * Line "D"                                                                 *
 *                                                                          *
 *                                                                          *
  **************************************************************************

   FILE NAME: VD.DAT
   TIME/DATE OF STUDY: 16:05 07/22/2020
****************************************************************************
               GRADUALLY VARIED FLOW ANALYSIS FOR PIPE SYSTEM
                          NODAL POINT STATUS TABLE
                (Note: "*" indicates nodal point data used.)
                      UPSTREAM RUN                    DOWNSTREAM RUN
   NODE    MODEL   PRESSURE      PRESSURE+           FLOW         PRESSURE+
  NUMBER  PROCESS  HEAD(FT)   MOMENTUM(POUNDS)    DEPTH(FT)   MOMENTUM(POUNDS)
  4000.00-              2.00*            855.63        1.90 Dc          848.73
        } FRICTION
  4017.16-              2.27*            908.27        1.90 Dc          848.73
        } FRICTION+BEND
  4050.66-              3.21*           1092.33        1.90 Dc          848.73
        } FRICTION
  4116.70-              4.26*           1298.13        1.64             881.21
        } JUNCTION
  4121.37-              3.46*           1080.51        1.49 Dc          864.09
        } FRICTION
  4157.16-              5.59*           1315.64        1.49 Dc          864.09
        } JUNCTION
  4161.83-              6.65*           1319.52        1.19             836.65
        } FRICTION
  4179.00-              7.21*           1381.20        1.09             901.72
        } FRICTION
  4183.20-              7.42*           1404.60        1.06             926.70
        } FRICTION+BEND
  4191.73-              7.44*           1406.24        1.06             928.72
        } FRICTION
  4350.14-              4.24*           1054.16        0.94            1048.29
        } MANHOLE
  4354.81-              4.19            1048.83        0.93*           1059.54
        } FRICTION
  4358.81-              3.94            1020.28        0.93*           1057.14
        } FRICTION+BEND
  4429.50-              1.49 Dc          751.22        1.02*            958.66
        } FRICTION+BEND
  4436.85-              1.49 Dc          751.22        1.05*            936.60
        } FRICTION
  4455.08-              1.49*Dc          751.22        1.49*Dc          751.22
----------------------------------------------------------------------------
  MAXIMUM NUMBER OF ENERGY BALANCES USED IN EACH PROFILE =  10
----------------------------------------------------------------------------
  NOTE: STEADY FLOW HYDRAULIC HEAD-LOSS COMPUTATIONS BASED ON THE MOST
  CONSERVATIVE FORMULAE FROM THE CURRENT LACRD,LACFCD, AND OCEMA
  DESIGN MANUALS.
****************************************************************************
  DOWNSTREAM PIPE FLOW CONTROL DATA:
  NODE NUMBER =  4000.00             FLOWLINE ELEVATION =   144.23
  PIPE FLOW =      32.70 CFS         PIPE DIAMETER =  24.00 INCHES
  ASSUMED DOWNSTREAM CONTROL HGL =   146.230 FEET
----------------------------------------------------------------------------
  NODE  4000.00 : HGL = <  146.230>;EGL= <  147.912>;FLOWLINE= <  144.230>

****************************************************************************
  FLOW PROCESS FROM NODE  4000.00 TO NODE  4017.16 IS CODE =  1
  UPSTREAM NODE  4017.16      ELEVATION =   144.32  (FLOW IS UNDER PRESSURE)
----------------------------------------------------------------------------
  CALCULATE FRICTION LOSSES(LACFCD):
  PIPE FLOW   =      32.70 CFS      PIPE DIAMETER =  24.00 INCHES
  PIPE LENGTH =      17.16 FEET          MANNING'S N  =  0.01300
  SF=(Q/K)**2 = ((     32.70)/(   226.225))**2 = 0.02089
  HF=L*SF = (     17.16)*(0.02089) =      0.359
----------------------------------------------------------------------------
  NODE  4017.16 : HGL = <  146.589>;EGL= <  148.271>;FLOWLINE= <  144.320>

****************************************************************************
  FLOW PROCESS FROM NODE  4017.16 TO NODE  4050.66 IS CODE =  3
  UPSTREAM NODE  4050.66      ELEVATION =   144.49  (FLOW IS UNDER PRESSURE)
----------------------------------------------------------------------------
  CALCULATE PIPE-BEND LOSSES(OCEMA):
  PIPE FLOW =      32.70 CFS             PIPE DIAMETER =  24.00 INCHES
  CENTRAL ANGLE = 85.100 DEGREES         MANNING'S N = 0.01300
  PIPE LENGTH =      33.50 FEET          BEND COEFFICIENT(KB) = 0.24310
  FLOW VELOCITY =  10.41 FEET/SEC.       VELOCITY HEAD =  1.682 FEET
  HB=KB*(VELOCITY HEAD) = ( 0.243)*( 1.682) =   0.409
  SF=(Q/K)**2 = ((     32.70)/(   226.223))**2 = 0.02089
```

```
  HF=L*SF = (     33.50)*(0.02089) =  0.700
  TOTAL HEAD LOSSES = HB + HF = ( 0.409)+( 0.700) =  1.109
--------------------------------------------------------------------------------
  NODE  4050.66 : HGL = <  147.697>;EGL= <  149.380>;FLOWLINE= <  144.490>

********************************************************************************
  FLOW PROCESS FROM NODE  4050.66 TO NODE  4116.70 IS CODE =  1
  UPSTREAM NODE  4116.70     ELEVATION =   144.82  (FLOW IS UNDER PRESSURE)
--------------------------------------------------------------------------------
  CALCULATE FRICTION LOSSES(LACFCD):
  PIPE FLOW   =      32.70 CFS     PIPE DIAMETER =  24.00 INCHES
  PIPE LENGTH =      66.04 FEET          MANNING'S N  =  0.01300
  SF=(Q/K)**2 = ((     32.70)/(   226.225))**2 = 0.02089
  HF=L*SF = (     66.04)*(0.02089) =      1.380
--------------------------------------------------------------------------------
  NODE  4116.70 : HGL = <  149.077>;EGL= <  150.760>;FLOWLINE= <  144.820>

********************************************************************************
  FLOW PROCESS FROM NODE  4116.70 TO NODE  4121.37 IS CODE =  5
  UPSTREAM NODE  4121.37     ELEVATION =   145.02  (FLOW IS UNDER PRESSURE)
--------------------------------------------------------------------------------
  CALCULATE JUNCTION LOSSES:
       PIPE       FLOW    DIAMETER   ANGLE    FLOWLINE   CRITICAL   VELOCITY
                  (CFS)   (INCHES) (DEGREES) ELEVATION  DEPTH(FT.)  (FT/SEC)
     UPSTREAM      26.70    18.00      0.00    145.02      1.49      15.109
    DOWNSTREAM     32.70    24.00       -      144.82      1.90      10.409
    LATERAL #1      6.00    18.00     90.00    145.16      0.95       3.395
    LATERAL #2      0.00     0.00      0.00      0.00      0.00       0.000
       Q5           0.00===Q5 EQUALS BASIN INPUT===

  LACFCD AND OCEMA FLOW JUNCTION FORMULAE USED:
  DY=(Q2*V2-Q1*V1*COS(DELTA1)-Q3*V3*COS(DELTA3)-
      Q4*V4*COS(DELTA4))/((A1+A2)*16.1)+FRICTION LOSSES
  UPSTREAM:    MANNING'S N = 0.01300;  FRICTION SLOPE = 0.06461
  DOWNSTREAM:  MANNING'S N = 0.01300;  FRICTION SLOPE = 0.02089
  AVERAGED FRICTION SLOPE IN JUNCTION ASSUMED AS 0.04275
  JUNCTION LENGTH =   4.67 FEET
  FRICTION LOSSES =  0.200 FEET         ENTRANCE LOSSES =  0.000 FEET
  JUNCTION LOSSES = (DY+HV1-HV2)+(ENTRANCE LOSSES)
  JUNCTION LOSSES = ( 1.264)+( 0.000) =   1.264
--------------------------------------------------------------------------------
  NODE  4121.37 : HGL = <  148.479>;EGL= <  152.024>;FLOWLINE= <  145.020>

********************************************************************************
  FLOW PROCESS FROM NODE  4121.37 TO NODE  4157.16 IS CODE =  1
  UPSTREAM NODE  4157.16     ELEVATION =   145.20  (FLOW IS UNDER PRESSURE)
--------------------------------------------------------------------------------
  CALCULATE FRICTION LOSSES(LACFCD):
  PIPE FLOW   =      26.70 CFS     PIPE DIAMETER =  18.00 INCHES
  PIPE LENGTH =      35.79 FEET          MANNING'S N  =  0.01300
  SF=(Q/K)**2 = ((     26.70)/(   105.043))**2 = 0.06461
  HF=L*SF = (     35.79)*(0.06461) =      2.312
--------------------------------------------------------------------------------
  NODE  4157.16 : HGL = <  150.791>;EGL= <  154.336>;FLOWLINE= <  145.200>

********************************************************************************
  FLOW PROCESS FROM NODE  4157.16 TO NODE  4161.83 IS CODE =  5
  UPSTREAM NODE  4161.83     ELEVATION =   145.40  (FLOW IS UNDER PRESSURE)
--------------------------------------------------------------------------------
  CALCULATE JUNCTION LOSSES:
       PIPE       FLOW    DIAMETER   ANGLE    FLOWLINE   CRITICAL   VELOCITY
                  (CFS)   (INCHES) (DEGREES) ELEVATION  DEPTH(FT.)  (FT/SEC)
     UPSTREAM      24.70    18.00      0.00    145.40      1.49      13.977
    DOWNSTREAM     26.70    18.00       -      145.20      1.49      15.109
    LATERAL #1      2.00    12.00     60.00    145.70      0.60       2.546
    LATERAL #2      0.00     0.00      0.00      0.00      0.00       0.000
       Q5           0.00===Q5 EQUALS BASIN INPUT===

  LACFCD AND OCEMA FLOW JUNCTION FORMULAE USED:
  DY=(Q2*V2-Q1*V1*COS(DELTA1)-Q3*V3*COS(DELTA3)-
      Q4*V4*COS(DELTA4))/((A1+A2)*16.1)+FRICTION LOSSES
  UPSTREAM:    MANNING'S N = 0.01300;  FRICTION SLOPE = 0.05529
  DOWNSTREAM:  MANNING'S N = 0.01300;  FRICTION SLOPE = 0.06461
  AVERAGED FRICTION SLOPE IN JUNCTION ASSUMED AS 0.05995
  JUNCTION LENGTH =   4.67 FEET
  FRICTION LOSSES =  0.280 FEET         ENTRANCE LOSSES =  0.000 FEET
  JUNCTION LOSSES = (DY+HV1-HV2)+(ENTRANCE LOSSES)
  JUNCTION LOSSES = ( 0.746)+( 0.000) =   0.746
--------------------------------------------------------------------------------
  NODE  4161.83 : HGL = <  152.049>;EGL= <  155.083>;FLOWLINE= <  145.400>

********************************************************************************
  FLOW PROCESS FROM NODE  4161.83 TO NODE  4179.00 IS CODE =  1
  UPSTREAM NODE  4179.00     ELEVATION =   145.79  (FLOW IS UNDER PRESSURE)
--------------------------------------------------------------------------------
  CALCULATE FRICTION LOSSES(LACFCD):
  PIPE FLOW   =      24.70 CFS     PIPE DIAMETER =  18.00 INCHES
  PIPE LENGTH =      17.17 FEET          MANNING'S N  =  0.01300
  SF=(Q/K)**2 = ((     24.70)/(   105.043))**2 = 0.05529
  HF=L*SF = (     17.17)*(0.05529) =      0.949
--------------------------------------------------------------------------------
  NODE  4179.00 : HGL = <  152.998>;EGL= <  156.032>;FLOWLINE= <  145.790>
```

```
******************************************************************************
  FLOW PROCESS FROM NODE  4179.00 TO NODE  4183.20 IS CODE =  1
  UPSTREAM NODE  4183.20     ELEVATION =   145.81  (FLOW IS UNDER PRESSURE)
------------------------------------------------------------------------------
  CALCULATE FRICTION LOSSES(LACFCD):
  PIPE FLOW   =      24.70 CFS     PIPE DIAMETER =  18.00 INCHES
  PIPE LENGTH =       4.20 FEET          MANNING'S N  =  0.01300
  SF=(Q/K)**2 = ((     24.70)/(   105.047))**2 = 0.05529
  HF=L*SF = (      4.20)*(0.05529) =      0.232
------------------------------------------------------------------------------
  NODE  4183.20 : HGL = <  153.231>;EGL= <  156.264>;FLOWLINE= <  145.810>

******************************************************************************
  FLOW PROCESS FROM NODE  4183.20 TO NODE  4191.73 IS CODE =  3
  UPSTREAM NODE  4191.73     ELEVATION =   146.45  (FLOW IS UNDER PRESSURE)
------------------------------------------------------------------------------
  CALCULATE PIPE-BEND LOSSES(OCEMA):
  PIPE FLOW =      24.70 CFS             PIPE DIAMETER =  18.00 INCHES
  CENTRAL ANGLE =  5.160 DEGREES         MANNING'S N = 0.01300
  PIPE LENGTH =       8.56 FEET          BEND COEFFICIENT(KB) = 0.05986
  FLOW VELOCITY =  13.98 FEET/SEC.       VELOCITY HEAD =  3.034 FEET
  HB=KB*(VELOCITY HEAD) = ( 0.060)*( 3.034) =   0.182
  SF=(Q/K)**2 = ((     24.70)/(   105.043))**2 = 0.05529
  HF=L*SF = (      8.56)*(0.05529) =  0.473
  TOTAL HEAD LOSSES = HB + HF = ( 0.182)+( 0.473) =  0.655
------------------------------------------------------------------------------
  NODE  4191.73 : HGL = <  153.885>;EGL= <  156.919>;FLOWLINE= <  146.450>

******************************************************************************
  FLOW PROCESS FROM NODE  4191.73 TO NODE  4350.14 IS CODE =  1
  UPSTREAM NODE  4350.14     ELEVATION =   158.40  (FLOW IS UNDER PRESSURE)
------------------------------------------------------------------------------
  CALCULATE FRICTION LOSSES(LACFCD):
  PIPE FLOW   =      24.70 CFS     PIPE DIAMETER =  18.00 INCHES
  PIPE LENGTH =     158.38 FEET          MANNING'S N  =  0.01300
  SF=(Q/K)**2 = ((     24.70)/(   105.043))**2 = 0.05529
  HF=L*SF = (    158.38)*(0.05529) =      8.757
------------------------------------------------------------------------------
  NODE  4350.14 : HGL = <  162.643>;EGL= <  165.676>;FLOWLINE= <  158.400>

******************************************************************************
  FLOW PROCESS FROM NODE  4350.14 TO NODE  4354.81 IS CODE =  2
  UPSTREAM NODE  4354.81     ELEVATION =   158.60  (FLOW IS UNDER PRESSURE)
  (NOTE: POSSIBLE JUMP IN OR UPSTREAM OF STRUCTURE)
------------------------------------------------------------------------------
  CALCULATE MANHOLE LOSSES(LACFCD):
  PIPE FLOW =      24.70 CFS            PIPE DIAMETER =  18.00 INCHES
  AVERAGED VELOCITY HEAD =  5.117 FEET
  HMN = .05*(AVERAGED VELOCITY HEAD) = .05*( 5.117) =  0.256
  NOTE: ENERGY GRADE LINE HAS BEEN ADJUSTED DUE TO
        CHANGING IN FLOW LINE ELEVATIONS
------------------------------------------------------------------------------
  NODE  4354.81 : HGL = <  159.527>;EGL= <  166.728>;FLOWLINE= <  158.600>

******************************************************************************
  FLOW PROCESS FROM NODE  4354.81 TO NODE  4358.81 IS CODE =  1
  UPSTREAM NODE  4358.81     ELEVATION =   159.08  (FLOW IS SUPERCRITICAL)
------------------------------------------------------------------------------
  CALCULATE FRICTION LOSSES(LACFCD):
  PIPE FLOW   =      24.70 CFS     PIPE DIAMETER =  18.00 INCHES
  PIPE LENGTH =       4.00 FEET          MANNING'S N  =  0.01300
------------------------------------------------------------------------------
  NORMAL DEPTH(FT) =      0.91           CRITICAL DEPTH(FT) =      1.49
==============================================================================
  UPSTREAM CONTROL ASSUMED FLOWDEPTH(FT) =     0.93
==============================================================================
  GRADUALLY VARIED FLOW PROFILE COMPUTED INFORMATION:
------------------------------------------------------------------------------
  DISTANCE FROM      FLOW DEPTH  VELOCITY      SPECIFIC        PRESSURE+
   CONTROL(FT)          (FT)    (FT/SEC)     ENERGY(FT)    MOMENTUM(POUNDS)
         0.000          0.929     21.474          8.094          1057.14
         4.000          0.927     21.527          8.128          1059.54
------------------------------------------------------------------------------
  NODE  4358.81 : HGL = <  160.009>;EGL= <  167.174>;FLOWLINE= <  159.080>

******************************************************************************
  FLOW PROCESS FROM NODE  4436.85 TO NODE  4429.50 IS CODE =  3
  UPSTREAM NODE  4429.50     ELEVATION =   167.53  (FLOW IS SUPERCRITICAL)
------------------------------------------------------------------------------
  CALCULATE PIPE-BEND LOSSES(OCEMA):
  PIPE FLOW =      24.70 CFS             PIPE DIAMETER =  18.00 INCHES
  CENTRAL ANGLE = 90.000 DEGREES         MANNING'S N = 0.01300
  PIPE LENGTH =      70.69 FEET
------------------------------------------------------------------------------
  NORMAL DEPTH(FT) =      0.91           CRITICAL DEPTH(FT) =      1.49
==============================================================================
  UPSTREAM CONTROL ASSUMED FLOWDEPTH(FT) =     1.02
==============================================================================
  GRADUALLY VARIED FLOW PROFILE COMPUTED INFORMATION:
------------------------------------------------------------------------------
  DISTANCE FROM      FLOW DEPTH  VELOCITY      SPECIFIC        PRESSURE+
   CONTROL(FT)          (FT)    (FT/SEC)     ENERGY(FT)    MOMENTUM(POUNDS)
         0.000          1.021     19.272          6.792           958.66
```

4.070	1.010	19.515	6.927	969.41
8.719	0.998	19.767	7.069	980.54
14.103	0.987	20.026	7.218	992.07
20.453	0.976	20.293	7.374	1004.01
28.124	0.964	20.569	7.538	1016.37
37.713	0.953	20.855	7.710	1029.18
50.338	0.941	21.149	7.891	1042.44
68.512	0.930	21.453	8.081	1056.18
70.690	0.929	21.474	8.094	1057.14

NODE 4429.50 : HGL = < 168.551>;EGL= < 174.322>;FLOWLINE= < 167.530>

FLOW PROCESS FROM NODE 4394.15 TO NODE 4436.85 IS CODE = 3
UPSTREAM NODE 4436.85 ELEVATION = 168.41 (FLOW IS SUPERCRITICAL)

CALCULATE PIPE-BEND LOSSES(OCEMA):
PIPE FLOW = 24.70 CFS PIPE DIAMETER = 18.00 INCHES
CENTRAL ANGLE = 10.000 DEGREES MANNING'S N = 0.01300
PIPE LENGTH = 7.35 FEET

NORMAL DEPTH(FT) = 0.91 CRITICAL DEPTH(FT) = 1.49

UPSTREAM CONTROL ASSUMED FLOWDEPTH(FT) = 1.05

GRADUALLY VARIED FLOW PROFILE COMPUTED INFORMATION:

DISTANCE FROM CONTROL(FT)	FLOW DEPTH (FT)	VELOCITY (FT/SEC)	SPECIFIC ENERGY(FT)	PRESSURE+ MOMENTUM(POUNDS)
0.000	1.046	18.769	6.520	936.60
3.886	1.032	19.048	6.670	948.81
7.350	1.021	19.272	6.792	958.66

NODE 4436.85 : HGL = < 169.456>;EGL= < 174.930>;FLOWLINE= < 168.410>

FLOW PROCESS FROM NODE 4436.85 TO NODE 4455.08 IS CODE = 1
UPSTREAM NODE 4455.08 ELEVATION = 171.59 (FLOW IS SUPERCRITICAL)

CALCULATE FRICTION LOSSES(LACFCD):
PIPE FLOW = 24.70 CFS PIPE DIAMETER = 18.00 INCHES
PIPE LENGTH = 18.23 FEET MANNING'S N = 0.01300

NORMAL DEPTH(FT) = 0.81 CRITICAL DEPTH(FT) = 1.49

UPSTREAM CONTROL ASSUMED FLOWDEPTH(FT) = 1.49

GRADUALLY VARIED FLOW PROFILE COMPUTED INFORMATION:

DISTANCE FROM CONTROL(FT)	FLOW DEPTH (FT)	VELOCITY (FT/SEC)	SPECIFIC ENERGY(FT)	PRESSURE+ MOMENTUM(POUNDS)
0.000	1.486	13.995	4.529	751.22
0.448	1.418	14.279	4.586	757.40
1.563	1.350	14.742	4.727	772.35
3.323	1.282	15.356	4.945	794.75
5.867	1.214	16.121	5.251	824.70
9.472	1.146	17.052	5.663	862.94
14.643	1.077	18.173	6.209	910.70
18.230	1.046	18.769	6.520	936.60

NODE 4455.08 : HGL = < 173.076>;EGL= < 176.119>;FLOWLINE= < 171.590>

UPSTREAM PIPE FLOW CONTROL DATA:
NODE NUMBER = 4455.08 FLOWLINE ELEVATION = 171.59
ASSUMED UPSTREAM CONTROL HGL = 173.08 FOR DOWNSTREAM RUN ANALYSIS

END OF GRADUALLY VARIED FLOW ANALYSIS

```
******************************************************************************
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  ************************** DESCRIPTION OF STUDY **************************
 * storm drain line @CB#1                                                   *
 *                                                                          *
 *                                                                          *
  **************************************************************************

   FILE NAME: VCB1.DAT
   TIME/DATE OF STUDY: 16:12 07/22/2020
******************************************************************************
               GRADUALLY VARIED FLOW ANALYSIS FOR PIPE SYSTEM
                         NODAL POINT STATUS TABLE
                (Note: "*" indicates nodal point data used.)
                      UPSTREAM RUN                  DOWNSTREAM RUN
    NODE    MODEL   PRESSURE      PRESSURE+         FLOW        PRESSURE+
   NUMBER  PROCESS  HEAD(FT)   MOMENTUM(POUNDS)   DEPTH(FT)  MOMENTUM(POUNDS)
   102.00-             6.30*            306.46       0.39              64.97
         } FRICTION
   109.62-             4.95*            240.49       0.74 Dc           40.83
------------------------------------------------------------------------------
  MAXIMUM NUMBER OF ENERGY BALANCES USED IN EACH PROFILE =  10
------------------------------------------------------------------------------
  NOTE: STEADY FLOW HYDRAULIC HEAD-LOSS COMPUTATIONS BASED ON THE MOST
  CONSERVATIVE FORMULAE FROM THE CURRENT LACRD,LACFCD, AND OCEMA
  DESIGN MANUALS.
******************************************************************************
  DOWNSTREAM PIPE FLOW CONTROL DATA:
  NODE NUMBER =   102.00           FLOWLINE ELEVATION =   145.70
  PIPE FLOW =       3.00 CFS       PIPE DIAMETER =  12.00 INCHES
  ASSUMED DOWNSTREAM CONTROL HGL =   152.000 FEET
------------------------------------------------------------------------------
  NODE   102.00 : HGL = <  152.000>;EGL= <  152.227>;FLOWLINE= <  145.700>

******************************************************************************
  FLOW PROCESS FROM NODE   102.00 TO NODE   109.62 IS CODE =  1
  UPSTREAM NODE   109.62      ELEVATION =   147.10  (FLOW IS UNDER PRESSURE)
------------------------------------------------------------------------------
  CALCULATE FRICTION LOSSES(LACFCD):
  PIPE FLOW   =       3.00 CFS      PIPE DIAMETER =  12.00 INCHES
  PIPE LENGTH =       7.61 FEET          MANNING'S N  =  0.01300
  SF=(Q/K)**2 = ((      3.00)/(    35.628))**2 = 0.00709
  HF=L*SF = (      7.61)*(0.00709) =      0.054
------------------------------------------------------------------------------
  NODE   109.62 : HGL = <  152.054>;EGL= <  152.281>;FLOWLINE= <  147.100>

******************************************************************************
  UPSTREAM PIPE FLOW CONTROL DATA:
  NODE NUMBER =   109.62           FLOWLINE ELEVATION =   147.10
  ASSUMED UPSTREAM CONTROL HGL =    147.84 FOR DOWNSTREAM RUN ANALYSIS

==============================================================================
  END OF GRADUALLY VARIED FLOW ANALYSIS
```

```
****************************************************************************
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  ************************** DESCRIPTION OF STUDY **************************
 * storm drain lateral @CB #2                                              *
 *                                                                         *
 *                                                                         *
  **************************************************************************

   FILE NAME: VCB2.DAT
   TIME/DATE OF STUDY: 16:09 07/22/2020
****************************************************************************
             GRADUALLY VARIED FLOW ANALYSIS FOR PIPE SYSTEM
                        NODAL POINT STATUS TABLE
              (Note: "*" indicates nodal point data used.)
                  UPSTREAM RUN                      DOWNSTREAM RUN
   NODE    MODEL   PRESSURE      PRESSURE+          FLOW         PRESSURE+
  NUMBER  PROCESS  HEAD(FT)   MOMENTUM(POUNDS)   DEPTH(FT)   MOMENTUM(POUNDS)
  5000.00-             6.84*            703.52        0.77               80.57
       } FRICTION
  5024.27-             6.64*            681.79        0.77               80.33
       } FRICTION+BEND
  5059.41-             6.44*            659.55        0.90 Dc            77.91
----------------------------------------------------------------------------
  MAXIMUM NUMBER OF ENERGY BALANCES USED IN EACH PROFILE =  10
----------------------------------------------------------------------------
  NOTE: STEADY FLOW HYDRAULIC HEAD-LOSS COMPUTATIONS BASED ON THE MOST
  CONSERVATIVE FORMULAE FROM THE CURRENT LACRD,LACFCD, AND OCEMA
  DESIGN MANUALS.
****************************************************************************
  DOWNSTREAM PIPE FLOW CONTROL DATA:
  NODE NUMBER =  5000.00            FLOWLINE ELEVATION =   145.16
  PIPE FLOW =        5.40 CFS       PIPE DIAMETER =  18.00 INCHES
  ASSUMED DOWNSTREAM CONTROL HGL =   152.000 FEET
----------------------------------------------------------------------------
  NODE  5000.00 : HGL = <  152.000>;EGL= <  152.145>;FLOWLINE= <  145.160>

****************************************************************************
  FLOW PROCESS FROM NODE  5000.00 TO NODE  5024.27 IS CODE =  1
  UPSTREAM NODE  5024.27      ELEVATION =   145.43  (FLOW IS UNDER PRESSURE)
----------------------------------------------------------------------------
  CALCULATE FRICTION LOSSES(LACFCD):
  PIPE FLOW   =        5.40 CFS     PIPE DIAMETER =  18.00 INCHES
  PIPE LENGTH =       27.60 FEET          MANNING'S N  =  0.01300
  SF=(Q/K)**2 = ((       5.40)/(   105.034))**2 = 0.00264
  HF=L*SF = (      27.60)*(0.00264) =      0.073
----------------------------------------------------------------------------
  NODE  5024.27 : HGL = <  152.073>;EGL= <  152.218>;FLOWLINE= <  145.430>

****************************************************************************
  FLOW PROCESS FROM NODE  5024.27 TO NODE  5059.41 IS CODE =  3
  UPSTREAM NODE  5059.41      ELEVATION =   145.75  (FLOW IS UNDER PRESSURE)
----------------------------------------------------------------------------
  CALCULATE PIPE-BEND LOSSES(OCEMA):
  PIPE FLOW =        5.40 CFS             PIPE DIAMETER =  18.00 INCHES
  CENTRAL ANGLE = 80.350 DEGREES          MANNING'S N = 0.01300
  PIPE LENGTH =       31.80 FEET          BEND COEFFICIENT(KB) = 0.23622
  FLOW VELOCITY =   3.06 FEET/SEC.        VELOCITY HEAD =  0.145 FEET
  HB=KB*(VELOCITY HEAD) = ( 0.236)*( 0.145) =   0.034
  SF=(Q/K)**2 = ((       5.40)/(   105.046))**2 = 0.00264
  HF=L*SF = (      31.80)*(0.00264) =  0.084
  TOTAL HEAD LOSSES = HB + HF = ( 0.034)+( 0.084) =  0.118
----------------------------------------------------------------------------
  NODE  5059.41 : HGL = <  152.191>;EGL= <  152.336>;FLOWLINE= <  145.750>

****************************************************************************
  UPSTREAM PIPE FLOW CONTROL DATA:
  NODE NUMBER =  5059.41            FLOWLINE ELEVATION =   145.75
  ASSUMED UPSTREAM CONTROL HGL =    146.65 FOR DOWNSTREAM RUN ANALYSIS

============================================================================
  END OF GRADUALLY VARIED FLOW ANALYSIS
```

```
*****************************************************************************
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  ************************** DESCRIPTION OF STUDY **************************
 * storm drain lateral CB #4                                                *
 *                                                                          *
 *                                                                          *
  **************************************************************************

   FILE NAME: VCB4.DAT
   TIME/DATE OF STUDY: 15:12 07/22/2020
*****************************************************************************
                GRADUALLY VARIED FLOW ANALYSIS FOR PIPE SYSTEM
                          NODAL POINT STATUS TABLE
                 (Note: "*" indicates nodal point data used.)
                      UPSTREAM RUN                    DOWNSTREAM RUN
   NODE    MODEL   PRESSURE      PRESSURE+          FLOW        PRESSURE+
  NUMBER  PROCESS  HEAD(FT)  MOMENTUM(POUNDS)   DEPTH(FT)  MOMENTUM(POUNDS)
  102.00-             1.51*            79.72        0.80 Dc           50.52
        } FRICTION
  110.97-             1.51*            79.52        0.80 Dc           50.52
-----------------------------------------------------------------------------
  MAXIMUM NUMBER OF ENERGY BALANCES USED IN EACH PROFILE =  10
-----------------------------------------------------------------------------
  NOTE: STEADY FLOW HYDRAULIC HEAD-LOSS COMPUTATIONS BASED ON THE MOST
  CONSERVATIVE FORMULAE FROM THE CURRENT LACRD,LACFCD, AND OCEMA
  DESIGN MANUALS.
*****************************************************************************
  DOWNSTREAM PIPE FLOW CONTROL DATA:
  NODE NUMBER =   102.00            FLOWLINE ELEVATION =   180.39
  PIPE FLOW =       3.50 CFS        PIPE DIAMETER =  12.00 INCHES
  ASSUMED DOWNSTREAM CONTROL HGL =   181.900 FEET
-----------------------------------------------------------------------------
  NODE   102.00 : HGL = <  181.900>;EGL= <  182.208>;FLOWLINE= <  180.390>

*****************************************************************************
  FLOW PROCESS FROM NODE   102.00 TO NODE   110.97 IS CODE =  1
  UPSTREAM NODE   110.97     ELEVATION =   180.50  (FLOW IS UNDER PRESSURE)
-----------------------------------------------------------------------------
  CALCULATE FRICTION LOSSES(LACFCD):
  PIPE FLOW   =       3.50 CFS     PIPE DIAMETER =  12.00 INCHES
  PIPE LENGTH =      10.97 FEET          MANNING'S N  =  0.01300
  SF=(Q/K)**2 = ((      3.50)/(    35.628))**2 = 0.00965
  HF=L*SF = (     10.97)*(0.00965) =      0.106
-----------------------------------------------------------------------------
  NODE   110.97 : HGL = <  182.006>;EGL= <  182.314>;FLOWLINE= <  180.500>

*****************************************************************************
  UPSTREAM PIPE FLOW CONTROL DATA:
  NODE NUMBER =   110.97            FLOWLINE ELEVATION =   180.50
  ASSUMED UPSTREAM CONTROL HGL =    181.30 FOR DOWNSTREAM RUN ANALYSIS

=============================================================================
  END OF GRADUALLY VARIED FLOW ANALYSIS
```

```
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----------------------------------------------------------------------------
  TIME/DATE OF STUDY: 11:37   7/22/2020
============================================================================

 ************************** DESCRIPTION OF STUDY **************************
* CB #1 sizing                                                             *
* use w=14'                                                                *
*                                                                          *
 **************************************************************************

****************************************************************************
>>>>FLOWBY CATCH BASIN INLET CAPACITY INPUT INFORMATION<<<<
----------------------------------------------------------------------------

    Curb Inlet Capacities are approximated based on the Bureau of
    Public Roads nomograph plots for flowby basins and sump basins.

    STREETFLOW(CFS) =    3.40
    GUTTER FLOWDEPTH(FEET) =  0.29
    BASIN LOCAL DEPRESSION(FEET) =  0.33
    FLOWBY BASIN WIDTH(FEET) =  10.00

    >>>>CALCULATED BASIN WIDTH FOR TOTAL INTERCEPTION =     12.5

    >>>>CALCULATED ESTIMATED INTERCEPTION(CFS) =    2.9

============================================================================
```

```
****************************************************************************
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----------------------------------------------------------------------------
  TIME/DATE OF STUDY: 11:24   7/22/2020
============================================================================


 ************************** DESCRIPTION OF STUDY **************************
* curb and gutter depth  of flow @CB #1                                    *
*                                                                          *
*                                                                          *
 **************************************************************************

****************************************************************************
>>>>STREETFLOW MODEL INPUT INFORMATION<<<<
----------------------------------------------------------------------------
    CONSTANT STREET GRADE(FEET/FEET) = 0.060000
    CONSTANT STREET FLOW(CFS) =    2.50
    AVERAGE STREETFLOW FRICTION FACTOR(MANNING) = 0.015000
    CONSTANT SYMMETRICAL STREET HALF-WIDTH(FEET) =   24.00
    DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   22.00
    INTERIOR STREET CROSSFALL(DECIMAL) = 0.010000
    OUTSIDE  STREET CROSSFALL(DECIMAL) = 0.010000
    CONSTANT SYMMETRICAL CURB HEIGHT(FEET) =   0.50
    CONSTANT SYMMETRICAL GUTTER-WIDTH(FEET) =   1.50
    CONSTANT SYMMETRICAL GUTTER-LIP(FEET) =  0.03125
    CONSTANT SYMMETRICAL GUTTER-HIKE(FEET) =  0.12500
    FLOW ASSUMED TO FILL STREET ON ONE SIDE, AND THEN SPLITS
============================================================================
    STREET FLOW MODEL RESULTS:
----------------------------------------------------------------------------
    STREET FLOW DEPTH(FEET) =  0.25
    HALFSTREET FLOOD WIDTH(FEET) =   10.64
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.59
    PRODUCT OF DEPTH&VELOCITY =    0.89
============================================================================
```

```
******************************************************************************
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------------------------------------------------------------------------------
  TIME/DATE OF STUDY: 11:35   7/22/2020
==============================================================================

 ************************** DESCRIPTION OF STUDY **************************
* CB #2 sizing                                                               *
* use W=14'                                                                  *
*                                                                            *
 **************************************************************************

******************************************************************************
>>>>FLOWBY CATCH BASIN INLET CAPACITY INPUT INFORMATION<<<<
------------------------------------------------------------------------------

    Curb Inlet Capacities are approximated based on the Bureau of
    Public Roads nomograph plots for flowby basins and sump basins.

    STREETFLOW(CFS) =    2.50
    GUTTER FLOWDEPTH(FEET) =  0.25
    BASIN LOCAL DEPRESSION(FEET) =  0.33
    FLOWBY BASIN WIDTH(FEET) =  10.00

    >>>>CALCULATED BASIN WIDTH FOR TOTAL INTERCEPTION =     10.7

    >>>>CALCULATED ESTIMATED INTERCEPTION(CFS) =    2.4

==============================================================================
```

```
****************************************************************************
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  TIME/DATE OF STUDY: 11:31   7/22/2020
============================================================================


 ************************** DESCRIPTION OF STUDY **************************
 * curb and gutter depth of flow @CB #2                                     *
 *                                                                          *
 *                                                                          *
 **************************************************************************

****************************************************************************
>>>>STREETFLOW MODEL INPUT INFORMATION<<<<
----------------------------------------------------------------------------
    CONSTANT STREET GRADE(FEET/FEET) = 0.064000
    CONSTANT STREET FLOW(CFS) =    3.40
    AVERAGE STREETFLOW FRICTION FACTOR(MANNING) = 0.015000
    CONSTANT SYMMETRICAL STREET HALF-WIDTH(FEET) =   24.00
    DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   22.00
    INTERIOR STREET CROSSFALL(DECIMAL) = 0.030000
    OUTSIDE  STREET CROSSFALL(DECIMAL) = 0.030000
    CONSTANT SYMMETRICAL CURB HEIGHT(FEET) =   0.50
    CONSTANT SYMMETRICAL GUTTER-WIDTH(FEET) =   1.50
    CONSTANT SYMMETRICAL GUTTER-LIP(FEET) =  0.03125
    CONSTANT SYMMETRICAL GUTTER-HIKE(FEET) =  0.12500
    FLOW ASSUMED TO FILL STREET ON ONE SIDE, AND THEN SPLITS
============================================================================
    STREET FLOW MODEL RESULTS:
----------------------------------------------------------------------------
    STREET FLOW DEPTH(FEET) =  0.29
    HALFSTREET FLOOD WIDTH(FEET) =    5.89
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    5.41
    PRODUCT OF DEPTH&VELOCITY =    1.56
============================================================================
```

```
****************************************************************************
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----------------------------------------------------------------------------
  TIME/DATE OF STUDY:  8:50   9/30/2016
============================================================================

 ************************** DESCRIPTION OF STUDY **************************
* Capacity of 3.5' catch basin at sump condition                           *
*                                                                          *
*                                                                          *
 **************************************************************************

****************************************************************************
>>>>SUMP TYPE BASIN INPUT INFORMATION<<<<
----------------------------------------------------------------------------

    Curb Inlet Capacities are approximated based on the Bureau of
    Public Roads nomograph plots for flowby basins and sump basins.

    BASIN INFLOW(CFS) =    6.85
    BASIN OPENING(FEET) =  0.54
    DEPTH OF WATER(FEET) =  0.83

    >>>>CALCULATED ESTIMATED SUMP BASIN WIDTH(FEET) =       3.50

============================================================================
```

```
****************************************************************************
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----------------------------------------------------------------------------
  TIME/DATE OF STUDY: 11:12   7/22/2020
============================================================================

 ************************** DESCRIPTION OF STUDY **************************
* Capacity of 7.0' catch basin at a sump condition                         *
*                                                                          *
*                                                                          *
 **************************************************************************

****************************************************************************
>>>>SUMP TYPE BASIN INPUT INFORMATION<<<<
----------------------------------------------------------------------------

    Curb Inlet Capacities are approximated based on the Bureau of
    Public Roads nomograph plots for flowby basins and sump basins.

    BASIN INFLOW(CFS) =   13.70
    BASIN OPENING(FEET) =  0.54
    DEPTH OF WATER(FEET) =  0.83

    >>>>CALCULATED ESTIMATED SUMP BASIN WIDTH(FEET) =       7.00

============================================================================
```

Encompass Health Chula Vista
Catch Basin Sizing

Catch Basin #	Type FB S	Q100 (cfs)	W (ft)	street slope (ft/ft)	curb & gutter depth of flow (ft)	notes
	(flow-by) (sump)					
1	FB	2.5	14	0.060	0.25	
2	FB	3.4	14	0.064	0.29	
3	S	6.5	3.5	-	-	
4	S	3.5	3.5	-	-	
5	S	4.6	3.5	-	-	use w= 7'

Capacity of catch basin at sump condition:

w (ft)	Q (cfs)
3.5	6.85
7	13.7

Section 7 – References

United States Department of Agriculture

NRCS

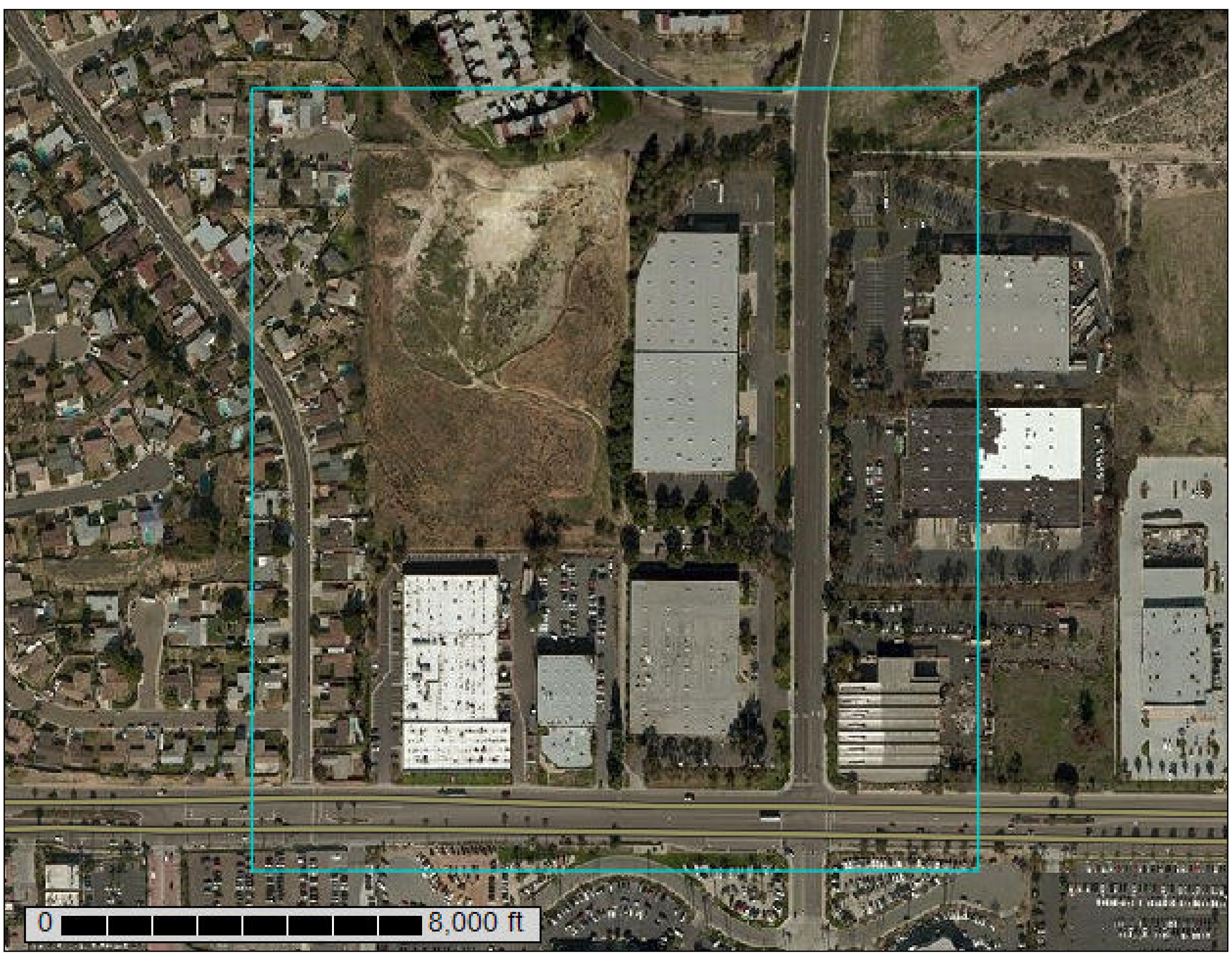
Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

San Diego County Area, California

chula vista



February 14, 2019

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map


117° 2' 0" W
117° 1' 40" W
496850
496940
497030
497120
497210
497300
497390
32° 35' 59" N
32° 35' 36" N
3606900
3606810
3606720
3606630
3606540
3606450
3606360
3606270
Mendocino Dr
DaD
OhE
Oleander Ave
SbC
OkC
Brandywine Ave
Main St
Main
Auto Park Dr
Soil Map may not be valid at this scale.
N
Map Scale: 1:3,500 if printed on A portrait (8.5" x 11") sheet.
0
50
100
200
300
Meters
0
150
300
600
900
Feet
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 Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

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: San Diego County Area, California
Survey Area Data: Version 13, Sep 12, 2018

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

Date(s) aerial images were photographed: Dec 7, 2014—Jan 4, 2015

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
DaD	Diablo clay, 9 to 15 percent slopes, warm MAAT, MLRA 20	0.0	0.0%
OhE	Olivenhain cobbly loam, 9 to 30 percent slopes	17.2	31.7%
OkC	Olivenhain-Urban land complex, 2 to 9 percent slopes	0.2	0.3%
SbC	Salinas clay loam, 2 to 9 percent slopes	37.0	68.0%
Totals for Area of Interest		**54.4**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

San Diego County Area, California

DaD—Diablo clay, 9 to 15 percent slopes, warm MAAT, MLRA 20

Map Unit Setting

National map unit symbol: 2w63f
Elevation: 0 to 2,340 feet
Mean annual precipitation: 10 to 27 inches
Mean annual air temperature: 58 to 65 degrees F
Frost-free period: 290 to 365 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Diablo and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Diablo

Setting

Landform: Mountain slopes, hillslopes
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Parent material: Residuum weathered from calcareous shale

Typical profile

A - 0 to 15 inches: clay
Bkss1 - 15 to 28 inches: clay
Bkss2 - 28 to 40 inches: clay loam
Cr - 40 to 79 inches: bedrock

Properties and qualities

Slope: 9 to 15 percent
Depth to restrictive feature: 39 to 79 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Available water storage in profile: Moderate (about 6.8 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: CLAYEY (1975) (R019XD001CA)
Hydric soil rating: No

Minor Components

Altamont

Percent of map unit: 10 percent
Landform: Hillslopes
Down-slope shape: Convex

Across-slope shape: Convex
Hydric soil rating: No

Linne

Percent of map unit: 3 percent
Landform: Hillslopes
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Oliventain

Percent of map unit: 2 percent
Landform: Terraces
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: No

OhE—Olivenhain cobbly loam, 9 to 30 percent slopes

Map Unit Setting

National map unit symbol: hbfc
Elevation: 100 to 600 feet
Mean annual precipitation: 14 inches
Mean annual air temperature: 63 degrees F
Frost-free period: 290 to 330 days
Farmland classification: Not prime farmland

Map Unit Composition

Olivenhain and similar soils: 85 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Olivenhain

Setting

Landform: Marine terraces
Landform position (three-dimensional): Riser
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Gravelly alluvium derived from mixed sources

Typical profile

H1 - 0 to 10 inches: cobbly loam
H2 - 10 to 27 inches: very cobbly clay, very cobbly clay loam
H2 - 10 to 27 inches: cobbly loam, cobbly clay loam
H3 - 27 to 45 inches:
H3 - 27 to 45 inches:

Properties and qualities

Slope: 9 to 30 percent
Depth to restrictive feature: About 10 inches to abrupt textural change

Natural drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.3 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: CLAYPAN (1975) (R019XD061CA)
Hydric soil rating: No

Minor Components

Diablo

Percent of map unit: 4 percent
Hydric soil rating: No

Linne

Percent of map unit: 2 percent
Hydric soil rating: No

Unnamed, ponded

Percent of map unit: 2 percent
Landform: Depressions
Hydric soil rating: Yes

Huerhuero

Percent of map unit: 2 percent
Hydric soil rating: No

OkC—Olivenhain-Urban land complex, 2 to 9 percent slopes

Map Unit Setting

National map unit symbol: hbff
Elevation: 100 to 600 feet
Mean annual precipitation: 14 inches
Mean annual air temperature: 63 degrees F
Frost-free period: 290 to 330 days
Farmland classification: Not prime farmland

Map Unit Composition

Olivenhain and similar soils: 50 percent
Urban land: 30 percent
Minor components: 6 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Olivenhain

Setting

Landform: Marine terraces
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Gravelly alluvium derived from mixed sources

Typical profile

H1 - 0 to 10 inches: cobbly loam
H2 - 10 to 42 inches: very cobbly clay, very cobbly clay loam
H2 - 10 to 42 inches: cobbly loam, cobbly clay loam
H3 - 42 to 60 inches:
H3 - 42 to 60 inches:

Properties and qualities

Slope: 2 to 9 percent
Depth to restrictive feature: About 10 inches to abrupt textural change
Natural drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Hydric soil rating: No

Description of Urban Land

Typical profile

H1 - 0 to 6 inches: variable

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Minor Components

Huerhuero

Percent of map unit: 2 percent
Hydric soil rating: No

Diablo

Percent of map unit: 2 percent
Hydric soil rating: No

Linne

Percent of map unit: 2 percent
Hydric soil rating: No

SbC—Salinas clay loam, 2 to 9 percent slopes

Map Unit Setting

National map unit symbol: hbgg
Elevation: 2,000 feet
Mean annual precipitation: 12 to 20 inches
Mean annual air temperature: 61 to 64 degrees F
Frost-free period: 300 to 340 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Salinas and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Salinas

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, rise
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Alluvium derived from mixed sources

Typical profile

H1 - 0 to 22 inches: clay loam
H2 - 22 to 46 inches: clay loam, clay
H2 - 22 to 46 inches: loam, clay loam
H3 - 46 to 64 inches:
H3 - 46 to 64 inches:

Properties and qualities

Slope: 2 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very high (about 16.5 inches)

Interpretive groups

Land capability classification (irrigated): 2e

Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Diablo

Percent of map unit: 5 percent
Hydric soil rating: No

Huerhuero

Percent of map unit: 5 percent
Hydric soil rating: No

Tujunga

Percent of map unit: 5 percent
Hydric soil rating: No

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April 15, 2019

Kellye Rohrabaugh
Encompass Health
9001 Liberty Parkway

Subject: **Updated Geotechnical and Geologic Investigation Report**
Encompass Health Hospital Site
512 Shinohara Lane
Chula Vista, California 91911
Partner Project No. 17-199602.7

Dear Kellye Rohrabaugh:

Partner Assessment Corporation (Partner) presents the following updated geotechnical/geologic investigation report based on our general experience with construction practices and geologic/geotechnical conditions on this and other sites. This report is in accordance with the proposal (#199602) dated 7/6/2018, approved by Kellye Rohrabaug of Encompass Health and also was later revised based on proposal (#199602) dated 12/17/2018, approved by John Tschudin of Encompass Health.

The descriptions and findings of our geotechnical report are presented for your use in this electronic format, for your use as shown in the hyperlinked outline below. To return to this page after clicking a hyperlink, hold “alt” and press the “left arrow key” on your keyboard.

We appreciate the opportunity to be of service during this phase of the work.

Sincerely,

Matthew Marcus, PE
Principal Engineer

Razi Quraishi, PG, CEG
Certified Engineering Geologist

Francisca Chan, EIT
Project Engineer

1. GEOTECHNICAL/GEOLOGIC EXECUTIVE SUMMARY

Geologic Zones and Site Hazards:

According to the report*: Regionally the site is located in Peninsular Ranges Geomorphic Province. The Peninsular Ranges Province is traversed by a group of sub-parallel faults and fault zones trending roughly northwest. Several of these faults are major active faults (Rose Canyon, Elsinore, San Jacinto and Newport – Inglewood). Undivided sediments/sedimentary rocks and San Diego Formation occurs within the regional area of the site. The subject property is currently vacant and undeveloped since 1904. Substantial grading, drainage improvements and hydro-seed applications occurred on the northern slopes in 2007. Surficial geology consists of topsoil and artificial fill, overlying residual weathered bedrock (San Diego Formation). The site is in an area where the seismic hazard potential was not evaluated by the State of California, and the historic groundwater levels were not provided by the California Department of Conservation. Based on our evaluation the slopes on the site are stable with regards to landsliding and slope stability. Given the seismic activity in the region we anticipate low to moderate ground shaking during the project life. No other geologic hazards are known or suspected on the project.

Excavation Conditions:

According to the report*: We anticipate extensive grading will be needed on the site to establish the finished grades for the new buildings. We anticipate cut slopes on the order of 20 feet or more on the north end of the property. The stability of the slopes during and after construction have been evaluated and will call for special considerations during construction. In general, the borings encountered soil that would be excavatable using conventional construction equipment in good working condition. However, hard digging conditions may be encountered on the norther portion of the site. Loose fill soils and native sandy soils may be prone to caving during excavation. Groundwater was not encountered during drilling; however, groundwater levels can fluctuate over time.

Foundation/Slab Support:

According to the report*: The upper 1 to 6 feet of soil encountered in our explorations consisted of artificial fill material, debris and plant material. Some debris and deleterious inclusions (paper bags, household garbage, etc.) were noted in the fill. Where present in new building or fill embankment areas, the fill and other deleterious/organic materials should be completely removed to expose clean, competent native soil. Spread foundations should be considered for the new hospital building. The foundations can be supported on engineered fill and/or competent, clean native soil compacted in-place, as described in the report. Slab-on-grade areas should be supported on non-expansive engineered fill extending to competent native soils that are approved by the engineer.

Mass Grading and Soil Reuse:

According to the report*: Site soils are generally expected to be usable as engineered fill on the site, after stripping/grubbing of organic material and disposal of trash, topsoil and debris. The native soil encountered had a relatively low in-place density. As such, we anticipate that volume loss of cut materials will occur after moisture conditioning and compaction, on the order of 15% to 25%. New fills of up to 20 feet in height to be placed on existing slopes should be benched and keyed per CBC requirements. It is recommended to use non-expansive structural fill that is free of deleterious materials, and is properly moisture conditioned and compacted to 95% of the modified proctor (ASTM D 1557) is recommended.

Pavement Design: According to the report*:

Roadway Type	*Subgrade Preparation*	*Pavement Section*
Parking Area Light Duty (TI=4)	Compacted Subgrade	3-in asphalt & 6-in aggregate base
Parking Area Heavy Duty (TI=7)	Compacted Subgrade	6-in concrete & 4-in aggregate base

This summary in no way replaces or overrides the detailed sections of the report*

2. REPORT OVERVIEW & LIMITATIONS

2.1 Report Overview

To develop this report, Partner accessed existing information and obtained site specific data from our exploration program. Partner also used standard industry practices and our experience on previous projects to perform engineering analysis and provide recommendations for construction along with construction considerations to guide the methods of site development. The opinions on the cover letter of this report do not constitute engineering recommendations, and are only general, based on our recent anecdotal experiences and not statistical analysis. Section 1.0, Executive Geotechnical Summary, compiles data from each of the report sections, while each of sections in the report presents a detailed description of our work. The detailed descriptions in Sections 4, 5, 6, 7 and 8 and Appendix A to address slope stability findings and Appendix D constitute our engineering recommendations for the project, and they supersede the Executive Geotechnical Summary.

The report overview, including a description of the planned construction and a list of references, as well as an explanation of the report limitations is provided in Section 2.0. The findings of Partner's geologic review are included in Sections 4.0 and 5.0, Geologic Conditions and Hazards. The descriptions of our methods of exploration and testing, as well as our findings are included in Section 7.0. In addition, logs of our trench excavations are included in Appendix A, Boring Logs are included in Appendix B, and geotechnical laboratory testing is included in Appendix C of the report. Site Location and Site Investigation Plan are included as Figures 1 and 2 in the report.

2.2 Assumed Construction

Partner's understanding of the planned construction was based on information provided by the project team. The proposed site plan is included as Figure 2 to this report. Partner's assumptions regarding the new construction are presented in the below table.

Property Data	
Property Use:	Encompass Health Hospital Site
Building footprint/height	One story above grade, roughly 130,000 sf
Land Acreage (Ac):	Approx. 9.6 Ac, APN 644-040-01-00
Number of Buildings:	1
Expected Cuts and Fills	Unknown
Type of Construction:	Unknown, assumed slab-on-grade with metal framing
Foundations Type	Unknown, assumed shallow foundations
Anticipated Loads	2,000 to 3,000 psf
Traffic Loading	Parking lot and loading dock
Site Information Sources:	APD Consultants, Conceptual Project Plans, 3/7/2019.

2.3 References

The following references were used to generate this report:

California Building Code IBC 2009 and ASCE 7-10

California Geological Survey, Note 36, *California Geomorphic Provinces*, 2002.

California Geological Survey Topographic Map 2015, 7.5 Minute series, *Imperial Beach, CA*, accessed via internet, accessed 1/24/18

Federal Emergency Management Agency, FEMA Flood Map Service Center, accessed 1/24/18

Federal Highway Administration, Rock Slope Engineering, 1979

Google Earth Pro (Online), accessed 1/24/18

Geologic Map of the San Diego Quadrangle, Regional Geologic Map No. 3, 1: Kennedy and Tan, 2008.

Geotechnical Engineering Portable Handbook, Robert W. Day, 2000

Historic Aerials by NETR Online, accessed 1/24/18

Naval Facilities Engineering Command, NAVFAC DM 7.1-.3, Design Manual, Soil Mechanics and Foundations, May 1982, April 1983.

Partner Engineering and Science, Inc., Phase 1 Environmental Assessment Report, *Industrial Land, 517 Shinohara Lane, Chula Vista*, *California,* dated February 1, 2018.

Partner Engineering and Science, Inc., Preliminary Geotechnical Report, *Industrial Land, 517 Shinohara Lane, Chula Vista*, *California,* dated January 16, 2018.

Willian A. Steen & Associates, Otay Valley Industrial Park (Phase 1), As Built, 517 Shinohara Lane, San Diego, CA, dated 10-31-07.

United States Geological Survey, Lower 48 States 2014 Seismic Hazard Map, accessed online 1/24/18

United States Geologic Survey, Earthquake Hazards Program (Online), accessed 1/24/18

2.4 Limitations

The conclusions, recommendations, and opinions in this report are based upon soil samples and data obtained in widely spaced locations that were accessible at the time of exploration, and collected based on project information available at that time. Our findings are subject to field confirmation that the samples we obtained were representative of site conditions. If conditions on the site are different than what was encountered in our borings, the report recommendations should be reviewed by our office, and new recommendations should be provided based on the new information and possible additional exploration if needed. It should be noted that geotechnical subsurface evaluations are not capable of predicting all subsurface conditions, and that our evaluation was performed to industry standards at the time of the study, no other warranty or guarantee is made.

Likewise, our document review and geologic research study made a good-faith effort to review readily available documents that we could access and were aware of at the time, as listed in this letter. We are not able to guarantee that we have discovered, observed, and reviewed all relevant site documents and conditions. If new documents or studies are available following the completion of the report, the recommendations herein should be reviewed by our office, and new recommendations should be provided based on the new information and possible additional exploration if needed.

This report is intended for the use of the client in its entirety for the proposed project as described in the text. Information from this report is not to be used for other projects or for other sites. All of the report must be reviewed and applied to the project or else the report recommendations may no longer apply. If pertinent changes are made in the project plans or conditions are encountered during construction that appear to be different than indicated by this report, please contact this office for review. Significant variations may necessitate a re-evaluation of the recommendations presented in this report. The findings in this report are valid for one year from the date of the report. This report has been completed under specific Terms and Conditions relating to scope, relying parties, limitations of liability, indemnification, dispute resolution, and other factors relevant to any reliance on this report. Any parties relying on this report do so having accepted Partner's standard Terms and Conditions, a copy of which can be found at http: / www.partneresi.com/terms-and-conditions.php

If parties other than Partner are engaged to provide construction geotechnical services, they must be notified that they will be required to assume complete responsibility for the geotechnical phase of the project by concurring with the findings and recommendations in this report or providing alternate recommendations.

3. SITE LOCATION AND PROJECT INFORMATION

3.1 Site Location and Project Information

The planned construction will be situated on a currently undeveloped parcel in Chula Vista, California. The immediately surrounding properties consist of light industrial buildings and residential buildings. Figure 2 presents the project site and the locations of our site exploration. Based on our review of available documents, the site has had the following previous uses:

Historical Use Information		
Period/Date	**Source**	**Description/Use**
1904-1995	Aerial Photographs, Topographic Maps, City Directories, Onsite Observations	Undeveloped Land
1995-Present	Aerial Photographs, Topographic Maps, City Directories, Onsite Observations	Some site improvements: grading, drainage, hydroseeding

4. GEOLOGIC FINDINGS

This section presents the results of a geologic review performed by Partner, for a proposed new construction on site. The general location of the project is shown on Figure 1.

4.1 Regional Geology

Regionally the site is located in Peninsular Ranges Geomorphic Province. The Peninsular Ranges Province is traversed by a group of sub-parallel faults and fault zones trending roughly northwest. Several of these faults are major active faults (Rose Canyon, Elsinore, San Jacinto and Newport – Inglewood). Undivided sediments/sedimentary rocks and San Diego Formation occurs within the regional area of the site. The province varies in width from approximately 30 to 100 miles. The western portion of the province, which includes the project area, consists generally of dissected coastal plain underlain by upper Cretaceous, Tertiary rocks and Quaternary sediments, very old Pleistocene marine and non-marine terrace deposits an bedrock of early Pleistocene and late Pliocene of San Diego Formation.

The Regional Geologic Maps are included in Figures 3 and 4.

Summary of Geologic Data		
Parameter	**Value**	**Source**
Geomorphic Zone	Peninsular Ranges	CGS, Geology of California
Site Ground Elevation Range	140 to 255 feet above MSL	USGS and Site Topographic Survey
Flood Elevation	Zone X (Minimal Flood Hazard)	FEMA
Seismic Hazard Zone	Low to Moderate	USGS and CGS
Geologic Hazards	Low Density Sandy Silty Soils	CGS/ Lab Results
Surface Cover	Artificial Fill/San Diego Formation	Geotechnical/Geologic Investigation
Site Modifications	Previously graded; seed soil type	Google Earth
Surficial Geology	Artificial Fill (AF)/San Diego Formation (Tsdss)	USGS, California Geologic Survey, Geologic Map of San Diego Quadrangle, Site Geologic Mapping
Depth to Residual Soils/ Weathered San Diego Formation	1.5 to 6.0 feet (Approximately)	Boring Logs/ Trenches/ Site Geologic Mapping
Approximate Groundwater Depth	45 to 85 feet	Partner ESA

4.2 Site Engineering Geology and Subsurface Conditions

The site geology and subsurface conditions have been summarized in this section from available geologic data, geologic mapping (Figure 5) and previous subsurface investigations consisting of exploratory six soil borings performed on January 25, 2018 (B-1,B-2, B-3, B-4 ,B-5 and B-6) and four exploratory trenches (TP-1,TP-2,TP-3 and TP-4) are shown at location in Figure 2. Additional borings were performed on February 12, 2019 (B-7, B-10 , B-12, B-13, B-14, B-15) and also continuous core borings on March 15, 2019 (B8-A, B11-A, B16-A).

Trench logs are provided in Appendix A. The soil boring and continuous core logs are provided in Appendix B. The subject property is located approximately at elevation 145 feet to 250 feet above MSL, in an area of sloping topographic relief sloping generally to the south and south east.

Generalized geologic cross sections A-A' and B-B' and C-C' are included in Figure 6, 7 and 8 respectively. Top soil was observed on the scattered areas of the site in varying thickness from 0.5 feet to 2.5 feet. The site is mapped to be underlain by artificial fill (AF) varying in thickness from approximately 1.0 feet to 6.0 feet. The fill generally consists of orangish brown fine to coarse sand, some silt and clay, fine to coarse gravel and cobbles.

Artificial Fill (AF) is underlain by bedrock of early Pleistocene and late Pliocene San Diego Formation (Tsdss). San Diego Formation (silty sandstone) consists of yellowish brown to whitish gray, slightly micaceous, silty fine sand (unified soil classification symbol "SM"), or slightly micaceous, medium dense to dense, moderately weathered grey fine sand, little silt ("SP-SM"). Exploratory trenches indicated the San Diego formation is poorly bedded. The San Diego Formation exhibits low angle, faint bedding dips approximately 4 to 5 degrees towards southwest and strikes approximately N 20 to 25 degrees northwest. The strikes and dips generally co-relates with the regional dip.

4.3 Groundwater and Caving

No active surface ground water seeps or springs were observed at the project site. Subsurface water was not encountered during our field exploration to maximum excavated/drilled depth of 50 feet below existing grade. Trench walls were stable during and after excavation.

However, based on data on an adjacent site, groundwater is approximated around 40-85 feet below ground surface. Seasonal and long-term fluctuations in the groundwater may occur as a result in variations in subsurface conditions, rainfall, run-off conditions and other factors. Therefore, variations from our observations may occur.

4.4 Slope Stability Analysis

Regional Geologic and Site Engineering Geologic Maps (Figures 4 and 5) and Seismic Hazards Map (Figure 9) indicated the site is not located in the landslide area. Site Geologic mapping indicated the residual soils/San Diego Formation slopes are stable. In addition, Partner performed global slope stability analysis of four site cross-sections which had planned retaining walls of 6 feet or higher at the base of soil slopes. The slopes were evaluated for global stability (circular failure) using Bishop and Janbu methods, and soil parameters determined from direct shear testing of relatively "undisturbed" site soils obtained during drilling in a California modified split-spoon sampler. The parameters used were a cohesion of 100 psf and friction angle of 30 degrees. The slope stability cross sections are shown in Appendix D, and the output of the Slide 2d Software models are shown in Appendix E.

Factors of safety in three of the sections were 1.5 or greater with normally sized and embedded foundations. Cross-section H-H', located on the north side of the project includes a roughly 40-ft high cut slope with a 13-ft high retaining wall at its base. This section did not have a 1.5 factor of safety with normally sized and embedded foundation. As such, we recommend that the retaining wall in this location have a cantilevered foundation embedded 4 feet below grade, and that extends 7.5 feet from the centerline of the wall, where wall heights are higher than 6 feet.

In addition, seismic stability analysis was performed on the slopes, based on a maximum horizontal acceleration of 0.375 g for soft rock (site class C) conditions. Based on the information in California SP 117, the K_{eq} factor was 0.5 x .375 for an M 7 earthquake event. As such, a K_{eq} factor of 0.19 was used for the site. The minimum factor of safety determined by this method was 1.06, which is acceptable per California SP 117.

Slope stability analysis at the northern slopes (Location STA #1, Figure 5) indicates the slopes are stable with a calculated factor of safety of 2.58 which is greater than the normally accepted minimum for stable slopes. Slope stability analysis was also conducted at the western areas (Location STA #2 and STA #3, Figure 5) indicated the disturbing forces tending to cause the block to slide down becomes negative. The bedding angle is greater than the slope angle. The bedding dips beneath the slope and the slopes are stable. Slope soil properties and Factor of Safety calculation are included in Appendix A.

All slopes will be subjected to surficial erosion. Therefore, slopes should be protected from surface runoff by means of top of the slopes compacted earth berms.

It is recommended that the slopes should be properly maintained in future by some of these methods: cleaning and removing loose debris, minor grading, controlling surface water, revegetation and by constructing benches. Over- watering and subsequent saturation of slope surface should be avoided.

4.5 Faulting and Seismicity

The subject site is in San Diego County of Southern California. Like the rest of Southern California, it is in a seismically active region. This region is located near the active margin between the North American and Pacific tectonic plates. The seismicity is due to movement along the regional active faults such as the San Andreas, Rose Canyon, Newport-Inglewood, Elsinore and San Jacinto.

According to the State Mining and Geology Board, an active fault is defined which has had surface displacement within the Holocene Epoch (roughly within the last 11,000 years). The State Mining and Geology Board define a potentially active fault as a fault which has been active during the Quaternary Period (roughly within the last 1.6 Million years). Historic and Holocene age faults are considered active, Late Quaternary and Quaternary age faults are considered potentially active, and pre-Quaternary age faults are considered inactive.

The above definitions are used in delineating Earthquake Fault Zones as mandated by the Alquist-Priolo Geologic Hazard Zones Act of 1972 and as subsequently revised in 1994 (Hart, 1997) as the Alquist-Priolo Geologic Hazard Zoning Act and Earthquake Fault Zones. The Act regulates development and construction of buildings intended for human occupancy to mitigate the hazards of surface fault rupture. It defines areas where ground rupture is likely to occur during future earthquakes. Where such zones are designated, a geologic study must be conducted to determine the locations of all active fault lines in the zone before any construction is allowed and to determine whether building setbacks should be established, and no building may be constructed on the fault lines.

Our review of geologic literature pertaining to the site area indicates that there are active faults within the regional area (Rose Canyon Fault, Elsinore Fault, San Jacinto Fault and Newport-Inglewood Fault. The nearest active zone is Rose Canyon Fault Zone located in 6.7 miles west of the project site.

Rose Canyon Fault Zone Parameters	
Length:	55 to 70 (km)
Fault Type:	Right Lateral/Strike Slip
Slip rate:	1.5 mm/ year
Dip:	90 degrees

Based on the 2010 California Fault Activity Map (Jennings and Bryant 2010, Figure 9), active faults are not mapped on the site. Quaternary La Nacion Fault Zone is located approximately 0.3 miles east from the project site. Geologic mapping by Partner indicated structural continuity across the site, further suggesting the absence of active faults in the area explored.

No evidence of active or potentially active faulting was observed or encountered in any of our excavations/trenches on the site. It should be noted that the Southern California region is an area of moderate to high seismic risk and it is not considered feasible to render structures fully resistant to seismic related hazard. The minimum seismic design should comply with the 2013 California Building Code (CBC) and ASCE 7-10 using the seismic parameters recommended in Section 6.0 of this report.

5. SECONDARY SEISMIC HAZARDS

This section presents the results of a geologic review performed by Partner, for a proposed new construction on site. The general location of the project is shown on Figure 1.

5.1 Surface/Subsurface Fault Rupture

Surface fault rupture resulting from the movement of nearby major faults is not known with certainty but is considered low. However, due to the known active and potentially active faults in the region, low to moderate ground shaking should be expected during the life of the proposed structures.

5.2 Liquefaction

Liquefaction is defined as a seismic phenomenon in which loose or soft, saturated, fine-grained soil mass suffers a substantial reduction in its shear strength when subjected to high-intensity ground shaking and exhibits a liquid-like behavior.

During earthquakes, excess pore water pressures may develop in saturated soil deposits as a result of induced cyclic shear stresses. Effects of liquefaction can include sand boils, settlement and bearing capacity failures. Liquefaction occurs when these ground conditions exist: 1) Shallow groundwater; 2) Low density, fine, clean sandy soils; and 3) High-intensity ground motion. Shallow ground water and saturated, clean, sandy soils are not present at the project site.

Published data from California Geological Survey - Seismic Hazards Zone Map, indicates that the project site is not located in an area identified as having a potential for soil liquefaction. The potential for site liquefaction is negligible (see Figure 9).

5.3 Seismically Induced Landslide

According to the published data from California Geological Survey "State of California Seismic Hazard Zones Official Map, the site is not within a landslide zone (see Figure 9).

6. SEISMIC / DESIGN PARAMETERS

When reviewing the 2010 California Building Code, IBC 2009 and ASCE 7-10 the following seismic data should be incorporated into the design.

6.1 Seismic Design Parameters

Latitude: 32.597463 N (Degrees)

Longitude: -117.031415 W (Degrees)

MCE: 2% Probability of Exceedance in 50 Years

Seismic Item	***Value***	***Seismic Item***	***Value***
Site Classification	D	Seismic Design Category	D
Fa (site coefficient)	1.043	Fv (site coefficient)	1.461
Ss (spectral response at 0.2 seconds)	0.892g	S_1 (spectral response at 1.0 second)	0.339g
S_{MS} (maximum considered earthquake spectral acceleration)	0.931g	S_{M1} (maximum considered earthquake acceleration)	0.496 g
S_{DS} (design spectral acceleration)	0.621g	S_{D1} (design spectral acceleration)	0.330g
PGA Max (ASCE '10)	0.375g	67% PGA (ASCE '10)	0.251g

Source: 2010 and 2016 CBC (IBC 2016/ ASCE 7-10) and USGS Seismic Hazards Design Maps.

The Structural Consultant should review the above parameters and the 2010 California Building Code (IBC 2009/ASCE 7-10) to evaluate the seismic design.

7. GEOTECHNICAL EXPLORATION & LABORATORY RESULTS

Our evaluation of soils on the site included field exploration and laboratory testing. The field exploration and laboratory testing programs are briefly described below. Data reports from the field exploration and laboratory testing are provided in Appendix B and Appendix C, respectively.

7.1 Soil/ Continuous Core Borings

The first soil boring program was conducted on January 25, 2018. Six (6) borings were advanced by the use of a track-mounted drill using solid flight auger drilling techniques. The borings were made to depths of 5 to 15 feet below ground surface. Boring B-5 encountered hard drilling material and then was terminated due to damage to the drill rig.

The second soil boring program was conducted on February 12, 2019. The approximate locations of the exploratory borings are shown on Figure 2. Six (6) borings were advanced by the use of a track-mounted drill using solid flight auger drilling techniques. The borings were made to depths of 16.5 feet below ground surface.

Three (3) continuous soil cores were performed on the site to depths of 40 to 50 feet for geologic mapping on March 15, 2019. The geologic data and stratigraphic evaluation from these borings are included in the boring Appendix B. Logs of subsurface conditions encountered in the borings were prepared in the field by a representative of Partner Engineering. Soil samples consisting of relatively undisturbed brass ring samples and Standard Penetration Tests (SPT) samples were collected at approximately 2.5 and 5-foot depth intervals and were returned to the laboratory for testing. The SPTs were performed in accordance with ASTM D 1586. Typed boring logs were prepared from the field logs and are presented in Appendix A. Continuous corings were also conducted on three borings for stratigraphic evaluation.

A summary table description is provided below:

Summary of Geologic Straiographic Data		
Strata	**Depth to Bottom of Layer (bgs*)**	**Description**
Surface Cover	0-1 feet	Grass/ Dirt
Fill Material	Up to 6 feet	Silty sand with gravel and cobbles
San Diego Formation	16+ feet	Silty sandstone, fine silty sand
Groundwater	NA	Not encountered
Bedrock (Very Hard)	NA	Not encountered

7.2 Trenches

The trenches were excavated during July 26 to July 27, 2018. Four (4) trenches were excavated using Backhoe Komatsu, PC 390 LC. The trenches were excavated to depths of 14 feet in the slopes of the parcel. The approximate locations of the trenches are shown on Figure 2.

Logs of subsurface conditions encountered in the trenches were prepared by our Certified Engineering Geologist. Soil Bag samples were taken at TP-1 at approximately 5.5 and 11.0-foot depth interval and were returned to the laboratory for testing. Test pits were backfilled on completion. Typed trench logs were prepared from the field logs and are presented in Appendix A.

7.3 Geotechnical Laboratory Evaluation

Soil samples were submitted to a certified testing laboratory, Hamilton & Associates. Results are attached in Appendix C. Tests performed included in-place moisture and density, sieve analysis, Atterberg and direct shear tests. We have reviewed the results from Hamilton & Associates and are in agreement with the results. The results of laboratory analyses are presented in the boring logs and in Appendix C.

8. PRELIMINARY GEOTECHNICAL RECOMMENDATIONS

The following discussion of findings for the site is based on the assumed construction, geologic review, results of the field exploration, and laboratory testing programs. The recommendations of this report are contingent upon adherence to Appendix D of this report, General Geotechnical Design and Construction Considerations. For additional details on the below recommendations, please see Appendix D.

8.1 Geotechnical Recommendations

- The proposed construction is generally feasible from a geotechnical perspective provided the recommendations and assumptions of this report are followed.

[illegible]

- Regionally the site is located in Peninsular Ranges Geomorphic Province. The Peninsular Ranges Province is traversed by a group of sub-parallel faults and fault zones trending roughly northwest. Several of these faults are major active faults (Rose Canyon, Elsinore, San Jacinto and Newport – Inglewood). Undivided sediments/sedimentary rocks and San Diego Formation occurs within the regional area of the site. The subject property is currently vacant and undeveloped since 1904, there was substantial grading, drainage improvements and hydro-seed applications on the northern slopes in 2007. The site is in an area where the seismic hazard potential was not evaluated, and the historic groundwater levels were not provided by the California Department of Conservation. Partner conducted geologic and seismic investigations in July – August 2018. Partner's evaluation indicated the hazards of landslide and liquefaction are not present at the project site. No other hazards are known. Due to the proximity to residential homes, additional regulations for construction noise and setbacks should be carefully reviewed during the planning stages.

[illegible]

- We anticipate extensive grading will be needed on the site to establish the finished grades for the new buildings. We anticipate site excavations can be made using conventional construction equipment in good working condition; However, given the quantity of cuts on the site, particularly on the north side of the property, hard excavation may be encountered in some of the deeper cuts. Groundwater was not encountered during drilling; however, groundwater levels can fluctuate over time. Loose fill soils and native sandy soils/San Diego Formation may be prone to caving during excavation. Excavations should be sloped or shored per OSHA requirements.
- On the north side of the property, cuts of up to 20 feet are anticipated. Laying back of cuts up to 20 feet can be done on a temporary basis per OSHA with the consideration of type C, sandy soils at a 1.5:1 horizontal to vertical slope. Such slopes should be monitored for sloughing or loose material on a daily basis for site safety. Where such slopes exceed 20 feet, a shoring or bracing system should be used. This can consist of a temporary soldier pile and lagging retaining wall. The soldier piles may require pre-drilling and grouting for installation. Spacing and depth calculations for this should be done by a certified contractor, and should comply with California and other local jurisdictional requirements. The design can use soil data from Section 8.2 of this report, and more information is provided in Appendix C under Excavations and Dewatering.

Spread Foundations

- We anticipate that spread foundations are planned for the site structure. We anticipate that spread foundations will be proportioned for bearing capacities ranging from 2,000 to 3,000 pounds per square foot or less. The foundations and slabs should be supported on a layer of in-place native soils that have been evaluated and approved by the engineer and compacted in-place, or bear on controlled fill that has been placed and compacted as a part of mass grading, as described below, in Section 8.2 and Appendix C.

Mass Grading Considerations

- All undocumented fills, debris, grass, roots and other plant materials should be removed from structural areas of the site. In the new fill areas, the cleaned subgrade should be proofrolled and evaluated by the engineer with a loaded water truck (4,000 gallon) or equivalent rubber tired equipment. Soft or unstable areas should be repaired per the direction of the engineer.
- Prior to the placement of new fill, Appendix J of the California building code should be carefully reviewed. Given the native slopes on the site, benching and keying of new fills will be needed as shown in Figure 10. The bulk of the new hospital building will be supported on native material; however, a portion is to bear on deep fills (up to 20 feet) placed over the existing slope. For new fill zones where more than 5 feet of fill will support the new building or parking areas, 95% compaction is required to reduce the potential of differential settlement. It is recommended, that this zone start 5 feet from the edge of building or pavement, and extend at a 1:1 slope to the base of fill. In order to achieve this level of compaction, careful attention to moisture conditioning, lift thickness, and compaction equipment selection will be needed.
- We assume that mass grading will be performed prior to the installation of new retaining walls, and the new fill will be cut back where needed to install retaining wall foundations, and to provide room for retaining wall backfill. However, in some cases, it may make sense to partially grade retaining wall areas, so that cut backs for wall installation do not create steep/unstable slopes (greater than 2:1 horizontal to vertical and/or higher than 20 feet) In the event that walls are in-place during grading operations, grading equipment should be routed to avoid retaining walls. Only lightweight equipment should be used to backfill retaining walls, as described below.

Retaining Wall Considerations

- Most of the site retaining walls are in support of new fills, and as such, can be staged so as to not result in a temporary steep cut-back condition for wall installation. However, the wall on the north of the property, cross-section H-H', will require a relatively large over-cut in the existing soil. Partner performed a slope stability analysis of this as a 1.5:1 horizontal to vertical cut, as shown in Appendix D, and demonstrated a factor of safety of 1.05 for global stability. This excavation should be stable on a temporary basis; however, if used, the slope should be regularly monitored and cleaned of any large rocks or loose soil that could slip. Alternatively, the excavation could be supported by a temporary shoring system, consisting of soldier piles or the permanent wall could be constructed of a soldier pile system. Appendix D contains our slope stability cross sections and results.
- The soil parameters for the design of site retaining walls is provided in Section 8.2. The wall designer should check the wall for sliding, overturning, and internal stability. Partner performed global

stability for the four site walls sections that were over 6 feet in height. Factors of safety in three of the four sections were 1.5 or greater with normally sized and embedded foundations. Cross-section H-H', located on the north side of the project includes a roughly 40-ft high cut slope with a 13-ft high retaining wall at its base. This section did not have a 1.5 factor of safety with normally sized and embedded foundation. As such, we recommend that the retaining wall in this location have a cantilevered foundation embedded 4 feet below grade, and that extends 7.5 feet from the centerline of the wall, where wall heights are higher than 6 feet. Construction should proceed in general accordance with Appendix C, with specific attention to Laterally Loaded Structures.

[illegible]

- Site soils were generally acceptable for use as engineered fill. The vegetation and debris should be stripped from the site and should not be incorporated into fill material. It is recommended to use non-expansive structural fill that is free of deleterious materials, and is properly moisture conditioned and compacted to 90-95% of the modified proctor (ASTM D 1557). For deep fills below the building, and at the pavement subgrade elevation 95% should be used, and 90% may be used in other areas where allowed by the building code.

[illegible]

- Concrete should be corrosion resistant, using Type II/V Portland Cement, and fly ash mixtures of 25 percent cement replacement. We recommend a water/cement ratio of 0.45 or less. Site soil may be corrosive to un-protected metallic elements such as pipes, poles, etc. Concrete exposed to freezing weather in cold climates should be air-entrained.

[illegible]

- The site surficial soils are generally undocumented fill and sandy soil. Surface drainage and landscaping design should be carefully planned to protect the new structures from erosion/undermining, and to maintain the site earthwork and structure subgrades in a relatively consistent moisture condition. Water should not flow towards or pond near to new structures, and high water demand plants should not be planned near to structures.

8.2 Geotechnical Parameters

Based on the findings of our field and laboratory testing, we recommend that design and construction proceed per industry accepted practices and procedures, as described in Appendix D, General Geotechnical Design and Construction Considerations (Considerations).

[illegible] – (hyperlink to Construction Considerations)

Subgrade Preparation				
Structure	**Bearing Capacity**	**Embedment Depth**	**Bearing Surface** [a]	**Settlement** [d]
Grade Slabs	k=150 pci [b]	NA	95% Compacted Fill or Native to 90%	<1 inch
Spread Foundations	3,000 [c] psf	30 inches	95% Compacted Fill or Native to 90%	<1 inch
Spread Foundations	2,500 [c] psf	24 inches	95% Compacted Fill or Native to 90%	<1 inch
Spread Foundations	2,000 [c] psf	18 inches	95% Compacted Fill or Native to 90%	<1 inch

[a] *Repairs in bearing surface areas should be structural fill per the recommendation of the Earthwork section of Appendix C that is moisture conditioned to within 3 percent below to optimum moisture content and compacted to 95 percent or more of the soil maximum dry density per ASTM D1557. Expansive material should not be located within the upper* 3 feet of the soil subgrade.

[b] *Subgrade modulus value "k", assuming the grade slab is supported by aggregate layer roughly equal to slab thickness (minimum 4 inches)*

[c] *Can be increased by 1/3 for temporary loading such as seismic and wind*

[d] *Differential settlement is expected to be half of total settlement*

[illegible] – (hyperlink to Construction Considerations)

Pavement Sections		
Roadway Type	**Subgrade Preparation** [a]	**Pavement Section**
Parking Area Light Duty (TI=4)	Proofrolled/Compacted Subgrade	3-in asphalt & 6-in aggregate base
Parking Area Heavy Duty (TI=7)	Proofrolled/Compacted Subgrade	4-in asphalt & 9-in aggregate base
Parking Area Heavy Duty (TI=7)	Proofrolled/Compacted Subgrade	6-in concrete & 4-in aggregate base
Special High Traffic Areas	Proofrolled/Compacted Subgrade	8-in concrete

[a] *Repairs in proofrolled areas should be structural fill per the recommendation of the Earthwork (hyperlink to Construction Considerations) that is moisture conditioned to within 3 percent below to optimum moisture content and compacted to 95 percent or more of the soil maximum dry density per ASTM D1557.*

[illegible]– (hyperlink to Construction Considerations)

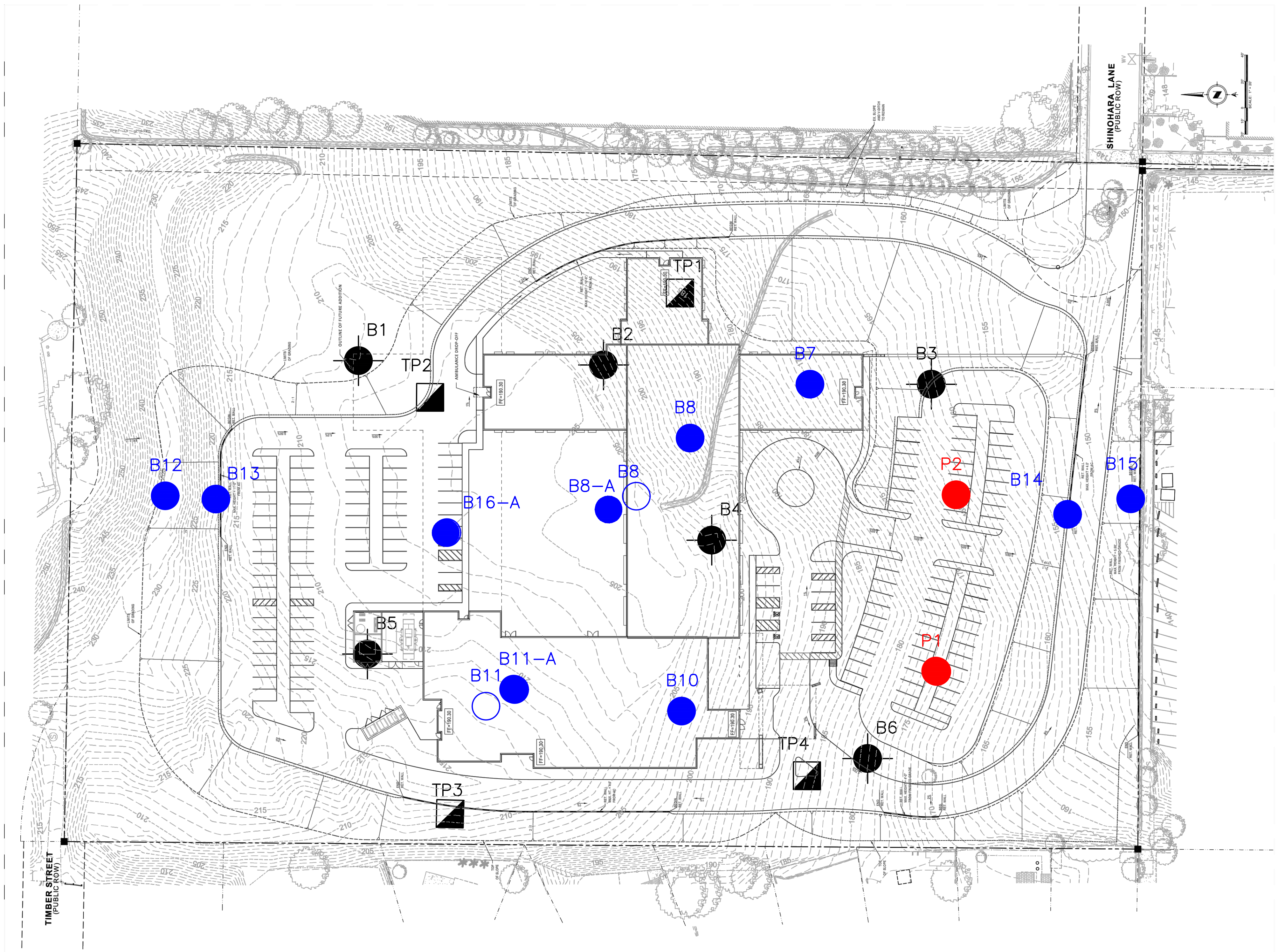
Lateral Earth Pressures				
Soil Type	**Coefficient of Friction (μ)**	**Static Fluid Pressure (pcf)**	**Active Fluid Pressure (pcf)**	**Passive Fluid Pressure (pcf)**
Fill Soil	0.3	50	35	300
Native Soil	0.3	50	35	350

**seismic equations*

Combined effect of static and seismic lateral force:
$P_{AE} = F_1 + F_2$

$F_1 = 1/2*A*H^2$ Resultant acting at a distance of H/3 from base of wall
$F_2 = 3/8*K_h*\gamma*H^2$ Resultant acting at a distance of (0.6*H) from base of wall

Where:
F_1 = Static Force (plf) based on active pressure
F_2 = Seismic Lateral Force (plf) based on seismic pressure
γ = 120 pcf
$K_h = S_{DS}/2.5$
A = Active Pressure (pcf)
H = Height of retained soil (ft)



*Source Drawing from EH Grading Plan, 517 Shinohara Lane, Chula Vista, CA

AERIAL IMAGERY PROVIDED BY GOOGLE AND ITS LICENSORS © 2016

LEGEND:

- APPROXIMATE FOOTPRINT OF HOSPITAL BUILDING.
- TP1 — TRENCH EXCAVATED DURING JULY 26-27, 2018.
- B1 — BORING DRILLED JANUARY 25, 2018.
- B1 — BORING DRILLED FEBRUARY 12, 2019.
- B11–A — CORE BORING DRILLED MARCH 15, 2019.
- B1 — CORE BORING NOT COMPLETED DUE TO MECHANICAL AND SAMPLING DIFFICULTIES.
- P1 — PERCOLATION TEST

NOTES:

- BGS = BELOW GROUND SURFACE
- BORING, TRENCHES AND PERCOLATION TEST LOCATIONS ON THIS MAP ARE APPROXIMATE

50' 0' 50' 100'

APPROXIMATE SCALE

TITLE: GEOTECHNICAL/GEOLOGIC INVESTIGATION PLAN			
FIGURE: 2	PREPARED BY: FC	DATE: MARCH 2019	PROJECT NUMBER: 17–199602.4
ADDRESS: 517 Shinohara Lane, Chula Vista, CA 91911			

PARTNER
Engineering and Science, Inc.®
2154 TORRANCE BOULEVARD, SUITE 200
TORRANCE, CALIFORNIA 90501

APPENDIX E

Percolation Test

Pecolation Test Data Sheet	
Project:	EHS Chula Vista
Project No.:	17-199602.7
Date:	3/14/2019
Test Hole:	P1
Tested by:	MM
Depth of Hole, ft, D:	3.25
Boring Radius, in:	6
UCSD:	SP

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

Pre-Soak Procedure (See notes)						Calculations	
Reading #	Start Time	Stop Time	Δ t Time Interval	Do Initial Depth to Water Level	Df Final Depth to Water Level	Δ D Change in Water Level	Greater than 6"
	hr:mm	hr:mm	min	in	in	in	(y/n)
1	10:30	11:00	30	12	19	7.0	
2	11:10	11:40	30	19	28	9.0	

IN RIVERSIDE, 2Y=SAND: 10 min intervals for 1 hour. **IF NOT SAND:** 12 intervals at 30 min each, refilling each time

IN SAN DIEGO, Presoak for at least 2 hours if sandy soils. Rates of fall are measured for six hours, refilling each half hour (or 10 minutes for sand). Tests are generally repeated until consistent results are obtained.

Raw Data						Calculations		
Reading #	Start Time	Stop Time	Δ t Time Interval (10 or 30)	Do Initial Depth to Water Level	Df Final Depth to Water Level	Δ D Change in Water Level	Percolation Rate	Corrected Infiltration Rate
	hr:mm	hr:mm	min	inches (0.25" precision)			min/ in	in/hr
1	13:40	14:00	20	4.5	5.0	0.5	40.0	0.12
2	14:00	14:20	20	5.0	5.5	0.5	40.0	0.12
3	14:20	14:30	20	5.5	5.8	0.3	80.0	**0.06**
4								
5								
6								
7								
8								
9								
10								
11								
12								

Sources:

Appendix D, Approved Infiltration Rate Assessment Methods for Selection of Storm Water BMPs (San Diego)

Appendix A, Infiltration Testing (Riverside County)

Appendix D, Infiltration Rate Protocol, 2011 (Orange County)

Pecolation Test Data Sheet	
Project:	EHS Chula Vista
Project No.:	17-199602.7
Date:	3/14/2019
Test Hole:	P2
Tested by:	MM
Depth of Hole, ft, D:	3
Boring Radius, in:	6
UCSD:	SP

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

Pre-Soak Procedure (See notes)						Calculations	
Reading #	Start Time	Stop Time	Δ t Time Interval	Do Initial Depth to Water Level	Df Final Depth to Water Level	Δ D Change in Water Level	Greater than 6"
	hr:mm	hr:mm	min	in	in	in	(y/n)
1	10:40	11:10	30	12	24	12.0	
2	11:10	11:40	30	24	36	12.0	

IN RIVERSIDE, 2Y=SAND: 10 min intervals for 1 hour. **IF NOT SAND:** 12 intervals at 30 min each, refilling each time

IN SAN DIEGO, Presoak for at least 2 hours if sandy soils. Rates of fall are measured for six hours, refilling each half hour (or 10 minutes for sand). Tests are generally repeated until consistent results are obtained.

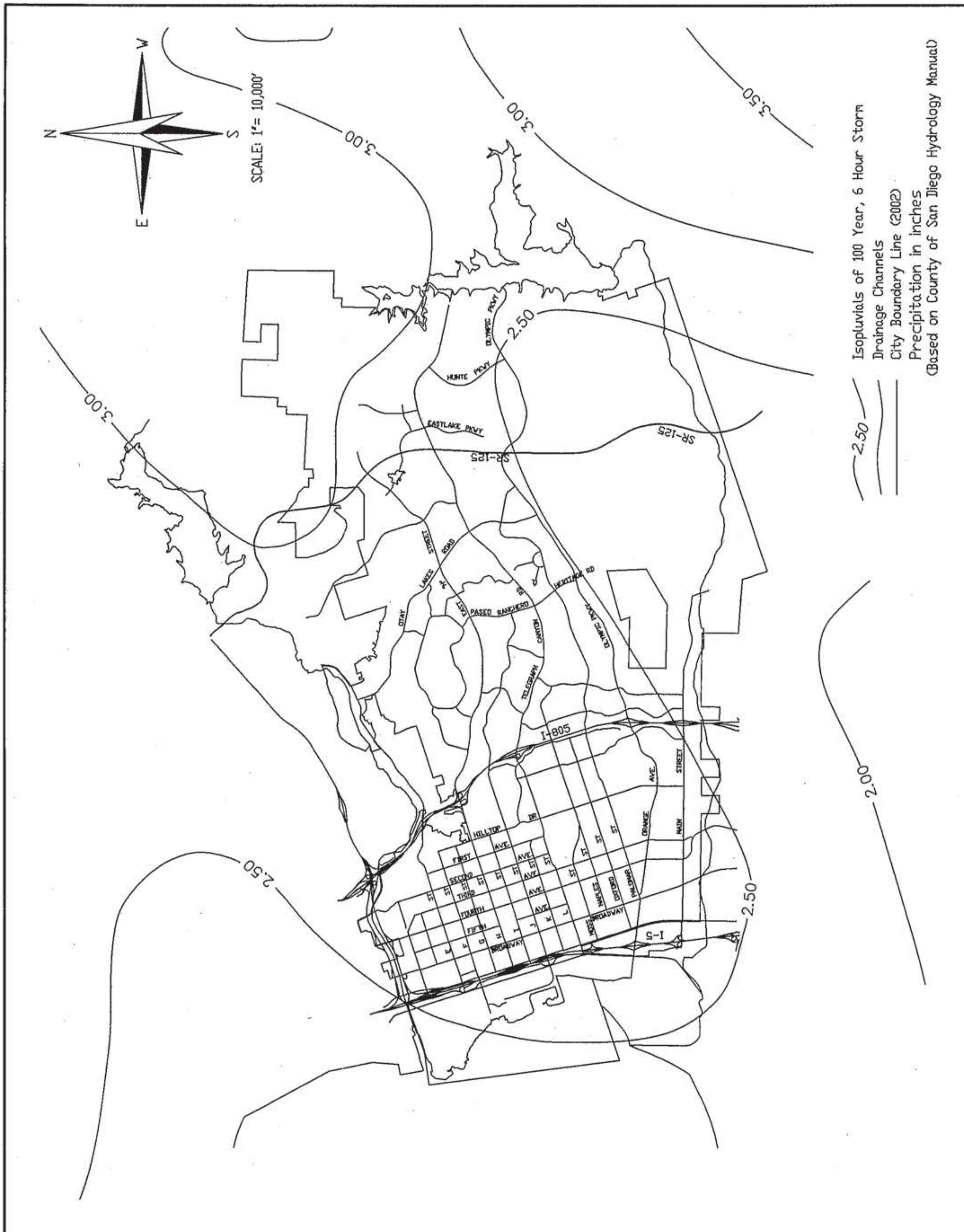
Raw Data						Calculations		
Reading #	Start Time	Stop Time	Δ t Time Interval (10 or 30)	Do Initial Depth to Water Level	Df Final Depth to Water Level	Δ D Change in Water Level	Percolation Rate	Corrected Infiltration Rate
	hr:mm	hr:mm	min	inches (0.25" precision)			min/ in	in/hr
1	13:40	14:00	20	0.0	5.3	5.3	3.8	1.30
2	14:00	14:20	20	5.3	8.0	2.8	7.3	0.76
3	14:20	14:30	10	0.0	2.3	2.3	4.4	1.07
4	14:13	14:23	20	2.3	5.0	2.8	7.3	0.70
5	14:23	14:33	10	5.0	6.3	1.3	8.0	**0.67**
6								
7								
8								
9								
10								
11								
12								

Sources:

Appendix D, Approved Infiltration Rate Assessment Methods for Selection of Storm Water BMPs (San Diego)

Appendix A, Infiltration Testing (Riverside County)

Appendix D, Infiltration Rate Protocol, 2011 (Orange County)



REVISION	BY	APPROVED	DATE
ORIGINAL			01/02
REVISION	CVM	C. SWANSON	11/02
REVISION	DPH	W. VALLE	11/17

CITY OF CHULA VISTA
ENGINEERING & CAPITAL PROJECTS
STANDARD DRAWING

100-YEAR, 6-HOUR PRECIPITATION

WILLIAM S. VALLE 11/21/2017
CITY ENGINEER

DRN-04

ATTACHMENT 6

Project's Geotechnical and Groundwater Investigation Report

Attach project's geotechnical and groundwater investigation report. Refer to Appendix C.4 to determine the reporting requirements.

United States
Department of
Agriculture

NRCS

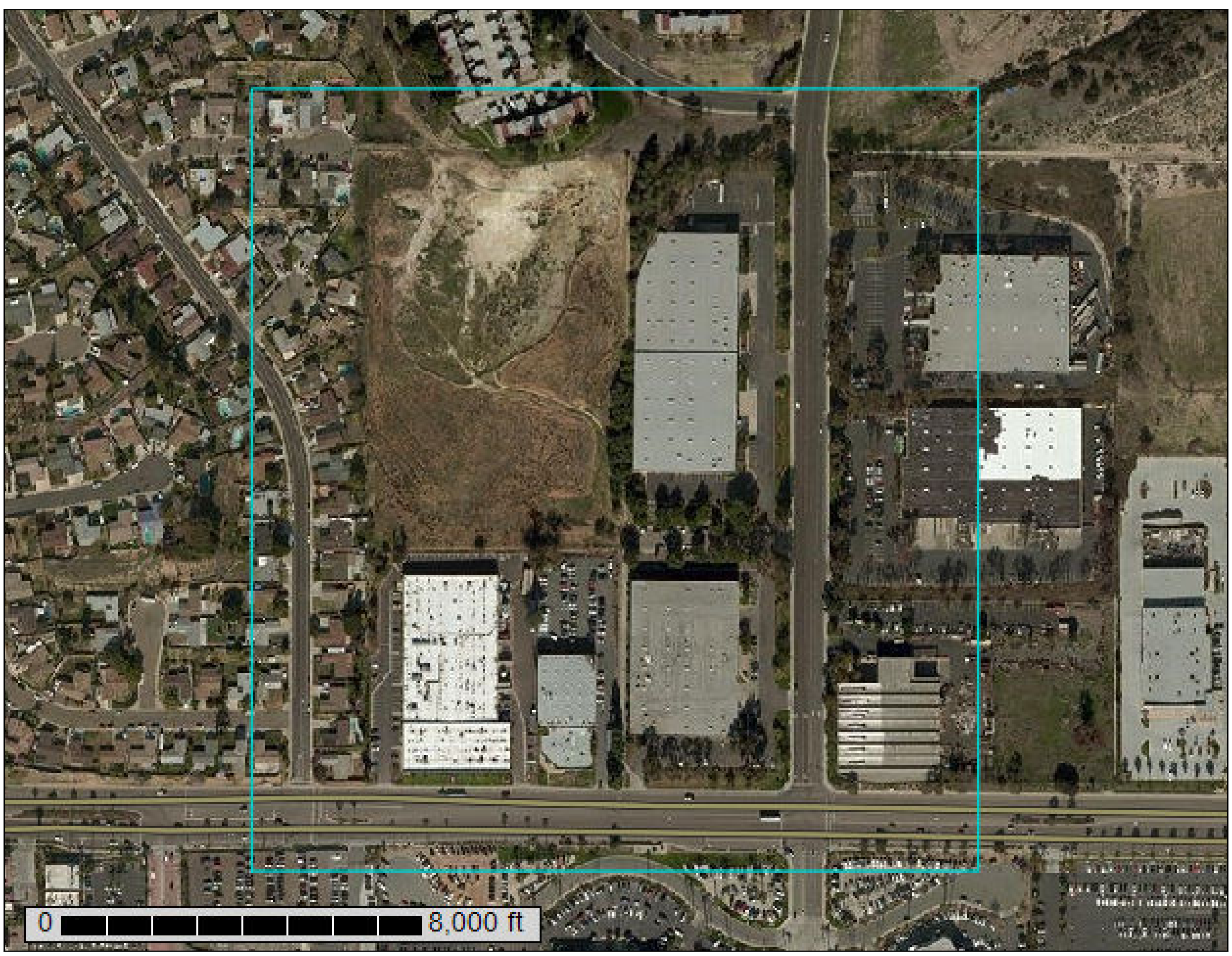
Natural
Resources
Conservation
Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

San Diego County Area, California

chula vista



February 14, 2019

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

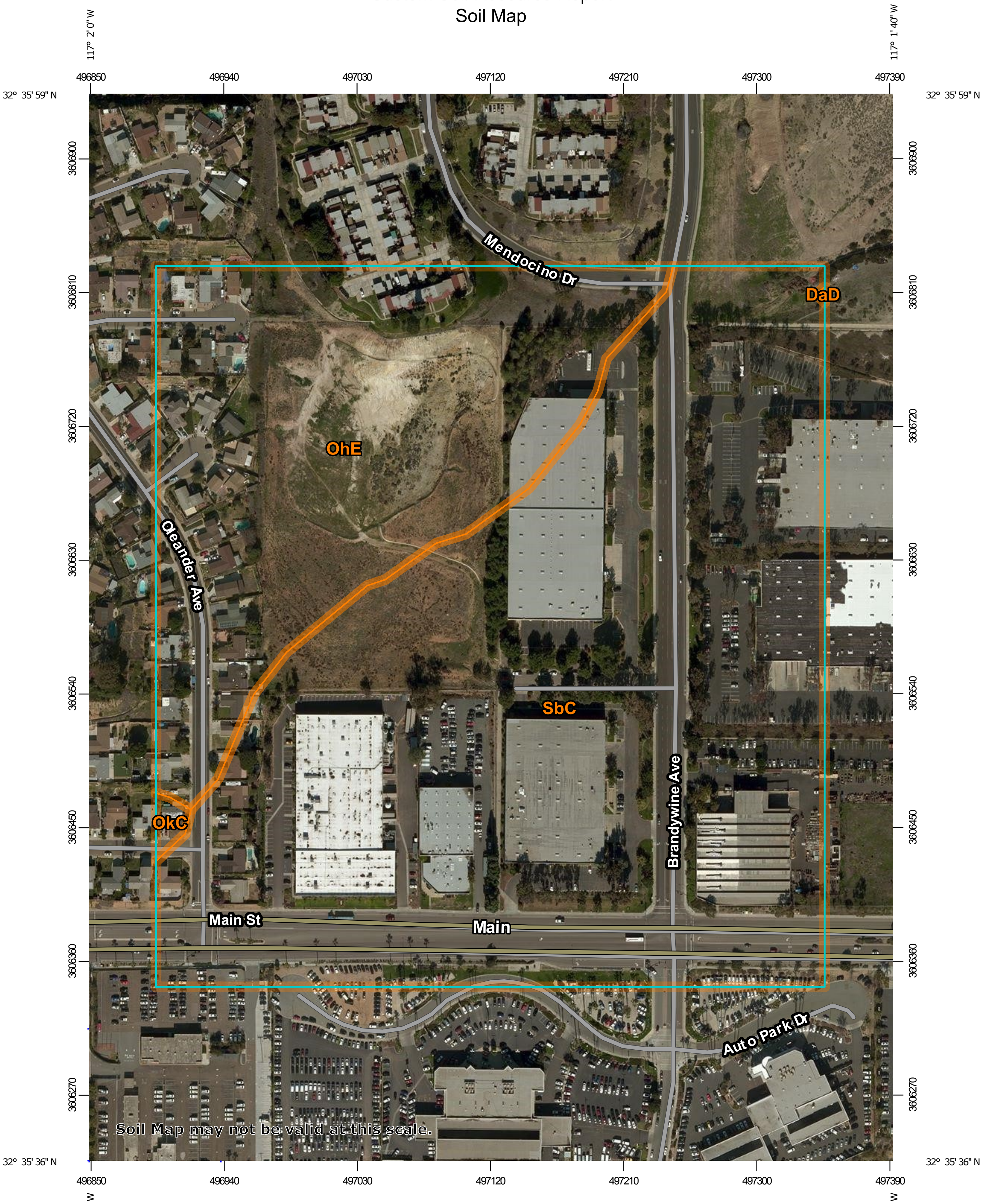
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map



Map Scale: 1:3,500 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 Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

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: San Diego County Area, California
Survey Area Data: Version 13, Sep 12, 2018

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

Date(s) aerial images were photographed: Dec 7, 2014—Jan 4, 2015

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
DaD	Diablo clay, 9 to 15 percent slopes, warm MAAT, MLRA 20	0.0	0.0%
OhE	Olivenhain cobbly loam, 9 to 30 percent slopes	17.2	31.7%
OkC	Olivenhain-Urban land complex, 2 to 9 percent slopes	0.2	0.3%
SbC	Salinas clay loam, 2 to 9 percent slopes	37.0	68.0%
Totals for Area of Interest		**54.4**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

San Diego County Area, California

DaD—Diablo clay, 9 to 15 percent slopes, warm MAAT, MLRA 20

Map Unit Setting

National map unit symbol: 2w63f
Elevation: 0 to 2,340 feet
Mean annual precipitation: 10 to 27 inches
Mean annual air temperature: 58 to 65 degrees F
Frost-free period: 290 to 365 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Diablo and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Diablo

Setting

Landform: Mountain slopes, hillslopes
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Parent material: Residuum weathered from calcareous shale

Typical profile

A - 0 to 15 inches: clay
Bkss1 - 15 to 28 inches: clay
Bkss2 - 28 to 40 inches: clay loam
Cr - 40 to 79 inches: bedrock

Properties and qualities

Slope: 9 to 15 percent
Depth to restrictive feature: 39 to 79 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Available water storage in profile: Moderate (about 6.8 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: CLAYEY (1975) (R019XD001CA)
Hydric soil rating: No

Minor Components

Altamont

Percent of map unit: 10 percent
Landform: Hillslopes
Down-slope shape: Convex

Across-slope shape: Convex
Hydric soil rating: No

Linne

Percent of map unit: 3 percent
Landform: Hillslopes
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Oliventain

Percent of map unit: 2 percent
Landform: Terraces
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: No

OhE—Olivenhain cobbly loam, 9 to 30 percent slopes

Map Unit Setting

National map unit symbol: hbfc
Elevation: 100 to 600 feet
Mean annual precipitation: 14 inches
Mean annual air temperature: 63 degrees F
Frost-free period: 290 to 330 days
Farmland classification: Not prime farmland

Map Unit Composition

Olivenhain and similar soils: 85 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Olivenhain

Setting

Landform: Marine terraces
Landform position (three-dimensional): Riser
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Gravelly alluvium derived from mixed sources

Typical profile

H1 - 0 to 10 inches: cobbly loam
H2 - 10 to 27 inches: very cobbly clay, very cobbly clay loam
H2 - 10 to 27 inches: cobbly loam, cobbly clay loam
H3 - 27 to 45 inches:
H3 - 27 to 45 inches:

Properties and qualities

Slope: 9 to 30 percent
Depth to restrictive feature: About 10 inches to abrupt textural change

Natural drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.3 inches)

Interpretive groups
Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: CLAYPAN (1975) (R019XD061CA)
Hydric soil rating: No

Minor Components

Diablo
Percent of map unit: 4 percent
Hydric soil rating: No

Linne
Percent of map unit: 2 percent
Hydric soil rating: No

Unnamed, ponded
Percent of map unit: 2 percent
Landform: Depressions
Hydric soil rating: Yes

Huerhuero
Percent of map unit: 2 percent
Hydric soil rating: No

OkC—Olivenhain-Urban land complex, 2 to 9 percent slopes

Map Unit Setting
National map unit symbol: hbff
Elevation: 100 to 600 feet
Mean annual precipitation: 14 inches
Mean annual air temperature: 63 degrees F
Frost-free period: 290 to 330 days
Farmland classification: Not prime farmland

Map Unit Composition
Olivenhain and similar soils: 50 percent
Urban land: 30 percent
Minor components: 6 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Olivenhain

Setting

Landform: Marine terraces
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Gravelly alluvium derived from mixed sources

Typical profile

H1 - 0 to 10 inches: cobbly loam
H2 - 10 to 42 inches: very cobbly clay, very cobbly clay loam
H2 - 10 to 42 inches: cobbly loam, cobbly clay loam
H3 - 42 to 60 inches:
H3 - 42 to 60 inches:

Properties and qualities

Slope: 2 to 9 percent
Depth to restrictive feature: About 10 inches to abrupt textural change
Natural drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Hydric soil rating: No

Description of Urban Land

Typical profile

H1 - 0 to 6 inches: variable

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Minor Components

Huerhuero

Percent of map unit: 2 percent
Hydric soil rating: No

Diablo

Percent of map unit: 2 percent
Hydric soil rating: No

Linne

Percent of map unit: 2 percent
Hydric soil rating: No

SbC—Salinas clay loam, 2 to 9 percent slopes

Map Unit Setting

National map unit symbol: hbgg
Elevation: 2,000 feet
Mean annual precipitation: 12 to 20 inches
Mean annual air temperature: 61 to 64 degrees F
Frost-free period: 300 to 340 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Salinas and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Salinas

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, rise
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Alluvium derived from mixed sources

Typical profile

H1 - 0 to 22 inches: clay loam
H2 - 22 to 46 inches: clay loam, clay
H2 - 22 to 46 inches: loam, clay loam
H3 - 46 to 64 inches:
H3 - 46 to 64 inches:

Properties and qualities

Slope: 2 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very high (about 16.5 inches)

Interpretive groups

Land capability classification (irrigated): 2e

Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Diablo

Percent of map unit: 5 percent
Hydric soil rating: No

Huerhuero

Percent of map unit: 5 percent
Hydric soil rating: No

Tujunga

Percent of map unit: 5 percent
Hydric soil rating: No

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PARTNER

GEOTECHNICAL DESIGN SUBMITTAL REPORT

Encompass Health Hospital Site
517 Shinohara Lane
Chula Vista, California 91911

March 25, 2019
Partner Project Number: 17-199602.7

Prepared for:

Encompass Health
9001 Liberty Parkway
Birmingham, Alabama 35242

Engineers who understand your business

March 25, 2019

Kellye Rohrabaugh
Encompass Health
9001 Liberty Parkway
Birmingham, Alabama 35242

Subject: **Geotechnical Design Submittal Report**
Encompass Health Hospital Site
512 Shinohara Lane
Chula Vista, California 91911
Partner Project No. 17-199602.7

Dear Kellye Rohrabaugh:

Partner Assessment Corporation (Partner) presents the following geotechnical report based on our general experience with construction practices and geotechnical conditions on this and other sites. This report is in accordance with the proposal (#199602) dated 7/6/2018, approved by Kellye Rohrabaugh of Encompass Health and also was later revised based on proposal (#199602) dated 12/17/2018, approved by John Tschudin of Encompass Health.

A separate Geologic Hazard Report will be issued to comply with State OSHPD requirements.

The descriptions and findings of our geotechnical report are presented for your use in this electronic format, for your use as shown in the hyperlinked outline below. To return to this page after clicking a hyperlink, hold "alt" and press the "left arrow key" on your keyboard.

We appreciate the opportunity to be of service during this phase of the work.

Sincerely,

DRAFT
Matthew Marcus, PE
Principal Engineer

DRAFT
Francisca Chan, EIT
Project Engineer.

1. GEOTECHNICAL/GEOLOGIC EXECUTIVE SUMMARY

Geologic Zones and Site Hazards:

According to the report*: Regionally the site is located in Peninsular Ranges Geomorphic Province. The Peninsular Ranges Province is traversed by a group of Sub-Parallel faults and fault zones trending roughly northwest. Several of these faults are major active faults (Rose Canyon, Elsinore, San Jacinto and Newport – Inglewood). Undivided sediments/sedimentary rocks and San Diego Formation occurs within the regional area of the site. The subject property is currently vacant and undeveloped since 1904, there was substantial grading, drainage improvements and hydro-seed applications on the northern slopes in 2007. Surficial geology consists of topsoil and artificial fill, overlying residual weathered bedrock (San Diego Formation). Based on our evaluation the slopes on the site are stable with regards to landsliding and slope stability, but modifications, including retaining walls and new permanent and temporary slopes will require special planning. Given the seismic activity in the region we anticipate low to moderate ground shaking during the project life. No other geologic hazards are known or suspected on the project.

Excavation Conditions:

According to the report*: We anticipate extensive grading will be needed on the site to establish the finished grades for the new buildings and parking areas. We anticipate cut slopes on the order of 20 feet or more on the north end of the property. The stability of the slopes during and after construction have been evaluated and will require special consideration during construction. In general, the exploration encountered material that would be excavatable using conventional construction equipment in good working condition; however hard digging conditions may be encountered on the northern portion of the site. Groundwater was not encountered during drilling; however, groundwater levels can fluctuate over time.

Foundation/Slab Support:

According to the report*: The upper 1 to 6 feet of soil encountered in our explorations consisted of artificial fill material, debris and plant material. Some debris and deleterious inclusions (paper bags, household garbage, etc.) were noted in the fill. Where present in new building or fill embankment areas, the fill and other deleterious/organic materials should be completely removed to exposed clean, competent native soil. Spread foundations should be considered for the new hospital building. The foundations can be supported on engineered fill and/or competent, clean native soil compacted in-place, as described in the report. Slab-on-grade areas should be supported on non-expansive engineered fill extending to competent native soils that are approved by the engineer.

Mass Grading and Soil Reuse:

According to the report*: Site soils are generally expected to be usable as engineered fill on the site, after stripping/grubbing of organic material and disposal of trash, topsoil and debris. The native soil encountered had a relatively low in-place density. As such, we anticipate that volume loss of cut materials will occur after moisture conditioning and compaction, on the order of 15 to 25%. New fills of up to 20 feet in height to be placed on existing slopes should be benched and keyed per CBC requirements. It is recommended to use non-expansive structural fill that is free of deleterious materials, and is properly moisture conditioned and compacted to 95% of the modified proctor (ASTM D 1557) is recommended.

Pavement Design: According to the report*:

Roadway Type	*Subgrade Preparation*	*Pavement Section*
Parking Area Light Duty (TI=4)	Compacted Subgrade	3-in asphalt & 6-in aggregate base
Parking Area Heavy Duty (TI=7)	Compacted Subgrade	6-in concrete & 4-in aggregate base

This summary in no way replaces or overrides the detailed sections of the report*

2. REPORT OVERVIEW & LIMITATIONS

2.1 Report Overview

To develop this report, Partner accessed existing information and obtained site specific data from our exploration program. Partner also used standard industry practices and our experience on previous projects to perform engineering analysis and provide recommendations for construction along with construction considerations to guide the methods of site development. The opinions on the cover letter of this report do not constitute engineering recommendations, and are only general, based on our recent anecdotal experiences and not statistical analysis. Section 1.0, Executive Geotechnical Summary, compiles data from each of the report sections, while each of sections in the report presents a detailed description of our work. The detailed descriptions in Sections 4,5,6,7 and 8 and Appendix A to address Slope stability findings and Appendix D constitute our engineering recommendations for the project, and they supersede the Executive Geotechnical Summary.

The report overview, including a description of the planned construction and a list of references, as well as an explanation of the report limitations is provided in Section 2.0. The findings of Partner's geologic review are included in Sections 4.0 and 5.0, Geologic Conditions and Hazards. The descriptions of our methods of exploration and testing, as well as our findings are included in Section 7.0. In addition, logs of our trench excavations are included in Appendix A, Boring Logs are included in Appendix B, and geotechnical laboratory testing is included in Appendix C of the report. Site Location and Site Investigation Plan are included as Figures 2 in the report.

2.2 Assumed Construction

Partner's understanding of the planned construction was based on information provided by the project team. The proposed site plan is included as Figure 2 to this report. Partner's assumptions regarding the new construction are presented in the below table.

Property Data	
Property Use:	Encompass Health Hospital Site
Building footprint/height	One story above grade, roughly 130,000 sf
Land Acreage (Ac):	Approx. 9.6 Ac, APN 644-040-01-00
Number of Buildings:	1
Expected Cuts and Fills	Unknown
Type of Construction:	Unknown, assumed slab-on-grade with metal framing
Foundations Type	Unknown, assumed shallow foundations
Anticipated Loads	2,000 to 3,000 psf
Traffic Loading	Parking lot and loading dock
Site Information Sources:	APD Consultants, Conceptual Project Plans, 3/7/2019.

2.3 References

The following references were used to generate this report:

California Building Code IBC 2009 and ASCE 7-10

California Geological Survey, Note 36*, California Geomorphic Provinces*, 2002.

California Geological Survey Topographic Map 2015, 7.5 Minute series, *Imperial Beach, CA*, accessed via internet, accessed 1/24/18

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Geologic Map of the San Diego Quadrangle, Regional Geologic Map No. 3, 1: Kennedy and Tan, 2008.

Geotechnical Engineering Portable Handbook, Robert W. Day, 2000

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Naval Facilities Engineering Command, NAVFAC DM 7.1-.3, Design Manual, Soil Mechanics and Foundations, May 1982, April 1983.

Partner Engineering and Science, Inc., Phase 1 Environmental Assessment Report, *Industrial Land, 517 Shinohara Lane, Chula Vista*, *California,* dated February 1, 2018.

Partner Engineering and Science, Inc., Preliminary Geotechnical Report, *Industrial Land, 517 Shinohara Lane, Chula Vista*, *California,* dated January 16, 2018.

Willian A. Steen & Associates, Otay Valley Industrial Park (Phase 1), As Built, 517 Shinohara Lane, San Diego, CA, dated 10-31-07.

United States Geological Survey, Lower 48 States 2014 Seismic Hazard Map, accessed online 1/24/18

United States Geologic Survey, Earthquake Hazards Program (Online), accessed 1/24/18

2.4 Limitations

The conclusions, recommendations, and opinions in this report are based upon soil samples and data obtained in widely spaced locations that were accessible at the time of exploration, and collected based on project information available at that time. Our findings are subject to field confirmation that the samples we obtained were representative of site conditions. If conditions on the site are different than what was encountered in our borings, the report recommendations should be reviewed by our office, and new recommendations should be provided based on the new information and possible additional exploration if needed. It should be noted that geotechnical subsurface evaluations are not capable of predicting all subsurface conditions, and that our evaluation was performed to industry standards at the time of the study, no other warranty or guarantee is made.

Likewise, our document review and geologic research study made a good-faith effort to review readily available documents that we could access and were aware of at the time, as listed in this letter. We are not able to guarantee that we have discovered, observed, and reviewed all relevant site documents and conditions. If new documents or studies are available following the completion of the report, the recommendations herein should be reviewed by our office, and new recommendations should be provided based on the new information and possible additional exploration if needed.

This report is intended for the use of the client in its entirety for the proposed project as described in the text. Information from this report is not to be used for other projects or for other sites. All of the report must be reviewed and applied to the project or else the report recommendations may no longer apply. If pertinent changes are made in the project plans or conditions are encountered during construction that appear to be different than indicated by this report, please contact this office for review. Significant variations may necessitate a re-evaluation of the recommendations presented in this report. The findings in this report are valid for one year from the date of the report. This report has been completed under specific Terms and Conditions relating to scope, relying parties, limitations of liability, indemnification, dispute resolution, and other factors relevant to any reliance on this report. Any parties relying on this report do so having accepted Partner's standard Terms and Conditions, a copy of which can be found at http: / www.partneresi.com/terms-and-conditions.php

If parties other than Partner are engaged to provide construction geotechnical services, they must be notified that they will be required to assume complete responsibility for the geotechnical phase of the project by concurring with the findings and recommendations in this report or providing alternate recommendations.

3. SITE LOCATION AND PROJECT INFORMATION

3.1 Site Location and Project Information

The planned construction will be situated on a currently undeveloped parcel in Chula Vista, California. The immediately surrounding properties consist of light industrial buildings and residential buildings. Figure 2 presents the project site and the locations of our site exploration. Based on our review of available documents, the site has had the following previous uses:

Historical Use Information		
Period/Date	**Source**	**Description/Use**
1904-1995	Aerial Photographs, Topographic Maps, City Directories, Onsite Observations	Undeveloped Land
1995-Present	Aerial Photographs, Topographic Maps, City Directories, Onsite Observations	Some site improvements: grading, drainage, hydroseeding

4. GEOLOGIC FINDINGS

This section presents the results of a geologic review performed by Partner, for a proposed new construction on site. The general location of the project is shown on Figure 1.

4.1 Regional Geology

Regionally the site is located in Peninsular Ranges Geomorphic Province. The Peninsular Ranges Province is traversed by a group of Sub-Parallel faults and fault zones trending roughly northwest. Several of these faults are major active faults (Rose Canyon, Elsinore, San Jacinto and Newport – Inglewood). Undivided sediments/sedimentary rocks and San Diego Formation occurs within the regional area of the site. The province varies in width from approximately 30 to 100 miles. The western portion of the province, which includes the project area, consists generally of dissected coastal plain underlain by upper Cretaceous, Tertiary rocks and Quaternary sediments, very old Pleistocene marine and non-marine terrace deposits and bedrock of early Pleistocene and late Pliocene of San Diego Formation.

The Regional Geologic Maps are included in Figures 3 and 4.

Summary of Geologic Data		
Parameter	**Value**	**Source**
Geomorphic Zone	Peninsular Ranges	CGS, Geology of California
Site Ground Elevation Range	140 to 255 feet above MSL	USGS and Site Topographic Survey
Flood Elevation	Zone X (Minimal Flood Hazard)	FEMA
Seismic Hazard Zone	Low to Moderate	USGS and CGS
Geologic Hazards	Low Density Sandy Silty Soils	CGS/ Lab Results
Surface Cover	Artificial Fill/San Diego Formation	Geotechnical/Geologic Investigation
Site Modifications	Previously graded; seed soil type	Google Earth
Surficial Geology	Artificial Fill (AF)/San Diego Formation (Tsdss)	USGS, California Geologic Survey, Geologic Map of San Diego Quadrangle, Site Geologic Mapping
Depth to Residual Soils/ Weathered San Diego Formation	1.5 to 6.0 feet (Approximately)	Boring Logs/ Trenches/ Site Geologic Mapping
Approximate Groundwater Depth	45 to 85 feet	Partner ESA

4.2 Site Engineering Geology and Subsurface Conditions

The site geology and subsurface conditions have been summarized in this section from available geologic data, geologic mapping (Figure 5) and previous subsurface investigations consisting of exploratory six soil borings (B-1 ,B-2, B-3, B-4 ,B-5 and B-6) and four exploratory trenches (TP-1,TP-2,TP-3 and TP-4) are shown at location in Figure 2. Trench logs are provided in Appendix A. The soil boring logs are provided in Appendix B. The subject property is located approximately at elevation 145 feet to 250 feet above MSL, in an area of sloping topographic relief sloping generally to the south and south east.

Generalized geologic cross sections A-A' and B-B' are included in Figure 6 and 7 respectively. Top soil was observed on the scattered areas of the site in varying thickness from 0.5 feet to 2.5 feet. The site is mapped to be underlain by artificial fill (AF) varying in thickness from approximately 1.0 feet to 6.0 feet. The fill generally consists of orangish brown fine to coarse sand, some silt and clay, fine to coarse gravel and cobbles.

Artificial Fill (AF) is underlain by bedrock of early Pleistocene and late Pliocene San Diego Formation (Tsdss). San Diego Formation (silty sandstone) consists of yellowish brown to whitish gray, micaceous, silty fine Sand (unified soil classification symbol "SM"), slightly micaceous, medium dense to dense, moderately weathered. Exploratory trenches indicated the San Diego formation is poorly bedded. The San Diego Formation exhibits low angle bedding dips approximately 4 to 5 degrees towards south-west and strikes approximately N 20 to 25 degrees north – west. The strikes and dips generally co-relates with the regional dip.

4.3 Groundwater and Caving

No active surface ground water seeps or springs were observed at the project site. Subsurface water was not encountered during our field exploration to maximum excavated/drilled depth of 16.5 feet below existing grade. Trench walls were stable during and after excavation.

However, based on data on an adjacent site, groundwater is approximated around 40-85 feet below ground surface. Seasonal and long-term fluctuations in the groundwater may occur as a result in variations in subsurface conditions, rainfall, run-off conditions and other factors. Therefore, variations from our observations may occur.

4.4 Slope Stability Analysis

Regional Geologic and Site Engineering Geologic Maps (Figures 4 and 5) and Seismic Hazards Map (Figure 8) indicated the site is not located in the landslide area. Site Geologic mapping indicated the native soil slopes are stable. In addition, Partner performed global slope stability analysis of four site cross-sections which had planned retaining walls of 6 feet or higher at the base of soil slopes. The slopes were evaluated for global stability (circular failure) using Bishop and Janbu methods, and soil parameters determined from direct shear testing of relatively "undisturbed" site soils obtained during drilling in a California modified split-spoon sampler. The parameters used were a cohesion of 100 psf and friction angle of 30 degrees. The slope stability cross sections are shown in Appendix D, and the output of the Slide 2d Software models are shown in Appendix E.

Factors of safety in three of the sections were 1.5 or greater with normally sized and embedded foundations. Cross-section H-H', located on the north side of the project includes a roughly 40-ft high cut slope with a 13-ft high retaining wall at its base. This section did not have a 1.5 factor of safety with normally sized and embedded foundation. As such, we recommend that the retaining wall in this location have a cantilevered foundation embedded 4 feet below grade, and that extends 7.5 feet from the centerline of the wall, where wall heights are higher than 6 feet.

In addition, seismic stability analysis was performed on the slopes, based on a maximum horizontal acceleration of 0.375 g for soft rock (site class C) conditions. Based on the information in California SP 117, the K_{eq} factor was 0.5 x .375 for an M 7 earthquake event. As such, a K_{eq} factor of 0.19 was used for the site. The minimum factor of safety determined by this method was 1.06, which is acceptable per California SP

117. All slopes will be subjected to surficial erosion. Therefore, slopes should be protected from surface runoff by means of top of the slopes compacted earth berms.

It is recommended that the slopes should be properly maintained in future by some of these methods: cleaning and removing loose debris, minor grading, controlling surface water, revegetation and by constructing benches. Over- watering and subsequent saturation of slope surface should be avoided.

4.5 Faulting and Seismicity

The subject site is in San Diego County of Southern California. Like the rest of Southern California, it is in a seismically active region. This region is located near the active margin between the North American and Pacific tectonic plates. The seismicity is due to movement along the regional active faults such as the San Andreas, Ventura, Red Mountain, San Cayetano, San Gabriel and San Fernando.

According to the State Mining and Geology Board, an active fault is defined which has had surface displacement within the Holocene Epoch (roughly within the last 11,000 years). The State Mining and Geology Board define a potentially active fault as a fault which has been active during the Quaternary Period (roughly within the last 1.6 Million years). Historic and Holocene age faults are considered active, Late Quaternary and Quaternary age faults are considered potentially active, and pre-Quaternary age faults are considered inactive.

The above definitions are used in delineating Earthquake Fault Zones as mandated by the Alquist-Priolo Geologic Hazard Zones Act of 1972 and as subsequently revised in 1994 (Hart, 1997) as the Alquist-Priolo Geologic Hazard Zoning Act and Earthquake Fault Zones. The Act regulates development and construction of buildings intended for human occupancy to mitigate the hazards of surface fault rupture. It defines areas where ground rupture is likely to occur during future earthquakes. Where such zones are designated, a geologic study must be conducted to determine the locations of all active fault lines in the zone before any construction is allowed and to determine whether building setbacks should be established, and no building may be constructed on the fault lines.

Our review of geologic literature pertaining to the site area indicates that there are active faults within the regional area (Rose Canyon Fault, Elsinore Fault, San Jacinto Fault and Newport-Inglewood Fault. The nearest active zone is Rose Canyon Fault Zone located in 6.7 miles west of the project site.

Rose Canyon Fault Zone Parameters	
Length:	55 to 70 (km)
Fault Type:	Right Lateral/Strike Slip
Slip rate:	1.5 mm/ year
Dip:	90 degrees

Based on the 2010 California Fault Activity Map (Jennings and Bryant 2010, Figure 9), active faults are not mapped on the site. La Nacion Fault Zone Quaternary is located approximately 0.3 miles east from the project site. Geologic mapping by Partner indicated structural continuity across the site, further suggesting the absence of faults in the area explored.

No evidence of active or potentially active faulting was observed or encountered in any of our excavations/trenches on the site. It should be noted that the Southern California region is an area of moderate to high seismic risk and it is not considered feasible to render structures fully resistant to seismic related hazard. The minimum seismic design should comply with the 2013 California Building Code (CBC) and ASCE 7-10 using the seismic parameters recommended in Section 6.0 of this report.

5. SECONDARY SEISMIC HAZARDS

This section presents the results of a geologic review performed by Partner, for a proposed new construction on site. The general location of the project is shown on Figure 1.

5.1 Surface/Subsurface Fault Rupture

Surface fault rupture resulting from the movement of nearby major faults is unknown with certainty but is considered low. However, due to the known active and potentially active faults in the region, low to moderate ground shaking should be expected during the life of the proposed structures.

5.2 Liquefaction

Liquefaction is defined as a seismic phenomenon in which loose or soft, saturated, fine-grained soil mass suffers a substantial reduction in its shear strength when subjected to high-intensity ground shaking and exhibits a liquid-like behavior.

During earthquakes, excess pore water pressures may develop in saturated soil deposits as a result of induced cyclic shear stresses. Effects of liquefaction can include sand boils, settlement and bearing capacity failures. Liquefaction occurs when these ground conditions exist: 1) Shallow groundwater; 2) Low density, fine, clean sandy soils; and 3) High-intensity ground motion. Shallow ground water and saturated, clean, sandy soils are not present at the project site.

Published data from California Geological Survey - Seismic Hazards Zone Map, indicates that the project site is not located in an area identified as having a potential for soil liquefaction. The potential for site liquefaction is negligible (see Figure 8).

5.3 Seismically Induced Landslide

According to the published data from California Geological Survey "State of California Seismic Hazard Zones Official Map, the site is not within a landslide zone (see Figure 8).

6. SEISMIC / DESIGN PARAMETERS

When reviewing the 2010 California Building Code, IBC 2009 and ASCE 7-10 the following seismic data should be incorporated into the design.

6.1 Seismic Design Parameters

Latitude: 32.597463 N (Degrees)

Longitude: -117.031415 W (Degrees)

MCE: 2% Probability of Exceedance in 50 Years

Seismic Item	***Value***	***Seismic Item***	***Value***
Site Classification	D	Seismic Design Category	D
Fa (site coefficient)	1.043	Fv (site coefficient)	1.461
Ss (spectral response at 0.2 seconds)	0.892g	S_1 (spectral response at 1.0 second)	0.339g
S_{MS} (maximum considered earthquake spectral acceleration)	0.931g	S_{M1} (maximum considered earthquake acceleration)	0.496 g
S_{DS} (design spectral acceleration)	0.621g	S_{D1} (design spectral acceleration)	0.330g
PGA Max (ASCE '10)	0.375g	67% PGA (ASCE '10)	0.251g

Source: 2010 and 2016 CBC (IBC 2016/ ASCE 7-10) and USGS Seismic Hazards Design Maps.

The Structural Consultant should review the above parameters and the 2010 California Building Code (IBC 2009/ASCE 7-10) to evaluate the seismic design.

7. GEOTECHNICAL EXPLORATION & LABORATORY RESULTS

Our evaluation of soils on the site included field exploration and laboratory testing. The field exploration and laboratory testing programs are briefly described below. Data reports from the field exploration and laboratory testing are provided in Appendix B and Appendix C, respectively.

7.1 Soil Borings

The first soil boring program was conducted on January 25, 2018. Six (6) borings were advanced by the use of a track-mounted drill using solid flight auger drilling techniques. The borings were made to depths of 5 to 15 feet below ground surface. Boring B-5 encountered hard drilling material and then was terminated due to damage to the drill rig.

The second soil boring program was conducted on February 12, 2019. The approximate locations of the exploratory borings are shown on Figure 2. Six (6) borings were advanced by the use of a track-mounted drill using solid flight auger drilling techniques. The borings were made to depths of 16.5 feet below ground surface.

Continuous soil cores were performed on the site to depths of 50 feet for geologic mapping on March 15, 2019. The data from those borings is included in the Geologic Hazard Report.

Logs of subsurface conditions encountered in the borings were prepared in the field by a representative of Partner Engineering. Soil samples consisting of relatively undisturbed brass ring samples and Standard Penetration Tests (SPT) samples were collected at approximately 2.5 and 5-foot depth intervals and were returned to the laboratory for testing. The SPTs were performed in accordance with ASTM D 1586. Typed boring logs were prepared from the field logs and are presented in Appendix A. A summary table description is provided below:

Surficial Geology		
Strata	**Depth to Bottom of Layer (bgs*)**	**Description**
Surface Cover	0-1 feet	Grass/ Dirt
Fill Material	Up to 6 feet	Silty Sand with gravel and cobbles
San Diego Formation	16+ feet	Silty Sandstone, fine silty sand
Groundwater	NA	Not observed
Bedrock (Hard)	NA	Not observed

7.2 Trenches

The trenches were excavated during July 26 to July 27, 2018. Four (4) trenches were excavated using Backhoe Komatsu, PC 390 LC. The trenches were excavated to depths of 14 feet in the slopes of the parcel. The approximate locations of the trenches are shown on Figure 2.

Logs of subsurface conditions encountered in the trenches were prepared by our Certified Engineering Geologist. Soil Bag samples were taken at TP-1 at approximately 5.5 and 11.0-foot depth interval and were returned to the laboratory for testing. Test pits were backfilled on completion. Typed trench logs were prepared from the field logs and are presented in Appendix A.

7.3 Geotechnical Laboratory Evaluation

Soil samples were submitted to a certified testing laboratory, Hamilton & Associates. Results are attached in Appendix C. Tests performed included in-place moisture and density, sieve analysis, Atterberg and direct shear tests. We have reviewed the results from Hamilton & Associates and are in agreement with the results. The results of laboratory analyses are presented in the boring logs and in Appendix C.

8. GEOTECHNICAL RECOMMENDATIONS

The following discussion of findings for the site is based on the assumed construction, geologic review, results of the field exploration, and laboratory testing programs. The recommendations of this report are contingent upon adherence to Appendix D of this report, General Geotechnical Design and Construction Considerations. For additional details on the below recommendations, please see Appendix D.

8.1 Geotechnical Recommendations

- The proposed construction is generally feasible from a geotechnical perspective provided the recommendations and assumptions of this report are followed.

Geologic/General Site Considerations

- Regionally the site is located in Peninsular Ranges Geomorphic Province. The Peninsular Ranges Province is traversed by a group of Sub-Parallel faults and fault zones trending roughly northwest. Several of these faults are major active faults (Rose Canyon, Elsinore, San Jacinto and Newport – Inglewood). Undivided sediments/sedimentary rocks and San Diego Formation occurs within the regional area of the site. The subject property is currently vacant and undeveloped since 1904, there was substantial grading, drainage improvements and hydro-seed applications on the northern slopes in 2007. The site is in an area where the seismic hazard potential was not evaluated, and the historic groundwater levels were not provided by the California Department of Conservation. Partner conducted geologic and seismic investigations in July – August 2018. Partner's evaluation indicated the hazards of landslide and liquefaction are not present at the project site. No other hazards are known. Due to the proximity to residential homes, additional regulations for construction noise and setbacks should be carefully reviewed during the planning stages.

Excavation Considerations

- We anticipate extensive grading will be needed on the site to establish the finished grades for the new buildings. We anticipate site excavations can be made using conventional construction equipment in good working condition; However, given the quantity of cuts on the site, particularly on the north side of the property, hard excavation may be encountered in some of the deeper cuts. Groundwater was not encountered during drilling; however, groundwater levels can fluctuate over time. Loose fill soils and native sandy soils may be prone to caving during excavation. Excavations should be sloped or shored per OSHA requirements.
- On the north side of the property, cuts of up to 20 feet are anticipated. Laying back of cuts up to 20 feet can be done on a temporary basis per OSHA with the consideration of type C, sandy soils at a 1.5:1 horizontal to vertical slope. Such slopes should be monitored for sloughing or loose material on a daily basis for site safety. Where such slopes exceed 20 feet, a shoring or bracing system should be used. This can consist of a temporary soldier pile and lagging retaining wall. The soldier piles may require pre-drilling and grouting for installation. Spacing and depth calculations for this should be done by a certified contractor, and should comply with California and other local jurisdictional requirements. The design can use soil data from Section 8.2 of this report, and more information is provided in Appendix C under Excavations and Dewatering.

Spread Foundation

- We anticipate that spread foundations are planned for the site structure. We anticipate that spread foundations will be proportioned for bearing capacities ranging from 2,000 to 3,000 pounds per square foot or less. The foundations and slabs should be supported on a layer of in-place native soils that have been evaluated and approved by the engineer and compacted in-place, or bear on controlled fill that has been placed and compacted as a part of mass grading, as described below, in Section 8.2 and Appendix C.

Mass Grading Considerations

- All undocumented fills, debris, grass, roots and other plant materials should be removed from structural areas of the site. In the new fill areas, the cleaned subgrade should be proofrolled and evaluated by the engineer with a loaded water truck (4,000 gallon) or equivalent rubber tired equipment. Soft or unstable areas should be repaired per the direction of the engineer.
- Prior to the placement of new fill, Appendix J of the California building code should be carefully reviewed. Given the native slopes on the site, benching and keying of new fills will be needed as shown in Figure 10. The bulk of the new hospital building will be supported on native material; however, a portion is to bear on deep fills (up to 20 feet) placed over the existing slope. For new fill zones where more than 5 feet of fill will support the new building or parking areas, 95% compaction is required to reduce the potential of differential settlement. It is recommended, that this zone start 5 feet from the edge of building or pavement, and extend at a 1:1 slope to the base of fill. In order to achieve this level of compaction, careful attention to moisture conditioning, lift thickness, and compaction equipment selection will be needed.
- We assume that mass grading will be performed prior to the installation of new retaining walls, and the new fill will be cut back where needed to install retaining wall foundations, and to provide room for retaining wall backfill. However, in some cases, it may make sense to partially grade retaining wall areas, so that cut backs for wall installation do not create steep/unstable slopes (greater than 2:1 horizontal to vertical and/or higher than 20 feet) In the event that walls are in-place during grading operations, grading equipment should be routed to avoid retaining walls. Only lightweight equipment should be used to backfill retaining walls, as described below.

Retaining Wall Considerations

- Most of the site retaining walls are in support of new fills, and as such, can be staged so as to not result in a temporary steep cut-back condition for wall installation. However, the wall on the north of the property, cross-section H-H’, will require a relatively large over-cut in the existing soil. Partner performed a slope stability analysis of this as a 1.5:1 horizontal to vertical cut, as shown in Appendix D, and demonstrated a factor of safety of 1.05 for global stability. This excavation should be stable on a temporary basis; however, if used, the slope should be regularly monitored and cleaned of any large rocks or loose soil that could slip. Alternatively, the excavation could be supported by a temporary shoring system, consisting of soldier piles or the permanent wall could be constructed of a soldier pile system. Appendix D contains our slope stability cross sections and results.
- The soil parameters for the design of site retaining walls is provided in Section 8.2. The wall designer should check the wall for sliding, overturning, and internal stability. Partner performed global

stability for the four site walls sections that were over 6 feet in height. Factors of safety in three of the four sections were 1.5 or greater with normally sized and embedded foundations. Cross-section H-H', located on the north side of the project includes a roughly 40-ft high cut slope with a 13-ft high retaining wall at its base. This section did not have a 1.5 factor of safety with normally sized and embedded foundation. As such, we recommend that the retaining wall in this location have a cantilevered foundation embedded 4 feet below grade, and that extends 7.5 feet from the centerline of the wall, where wall heights are higher than 6 feet. Construction should proceed in general accordance with Appendix C, with specific attention to Laterally Loaded Structures.

Soil Reuse Considerations

- Site soils were generally acceptable for use as engineered fill. The vegetation and debris should be stripped from the site and should not be incorporated into fill material. It is recommended to use non-expansive structural fill that is free of deleterious materials, and is properly moisture conditioned and compacted to 90-95% of the modified proctor (ASTM D 1557). For deep fills below the building, and at the pavement subgrade elevation 95% should be used, and 90% may be used in other areas where allowed by the building code.

Concrete Considerations

- Concrete should be corrosion resistant, using Type II/V Portland Cement, and fly ash mixtures of 25 percent cement replacement. We recommend a water/cement ratio of 0.45 or less. Site soil may be corrosive to un-protected metallic elements such as pipes, poles, etc. Concrete exposed to freezing weather in cold climates should be air-entrained.

Site Storm Water Considerations

- The site surficial soils are generally undocumented fill and sandy soil. Surface drainage and landscaping design should be carefully planned to protect the new structures from erosion/undermining, and to maintain the site earthwork and structure subgrades in a relatively consistent moisture condition. Water should not flow towards or pond near to new structures, and high water demand plants should not be planned near to structures.

8.2 Geotechnical Parameters

Based on the findings of our field and laboratory testing, we recommend that design and construction proceed per industry accepted practices and procedures, as described in Appendix D, General Geotechnical Design and Construction Considerations (Considerations).

Subgrade Preparation Parameters – (hyperlink to Construction Considerations)

Subgrade Preparation				
Structure	**Bearing Capacity**	**Embedment Depth**	**Bearing Surface** [a]	**Settlement** [d]
Grade Slabs	k=150 pci [b]	NA	95% Compacted Fill or Native to 90%	<1 inch
Spread Foundations	3,000 [c] psf	30 inches	95% Compacted Fill or Native to 90%	<1 inch
Spread Foundations	2,500 [c] psf	24 inches	95% Compacted Fill or Native to 90%	<1 inch
Spread Foundations	2,000 [c] psf	18 inches	95% Compacted Fill or Native to 90%	<1 inch

[a] *Repairs in bearing surface areas should be structural fill per the recommendation of the* *Earthwork* *section of Appendix C that is moisture conditioned to within 3 percent below to optimum moisture content and compacted to 95 percent or more of the soil maximum dry density per ASTM D1557. Expansive material should not be located within the upper* 3 feet of the soil subgrade.

[b] *Subgrade modulus value "k", assuming the grade slab is supported by aggregate layer roughly equal to slab thickness (minimum 4 inches)*

[c] *Can be increased by 1/3 for temporary loading such as seismic and wind*

[d] *Differential settlement is expected to be half of total settlement*

Paving Structural Sections – (hyperlink to Construction Considerations)

Pavement Sections		
Roadway Type	**Subgrade Preparation** [a]	**Pavement Section**
Parking Area Light Duty (TI=4)	Proofrolled/Compacted Subgrade	3-in asphalt & 6-in aggregate base
Parking Area Heavy Duty (TI=7)	Proofrolled/Compacted Subgrade	4-in asphalt & 9-in aggregate base
Parking Area Heavy Duty (TI=7)	Proofrolled/Compacted Subgrade	6-in concrete & 4-in aggregate base
Special High Traffic Areas	Proofrolled/Compacted Subgrade	8-in concrete

[a] *Repairs in proofrolled areas should be structural fill per the recommendation of the* *Earthwork* *(hyperlink to Construction Considerations) that is moisture conditioned to within 3 percent below to optimum moisture content and compacted to 95 percent or more of the soil maximum dry density per ASTM D1557.*

Laterally Loaded Structures Parameters– (hyperlink to Construction Considerations)

Lateral Earth Pressures				
Soil Type	**Coefficient of Friction (µ)**	**Static Fluid Pressure (pcf)**	**Active Fluid Pressure (pcf)**	**Passive Fluid Pressure (pcf)**
Fill Soil	0.3	50	35	300
Native Soil	0.3	50	35	350

**seismic equations*

Combined effect of static and seismic lateral force:

$P_{AE} = F_1 + F_2$

$F_1 = 1/2*A*H^2$ Resultant acting at a distance of H/3 from base of wall

$F_2 = 3/8*K_h*\gamma*H^2$ Resultant acting at a distance of (0.6*H) from base of wall

Where:

F_1 = Static Force (plf) based on active pressure

F_2 = Seismic Lateral Force (plf) based on seismic pressure

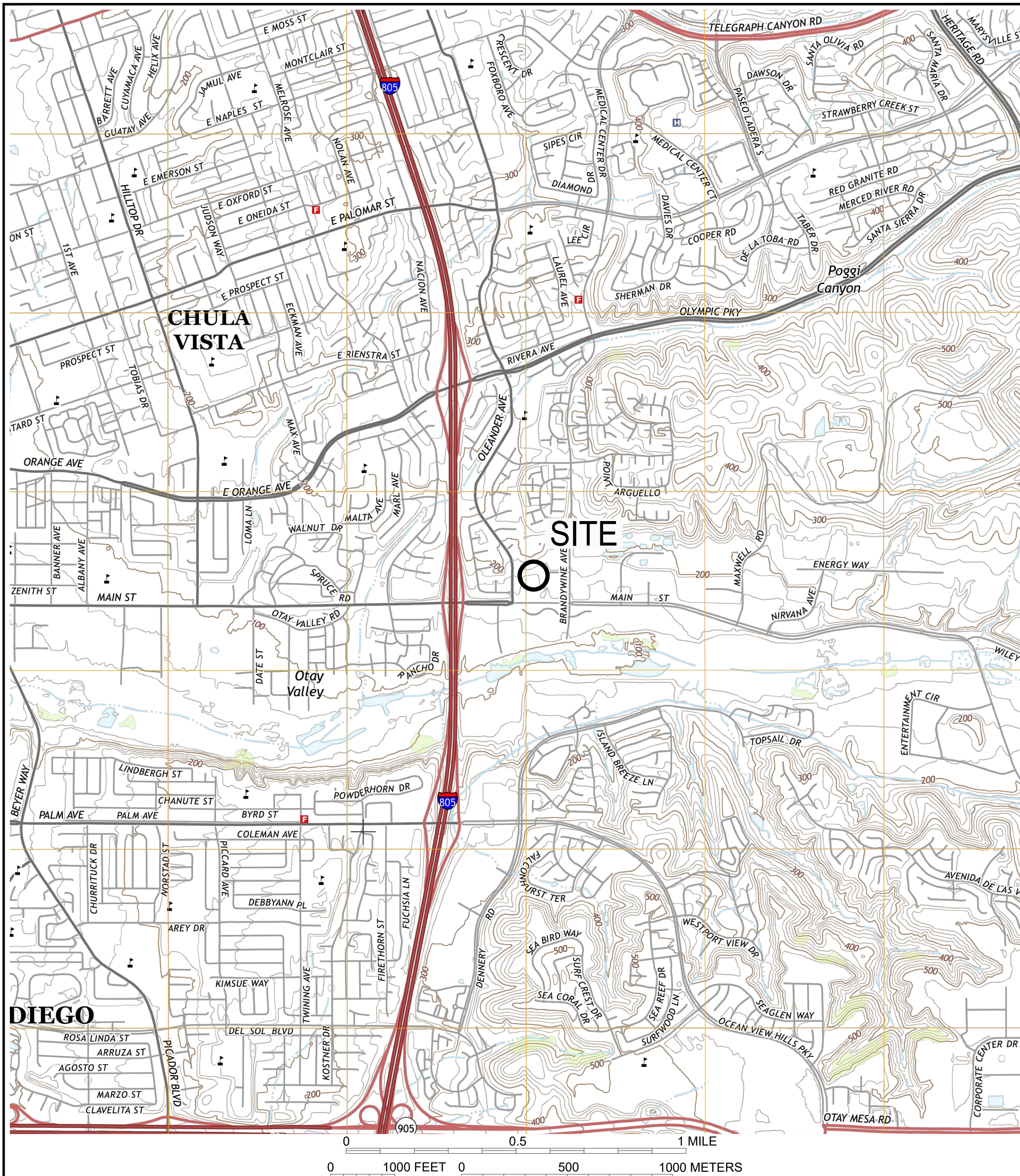
γ = 120 pcf

$K_h = S_{DS}/2.5$

A = Active Pressure (pcf)

H = Height of retained soil (ft)

FIGURES



SITE LOCATION MAP

517 Shinohara Lane, Chula Vista, CA 91911

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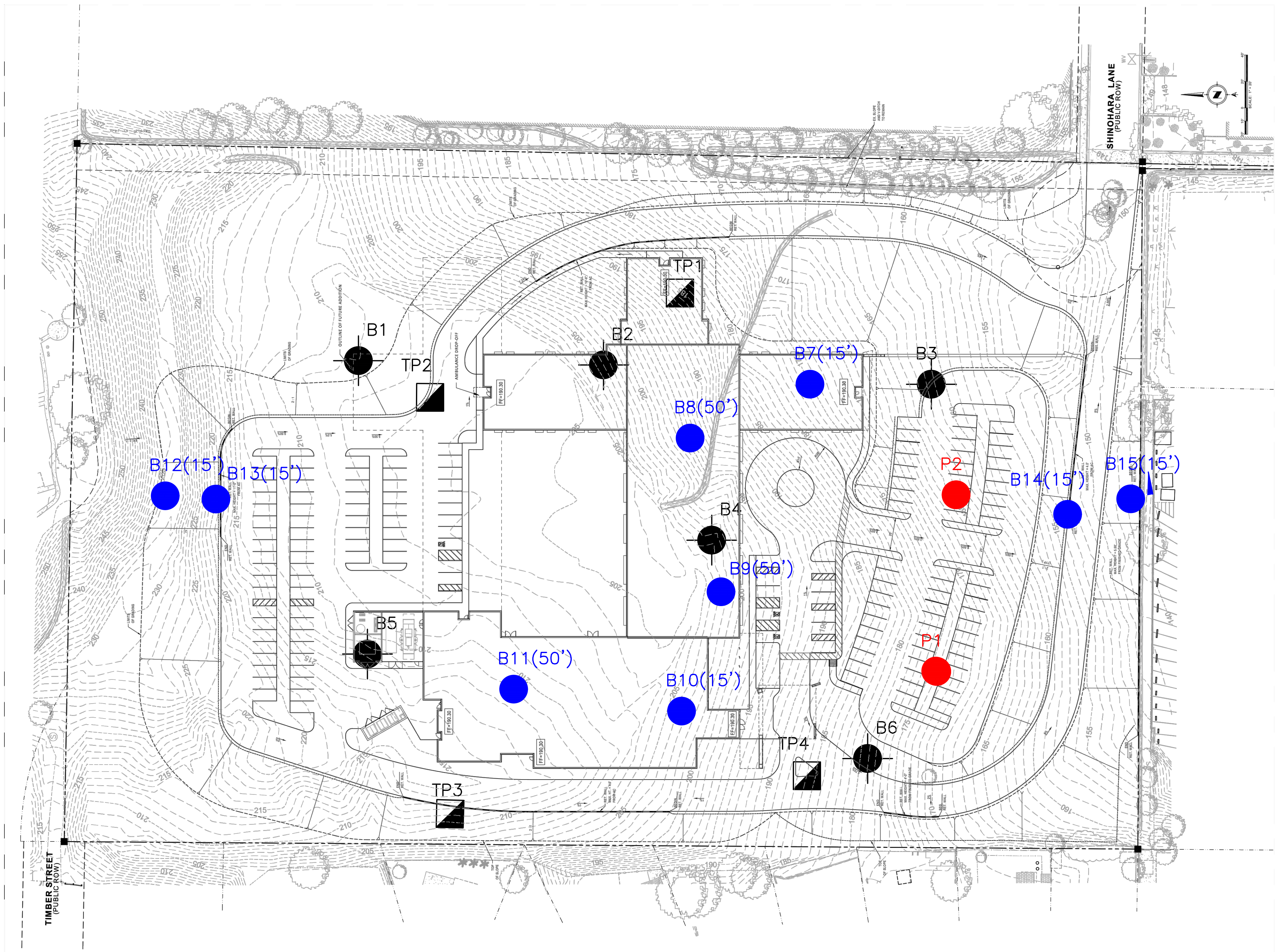
FIGURE 1

Reference: USGS, US Topo, Imperial Quadrangle, California-Los Angeles Co., 7.5 - Minute Series, 2015.



LEGEND:

APPROXIMATE FOOTPRINT OF HOSPITAL BUILDING.

TP1 — TRENCH EXCAVATED DURING JULY 26-27, 2018.

B1 — BORING DRILLED JANUARY 25, 2018.

B1(DEPTH) — BORING DRILLED FEBRUARY 12, 2019 & MARCH 14, 2019.

P1 — PERCOLATION TEST

NOTES:

- BGS = BELOW GROUND SURFACE

50' 0' 50' 100'

APPROXIMATE SCALE

TITLE: GEOTECHNICAL/GEOLOGIC INVESTIGATION PLAN			
FIGURE: 2	PREPARED BY: FC	DATE: MARCH 2019	PROJECT NUMBER: 17-199602.4
ADDRESS: 517 Shinohara Lane, Chula Vista, CA 91911			

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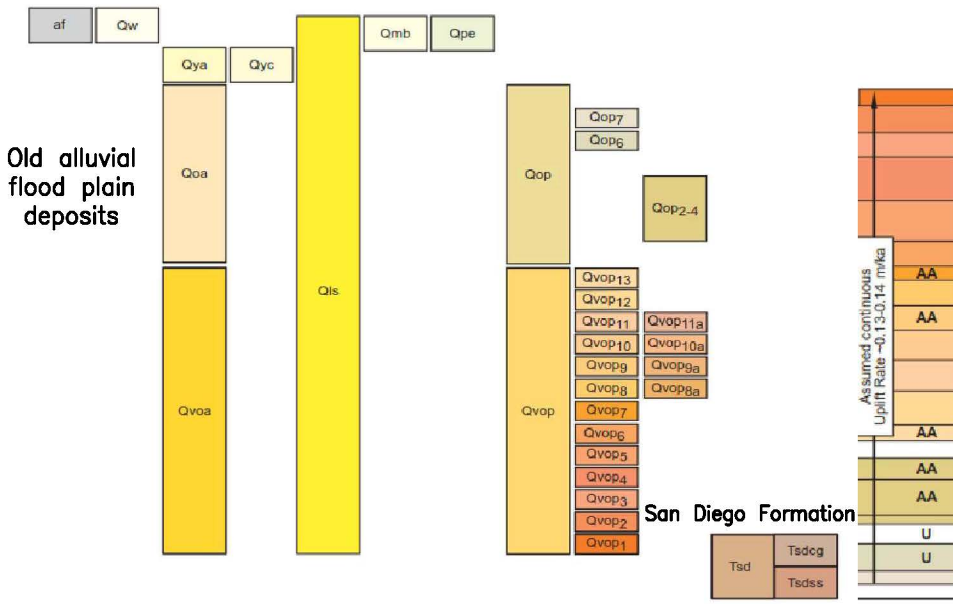
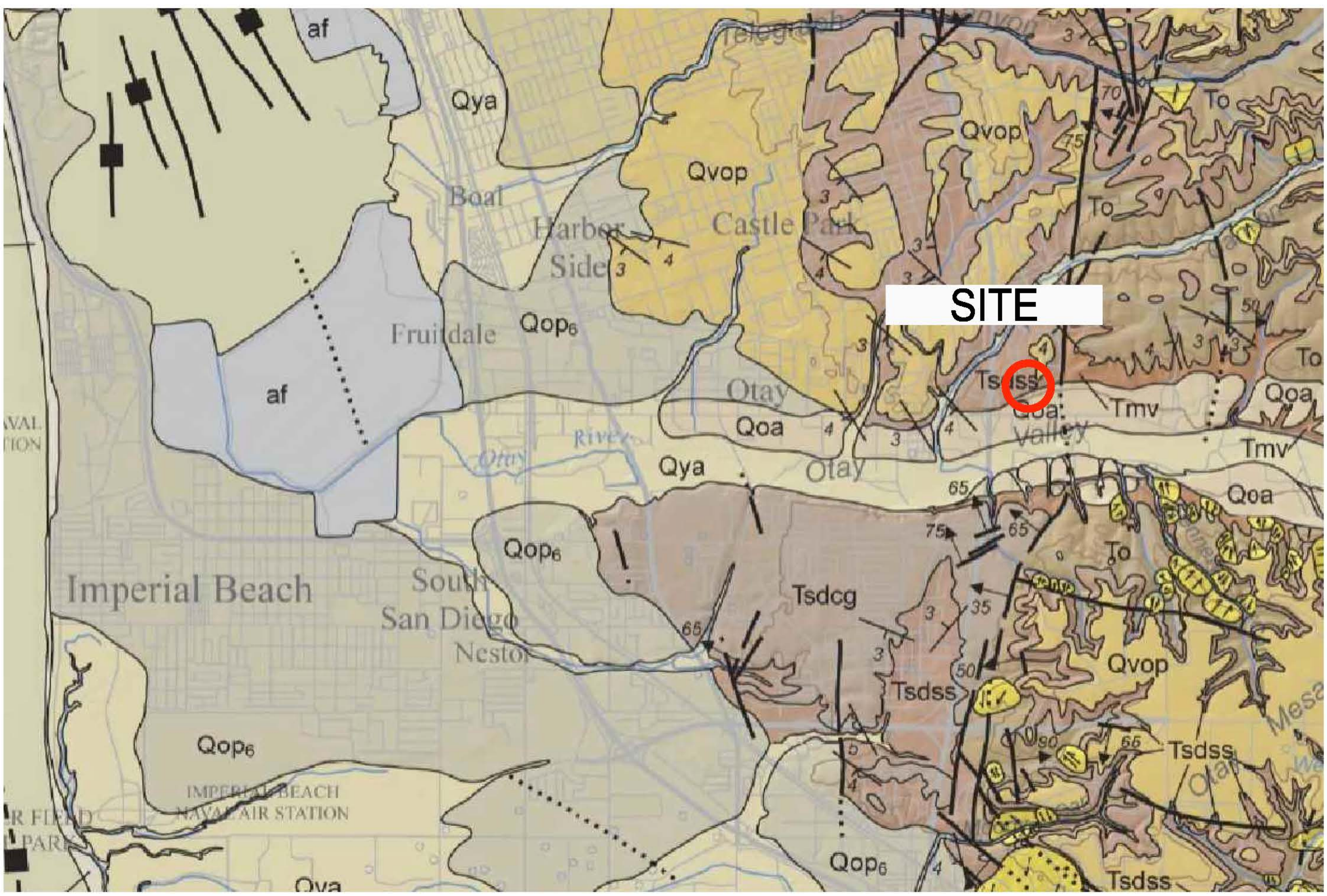
TORRANCE, CALIFORNIA 90501

*Source Drawing from EH Grading Plan, 517 Shinohara Lane, Chula Vista, CA



Approximate age in years (ka = 1000 yrs)	Approximate elevation in meters/feet	Terrace name Kern, 1996b	Terrace deposit symbol on map
~1525 ka	203 m/666'	Eagle	Qvop1
~1445 ka	192 m/630'	Flores Hill	Qvop2
~1375 ka	183 m/600'	Alison Canyon	Qvop3
~1290 ka	172 m/564'	Aqueduct	Qvop4
~1160 ka	155 m/509'	Rifle Range	Qvop5
~1050 ka	139 m/456'	Black Mountain	Qvop6
~975 ka	130 m/427'	Mira Mesa	Qvop7
~930 ka	124 m/407'	Tierra Santa	Qvop8
~855 ka	114 m/374'	Linda Vista	Qvop9
~800 ka	105 m/345'	Tecolote	Qvop10
~698 ka	93 m/305'	Clairemont	Qvop11
~630 ka	84 m/276'	Fire Mountain	Qvop12
~510 ka	68 m/223'	San Elijo	Qvop13
~450 ka	62 m/203'	Golf Course	Qop1
~413 ka	55 m/180'	Parry Grove	Qop2
~320 ka	47 m/154'	Guy Fleming	Qop3
~220 ka	33 m/108'	Stuart Mesa	Qop4
~180 ka	29 m/95'	San Clemente	Qop5
~120 ka	22 m/72'	Nestor	Qop6
~80 ka	10 m/33'	Bird Rock	Qop7
~45 ka	6 m/20'	St. Louis	Qop8



0 0.5 1 MILE

0 1000 FEET 0 500 1000 METERS

N

REGIONAL GEOLOGIC MAP

517 Shinohara Lane, Chula Vista, CA 91911

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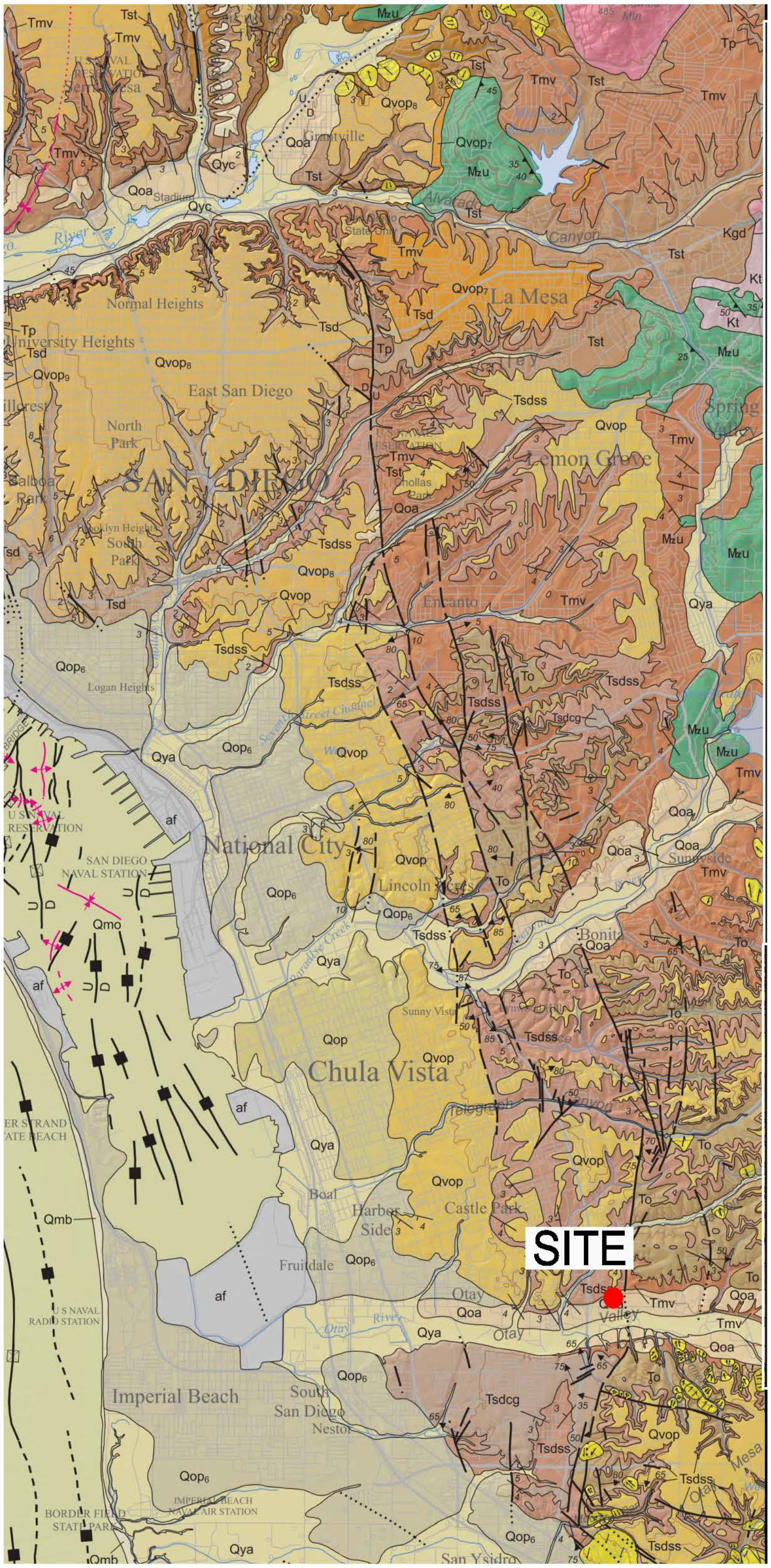
FIGURE 3

Reference: CGS, Geologic Map of San Diego Quadrangle



SEDIMENTARY AND VOLCANIC BEDROCK UNITS

- **QTso** Undivided sediments and sedimentary rocks in offshore region (Holocene, Pleistocene, Pliocene and Miocene)
- **Tsdcg / Tsdss / Tsd** San Diego Formation (early Pleistocene and late Pliocene)
  - Tsd - undivided
  - Tsdcg - transitional marine and nonmarine pebble and cobble conglomerate
  - Tsdss - marine sandstone
- **Tba** Basaltic-andesite dike (Miocene)
- **Tmo** Undivided sedimentary rocks in offshore region (Miocene)
- **Tmvo** Undivided volcanic rocks in offshore region (Miocene)
- **Tmuo** Undivided volcanic and sedimentary rocks in offshore region (Miocene)
- **To** Otay Formation (late Oligocene)
- **Tp / Tpm** Pomerado Conglomerate (middle Eocene)
  - Tpm - Miramar Sandstone Member
- **Tmv** Mission Valley Formation (middle Eocene)
- **Tst** Stadium Conglomerate (middle Eocene)
- **Tf** Friars Formation (middle Eocene)
- **Tscu / Tsc** Scripps Formation (middle Eocene)
  - Tscu - upper unit
- **Ta** Ardath Shale (middle Eocene)
- **Tt** Torrey Sandstone (middle Eocene)
- **Td** Delmar Formation (middle Eocene)

Strike and dip of beds

- 70 Inclined

Strike and dip of igneous joints

- 60 Inclined
- Vertical

Strike and dip of metamorphic foliation

- 55 Inclined

N

GEOLOGIC MAP OF SAN DIEGO QUADRANGLE

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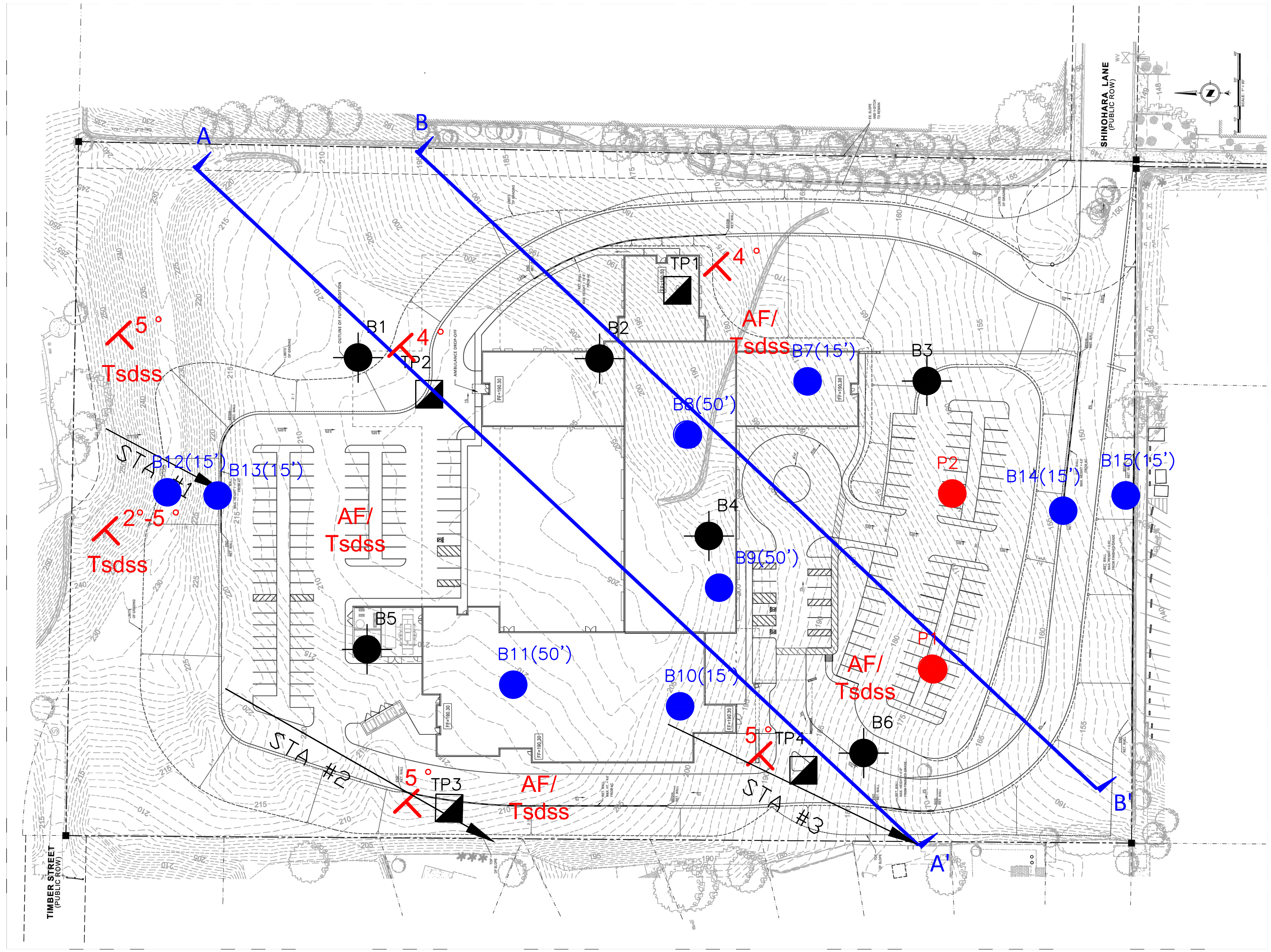
FIGURE 4

Reference: Dibble, and Ehrenspeck, 1992, Geologic Map of the San Diego Quadrangle, San Diego County, California Dept. of Conservation



LEGEND:

APPROXIMATE FOOTPRINT OF HOSPITAL BUILDING

A — A' GEOLOGIC CROSS SECTION

TP1 TRENCH EXCAVATED DURING JULY 26-27, 2018.

B1 BORING DRILLED JANUARY 25, 2018.

B1(DEPTH) BORING DRILLED FEBRUARY 12, 2019 & MARCH 14, 2019.

P1 PERCOLATION TEST

STRIKE AND DIP OF BEDDING

AF: ARTIFICIAL FILL APPROXIMATELY1 FOOT TO 6 FEET THICK ALONG THE PROJECT SITE

Tsdss: SAN DIEGO FORMATION: SILTY SANDSTONE, GRAYISH WHITE TO YELLOWISH WHITE, FINE, SILTY SAND/ SANDY SILT, MOIST, SLIGHTLY MICACEOUS, MEDIUM DENSE, MODERATELY WEATHERED, EARLY PLEISTOCENE TO LATE PLIOCENE

STA #: LOCATION OF SLOPE STABILITY ANALYSIS

NOTES:

- BGS = BELOW GROUND SURFACE

50' 0' 50' 100'

APPROXIMATE SCALE

*Source Drawing from DVELE Architecture Drawings, 752 Skyview Terrace, Ventura, CA, Sheet A1-02, Apr 2018.

AERIAL IMAGERY PROVIDED BY GOOGLE AND ITS LICENSORS © 2016

TITLE:			
SITE ENGINEERING GEOLOGIC MAP			
FIGURE: 5	PREPARED BY: FC	DATE: MARCH 2019	PROJECT NUMBER: 17-199602.4
ADDRESS: 517 Shinohara Lane, Chula Vista, CA 91911			

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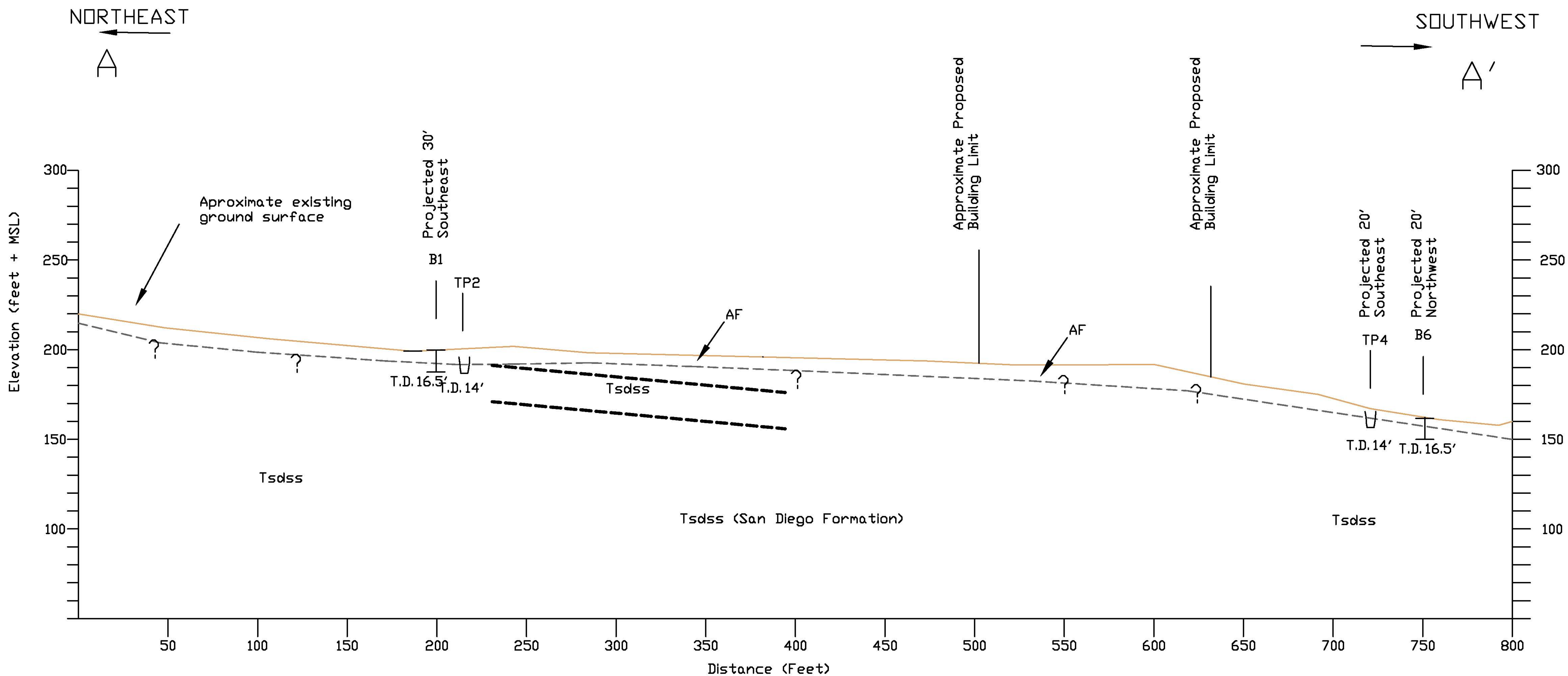

Geologic Units:

AF — Artifical Fill (orange brown, fine to coarse grained sand, someSM-GM) silt and clay, fine to coarse gravel and cobbles, moist,

Tsdss — San Diego Formation (silty sandstone, grayish white to yellowish white, fine, silty sand/ sandy silt, moist, slightly micaceous, medium dense, moderately weathered, early Pleistocene and late Pliocene)

— ? — Inferred lithologic contact, queried where uncertain

Bedding 4°-5° degrees towards southwest strike, N 20° to 25° W

Note: Section is shown at location in Figure 5

B1 — Partner Hollow Stem Auger Boring (JAN 2018)

Partner Trench (JUL 2018)

TD — Total Depth of Boring and Trenches (feet)

HORIZONTAL SCALE = VERTICAL SCALE

25' 0' 25' 50'

HORIZONTAL SCALE IN FEET

TITLE:

CROSS SECTION A-A'

FIGURE:	PREPARED BY:	DATE:	PROJECT NUMBER:
6	FC	AUG 2018	17-199602.4

ADDRESS:

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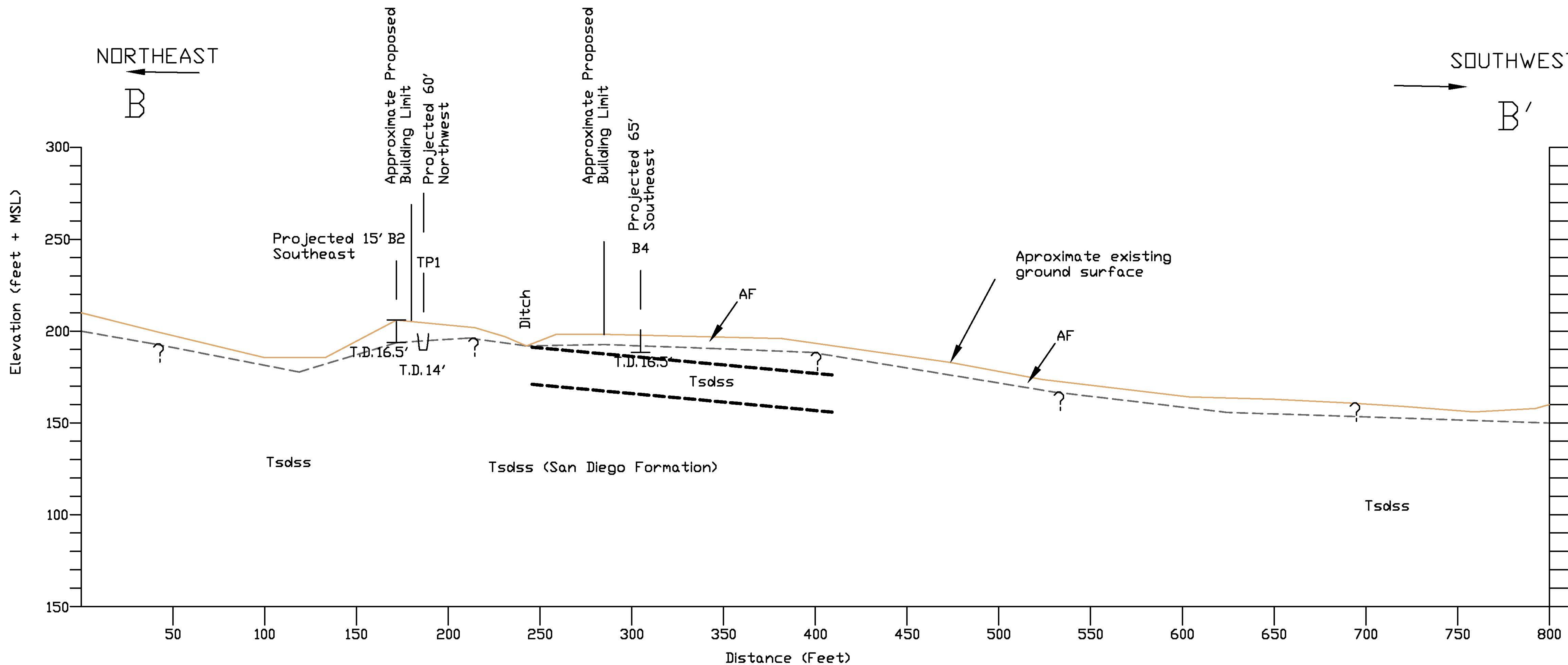

HORIZONTAL SCALE = VERTICAL SCALE

25' 0' 25' 50'

HORIZONTAL SCALE IN FEET

Geologic Units:

AF	Artifical Fill (orange brown, fine to coarse grained sand, someSM-GM) silt and clay, fine to coarse gravel and cobbles, moist,
Tsdss	San Diego Formation (silty sandstone, grayish white to yellowish white, fine, silty sand/ sandy silt, moist, slightly micaceous, medium dense, moderately weathered, early Pleistocene and late Pliocene)
--?--	Inferred lithologic contact, queried where uncertain
▬ ▬ ▬	Bedding 4°-5° degrees towards southwest strike, N 20° to 25° W

B1	Partner Hollow Stem Auger Boring (JAN 2018)
⋃	Partner Trench (JUL 2018)
TD	Total Depth of Boring and Trenches (feet)

Note: Section is shown at location in Figure 5

TITLE:

CROSS SECTION B-B'

FIGURE:	PREPARED BY:	DATE:	PROJECT NUMBER:
7	FC	AUG 2018	17-199602.4

ADDRESS:

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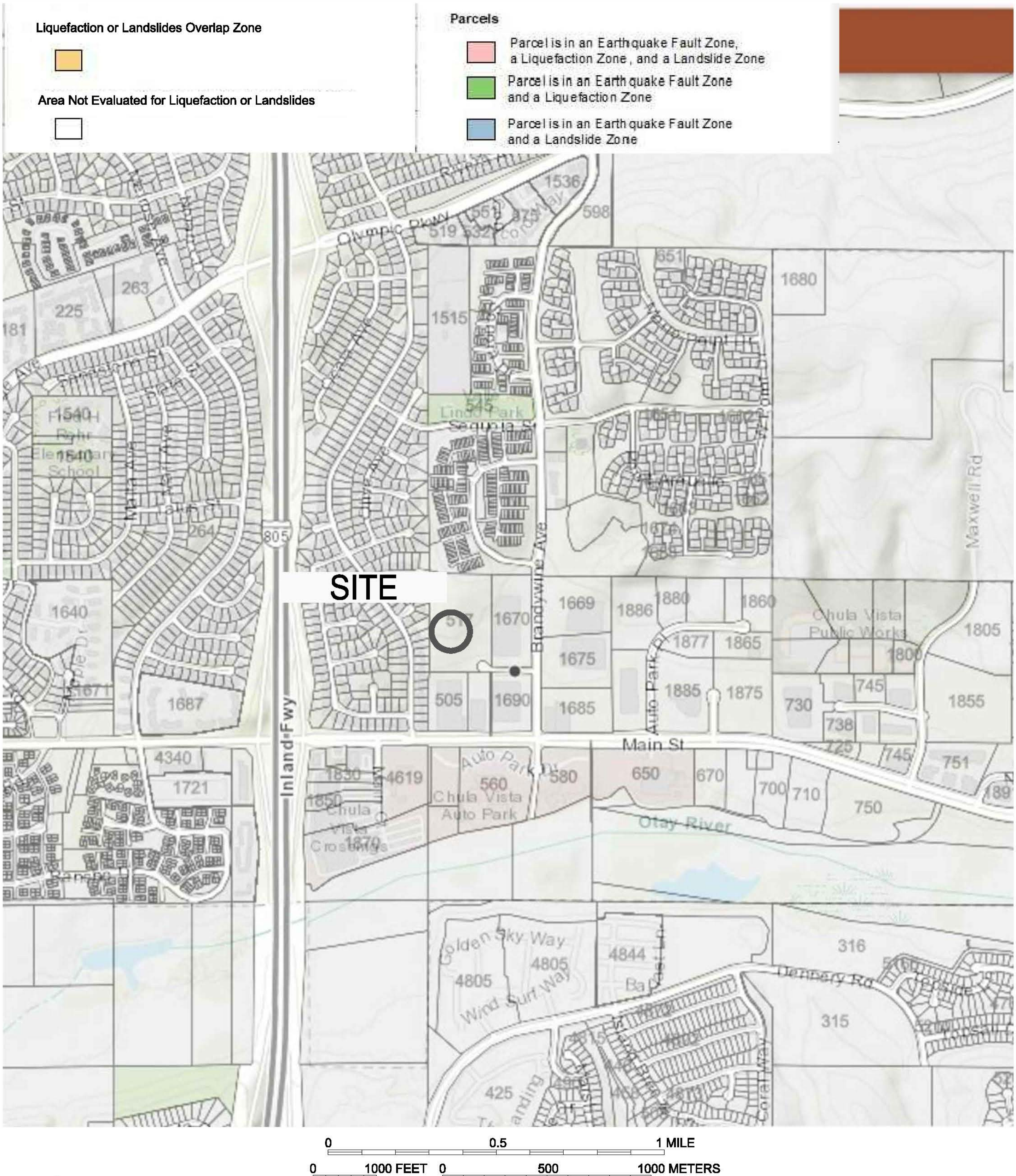

SEISMIC HAZARDS ZONES MAP

517 Shinohara Lane, Chula Vista, CA 91911

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FIGURE 8

Reference: State of California, Earthquakes Zones of Required Investigation, Chula Vista, Bureau of Land Management, ESRI.

SYMBOL EXPLANATION

Fault traces on land are indicated by solid lines where well located, by dashed lines where approximately located or inferred, and by dotted lines where concealed by younger rocks or by lakes or bays. Fault traces are queried where continuation or existence is uncertain. All offshore faults based on seismic reflection profile records are shown as solid lines where well defined, dashed where inferred, queried where uncertain.

FAULT CLASSIFICATION COLOR CODE
(Indicating Recency of Movement)

Fault along which historic (last 200 years) displacement has occurred.

1906 ▶ ◀ 1906

1838 ▷ ◁ 1838

Holocene fault displacement (during past 11,700 years) without historic record.

Late Quaternary fault displacement (during past 700,000 years).

Quaternary fault (age undifferentiated).

Pre-Quaternary fault (older that 1.6 million years) or fault without recognized Quaternary displacement.

ADDITIONAL FAULT SYMBOLS

Bar and ball on downthrown side (relative or apparent).

Arrows along fault indicate relative or apparent direction of lateral movement.

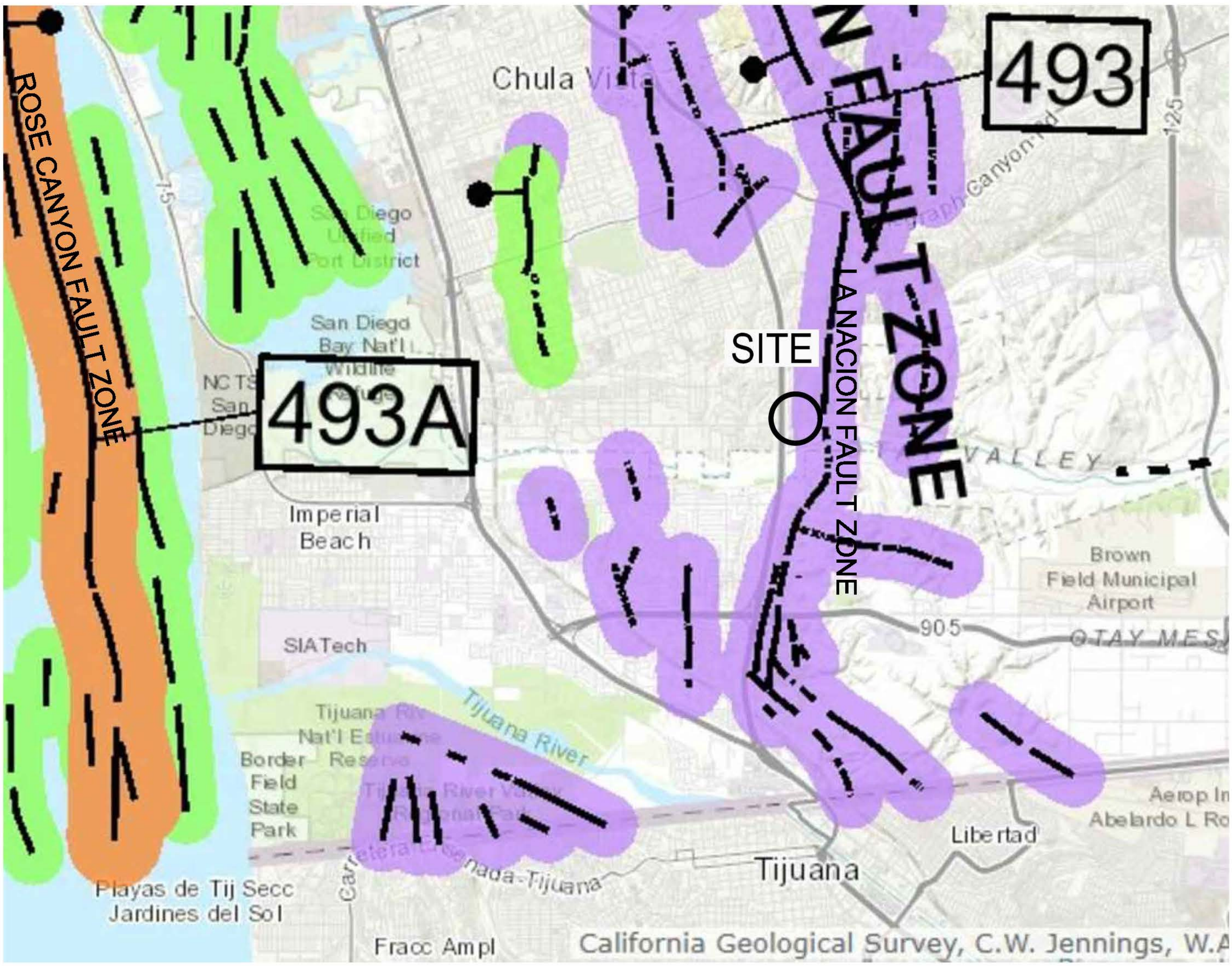
Arrow on fault indicates direction of dip.

Low angle fault (barbs on upper plate).

OTHER SYMBOLS

491

Numbers refer to annotations listed in the appendices of the accompanying report.



0 2 4 MILE

0 4,000 FEET 0 2,000 4,000 METERS

N

CALIFORNIA FAULT ACTIVITY MAP

517 Shinohara Lane, Chula Vista, CA 91911

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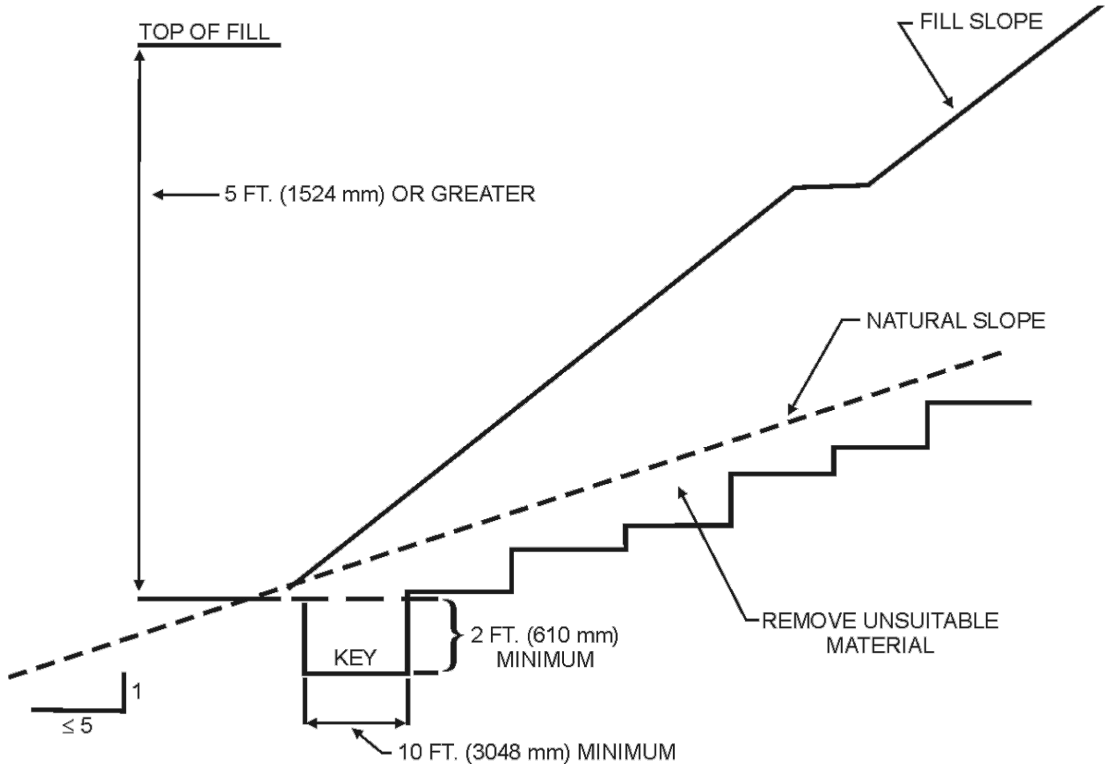
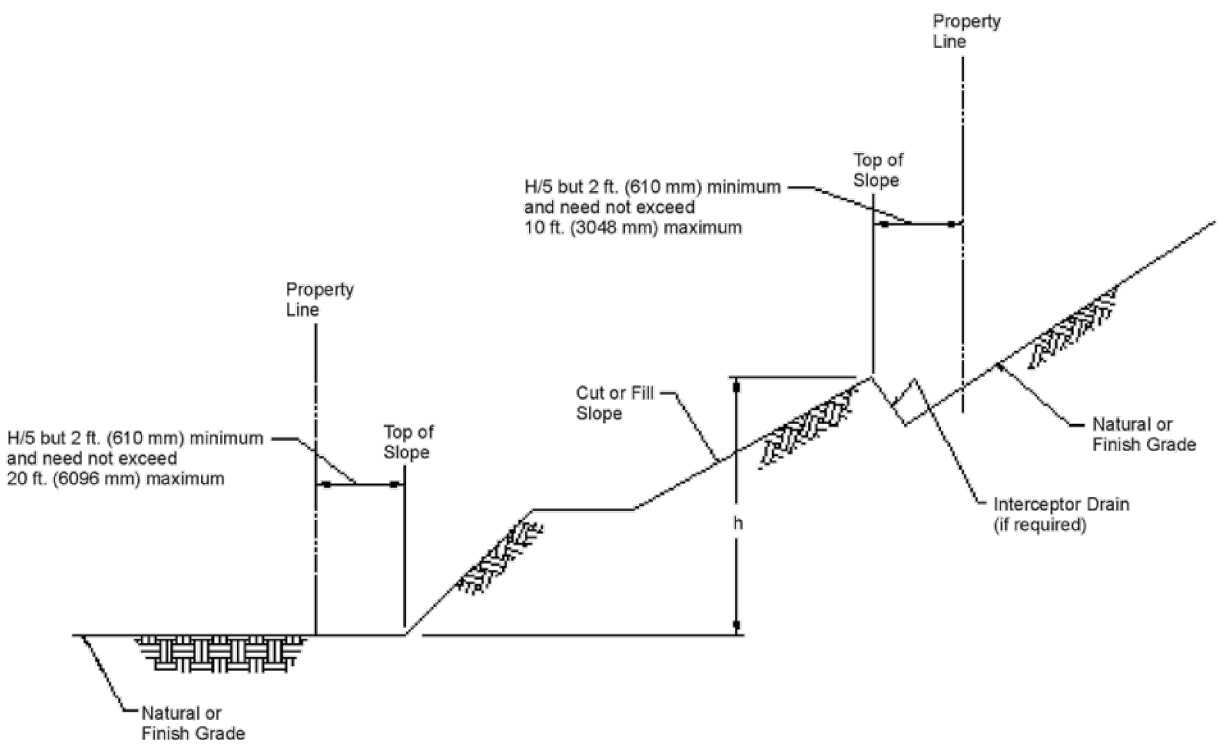
FIGURE 9

Reference: CGS, Geologic Data Map 06, Fault Activity Map, 2010, Jennings, California Division of Mines and Geology.



For SI: 1 foot = 304.8 mm.

FIGURE J107.3
BENCHING DETAILS



BENCHING DETAILS AND DRAINAGE DIMENSIONS

PARTNER Engineering and Science, Inc.®

FIGURE 10

Reference: CBC 2013, Figure J107.3 Benching Detail and J108.1 Drainage Dimensions

APPENDIX A

Trench Logs & Boring Logs

PARTNER

PROJECT NUMBER	TRENCH NUMBER SHEET 1 OF 1
17-199602.4	TP-1

TRENCH WALL LOG (A)

PROJECT: Encompass Health LOCATION: 517 Shinohara Lane, Chula Vista, CA 91911

ELEVATION: 180~; ft MSL CONTRACTOR: AMG Demolition DATE EXCAVATED: July 26, 2018

GROUNDWATER LEVEL & DATE: Not encountered EXCAVATION METHOD: Backhoe: Komatsu PC 390 LC GEOLOGIST: R. Quraishi

APPROXIMATE DIMENSIONS: LENGTH: 20 ft WIDTH: 15 ft DEPTH: 14 ft REMARKS: Trench walls stable

LITHOLOGIC DESCRIPTION

(a) 0 to 2.5 ft: Topsoil, blackish brown; fine to coarse sand, some clay & silt, root fragments organic (moist)

(AF) 2.5 ft to 4 ft: Artificial Fill; orangish brown; fine to coarse sand, some silt & clay, fine to coarse gravel and cobbles, moist (SM* - GM*)

Tsdss (4 to 14 ft) San Diego Formation (silty sandstone): Grayish white to yellowish white, fine, silty sand/sandy silt, moist slightly micaceous, medium dense to dense, moderately weathered to weathered. early Pleistocene and late Pliocene

NOTES

R = Ring Sample

B = Bag Sample

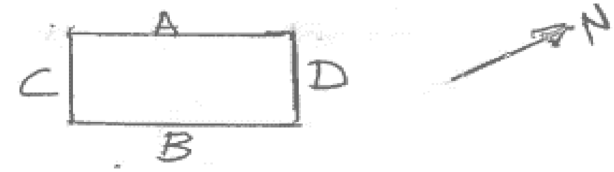
(xxxx symbol) : Approx. limits of excavation

- - - - - - : Lithologic contact

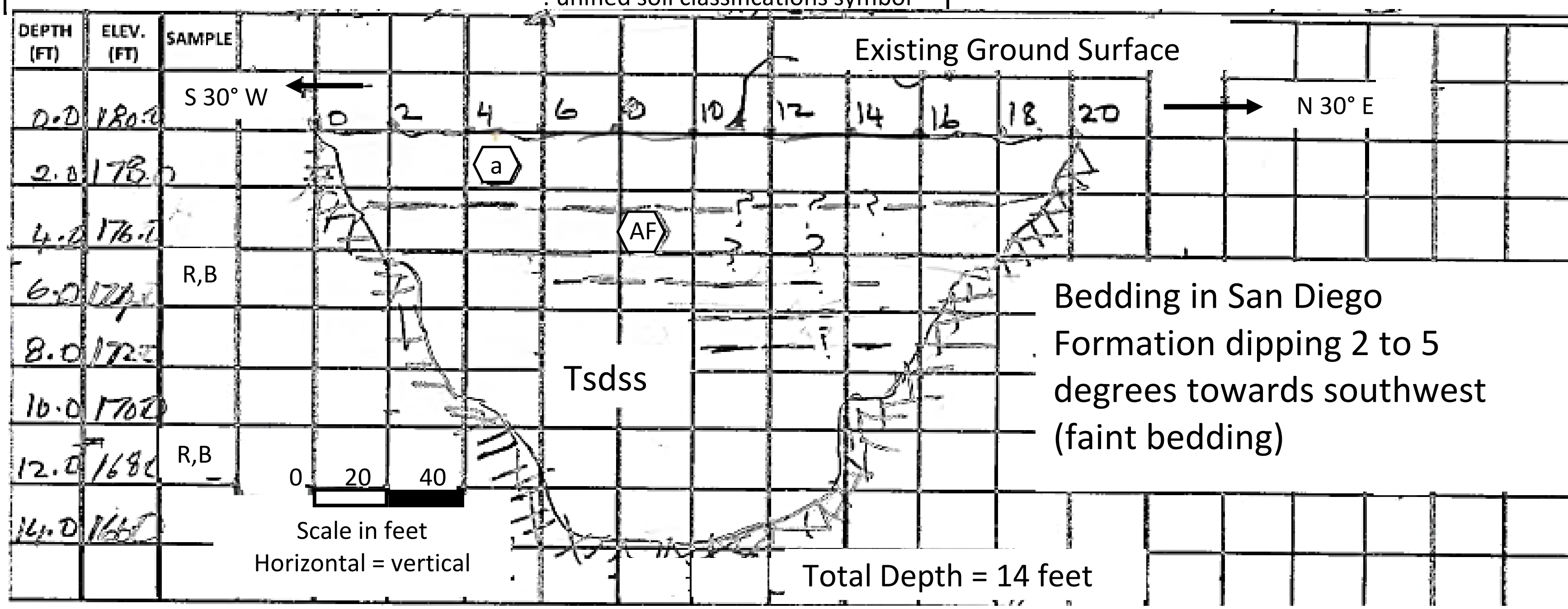
?--?--?--? queried where uncertain

* : unified soil classifications symbol

PLAN



Not to scale



PARTNER

PROJECT NUMBER	TRENCH NUMBER SHEET 1 OF 1
17-199602.4	TP-2

TRENCH WALL LOG (A)

PROJECT: Encompass Health LOCATION: 517 Shinohara Lane, Chula Vista, CA 91911

ELEVATION: 204~ ft MSL CONTRACTOR: AMG Demolition DATE EXCAVATED: July 26, 2018

GROUNDWATER LEVEL & DATE: Not encountered EXCAVATION METHOD: Backhoe: Komatsu PC 390 LC GEOLOGIST: R. Quraishi

APPROXIMATE DIMENSIONS: LENGTH: 32 ft WIDTH: 9.75 ft DEPTH: 14 ft REMARKS: Trench walls stable

LITHOLOGIC DESCRIPTION

(a) 0 to 0.75 ft: Topsoil; blackish brown; fine to coarse sand, some clay & silt, root fragments organic (moist)

(AF) 0.75 ft to 3.3 ft: Aritifical Fill; orangish brown; fine to coarse sand, some silt & clay, fine to coarse gravel and cobbles (SM* - GM*)

Tsdss (3.3 to 14 ft) San Diego Formation (silty sandstone): Grayish white to yellowish white, fine, silty sand/sandy silt, moist slightly micaceous, medium dense to dense, moderately weathered to weathered. early Pleistocene and late Pliocene

NOTES

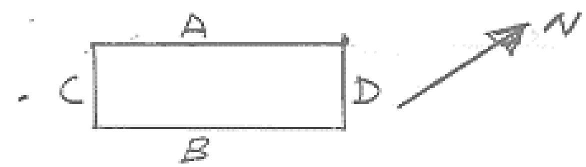
B = Bag Sample

XXXX : Approx. limits of excavation

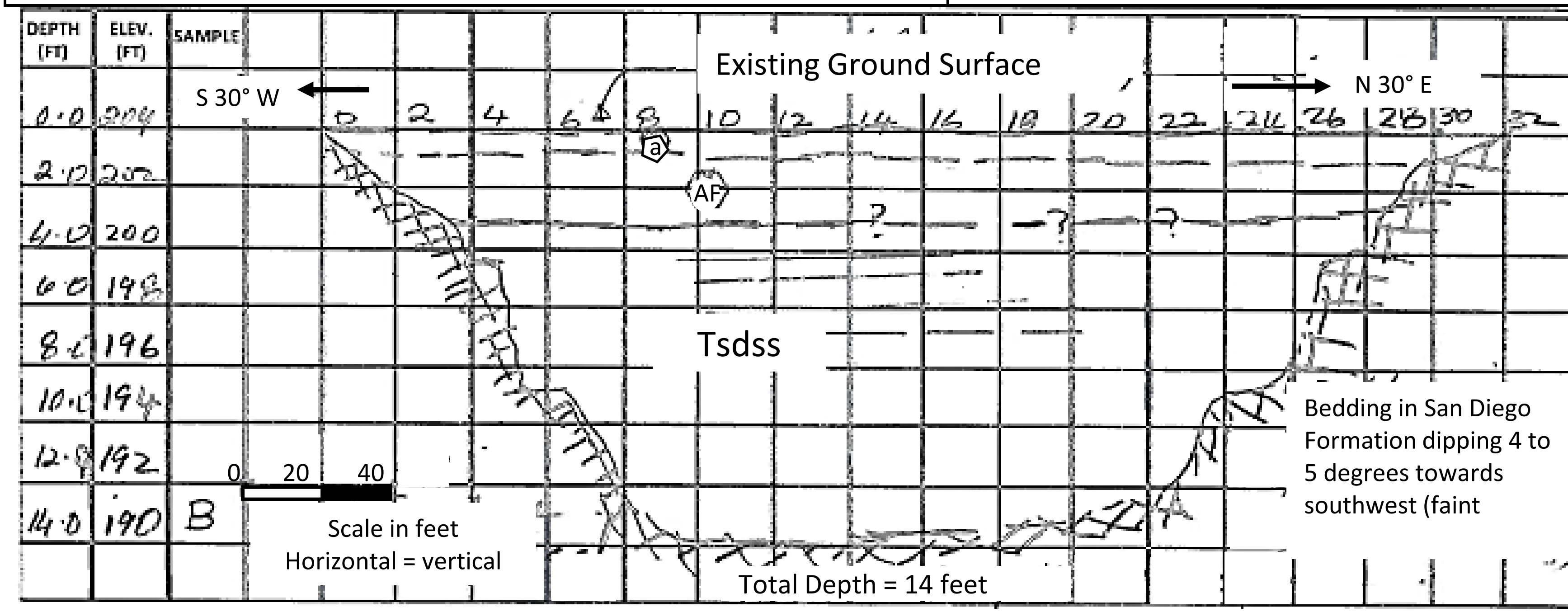
- - - - - - : Lithologic contact

?--?--?--? queried where uncertain

PLAN



Not to scale



PARTNER

PROJECT NUMBER	TRENCH NUMBER SHEET 1 OF 1
17-199602.4	TP-3
	TRENCH WALL LOG (A)

PROJECT: Encompass Health LOCATION: 517 Shinohara Lane, Chula Vista, CA 91911

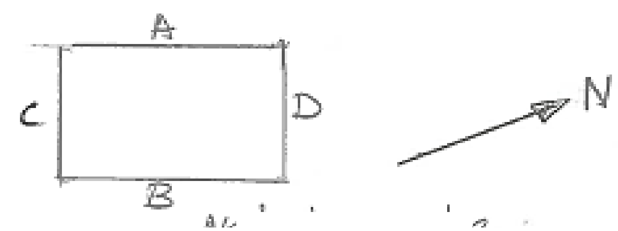
ELEVATION: 211~ ft MSL CONTRACTOR: AMG Demolition DATE EXCAVATED: July 27, 2018

GROUNDWATER LEVEL & DATE: Not encountered EXCAVATION METHOD: Backhoe: Komatsu PC 390 LC GEOLOGIST: R. Quraishi

APPROXIMATE DIMENSIONS: LENGTH: 25 ft WIDTH: 21 ft DEPTH: 14 ft REMARKS: Trench walls stable

LITHOLOGIC DESCRIPTION	NOTES
(a) 0 to 0.5 ft: Topsoil; blackish brown; fine to coarse sand, some clay & silt, root fragments organic (moist)	
(AF) 0.5 ft to 1.5 ft: Artificial Fill; orangish brown; fine to coarse sand, some silt & clay, fine to coarse gravel and cobbles (SM* - GM*)	(hatched line) : Approx. limits of excavation
Tsdss (1.5 to 14 ft) San Diego Formation (silty sandstone): Grayish white to yellowish white, fine, silty sand/sandy silt, moist slightly micaceous, medium dense to dense, moderately weathered to weathered. early Pleistocene and late Pliocene	- - - - - - ?--?--?--? : Lithologic contact queried where line uncertain

PLAN



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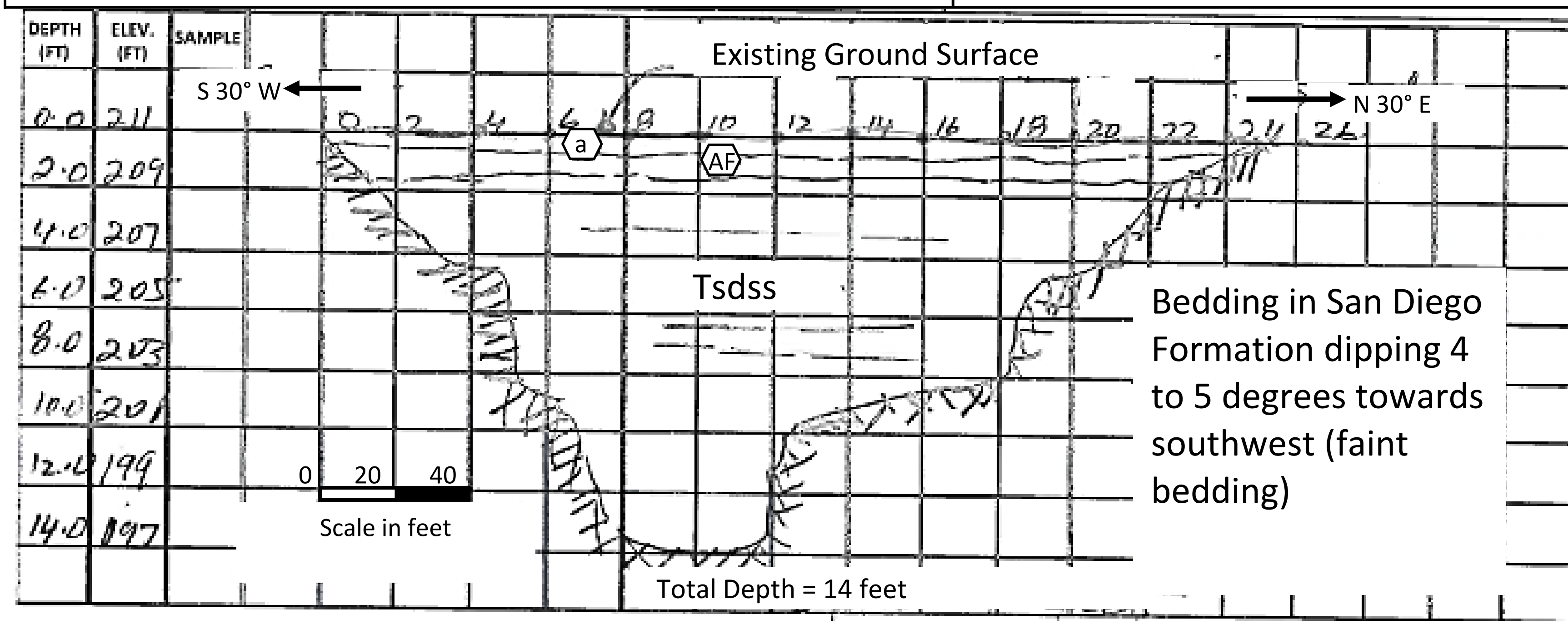


PARTNER

PROJECT NUMBER	TRENCH NUMBER SHEET 1 OF 1
17-199602.4	TP-4

TRENCH WALL LOG (A)

PROJECT: Encompass Health LOCATION: 517 Shinohara Lane, Chula Vista, CA 91911

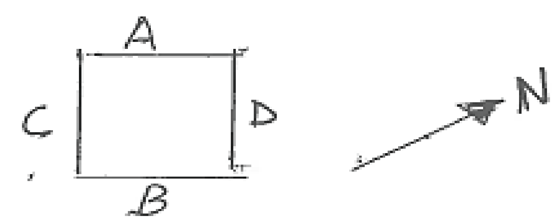
ELEVATION: 184~ ft MSL CONTRACTOR: AMG Demolition DATE EXCAVATED: July 27, 2018

GROUNDWATER LEVEL & DATE: Not encountered EXCAVATION METHOD: Backhoe: Komatsu PC 390 LC GEOLOGIST: R. Quraishi

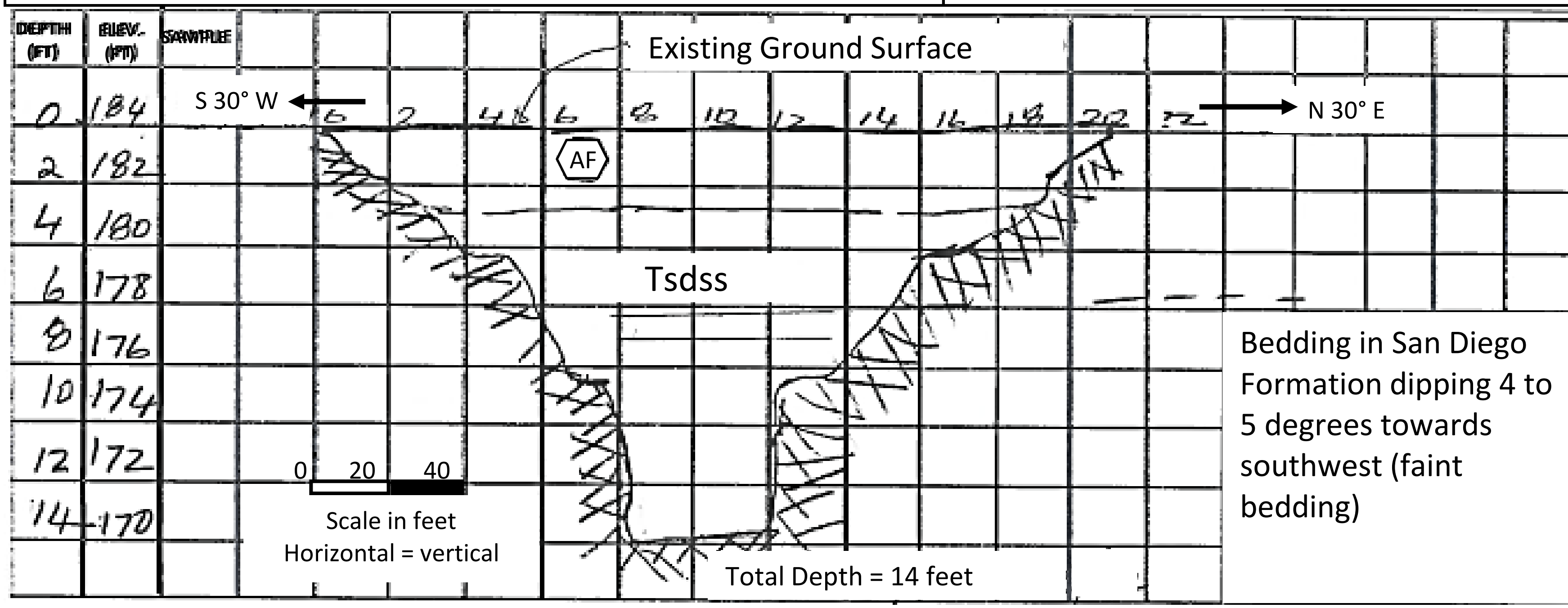
APPROXIMATE DIMENSIONS: LENGTH: 21 ft WIDTH: 25 ft DEPTH: 14 ft REMARKS: Trench walls stable

LITHOLOGIC DESCRIPTION	NOTES	
(AF) 0 ft to 3.0 ft: Artificial Fill; orangish brown; fine to coarse sand, some silt & clay, fine to coarse gravel and cobbles (SM* - GM*)	* :	unified soil
Tsdss (3 to 14 ft) San Diego Formation (silty sandstone): Grayish white to yellowish white, fine, silty sand/sandy silt, moist slightly micaceous, medium dense to dense, moderately weathered to weathered. early Pleistocene and late Pliocene, (SM*), (SM/ML*)	XXXXX	: Approx. limits of excavation
	- - - - - - ?--?--?--?	: Lithologic contact queried where line uncertain

PLAN



Not to scale



UNIFIED SOIL CLASSIFICATION SYSTEM

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)		
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravels (Less than 5% 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 (More than 12% fines)	
	GM	Silty gravels, gravel-sand-silt mixtures
	GC	Clayey gravels, gravel-sand-clay mixtures
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sands (Less than 5% fines)	
	SW	Well-graded sands, gravelly sands, little or no fines
	SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)	
	SM	Silty sands, sand-silt mixtures
	SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more 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 of 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 50% or greater	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
	CH	Inorganic clays of high plasticity, fat clays
	OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS	PT	Peat and other highly organic soils

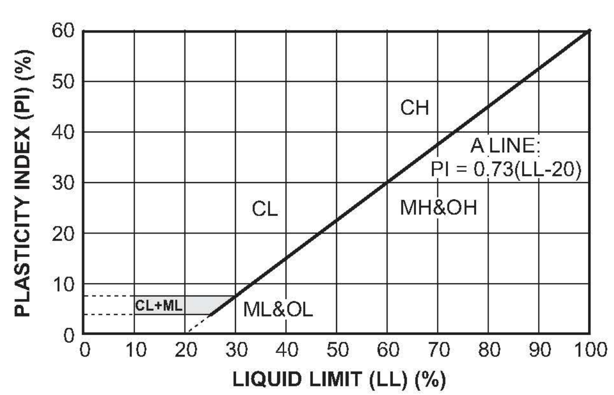
LABORATORY CLASSIFICATION CRITERIA

GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with P.I. greater than 7	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for GW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
SC	Atterberg limits above "A" line with P.I. greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent .... GW, GP, SW, SP
More than 12 percent .... GM, GC, SM, SC
5 to 12 percent .... Borderline cases requiring dual symbols

PLASTICITY CHART



BORING LOG KEY - EXPLANATION OF TERMS

SURFACE COVER: General discription with thickness to the inch, ex. Topsoil, Concrete, Asphalt, etc,

FILL: General description with thickness to the 0.5 feet. Ex. Roots, Debris, Processed Materials (Pea Gravel, etc.)

NATIVE GEOLOGIC MATERIAL: Deposit type, 1.Color, 2.moisture, 3.density, 4.SOIL TYPE, other notes - Thickness to 0.5 feet

1. Color - Generalized

Light Brown (usually indicates dry soil, rock, caliche)
Brown (usually indicates moist soil)
Dark Brown (moist to wet soil, organics, clays)
Reddish (or other bright colors) Brown (moist, indicates some soil development/or residual soil)
Greyish Brown (Marine, sub groundwater - not the same as light brown above)
Mottled (brown and gray, indicates groundwater fluctuations)

2. Moisture

dry - only use for wind-blown silts in the desert
damp - soil with little moisture content
moist - near optimum, has some cohesion and stickyness
wet - beyond the plastic limit for clayey soils, and feels wet to the touch for non clays
saturated - Soil below the groundwater table, sampler is wet on outside

3. Density (based on blow counts or hand evaluation)

SPT	Ring	Granular	Cohesive		
0-5	0-7	very loose	very soft	Unsuitable	Thumb penetrates through
5-10	7-14	loose	soft	<1,500psf	Thumb penetrates part way
10-20	14-28	medium dense	firm	<3,000psf	Thumb dents only
20-75	28-100	dense	stiff	>3,000psf	Thumbnail dents
75+	100+	very dense	hard	Hard Dig	Thumbnail does not dent

4. Classification

Determine percent Gravel (bigger than 3/8")
Determine percent fines (silt and clay feel soft, with no grit)
Determine percent sand (between silt and clay, feels gritty)
Determine if clayey (make soil moist, if it easily roll into a snake it is clayey)

Sands and gravels (more gravel starts with G, more sand starts with S)

GP	SP	Mostly sand and gravel, with less than 5 % fines	sandy GRAVEL	SAND
GP-GM	SP-SM	Mostly sand and gravel 7-12% fines, non-clayey	sandy GRAVEL with silt	SAND with Silt
GP-GC	SP-SC	Mostly sand and gravel 7-12% fines, clayey	sandy GRAVEL with clay	SAND with clay
GC	SC	Mostly sand and gravel >12% fines clayey	clayey GRAVEL	clayey SAND
GM	SM	Mostly sand and gravel >12% fines non-clayey	silty GRAVEL	silty SAND

Cohesive Soil (generaly forms long chunks (more than 2 inches) in sampler

ML	Soft, non clayey	SILT with sand
MH	Very rare, holds a lot of water, and is pliable with very low strength	high plasticity SILT
CL	If sandy can be hard when dry, will be stiff/plastic when wet	CLAY with sand/silt
CH	Hard and resiliant when dry, very strong/sticky when wet (may have sand in it)	FAT CLAY

H = Liquid limit over 50%, L - LL under 50%
C = Clay
M = Silt

Samplers

S = Standard split spoon (SPT)
R = Modified ring
Bulk = Excavation spoils
ST = Shelby tube
C = Rock core

Boring Number:	B1		Page 1 of 1
Location:	See Figure	Date Started:	1/25/2018
Site Address:	517 Shinohara Lane Chula Vista, CA 91911	Date Completed:	1/25/2018
		Depth to Groundwater:	N/A
Project Number:	17-199602.3	Field Technician:	JM
Drill Rig Type:	LAR DUAL RIG 75	**Partner Engineering and Science**	
Sampling Equipment:	SPT	**2154 Torrance Blvd, Suite 201**	
Borehole Diameter:	8"	**Torrance, CA 90501**	

Depth	Sample	N-Value	USCS	Description
0				**SURFACE COVER**: Grass/Dirt
1				**FILL**: Brown, moist, loose, fine to medium-grained sand, silty SAND
2				
3				
4				
5	S	18	SM	**SAN DIEGO FORMATION:** gray, moist, medium dense, fine to medium-grained, silty SAND
6				
7				
8				
9				
10	S	29		Dense
11				
12				
13				
14				
15	S	27		
16				Boring Terminated at 16.5 feet
17				Backfilled with spoils upon completion
18				Groundwater not encountered
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				

Boring Number:	B2	Page 1 of 1	
Location:	See Figure	Date Started:	1/25/2018
Site Address:	517 Shinohara Lane Chula Vista, CA 91911	Date Completed:	1/25/2018
		Depth to Groundwater:	N/A
Project Number:	17-199602.3	Field Technician:	J.M.
Drill Rig Type:	LAR DUAL RIG 75	**Partner Engineering and Science** **2154 Torrance Blvd, Suite 201** **Torrance, CA 90501**	
Sampling Equipmer	SPT		
Borehole Diameter	8"		

Depth	Sample	N-Value	USCS	Description
0				**SURFACE COVER**: Grass/Dirt
1				Topsoil mixed wth fill
2				
3				
4				
5	■	10	SM	**FILL**: Brown, moist, loose, fine to medium-grained sand, silty SAND
6				
7				
8				
9				
10	■	32	SM	**SAN DIEGO FORMATION:** Yellowish-brown, moist, dense, fine to medium-grained, silty SAND
11				
12				
13				
14				
15	■	16		Gray, medium dense, fine-grained, silty SAND
16				Boring Terminated at 16.5 feet
17				Backfilled with spoils upon completion
18				Groundwater not encountered
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				

Boring Number:	B3		Page 1 of 1
Location:	See Figure	Date Started:	1/25/2018
Site Address:	517 Shinohara Lane Chula Vista, CA 91911	Date Completed:	1/25/2018
		Depth to Groundwater:	N/A
Project Number:	17-199602.3	Field Technician:	J.M.
Drill Rig Type:	LAR DUAL RIG 75	**Partner Engineering and Science**	
Sampling Equipment	SPT	**2154 Torrance Blvd, Suite 201**	
Borehole Diameter:	8"	**Torrance, CA 90501**	

Depth	Sample	N-Value	USCS	Description
0				**SURFACE COVER**: Grass/Dirt
1				
2				
3				
4				
5		11	SM	**FILL**:Brown, moist, loose, fine to medium-grained, silty SAND
6				**SAN DIEGO FORMATION:** Yellowish-brown, moist, dense, fine to
7				medium-grained, silty SAND
8				
9				
10		44		dense
11				
12				encountered harder drilling around 11-13'
13				
14				
15		19		medium dense
16				
17				
18				Boring Terminated at 16.5 feet
19				Backfilled with spoils upon completion
20				Groundwater not encountered
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				

Boring Number:	B4	Page _1_ of _1	
Location:	Near center of property	Date Started:	1/25/2018
Site Address:	517 Shinohara Lane Chula Vista, CA 91911	Date Completed:	1/25/2018
		Depth to Groundwater:	N/A
Project Number:	17-199602.3	Field Technician:	J.M.
Drill Rig Type:	LAR DUAL RIG 75	**Partner Engineering and Science**	
Sampling Equipment:	SPT	**2154 Torrance Blvd, Suite 201**	
Borehole Diameter:	8"	**Torrance, CA 90501**	

Depth	Sample	N-Value	USCS	Description
0				**SURFACE COVER**: Grass/Dirt
1				
2				
3				
4				
5	■	37	SM	**FILL**: Brown (reddish), moist, dense, fine to medium-grained,
6				silty SAND with little clay (Moisture Content: 7%; NP)
7				
8				
9				
10	■	16	SM	**SAN DIEGO FORMATION**: Brown, moist, medium dense, fine to medium-grained, silty SAND
11				
12				
13				
14				layer of gravel and silt
15	■	47		dense
16				
17				Boring terminated at 16.5 feet
18				Backfilled with spoils upon completion
19				Groundwater not encountered
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				

Boring Number:	B5		Page _1_ of _1
Location:	See Figure	Date Started:	1/25/2018
Site Address:	517 Shinohara Lane Chula Vista, CA 91911	Date Completed:	1/25/2018
		Depth to Groundwater:	N/A
Project Number:	17-199602.3	Field Technician:	J.M.
Drill Rig Type:	LAR DUAL RIG 75	**Partner Engineering and Science**	
Sampling Equipment:	SPT	**2154 Torrance Blvd, Suite 201**	
Borehole Diameter:	8"	**Torrance, CA 90501**	

Depth	Sample	N-Value	USCS	Description
0				
1				
2				
3				
4	■	50/4"	SM	**FILL**: Brown, moist, dense, fine to medium-grained, silty SAND,
5				some gravel and some clay
6				
7				
8				Boring terminated at 6 feet
9				Backfilled with spoils upon completion
10				Groundwater not encountered
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				

Boring Number:	B6		Page 1 of 1
Location:	See Figure	Date Started:	1/25/2018
Site Address:	517 Shinohara Lane Chula Vista, CA 91911	Date Completed:	1/25/2018
		Depth to Groundwater:	N/A
Project Number:	17-199602.3	Field Technician:	J.M.
Drill Rig Type:	LAR DUAL RIG 75	**Partner Engineering and Science**	
Sampling Equipment:	SPT	**2154 Torrance Blvd, Suite 201**	
Borehole Diameter:	8"	**Torrance, CA 90501**	

Depth	Sample	N-Value	USCS	Description
0				**SURFACE COVER**: Grass/Dirt
1				
2				
3			3'	layers of gravel
4				
5		45	SM	**FILL**: Brown mottled with white, dense, silty SAND, little gravel
6				
7				
8				
9				
10		39	SC	**SAN DIEGO FORMATION**: Brown, moist, fine-grained, clayey SAND
11				(Moisture Content: 10%, PI=15)
12				hard layer of gravel at 11'
13				
14				
15		25	SM	Brownish yellow, moist, fine-grained, silty SAND
16				
17				Boring Terminated at 16.5 feet
18				Backfilled with spoils upon completion
19				Groundwater not encountered
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				

Boring Number:	B-7	Boring Log Page 1 of 1	
Location:	Slope Center (SE proposed building	Date Started:	2/12/2019
Site Address:	517 Shinohara Lane	Date Completed:	2/12/2019
	Chula Vista, California	Depth to Groundwater:	N/A
Project Number:	17-199602.7	Field Technician:	J. Eudell
Drill Rig Type:	FRASTE	**Partner Engineering and Science**	
Sampling Equipment:	6" H.S.A, SPT & Ring sampler	**2154 Torrance Boulevard, Suite 200**	
Borehole Diameter:	6"	**Torrance, California 90501**	

Depth	Sample	N-Value	USCS	Description
0				**SURFACE COVER**: Grass covered topsoil
1				
2				
3				
4				
5	S	62	SM	**SAN DIEGO FORMATION**: Brown, moist, dense, silty SAND with clay and few rocks
6				
7				
8				
9				
10	S	38		
11				
12				
13				
14				
15	S	32		
16				Boring terminated at 16.5' bgs
17				Boring backfilled with spoils upon completion
18				Groundwater not encountered
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				

Boring Number:	B-10	Boring Log Page 1 of 1	
Location:	20' NE of stake	Date Started:	2/12/2019
Site Address:	517 Shinohara Lane	Date Completed:	2/12/2019
	Chula Vista, California	Depth to Groundwater:	N/A
Project Number:	17-199602.7	Field Technician:	J. Eudell
Drill Rig Type:	FRASTE	**Partner Engineering and Science**	
Sampling Equipment:	6" H.S.A, SPT & Ring sampler	**2154 Torrance Boulevard, Suite 200**	
Borehole Diameter:	6"	**Torrance, California 90501**	

Depth	Sample	N-Value	USCS	Description
0				**SURFACE COVER**: Grass covered topsoil
1				
2				
3				
4				
5	S	37	SM	**SAN DIEGO FORMATION**: Brown, damp, dense, silty SAND
6				
7				
8				
9				
10	S	23		
11				
12				
13				
14				
15	S	20		
16				Boring terminated at 16.5' bgs
17				Boring backfilled with spoils upon completion
18				Groundwater not encountered
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				

Boring Number:	B-12	Boring Log Page 1 of 1	
Location:	Middle of cliff, north side	Date Started:	2/12/2019
Site Address:	517 Shinohara Lane	Date Completed:	2/12/2019
	Chula Vista, California	Depth to Groundwater:	N/A
Project Number:	17-199602.7	Field Technician:	J. Eudell
Drill Rig Type:	FRASTE	**Partner Engineering and Science**	
Sampling Equipment:	6" H.S.A, SPT & Ring sampler	**2154 Torrance Boulevard, Suite 200**	
Borehole Diameter:	6"	**Torrance, California 90501**	

Depth	Sample	N-Value	USCS	Description
0				**SURFACE COVER**: Grass/Dirt
1				
2	S	24	SP	**FILL**: Brown to gray, damp, dense, poorly graded SAND
3				
4				
5	R	52	SM	**SAN DIEGO FORMATION**: Reddish brown, damp, dense, silty SAND
6				
7	S	23	ML	Yellowish gray, damp, stiff, SILT
8				
9				
10	R	32		
11				
12				
13				
14				
15	S	24		
16				Boring terminated at 16.5' bgs
17				Boring backfilled with spoils upon completion
18				Groundwater not encountered
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				

Boring Number:	B-13	Boring Log Page 1 of 1	
Location:	Bottom of cliff, north end	Date Started:	2/12/2019
Site Address:	517 Shinohara Lane	Date Completed:	2/12/2019
	Chula Vista, California	Depth to Groundwater:	N/A
Project Number:	17-199602.7	Field Technician:	J. Eudell
Drill Rig Type:	FRASTE	**Partner Engineering and Science**	
Sampling Equipment:	6" H.S.A, SPT & Ring sampler	**2154 Torrance Boulevard, Suite 200**	
Borehole Diameter:	6"	**Torrance, California 90501**	

Depth	Sample	N-Value	USCS	Description
0				**SURFACE COVER**: Grass/Dirt
1				
2	S	12	SP	**FILL**: Gray to brown, damp, medium dense, poorly graded SAND
3				
4				
5	S	29	SM	**SAN DIEGO FORMATION**: Yellowish gray to brown, damp, dense, silty SAND
6				
7				
8				
9				
10	S	27		
11				
12				
13				
14				
15	S	32	SP	Brown, damp, dense, poorly graded SAND
16				Boring terminated at 16.5' bgs
17				Boring backfilled with spoils upon completion
18				Groundwater not encountered
19				
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27				
28				
29				

Boring Number:	B-14	Boring Log Page 1 of 1	
Location:	New Southern fence	Date Started:	2/12/2019
Site Address:	517 Shinohara Lane	Date Completed:	2/12/2019
	Chula Vista, California	Depth to Groundwater:	N/A
Project Number:	17-199602.7	Field Technician:	J. Eudell
Drill Rig Type:	FRASTE	**Partner Engineering and Science**	
Sampling Equipment:	6" H.S.A, SPT & Ring sampler	**2154 Torrance Boulevard, Suite 200**	
Borehole Diameter:	6"	**Torrance, California 90501**	

Depth	Sample	N-Value	USCS	Description
0				**SURFACE COVER**: Grass/Dirt
1				
2	S	42	ML	**SAN DIEGO FORMATION:** Dark brown, moist, stiff, sandy SILT
3				
4				
5	S	33		
6				
7				
8				
9				
10	S	27		
11				
12				
13				
14				
15	S	32		
16				Boring terminated at 16.5' bgs
17				Boring backfilled with spoils upon completion
18				Groundwater not encountered
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				

Boring Number:	B-15	Boring Log Page 1 of 1	
Location:	Southern fence	Date Started:	2/12/2019
Site Address:	517 Shinohara Lane	Date Completed:	2/12/2019
	Chula Vista, California	Depth to Groundwater:	N/A
Project Number:	17-199602.7	Field Technician:	J. Eudell
Drill Rig Type:	FRASTE	**Partner Engineering and Science**	
Sampling Equipment:	6" H.S.A, SPT & Ring sampler	**2154 Torrance Boulevard, Suite 200**	
Borehole Diameter:	6"	**Torrance, California 90501**	

Depth	Sample	N-Value	USCS	Description
0				**SURFACE COVER**: Grass/dirt
1				
2	R	55	ML	**SAN DIEGO FORMATION:** Dark brown, moist, stiff, sandy SILT
3				
4				
5	S	40		Some clay present
6				
7	R	40	CL	Brown, damp, dense, silty CLAY with rocks
8				
9				
10	S	24		
11				
12				
13				
14				
15	S	24	SM	Brown, damp, dense, silty SAND
16				Boring terminated at 16.5' bgs
17				Boring backfilled with spoils upon completion
18				Groundwater not encountered
19				
20				
21				
22				
23				
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25				
26				
27				
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29				

APPENDIX B

Laboratory Test Results

PARTNER

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1641 Border Avenue • Torrance, CA 90501 T 310.618.2190 888.618.2190 F 310.618.2191 W hamilton-associates.net

A□g□□t 2, 2□□8
H□A □ro□ect □o□ □8□248□
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Partner Engineering and Science, Inc.
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Attention□ Mr□Matthe□ Marc□□, Technical Director□Geotechnical □ngineering

S□b□ect□ Laborator□Te□ting o□Soil Sa□ □le□□□artner □Ch□la □i□ta□
5□□ Shinohara Lane, Ch□la □i□ta, CA 9□9□□

Dear Mr□Marc□□□

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HAMILTON & ASSOCIATES, INC.

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□2□Brett Bo□a, bbo□a□ □artnere□i□co□

MOISTURE CONTENT AND DENSITY TESTS

Relatively undisturbed soil retained within the rings of the Modified California barrel samplers were tested in the laboratory to determine in-place dry density and moisture content. Test results are presented in Table [illegible]

DIRECT SHEAR TESTS

Direct shear (ASTM D3080) tests were performed on selected relatively undisturbed samples to determine the shear strength parameters of various soil samples, respectively. The results of these tests are shown graphically on the appended “D” plates.

ATTERBERG LIMITS

Atterberg Limits (ASTM D 4318) tests were performed on selected samples to determine the liquid limit, plastic limit, and the plasticity index of soils. Test pits at [illegible] and [illegible] feet has mostly sand with some fines, therefore non-plastic limits and Atterberg limits cannot be determined.

PARTICLE SIZE ANALYSIS WITHOUT HYDROMETER

Grain size analyses were performed on selected samples to determine soil characteristics in accordance with ASTM D422. The results of this test are shown graphically on the appended ‘G’ plates.

HAMILTON
& Associates

TABLE 1: LABORATORY RESULTS

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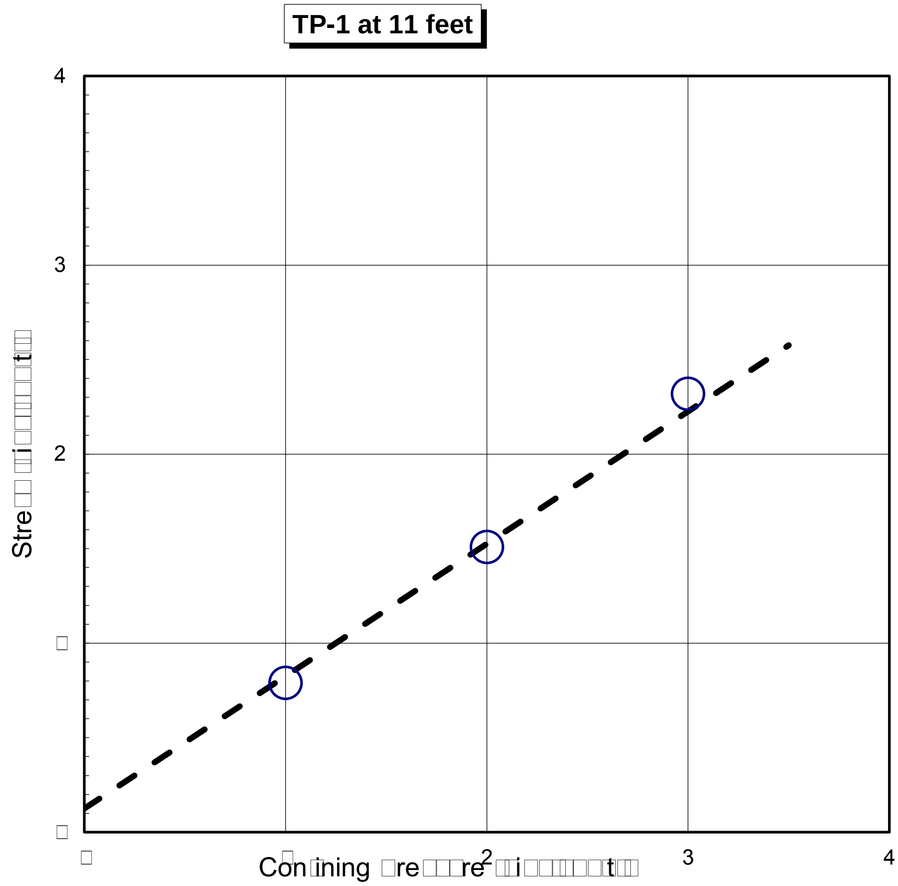
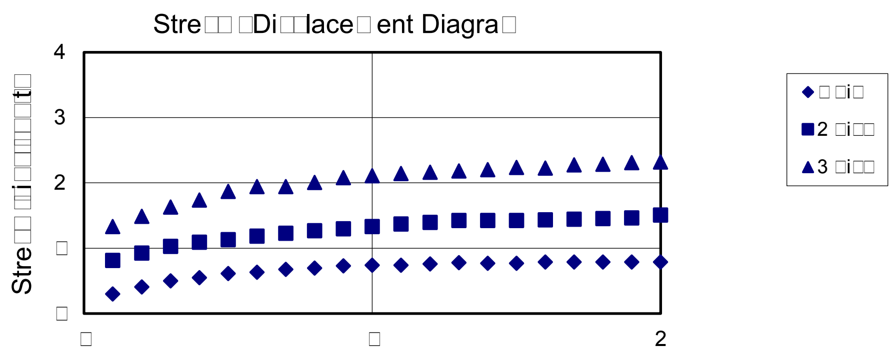
SHEAR TEST RESULTS





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HAMILTON & ASSOCIATES

HAMILTON & Associates

No. 200 Wash and Grain Analysis
ASTM D □□4□

Project Name:	**Partner (Chula Vista)**	**Tested By:**	**RM**
Project No.:	**18-2487**	**Checked By:**	
Boring No.:	**TP-1**	**Depth (ft.):**	**5.5**
Sample No.:	**N/A**	**Date:**	**8/1/2018**

Soil Description: **Tan silty sand**

Moisture Determination

Tare No.	L□34
Tare Weight (g)	3□6
Wet Weight of Soil plus Tare (g)	99□3
Oven Dried Weight of Soil plus Tare (g)	93□6
Moisture Content (%)	6□3

Grain Analysis

Post #200 Wash Mass of Oven Dried Soil for Grain Analysis plus Tare (g)	62□8	
Mass of Soil Retained on Seive (g)	3"	□□
	□ □2"	□□
	□"	□□
	3□4"	□□
	3□8"	□□
	#4	□□
	#□□	□□
	#2□	□9
	#4□	□8
	#6□	□8
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□□	□ Gra□el
66□□	□ Sand
38□9	□ □ine□

□late G□□

HAMILTON & Associates

No. 200 Wash and Grain Analysis

ASTM D □□4□

Project Name:	**Partner (Chula Vista)**	**Tested By:**	**RM**
Project No.:	**18-2487**	**Checked By:**	
Boring No.:	**TP-1**	**Depth (ft.):**	**11**
Sample No.:	**N/A**	**Date:**	**8/1/2018**

Soil Description: **Tan silty sand**

Moisture Determination

Tare No.	9□□□
Tare Weight (g)	3□□
Wet Weight of Soil plus Tare (g)	9□□9
Oven Dried Weight of Soil plus Tare (g)	86□□
Moisture Content (%)	□□□

Grain Analysis

Post #200 Wash Mass of Oven Dried Soil for Grain Analysis plus Tare (g)	62□5	
Mass of Soil Retained on Seive (g)	3"	□□□
	□ □2"	□□□
	□"	□□□
	3□4"	□□□
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	#□□□	2□□
	#□4□	□4□□
	#2□□	33□□
	□a□□#2□□	5□3

□□□	□ Gra□el
64□3	□ Sand
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HAMILTON
& Associates

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Partner Engineering and Science, Inc.
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Attention□ Mr□Matthe□ Marc□□, Technical Director□Geotechnical □ngineering

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HAMILTON & ASSOCIATES, INC.

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MOISTURE CONTENT AND DENSITY TESTS

Relati□el□ □ndi□t□rbed □oil retained □ithin the ring□o□the Modi□ied Cali□ornia barrel □a□ □ler □a□te□ted in the laborator□to deter□ine in□□lace dr□den□it□and □oi□t□re content□Te□t re□□lt□are □re□ented in Table □□

DIRECT SHEAR TESTS

Direct □hear □ASTM D3□8□□te□t□ □ere □er□or□ed on □elected relati□el□ □ndi□t□rbed □a□ □le□to deter□ine the □hear □trength □ara□eter□o□□ario□□ □oil □a□ □le□, respectively. The results of these tests are shown graphically on the appended “D” □late□□

HAMILTON & Associates

LABORATORY SCHEDULE SHEET

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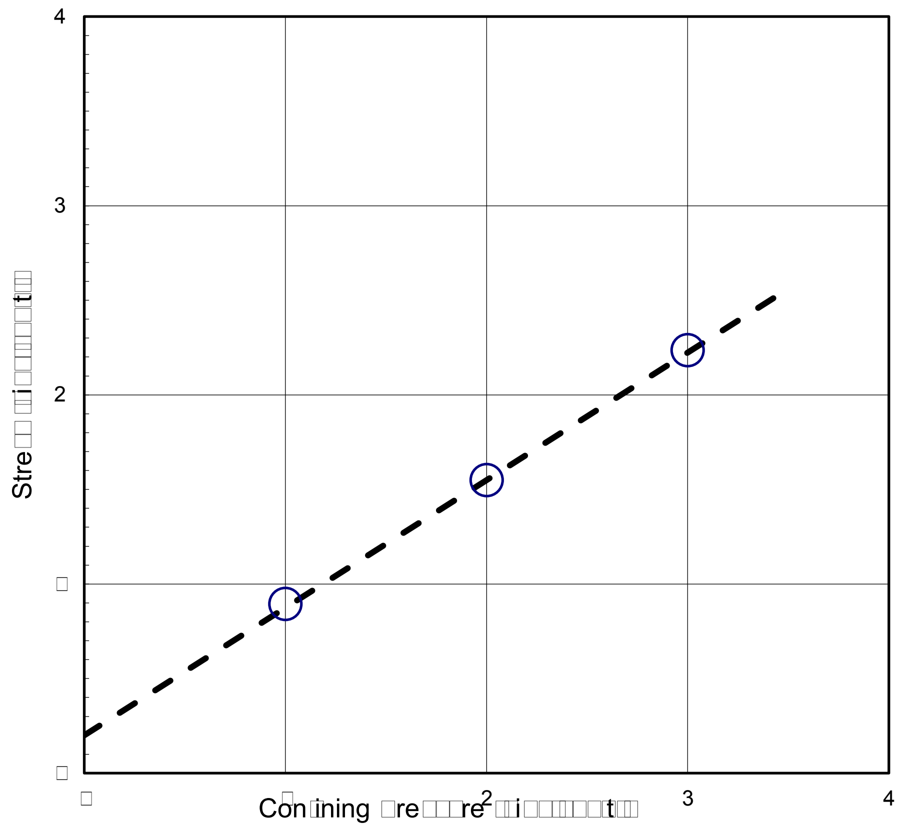
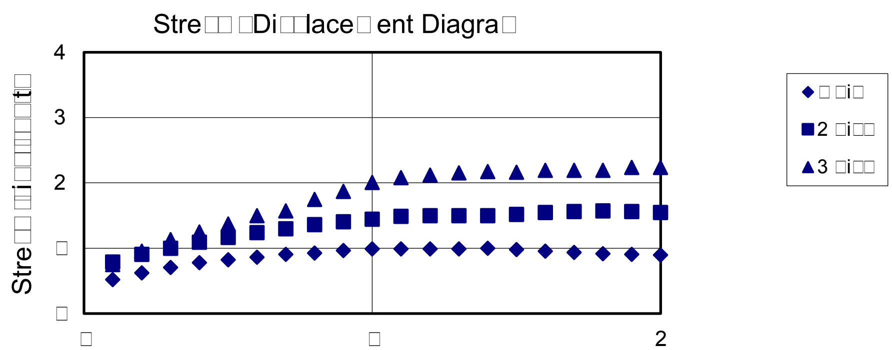
SHEAR TEST RESULTS





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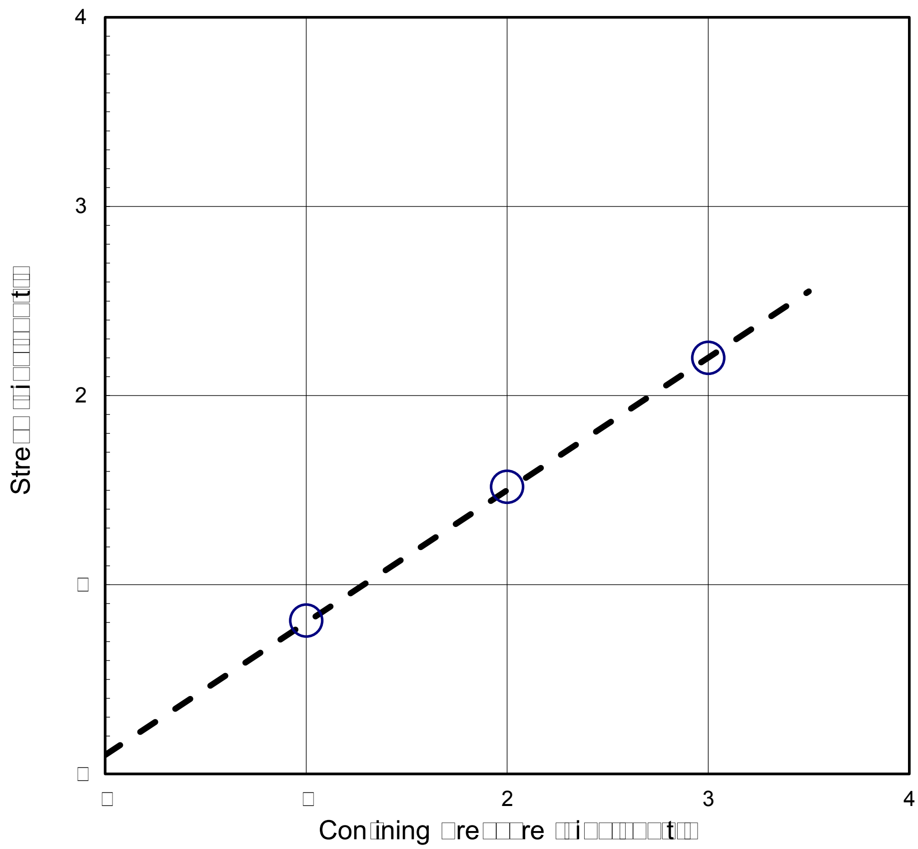
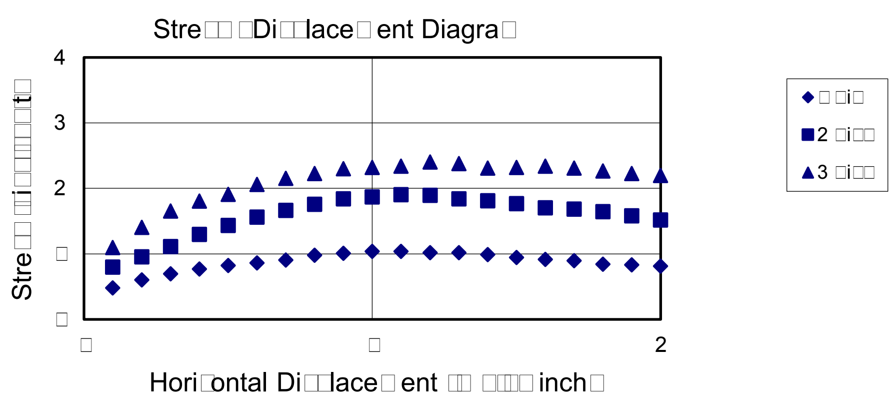
HAMILTON & ASSOCIATES

SHEAR TEST RESULTS





Silty sand samples were submerged for at least 24 hours.

The samples had a density of □□3□5 lbs/cu.ft. and a moisture content of 5□3 %

Cohesion = □□□ □□□

Friction Angle = 35 degrees

Based on Ultimate Strength

Geotechnical Engineering Investigation 5□□ Shinohara Lane Chula Vista, California	Project No. □8□248□ Plate D□2

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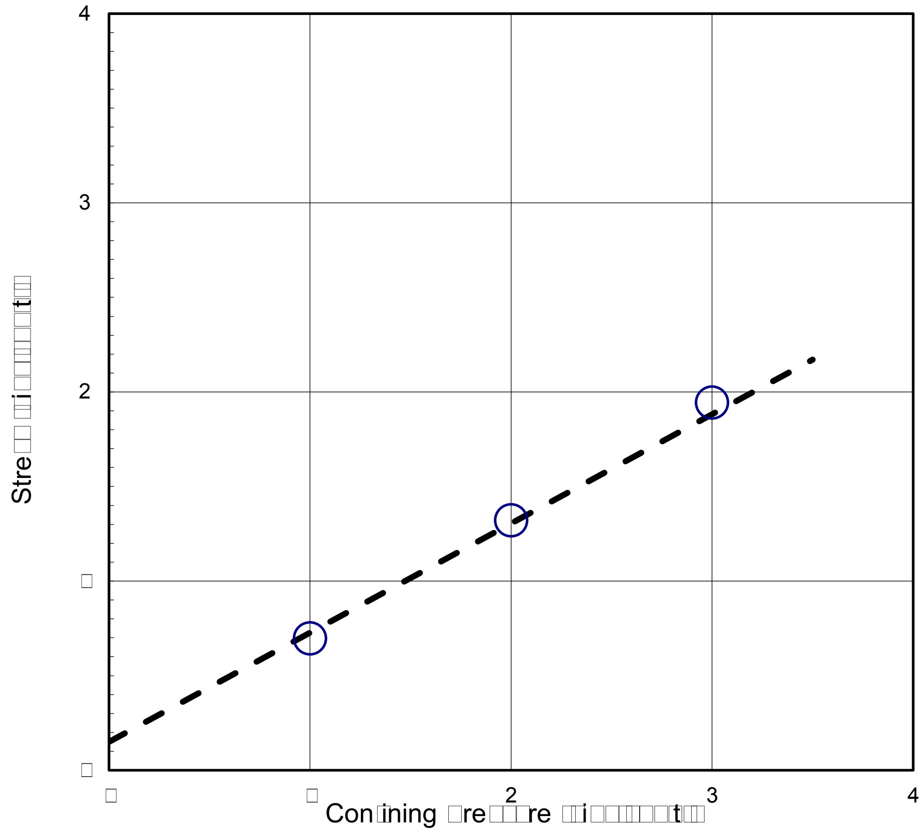
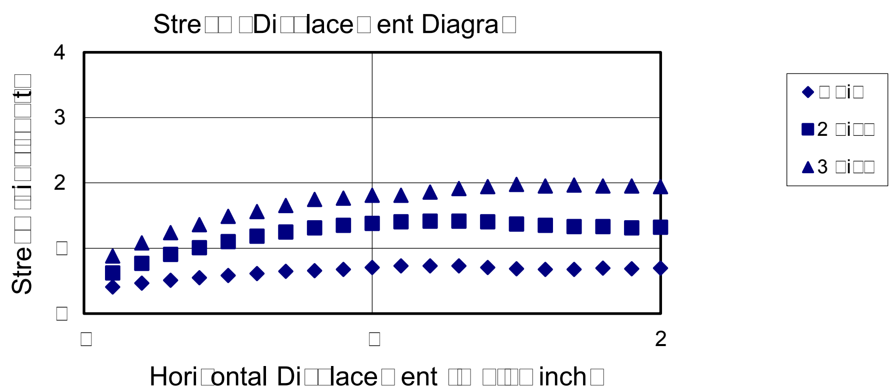
SHEAR TEST RESULTS

B-12 at 10 feet





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□riction Angle □ 3□ degree□

Ba□ed on □lti□ate Strength

Geotechnical □ngineering In□e□tigation
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HAMILTON & ASSOCIATES

APPENDIX C

General Geotechnical Design and Construction Considerations

Subgrade Preparation

Earthwork – Structural Fill/Excavations

Underground Pipeline Installation – Structural Backfill

Cast-in-Place Concrete

Foundations

Laterally Loaded Structures

Excavations and Dewatering

Waterproofing and Drainage

Chemical Treatment of Soils

Paving

Site Grading and Drainage

PARTNER

SUBGRADE PREPARATION

1. In general, construction should proceed per the project specifications and contract documents, as well as governing jurisdictional guidelines for the project site, including but not limited to the applicable State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Subgrade preparation in this section is considered to apply to the initial modifications to existing site conditions to prepare for new planned construction.
3. Prior to the start of subgrade preparation, a detailed conflict study including as-builts, utility locating, and potholing should be conducted. Existing features that are to be demolished should also be identified and the geotechnical study should be referenced to determine the need for subgrade preparation, such as over-excavation, scarification and compaction, moisture conditioning, and/or other activities below planned new structural fills, slabs on grade, pavements, foundations, and other structures.
4. The site conflicts, planned demolitions, and subgrade preparation requirements should be discussed in a pre-construction meeting with the pertinent parties, including the geotechnical engineer, inspector, contractors, testing laboratory, surveyor, and others.
5. In the event of preparations that will require work near to existing structures to remain in-place, protection of the existing structures should be considered. This also includes a geotechnical review of excavations near to existing structures and utilities and other concerns discussed in General Geotechnical Design and Construction Considerations, EARTHWORK and UNDERGROUND PIPELINE INSTALLATION.
6. Features to be demolished should be completely removed and disposed of per jurisdictional requirements and/or other conditions set forth as a part of the project. Resulting excavations or voids should be backfilled per the recommendations in the General Geotechnical Design and Construction Considerations, EARTHWORK section.
7. Vegetation, roots, soils containing organic materials, debris and/or other deleterious materials on the site should be removed from structural areas and should be disposed of as above. Replacement of such materials should be in accordance with the recommendations in the General Geotechnical Design and Construction Considerations, EARTHWORK section
8. Subgrade preparation required by the geotechnical report may also call for as over-excavation, scarification and compaction, moisture conditioning, and/or other activities below planned structural fills, slabs on grade, pavements, foundations, and other structures. These requirements should be provided within the geotechnical report. The execution of this work should be observed by the geotechnical engineering representative or inspector for the site. Testing of the subgrade preparation should be performed per the recommendations in the General Geotechnical Design and Construction Considerations, EARTHWORK section.

9. Subgrade Preparation cannot be completed on frozen ground or on ground that is not at a proper moisture condition. Wet subgrades may be dried under favorable weather if they are disked and/or actively worked during hot, dry, weather, when exposed to wind and sunlight. Frozen ground or wet material can be removed and replaced with suitable material. Dry material can be pre-soaked, or can have water added and worked in with appropriate equipment. The soil conditions should be monitored by the geotechnical engineer prior to compaction. Following this type of work, approved subgrades should be protected by direction of surface water, covering, or other methods, otherwise, re-work may be needed.

EARTHWORK – STRUCTURAL FILL

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Earthwork in this section is considered to apply to the re-shaping and grading of soil, rock, and aggregate materials for the purpose of supporting man-made structures. Where earthwork is needed to raise the elevation of the site for the purpose of supporting structures or forming slopes, this is referred to as the placement of structural fill. Where lowering of site elevations is needed prior to the installation of new structures, this is referred to as earthwork excavations.
3. Prior to the start of earthwork operations, the geotechnical study should be referenced to determine the need for subgrade preparation, such as over-excavation or scarification and compaction of unsuitable soils below planned structural fills, slabs on grade, pavements, foundations, and other structures. These required preparations should be discussed in a pre-construction meeting with the pertinent parties, including the geotechnical engineer, inspector, contractors, testing laboratory, surveyor, and others. The preparations should be observed by the inspector or geotechnical engineer representative, and following such subgrade preparation, the geotechnical engineer should observe the prepared subgrade to approve it for the placement of earthwork fills or new structures.
4. Structural fill materials should be relatively free of organic materials, man-made debris, environmentally hazardous materials, and brittle, non-durable aggregate, frozen soil, soil clods or rocks and/or any other materials that can break down and degrade over time.
5. In deeper structural fill zones, expansive soils (greater than 1.5 percent swell at 100 pounds per square foot surcharge) and rock fills (fills containing particles larger than 4 inches and/or containing more than 35 percent gravel larger than ¾-inch diameter or more than 50 percent gravel) may be used with the approval and guidance of the geotechnical report or geotechnical engineer. This may require the placement of geotextiles or other added costs and/or conditions. These conditions may also apply to corrosive soils (less than 2,000 ohm-cm resistivity, more than 50 ppm chloride content, more than 0.1 percent sulfates)
6. For structural fill zones that are closer in depth below planed structures, low expansive materials, and materials with smaller particle size are generally recommended, as directed by the geotechnical report (see criteria above in 5). This may also apply to corrosive soils.
7. For structural fill materials, in general the compaction equipment should be appropriate for the thickness of the loose lift being placed, and the thickness of the loose lift being placed should be at least two times the maximum particle size incorporated in the fill.
8. Fill lift thickness (including bedding) should generally be proportioned to achieve 95 percent or more of a standard proctor (ASTM D689) maximum dry density (MDD) or 90 percent or more of a modified proctor (ASTM D1557) MDD, depending on the state practices. For subgrades below

roadways, the general requirement for soil compaction is usually increased to 100 percent or more of the standard proctor MDD and 95 percent or more of the modified proctor MDD.

9. Soil compaction should be performed at a moisture content generally near optimum moisture content determined by either standard or modified proctor, and ideally within 3 percent below to 1 percent over the optimum for a standard proctor, and from 2 percent below to 2 percent above optimum for a modified proctor.
10. In some instances fill areas are difficult to access. In such cases a low-strength soil-cement slurry can be used in the place of compacted fill soil. In general such fills should be rated to have a 28-day strength of 75 to 125 psi, which in some areas is referred to as a "1-sack" slurry. It should be noted that these materials are wet during placement, and require a period of 2 days (24 hours) to cure before additional fill can be placed above them. Testing of this material can be done using concrete cylinder compression strength testing equipment, but care is needed in removing the test specimens from the molds. Field testing using the ball method, and spread or flow testing is also acceptable.
11. For fills to be placed on slopes, benching of fill lifts is recommended, which may require cutting into existing slopes to create a bench perpendicular to the slope where soil can be placed in a relatively horizontal orientation. For the construction of slopes, the slopes should be over-built and cut back to grade, as the material in the outer portion of the slope may not be well compacted.
12. For subgrade below roadways, runways, railways or other areas to receive dynamic loading, a proofroll of the finished, compacted subgrade should be performed by the geotechnical engineer or inspector prior to the placement of structural aggregate, asphalt or concrete. Proofrolling consists of observing the performance of the subgrade under heavy-loaded equipment, such as full, 4,000 Gallon water truck, loaded tandem-axel dump truck or similar. Areas that exhibit instability during proofroll should be marked for additional work prior to approval of the subgrade for the next stage of construction.
13. Quality control testing should be provided on earthwork. Proctor testing should be performed on each soil type, and one-point field proctors should be used to verify the soil types during compaction testing. If compaction testing is performed with a nuclear density gauge, it should be periodically correlated with a sand cone test for each soil type. Density testing should be performed per project specifications and or jurisdictional requirements, but not less than once per 12 inches elevation of any fill area, with additional tests per 12-inch fill area for each additional 7,500 square-foot section or portion thereof.
14. For earthwork excavations, OSHA guidelines should be referenced for sloping and shoring. Excavations over a depth of 20 feet require a shoring design. In the event excavations are planned near to existing structures, the geotechnical engineer should be consulted to evaluate whether such excavation will call for shoring or underpinning the adjacent structure. Pre-construction and post-construction condition surveys and vibration monitoring might also be helpful to evaluate any potential damage to surrounding structures.
15. Excavations into rock, partially weathered rock, cemented soils, boulders and cobbles, and other hard soil or "hard-pan" materials, may result in slower excavation rates, larger equipment with

specialized digging tools, and even blasting. It is also not unusual in these situations for screening and or crushing of rock to be called for. Blasting, hard excavating, and material processing equipment have special safety concerns and are more costly than the use of soil excavation equipment. Additionally, this type of excavation, especially blasting, is known to cause vibrations that should be monitored at nearby structures. As above, a pre-blast and post-blast conditions assessment might also be warranted.

UNDERGROUND PIPELINE – STRUCTURAL BACKFILL

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable State Department of Transportation, the State Department of Environmental Quality, the US Environmental Protection Agency, City and/or County Public Works, Occupational Safety and Health Administration (OSHA), Private Utility Companies, and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered, and in some cases work may take place to multiple different standards. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Underground pipeline in this section is considered to apply to the installation of underground conduits for water, storm water, irrigation water, sewage, electricity, telecommunications, gas, etc. Structural backfill refers to the activity of restoring the grade or establishing a new grade in the area where excavations were needed for the underground pipeline installation.
3. Prior to the start of underground pipeline installation, a detailed conflict study including as-builts, utility locating, and potholing should be conducted. The geotechnical study should be referenced to determine subsurface conditions such as caving soils, unsuitable soils, shallow groundwater, shallow rock and others. In addition, the utility company responsible for the line also will have requirements for pipe bedding and support as well as other special requirements. Also, if the underground pipeline traverses other properties, rights-of-way, and/or easements etc. (for roads, waterways, dams, railways, other utility corridors, etc.) those owners may have additional requirements for construction.
4. The required preparations above should be discussed in a pre-construction meeting with the pertinent parties, including the geotechnical engineer, inspector, contractors, testing laboratory, surveyor, and other stake holders.
5. For pipeline excavations, OSHA guidelines should be referenced for sloping and shoring. Excavations over a depth of 20 feet require a shoring design. In the event excavations are planned near to existing structures or pipelines, the geotechnical engineer should be consulted to evaluate whether such excavation will call for shoring or supporting the adjacent structure or pipeline. A pre-construction and post-construction condition survey and vibration monitoring might also be helpful to evaluate any potential damage to surrounding structures.
6. Excavations into rock, partially weathered rock, cemented soils, boulders and cobbles, and other hard soil or "hard-pan" materials, may result in slower excavation rates, larger equipment with specialized digging tools, and even blasting. It is also not unusual in these situations for screening and or crushing of rock to be called for. Blasting, hard excavating and material processing equipment have special safety concerns and are more costly than the use soil excavation equipment. Additionally, this type of excavation, especially blasting, is known to cause vibrations that should be monitored at nearby structures. As above, a pre-blast and post-blast conditions assessment might also be warranted.
7. Bedding material requirements vary between utility companies and might depend of the type of pipe material and availability of different types of aggregates in different locations. In

general, bedding refers to the material that supports the bottom of the pipe, and extends to 1 foot above the top of the pipe. In general the use of aggregate base for larger diameter pipes (6-inch diameter or more) is recommended lacking a jurisdictionally specified bedding material. Gas lines and smaller diameter lines are often backfilled with fine aggregate meeting the ASTM requirements for concrete sand. In all cases bedding with less than 2,000 ohm-cm resistivity, more than 50 ppm chloride content or more than 0.1 percent sulfates should not be used.

8. Structural backfill materials above the bedding should be relatively free of organic materials, man-made debris, environmentally hazardous materials, frozen material, and brittle, non-durable aggregate, soil clods or rocks and/or any other materials that can break down and degrade over time.
9. In general the backfill soil requirements will depend on the future use of the land above the buried line, but in most cases, excessive settlement of the pipe trench is not considered advisable or acceptable. As such, the structural backfill compaction equipment should be appropriate for the thickness of the loose lift being placed. The thickness of the loose lift being placed should be at least two times the maximum particle size incorporated in the fill. Care should be taken not to damage the pipe during compaction or compaction testing.
10. Fill lift thickness (including bedding) should generally be proportioned to achieve 95 percent or more of a standard proctor (ASTM D689) maximum dry density (MDD) or 90 percent or more of a modified proctor (ASTM D1557) MDD, depending on the state practices (in general the modified proctor is required in California and for projects in the jurisdiction of the Army Corps of Engineers). For backfills within the upper poritons of roadway subgrades, the general requirement for soil compaction is usually increased to 100 percent or more of the standard proctor MDD and 95 percent or more of the modified proctor MDD.
11. Soil compaction should be performed at a moisture content generally near optimum moisture content determined by either standard or modified proctor, and ideally within 3 percent below to 1 percent over the optimum for a standard proctor, and from 2 percent below to 2 percent above optimum for a modified proctor.
12. In some instances fill areas are difficult to access. In such cases a low-strength soil-cement slurry can be used in the place of compacted fill soil. In general such fills should be rated to have a 28-day strength of 75 to 125 psi, which in some areas is referred to as a "1-sack" slurry. It should be noted that these materials are wet, and require a period of 2 days (24 hours) to cure before additional fill can be placed above it. Testing of this material can be done using concrete cylinder compression strength testing equipment, but care is needed in removing the test specimens from the molds. Field testing using the ball method, and spread or flow testing is also acceptable.
13. Quality control testing should be provided on structural backfill to assist the contractor in meeting project specifications. Proctor testing should be performed on each soil type, and one-point field proctors should be used to verify the soil types during compaction testing. If compaction testing is performed with a nuclear density gauge, it should be periodically correlated with a sand cone test for each soil type.

14. Density testing should be performed on structural backfill per project specifications and or jurisdictional requirements, but not less than once per 12 inches elevation in each area, and additional tests for each additional 500 linear-foot section or portion thereof.

CAST-IN-PLACE CONCRETE SLABS-ON-GRADE/STRUCTURES/PAVEMENTS

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Cast-in-place concrete (concrete) in this section is considered to apply to the installation of cast-in-place concrete slabs on grade, including reinforced and non-reinforced slabs, structures, and pavements.
3. In areas where concrete is bearing on prepared subgrade or structural fill soils, testing and approval of this work should be completed prior to the beginning of concrete construction.
4. In locations where a concrete is approved to bear on in-place (native) soil or in locations where approved documented fills have been exposed to weather conditions after approval, a concrete subgrade evaluation should be performed prior to the placement of reinforcing steel and or concrete. This can consist of probing with a "t"-handled rod, borings, penetrometer testing, dynamic cone penetration testing and/or other methods requested by the geotechnical engineer and/or inspector. Where unsuitable, wet, or frozen bearing material is encountered, the geotechnical engineer should be consulted for additional recommendations.
5. Slabs on grade should be placed on a 4-inch thick or more capillary barrier consisting of non-corrosive (more than 2,000 ohm-cm resistivity, less than 50 ppm chloride content and less than 0.1 percent sulfates) aggregate base or open-graded aggregate material. This material should be compacted or consolidated per the recommendations of the structural engineer or otherwise would be covered by the General Considerations for EARTHWORK.
6. Depending on the site conditions and climate, vapor barriers may be required below in-door grade-slabs to receive flooring. This reduces the opportunity for moisture vapor to accumulate in the slab, which could degrade flooring adhesive and result in mold or other problems. Vapor barriers should be specified by the structural engineer and/or architect. The installation of the barrier should be inspected to evaluate the correct product and thickness is used, and that it has not been damaged or degraded.
7. At times when rainfall is predicted during construction, a mud-mat or a thin concrete layer can be placed on prepared and approved subgrades prior to the placement of reinforcing steel or tendons. This serves the purpose of protecting the subgrades from damage once the reinforcement placement has begun.
8. Prior to the placement of concrete, exposed subgrade or base material and forms should be wetted, and form release compounds should be applied. Reinforcement support stands or ties should be

checked. Concrete bases or subgrades should not be so wet that they are softened or have standing water.

9. For a cast-in-place concrete, the form dimensions, reinforcement placement and cover, concrete mix design, and other code requirements should be carefully checked by an inspector before and during placement. The reinforcement should be specified by the structural engineering drawings and calculations.
10. For post-tension concrete, an additional check of the tendons is needed, and a tensioning inspection form should be prepared prior to placement of concrete.
11. For Portland cement pavements, forms an additional check of reinforcing dowels should performed per the design drawings.
12. During placement, concrete should be tested, and should meet the ACI and jurisdictional requirements and mix design targets for slump, air entrainment, unit weight, compressive strength, flexural strength (pavements), and any other specified properties. In general concrete should be placed within 90 minutes of batching at a temperature of less than 90 degrees Fahrenheit. Adding of water to the truck on the jobsite is generally not encouraged.
13. Concrete mix designs should be created by the accredited and jurisdictionally approved supplier to meet the requirements of the structural engineer. In general a water/cement ratio of 0.45 or less is advisable, and aggregates, cement, flyash, and other constituents should be tested to meet ASTM C-33 standards, including Alkali Silica Reaction (ASR). To further mitigate the possibility of concrete degradation from corrosion and ASR, Type II or V Portland Cement should be used, and fly ash replacement of 25 percent is also recommended. Air entrained concrete should be used in areas where concrete will be exposed to frozen ground or ambient temperatures below freezing.
14. Control joints are recommended to improve the aesthetics of the finished concrete by allowing for cracking within partially cut or grooved joints. The control joints are generally made to depths of about 1/4 of the slab thickness and are generally completed within the first day of construction. The spacing should be laid out by the structural engineer, and is often in a square pattern. Joint spacing is generally 5 to 15 feet on-center but this can vary and should be decided by the structural engineer. For pavements, construction joints are generally considered to function as control joints. Post-tensioned slabs generally do not have control joints.
15. Some slabs are expected to meet flatness and levelness requirements. In those cases, testing for flatness and levelness should be completed as soon as possible, usually the same day as concrete placement, and before cutting of control joints if possible. Roadway smoothness can also be measured, and is usually specified by the jurisdictional owner if is required.
16. Prior to tensioning of post-tension structures, placement of soil backfills or continuation of building on newly-placed concrete, a strength requirement is generally required, which should be specified by the structural engineer. The strength progress can be evaluated by the use of concrete compressive strength cylinders or maturity monitoring in some jurisdictions. Advancing with backfill, additional concrete work or post-tensioning without reaching strength benchmarks could result in damage and failure of the concrete, which could result in danger and harm to nearby people and property.

17. In general, concrete should not be exposed to freezing temperatures in the first 7 days after placement, which may require insulation or heating. Additionally, in hot or dry, windy weather, misting, covering with wet burlap or the use of curing compounds may be called for to reduce shrinkage cracking and curling during the first 7 days.

FOUNDATIONS

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Foundations in this section are considered to apply to the construction of structural supports which directly transfer loads from man-made structures into the earth. In general, these include shallow foundations and deep foundations. Shallow foundations are generally constructed for the purpose of distributing the structural loads horizontally over a larger area of earth. Some types of shallow foundations (or footings) are spread footings, continuous footings, mat foundations, and reinforced slabs-on-grade. Deep foundations are generally designed for the purpose of distributing the structural loads vertically deeper into the soil by the use of end bearing and side friction. Some types of deep foundations are driven piles, auger-cast piles, drilled shafts, caissons, helical piers, and micro-piles.
3. For shallow foundations, the minimum bearing depth considered should be greater than the maximum design frost depth for the location of construction. This can be found on frost depth maps (ICC), but the standard of practice in the city and/or county should also be consulted. In general the bearing depth should never be less than 18 inches below planned finished grades.
4. Shallow continuous foundations should be sized with a minimum width of 18 inches and isolated spread footings should be a minimum of 24 inches in each direction. Foundation sizing, spacing, and reinforcing steel design should be performed by a qualified structural engineer.
5. The geotechnical engineer will provide an estimated bearing capacity and settlement values for the project based on soil conditions and estimated loads provided by the structural engineer. It is assumed that appropriate safety factors will be applied by the structural engineer.
6. In areas where shallow foundations are bearing on prepared subgrade or structural fill soils, testing and approval of this work should be completed prior to the beginning of foundation construction.
7. In locations where the shallow foundations are approved to bear on in-place (native) soil or in locations where approved documented fills have been exposed to weather conditions after approval, a foundation subgrade evaluation should be performed prior to the placement of reinforcing steel. This can consist of probing with a “t”-handled rod, borings, penetrometer testing, dynamic cone penetration testing and/or other methods requested by the geotechnical engineer and/or inspector. Where unsuitable foundation bearing material is encountered, the geotechnical engineer should be consulted for additional recommendations.
8. For shallow foundations to bear on rock, partially weathered rock, hard cemented soils, and/or boulders, the entire foundation system should bear directly on such material. In this case, the rock surface should be prepared so that it is clean, competent, and formed into a roughly horizontal, stepped base. If that is not possible, then the entire structure should be underlain by a zone of

structural fill. This may require the over-excavation in areas of rock removal and/or hard dig. In general this zone can vary in thickness but it should be a minimum of 1 foot thick. The geotechnical engineer should be consulted in this instance.

9. At times when rainfall is predicted during construction, a mud-mat or a thin concrete layer can be placed on prepared and approved subgrades prior to the placement of reinforcing steel. This serves the purpose of protecting the subgrades from damage once the reinforcing steel placement has begun.
10. For cast-in-place concrete foundations, the excavations dimensions, reinforcing steel placement and cover, structural fill compaction, concrete mix design, and other code requirements should be carefully checked by an inspector before and during placement.

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11. For deep foundations, the geotechnical engineer will generally provide design charts that provide foundations axial capacity and uplift resistance at various depths given certain-sized foundations. These charts may be based on blow count data from drilling and or laboratory testing. In general safety factors are included in these design charts by the geotechnical engineer.
12. In addition, the geotechnical engineer may provide other soil parameters for use in the lateral resistance analysis. These parameters are usually raw data, and safety factors should be provided by the shaft designer. Sometimes, direct shear and or tri-axial testing is performed for this analysis.
13. In general the spacing of deep foundations is expected to be 6 shaft diameters or more. If that spacing is reduced, a group reduction factor should be applied by the structural engineer to the foundation capacities per FHWA guidelines. The spacing should not be less than 2.5 shaft diameters.
14. For deep foundations, a representative of the geotechnical engineer should be on-site to observe the excavations (if any) to evaluate that the soil conditions are consistent with the findings of the geotechnical report. Soil/rock stratigraphy will vary at times, and this may result in a change in the planned construction. This may require the use of fall protection equipment to perform observations close to an open excavation.
15. For driven foundations, a representative of the geotechnical engineer should be on-site to observe the driving process and to evaluate that the resistance of driving is consistent with the design assumptions. Soil/rock stratigraphy will vary at times and may this may result in a change in the planned construction.
16. For deep foundations, the size, depth, and ground conditions should be verified during construction by the geotechnical engineer and/or inspector responsible. Open excavations should be clean, with any areas of caving and groundwater seepage noted. In areas below the groundwater table, or areas where slurry is used to keep the trench open, non-destructive testing techniques should be used as outlined below.
17. Steel members including structural steel piles, reinforcing steel, bolts, threaded steel rods, etc. should be evaluated for design and code compliance prior to pick-up and placement in the foundation. This includes verification of size, weight, layout, cleanliness, lap-splices, etc. In addition, if non-destructive testing such as crosshole sonic logging or gamma-gamma logging is required, access tubes should be attached to the steel reinforcement prior to placement, and should be

relatively straight, capped at the bottom, and generally kept in-round. These tubes must be filled with water prior to the placement of concrete.

18. In cases where steel welding is required, this should be observed by a certified welding inspector.
19. In many cases, a crane will be used to lower steel members into the deep foundations. Crane picks should be carefully planned, including the ground conditions at placement of outriggers, wind conditions, and other factors. These are not generally provided in the geotechnical report, but can usually be provided upon request.
20. Cast-in-place concrete, grout or other cementations materials should be pumped or distributed to the bottom of the excavation using a tremmie pipe or hollow stem auger pipe. Depending on the construction type, different mix slumps will be used. This should be carefully checked in the field during placement, and consolidation of the material should be considered. Use of a vibrator may be called for.
21. For work in a wet excavation (slurry), the concrete placed at the bottom of the excavation will displace the slurry as it comes up. The upper layer of concrete that has interacted with the slurry should be removed and not be a part of the final product.
22. Bolts or other connections to be set in the top after the placement is complete should be done immediately after final concrete placement, and prior to the on-set of curing.
23. For shafts requiring crosshole sonic logging or gamma-gamma testing, this should be performed within the first week after placement, but not before a 2 day curing period. The testing company and equipment manufacturer should provide more details on the requirements of the testing.
24. Load testing of deep foundations is recommended, and it is often a project requirement. In some cases, if test piles are constructed and tested, it can result in a significant reduction of the amount of needed foundations. The load testing frame and equipment should be sized appropriately for the test to be performed, and should be observed by the geotechnical engineer or inspector as it is performed. The results are provided to the structural engineer for approval.

LATERALLY LOADED STRUCTURES - RETAINING WALLS/SLOPES/DEEP FOUNDATIONS/MISCELLANEOUS

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Laterally loaded structures for this section are generally meant to describe structures that are subjected to loading roughly horizontal to the ground surface. Such structures include retaining walls, slopes, deep foundations, tall buildings, box culverts, and other buried or partially buried structures.
3. The recommendations put forth in General Geotechnical Design and Construction Considerations for FOUNDATIONS, CAST-IN-PLACE CONCRETE, EARTHWORK, and SUBGRADE PREPARATION should be reviewed, as they are not all repeated in this section, but many of them will apply to the work. Those recommendations are incorporated by reference herein.
4. Laterally loaded structures are generally affected by overburden pressure, water pressure, surcharges, and other static loads, as well as traffic, seismic, wind, and other dynamic loads. The structural engineer must account for these loads. In addition, eccentric loading of the foundation should be evaluated and accounted for by the structural engineer. The structural engineer is also responsible for applying the appropriate factors of safety to the raw data provided by the geotechnical engineer.
5. The geotechnical report should provide data regarding soil lateral earth pressures, seismic design parameters, and groundwater levels. In the report the pressures are usually reported as raw data in the form of equivalent fluid pressures for three cases. 1. Static is for soil pressure against a structure that is fixed at top and bottom, like a basement wall or box culvert. 2. Active is for soil pressure against a wall that is free to move at the top, like a retaining wall. 3. Passive is for soil that is resisting the movement of the structure, usually at the toe of the wall where the foundation and embedded section are located. The structural engineer is responsible for deciding on safety factors for design parameters and groundwater elevations based on the raw data in the geotechnical report.
6. Generally speaking, direct shear or tri-axial shear testing should be performed for this evaluation in cases of soil slopes or unrestrained soil retaining walls over 6 feet in height or in lower walls in some cases based on the engineer's judgment. For deep foundations and completely buried structures, this testing will be required per the discretion of the structural engineer.
7. For non-confined retaining walls (walls that are not attached at the top) and slopes, a geotechnical engineer should perform overall stability analysis for sliding, overturning, and global stability. For walls that are structurally restrained at the top, the geotechnical engineer does not generally perform this analysis. Internal wall stability should be designed by the structural engineer.

8. Cut slopes into rock should be evaluated by an engineering geologist, and rock coring to identify the orientation of fracture plans, faults, bedding planes, and other features should be performed. An analysis of this data will be provided by the engineering geologist to identify modes of failure including sliding, wedge, and overturning, and to provide design and construction recommendations.
9. For laterally loaded deep foundations that support towers, bridges or other structures with high lateral loads, geotechnical reports generally provide parameters for design analysis which is performed by the structural engineer. The structural engineer is responsible for applying appropriate safety factors to the raw data from the geotechnical engineer.
10. Construction recommendations for deep foundations can be found in the General Geotechnical Design and Construction Considerations-FOUNDATIONS section.
11. Construction of retaining walls often requires temporary slope excavations and shoring, including soil nails, soldier piles and lagging or laid-back slopes. This should be done per OSHA requirements and may require specialty design and contracting.
12. In general, surface water should not be directed over a slope or retaining wall, but should be captured in a drainage feature trending parallel to the slope, with an erosion protected outlet to the base of the wall or slope.
13. Waterproofing for retaining walls is generally required on the backfilled side, and they should be backfilled with an 18-inch zone of open graded aggregate wrapped in filter fabric or a synthetic draining product, which outlets to weep holes or a drain at the base of the wall. The purpose of this zone, which is immediately behind the wall is to relieve water pressures from building behind the wall.
14. Backfill compaction around retaining walls and slopes requires special care. Lighter equipment should be considered, and consideration to curing of cementitious materials used during construction will be called for. Additionally, if mechanically stabilized earth walls are being constructed, or if tie-backs are being utilized, additional care will be necessary to avoid damaging or displacing the materials. Use of heavy or large equipment, and/or beginning of backfill prior to concrete strength verification can create dangers to construction and human safety. Please refer to the General Geotechnical Design and Construction Considerations-CAST-IN-PLACE CONCRETE section. These concerns will also apply to the curing of cell grouting within reinforced masonry walls.
15. Usually safety features such as handrails are designed to be installed at the top of retaining walls and slopes. Prior to their installation, workers in those areas will need to be equipped with appropriate fall protection equipment.

EXCAVATION AND DEWATERING

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Excavation and Dewatering for this section are generally meant to describe structures that are intended to create stable, excavations for the construction of infrastructure near to existing development and below the groundwater table.
3. The recommendations put forth in General Geotechnical Design and Construction Considerations for LATERALLY LOADED STRUCTURES, FOUNDATIONS, CAST-IN-PLACE CONCRETE, EARTHWORK, and SUBGRADE PREPARATION should be reviewed, as they are not all repeated in this section, but many of them will apply to the work. Those recommendations are incorporated by reference herein.
4. The site excavations will generally be affected by overburden pressure, water pressure, surcharges, and other static loads, as well as traffic, seismic, wind, and other dynamic loads. The structural engineer must account for these loads as described in Section of this report. In addition, eccentric loading of the foundation should be evaluated and accounted for by the structural engineer. The structural engineer is also responsible for applying the appropriate factors of safety to the raw data provided by the geotechnical engineer.
5. The geotechnical report should provide data regarding soil lateral earth pressures, seismic design parameters, and groundwater levels. In the report the pressures are usually reported as raw data in the form of equivalent fluid pressures for three cases. 1. Static is for soil pressure against a structure that is fixed at top and bottom, like a basement wall or box culvert. 2. Active is for soil pressure against a wall that is free to move at the top, like a retaining wall. 3. Passive is for soil that is resisting the movement of the structure, usually at the toe of the wall where the foundation and embedded section are located. The structural engineer is responsible for deciding on safety factors for design parameters and groundwater elevations based on the raw data in the geotechnical report.
6. The parameters provided above are based on laboratory testing and engineering judgement. Since numerous soil layers with different properties will be encountered in a large excavation, assumptions and judgement are used to generate the equivalent fluid pressures to be used in design. Factors of safety are not included in those numbers and should be evaluated prior to design.
7. Groundwater, if encountered will dramatically change the stability of the excavation. In addition, pumping of groundwater from the bottom of the excavation can be difficult and costly, and it can result in potential damage to nearby structures if groundwater drawdown occurs. As such, we recommend that groundwater monitoring be performed across the site during design and prior to construction to assist in the excavation design and planning.
8. Groundwater pumping tests should be performed if groundwater pumping will be needed during construction. The pumping tests can be used to estimate drawdown at nearby properties, and also

will be needed to determine the hydraulic conductivity of the soil for the design of the dewatering system.

9. For excavation stabilization in granular and dense soil, the use of soldier piles and lagging is recommended. The soldier pile spacing and size should be determined by the structural engineer based on the lateral loads provided in the report. In general, the spacing should be more than two pile diameters, and less than 8 feet. Soldier piles should be advanced 5 feet or more below the base of the excavation. Passive pressures from Section can be used in the design of soldier piles for the portions of the piles below the excavation.
10. If the piles are drilled, they should be grouted in-place. If below the groundwater table, the grouting should be accomplished by tremmie pipe, and the concrete should be a mix intended for placement below the groundwater table. For work in a wet excavation, the concrete placed at the bottom of the excavation will displace the water as it comes up. The upper layer of concrete that has interacted with the water should be removed and not be a part of the final product. Lagging should be specially designed timber or other lagging. The temporary excavation will need to account for seepage pressures at the toe of the wall as well as hydrostatic forces behind the wall.
11. Depending on the loading, tie back anchors and/or soil nails may be needed. These should be installed beyond the failure envelope of the wall. This would be a plane that is rotated upward 60 degrees from horizontal. The strength of the anchors behind this plane should be considered, and bond strength inside the plane should be ignored. If friction anchors are used, they should extend 10 feet or more beyond the failure envelope. Evaluation of the anchor length and encroachment onto other properties, and possible conflicts with underground utilities should be carefully considered. Anchors are typically installed 25 to 40 degrees below horizontal. The capacity of the anchors should be checked on 10% of locations by loading to 200% of the design strength. All should be loaded to 120% of design strength, and should be locked off at 80%
12. The shoring and tie backs should be designed to allow less than ½ inch of deflection at the top of the excavation wall, where the wall is within an imaginary 1:1 line extending downward from the base of surrounding structures. This can be expanded to 1 inch of deflection if there is no nearby structure inside that plane. An analysis of nearby structures to locate their depth and horizontal position should be conducted prior to shored excavation design.
13. Assuming that the excavations will encroach below the groundwater table, allowances for drainage behind and through the lagging should be made. The drainage can be accomplished by using an open-graded gravel material that is wrapped in geotextile fabric. The lagging should allow for the collected water to pass through the wall at select locations into drainage trenches below the excavation base. These trenches should be considered as sump areas where groundwater can be pumped out of the excavation.
14. The pumped groundwater needs to be handled properly per jurisdictional guidelines.
15. In general, surface water should not be directed over a slope or retaining wall, but should be captured in a drainage feature trending parallel to the slope, with an erosion protected outlet to the base of the wall or slope.

16. Safety features such as handrails or barriers are to be designed to be installed at the top of retaining walls and slopes. Prior to their installation, workers in those areas will need to be equipped with appropriate fall protection equipment.

Waterproofing and Back Drainage

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Waterproofing and Back drainage structures for this section are generally meant to describe permanent subgrade structures that are planned to be below the historic high groundwater elevation of 20 feet below existing grades.
3. The recommendations put forth in General Geotechnical Design and Construction Considerations for FOUNDATIONS, CAST-IN-PLACE CONCRETE, EARTHWORK, and SUBGRADE PREPARATION should be reviewed, as they are not all repeated in this section, but many of them will apply to the work. Those recommendations are incorporated by reference herein.
4. In general, surface water should not be directed over a slope or retaining wall, but should be captured in a drainage feature trending parallel to the slope, with an erosion protected outlet to the base of the wall or slope.
5. Waterproofing for retaining walls is generally required on the backfilled side, and they should be backfilled with an 18-inch zone of open graded aggregate wrapped in filter fabric or a synthetic draining product, which outlets to weep holes or a drain at the base of the wall. The purpose of this zone, which is immediately behind the wall is to relieve water pressures from building behind the wall.
6. For the basement walls on this site, sump pumps will be needed to reduce the build-up of water in the basement. The design should be for a historic high groundwater level of 20 feet bgs. The pumping system should be designed to keep the slab and walls relatively dry so that mold, efflorescence, and other detrimental effects to the concrete structure will not result.
7. Backfill compaction around retaining walls and slopes requires special care. Lighter equipment should be considered, and consideration to curing of cementitious materials used during construction will be called for. Additionally, if mechanically stabilized earth walls are being constructed, or if tie-backs are being utilized, additional care will be necessary to avoid damaging or displacing the materials. Use of heavy or large equipment, and/or beginning of backfill prior to concrete strength verification can create dangers to construction and human safety. Please refer to the General Geotechnical Design and Construction Considerations-CAST-IN-PLACE CONCRETE section. These concerns will also apply to the curing of cell grouting within reinforced masonry walls.

CHEMICAL TREATMENT OF SOIL

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, State Department of Environmental Quality, the US Environmental Protection Agency, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Chemical treatment of soil for this section is generally meant to describe the process of improving soil properties for a specific purpose, using cement or chemical lime.
3. A mix design should be performed by the geotechnical engineer to help it meet the specific strength, plasticity index, durability, and/or other desired properties. The mix design should be performed using the proposed chemical lime or cement proposed for use by the contractor, along with samples of the site soil that are taken from the material to be used in the process.
4. For the mix design the geotechnical engineer should perform proctor testing to determine optimum moisture content of the soil, and then mix samples of the soil at 3 percent above optimum moisture content with varying concentrations of lime or cement. The samples will be prepared and cured per ASTM standards, and then after 7-days for curing, they will be tested for compression strength. Durability testing goes on for 28 days.
5. Following this testing, the geotechnical engineer will provide a recommended mix ratio of cement or chemical lime in the geotechnical report for use by the contractor. The geotechnical engineer will generally specify a design ratio of 2 percent more than the minimum to account for some error during construction.
6. Prior to treatment, the in-place soil moisture should be measured so that the correct amount of water can be used during construction. Work should not be performed on frozen ground.
7. During construction, special considerations for construction of treated soils should be followed. The application process should be conducted to prevent the loss of the treatment material to wind which might transport the materials off site, and workers should be provided with personal protective equipment for dust generated in the process.
8. The treatment should be applied evenly over the surface, and this can be monitored by use of a pan placed on the subgrade. This can also be tested by preparing test specimens from the in-place mixture for laboratory testing.
9. Often, after or during the chemical application, additional water may be needed to activate the chemical reaction. In general, it should be maintained at about 3 percent or more above optimum moisture. Following this, mixing of the applied material is generally performed using specialized equipment.
10. The total amount of chemical provided can be verified by collecting batch tickets from the delivery trucks, and the depth of the treatment can be verified by digging of test pits, and the use of reagents that react with lime and or cement.

11. For the use of lime treatment, compaction should be performed after a specified amount of time has passed following mixing and re-grading. For concrete, compaction should be performed immediately after mixing and re-grading. In both cases, some swelling of the surface should be expected. Final grading should be performed the following day of the initial work for lime treatment, and within 2 to 4 hours for soil cement.
12. Quality control testing of compacted treated subgrades should be performed per the recommendations of the geotechnical report, and generally in accordance with General Geotechnical Design and Construction Considerations - <u>EARTHWORK</u>

PAVING

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Paving for this section is generally meant to describe the placement of surface treatments on travel-ways to be used by rubber-tired vehicles, such as roadways, runways, parking lots, etc.
3. The geotechnical engineer is generally responsible for providing structural analysis to recommend the thickness of pavement sections, which can include asphalt, concrete pavements, aggregate base, cement or lime treated aggregate base, and cement or lime treated subgrades.
4. The civil engineer is generally responsible for determining which surface finishes and mixes are appropriate, and often the owner, general contractor and/or other party will decide on lift thickness, the use of tack coats and surface treatments, etc.
5. The geotechnical engineer will generally be provided with the planned traffic loading, as well as reliability, design life, and serviceability factors by the jurisdiction, traffic engineer, designer, and/or owner. The geotechnical study will provide data regarding soil resiliency and strength. A pavement modeling software is generally used to perform the analysis for design, however, jurisdictional minimum sections also must be considered, as well as construction considerations and other factors.
6. The geotechnical report report will generally provide pavement section thicknesses if requested.
7. For construction of overlays, where new pavement is being placed on old pavement, an evaluation of the existing pavement is needed, which should include coring the pavement, evaluation of the overall condition and thickness of the pavement, and evaluation of the pavement base and subgrade materials.
8. In general, the existing pavement is milled and treated with a tack coat prior to the placement of new pavement for the purpose of creating a stronger bond between the old and new material. This is also a way of removing aged asphalt and helping to maintain finished grades closer to existing conditions grading and drainage considerations.
9. If milling is performed, a minimum of 2 inches of existing asphalt should be left in-place to reduce the likelihood of equipment breaking through the asphalt layer and destroying its integrity. After milling and before the placement of tack coat, the surface should be evaluated for cracking or degradation. Cracked or degraded asphalt should be removed, spanned with geosynthetic reinforcement, or be otherwise repaired per the direction of the civil and or geotechnical engineer prior to continuing construction. Proofrolling may be requested.
10. For pavements to be placed on subgrade or base materials, the subgrade and base materials should be prepared per the General Geotechnical Design and Construction Considerations – EARTHWORK section.

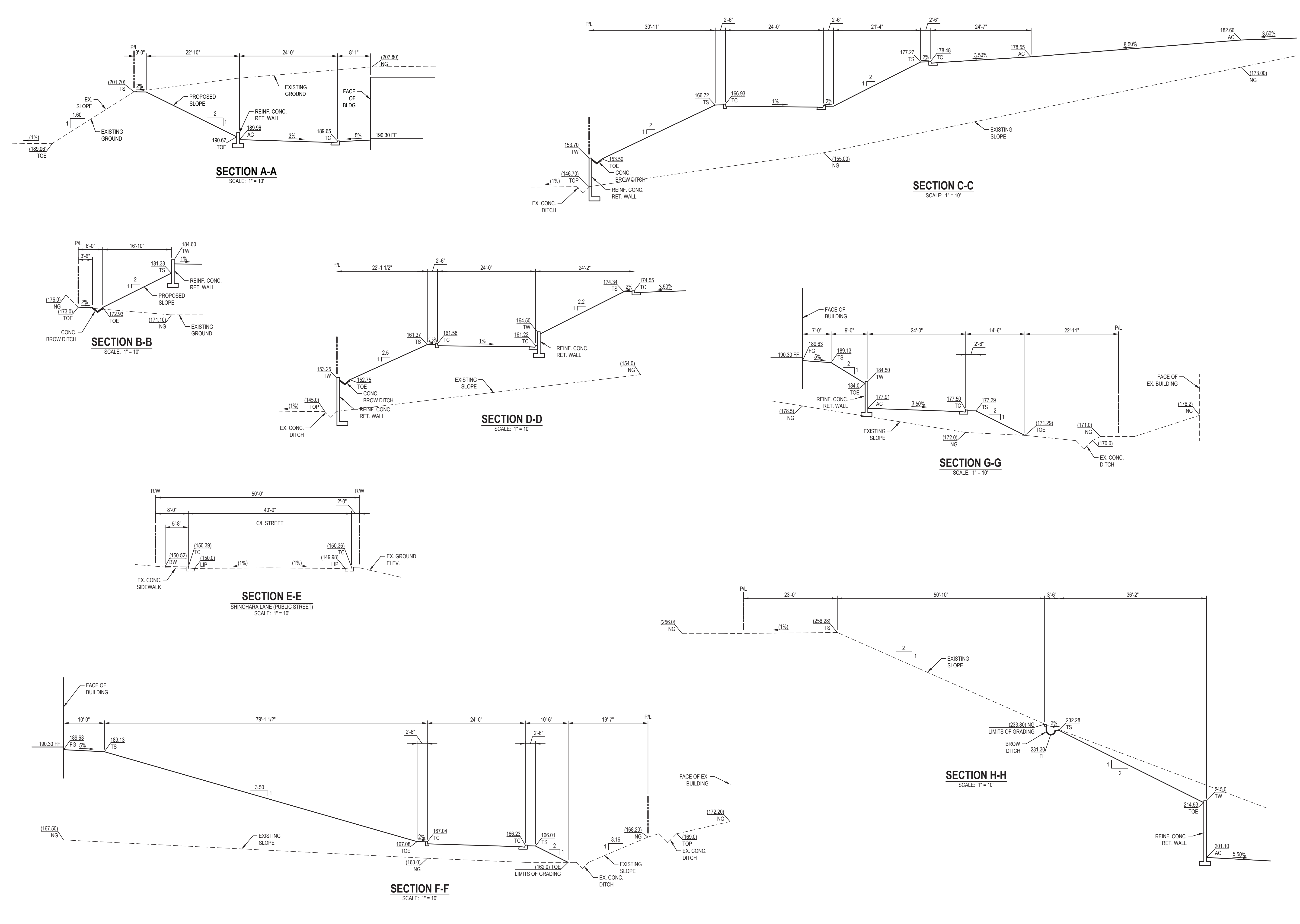
11. Following the proofrolling as described in the General Geotechnical Design and Construction Considerations – EARTHWORK section, the application of subgrade treatment, base material, and paving materials can proceed per the recommendations in the geotechnical report and/or project plans. The placement of pavement materials or structural fills cannot take place on frozen ground.
12. The placement of aggregate base material should conform to the jurisdictional guidelines. In general, the materials should be provided by an accredited supplier, and the material should meet the standards of ASTM C-33. Material that has been stockpiled and exposed to weather including wind and rain should be retested for compliance since fines could be lost. Frozen material cannot be used.
13. The placement of asphalt material should conform to the jurisdictional guidelines. In general, the materials should be provided by an accredited supplier, and the material should meet the standards of ASTM C-33. The material can be placed in a screed by end-dumping, or it can be placed directly on the paving surface. The temperature of the mix at placement should generally be on the order of 300 degrees Fahrenheit at time of placement and screeding.
14. Compaction of the screeded asphalt should begin as soon as practical after placement, and initial rolling should be performed before the asphalt has cooled significantly. Compaction equipment should have vibratory capabilities, and should be of appropriate size and weight given the thickness of the lift being placed and the sloping of the ground surface.
15. In cold and/or windy weather, the cooling of the screeded asphalt is a quality issue, so preparations should be made to perform screeding immediately after placement, and compaction immediately after screeding.
16. Quality control testing of the asphalt should be performed during placement to verify compaction and mix design properties are being met and that delivery temperatures are correct. Results of testing data from asphalt laboratory testing should be provided within 24 hours of the paving.

SITE GRADING AND DRAINAGE

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, State Department of Environmental Quality, the US Environmental Protection Agency, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Site grading and drainage for this section is generally meant to describe the effect of new construction on surface hydrology, which impacts the flow of rainfall or other water running across, onto or off-of, a newly constructed or modified development.
3. This section does not apply to the construction of site grading and drainage features. Recommendations for the construction of such features are covered in General Geotechnical Design and Construction Considerations for Earthwork – Structural Fills section and Underground Pipeline Installation – Backfill section.
4. In general, surface water flows should be directed towards storm drains, natural channels, retention or detention basins, swales, and/or other features specifically designed to capture, store, and or transmit them to specific off-site outfalls.
5. The surface water flow design is generally performed by a site civil engineer, and it can be impacted by hydrology, roof lines, and other site structures that do not allow for water to infiltrate into the soil, and that modify the topography of the site.
6. Soil permeability, density, and strength properties are relevant to the design of storm drain systems, including dry wells, retention basins, swales, and others. These properties are usually only provided in a geotechnical report if specifically requested, and recommendations will be provided in the geotechnical report in those cases.
7. Structures or site features that are not a part of the surface water drainage system should not be exposed to surface water flows, standing water or water infiltration. In general, roof drains and scuppers, exterior slabs, pavements, landscaping, etc. should be constructed to drain water away from structures and foundations. The purpose of this is to reduce the opportunity for water damage, erosion, and/or altering of structural soil properties by wetting. In general, a 5 percent or more slope away from foundations, structural fills, slopes, structures, etc. should be maintained.
8. Special considerations should be used for slopes and retaining walls, as described in the General Geotechnical Design and Construction Considerations - LATERALLY LOADED STRUCTURES section.
9. Additionally, landscaping features including irrigation emitters and plants that require large amounts of water should not be placed near to new structures, as they have the potential to alter soil moisture states. Changing of the moisture state of soil that provides structural support can lead to damage to the supported structures.

APPENDIX D

Stability Analyses



BENCH MARK
CITY OF CHULA VISTA SURVEY CONTROL NETWORK BENCHMARK DESIGNATION 1046, BEING A 1-1/2" BRASS DISK ON N SIDE MAIN ST 150' ±E OF OLEANDER AVE ON E END OF CURB INLET. ELEVATION 128.970 FEET (NAVD88).

BASIS OF BEARINGS
BEING THE WESTERLY LINE OF LOT 1 OF SEC 19, T18S, R1W, S.B.M. AS SHOWN ON ROS 21570, COUNTY OF SAN DIEGO, A BEARING OF N00°24'07"E

NO.	DATE	REVISION DESCRIPTION	APP'D	DATE

APD CONSULTANTS, INC.
PLANNING, ENGINEERING, CONSTRUCTION MANAGEMENT
188 Technology Dr., Suite B, IRVINE, CA 92618
TEL (949) 336-6336 FAX (949) 336-6338 www.apdcon.com

RABIH F. MAHMOUD, P.E. R.C.E. NO. 60421 — DATE 3/15/2019

SECTIONS AND DETAILS
ENCOMPASS HEALTH CHULA VISTA
517 SHINOHARA LANE, CHULA VISTA, CA 91911

JOB NO. 18033
DATE: 3/15/2019
SHEET 2 OF 5 SHEETS

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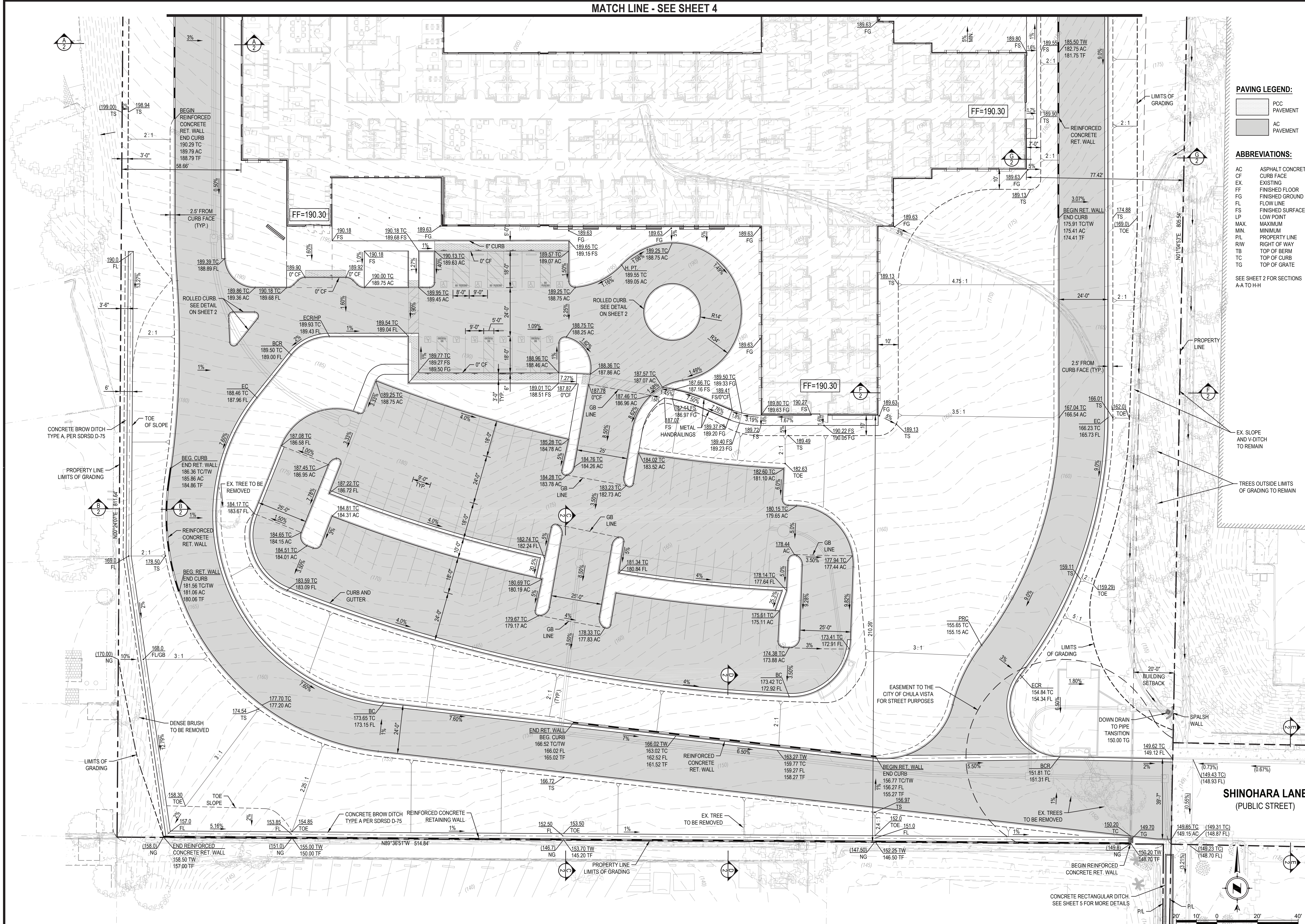

PAVING LEGEND:

- PCC PAVEMENT
- AC PAVEMENT

ABBREVIATIONS:

AC	ASPHALT CONCRETE
CF	CURB FACE
EX.	EXISTING
FF	FINISHED FLOOR
FG	FINISHED GROUND
FL	FLOW LINE
FS	FINISHED SURFACE
LP	LOW POINT
MAX.	MAXIMUM
MIN.	MINIMUM
P/L	PROPERTY LINE
R/W	RIGHT OF WAY
TB	TOP OF BERM
TC	TOP OF CURB
TG	TOP OF GRATE

SEE SHEET 2 FOR SECTIONS A-A TO H-H

BENCH MARK

CITY OF CHULA VISTA SURVEY CONTROL NETWORK BENCHMARK DESIGNATION 1046, BEING A 1-1/2" BRASS DISK ON N SIDE MAIN ST 150' +-E OF OLEANDER AVE ON E END OF CURB INLET. ELEVATION 128.970 FEET (NAVD88).

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NO.	DATE	REVISION DESCRIPTION	APP'D	DATE
-	-	-		

REGISTERED PROFESSIONAL ENGINEER RABIH F. MAHMOUD 60421 EXPIRES 6/30/20 CIVIL STATE OF CALIFORNIA

APD CONSULTANTS, INC.
PLANNING . ENGINEERING . CONSTRUCTION MANAGEMENT
188 Technology Dr., Suite B, IRVINE, CA 92618
TEL: (949) 336-6336 FAX: (949) 336-6338 www.apdcon.com

RABIH F. MAHMOUD, P.E. R.C.E. NO.: 60421 3/15/2019 DATE

PRELIMINARY GRADING AND DRAINAGE PLAN

ENCOMPASS HEALTH CHULA VISTA

517 SHINOHARA LANE, CHULA VISTA, CA 91911

JOB NO. 18033

DATE: 3/15/2019

SHEET 3 OF 5 SHEETS

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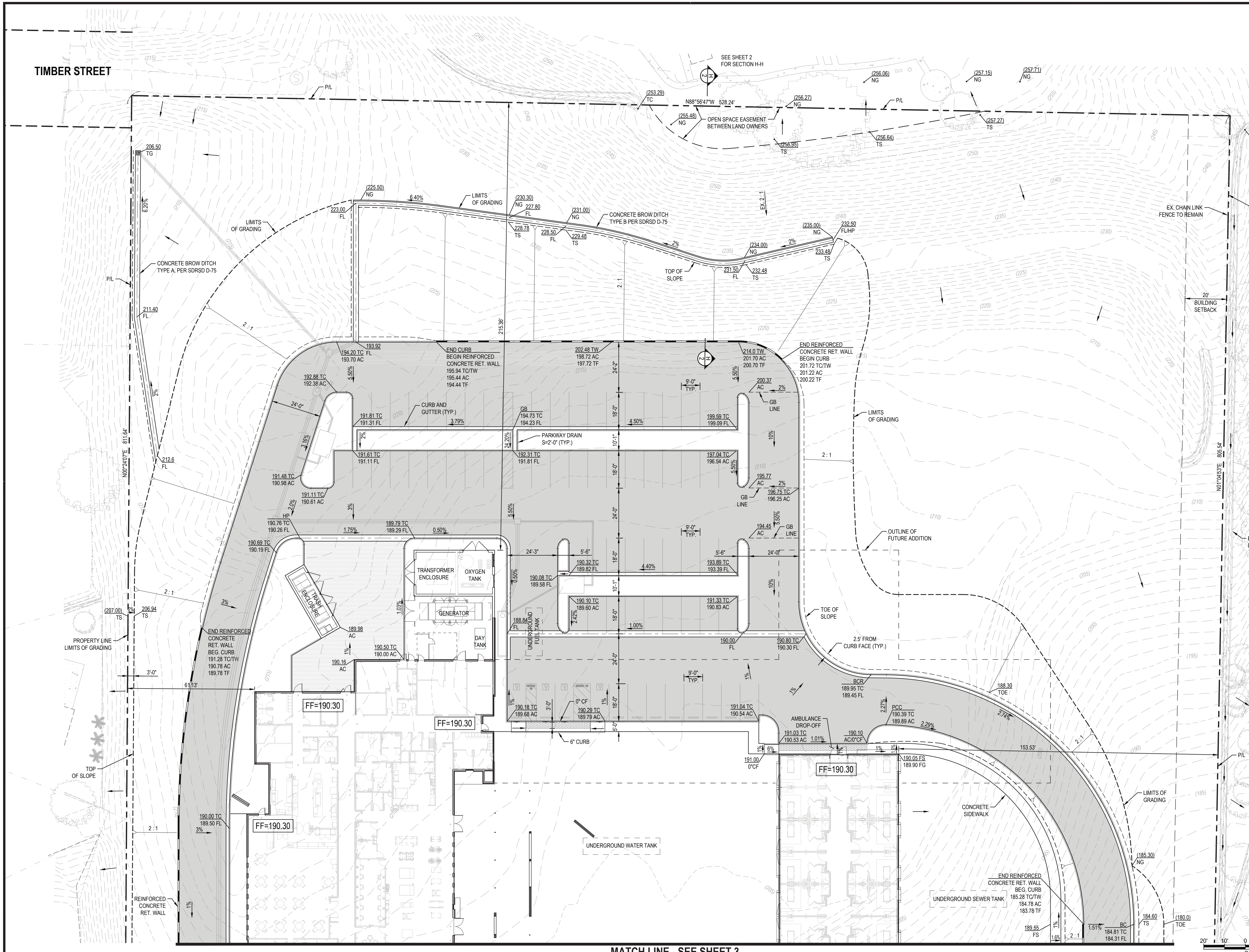

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SEE SHEET 2 FOR SECTIONS A-A TO H-H

BENCH MARK
CITY OF CHULA VISTA SURVEY CONTROL NETWORK BENCHMARK DESIGNATION 1046, BEING A 1-1/2" BRASS DISK ON N SIDE MAIN ST 150' +-E OF OLEANDER AVE ON E END OF CURB INLET. ELEVATION 128.970 FEET (NAVD88).

BASIS OF BEARINGS
BEING THE WESTERLY LINE OF LOT 1 OF SEC 19, T18S, R1W, S.B.M, AS SHOWN ON ROS 21570, COUNTY OF SAN DIEGO, A BEARING OF N00°24'07"E.

NO.	DATE	REVISION DESCRIPTION	APP'D	DATE
-	-	-		

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RABIH F. MAHMOUD, P.E. R.C.E. NO.: 60421 3/15/2019 DATE

PRELIMINARY GRADING AND DRAINAGE PLAN

ENCOMPASS HEALTH CHULA VISTA

517 SHINOHARA LANE, CHULA VISTA, CA 91911

JOB NO. **18033**

DATE: **3/15/2019**

SHEET **4** OF 5 SHEETS

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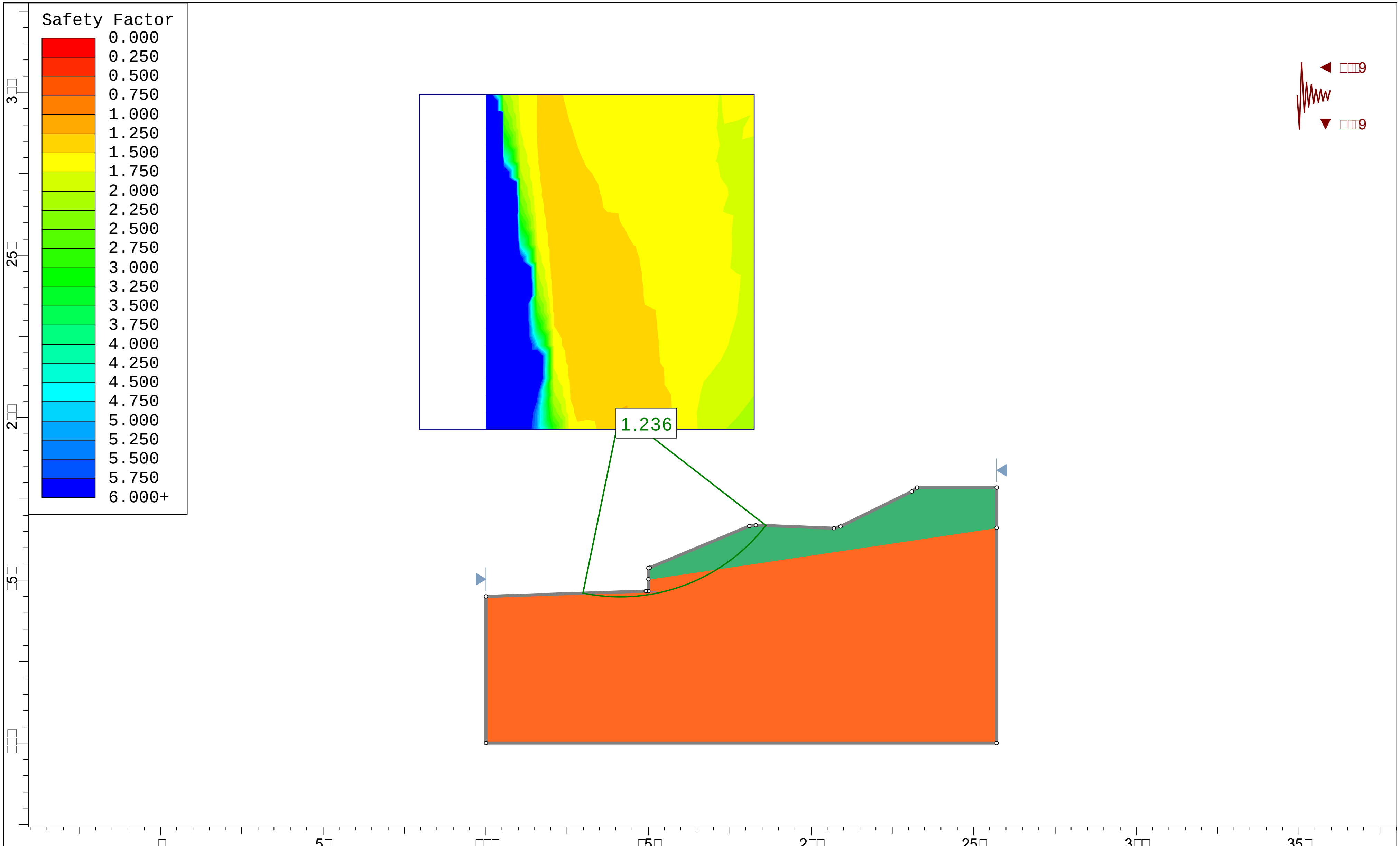

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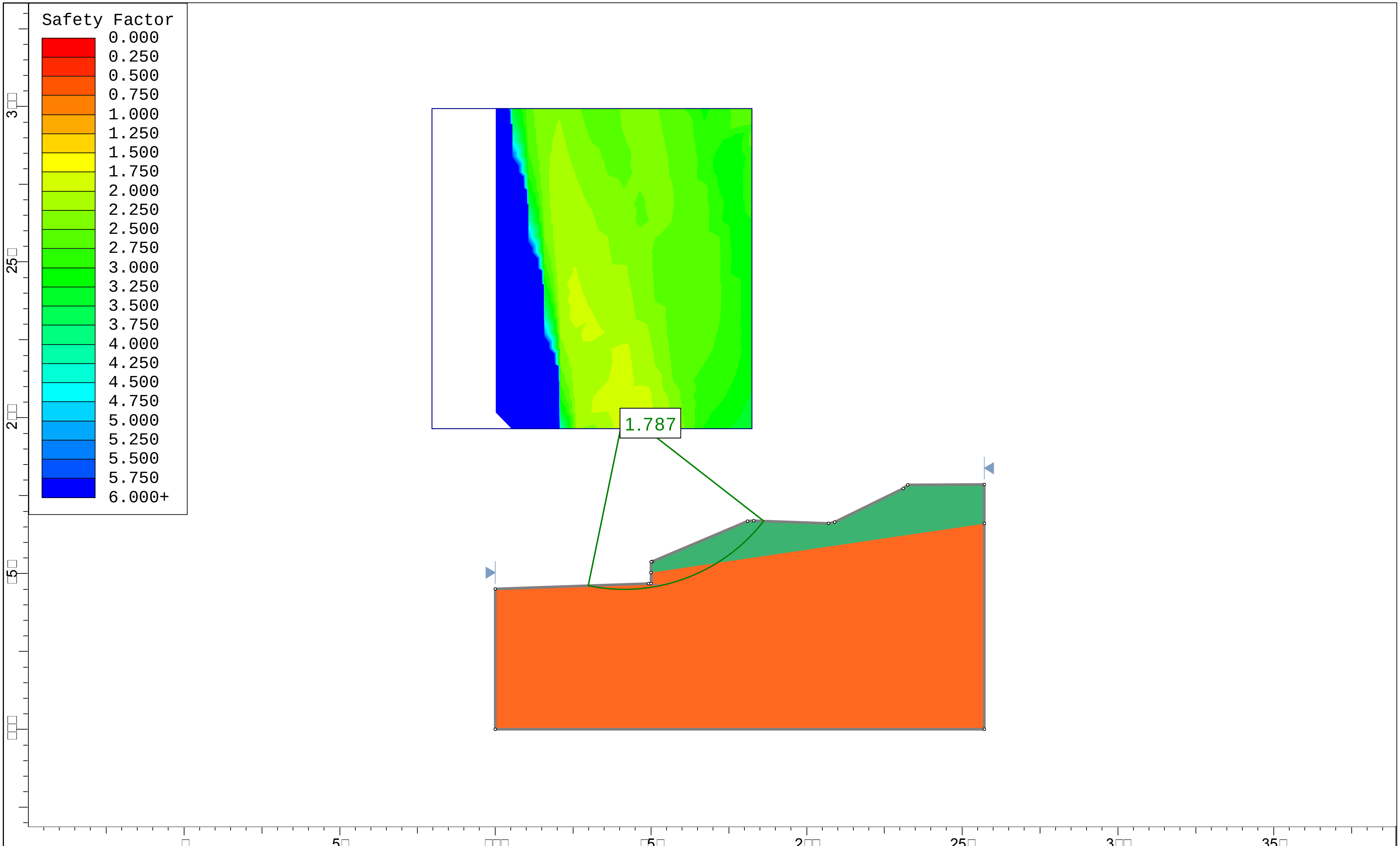

rocscience

SLIDEINTERPRET 8.021

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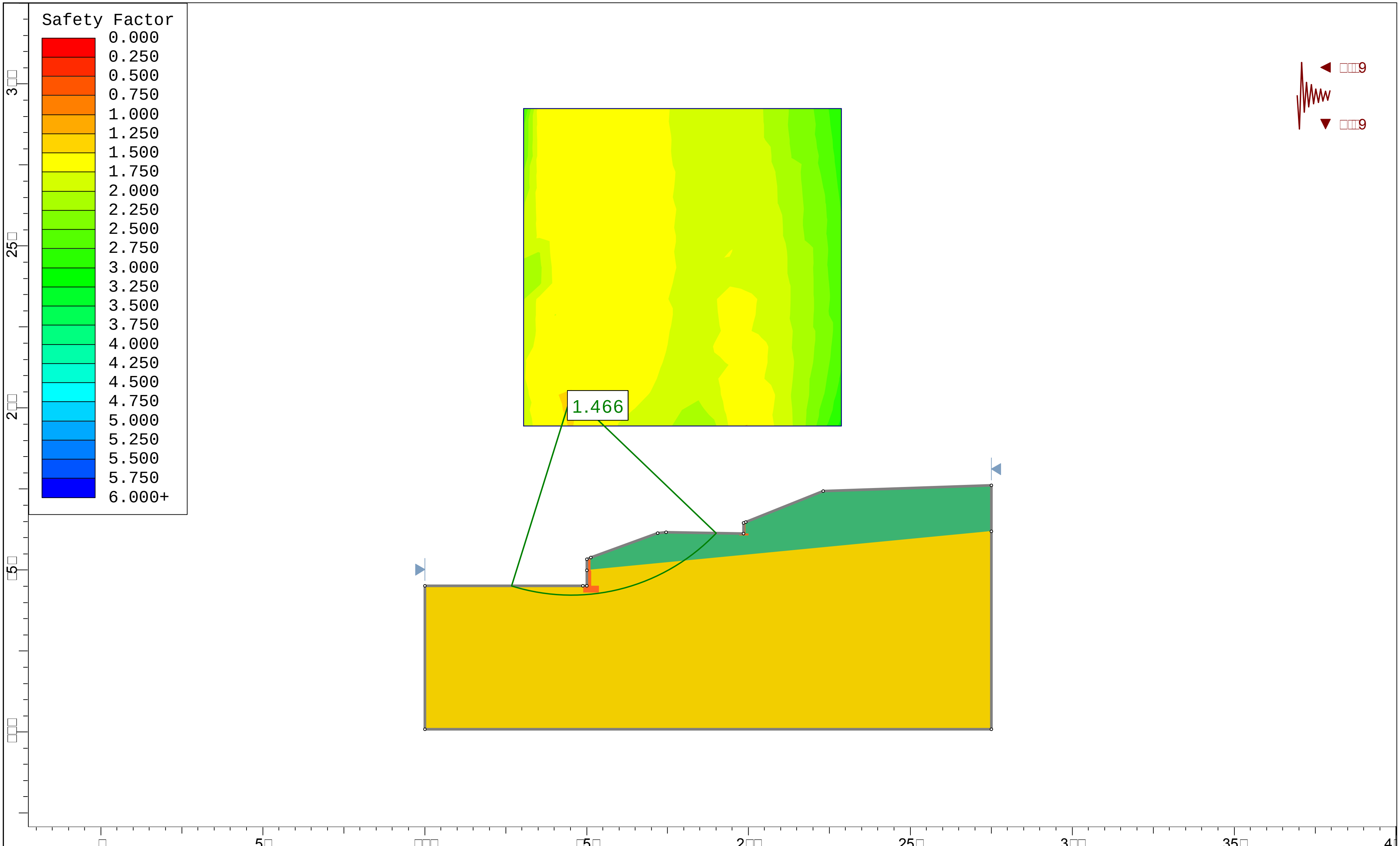

rocscience

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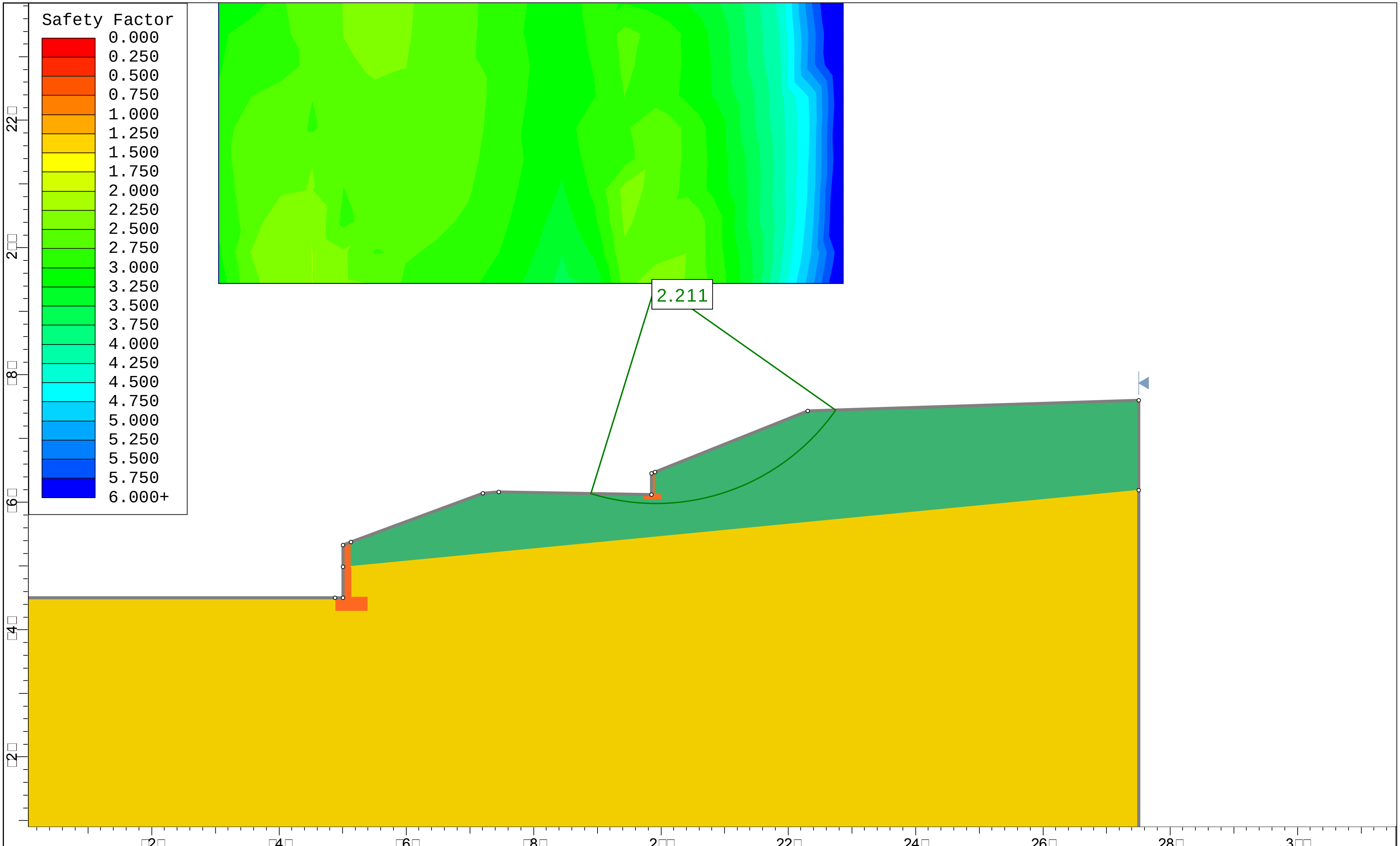

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SLIDEINTERPRET 8.021

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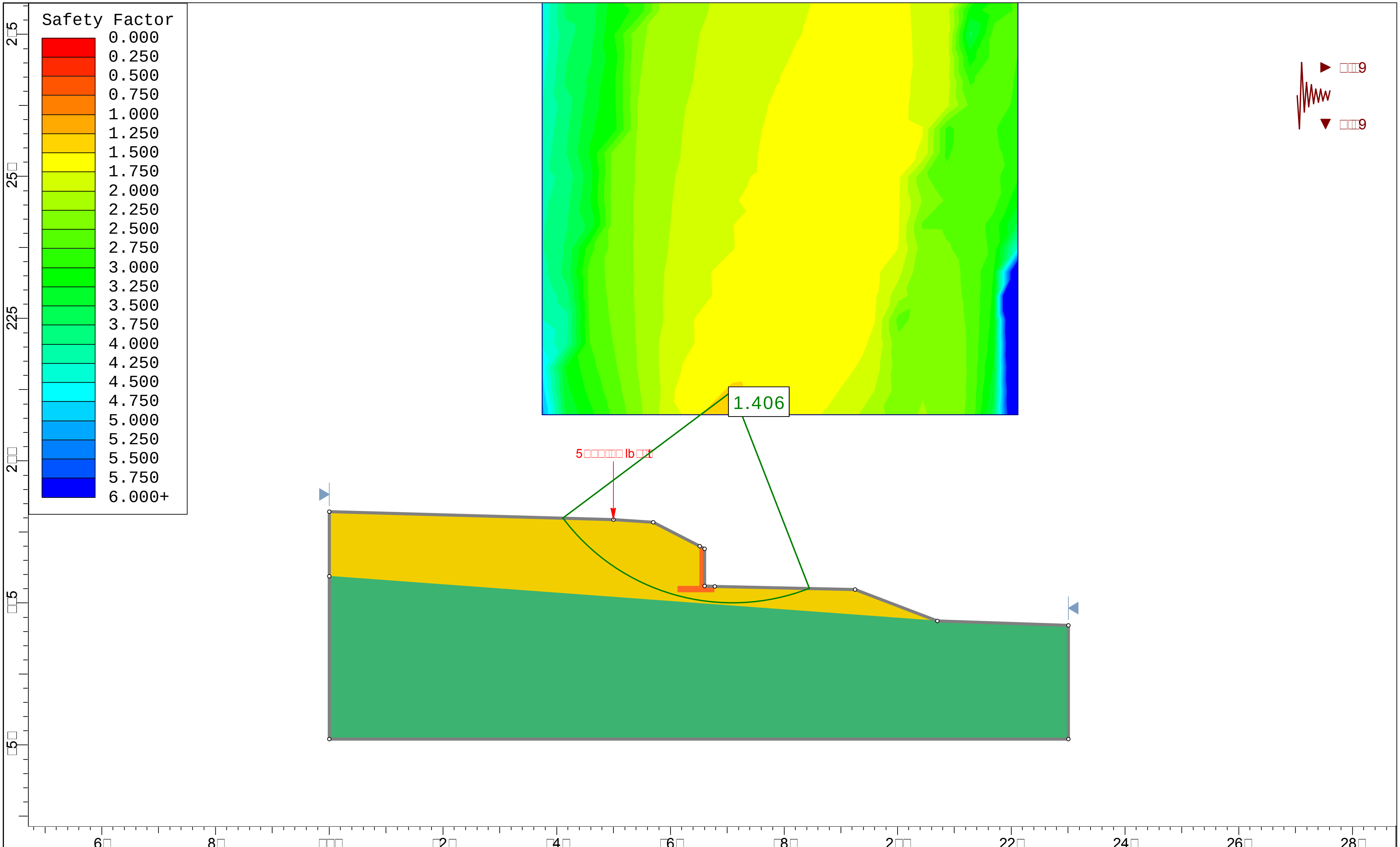

rocscience

SLIDEINTERPRET 8.021

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Analysis Description	Ret Wall Global Stability
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Company	Partner Engineering
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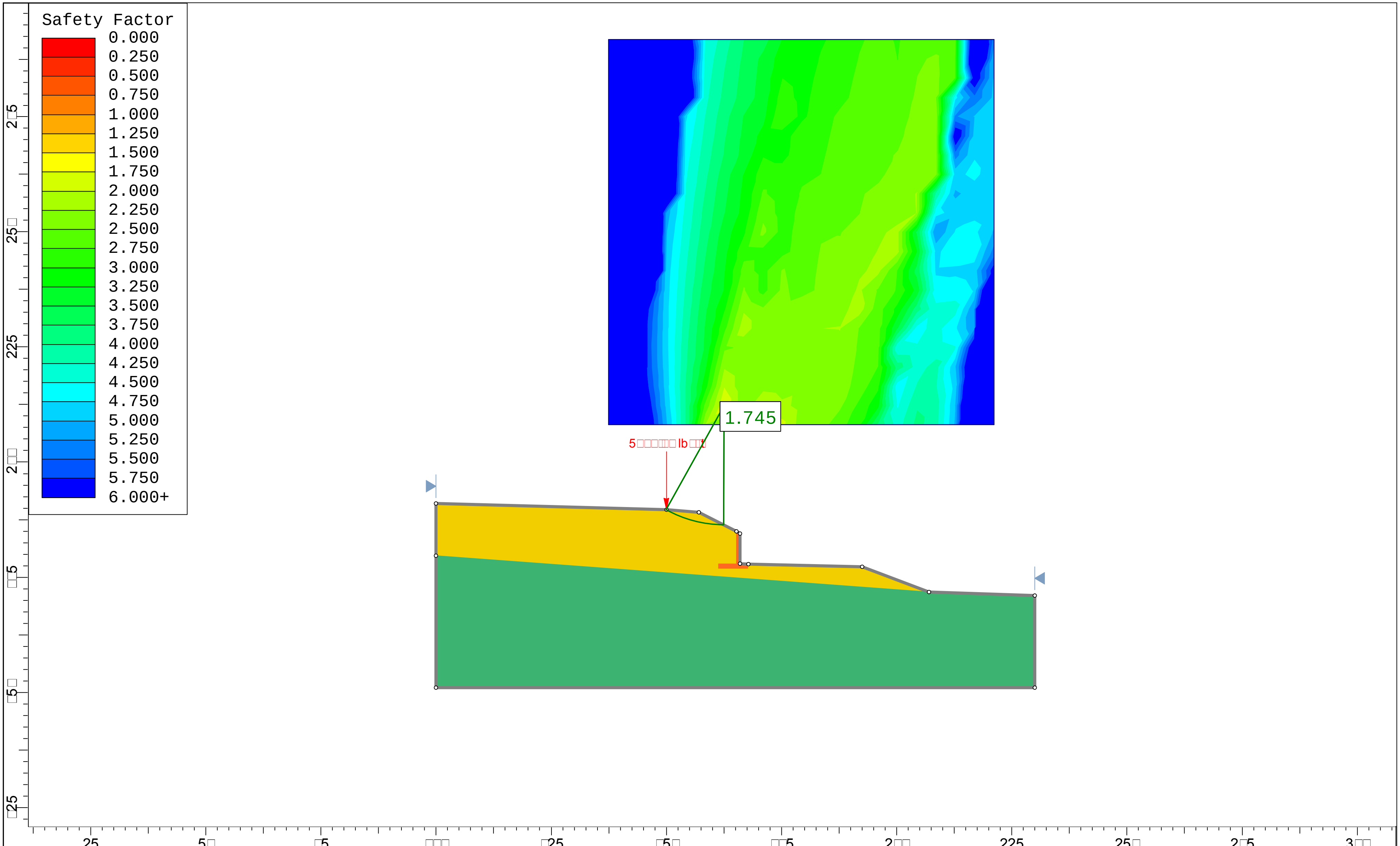

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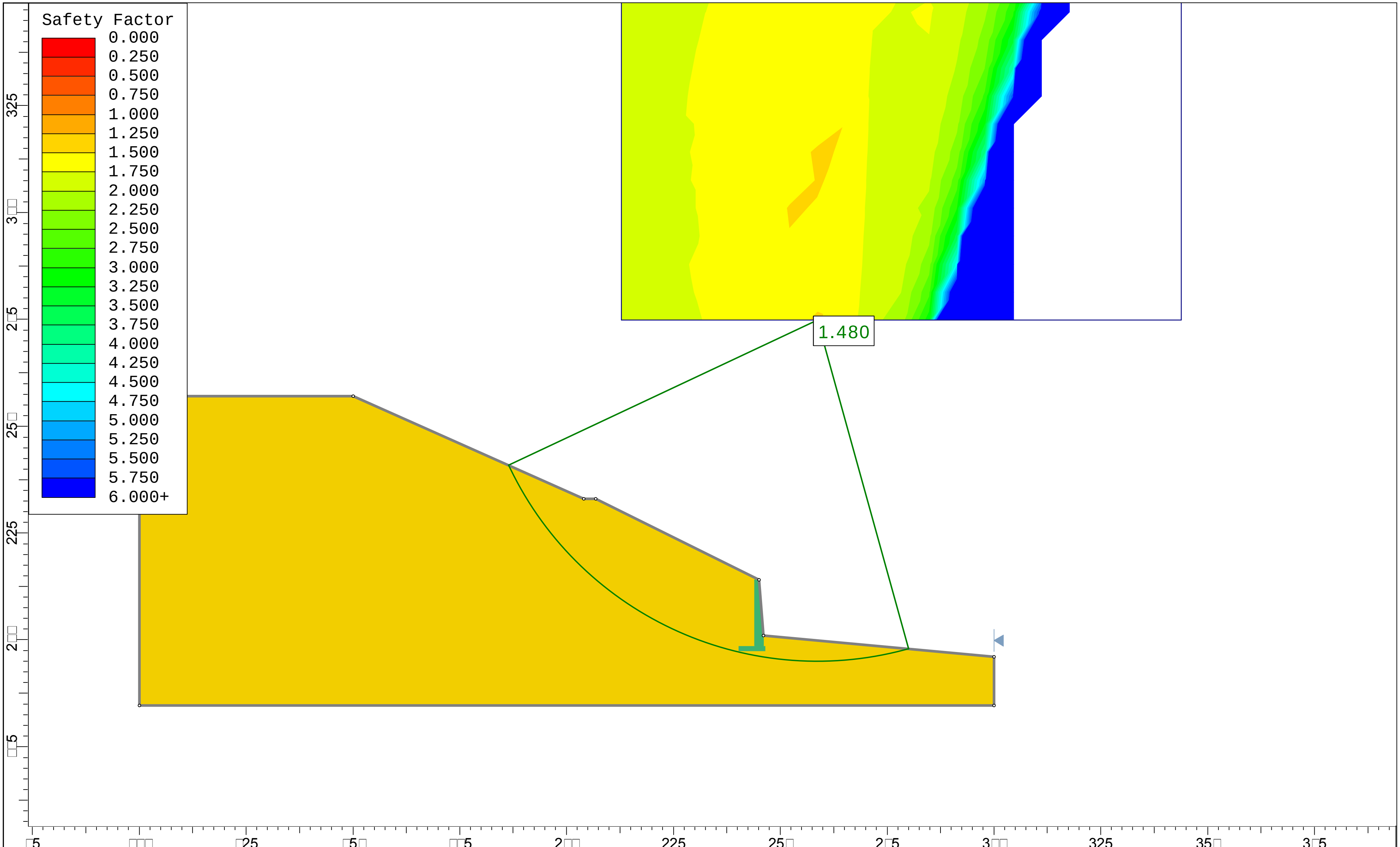

rocscience	*Project* Encompass Hospital
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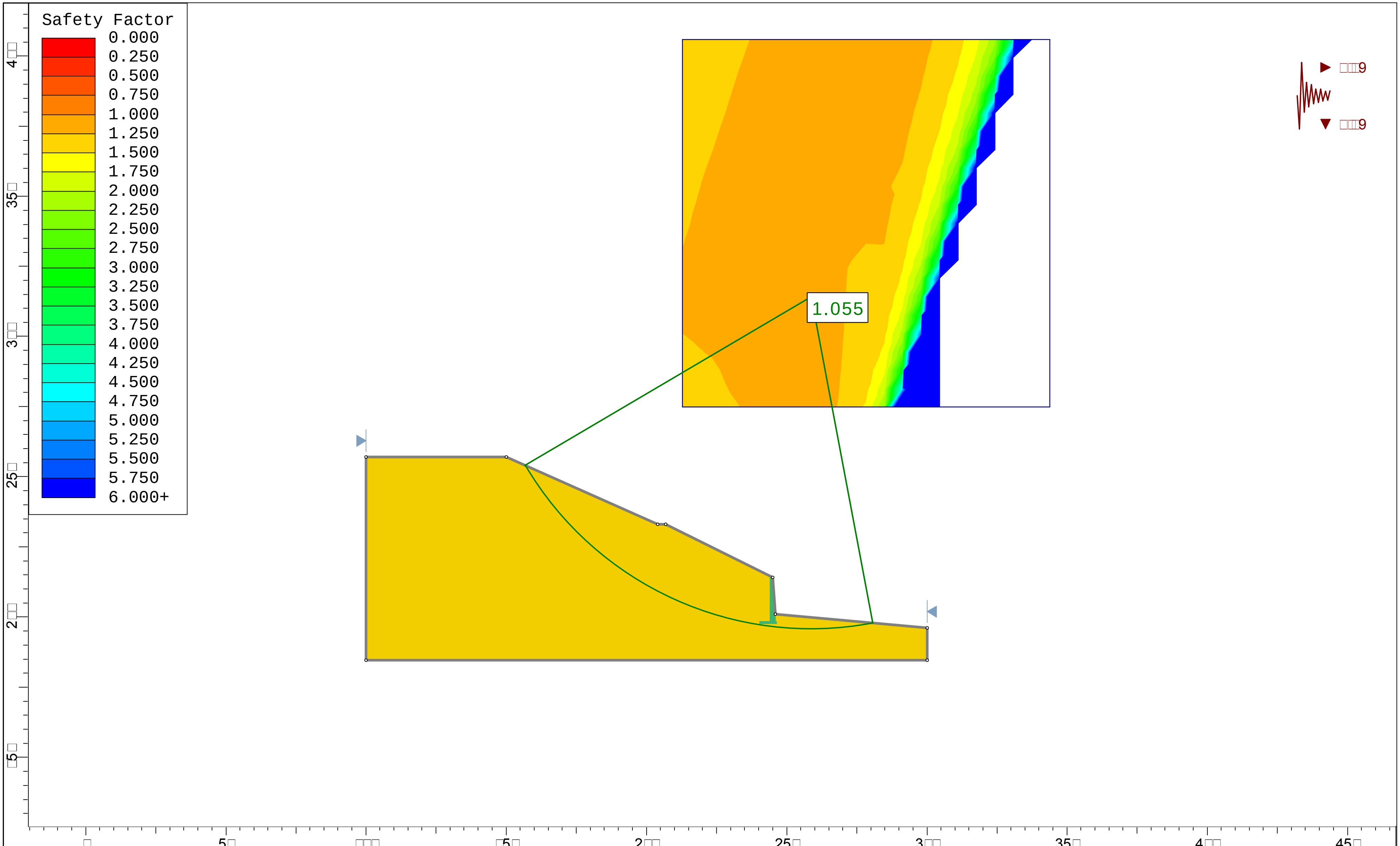

rocscience

SLIDEINTERPRET 8.021

Project	Encompass Hospital
Analysis Description	Ret Wall Global Stability
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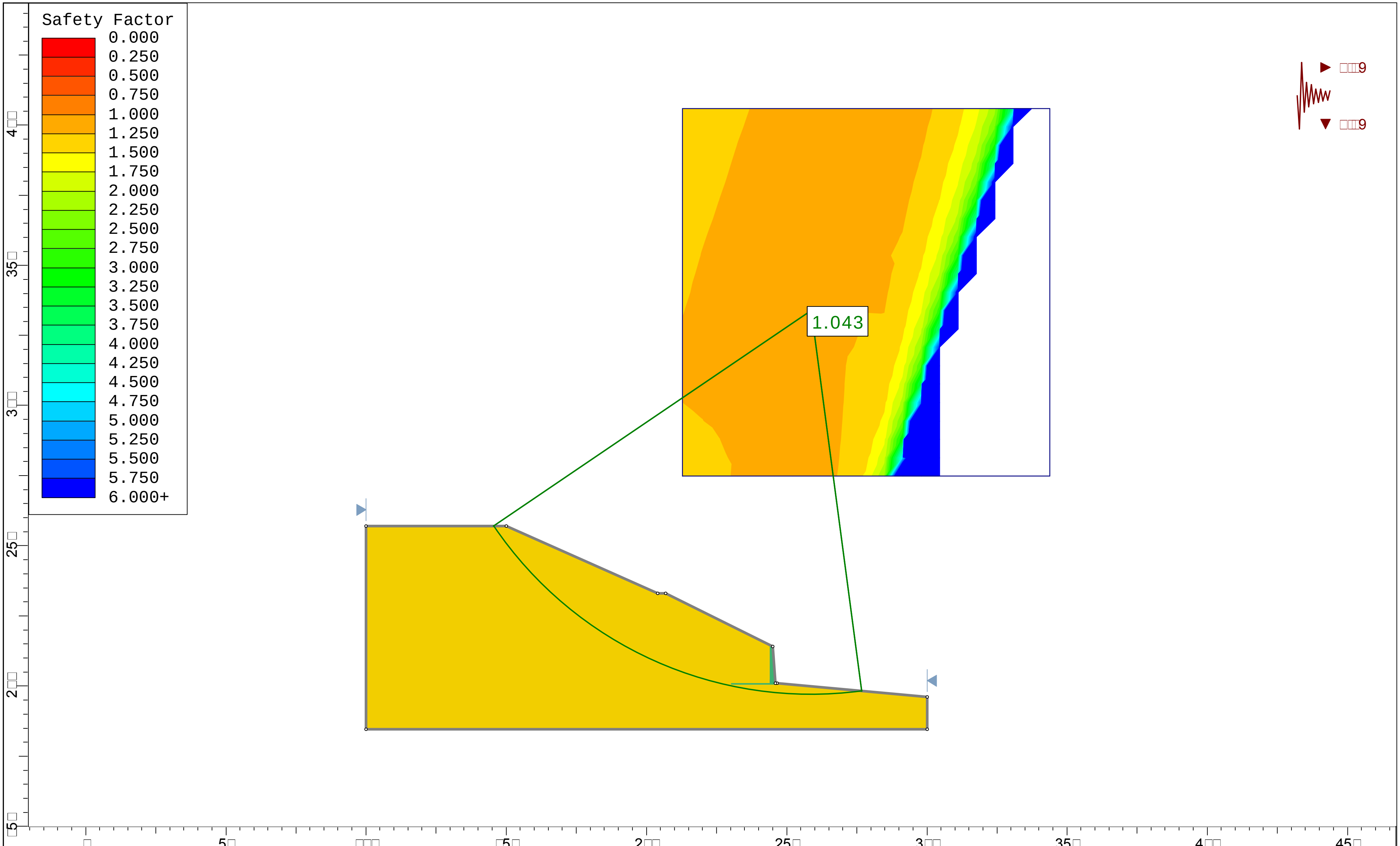

rocscience

SLIDEINTERPRET 8.021

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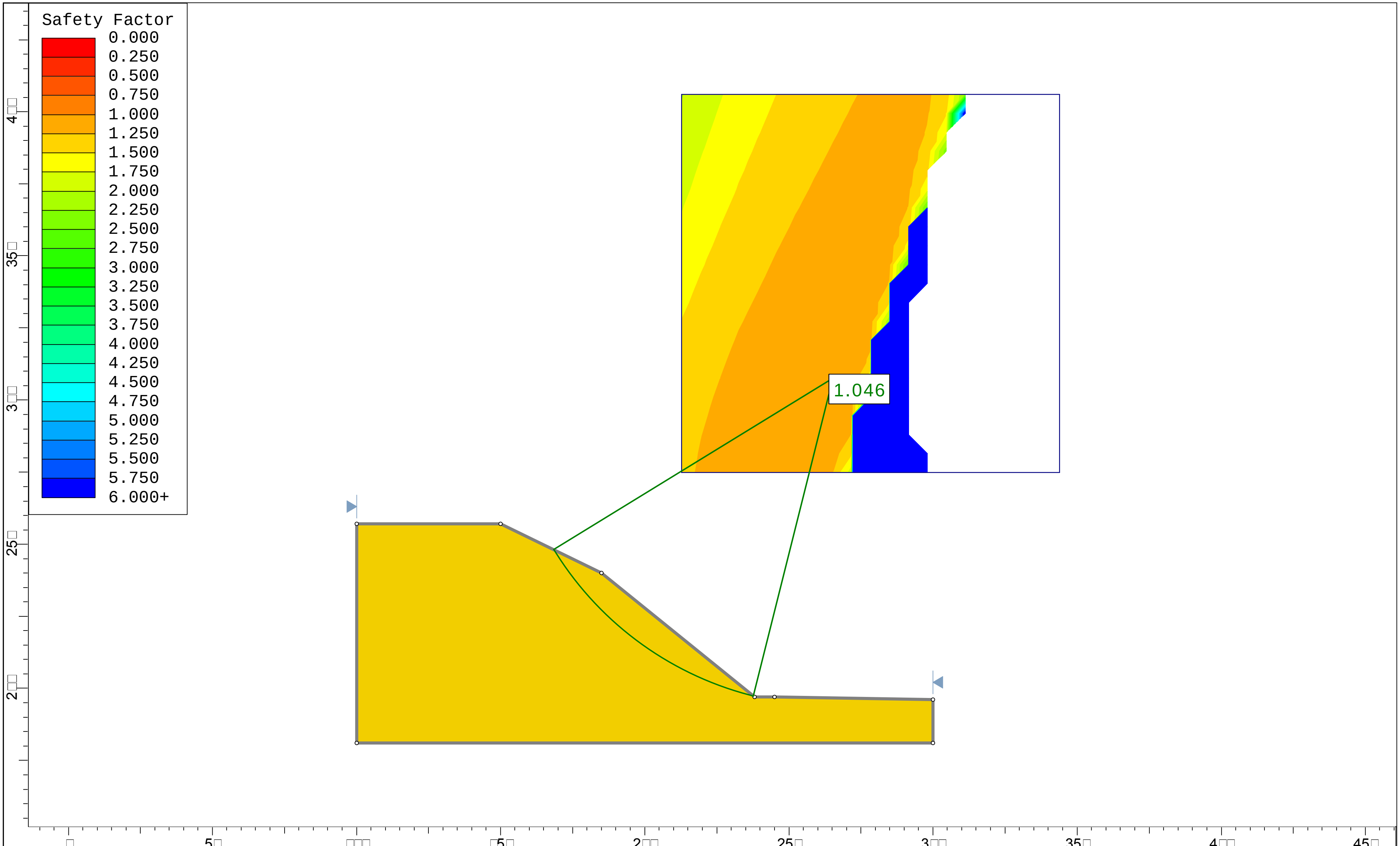

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SLIDEINTERPRET 8.021

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Analysis Description	Temporary Cut HH' for wall
Drawn By	Marcus
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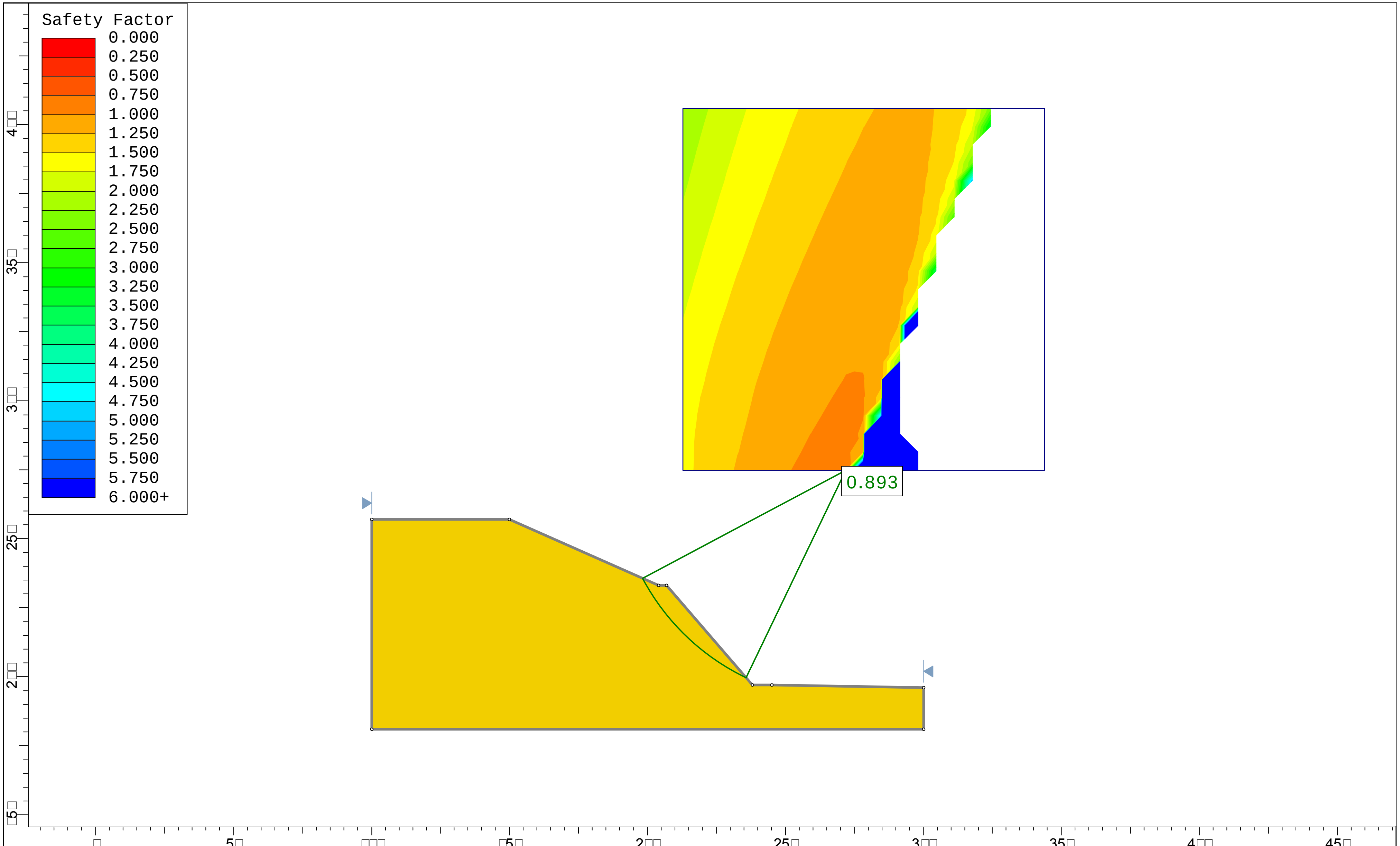

rocscience

SLIDEINTERPRET 8.021

Project
SLIDE - An Interactive Slope Stability Program

Analysis Description
Temporary Cut HH' for wall

Drawn By Marcus

Scale 1:577

Company Partner

Date 3/12/2019, 12:47:29 PM

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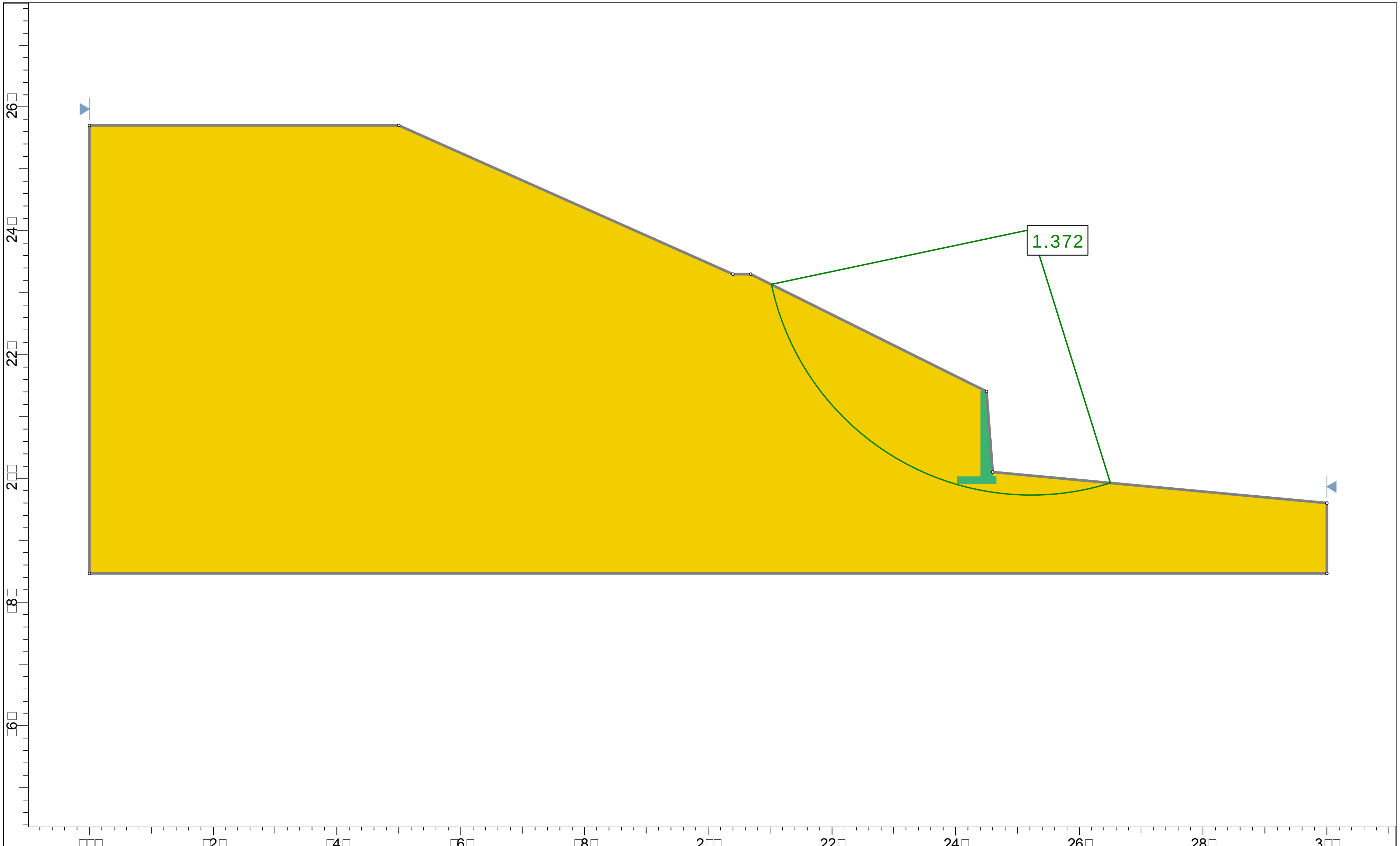

Project	Encompass Hospital		
Analysis Description	Ret Wall Global Stability		
Drawn By: Marcus	Scale: 1:258	Company	Partner Engineering
Date	3/21/2019	File Name	Slope Analysis Rear Retaining Wall.slmd

SLIDEINTERPRET 8.021

Stability Analyses

Regional Geologic and Site Engineering Geologic Maps (Figures 4 and 5) and Seismic Hazards Map (Figure 8) indicated the site is not located in the landslide area. Site Geologic mapping indicated the slopes are stable. In addition, Partner performed a slope stability analysis using Rocscience software Slide 2D. A summary of our results is shown in the below table.

All slopes will be subjected to surficial erosion. Therefore, slopes should be protected from surface runoff by means of top of the slopes compacted earth berms.

It is recommended that the slopes should be properly maintained in future by some of these methods: cleaning and removing loose debris, minor grading, controlling surface water, revegetation and by constructing benches. Over- watering and subsequent saturation of slope surface should be avoided.

Slope Stability Analysis – Bishop/Janbu (lowest reported)

Cross-Section	Slope Height	Slope Angle	Max Retaining Wall Height	Cohesion	Friction Angle	FS Static/Seismic
C-C′	33 feet	2:1 Max	7 feet	100 psf	30 deg	1.8/1.2
D-D′	29 feet	2.2:1 Max	8 feet	100 psf	30 deg	2.2/1.5
G-G′	20 feet	2:1 Max	7 feet	100 psf	30 deg	1.7/1.4
H-H′	45 feet	2:1 Max	14 feet	100 psf	30 deg	***1.37***[a]

[a] ***Factor of safety not sufficient – additional analysis required***

Additional Slope Stability Analysis – Bishop/Janbu (Cross Section H-H′)

Condition	Slope Height	Slope Angle	Max Retaining Wall Height	Cohesion	Friction Angle	FS Static
Construction Cut	45 feet	1:1 Max	14 feet	100 psf	30 deg	***0.9***[a]
Construction Cut	45 feet	1.5:1 Max	14 feet	100 psf	30 deg	1.05
Foundation 4-ft embedment, 7.5 feet back from wall CL	45 feet	2:1 Max	14 feet	100 psf	30 deg	1.5/1.04

[a] ***Factor of safety not sufficient – additional analysis required***

Pecolation Test Data Sheet

Project:	EHS Chula Vista
Project No.:	17-199602.7
Date:	3/14/2019
Test Hole:	P1
Tested by:	MM
Depth of Hole, ft, D:	3.25
Boring Radius, in:	6
UCSD:	SP

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

Pre-Soak Procedure (See notes)						Calculations	
Reading #	Start Time	Stop Time	Δ t Time Interval	Do Initial Depth to Water Level	Df Final Depth to Water Level	Δ D Change in Water Level	Greater than 6"
	hr:mm	hr:mm	min	in	in	in	(y/n)
1	10:30	11:00	30	12	19	7.0	
2	11:10	11:40	30	19	28	9.0	

IN RIVERSIDE, 2Y=SAND: 10 min intervals for 1 hour. **IF NOT SAND:** 12 intervals at 30 min each, refilling each time

IN SAN DIEGO, Presoak for at least 2 hours if sandy soils. Rates of fall are measured for six hours, refilling each half hour (or 10 minutes for sand). Tests are generally repeated until consistent results are obtained.

Raw Data						Calculations		
Reading #	Start Time	Stop Time	Δ t Time Interval (10 or 30)	Do Initial Depth to Water Level	Df Final Depth to Water Level	Δ D Change in Water Level	Percolation Rate	Corrected Infiltration Rate
	hr:mm	hr:mm	min	inches (0.25" precision)			min/ in	in/hr
1	13:40	14:00	20	4.5	5.0	0.5	40.0	0.12
2	14:00	14:20	20	5.0	5.5	0.5	40.0	0.12
3	14:20	14:30	20	5.5	5.8	0.3	80.0	**0.06**
4								
5								
6								
7								
8								
9								
10								
11								
12								

Sources:

Appendix D, Approved Infiltration Rate Assessment Methods for Selection of Storm Water BMPs (San Diego)

Appendix A, Infiltration Testing (Riverside County)

Appendix D, Infiltration Rate Protocol, 2011 (Orange County)

Pecolation Test Data Sheet

Project:	EHS Chula Vista
Project No.:	17-199602.7
Date:	3/14/2019
Test Hole:	P2
Tested by:	MM
Depth of Hole, ft, D:	3
Boring Radius, in:	6
UCSD:	SP

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

Pre-Soak Procedure (See notes)						Calculations	
Reading #	Start Time	Stop Time	Δ t Time Interval	Do Initial Depth to Water Level	Df Final Depth to Water Level	Δ D Change in Water Level	Greater than 6"
	hr:mm	hr:mm	min	in	in	in	(y/n)
1	10:40	11:10	30	12	24	12.0	
2	11:10	11:40	30	24	36	12.0	

IN RIVERSIDE, 2Y=SAND: 10 min intervals for 1 hour. **IF NOT SAND:** 12 intervals at 30 min each, refilling each time

IN SAN DIEGO, Presoak for at least 2 hours if sandy soils. Rates of fall are measured for six hours, refilling each half hour (or 10 minutes for sand). Tests are generally repeated until consistent results are obtained.

Raw Data						Calculations		
Reading #	Start Time	Stop Time	Δ t Time Interval (10 or 30)	Do Initial Depth to Water Level	Df Final Depth to Water Level	Δ D Change in Water Level	Percolation Rate	Corrected Infiltration Rate
	hr:mm	hr:mm	min	inches (0.25" precision)			min/ in	in/hr
1	13:40	14:00	20	0.0	5.3	5.3	3.8	1.30
2	14:00	14:20	20	5.3	8.0	2.8	7.3	0.76
3	14:20	14:30	10	0.0	2.3	2.3	4.4	1.07
4	14:13	14:23	20	2.3	5.0	2.8	7.3	0.70
5	14:23	14:33	10	5.0	6.3	1.3	8.0	**0.67**
6								
7								
8								
9								
10								
11								
12								

<u>Sources:</u>

Appendix D, Approved Infiltration Rate Assessment Methods for Selection of Storm Water BMPs (San Diego)

Appendix A, Infiltration Testing (Riverside County)

Appendix D, Infiltration Rate Protocol, 2011 (Orange County)