CITY OF
CHULA VISTA

PDP SWQMP

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

Project Name Nirvana Business Park

Assessor's Parcel Number(s) 644-050-13, 644-050-14, 644-050-80

Permit Application Number DR21-0024

Drawing Numbers ______________________

CIVIL ENGINEER NAME: Gregory W. Lang; **PE #** 68075

Gregory W. Lang
Wet Signature and Stamp

REGISTERED PROFESSIONAL ENGINEER
GREGORY W. LANG
No. RCE 68075
EXP. 06-30-23
Civil
STATE OF CALIFORNIA

PREPARED FOR: Applicant Name: VWP-OP Nirvana Owner, LLC
Address: 2390 East Camelback Road, Suite 305
Phoenix, AZ 85016
Telephone # (602) 957-8300

PREPARED BY: Company Name: Pasco Laret Suiter & Associates
Address: 535 N. Highway 101, Suite A
Solana Beach, CA 92075
Telephone # (858) 259-8212

DATE: March 14, 2022

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

Project Name/ Nirvana Business Park

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

Certification Page

Project Name: Nirvana Business Park

Permit Application Number: DR21-0024

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.

Gregory W. Lang
Engineer of Work's Signature

03/14/2022
Date

68075
PE #

6/30/2023
Expiration Date

Gregory W. Lang
Print Name

Pasco Laret Suiter & Associates
Company

Registered Professional Engineer
Gregory W. Lang
No. RCE 68075
EXP. 06-30-23
Civil
State of California
Engineer's Seal

Project Name/ Nirvana Business Park

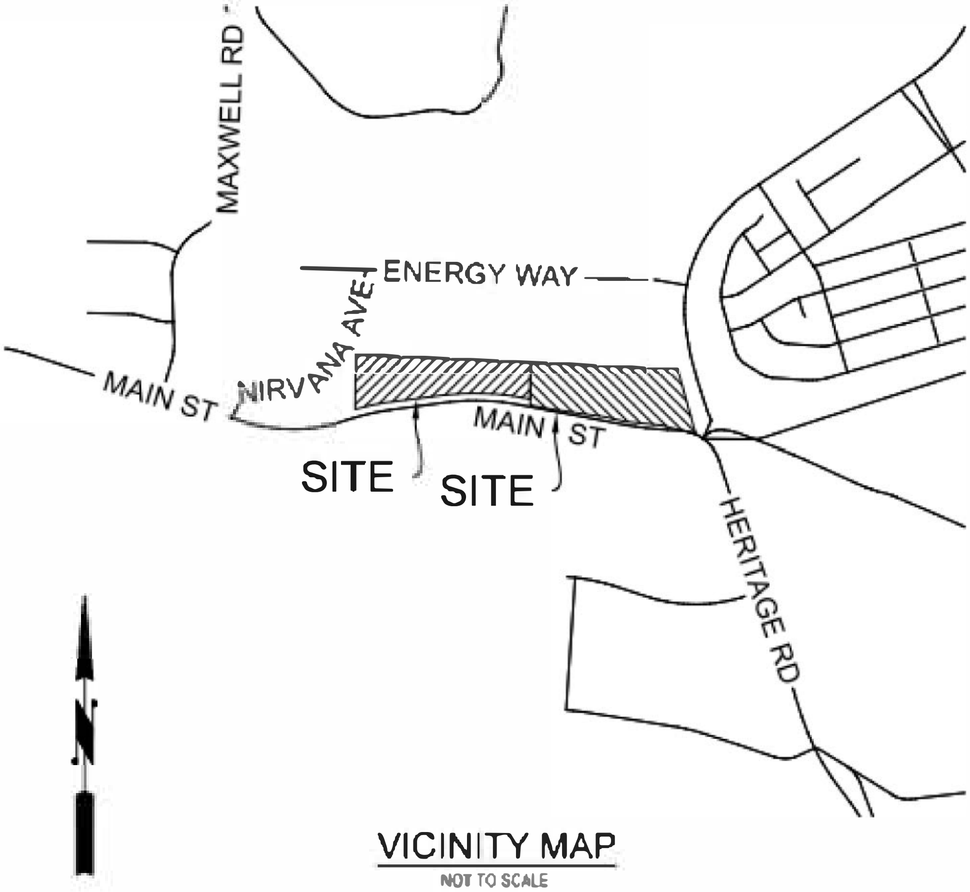
SUBMITTAL RECORD

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	9/22/2021	☒ Preliminary Design / Planning/ CEQA ☐ Final Design	Initial Submittal
2	12/10/2021	☒ Preliminary Design / Planning/ CEQA ☐ Final Design	Revision per City plan check comments
3	3/14/2022	☒ Preliminary Design / Planning/ CEQA ☐ Final Design	Revision per City plan check comments
4		☐ Preliminary Design / Planning/ CEQA ☐ Final Design	

Project Name/ Nirvana Business Park

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

CITY OF CHULA VISTA

Storm Water Requirements Applicability Checklist for All Permit Applications

Intake Form

March 2019 Update

Project Information

Project Address: 821 Main Street, Chula Vista, CA 91911	Project Application # DR21-0024
Project Name: Nirvana Business Park	APN(s) 644-050-13, 644-050-14, 644-050-08

Brief Description of Work Proposed: Proposed industrial development

The project is (select one):

☑ New Development Total Impervious Area 424,544 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: Gregory W. Lang

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

Email: glang@plsaengineering.com Phone: (858) 259-8212

Signature: Gregory W. Lang Date Completed: 3/14/2022

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: Gregory W. Lang Title: Principal Engineer

Signature: Gregory W. Lang Date: 3/14/2022

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: _______________ ft^2 (A)

The total proposed newly created or replaced impervious area is _________________ ft^2 (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 <u>ONLY</u> 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**

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.

Nirvana Business Park

Project Name/____

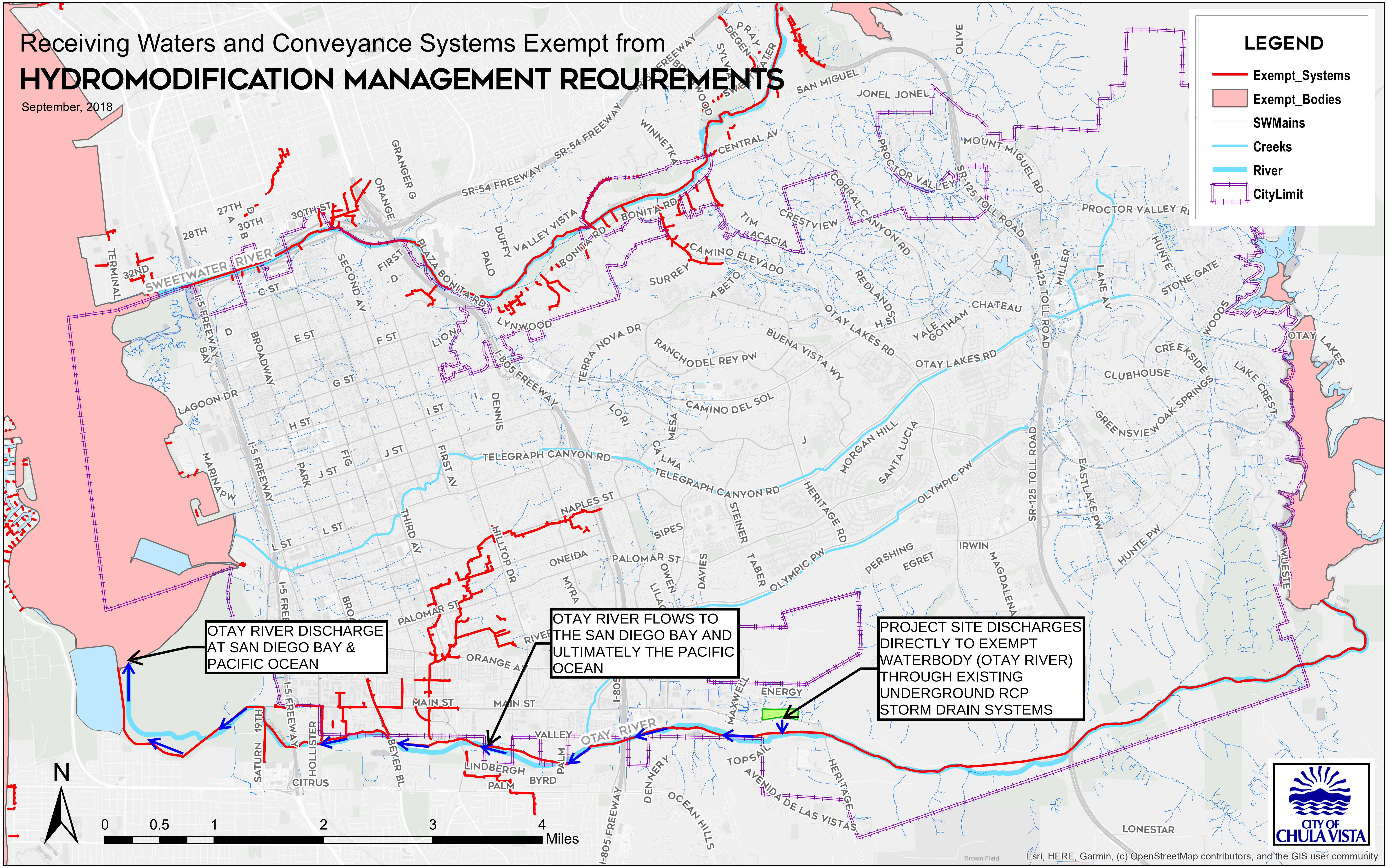
HMP Exemption Exhibit

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.**

Receiving Waters and Conveyance Systems Exempt from

HYDROMODIFICATION MANAGEMENT REQUIREMENTS

September, 2018



OTAY RIVER DISCHARGE AT SAN DIEGO BAY & PACIFIC OCEAN

OTAY RIVER FLOWS TO THE SAN DIEGO BAY AND ULTIMATELY THE PACIFIC OCEAN

PROJECT SITE DISCHARGES DIRECTLY TO EXEMPT WATERBODY (OTAY RIVER) THROUGH EXISTING UNDERGROUND RCP STORM DRAIN SYSTEMS

LEGEND

- Exempt_Systems
- Exempt_Bodies
- SWMains
- Creeks
- River
- CityLimit

CITY OF CHULA VISTA

Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

Nirvana Business Park

Project Name/____

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: Nirvana Business Park

Site Information Checklist	**Form I-3B**
Project Summary Information	
Project Name	Nirvana Business Park
Project Address	821 Main Street Chula Vista, CA 91911
Assessor's Parcel Number(s) (APN(s))	644-050-13, 644-050-14, 644-050-80
Permit Application Number	DR21-0024
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)	13.31 Acres (579,977 Square Feet)
Area to be Disturbed by the Project (Project Footprint)	14.11 Acres (614,773 Square Feet)
Project Proposed Impervious Area (subset of Project Footprint)	9.75 Acres (424,544 Square Feet)
Project Proposed Pervious Area (subset of Project Footprint)	4.37 Acres (190,229 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	100 %

Project Name: Nirvana Business Park

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
☒ Vacant, undeveloped/natural

Description / Additional Information:

The existing site is currently undeveloped except for drainage infrastructure located at the southern property boundary.

Existing Land Cover Includes (select all that apply):

☐ Vegetative Cover
☒ 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
☒ NRCS Type D

Approximate Depth to Groundwater (GW):

☐ GW Depth < 5 feet
☐ 5 feet < GW Depth < 10 feet
☐ 10 feet < GW Depth < 20 feet
☒ GW Depth > 20 feet

Existing Natural Hydrologic Features (select all that apply):

☒ Watercourses
☐ Seeps
☐ Springs
☐ Wetlands
☐ None

Description / Additional Information:

Offsite drainage from the developments to the north is conveyed through the project site. The Otay River is located south of Main Street. The project site not within the 100-year FEMA flood plain boundary.

Project Name: Nirvana Business Park

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:

Topographically, the site slopes steeply to the south from the northern property boundary, forming four (4) drainage basins with four (4) discharge locations to mimic existing conditions. There are two (2) major offsite drainage conveyances through the project site. Existing Drainage Basin A comprises the western portion of the site and includes offsite runoff from the northwest. Offsite runoff is conveyed through a 60” CSP storm drain and discharges through a headwall at the northwest corner of the site. The existing 100-year peak source flow is 146 cubic feet per second. Flow then travels south through a natural open channel to an existing 6' x 2.5' double RCB culvert system underneath Main Street. The culvert system discharges to the south of Main Street and into the Otay River.

Existing Drainage Basin B is located in the center of the site and includes offsite runoff from the north. Offsite runoff is conveyed through a 72” CSP storm drain and discharges through a headwall at the northern property boundary. Flow then travels south through an open channel to three (3) existing 48" RCP storm drains underneath Main Street. The culvert system discharges to the south of Main Street and into the Otay River.

Existing Drainage Basin C comprises the eastern portion of the site. Runoff surface flows down the existing hillside and across the southern property boundary onto Main Street. Runoff is then directed via curb and gutter to an existing Type B curb inlet on Main Street. The curb inlet discharges south through an existing 24” RCP storm drain and into the Otay River.

Project Name: Nirvana Business Park

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:

Existing Drainage Basin D comprises the southern portion of the site. Runoff sheet flows down the existing hillside and across the southern property boundary onto Main Street. Runoff is then directed via curb and gutter to an existing Type B curb inlet on Main Street. The curb inlet discharges south through an existing 18” RCP storm drain and into the Otay River.

The Otay River travels west and outlets at the San Diego Bay and ultimately the Pacific Ocean.

For additional information regarding the existing storm drain infrastructure conveying offsite drainage, refer to As-Built Drawing No. 75-97, 75-98D and 75-101D on file with the City of Chula Vista.

The site is not within a FEMA 100-year floodplain boundary or regulatory floodway.

Project Name: Nirvana Business Park

Form I-3B Page 4 of 0

Description of Proposed Site Development and Drainage Patterns

Project Description / Proposed Land Use and/or Activities:

The project will include the construction of four industrial buildings, paved roadways and parking areas, retaining walls, and other associated improvements. Drainage improvements will consist of catch basins, curb inlets and storm drain pipes. Proprietary Modular Wetland Systems are proposed for storm water treatment. Underground detention vaults are proposed for peak flow attenuation. The project will be accessed by a proposed driveway off Nirvana Avenue. The proposed land use is ILP- Limited Industrial.

List/describe proposed impervious features of the project (e.g., buildings, roadways, parking lots, courtyards, athletic courts, other impervious features):

The proposed impervious features of the project consist of buildings, asphalt driveways and parking lots, and concrete hardscape.

List/describe proposed pervious features of the project (e.g., landscape areas):

The proposed pervious features of the project include landscape areas.

Does the project include grading and changes to site topography?

☒ Yes
☐ No

Description / Additional Information:

Grading is proposed to accommodate the proposed development. Cuts of approximately 14 feet will be made across building pad areas. Fills of approximately 16 feet will be made to reach planned grades along the southern portion of the site where driveways and parking lots will be extended into the existing slope area. Geogrid retaining walls are proposed along the northern, western and southern portions of the 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 proposed site will consist of four (4) major drainage basins with four (4) discharge locations to mimic existing conditions. See project Drainage Study for depiction of major drainage basins. The site will consist of six (6) Drainage Management Areas (DMAs) based on onsite drainage patterns and BMP locations.

The two major offsite drainage conveyances will be channeled and routed south through the project site to their existing culverts underneath Main Street. A 60" RCP storm drain is proposed to convey offsite runoff from the northwest and discharges to the existing 6' x 2.5' double RCB culvert system underneath Main Street. The culvert system discharges to the south of Main Street and into the Otay River. A 72" RCP storm drain is proposed to convey offsite runoff from the north and discharges to the three (3) existing 48" RCP storm drains underneath Main Street. The culvert system discharges to the south of Main Street and into the Otay River.

Storm water runoff from the western portion of the proposed development (DMA-A) is routed to the northwest corner of the site for storm water treatment and detention and discharged into the proposed 60" RCP offsite runoff storm drain system. Storm water from the eastern portion of the proposed development (DMA-B) is routed to the northeast corner of the site for storm water treatment and detention and discharged into the proposed 72" RCP offsite runoff storm drain system.

Runoff from the cut slope at the northwest corner of the site will discharge directly to the 60" RCP storm drain system. This area (DMA-C) is considered a Self-Mitigating DMA per Chapter 5.2.1 of the City of Chula Vista BMP Design Manual. Fill slope runoff along the northern property boundary will discharge directly into the proposed 72” RCP storm drain system. This area (DMA-D) is also considered a Self-Mitigating DMA per the BMP Design Manual.

Project Name: Nirvana Business Park

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:

Slope runoff along the southern property boundary will sheet flow onto Main Street. There is a high point on Main Street forming two Self-Mitigating DMAs. Runoff from Self-Mitigating DMA-E will discharge into the existing Type B curb inlet and existing 18" RCP storm drain under Main Street. Runoff from Self-Mitigating DMA-F will discharge into the existing Type B curb inlet and existing 24" RCP storm drain under Main Street.

All developed site runoff discharges through existing storm drain infrastructure and into the Otay River. The Otay River travels west and outlets at the San Diego Bay and ultimately the Pacific Ocean.

Prior to discharging from the project site, developed site runoff is drained to a series of BMPs including trash screen devices, Contech pretreatment units, StormTrap underground detention vaults, and BioClean Modular Wetland Systems. The underground detention vaults have been designed to meet 100-year peak flow detention requirements. The Modular Wetland Systems (MWS) have been designed for storm water treatment. The project is exempt from hydromodification management requirements.

The underground detention vaults have been designed to provide flow control in the form of volume reduction and peak flow attenuation. The vaults have been modified to include low-flow and mid-flow orifice outlets and an overflow weir to control peak flows. The required water quality treatment flow is diverted to the downstream Modular Wetland System in accordance with Worksheet B.5-5 of the City of Chula Vista BMP Design Manual. Overflow relief for the 100-year storm event is provided with a partition weir installed within the vaults and discharged directly to the proposed 60"-dia and 72"-dia storm drain pipes conveying offsite runoff through the project site.

Project Name: Nirvana Business Park

Form I-3B Page 2

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:

Project Name: Nirvana Business Park

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):

There are four (4) discharge locations from the project site. All locations discharge through existing underground storm drain systems and outlet at the Otay River, an exempt river reach per the WMAA. The Otay River flows to the San Diego Bay and ultimately the Pacific Ocean.

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 Bay	PCBs (Polychlorinated biphenyls)	WQIP Highest Priority Pollutant:
		Indicator Bacteria,
		Dissolved Copper, Lead
		Zinc (wet weather)

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: Nirvana Business Park

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):

There are four (4) discharge locations from the project site. All locations discharge through existing underground storm drain systems and outlet at the Otay River, an exempt river reach per the WMAA. The Otay River flows to the San Diego Bay and ultimately the Pacific Ocean. Since the project discharges to an exempt river reach, the project is exempt from PDP hydromodification management requirements. Refer to the HMP Exemption Exhibit in the project SWQMP.

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:

Not applicable since hydromodification management requirements do not apply.

Project Name: Nirvana Business Park

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.

Not applicable since hydromodification management requirements do not apply.

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)

Nirvana Business Park

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.
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

Project Name: Nirvana Business Park

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:			

Project Name: Nirvana Business Park

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

Project Name.: Nirvana Business Park

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
4.3.2 Conserve Natural Areas, Soils, and Vegetation	☐ Yes	☒ No	☐ N/A
Due to existing steep slopes, project is unable to conserve natural areas. The entire site will graded but will meet grading/property line setbacks per City of Chula Vista and County of San Diego requirements.			
4.3.3 Minimize Impervious Area	☒ Yes	☐ No	☐ N/A
Driveways and parking lots are constructed to minimum widths necessary.			
4.3.4 Minimize Soil Compaction	☒ Yes	☐ No	☐ N/A
Soil compaction is minimized in all landscape areas.			
4.3.5 Impervious Area Dispersion	☒ Yes	☐ No	☐ N/A
Sidewalks are disconnected through distributed pervious areas.			

Nirvana Business Park
Project Name/Address/N ____

Site Design BMP Checklist for All Development Projects	Form I-5		
Site Design Requirement	**Applied?**		
4.3.6 Runoff Collection	☐ Yes	☒ No	☐ N/A
Green roofs and permeable pavements are not applicable BMPs for this project. The site requires rigid pavement suitable for heavy trucks and fire lanes.			
4.3.7 Landscaping with Native or Drought Tolerant Species	☒ Yes	☐ No	☐ N/A
Native or drought tolerant species are used in all landscape areas.			
4.3.8 Harvesting and Using Precipitation	☐ Yes	☐ No	☒ N/A
Discussion / justification for all "No" answers shown above: Harvest and use is considered infeasible per Worksheet B.3-1: Form I-7 (Attachment 1c).			

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

Nirvana Business Park

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.

For the purpose of this SWQMP, the proposed site condition has been divided into two (2) Drainage Management Areas (DMAs) draining to structural BMPs and four (4) Self-Mitigating DMAs. The DMAs have been delineated based on on-site drainage patterns and BMP locations.

The types of structural BMPs chosen for the project were based on the flow chart presented in Figures 5-1 and 5-2 of the City of Chula Vista BMP Design Manual (March 2019). Using Form I-7 (Worksheet B.3-1) to gauge the feasibility of implementing capture and use techniques for the project site, it was determined that harvest and use BMPs are considered infeasible. See Attachment 1C.

A feasibility study was then conducted for infiltration and if infiltration is fully or partially feasible for the project's structural BMPs. The negative impacts associated with retention were identified and substantiated through the completion of Form I-8A (Worksheet C.4-1). Please refer to Attachment 1D.

Based on site geologic conditions and existing fill material, it has been determined that full or partial infiltration of storm water is considered infeasible. Since infiltration is considered infeasible, a cistern (HU-1) and proprietary biofiltration BMP (BF-3) were chosen as the types of structural BMPs for DMA-A and DMA-B.

(continued on following page)

Nirvana Business Park

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.

(continued from previous page)
DMA-A:
The type of underground detention vault is a StormTrap and identified as BMP-A1. Prior to entering the detention vault, storm water will be pre-treated by a high-flow capacity trash screen device. The required treatment volume, or DCV, will be drained the downstream Modular Wetland through a 3”-dia flow control orifice located at the invert of the vault. A partition weir will be constructed within the vault with a 3.0’L X 0.25’H slot orifice set at 2.75 feet above the invert of the vault (elev=171.25) and a 12’L weir set at 6.75 feet above the invert of the vault (elev=178.0), such that peak flows can be safely discharged to the storm drain system.

Since the Modular Wetland System is downstream of the storage unit, the required treatment volume is based on the project DCV and drawdown time of the storage unit, in accordance with Table B.5-5 of the City of Chula Vista BMP Design Manual. The drawdown time of the storage unit is 12 hours; therefore, the required treatment volume of the downstream biofiltration BMP is 0.85DCV. See BMP-A1 vault drawdown calculation provided in Attachment 1D. The type of downstream Modular Wetland System is a MWS-L-8-24 unit, and identified as BMP-A2.

The volume retention requirement for DMA-A has been calculated using Worksheet B.5-2. Two (2) tree wells with underdrains are proposed to meet the volume retention requirement, as documented in Worksheet B.5-6. Since underdrains are proposed, the tree credit volume is adjusted in accordance with Equation B.2-1 of the BMP DM.

Nirvana Business Park

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.

(continued from previous page)
DMA-B:
The type of underground detention vault is a StormTrap and identified as BMP-B1. Prior to entering the detention vault, storm water will be pre-treated by a high-flow capacity trash screen device. The required treatment volume, or DCV, will be drained the downstream Modular Wetland through a 3”-dia flow control orifice located at the invert of the vault. A partition weir will be constructed within the vault with a 3.0’L X 0.25’H slot orifice set at 2.0 feet above the invert of the vault (elev=178.0) and a 12’L weir set at 4.75 feet above the invert of the vault (elev=182.75), such that peak flows can be safely discharged to the storm drain system.

Since the Modular Wetland System is downstream of the storage unit, the required treatment volume is based on the project DCV and drawdown time of the storage unit, in accordance with Table B.5-5 of the City of Chula Vista BMP Design Manual. The drawdown time of the storage unit is 12 hours; therefore, the required treatment volume of the downstream biofiltration BMP is 0.85DCV. See BMP-B1 vault drawdown calculation provided in Attachment 1D. The type of downstream Modular Wetland System is a MWS-L-8-20 unit, and identified as BMP-B2.

The volume retention requirement for DMA-B has been calculated using Worksheet B.5-2. One (1) tree well with an underdrain is proposed to meet the volume retention requirement, as documented in Worksheet B.5-6. Since an underdrain is proposed, the tree credit volume is adjusted in accordance with Equation B.2-1 of the BMP DM.

Project Name: Nirvana Business Park

Form I-6 Page 2 of ____ *(Copy and attach as many as needed)*

Structural BMP ID No. BMP-A1

Construction Plan Sheet No.

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)	Gregory W. Lang, RCE 68075 535 N. Highway 101, Suite A Solana Beach, CA 92075 (858) 259-8212
Who will be the final owner of this BMP?	VWP-OP Nirvana Owner, LLC 2390 East Camelback Road, Suite 305 Phoenix, AZ 85016
Who will maintain this BMP into perpetuity?	VWP-OP Nirvana Owner, LLC 2390 East Camelback Road, Suite 305 Phoenix, AZ 85016
What is the funding mechanism for maintenance?	VWP-OP Nirvana Owner, LLC 2390 East Camelback Road, Suite 305 Phoenix, AZ, 85016

Nirvana Business Park

Project Name: ____

Form I-6 Page 3 of *(Copy and attach as many as needed)*
Structural BMP ID No. BMP-A1
Construction Plan Sheet No.
Discussion (as needed, must include worksheets showing BMP sizing calculations in the SWQMP): The StormTrap underground detention vault, BMP-A1, is responsible for handling peak flow reduction requirements for a portion of the project site (DMA-A).

Project Name: Nirvana Business Park

Form I-6 Page 2 of ____ *(Copy and attach as many as needed)*

Structural BMP ID No. BMP-A2

Construction Plan Sheet No.

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)	Gregory W. Lang, RCE 68075 535 N. Highway 101, Suite A Solana Beach, CA 92075 (858) 259-8212
Who will be the final owner of this BMP?	VWP-OP Nirvana Owner, LLC 2390 East Camelback Road, Suite 305 Phoenix, AZ 85016
Who will maintain this BMP into perpetuity?	VWP-OP Nirvana Owner, LLC 2390 East Camelback Road, Suite 305 Phoenix, AZ 85016
What is the funding mechanism for maintenance?	VWP-OP Nirvana Owner, LLC 2390 East Camelback Road, Suite 305 Phoenix, AZ, 85016

Nirvana Business Park

Project Name: ____

Form I-6 Page 3 of *(Copy and attach as many as needed)*
Structural BMP ID No. BMP-A2
Construction Plan Sheet No.
Discussion (as needed, must include worksheets showing BMP sizing calculations in the SWQMP): The proprietary Modular Wetland System, BMP-A2, is responsible for handling pollutant control requirements for a portion of the project site (DMA-A).

Project Name: Nirvana Business Park

Form I-6 Page 2 of ____ *(Copy and attach as many as needed)*	
Structural BMP ID No. BMP-B1	
Construction Plan Sheet No.	

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)	Gregory W. Lang, RCE 68075 535 N. Highway 101, Suite A Solana Beach, CA 92075 (858) 259-8212
Who will be the final owner of this BMP?	VWP-OP Nirvana Owner, LLC 2390 East Camelback Road, Suite 305 Phoenix, AZ 85016
Who will maintain this BMP into perpetuity?	VWP-OP Nirvana Owner, LLC 2390 East Camelback Road, Suite 305 Phoenix, AZ 85016
What is the funding mechanism for maintenance?	VWP-OP Nirvana Owner, LLC 2390 East Camelback Road, Suite 305 Phoenix, AZ, 85016

Nirvana Business Park

Project Name: ____

Form I-6 Page 3 of *(Copy and attach as many as needed)*
Structural BMP ID No. BMP-B1
Construction Plan Sheet No.
Discussion (as needed, must include worksheets showing BMP sizing calculations in the SWQMP): The StormTrap underground detention vault, BMP-B1, is responsible for handling peak flow reduction requirements for a portion of the project site (DMA-B).

Project Name: Nirvana Business Park

Form I-6 Page 2 of ____ *(Copy and attach as many as needed)*	
Structural BMP ID No. BMP-B2	
Construction Plan Sheet No.	
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)	Gregory W. Lang, RCE 68075 535 N. Highway 101, Suite A Solana Beach, CA 92075 (858) 259-8212
Who will be the final owner of this BMP?	VWP-OP Nirvana Owner, LLC 2390 East Camelback Road, Suite 305 Phoenix, AZ 85016
Who will maintain this BMP into perpetuity?	VWP-OP Nirvana Owner, LLC 2390 East Camelback Road, Suite 305 Phoenix, AZ 85016
What is the funding mechanism for maintenance?	VWP-OP Nirvana Owner, LLC 2390 East Camelback Road, Suite 305 Phoenix, AZ, 85016

Project Name: Nirvana Business Park

Form I-6 Page 3 of *(Copy and attach as many as needed)*
Structural BMP ID No. BMP-B2
Construction Plan Sheet No.
Discussion (as needed, must include worksheets showing BMP sizing calculations in the SWQMP): The proprietary Modular Wetland System, BMP-B2, is responsible for handling pollutant control requirements for a portion of the project site (DMA-B).

ATTACHMENT 1

Backup for PDP Pollutant Control BMPs

Project Name/ Nirvana Business Park

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/ Nirvana Business Park

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
- ☒ Existing natural hydrologic features (watercourses, seeps, springs, wetlands)
- ☒ Critical coarse sediment yield areas to be protected
- ☒ 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)

Attachment 1A

DMA Exhibit

LEGEND

DESCRIPTION	SYMBOL
RIGHT-OF-WAY	—R/W— — — ——
PROPERTY LINE	—P/L— — — ——
DMA BOUNDARY	🟪
PROPOSED TREE WELL	🟩
DIRECTION OF FLOW	→

HYDROLOGIC SOIL GROUP

HYDROLOGIC SOIL TYPE: C & D

DEPTH TO GROUNDWATER

DEPTH TO GROUNDWATER > 20 FT

PROJECT CHARACTERISTICS

PARCEL AREA:	13.31 AC
PROPOSED DISTURBED AREA:	14.11 AC
PROPOSED IMPERVIOUS AREA:	9.75 AC
PROPOSED PERVIOUS / LANDSCAPE AREA:	4.37 AC

STRUCTURAL BMPS

UNDERGROUND DETENTION VAULT (HU-1)	V
MODULAR WETLAND, PROPRIETARY BIOFILTRATION (BF-3)	MW

SITE DESIGN BMPS

TREE WELL (SD-A)	T

CCSYAS

THE PROJECT IS EXEMPT FROM HYDROMODIFICATION REQUIREMENTS; THEREFORE PROTECTION OF CRITICAL COARSE SEIDMENT YIELD AREAS DOES NOT APPLY.

REFER TO THE HMP EXEMPTION EXHIBIT INCLUDED IN THE "CITY OF CHULA VISTA PRIORITY DEVELOPMENT PROJECT (PDP) SWQMP FOR NIRVANA BUSINESS PARK, VWP-OP NIRVANA OWNER, LLC" DATED MARCH 2022.

SITE DESIGN BMPS

SD-3	MINIMIZE IMPERVIOUS AREAS
SD-4	MINIMIZE SOIL COMPACTION
SD-5	IMPERVIOUS AREA DISPERSION
SD-7	LANDSCAPING WITH NATIVE OR DROUGHT TOLERANT SPECIES

SOURCE CONTROL BMPS

SC-1	PREVENTION OF ILLICIT DISCHARGES TO THE MS4
SC-2	STORM DRAIN STENCILING AND SIGNAGE
SC-5	PROTECT TRASH STORAGE AREAS FROM RAINFALL, RUN-ON, AND WIND DISPERSAL
SC-6	ADDITIONAL BMPS BASED ON POTENTIAL RUNOFF POLLUTANTS:
SC-A	ONSITE STORM DRAIN INLETS
SC-D1	NEED FOR FUTURE INDOOR & STRUCTURAL PEST CONTROL
SC-D2	LANDSCAPE/OUTDOOR PESTICIDE USE
SC-G	REFUSE AREAS
SC-H	INDUSTRIAL PROCESSES
SC-M	LOADING DOCKS
SC-N	FIRE SPRINKLER TEST WATER
SC-O	MISCELLANEOUS DRAIN OR WASH WATER
SC-P	PLAZAS, SIDEWALKS, AND PARKING LOTS

INDUSTRIAL PROCESSES NOTE

ALL PROCESS ACTIVITIES TO BE PERFORMED INDOORS. NO PROCESSES TO DRAIN TO EXTERIOR OR TO STORM DRAIN SYSTEM.

RETENTION REQUIREMENTS

DMA-A:
TARGET VOLUME RETENTION = 215 CU. FT.

SITE DESIGN BMP USED: BMP-A4, TREE WELL W/ UNDERDRAIN
TCV = 114 CU. FT.
SOIL AREA = 284 SQ. FT.
SOIL VOLUME (SV) = 1,136 CU. FT.

SITE DESIGN BMP USED: BMP-A5, TREE WELL W/ UNDERDRAIN
TCV = 108 CU. FT.
SOIL AREA = 271 SQ. FT.
SOIL VOLUME (SV) = 1,084 CU. FT.

SUM OF VOLUME RETENTION BENEFITS = 222 CU. FT.

DMA-B:
TARGET VOLUME RETENTION = 174 CU. FT.

SITE DESIGN BMP USED: BMP-B4, TREE WELL W/ UNDERDRAIN
TCV = 176 CU. FT.
SOIL AREA = 439 SQ. FT.
SOIL VOLUME (SV) = 1,756 CU. FT.

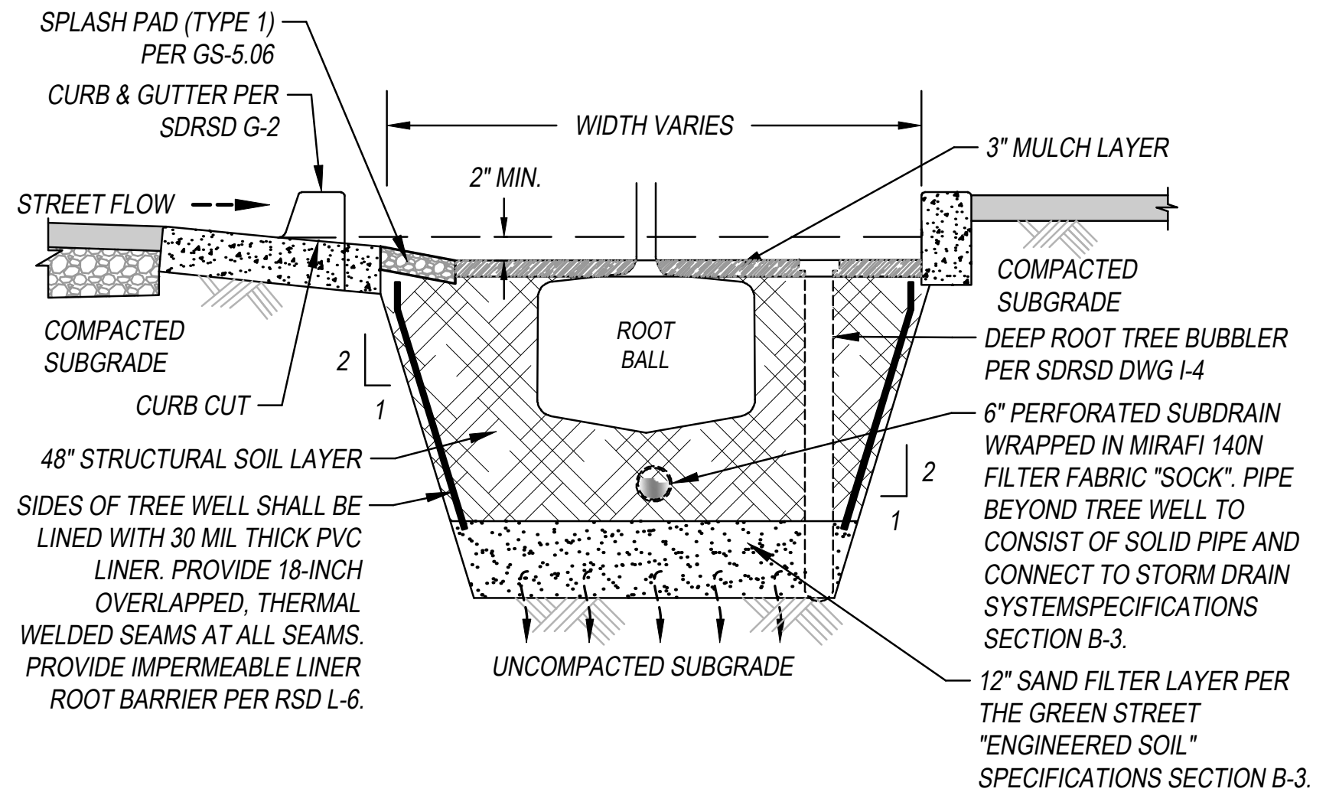
SUM OF VOLUME RETENTION BENEFITS = 176 CU. FT.

SEE DETAIL 'A' THIS SHEET FOR TYPICAL TREE WELL DETAIL

SUMMARY OF DRAINAGE MANAGEMENT AREAS

DMA	DRAINAGE AREA (AC)	IMPERVIOUS AREA (AC)	% IMP	DMA RUNOFF COEFFICIENT, C	DCV (CU.FT.)	TREATED BY (BMP ID)	POLLUTANT CONTROL TYPE	REQUIRED TREATMENT VOLUME (CU.FT.)
DMA-A	6.49	5.38	82.8%	0.76	9,343	BMP-A2, MWS-L-8-20	PROPRIETARY BIOFILTRATION (BF-3)	7,941
DMA-B	5.22	4.37	83.7%	0.77	7,585	BMP-B2, MWS-L-8-20	PROPRIETARY BIOFILTRATION (BF-3)	6,447
DMA-C	0.58	0.00	0%	- -	- -	N/A - SELF-MITIGATING	- -	- -
DMA-D	0.42	0.00	0%	- -	- -	N/A - SELF-MITIGATING	- -	- -
DMA-E	0.40	0.00	0%	- -	- -	N/A - SELF-MITIGATING	- -	- -
DMA-F	0.09	0.00	0%	- -	- -	N/A - SELF-MITIGATING	- -	- -
DMA-G	0.31	0.00	0%	- -	- -	N/A - SELF-MITIGATING	- -	- -
DMA-H	0.48	0.00	0%	- -	- -	N/A - SELF-MITIGATING	- -	- -
TOTAL	14.00	9.75	69.6%	0.66	16,928			

NOTE: REQUIRED TREATMENT VOLUME BASED ON DRAWDOWN TIME OF UPSTREAM STORAGE UNIT PER TABLE B.5-5 OF THE CITY OF CHULA VISTA BMP DESIGN MANUAL. SINCE THE DRAWDOWN TIME OF THE UPSTREAM STORAGE UNITS (BMP-A1 AND BMP-B1) IS 12 HOURS, THE REQUIRED TREATMENT VOLUME IS 0.85 TIMES THE DCV.



Ⓐ TYPICAL TREE WELL DETAIL

NOT TO SCALE

50' 25' 0 50' 100' 150'
SCALE: 1" = 50'

PASCO LARET SUITER
& ASSOCIATES
San Diego | Encinitas | Orange County
Phone 858.259.8212 | www.plsaengineering.com

DRAINAGE MANAGEMENT
AREA EXHIBIT
NIRVANA BUSINESS PARK
821 MAIN STREET
CHULA VISTA, CA
PLSA JOB NO. 3668
MARCH 2022

Attachment 1B

DMA Summary

Project Name: Nirvana Business Park

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)
DMA-A	6.49	5.38	82.8%	C & D	0.76	9,343	BMP-A2	Biof.(BF-3)	POC-1
DMA-B	5.22	4.37	83.7%	C & D	0.77	7,585	BMP-B2	Biof.(BF-3)	POC-2
DMA-C	0.58	0.00	0%	C & D	N/A	N/A	N/A-Self-Mit.	N/A-Self-Mi	POC-1
DMA-D	0.42	0.00	0%	C & D	N/A	N/A	N/A-Self-Mit.	N/A-Self-Mi	POC-1
DMA-E	0.40	0.00	0%	C & D	N/A	N/A	N/A-Self-Mit.	N/A-Self-Mi	POC-2
DMA-F	0.09	0.00	0%	C & D	N/A	N/A	N/A-Self-Mit.	N/A-Self-Mi	POC-2
DMA-G	0.31	0.00	0%	C & D	N/A	N/A	N/A-Self-Mit.	N/A-Self-Mi	POC-4
DMA-H	0.48	0.00	0%	C & D	N/A	N/A	N/A-Self-Mit.	N/A-Self-Mi	POC-3

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
8	14.00	9.75	69.6%	C & D	0.66	16,928	11.71		4

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

Attachment 1C

Harvest and Use Feasibility (Form I-7)

Nirvana Business Park

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.

[Provide a summary of calculations here]

Landscape Irrigation
(4.37 ac irrigated) x (390 gal/ac-36hr) x (0.13368 cu-ft/gal) =228 cu-ft/36hr

3. Calculate the DCV using worksheet B-2.1.

[Provide a result here]

DCV = 16,928 cu-ft

0.25 DCV = 4,232 cu-ft

3a. Is the 36-hour demand greater than or equal to the DCV? Yes / [✓ No ⇨] ⇩	3b. Is the 36-hour demand greater than 0.25DCV but less than the full DCV? Yes / [✓ No ⇨] ⇩	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.

Attachment 1D

Infiltration Feasibility

Nirvana Business Park

Project Name: ____

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:**
DMA-A & DMA-B		Preliminary Design
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.

Project Name: Nirvana Business Park

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.

The geotechnical engineer performed eight exploratory test pits and five large diameter geotechnical borings to characterize the specific engineering properties of the underlying soils within the area of the proposed improvements. Final boring and testing logs were prepared based upon their interpretation of field logs and laboratory data.

Due to the presence of undocumented fill and compacted fill found in the boring logs, the site is considered as having a "no infiltration" condition per the geotechnical engineer's recommend.

See copy of report titled "Preliminary Geotechnical Investigation, Nirvana Industrial Buildings and Self-Storage Complex, 821 Main Street, Chula Vista, California" prepared by Geocon, Inc., dated September 14, 2021 (Project No. G2755-42-01). A copy of the report is included in Attachment 6 of this SWQMP.

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.

Project Name: Nirvana Business Park

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

Nirvana Business Park

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.

Project Name: Nirvana Business Park

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:**
DMA-A	Preliminary Design

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).

A review of the soil survey maps indicates Type C soils in the location of the project site. According to NRCS web soil survey, Type C soils are generally rated for low infiltration capacity (approximatley 0.15 in/hr).

Project Name: Nirvana Business Park

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

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: Nirvana Business Park

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.

The site is underlain by undocumented fill, slope wash, topsoil, Alluvium, Terrace Deposits, and Otay Formation as illustrated in the Geologic Map, Figure 2, of the Preliminary Geotechnical Investigation by Geocon (see Attachment 6). The undocumented fill is characterized as medium dense, damp to moist, clayey sand with gravel and cobbles with estimated thickness of 10 to 20 feet.

Top soil and slope wash range from approximately 1 to 4 feet thick. The alluvium extends to depths greater than 5 feet and may be thicker in unexplored areas of the site.

Due to the presence of existing fill material, as well as the proposed MSE walls and deep fills required in the southern portion of the site, infiltration of stormwater is not recommended on the site per the geotechnical engineer and geotechincal report.

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.

Attachment 1E

BMP Design Worksheets

The City of SAN DIEGO

Project Name	Nirvana Business Park
BMP ID	BMP-A2

Sizing Method for Volume Retention Criteria

Worksheet B.5-2

1	Area draining to the BMP	282662	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.7628	
3	85th percentile 24-hour rainfall depth	0.52	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	9343	cu. ft.
Volume Retention Requirement			
5	Measured infiltration rate in the DMA Note: When mapped hydrologic soil groups are used enter 0.10 for NRCS Type D soils and for NRCS Type C soils enter 0.30 When in no infiltration condition and the actual measured infiltration rate is unknown enter 0.0 if there are geotechnical and/or groundwater hazards identified in Appendix C or	0	in/hr.
6	Factor of safety	2	
7	Reliable infiltration rate, for biofiltration BMP sizing [Line 5 / Line 6]	0	in/hr.
8	Average annual volume reduction target (Figure B.5-2) When Line 7 > 0.01 in/hr. = Minimum (40, 166.9 x Line 7 +6.62) When Line 7 ≤ 0.01 in/hr. = 3.5%	3.5	%
9	Fraction of DCV to be retained (Figure B.5-3) When Line 8 > 8% = 0.0000013 x Line 8^3 - 0.000057 x Line 8^2 + 0.0086 x Line 8 - 0.014 When Line 8 ≤ 8% = 0.023	0.023	
10	Target volume retention [Line 9 x Line 4]	215	cu. ft.

The City of SAN DIEGO

Project Name	Nirvana Business Park
BMP ID	BMP-A2

Optimized Biofiltration BMP Footprint when Downstream of a Storage Unit

Worksheet B.5-5

1	Area draining to the storage unit and biofiltration BMP	282,662	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.7628	
3	Effective impervious area draining to the storage unit and biofiltration BMP [Line 1 x Line 2]	215614.5736	sq. ft.
4	Remaining DCV after implementing retention BMPs	9343	cu. ft.
5	Design infiltration rate (measured infiltration rate / 2)	0	ft./hr.
6	Media thickness [1.5 feet minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	0	ft.
7	Media filtration rate to be used for sizing (0.42 ft/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate)	0	ft./hr.
8	Media retained pore space	0.05	in/in
Storage Unit Requirement			
9	Drawdown time of the storage unit, minimum(from the elevation that bypasses the biofiltration BMP, overflow elevation)	12	hours
10	Storage required to achieve greater than 92 percent capture (see Table B.5-5)	0.85	fraction
11	Storage required in cubic feet (Line 4 x Line 10)	7941.803461	cu. ft.
12	Storage provided in the design, minimum(from the elevation that bypasses the biofiltration BMP, overflow elevation)	8100	cu. ft.
13	Is Line 12 ≥ Line 11?	Storage Requirement is Met	
Criteria 1: BMP Footprint Biofiltration Capacity			
14	Peak flow from the storage unit to the biofiltration BMP (using the elevation used to evaluate the percent capture)		cfs
15	Required biofiltration footprint [(3,600 x Line 14)/Line 7]	0	sq. ft.
Criteria 2: Alternative Minimum Sizing Factor (Clogging)			
16	Alternative Minimum Footprint Sizing Factor [Line 11 of Worksheet B.5-4]		fraction
17	Required biofiltration footprint [Line 3 x Line 16]	0	sq. ft.
Criteria 3: Retention requirement [Not applicable for No Infiltration Condition]			
18	Retention Target (Line 10 in Worksheet B.5-2)		cu. ft.
19	Average discharge rate from the storage unit to the biofiltration BMP		cfs
20	Depth retained in the optimized biofiltration BMP {Line 6 x Line 8} + {[(Line 4)/(2400 x Line 19)] x Line 5}	0	ft
21	Required optimized biofiltration footprint (Line 18/Line 20)	0	sq. ft.
Optimized Biofiltration Footprint			
22	Optimized biofiltration footprint, maximum(Line 15, Line 17, Line 21)	0	sq. ft.

The City of SAN DIEGO	**Project Name**	Nirvana Business Park
	BMP ID	BMP-A2

Volume Retention for No Infiltration Condition | Worksheet B.5-6

1	Area draining to the biofiltration BMP	282662	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.7628	
3	Effective impervious area draining to the BMP [Line 1 x Line 2]	215615	sq. ft.
4	Required area for Evapotranspiration [Line 3 x 0.03]	6468	sq. ft.
5	Biofiltration BMP Footprint	0	sq. ft.

Landscape Area (must be identified on DS-3247)

	Identification	1	2	3	4	5
6	Landscape area that meet the requirements in SD-B and SD-F Fact Sheet (sq. ft.)					
7	Impervious area draining to the landscape area (sq. ft.)					
8	Impervious to Pervious Area ratio [Line 7/Line 6]	0.00	0.00	0.00	0.00	0.00
9	Effective Credit Area If (Line 8 >1.5, Line 6, Line 7/1.5]	0	0	0	0	0

10	Sum of Landscape area [sum of Line 9 Id's 1 to 5]	0	sq. ft.
11	Provided footprint for evapotranspiration [Line 5 + Line 10]	0	sq. ft.

Volume Retention Performance Standard

12	Is Line 11 ≥ Line 4?	No, Proceed to Line 13	
13	Fraction of the performance standard met through the BMP footprint and/or landscaping [Line 11/Line 4]	0	
14	Target Volume Retention [Line 10 from Worksheet B.5.2]	215	cu. ft.
15	Volume retention required from other site design BMPs [(1-Line 13) x Line 14]	214.8958584	cu. ft.

Site Design BMP

	Identification	Site Design Type	Credit	
16	1	(1) Tree Well w/ Underdrain (Area=284 sq-ft, SV=1,136 cu-ft)	114	cu. ft.
	2	(1) Tree Well w/ Underdrain (Area=271 sq-ft, SV=1,084 cu-ft)	108	cu. ft.
	3			cu. ft.
	4			cu. ft.
	5			cu. ft.
	Sum of volume retention benefits from other site design BMPs (e.g. trees; rain barrels etc.). [sum of Line 16 Credits for Id's 1 to 5] Provide documentation of how the site design credit is calculated in the PDP SWQMP.		222	cu. ft.
17	Is Line 16 ≥ Line 15?	Volume Retention Performance Standard is Met		

Vault Drawdown Calculation - BMP-A1

Project Name	Nirvana Business Park
PLSA Project No.	3668
Vault Drawdown	**11.7**	**hrs**

Vault Dimensions

Vault Volume	20,250	cf
Chamber Height	7.5	ft
Vault Area	2,700	sf

Note: Drawdown time is calculated assuming an initial water surface depth equal to the invert of the lowest surface discharge opening in the basin outlet structure.

Underdrain Orifice Diameter:	**3**	in
C:	**0.6**	

Surface Depth (ft)	Volume (cf)	Qorifice (cfs)	ΔT (hr)	Total Time (hr)
3.00	8100	0.403	0.00	0.00
2.50	6750	0.367	0.97	0.97
2.25	6075	0.348	0.52	1.50
2.00	5400	0.327	0.56	2.05
1.75	4725	0.305	0.59	2.65
1.50	4050	0.281	0.64	3.29
1.25	3375	0.255	0.70	3.99
1.00	2700	0.226	0.78	4.76
0.75	2025	0.193	0.89	5.66
0.50	1350	0.152	1.09	6.75
0.00	0	0.00	4.92	11.66

Storage Unit Requirement

DCV	9,343
0.85DCV	7,941
Storage provided in the design	8,100
Is storage requirement met?	yes

The City of SAN DIEGO	Project Name	Nirvana Business Park
	BMP ID	BMP-B2
Sizing Method for Volume Retention Criteria		**Worksheet B.5-2**

1	Area draining to the BMP	227431	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.7696	
3	85th percentile 24-hour rainfall depth	0.52	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	7585	cu. ft.
Volume Retention Requirement			
5	Measured infiltration rate in the DMA Note: When mapped hydrologic soil groups are used enter 0.10 for NRCS Type D soils and for NRCS Type C soils enter 0.30 When in no infiltration condition and the actual measured infiltration rate is unknown enter 0.0 if there are geotechnical and/or groundwater hazards identified in Appendix C or	0	in/hr.
6	Factor of safety	2	
7	Reliable infiltration rate, for biofiltration BMP sizing [Line 5 / Line 6]	0	in/hr.
8	Average annual volume reduction target (Figure B.5-2) When Line 7 > 0.01 in/hr. = Minimum (40, 166.9 x Line 7 +6.62) When Line 7 ≤ 0.01 in/hr. = 3.5%	3.5	%
9	Fraction of DCV to be retained (Figure B.5-3) When Line 8 > 8% = 0.0000013 x Line 8^3 - 0.000057 x Line 8^2 + 0.0086 x Line 8 - 0.014 When Line 8 ≤ 8% = 0.023	0.023	
10	Target volume retention [Line 9 x Line 4]	174	cu. ft.

The City of SAN DIEGO	**Project Name**	Nirvana Business Park	
	BMP ID	BMP-B2	
Optimized Biofiltration BMP Footprint when Downstream of a Storage Unit		**Worksheet B.5-5**	
1	Area draining to the storage unit and biofiltration BMP	227,431	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.7696	
3	Effective impervious area draining to the storage unit and biofiltration BMP [Line 1 x Line 2]	175030.8976	sq. ft.
4	Remaining DCV after implementing retention BMPs	7585	cu. ft.
5	Design infiltration rate (measured infiltration rate / 2)	0	ft./hr.
6	Media thickness [1.5 feet minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	0	ft.
7	Media filtration rate to be used for sizing (0.42 ft/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate)	0	ft./hr.
8	Media retained pore space	0.05	in/in
Storage Unit Requirement			
9	Drawdown time of the storage unit, minimum(from the elevation that bypasses the biofiltration BMP, overflow elevation)	12	hours
10	Storage required to achieve greater than 92 percent capture (see Table B.5-5)	0.85	fraction
11	Storage required in cubic feet (Line 4 x Line 10)	6446.971395	cu. ft.
12	Storage provided in the design, minimum(from the elevation that bypasses the biofiltration BMP, overflow elevation)	7000	cu. ft.
13	Is Line 12 ≥ Line 11?	Storage Requirement is Met	
Criteria 1: BMP Footprint Biofiltration Capacity			
14	Peak flow from the storage unit to the biofiltration BMP (using the elevation used to evaluate the percent capture)		cfs
15	Required biofiltration footprint [(3,600 x Line 14)/Line 7]	0	sq. ft.
Criteria 2: Alternative Minimum Sizing Factor (Clogging)			
16	Alternative Minimum Footprint Sizing Factor [Line 11 of Worksheet B.5-4]		fraction
17	Required biofiltration footprint [Line 3 x Line 16]	0	sq. ft.
Criteria 3: Retention requirement [Not applicable for No Infiltration Condition]			
18	Retention Target (Line 10 in Worksheet B.5-2)		cu. ft.
19	Average discharge rate from the storage unit to the biofiltration BMP		cfs
20	Depth retained in the optimized biofiltration BMP {Line 6 x Line 8} + {[(Line 4)/(2400 x Line 19)] x Line 5}	0	ft
21	Required optimized biofiltration footprint (Line 18/Line 20)	0	sq. ft.
Optimized Biofiltration Footprint			
22	Optimized biofiltration footprint, maximum(Line 15, Line 17, Line 21)	0	sq. ft.

The City of SAN DIEGO

Project Name	Nirvana Business Park
BMP ID	BMP-B2

Volume Retention for No Infiltration Condition — Worksheet B.5-6

1	Area draining to the biofiltration BMP	227431	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.7696	
3	Effective impervious area draining to the BMP [Line 1 x Line 2]	175031	sq. ft.
4	Required area for Evapotranspiration [Line 3 x 0.03]	5251	sq. ft.
5	Biofiltration BMP Footprint	0	sq. ft.

Landscape Area (must be identified on DS-3247)

	Identification	1	2	3	4	5
6	Landscape area that meet the requirements in SD-B and SD-F Fact Sheet (sq. ft.)					
7	Impervious area draining to the landscape area (sq. ft.)					
8	Impervious to Pervious Area ratio [Line 7/Line 6]	0.00	0.00	0.00	0.00	0.00
9	Effective Credit Area If (Line 8 >1.5, Line 6, Line 7/1.5]	0	0	0	0	0

10	Sum of Landscape area [sum of Line 9 Id's 1 to 5]	0	sq. ft.
11	Provided footprint for evapotranspiration [Line 5 + Line 10]	0	sq. ft.

Volume Retention Performance Standard

12	Is Line 11 ≥ Line 4?	No, Proceed to Line 13	
13	Fraction of the performance standard met through the BMP footprint and/or landscaping [Line 11/Line 4]	0	
14	Target Volume Retention [Line 10 from Worksheet B.5.2]	174	cu. ft.
15	Volume retention required from other site design BMPs [(1-Line 13) x Line 14]	174.4474613	cu. ft.

Site Design BMP

	Identification	Site Design Type	Credit	
16	1	(1) Tree Well w/ Underdrain (Area=439 sq-ft, SV=1,756 cu-ft)	176	cu. ft.
	2			cu. ft.
	3			cu. ft.
	4			cu. ft.
	5			cu. ft.
	Sum of volume retention benefits from other site design BMPs (e.g. trees; rain barrels etc.). [sum of Line 16 Credits for Id's 1 to 5] Provide documentation of how the site design credit is calculated in the PDP SWQMP.		176	cu. ft.
17	Is Line 16 ≥ Line 15?	Volume Retention Performance Standard is Met		

Vault Drawdown Calculation - BMP-B1

Project Name Nirvana Business Park

PLSA Project No. 3668

Vault Drawdown	**12.5**	**hrs**

Vault Dimensions

Vault Volume	19,845	cf
Chamber Height	5.67	ft
Vault Area	3,500	sf

Note: Drawdown time is calculated assuming an initial water surface depth equal to the invert of the lowest surface discharge opening in the basin outlet structure.

Underdrain Orifice Diameter:	**3**	in
C:	**0.6**	

Surface Depth (ft)	Volume (cf)	Qorifice (cfs)	ΔT (hr)	Total Time (hr)
2.00	7000	0.327	0.00	0.00
1.75	6125	0.305	0.77	0.77
1.50	5250	0.281	0.83	1.60
1.25	4375	0.255	0.91	2.50
1.00	3500	0.226	1.01	3.51
0.75	2625	0.193	1.16	4.67
0.50	1750	0.152	1.41	6.08
0.00	0	0.00	6.38	12.46

Storage Unit Requirement

DCV	7,585
0.85DCV	6,447
Storage provided in the design	7,000
Is storage requirement met?	yes

SITE SPECIFIC DATA			
PROJECT NUMBER	13984		
PROJECT NAME	NIRVANA SELF STORAGE		
PROJECT LOCATION	CHULA VISTA, CA		
STRUCTURE ID	BMP A2		
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
7,941		N/A	
TREATMENT HGL AVAILABLE (FT)			4.1
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			N/A
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	169.90	PVC	6"
INLET PIPE 2	N/A	N/A	N/A
OUTLET PIPE	169.40	PVC	6"
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION	183.40	183.40	183.40
SURFACE LOAD	H-20 DIRECT	H-20 DIRECT	H-20 DIRECT
FRAME & COVER	3EA ø30"	3EA 30" X 48"	ø30"
WETLANDMEDIA VOLUME (CY)			10.35
ORIFICE SIZE (DIA. INCHES)			ø1.94 EA

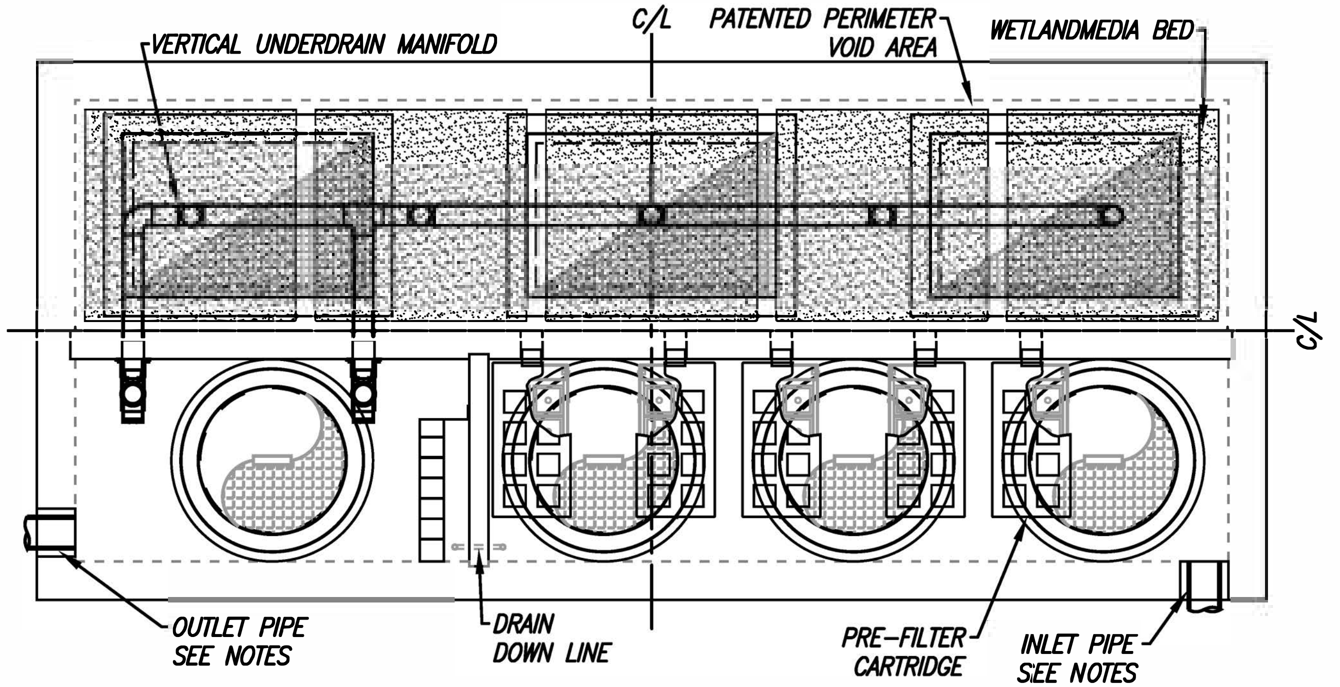
NOTES: PRELIMINARY NOT FOR CONSTRUCTION. 8" WALLS REQUIRED DUE TO STRUCTURAL EVALUATION.

INSTALLATION NOTES

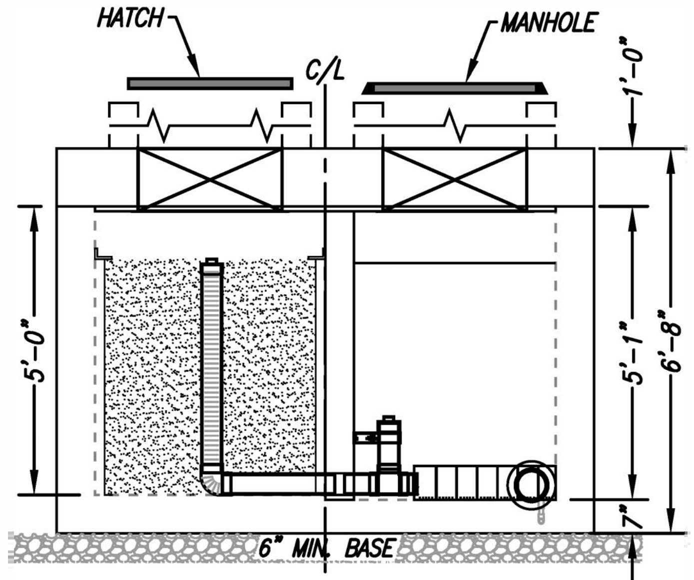
1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURERS' SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURER'S CONTRACT.
2. UNIT MUST BE INSTALLED ON LEVEL BASE. MANUFACTURER RECOMMENDS A MINIMUM 6" LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE FOR VERIFYING PROJECT ENGINEER'S RECOMMENDED BASE SPECIFICATIONS.
4. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE (PIPES CANNOT INTRUDE BEYOND FLUSH). INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR. ALL PIPES SHALL BE SEALED WATERTIGHT PER MANUFACTURER'S STANDARD CONNECTION DETAIL.
5. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL PIPES, RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO GROUT ALL MANHOLES AND HATCHES TO MATCH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.
6. VEGETATION SUPPLIED AND INSTALLED BY OTHERS. ALL UNITS WITH VEGETATION MUST HAVE DRIP OR SPRAY IRRIGATION SUPPLIED AND INSTALLED BY OTHERS.
7. CONTRACTOR RESPONSIBLE FOR CONTACTING BIO CLEAN FOR ACTIVATION OF UNIT. MANUFACTURER'S WARRANTY IS VOID WITHOUT PROPER ACTIVATION BY A BIO CLEAN REPRESENTATIVE.

GENERAL NOTES

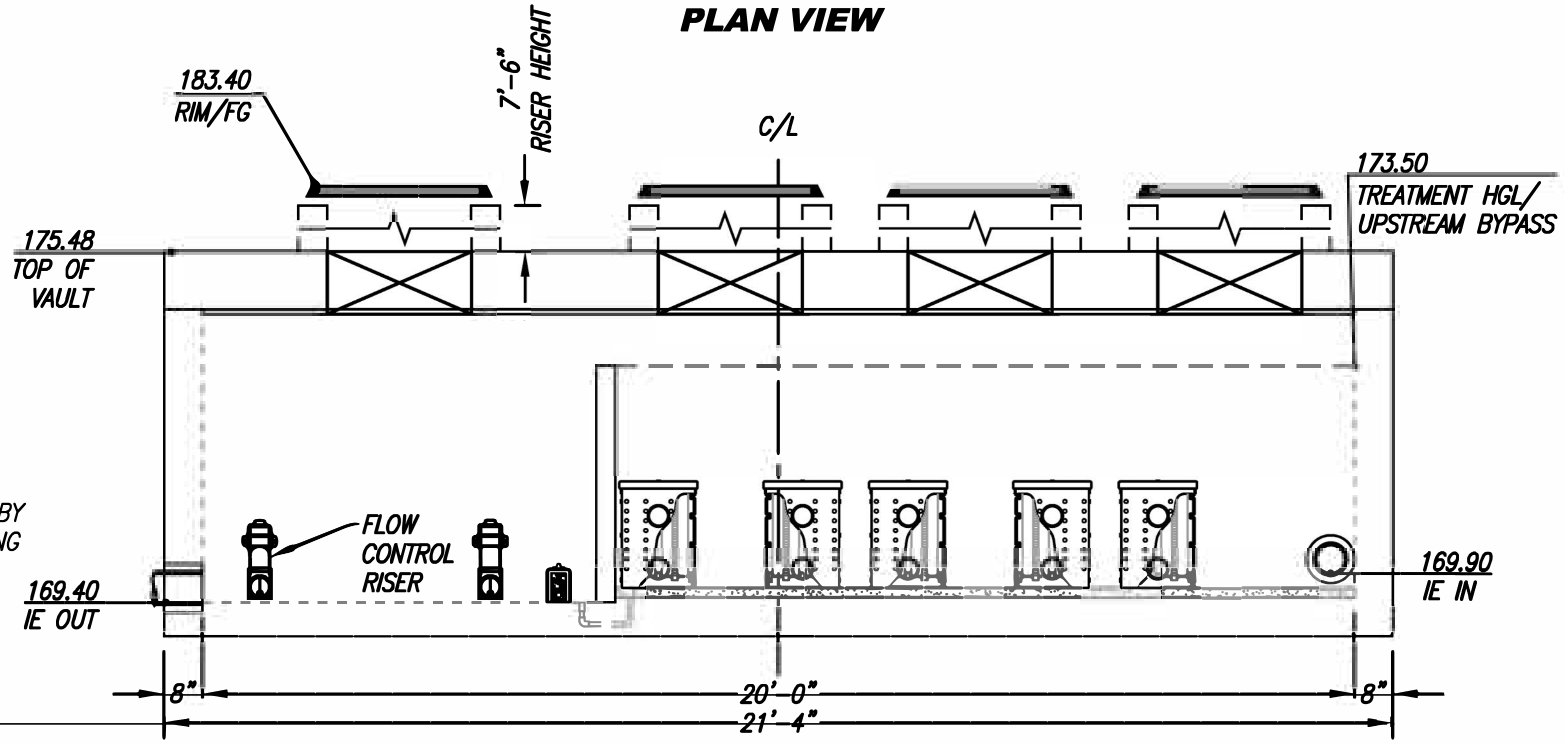
1. MANUFACTURER TO PROVIDE ALL MATERIALS UNLESS OTHERWISE NOTED.
2. ALL DIMENSIONS, ELEVATIONS, SPECIFICATIONS AND CAPACITIES ARE SUBJECT TO CHANGE. FOR PROJECT SPECIFIC DRAWINGS DETAILING EXACT DIMENSIONS, WEIGHTS AND ACCESSORIES PLEASE CONTACT BIO CLEAN.



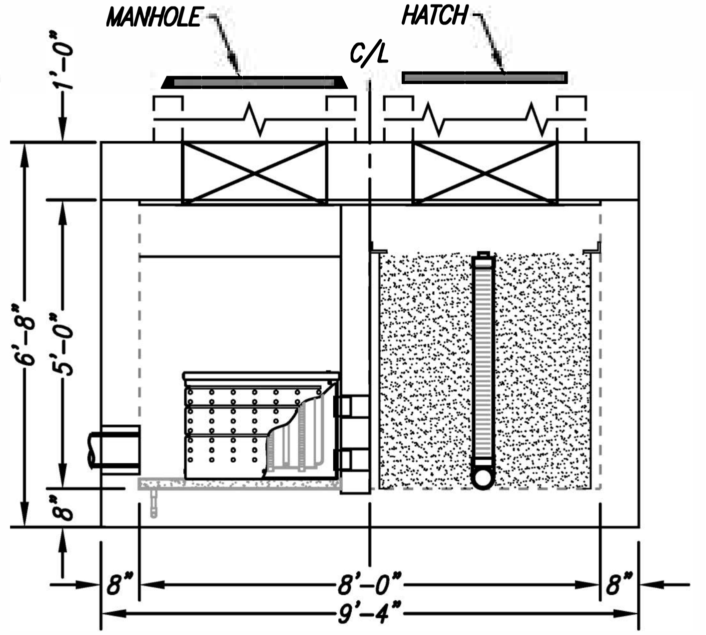
PLAN VIEW



LEFT END VIEW



ELEVATION VIEW



RIGHT END VIEW

REQUIRED TREATMENT VOLUME (CF)	7,941
DRAINDOWN DURATION (HOURS)	11
AVERAGE DISCHARGE RATE PER MWS UNIT(GPM)	91.02
OPERATING HEAD (FT)	4.1
WETLANDMEDIA INFILTRATION RATE (IN/HR)	30
OR	
WETLANDMEDIA LOADING RATE (GPM/SF)	0.30

MODULAR WETLANDS

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING US PATENTS: 7,425,262; 7,470,362; 7,674,378; 8,303,816; RELATED FOREIGN PATENTS OR OTHER PATENTS PENDING

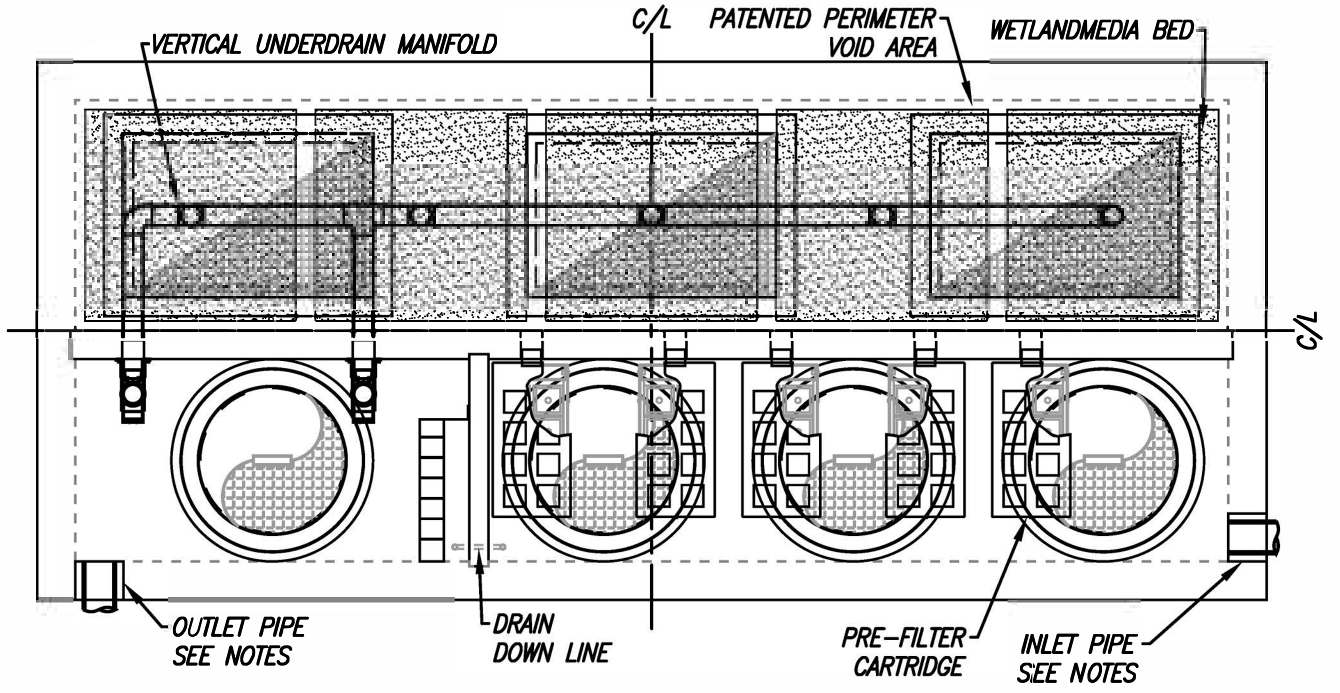
Bio Clean
A Forterra Company

MWS-L-8-20-5'-0"-V-UG
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL

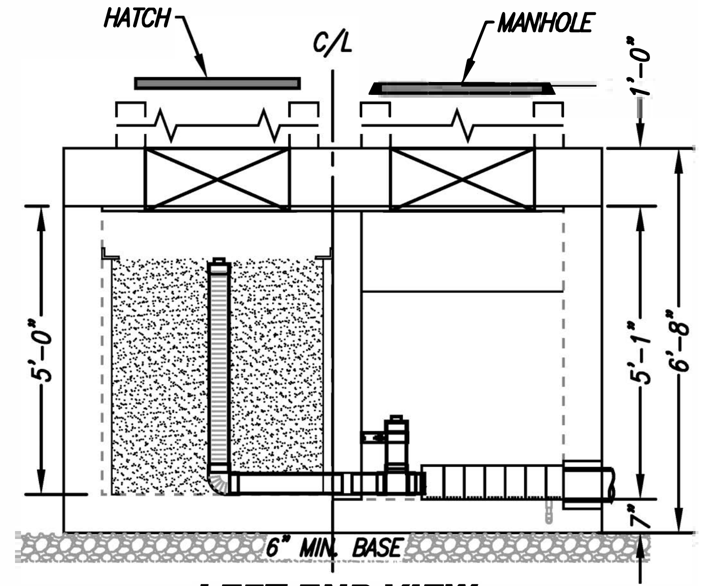
SITE SPECIFIC DATA

PROJECT NUMBER	13984		
PROJECT NAME	NIRVANA SELF STORAGE		
PROJECT LOCATION	CHULA VISTA, CA		
STRUCTURE ID	BMP B2		
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
6,479		N/A	
TREATMENT HGL AVAILABLE (FT)			3.6
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			OFFLINE
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	174.65	PVC	6”
INLET PIPE 2	N/A	N/A	N/A
OUTLET PIPE	174.15	PVC	6”
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION	186.70	186.70	186.70
SURFACE LOAD	H-20 DIRECT	H-20 DIRECT	H-20 DIRECT
FRAME & COVER	3EA ø30”	3EA 30” X 48”	ø30”
WETLANDMEDIA VOLUME (CY)			10.35
ORIFICE SIZE (DIA. INCHES)			ø1.75 EA

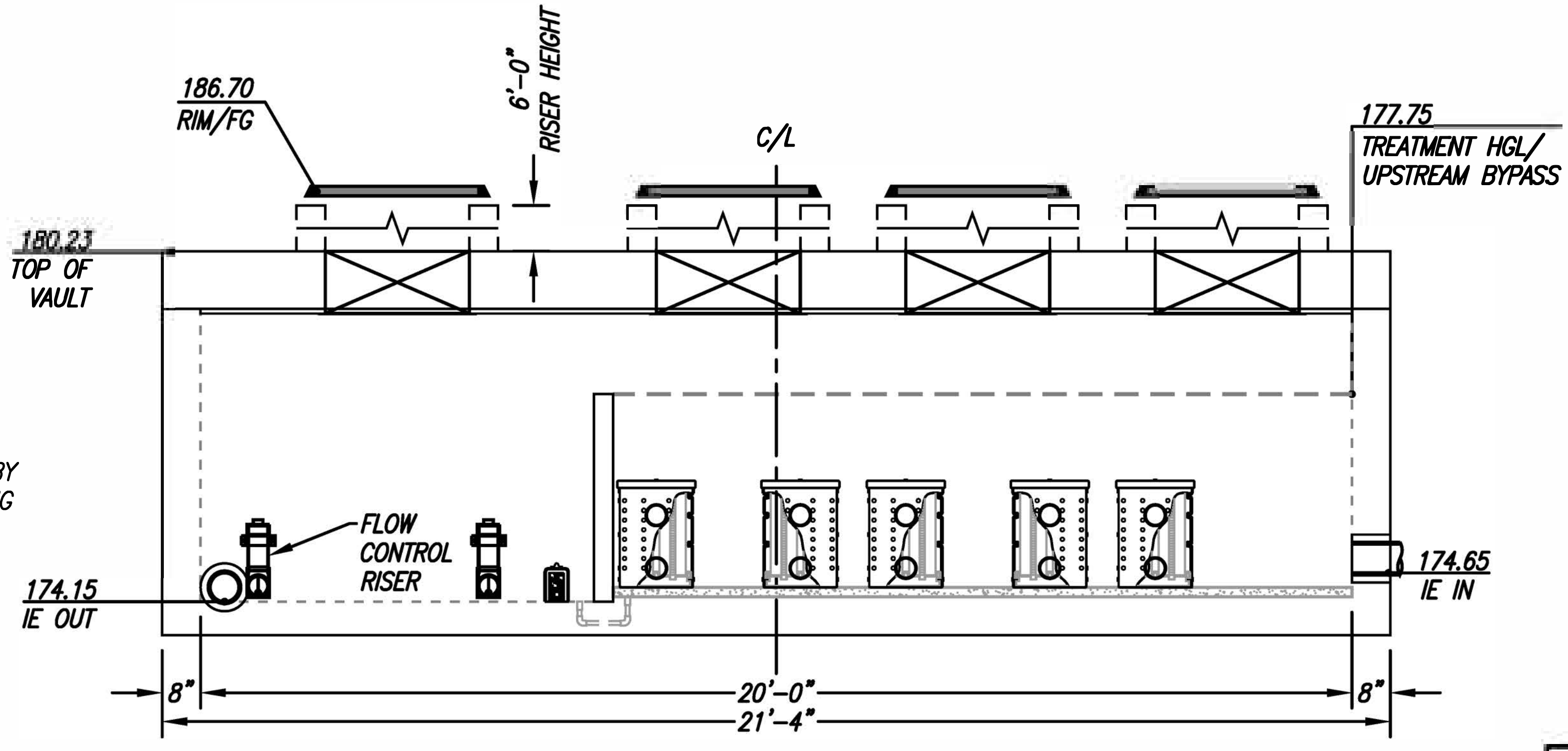
NOTES: PRELIMINARY NOT FOR CONSTRUCTION. 8” WALLS REQUIRED DUE TO STRUCTURAL EVALUATION.



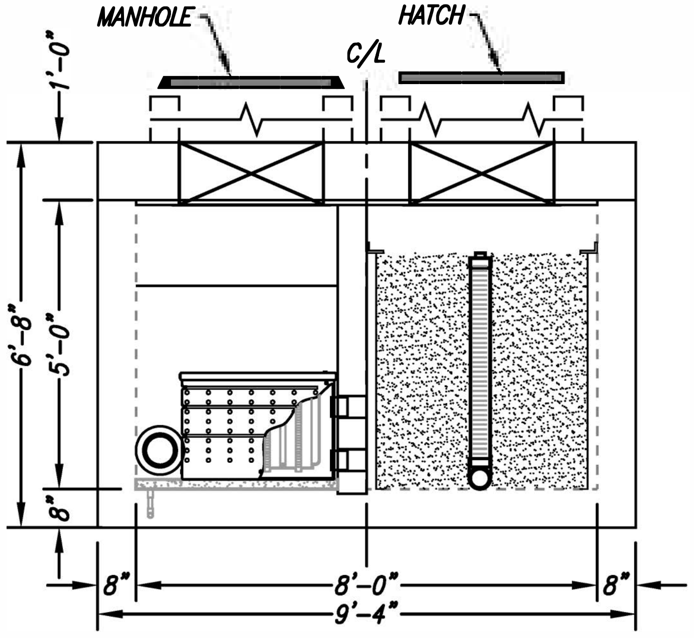
PLAN VIEW



LEFT END VIEW



ELEVATION VIEW



RIGHT END VIEW

REQUIRED TREATMENT VOLUME (CF)	6,479
DRAINDOWN DURATION (HOURS)	12
AVERAGE DISCHARGE RATE PER MWS UNIT(GPM)	69.26
OPERATING HEAD (FT)	3.6
WETLANDMEDIA INFILTRATION RATE (IN/HR)	26
	OR
WETLANDMEDIA LOADING RATE (GPM/SF)	0.26

INSTALLATION NOTES

1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURERS' SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURER'S CONTRACT.
2. UNIT MUST BE INSTALLED ON LEVEL BASE. MANUFACTURER RECOMMENDS A MINIMUM 6” LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE FOR VERIFYING PROJECT ENGINEER'S RECOMMENDED BASE SPECIFICATIONS.
4. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE (PIPES CANNOT INTRUDE BEYOND FLUSH). INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR. ALL PIPES SHALL BE SEALED WATERTIGHT PER MANUFACTURER'S STANDARD CONNECTION DETAIL.
5. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL PIPES, RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO GROUT ALL MANHOLES AND HATCHES TO MATCH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.
6. VEGETATION SUPPLIED AND INSTALLED BY OTHERS. ALL UNITS WITH VEGETATION MUST HAVE DRIP OR SPRAY IRRIGATION SUPPLIED AND INSTALLED BY OTHERS.
7. CONTRACTOR RESPONSIBLE FOR CONTACTING BIO CLEAN FOR ACTIVATION OF UNIT. MANUFACTURER'S WARRANTY IS VOID WITHOUT PROPER ACTIVATION BY A BIO CLEAN REPRESENTATIVE.

GENERAL NOTES

1. MANUFACTURER TO PROVIDE ALL MATERIALS UNLESS OTHERWISE NOTED.
2. ALL DIMENSIONS, ELEVATIONS, SPECIFICATIONS AND CAPACITIES ARE SUBJECT TO CHANGE. FOR PROJECT SPECIFIC DRAWINGS DETAILING EXACT DIMENSIONS, WEIGHTS AND ACCESSORIES PLEASE CONTACT BIO CLEAN.

MODULAR WETLANDS

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING US PATENTS: 7,425,262; 7,470,362; 7,674,378; 8,303,816; RELATED FOREIGN PATENTS OR OTHER PATENTS PENDING

PROPRIETARY AND CONFIDENTIAL:

THE INFORMATION CONTAINED IN THIS DOCUMENT IS THE SOLE PROPERTY OF FORTERRA AND ITS COMPANIES. THIS DOCUMENT, NOR ANY PART THEREOF, MAY BE USED, REPRODUCED OR MODIFIED IN ANY MANNER WITH OUT THE WRITTEN CONSENT OF FORTERRA.

Bio Clean
A Forterra Company

MWS-L-8-20-5'-0"-V-UG
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL

Project Name/ Nirvana Business Park

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/ Nirvana Business Park

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/ Nirvana Business Park

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

Nirvana Business Park

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).

☒ Maintenance recommendations and frequency

RECORDING REQUESTED BY AND
WHEN RECORDED RETURN TO:

CITY OF CHULA VISTA
OFFICE OF THE CITY CLERK
276 FOURTH AVENUE
CHULA VISTA, CA 91910

This Instrument Benefits City Only. Above Space for Recorder's Use
No Fee Required.

CCV File No. ___________

STORM WATER MANAGEMENT FACILITIES MAINTENANCE AGREEMENT WITH GRANT OF ACCESS AND COVENANTS

CHULA HEIGHTS COMMERCE PARK

THIS STORM WATER MANAGEMENT FACILITIES MAINTENANCE AGREEMENT ("Agreement"), dated _____ _____, 2021 for the purpose of reference only and effective the date on which the last party hereto affixes his/her signature ("Effective Date"), is entered into between VWP-OP Nirvana Owner, LLC, ("Owner(s)") and the City of Chula Vista, a municipal corporation, ("City") (individually, each may be referred to as "Party" and collectively as "Parties") with reference to the following facts:

RECITALS

WHEREAS, Owner(s) has(have) filed a Tentative Map and applied for a Grading Permit for the development of Chula Heights Commerce Park ("Project"), located on Parcel 1 and 2 of Parcel Map 21587 and a portion of Lot 2, Sec 20, T18S, R1E San Bernadino Meridian of ROS 16999, "Project Site" as depicted in Exhibit "A" and more particularly described in Exhibit "B", both attached hereto and incorporated herein by reference; and

WHEREAS, as a condition of (or condition # x of y), Owner(s) is(are) required to implement and maintain structural or non-structural pollution prevention measures, such as site design, source control, treatment control, and hydromodification control (where applicable) methods required to minimize polluted runoff and any other environmental impacts from Project during the post-development phase (collectively "BMPs"); and

WHEREAS, pursuant to City's urban runoff regulations, including Chula Vista Municipal Code, Chapter 14.20 (the "Storm Water Management and Discharge Control Ordinance) and the Chula Vista BMP Design Manual, Owner(s) is(are) required to prepare and submit a Stormwater Quality Management Plan (SWQMP), which includes an Inspection, Operation, and Maintenance Plan (IOMP); and

WHEREAS, the Owner(s) has(have) submitted SWQMP, which is on file in the office of the City Engineer; and

WHEREAS, the SWQMP proposes that storm water runoff from Project be detained and treated by the use of permanent Storm Water Management Facilities ("SWMFs"); and

WHEREAS, the SWMFs are classified in the SWQMP as site design, treatment control, and hydromodification control BMPs; and

WHEREAS, the SWQMP specifies the manner and standards by which the SWMFs must be inspected, maintained, and repaired in order to retain their effectiveness; and

WHEREAS, prior to the issuance of any construction permits for Project, City requires Owner(s) to enter into Agreement to ensure the installation, inspection, maintenance, and repair of permanent SWMFs.

NOW, THEREFORE, for good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the parties agree to the following covenants, terms, and conditions:

ARTICLE I. DEFINITIONS

1.1 Unless context indicates otherwise, for the purpose of this Agreement, all the below-listed terms shall be defined as follows:

"Agreement" means this Storm Water Management Facilities Maintenance Agreement.

"Best Management Practices, or BMPs" means structural or non-structural pollution prevention measures, such as site design, source control, treatment control, and hydromodification control methods required to minimize polluted runoff from Project during the post-development phase. BMPs include, but are not limited to, Storm Water Management Facilities.

"City" means the City of Chula Vista, an official of the City, or any staff member authorized to act on behalf of the City.

"Inspection, Operation, and Maintenance Plan, or IOMP" means a description of inspection, operation, and maintenance activities and schedules required to ensure proper operation and effectiveness of the SWMFs into perpetuity.

"Owner(s)" means the land owner(s) of Project Site, which is the subject of this Agreement, anyone authorized to act on behalf of the land owner(s) of Project Site, and any and all of owner's successors in interest, whether individual, partnership, corporation, or other entity such as a Home Owners' Association, regardless of the manner of transfer, including purchase, devise, or gift. If land owner of SWMFs is different from development land owner (as may be in the case of offsite SWMFs), both owners are parties to Agreement and shall sign the Signature Page as Owner(s)

"Project" means all improvements and land dedicated to the development, which is the subject of Agreement, including any offsite water quality facilities.

"Project Site" means the land dedicated to the development, which is the subject of Agreement, including any offsite water quality facilities.

"Responsible Party" means Owner(s) and any other person, corporation, or legal entity accepting, in writing and in City approved form, responsibility on behalf of Owner(s).

"Security" means any Bond, Cash Deposit, or Letter of Credit that City may require from Owner(s) to assure the faithful performance of the obligations of Agreement.

"Storm Water Management Facilities" ("SWMFs") means all onsite and offsite structural facilities constructed as Project's site design, treatment control, or hydromodification control BMPs, proposed as part of the development project submittals, and as approved by City prior to the issuance of a development permit, or as amended with City's approval after the development is complete.

"Water Quality Technical Report" ("SWQMP") means a document prepared in accordance with the requirements of the Chula Vista Development Storm Water Manual, and submitted to the City as part of Project's permit application documents.

ARTICLE II. – OWNER'S OBLIGATIONS

2.1 **Maintenance of Stormwater Management Facilities.** Owner(s) shall install, inspect, maintain, repair, and replace all SWMFs for the Project as required by the Director of Public Works, or his/her designated representative ("Director).

2.1.1 Scope of Maintenance. Maintenance shall include inspection and servicing of SWMFs on the schedule determined necessary to ensure the SWMFs retain their effectiveness.

2.1.2 Duration of Obligation. Owner's obligation to maintain, repair and replace the SWMFs shall continue in perpetuity until all obligations under this Agreement are transferred to, and assumed by, another owner or entity approved by City ("Responsible Party").

2.2 **Grant of Right of Entry**. Owner(s) shall grant to the City, its representatives, or contractors, or any Responsible Party, the right to enter the Project to inspect SWMFs, or perform any permitted acts or obligations under this Agreement, including maintenance of said facilities in the event the Owner(s) fails(fail) to fulfill its(their) maintenance obligations after proper notice.

2.2.1 No Prior Notice. City shall have the right, at any time and without prior notice to Owner(s), to enter upon any part of Project as may be necessary or convenient for any acts permitted hereunder.

2.2.2 Unobstructed Access. Owner(s) shall at all times maintain Project so as to make City's access clear and unobstructed.

2.3 **Modification of IOMP**. Owner(s) shall, at the City's request, in City's sole discretion, amend the IOMP. The Owner(s) may amend the IOMP from time-to-time, subject to City approval. The IOMP is attached hereto as Exhibit "C."

2.3.1 Part of Owner's Obligations. Any obligations, conditions, or requirements of an amended IOMP shall become part of this Agreement immediately as if originally included herein, and the Owner(s) shall be responsible for such amended obligations, conditions, or requirements. The amended IOMP shall not be applied retroactively.

The IOMP shall describe employee training programs and duties, routine inspection, service and operating schedules, maintenance frequency, and specific maintenance activities.

2.4 **Submission of Documents**. Owner(s) shall include a copy of the Inspection, Operation, and Maintenance Plan ("IOMP") for the SWMFs in the SWQMP for Project and submit a copy to City, at the time Agreement is executed.

ARTICLE III. – CITY'S RIGHTS

3.1 **Perform Maintenance**. City shall have the right, but not the obligation, to elect to perform any or all of the maintenance activities

3.1.1 Notice. Except in the Case of an emergency, prior to performing any maintenance activities, City shall provide Owner(s) with a written notice, informing Owner(s) of its (their) failure to satisfactorily perform its (their) obligations under Agreement.

3.1.1.1 *Emergencies*. In the event of an emergency, as determined by City, City shall not be required to provide Owner(s) with notice in advance of performing any and all maintenance activities it deems necessary.

3.1.2 Time to Cure. Owner(s) shall have a reasonable time, as defined in the Notice, to cure any failure to perform its (their) maintenance obligations. If a cure cannot be completed within the time limit identified in the Notice, Owner(s) shall provide City with a written request for additional time, which shall include sufficiently detailed explanation as to why the cure cannot be completed within such timeframe. If the City approves a request for additional time, Owner(s) shall immediately commence such cure and diligently pursue to completion.

3.1.3 Costs of Maintenance. In the event City performs any maintenance under this Article III, then Owner(s) shall pay all costs City incurred in performing said maintenance activities. Payment shall be subject to the following terms:

3.1.3.1 *Due Date*. Net 30.

3.1.3.2 *Interest*. Any late payment shall be subject to a rate of eight percent (8%) interest per annum.

3.1.3.3 *Use of Security*. If payment is not received by the Due Date, City may, at its option, recover its costs through use of any security provided by Owner(s). Any costs associated with recovery shall be charged to and be an obligation of Owner(s).

3.2 **City Inspections**. City shall have the right to conduct inspections of the SWMFs from time-to-time as required by the National Pollutant Discharge Elimination System Municipal Permit, Order No. R9-2013-0001 and any re-issuances thereof, to ensure adequate maintenance and effectiveness of the SWMFs. Owner(s) agrees (agree) to pay all inspection fees as may be established by City.

ARTICLE IV. INDEMNITY

4.1 **General Requirement**. Owner(s) shall defend, indemnify, protect and hold harmless the City, its elected and appointed officers, agents, employees, and volunteers ("Indemnitees") from and against any and all claims, demands, causes of action, costs, expenses, liability, loss, damage or injury, in law or equity, to property or persons, including wrongful death, in any manner arising out of or incident to any alleged acts, omissions, negligence, or willful misconduct of Owner(s), its officials, officers, employees, agents, and contractors ("Indemnitors"), arising out of or related to the installation, inspection, maintenance, repair, or replacement of the BMPs or this Agreement. This indemnity provision does not include any claims, damages, liability, costs and expenses (including without limitations, attorneys fees) arising from the sole negligence or sole willful misconduct of the Indemnitees. Also covered is under the indemnity obligations is liability arising from, connected with, caused by or claimed to be caused by the active or passive negligent acts or omissions of the Indemnitees, which may be in combination with the active or passive negligent acts or omissions of the Indemnitors.

4.2 **Costs of Defense and Award**. Included in the obligations in Section 4.1, above, is the Owner's obligation to defend, at Owner's own cost, expense and risk, any and all aforesaid suits, actions or other legal proceedings of every kind that may be brought or instituted against the Indemnitees. Owner(s) shall pay and satisfy any judgment, award or decree that may be rendered against Indemnitees for any and all legal expense and cost incurred by each of them in connection therewith.

4.3 **Conduct Own Defense**. If City elects, at its sole discretion, to conduct its own defense, participate in its own defense, or obtain independent legal counsel in defense on any claim related to the installation, inspection, maintenance, repair or replacement of the SWMFs, Owner(s) agrees (agree) to pay the reasonable value of attorney's fees and all of City's reasonable costs.

4.4 **Insurance Proceeds**. Owner's obligation to indemnify shall not be restricted to insurance proceeds, if any, received by Indemnitees.

4.5 **Declarations**. Owner's obligations under this Article IV shall not be limited by any prior or subsequent declaration by the Owner(s).

4.6 **Enforcement Costs**. Owner(s) agrees (agree) to pay any and all costs Indemnitees incur enforcing the indemnity and defense provisions set forth in this Article IV.

4.7 **Survival**. Owner's obligations under this Article IV shall survive the termination of this Agreement.

ARTICLE V. INSURANCE

5.1 **Insurance**. In the event that insurance is required by City, Owner(s) shall not begin work under this Agreement until it has (they have) : (i) obtained, and upon the City's request provided to the City, insurance certificates reflecting evidence of all insurance required in this Article V; (ii) obtained City approval of each company or companies; and (iii) confirmed that all policies contain the specific provisions required by this Section.

5.2 **Types of Insurance**. At all times during the term of this Agreement, Owner(s) shall maintain those types of insurance coverage and amounts of coverage required by City to protect the City from any potential claims, which may arise from the installation, inspection, maintenance, repair or replacement of the SWMFs or any other obligations under this Agreement.

5.3 **Policy Endorsements Required**.

5.3.1 Additional Insureds. City of Chula Vista, its officers, officials, employees, agents and volunteers are to be named as additional insureds with respect all required policies of insurance with respect to liability arising out of obligations under this Agreement performed by or on behalf of the Owner(s).

5.3.2 Primary Insurance. The Owner's General Liability insurance coverage must be primary insurance as it pertains to the City, its officers, officials, employees, agents, and volunteers. Any insurance or self-insurance maintained by the City, its officers, officials, employees, or volunteers is wholly separate from the insurance of the Owner(s) and in no way relieves the Owner(s) from its (their) responsibility to provide insurance.

5.3.3 Waiver of Subrogation. Owner's insurer will provide a Waiver of Subrogation in favor of the City for each required policy providing coverage for the term required by this Agreement.

5.3.4 Cancellation. The insurance policies required must be endorsed to state that coverage will not be canceled by either party, except after thirty (30) days' prior written notice to the City by certified mail, return receipt requested. The words "will endeavor" and "but failure to mail such notice shall impose no obligation or liability of any kind upon the company, its agents, or representatives" shall be deleted from all certificates.

5.4 **Proof of Insurance Coverage**. Owner(s) shall furnish the City with original certificates and amendatory endorsements affecting coverage required. The endorsements should be on insurance industry forms, provided those endorsements or policies conform to the contract requirements. All certificates and endorsements are to be received and approved by the City before work commences on the Project. The City reserves the right to require, at any time, complete, certified copies of all required insurance policies, including endorsements evidencing the coverage required by these specifications.

5.5 **Deductibles and Self-Insured Retentions**. Any deductibles or self-insured retentions must be declared to and approved by the City. At the option of the City, either the insurer will reduce or eliminate such deductibles or self-insured retentions as they pertain to the City, its officers, officials, employees and volunteers; or the Owner(s) will provide a financial guarantee satisfactory to the City guaranteeing payment of losses and related investigations, claim administration, and defense expenses.

5.6 **Active Negligence**. Coverage shall not extend to any indemnity coverage for the active negligence of the additional insureds in any case where an agreement to indemnify the additional insured would be invalid under Subdivision (b) of Section 2782 of the Civil Code.

5.7 **Not a Limitation of Other Obligations**. Insurance provisions under this Article shall not be construed to limit the Owner's obligations under this Agreement, including Indemnity.

ARTICLE VI. SECURITY

6.1 **Security Required**. If within any five-year period, City inspectors determine on two occasions that Owner(s) has (have) failed to effectively operate, maintain, or repair the SWMFs, City may require Owner(s) to provide City with Security to assure the faithful performance of the obligations of this Agreement.

6.1.1 Amount of Security. The amount of the security shall equal the cost to maintain the SWMFs for two (2) years, which cost shall be determined as identified in the Project SWQMP ("Security Amount").

6.1.2 Type of Security. Security may be of any of the following types:

6.1.2.1 *Performance Bond*. Owner(s) shall provide to the City a performance bond in favor of the City in the Security Amount and subject to the provisions below.

a. Certificate of Agency. All bonds signed by an agent must be accompanied by a certified copy of such agent's authority to act.

b. Licensing and Rating. The bonds shall be from surety companies admitted to do business in the State of California, licensed or authorized in the jurisdiction in which the Project is located to issue bonds for the limits required by this agreement, listed as approved by the United States

Department of Treasury Circular 570, http://www.fms.treas.gov/c570, and which also satisfy the requirements stated in Section 995.660 of the Code of Civil Procedure, except as provided otherwise by laws or regulation, and have a minimum AM Best rating of "A-" to an amount not to exceed ten percent (10%) of its capital and surplus.

c. Insolvency or Bankruptcy. If the surety on any bond furnished by the Owner(s) is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located, Owner(s) shall within seven (7) days thereafter substitute or require the substitution of another bond and surety, acceptable to the City.

6.1.2.2 *Letter of Credit*. As security for Owner's obligations under this Agreement, Owner(s) shall cause an irrevocable letter of credit in the Security Amount ("Letter of Credit") to be issued in favor of the City by a reputable state or national financial institution with a branch located in Chula Vista.

a. Draw on Letter of Credit. The City may draw upon the Letter of Credit for the full amount or any series of partial amounts as necessary by means of a sight draft accompanied by a statement from the City Manager, Deputy City Manager, Business Center Manager, that the Owner(s) has(have) not satisfied Owner's obligations hereunder.

6.1.2.3 *Cash Deposit*. In lieu of a Performance Bond or Letter of Credit, Owner(s) may deposit the Security Amount with the City.

a. Return of Security. Any unused balance of the Security at the end of the Term shall be returned to the Owner(s) in accordance with City's accounting procedures.

6.1.3 Adjustment for Inflation. The Security Amount shall be adjusted at a rate of 5% per annum.

6.1.4 Term. Security shall remain in full force and effect for two (2) years from the date it is received by the City provided no further failures are identified by City Inspectors during the initial two (2) year period. In the event additional violations occur, the City shall retain the Security until such time as the City Manager, in his sole discretion, deems appropriate to ensure the Owner's obligations will be satisfied.

6.1.5 Form of Security. Security required under this Article shall be in a form satisfactory to the City Manager and City Attorney.

6.1.6 Use of Security. In accordance with Article III, City may use all or any portion of this Security to fund the costs associated with the City's performance of any of the maintenance activities for the Project's SWMFs.

6.1.7 Replenish Security. If at any time the Security Amount shall drop below the amount required under Section 6.1.1, Owner(s) shall deposit additional funds, provide an additional Letter of Credit to City, or provide an additional bond within thirty (30) days, such that the total amount of Security available to the City is equal to the amount required in Section 6.1.1.

ARTICLE VII. RECORDS

7.1 **Record Keeping**. The designation of a Responsible Party to maintain the SWMFs does not relieve Owner(s) of any of the obligations or duties under this Agreement. Owner(s), its (their) successors, or a designated Responsible Party, shall retain records of the IOMP and maintenance and inspection activities for at least five years. Said records shall be made available within 5 days, upon request by City.

ARTICLE VIII. STANDARD PROVISIONS

8.1 **Headings**. All headings are for convenience only and shall not affect the interpretation of this Agreement.

8.2 **Gender & Number**. Whenever the context requires, the use herein of (i) the neuter gender includes the masculine and the feminine genders and (ii) the singular number includes the plural number.

8.3 **Reference to Paragraphs**. Each reference in this Agreement to an Article or Section refers, unless otherwise stated, to an Article or Section in this Agreement.

8.4. **Incorporation of Recitals**. All recitals herein are incorporated into this Agreement and are made a part hereof.

8.5 **Covenants and Conditions**. All provisions of this Agreement expressed as either covenants or conditions on the part of the City or the Owner(s), shall be deemed to be both covenants and conditions.

8.6 **Integration.** This Agreement and the Exhibits and references incorporated into this Agreement fully express all understandings of the Parties concerning the matters covered in this Agreement. No change, alteration, or modification of the terms or conditions of this Agreement, and no verbal understanding of the Parties, their officers, agents, or employees shall be valid unless made in the form of a written change agreed to in writing by both Parties or an amendment to this Agreement agreed to by both Parties. All prior negotiations and agreements are merged into this Agreement.

8.7 **Severability**. The unenforceability, invalidity, or illegality of any provision of this Agreement shall not render any other provision of this Agreement unenforceable, invalid, or illegal. In the event that any provision of this Agreement shall for any reason, be determined to be invalid, illegal, or unenforceable in any respect, the remainder of this Agreement shall remain in full force and effect and the parties hereto shall negotiate in good faith and agree to such amendments, modifications, or supplements to this Agreement or such other appropriate action as shall, to the maximum extent practicable in light of such determination, implement and give effect to the intentions of the parties as reflected herein.

8.8 **Drafting Ambiguities**. The Parties agree that they are aware that they have the right to be advised by counsel with respect to the negotiations, terms and conditions of this Agreement, and the decision of whether or not to seek advice of counsel with respect to this Agreement is a decision that is the sole responsibility of each Party. This Agreement shall not be construed in favor of or against either Party by reason of the extent to which each Party participated in the drafting of the Agreement.

8.9 **Conflicts Between Terms**. If an apparent conflict or inconsistency exists between the main body of this Agreement and the Exhibits, the main body of this Agreement shall control. If a conflict exists between an applicable federal, state, or local law, rule, regulation, order, or code and this Agreement, the law, rule, regulation, order, or code shall control. Varying degrees of stringency among the main body of this Agreement, the Exhibits, and laws, rules, regulations, orders, or codes are not deemed conflicts, and the most stringent requirement shall control. Each Party shall notify the other immediately upon the identification of any apparent conflict or inconsistency concerning this Agreement.

8.10 **Prompt Performance**. Time is of the essence of each covenant and condition set forth in this Agreement.

8.11 **Good Faith Performance**. The Parties shall cooperate with each other in good faith, and assist each other in the performance of the provisions of this Agreement.

8.12 **Further Assurances**. City and Owner each agree to execute and deliver such additional documents as may be required to effectuate the purposes of this Agreement.

8.13 **Exhibits**. Each of the following Exhibits is attached hereto and incorporated herein by this reference:

Exhibit A: Vicinity map
Exhibit B: Legal Description for Project
Exhibit C: BMP and HMP type, location and dimensions
Exhibit D: Maintenance recommendations and frequency. Inspection, Operation, and Maintenance Plan (IOMP)

8.14 **Compliance with Controlling Law**. The Owner(s) shall comply with all laws, ordinances, regulations, and policies of the federal, state, and local governments applicable to this Agreement. In addition, the Owner(s) shall comply immediately with all directives issued by the City or its authorized representatives under authority of any laws, statutes, ordinances, rules, or regulations.

8.15 **Enforcement**. Failure to comply with the terms of this Agreement constitutes a violation of the Chula Vista Municipal Code Chapter 14.20 "Storm Water Management and Discharge Control" and may result in enforcement action pursuant to City's storm water regulations and administrative procedures.

8.16 **Jurisdiction, Venue, and Attorney Fees**. This Agreement shall be governed by and construed in accordance with the laws of the State of California. Any action arising under or relating to this Agreement shall be brought only in the federal or state courts located in San Diego County, State of California, and if applicable, the City of Chula Vista, or as close thereto as possible. Venue for this Agreement, and performance hereunder, shall be the City of Chula Vista. The prevailing Party in any such suit or proceeding shall be entitled to a reasonable award of attorney fees in addition to any other award made in such suit or proceeding.

8.17 **Administrative Claims Requirement and Procedures**. No suit shall be brought arising out of this agreement, against the City, unless a claim has first been presented in writing and filed with the City of Chula Vista and acted upon by the City of Chula Vista in accordance with the procedures set forth in Chapter 1.34 of the Chula Vista Municipal Code, the provisions of which are incorporated by this reference as if fully set forth herein.

8.18 **Third Party Relationships**. Nothing in this Agreement shall create a contractual relationship between City and any individual, entity, or other not a party to this Agreement.

8.19 **Non-Assignment**. The Owner(s) shall not assign the obligations under this Agreement, whether by express assignment, by sale of the company, or any monies due or to become due, without the City's prior written approval. Any assignment in violation of this paragraph shall constitute a Default. In no event shall any putative assignment create a contractual relationship between the City and any putative assignee.

8.20 **Successors in Interest**. This Agreement and all rights and obligations created by this Agreement shall be in force and effect whether or not any Parties to the Agreement have been succeeded by another entity, and all rights and obligations created by this Agreement shall be vested and binding on any Party's successor in interest.

8.21 **Agreement Runs with Project**. The terms, covenants and conditions contained in this Agreement shall constitute covenants running with the land and shall be binding upon the heirs, executors, administrators, successors and assigns of Owner(s) and City and shall be deemed to be for the benefit of all persons owning any interest in Project, the City, and the Public. It is the intent of the Parties that this Agreement be recorded and be binding upon all persons purchasing or otherwise acquiring all or any lot, unit or other portion of Project, who shall be deemed to have consented to and become bound by all the provisions of this Agreement. This Agreement shall commence upon execution of this Agreement by all Parties named in the Agreement.

8.22 **Independent Contractors**. The Owner(s), any contractors, subcontractors, and any other individuals employed by the Owner(s) shall be independent contractors and not agents of the City. Any provisions of this Agreement that may appear to give the City any right to direct the Owner(s) concerning the details of performing the Services under this Agreement, or to exercise any control over such performance, shall mean only that the Owner(s) shall follow the direction of the City concerning the end results of the performance.

8.23 **No Waiver**. No failure of either the City or Owner(s) to insist upon the strict performance by the other of any covenant, term or condition of this Agreement, nor any failure to exercise any right or remedy consequent upon a breach of any covenant, term, or condition of this Agreement, shall constitute a waiver of any such breach of such covenant, term or condition. No waiver of any breach shall affect or alter this Agreement, and each and every covenant, condition, and term hereof shall continue in full force and effect to any existing or subsequent breach.

8.24 **Notices**. Owner(s) agrees(agree) that it shall, prior to transferring ownership of any land on which any part of the Project covered by this Agreement are located, and also prior to transferring ownership of any such SWMFs, provide clear written notice of the above maintenance obligations associated with that SWMF to the transferee. Owner(s) further agrees(agree) to provide evidence that Owner(s) has(have) requested the California Department of Real Estate to include in the public report issued for the development of Project, a notification regarding the SWMF maintenance requirements described in this Agreement.

8.24.1 Serving Notice. All notices, demands or requests provided for or permitted to be given pursuant to this Agreement must be in writing. All notices, demands and requests to be sent to any Party shall be deemed to have been properly given or served if personally served or deposited in the United States mail, addressed to such party, postage prepaid, registered or certified, with return receipt requested

8.25 **Entitlement to Subsequent Notices**. No notice to or demand on the Parties for notice of an event not herein legally required to be given shall in itself create the right in the Parties to any other or further notice or demand in the same, similar or other circumstances.

8.26 **Remedies**. The rights of the Parties under this Agreement are cumulative and not exclusive of any rights or remedies that the Parties might otherwise have unless this Agreement provides to the contrary.

8.27 **Counterparts**. This Agreement may be executed in more than one counterpart, each of which shall be deemed to be an original but all of which, when taken together shall constitute but one instrument.

8.28 **Signing Authority**. Each signatory and party hereto hereby warrants and represents to the other party that it has legal authority and capacity and direction from its principal to enter into this Agreement; that all resolutions or other actions have been taken so as to enable it to enter into this Agreement and agrees to hold the other Party or Parties hereto harmless if it is later determined that such authority does not exist.

End of page (next page is signature page)

SIGNATURE PAGE FOR
STORM WATER MANAGEMENT FACILITIES MAINTENANCE
AGREEMENT WITH GRANT OF ACCESS AND COVENANTS

750 MAIN STREET

IN WITNESS WHEREOF, the parties have executed this Agreement on the____day of ________________________, 2021.

OWNER:

____

VWP-OP Nirvana Owner, LLC

By: __________________________________

Its: __________________________________

By: __________________________________

Its: __________________________________

CITY OF CHULA VISTA:

____
City Engineer

APPROVED AS TO FORM:

____
City Attorney

ATTEST:

____
City Clerk

Dated: __________________________

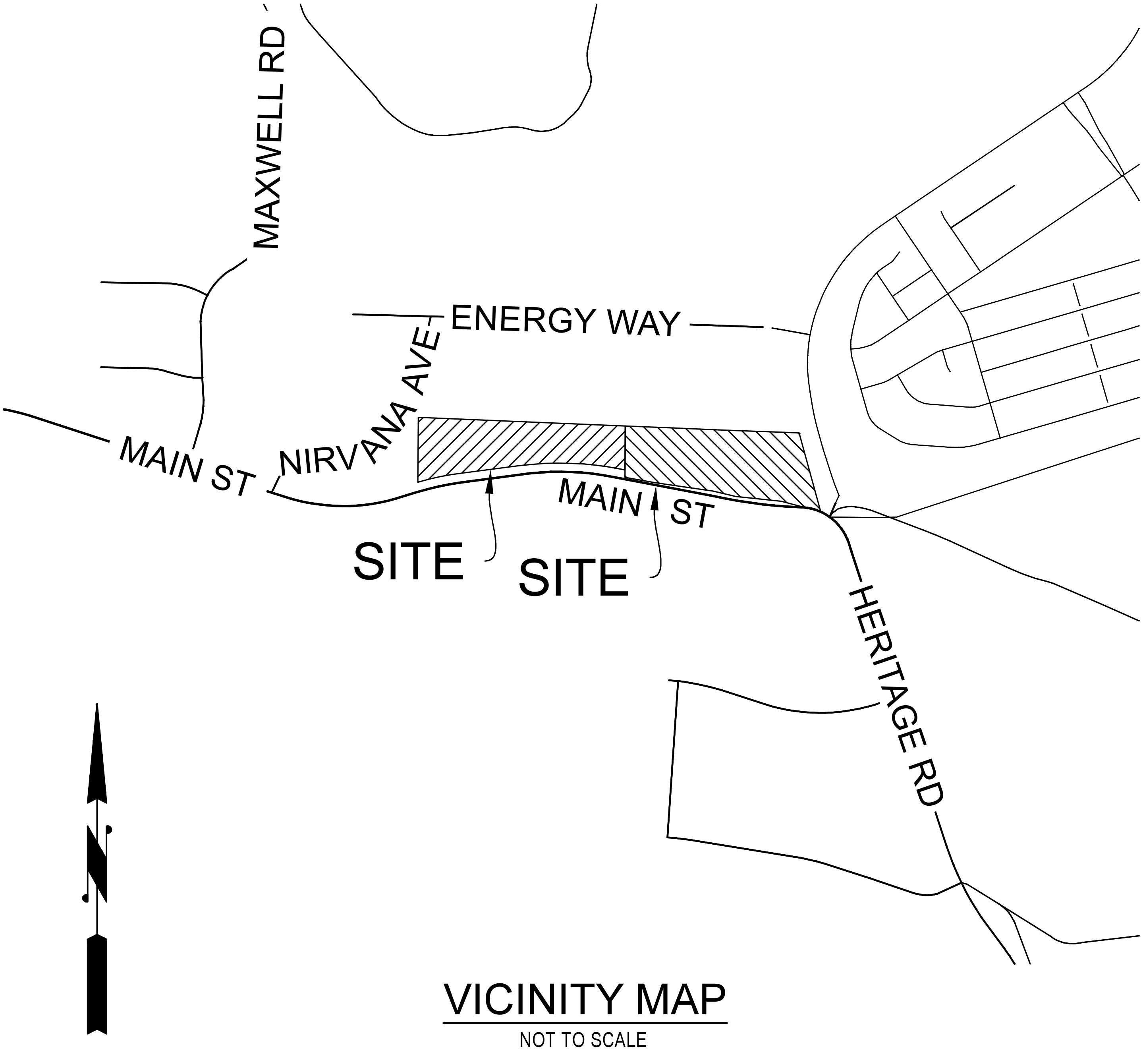
(Notary to attach acknowledgment for each signature.)
(Corporate Authority required for each Signatory, if applicable.)

Attachments:

1. Exhibit A: Depiction of Project Site
2. Exhibit B: Legal Description for Project Site
3. Exhibit C: BMP and HMP type, location and dimensions
4. Exhibit D: Maintenance recommendations and frequency. Inspection, Operation, and Maintenance Plan (IOMP)

J:\Engineer\LANDDEV\NPDES(LANDDEV ONLY)\STORM WATER AGREEMENTS\SSW Main Agree _VERSION 2015.doc

EXHIBIT A



VICINITY MAP

NOT TO SCALE

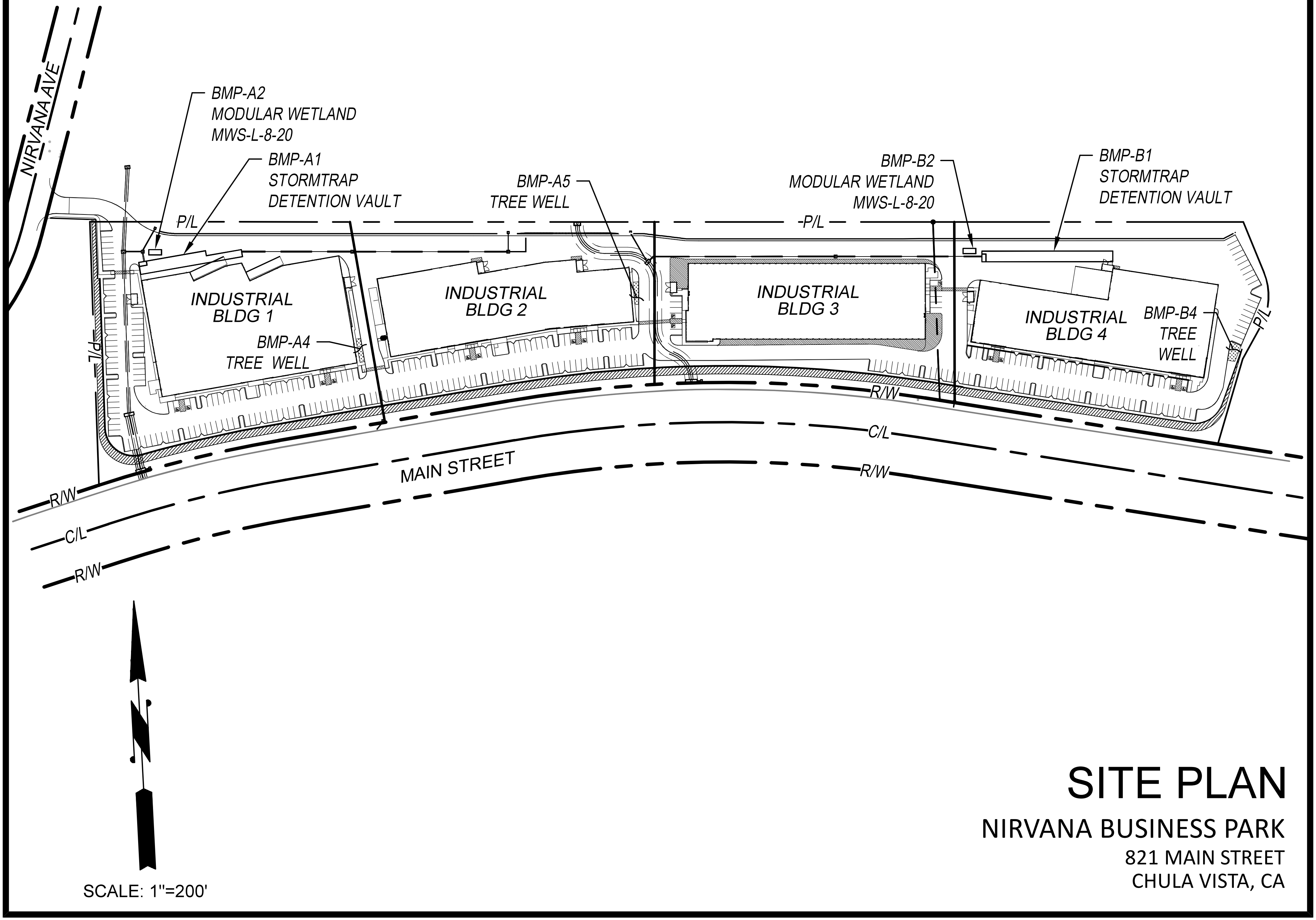
EXHIBIT B

LEGAL DESCRIPTION

THAT PORTION OF LOT 2, SECTION 20, TOWNSHIP 18 SOUTH, RANGE 1 EAST, SAN BERNARDINO MERIDIAN, ACCORDING TO THE OFFICIAL PLAT THEREOF, IN THE CITY OF CHULA VISTA, COUNTY OF SAN DIEGO, STATE OF CALIFORNIA.

PARCELS 1 AND 2 OF PARCEL MAP NO. 21587 IN THE CITY OF CHULA VISTA, COUNTY OF SAN DIEGO, STATE OF CALIFORNIA, AS PER MAP RECORDED IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY, MAY 18, 2018.

EXHIBIT C



SCALE: 1"=200'

SITE PLAN

NIRVANA BUSINESS PARK

821 MAIN STREET
CHULA VISTA, CA

EXHIBIT D

HU-1
Cistern

BMP MAINTENANCE FACT SHEET
FOR
STRUCTURAL BMP HU-1 CISTERN

Cisterns are containers that capture runoff (typically rooftop runoff) and store it for future use such as irrigation or alternative grey water between storm events. Cisterns can be aboveground or below ground systems. Typical cistern components include:

- Storage container, barrel or tank for holding captured flows
- Inlet and associated valves and piping
- Outlet and associated valves and piping
- Overflow outlet
- Access riser or tank serviceway (i.e., access for underground and above-ground cisterns)
- Optional pump
- Optional first flush diverters
- Optional debris screen or pretreatment BMP (e.g., roof drain filter, drainage inlet insert)
- Optional roof, supports, foundation, level indicator, and other accessories

Normal Expected Maintenance

Cisterns can be expected to accumulate sediment and debris that is small enough to pass through the inlet into the storage container. Larger debris such as leaves or trash may accumulate at the inlet. While the storage container is generally a permanent structure, ancillary parts including valves, piping, screens, level indicators, and other accessories will wear and require occasional replacement. Maintenance of a cistern generally involves: removing accumulated sediment and debris from the inlet and storage container on a routine basis; and replacement of ancillary parts on an as-needed basis. A summary table of standard inspection and maintenance indicators is provided within this Fact Sheet. If the system as a whole includes a pump or other electrical equipment, maintenance of the equipment shall be based on the manufacturer's recommended maintenance plan.

Non-Standard Maintenance or BMP Failure

If any of the following scenarios are observed, the BMP is not performing as intended to protect downstream waterways from pollution and/or erosion. Corrective maintenance, increased inspection and maintenance, BMP replacement, or a different BMP type will be required.

- The inlet is found to be obstructed at every inspection such that storm water bypasses the cistern. The cistern is not functioning properly if it is not capturing storm water. This would require addition of ancillary features to protect the inlet, or pretreatment measures within the watershed draining to the cistern to intercept larger debris, such as screens on roof gutters, or drainage inserts within catch basins. Increase the frequency of inspection until the issue is resolved.
- Accumulation of sediment within one year is greater than 25% of the volume of the cistern. This means the sediment load from the tributary drainage area has diminished the storage volume of the cistern and the cistern will not capture the required volume of storm water. This would require pretreatment measures within the tributary area draining to the cistern to intercept sediment.
- The cistern is not drained between storm events. If the cistern is not drained between storm events, the storage volume will be diminished and the cistern will not capture the required volume of storm water from subsequent storms. This would require implementation of practices onsite to drain and use the stored water, or a different BMP if onsite use cannot be reliably sustained.

SUMMARY OF STANDARD INSPECTION AND MAINTENANCE FOR HU-1 CISTERN

The property owner is responsible to ensure inspection, operation and maintenance of permanent BMPs on their property unless responsibility has been formally transferred to an agency, community facilities district, homeowners association, property owners association, or other special district.

Maintenance frequencies listed in this table are average/typical frequencies. Actual maintenance needs are site-specific, and maintenance may be required more frequently. Maintenance must be performed whenever needed, based on maintenance indicators presented in this table. The BMP owner is responsible for conducting regular inspections to see when maintenance is needed based on the maintenance indicators. During the first year of operation of a structural BMP, inspection is recommended at least once prior to August 31 and then monthly from September through May. Inspection during a storm event is also recommended. After the initial period of frequent inspections, the minimum inspection and maintenance frequency can be determined based on the results of the first year inspections.

Threshold/Indicator	Maintenance Action	Typical Inspection and Maintenance Frequency
Accumulation of sediment, litter, or debris at the inlet	Remove and properly dispose of accumulated materials.	• Inspect monthly and after every 0.5-inch or larger storm event. • Remove any accumulated materials found at each inspection.
Outlet blocked	Clear blockage.	• Inspect monthly and after every 0.5-inch or larger storm event. • Remove any accumulated materials found at each inspection.
Accumulation of sediment, litter, or debris in the storage container	Remove and properly dispose of accumulated materials.	• Inspect monthly. If the BMP is 25% full* or more in one month, increase inspection frequency to monthly plus after every 0.1-inch or larger storm event. • Remove materials annually (minimum), or more frequently when BMP is 25% full* (or at manufacturer threshold if manufacturer threshold is less than 25% full*) in less than one year, or if accumulation blocks outlet
Standing water in storage container between storm events outside of normal use timeframe for the stored water. Normal use timeframe is 36 to 96 hours following a storm event depending on the purpose and design of the cistern.	Use the water as intended, or disperse to landscaping. Implement practices onsite to drain and use the stored water. Contact the [City Engineer] to determine a solution if onsite use cannot be reliably sustained.	• Inspect monthly and after every 0.5-inch or larger storm event. If standing water is observed, increase inspection frequency to after every 0.1-inch or larger storm event. • Maintenance when needed.

*"25% full" is defined as ¼ of the depth from the design bottom elevation to the crest of the outflow structure (e.g., if the height to the outflow opening is 12 inches from the bottom elevation, then the materials must be removed when there is 3 inches of accumulation – this should be marked on the outflow structure)

SUMMARY OF STANDARD INSPECTION AND MAINTENANCE FOR HU-1 CISTERN (Continued from previous page)

Threshold/Indicator	Maintenance Action	Typical Inspection and Maintenance Frequency
Presence of mosquitos/larvae For images of egg rafts, larva, pupa, and adult mosquitos, see http://www.mosquito.org/biology	If mosquitos/larvae are observed: first, immediately remove any standing water by using the water as intended for irrigation or alternative grey water, or by dispersing to landscaping; second, check cistern outlet for blockage and clear blockage if applicable to restore drainage; third, install barriers such as screens that prevent mosquito access to the storage container.	• Inspect monthly and after every 0.5-inch or larger storm event. If mosquitos are observed, increase inspection frequency to after every 0.1-inch or larger storm event. • Maintenance when needed.
Leaks or other damage to ancillary parts including valves, piping, screens, level indicators, and other accessories	Repair or replace as applicable.	• Inspect twice per year. • Maintenance when needed.
Leaks or other damage to storage container	Repair or replace as applicable.	• Inspect twice per year. • Maintenance when needed.
Cistern leaning or unstable, damage to roof, supports, anchors, or foundation	Make repairs as appropriate to correct the problem and stabilize the system.	• Inspect twice per year. • Maintenance when needed.

References

American Mosquito Control Association.
http://www.mosquito.org/
California Storm Water Quality Association (CASQA). 2003. Municipal BMP Handbook.
https://www.casqa.org/resources/bmp-handbooks/municipal-bmp-handbook
County of San Diego. 2014. Low Impact Development Handbook.
http://www.sandiegocounty.gov/content/sdc/dpw/watersheds/susmp/lid.html
San Diego County Copermittees. 2016. Model BMP Design Manual, Appendix E, Fact Sheet HU-1.
http://www.projectcleanwater.org/index.php?option=com_content&view=article&id=250&Itemid=220

Page Intentionally Blank for Double-Sided Printing

HU-1
Cistern

Date:
Inspector:
BMP ID No.:
Permit No.:
APN(s):
Property / Development Name:
Responsible Party Name and Phone Number:
Property Address of BMP:
Responsible Party Address:

INSPECTION AND MAINTENANCE CHECKLIST FOR HU-1 CISTERN PAGE 1 of 4

Threshold/Indicator	Maintenance Recommendation	Date	Description of Maintenance Conducted
Accumulation of sediment, litter, or debris at the inlet Maintenance Needed? ☐ YES ☐ NO ☐ N/A	☐ Remove and properly dispose of accumulated materials ☐ If the inlet is found to be obstructed at every inspection, add features to protect the inlet, or pretreatment measures within the watershed ☐ Other / Comments:		
Outlet blocked Maintenance Needed? ☐ YES ☐ NO ☐ N/A	☐ Clear blockage ☐ Other / Comments:		

Date:	Inspector:	BMP ID No.:
Permit No.:	APN(s):	

INSPECTION AND MAINTENANCE CHECKLIST FOR HU-1 CISTERN PAGE 2 of 4

Threshold/Indicator	Maintenance Recommendation	Date	Description of Maintenance Conducted
Standing water in storage container between storm events outside of normal use timeframe for the stored water. Normal use timeframe is 36 to 96 hours following a storm event depending on the purpose and design of the cistern. Maintenance Needed? ☐ YES ☐ NO ☐ N/A	☐ Use the water as intended, or disperse to landscaping ☐ Implement practices onsite to drain and use the stored water ☐ Contact the [City Engineer] to determine a solution if onsite use cannot be reliably sustained ☐ Other / Comments:		
Presence of mosquitos/larvae For images of egg rafts, larva, pupa, and adult mosquitos, see http://www.mosquito.org/biology Maintenance Needed? ☐ YES ☐ NO ☐ N/A	☐ Use the water as intended, or disperse to landscaping ☐ Install barriers such as screens that prevent mosquito access to the storage container ☐ Other / Comments:		

Date:	Inspector:	BMP ID No.:
Permit No.:	APN(s):	

INSPECTION AND MAINTENANCE CHECKLIST FOR HU-1 CISTERN PAGE 3 of 4			
Threshold/Indicator	**Maintenance Recommendation**	**Date**	**Description of Maintenance Conducted**
Accumulation of sediment, litter, or debris in the storage container – to be cleared once per year or when debris accumulation is 25% of the total container volume, or accumulation blocks outlet, whichever is more frequent Maintenance Needed? ☐ YES ☐ NO ☐ N/A	☐ Remove and properly dispose of accumulated materials ☐ If accumulation of sediment within one year is >25% of the volume of the cistern, add pretreatment measures within the watershed ☐ Other / Comments:		
Leaks or other damage to storage container Maintenance Needed? ☐ YES ☐ NO ☐ N/A	☐ Repair or replace as applicable ☐ Other / Comments:		

Date:	Inspector:	BMP ID No.:
Permit No.:	APN(s):	

INSPECTION AND MAINTENANCE CHECKLIST FOR HU-1 CISTERN PAGE 4 of 4

Threshold/Indicator	Maintenance Recommendation	Date	Description of Maintenance Conducted
Leaks or other damage to ancillary parts including valves, piping, screens, level indicators, and other accessories Maintenance Needed? ☐ YES ☐ NO ☐ N/A	☐ Repair or replace as applicable ☐ Other / Comments:		
Cistern leaning or unstable, damage to roof, supports, anchors, or foundation Maintenance Needed? ☐ YES ☐ NO ☐ N/A	☐ Make repairs as appropriate to correct the problem and stabilize the system ☐ Other / Comments:		

SD-1
Tree Wells

BMP MAINTENANCE FACT SHEET
FOR
SITE DESIGN BMP SD-1 TREE WELLS

Tree wells as site design BMPs are trees planted in configurations that allow storm water runoff to be directed into the soil immediately surrounding the tree. The tree may be contained within a planter box or structural cells. The surrounding area will be graded to direct runoff to the tree well. There may be features such as tree grates, suspended pavement design, or shallow surface depressions designed to allow runoff into the tree well. Typical tree well components include:

- Trees of the appropriate species for site conditions and constraints
- Available growing space based on tree species, soil type, water availability, surrounding land uses, and project goals
- Entrance/opening that allows storm water runoff to flow into the tree well (e.g., a curb opening, tree grate, or surface depression)
- Optional suspended pavement design to provide structural support for adjacent pavement without requiring compaction of underlying layers
- Optional root barrier devices as needed; a root barrier is a device installed in the ground, between a tree and the sidewalk, intended to guide roots down and away from the sidewalk in order to prevent sidewalk lifting from tree roots
- Optional tree grates; to be considered to maximize available space for pedestrian circulation and to protect tree roots from compaction related to pedestrian circulation; tree grates are typically made up of porous material that will allow the runoff to soak through
- Optional shallow surface depression for ponding of excess runoff
- Optional planter box drain

Normal Expected Maintenance

Tree health shall be maintained as part of normal landscape maintenance. Additionally, ensure that storm water runoff can be conveyed into the tree well as designed. That is, the opening that allows storm water runoff to flow into the tree well (e.g., a curb opening, tree grate, or surface depression) shall not be blocked, filled, re-graded, or otherwise changed in a manner that prevents storm water from draining into the tree well. A summary table of standard inspection and maintenance indicators is provided within this Fact Sheet.

Non-Standard Maintenance or BMP Failure

Tree wells are site design BMPs that normally do not require maintenance actions beyond routine landscape maintenance. The normal expected maintenance described above ensures the BMP functionality. If changes have been made to the tree well entrance / opening such that runoff is prevented from draining into the tree well (e.g., a curb inlet opening is blocked by debris or a grate is clogged causing runoff to flow around instead of into the tree well, or a surface depression has been filled so runoff flows away from the tree well), the BMP is not performing as intended to protect downstream waterways from pollution and/or erosion. Corrective maintenance will be required to restore drainage into the tree well as designed.

Surface ponding of runoff directed into tree wells is expected to infiltrate/evapotranspirate within 24-96 hours following a storm event. Surface ponding longer than approximately 24 hours following a storm event may be detrimental to vegetation health, and surface ponding longer than approximately 96 hours following a storm event poses a risk of vector (mosquito) breeding. Poor drainage can result from clogging or compaction of the soils surrounding the tree. Loosen or replace the soils to restore drainage.

Other Special Considerations

Site design BMPs, such as tree wells, installed within a new development or redevelopment project are components of an overall storm water management strategy for the project. The presence of site design BMPs within a project is usually a factor in the determination of the amount of runoff to be managed with structural BMPs (i.e., the amount of runoff expected to reach downstream retention or biofiltration basins that process storm water runoff from the project as a whole). When site design BMPs are not maintained or are removed, this can lead to clogging or failure of downstream structural BMPs due to greater delivery of runoff and pollutants than intended for the structural BMP. Therefore, the [City Engineer] may require confirmation of maintenance of site design BMPs as part of their structural BMP maintenance documentation requirements. Site design BMPs that have been installed as part of the project should not be removed, nor should they be bypassed by re-routing roof drains or re-grading surfaces within the project. If changes are necessary, consult the [City Engineer] to determine requirements.

SUMMARY OF STANDARD INSPECTION AND MAINTENANCE FOR SD-1 TREE WELLS		
The property owner is responsible to ensure inspection, operation and maintenance of permanent BMPs on their property unless responsibility has been formally transferred to an agency, community facilities district, homeowners association, property owners association, or other special district. Maintenance frequencies listed in this table are average/typical frequencies. Actual maintenance needs are site-specific, and maintenance may be required more frequently. Maintenance must be performed whenever needed, based on maintenance indicators presented in this table. The BMP owner is responsible for conducting regular inspections to see when maintenance is needed based on the maintenance indicators. During the first year of operation of a structural BMP, inspection is recommended at least once prior to August 31 and then monthly from September through May. Inspection during a storm event is also recommended. After the initial period of frequent inspections, the minimum inspection and maintenance frequency can be determined based on the results of the first year inspections.		
Threshold/Indicator	**Maintenance Action**	**Typical Maintenance Frequency**
Tree health	Routine actions as necessary to maintain tree health.	• Inspect monthly. • Maintenance when needed.
Dead or diseased tree	Remove dead or diseased tree. Replace per original plans.	• Inspect monthly. • Maintenance when needed.
Standing water in tree well for longer than 24 hours following a storm event Surface ponding longer than approximately 24 hours following a storm event may be detrimental to tree health	Loosen or replace soils surrounding the tree to restore drainage.	• Inspect monthly and after every 0.5-inch or larger storm event. If standing water is observed, increase inspection frequency to after every 0.1-inch or larger storm event. • Maintenance when needed.
Presence of mosquitos/larvae For images of egg rafts, larva, pupa, and adult mosquitos, see http://www.mosquito.org/biology	Disperse any standing water from the tree well to nearby landscaping. Loosen or replace soils surrounding the tree to restore drainage (and prevent standing water).	• Inspect monthly and after every 0.5-inch or larger storm event. If mosquitos are observed, increase inspection frequency to after every 0.1-inch or larger storm event. • Maintenance when needed
Entrance / opening to the tree well is blocked such that storm water will not drain into the tree well (e.g., a curb inlet opening is blocked by debris or a grate is clogged causing runoff to flow around instead of into the tree well; or a surface depression is filled such that runoff drains away from the tree well)	Make repairs as appropriate to restore drainage into the tree well.	• Inspect monthly. • Maintenance when needed.

References

American Mosquito Control Association.
http://www.mosquito.org/
County of San Diego. 2014. Low Impact Development Handbook.
http://www.sandiegocounty.gov/content/sdc/dpw/watersheds/susmp/lid.html
San Diego County Copermittees. 2016. Model BMP Design Manual, Appendix E, Fact Sheet SD-1.
http://www.projectcleanwater.org/index.php?option=com_content&view=article&id=250&Itemid=220

SD-1

Tree Wells

Date:	Inspector:	BMP ID No.:
Permit No.:	APN(s):	
Property / Development Name:	Responsible Party Name and Phone Number:	
Property Address of BMP:	Responsible Party Address:	

INSPECTION AND MAINTENANCE CHECKLIST FOR SD-1 TREE WELLS PAGE 1 of 2

Threshold/Indicator	Maintenance Recommendation	Date	Description of Maintenance Conducted
Dead or diseased tree Maintenance Needed? ☐ YES ☐ NO ☐ N/A	☐ Remove dead or diseased tree ☐ Replace per original plans ☐ Other / Comments:		
Standing water in tree well for longer than 24 hours following a storm event Surface ponding longer than approximately 24 hours following a storm event may be detrimental to tree health Maintenance Needed? ☐ YES ☐ NO ☐ N/A	☐ Loosen or replace soils surrounding the tree to restore drainage ☐ Other / Comments:		

Date:	Inspector:	BMP ID No.:
Permit No.:	APN(s):	

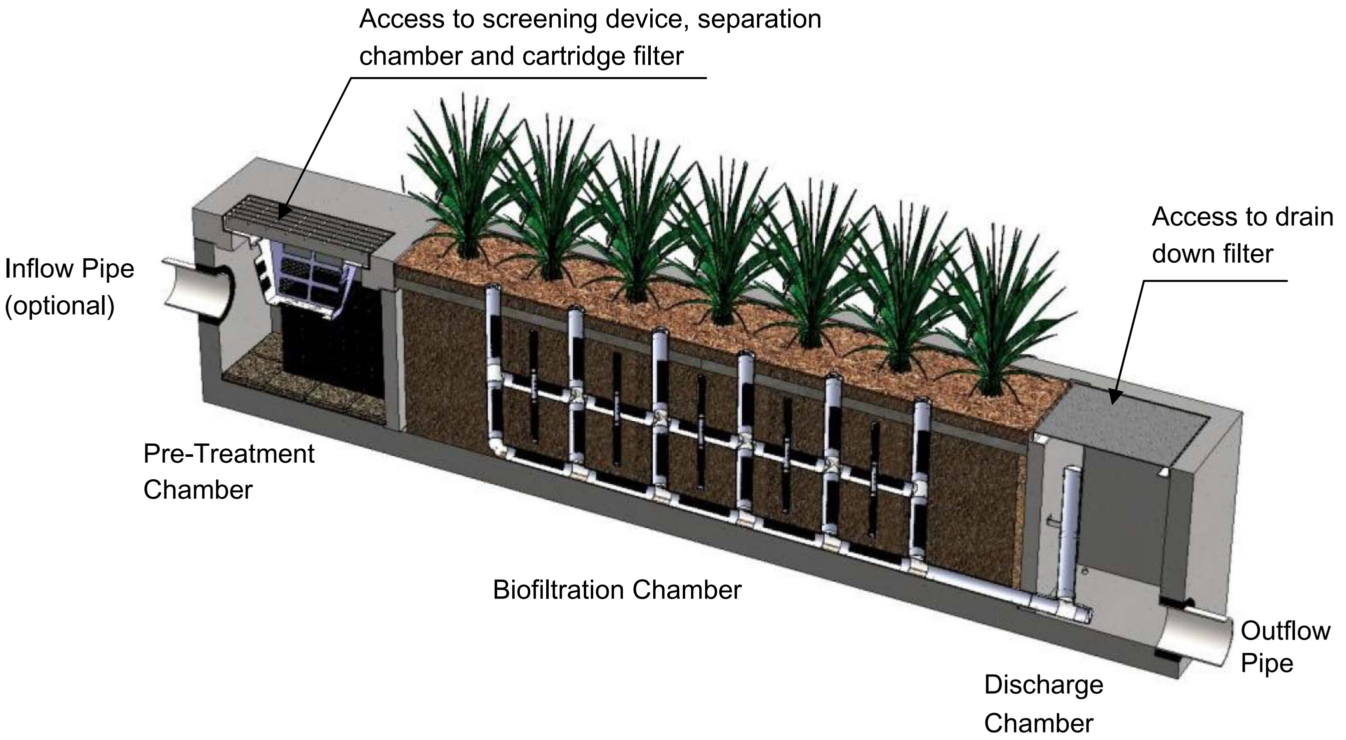
INSPECTION AND MAINTENANCE CHECKLIST FOR SD-1 TREE WELLS PAGE 2 of 2			
Threshold/Indicator	**Maintenance Recommendation**	**Date**	**Description of Maintenance Conducted**
Presence of mosquitos/larvae For images of egg rafts, larva, pupa, and adult mosquitos, see http://www.mosquito.org/biology Maintenance Needed? ☐ YES ☐ NO ☐ N/A	☐ Disperse any standing water from the tree well to nearby landscaping ☐ Loosen or replace soils surrounding the tree to restore drainage (and prevent standing water) ☐ Other / Comments:		
Entrance / opening to the tree well is blocked such that storm water will not drain into the tree well (e.g., a curb inlet opening is blocked by debris or a grate is clogged causing runoff to flow around instead of into the tree well; or a surface depression is filled such that runoff drains away from the tree well) Maintenance Needed? ☐ YES ☐ NO ☐ N/A	☐ Make repairs as appropriate to restore drainage into the tree well ☐ Other / Comments:		

Maintenance Guidelines for Modular Wetland System - Linear

Maintenance Summary

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

System Diagram



Maintenance Procedures

Screening Device

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

Separation Chamber

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

Cartridge Filters

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

Drain Down Filter

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

Maintenance Notes

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

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

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

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

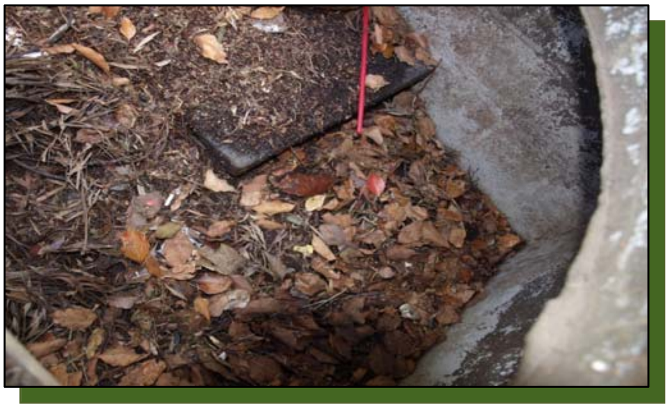
5. No fertilizer shall be used in the Biofiltration Chamber.

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

Maintenance Procedure Illustration

Screening Device

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

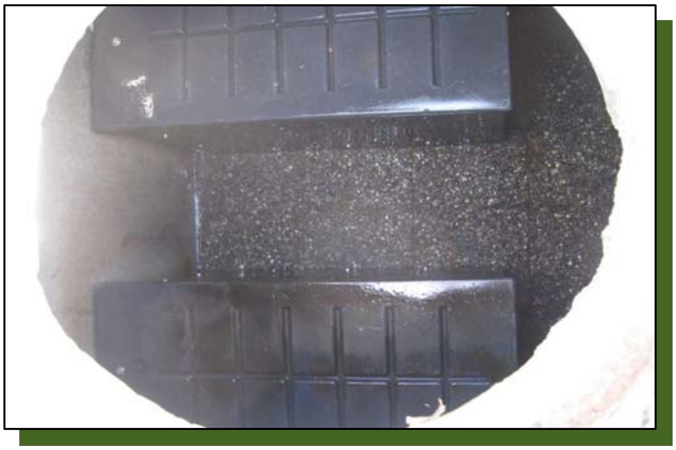


Separation Chamber

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

Cartridge Filters

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



2027/11/07

Drain Down Filter

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

Trim Vegetation

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

Inspection Form

Modular Wetland System, Inc.
P. 760.433-7640
F. 760-433-3176
E. Info@modularwetlands.com

www.modularwetlands.com

BIO CLEAN
ENVIRONMENTAL SERVICES, INC.

Inspection Report
Modular Wetlands System

MODULAR WETLANDS

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

Project Name ____________________

Project Address ____________________ (city) (Zip Code)

Owner / Management Company ____________________

Contact ____________________ Phone ( ) –

Inspector Name ____________________ Date ____ / ____ / ______ Time ________ AM / PM

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

Weather Condition ____________________ Additional Notes ____________________

Inspection Checklist

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

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

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

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

Plant Information	
Damage to Plants	
Plant Replacement	
Plant Trimming	

Additional Notes: ____________________

Maintenance Report

Modular Wetland System, Inc.
P. 760.433-7640
F. 760-433-3176
E. Info@modularwetlands.com

www.modularwetlands.com

Cleaning and Maintenance Report
Modular Wetlands System

For Office Use Only

(Reviewed By)

(Date)

Office personnel to complete section to the left.

Project Name ______________________________

Project Address ______________________________ (city) (Zip Code)

Owner / Management Company ______________________________

Contact ______________________________ Phone (   )   –

Inspector Name ______________________________ Date ____ / ____ / ______ Time ________ AM / PM

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

Weather Condition ______________________________ Additional Notes ______________________________

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

Comments:

2972 San Luis Rey Road, Oceanside, CA 92058 P. 760.433.7640 F. 760.433.3176

STORMTRAP MAINTENANCE MANUAL

1. Introduction

Regular inspections are recommended to ensure that the system is functioning as designed. Please call your Authorized StormTrap Representative if you have questions in regards to the inspection and maintenance of the StormTrap system. Prior to entry into any underground storm sewer or underground detention systems, appropriate OSHA and local safety regulations and guidelines should be followed.

2. Inspection Schedules for Municipalities

StormTrap Stormwater Management Systems are recommended for inspection whenever the upstream and downstream catch basins and stormwater pipes of the stormwater collection system are inspected or maintained. This will economize the cost of the inspection if it is done at the same time the Municipal crews are visiting the area.

3. Inspection Schedules for Private Development

StormTrap Stormwater Mangement Systems, for a private development, are recommended for inspection after each major storm water event. At a minimum, until a cleaning schedule can be established, an annual inspection is recommended. If inspected on an annual basis, the inspection should be conducted before the stormwater season begins to be sure that everything is functioning properly for the upcoming storm season.

4. Inspection Process

Inspections should be done such that at least 2-3 days has lapsed since the most recent rain event to allow for draining. Visually inspect the system at all manhole locations. Utilizing a sediment pole, measure and document the amount of silt at each manhole location (Figure 1). Inspect each pipe opening to ensure that the silt level or any foreign objects are not blocking the pipes. Be sure to inspect the outlet pipe(s) because this is typically the smallest pipe in the system. It is common that most of the larger materials will be collected upstream of the system in catch basins, and it is therefore important at time of inspections to check these structures for large trash or blockages.

Remove any blockages if you can during the inspection process only if you can do so safely from the top of the system without entering into the system**. Do not go into the system under any circumstances** without proper ventilation equipment and training. Pass any information requiring action onto the appropriate maintenance personnel if you cannot remove the blockages from above during the inspection process. Be sure to describe the location of each manhole and the type of material that needs to be removed.

The sediment level of the system should also be measured and recorded during the inspection process. Recording the sediment level at each manhole is very important in order get a history of sediment that can be graphed over time (i.e. years) in order to estimate when the system will need to be maintained next. It is also important to keep these records to verify that the inspection process was actually performed if anyone asks for your records in the future.

The sediment level in the underground detention system can be determined from the outside of the system by opening up all the manholes and using a sediment pole to measure the amount of sediment at each location. Force the stick to the bottom of the system and then remove it and measure the amount of sediment at that location. Again, do not go into the system under any circumstances without proper ventilation equipment and training.

5. When to Clean the System

Any blockages should be safely removed as soon as practical so that the Stormwater detention system will fill and drain properly before the next stormwater event.

The Dry Detention System should be completely cleaned whenever the sediment occupies more than 10% to 15% of the originally designed system’s volume. The Wet Detention System should be cleaned when the sediment occupies more than 30% or 1/3rd of the originally designed system’s volume. NOTE: Check with your municipality in regards to cleaning criteria, as the allowable sediment before cleaning may be more or less then described above.

6. How to Clean the StormTrap

The system should be completely cleaned back to 100% of the originally designed storage volume whenever the above sediment levels have been reached. Be sure to wait at least 3 days after a stormwater event to be sure that the system is completely drained (if it is a Dry Detention System), and all of the sediments have settled to the bottom of the system (if it is a Wet Detention System).

Do not enter the System unless you are properly trained, equipped, and qualified to enter a confined space as identified by local occupational safety and health regulations.

There are many maintenance companies that are in business to help you clean your underground stormwater detention systems and water quality units. Please call your StormTrap representative for referrals in your area.

A. Dry Detention System Cleaning

Maintenance is typically performed using a vacuum truck. Sediment should be flushed towards a vacuum hose for thorough removal. For a Dry Detention System, remove the manhole cover at the top of the system and lower a vacuum hose into one of the rows of the StormTrap system. Open up the manhole at the opposite end of the StormTrap and use sewer jetting equipment to force water in the same row from one end of the StormTrap row to the opposite side. The rows of the StormTrap are completely open in one contiguous channel from one end to the other for easy cleaning.

Place the vacuum hose and the sewer jetting equipment in the next row and repeat the process until all of the rows have been cleaned.

When finished, replace all covers that were removed and dispose of the collected material properly.

B. Wet Detention System Cleaning

If the system was designed to maintain a permanent pool of water, floatables and any oil should be removed in a separate procedure prior to the removal of all sediment.

The floatable trash is removed first by using a bucket strainer to capture and remove any floating debris.

The floatable oils are then removed off the top of the water by using the vacuum truck to suck off any floatable fluids and liquids.

The next step is to use the vacuum truck to gently remove the clarified water above the sediment layer.

The final step is to clean the sediment for each row as described above in the paragraph "A. Dry Detention System Cleaning". For smaller systems, the vacuum truck can remove all of the sediment in the basin without using the sewer jetting equipment because of the smaller space.

7. Inspection Reports

Proof of these inspections is the responsibility of the property owner. All inspection reports and data should be kept on site or at a location where they will be accessible for years in the future. Some municipalities require these inspection and cleaning reports to be forwarded to the proper governmental permitting agency on an annual basis.

Refer to your local and national regulations for any additional maintenance requirements and schedules not contained herein. Inspections should be a part of your standard operating procedure.

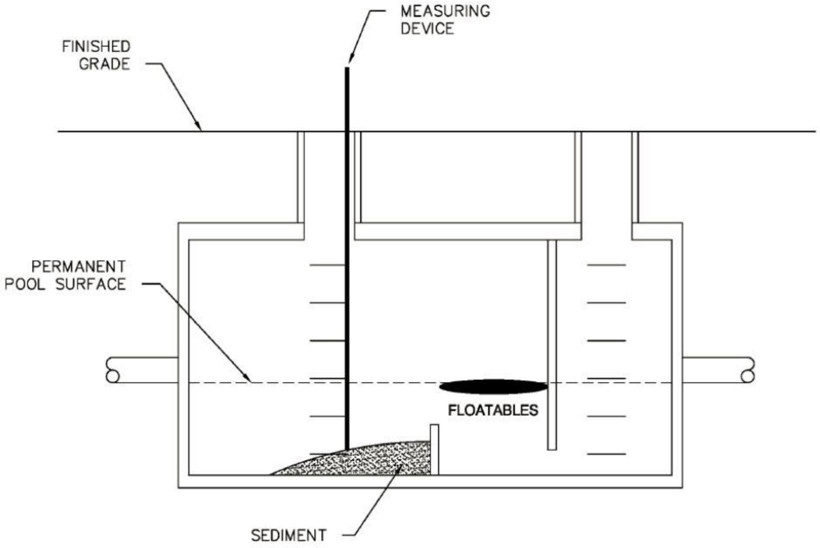


Figure 1. During inspection, measure the distance from finished grade to the top of the sediment inside the system.

Sample inspection and maintenance log

Date	Depth of Sediment	Accumulated Trash	Maintenance Performed	Maintenance Personnel	Comments
2/5/2012	3”	None	Sediment Removal/Vac	B. Johnson	

ATTACHMENT 4

Copy of Plan Sheets Showing Permanent Storm Water BMPs

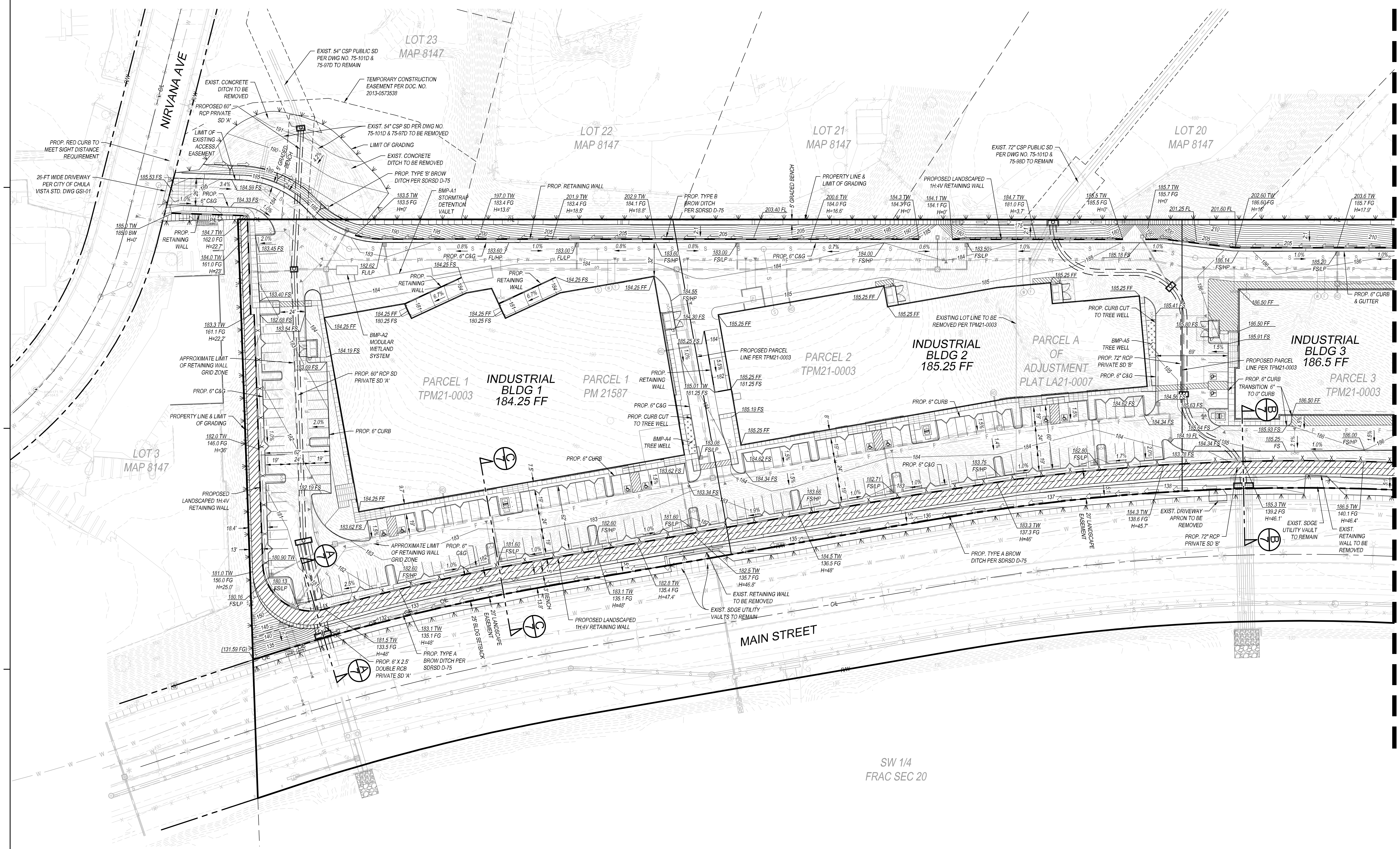
Project Name/ Nirvana Business Park

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

The plans must identify:

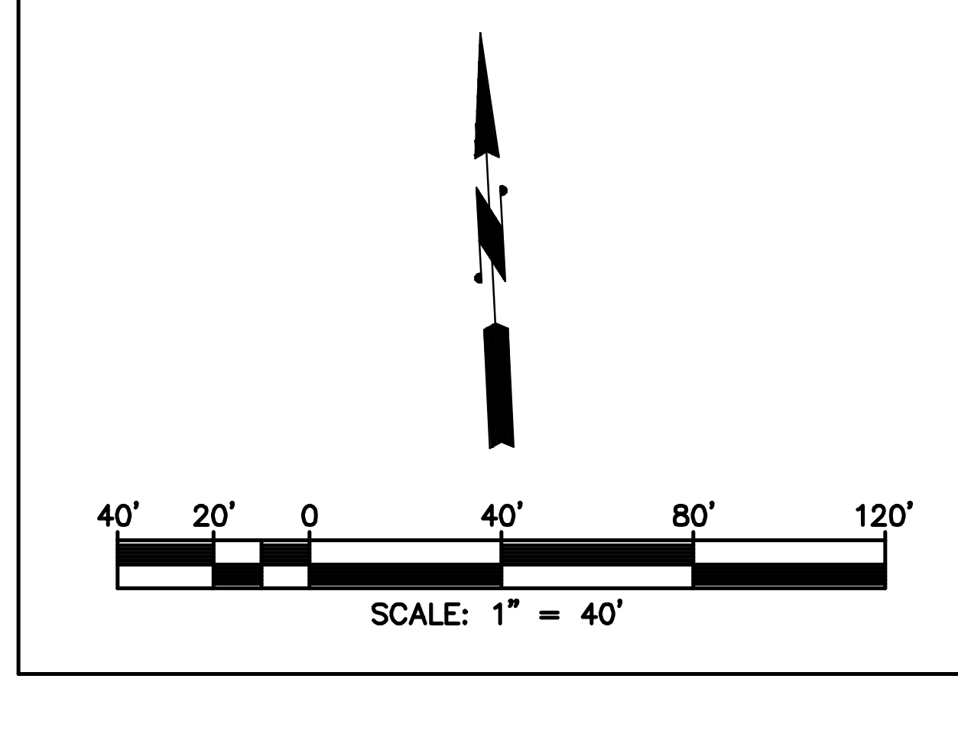
- ☒ Structural BMP(s) with ID numbers matching Form I-6 Summary of PDP Structural BMPs
- ☒ The grading and drainage design shown on the plans must be consistent with the delineation of DMAs shown on the DMA exhibit
- ☒ Details and specifications for construction of structural BMP(s)
- ☒ Signage indicating the location and boundary of structural BMP(s) as required by the City Engineer
- ☒ How to access the structural BMP(s) to inspect and perform maintenance
- ☒ 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)
- ☒ Manufacturer and part number for proprietary parts of structural BMP(s) when applicable
- ☒ 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)
- ☒ Recommended equipment to perform maintenance
- ☒ When applicable, necessary special training or certification requirements for inspection and maintenance personnel such as confined space entry or hazardous waste management
- ☒ 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.

CAUTION: IF THIS SHEET IS NOT 30"x42" IT IS A REDUCED PRINT



GRADING PLAN

SCALE 1"=40'



PASCO LARET SUITER & ASSOCIATES
San Diego | Encinitas | Orange County
Phone 858.259.8212 | www.plsaengineering.com

119 Aberdeen Drive
Cardiff By The Sea, CA 92007
T. 858.259.8212

REGISTERED PROFESSIONAL ENGINEER
GREGORY W. LANG
No. RCE 68075
EXP. 06-30-23
Civil
STATE OF CALIFORNIA

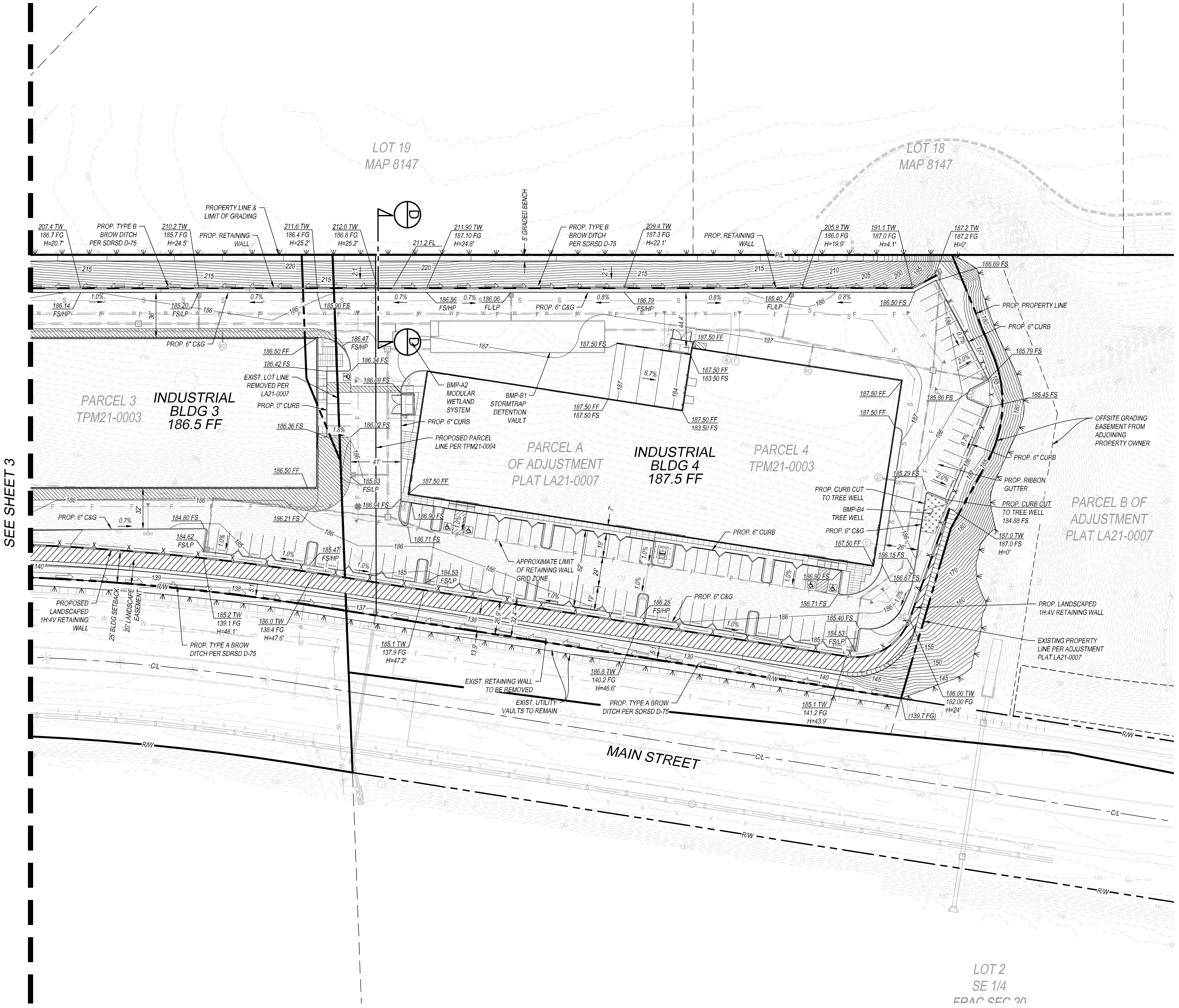
NIRVANA BUSINESS PARK
821 MAIN STREET
CHULA VISTA, CA 91911

GRADING PLAN

	DATE	REMARKS
1	09/21/2021	DESIGN REVIEW SUBMITTAL
2	12/16/2021	DESIGN REVIEW RE-SUBMITTAL
3	03/25/2022	DESIGN REVIEW RE-SUBMITTAL

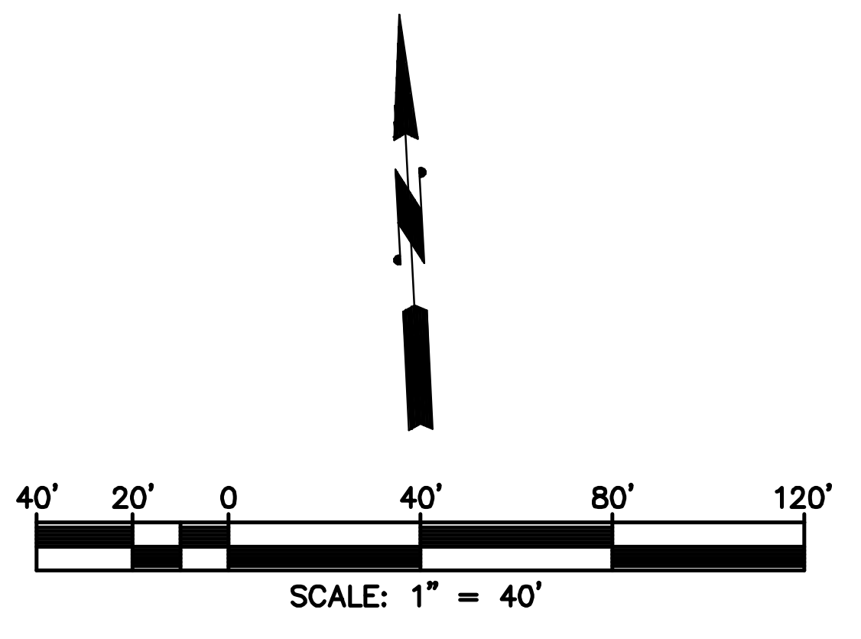
PA/PM:	GL
DRAWN BY.:	MM
JOB NO.:	3668

SHEET
C3.0



GRADING PLAN

SCALE 1"=40'



PASCO LARET SUITER
& ASSOCIATES
San Diego | Encinitas | Orange County
Phone 858.259.8212 | www.plsaengineering.com

119 Aberdeen Drive
Cardiff By The Sea, CA 92007
T. 858.259.8212

REGISTERED PROFESSIONAL ENGINEER
GREGORY W. LANG
No. RCE 68075
EXP. 06-30-23
Civil
STATE OF CALIFORNIA

NIRVANA BUSINESS PARK
821 MAIN STREET
CHULA VISTA, CA 91911

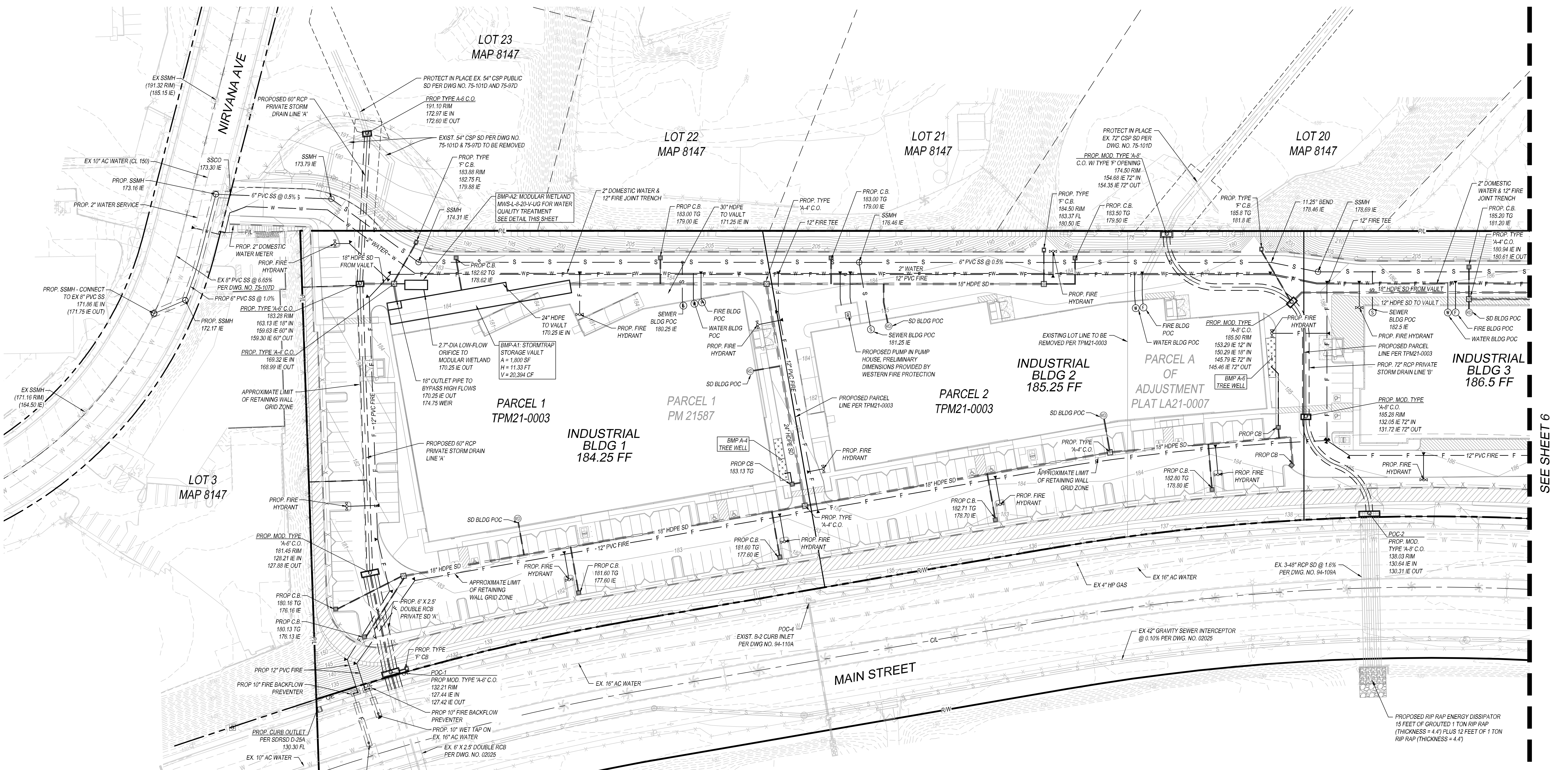
GRADING PLAN

	DATE	REMARKS
1	09/21/2021	DESIGN REVIEW SUBMITTAL
2	12/16/2021	DESIGN REVIEW RE-SUBMITTAL
3	03/25/2022	DESIGN REVIEW RE-SUBMITTAL

PA/PM:	GL
DRAWN BY.:	MM
JOB NO.:	3668

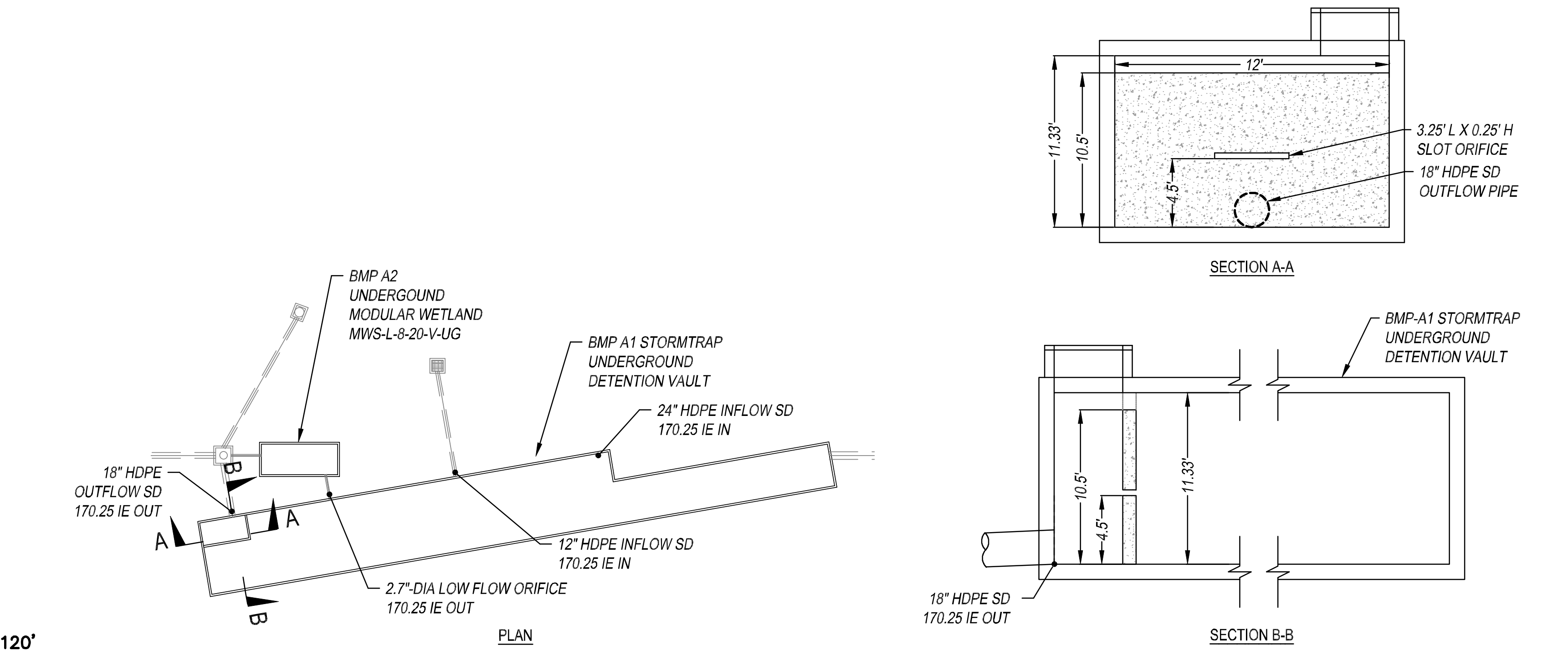
SHEET
C4.0

CAUTION: IF THIS SHEET IS NOT 30"x42" IT IS A REDUCED PRINT



UTILITY PLAN

SCALE 1"=40'



BMP-A1: STORMTRAP UNDERGROUND DETENTION VAULT DETAIL

NOT TO SCALE

SITE SPECIFIC DATA			
PROJECT NUMBER		13984	
PROJECT NAME		NIRVANA SELF STORAGE	
PROJECT LOCATION		CHULA VISTA, CA	
STRUCTURE ID		BMP A2	
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
7,941		N/A	
TREATMENT HGL AVAILABLE (FT)			4.1
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			N/A
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	169.90	PVC	6"
INLET PIPE 2	N/A	N/A	N/A
OUTLET PIPE	169.40	PVC	6"
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION	183.40	183.40	183.40
SURFACE LOAD	H–20 DIRECT	H–20 DIRECT	H–20 DIRECT
FRAME & COVER	3EA ø30"	3EA 30" X 48"	ø30"
WETLANDMEDIA VOLUME (CY)			10.35
ORIFICE SIZE (DIA. INCHES)			ø1.94 EA

NOTES: PRELIMINARY NOT FOR CONSTRUCTION. 8" WALLS REQUIRED DUE TO STRUCTURAL EVALUATION.

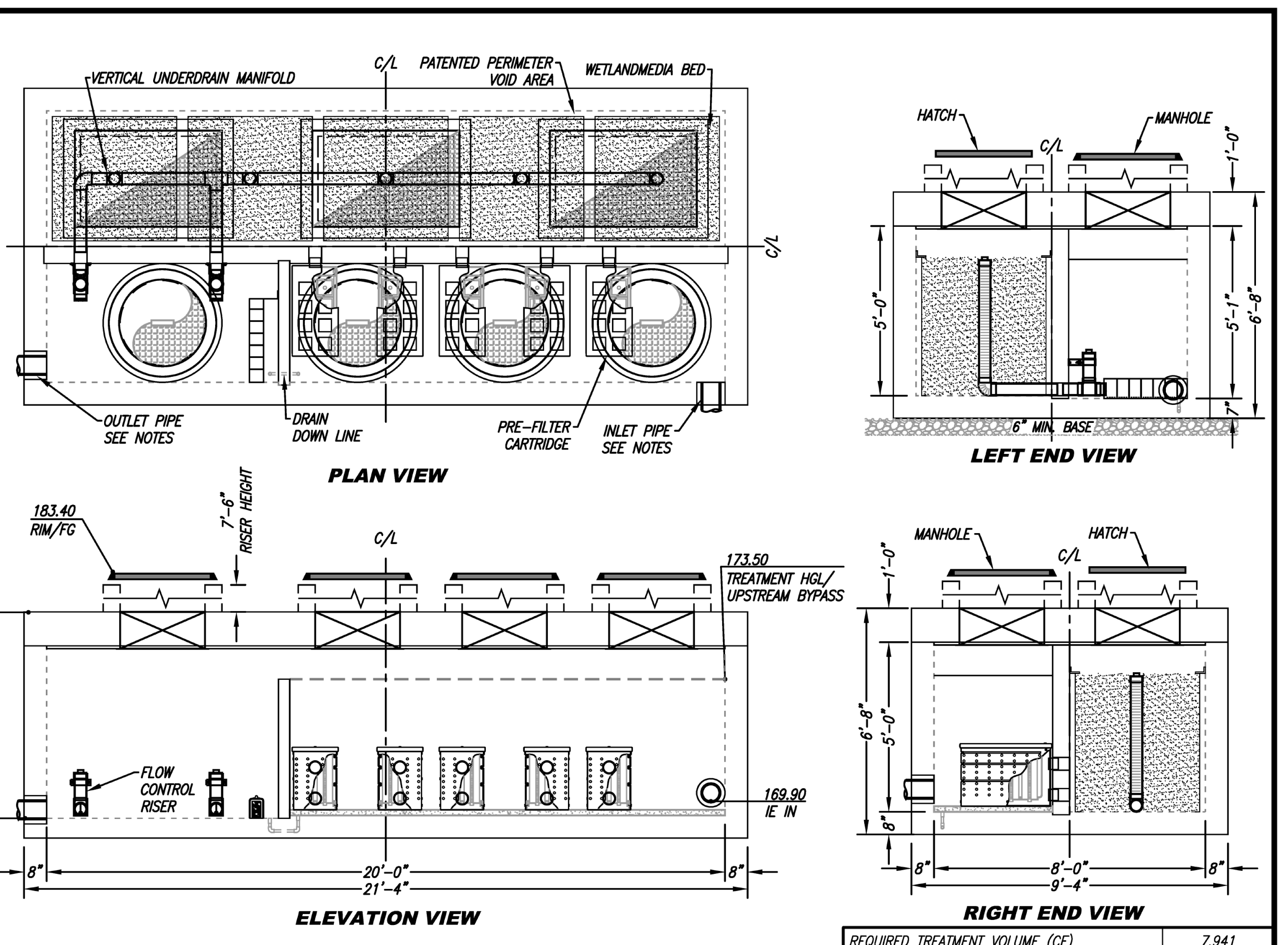
INSTALLATION NOTES

1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURERS' SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURER'S CONTRACT.
2. UNIT MUST BE INSTALLED ON LEVEL BASE. MANUFACTURER RECOMMENDS A MINIMUM 6" LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE FOR VERIFYING PROJECT ENGINEER'S RECOMMENDED BASE SPECIFICATIONS.
4. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE (PIPES CANNOT INTRUDE BEYOND FLUSH). INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR. ALL PIPES SHALL BE SEALED WATERTIGHT PER MANUFACTURER'S STANDARD CONNECTION DETAIL.
5. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL PIPES, RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO GROUT ALL MANHOLES AND HATCHES TO MATCH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.
6. VEGETATION SUPPLIED AND INSTALLED BY OTHERS. ALL UNITS WITH VEGETATION MUST HAVE DRIP OR SPRAY IRRIGATION SUPPLIED AND INSTALLED BY OTHERS.
7. CONTRACTOR RESPONSIBLE FOR CONTACTING BIO CLEAN FOR ACTIVATION OF UNIT. MANUFACTURER'S WARRANTY IS VOID WITHOUT PROPER ACTIVATION BY A BIO CLEAN REPRESENTATIVE.

GENERAL NOTES

1. MANUFACTURER TO PROVIDE ALL MATERIALS UNLESS OTHERWISE NOTED.
2. ALL DIMENSIONS, ELEVATIONS, SPECIFICATIONS AND CAPACITIES ARE SUBJECT TO CHANGE. FOR PROJECT SPECIFIC DRAWINGS DETAILING EXACT DIMENSIONS, WEIGHTS AND ACCESSORIES PLEASE CONTACT BIO CLEAN.

3/10/22BREVE



REQUIRED TREATMENT VOLUME (CF)	7,941
DRAINDOWN DURATION (HOURS)	11
AVERAGE DISCHARGE RATE PER MWS UNIT(GPM)	91.02
OPERATING HEAD (FT)	4.1
WETLANDMEDIA INFILTRATION RATE (IN/HR)	30
OR	
WETLANDMEDIA LOADING RATE (GPM/SF)	0.30

MODULAR WETLANDS

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING US PATENTS: 7,425,262; 7,470,362; 7,674,378; 8,303,816; RELATED FOREIGN PATENTS OR OTHER PATENTS PENDING

PROPRIETARY AND CONFIDENTIAL:

THE INFORMATION CONTAINED IN THIS DOCUMENT IS THE SOLE PROPERTY OF FORTERRA AND ITS COMPANIES. THIS DOCUMENT, NOR ANY PART THEREOF, MAY BE USED, REPRODUCED OR MODIFIED IN ANY MANNER WITH OUT THE WRITTEN CONSENT OF FORTERRA.

Bio Clean
A Forterra Company

MWS-L-8-20-5'-0"-V-UG
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL

BMP-A2: MODULAR WETLAND DETAIL

PASCO LARET SUITER
& ASSOCIATES
San Diego | Encinitas | Orange County
Phone 858.259.8212 | www.plsaengineering.com

119 Aberdeen Drive
Cardiff By The Sea, CA 92007
T. 858.259.8212

GREGORY W. LANG
No. RCE 68075
EXP. 06–30–23
Civil

NIRVANA BUSINESS PARK
821 MAIN STREET
CHULA VISTA, CA 91911

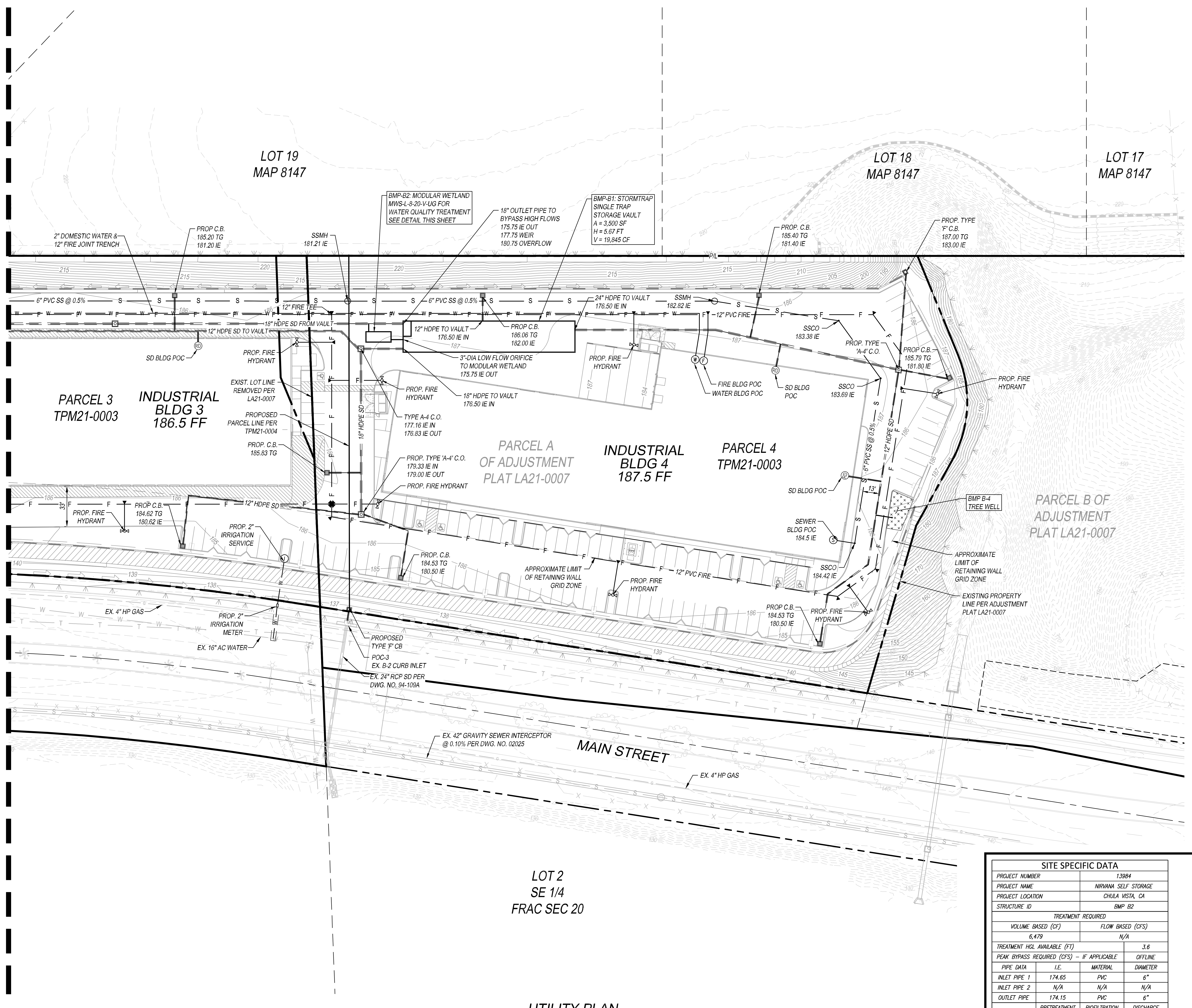
UTILITY PLAN

	DATE	REMARKS
1	09/21/2021	DESIGN REVIEW SUBMITTAL
2	12/16/2021	DESIGN REVIEW RE-SUBMITTAL
3	03/25/2022	DESIGN REVIEW RE-SUBMITTAL

PA/PM:	GL
DRAWN BY.:	MM
JOB NO.:	3668

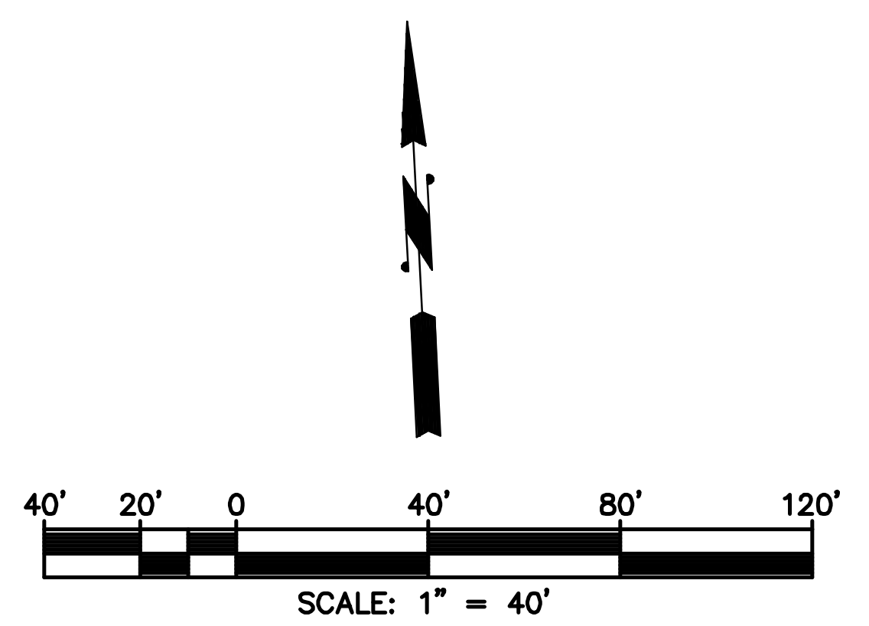
SHEET
C5.0

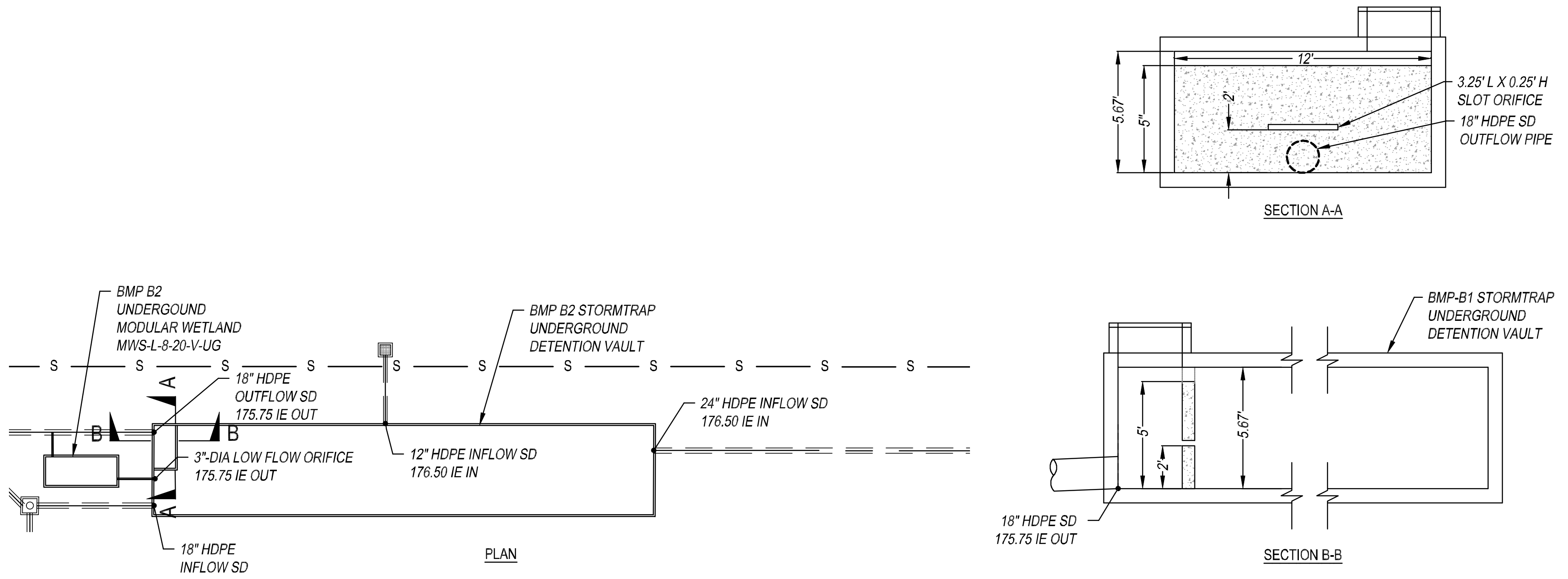
CAUTION: IF THIS SHEET IS NOT 30"x42" IT IS A REDUCED PRINT



UTILITY PLAN

SCALE 1"=40'





BMP B1: STORMTRAP UNDERGROUND DETENTION VAULT DETAIL

NOT TO SCALE

SITE SPECIFIC DATA			
PROJECT NUMBER		13984	
PROJECT NAME		NIRVANA SELF STORAGE	
PROJECT LOCATION		CHULA VISTA, CA	
STRUCTURE ID		BMP B2	
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
6,479		N/A	
TREATMENT HGL AVAILABLE (FT)			3.6
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			OFFLINE
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	174.65	PVC	6"
INLET PIPE 2	N/A	N/A	N/A
OUTLET PIPE	174.15	PVC	6"
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION	186.70	186.70	186.70
SURFACE LOAD	H–20 DIRECT	H–20 DIRECT	H–20 DIRECT
FRAME & COVER	3EA ø30"	3EA 30" X 48"	ø30"
WETLANDMEDIA VOLUME (CY)			10.35
ORIFICE SIZE (DIA. INCHES)			ø1.75 EA
NOTES: PRELIMINARY NOT FOR CONSTRUCTION. 8" WALLS REQUIRED DUE TO STRUCTURAL EVALUATION.			

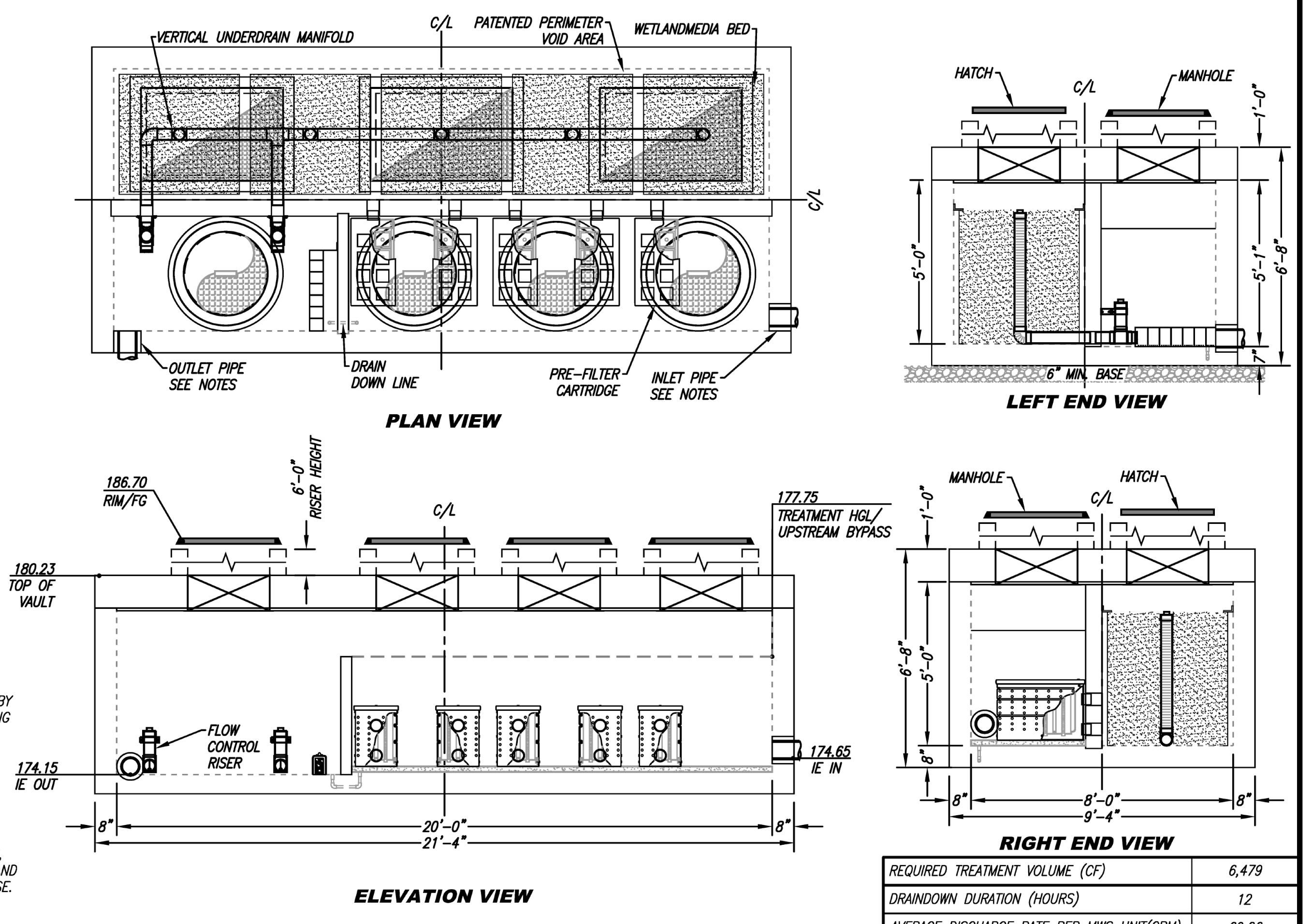
INSTALLATION NOTES

1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURERS' SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURER'S CONTRACT.
2. UNIT MUST BE INSTALLED ON LEVEL BASE. MANUFACTURER RECOMMENDS A MINIMUM 6" LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE FOR VERIFYING PROJECT ENGINEER'S RECOMMENDED BASE SPECIFICATIONS.
4. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE (PIPES CANNOT INTRUDE BEYOND FLUSH). INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR. ALL PIPES SHALL BE SEALED WATERTIGHT PER MANUFACTURER'S STANDARD CONNECTION DETAIL.
5. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL PIPES, RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO GROUT ALL MANHOLES AND HATCHES TO MATCH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.
6. VEGETATION SUPPLIED AND INSTALLED BY OTHERS. ALL UNITS WITH VEGETATION MUST HAVE DRIP OR SPRAY IRRIGATION SUPPLIED AND INSTALLED BY OTHERS.
7. CONTRACTOR RESPONSIBLE FOR CONTACTING BIO CLEAN FOR ACTIVATION OF UNIT. MANUFACTURER'S WARRANTY IS VOID WITHOUT PROPER ACTIVATION BY A BIO CLEAN REPRESENTATIVE.

GENERAL NOTES

1. MANUFACTURER TO PROVIDE ALL MATERIALS UNLESS OTHERWISE NOTED.
2. ALL DIMENSIONS, ELEVATIONS, SPECIFICATIONS AND CAPACITIES ARE SUBJECT TO CHANGE. FOR PROJECT SPECIFIC DRAWINGS DETAILING EXACT DIMENSIONS, WEIGHTS AND ACCESSORIES PLEASE CONTACT BIO CLEAN.

3/10/22BREVE



REQUIRED TREATMENT VOLUME (CF)	6,479
DRAINDOWN DURATION (HOURS)	12
AVERAGE DISCHARGE RATE PER MWS UNIT(GPM)	69.26
OPERATING HEAD (FT)	3.6
WETLANDMEDIA INFILTRATION RATE (IN/HR)	26
OR	
WETLANDMEDIA LOADING RATE (GPM/SF)	0.26

MODULAR WETLANDS

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING US PATENTS: 7,425,262; 7,470,362; 7,674,378; 8,303,816; RELATED FOREIGN PATENTS OR OTHER PATENTS PENDING

PROPRIETARY AND CONFIDENTIAL:

THE INFORMATION CONTAINED IN THIS DOCUMENT IS THE SOLE PROPERTY OF FORTERRA AND ITS COMPANIES. THIS DOCUMENT, NOR ANY PART THEREOF, MAY BE USED, REPRODUCED OR MODIFIED IN ANY MANNER WITH OUT THE WRITTEN CONSENT OF FORTERRA.

Bio Clean
A Forterra Company

MWS-L-8-20-5'-0"-V-UG
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL

BMP B2: MODULAR WETLAND DETAIL

PASCO LARET SUITER
& ASSOCIATES
San Diego | Encinitas | Orange County
Phone 858.259.8212 | www.plsaengineering.com

119 Aberdeen Drive
Cardiff By The Sea, CA 92007
T. 858.259.8212

REGISTERED PROFESSIONAL ENGINEER
GREGORY W. LAND
No. RCE 68075
EXP. 06-30-23
Civil
STATE OF CALIFORNIA

NIRVANA BUSINESS PARK
821 MAIN STREET
CHULA VISTA, CA 91911

UTILITY PLAN

	DATE	REMARKS
1	09/21/2021	DESIGN REVIEW SUBMITTAL
2	12/16/2021	DESIGN REVIEW RE-SUBMITTAL
3	03/25/2022	DESIGN REVIEW RE-SUBMITTAL

PA/PM:	GL
DRAWN BY.:	MM
JOB NO.:	3668

SHEET
C6.0

Nirvana Business Park

Project Name/

ATTACHMENT 5

Drainage Report

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

PRELIMINARY DRAINAGE STUDY

For:

Nirvana Business Park
DR21-0024

821 Main Street
Chula Vista, CA 91911

APN: 644-050-13, 644-050-14, and 644-050-80

Prepared By:

Gregory W. Lang
3-14-2022

Gregory W. Lang, P.E. RCE 68075 EXP: 06-30-23
Pasco Laret Suiter & Associates, Inc.
119 Aberdeen Drive
Cardiff, CA 92007

GREGORY W. LANG
No. RCE 68075
EXP. 06-30-23
Civil

PASCO LARET SUITER
& ASSOCIATES
CIVIL ENGINEERING + LAND PLANNING + LAND SURVEYING

Prepared for:

VWP-OP Nirvana Owner, LLC
2390 East Camelback Road, Suite 305
Phoenix, AZ 85016

May 5, 2022

PLSA Job No. 3668

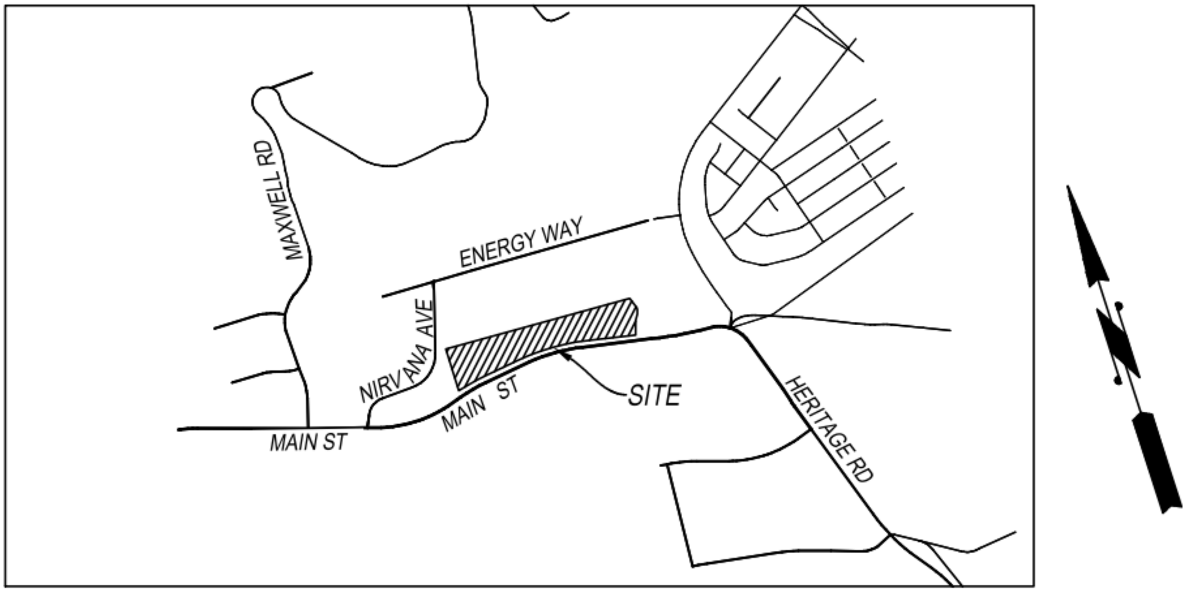
DECLARATION OF RESPONSIBLE CHARGE

I, hereby declare that I am the Engineer of Work for this project. That I have exercised responsible charge over the design of the project as defined in section 6703 of the business and professions code, and that the design is consistent with current standards.

I understand that the check of project drawings and specifications by the City of Chula Vista is confined to a review only and does not relieve me, as engineer of work, of my responsibilities for project design.

Gregory W. Lang R.C.E. 68075 EXP. 6-30-23	DATE

TABLE OF CONTENTS



VICINITY MAP

NOT TO SCALE

1. INTRODUCTION

This Preliminary Drainage Study for the proposed Nirvana Business Park has been prepared to analyze the hydrologic characteristics of the existing and proposed project site. This report presents both the methodology and the calculations used for determining the storm water runoff from the project site in the existing and proposed conditions produced by the 50-year and 100-year, 6-hour storm event.

1.1 Project Description

The Nirvana Business Park is an industrial complex consisting of three two-story buildings and one three-story storage facility totaling 296,753 square feet on 13.31 acres, located at 821 Main Street in the City of Chula Vista, San Diego County, California. The property is defined as Parcel 1 and 2 of Parcel Map 21587 and a portion of Lot 2, Sec 20, T18S, R1E San Bernadino Meridian of ROS 16999.

The project site is identified as Tax Assessor parcel numbers – APN 644-050-13, 14 and a portion of 644-050-80. The project includes Design Review to construct four buildings as follows:

- Building 1 – a 59,044 square-foot warehouse with office and mezzanine
- Building 2 – a 44,592 square-foot warehouse with office and mezzanine
- Building 3 – a 140,802 square-foot, 3-story self-storage building
- Building 4 – a 50,030 warehouse with office and mezzanine

The site is General Plan designated IL – Limited Industrial and Zoned (ILP) Limited Industrial. The proposed light industrial uses include primarily warehouse and manufacturing, assembly, storage, and warehouse distribution. The self-storage facility will feature interior and exterior accessible storage spaces, with surface loading and elevators for upper floors.

Hours of operation for the business park are planned to be Monday through Friday 6:00 a.m. to 6:00 p.m. and Saturday 6:00 a.m. to noon. The self-storage facilities will have 24/7 access.

The existing site is currently undeveloped except for existing, public drainage infrastructure located along the southern property boundary on the north side of Main Street. The site is bounded to the north by automobile salvage yards, to the west by industrial buildings, to the south by Main Street, and to the east by the Otay Ranch Village 3 development.

The site condition is divided into four (4) drainage basins, Basin A through Basin D, and four (4) separate discharge locations across the project site.

Treatment of storm water runoff from the site has been addressed in a separate report- *Storm Water Quality Management Plan for Nirvana Business Park* by PLSA, dated March 14, 2022. The project's Points of Compliance (POCs) for hydromodification management have been detailed on the Node Maps found in Appendix 1 and 2.

Per Section 3 – General Design Criteria of the City of Chula Vista Subdivision Manual (March 2012), the Modified Rational Method should be used to determine peak flow rates when the contributing drainage area is up to 1.0 square mile in size. All public and private drainage facilities shall be designed for a 100-year frequency storm. In addition, all drainage facilities within street right of ways shall be designed for a 50-year frequency storm.

Methodology used for the computation of design rainfall events, runoff coefficients, and rainfall intensity values are consistent with the criteria set forth in Section 3 – General Design Criteria of the City of Chula Vista Subdivision Manual, revised March 2012.

Existing hydrologic data was found from the City of Chula Vista Drainage Master Plan, dated February 2005. The project site is located in the Otay River Drainage Basin.

1.2 Existing Conditions

The 13.31-acre project site consists of undeveloped land located northeast of the intersection of Main Street and Nirvana Avenue along the north side of Main Street. Topographically, the site slopes from the north to the southerly property boundary, comprised of four (4) existing drainage basins with four (4) discharge locations. There are two (2) major offsite drainage conveyances through the project site.

Existing Drainage Basin A comprises the western portion of the site and includes offsite runoff from an offsite area northwest of the project site. Offsite runoff is conveyed through a 60” corrugated steel pipe (CSP) storm drain and splits into two (2) 54” CSP storm drains before discharging through a headwall at the northwest corner of the site. The existing 50-year offsite flow is 181.47 cubic feet per second per the City of Chula Vista Drainage Master Plan (see Appendix 3 for references). Flow then travels south through an open channel to an existing public 6' x 2.5' double RCB culvert system underneath Main Street. The culvert system discharges to the south of Main Street and into the Otay River Valley.

Existing Drainage Basin B is located in the center of the site and includes offsite runoff from the north. Offsite runoff is conveyed through a 72” CSP storm drain and discharges through a headwall at the northern property boundary. The existing 50-year peak source flow is 312.81 cubic feet per second per the City of Chula Vista Drainage Master Plan (see Appendix 3 for references). Flow then travels south through an open channel to three (3) existing public 48" RCP storm drains underneath Main Street. The culvert system discharges to the south of Main Street and into the Otay River Valley.

Existing Drainage Basin C comprises the eastern portion of the site. Runoff surface flows down the existing hillside and across the southern property boundary into Main Street. Runoff is then directed via curb and gutter to an existing Type B curb inlet along Main Street. The curb inlet discharges south through an existing 24” RCP storm drain and into the Otay River Valley.

Existing Drainage Basin D comprises the southern portion of the site. Runoff sheet flows down the existing hillside and across the southern property boundary into Main Street. Runoff is then directed via curb and gutter to an existing Type B curb inlet along Main Street. The curb inlet discharges south through an existing 18” RCP storm drain and into the Otay River Valley.

For additional information regarding the existing storm drain infrastructure conveying offsite drainage, refer to As-Built Drawing No. 75-97, 75-98D and 75-101D on file with the City of Chula Vista. Existing 50-year peak flow rates at the storm drain outfalls were found from the City of Chula Vista Drainage Master Plan (see Appendix 3 for references).

The Otay River flows to the west and outlets at the San Diego Bay and ultimately the Pacific Ocean. The site is not within a FEMA 100-year floodplain boundary or regulatory floodway.

Per the United States Department of Agriculture (USDA) Web Soil Survey, the project site is Hydrologic Soil Group C and D. Refer to Appendix C of this report for the USDA Web Soil Survey and geotechnical findings.

Table 1.1 summarizes the existing condition 100-year peak flows at the project's discharge locations. Table 1.2 summarizes the existing condition 50-year peak flows at the project's discharge locations including offsite flow from the public storm drain channels. For delineated basin details, please refer to the Existing Condition Hydrology Node Map included in Appendix 1 of this report.

TABLE 1.1 – Summary of Existing Condition 100-Year Peak Flows

Existing Drainage Basin	Drainage Area (ac)	Runoff Coefficient, C	Tc (min)	100-Year Intensity, I (in/hr)	Existing Q100 (cfs)
Basin A	4.41	0.57	5.19	6.24	15.44
Basin B	2.96	0.58	4.35	6.32	10.90
Basin C	4.77	0.57	4.87	6.32	17.22
Basin D	1.26	0.60	5.00	6.32	4.77
Total	13.39	0.58			48.33

TABLE 1.2 – Summary of Existing Condition 50-Year Peak Flows

Existing Drainage Basin	Drainage Area (ac)	Runoff Coefficient, C	Tc (min)	50-Year Intensity, I (in/hr)	Existing Q50 (cfs)	Offsite Flow Q50 (cfs)	Summed Data Flow Q50 (cfs)
Basin A	4.41	0.57	4.46	5.53	13.70	181.47	195.17
Basin B	2.96	0.58	3.34	5.53	9.54	312.81	322.35
Basin C	4.77	0.57	4.87	5.53	15.07	0	15.07
Basin D	1.26	0.60	5.00	5.53	4.18	0	4.18
Total	13.39	0.58			42.49	494.28	536.77

Note: Offsite flows are the cumulative source flows from the existing offsite drainage conveyances. See the Existing Condition Hydrology Node Map (Appendix 1) for location of existing offsite drainage conveyances. Summed Data flow is the Existing 50-year peak flow plus the Offsite Flow.

1.3 Proposed Conditions

The project will include the construction of four industrial buildings, paved roadways and parking areas, retaining walls, and other associated improvements. The project will be accessed by a proposed driveway off Nirvana Avenue. Drainage improvements will consist of curb inlets, catch basins, ribbon gutters, brow ditches, and storm drain pipes. The project will also have two underground detention systems and for peak flow attenuation as well as two proprietary Modular Wetland Systems for storm water quality treatment.

The proposed site will consist of four (4) major drainage basins with four (4) discharge locations to mimic the existing conditions. The site grading and onsite storm drain system have been designed to avoid diversion of drainage.

The two existing on-site, open channel drainage conveyances which transport off-site storm water from upstream public storm drain infrastructure will be replaced with a new 60" RCP pipe and a 72" RCP pipe. The existing open channels will be replaced by pipe storm drain infrastructure to allow the grading and development of the property since the existing channels bisect the property from its access point out to

Nirvana Avenue. The proposed alignment of these two new drainage systems will be slightly adjusted from the existing open channel flow paths through the property but maintain the same connection points to the existing public storm drain infrastructure north of the project site and south of the project site as in the existing condition. The new on-site storm drain infrastructure will convey the off-site run-on to the existing discharge points along the southerly property line to the existing public storm drain infrastructure underneath Main Street. The existing public storm drain easements per PM 21587 will be vacated and new public storm drain easements will be prepared to align with the proposed public, on-site storm drain infrastructure.

A 60"-dia RCP storm drain will convey offsite runoff from the northwest and discharge to the existing 6' x 2.5' double RCB culvert system underneath Main Street. The existing culvert system discharges to the south of Main Street and into the Otay River. A 72"-dia RCP storm drain will convey offsite runoff from the north and discharge to the three (3) existing 48"-dia RCP storm drains underneath Main Street. The three (3) existing 48"-dia RCP storm drains discharge to the south of Main Street and into the Otay River.

Storm water runoff from the western portion of the proposed development (Drainage Basin A) is routed to the northwest corner of the site for storm water treatment and detention and discharged into the proposed 60" RCP offsite runoff storm drain system. Runoff from the cut slope at the northwest corner of the site will discharge directly to the 60" RCP storm drain system. The proposed 60” RCP storm drain will connect to the existing 6' x 2.5' double RCB culvert system underneath Main Street.

Storm water from the eastern portion of the proposed development (Drainage Basin B) is routed to the northeast corner of the site for storm water treatment and detention and discharged into the proposed 72" RCP offsite runoff storm drain system. Slope runoff along the northern property boundary will discharge directly into the proposed 72” RCP storm drain system. The proposed 72” RCP storm drain will connect to the existing triple 48" RCP storm drain system underneath Main Street.

Slope runoff along the southern property boundary will sheet flow into a new brow ditch located along the right-of-way line along Main Street. There is a high point on Main Street which forms two drainage basins. Runoff from Drainage Basin C will discharge into the existing Type B curb inlet and existing 18” RCP storm drain under Main Street. Runoff from Drainage Basin D will discharge into the existing Type B curb inlet and existing 24” RCP storm drain under Main Street.

All developed site runoff discharges through existing storm drain infrastructure and into the Otay River. The Otay River travels west and outlets at the San Diego Bay and ultimately the Pacific Ocean.

Prior to discharging from the project site, the project’s runoff is directed to a series of BMPs including trash screen devices, Contech pretreatment units, StormTrap underground detention vaults, and BioClean Modular Wetland Systems. The underground detention vaults have been designed to meet 50-year and 100-year peak flow detention requirements. The Modular Wetland Systems (MWS) have been designed for storm water treatment. Treatment of storm water runoff from the site has been addressed in a separate report- “Priority Development Project (PDP) Storm Water Quality Management Plan (SWQMP) for Nirvana Business Park” by Pasco Laret Suiter & Associates. The project is exempt from hydromodification management requirements.

The underground detention vaults have been designed to provide flow control in the form of peak flow attenuation. The vaults have been designed to include low-flow and mid-flow orifice outlets and an overflow weir to control peak flows for the design storms analyzed. The required water quality treatment flow is diverted to the downstream Modular Wetland System in accordance with City of Chula Vista BMP Design Manual. Overflow relief for the 100-year storm event is provided with a partition weir installed within the vaults and discharged directly to the proposed 60"-dia and 72"-dia storm drain pipes conveying offsite runoff through the project site.

Table 1.3 below summarizes the proposed and detained condition 100-year peak flows at the project's discharge locations. Table 1.4 below summarizes the proposed and detained condition 50-year peak flows at the project's discharge locations, including offsite flow from the public storm drain channels.

For delineated basin details, please refer to the Proposed Condition Hydrology Node Map included as an Attachment of this report.

TABLE 1.3 – Summary of Proposed Condition 100-Year Peak Flows

Proposed Drainage Basin	Drainage Area (ac)	Runoff Coefficient, C	Tc (min)	100-Year Intensity, I (in/hr)	Proposed Q100 (cfs)	Detained Q100 (cfs)
Basin A	7.50	0.81	9.31	4.47	27.06	14.44
Basin B	5.72	0.82	6.00	5.93	27.54	10.64
Basin C	0.48	0.60	5.00	6.32	1.82	1.82
Basin D	0.31	0.60	5.00	6.32	1.16	1.16
Total	14.00	0.80			57.58	28.06

Note: Proposed 100-year flows are post-project peak flows that have not been reduced from detention routing.

TABLE 1.4 – Summary of Proposed Condition 50-Year Peak Flows

Proposed Drainage Basin	Drainage Area (ac)	Runoff Coefficient, C	Tc (min)	50-Year Intensity, I (in/hr)	Proposed Q50 (cfs)	Detained Q50 (cfs)	Offsite Flow Q50 (cfs)	Summed Data Flow Q50 (cfs)
Basin A	7.50	0.81	9.20	4.47	23.34	9.33	181.47	190.80
Basin B	5.72	0.82	6.11	5.15	23.91	7.14	312.81	319.95
Basin C	0.48	0.60	5.00	5.53	1.59	1.59	0	1.59
Basin D	0.31	0.60	5.00	5.53	1.01	1.01	0	1.01
Total	14.00	0.80			49.86	19.08	494.28	513.36

Note: Proposed 50-year flows are post-project peak flows that have not been reduced from detention routing.
Offsite flows are the cumulative source flows from the existing offsite drainage conveyances. See Proposed Condition Hydrology Node Map (Appendix 2) for location of existing offsite drainage conveyances.
Summed Data flow is the Detained 50-year peak flow plus the Offsite Flow.

2. METHODOLOGY

Runoff calculations for Nirvana Business Park, have been performed in accordance with Section 3 – General Design Criteria of the City of Chula Vista Subdivision Manual dated March 2012. Per City of City of Chula Vista design criteria, the Modified Rational Method should be used to determine peak flowrates for local drainage basins. Advanced Engineering Software (AES) was used to calculate the peak runoff from the 50-year and 100-year, 6-hour storm event using the Rational Method. Please refer to this report's Appendix for the results of these calculations.

2.1 Rational Method

As mentioned above, runoff from the project site was calculated for the 50-year and 100-year storm event. Runoff was calculated using the Rational Method which is given by the following equation:

$Q = C \times I \times A$

Where:
Q = Flow rate in cubic feet per second (cfs)
C = Runoff coefficient
I = Rainfall Intensity in inches per hour (in/hr)
A = Drainage basin area in acres, (ac)

Rational Method calculations were performed using the AES 2016 computer program. To perform the hydrology routing, the total watershed area is divided into sub-areas which discharge at designated nodes. The procedure for the sub-area summation model is as follows:

(1) Subdivide the watershed into an initial sub-areas and subsequent sub-areas, which are generally less than 10 acres in size. Assign upstream and downstream node numbers to each sub-area.

(2) Estimate an initial T_c by using the appropriate nomograph or overland flow velocity estimation. The minimum T_c considered is 5.0 minutes. All T_c values for the proposed project were assumed to be 5 minutes due to the small size of each contributing drainage area.

(3) Using the initial T_c, determine the corresponding values of I. Then Q = CIA.

(4) Using Q, estimate the travel time between this node and the next by Manning's equation as applied to particular channel or conduit linking the two nodes. Then, repeat the calculation for Q based on the revised intensity (which is a function of the revised time of concentration)

For drainage areas where the runoff is not conveyed in a defined channel, or the drainage pattern is sheet flow, the 50-year and 100-year flow rates are calculated using Q = CIA. The time of concentration is assumed to be 5 minutes when calculating the rainfall intensity. Refer to Table 1.1 for the 50-year and 100-year peak flow calculation for Existing Drainage Basin D, and Table 1.2 for the 50-year and 100-year peak flow calculation for Proposed Drainage Basin C and Proposed Drainage Basin D.

2.2 Runoff Coefficient

In accordance with City of Chula Vista design standards, runoff coefficients were based on land use. An appropriate runoff coefficient (C) for each type of land use in the subarea was selected from Section 3-203.3 of the City of Chula Vista Subdivision Manual and multiplied by the percentage of total area (A) included in that class. The sum of products for all land uses is the weighted runoff coefficient (∑[C]). See Tables 2.1 and 2.2 below for weighted runoff coefficient "C" calculations. The Existing and Proposed Condition Hydrology Node Maps show the drainage basin subareas, on-site drainage system and nodal points.

Runoff coefficients of 0.55 and 0.60 were selected from Section 3-203.3 for hilly and steep vegetated slopes, consistent with existing conditions. The existing site is assumed to be 0% impervious. See Table 2.1 below for existing condition weighted runoff coefficient "C" calculations.

In the proposed condition, the developed site was assigned a runoff coefficient of 0.85 for commercial area. Developed slopes along the northern and southern property boundary were classified as steep per Section 3-203.3 and assigned a runoff coefficient of 0.60. See Table 2.2 below for proposed condition weighted runoff coefficient "C" calculations.

TABLE 2.1- Summary of Existing Condition Weighted Runoff Coefficient Calculations

Existing Condition - Weighted Runoff Coefficient							
Up Node	Down Node	Area (ac)	C_1	A_1	C_2	A_2	C
10	11	0.13	0.45	0.13	0.60	0.00	0.45
11	12	3.48	0.45	3.48	0.60	0.00	0.45
20	13	0.13	0.45	0.00	0.60	0.13	0.60
21	21	0.13	0.45	0.13	0.60	0.00	0.45
30	22	2.10	0.45	2.10	0.60	0.00	0.45
Basin D		2.24	0.45	0.00	0.60	2.24	0.60

Note: C values taken from Section 3-203.3 of the City of Chula Vista Subdivision Manual
Runoff Coefficient of 0.55 for Vegetated Slopes, Hilly
Runoff Coefficient of 0.60 for Vegetated Slopes, Steep

TABLE 2.2- Summary of Proposed Condition Weighted Runoff Coefficient Calculations

Proposed Condition - Weighted Runoff Coefficient							
Up Node	Down Node	Area (ac)	C_1	A_1	C_2	A_2	C
100	101	0.12	0.85	0.12	0.60	0.00	0.85
101	102	0.62	0.85	0.62	0.60	0.00	0.85
103	102	0.16	0.85	0.16	0.60	0.00	0.85
105	104	0.64	0.85	0.64	0.60	0.00	0.85
107	106	0.63	0.85	0.63	0.60	0.00	0.85
109	108	1.62	0.85	1.62	0.60	0.00	0.85
111	110	0.20	0.85	0.20	0.60	0.00	0.85
113	112	1.23	0.85	1.16	0.60	0.07	0.83
115	114	1.14	0.85	1.14	0.60	0.00	0.85
118	117	0.58	0.85	0.00	0.60	0.58	0.60
122	122	0.42	0.85	0.00	0.60	0.42	0.60
200	201	0.05	0.85	0.05	0.60	0.00	0.85
201	202	0.65	0.85	0.65	0.60	0.00	0.85
203	202	0.60	0.85	0.60	0.60	0.00	0.85
205	204	0.28	0.85	0.00	0.60	0.28	0.60
207	206	0.31	0.85	0.31	0.60	0.00	0.85
208	208	0.34	0.85	0.34	0.60	0.00	0.85
209	210	0.31	0.85	0.31	0.60	0.00	0.85
211	211	0.45	0.85	0.45	0.60	0.00	0.85
213	212	0.68	0.85	0.68	0.60	0.00	0.85
215	214	1.53	0.85	1.53	0.60	0.00	0.85
218	218	0.32	0.85	0.00	0.60	0.32	0.60
219	219	0.08	0.85	0.00	0.60	0.08	0.60
220	220	0.09	0.85	0.00	0.60	0.09	0.60
Basin C		0.48	0.85	0.00	0.60	0.48	0.60
Basin D		0.31	0.85	0.00	0.60	0.31	0.60

Note: C values taken from Section 3-203.3 of the City of Chula Vista Subdivision Manual
Runoff Coefficient of 0.85 for Commercial Area
Runoff Coefficient of 0.60 for Vegetated Slopes, Steep

2.3 Rainfall Intensity

Rainfall intensity is calculated per Section 3-203.3 of the City of Chula Vista Subdivision Manual, which is given by the following equation:

$I = 7.44P_6D^{-0.645}$

Where:
I = Rainfall Intensity in inches per hour (in/hr)
P_6 = Adjusted 6-hour storm precipitation
D = Duration in minutes (use Tc)

The intensity values for varying time of concentrations were input manually into the AES computer program where runoff calculations were performed. The 6-hour storm rainfall amount (P_6) for the 50-year and 100-year storm frequency was determined using City of Chula Vista Isopluvial Maps provided from Figure 7 of the City of Chula Vista Drainage Master Plan. See Appendix 3 of this report for Isopluvial maps for the 50-year and 100-year rainfall event.

2.4 Tributary Areas

Drainage basins for the existing and proposed project site are delineated in the Existing and Proposed Condition Hydrology Node Maps located in Appendix 1 and 2 of this report and graphically portray the tributary area for each drainage basin.

2.5 Hydraulics

The hydraulics of existing and proposed storm drain pipes were analyzed using the AES computer program. For pipe flow, a Manning's N value of 0.011 was used to reflect the use of HDPE pipe. A Manning's N value of 0.013 was used to reflect the use of RCP pipe.

The County of Los Angeles Water Surface Pressure Gradient (WSPGW) program was used to perform the hydraulic grade line analysis of the proposed 60" and 72" storm drain conveyance systems in conformance with the City of Chula Vista Subdivision Manual (March 2012). The WSPGW program computes and plots uniform and non-uniform steady flow water surface profiles and pressure gradients in open channels or closed conduits with irregular or regular sections. The flow in a system may alternate between supercritical, sub-critical, or pressure flow in any sequence. The program uses mathematical and hydraulic principles to calculate data such as cross-sectional area, wetted perimeter, normal depth, critical depth, velocity, pressure, and momentum. Hydraulic analysis has been performed based on the proposed 50-year condition as described in Section 1.3. Refer to Appendix 6 for detailed WSPGW output.

The 50-year storm was analyzed for the storm drains that convey the off-site run-on and the existing public storm drain infrastructure per the City of Chula Vista's Subdivision Manual Section 3 General Design Criteria in Section 3-201.3.

The results of the WSPGW analysis shows high velocities in the proposed 60" RCP and 72" RCP storm drain pipes. To mitigate potential RCP pipe abrasion from high peak velocities, thicker wall RCP pipe with high-strength concrete will be used. The new RCP pipes will also be installed with a slurry backfill in the pipe bedding zone. For pipe velocities that exceed 20 feet per second, the concrete thickness on the inside of the RCP pipe will be increased by a minimum of 1.5 inches to provide additional concrete cover over the pipe's reinforcing steel and over the reinforcing steel for the proposed box culvert. The concrete design strength for reinforced concrete pipe and box culverts in these reaches shall be 5,000 psi for velocities exceeding 20 feet per second and 6,000 psi for velocities exceeding 30 feet per second. In addition, water tight joints will be utilized in accordance with ASTM C76/C443/C361 & C655, Greenbook S 207-2 and Caltrans S 65 requirements.

2.6 Energy Dissipation

The proposed flow velocity at the downstream end of the existing public storm drain facilities was calculated using WSPGW. The size of existing rip rap energy dissipation at the existing storm drain systems' outfalls are per As-Built Drawing No. 92-160 for the existing double 48" RCP storm drain outfall under Main Street (50-Year Existing Condition Hydrology Node 14) and Drawing No. 94-103 for the existing triple 48" RCP storm drain outfall under Main Street (50-Year Existing Condition Hydrology Node 23). The proposed peak 50-year velocities were compared to the design velocity rating of the existing rip rap rock class and thickness per the table found in San Diego Regional Standard Drawing (SDRSD) D-40. Since the existing rip rap energy dissipaters are not sufficiently sized for energy dissipation the proposed 50-year peak flow rates and velocities, the existing rip rap pads will be re-constructed. The existing rip rap pads will be grouted and additional rip rap will be placed down gradient of the grouted rip rap at lengths shown on the Proposed Condition Hydrology Node Map – 50-Year Storm Frequency. See 50-Year Proposed Condition Hydrology Nodes 124 and 221 for proposed rip rap locations.

The sizes of the new rip rap pads have been calculated using HEC-RAS software. Please refer to Appendix 7 for HEC-RAS output.

The 50-year storm was analyzed for the storm drains that convey the off-site run-on and the existing public storm drain infrastructure per the City of Chula Vista's Subdivision Manual Section 3 General Design Criteria in Section 3-201.3.

2.7 Curb Inlet and Catch Basin Sizing

Curb inlets and catch basins will be sized in accordance with City of Chula Vista Subdivision Manual (March 2012) upon final engineering.

2.8 Detention Basin Routing

The detention facility was modeled using the Army Corps of Engineers HEC-HMS 4.3 software. Hydraulic Modified-Puls detention routing was performed to analyze the developed condition 50-year and 100-year peak flow rate at the project's detention system. Stage-storage-discharge tables were generated and input into HEC-HMS to model the design of the vault outlet structure. This procedure was selected in order to model the flow control requirements and to accurately represent the middle stages of the BMP for accurate mid-flow orifice and emergency weir sizing. The stage-storage-discharge tables have been provided in Appendix 5. The HEC-HMS Modified-Puls results are summarized in Table 2.3 below.

TABLE 2.3- Summary of 100-Year Detention Basin Routing

Detention Basin	Tributary Area (ac)	Runoff Coefficient, C	Inflow Tc (min)^1	100-Year Peak Inflow (cfs)	Outflow Tc (min)	100-Year Peak Outflow (cfs)	Peak Elevation (ft)^2
BMP-A1	6.49	0.85	10	25.13	16	12.79	6.99
BMP-B1	5.22	0.85	6	27.00	12	9.98	5.14

Notes: (1) Inflow time of concentration rounded to the nearest time interval that HEC-HMS could accept
(2) Peak elevation measured from the invert of the mid-flow orifice
(3) P6-100yr = 2.4 inches

TABLE 2.4- Summary of 50-Year Detention Basin Routing

Detention Basin	Tributary Area (ac)	Runoff Coefficient, C	Inflow Tc (min)^1	50-Year Peak Inflow (cfs)	Outflow Tc (min)	50-Year Peak Outflow (cfs)	Peak Elevation (ft)^2
BMP-A1	6.49	0.85	10	21.67	17	7.91	6.55
BMP-B1	5.22	0.85	6	23.47	11	6.44	4.38

Notes: (1) Inflow time of concentration rounded to the nearest time interval that HEC-HMS could accept
(2) Peak elevation measured from the invert of the mid-flow orifice
(3) P6-50yr = 2.1 inches

A Rational Method inflow hydrograph was generated using RickRat Hydro software from Rick Engineering. The parameters of the drainage area were entered into RickRat Hydro software to generate an inflow hydrograph. The data from this hydrograph was then entered into HEC-HMS software to model the release rates from the detention system.

HEC-HMS allows for hydrology input time steps of 1, 2, 3, 4, 5, 10, 15 & 20 minutes. Rick Rat Hydro requires a minimum time of concentration (Tc) of 5 minutes. Therefore, the time of concentration (Tc) used for the concentration of the hydrograph was rounded to the nearest time interval that RickRat Hydro and HEC-HMS could accept. The peak flow remains as per the modified Rational Method analysis and is not reduced (or increased) from this hydrograph development accordingly.

Rational Method hydrographs, stage-storage-discharge relationships and HEC-HMS model output is provided in Appendix 5 of this report.

3. CALCULATIONS/RESULTS

3.1 Pre- & Post-Development Peak Flow Comparison

Below are a series of tables which summarize the calculations provided in the appendices of this report.

Table 3.1 itemizes the existing condition peak flow rates for the 50-year and 100-year storm event at the project's discharge locations.

TABLE 3.1- Existing Condition Peak Flow Summary

Drainage Basin	Drainage Area (ac)	Runoff Coefficient, C	Existing Q100 (cfs)	Existing Q50 (cfs)
Basin A	4.41	0.57	15.44	13.70
Basin B	2.96	0.58	10.90	9.54
Basin C	4.77	0.57	17.22	15.07
Basin D	1.26	0.60	4.77	4.18
Total	13.39	0.58	48.33	42.49

Table 3.2 itemizes the proposed unmitigated and mitigated condition peak flow rates for the 50-year and 100-year storm event at the project's discharge locations.

TABLE 3.2- Proposed and Detained Condition Peak Flow Summary

Drainage Basin	Drainage Area (ac)	Runoff Coefficient, C	Detained Q100 (cfs)	Detained Q50 (cfs)
Basin A	7.50	0.81	14.44	9.33
Basin B	5.72	0.82	10.64	7.14
Basin C	0.48	0.60	1.82	1.82
Basin D	0.31	0.60	1.16	1.16
Total	14.00	0.80	28.06	19.45

Table 3.3 shows that the total storm water peak flow for the proposed development is less than the existing storm water peak flow for the 50-year and 100-year rainfall event.

TABLE 3.3- Existing Vs. Detained Condition Peak Flow Summary

Drainage Basin	Existing Q100 (cfs)	Detained Q100 (cfs)	Existing Vs. Detained Q100 (cfs)	Existing Q50 (cfs)	Detained Q50 (cfs)	Existing Vs. Detained Q50 (cfs)
Basin A	15.44	14.44	-1.00	13.70	9.33	-4.37
Basin B	10.90	10.64	-0.26	9.54	7.14	-2.40
Basin C	17.22	1.82	-15.40	15.07	1.82	-13.25
Basin D	4.77	1.16	-3.61	4.18	1.16	-3.02
Total	48.33	28.06	-20.28	42.49	19.45	-23.04

3.2 Storm Water Quality

The proposed site will have a Modular Wetland System that will provide the required storm water quality treatment for the project. For information regarding BMP sizing and the water quality design, refer to the *Storm Water Quality Management Plan for Nirvana Business Park* by PLSA, dated March 14, 2022, under separate cover.

3.3 Hydromodification

The project is exempt from hydromodification management plan (HMP) requirements. For additional information regarding HMP exemption, refer to the *Storm Water Quality Management Plan for Nirvana Business Park* by PLSA, dated March 14, 2022, under separate cover.

4. CONCLUSION

This report analyzed the 50-year and 100-year storm event hydrology for the proposed site using the Advanced Engineering Software (AES) and demonstrated that the post-developed peak flow rates are less than the pre-developed peak flow rates at the project's discharge locations. In addition, the proposed storm drain systems are sized to convey the proposed flow rates and calculations can be found in the appendices of this report. As shown in Tables 3.1 through 3.3, the proposed project will not contribute storm water runoff which would exceed the capacity of existing or planned storm water drainage systems.

As discussed in Section 2.5, the proposed RCP pipe and concrete box culverts will be slurry backfilled to help mitigate the anticipated peak flow velocities through these systems. In addition, concrete cover over the reinforcing steel inside of the storm drain conduits will be increased by 1-1/2 inches, higher strength concrete will be utilized, and water tight gasket joints will be constructed as additional measures to help mitigate the anticipated high velocities in the new proposed storm drain systems.

While the 50-year peak flow velocity in the two existing public storm drain systems in Main Street are higher than in the existing condition, the proposed redesigned rip rap energy dissipaters will effectively attenuate the flows as per the County of San Diego's Hydraulic Design Manual. As showing in the hydraulic analysis presented in Appendix 7, the proposed rip rap energy dissipaters at the existing public storm drain outfalls into the Otay River have been adequately sized to handle the increased peak 50-year velocities from the proposed project.

Appendix 1

Existing Condition Hydrology Node Maps

LEGEND

DESCRIPTION	SYMBOL
HYDROLOGY NODE EXISITNG Q50 (CFS)	100 1.00
SUB-BASIN AREA	A=0.10
WEIGHTED RUNOFF COEFFICIENT	C=0.45
RIGHT-OF-WAY	—R/W— — — ——
PROPERTY LINE	—P/L— — — ——
BASIN BOUNDARY	🟥 🟥 🟥 🟥
SUB-BASIN BOUNDARY	🟦
FLOWLINE	· · → ·
DIRECTION OF FLOW	→

HYDROLOGIC SOIL GROUP

HYDROLOGIC SOIL TYPE: C & D

DEPTH TO GROUNDWATER

DEPTH TO GROUNDWATER > 20 FT

PROJECT CHARACTERISTICS

PARCEL AREA:	13.31 AC
EXISTING IMPERVIOUS AREA:	0 AC
EXISTING LANDSCAPE AREA:	0 AC
EXISTING PERVIOUS AREA:	13.31 AC

RUNOFF COEFFICIENT

IN ACCORDANCE WITH SECTION 3 - GENERAL DESIGN CRITERIA OF THE CITY OF CHULA VISTA SUBDIVISION MANUAL, RUNOFF COEFFICIENTS WERE BASED ON LAND USE. AN APPROPRIATE RUNOFF COEFFICIENT WAS SELECTED FROM SECTION 3-203.3 AND MULTIPLIED BY THE PERCENTAGE OF TOTAL AREA IN THAT CLASS. THE SUM OF THE PRODUCTS FOR ALL LAND USES IS THE WEIGHTED RUNOFF COEFFICIENT.

SEE TABLE 2.2 OF THE "PRELIMINARY DRAINAGE STUDY FOR NIRVANA BUSINESS PARK" BY PLSA DATED MARCH 2022 FOR EXISTING CONDITION WEIGHTED RUNOFF COEFFICIENT "C" CALCULATIONS.

SUMMARY OF EXISTING CONDITION 50-YEAR PEAK FLOWS

DRAINAGE BASIN	DRAINAGE AREA (AC)	IMPERVIOUS AREA (AC)	% IMP	WEIGHTED RUNOFF COEFFICIENT, C	EXISTING 50-YEAR PEAK FLOW (CFS)	OFFSITE 50-YEAR FLOW (CFS)	SUMMED DATA 50-YEAR FLOW (CFS)
BASIN A	4.41	0	0%	0.57	13.70	181.47	195.17
BASIN B	2.96	0	0%	0.58	9.54	312.81	322.35
BASIN C	4.77	0	0%	0.57	15.07	0	15.07
BASIN D	1.26	0	0%	0.60	4.18	0	4.18
TOTAL	13.39	0	0%	0.58	42.49	494.28	536.77

NOTE:
OFFSITE FLOWS ARE FLOWS FROM THE EXISTING OFFSITE DRAINAGE CONVEYANCES. SEE THE EXISTING CONDITION HYDROLOGY NODE MAP FOR LOCATION OF EXISTING OFFSITE DRAINAGE CONVEYANCES.
SUMMED DATA FLOW IS THE EXISTING 50-YEAR PEAK FLOW PLUS THE OFFSITE FLOW.

EXISTING CONDITION HYDROLOGY NODE MAP
50-YEAR STORM FREQUENCY
SCALE 1"=50'

PASCO LARET SUITER
& ASSOCIATES
San Diego | Encinitas | Orange County
Phone 858.259.8212 | www.plsaengineering.com

EXISTING CONDITION
HYDROLOGY NODE MAP
50-YEAR STORM FREQUENCY
NIRVANA BUSINESS PARK
821 MAIN STREET
CHULA VISTA, CA
PLSA JOB NO. 3668
MARCH 2022

LEGEND

DESCRIPTION	SYMBOL
HYDROLOGY NODE *EXISITNG Q100 (CFS)*	100 1.00
SUB-BASIN AREA	A=0.10
WEIGHTED RUNOFF COEFFICIENT	C=0.45
RIGHT-OF-WAY	—R/W— — — ——
PROPERTY LINE	—P/L— — — ——
BASIN BOUNDARY	🟥 🟥 🟥 🟥
SUB-BASIN BOUNDARY	▬
FLOWLINE	· · · ⟶ ·
DIRECTION OF FLOW	⟶

HYDROLOGIC SOIL GROUP

HYDROLOGIC SOIL TYPE: C & D

DEPTH TO GROUNDWATER

DEPTH TO GROUNDWATER > 20 FT

PROJECT CHARACTERISTICS

PARCEL AREA:	*13.31 AC*
EXISTING IMPERVIOUS AREA:	*0 AC*
EXISTING LANDSCAPE AREA:	*0 AC*
EXISTING PERVIOUS AREA:	*13.31 AC*

RUNOFF COEFFICIENT

IN ACCORDANCE WITH SECTION 3 - GENERAL DESIGN CRITERIA OF THE CITY OF CHULA VISTA SUBDIVISION MANUAL, RUNOFF COEFFICIENTS WERE BASED ON LAND USE. AN APPROPRIATE RUNOFF COEFFICIENT WAS SELECTED FROM SECTION 3-203.3 AND MULTIPLIED BY THE PERCENTAGE OF TOTAL AREA IN THAT CLASS. THE SUM OF THE PRODUCTS FOR ALL LAND USES IS THE WEIGHTED RUNOFF COEFFICIENT.

SEE TABLE 2.2 OF THE "PRELIMINARY DRAINAGE STUDY FOR NIRVANA BUSINESS PARK" BY PLSA DATED MARCH 2022 FOR EXISTING CONDITION WEIGHTED RUNOFF COEFFICIENT "C" CALCULATIONS.

SUMMARY OF EXISTING CONDITION 100-YEAR PEAK FLOWS

DRAINAGE BASIN	DRAINAGE AREA (AC)	IMPERVIOUS AREA (AC)	% IMP	WEIGHTED RUNOFF COEFFICIENT, C	EXISTING 100-YEAR PEAK FLOW (CFS)
BASIN A	4.41	0	0%	0.57	15.44
BASIN B	2.96	0	0%	0.58	10.90
BASIN C	4.77	0	0%	0.57	17.22
BASIN D	1.26	0	0%	0.60	4.77
TOTAL	13.39	0	0%	0.58	48.33

EXISTING CONDITION HYDROLOGY NODE MAP
100-YEAR STORM FREQUENCY
SCALE 1"=50'

50' 25' 0 50' 100' 150'
SCALE: 1" = 50'

PASCO LARET SUITER
& ASSOCIATES
San Diego | Encinitas | Orange County
Phone 858.259.8212 | www.plsaengineering.com

EXISTING CONDITION
HYDROLOGY NODE MAP
100-YEAR STORM FREQUENCY
NIRVANA BUSINESS PARK
821 MAIN STREET
CHULA VISTA, CA
PLSA JOB NO. 3668
MARCH 2022

Appendix 2

Proposed Condition Hydrology Node Maps

LEGEND

DESCRIPTION	SYMBOL
HYDROLOGY NODE DETAINED Q50 (CFS)	100 1.00
SUB-BASIN AREA	A=0.10
WEIGHTED RUNOFF COEFFICIENT	C=0.45
RIGHT-OF-WAY	—R/W— — — ——
PROPERTY LINE	—P/L— — — ——
BASIN BOUNDARY	🟥 🟥 🟥 🟥
SUB-BASIN BOUNDARY	——
DIRECTION OF FLOW	→
FLOWLINE	· · · → ·

HYDROLOGIC SOIL GROUP

HYDROLOGIC SOIL TYPE: C & D

DEPTH TO GROUNDWATER

DEPTH TO GROUNDWATER > 20 FT

PROJECT CHARACTERISTICS

PARCEL AREA:	13.31 AC
PROPOSED DISTURBED AREA:	14.11 AC
PROPOSED IMPERVIOUS AREA:	9.75 AC
PROPOSED PERVIOUS / LANDSCAPE AREA:	4.37 AC

RUNOFF COEFFICIENT

IN ACCORDANCE WITH SECTION 3 - GENERAL DESIGN CRITERIA OF THE CITY OF CHULA VISTA SUBDIVISION MANUAL, RUNOFF COEFFICIENTS WERE BASED ON LAND USE. AN APPROPRIATE RUNOFF COEFFICIENT WAS SELECTED FROM SECTION 3-203.3 AND MULTIPLIED BY THE PERCENTAGE OF TOTAL AREA IN THAT CLASS. THE SUM OF THE PRODUCTS FOR ALL LAND USES IS THE WEIGHTED RUNOFF COEFFICIENT.

SEE TABLE 2.2 OF THE "PRELIMINARY DRAINAGE STUDY FOR NIRVANA BUSINESS PARK" BY PLSA DATED MARCH 2022 FOR PROPOSED CONDITION WEIGHTED RUNOFF COEFFICIENT "C" CALCULATIONS.

SUMMARY OF PROPOSED CONDITION 50-YEAR PEAK FLOWS

DRAINAGE BASIN	DRAINAGE AREA (AC)	IMPERVIOUS AREA (AC)	% IMP	WEIGHTED RUNOFF COEFFICIENT, C	PROPOSED 50-YEAR PEAK FLOW (CFS)	DETAINED 50-YEAR PEAK FLOW (CFS)	OFFSITE 50-YEAR FLOW (CFS)	SUMMED DATA 50-YEAR FLOW (CFS)
BASIN A	7.50	5.38	71.7%	0.81	23.34	9.33	181.47	190.80
BASIN B	5.72	4.37	76.5%	0.82	23.91	7.14	312.81	319.95
BASIN C	0.48	0	0%	0.60	1.59	1.59	0	1.59
BASIN D	0.31	0	0%	0.60	1.01	1.01	0	1.01
TOTAL	14.00	9.75	69.6%	0.80	49.86	19.08	494.28	513.36

NOTE:
PROPOSED 100-YEAR PEAK FLOWS ARE POST-PROJECT PEAK FLOWS THAT HAVE NOT BEEN REDUCED FROM DETENTION ROUTING.
DETAINED 100-YEAR PEAK FLOWS ARE POST-PROJECT PEAK FLOWS THAT HAVE BEEN REDUCED BY ROUTING THROUGH THE PROJECT'S DETENTION FACILITIES.
OFFSITE FLOWS ARE FLOWS FROM THE EXISTING OFFSITE DRAINAGE CONVEYANCES. SEE THE PROPOSED CONDITION HYDROLOGY NODE MAP FOR LOCATION OF EXISTING OFFSITE DRAINAGE CONVEYANCES.
SUMMED DATA FLOW IS THE DETAINED 50-YEAR PEAK FLOW PLUS THE OFFSITE FLOW.

PROPOSED CONDITION HYDROLOGY NODE MAP
50-YEAR STORM FREQUENCY
SCALE 1"=50'

50' 25' 0 50' 100' 150'
SCALE: 1" = 50'

PASCO LARET SUITER
& ASSOCIATES
San Diego | Encinitas | Orange County
Phone 858.259.8212 | www.plsaengineering.com

PROPOSED CONDITION HYDROLOGY NODE MAP
50-YEAR STORM FREQUENCY
NIRVANA BUSINESS PARK
821 MAIN STREET
CHULA VISTA, CA
PLSA JOB NO. 3668
MARCH 2022

LEGEND

DESCRIPTION	SYMBOL
HYDROLOGY NODE DETAINED Q100 (CFS)	100 1.00
SUB-BASIN AREA	A=0.10
WEIGHTED RUNOFF COEFFICIENT	C=0.45
RIGHT-OF-WAY	—R/W— — — ——
PROPERTY LINE	—P/L— — — ——
BASIN BOUNDARY	🟥 🟥 🟥 🟥
SUB-BASIN BOUNDARY	🟦
DIRECTION OF FLOW	→
FLOWLINE	· · · → ·

HYDROLOGIC SOIL GROUP

HYDROLOGIC SOIL TYPE: C & D

DEPTH TO GROUNDWATER

DEPTH TO GROUNDWATER > 20 FT

PROJECT CHARACTERISTICS

PARCEL AREA:	13.31 AC
PROPOSED DISTURBED AREA:	14.11 AC
PROPOSED IMPERVIOUS AREA:	9.75 AC
PROPOSED PERVIOUS / LANDSCAPE AREA:	4.37 AC

RUNOFF COEFFICIENT

IN ACCORDANCE WITH SECTION 3 - GENERAL DESIGN CRITERIA OF THE CITY OF CHULA VISTA SUBDIVISION MANUAL, RUNOFF COEFFICIENTS WERE BASED ON LAND USE. AN APPROPRIATE RUNOFF COEFFICIENT WAS SELECTED FROM SECTION 3-203.3 AND MULTIPLIED BY THE PERCENTAGE OF TOTAL AREA IN THAT CLASS. THE SUM OF THE PRODUCTS FOR ALL LAND USES IS THE WEIGHTED RUNOFF COEFFICIENT.

SEE TABLE 2.2 OF THE "PRELIMINARY DRAINAGE STUDY FOR NIRVANA BUSINESS PARK" BY PLSA DATED MARCH 2022 FOR PROPOSED CONDITION WEIGHTED RUNOFF COEFFICIENT "C" CALCULATIONS.

SUMMARY OF PROPOSED CONDITION 100-YEAR PEAK FLOWS

DRAINAGE BASIN	DRAINAGE AREA (AC)	IMPERVIOUS AREA (AC)	% IMP	WEIGHTED RUNOFF COEFFICIENT, C	PROPOSED 100-YEAR PEAK FLOW (CFS)	DETAINED 100-YEAR PEAK FLOW (CFS)
BASIN A	7.50	5.38	71.7%	0.81	27.06	14.44
BASIN B	5.72	4.37	76.5%	0.82	27.54	10.64
BASIN C	0.48	0	0%	0.60	1.82	1.82
BASIN D	0.31	0	0%	0.60	1.16	1.16
TOTAL	14.00	9.75	69.6%	0.80	57.58	28.06

NOTE:
PROPOSED 100-YEAR PEAK FLOWS ARE POST-PROJECT PEAK FLOWS THAT HAVE NOT BEEN REDUCED FROM DETENTION ROUTING.
DETAINED 100-YEAR PEAK FLOWS ARE POST-PROJECT PEAK FLOWS THAT HAVE BEEN REDUCED BY ROUTING THROUGH THE PROJECT'S DETENTION FACILITIES.

SCALE: 1" = 50'

PROPOSED CONDITION HYDROLOGY NODE MAP
100-YEAR STORM FREQUENCY

SCALE 1"=50'

PASCO LARET SUITER & ASSOCIATES
San Diego | Encinitas | Orange County
Phone 858.259.8212 | www.plsaengineering.com

PROPOSED CONDITION
HYDROLOGY NODE MAP
100-YEAR STORM FREQUENCY
NIRVANA BUSINESS PARK
821 MAIN STREET
CHULA VISTA, CA
PLSA JOB NO. 3668
MARCH 2022

Appendix 3

Hydrology Design Summary

Hydrologic Soil Group—San Diego County Area, California

Map Scale: 1:2,330 if printed on A landscape (11" x 8.5") sheet.

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: San Diego County Area, California
Survey Area Data: Version 15, May 27, 2020

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

Date(s) aerial images were photographed: Aug 18, 2018—Aug 22, 2018

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
DoE	Diablo-Olivenhain complex, 9 to 30 percent slopes	D	0.5	4.1%
GP	Gravel pits		0.1	1.1%
LsE	Linne clay loam, 9 to 30 percent slopes	C	0.6	5.6%
OkE	Olivenhain-Urban land complex, 9 to 30 percent slopes	D	2.8	25.0%
SbC	Salinas clay loam, 2 to 9 percent slopes	C	4.2	37.5%
TeF	Terrace escarpments		3.0	26.6%
Totals for Area of Interest			**11.3**	**100.0%**

Description

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

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

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

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

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

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

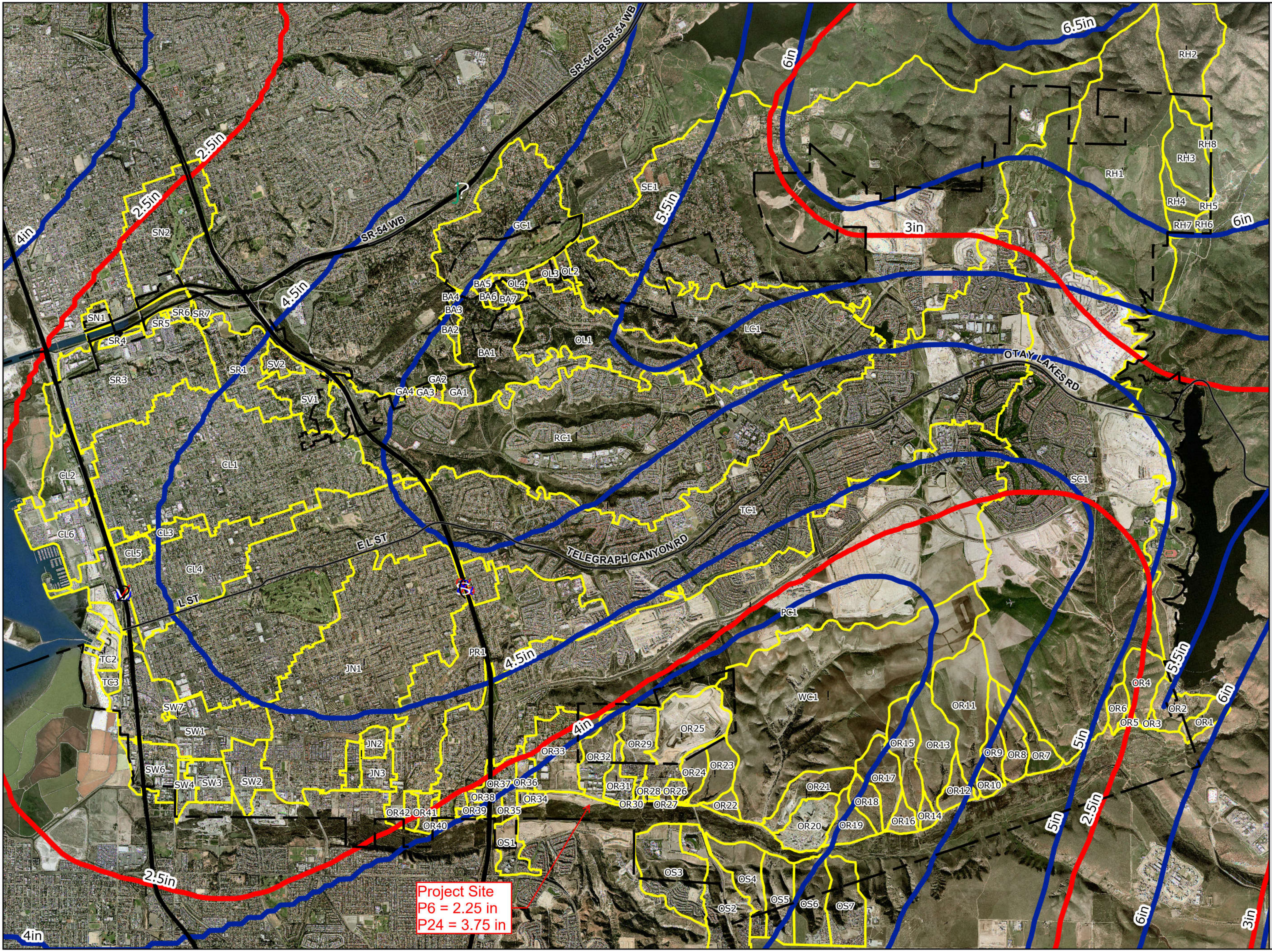
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher



Project Site
P6 = 2.25 in
P24 = 3.75 in

Chula Vista Drainage Master Plan

Figure 7: Rainfall Isopluvials

100 Year Rainfall Event

🟥 6 Hour Isopluvial

🟦 24 Hour Isopluvial

1 inch equals 4,200 feet

CITY OF
CHULA VISTA

PBSJ

Map Date:	Feb 12, 2004
Projection:	State Plane
Datum:	NAD 83
Zone:	California VI
Units:	Feet

06/24/04 Z:\Projects\IS\ChulaVistaMP\Stormwater\mxd\Working\11x17 REPORT\100YRPRECIP.mxd

Appendix 4

AES Rational Method Calculations

EXISTING CONDITION - 50 YEAR

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

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
         (c) Copyright 1982-2008 Advanced Engineering Software (aes)
             Ver. 15.0 Release Date: 04/01/2008  License ID 1452

                           Analysis prepared by:

                      PASCO LARET SUITER & ASSOCIATES
                           535 NORTH HIGHWAY 101
                                  SUITE A
                           SOLANA BEACH CA 92705

----------------------------------------------------------------------------
  FILE NAME: 3668E50.DAT
  TIME/DATE OF STUDY: 16:14 03/23/2022
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =  50.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   4.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  RAINFALL-INTENSITY ADJUSTMENT FACTOR = 1.000
  *USER SPECIFIED:
  NUMBER OF [TIME,INTENSITY] DATA PAIRS =  9
   1)   5.000;  5.533
   2)  10.000;  3.538
   3)  15.000;  2.724
   4)  20.000;  2.263
   5)  25.000;  1.959
   6)  30.000;  1.742
   7)  40.000;  1.447
   8)  50.000;  1.253
   9)  60.000;  1.114
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: ONLY PEAK CONFLUENCE VALUES CONSIDERED
  *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 0.0312 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     10.00 TO NODE     11.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .6000
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    77.00
  UPSTREAM ELEVATION(FEET) =    190.00
```

```
  DOWNSTREAM ELEVATION(FEET) =    159.00
  ELEVATION DIFFERENCE(FEET) =     31.00
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.666
  WARNING: THE MAXIMUM OVERLAND FLOW SLOPE, 10.%, IS USED IN Tc CALCULATION!
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.533
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.60
  TOTAL AREA(ACRES) =      0.18   TOTAL RUNOFF(CFS) =      0.60

*****************************************************************************
  FLOW PROCESS FROM NODE     11.00 TO NODE     11.00 IS CODE =  16
-----------------------------------------------------------------------------
  >>>>>USER SPECIFIED CONSTANT SOURCE FLOW AT NODE<<<<<
=============================================================================
  USER-SPECIFIED CONSTANT SOURCE FLOW =   181.47(CFS)
  USER-SPECIFIED AREA ASSOCIATED TO SOURCE FLOW =   115.00(ACRES)
  * CUMULATIVE SOURCE FLOW DATA: FLOW(CFS) =   181.47  AREA(AC.) =   115.00
  * SUMMED DATA: FLOW(CFS) =   182.07    TOTAL AREA(ACRES) =   115.18

*****************************************************************************
  FLOW PROCESS FROM NODE     11.00 TO NODE     12.00 IS CODE =  51
-----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
=============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    159.00  DOWNSTREAM(FEET) =    130.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   483.00   CHANNEL SLOPE =  0.0600
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.533
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .5600
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =     188.62
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =  12.09
  AVERAGE FLOW DEPTH(FEET) =   2.34   TRAVEL TIME(MIN.) =   0.67
  Tc(MIN.) =    4.33
  SUBAREA AREA(ACRES) =     4.23       SUBAREA RUNOFF(CFS) =   13.11
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.562
  TOTAL AREA(ACRES) =        4.4         PEAK FLOW RATE(CFS) =      13.70

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  2.37   FLOW VELOCITY(FEET/SEC.) =  12.22
  * TOTAL SOURCE FLOW(CFS) =     181.47
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     12.00 =     560.00 FEET.

*****************************************************************************
  FLOW PROCESS FROM NODE     12.00 TO NODE     13.00 IS CODE =  41
-----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
=============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   129.01  DOWNSTREAM(FEET) =   126.97
  FLOW LENGTH(FEET) =    99.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  52.0 INCH PIPE IS  33.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  18.55
  GIVEN PIPE DIAMETER(INCH) =  52.00    NUMBER OF PIPES =   2
  PIPE-FLOW(CFS) =     195.17
  PIPE TRAVEL TIME(MIN.) =   0.09    Tc(MIN.) =    4.42
  * TOTAL SOURCE FLOW(CFS) =     181.47
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     13.00 =     659.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE     13.00 TO NODE     14.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   119.00  DOWNSTREAM(FEET) =   118.80
  FLOW LENGTH(FEET) =    33.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =   9.89
  (PIPE FLOW VELOCITY CORRESPONDING TO NORMAL-DEPTH FLOW
   AT DEPTH = 0.82 * DIAMETER)
  GIVEN PIPE DIAMETER(INCH) =  48.00    NUMBER OF PIPES =   2
  PIPE-FLOW(CFS) =     195.17
  PIPE TRAVEL TIME(MIN.) =   0.06    Tc(MIN.) =    4.48
  * TOTAL SOURCE FLOW(CFS) =     181.47
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     14.00 =     692.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     20.00 TO NODE     21.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .6000
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    52.00
  UPSTREAM ELEVATION(FEET) =    175.00
  DOWNSTREAM ELEVATION(FEET) =    154.00
  ELEVATION DIFFERENCE(FEET) =     21.00
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.013
  WARNING: THE MAXIMUM OVERLAND FLOW SLOPE, 10.%, IS USED IN Tc CALCULATION!
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.533
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.27
  TOTAL AREA(ACRES) =      0.08   TOTAL RUNOFF(CFS) =      0.27

****************************************************************************
  FLOW PROCESS FROM NODE     21.00 TO NODE     21.00 IS CODE =  16
----------------------------------------------------------------------------
  >>>>>USER SPECIFIED CONSTANT SOURCE FLOW AT NODE<<<<<
============================================================================
  USER-SPECIFIED CONSTANT SOURCE FLOW =   312.81(CFS)
  USER-SPECIFIED AREA ASSOCIATED TO SOURCE FLOW =   227.30(ACRES)
  * CUMULATIVE SOURCE FLOW DATA: FLOW(CFS) =   312.81  AREA(AC.) =   227.30
  * SUMMED DATA: FLOW(CFS) =   313.08    TOTAL AREA(ACRES) =   227.38

****************************************************************************
  FLOW PROCESS FROM NODE     21.00 TO NODE     22.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    175.00  DOWNSTREAM(FEET) =    130.60
  CHANNEL LENGTH THRU SUBAREA(FEET) =   346.00   CHANNEL SLOPE =  0.1283
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =  10.00
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.533
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .5800
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =     317.71
```

```
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =  18.35
  AVERAGE FLOW DEPTH(FEET) =   2.48   TRAVEL TIME(MIN.) =   0.31
  Tc(MIN.) =    3.33
  SUBAREA AREA(ACRES) =     2.89       SUBAREA RUNOFF(CFS) =    9.27
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.581
  TOTAL AREA(ACRES) =        3.0         PEAK FLOW RATE(CFS) =       9.54

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  2.51   FLOW VELOCITY(FEET/SEC.) =  18.35
  * TOTAL SOURCE FLOW(CFS) =     312.81
  LONGEST FLOWPATH FROM NODE     20.00 TO NODE     22.00 =     398.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     22.00 TO NODE     23.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   130.31  DOWNSTREAM(FEET) =   128.05
  FLOW LENGTH(FEET) =   137.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  16.31
  (PIPE FLOW VELOCITY CORRESPONDING TO NORMAL-DEPTH FLOW
   AT DEPTH = 0.82 * DIAMETER)
  GIVEN PIPE DIAMETER(INCH) =  48.00    NUMBER OF PIPES =   3
  PIPE-FLOW(CFS) =     322.35
  PIPE TRAVEL TIME(MIN.) =   0.14    Tc(MIN.) =    3.47
  * TOTAL SOURCE FLOW(CFS) =     312.81
  LONGEST FLOWPATH FROM NODE     20.00 TO NODE     23.00 =     535.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     30.00 TO NODE     31.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .6000
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    86.00
  UPSTREAM ELEVATION(FEET) =    221.00
  DOWNSTREAM ELEVATION(FEET) =    214.00
  ELEVATION DIFFERENCE(FEET) =      7.00
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.149
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.533
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.43
  TOTAL AREA(ACRES) =      0.13   TOTAL RUNOFF(CFS) =      0.43

****************************************************************************
  FLOW PROCESS FROM NODE     31.00 TO NODE     32.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    214.00  DOWNSTREAM(FEET) =    139.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   240.00   CHANNEL SLOPE =  0.3125
  CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =   5.000
  MANNING'S FACTOR = 0.040   MAXIMUM DEPTH(FEET) =   2.00
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.533
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .5700
  S.C.S. CURVE NUMBER (AMC II) =   0
```

```
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       7.75
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   5.40
  AVERAGE FLOW DEPTH(FEET) =   0.13   TRAVEL TIME(MIN.) =   0.74
  Tc(MIN.) =    4.89
  SUBAREA AREA(ACRES) =     4.64       SUBAREA RUNOFF(CFS) =   14.63
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.571
  TOTAL AREA(ACRES) =        4.8         PEAK FLOW RATE(CFS) =      15.07

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.20   FLOW VELOCITY(FEET/SEC.) =   6.73
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE     32.00 =     326.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        4.8  TC(MIN.) =      4.89
  PEAK FLOW RATE(CFS)   =      15.07
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

PROPOSED CONDITION - 50 YEAR

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

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
         (c) Copyright 1982-2008 Advanced Engineering Software (aes)
             Ver. 15.0 Release Date: 04/01/2008  License ID 1452

                           Analysis prepared by:

                      PASCO LARET SUITER & ASSOCIATES
                           535 NORTH HIGHWAY 101
                                  SUITE A
                           SOLANA BEACH CA 92705

----------------------------------------------------------------------------
  FILE NAME: 3668P50.DAT
  TIME/DATE OF STUDY: 16:21 03/23/2022
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =  50.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   4.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  RAINFALL-INTENSITY ADJUSTMENT FACTOR = 1.000
  *USER SPECIFIED:
  NUMBER OF [TIME,INTENSITY] DATA PAIRS =  9
   1)   5.000;  5.533
   2)  10.000;  3.538
   3)  15.000;  2.724
   4)  20.000;  2.263
   5)  25.000;  1.959
   6)  30.000;  1.742
   7)  40.000;  1.447
   8)  50.000;  1.253
   9)  60.000;  1.114
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: ONLY PEAK CONFLUENCE VALUES CONSIDERED
  *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 0.0312 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    100.00 TO NODE    101.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  UPSTREAM ELEVATION(FEET) =    184.00
```

```
  DOWNSTREAM ELEVATION(FEET) =    183.80
  ELEVATION DIFFERENCE(FEET) =      0.20
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.009
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    50.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.533
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.56
  TOTAL AREA(ACRES) =      0.12   TOTAL RUNOFF(CFS) =      0.56

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  183.80  DOWNSTREAM ELEVATION(FEET) =  180.16
  STREET LENGTH(FEET) =   339.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.86
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.32
    HALFSTREET FLOOD WIDTH(FEET) =    8.66
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.15
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.68
  STREET FLOW TRAVEL TIME(MIN.) =   2.63   Tc(MIN.) =    6.64
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.880
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.850
  SUBAREA AREA(ACRES) =    0.62      SUBAREA RUNOFF(CFS) =    2.57
  TOTAL AREA(ACRES) =        0.7        PEAK FLOW RATE(CFS) =       3.07

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.36   HALFSTREET FLOOD WIDTH(FEET) =  11.05
  FLOW VELOCITY(FEET/SEC.) =  2.39   DEPTH*VELOCITY(FT*FT/SEC.) =   0.86
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     439.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    102.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.880
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8500
  SUBAREA AREA(ACRES) =    0.16   SUBAREA RUNOFF(CFS) =    0.66
  TOTAL AREA(ACRES) =        0.9   TOTAL RUNOFF(CFS) =       3.73
```

```
  TC(MIN.) =    6.64

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    104.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   176.10  DOWNSTREAM(FEET) =   174.81
  FLOW LENGTH(FEET) =   226.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  15.0 INCH PIPE IS   8.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.90
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.73
  PIPE TRAVEL TIME(MIN.) =   0.77    Tc(MIN.) =    7.40
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    104.00 =     665.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    104.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.574
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8500
  SUBAREA AREA(ACRES) =    0.64   SUBAREA RUNOFF(CFS) =    2.49
  TOTAL AREA(ACRES) =        1.5   TOTAL RUNOFF(CFS) =       5.99
  TC(MIN.) =    7.40

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    106.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   174.81  DOWNSTREAM(FEET) =   173.70
  FLOW LENGTH(FEET) =   185.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  10.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.62
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       5.99
  PIPE TRAVEL TIME(MIN.) =   0.55    Tc(MIN.) =    7.95
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    106.00 =     850.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    107.00 TO NODE    106.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.355
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8500
  SUBAREA AREA(ACRES) =    0.63   SUBAREA RUNOFF(CFS) =    2.33
  TOTAL AREA(ACRES) =        2.2   TOTAL RUNOFF(CFS) =       8.03
  TC(MIN.) =    7.95

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    108.00 IS CODE =  31
----------------------------------------------------------------------------
```

```
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   173.70  DOWNSTREAM(FEET) =   173.52
  FLOW LENGTH(FEET) =    28.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  12.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.13
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       8.03
  PIPE TRAVEL TIME(MIN.) =   0.08    Tc(MIN.) =    8.03
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    108.00 =     878.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    109.00 TO NODE    108.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.324
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8500
  SUBAREA AREA(ACRES) =    1.62   SUBAREA RUNOFF(CFS) =    5.95
  TOTAL AREA(ACRES) =        3.8   TOTAL RUNOFF(CFS) =      13.93
  TC(MIN.) =    8.03

****************************************************************************
  FLOW PROCESS FROM NODE    108.00 TO NODE    110.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   173.19  DOWNSTREAM(FEET) =   173.08
  FLOW LENGTH(FEET) =    23.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  15.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.33
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      13.93
  PIPE TRAVEL TIME(MIN.) =   0.06    Tc(MIN.) =    8.09
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    110.00 =     901.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    111.00 TO NODE    110.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.300
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8500
  SUBAREA AREA(ACRES) =    0.20   SUBAREA RUNOFF(CFS) =    0.73
  TOTAL AREA(ACRES) =        4.0   TOTAL RUNOFF(CFS) =      14.58
  TC(MIN.) =    8.09

****************************************************************************
  FLOW PROCESS FROM NODE    110.00 TO NODE    112.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   173.08  DOWNSTREAM(FEET) =   172.00
  FLOW LENGTH(FEET) =   181.00   MANNING'S N =  0.011
```

```
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  15.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.98
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      14.58
  PIPE TRAVEL TIME(MIN.) =   0.43    Tc(MIN.) =    8.52
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    112.00 =    1082.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    113.00 TO NODE    112.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.128
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8100
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8399
  SUBAREA AREA(ACRES) =    1.35   SUBAREA RUNOFF(CFS) =    4.51
  TOTAL AREA(ACRES) =        5.3   TOTAL RUNOFF(CFS) =      18.51
  TC(MIN.) =    8.52

****************************************************************************
  FLOW PROCESS FROM NODE    112.00 TO NODE    114.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   171.67  DOWNSTREAM(FEET) =   170.50
  FLOW LENGTH(FEET) =   176.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  17.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.62
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      18.51
  PIPE TRAVEL TIME(MIN.) =   0.39    Tc(MIN.) =    8.91
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    114.00 =    1258.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    115.00 TO NODE    114.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.974
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8417
  SUBAREA AREA(ACRES) =    1.14   SUBAREA RUNOFF(CFS) =    3.85
  TOTAL AREA(ACRES) =        6.5   TOTAL RUNOFF(CFS) =      21.67
  TC(MIN.) =    8.91

****************************************************************************
  FLOW PROCESS FROM NODE    116.00 TO NODE    117.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   170.50  DOWNSTREAM(FEET) =   169.32
  FLOW LENGTH(FEET) =    14.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  10.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  20.91
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      21.67
  PIPE TRAVEL TIME(MIN.) =   0.01    Tc(MIN.) =    8.92
```

```
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    117.00 =    1272.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    118.00 TO NODE    117.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.970
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .6000
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8218
  SUBAREA AREA(ACRES) =    0.58   SUBAREA RUNOFF(CFS) =    1.38
  TOTAL AREA(ACRES) =        7.1   TOTAL RUNOFF(CFS) =      23.03
  TC(MIN.) =    8.92

****************************************************************************
  FLOW PROCESS FROM NODE    117.00 TO NODE    119.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   168.99  DOWNSTREAM(FEET) =   162.63
  FLOW LENGTH(FEET) =    26.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  15.0 INCH PIPE IS   8.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  31.65
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      23.03
  PIPE TRAVEL TIME(MIN.) =   0.01    Tc(MIN.) =    8.93
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    119.00 =    1298.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    120.00 TO NODE    119.00 IS CODE =  16
----------------------------------------------------------------------------
  >>>>>USER SPECIFIED CONSTANT SOURCE FLOW AT NODE<<<<<
============================================================================
  USER-SPECIFIED CONSTANT SOURCE FLOW =   181.47(CFS)
  USER-SPECIFIED AREA ASSOCIATED TO SOURCE FLOW =   115.00(ACRES)
  * CUMULATIVE SOURCE FLOW DATA: FLOW(CFS) =   181.47  AREA(AC.) =   115.00
  * SUMMED DATA: FLOW(CFS) =   204.50    TOTAL AREA(ACRES) =   122.06

****************************************************************************
  FLOW PROCESS FROM NODE    119.00 TO NODE    121.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   159.30  DOWNSTREAM(FEET) =   128.21
  FLOW LENGTH(FEET) =   258.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  60.0 INCH PIPE IS  19.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  36.54
  GIVEN PIPE DIAMETER(INCH) =  60.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     204.50
  PIPE TRAVEL TIME(MIN.) =   0.12    Tc(MIN.) =    9.05
  * TOTAL SOURCE FLOW(CFS) =     181.47
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    121.00 =    1556.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    121.00 TO NODE    122.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
```

```
  ELEVATION DATA: UPSTREAM(FEET) =   127.88  DOWNSTREAM(FEET) =   127.44
  FLOW LENGTH(FEET) =    88.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =   9.47
  (PIPE FLOW VELOCITY CORRESPONDING TO NORMAL-DEPTH FLOW
   AT DEPTH = 0.82 * DIAMETER)
  GIVEN PIPE DIAMETER(INCH) =  52.00    NUMBER OF PIPES =   2
  PIPE-FLOW(CFS) =     204.50
  PIPE TRAVEL TIME(MIN.) =   0.15    Tc(MIN.) =    9.20
  * TOTAL SOURCE FLOW(CFS) =     181.47
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    122.00 =    1644.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    122.00 TO NODE    122.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.855
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .6000
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8094
  SUBAREA AREA(ACRES) =    0.42   SUBAREA RUNOFF(CFS) =    0.97
  TOTAL AREA(ACRES) =        7.5   TOTAL RUNOFF(CFS) =      23.34
  TC(MIN.) =    9.20

  * SOURCE FLOW DATA: FLOW(CFS) =     181.47     AREA(ACRES) =      115.0
  * SUMMED DATA: FLOW(CFS) =     204.81    TOTAL AREA(ACRES) =      122.5

****************************************************************************
  FLOW PROCESS FROM NODE    122.00 TO NODE    123.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   127.42  DOWNSTREAM(FEET) =   126.97
  FLOW LENGTH(FEET) =    95.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =   9.22
  (PIPE FLOW VELOCITY CORRESPONDING TO NORMAL-DEPTH FLOW
   AT DEPTH = 0.82 * DIAMETER)
  GIVEN PIPE DIAMETER(INCH) =  52.00    NUMBER OF PIPES =   2
  PIPE-FLOW(CFS) =     204.81
  PIPE TRAVEL TIME(MIN.) =   0.17    Tc(MIN.) =    9.38
  * TOTAL SOURCE FLOW(CFS) =     181.47
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    123.00 =    1739.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    123.00 TO NODE    124.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   119.00  DOWNSTREAM(FEET) =   118.80
  FLOW LENGTH(FEET) =    40.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.98
  (PIPE FLOW VELOCITY CORRESPONDING TO NORMAL-DEPTH FLOW
   AT DEPTH = 0.82 * DIAMETER)
  GIVEN PIPE DIAMETER(INCH) =  48.00    NUMBER OF PIPES =   2
  PIPE-FLOW(CFS) =     204.81
  PIPE TRAVEL TIME(MIN.) =   0.07    Tc(MIN.) =    9.45
  * TOTAL SOURCE FLOW(CFS) =     181.47
```

```
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    124.00 =    1779.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    76.00
  UPSTREAM ELEVATION(FEET) =    187.50
  DOWNSTREAM ELEVATION(FEET) =    186.10
  ELEVATION DIFFERENCE(FEET) =      1.40
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.200
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.533
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.24
  TOTAL AREA(ACRES) =      0.05   TOTAL RUNOFF(CFS) =      0.24

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  186.10  DOWNSTREAM ELEVATION(FEET) =  184.53
  STREET LENGTH(FEET) =   140.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.76
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.31
    HALFSTREET FLOOD WIDTH(FEET) =    8.34
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.16
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.67
  STREET FLOW TRAVEL TIME(MIN.) =   1.08   Tc(MIN.) =    4.28
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.533
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.850
  SUBAREA AREA(ACRES) =    0.65      SUBAREA RUNOFF(CFS) =    3.06
  TOTAL AREA(ACRES) =        0.7        PEAK FLOW RATE(CFS) =       3.29

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.36   HALFSTREET FLOOD WIDTH(FEET) =  11.29
  FLOW VELOCITY(FEET/SEC.) =  2.47   DEPTH*VELOCITY(FT*FT/SEC.) =   0.90
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =     216.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    203.00 TO NODE    202.00 IS CODE =  81
----------------------------------------------------------------------------
```

```
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.533
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8500
  SUBAREA AREA(ACRES) =    0.60   SUBAREA RUNOFF(CFS) =    2.82
  TOTAL AREA(ACRES) =        1.3   TOTAL RUNOFF(CFS) =       6.11
  TC(MIN.) =    4.28

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    204.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   180.50  DOWNSTREAM(FEET) =   178.30
  FLOW LENGTH(FEET) =   274.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  15.0 INCH PIPE IS  11.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.16
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.11
  PIPE TRAVEL TIME(MIN.) =   0.74    Tc(MIN.) =    5.02
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    204.00 =     490.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    205.00 TO NODE    204.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.525
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .6000
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8057
  SUBAREA AREA(ACRES) =    0.28   SUBAREA RUNOFF(CFS) =    0.93
  TOTAL AREA(ACRES) =        1.6   TOTAL RUNOFF(CFS) =       7.03
  TC(MIN.) =    5.02

****************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    206.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   178.30  DOWNSTREAM(FEET) =   177.30
  FLOW LENGTH(FEET) =    87.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  15.0 INCH PIPE IS  10.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.33
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       7.03
  PIPE TRAVEL TIME(MIN.) =   0.20    Tc(MIN.) =    5.22
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    206.00 =     577.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    207.00 TO NODE    206.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.446
  *USER SPECIFIED(SUBAREA):
```

```
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8130
  SUBAREA AREA(ACRES) =    0.31   SUBAREA RUNOFF(CFS) =    1.44
  TOTAL AREA(ACRES) =        1.9   TOTAL RUNOFF(CFS) =       8.37
  TC(MIN.) =    5.22

****************************************************************************
  FLOW PROCESS FROM NODE    206.00 TO NODE    208.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   177.26  DOWNSTREAM(FEET) =   176.50
  FLOW LENGTH(FEET) =    61.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  10.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.05
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       8.37
  PIPE TRAVEL TIME(MIN.) =   0.13    Tc(MIN.) =    5.34
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    208.00 =     638.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    208.00 TO NODE    208.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.396
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8186
  SUBAREA AREA(ACRES) =    0.34   SUBAREA RUNOFF(CFS) =    1.56
  TOTAL AREA(ACRES) =        2.2   TOTAL RUNOFF(CFS) =       9.85
  TC(MIN.) =    5.34

****************************************************************************
  FLOW PROCESS FROM NODE    208.00 TO NODE    208.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    209.00 TO NODE    210.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  UPSTREAM ELEVATION(FEET) =    186.50
  DOWNSTREAM ELEVATION(FEET) =    184.62
  ELEVATION DIFFERENCE(FEET) =      1.88
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.326
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    83.20
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.533
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      1.46
  TOTAL AREA(ACRES) =      0.31   TOTAL RUNOFF(CFS) =      1.46
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    210.00 TO NODE    211.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   180.62  DOWNSTREAM(FEET) =   179.33
  FLOW LENGTH(FEET) =   154.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN   9.0 INCH PIPE IS   6.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.42
  ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.46
  PIPE TRAVEL TIME(MIN.) =   0.58    Tc(MIN.) =    3.91
  LONGEST FLOWPATH FROM NODE    209.00 TO NODE    211.00 =     254.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    211.00 TO NODE    211.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.533
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8500
  SUBAREA AREA(ACRES) =    0.45   SUBAREA RUNOFF(CFS) =    2.12
  TOTAL AREA(ACRES) =        0.8   TOTAL RUNOFF(CFS) =       3.57
  TC(MIN.) =    3.91

****************************************************************************
  FLOW PROCESS FROM NODE    211.00 TO NODE    212.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   179.00  DOWNSTREAM(FEET) =   178.63
  FLOW LENGTH(FEET) =    30.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   8.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.43
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.57
  PIPE TRAVEL TIME(MIN.) =   0.08    Tc(MIN.) =    3.98
  LONGEST FLOWPATH FROM NODE    209.00 TO NODE    212.00 =     284.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    213.00 TO NODE    212.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.533
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8500
  SUBAREA AREA(ACRES) =    0.68   SUBAREA RUNOFF(CFS) =    3.20
  TOTAL AREA(ACRES) =        1.4   TOTAL RUNOFF(CFS) =       6.77
  TC(MIN.) =    3.98

****************************************************************************
  FLOW PROCESS FROM NODE    212.00 TO NODE    214.00 IS CODE =  31
```

```
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   178.63  DOWNSTREAM(FEET) =   177.11
  FLOW LENGTH(FEET) =   123.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  15.0 INCH PIPE IS  10.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.52
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.77
  PIPE TRAVEL TIME(MIN.) =   0.27    Tc(MIN.) =    4.26
  LONGEST FLOWPATH FROM NODE    209.00 TO NODE    214.00 =     407.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    215.00 TO NODE    214.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.533
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8500
  SUBAREA AREA(ACRES) =    1.53   SUBAREA RUNOFF(CFS) =    7.20
  TOTAL AREA(ACRES) =        3.0   TOTAL RUNOFF(CFS) =      13.97
  TC(MIN.) =    4.26

****************************************************************************
  FLOW PROCESS FROM NODE    214.00 TO NODE    216.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   176.60  DOWNSTREAM(FEET) =   176.50
  FLOW LENGTH(FEET) =     5.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  12.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.80
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      13.97
  PIPE TRAVEL TIME(MIN.) =   0.01    Tc(MIN.) =    4.27
  LONGEST FLOWPATH FROM NODE    209.00 TO NODE    216.00 =     412.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    208.00 TO NODE    216.00 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       13.97     4.27       5.533        2.97
  LONGEST FLOWPATH FROM NODE    209.00 TO NODE    216.00 =     412.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1        9.85     5.34       5.396        2.23
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    216.00 =     638.00 FEET.

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
```

```
  NUMBER     (CFS)      (MIN.)   (INCH/HOUR)
      1      21.83       4.27        5.533
      2      23.47       5.34        5.396

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      23.47   Tc(MIN.) =    5.34
  TOTAL AREA(ACRES) =        5.2

****************************************************************************
  FLOW PROCESS FROM NODE    217.00 TO NODE    218.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   175.75  DOWNSTREAM(FEET) =   146.69
  FLOW LENGTH(FEET) =   538.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  12.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  17.81
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      23.47
  PIPE TRAVEL TIME(MIN.) =   0.50    Tc(MIN.) =    5.85
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    218.00 =    1176.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    218.00 TO NODE    218.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.195
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .6000
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8228
  SUBAREA AREA(ACRES) =    0.32   SUBAREA RUNOFF(CFS) =    1.00
  TOTAL AREA(ACRES) =        5.5   TOTAL RUNOFF(CFS) =      23.59
  TC(MIN.) =    5.85

****************************************************************************
  FLOW PROCESS FROM NODE    219.00 TO NODE    219.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.195
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .6000
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8196
  SUBAREA AREA(ACRES) =    0.08   SUBAREA RUNOFF(CFS) =    0.25
  TOTAL AREA(ACRES) =        5.6   TOTAL RUNOFF(CFS) =      23.84
  TC(MIN.) =    5.85

****************************************************************************
  FLOW PROCESS FROM NODE    219.00 TO NODE    218.00 IS CODE =  16
----------------------------------------------------------------------------
  >>>>>USER SPECIFIED CONSTANT SOURCE FLOW AT NODE<<<<<
============================================================================
  USER-SPECIFIED CONSTANT SOURCE FLOW =   312.81(CFS)
  USER-SPECIFIED AREA ASSOCIATED TO SOURCE FLOW =   227.30(ACRES)
  * CUMULATIVE SOURCE FLOW DATA: FLOW(CFS) =   312.81  AREA(AC.) =   227.30
  * SUMMED DATA: FLOW(CFS) =   336.65    TOTAL AREA(ACRES) =   232.90

****************************************************************************
  FLOW PROCESS FROM NODE    218.00 TO NODE    220.00 IS CODE =  41
```

```
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   141.86  DOWNSTREAM(FEET) =   130.64
  FLOW LENGTH(FEET) =   216.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  72.0 INCH PIPE IS  29.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  30.51
  GIVEN PIPE DIAMETER(INCH) =  72.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     336.65
  PIPE TRAVEL TIME(MIN.) =   0.12    Tc(MIN.) =    5.97
  * TOTAL SOURCE FLOW(CFS) =     312.81
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    220.00 =    1392.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    220.00 TO NODE    220.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.148
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .6000
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8162
  SUBAREA AREA(ACRES) =    0.09   SUBAREA RUNOFF(CFS) =    0.28
  TOTAL AREA(ACRES) =        5.7   TOTAL RUNOFF(CFS) =      23.91
  TC(MIN.) =    5.97

  * SOURCE FLOW DATA: FLOW(CFS) =     312.81     AREA(ACRES) =      227.3
  * SUMMED DATA: FLOW(CFS) =     336.72    TOTAL AREA(ACRES) =      233.0

****************************************************************************
  FLOW PROCESS FROM NODE    220.00 TO NODE    221.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   130.31  DOWNSTREAM(FEET) =   128.05
  FLOW LENGTH(FEET) =   137.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  16.31
  (PIPE FLOW VELOCITY CORRESPONDING TO NORMAL-DEPTH FLOW
   AT DEPTH = 0.82 * DIAMETER)
  GIVEN PIPE DIAMETER(INCH) =  48.00    NUMBER OF PIPES =   3
  PIPE-FLOW(CFS) =     336.72
  PIPE TRAVEL TIME(MIN.) =   0.14    Tc(MIN.) =    6.11
  * TOTAL SOURCE FLOW(CFS) =     312.81
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    221.00 =    1529.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        5.7  TC(MIN.) =      6.11
  PEAK FLOW RATE(CFS)   =      23.91
  * CUMULATIVE SOURCE FLOW DATA: FLOW(CFS) =     312.81  AREA(AC.) =      227.3
  * SUMMED DATA: FLOW(CFS) =     336.72    TOTAL AREA(ACRES) =      233.0
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

DETAINED CONDITION - 50 YEAR

```
____________________________________________________________________________
****************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
         (c) Copyright 1982-2008 Advanced Engineering Software (aes)
             Ver. 15.0 Release Date: 04/01/2008  License ID 1452

                           Analysis prepared by:

                      PASCO LARET SUITER & ASSOCIATES
                           535 NORTH HIGHWAY 101
                                  SUITE A
                           SOLANA BEACH CA 92705

----------------------------------------------------------------------------
  FILE NAME: 3668P50.DAT
  TIME/DATE OF STUDY: 16:20 03/23/2022
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =  50.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   4.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  RAINFALL-INTENSITY ADJUSTMENT FACTOR = 1.000
  *USER SPECIFIED:
  NUMBER OF [TIME,INTENSITY] DATA PAIRS =  9
   1)   5.000;  5.533
   2)  10.000;  3.538
   3)  15.000;  2.724
   4)  20.000;  2.263
   5)  25.000;  1.959
   6)  30.000;  1.742
   7)  40.000;  1.447
   8)  50.000;  1.253
   9)  60.000;  1.114
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: ONLY PEAK CONFLUENCE VALUES CONSIDERED
  *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 0.0312 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    100.00 TO NODE    101.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  UPSTREAM ELEVATION(FEET) =    184.00
```

```
  DOWNSTREAM ELEVATION(FEET) =    183.80
  ELEVATION DIFFERENCE(FEET) =      0.20
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.009
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    50.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.533
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.56
  TOTAL AREA(ACRES) =      0.12   TOTAL RUNOFF(CFS) =      0.56

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  183.80  DOWNSTREAM ELEVATION(FEET) =  180.16
  STREET LENGTH(FEET) =   339.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.86
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.32
    HALFSTREET FLOOD WIDTH(FEET) =    8.66
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.15
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.68
  STREET FLOW TRAVEL TIME(MIN.) =   2.63   Tc(MIN.) =    6.64
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.880
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.850
  SUBAREA AREA(ACRES) =    0.62      SUBAREA RUNOFF(CFS) =    2.57
  TOTAL AREA(ACRES) =        0.7        PEAK FLOW RATE(CFS) =       3.07

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.36   HALFSTREET FLOOD WIDTH(FEET) =  11.05
  FLOW VELOCITY(FEET/SEC.) =  2.39   DEPTH*VELOCITY(FT*FT/SEC.) =   0.86
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     439.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    102.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.880
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8500
  SUBAREA AREA(ACRES) =    0.16   SUBAREA RUNOFF(CFS) =    0.66
  TOTAL AREA(ACRES) =        0.9   TOTAL RUNOFF(CFS) =       3.73
```

```
  TC(MIN.) =    6.64

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    104.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   176.10  DOWNSTREAM(FEET) =   174.81
  FLOW LENGTH(FEET) =   226.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  15.0 INCH PIPE IS   8.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.90
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.73
  PIPE TRAVEL TIME(MIN.) =   0.77    Tc(MIN.) =    7.40
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    104.00 =     665.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    104.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.574
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8500
  SUBAREA AREA(ACRES) =    0.64   SUBAREA RUNOFF(CFS) =    2.49
  TOTAL AREA(ACRES) =        1.5   TOTAL RUNOFF(CFS) =       5.99
  TC(MIN.) =    7.40

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    106.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   174.81  DOWNSTREAM(FEET) =   173.70
  FLOW LENGTH(FEET) =   185.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  10.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.62
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       5.99
  PIPE TRAVEL TIME(MIN.) =   0.55    Tc(MIN.) =    7.95
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    106.00 =     850.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    107.00 TO NODE    106.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.355
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8500
  SUBAREA AREA(ACRES) =    0.63   SUBAREA RUNOFF(CFS) =    2.33
  TOTAL AREA(ACRES) =        2.2   TOTAL RUNOFF(CFS) =       8.03
  TC(MIN.) =    7.95

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    108.00 IS CODE =  31
----------------------------------------------------------------------------
```

```
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   173.70  DOWNSTREAM(FEET) =   173.52
  FLOW LENGTH(FEET) =    28.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  12.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.13
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       8.03
  PIPE TRAVEL TIME(MIN.) =   0.08    Tc(MIN.) =    8.03
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    108.00 =     878.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    109.00 TO NODE    108.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.324
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8500
  SUBAREA AREA(ACRES) =    1.62   SUBAREA RUNOFF(CFS) =    5.95
  TOTAL AREA(ACRES) =        3.8   TOTAL RUNOFF(CFS) =      13.93
  TC(MIN.) =    8.03

****************************************************************************
  FLOW PROCESS FROM NODE    108.00 TO NODE    110.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   173.19  DOWNSTREAM(FEET) =   173.08
  FLOW LENGTH(FEET) =    23.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  15.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.33
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      13.93
  PIPE TRAVEL TIME(MIN.) =   0.06    Tc(MIN.) =    8.09
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    110.00 =     901.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    111.00 TO NODE    110.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.300
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8500
  SUBAREA AREA(ACRES) =    0.20   SUBAREA RUNOFF(CFS) =    0.73
  TOTAL AREA(ACRES) =        4.0   TOTAL RUNOFF(CFS) =      14.58
  TC(MIN.) =    8.09

****************************************************************************
  FLOW PROCESS FROM NODE    110.00 TO NODE    112.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   173.08  DOWNSTREAM(FEET) =   172.00
  FLOW LENGTH(FEET) =   181.00   MANNING'S N =  0.011
```

```
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  15.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.98
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      14.58
  PIPE TRAVEL TIME(MIN.) =   0.43    Tc(MIN.) =    8.52
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    112.00 =    1082.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    113.00 TO NODE    112.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.128
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8100
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8399
  SUBAREA AREA(ACRES) =    1.35   SUBAREA RUNOFF(CFS) =    4.51
  TOTAL AREA(ACRES) =        5.3   TOTAL RUNOFF(CFS) =      18.51
  TC(MIN.) =    8.52

****************************************************************************
  FLOW PROCESS FROM NODE    112.00 TO NODE    114.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   171.67  DOWNSTREAM(FEET) =   170.50
  FLOW LENGTH(FEET) =   176.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  17.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.62
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      18.51
  PIPE TRAVEL TIME(MIN.) =   0.39    Tc(MIN.) =    8.91
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    114.00 =    1258.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    115.00 TO NODE    114.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.974
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8417
  SUBAREA AREA(ACRES) =    1.14   SUBAREA RUNOFF(CFS) =    3.85
  TOTAL AREA(ACRES) =        6.5   TOTAL RUNOFF(CFS) =      21.67
  TC(MIN.) =    8.91

****************************************************************************
  FLOW PROCESS FROM NODE    116.00 TO NODE    116.00 IS CODE =   7
----------------------------------------------------------------------------
  >>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<<
============================================================================
  USER-SPECIFIED VALUES ARE AS FOLLOWS:
  TC(MIN) =  17.00   RAIN INTENSITY(INCH/HOUR) =  2.54
  TOTAL AREA(ACRES) =     6.49   TOTAL RUNOFF(CFS) =      7.91

****************************************************************************
  FLOW PROCESS FROM NODE    116.00 TO NODE    117.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
```

```
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   170.50  DOWNSTREAM(FEET) =   169.32
  FLOW LENGTH(FEET) =    14.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   7.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  16.23
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       7.91
  PIPE TRAVEL TIME(MIN.) =   0.01    Tc(MIN.) =   17.01
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    117.00 =    1272.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    118.00 TO NODE    117.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.538
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .6000
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.4898
  SUBAREA AREA(ACRES) =    0.58   SUBAREA RUNOFF(CFS) =    0.88
  TOTAL AREA(ACRES) =        7.1   TOTAL RUNOFF(CFS) =       8.79
  TC(MIN.) =   17.01

****************************************************************************
  FLOW PROCESS FROM NODE    117.00 TO NODE    119.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   168.99  DOWNSTREAM(FEET) =   162.63
  FLOW LENGTH(FEET) =    26.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN   9.0 INCH PIPE IS   6.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  24.23
  ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       8.79
  PIPE TRAVEL TIME(MIN.) =   0.02    Tc(MIN.) =   17.03
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    119.00 =    1298.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    120.00 TO NODE    119.00 IS CODE =  16
----------------------------------------------------------------------------
  >>>>>USER SPECIFIED CONSTANT SOURCE FLOW AT NODE<<<<<
============================================================================
  USER-SPECIFIED CONSTANT SOURCE FLOW =   181.47(CFS)
  USER-SPECIFIED AREA ASSOCIATED TO SOURCE FLOW =   115.00(ACRES)
  * CUMULATIVE SOURCE FLOW DATA: FLOW(CFS) =   181.47  AREA(AC.) =   115.00
  * SUMMED DATA: FLOW(CFS) =   190.26    TOTAL AREA(ACRES) =   122.07

****************************************************************************
  FLOW PROCESS FROM NODE    119.00 TO NODE    121.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   159.30  DOWNSTREAM(FEET) =   128.21
  FLOW LENGTH(FEET) =   258.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  60.0 INCH PIPE IS  18.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  35.81
  GIVEN PIPE DIAMETER(INCH) =  60.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     190.26
  PIPE TRAVEL TIME(MIN.) =   0.12    Tc(MIN.) =   17.15
```

```
  * TOTAL SOURCE FLOW(CFS) =     181.47
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    121.00 =    1556.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    121.00 TO NODE    122.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   127.88  DOWNSTREAM(FEET) =   127.44
  FLOW LENGTH(FEET) =    88.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =   9.47
  (PIPE FLOW VELOCITY CORRESPONDING TO NORMAL-DEPTH FLOW
   AT DEPTH = 0.82 * DIAMETER)
  GIVEN PIPE DIAMETER(INCH) =  52.00    NUMBER OF PIPES =   2
  PIPE-FLOW(CFS) =     190.26
  PIPE TRAVEL TIME(MIN.) =   0.15    Tc(MIN.) =   17.31
  * TOTAL SOURCE FLOW(CFS) =     181.47
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    122.00 =    1644.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    122.00 TO NODE    122.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.511
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .6000
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.4959
  SUBAREA AREA(ACRES) =    0.42   SUBAREA RUNOFF(CFS) =    0.63
  TOTAL AREA(ACRES) =        7.5   TOTAL RUNOFF(CFS) =       9.33
  TC(MIN.) =   17.31

  * SOURCE FLOW DATA: FLOW(CFS) =     181.47     AREA(ACRES) =      115.0
  * SUMMED DATA: FLOW(CFS) =     190.80    TOTAL AREA(ACRES) =      122.5

****************************************************************************
  FLOW PROCESS FROM NODE    122.00 TO NODE    123.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   127.42  DOWNSTREAM(FEET) =   126.97
  FLOW LENGTH(FEET) =    95.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =   9.22
  (PIPE FLOW VELOCITY CORRESPONDING TO NORMAL-DEPTH FLOW
   AT DEPTH = 0.82 * DIAMETER)
  GIVEN PIPE DIAMETER(INCH) =  52.00    NUMBER OF PIPES =   2
  PIPE-FLOW(CFS) =     190.80
  PIPE TRAVEL TIME(MIN.) =   0.17    Tc(MIN.) =   17.48
  * TOTAL SOURCE FLOW(CFS) =     181.47
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    123.00 =    1739.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    123.00 TO NODE    124.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   119.00  DOWNSTREAM(FEET) =   118.80
```

```
  FLOW LENGTH(FEET) =    40.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.98
  (PIPE FLOW VELOCITY CORRESPONDING TO NORMAL-DEPTH FLOW
   AT DEPTH = 0.82 * DIAMETER)
  GIVEN PIPE DIAMETER(INCH) =  48.00    NUMBER OF PIPES =   2
  PIPE-FLOW(CFS) =     190.80
  PIPE TRAVEL TIME(MIN.) =   0.07    Tc(MIN.) =   17.55
  * TOTAL SOURCE FLOW(CFS) =     181.47
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    124.00 =    1779.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    76.00
  UPSTREAM ELEVATION(FEET) =    187.50
  DOWNSTREAM ELEVATION(FEET) =    186.10
  ELEVATION DIFFERENCE(FEET) =      1.40
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.200
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.533
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.24
  TOTAL AREA(ACRES) =      0.05   TOTAL RUNOFF(CFS) =      0.24

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  186.10  DOWNSTREAM ELEVATION(FEET) =  184.53
  STREET LENGTH(FEET) =   140.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.76
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.31
    HALFSTREET FLOOD WIDTH(FEET) =    8.34
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.16
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.67
  STREET FLOW TRAVEL TIME(MIN.) =   1.08   Tc(MIN.) =    4.28
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.533
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.850
  SUBAREA AREA(ACRES) =    0.65      SUBAREA RUNOFF(CFS) =    3.06
  TOTAL AREA(ACRES) =        0.7        PEAK FLOW RATE(CFS) =       3.29
```

```
  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.36   HALFSTREET FLOOD WIDTH(FEET) =  11.29
  FLOW VELOCITY(FEET/SEC.) =  2.47   DEPTH*VELOCITY(FT*FT/SEC.) =   0.90
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =     216.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    203.00 TO NODE    202.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.533
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8500
  SUBAREA AREA(ACRES) =    0.60   SUBAREA RUNOFF(CFS) =    2.82
  TOTAL AREA(ACRES) =        1.3   TOTAL RUNOFF(CFS) =       6.11
  TC(MIN.) =    4.28

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    204.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   180.50  DOWNSTREAM(FEET) =   178.30
  FLOW LENGTH(FEET) =   274.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  15.0 INCH PIPE IS  11.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.16
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.11
  PIPE TRAVEL TIME(MIN.) =   0.74    Tc(MIN.) =    5.02
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    204.00 =     490.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    205.00 TO NODE    204.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.525
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .6000
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8057
  SUBAREA AREA(ACRES) =    0.28   SUBAREA RUNOFF(CFS) =    0.93
  TOTAL AREA(ACRES) =        1.6   TOTAL RUNOFF(CFS) =       7.03
  TC(MIN.) =    5.02

****************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    206.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   178.30  DOWNSTREAM(FEET) =   177.30
  FLOW LENGTH(FEET) =    87.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  15.0 INCH PIPE IS  10.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.33
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       7.03
  PIPE TRAVEL TIME(MIN.) =   0.20    Tc(MIN.) =    5.22
```

```
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    206.00 =     577.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    207.00 TO NODE    206.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.446
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8130
  SUBAREA AREA(ACRES) =    0.31   SUBAREA RUNOFF(CFS) =    1.44
  TOTAL AREA(ACRES) =        1.9   TOTAL RUNOFF(CFS) =       8.37
  TC(MIN.) =    5.22

****************************************************************************
  FLOW PROCESS FROM NODE    206.00 TO NODE    208.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   177.26  DOWNSTREAM(FEET) =   176.50
  FLOW LENGTH(FEET) =    61.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  10.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.05
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       8.37
  PIPE TRAVEL TIME(MIN.) =   0.13    Tc(MIN.) =    5.34
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    208.00 =     638.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    208.00 TO NODE    208.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.396
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8186
  SUBAREA AREA(ACRES) =    0.34   SUBAREA RUNOFF(CFS) =    1.56
  TOTAL AREA(ACRES) =        2.2   TOTAL RUNOFF(CFS) =       9.85
  TC(MIN.) =    5.34

****************************************************************************
  FLOW PROCESS FROM NODE    208.00 TO NODE    208.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    209.00 TO NODE    210.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  UPSTREAM ELEVATION(FEET) =    186.50
  DOWNSTREAM ELEVATION(FEET) =    184.62
  ELEVATION DIFFERENCE(FEET) =      1.88
```

```
 URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.326
 WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
          THE MAXIMUM OVERLAND FLOW LENGTH =    83.20
          (Reference: Table 3-1B of Hydrology Manual)
          THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.533
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
 SUBAREA RUNOFF(CFS) =      1.46
 TOTAL AREA(ACRES) =      0.31   TOTAL RUNOFF(CFS) =      1.46

****************************************************************************
 FLOW PROCESS FROM NODE    210.00 TO NODE    211.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   180.62  DOWNSTREAM(FEET) =   179.33
 FLOW LENGTH(FEET) =   154.00   MANNING'S N =  0.011
 DEPTH OF FLOW IN   9.0 INCH PIPE IS   6.3 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   4.42
 ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       1.46
 PIPE TRAVEL TIME(MIN.) =   0.58    Tc(MIN.) =    3.91
 LONGEST FLOWPATH FROM NODE    209.00 TO NODE    211.00 =     254.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    211.00 TO NODE    211.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.533
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
 *USER SPECIFIED(SUBAREA):
 USER-SPECIFIED RUNOFF COEFFICIENT = .8500
 S.C.S. CURVE NUMBER (AMC II) =   0
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.8500
 SUBAREA AREA(ACRES) =    0.45   SUBAREA RUNOFF(CFS) =    2.12
 TOTAL AREA(ACRES) =        0.8   TOTAL RUNOFF(CFS) =       3.57
 TC(MIN.) =    3.91

****************************************************************************
 FLOW PROCESS FROM NODE    211.00 TO NODE    212.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   179.00  DOWNSTREAM(FEET) =   178.63
 FLOW LENGTH(FEET) =    30.00   MANNING'S N =  0.011
 DEPTH OF FLOW IN  12.0 INCH PIPE IS   8.0 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   6.43
 ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       3.57
 PIPE TRAVEL TIME(MIN.) =   0.08    Tc(MIN.) =    3.98
 LONGEST FLOWPATH FROM NODE    209.00 TO NODE    212.00 =     284.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    213.00 TO NODE    212.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.533
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
 *USER SPECIFIED(SUBAREA):
```

```
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8500
  SUBAREA AREA(ACRES) =    0.68   SUBAREA RUNOFF(CFS) =    3.20
  TOTAL AREA(ACRES) =        1.4   TOTAL RUNOFF(CFS) =       6.77
  TC(MIN.) =    3.98

****************************************************************************
  FLOW PROCESS FROM NODE    212.00 TO NODE    214.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   178.63  DOWNSTREAM(FEET) =   177.11
  FLOW LENGTH(FEET) =   123.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  15.0 INCH PIPE IS  10.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.52
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.77
  PIPE TRAVEL TIME(MIN.) =   0.27    Tc(MIN.) =    4.26
  LONGEST FLOWPATH FROM NODE    209.00 TO NODE    214.00 =     407.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    215.00 TO NODE    214.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.533
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8500
  SUBAREA AREA(ACRES) =    1.53   SUBAREA RUNOFF(CFS) =    7.20
  TOTAL AREA(ACRES) =        3.0   TOTAL RUNOFF(CFS) =      13.97
  TC(MIN.) =    4.26

****************************************************************************
  FLOW PROCESS FROM NODE    214.00 TO NODE    216.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   176.60  DOWNSTREAM(FEET) =   176.50
  FLOW LENGTH(FEET) =     5.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  12.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.80
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      13.97
  PIPE TRAVEL TIME(MIN.) =   0.01    Tc(MIN.) =    4.27
  LONGEST FLOWPATH FROM NODE    209.00 TO NODE    216.00 =     412.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    208.00 TO NODE    216.00 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       13.97     4.27       5.533        2.97
  LONGEST FLOWPATH FROM NODE    209.00 TO NODE    216.00 =     412.00 FEET.
```

```
  ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1        9.85     5.34       5.396        2.23
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    216.00 =     638.00 FEET.

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
     1      21.83       4.27        5.533
     2      23.47       5.34        5.396

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      23.47   Tc(MIN.) =    5.34
  TOTAL AREA(ACRES) =        5.2

****************************************************************************
  FLOW PROCESS FROM NODE    217.00 TO NODE    217.00 IS CODE =   7
----------------------------------------------------------------------------
  >>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<<
============================================================================
  USER-SPECIFIED VALUES ARE AS FOLLOWS:
  TC(MIN) =  11.00   RAIN INTENSITY(INCH/HOUR) =  3.38
  TOTAL AREA(ACRES) =     5.22   TOTAL RUNOFF(CFS) =      6.44

****************************************************************************
  FLOW PROCESS FROM NODE    217.00 TO NODE    218.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   175.75  DOWNSTREAM(FEET) =   146.69
  FLOW LENGTH(FEET) =   538.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   7.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  13.04
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.44
  PIPE TRAVEL TIME(MIN.) =   0.69    Tc(MIN.) =   11.69
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    218.00 =    1176.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    218.00 TO NODE    218.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.263
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .6000
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.3791
  SUBAREA AREA(ACRES) =    0.32   SUBAREA RUNOFF(CFS) =    0.63
  TOTAL AREA(ACRES) =        5.5   TOTAL RUNOFF(CFS) =       6.85
  TC(MIN.) =   11.69

****************************************************************************
  FLOW PROCESS FROM NODE    219.00 TO NODE    219.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.263
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .6000
```

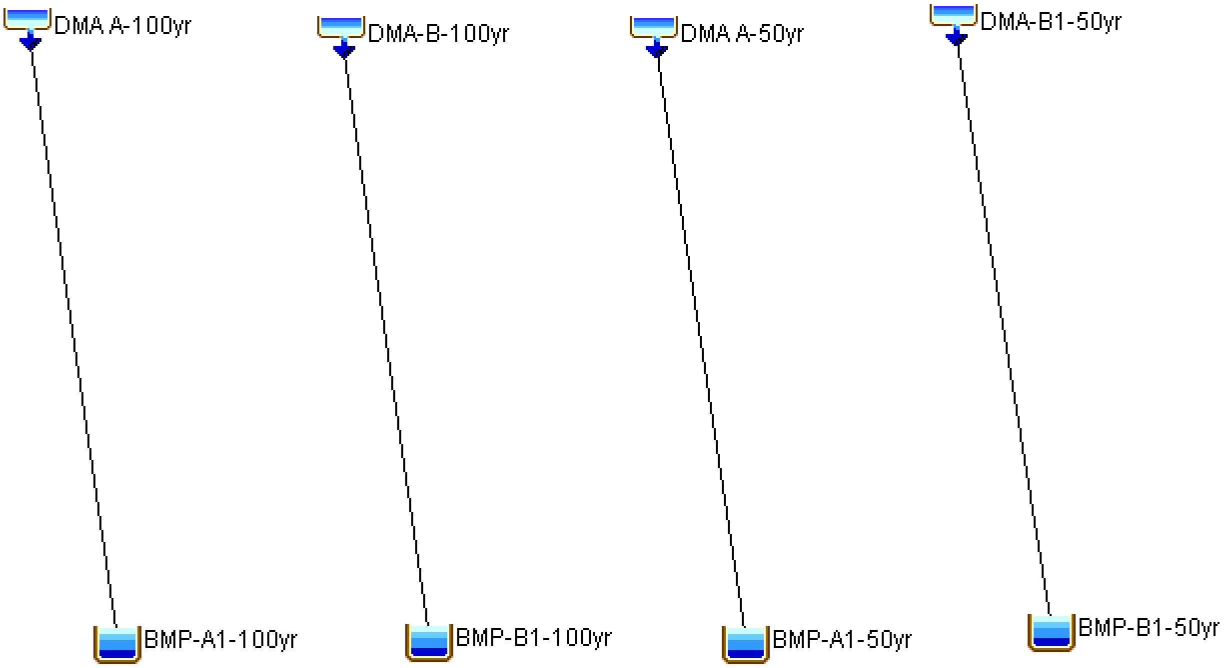
```
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.3822
  SUBAREA AREA(ACRES) =    0.08   SUBAREA RUNOFF(CFS) =    0.16
  TOTAL AREA(ACRES) =        5.6   TOTAL RUNOFF(CFS) =       7.01
  TC(MIN.) =   11.69

****************************************************************************
  FLOW PROCESS FROM NODE    219.00 TO NODE    218.00 IS CODE =  16
----------------------------------------------------------------------------
  >>>>>USER SPECIFIED CONSTANT SOURCE FLOW AT NODE<<<<<
============================================================================
  USER-SPECIFIED CONSTANT SOURCE FLOW =   312.81(CFS)
  USER-SPECIFIED AREA ASSOCIATED TO SOURCE FLOW =   227.30(ACRES)
  * CUMULATIVE SOURCE FLOW DATA: FLOW(CFS) =   312.81  AREA(AC.) =   227.30
  * SUMMED DATA: FLOW(CFS) =   319.82    TOTAL AREA(ACRES) =   232.92

****************************************************************************
  FLOW PROCESS FROM NODE    218.00 TO NODE    220.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   141.86  DOWNSTREAM(FEET) =   130.64
  FLOW LENGTH(FEET) =   216.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  72.0 INCH PIPE IS  28.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  30.09
  GIVEN PIPE DIAMETER(INCH) =  72.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     319.82
  PIPE TRAVEL TIME(MIN.) =   0.12    Tc(MIN.) =   11.81
  * TOTAL SOURCE FLOW(CFS) =     312.81
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    220.00 =    1392.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    220.00 TO NODE    220.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.244
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .6000
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.3856
  SUBAREA AREA(ACRES) =    0.09   SUBAREA RUNOFF(CFS) =    0.18
  TOTAL AREA(ACRES) =        5.7   TOTAL RUNOFF(CFS) =       7.14
  TC(MIN.) =   11.81

  * SOURCE FLOW DATA: FLOW(CFS) =     312.81     AREA(ACRES) =      227.3
  * SUMMED DATA: FLOW(CFS) =     319.95    TOTAL AREA(ACRES) =      233.0

****************************************************************************
  FLOW PROCESS FROM NODE    220.00 TO NODE    221.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   130.31  DOWNSTREAM(FEET) =   128.05
  FLOW LENGTH(FEET) =   137.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  16.31
  (PIPE FLOW VELOCITY CORRESPONDING TO NORMAL-DEPTH FLOW
   AT DEPTH = 0.82 * DIAMETER)
  GIVEN PIPE DIAMETER(INCH) =  48.00    NUMBER OF PIPES =   3
  PIPE-FLOW(CFS) =     319.95
```

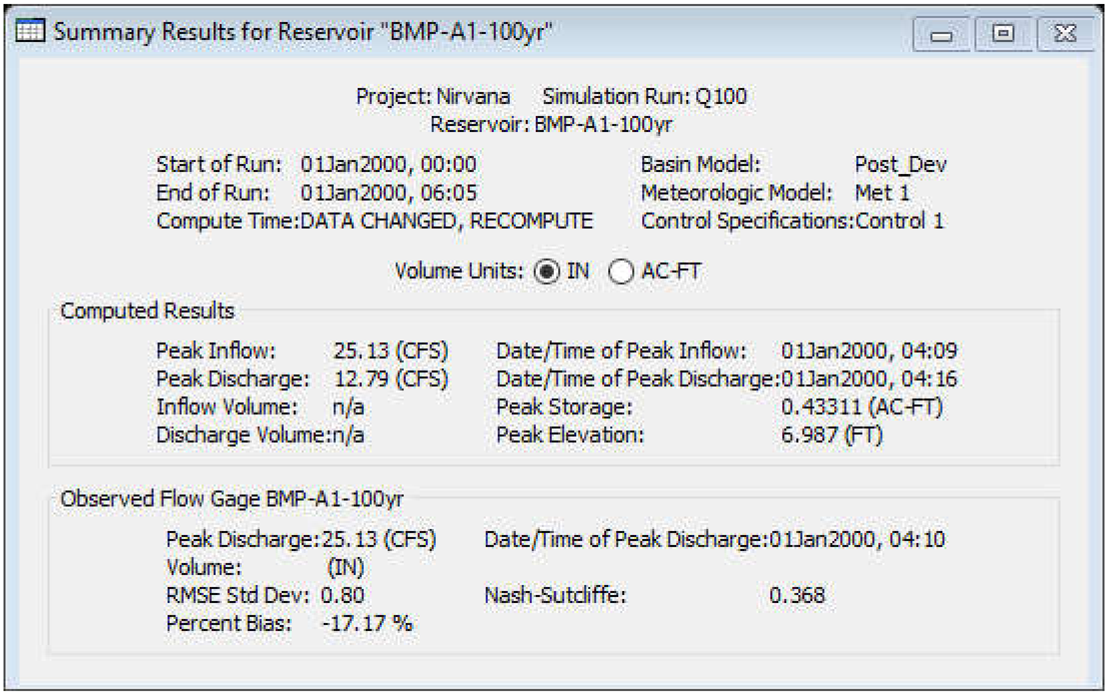
```
  PIPE TRAVEL TIME(MIN.) =   0.14    Tc(MIN.) =   11.95
  * TOTAL SOURCE FLOW(CFS) =     312.81
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    221.00 =    1529.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        5.7  TC(MIN.) =     11.95
  PEAK FLOW RATE(CFS)   =       7.14
  * CUMULATIVE SOURCE FLOW DATA: FLOW(CFS) =     312.81  AREA(AC.) =      227.3
  * SUMMED DATA: FLOW(CFS) =     319.95    TOTAL AREA(ACRES) =      233.0
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

Appendix 5

Modified-Puls Detention Routing

HEC-HMS Detention Routing Summary





Project: Nirvana Simulation Run: Q100
Reservoir: BMP-A1-100yr

Start of Run: 01Jan2000, 00:00
End of Run: 01Jan2000, 06:05
Compute Time: DATA CHANGED, RECOMPUTE

Basin Model: Post_Dev
Meteorologic Model: Met 1
Control Specifications: Control 1

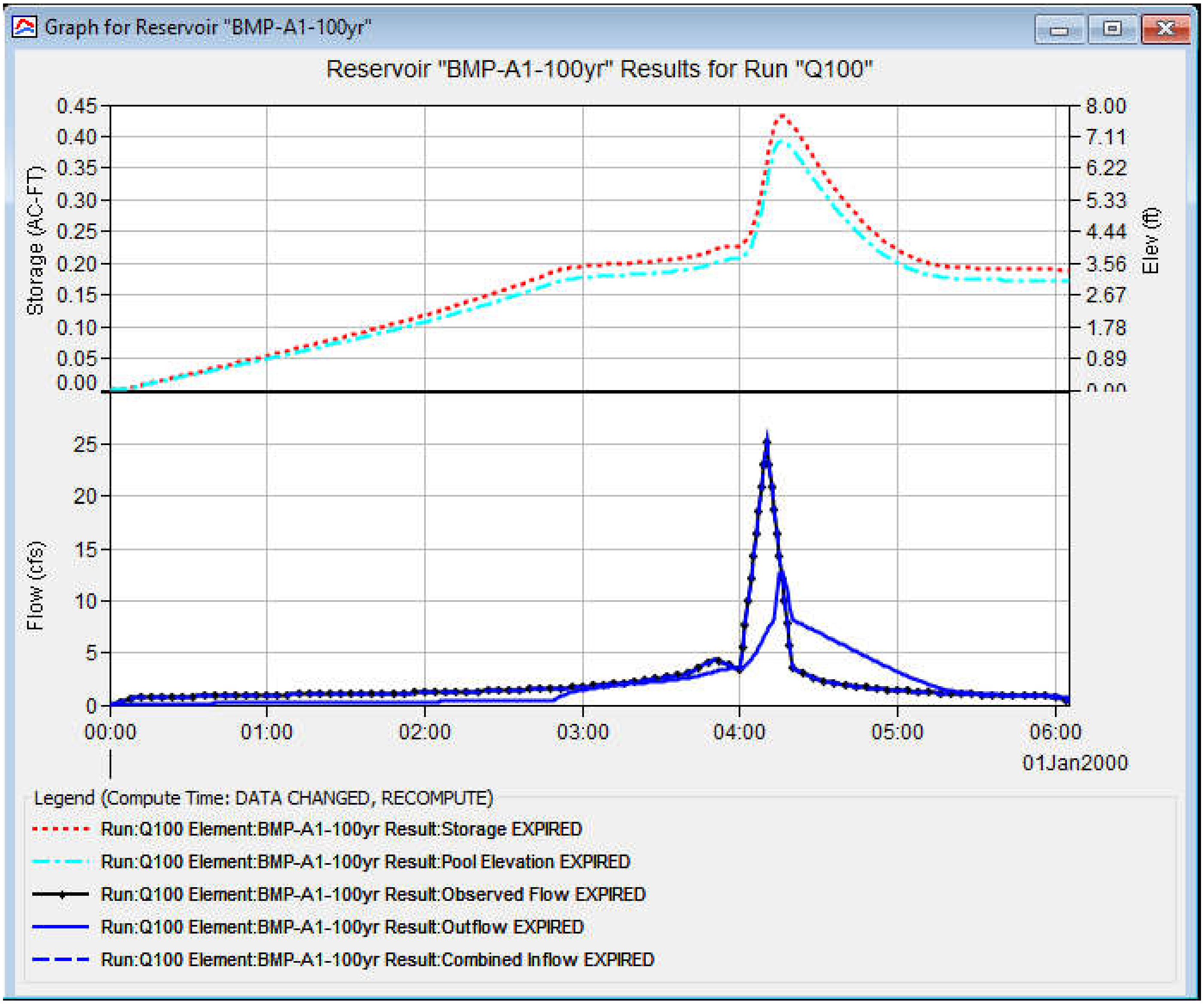
Volume Units: ● IN ○ AC-FT

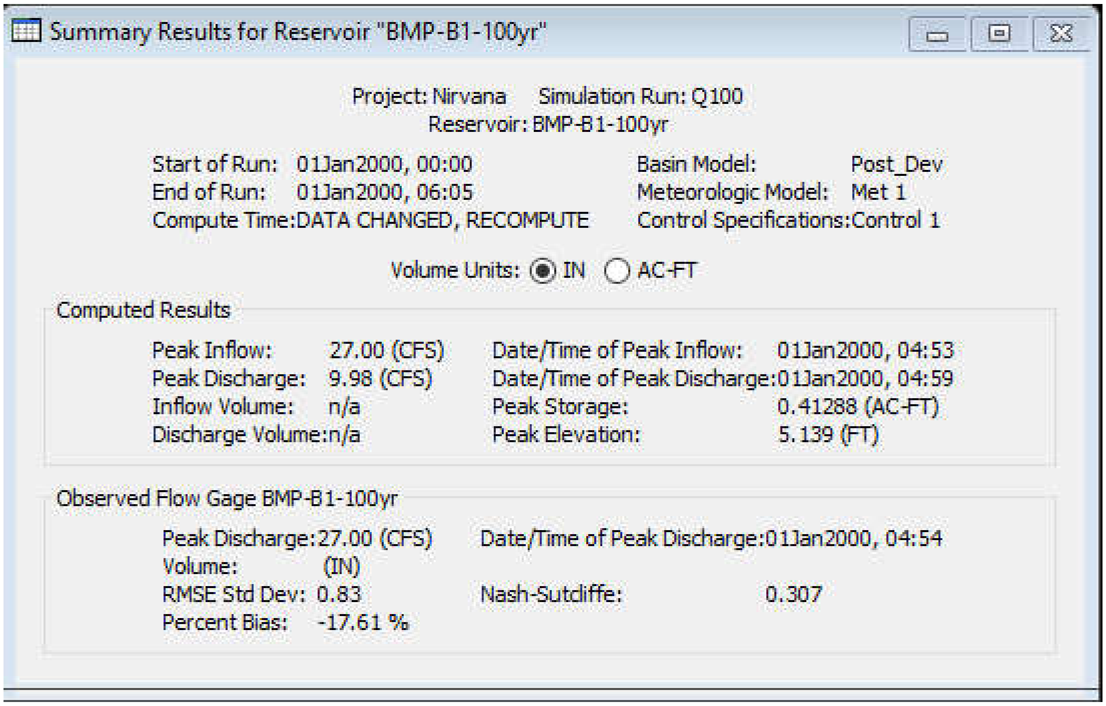
Computed Results

Peak Inflow: 25.13 (CFS)
Peak Discharge: 12.79 (CFS)
Inflow Volume: n/a
Discharge Volume: n/a
Date/Time of Peak Inflow: 01Jan2000, 04:09
Date/Time of Peak Discharge: 01Jan2000, 04:16
Peak Storage: 0.43311 (AC-FT)
Peak Elevation: 6.987 (FT)

Observed Flow Gage BMP-A1-100yr

Peak Discharge: 25.13 (CFS)
Volume: (IN)
RMSE Std Dev: 0.80
Percent Bias: -17.17 %
Date/Time of Peak Discharge: 01Jan2000, 04:10
Nash-Sutcliffe: 0.368





Summary Results for Reservoir "BMP-B1-100yr"

Project: Nirvana Simulation Run: Q100
Reservoir: BMP-B1-100yr

Start of Run:	01Jan2000, 00:00	Basin Model:	Post_Dev
End of Run:	01Jan2000, 06:05	Meteorologic Model:	Met 1
Compute Time:	DATA CHANGED, RECOMPUTE	Control Specifications:	Control 1

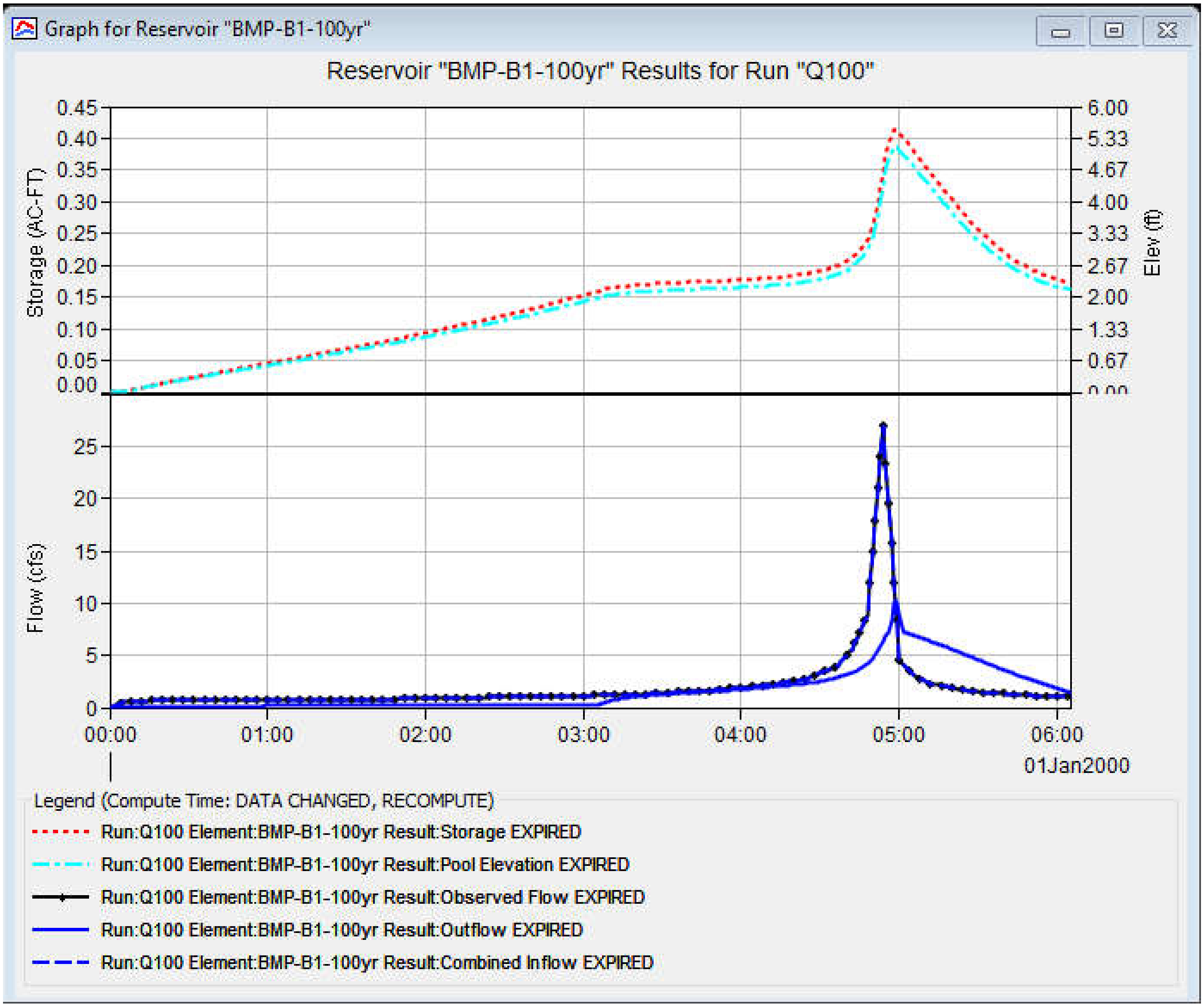
Volume Units: ● IN ○ AC-FT

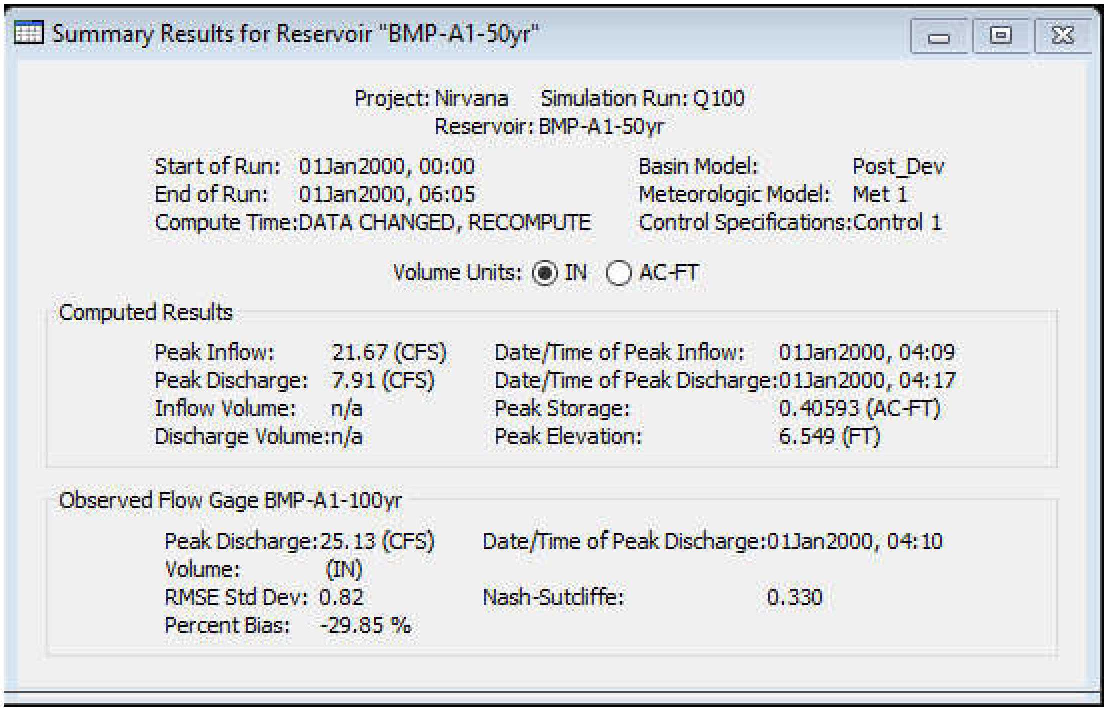
Computed Results

Peak Inflow:	27.00 (CFS)	Date/Time of Peak Inflow:	01Jan2000, 04:53
Peak Discharge:	9.98 (CFS)	Date/Time of Peak Discharge:	01Jan2000, 04:59
Inflow Volume:	n/a	Peak Storage:	0.41288 (AC-FT)
Discharge Volume:	n/a	Peak Elevation:	5.139 (FT)

Observed Flow Gage BMP-B1-100yr

Peak Discharge:	27.00 (CFS)	Date/Time of Peak Discharge:	01Jan2000, 04:54
Volume:	(IN)		
RMSE Std Dev:	0.83	Nash-Sutcliffe:	0.307
Percent Bias:	-17.61 %		





Summary Results for Reservoir "BMP-A1-50yr"

Project: Nirvana Simulation Run: Q100
Reservoir: BMP-A1-50yr

Start of Run: 01Jan2000, 00:00
End of Run: 01Jan2000, 06:05
Compute Time: DATA CHANGED, RECOMPUTE

Basin Model: Post_Dev
Meteorologic Model: Met 1
Control Specifications: Control 1

Volume Units: ● IN ○ AC-FT

Computed Results

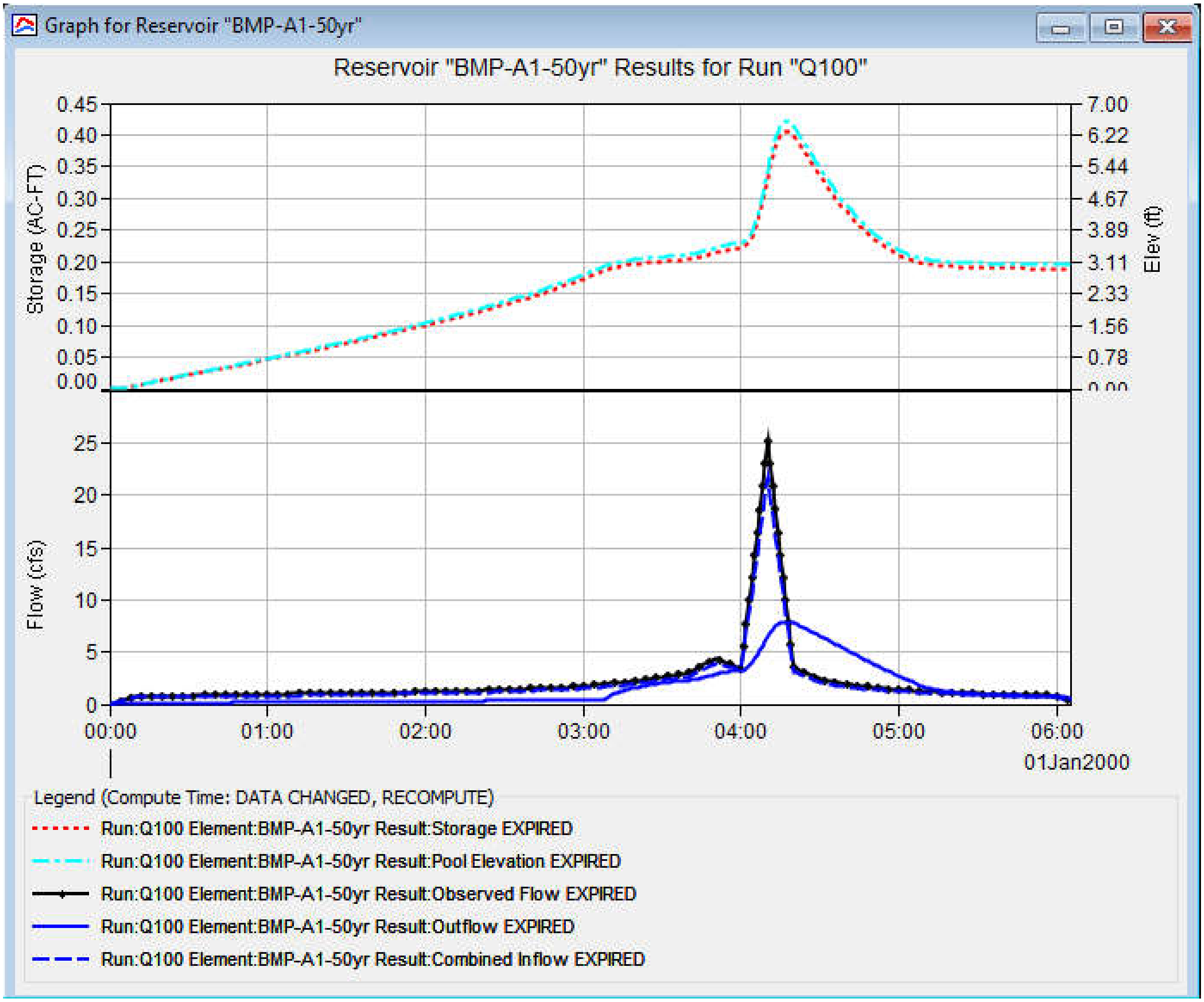
Peak Inflow: 21.67 (CFS)
Peak Discharge: 7.91 (CFS)
Inflow Volume: n/a
Discharge Volume: n/a

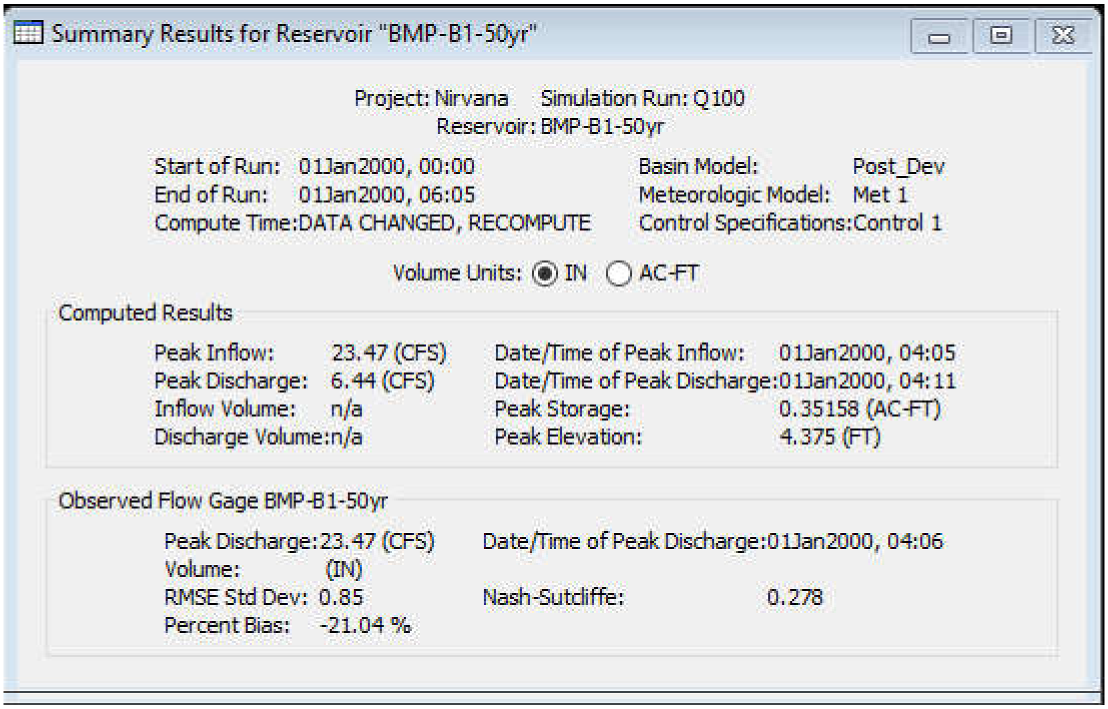
Date/Time of Peak Inflow: 01Jan2000, 04:09
Date/Time of Peak Discharge: 01Jan2000, 04:17
Peak Storage: 0.40593 (AC-FT)
Peak Elevation: 6.549 (FT)

Observed Flow Gage BMP-A1-100yr

Peak Discharge: 25.13 (CFS)
Volume: (IN)
RMSE Std Dev: 0.82
Percent Bias: -29.85 %

Date/Time of Peak Discharge: 01Jan2000, 04:10
Nash-Sutcliffe: 0.330





Summary Results for Reservoir "BMP-B1-50yr"

Project: Nirvana Simulation Run: Q100
Reservoir: BMP-B1-50yr

Start of Run:	01Jan2000, 00:00	Basin Model:	Post_Dev
End of Run:	01Jan2000, 06:05	Meteorologic Model:	Met 1
Compute Time:	DATA CHANGED, RECOMPUTE	Control Specifications:	Control 1

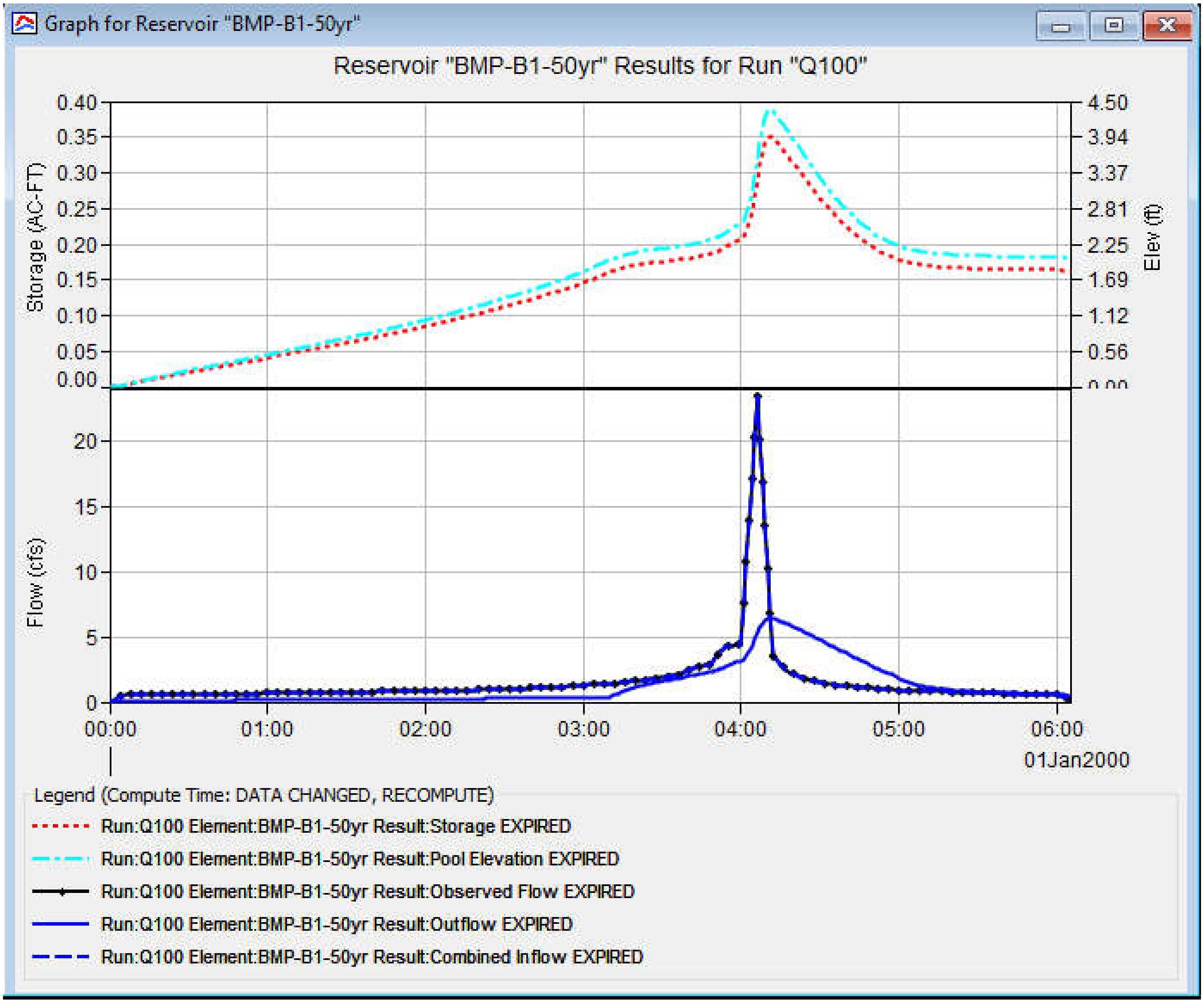
Volume Units: ● IN ○ AC-FT

Computed Results

Peak Inflow:	23.47 (CFS)	Date/Time of Peak Inflow:	01Jan2000, 04:05
Peak Discharge:	6.44 (CFS)	Date/Time of Peak Discharge:	01Jan2000, 04:11
Inflow Volume:	n/a	Peak Storage:	0.35158 (AC-FT)
Discharge Volume:	n/a	Peak Elevation:	4.375 (FT)

Observed Flow Gage BMP-B1-50yr

Peak Discharge:	23.47 (CFS)	Date/Time of Peak Discharge:	01Jan2000, 04:06
Volume:	(IN)		
RMSE Std Dev:	0.85	Nash-Sutcliffe:	0.278
Percent Bias:	-21.04 %		



Outlet Structure for Discharge of BMP-A1

Discharge vs. Elevation Table

Low-flow orifice
No.: 1
Invert: 0 ft
Dia: 3 in
Dia: 0.25 ft
A: 0.049 sq.ft.
C_o: 0.6

Slot orifice
No.: 1
Invert: 3.00 ft
Length: 3.25 ft
Height 0.25 ft
A: 0.81 sq.ft
C_o: 0.6

Emergency Overflow
Invert: 6.75 ft
L: 12 ft
C_w: 3.1

Tank Dimensions
Area: 2,700 sq.ft.
Height: 7.50 ft
Total Vol: 20,250 cu.ft.

***Note: h = head above the invert of the lowest surface discharge opening.**

Elev (ft)	h* (ft)	Volume (ac-ft)	$Q_{orifice\text{-}low}$ (cfs)	$Q_{slot\text{-}mid}$ (cfs)	Q_{emerg} (cfs)	Q_{total} (cfs)
170.50	0.00	0.0000	0.0000	0.000	0.000	0.0000
170.75	0.25	0.0155	0.0969	0.000	0.000	0.0969
171.00	0.50	0.0310	0.1563	0.000	0.000	0.1563
171.25	0.75	0.0465	0.1960	0.000	0.000	0.1960
171.50	1.00	0.0620	0.2288	0.000	0.000	0.2288
171.75	1.25	0.0775	0.2576	0.000	0.000	0.2576
172.00	1.50	0.0930	0.2834	0.000	0.000	0.2834
172.25	1.75	0.1085	0.3070	0.000	0.000	0.3070
172.50	2.00	0.1240	0.3290	0.000	0.000	0.3290
172.75	2.25	0.1395	0.3496	0.000	0.000	0.3496
173.00	2.50	0.1550	0.3690	0.000	0.000	0.3690
173.25	2.75	0.1705	0.3875	0.000	0.000	0.3875
173.50	3.00	0.1860	0.4051	0.000	0.000	0.4051
173.75	3.25	0.2014	0.4220	1.694	0.000	2.1160
174.00	3.50	0.2169	0.4382	2.588	0.000	3.0259
174.25	3.75	0.2324	0.4539	3.244	0.000	3.6977
174.50	4.00	0.2479	0.4690	3.788	0.000	4.2569
174.75	4.25	0.2634	0.4837	4.263	0.000	4.7468
175.00	4.50	0.2789	0.4979	4.691	0.000	5.1884
175.25	4.75	0.2944	0.5117	5.082	0.000	5.5938
175.50	5.00	0.3099	0.5252	5.446	0.000	5.9707
175.75	5.25	0.3254	0.5383	5.786	0.000	6.3245
176.00	5.50	0.3409	0.5511	6.108	0.000	6.6590
176.25	5.75	0.3564	0.5637	6.413	0.000	6.9771
176.50	6.00	0.3719	0.5759	6.705	0.000	7.2810
176.75	6.25	0.3874	0.5879	6.985	0.000	7.5725
177.00	6.50	0.4029	0.5997	7.253	0.000	7.8530
177.25	6.75	0.4184	0.6112	7.512	0.000	8.1237
177.50	7.00	0.4339	0.6225	7.763	4.650	13.0355
177.75	7.25	0.4494	0.6337	8.006	13.152	21.7915
178.00	7.50	0.4649	0.6446	8.241	24.162	33.0478

Note:

1. Weir equation, $Q=C_wL_e(h)^{3/2}$
2. Orifice equation, $Q=C_oA_e(2gh)^{1/2}$
3. Slot orifice acts as a weir when $h^* < h_{slot}$; slot orifice acts as an orifice when $h^* \geq h_{slot}$

Outlet Structure for Discharge of BMP-B1

Discharge vs. Elevation Table

Low-flow orifice			Slot orifice			Emergency Overflow		
No.:	1		No.:	1		Invert:	5.00	ft
Invert:	0	ft	Invert:	2.00	ft	L:	12	ft
Dia:	3	in	Length:	3.25	ft	C_w:	3.1	
Dia:	0.25	ft	Height	0.25	ft	Tank Dimensions		
A:	0.049	sq.ft.	A:	0.81	sq.ft	Area:	3,500	sq.ft.
C_o:	0.6		C_o:	0.6		Height:	5.67	ft
						Total Vol:	19,845	cu.ft.

***Note: h = head above the invert of the lowest surface discharge opening.**

Elev (ft)	h* (ft)	Volume (ac-ft)	$Q_{orifice-low}$ (cfs)	$Q_{slot-mid}$ (cfs)	Q_{emerg} (cfs)	Q_{total} (cfs)
175.75	0.00	0.0000	0.0000	0.000	0.000	0.0000
176.00	0.25	0.0201	0.0969	0.000	0.000	0.0969
176.25	0.50	0.0402	0.1563	0.000	0.000	0.1563
176.50	0.75	0.0603	0.1960	0.000	0.000	0.1960
176.75	1.00	0.0803	0.2288	0.000	0.000	0.2288
177.00	1.25	0.1004	0.2576	0.000	0.000	0.2576
177.25	1.50	0.1205	0.2834	0.000	0.000	0.2834
177.50	1.75	0.1406	0.3070	0.000	0.000	0.3070
177.75	2.00	0.1607	0.3290	0.000	0.000	0.3290
178.00	2.25	0.1808	0.3496	1.694	0.000	2.0436
178.25	2.50	0.2009	0.3690	2.588	0.000	2.9567
178.50	2.75	0.2210	0.3875	3.244	0.000	3.6313
178.75	3.00	0.2410	0.4051	3.788	0.000	4.1930
179.00	3.25	0.2611	0.4220	4.263	0.000	4.6852
179.25	3.50	0.2812	0.4382	4.691	0.000	5.1287
179.50	3.75	0.3013	0.4539	5.082	0.000	5.5359
179.75	4.00	0.3214	0.4690	5.446	0.000	5.9145
180.00	4.25	0.3415	0.4837	5.786	0.000	6.2698
180.25	4.50	0.3616	0.4979	6.108	0.000	6.6058
180.50	4.75	0.3817	0.5117	6.413	0.000	6.9252
180.75	5.00	0.4017	0.5252	6.705	0.000	7.2303
181.00	5.25	0.4218	0.5383	6.985	4.650	12.1729
181.25	5.50	0.4419	0.5511	7.253	13.152	20.9567
181.42	5.67	0.4556	0.5597	7.431	20.401	28.3914

Note:

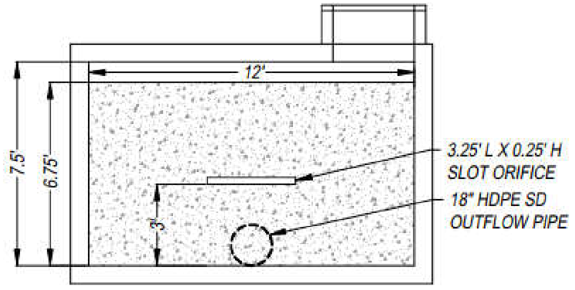
1. Weir equation, $Q=C_wL_e(h)^{3/2}$
2. Orifice equation, $Q=C_oA_e(2gh)^{1/2}$
3. Slot orifice acts as a weir when $h^* < h_{slot}$; slot orifice acts as an orifice when $h^* \geq h_{slot}$

```
RATIONAL METHOD HYDROGRAPH PROGRAM
COPYRIGHT 1992, 2001 RICK ENGINEERING COMPANY

RUN DATE   3/7/2022
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION  10  MIN.
6 HOUR RAINFALL  2.4  INCHES
BASIN AREA  6.49  ACRES
RUNOFF COEFFICIENT  0.85
PEAK DISCHARGE  25.13  CFS

TIME (MIN) =  0          DISCHARGE (CFS) =  0
TIME (MIN) =  10         DISCHARGE (CFS) =  0.8
TIME (MIN) =  20         DISCHARGE (CFS) =  0.8
TIME (MIN) =  30         DISCHARGE (CFS) =  0.8
TIME (MIN) =  40         DISCHARGE (CFS) =  0.9
TIME (MIN) =  50         DISCHARGE (CFS) =  0.9
TIME (MIN) =  60         DISCHARGE (CFS) =  0.9
TIME (MIN) =  70         DISCHARGE (CFS) =  1
TIME (MIN) =  80         DISCHARGE (CFS) =  1
TIME (MIN) =  90         DISCHARGE (CFS) =  1
TIME (MIN) =  100        DISCHARGE (CFS) =  1.1
TIME (MIN) =  110        DISCHARGE (CFS) =  1.1
TIME (MIN) =  120        DISCHARGE (CFS) =  1.2
TIME (MIN) =  130        DISCHARGE (CFS) =  1.3
TIME (MIN) =  140        DISCHARGE (CFS) =  1.3
TIME (MIN) =  150        DISCHARGE (CFS) =  1.4
TIME (MIN) =  160        DISCHARGE (CFS) =  1.5
TIME (MIN) =  170        DISCHARGE (CFS) =  1.6
TIME (MIN) =  180        DISCHARGE (CFS) =  1.7
TIME (MIN) =  190        DISCHARGE (CFS) =  2
TIME (MIN) =  200        DISCHARGE (CFS) =  2.2
TIME (MIN) =  210        DISCHARGE (CFS) =  2.6
TIME (MIN) =  220        DISCHARGE (CFS) =  3
TIME (MIN) =  230        DISCHARGE (CFS) =  4.4
TIME (MIN) =  240        DISCHARGE (CFS) =  3.4
TIME (MIN) =  250        DISCHARGE (CFS) =  25.13
TIME (MIN) =  260        DISCHARGE (CFS) =  3.5
TIME (MIN) =  270        DISCHARGE (CFS) =  2.4
TIME (MIN) =  280        DISCHARGE (CFS) =  1.9
TIME (MIN) =  290        DISCHARGE (CFS) =  1.6
TIME (MIN) =  300        DISCHARGE (CFS) =  1.4
TIME (MIN) =  310        DISCHARGE (CFS) =  1.2
TIME (MIN) =  320        DISCHARGE (CFS) =  1.1
TIME (MIN) =  330        DISCHARGE (CFS) =  1
TIME (MIN) =  340        DISCHARGE (CFS) =  0.9
TIME (MIN) =  350        DISCHARGE (CFS) =  0.9
TIME (MIN) =  360        DISCHARGE (CFS) =  0.8
TIME (MIN) =  370        DISCHARGE (CFS) =  0
```

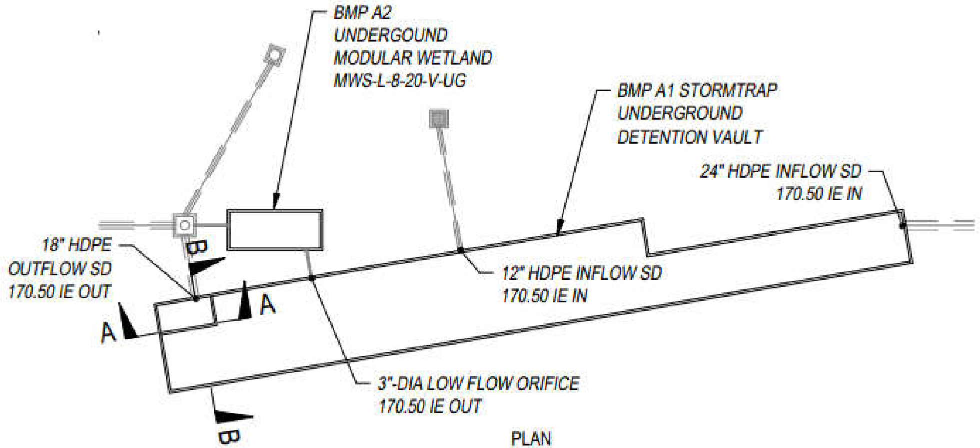
```
RATIONAL METHOD HYDROGRAPH PROGRAM
COPYRIGHT 1992, 2001 RICK ENGINEERING COMPANY

RUN DATE   3/7/2022
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION  5  MIN.
6 HOUR RAINFALL  2.4  INCHES
BASIN AREA  5.22  ACRES
RUNOFF COEFFICIENT  0.85
PEAK DISCHARGE  27  CFS

TIME (MIN) =  0          DISCHARGE (CFS) =  0
TIME (MIN) =  5          DISCHARGE (CFS) =  0.6
TIME (MIN) =  10         DISCHARGE (CFS) =  0.6
TIME (MIN) =  15         DISCHARGE (CFS) =  0.7
TIME (MIN) =  20         DISCHARGE (CFS) =  0.7
TIME (MIN) =  25         DISCHARGE (CFS) =  0.7
TIME (MIN) =  30         DISCHARGE (CFS) =  0.7
TIME (MIN) =  35         DISCHARGE (CFS) =  0.7
TIME (MIN) =  40         DISCHARGE (CFS) =  0.7
TIME (MIN) =  45         DISCHARGE (CFS) =  0.7
TIME (MIN) =  50         DISCHARGE (CFS) =  0.7
TIME (MIN) =  55         DISCHARGE (CFS) =  0.7
TIME (MIN) =  60         DISCHARGE (CFS) =  0.7
TIME (MIN) =  65         DISCHARGE (CFS) =  0.8
TIME (MIN) =  70         DISCHARGE (CFS) =  0.8
TIME (MIN) =  75         DISCHARGE (CFS) =  0.8
TIME (MIN) =  80         DISCHARGE (CFS) =  0.8
TIME (MIN) =  85         DISCHARGE (CFS) =  0.8
TIME (MIN) =  90         DISCHARGE (CFS) =  0.8
TIME (MIN) =  95         DISCHARGE (CFS) =  0.9
TIME (MIN) =  100        DISCHARGE (CFS) =  0.9
TIME (MIN) =  105        DISCHARGE (CFS) =  0.9
TIME (MIN) =  110        DISCHARGE (CFS) =  0.9
TIME (MIN) =  115        DISCHARGE (CFS) =  0.9
TIME (MIN) =  120        DISCHARGE (CFS) =  1
TIME (MIN) =  125        DISCHARGE (CFS) =  1
TIME (MIN) =  130        DISCHARGE (CFS) =  1
TIME (MIN) =  135        DISCHARGE (CFS) =  1.1
TIME (MIN) =  140        DISCHARGE (CFS) =  1.1
TIME (MIN) =  145        DISCHARGE (CFS) =  1.1
TIME (MIN) =  150        DISCHARGE (CFS) =  1.1
TIME (MIN) =  155        DISCHARGE (CFS) =  1.2
TIME (MIN) =  160        DISCHARGE (CFS) =  1.2
TIME (MIN) =  165        DISCHARGE (CFS) =  1.3
TIME (MIN) =  170        DISCHARGE (CFS) =  1.3
TIME (MIN) =  175        DISCHARGE (CFS) =  1.4
TIME (MIN) =  180        DISCHARGE (CFS) =  1.5
TIME (MIN) =  185        DISCHARGE (CFS) =  1.6
TIME (MIN) =  190        DISCHARGE (CFS) =  1.6
TIME (MIN) =  195        DISCHARGE (CFS) =  1.8
TIME (MIN) =  200        DISCHARGE (CFS) =  1.9
TIME (MIN) =  205        DISCHARGE (CFS) =  2.1
TIME (MIN) =  210        DISCHARGE (CFS) =  2.2
TIME (MIN) =  215        DISCHARGE (CFS) =  2.5
TIME (MIN) =  220        DISCHARGE (CFS) =  2.7
TIME (MIN) =  225        DISCHARGE (CFS) =  3.3
TIME (MIN) =  230        DISCHARGE (CFS) =  3.8
TIME (MIN) =  235        DISCHARGE (CFS) =  5.6
TIME (MIN) =  240        DISCHARGE (CFS) =  8.9
TIME (MIN) =  245        DISCHARGE (CFS) =  27
TIME (MIN) =  250        DISCHARGE (CFS) =  4.5
TIME (MIN) =  255        DISCHARGE (CFS) =  3
TIME (MIN) =  260        DISCHARGE (CFS) =  2.3
TIME (MIN) =  265        DISCHARGE (CFS) =  2
TIME (MIN) =  270        DISCHARGE (CFS) =  1.7
TIME (MIN) =  275        DISCHARGE (CFS) =  1.5
TIME (MIN) =  280        DISCHARGE (CFS) =  1.4
TIME (MIN) =  285        DISCHARGE (CFS) =  1.3
TIME (MIN) =  290        DISCHARGE (CFS) =  1.2
TIME (MIN) =  295        DISCHARGE (CFS) =  1.1
TIME (MIN) =  300        DISCHARGE (CFS) =  1
TIME (MIN) =  305        DISCHARGE (CFS) =  1
TIME (MIN) =  310        DISCHARGE (CFS) =  0.9
TIME (MIN) =  315        DISCHARGE (CFS) =  0.9
TIME (MIN) =  320        DISCHARGE (CFS) =  0.8
TIME (MIN) =  325        DISCHARGE (CFS) =  0.8
TIME (MIN) =  330        DISCHARGE (CFS) =  0.8
TIME (MIN) =  335        DISCHARGE (CFS) =  0.8
TIME (MIN) =  340        DISCHARGE (CFS) =  0.7
TIME (MIN) =  345        DISCHARGE (CFS) =  0.7
TIME (MIN) =  350        DISCHARGE (CFS) =  0.7
TIME (MIN) =  355        DISCHARGE (CFS) =  0.7
TIME (MIN) =  360        DISCHARGE (CFS) =  0.6
TIME (MIN) =  365        DISCHARGE (CFS) =  0
```

```
RATIONAL METHOD HYDROGRAPH PROGRAM
COPYRIGHT 1992, 2001 RICK ENGINEERING COMPANY

RUN DATE   3/18/2022
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION  10  MIN.
6 HOUR RAINFALL  2.1  INCHES
BASIN AREA  6.49  ACRES
RUNOFF COEFFICIENT  0.85
PEAK DISCHARGE  21.67  CFS

TIME (MIN) =  0              DISCHARGE (CFS) =  0
TIME (MIN) =  10             DISCHARGE (CFS) =  0.7
TIME (MIN) =  20             DISCHARGE (CFS) =  0.7
TIME (MIN) =  30             DISCHARGE (CFS) =  0.7
TIME (MIN) =  40             DISCHARGE (CFS) =  0.7
TIME (MIN) =  50             DISCHARGE (CFS) =  0.8
TIME (MIN) =  60             DISCHARGE (CFS) =  0.8
TIME (MIN) =  70             DISCHARGE (CFS) =  0.8
TIME (MIN) =  80             DISCHARGE (CFS) =  0.9
TIME (MIN) =  90             DISCHARGE (CFS) =  0.9
TIME (MIN) =  100            DISCHARGE (CFS) =  0.9
TIME (MIN) =  110            DISCHARGE (CFS) =  1
TIME (MIN) =  120            DISCHARGE (CFS) =  1
TIME (MIN) =  130            DISCHARGE (CFS) =  1.1
TIME (MIN) =  140            DISCHARGE (CFS) =  1.1
TIME (MIN) =  150            DISCHARGE (CFS) =  1.2
TIME (MIN) =  160            DISCHARGE (CFS) =  1.3
TIME (MIN) =  170            DISCHARGE (CFS) =  1.4
TIME (MIN) =  180            DISCHARGE (CFS) =  1.5
TIME (MIN) =  190            DISCHARGE (CFS) =  1.7
TIME (MIN) =  200            DISCHARGE (CFS) =  1.9
TIME (MIN) =  210            DISCHARGE (CFS) =  2.3
TIME (MIN) =  220            DISCHARGE (CFS) =  2.6
TIME (MIN) =  230            DISCHARGE (CFS) =  3.9
TIME (MIN) =  240            DISCHARGE (CFS) =  3.3
TIME (MIN) =  250            DISCHARGE (CFS) =  21.67
TIME (MIN) =  260            DISCHARGE (CFS) =  3.1
TIME (MIN) =  270            DISCHARGE (CFS) =  2.1
TIME (MIN) =  280            DISCHARGE (CFS) =  1.6
TIME (MIN) =  290            DISCHARGE (CFS) =  1.4
TIME (MIN) =  300            DISCHARGE (CFS) =  1.2
TIME (MIN) =  310            DISCHARGE (CFS) =  1.1
TIME (MIN) =  320            DISCHARGE (CFS) =  1
TIME (MIN) =  330            DISCHARGE (CFS) =  0.9
TIME (MIN) =  340            DISCHARGE (CFS) =  0.8
TIME (MIN) =  350            DISCHARGE (CFS) =  0.8
TIME (MIN) =  360            DISCHARGE (CFS) =  0.7
TIME (MIN) =  370            DISCHARGE (CFS) =  0
```

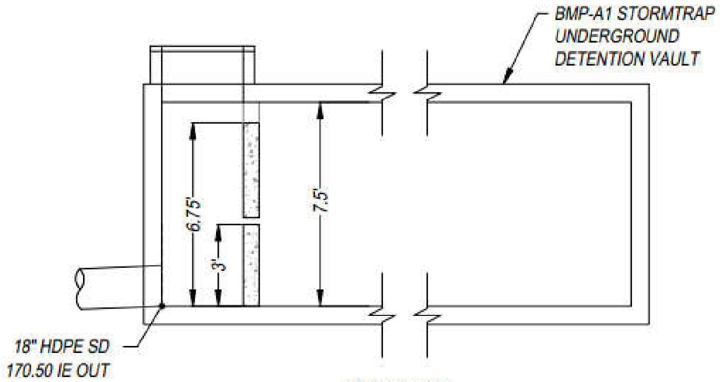
```
RATIONAL METHOD HYDROGRAPH PROGRAM
COPYRIGHT 1992, 2001 RICK ENGINEERING COMPANY

RUN DATE   3/18/2022
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION  6  MIN.
6 HOUR RAINFALL  2.1  INCHES
BASIN AREA  5.22  ACRES
RUNOFF COEFFICIENT  0.85
PEAK DISCHARGE  23.47  CFS

TIME (MIN) =  0              DISCHARGE (CFS) =  0
TIME (MIN) =  6              DISCHARGE (CFS) =  0.6
TIME (MIN) =  12             DISCHARGE (CFS) =  0.6
TIME (MIN) =  18             DISCHARGE (CFS) =  0.6
TIME (MIN) =  24             DISCHARGE (CFS) =  0.6
TIME (MIN) =  30             DISCHARGE (CFS) =  0.6
TIME (MIN) =  36             DISCHARGE (CFS) =  0.6
TIME (MIN) =  42             DISCHARGE (CFS) =  0.6
TIME (MIN) =  48             DISCHARGE (CFS) =  0.6
TIME (MIN) =  54             DISCHARGE (CFS) =  0.6
TIME (MIN) =  60             DISCHARGE (CFS) =  0.7
TIME (MIN) =  66             DISCHARGE (CFS) =  0.7
TIME (MIN) =  72             DISCHARGE (CFS) =  0.7
TIME (MIN) =  78             DISCHARGE (CFS) =  0.7
TIME (MIN) =  84             DISCHARGE (CFS) =  0.7
TIME (MIN) =  90             DISCHARGE (CFS) =  0.7
TIME (MIN) =  96             DISCHARGE (CFS) =  0.7
TIME (MIN) =  102            DISCHARGE (CFS) =  0.8
TIME (MIN) =  108            DISCHARGE (CFS) =  0.8
TIME (MIN) =  114            DISCHARGE (CFS) =  0.8
TIME (MIN) =  120            DISCHARGE (CFS) =  0.8
TIME (MIN) =  126            DISCHARGE (CFS) =  0.9
TIME (MIN) =  132            DISCHARGE (CFS) =  0.9
TIME (MIN) =  138            DISCHARGE (CFS) =  0.9
TIME (MIN) =  144            DISCHARGE (CFS) =  1
TIME (MIN) =  150            DISCHARGE (CFS) =  1
TIME (MIN) =  156            DISCHARGE (CFS) =  1
TIME (MIN) =  162            DISCHARGE (CFS) =  1.1
TIME (MIN) =  168            DISCHARGE (CFS) =  1.1
TIME (MIN) =  174            DISCHARGE (CFS) =  1.2
TIME (MIN) =  180            DISCHARGE (CFS) =  1.3
TIME (MIN) =  186            DISCHARGE (CFS) =  1.4
TIME (MIN) =  192            DISCHARGE (CFS) =  1.4
TIME (MIN) =  198            DISCHARGE (CFS) =  1.6
TIME (MIN) =  204            DISCHARGE (CFS) =  1.7
TIME (MIN) =  210            DISCHARGE (CFS) =  1.9
TIME (MIN) =  216            DISCHARGE (CFS) =  2.1
TIME (MIN) =  222            DISCHARGE (CFS) =  2.6
TIME (MIN) =  228            DISCHARGE (CFS) =  2.9
TIME (MIN) =  234            DISCHARGE (CFS) =  4.3
TIME (MIN) =  240            DISCHARGE (CFS) =  4.4
TIME (MIN) =  246            DISCHARGE (CFS) =  23.47
TIME (MIN) =  252            DISCHARGE (CFS) =  3.5
TIME (MIN) =  258            DISCHARGE (CFS) =  2.3
TIME (MIN) =  264            DISCHARGE (CFS) =  1.8
TIME (MIN) =  270            DISCHARGE (CFS) =  1.5
TIME (MIN) =  276            DISCHARGE (CFS) =  1.3
TIME (MIN) =  282            DISCHARGE (CFS) =  1.2
TIME (MIN) =  288            DISCHARGE (CFS) =  1.1
TIME (MIN) =  294            DISCHARGE (CFS) =  1
TIME (MIN) =  300            DISCHARGE (CFS) =  0.9
TIME (MIN) =  306            DISCHARGE (CFS) =  0.9
TIME (MIN) =  312            DISCHARGE (CFS) =  0.8
TIME (MIN) =  318            DISCHARGE (CFS) =  0.8
TIME (MIN) =  324            DISCHARGE (CFS) =  0.7
TIME (MIN) =  330            DISCHARGE (CFS) =  0.7
TIME (MIN) =  336            DISCHARGE (CFS) =  0.7
TIME (MIN) =  342            DISCHARGE (CFS) =  0.6
TIME (MIN) =  348            DISCHARGE (CFS) =  0.6
TIME (MIN) =  354            DISCHARGE (CFS) =  0.6
TIME (MIN) =  360            DISCHARGE (CFS) =  0.6
TIME (MIN) =  366            DISCHARGE (CFS) =  0
```



SECTION A-A



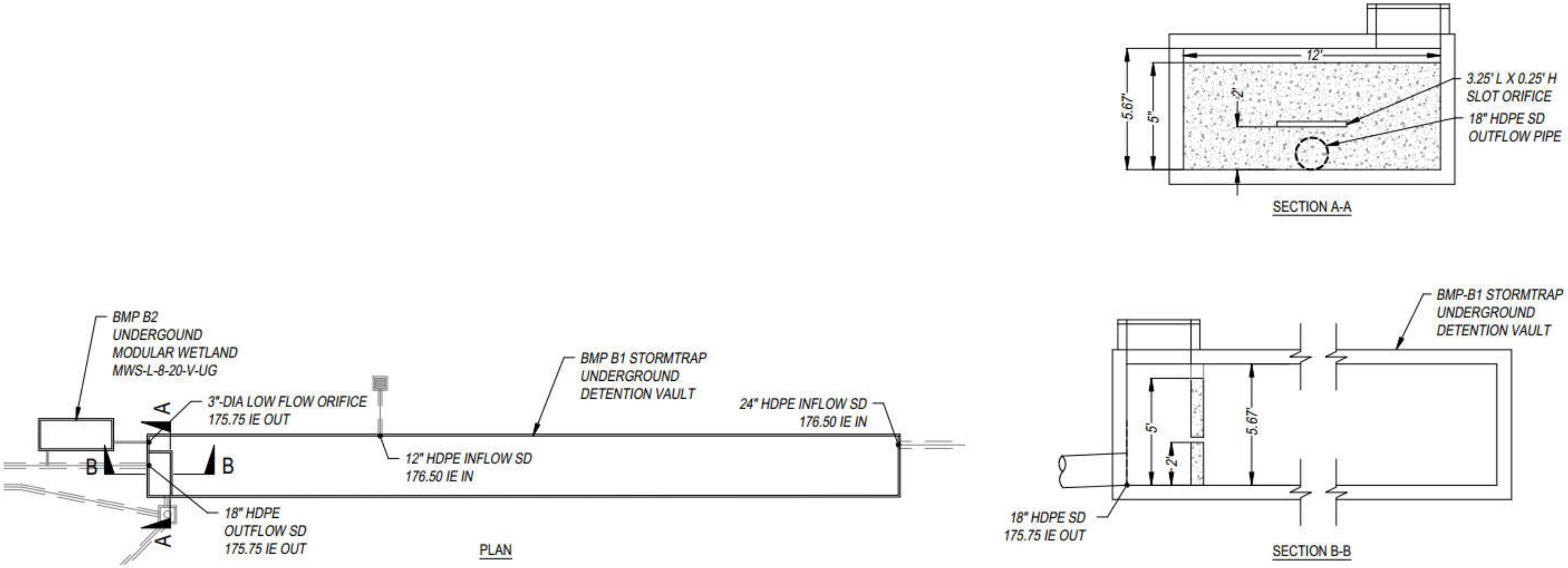
PLAN



SECTION B-B

BMP A1: STORMTRAP UNDERGROUND DETENTION VAULT DETAIL

NOT TO SCALE



SECTION A-A

PLAN

SECTION B-B

BMP B1: STORMTRAP UNDERGROUND DETENTION VAULT DETAIL

NOT TO SCALE

Appendix 6

WSPGW Output

```
FILE: SDA-50.WSW                            W S P G W - CIVILDESIGN Version 14.08                                         PAGE    1
                               Program Package Serial Number: 7131
                                                   WATER SURFACE PROFILE LISTING                    Date: 3-24-2022  Time: 1:55:53
                         3668- HGL Analysis- SD-A

************************************************************************************************************************** ********
         | Invert  |  Depth | Water   |    Q    |  Vel     Vel  |  Energy | Super |Critical|Flow Top|Height/|Base Wt|      |No Wth
 Station |  Elev   |  (FT)  |  Elev   |  (CFS)  | (FPS)    Head |  Grd.El.|  Elev | Depth  | Width  |Dia.-FT|or I.D.|  ZL  |Prs/Pip
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-    -|
 L/Elem  |Ch Slope |        |         |         |         SF Ave|    HF   |SE Dpth|Froude N|Norm Dp |  "N"  | X-Fall|  ZR  |Type Ch
*********|*********|********|*********|*********|*******|*******|*********|*******|********|********|*******|*******|***** |*******
         |         |        |         |         |               |         |       |        |        |       |       |      |
     .000   118.800    1.442   120.242    190.89   23.40    8.50   128.74     .00    2.96     3.84    4.000     .000   .00   2   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
    4.979    .0061                                         .0585      .29     1.44    2.83    2.84    .013       .00   .00 PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
    4.979   118.830    1.425   120.255    190.89   23.78    8.78   129.04     .00    2.96     3.83    4.000     .000   .00   2   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
   14.306    .0061                                         .0640      .92     1.42    2.89    2.84    .013       .00   .00 PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
   19.285   118.917    1.376   120.292    190.89   24.94    9.66   129.95     .00    2.96     3.80    4.000     .000   .00   2   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
   13.715    .0061                                         .0731     1.00     1.38    3.10    2.84    .013       .00   .00 PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
   33.000   119.000    1.329   120.329    190.89   26.16   10.62   130.95     .00    2.96     3.77    4.000     .000   .00   2   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
JUNCT STR  1.0351                                          .0492      .38    1.33    3.31             .013       .00   .00 PIPE
                       -------------------- WARNING - Junction Analysis - Change in Channel Type ---------------
         |         |        |         |         |               |         |       |        |        |       |       |      |
   40.700   126.970    1.152   128.122    190.89   14.41    3.22   131.35     .00    2.05    12.00    2.500   12.000   .00   1   .5
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
    3.978    .0047                                         .0210      .08     1.15    2.42    1.92    .013       .00   .00 BOX
         |         |        |         |         |               |         |       |        |        |       |       |      |
   44.678   126.989    1.138   128.127    190.89   14.59    3.30   131.43     .00    2.05    12.00    2.500   12.000   .00   1   .5
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
   15.191    .0047                                         .0230      .35     1.14    2.46    1.92    .013       .00   .00 BOX
         |         |        |         |         |               |         |       |        |        |       |       |      |
   59.869   127.061    1.085   128.146    190.89   15.30    3.63   131.78     .00    2.05    12.00    2.500   12.000   .00   1   .5
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
   14.382    .0047                                         .0265      .38     1.09    2.64    1.92    .013       .00   .00 BOX
         |         |        |         |         |               |         |       |        |        |       |       |      |
   74.251   127.129    1.035   128.164    190.89   16.04    4.00   132.16     .00    2.05    12.00    2.500   12.000   .00   1   .5
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
   13.628    .0047                                         .0305      .42     1.03    2.84    1.92    .013       .00   .00 BOX
```

```
FILE: SDA-50.WSW                           W S P G W - CIVILDESIGN Version 14.08                                        PAGE    2
                               Program Package Serial Number: 7131
                                                   WATER SURFACE PROFILE LISTING                    Date: 3-24-2022  Time: 1:55:53
                         3668- HGL Analysis- SD-A

************************************************************************************************************************** ********
         | Invert  | Depth |  Water   |    Q    |  Vel     Vel  |  Energy | Super |Critical|Flow Top|Height/|Base Wt|      |No Wth
 Station |  Elev   |  (FT) |  Elev    |  (CFS)  | (FPS)    Head |  Grd.El.| Elev  | Depth  | Width  |Dia.-FT|or I.D.|  ZL  |Prs/Pip
        -|-       -|-     -|-        -|-       -|-      -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-    -|
 L/Elem  |Ch Slope |       |          |         |         SF Ave|    HF   |SE Dpth|Froude N|Norm Dp |  "N"  | X-Fall|  ZR  |Type Ch
*********|*********|********|*********|*********|*******|*******|*********|*******|********|********|*******|*******|***** |*******
         |         |        |         |         |               |         |       |        |        |       |       |      |
  87.879   127.193     .986   128.180    190.89   16.83    4.40   132.58     .00     2.05    12.00   2.500  12.000    .00   1   .5
        -|-       -|-      -|-       -|-       -|-      -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-    |-
  12.920     .0047                                        .0352      .45     .99     3.05     1.92    .013      .00    .00  BOX
         |         |        |         |         |               |         |       |        |        |       |       |      |
 100.799   127.255     .941   128.195    190.89   17.65    4.84   133.03     .00     2.05    12.00   2.500  12.000    .00   1   .5
        -|-       -|-      -|-       -|-       -|-      -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-    |-
  12.253     .0047                                        .0406      .50     .94     3.28     1.92    .013      .00    .00  BOX
         |         |        |         |         |               |         |       |        |        |       |       |      |
 113.051   127.313     .897   128.209    190.89   18.51    5.32   133.53     .00     2.05    12.00   2.500  12.000    .00   1   .5
        -|-       -|-      -|-       -|-       -|-      -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-    |-
  11.623     .0047                                        .0469      .55     .90     3.52     1.92    .013      .00    .00  BOX
         |         |        |         |         |               |         |       |        |        |       |       |      |
 124.674   127.368     .855   128.223    190.89   19.41    5.85   134.08     .00     2.05    12.00   2.500  12.000    .00   1   .5
        -|-       -|-      -|-       -|-       -|-      -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-    |-
  11.026     .0047                                        .0542      .60     .86     3.78     1.92    .013      .00    .00  BOX
         |         |        |         |         |               |         |       |        |        |       |       |      |
 135.700   127.420     .815   128.235    190.89   20.36    6.44   134.67    2.50     2.05    12.00   2.500  12.000    .00   1   .5
        -|-       -|-      -|-       -|-       -|-      -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-    |-
JUNCT STR   .0050                                         .0605      .24    2.50     4.06             .013      .00    .00  BOX
         |         |        |         |         |               |         |       |        |        |       |       |      |
 139.700   127.440     .793   128.233    190.26   20.87    6.77   135.00     .00     2.04    12.00   2.500  12.000    .00   1   .5
        -|-       -|-      -|-       -|-       -|-      -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-    |-
   1.515     .0050                                        .0636      .10     .79     4.22     1.88    .013      .00    .00  BOX
         |         |        |         |         |               |         |       |        |        |       |       |      |
 141.215   127.448     .787   128.235    190.26   21.02    6.86   135.10     .00     2.04    12.00   2.500  12.000    .00   1   .5
        -|-       -|-      -|-       -|-       -|-      -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-    |-
  10.106     .0050                                        .0693      .70     .79     4.27     1.88    .013      .00    .00  BOX
         |         |        |         |         |               |         |       |        |        |       |       |      |
 151.321   127.498     .750   128.249    190.26   22.05    7.55   135.80     .00     2.04    12.00   2.500  12.000    .00   1   .5
        -|-       -|-      -|-       -|-       -|-      -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-    |-
   9.580     .0050                                        .0802      .77     .75     4.58     1.88    .013      .00    .00  BOX
         |         |        |         |         |               |         |       |        |        |       |       |      |
 160.901   127.546     .716   128.262    190.26   23.12    8.30   136.56     .00     2.04    12.00   2.500  12.000    .00   1   .5
        -|-       -|-      -|-       -|-       -|-      -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-    |-
   9.081     .0050                                        .0928      .84     .72     4.92     1.88    .013      .00    .00  BOX
```

```
FILE: SDA-50.WSW                            W S P G W - CIVILDESIGN Version 14.08                                      PAGE    3
                              Program Package Serial Number: 7131
                                                  WATER SURFACE PROFILE LISTING                    Date: 3-24-2022  Time: 1:55:53
                        3668- HGL Analysis- SD-A


******************************************************************************************************************************* ********
         | Invert  |  Depth |  Water  |    Q    |  Vel     Vel  |  Energy | Super |Critical|Flow Top|Height/|Base Wt|      |No Wth
 Station | Elev    |  (FT)  |  Elev   |  (CFS)  | (FPS)    Head | Grd.El.|  Elev | Depth  | Width  |Dia.-FT|or I.D.|  ZL  |Prs/Pip
        -|-       -|-      -|-       -|-       -|-      -|-     -|-        -|-     -|-      -|-      -|-     -|-     -|-    -|
 L/Elem  |Ch Slope |        |         |         |         SF Ave|    HF   |SE Dpth|Froude N|Norm Dp |  "N"  | X-Fall|  ZR  |Type Ch
*********|*********|********|*********|*********|*******|*******|*********|*******|********|********|*******|*******|***** |*******
         |         |        |         |         |               |         |       |        |        |       |       |      |
  169.983  127.592     .682  128.274    190.26   24.25    9.13  137.41     .00    2.04    12.00    2.500  12.000    .00   1   .5
        -|-       -|-      -|-       -|-       -|-      -|-     -|-        -|-     -|-      -|-      -|-     -|-     -|-    |-
   8.607    .0050                                         .1074     .92     .68    5.29    1.88    .013      .00    .00  BOX
         |         |        |         |         |               |         |       |        |        |       |       |      |
  178.590  127.635     .650  128.286    190.26   25.43   10.05  138.33     .00    2.04    12.00    2.500  12.000    .00   1   .5
        -|-       -|-      -|-       -|-       -|-      -|-     -|-        -|-     -|-      -|-      -|-     -|-     -|-    |-
   8.157    .0050                                         .1245    1.02     .65    5.68    1.88    .013      .00    .00  BOX
         |         |        |         |         |               |         |       |        |        |       |       |      |
  186.747  127.676     .620  128.296    190.26   26.68   11.05  139.35     .00    2.04    12.00    2.500  12.000    .00   1   .5
        -|-       -|-      -|-       -|-       -|-      -|-     -|-        -|-     -|-      -|-      -|-     -|-     -|-    |-
   7.729    .0050                                         .1443    1.11     .62    6.10    1.88    .013      .00    .00  BOX
         |         |        |         |         |               |         |       |        |        |       |       |      |
  194.476  127.715     .591  128.306    190.26   27.98   12.15  140.46     .00    2.04    12.00    2.500  12.000    .00   1   .5
        -|-       -|-      -|-       -|-       -|-      -|-     -|-        -|-     -|-      -|-      -|-     -|-     -|-    |-
   7.322    .0050                                         .1673    1.22     .59    6.55    1.88    .013      .00    .00  BOX
         |         |        |         |         |               |         |       |        |        |       |       |      |
  201.798  127.752     .564  128.315    190.26   29.34   13.37  141.69     .00    2.04    12.00    2.500  12.000    .00   1   .5
        -|-       -|-      -|-       -|-       -|-      -|-     -|-        -|-     -|-      -|-      -|-     -|-     -|-    |-
   6.935    .0050                                         .1940    1.35     .56    7.03    1.88    .013      .00    .00  BOX
         |         |        |         |         |               |         |       |        |        |       |       |      |
  208.733  127.786     .538  128.324    190.26   30.78   14.71  143.03     .00    2.04    12.00    2.500  12.000    .00   1   .5
        -|-       -|-      -|-       -|-       -|-      -|-     -|-        -|-     -|-      -|-      -|-     -|-     -|-    |-
   6.567    .0050                                         .2252    1.48     .54    7.56    1.88    .013      .00    .00  BOX
         |         |        |         |         |               |         |       |        |        |       |       |      |
  215.300  127.819     .513  128.332    190.26   32.28   16.18  144.51     .00    2.04    12.00    2.500  12.000    .00   1   .5
        -|-       -|-      -|-       -|-       -|-      -|-     -|-        -|-     -|-      -|-      -|-     -|-     -|-    |-
   6.217    .0050                                         .2614    1.63     .51    8.12    1.88    .013      .00    .00  BOX
         |         |        |         |         |               |         |       |        |        |       |       |      |
  221.516  127.850     .489  128.339    190.26   33.85   17.80  146.14     .00    2.04    12.00    2.500  12.000    .00   1   .5
        -|-       -|-      -|-       -|-       -|-      -|-     -|-        -|-     -|-      -|-      -|-     -|-     -|-    |-
   5.884    .0050                                         .3036    1.79     .49    8.72    1.88    .013      .00    .00  BOX
         |         |        |         |         |               |         |       |        |        |       |       |      |
  227.400  127.880     .466  128.346    190.26   35.51   19.58  147.92    2.50    2.04    12.00    2.500  12.000    .00   1   .5
        -|-       -|-      -|-       -|-       -|-      -|-     -|-        -|-     -|-      -|-      -|-     -|-     -|-    |-
JUNCT STR   .0825                                         .2189     .88    2.50    9.36            .013      .00    .00  BOX
                       -------------------- WARNING - Junction Analysis - Change in Channel Type ---------------
```

```
**************************************************************************************************************************  ********
         | Invert  |  Depth |  Water  |    Q    |  Vel     Vel  |  Energy | Super |Critical|Flow Top|Height/|Base Wt|       |No Wth
 Station |  Elev   |  (FT)  |  Elev   |  (CFS)  | (FPS)    Head |  Grd.El.|  Elev  | Depth  | Width  |Dia.-FT|or I.D.|  ZL   |Prs/Pip
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-      -|
 L/Elem  |Ch Slope |        |         |         |         SF Ave|    HF   |SE Dpth|Froude N|Norm Dp |  "N"  | X-Fall|  ZR   |Type Ch
*********|*********|********|*********|*********|*******|*******|*********|*******|********|********|*******|*******|*****  |*******
         |         |        |         |         |               |         |       |        |        |       |       |       |
  231.400   128.210    1.588   129.798    190.26   35.48   19.54   149.34     .00    3.94     4.66   5.000     .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-      |-
   84.896    .1205                                         .1070     9.09     1.59    5.83    1.56    .013       .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |       |
  316.296   138.440    1.624   140.064    190.26   34.41   18.39   158.45     .00    3.94     4.68   5.000     .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-      |-
   66.315    .1205                                         .0962     6.38     1.62    5.58    1.56    .013       .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |       |
  382.611   146.432    1.681   148.113    190.26   32.81   16.72   164.83     .00    3.94     4.72   5.000     .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-      |-
   40.280    .1205                                         .0843     3.39     1.68    5.22    1.56    .013       .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |       |
  422.891   151.285    1.741   153.026    190.26   31.28   15.20   168.22     .00    3.94     4.76   5.000     .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-      |-
   28.282    .1205                                         .0738     2.09     1.74    4.88    1.56    .013       .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |       |
  451.173   154.694    1.803   156.497    190.26   29.83   13.82   170.31     .00    3.94     4.80   5.000     .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-      |-
   21.365    .1205                                         .0647     1.38     1.80    4.56    1.56    .013       .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |       |
  472.538   157.268    1.868   159.136    190.26   28.44   12.56   171.70     .00    3.94     4.84   5.000     .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-      |-
   16.862    .1205                                         .0568      .96     1.87    4.26    1.56    .013       .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |       |
  489.400   159.300    1.935   161.235    190.26   27.12   11.42   172.65    2.37    3.94     4.87   5.000     .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-      |-
JUNCT STR   .0825                                          .0583      .23    4.31    3.98            .013       .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |       |
  493.400   159.630    1.797   161.427    181.47   28.58   12.68   174.11     .00    3.86     4.80   5.000     .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-      |-
    9.535    .0982                                         .0623      .59     1.80    4.38    1.60    .013       .00   .00  PIPE
```

```
************************************************************************************************************************** ********
         | Invert  |  Depth |  Water   |    Q    |  Vel     Vel  |  Energy | Super |Critical|Flow Top|Height/|Base Wt|      |No Wth
 Station |  Elev   |  (FT)  |  Elev    |  (CFS)  | (FPS)    Head |  Grd.El.|  Elev | Depth  | Width  |Dia.-FT|or I.D.|  ZL  |Prs/Pip
        -|-       -|-      -|-        -|-       -|-      -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-    -|
 L/Elem  |Ch Slope |        |          |         |         SF Ave|    HF   |SE Dpth|Froude N|Norm Dp |  "N"  | X-Fall|  ZR  |Type Ch
*********|*********|********|*********|*********|*******|*******|*********|*******|********|********|*******|*******|***** |*******
         |         |        |          |         |               |         |       |        |        |       |       |      |
  502.935  160.566    1.816   162.382    181.47   28.18   12.33   174.71     .00    3.86     4.81    5.000     .000   .00   1   .0
        -|-       -|-      -|-        -|-       -|-      -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-    |-
   25.844    .0982                                        .0573     1.48     1.82    4.29    1.60    .013       .00   .00  PIPE
         |         |        |          |         |               |         |       |        |        |       |       |      |
  528.779  163.104    1.881   164.985    181.47   26.86   11.21   176.19     .00    3.86     4.84    5.000     .000   .00   1   .0
        -|-       -|-      -|-        -|-       -|-      -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-    |-
   19.856    .0982                                        .0503     1.00     1.88    4.01    1.60    .013       .00   .00  PIPE
         |         |        |          |         |               |         |       |        |        |       |       |      |
  548.635  165.053    1.949   167.002    181.47   25.61   10.19   177.19     .00    3.86     4.88    5.000     .000   .00   1   .0
        -|-       -|-      -|-        -|-       -|-      -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-    |-
   15.825    .0982                                        .0441      .70     1.95    3.75    1.60    .013       .00   .00  PIPE
         |         |        |          |         |               |         |       |        |        |       |       |      |
  564.460  166.607    2.020   168.627    181.47   24.42    9.26   177.89     .00    3.86     4.91    5.000     .000   .00   1   .0
        -|-       -|-      -|-        -|-       -|-      -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-    |-
   12.922    .0982                                        .0387      .50     2.02    3.50    1.60    .013       .00   .00  PIPE
         |         |        |          |         |               |         |       |        |        |       |       |      |
  577.382  167.876    2.093   169.969    181.47   23.29    8.42   178.39     .00    3.86     4.93    5.000     .000   .00   1   .0
        -|-       -|-      -|-        -|-       -|-      -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-    |-
   10.729    .0982                                        .0340      .36     2.09    3.26    1.60    .013       .00   .00  PIPE
         |         |        |          |         |               |         |       |        |        |       |       |      |
  588.111  168.929    2.170   171.099    181.47   22.20    7.65   178.75     .00    3.86     4.96    5.000     .000   .00   1   .0
        -|-       -|-      -|-        -|-       -|-      -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-    |-
    9.010    .0982                                        .0299      .27     2.17    3.05    1.60    .013       .00   .00  PIPE
         |         |        |          |         |               |         |       |        |        |       |       |      |
  597.122  169.814    2.251   172.064    181.47   21.17    6.96   179.02     .00    3.86     4.98    5.000     .000   .00   1   .0
        -|-       -|-      -|-        -|-       -|-      -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-    |-
    7.628    .0982                                        .0263      .20     2.25    2.84    1.60    .013       .00   .00  PIPE
         |         |        |          |         |               |         |       |        |        |       |       |      |
  604.749  170.563    2.335   172.897    181.47   20.18    6.33   179.22     .00    3.86     4.99    5.000     .000   .00   1   .0
        -|-       -|-      -|-        -|-       -|-      -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-    |-
    6.490    .0982                                        .0231      .15     2.33    2.65    1.60    .013       .00   .00  PIPE
         |         |        |          |         |               |         |       |        |        |       |       |      |
  611.239  171.200    2.422   173.622    181.47   19.24    5.75   179.37     .00    3.86     5.00    5.000     .000   .00   1   .0
        -|-       -|-      -|-        -|-       -|-      -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-    |-
    5.532    .0982                                        .0203      .11     2.42    2.47    1.60    .013       .00   .00  PIPE
```

```
FILE: SDA-50.WSW                            W S P G W - CIVILDESIGN Version 14.08                                         PAGE    6
                               Program Package Serial Number: 7131
                                                   WATER SURFACE PROFILE LISTING                    Date: 3-24-2022  Time: 1:55:53
                         3668- HGL Analysis- SD-A


************************************************************************************************************************** ********
         | Invert  |  Depth |  Water  |    Q    |  Vel     Vel  |  Energy | Super |Critical|Flow Top|Height/|Base Wt|      |No Wth
 Station |  Elev   |  (FT)  |  Elev   |  (CFS)  | (FPS)    Head |  Grd.El.|  Elev | Depth  | Width  |Dia.-FT|or I.D.|  ZL  |Prs/Pip
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-    -|
 L/Elem  |Ch Slope |        |         |         |         SF Ave|    HF   |SE Dpth|Froude N|Norm Dp |  "N"  | X-Fall|  ZR  |Type Ch
*********|*********|********|*********|*********|*******|*******|*********|*******|********|********|*******|*******|***** |*******
         |         |        |         |         |               |         |       |        |        |       |       |      |
  616.771   171.743    2.515   174.258    181.47   18.35    5.23   179.49     .00    3.86     5.00    5.000    .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
    4.717    .0982                                         .0179       .08    2.51     2.30    1.60    .013      .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  621.488   172.206    2.611   174.817    181.47   17.49    4.75   179.57     .00    3.86     5.00    5.000    .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
    4.012    .0982                                         .0158       .06    2.61     2.14    1.60    .013      .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  625.500   172.600    2.713   175.313    181.47   16.68    4.32   179.63    5.00    3.86     4.98    5.000    .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
JUNCT STR   .0925                                          .0151       .06    5.00    1.99             .013      .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  629.500   172.970    2.892   175.862    181.47   16.80    4.38   180.24     .00    3.90     4.31    4.500    .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
   10.934    .0250                                         .0150       .16    2.89     1.87    2.47    .013      .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  640.434   173.243    2.937   176.180    181.47   16.51    4.23   180.41     .00    3.90     4.29    4.500    .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
   23.314    .0250                                         .0139       .32    2.94     1.82    2.47    .013      .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  663.748   173.825    3.063   176.888    181.47   15.74    3.85   180.73     .00    3.90     4.20    4.500    .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
   16.966    .0250                                         .0124       .21    3.06     1.67    2.47    .013      .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  680.714   174.249    3.199   177.448    181.47   15.01    3.50   180.94     .00    3.90     4.08    4.500    .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
   12.259    .0250                                         .0111       .14    3.20     1.54    2.47    .013      .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  692.973   174.555    3.347   177.901    181.47   14.31    3.18   181.08     .00    3.90     3.93    4.500    .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
    8.469    .0250                                         .0099       .08    3.35     1.40    2.47    .013      .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  701.442   174.766    3.508   178.274    181.47   13.64    2.89   181.16     .00    3.90     3.73    4.500    .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
    5.138    .0250                                         .0090       .05    3.51     1.27    2.47    .013      .00   .00  PIPE
```

```
FILE: SDA-50.WSW                            W S P G W - CIVILDESIGN Version 14.08                                         PAGE    7
                               Program Package Serial Number: 7131
                                                   WATER SURFACE PROFILE LISTING                    Date: 3-24-2022  Time: 1:55:53
                         3668- HGL Analysis- SD-A


************************************************************************************************************************** ********
         | Invert  |  Depth |  Water  |    Q    |  Vel     Vel  |  Energy | Super |Critical|Flow Top|Height/|Base Wt|      |No Wth
 Station |  Elev   |  (FT)  |  Elev   |  (CFS)  | (FPS)    Head |  Grd.El.|  Elev | Depth  | Width  |Dia.-FT|or I.D.|  ZL  |Prs/Pip
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-    -|
 L/Elem  |Ch Slope |        |         |         |         SF Ave|    HF   |SE Dpth|Froude N|Norm Dp |  "N"  | X-Fall|  ZR  |Type Ch
*********|*********|********|*********|*********|*******|*******|*********|*******|********|********|*******|*******|***** |*******
         |         |        |         |         |               |         |       |        |        |       |       |      |
  706.580   174.895    3.689   178.583    181.47   13.01    2.63   181.21     .00    3.90     3.46    4.500     .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
    1.820    .0250                                         .0082      .01     3.69    1.14     2.47    .013       .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  708.400   174.940    3.898   178.838    181.47   12.40    2.39   181.22     .00    3.90     3.06    4.500     .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
```

```
FILE: SDB-50.WSW                            W S P G W - CIVILDESIGN Version 14.08                                         PAGE    1
                               Program Package Serial Number: 7131
                                                   WATER SURFACE PROFILE LISTING                    Date: 3-24-2022  Time: 1:56:26
                         3668- HGL Analysis- SD B

************************************************************************************************************************** ********
         | Invert  |  Depth |  Water  |    Q    |  Vel     Vel  |  Energy | Super |Critical|Flow Top|Height/|Base Wt|      |No Wth
 Station |  Elev   |  (FT)  |  Elev   |  (CFS)  | (FPS)    Head |  Grd.El.|  Elev | Depth  | Width  |Dia.-FT|or I.D.| ZL   |Prs/Pip
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-    -|
 L/Elem  |Ch Slope |        |         |         |         SF Ave|    HF   |SE Dpth|Froude N|Norm Dp | "N"   | X-Fall| ZR   |Type Ch
*********|*********|********|*********|*********|*******|*******|*********|*******|********|********|*******|*******|***** |*******
         |         |        |         |         |               |         |       |        |        |       |       |      |
     .000   128.050    1.648   129.698    320.22   21.86    7.42   137.12     .00    3.13     3.94    4.000     .000   .00   3   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
   16.041    .0165                                         .0457      .73     1.65    2.00    2.18    .013       .00   .00 PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
   16.041   128.315    1.607   129.922    320.22   22.61    7.93   137.86     .00    3.13     3.92    4.000     .000   .00   3   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
   21.259    .0165                                         .0512     1.09     1.61    2.10    2.18    .013       .00   .00 PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
   37.300   128.665    1.551   130.216    320.22   23.71    8.73   138.94     .00    3.13     3.90    4.000     .000   .00   3   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
   19.575    .0165                                         .0583     1.14     1.55    2.24    2.18    .013       .00   .00 PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
   56.875   128.988    1.497   130.485    320.22   24.87    9.60   140.09     .00    3.13     3.87    4.000     .000   .00   3   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
   18.161    .0165                                         .0665     1.21     1.50    2.40    2.18    .013       .00   .00 PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
   75.035   129.288    1.445   130.733    320.22   26.08   10.56   141.29     .00    3.13     3.84    4.000     .000   .00   3   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
   16.951    .0165                                         .0759     1.29     1.45    2.57    2.18    .013       .00   .00 PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
   91.987   129.567    1.395   130.963    320.22   27.35   11.62   142.58     .00    3.13     3.81    4.000     .000   .00   3   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
   15.900    .0165                                         .0866     1.38     1.40    2.75    2.18    .013       .00   .00 PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  107.887   129.830    1.348   131.177    320.22   28.69   12.78   143.96     .00    3.13     3.78    4.000     .000   .00   3   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
   14.971    .0165                                         .0988     1.48     1.35    2.94    2.18    .013       .00   .00 PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  122.858   130.077    1.302   131.378    320.22   30.09   14.06   145.44     .00    3.13     3.75    4.000     .000   .00   3   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
   14.142    .0165                                         .1128     1.59     1.30    3.15    2.18    .013       .00   .00 PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  137.000   130.310    1.257   131.567    320.22   31.56   15.46   147.03     .00    3.13     3.71    4.000     .000   .00   3   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
JUNCT STR   .0825                                          .0855      .34    3.81    3.36             .013       .00   .00 PIPE
```

```
FILE: SDB-50.WSW                                  W S P G W - CIVILDESIGN Version 14.08                                   PAGE    2
                              Program Package Serial Number: 7131
                                                  WATER SURFACE PROFILE LISTING                      Date: 3-24-2022  Time: 1:56:26
                        3668- HGL Analysis- SD B


************************************************************************************************************************* ********
         | Invert  |  Depth |  Water   |    Q    |  Vel    Vel  |  Energy | Super |Critical|Flow Top|Height/|Base Wt|     |No Wth
 Station |  Elev   |  (FT)  |  Elev    |  (CFS)  | (FPS)   Head |  Grd.El.|  Elev | Depth  | Width  |Dia.-FT|or I.D.|  ZL |Prs/Pip
        -|-       -|-      -|-        -|-       -|-      -|-    -|-       -|-     -|-      -|-      -|-     -|-     -|-   -|
 L/Elem  |Ch Slope |        |          |         |        SF Ave|    HF   |SE Dpth|Froude N|Norm Dp |  "N"  | X-Fall|  ZR |Type Ch
*********|*********|********|*********|*********|*******|*******|*********|*******|********|********|*******|*******|***** |*******
         |         |        |         |         |               |         |       |        |        |       |       |      |
  141.000   130.640    2.395  133.035    320.04   30.40   14.35   147.38    6.00    4.88     5.88    6.000     .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-      -|-    -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
   53.900    .0521                                              .0505     2.72    6.00    4.00     2.38    .013       .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  194.900   133.450    2.400  135.850    320.04   30.30   14.26   150.11    6.00    4.88     5.88    6.000     .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-      -|-    -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
   54.000    .0524                                              .0499     2.70    6.00    3.98     2.37    .013       .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  248.900   136.280    2.409  138.689    320.04   30.15   14.11   152.80     .00    4.88     5.88    6.000     .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-      -|-    -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
   74.300    .0522                                              .0490     3.64    2.41    3.95     2.38    .013       .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  323.200   140.160    2.426  142.586    320.04   29.87   13.86   156.44    6.00    4.88     5.89    6.000     .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-      -|-    -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
   32.600    .0521                                              .0480     1.57    6.00    3.90     2.38    .013       .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  355.800   141.860    2.435  144.295    320.04   29.72   13.71   158.01     .00    4.88     5.89    6.000     .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-      -|-    -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
JUNCT STR   .0825                                               .0494      .20    6.00    3.87             .013       .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  359.800   142.190    2.359  144.549    312.97   30.32   14.28   158.83    6.00    4.83     5.86    6.000     .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-      -|-    -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
    2.658    .0859                                              .0510      .14    6.00    4.03     2.05    .013       .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  362.458   142.418    2.365  144.783    312.97   30.22   14.18   158.97    6.00    4.83     5.86    6.000     .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-      -|-    -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
   31.442    .0859                                              .0476     1.50    6.00    4.01     2.05    .013       .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  393.900   145.120    2.451  147.571    312.97   28.82   12.89   160.46     .00    4.83     5.90    6.000     .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-      -|-    -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
   14.643    .0857                                              .0430      .63    2.45    3.74     2.06    .013       .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  408.543   146.375    2.501  148.876    312.97   28.05   12.22   161.10     .00    4.83     5.92    6.000     .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-      -|-    -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
   21.757    .0857                                              .0389      .85    2.50    3.60     2.06    .013       .00   .00  PIPE
```

```
FILE: SDB-50.WSW                            W S P G W - CIVILDESIGN Version 14.08                                         PAGE    3
                               Program Package Serial Number: 7131
                                                   WATER SURFACE PROFILE LISTING                    Date: 3-24-2022  Time: 1:56:26
                         3668- HGL Analysis- SD B

************************************************************************************************************************** ********
         | Invert  |  Depth |  Water   |    Q     |  Vel     Vel  |  Energy | Super |Critical|Flow Top|Height/|Base Wt|      |No Wth
 Station | Elev    |  (FT)  |  Elev    |  (CFS)   | (FPS)    Head |  Grd.El.| Elev  | Depth  | Width  |Dia.-FT|or I.D.|  ZL  |Prs/Pip
        -|-       -|-      -|-        -|-        -|-       -|-     -|-       -|-     -|-      -|-      -|-      -|-      -|-    -|
 L/Elem  |Ch Slope |        |          |          |         SF Ave|    HF   |SE Dpth|Froude N|Norm Dp |  "N"  | X-Fall|  ZR  |Type Ch
*********|*********|********|*********|*********|*******|*******|*********|*******|********|********|*******|*******|***** |*******
         |         |        |         |         |               |         |       |        |        |       |       |      |
  430.300   148.240    2.593   150.833    312.97   26.75   11.11   161.94    2.94    4.83    5.94    6.000      .000   .00   1   .0
        -|-      -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-      |-
   17.413    .0858                                         .0342      .60    5.53     3.36    2.05    .013       .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  447.713   149.734    2.686   152.421    312.97   25.53   10.12   162.54    2.68    4.83    5.97    6.000      .000   .00   1   .0
        -|-      -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-      |-
   14.722    .0858                                         .0301      .44    5.37     3.14    2.05    .013       .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  462.436   150.998    2.786   153.784    312.97   24.34    9.20   162.99    2.45    4.83    5.98    6.000      .000   .00   1   .0
        -|-      -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-      |-
   12.333    .0858                                         .0265      .33    5.23     2.93    2.05    .013       .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  474.768   152.056    2.891   154.947    312.97   23.21    8.37   163.31    2.23    4.83    6.00    6.000      .000   .00   1   .0
        -|-      -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-      |-
   10.411    .0858                                         .0233      .24    5.12     2.73    2.05    .013       .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  485.179   152.949    3.001   155.950    312.97   22.13    7.60   163.55    2.03    4.83    6.00    6.000      .000   .00   1   .0
        -|-      -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-      |-
    8.826    .0858                                         .0205      .18    5.03     2.54    2.05    .013       .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  494.005   153.707    3.116   156.823    312.97   21.10    6.91   163.74    1.84    4.83    6.00    6.000      .000   .00   1   .0
        -|-      -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-      |-
    7.495    .0858                                         .0181      .14    4.96     2.36    2.05    .013       .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  501.500   154.350    3.237   157.587    312.97   20.12    6.28   163.87    6.00    4.83    5.98    6.000      .000   .00   1   .0
        -|-      -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-      |-
JUNCT STR   .0825                                          .0199      .08    6.00     2.20            .013       .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  505.500   154.680    2.960   157.640    312.81   22.51    7.87   165.51     .00    4.83    6.00    6.000      .000   .00   1   .0
        -|-      -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-      |-
   61.615    .0295                                         .0218     1.34    2.96     2.61    2.75    .013       .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  567.115   156.498    3.048   159.546    312.81   21.69    7.30   166.85     .00    4.83    6.00    6.000      .000   .00   1   .0
        -|-      -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-      |-
   54.411    .0295                                         .0195     1.06    3.05     2.46    2.75    .013       .00   .00  PIPE
```

```
                            3668- HGL Analysis- SD B

************************************************************************************************************************* ********
         | Invert  |  Depth |  Water   |    Q    |  Vel     Vel   |  Energy  | Super |Critical|Flow Top|Height/|Base Wt|     |No Wth
 Station |  Elev   |  (FT)  |  Elev    |  (CFS)  | (FPS)    Head  |  Grd.El.|  Elev  | Depth  | Width  |Dia.-FT|or I.D.|  ZL  |Prs/Pip
        -|-       -|-      -|-        -|-       -|-       -|-     -|-       -|-     -|-       -|-      -|-     -|-      -|-    -|
 L/Elem  |Ch Slope |        |          |         |         SF Ave|    HF    |SE Dpth|Froude N|Norm Dp |  "N"  | X-Fall|  ZR  |Type Ch
*********|*********|********|*********|*********|*******|*******|*********|*******|********|********|*******|*******|***** |*******
         |         |        |          |         |               |          |       |        |        |       |       |      |
  621.527  158.103   3.165   161.268    312.81   20.68    6.64   167.91     .00    4.83     5.99    6.000     .000   .00   1   .0
        -|-       -|-      -|-        -|-       -|-       -|-     -|-       -|-     -|-       -|-      -|-     -|-      -|-    |-
   38.884   .0295                                         .0172      .67    3.17    2.29     2.75    .013      .00   .00  PIPE
         |         |        |          |         |               |          |       |        |        |       |       |      |
  660.410  159.250   3.289   162.539    312.81   19.72    6.04   168.57     .00    4.83     5.97    6.000     .000   .00   1   .0
        -|-       -|-      -|-        -|-       -|-       -|-     -|-       -|-     -|-       -|-      -|-     -|-      -|-    |-
   29.155   .0295                                         .0151      .44    3.29    2.13     2.75    .013      .00   .00  PIPE
         |         |        |          |         |               |          |       |        |        |       |       |      |
  689.565  160.110   3.419   163.529    312.81   18.80    5.49   169.02     .00    4.83     5.94    6.000     .000   .00   1   .0
        -|-       -|-      -|-        -|-       -|-       -|-     -|-       -|-     -|-       -|-      -|-     -|-      -|-    |-
   22.426   .0295                                         .0134      .30    3.42    1.98     2.75    .013      .00   .00  PIPE
         |         |        |          |         |               |          |       |        |        |       |       |      |
  711.992  160.772   3.556   164.328    312.81   17.92    4.99   169.32     .00    4.83     5.90    6.000     .000   .00   1   .0
        -|-       -|-      -|-        -|-       -|-       -|-     -|-       -|-     -|-       -|-      -|-     -|-      -|-    |-
   17.448   .0295                                         .0118      .21    3.56    1.84     2.75    .013      .00   .00  PIPE
         |         |        |          |         |               |          |       |        |        |       |       |      |
  729.440  161.287   3.701   164.988    312.81   17.09    4.53   169.52     .00    4.83     5.83    6.000     .000   .00   1   .0
        -|-       -|-      -|-        -|-       -|-       -|-     -|-       -|-     -|-       -|-      -|-     -|-      -|-    |-
   13.570   .0295                                         .0105      .14    3.70    1.70     2.75    .013      .00   .00  PIPE
         |         |        |          |         |               |          |       |        |        |       |       |      |
  743.009  161.687   3.855   165.542    312.81   16.29    4.12   169.66     .00    4.83     5.75    6.000     .000   .00   1   .0
        -|-       -|-      -|-        -|-       -|-       -|-     -|-       -|-     -|-       -|-      -|-     -|-      -|-    |-
   10.417   .0295                                         .0093      .10    3.86    1.57     2.75    .013      .00   .00  PIPE
         |         |        |          |         |               |          |       |        |        |       |       |      |
  753.426  161.994   4.020   166.014    312.81   15.54    3.75   169.76     .00    4.83     5.64    6.000     .000   .00   1   .0
        -|-       -|-      -|-        -|-       -|-       -|-     -|-       -|-     -|-       -|-      -|-     -|-      -|-    |-
    7.747   .0295                                         .0083      .06    4.02    1.45     2.75    .013      .00   .00  PIPE
         |         |        |          |         |               |          |       |        |        |       |       |      |
  761.173  162.223   4.196   166.419    312.81   14.81    3.41   169.83     .00    4.83     5.50    6.000     .000   .00   1   .0
        -|-       -|-      -|-        -|-       -|-       -|-     -|-       -|-     -|-       -|-      -|-     -|-      -|-    |-
    5.401   .0295                                         .0074      .04    4.20    1.33     2.75    .013      .00   .00  PIPE
         |         |        |          |         |               |          |       |        |        |       |       |      |
  766.573  162.382   4.386   166.769    312.81   14.12    3.10   169.87     .00    4.83     5.32    6.000     .000   .00   1   .0
        -|-       -|-      -|-        -|-       -|-       -|-     -|-       -|-     -|-       -|-      -|-     -|-      -|-    |-
    3.228   .0295                                         .0066      .02    4.39    1.22     2.75    .013      .00   .00  PIPE
```

```
****************************************************************************************************************************** ********
         | Invert  |  Depth |  Water   |    Q    |  Vel     Vel   |  Energy | Super |Critical|Flow Top|Height/|Base Wt|       |No Wth
 Station |  Elev   |  (FT)  |  Elev    |  (CFS)  | (FPS)    Head  | Grd.El.|  Elev | Depth  | Width  |Dia.-FT|or I.D.|  ZL   |Prs/Pip
        -|-       -|-      -|-        -|-       -|-      -|-      -|-       -|-     -|-      -|-      -|-     -|-     -|-    -|
 L/Elem  |Ch Slope |        |          |         |       SF Ave|    HF   |SE Dpth|Froude N|Norm Dp |  "N"  | X-Fall|  ZR   |Type Ch
*********|*********|********|*********|*********|*******|*******|*********|*******|********|********|*******|*******|***** |*******
         |         |        |          |         |               |         |       |        |        |       |       |       |
  769.801   162.478    4.594   167.071    312.81   13.47    2.82   169.89     .00    4.83     5.08    6.000     .000   .00   1   .0
        -|-       -|-      -|-        -|-       -|-      -|-      -|-       -|-     -|-      -|-      -|-     -|-     -|-      |-
    1.099    .0295                                          .0060      .01     4.59    1.11     2.75    .013       .00   .00  PIPE
         |         |        |          |         |               |         |       |        |        |       |       |       |
  770.900   162.510    4.825   167.335    312.81   12.84    2.56   169.89     .00    4.83     4.76    6.000     .000   .00   1   .0
        -|-       -|-      -|-        -|-       -|-      -|-      -|-       -|-     -|-      -|-      -|-     -|-     -|-      |-
```

Appendix 7

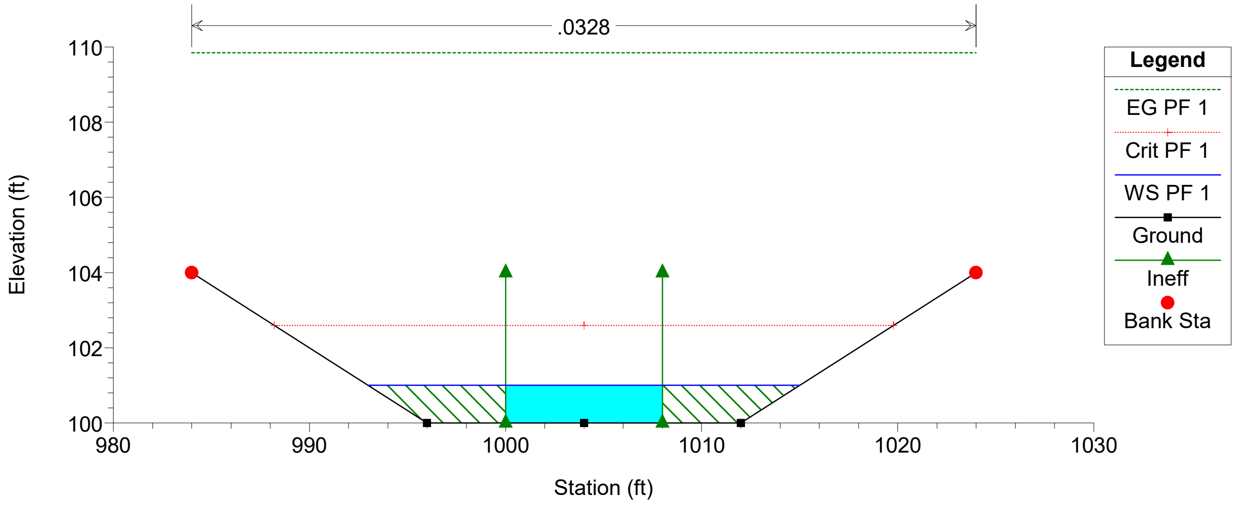
HEC-RAS Output

HEC-RAS Plan: Node 124 -50yr River: River01 Reach: Reach01 Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Mann Wtd Chnl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		
Reach01	100	PF 1	190.89	100.00	101.00	102.60	109.85	0.277424	23.86	8.00	22.00	4.21	0.033
Reach01	99.000*	PF 1	190.89	100.00	100.96	102.49	109.46	0.281568	23.39	8.16	22.26	4.21	0.033
Reach01	98.000*	PF 1	190.89	99.99	100.92	102.39	109.08	0.283817	22.92	8.33	22.55	4.20	0.033
Reach01	97.000*	PF 1	190.89	99.99	100.89	102.31	108.69	0.282870	22.41	8.52	22.88	4.17	0.033
Reach01	96.000*	PF 1	190.89	99.98	100.85	102.22	108.30	0.280612	21.90	8.72	23.23	4.14	0.033
Reach01	95.000*	PF 1	190.89	99.97	100.82	102.14	107.92	0.276386	21.38	8.93	23.60	4.09	0.033
Reach01	94.000*	PF 1	190.89	99.97	100.80	102.07	107.54	0.269503	20.83	9.17	24.00	4.02	0.033
Reach01	93.000*	PF 1	190.89	99.96	100.78	102.00	107.18	0.262270	20.29	9.41	24.41	3.96	0.033
Reach01	92.000*	PF 1	190.89	99.96	100.77	101.94	106.82	0.252754	19.73	9.68	24.84	3.87	0.033
Reach01	91.000*	PF 1	190.89	99.96	100.76	101.89	106.47	0.242928	19.18	9.95	25.28	3.79	0.033
Reach01	90.000*	PF 1	190.89	99.95	100.74	101.83	106.14	0.233150	18.65	10.23	25.72	3.71	0.033
Reach01	89.000*	PF 1	190.89	99.94	100.72	101.78	105.83	0.223129	18.13	10.53	26.18	3.62	0.033
Reach01	88.000*	PF 1	190.89	99.94	100.72	101.73	105.52	0.211483	17.58	10.86	26.65	3.52	0.033
Reach01	87.000*	PF 1	190.89	99.93	100.71	101.68	105.10	0.425251	16.81	11.36	27.20	3.35	0.049
Reach01	86.000*	PF 1	190.89	99.93	100.75	101.64	104.53	0.347775	15.61	12.23	27.89	3.05	0.049
Reach01	85.000*	PF 1	190.89	99.92	100.77	101.59	104.06	0.288535	14.57	13.11	28.57	2.79	0.049
Reach01	84	PF 1	190.89	99.92	100.80	101.56	103.67	0.239589	13.60	14.03	29.26	2.56	0.049
Reach01	83.000*	PF 1	190.89	99.92	100.83	101.53	103.36	0.201659	12.76	14.96	29.44	2.36	0.049
Reach01	82.000*	PF 1	190.89	99.91	100.85	101.48	103.09	0.171369	12.01	15.90	29.61	2.19	0.049
Reach01	81.000*	PF 1	190.89	99.90	102.30	101.44	102.62	0.006957	4.54	42.06	38.42	0.52	0.049
Reach01	80.000*	PF 1	190.89	99.90	102.31		102.61	0.006524	4.40	43.37	38.46	0.50	0.049
Reach01	79.000*	PF 1	190.89	99.89	102.32		102.60	0.006036	4.25	44.88	38.56	0.48	0.049
Reach01	78.000*	PF 1	190.89	99.89	102.32		102.59	0.005695	4.14	46.16	38.58	0.47	0.049
Reach01	77.000*	PF 1	190.89	99.88	102.32		102.57	0.005295	4.00	47.67	38.67	0.45	0.049
Reach01	76.000*	PF 1	190.89	99.88	102.33	101.29	102.56	0.005010	3.90	48.96	38.69	0.44	0.049

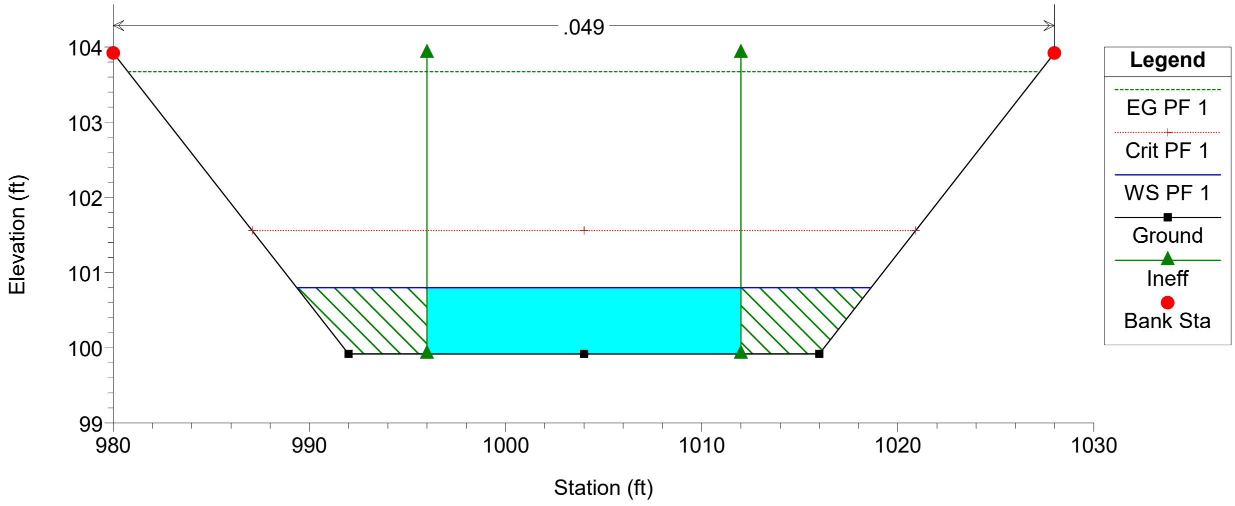
D-40 Riprap Sizing   Plan: Node 124 - 50-yr MDP   3/24/2022

River = River01   Reach = Reach01   RS = 100   Start of D-40 instantaneously outside of storm drain pipe



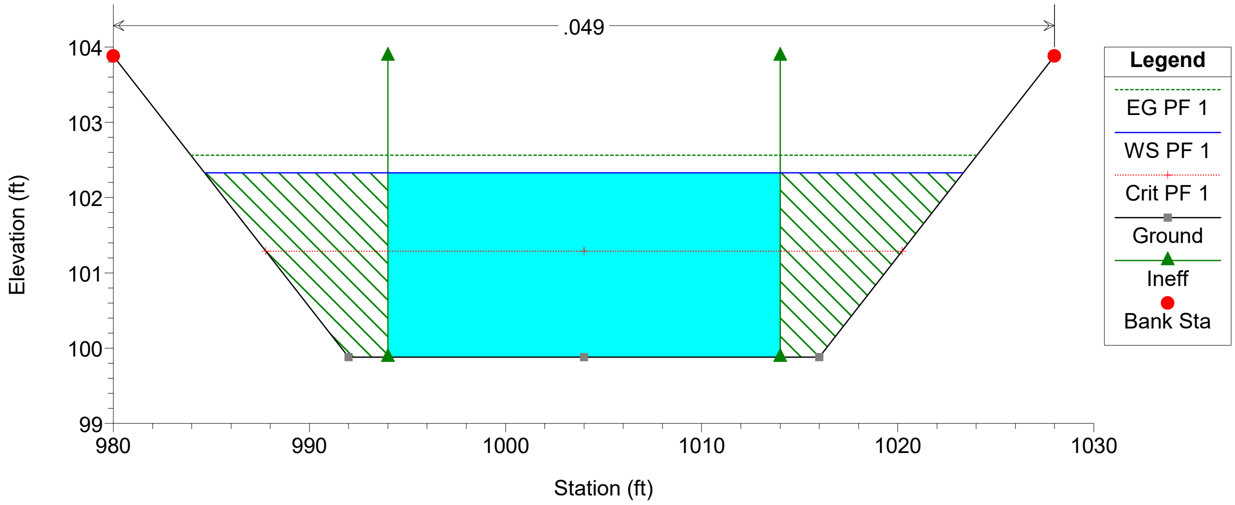
D-40 Riprap Sizing   Plan: Node 124 - 50-yr MDP   3/24/2022

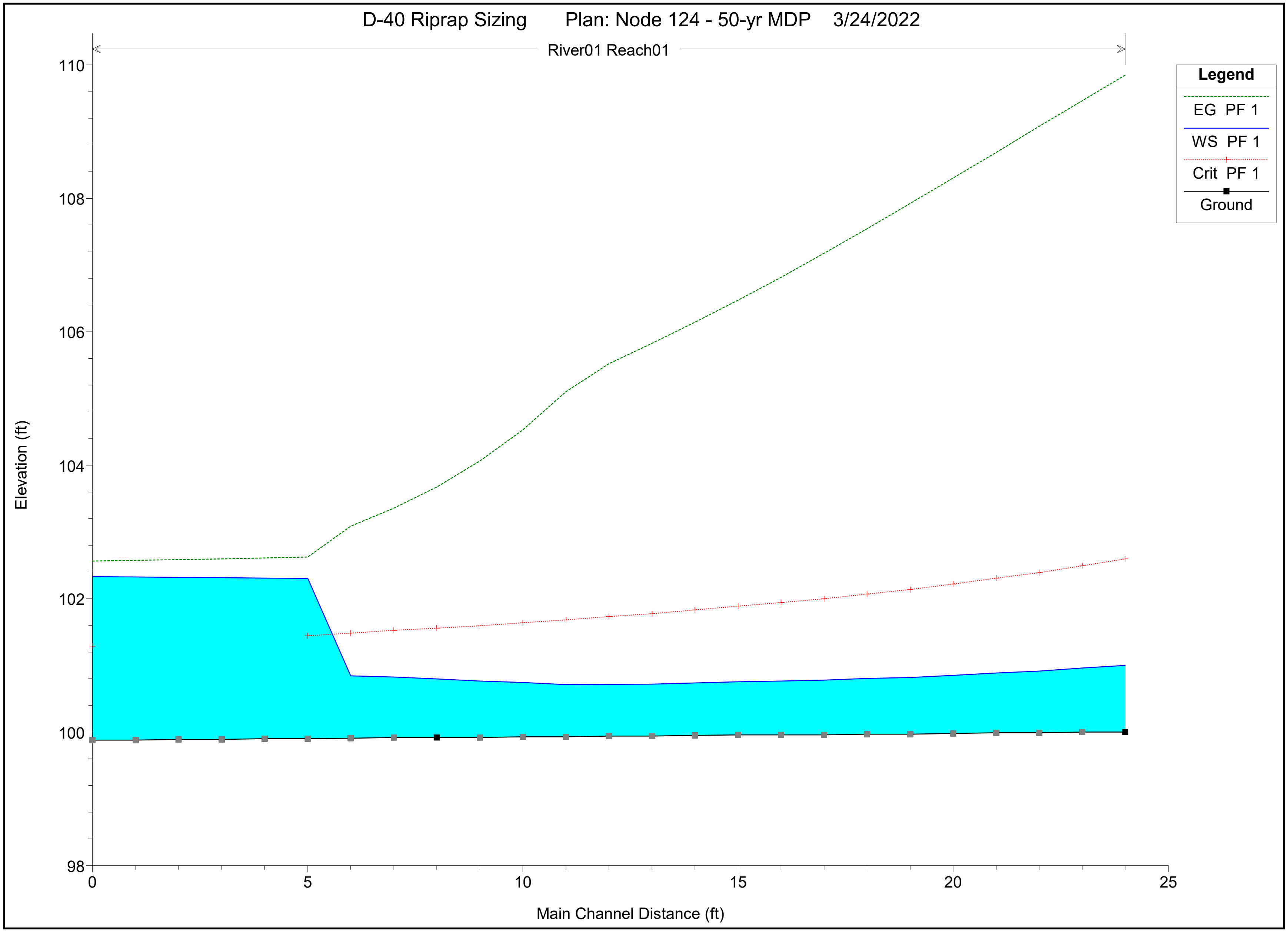
River = River01   Reach = Reach01   RS = 84   D-40 End of transition from 2D wide to 3D wide



D-40 Riprap Sizing   Plan: Node 124 - 50-yr MDP   3/24/2022

River = River01   Reach = Reach01   RS = 76.000*



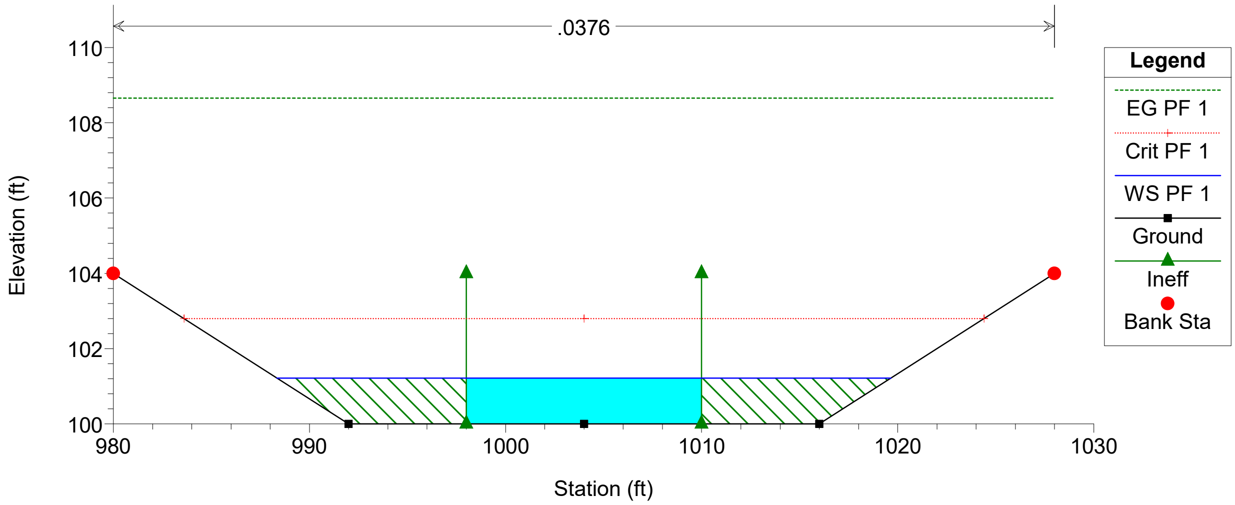

D-40 Riprap Sizing Plan: Node 124 - 50-yr MDP 3/24/2022
River01 Reach01
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
110
108
106
104
102
100
98
0
5
10
15
20
25
Main Channel Distance (ft)

HEC-RAS Plan: Node 221 - 50 yr River: River01 Reach: Reach01 Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Mann Wtd Chnl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		
Reach01	100	PF 1	320.22	100.00	101.22	102.80	108.66	0.234991	21.87	14.64	31.32	3.49	0.038
Reach01	99.000*	PF 1	320.22	100.00	101.19	102.72	108.35	0.232543	21.45	14.93	31.67	3.46	0.038
Reach01	98.000*	PF 1	320.22	99.99	101.16	102.64	108.03	0.229116	21.02	15.23	32.03	3.42	0.038
Reach01	97.000*	PF 1	320.22	99.99	101.14	102.58	107.72	0.223842	20.56	15.57	32.42	3.38	0.038
Reach01	96.000*	PF 1	320.22	99.98	101.12	102.51	107.41	0.218772	20.13	15.91	32.82	3.33	0.038
Reach01	95.000*	PF 1	320.22	99.97	101.09	102.44	107.12	0.213132	19.69	16.26	33.23	3.28	0.038
Reach01	94.000*	PF 1	320.22	99.97	101.08	102.38	106.82	0.205800	19.22	16.66	33.66	3.22	0.038
Reach01	93.000*	PF 1	320.22	99.96	101.06	102.32	106.54	0.199075	18.79	17.05	34.10	3.16	0.038
Reach01	92.000*	PF 1	320.22	99.96	101.05	102.27	106.27	0.191080	18.32	17.48	34.55	3.09	0.038
Reach01	91.000*	PF 1	320.22	99.96	101.05	102.23	106.01	0.182946	17.86	17.93	35.02	3.02	0.038
Reach01	90.000*	PF 1	320.22	99.95	101.03	102.17	105.76	0.175755	17.44	18.36	35.48	2.96	0.038
Reach01	89.000*	PF 1	320.22	99.94	101.01	102.12	105.52	0.168511	17.02	18.81	35.95	2.89	0.038
Reach01	88.000*	PF 1	320.22	99.94	101.01	102.08	105.27	0.159279	16.55	19.35	36.45	2.81	0.038
Reach01	87.000*	PF 1	320.22	99.93	101.00	102.03	105.06	0.152294	16.15	19.83	36.93	2.75	0.038
Reach01	86.000*	PF 1	320.22	99.93	101.00	101.99	104.85	0.144384	15.73	20.36	37.43	2.68	0.038
Reach01	85.000*	PF 1	320.22	99.92	100.99	101.95	104.64	0.137075	15.32	20.90	37.93	2.61	0.038
Reach01	84.000*	PF 1	320.22	99.92	101.00	101.91	104.41	0.197535	14.80	21.63	38.49	2.51	0.047
Reach01	83.000*	PF 1	320.22	99.92	101.02	101.88	104.13	0.175485	14.15	22.63	39.12	2.37	0.047
Reach01	82.000*	PF 1	320.22	99.91	101.03	101.84	103.90	0.158123	13.58	23.58	39.74	2.26	0.047
Reach01	81.000*	PF 1	320.22	99.90	101.04	101.80	103.68	0.142509	13.04	24.56	40.35	2.15	0.047
Reach01	80.000*	PF 1	320.22	99.90	101.07	101.77	103.49	0.127122	12.49	25.65	40.99	2.04	0.047
Reach01	79.000*	PF 1	320.22	99.89	102.65	101.73	103.06	0.006911	5.17	61.99	51.03	0.55	0.047
Reach01	78.000*	PF 1	320.22	99.89	102.65		103.05	0.006566	5.04	63.51	51.57	0.53	0.047
Reach01	77.000*	PF 1	320.22	99.88	102.66		103.03	0.006161	4.90	65.29	52.17	0.52	0.047
Reach01	76	PF 1	320.22	99.88	102.66		103.02	0.005880	4.80	66.77	52.69	0.51	0.047
Reach01	75.000*	PF 1	320.22	99.87	102.67		103.01	0.005535	4.67	68.56	52.79	0.49	0.047
Reach01	74.000*	PF 1	320.22	99.87	102.67		103.00	0.005296	4.57	70.03	52.81	0.48	0.047
Reach01	73.000*	PF 1	320.22	99.86	102.68	101.55	102.99	0.005000	4.46	71.82	52.90	0.47	0.047

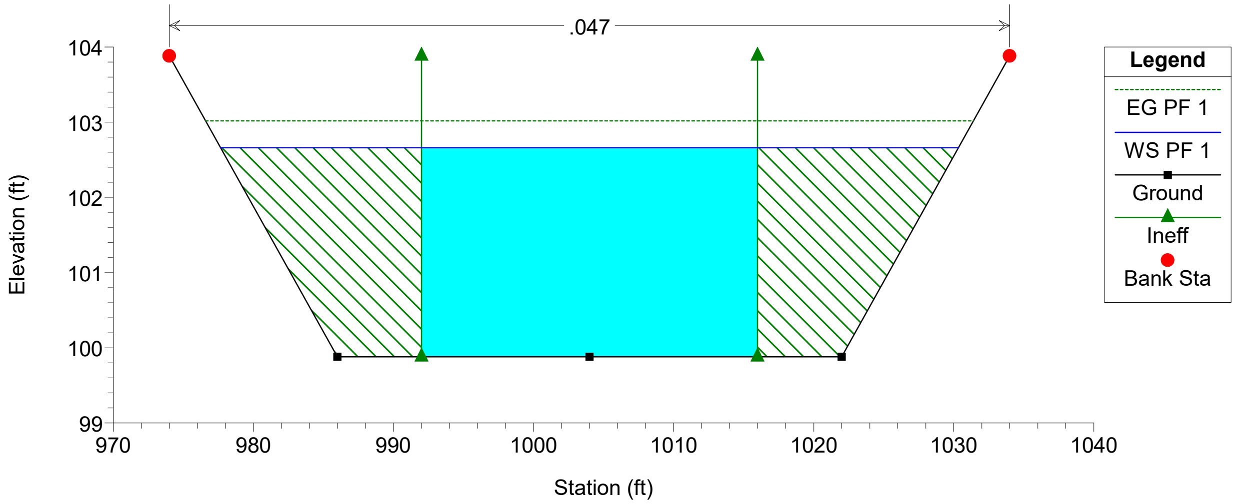
D-40 Riprap Sizing Plan: Node 221 - 50-yr MDP 3/24/2022

River = River01 Reach = Reach01 RS = 100 Start of D-40 instantaneously outside of storm drain pipe



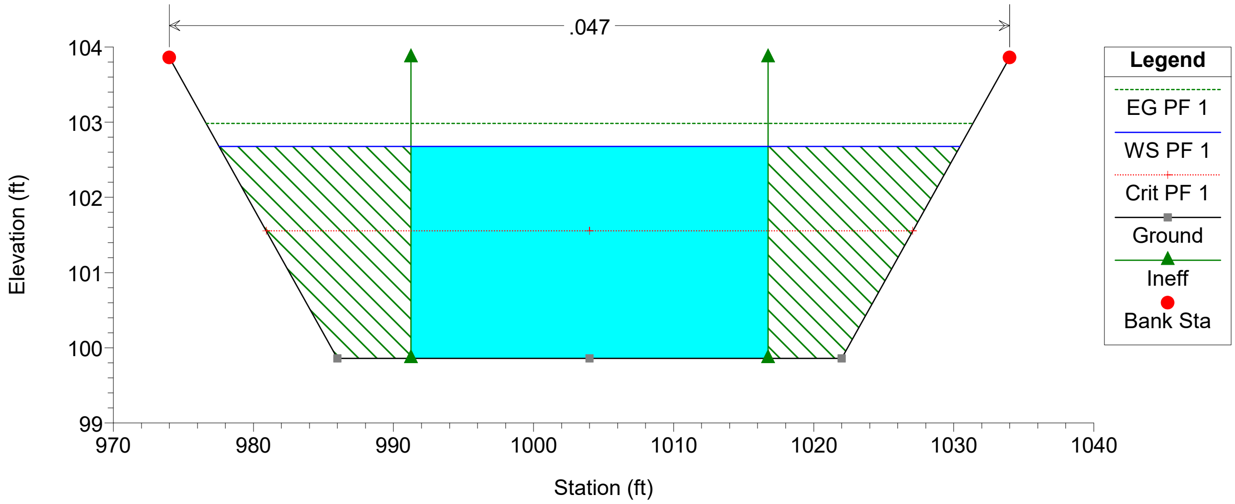
D-40 Riprap Sizing Plan: Node 221 - 50-yr MDP 3/24/2022

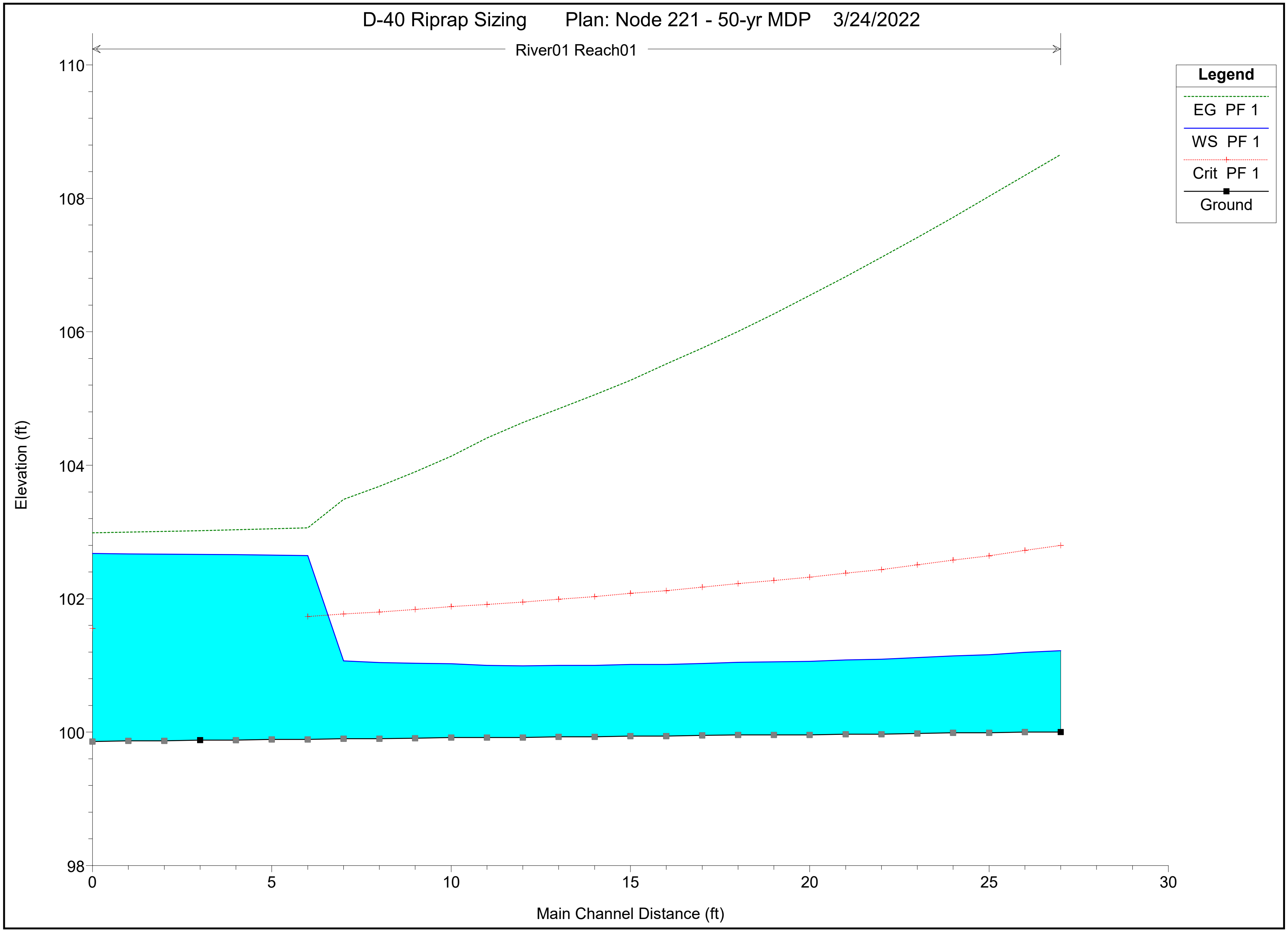
River = River01 Reach = Reach01 RS = 76 D-40 End of transition from 2D wide to 3D wide



D-40 Riprap Sizing Plan: Node 221 - 50-yr MDP 3/24/2022

River = River01 Reach = Reach01 RS = 73.000*




D-40 Riprap Sizing Plan: Node 221 - 50-yr MDP 3/24/2022
River01 Reach01
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
110
108
106
104
102
100
98
0
5
10
15
20
25
30
Main Channel Distance (ft)

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.

PRELIMINARY
GEOTECHNICAL INVESTIGATION

NIRVANA INDUSTRIAL BUILDINGS
AND SELF STORAGE COMPLEX
821 MAIN STREET
CHULA VISTA, CALIFORNIA

PREPARED FOR

VWP-OP NIRVANA OWNER, LLC
PHOENIX, ARIZONA

SEPTEMBER 14, 2021
PROJECT NO. G2755-42-01

Project No. G2755-42-01
September 14, 2021

VWP-OP Nirvana Owner, LLC
2390 East Camelback Road, Suite 305
Phoenix, Arizona 85016

Attention: Mr. Steven Schwarz

Subject: PRELIMINARY GEOTECHNICAL INVESTIGATION
NIRVANA INDUSTRIAL BUILDINGS
AND SELF STORAGE COMPLEX
821 MAIN STREET
CHULA VISTA, CALIFORNIA

Dear Mr. Schwarz:

In accordance with your request, we have prepared this preliminary geotechnical investigation report for the proposed industrial buildings at the subject site. The site is underlain by Tertiary-age Otay Formation mantled by Very Old Paralic Deposits, alluvium, topsoil, and slope wash. Minor amounts of undocumented fill are also present on the property.

This report is based on review of available published geotechnical reports and literature, a previous subsurface geotechnical exploration by others, a site reconnaissance, observations made during our field investigation performed between July 29, 2021 and August 8. 2021, and laboratory testing. Based on the results of this study, we opine that the subject site is suitable for construction of the proposed industrial buildings. The accompanying report includes the results of our study and conclusions and recommendations regarding geotechnical aspects of site development.

Should you have questions regarding this investigation, or if we may be of further service, please contact the undersigned at your convenience.

Very truly yours,

GEOCON INCORPORATED

Rodney C. Mikesell
GE 2533

REGISTERED PROFESSIONAL ENGINEER
RODNEY C. MIKESELL
No.2533
GEOTECHNICAL
STATE OF CALIFORNIA

Rupert Adams
CEG 2561

PROFESSIONAL GEOLOGIST
RUPERT S. ADAMS
NO. 2561
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

RCM:RSA:arm

(e-mail) Addressee

TABLE OF CONTENTS

TABLE OF CONTENTS (Concluded)

PRELIMINARY GEOTECHNICAL INVESTIGATION

1. PURPOSE AND SCOPE

This report contains the results of our preliminary geotechnical investigation for proposed industrial buildings and self-storage facility located at 821 Main Street, in Chula Vista, California (see Vicinity Map).

Vicinity Map

The purpose of our investigation was to evaluate subsurface soil and geologic conditions at the site and provide conclusions and recommendations pertaining to geotechnical aspects of developing the property as proposed.

The scope of our study included performing a site reconnaissance and geologic mapping, reviewing readily available published geologic literature pertinent to the property, reviewing available geotechnical reports on this property and in the site vicinity (see List of References), and excavating and logging eight backhoe test pits and five large diameter borings. Appendix A presents a discussion of our field investigation. We performed laboratory tests on soil samples obtained from the exploratory test pits to evaluate pertinent physical properties for engineering analyses. The results of laboratory testing are presented in Appendix B. Exploratory borings and trenches performed by others is provided in Appendix C.

Site geologic conditions are depicted on Figure 1 (Geologic Map). A CAD file of the preliminary grading study prepared by Pasco Laret Suiter & Associates was utilized as a base map to plot geologic contacts and exploratory excavation locations.

The conclusions and recommendations presented herein are based on our analysis of the data obtained during the investigation, and our experience with similar soil and geologic conditions on this and adjacent properties.

2. SITE AND PROJECT DESCRIPTION

The subject site encompasses approximately 13 acres of undeveloped land bounded on the north by automobile salvage yards, on the west by commercial buildings, on the south by Main Street and the Otay Riverbed, and on the east by the Otay Ranch Village 3 development. The property consists of natural, south-facing sloping terrain with elevations ranging from approximately 135 feet above mean sea level (MSL) to 220 feet MSL, with ephemeral drainages at the west and east ends of the property and one in the central area of the site. A storm drain pipe outlets near the toe of a fill slope at the upstream end of the central drainage. Storm water runoff then travels through the central drainage to a storm drain inlet near the southern property line. Trash, tires and debris are present in the drainage areas.

Proposed site development includes constructing four industrial buildings totaling approximately 290,500 square-feet, with associated improvements including utilities, paving, storm water management devices, and landscape improvements. One of the four proposed industrial buildings will be a self-storage facility. Proposed cuts and fills are estimated to be up to 50 feet, with proposed new slopes up to approximately 10 feet in height. Retaining walls are planned on north, south, and west sides of the site. The walls will have heights up to approximately 40 feet. A soil nail wall is planned along the majority of the northern property margin where cuts will be made to reach pad grade. In the central portion of the site the soil nail wall will transition into a mechanically stabilized earth (MSE) wall where fill is planned to reach pad grades. Along the south and west sides of the property MSE walls are planned to create proposed pad grades. New 72-inch-diameter and 60-inch-diameter storm drains will be installed on the property to convey storm water runoff from the properties to the north to a storm drain system below Main Street. Paved parking lots and driveways are planned along the perimeter of the site. Site access will be from Nirvana Street at the northwest corner of the property.

The locations and descriptions of the site and proposed development are based on our site reconnaissance and recent field investigations, and our understanding of site development as shown on the preliminary grading study prepared by Pasco Laret Suiter & Associates. If project details vary significantly from those described, Geocon Incorporated should be contacted to review the changes and provide additional analyses and/or revisions to this report, if warranted.

3. SOIL AND GEOLOGIC CONDITIONS

Based on the results of the field investigation, the site is underlain by Tertiary Otay Formation capped with Terrace Deposits, alluvium, topsoil, slope wash, and undocumented fill. A description of the soil and geologic conditions is provided below. Mapped geologic conditions are depicted on the *Geologic Map* (Figure 1), and on the *Geologic Cross Sections* (Figure 2). Exploratory boring and test pit logs are presented in Appendix A.

3.1 Undocumented Fill (Qudf)

A prism of undocumented fill is mapped within the north-central portion of the site at the upstream end of the drainage. Some end-dumped piles of undocumented fill generally consisting of silty to clayey sand with cobbles is present on the property. Trash piles consisting of construction debris, auto parts and tires are also present at the site.

Undocumented fill and trash are unsuitable for support of structural fill and improvements. Undocumented fill should be removed and replaced as compacted fill. Trash should be hauled offsite prior to grading and not mixed with the fills.

3.2 Slope Wash (Unmapped)

Steep, south-facing slopes are mantled with up to two feet of Holocene-age slope wash soils consisting of loose, dry, silty sand and sandy silt with cobble. The slope wash soils obscure the contact between the Terrance Deposits and the underlying Otay Formation, and the surface outcrop of bentonitic claystone beds within the Otay Formation.

The slope wash is compressible and possesses a “very low” to “high” expansion potential (expansion index of 130 or less). Slope wash should be removed during grading. Due to the limited thickness and extent of these deposits, slope wash is not shown on the Geologic Map (Figure 1).

3.3 Topsoil (Unmapped)

Holocene-age topsoil is present as a relatively thin veneer locally overlying surficial and formational materials. The topsoil has a thickness of up to two feet and can be characterized as soft to stiff and loose to medium dense, dry to damp, dark brown, sandy clay to clayey sand with gravel and cobble. The topsoil is typically compressible and possesses a “very low” to “high” expansion potential (expansion index of 130 or less). Removal of the topsoil will be necessary within the limits of grading in areas supporting proposed fill or improvements. Due the limited thickness and extent of these deposits, topsoil is not shown on the Geologic Map (Figure 1).

3.4 Alluvium (Qal)

Alluvium is present in the shallow, north-south trending drainages (Figure 1). The thickness of the alluvium is unknown, but previous studies indicate that it is at least five feet deep below existing grade. The alluvium generally consists of loose to medium dense to dense, silty to clayey sand with gravel and cobble. Removal of the alluvium will be necessary within the limits of grading in areas supporting proposed fill or improvements.

3.5 Terrace Deposits (Qt)

Pleistocene-age Terrace Deposits, also referred to as Old Alluvial Deposits, cap most of the site. Terrace Deposit thickness ranges between approximately 4 to 30 feet. The Terrace Deposits are generally dense to very dense, reddish brown, silty to clayey sand with gravel and cobble. The lower portions of the unit contain higher volume of larger cobbles and boulder-sized material up to about three feet in diameter. The Terrace Deposits are suitable for the support of proposed fill and structural loads; however, select grading and/or onsite screening operations will be required to properly place the cobble- and boulder-sized material in deeper fill areas, and generate soils suitable for mechanically stabilized earth (MSE) wall construction.

3.6 Otay Formation (To)

The Tertiary-age (upper Oligocene) Otay Formation is exposed in the lower portion of the slope adjacent to Main Street and underlies the Terrace Deposits across the site. The Otay Formation consists of dense, silty, fine- to coarse-grained sandstone, clayey and sandy siltstone, and silty claystone with continuous and discontinuous interbeds of highly expansive bentonitic claystone. The coarse-grained portions of the Otay Formation typically possess a “very low” to “low” expansion potential (expansion index of 50 or less) and adequate shear strength. The fine-grained siltstone and claystone portions of the formation can exhibit a “medium” to “very high” expansion potential (expansion index greater than 50). The Otay Formation is suitable for the support of compacted fill and structural loads. Bentonitic claystone located within 5 feet of finish pad grade or within 2 feet of the bottom of structural footings will need to be undercut during grading and placed in deeper fill areas.

We identified two bentonitic claystone beds in large diameter borings, between 2 and 10 feet in thickness, extending under the site at elevations ranging between 145-155 feet MSL and 175-185 feet MSL. The bentonitic claystone beds consist of highly expansive clays, which typically exhibit low shear strength. Remolded clay seams referred to as bedding plane shears can develop on or within bentonitic claystone beds which can form landslide failure surfaces.

4. GEOLOGIC STRUCTURE

Bedding attitudes observed within formational materials during logging of large diameter brings for this study, and during investigation and grading of the adjacent Otay Ranch Village 3 site to the east, are approximately horizontal to slightly dipping toward the southwest. The regional dip of sedimentary units in the eastern Chula Vista area is generally 1 to 5 degrees toward the southwest. The granular portions of the formational units are typically massive with bedding not discernible. Bentonitic claystones and/or bedding plane shears create a possibility for slope instability and will require stabilization during grading. It is our opinion that the site geologic structure does not present a significant geologic hazard to the proposed development of the site provided the geotechnical recommendations in this report are incorporated into design and construction.

5. GROUNDWATER

We encountered seepage during the field investigation in several of our borings at depths ranging from 65 to 87 feet below existing grade (elevation 112 to 153 feet NGVD29) as shown in Table 5. The seepage depths recorded in borings LB-1 and LB-2 are considered most representative of conditions across the site. Seepage is likely a perched condition. The most likely location to encounter seepage is within the drainage areas and within backcuts for the lower retaining walls and/or stability buttresses. Although, we do not expect groundwater will significantly impact grading and construction of the planned improvements, management of seepage may be necessary if it is encountered during grading. It is not uncommon for groundwater or seepage conditions to develop where none previously existed. Groundwater and seepage is dependent on seasonal precipitation, irrigation, land use, among other factors, and varies as a result. Proper surface drainage will be important to future performance of the project.

TABLE 5
ESTIMATED SEEPAGE ELEVATION

Boring No.	Date Recorded	Approximate Depth of Groundwater Below Existing Grade (feet)	Approximate Elevation of Groundwater (feet, NVGD29)
LB-1	7/29/2021	68	116
LB-2	7/30/2021	87	112
LB-3	7/30/2021	72*	122*
LB-5	08/03/2021	65**	153**

* Seepage conditions
** Inferred from boring spoils

6. GEOLOGIC HAZARDS

6.1 Faulting and Seismicity

A review of the referenced geologic materials and our knowledge of the general area indicate that the site is not underlain by active faults. A fault strand related to the potentially active La Nacion Fault is mapped on regional fault maps transecting the west property boundary. A study performed by AGS (2014) did not encounter the fault in a fault trench excavation.

The La Nacion Fault is considered to be potentially active. However, it is our opinion that the potential for fault rupture on the site is considered to be low based on review of geologic literature for the area and our experience. Additional studies should be performed to evaluate if the fault is present on the property.

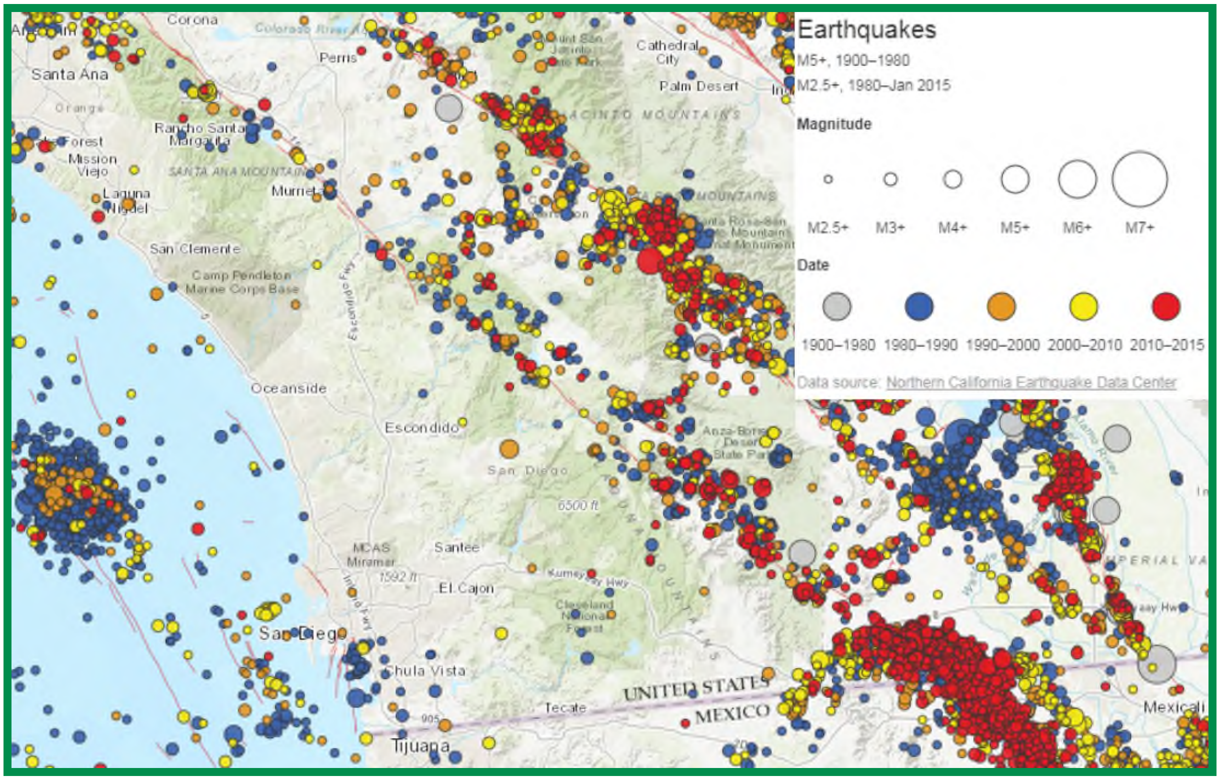
An active fault is defined by the California Geological Survey (CGS) as a fault showing evidence for activity within the last 11,700 years. The site is not located within a State of California Earthquake Fault Zone.

The USGS has developed a program to evaluate the approximate location of faulting in the area of properties. The following figure shows the location of the existing faulting in the San Diego County and Southern California region. The fault traces are shown as solid, dashed and dotted that represent well-constrained, moderately constrained and inferred, respectively. The fault line colors represent faults with ages less than 150 years (red), 15,000 years (orange), 130,000 years (green), 750,000 years (blue) and 1.6 million years (black).

Approximate Site Location

Faults in the San Diego Area

The San Diego County and Southern California region is seismically active. The following figure presents the occurrence of earthquakes with a magnitude greater than 2.5 from the period of 1900 through 2015 according to the Bay Area Earthquake Alliance website.



Earthquakes in Southern California

Considerations important in seismic design include the frequency and duration of motion and the soil conditions underlying the site. Seismic design of structures should be evaluated in accordance with the California Building Code (CBC) guidelines currently adopted by the local agency.

6.2 Ground Rupture

The risk associated with ground rupture hazard is low due to the absence of active faults at the subject site.

6.3 Storm Surge, Tsunamis, and Seiches

The site is located approximately seven miles from the Pacific Ocean and is at an elevation of about 138 feet or greater above Mean Sea Level (MSL). Therefore, the potential of storm surges and tsunami affecting the site is considered low.

The site is not located in the vicinity of or downstream from such bodies of water. Therefore, the risk of seiches affecting the site is negligible.

6.4 Flooding

According to maps produced by the Federal Emergency Management Agency (FEMA), the site is zoned as “Zone X – Minimal Flood Hazard.” Based on our review of FEMA flood maps, the risk of site flooding is low.

6.5 Liquefaction

Due to the lack of a permanent, near-surface groundwater table and the dense nature of the underlying geologic units on the property, the potential for liquefaction is low.

6.6 Landslides

We did not observe evidence of previous or incipient slope instability at the site during our study. Published geologic mapping indicates landslides are not present on or immediately adjacent to the site. Therefore, the risk of landsliding at the site is low.

6.7 Expansive Soil

The fine-grained clay beds within the Otay Formation may possess a “high” to “very high” expansion potential (expansion index of 91 to greater than 130). We expect topsoil, Terrace Deposits, and sandy portions of the Otay Formation will likely possess a “medium” to “high” expansive potential (Expansion Index of 51 to 130).

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 General

7.1.1 No soil or geologic conditions were observed that would preclude the development of the property as presently proposed provided that the recommendations of this report are followed.

7.1.2 The site is underlain by compressible surficial deposits consisting of undocumented fill, topsoil, slope wash, and alluvium, overlying Quaternary-age Terrace Deposits and Tertiary-age Otay Formation. We estimate the undocumented fill at the north end of the central drainage to be between ten to twenty feet thick. Topsoil and slope wash range from approximately one to four feet thick. The alluvium extends to depths greater than five feet and may be thicker in unexplored areas of the site. Minor amounts of trash and construction debris are present at the site that will require offsite disposal.

7.1.3 Undocumented fill, topsoil, slope wash, and alluvium are unsuitable in their present condition to support fill or settlement-sensitive structures and will require removal and recompaction.

7.1.4 Two bentonitic claystone beds within the Otay Formation identified as laterally continuous across the site require slope buttressing, stability fills, and consideration in wall design to provide stable slope conditions.

7.1.5 A concealed segment of the potentially active La Nacion Fault is mapped at a regional scale, crossing the western side of the property. We did not evaluate the presence or absence of this fault on the property during our investigation, but fault trenching performed by others did not identify the fault. Additional trenching will be necessary to determine if the fault crosses the property.

7.1.6 Based on the current grading plan, an east-west trending cut to fill- transition will be present at finish grade. The cut side of the transition will need to be undercut in building pads to reduce differential settlement across the transition.

7.1.7 Excavation to reach pad grades will also expose an expansive claystone bed at or near finish pad grade. The claystone bed will need to be undercut during grading where it is present within 5 feet of finish pad grade or 2 feet below the bottom of footings. Grading should be planned to bury the expansive clay in deeper fill areas, outside of wall backfill zones, and at least 15 feet from the face of slopes.

7.1.8 Gravel and cobble greater than six inches in diameter is present in portions of the Terrace Deposits. Selective grading and potentially screening will be necessary if the cobble Terrace Deposits will be utilized as MSE wall backfill.

7.1.9 We encountered seepage in exploratory borings; however, we don't expect groundwater will be a constraint to project development. Seepage within surficial soils and formational materials may be encountered during grading operations, especially during the rainy seasons.

7.1.10 Except for possible strong seismic shaking and slope instability, no significant geologic hazards were observed or are known to exist on the site that would adversely affect the site. No special seismic design considerations, other than those recommended herein, are required. Slope stabilization requirements are discussed in the grading section of this report.

7.1.11 Proper drainage should be maintained in order to preserve the engineering properties of the fill in both the building pads and slope areas. Recommendations for site drainage are provided herein.

7.1.12 We did not perform infiltration testing as part of this study as preliminary design plans were not available. Due to the proposed MSE walls and deep fills required in the south (down-gradient) portion of the site needed to create a level building pad, infiltration of storm water is not recommended on this site.

7.1.13 Provided the recommendations of this report are followed, it is our opinion that the proposed development will not destabilize or result in settlement of adjacent properties or the City right-of-way.

7.1.14 Subsurface conditions observed may be extrapolated to reflect general soil/geologic conditions; however, some variations in subsurface conditions between boring and test pit locations should be anticipated.

7.2 Soil and Excavation Characteristics

7.2.1 The recommendations included herein are provided for stable excavations. It is the responsibility of the contractor and their competent person to ensure all excavations, temporary slopes and trenches are properly constructed and maintained in accordance with applicable OSHA guidelines in order to maintain safety and the stability of the excavations and adjacent improvements. These excavations should not be allowed to become saturated or to dry out. Surcharge loads should not be permitted to a distance equal to the height of the excavation from the top of the excavation. The top of the excavation should be a minimum of 15 feet from the edge of existing improvements. Excavations steeper than those recommended or closer than 15 feet from an existing surface improvement should be shored in accordance with applicable OSHA codes and regulations.

7.2.2 The stability of the excavations is dependent on the design and construction of the shoring system and site conditions. Therefore, Geocon Incorporated cannot be responsible for site safety and the stability of the proposed excavations.

7.2.3 Excavation of undocumented fill and surficial deposits should be possible with moderate to heavy effort using conventional heavy-duty equipment. We expect excavation of the Terrace Deposits and the Otay Formation will require moderate to very heavy effort. Weakly to moderately cemented gravel and/or cobble and zones may be encountered requiring very heavy effort to excavate.

7.2.4 The soil encountered in the field investigation is considered to be both “non-expansive” (expansion index [EI] of 20 and less) and “expansive” (EI greater than 20) as defined by 2019 California Building Code (CBC) Section 1803.5.3. Table 7.2.1 presents soil classifications based on the expansion index. We expect the majority of the soils that will be encountered in remedial grading and cut areas will have a “low” to “medium” expansion potential. Portions of the topsoil and the clay beds possess a “high” to “very high” expansion potential (EI greater than 90).

TABLE 7.2.1
EXPANSION CLASSIFICATION BASED ON EXPANSION INDEX

Expansion Index (EI)	ASTM D 4829 Expansion Classification	2019 CBC Expansion Classification
0 – 20	Very Low	Non-Expansive
21 – 50	Low	Expansive
51 – 90	Medium	
91 – 130	High	
Greater Than 130	Very High	

7.2.5 We performed laboratory tests on samples of the site materials to evaluate the percentage of water-soluble sulfate content. Appendix B presents results of the laboratory water-soluble sulfate content tests. The test results indicate the on-site materials at the locations tested possess “S0” sulfate exposure to concrete structures as defined by 2019 CBC Section 1904 and ACI 318-14 Chapter 19. Table 7.2.2 presents a summary of concrete requirements set forth by 2019 CBC Section 1904 and ACI 318. The presence of water-soluble sulfates is not a visually discernible characteristic; therefore, other soil samples from the site could yield different concentrations. Additionally, over time landscaping activities (i.e., addition of fertilizers and other soil nutrients) may affect the concentration.

TABLE 7.2.2
REQUIREMENTS FOR CONCRETE EXPOSED TO SULFATE-CONTAINING SOLUTIONS

Exposure Class	Water-Soluble Sulfate (SO_4) Percent by Weight	Cement Type (ASTM C 150)	Maximum Water to Cement Ratio by Weight[1]	Minimum Compressive Strength (psi)
S0	$SO_4<0.10$	No Type Restriction	n/a	2,500
S1	$0.10\leq SO_4<0.20$	II	0.50	4,000
S2	$0.20\leq SO_4\leq 2.00$	V	0.45	4,500
S3	$SO_4>2.00$	V+Pozzolan or Slag	0.45	4,500

7.2.6 We tested samples for potential of hydrogen (pH) and resistivity and chloride to aid in evaluating the corrosion potential. Appendix B presents the laboratory test results.

7.2.7 Geocon Incorporated does not practice in the field of corrosion engineering. Therefore, further evaluation by a corrosion engineer may be needed if improvements susceptible to corrosion are planned.

7.3 Slope Stability

7.3.1 Slope stability analyses were performed to evaluate impacts the bentonitic claybeds have on the proposed project. A discussion of the slope stability analysis and the results of our analyses are discussed below and presented in Appendix D.

7.3.2 Based on our analysis, remedial grading to remove the claystone bed will be required within the existing hillside slope along the south and east sides of the property. Along the south side of the property, the backcut to enable placement of reinforcing grid for the MSE wall may sufficiently remove the claystone bed such that additional remedial removal is not required. Confirmation of this will be needed once wall design is complete and grid lengths are known. Where the wall backcut does not extend far enough into the hillside slope, additional clay bed removal will be required. The minimum removal length measured from the face of the wall is provided on the stability figures in Appendix D and cross sections on Figure 2. The front extent of the clay bed removal is shown on Figure 1.

7.3.3 On the east side of the site where the planned MSE wall terminates, a buttress will need to be constructed at the toe of the hillside slope below the planned MSE wall. The width of the required buttress measured from the toe of the slope is approximately 50 feet as shown on the Cross Section G-G (Figure 2) and on the stability figure in Appendix D. The estimated front extent of the clay bed removal is shown on Figure 1.

7.3.4 The recommended buttress/clay bed removal encompasses the area from the front key removal shown on Figure 1 and dipping into the slope at a minimum of 5 percent to the back of the recommended key width and then up at a 1:1 plane to where it intersects the existing ground surface as shown on the geologic cross sections (Figure 2). A typical buttress detail is shown on Figure 3.

7.3.5 Internal drainage of the buttress key should be constructed in accordance with Figure 3. The location of the heel drains and outlet points should be shown on the grading plans. All keyway and drainage features should be as-built in the field by the project civil engineer/surveyor.

7.3.6 A stability fill will also be needed along the top of the eastern slope where the clay bed is exposed on the slope face. The stability fill should have a minimum width of 15 feet measured from the slope face. The stability fill should include a back drain that outlets to the slope face. Subdrain cut off and head walls as shown in Section 7.7 of this report should be constructed. An outlet should be provided every approximately 100 feet of the stability fill.

7.3.7 The clay bed is expected to be present near the bottom of the wall cut along the north side of the property. The wall design will need to pin the clay bed to prevent slope instability. Geocon Incorporated can provide additional stability analysis and coordination with the wall designer, as needed.

7.3.8 Additional slope stability analysis should be performed to check buttress widths and limits once the MSE walls have been designed and grid type, location, and vertical spacing is known. Modifications to the buttress widths may be needed. Additional stability analysis should be performed on for the vertical slope supported by the soil nail wall once nail spacing and method to pin the claystone bed is known.

7.3.9 General slope stability analyses were performed for proposed cut and fill slopes up to 10 feet high (2:1 gradient). The stability analyses were performed using simplified Janbu analysis. The analyses indicate planned slopes above retaining walls will have a calculated factors of safety in excess of 1.5 under static conditions for both deep-seated failure and shallow sloughing conditions. Table 7.3.1 presents the slope stability analysis. Slope stability analysis for MSE walls should be performed once the wall design is complete and grid locations and lengths are known.

TABLE 7.3.1
SLOPE STABILITY EVALUATION

Parameter	Value
Slope Height, H	10 Feet
Slope Inclination, I (Horizontal to Vertical)	2:1
Total Soil Unit Weight, γ	130 pcf
Friction Angle, ϕ	28 Degrees
Cohesion, C	250 psf
Slope Factor $\lambda_{C\phi}$= (γHtanϕ)/C	2.8
NCf (From Chart)	14
Factor of Safety = (N_{Cf}C)/(γH)	2.7

7.3.10 Table 7.3.2 presents the surficial slope stability analysis for the proposed sloping conditions.

TABLE 7.3.2
SURFICIAL SLOPE STABILITY EVALUATION

Parameter	Value
Slope Height, H	∞
Vertical Depth of Saturation, Z	3 Feet
Slope Inclination, I (Horizontal to Vertical)	2:1 (26.6 Degrees)
Total Soil Unit Weight, γ	130 pcf
Water Unit Weight, γ_W	62.4 pcf
Friction Angle, ϕ	28 Degrees
Cohesion, C	250 psf
Factor of Safety = $(C+(\gamma+\gamma_W)Z\cos^2 I \tan\phi)/(\gamma Z \sin I \cos I)$	2.2

7.3.11 All cut slope excavations should be observed during grading by an engineering geologist to verify that soil and geologic conditions do not differ significantly from those anticipated.

7.4 Slope Grading

7.4.1 Construction of fill slopes should begin with excavation of a fill slope keyway in accordance with the Fill Slope Keyway detail shown in the *Recommended Grading Specifications* in Appendix E.

7.4.2 The outer 15 feet (or a distance equal to the height of the slope, whichever is less) of fill slopes should be composed of properly compacted granular “soil” fill to reduce the potential for surficial sloughing. In general, soils with an Expansion Index of less than 50 should be acceptable as “granular” fill. Soils of questionable strength to satisfy surficial stability should be tested in the laboratory for acceptable drained shear strength.

7.4.3 Fill slopes should be overbuilt at least three feet horizontally, and cut back to the design finish grade. As an alternative, fill slopes may be compacted by back-rolling at vertical intervals not to exceed four feet and then track-walking with a D-8 dozer, or equivalent, upon completion such that the fill soils are uniformly compacted to at least 90 percent relative compaction to the face of the finished slope.

7.4.4 All slopes should be landscaped with drought-tolerant vegetation, having variable root depths and requiring minimal landscape irrigation. In addition, all slopes should be drained and properly maintained to reduce erosion.

7.4.5 Grading budgets should be established that include selective grading to provide suitable soil for the wall backfill, stability buttresses, as well as the outer 15 feet (or a distance equal to the height of the slope, whichever is less) of fill slopes with properly compacted granular “soil” fill to reduce the potential for slope creep and surficial sloughing. In general, soil with an EI≤50 should be used within the outer slope zone. Minimum soil strength parameters for the stability buttresses is provided in the grading section.

7.5 Grading Recommendations

7.5.1 Grading should be performed in accordance with the recommendations provided in this report, the Recommended Grading Specifications contained in Appendix E and the City of Chula Vista’s Grading Ordinance. Where the recommendations of this section conflict with those of Appendix E, the recommendations of this section take precedence. Geocon Incorporated should observe the grading operations on a full-time basis and provide testing during the fill placement.

7.5.2 Prior to commencing grading, a preconstruction meeting should be held at the site with the City inspector, developer, grading and underground contractors, civil engineer, and geotechnical engineer in attendance. Special soil handling and/or the grading plans can be discussed at that time.

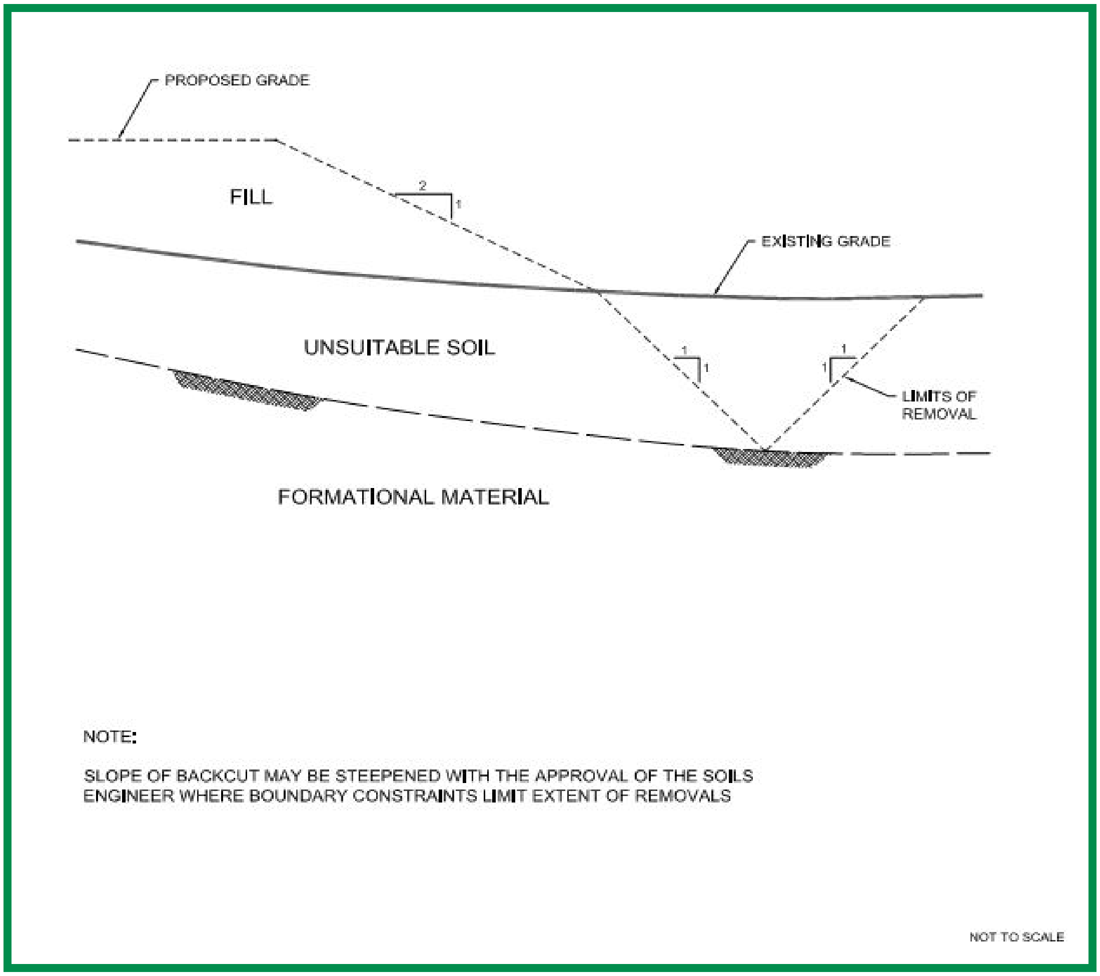
7.5.3 Site preparation should begin with the removal of deleterious material, trash and debris, and vegetation. The depth of vegetation removal should be such that material exposed in cut areas or soil to be used as fill is relatively free of organic matter. Material generated during stripping and/or site demolition should be exported from the site. Asphalt and concrete (if encountered) should not be mixed with the fill soil unless approved by the Geotechnical Engineer.

7.5.4 Abandoned foundations and buried utilities (if encountered) should be removed and the resulting depressions and/or trenches backfilled with properly compacted material as part of the remedial grading.

7.5.5 We recommend undocumented fill, topsoil, slope wash, and alluvium be removed to expose competent Terrace Deposits or Otay Formation and replaced as compacted fill throughout the site. Trash and debris may be encountered in the undocumented fill. Trash and debris, if encountered, should be removed from the fill and exported.

7.5.6 The actual depth of remedial removals should be determined in the field during grading by a representative of Geocon Incorporated prior to placement and compaction of fill.

7.5.7. Removals at the toes of slopes and in front of retaining walls should extend horizontally beyond the edge of the slope toe or wall a distance equal to the depth of removal. A typical detail of remedial grading beyond slope toes is presented below.



Typical Limit of Remedial Grading

7.5.8 Off-site grading within the adjacent property to the north will be required to remove the undocumented fill in the central drainage. Off-site grading will also be required to construct the stability buttress/fills on the eastern hillside slope.

7.5.9 Removal of the clay beds for slope stability purposes should be performed to the limits shown on Figures 1 and 2. Buttress and stability fills should be constructed as discussed in Section 7.3 of this report, Appendix D, and Figure 3. All fill placed within the buttress/stability fill area should meet the minimum strength requirement shown on the following table.

TABLE 7.5.1
RECOMMENDED SOIL STRENGTH PARAMETERS FOR BUTTRESS/STABILITY FILLS

Friction Angle (degrees)	Cohesion (psf)
28	250

7.5.10 Grading will result in fill to formation transitions across the building pads. To reduce the potential for differential settlement, the cut portion of the transition should be over-excavated (undercut) at least 5 feet below proposed finish grade or at least two foot below the lowest foundation element, whichever is deeper, and replaced with properly compacted "very low" to "low" expansive fill soils. Overexcavations should extend to a horizontal distance of at least 5 feet beyond the edge of the building pad and cut at a gradient of one percent toward the deepest fill area to provide drainage for moisture migration along the contact between the native soil and compacted fill.

7.5.11 We expect the bentonitic clay bed will be encountered near finish subgrade across the site. The clay bed should be undercut to a depth of at least 5 feet below finish subgrade or at least 2 feet below the lowest foundation element, whichever is deeper, and replaced with properly compacted "very low" to "low" expansive fill soils. The clay bed undercut should be performed within both the building pads and below all structural improvements (pavement, concrete flatwork, retaining walls, etc.).

7.5.12 Expansive soils should be placed in deeper fill areas, outside of the foundation, reinforced and retained zones of MSE walls, and at least five feet below pad grade or two feet below the deepest foundation element, whichever is deeper.

7.5.13 A summary of grading recommendations is shown on the table below.

TABLE 7.5.2
SUMMARY OF REMEDIAL REMOVALS AND GRADING RECOMMENDATIONS

Area	Removal Requirements
All Structural Improvement Areas	Remove all undocumented fill, topsoil, slope wash, and alluvium. Overexcavate clay bed to a depth of 5 feet below finish subgrade or 2 feet below building footing (whichever is deeper)
Building Pads with Cut to Fill Transition	Undercut building pad 5 feet below pad grade or 2 feet below bottom of building footings (whichever is deeper)
Fill Areas	Expansive Soil Buried at Least 5 Feet Below Pad Grade or at Least 2 Feet Below Bottom of Footings
Remedial Grading Limits	• 5 Feet Outside of Building Pads; • 2 Feet Outside of Improvement Areas; • Beyond toe of slopes and retaining walls a distance equal to the depth of the remedial excavation, where possible
Exposed Bottoms of Remedial Grading	Scarify Upper 12 Inches

7.5.14 Prior to fill soil being placed, the existing ground surface should be scarified, moisture conditioned as necessary, and compacted to a depth of at least 12 inches. Deeper removals may be required if saturated or loose fill soil is encountered. A representative of Geocon should be on-site during removals to evaluate the limits of the remedial grading.

7.5.15 The site should then be brought to final subgrade elevations with fill compacted in layers. In general, soil native to the site is suitable for use as fill if relatively free from vegetation, debris and other deleterious material. Layers of fill should be no thicker than will allow for adequate bonding and compaction. Fill, including backfill and scarified ground surfaces, should be compacted to a dry density of at least 90 percent of the laboratory maximum dry density near to slightly above optimum moisture content in accordance with ASTM Test Procedure D 1557. Fill materials placed below optimum moisture content may require additional moisture conditioning prior to placing additional fill.

7.5.16 Imported fill (if necessary) should consist of the characteristics presented in Table 7.5.3. Geocon Incorporated should be notified of the import soil source and should perform laboratory testing of import soil prior to its arrival at the site to determine its suitability as fill material.

TABLE 7.5.3
SUMMARY OF IMPORT FILL RECOMMENDATIONS

Soil Characteristic	Values
Expansion Potential	"Very Low" to "Low" (Expansion Index of 50 or less)
Particle Size	Maximum Dimension Less Than 3 Inches
	Generally Free of Debris

7.6 Earthwork Grading Factors

7.6.1 Estimates of shrink-swell factors are based on comparing laboratory compaction tests with the density of the material in its natural state and experience with similar soil types. Variations in natural soil density and compacted fill render shrinkage value estimates very approximate. As an example, the contractor can compact fill to a density of 90 percent or higher of the laboratory maximum dry density. Thus, the contractor has at least a 10 percent range of control over the fill volume. Based on the work performed to date and considering the discussion herein, the earthwork factors in the following table may be used as a basis for estimating how much the on-site soils may shrink or swell when removed from their natural state and placed as compacted fill.

TABLE 7.6
SHRINKAGE AND BULK FACTORS

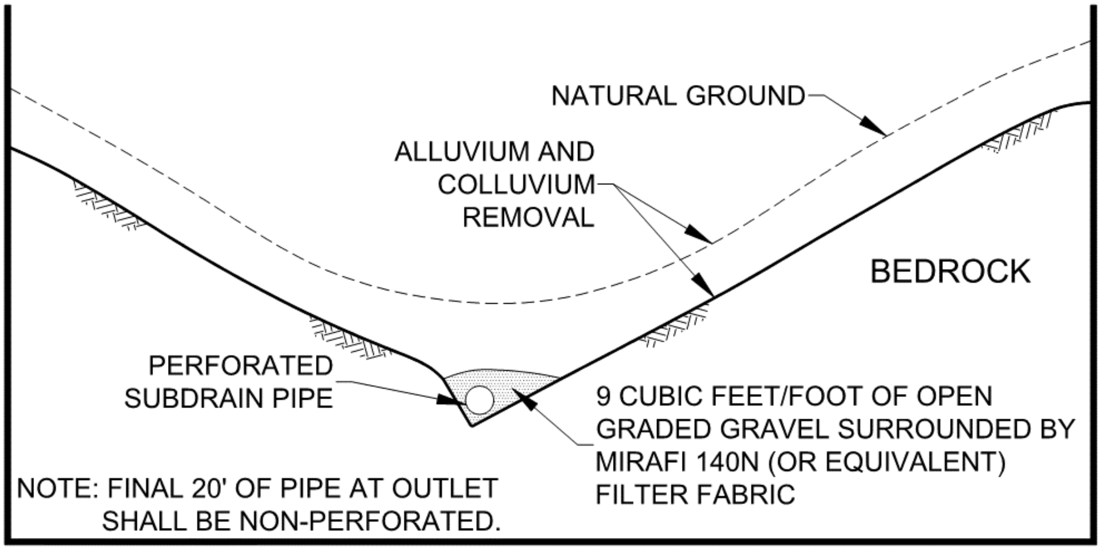
Soil Unit	Shrink/Bulk Factor
Undocumented Fill (Dumped; Qudf)	10-15% Shrink
Undocumented Fill (Previously Compacted; Qudf)	0-3% Shrink
Topsoil and slope wash (unmapped)	5-10% Shrink
Alluvium (Qal)	4-10% Shrink
Terrace Deposits (Qt)	0-5% Bulk
Otay Formation (To)	3-5% Bulk

7.7 Subdrains

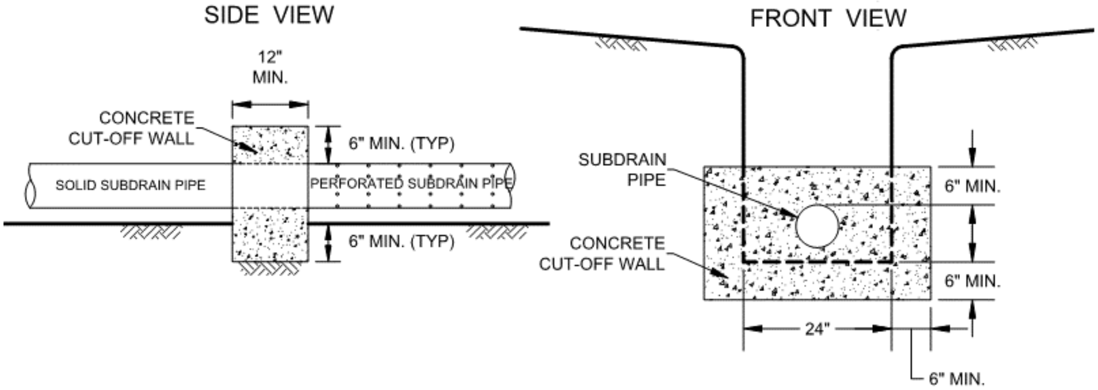
7.7.1 Subdrains should be installed in the canyon drainages that will be infilled. Typical subdrain installation details are presented below.

7.7.2 Canyon subdrains should be constructed from 6-inch Schedule 40 PVC pipe or equivalent. The approximate locations of proposed subdrains are shown on Figure 1. The recommended subdrain locations are based on anticipated site conditions prior to grading and are subject to change depending on the conditions encountered in the field.. Appropriate subdrain outlets should be evaluated prior to finalizing the grading plan.

7.7.3 The final 20-foot segment of a subdrain should consist of non-perforated drainpipe. At the non-perforated/perforated interface, a seepage cutoff wall should be constructed on the downslope side of the junction in accordance with the figure below. The subdrains should be tied into the storm drain system that outlets to Main Street.

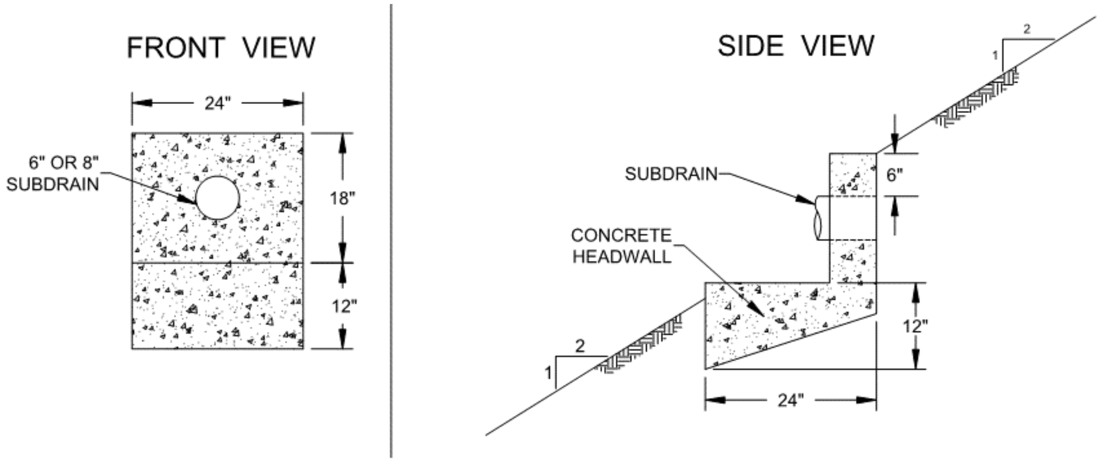


Typical Canyon Subdrain Detail



Typical Cutoff Wall Detail

7.7.4 Subdrains that discharge into a natural drainage course or open space area should be provided with a permanent headwall structure as shown herein.



Typical Headwall Detail

7.7.5 The final grading plans should show the location of the proposed subdrains. Upon completion of remedial excavations and subdrain installation, the project civil engineer should survey the drain locations and prepare an "as-built" map depicting the existing conditions. The final outlet and connection locations should be determined during grading. The grading contractor should consider videoing the subdrains shortly after burial to check proper installation and to check that the pipe has not been crushed. The contractor is responsible for the performance of the drains.

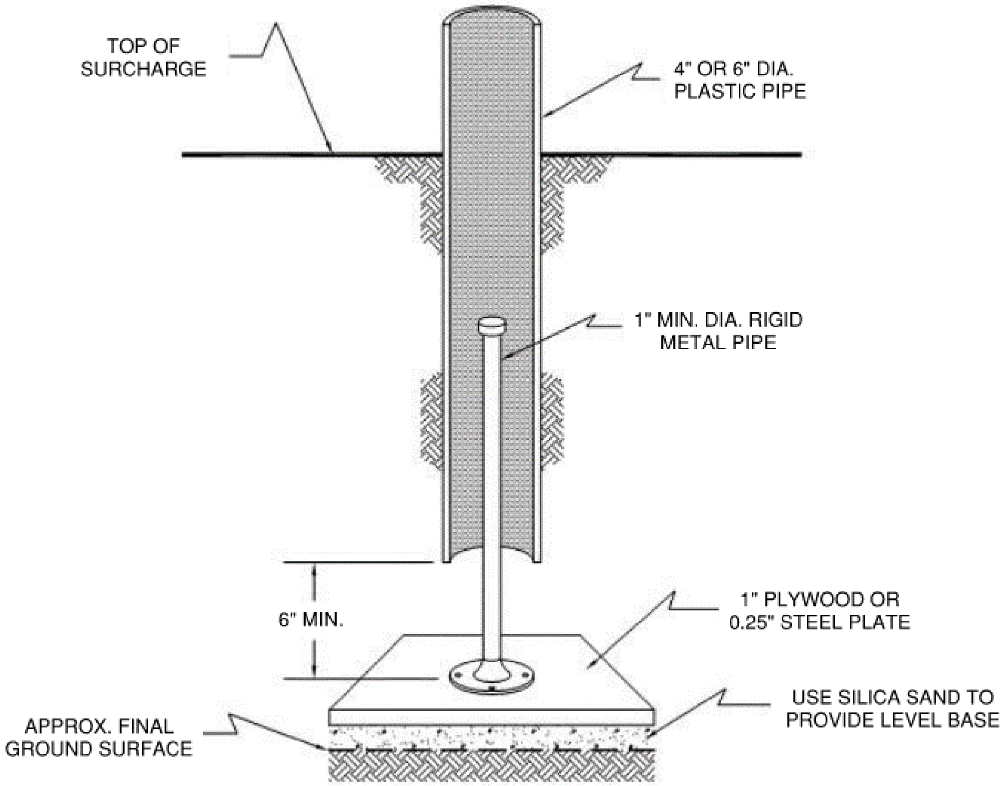
7.8 Settlement Monitoring

7.8.1 At the completion of grading, the south side of the site will be underlain by up to 45 feet of compacted fill behind MSE walls. Post-grading settlement (hydro-compression) of properly compacted new fill with a maximum thickness of 45 feet could be up to about 2.5 inches. We expect the settlement could occur over 20+ years depending on the influx of rain and irrigation water into the fill mass. This settlement will likely be linear from the time the fill is placed to the end of the settlement period. We do not expect the settlement will impact proposed utilities with proposed gradients of 1 percent or greater. The building foundation design should be designed to account for potential hydro-compression settlement. It has been our experience that developments/improvements, such as proposed, can be constructed with the planned fill depths and proposed settlements.

7.8.2 We expect settlement in the fill as a result of self-weight compression could take up to 3 to 9 months. If building foundations will be constructed shortly after completion of the fill mass, building foundations will need to be designed to accommodate differential settlement as a result of self-weight compression. If the planned structures cannot tolerate the expected movement, a construction waiting period should be implemented until settlement monitoring indicates self-weight compression has essentially ceased.

7.8.3 Due to the height of the MSE walls, we expect some settlement/lateral wall movement will occur. This could result in cracking in flatwork and pavement placed within the reinforced and retained zones of the wall.

7.8.4 At the south end of the property where fills are the greatest, we recommend settlement monuments be installed subsequent to the MSE wall construction. A typical settlement monument is shown below.



Settlement Plate Detail

7.8.5 Surveying of the surface monument should be performed by the project civil engineer every two weeks for at least four months with the results provided to Geocon for review. Settlement due to primary consolidation will be considered to have ceased when survey readings show a relatively level plateau of settlement data over 4 consecutive readings.

7.9 Seismic Design Criteria

7.9.1 Table 7.9.1 summarizes site-specific design criteria obtained from the 2019 California Building Code (CBC; Based on the 2018 International Building Code [IBC] and ASCE 7-16), Chapter 16 Structural Design, Section 1613 Earthquake Loads. We used the computer program *Seismic Design Maps*, provided by the Structural Engineers Association (SEA) to calculate the seismic design parameters. The short spectral response uses a period of 0.2 second. We evaluated the Site Class based on the discussion in Section 1613.2.2 of the 2019 CBC and Table 20.3-1 of ASCE 7-16. The values presented herein are for the risk-targeted maximum considered earthquake (MCE_R) for Site Classes C and D. The southern portion of the building will be underlain by compacted fill in excess of 40 feet. A Site Class D is appropriate for areas underlain by more than 20 feet of fill. The northern portion of the building pads will be underlain by shallow compacted fills. Site Class C is appropriate for this condition.

TABLE 7.9.1
2019 CBC SEISMIC DESIGN PARAMETERS

Parameter	Value		2019 CBC Reference
Site Class	C	D	Section 1613.2.2
MCE_R Ground Motion Spectral Response Acceleration – Class B (short), S_S	0.835g	0.835g	Figure 1613.2.1(1)
MCE_R Ground Motion Spectral Response Acceleration – Class B (1 sec), S_1	0.297g	0.297g	Figure 1613.2.1(2)
Site Coefficient, F_A	1.2	1.166	Table 1613.2.3(1)
Site Coefficient, F_V	1.5	2.007*	Table 1613.2.3(2)
Site Class Modified MCE_R Spectral Response Acceleration (short), S_{MS}	1.002g	0.973g	Section 1613.2.3 (Eqn 16-36)
Site Class Modified MCE_R Spectral Response Acceleration – (1 sec), S_{M1}	0.445g	0.595g*	Section 1613.2.3 (Eqn 16-37)
5% Damped Design Spectral Response Acceleration (short), S_{DS}	0.668g	0.649g	Section 1613.2.4 (Eqn 16-38)
5% Damped Design Spectral Response Acceleration (1 sec), S_{D1}	0.297g	0.397g*	Section 1613.2.4 (Eqn 16-39)

*****Using the code-based values presented in this table, in lieu of a performing a ground motion hazard analysis, requires the exceptions outlined in ASCE 7-16 Section 11.4.8 be followed by the project structural engineer. Per Section 11.4.8 of ASCE/SEI 7-16, a ground motion hazard analysis should be performed for projects for Site Class “E” sites with Ss greater than or equal to 1.0g and for Site Class “D” and “E” sites with S1 greater than 0.2g. Section 11.4.8 also provides exceptions which indicates that the ground motion hazard analysis may be waived provided the exceptions are followed.

7.9.2 Table 7.9.2 presents the mapped maximum considered geometric mean (MCE_G) seismic design parameters for projects located in Seismic Design Categories of D through F in accordance with ASCE 7-16.

TABLE 7.9.2
ASCE 7-16 PEAK GROUND ACCELERATION

Parameter	Value		ASCE 7-16 Reference
Site Class	C	D	Section 1613.2.2 (2019 CBC)
Mapped MCE_G Peak Ground Acceleration, PGA	0.365g	0.365g	Figure 22-7
Site Coefficient, F_{PGA}	1.2	1.235	Table 11.8-1
Site Class Modified MCE_G Peak Ground Acceleration, PGA_M	0.438g	0.451g	Section 11.8.3 (Eqn 11.8-1)

7.9.3 Conformance to the criteria in Tables 7.9.1 and 7.9.2 for seismic design does not constitute any kind of guarantee or assurance that significant structural damage or ground failure will not occur if a large earthquake occurs. The primary goal of seismic design is to protect life, not to avoid all damage, since such design may be economically prohibitive.

7.9.4 The project structural engineer and architect should evaluate the appropriate Risk Category and Seismic Design Category for the planned structures. The values presented herein assume a Risk Category of II and resulting in a Seismic Design Category D. Table 7.9.3 presents a summary of the risk categories.

TABLE 7.9.3
ASCE 7-16 RISK CATEGORIES

Risk Category	Building Use	Examples
I	Low risk to Human Life at Failure	Barn, Storage Shelter
II	Nominal Risk to Human Life at Failure (Buildings Not Designated as I, III or IV)	Residential, Commercial and Industrial Buildings
III	Substantial Risk to Human Life at Failure	Theaters, Lecture Halls, Dining Halls, Schools, Prisons, Small Healthcare Facilities, Infrastructure Plants, Storage for Explosives/Toxins
IV	Essential Facilities	Hazardous Material Facilities, Hospitals, Fire and Rescue, Emergency Shelters, Police Stations, Power Stations, Aviation Control Facilities, National Defense, Water Storage

7.10 Shallow Foundations

7.10.1 The proposed structure can be supported on a shallow foundation system bearing in compacted fill provided the grading and buttress recommendations provide in this report are followed. Foundations for the structure should consist of continuous strip footings and/or isolated spread footings. Table 7.10.1 provides a summary of the foundation design recommendations.

TABLE 7.10.1
SUMMARY OF FOUNDATION RECOMMENDATIONS

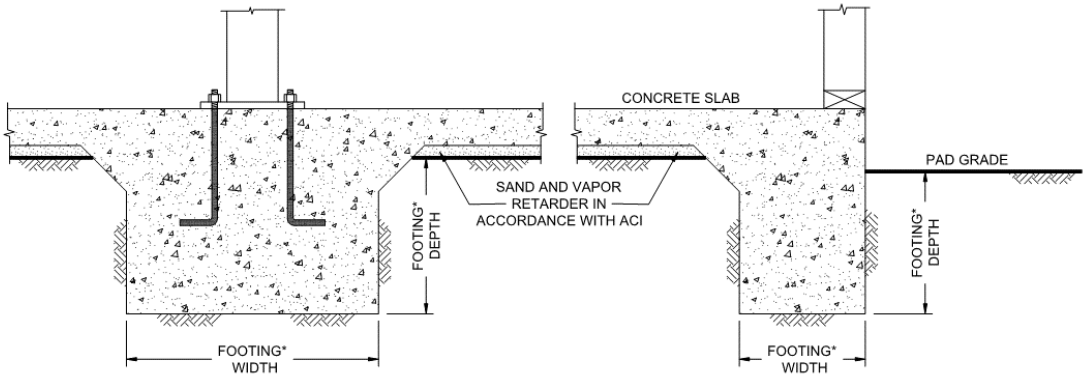
Parameter	Value
Minimum Continuous Foundation Width	12 inches
Minimum Isolated Foundation Width	24 inches
Minimum Foundation Depth	24 Inches Below Lowest Adjacent Grade
Minimum Steel Reinforcement	4 No. 5 Bars, 2 at the Top and 2 at the Bottom
Allowable Bearing Capacity	2,500 psf
Bearing Capacity Increase	500 psf per Foot of Depth
	300 psf per Foot of Width
Maximum Allowable Bearing Capacity	4,000 psf
Estimated Total Settlement	1 Inch
Estimated Static Differential Settlement	½ Inch in 40 Feet
Footing Size Used for Settlement	8-Foot Square
Design Expansion Index	50 or less

7.10.2 Additional settlement as a result of self-weight compression and hydro-compression could occur over the life of the structures. We estimate approximately 0.4 percent of the total fill thickness underlying the building pad. Self-weight compression is expected to occur over 3 to 9 months. Hydro-compression is expected to occur over a 20 year or more duration. The estimated fill thickness and total settlement as a result of self-weight compression and hydro-compression is shown on Table 7.10.2 and is in addition to the static settlement indicated on Table 7.10.1. The largest settlement over the shortest distance occurs in Buildings 2 and 3 that overlie the central drainage area. Foundations should be designed to accommodate total and differential settlement from both static loading and self-weight compression/hydro-compression.

TABLE 7.10.2
ESTIMATED FILL THICKNESS AND TOTAL AND DIFFERENTIAL FILL SETTLEMENT AS A RESULT OF SELF-WEIGHT AND HYDRO-COMPRESSION

Location	Estimated Compacted Fill Thickness in Building Pads (after grading) (feet)	Estimated Total Settlement (Self-Weight and Hydro-Compression) (inches)	Estimated Differential Settlement (Self-Weight and Hydro-Compression) (inches)
Building 1 (Southwest Corner)	30	1.5	1.25 inches over a span of 130 feet (angular distortion of 1/1250)
Building 1 (Northeast Half)	5	0.25	0.25 over a span of 140 feet (angular distortion of 1/6700)
Building 2 (Northeast Portion)	45	2.2	2 inches over a span of 60 feet (angular distortion of 1/360)
Building 2 (Southeast Portion)	50	2.4	2.2 inches over a span of 160 feet (angular distortion of 1/900
Building 2 (Western Half)	5	0.25	0.25 over a span of 120 feet (angular distortion of 1/5800)
Building 3 (Southwest Corner)	40	1.9	1.7 inches over a span of 60 feet (angular distortion of 1/425)
Building 3 (Northeast)	5	0.25	0.25 over a span of 110 feet (angular distortion of 1/5300)
Building 4	5	0.25	NA

7.10.3 The foundations should be embedded in accordance with the recommendations herein and the Wall/Column Footing Dimension Detail. The embedment depths should be measured from the lowest adjacent pad grade for both interior and exterior footings. Footings should be deepened such that the bottom outside edge of the footing is at least 7 feet horizontally from the face of the slope (unless designed with a post-tensioned foundation system as discussed herein).



Wall/Column Footing Dimension Detail

7.10.4 The bearing capacity values presented herein are for dead plus live loads and may be increased by one-third when considering transient loads due to wind or seismic forces.

7.10.5 Where buildings or other improvements are planned near the top of a slope steeper than 3:1 (horizontal:vertical), special foundations and/or design considerations are recommended due to the tendency for lateral soil movement to occur.

- For fill slopes less than 20 feet high or cut slopes regardless of height, footings should be deepened such that the bottom outside edge of the footing is at least 7 feet horizontally from the face of the slope.
- When located next to a descending 3:1 (horizontal:vertical) fill slope or steeper, the foundations should be extended to a depth where the minimum horizontal distance is equal to H/3 (where H equals the vertical distance from the top of the fill slope to the base of the fill soil) with a minimum of 7 feet but need not exceed 40 feet. The horizontal distance is measured from the outer, deepest edge of the footing to the face of the slope. A post-tensioned slab and foundation system or mat foundation system can be used to reduce the potential for distress in the structures associated with strain softening and lateral fill extension. Specific design parameters or recommendations for either of these alternatives can be provided once the building location and fill slope geometry have been determined.
- Although other improvements, which are relatively rigid or brittle, such as concrete flatwork or masonry walls, may experience some distress if located near the top of a slope, it is generally not economical to mitigate this potential. It may be possible, however, to incorporate design measures that would permit some lateral soil movement without causing extensive distress. Geocon Incorporated should be consulted for specific recommendations.

7.10.6 We should observe the foundation excavations prior to the placement of reinforcing steel and concrete to check that the exposed soil conditions are similar to those expected and that they have been extended to the appropriate bearing strata. Foundation modifications may be required if unexpected soil conditions are encountered.

7.10.7 Geocon Incorporated should be consulted to provide additional design parameters as required by the structural engineer.

7.11 Conventional Retaining Wall Recommendations

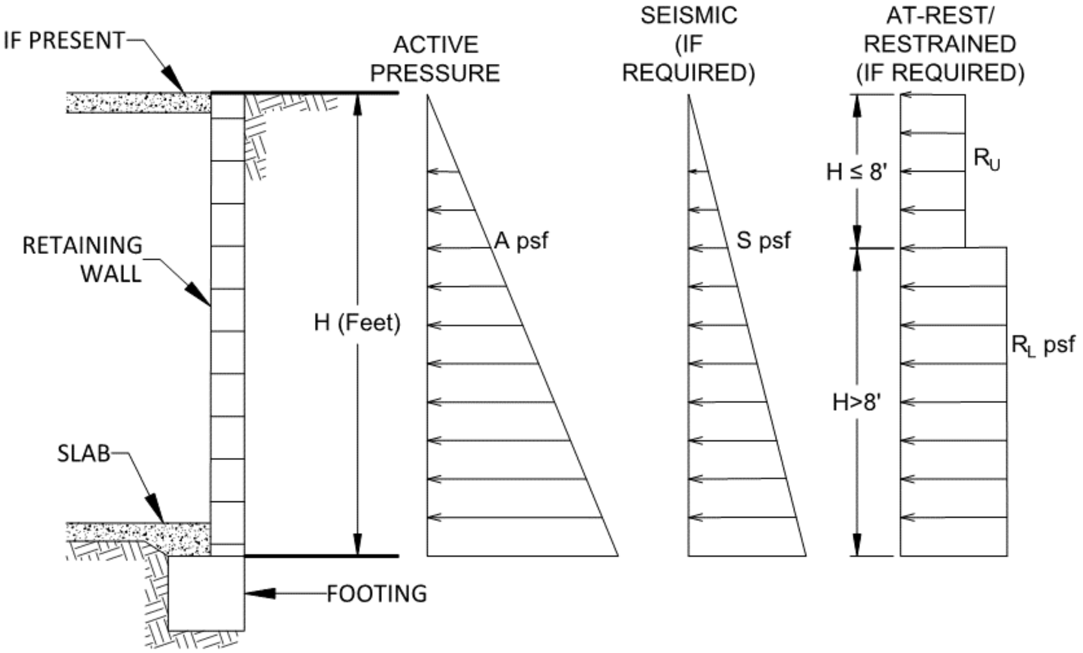
7.11.1 Retaining walls should be designed using the values presented in Table 7.11.1. Soil with an expansion index (EI) of greater than 50 should not be used as backfill soil behind retaining walls.

TABLE 6.11.1
RETAINING WALL DESIGN RECOMMENDATIONS

Parameter	Value
Active Soil Pressure, A (Fluid Density, Level Backfill)	35 pcf
Active Soil Pressure, A (Fluid Density, 2:1 Sloping Backfill)	50 pcf
Seismic Pressure, S	18H psf
At-Rest/Restrained Walls Additional Uniform Pressure (0 to 8 Feet High)	7H psf
At-Rest/Restrained Walls Additional Uniform Pressure (8+ Feet High)	13H psf
Expected Expansion Index for the Subject Property	EI≤50

H equals the height of the retaining portion of the wall

7.11.2 The project retaining walls should be designed as shown in the Retaining Wall Loading Diagram.



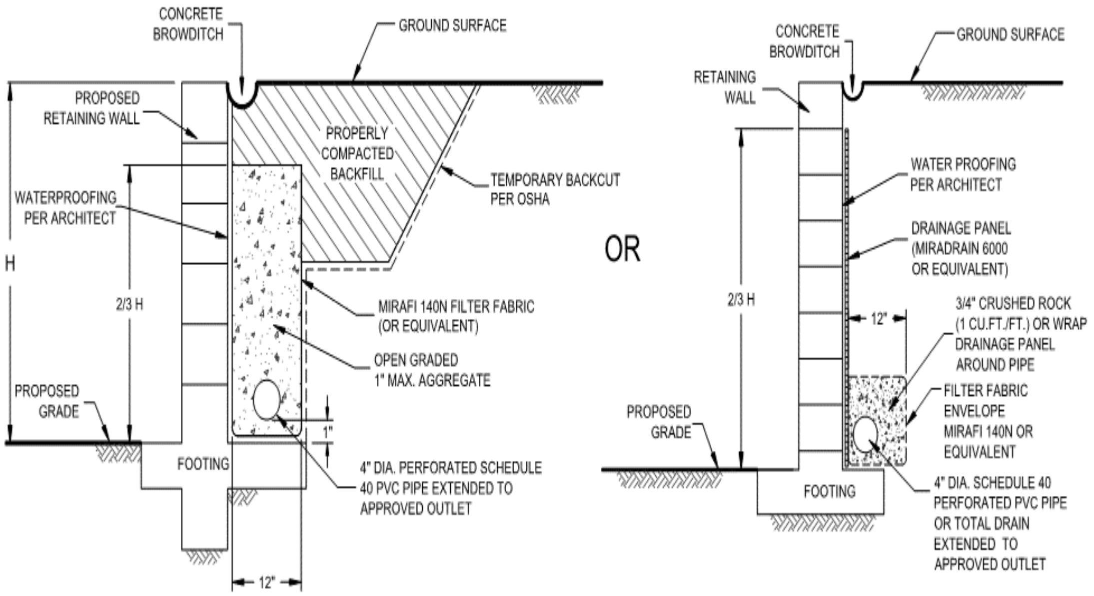
Retaining Wall Loading Diagram

7.11.3 Unrestrained walls are those that are allowed to rotate more than 0.001H (where H equals the height of the retaining portion of the wall) at the top of the wall. Where walls are restrained from movement at the top (at-rest condition), an additional uniform pressure should be applied to the wall. For retaining walls subject to vehicular loads within a horizontal distance equal to two-thirds the wall height, a surcharge equivalent to 2 feet of fill soil should be added.

7.11.4 The structural engineer should determine the Seismic Design Category for the project in accordance with Section 1613.2.5 of the 2019 CBC or Section 11.6 of ASCE 7-16. For structures assigned to Seismic Design Category of D, E, or F, retaining walls that support more than 6 feet of backfill should be designed with seismic lateral pressure in accordance with Section 1803.5.12 of the 2019 CBC. The seismic load is dependent on the retained height where H is the height of the wall, in feet, and the calculated loads result in pounds per square foot (psf) exerted at the base of the wall and zero at the top of the wall.

7.11.5 Retaining walls should be designed to ensure stability against overturning sliding, and excessive foundation pressure. Where a keyway is extended below the wall base with the intent to engage passive pressure and enhance sliding stability, it is not necessary to consider active pressure on the keyway.

7.11.6 Drainage openings through the base of the wall (weep holes) should not be used where the seepage could be a nuisance or otherwise adversely affect the property adjacent to the base of the wall. The recommendations herein assume a properly compacted granular (EI of 50 or less) free-draining backfill material with no hydrostatic forces or imposed surcharge load. The retaining wall should be properly drained as shown in the Typical Retaining Wall Drainage Detail. If conditions different than those described are expected, or if specific drainage details are desired, Geocon Incorporated should be contacted for additional recommendations.



Typical Retaining Wall Drainage Detail

7.11.7 The retaining walls may be designed using either the active and restrained (at-rest) loading condition or the active and seismic loading condition as suggested by the structural engineer. Typically, it appears the design of the restrained condition for retaining wall loading may be adequate for the seismic design of the retaining walls. However, the active earth pressure combined with the seismic design load should be reviewed and also considered in the design of the retaining walls.

7.11.8 In general, wall foundations should be designed in accordance with Table 7.11.2. The proximity of the foundation to the top of a slope steeper than 3:1 could impact the allowable soil bearing pressure. Therefore, retaining wall foundations should be deepened such that the bottom outside edge of the footing is at least 7 feet horizontally from the face of the slope.

TABLE 7.11.2
SUMMARY OF RETAINING WALL FOUNDATION RECOMMENDATIONS

Parameter	Value
Minimum Retaining Wall Foundation Width	12 inches
Minimum Retaining Wall Foundation Depth	12 Inches
Minimum Steel Reinforcement	Per Structural Engineer
Bearing Capacity	2,500 psf
Bearing Capacity Increase	500 psf per additional foot of footing depth
	300 psf per additional foot of footing width
Maximum Bearing Capacity	4,000 psf
Estimated Total Settlement	1 Inch
Estimated Differential Settlement	½ Inch in 40 Feet

7.11.9 The recommendations presented herein are generally applicable to the design of rigid concrete or masonry retaining walls. Additional recommendations for MSE walls and soil nail walls are provided in Sections 7.13 and 7.14.

7.11.10 Unrestrained walls will move laterally when backfilled and loading is applied. The amount of lateral deflection is dependent on the wall height, the type of soil used for backfill, and loads acting on the wall. The retaining walls and improvements above the retaining walls should be designed to incorporate an appropriate amount of lateral deflection as determined by the structural engineer.

7.11.11 Soil contemplated for use as retaining wall backfill, including import materials, should be identified in the field prior to backfill. At that time, Geocon Incorporated should obtain samples for laboratory testing to evaluate its suitability. Modified lateral earth pressures may be necessary if the backfill soil does not meet the required expansion index or shear strength. City or regional standard wall designs, if used, are based on a specific active lateral earth pressure and/or soil friction angle. In this regard, on-site soil to be used as backfill may or may not meet the values for standard wall designs. Geocon Incorporated should be consulted to assess the suitability of the on-site soil for use as wall backfill if standard wall designs will be used.

7.12 Lateral Loading

7.12.1 Table 7.12 should be used to help design the proposed structures and improvements to resist lateral loads for the design of footings or shear keys. The allowable passive pressure assumes a horizontal surface extending at least 5 feet, or three times the surface generating the passive pressure, whichever is greater. The upper 12 inches of material in areas not protected by floor slabs or pavement should not be included in design for passive resistance. Where walls are planned adjacent to and/or on descending slopes, a passive pressure of 150 pcf should be used in design.

TABLE 7.12
SUMMARY OF LATERAL LOAD DESIGN RECOMMENDATIONS

Parameter	Value
Passive Pressure Fluid Density	350 pcf
Passive Pressure Fluid Density Adjacent to and/or on Descending Slopes	150 pcf
Coefficient of Friction (Concrete and Soil)	0.35
Coefficient of Friction (Along Vapor Barrier)	0.2 to 0.25*

*Per manufacturer’s recommendations.

7.12.2 The passive and frictional resistant loads can be combined for design purposes. The lateral passive pressures may be increased by one-third when considering transient loads due to wind or seismic forces.

7.13 Mechanically Stabilized Earth (MSE) Retaining Walls

7.13.1 Mechanized stabilized earth (MSE) retaining walls are planned for the project. MSE retaining walls are alternative walls that consist of modular block facing units with geogrid reinforced earth behind the block. The reinforcement grid attaches to the block units and is typically placed at specified vertical intervals and embedment lengths. The grid length and spacing will be determined by the wall designer.

7.13.2 The geotechnical parameters listed in Table 7.13.1 can be used for preliminary design of the MSE walls. Once actual soil to be used as backfill has been determined and stockpiled, laboratory testing should be performed to check that the soil meets the parameters used in the design of the MSE walls. Screening of onsite soil intended for MSE wall backfill may be necessary to meet maximum particle size requirements for soil used in the reinforced zone.

TABLE 7.13.1
GEOTECHNICAL PARAMETERS FOR MSE WALLS

Parameter	Reinforced Zone	Retained Zone	Foundation Zone
Angle of Internal Friction	28 degrees	28 degrees	28 degrees
Cohesion	100 psf	100 psf	100 psf
Wet Unit Density	130 pcf	130 pcf	130 pcf

7.13.3 The soil parameters presented in Table 7.13.1 are based on our experience and direct shear-strength tests performed during the geotechnical investigation and represent some of the on-site materials. Geocon has no way of knowing which materials will actually be used as backfill behind the wall during construction. It is up to the wall designers to use their judgment in selection of the design parameters. As such, once backfill materials have been selected and/or stockpiled, sufficient shear tests should be conducted on samples of the proposed backfill materials to check that they conform to actual design values. Results should be provided to the designer to re-evaluate stability of the walls. Dependent upon test results, the designer may require modifications to the original wall design (e.g., longer reinforcement embedment lengths and/or steel reinforcement).

7.13.4 Wall foundations should be designed in accordance with Table 7.13.2 The walls should be deepened such that the bottom outside edge of the footing is at least 7 feet horizontally from the face of the slope. The bearing zone on the MSE wall can be taken across the width of the reinforced zone.

TABLE 7.13.2
SUMMARY OF MSE RETAINING WALL FOUNDATION RECOMMENDATIONS

Parameter	Value
Minimum Retaining Wall Foundation Width	12 inches
Minimum Retaining Wall Foundation Depth	12 Inches
Bearing Capacity	2,000 psf
Bearing Capacity Increase	500 psf per Foot of Depth
	300 psf per Foot of Width
Maximum Bearing Capacity	4,000 psf
Estimated Total Settlement	1 Inch
Estimated Differential Settlement	½ Inch in 40 Feet

7.13.5 Backfill materials within the reinforced zone should be compacted to a dry density of at least 90 percent of the laboratory maximum dry density near to slightly above optimum moisture content in accordance with ASTM D 1557. This is applicable to the entire embedment width of the reinforcement. Typically, wall designers specify no heavy compaction equipment within 3 feet of the face of the wall. However, smaller equipment (e.g., walk-behind, self-driven compactors or hand whackers) can be used to compact the materials without causing deformation of the wall. If the designer specifies no compactive effort for this zone, the materials are essentially not properly compacted and the reinforcement grid within the uncompacted zone should not be relied upon for reinforcement, and overall embedment lengths will have to be increased to account for the difference.

7.13.6 The wall should be provided with a drainage system sufficient to prevent excessive seepage through the wall and the base of the wall, thus preventing hydrostatic pressures behind the wall.

7.13.7 Geosynthetic reinforcement must elongate to develop full tensile resistance. This elongation generally results in movement at the top of the wall. The amount of movement is dependent on the height of the wall (e.g., higher walls rotate more) and the type of reinforcing grid used. In addition, over time the reinforcement grid has been known to exhibit creep (sometimes as much as 5 percent) and can undergo additional movement. Given this condition, the owner should be aware that structures and pavement placed within the reinforced and retained zones of the wall will likely undergo movement for the wall heights proposed on this project.

7.13.8 The MSE wall contractor should provide the estimated deformation of wall and adjacent ground in associated with wall construction. The calculated horizontal and vertical deformations should be determined by the wall designer. Where buildings are located adjacent to the walls, the estimated movements should be provided to the project structural engineer to evaluate if the building foundation can tolerate the expected movements. With respect to improvements adjacent to the wall, cracking and/or movement should be expected.

7.13.9 The MSE wall designer/contractor should review this report, including the slope stability requirements, and incorporate our recommendations as presented herein. We should be provided the plans for the MSE walls to check if they are in conformance with our recommendations prior to issuance of a permit and construction.

7.14 Soil Nail Walls

7.14.1 We understand soil nail walls are planned for the northern property line wall. Soil nail walls consist of installing closely spaced steel bars (nails) into a slope or excavation in a top-down construction sequence. Following installation of a horizontal row of nails, drains, waterproofing and wall reinforcing steel are placed and shotcrete applied to create a final wall. The wall should be designed by an engineer familiar with the design of soil nail walls.

7.14.2 In general, ground conditions are moderately suited to soil nail wall construction techniques. However, localized gravel, cobble and oversized material could be encountered that may be difficult to drill. Additionally, relatively clean sands may be encountered that may result in some raveling of the unsupported excavation. Casing or specialized drilling techniques should be planned where raveling exists (e.g. casing).

7.14.3 Testing of the soil nails should be performed in accordance with the guidelines of the Federal Highway Administration or similar guidelines. At least two verification tests should be performed to confirm design assumptions for each soil/rock type encountered. Verification tests nails should be sacrificial and should not be used to support the proposed wall. The bond length should be adjusted to allow for pullout testing of the verification nails to evaluate the ultimate bond stress. A minimum of 5 percent of the production nails should also be proof tested and a minimum of 4 sacrificial nails should be tested at the discretion of Geocon Incorporated. Consideration should be given to testing sacrificial nails with an adjusted bond length rather than testing production nails. Geocon Incorporated should observe the nail installation and perform the nail testing.

7.14.4 The soil strength parameters listed in Table 7.14 can be used in design of the soil nails. The bond stress is dependent on drilling method, diameter, and construction method. Therefore, the designer should evaluate the bond stress based on soil conditions and the construction method.

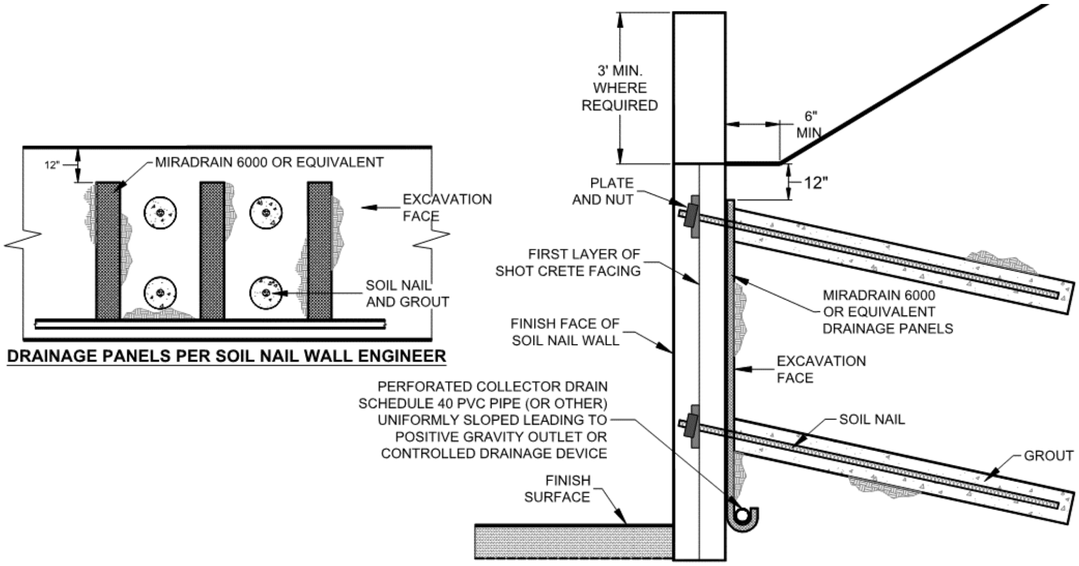
TABLE 7.14
SOIL STRENGTH PARAMETERS FOR SOIL NAIL WALLS

Description	Cohesion (psf)	Friction Angle (degrees)	Estimated Ultimate Bond Stress (psi)*
Compacted Fill	100	28	10
Very Old Paralic Deposits	200	33	20
Otay Formation	200	33	20

*Assuming gravity fed, open hole drilling techniques.

7.14.5 A wall drain system should be incorporated into the design of the soil nail wall as shown herein. Corrosion protection should be provided for the nails.

7.14.6 A bentonitic clay bed is expected to be present near the bottom of the wall cut along the north side of the property. The wall design will need to pin the clay bed to prevent slope instability. Geocon Incorporated can provide additional stability analysis and coordination with the wall designer, as needed.



Soil Nail Wall Drainage Detail

7.15 Preliminary Pavement Recommendations

7.15.1 Preliminary pavement recommendations for the driveways and parking areas are provided below. The final pavement sections should be based on the R-Value of the subgrade soil encountered at final subgrade elevation. For preliminary design, we used a laboratory R-Value of 15. We calculated the preliminary flexible pavement sections for asphalt concrete using varying traffic indices (TIs) in general conformance with the *Caltrans Method of Flexible Pavement Design* (Highway Design Manual, Section 608.4). The project civil engineer or traffic engineer should determine the appropriate Traffic Index (TI) or traffic loading expected on the project for the various pavement areas that will be constructed. Recommended preliminary asphalt concrete pavement sections are provided on Table 7.15.1.

TABLE 7.15.1
PRELIMINARY ASPHALT CONCRETE PAVEMENT SECTIONS

Traffic Index	Asphalt Concrete (inches)	Class 2 Base (inches)
4.5	3	6
5	3	8
5.5	3	10
6	3.5	10.5
6.5	3.5	12.5
7	4	13
7.5	4.5	15
8	5	15

7.15.2 Asphalt concrete should conform to Section 203-6 of the *Standard Specifications for Public Works Construction* (Green Book). Class 2 aggregate base materials should conform to Section 26-1.02B of the *Standard Specifications of the State of California, Department of Transportation* (Caltrans).

7.15.3 Prior to placing base material, the subgrade should be scarified, moisture conditioned and recompacted to a minimum of 95 percent relative compaction. The depth of compaction should be at least 12 inches. The base material should be compacted to at least 95 percent relative compaction. Asphalt concrete should be compacted to a density of at least 95 percent of the laboratory Hveem density in accordance with ASTM D 2726.

7.15.4 A rigid Portland Cement concrete (PCC) pavement section can also be used. We calculated the rigid pavement section in general conformance with the procedure recommended by the American Concrete Institute report ACI 330R-08 Guide for Design and Construction of Concrete Parking Lots using the parameters presented in Table 7.15.2.

TABLE 7.15.2
PRELIMINARY RIGID PAVEMENT DESIGN PARAMETERS

Design Parameter	Design Value
Modulus of subgrade reaction, k	100 pci
Modulus of rupture for concrete, M_R	500 psi
Concrete Compressive Strength	3,000 psi
Traffic Category, TC	A and C
Average daily truck traffic, ADTT	10 and 300

7.15.5 Based on the criteria presented herein, the PCC pavement sections should have a minimum thickness as presented in Table 7.15.3.

TABLE 7.15.3
RIGID VEHICULAR PAVEMENT RECOMMENDATIONS

Location	Portland Cement Concrete (inches)
Automobile Parking Stalls (TC=A, ADTT=10)	5.5
Driveways (TC=C, ADTT=100)	7.5

7.15.6 The PCC vehicular pavement should be placed over subgrade soil that is compacted to a dry density of at least 95 percent of the laboratory maximum dry density near to slightly above optimum moisture content.

7.15.7 The rigid pavement should also be designed and constructed incorporating the parameters presented in Table 7.15.4.

TABLE 7.15.4
ADDITIONAL RIGID PAVEMENT RECOMMENDATIONS

Subject	Value
Thickened Edge	1.2 Times Slab Thickness
	Minimum Increase of 2 Inches
	4 Feet Wide
Crack Control Joint Spacing	30 Times Slab Thickness
	Max. Spacing of 12 feet for 5.5-Inch-Thick
	Max. Spacing of 15 Feet for Slabs 6 Inches and Thicker
Crack Control Joint Depth	Per ACI 330R-08
	1 Inch Using Early-Entry Saws on Slabs Less Than 9 Inches Thick
Crack Control Joint Width	¼-Inch for Sealed Joints
	⅜-Inch is Common for Sealed Joints
	$^{1}/_{10}$- to $^{1}/_{8}$-Inch is Common for Unsealed Joints

7.15.8 Concrete reinforcing steel will not be necessary within the concrete for geotechnical purposes with the possible exception of dowels at construction joints as discussed herein.

7.15.9 To control the location and spread of concrete shrinkage cracks, crack-control joints (weakened plane joints) should be included in the design of the concrete pavement slab. Crack-control joints should be sealed with an appropriate sealant to prevent the migration of water through the control joint to the subgrade materials. The depth of the crack-control joints should be determined by the referenced ACI report.

7.15.10 To provide load transfer between adjacent pavement slab sections, a butt-type construction joint should be constructed. The butt-type joint should be thickened by at least 20 percent at the edge and taper back at least 4 feet from the face of the slab. As an alternative to the butt-type construction joint, dowelling can be used between construction joints for pavements of 7 inches or thicker. As discussed in the referenced ACI guide, dowels should consist of smooth, 1-inch-diameter reinforcing steel 14 inches long embedded a minimum of 6 inches into the slab on either side of the construction joint. Dowels should be located at the midpoint of the slab, spaced at 12 inches on center and lubricated to allow joint movement while still transferring loads. In addition, tie bars should be installed as recommended in Section 3.8.3 of the referenced ACI guide. The structural engineer should provide other alternative recommendations for load transfer.

7.15.11 Concrete curb/gutter should be placed on soil subgrade compacted to a dry density of at least 90 percent of the laboratory maximum dry density near to slightly above optimum moisture content. Cross-gutters that receives vehicular should be placed on subgrade soil compacted to a dry density of at least 95 percent of the laboratory maximum dry density near to slightly above optimum moisture content. Base materials should not be placed below the curb/gutter, or cross-gutters so water is not able to migrate from the adjacent parkways to the pavement sections. Where flatwork is located directly adjacent to the curb/gutter, the concrete flatwork should be structurally connected to the curbs to help reduce the potential for offsets between the curbs and the flatwork.

7.16 Exterior Concrete Flatwork

7.16.1 Exterior concrete flatwork not subject to vehicular traffic should be constructed in accordance with the recommendations presented in Table 7.16. The recommended steel reinforcement would help reduce the potential for cracking.

TABLE 7.16
MINIMUM CONCRETE FLATWORK RECOMMENDATIONS

Expansion Index, EI	Minimum Steel Reinforcement* Options	Minimum Thickness
EI $\leq$ 90	6x6-W2.9/W2.9 (6x6-6/6) welded wire mesh	4 Inches
	No. 3 Bars 18 inches on center, Both Directions	
EI $\leq$ 130	4x4-W4.0/W4.0 (4x4-4/4) welded wire mesh	
	No. 4 Bars 12 inches on center, Both Directions	

*In excess of 8 feet square.

7.16.2 Even with the incorporation of the recommendations of this report, the exterior concrete flatwork has a potential to experience some uplift due to expansive soil beneath grade. The steel reinforcement should overlap continuously in flatwork to reduce the potential for vertical offsets within flatwork. Additionally, flatwork should be structurally connected to the curbs, where possible, to reduce the potential for offsets between the curbs and the flatwork.

7.16.3 Concrete flatwork should be provided with crack control joints to reduce and/or control shrinkage cracking. Crack control spacing should be determined by the project structural engineer based upon the slab thickness and intended usage. Criteria of the American Concrete Institute (ACI) should be taken into consideration when establishing crack control spacing. Subgrade soil for exterior slabs not subjected to vehicle loads should be compacted in accordance with criteria presented in the grading section prior to concrete placement. Subgrade soil should be properly compacted, and the moisture content of subgrade soil should be verified prior to placing concrete. Base materials will not be required below concrete improvements.

7.16.4 Where exterior flatwork abuts the structure at entrant or exit points, the exterior slab should be dowelled into the structure's foundation stemwall. This recommendation is intended to reduce the potential for differential elevations that could result from differential settlement or minor heave of the flatwork. Dowelling details should be designed by the project structural engineer.

7.16.5 The recommendations presented herein are intended to reduce the potential for cracking of exterior slabs as a result of differential movement. However, even with the incorporation of the recommendations presented herein, slabs-on-grade will still crack. The occurrence of concrete shrinkage cracks is independent of the soil supporting characteristics. Their occurrence may be reduced and/or controlled by limiting the slump of the concrete, the use of crack control joints and proper concrete placement and curing. Crack control joints should be spaced at intervals no greater than 12 feet. Literature provided by the Portland Concrete Association (PCA) and American Concrete Institute (ACI) present recommendations for proper concrete mix, construction, and curing practices, and should be incorporated into project construction.

7.17 Slope Maintenance

7.17.1 Slopes that are steeper than 3:1 (horizontal:vertical) may, under conditions which are both difficult to prevent and predict, be susceptible to near surface (surficial) slope instability. The instability is typically limited to the outer three feet of a portion of the slope and usually does not directly impact the improvements on the pad areas above or below the slope. The occurrence of surficial instability is more prevalent on fill slopes and is generally preceded by a period of heavy rainfall, excessive irrigation, or the migration of subsurface seepage. The disturbance and/or loosening of the surficial soils, as might result from root growth, soil expansion, or excavation for irrigation lines and slope planting, may also be a significant contributing factor to surficial instability. It is, therefore, recommended that, to the maximum extent practical: (a) disturbed/loosened surficial soils be either removed or properly recompacted, (b) irrigation systems be periodically inspected and maintained to eliminate leaks and excessive irrigation, and (c) surface drains on and adjacent to slopes be periodically maintained to preclude ponding or erosion. Although the incorporation of the above recommendations should reduce the potential for surficial slope instability, it will not eliminate the possibility, and, therefore, it may be necessary to rebuild or repair a portion of the project's slopes in the future.

7.18 Storm Water Management

7.18.1 If storm water management devices are not properly designed and constructed, there is a risk for distress to improvements and property located hydrologically down gradient or adjacent to these devices. Factors such as the amount of water being detained, its residence time, and soil permeability have an important effect on seepage transmission and the potential adverse impacts that may occur if the storm water management features are not properly designed and constructed. We have not performed a hydrogeological study at the site. If infiltration of storm water runoff into the subsurface occurs, downstream improvements may be subjected to seeps, springs, slope instability, raised groundwater, movement of foundations and slabs, or other undesirable impacts as a result of water infiltration.

7.18.2 We did not perform an infiltration study on the property. However, based on predicted site conditions at the completion of grading, full and partial infiltration is considered infeasible due to the presence of deep fills surrounded by MSE walls at the down-gradient end of the site. Basins or other storm water devices should utilize a liner to prevent infiltration from causing adverse settlement and heave, and migrating to utilities, and foundations.

7.19 Site Drainage and Moisture Protection

7.19.1 Adequate site drainage is critical to reduce the potential for differential soil movement, erosion and subsurface seepage. Under no circumstances should water be allowed to pond adjacent to footings. The site should be graded and maintained such that surface drainage is directed away from structures in accordance with 2019 CBC 1803.3 or other applicable standards. In addition, surface drainage should be directed away from the top of slopes into swales or other controlled drainage devices. Roof and pavement drainage should be directed into conduits that carry runoff away from the proposed structure.

7.19.2 In the case of basement walls or building walls retaining landscaping areas, a water-proofing system should be used on the wall and joints, and a Miradrain drainage panel (or similar) should be placed over the waterproofing. The project architect or civil engineer should provide detailed specifications on the plans for all waterproofing and drainage.

7.19.3 Underground utilities should be leak free. Utility and irrigation lines should be checked periodically for leaks, and detected leaks should be repaired promptly. Detrimental soil movement could occur if water is allowed to infiltrate the soil for prolonged periods of time.

7.19.4 Landscaping planters adjacent to paved areas are not recommended due to the potential for surface or irrigation water to infiltrate the pavement's subgrade and base course. We recommend that subdrains to collect excess irrigation water and transmit it to drainage structures, or impervious above-grade planter boxes be used. In addition, where landscaping is planned adjacent to the pavement, we recommend construction of a cutoff wall along the edge of the pavement that extends at least 6 inches below the bottom of the base material.

7.20 Grading and Foundation Plan Review

7.20.1 Geocon Incorporated should review the grading plans and foundation plans for the project prior to final design submittal to evaluate whether additional analyses and/or recommendations are required.

7.21 Testing and Observation Services During Construction

7.21.1 Geocon Incorporated should provide geotechnical testing and observation services during the grading operations, foundation construction, utility installation, retaining wall backfill and pavement installation. Table 7.21 presents the typical geotechnical observations we would expect for the proposed improvements.

TABLE 7.21
EXPECTED GEOTECHNICAL TESTING AND OBSERVATION SERVICES

Construction Phase	Observations	Expected Time Frame
Ground Modification	Ground Modification Installation	Full Time
	Confirmation Testing	Part Time to Full Time
Grading	Base of Removal	Part Time During Removals
	Geologic Logging	Part Time to Full Time
	Fill Placement and Soil Compaction	Full Time
MSE Walls	Fill Placement and Soil Compaction	Full Time
Tieback Anchors	Tieback Drilling and Installation	Full Time
	Tieback Testing	Full Time
Soil Nail Walls	Soil Nail Drilling and Installation	Full Time
	Soil Nail Testing	Full Time
Foundations	Drilling Operations for Piles	Full Time
	Foundation Excavation Observations	Part Time
Utility Backfill	Fill Placement and Soil Compaction	Part Time to Full Time
Retaining Wall Backfill	Fill Placement and Soil Compaction	Part Time to Full Time
Subgrade for Sidewalks, Curb/Gutter and Pavement	Soil Compaction	Part Time
Pavement Construction	Base Placement and Compaction	Part Time
	Asphalt Concrete Placement and Compaction	Full Time

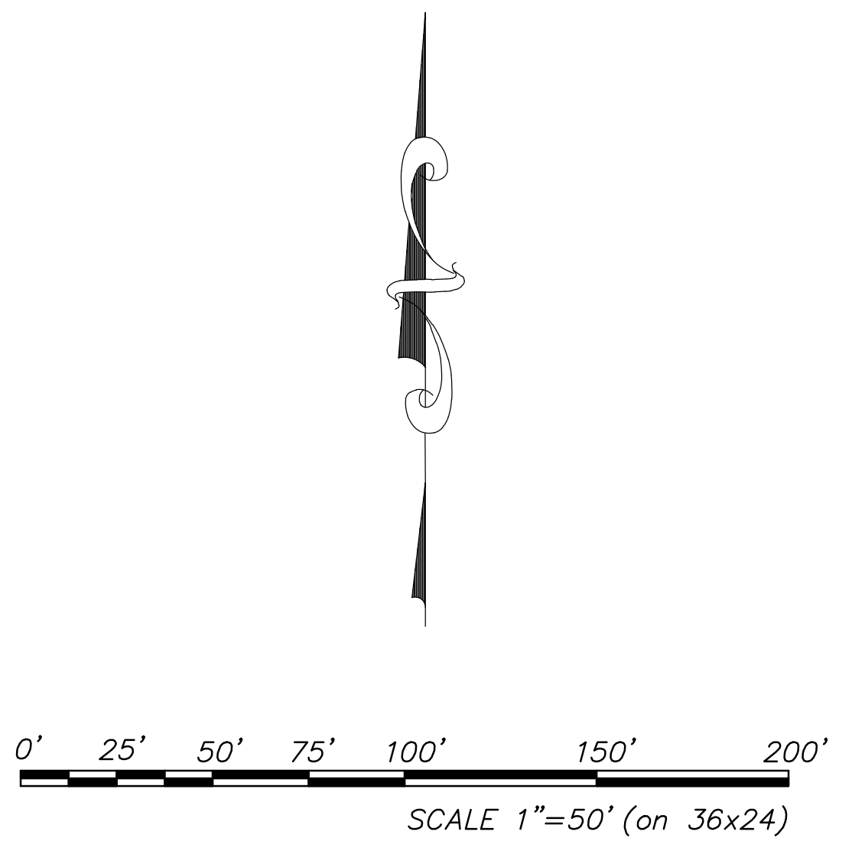
LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The firm that performed the geotechnical investigation for the project should be retained to provide testing and observation services during construction to provide continuity of geotechnical interpretation and to check that the recommendations presented for geotechnical aspects of site development are incorporated during site grading, construction of improvements, and excavation of foundations. If another geotechnical firm is selected to perform the testing and observation services during construction operations, that firm should prepare a letter indicating their intent to assume the responsibilities of project geotechnical engineer of record. A copy of the letter should be provided to the regulatory agency for their records. In addition, that firm should provide revised recommendations concerning the geotechnical aspects of the proposed development, or a written acknowledgement of their concurrence with the recommendations presented in our report. They should also perform additional analyses deemed necessary to assume the role of Geotechnical Engineer of Record.

2. The recommendations of this report pertain only to the site investigated and are based upon the assumption that the soil conditions do not deviate from those disclosed in the investigation. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that anticipated herein, Geocon Incorporated should be notified so that supplemental recommendations can be given. The evaluation or identification of the potential presence of hazardous or corrosive materials was not part of the scope of services provided by Geocon Incorporated.

3. This report is issued with the understanding that it is the responsibility of the owner or his representative to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project and incorporated into the plans, and the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

4. The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of three years.



GEOCON LEGEND

- Qudf ........UNDOCUMENTED FILL
- Qal ....ALLUVIUM
- Qt ....TERRACE DEPOSITS
- To ....OTAY FORMATION
- ∼ ....APPROX. LOCATION OF GEOLOGIC CONTACT
- LB-5 ....APPROX. LOCATION OF EXPLORATORY LARGE DIAMETER BORING (Current)
- B-2 ⊕ ....APPROX. LOCATION OF EXPLORATORY BORING
- TP-8 ▬ ....APPROX. LOCATION OF EXPLORATORY TEST PIT (Current)
- TP-7 ....APPROX. LOCATION OF EXPLORATORY TEST PIT (AGS, 2014)
- T-6 ....APPROX. LOCATION OF EXPLORATORY TEST PIT (AET, 2008)
- G G' ....APPROX. LOCATION OF GEOLOGIC CROSS SECTION
- ....APPROX. LOCATION OF PROPOSED SUBDRAIN
- ▨ ....APPROX. SURFACE EXPOSURE OF BENTONITIC CLAYSTONE

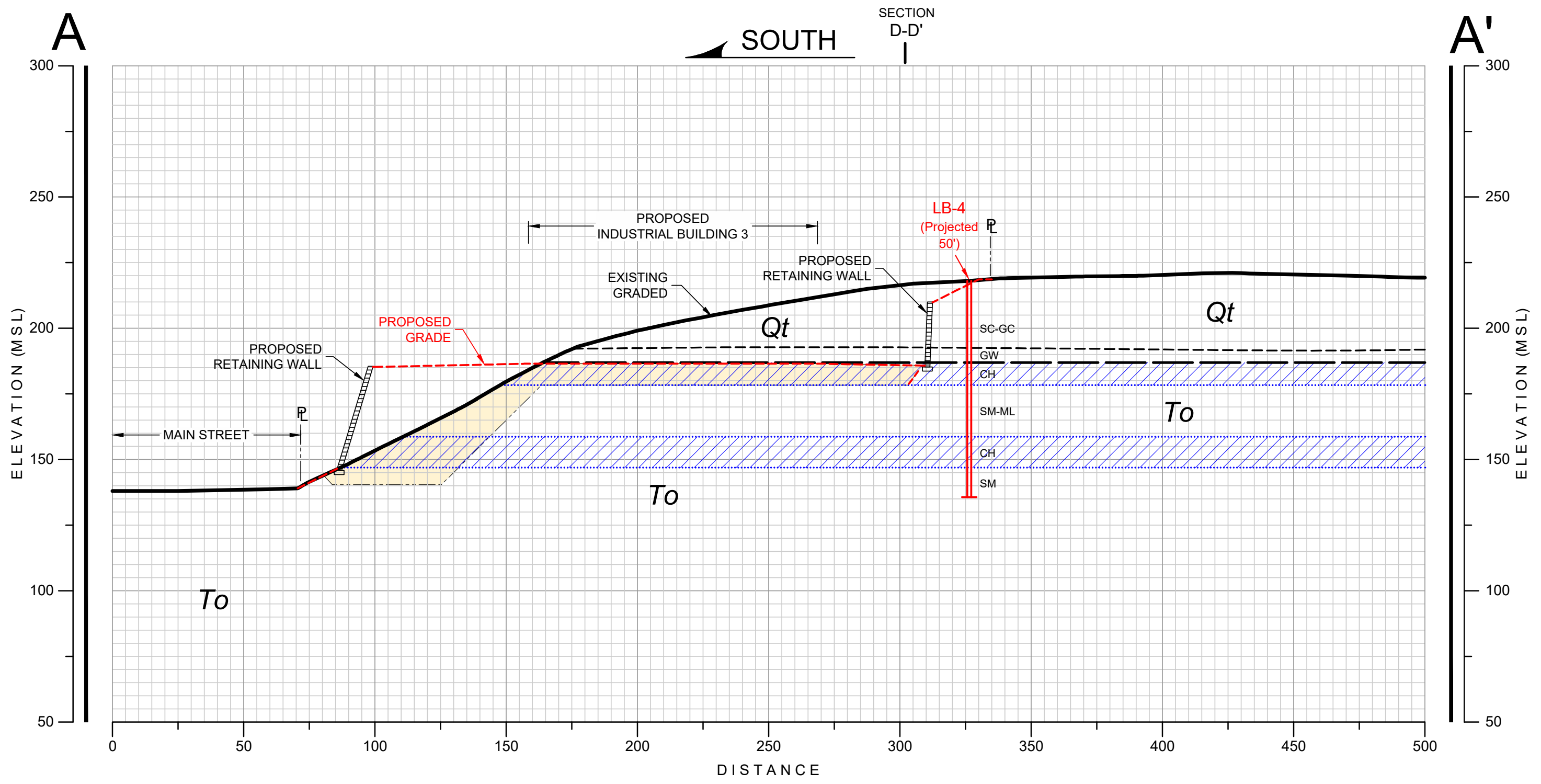
GEOLOGIC MAP

NIRVANA INDUSTRIAL BUILDINGS AND SELF STORAGE COMPLEX
821 MAIN STREET
CHULA VISTA, CALIFORNIA

GEOCON
INCORPORATED
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

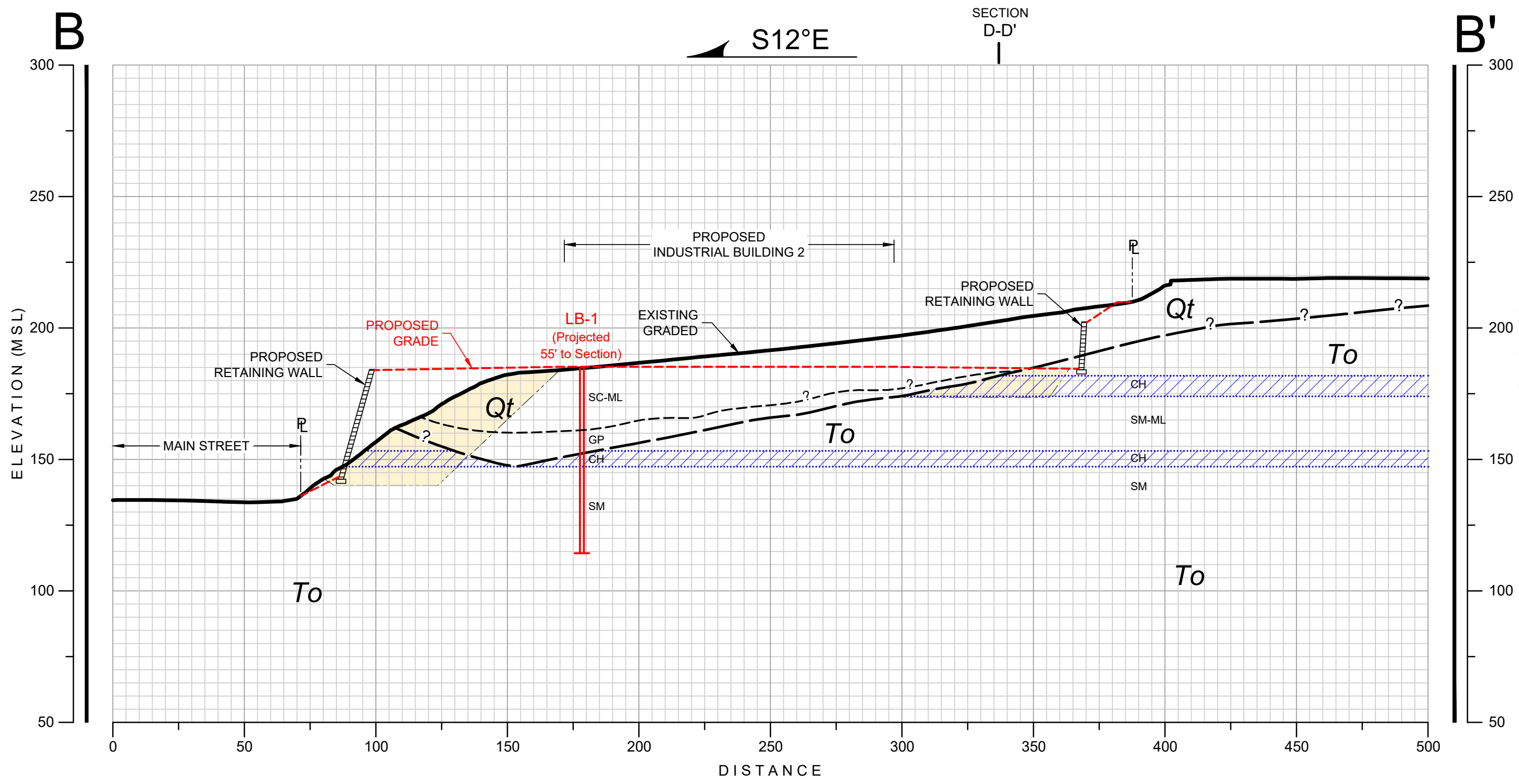
SCALE 1" = 50'
DATE 09 - 14 - 2021
PROJECT NO. G2755 - 42 - 01
FIGURE 1
SHEET 1 OF 1

Plotted:09/14/2021 8:36AM | By:ALVIN LADRILLONO | File Location:Y:\PROJECTS\G2755-42-01 (Nirvana Self Storage)\SHEETS\G2755-42-01 Geo Map.dwg



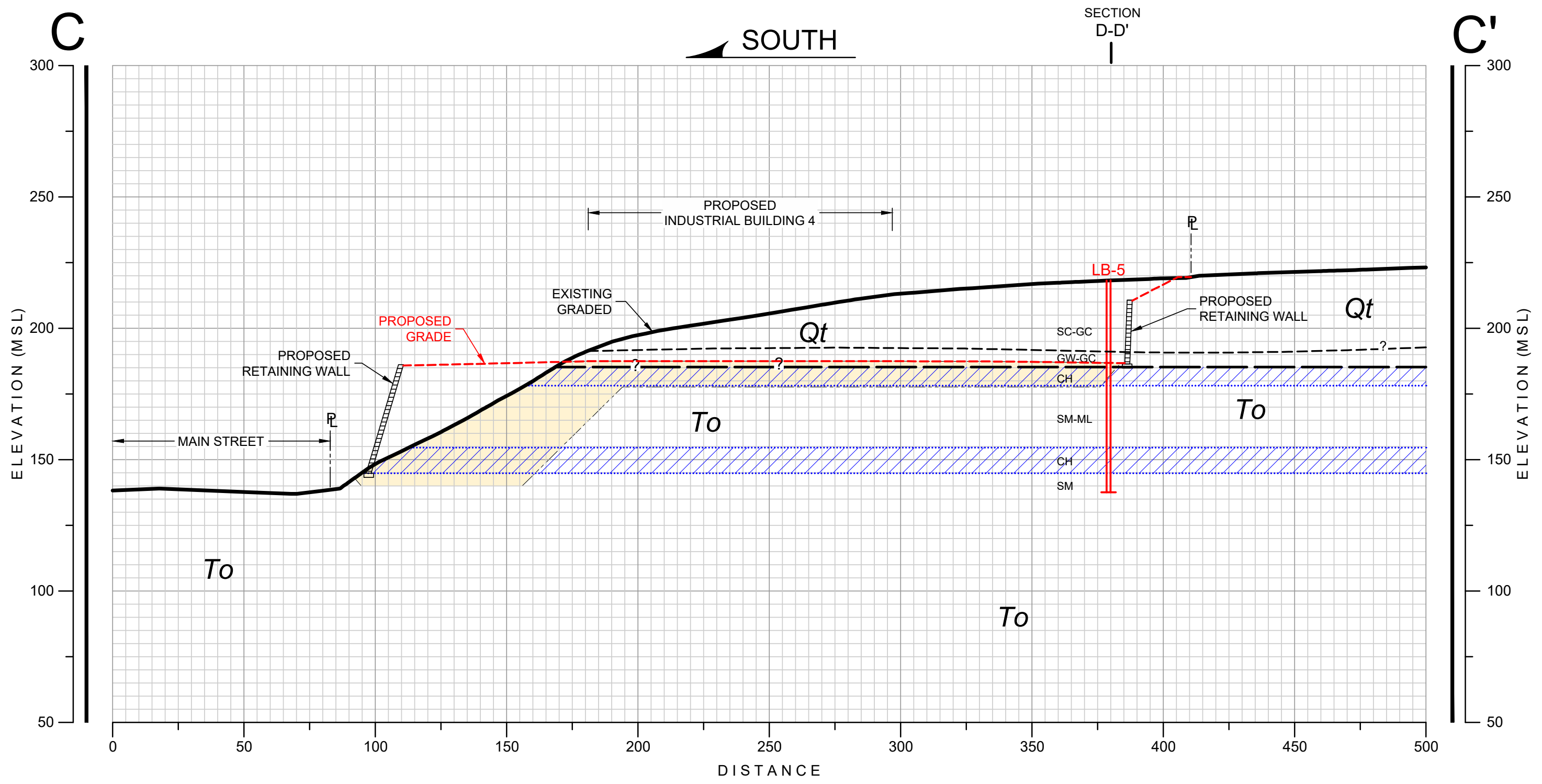
GEOLOGIC CROSS-SECTION A-A'

SCALE: 1" = 50' (Vert. = Horiz.)



GEOLOGIC CROSS-SECTION B-B'

SCALE: 1" = 50' (Vert. = Horiz.)

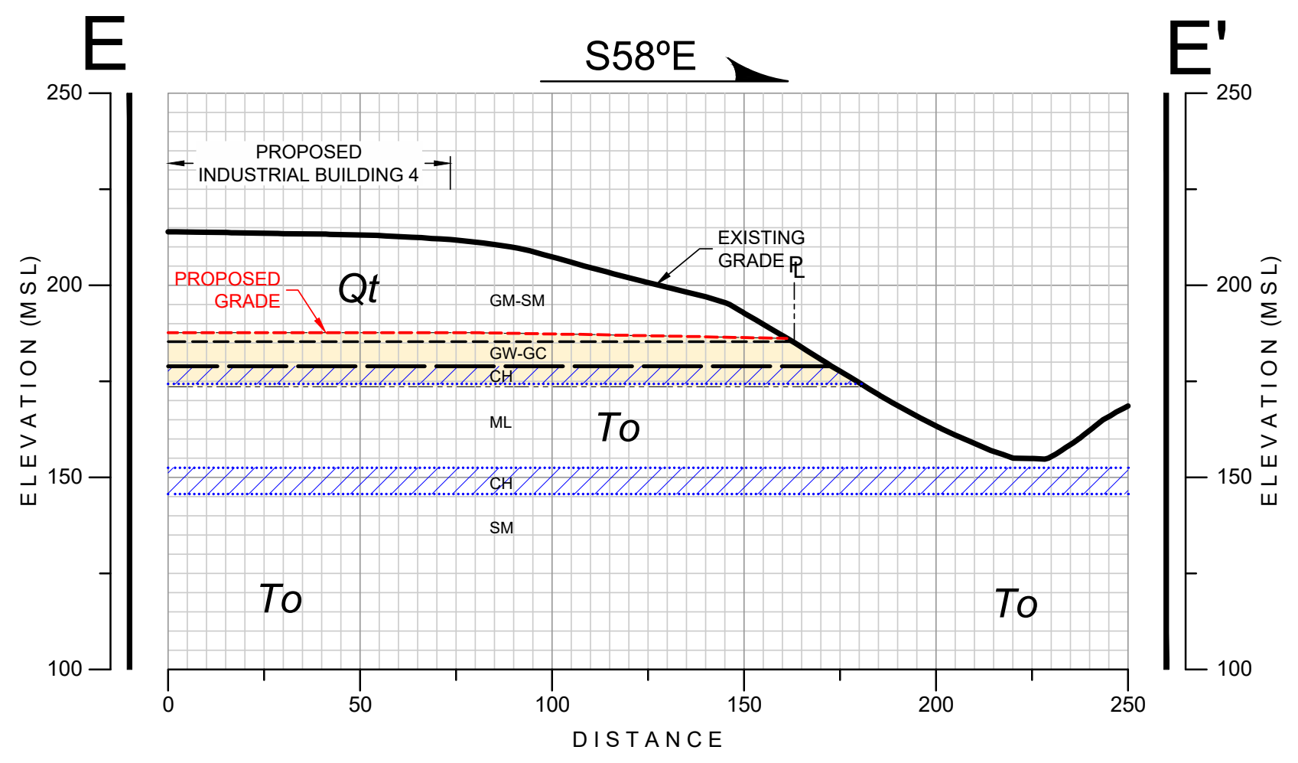


GEOLOGIC CROSS-SECTION C-C'

SCALE: 1" = 50' (Vert. = Horiz.)

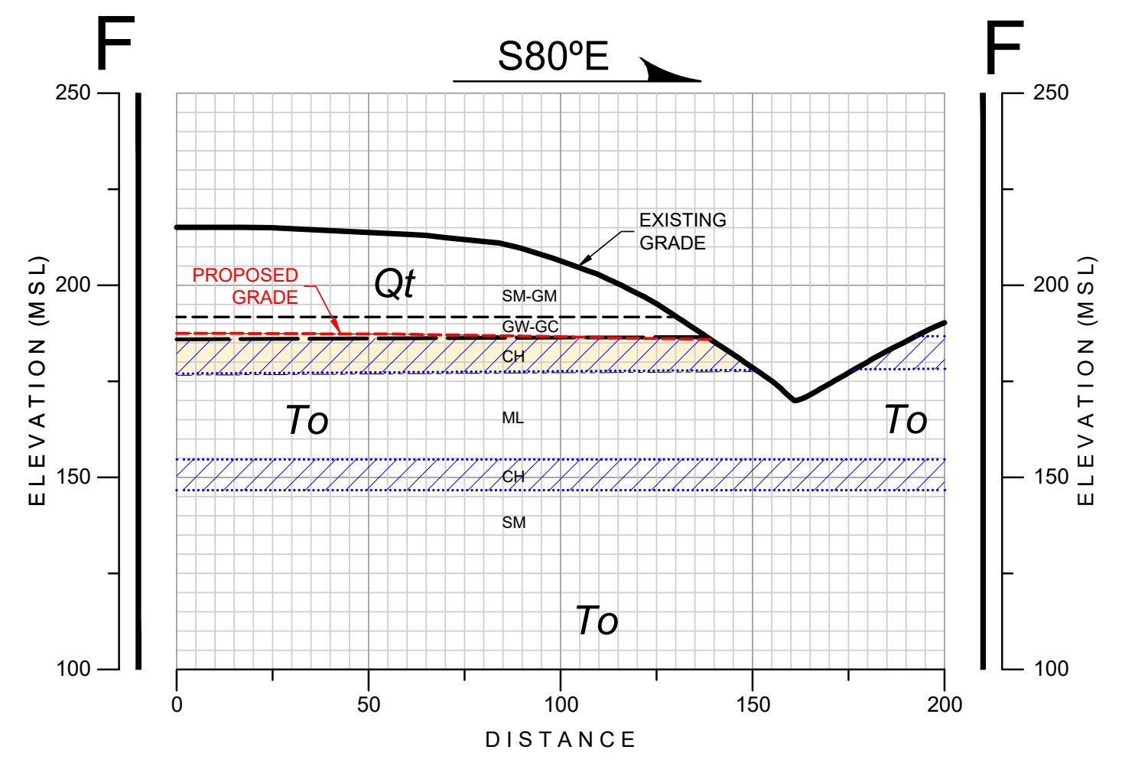
GEOLOGIC CROSS-SECTION D-D'

SCALE: 1" = 50' (Vert. = Horiz.)



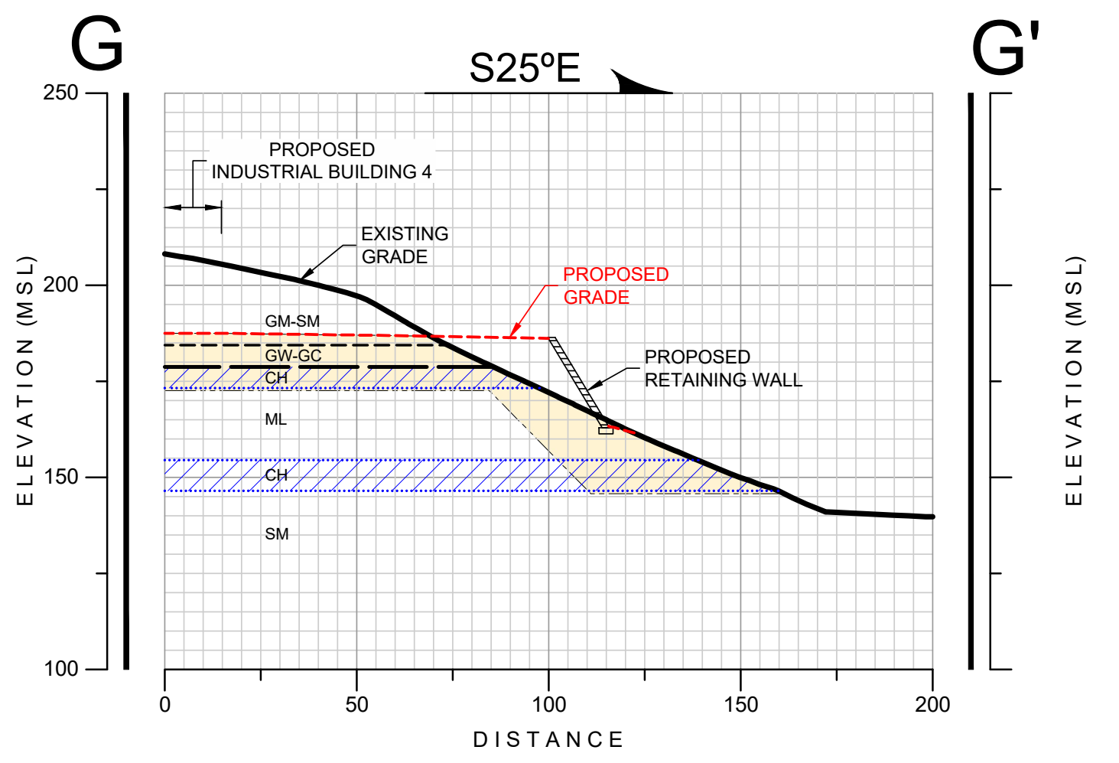
GEOLOGIC CROSS-SECTION E-E'

SCALE: 1" = 50' (Vert. = Horiz.)



GEOLOGIC CROSS-SECTION F-F'

SCALE: 1" = 50' (Vert. = Horiz.)



GEOLOGIC CROSS-SECTION G-G'

SCALE: 1" = 50' (Vert. = Horiz.)

GEOCON LEGEND

Qt	........TERRACE DEPOSITS
To	........OTAY FORMATION
~?~	........APPROX. LOCATION OF GEOLOGIC CONTACT (Queried Where Uncertain)
B-5	........APPROX. LOCATION OF EXPLORATORY LARGE DIAMETER BORING
▨	.........ESTIMATED CLAYSTONE AND BEDROCK REMEDIAL REMOVAL

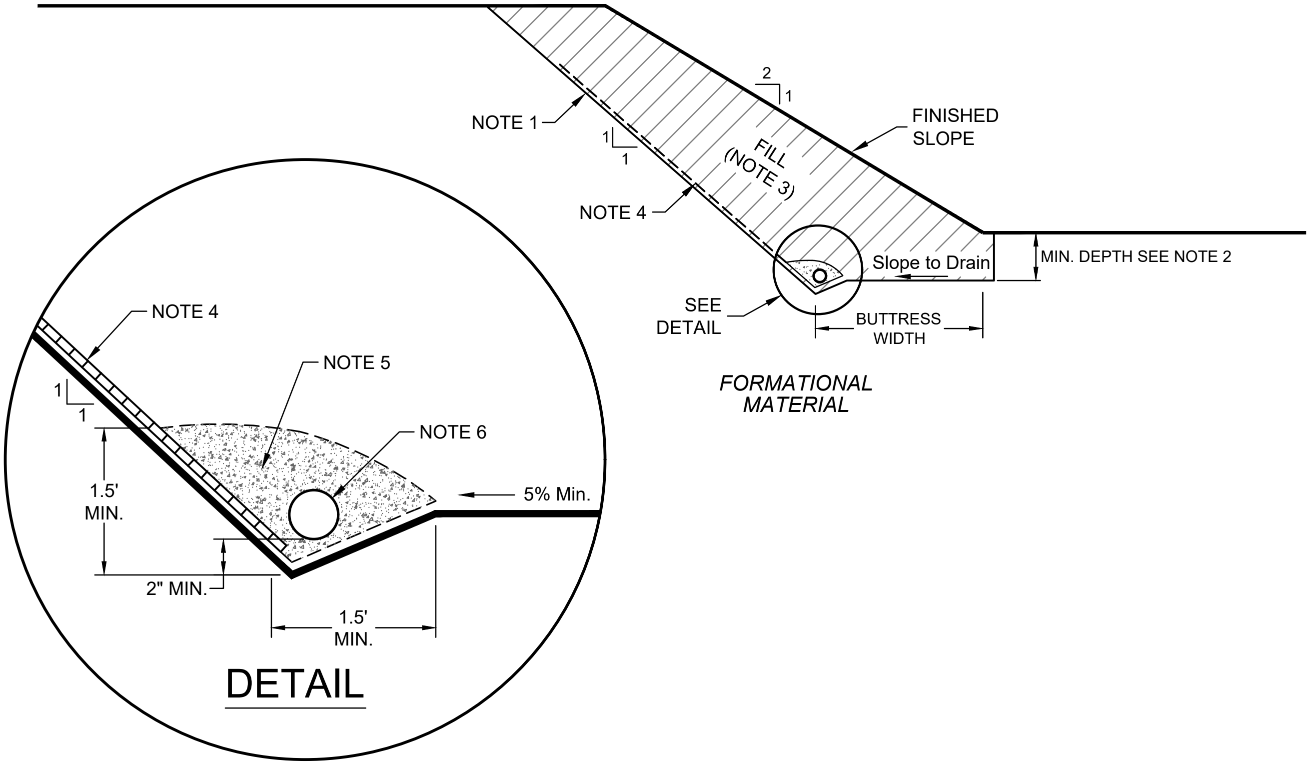
GEOLOGIC MAP

NIRVANA INDUSTRIAL BUILDINGS AND SELF STORAGE COMPLEX
821 MAIN STREET
CHULA VISTA, CALIFORNIA

GEOCON
INCORPORATED
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

SCALE 1" = 50'
DATE 09 - 14 - 2021
PROJECT NO. G2755 - 42 - 01
FIGURE 2
SHEET 1 OF 1

Plotted:09/14/2021 8:26AM | By:ALVIN LADRILLONO | File Location:Y:\PROJECTS\G2755-42-01 (Nirvana Self Storage)\SHEETS\G2755-42-01 XSections.dwg



NOTES:

1.....EXCAVATE BACKCUT AT 1:1 INCLINATION (UNLESS OTHERWISE NOTED).

2.....BASE OF BUTTRESS FILL TO BE 3 FEET INTO FORMATIONAL MATERIAL OR 5 FEET BELOW BEDDING PLANE SHEAR OR LANDSLIDE SLIP SURFACE SLOPING A MINIMUM 5% INTO SLOPE.

3.....BUTTRESS/STABILITY FILL TO BE COMPOSED OF PROPERLY COMPACTED GRANULAR SOIL.

4.....CHIMNEY DRAINS TO BE APPROVED PREFABRICATED CHIMNEY DRAIN PANELS (MIRADRAIN G200N OR EQUIVALENT) SPACED APPROXIMATELY 20 FEET CENTER TO CENTER AND 4 FEET WIDE. CLOSER SPACING MAY BE REQUIRED IF SEEPAGE IS ENCOUNTERED.

5.....FILTER MATERIAL TO BE 3/4-INCH, OPEN-GRADED CRUSHED ROCK ENCLOSED IN APPROVED FILTER FABRIC (MIRAFI 140NC).

6.....COLLECTOR PIPE TO BE 4-INCH MINIMUM DIAMETER, PERFORATED, THICK-WALLED PVC SCHEDULE 40 OR EQUIVALENT, AND SLOPED TO DRAIN AT 1 PERCENT MINIMUM TO APPROVED OUTLET.

TYPICAL BUTTRESS/STABILITY FILL DETAIL

GEOCON
INCORPORATED
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

NIRVANA INDUSTRIAL BUILDINGS AND
SELF STORAGE COMPLEX
821 MAIN STREET
CHULA VISTA, CALIFORNIA

RM / AML		DSK/GTYPD	DATE 09 - 14 - 2021	PROJECT NO. G2755 - 42 - 01	FIG. 3

Plotted:09/14/2021 8:23AM | By:ALVIN LADRILLONO | File Location:Y:\PROJECTS\G2755-42-01 (Nirvana Self Storage)\DETAILS\Typical Slope Fill.dwg

APPENDIX A

APPENDIX A

FIELD INVESTIGATION

We performed our field investigation between July 29 and August 8, 2021. Our investigation consisted of a site reconnaissance, logging of eight exploratory test pits and five large diameter borings. The exploratory test pits were excavated to depths between 2- and 11-feet using a rubber-tire Caterpillar 430F backhoe. Exploratory borings were drilled to depths between 70- and 90-feet using a truck-mounted bucket auger drill rig. The approximate locations of the exploratory test pits borings tests are shown on Figure 1.

The soil conditions encountered in the trenches were visually examined, classified, and logged in general conformance with the American Society for Testing and Materials (ASTM) Practice for Description and Identification of Soils (Visual-Manual Procedure D 2488). Exploratory boring logs are presented in Figures A-1 through A-5, and test pit logs are presented on Figures A-6 through A-13. The logs depict the various soil types encountered and indicate the depths at which samples were obtained.

PROJECT NO. G2755-42-01

BORING LB 1

ELEV. (MSL.) **184'** DATE COMPLETED **07-29-2021**

EQUIPMENT BY: **R. ADAMS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				CL	**TERRACE DEPOSITS (Qt)** Stiff, dry to damp, brown, Sandy CLAY; abundant caliche; few roots			
2								
				SC	Medium dense, damp, grayish brown, Clayey SAND; few subrounded gravel; little caliche			
4								
	LB1-1					4		
6								
8				SC	Medium dense to dense, damp, grayish brown, Clayey, medium to coarse SAND; interbedded with coarse sandy gravel beds; trace subrounded cobble up to 6-inch diameter; some cross-bedding			
10	LB1-2					6/8"		
12				ML	Stiff, damp, grayish brown to olive brown, Clayey SILT; massive; trace fine gravel			
14								
16								
18					-At 18 feet: few 4"-6" thick sandy gravel interbeds; horizontal			
20	LB1-3					3		
22								
				GP	Medium dense to dense, damp, yellowish brown to orangish brown, coarse Sandy GRAVEL; gravel and cobble up to 12-inch diameter, subrounded to subangular: Hole belled out to 60"			
24								
26								
28								

Figure A-1,
Log of Boring LB 1, Page 1 of 3

G2755-42-01.GPJ

SAMPLE SYMBOLS			
	▒ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
	⊠ ... DISTURBED OR BAG SAMPLE	◪ ... CHUNK SAMPLE	▼ ... WATER TABLE OR ▽ ... SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

BORING LB 1

ELEV. (MSL.) **184'** DATE COMPLETED **07-29-2021**

EQUIPMENT BY: **R. ADAMS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	LB1-4 ■			ML	**OTAY FORMATION (To)** Hard, dry to damp, yellowish gray, SILTSTONE; massive	10/10"		
32	LB1-5 ◣			CH	Stiff to hard, damp to moist, dark reddish brown, bentonitic CLAYSTONE; moderately; fissured but not remolded			
34								
36				SM	Dense to very dense, damp, yellowish brown to grayish brown (mottled), Silty, fine- to medium-grained SANDSTONE; massive			
38								
40	LB1-6 ■					10/8"		
42								
44					At 45 feet: becomes yellowish brown to reddish brown			
46				SM	Very dense, damp, grayish white, Silty, fine to medium SANDSTONE; trace clay, massive			
48								
50	LB1-7 ■					10/10"		
52								
54								
56	LB1-8 ▩							
58					At 58 feet: becomes moist to wet			

Figure A-1,
Log of Boring LB 1, Page 2 of 3

SAMPLE SYMBOLS

	☐ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
	▩ ... DISTURBED OR BAG SAMPLE	◣ ... CHUNK SAMPLE	▼ ... WATER TABLE OR ▽ ... SEEPAGE

BORING LB 1

ELEV. (MSL.) **184'** DATE COMPLETED **07-29-2021**

EQUIPMENT BY: **R. ADAMS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
60	LB1-9 ■			SM		12		
62			▽		At 63 feet: seepage			
64								
66								
68			▼		At 68 feet; standing water			
70					BORING TERMINATED AT 70 FEET Groundwater encountered at 68 Backfilled on 07-29-2021			

Figure A-1,
Log of Boring LB 1, Page 3 of 3

G2755-42-01.GPJ

SAMPLE SYMBOLS			
	☐ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
	⊠ ... DISTURBED OR BAG SAMPLE	◪ ... CHUNK SAMPLE	▼ ... WATER TABLE OR ▽ ... SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2755-42-01

BORING LB 2

ELEV. (MSL.) 199' DATE COMPLETED 07-30-2021

EQUIPMENT BY: R. ADAMS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				CL	**TOPSOIL** Stiff, dry to damp, brown, Sandy CLAY; subrounded cobble up to 6-inch diameter			
2								
				SM	**TERRACE DEPOSITS (Qt)** Medium dense, damp, grayish brown, Silty SAND; trace clay, trace gravel			
4								
6					At 6 feet: subrounded cobble layer			
8								
10								
				GP	Dense, damp, orangish brown, coarse Sandy GRAVEL; subrounded gravel and cobble up to 10-inch diameter			
12								
				CH	**OTAY FORMATION (To)** Hard to very hard, damp, dark reddish brown to pinkish brown, bentonitic CLAYSTONE; weakly to moderately fissured with many polished and striated surfaces, occasional discontinuous anastomosing clay films that are remolded plastic and remolded up to 1/2-inch thick			
14								
16								
					At 17 feet: 1/32-inch moderately remolded plastic clay seam; horizontal to undulatory with polished parting surfaces only			
18								
20				SM	Very dense, damp, reddish brown to grayish brown, Silty, medium coarse SANDSTONE; trace clay, massive			
22								
24								
26								
28								
				SW	Very dense, dry to damp, light brown, very coarse grained SANDSTONE;			

Figure A-2,
Log of Boring LB 2, Page 1 of 4

G2755-42-01.GPJ

SAMPLE SYMBOLS

▢ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
⊠ ... DISTURBED OR BAG SAMPLE	◪ ... CHUNK SAMPLE	▼ ... WATER TABLE OR ▽ ... SEEPAGE

BORING LB 2

ELEV. (MSL.) 199' DATE COMPLETED 07-30-2021

EQUIPMENT BY: R. ADAMS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30				ML-SM	bedding horizontal Very hard, damp, grayish white to pinkish brown, fine grained Sandy SILTSTONE; massive, gunbarrel			
32								
34								
	LB2-1					10/8"		
36								
38				SM	Very dense, damp, yellowish brown, Silty, very fine grained SANDSTONE; massive gunbarrel			
40								
42								
				CH	Hard, damp, dark reddish brown, bentonitic CLAYSTONE; weakly fissured, no obvious clay films			
44								
	LB2-2			SM	Very dense,damp, grayish brown, Silty, fine SANDSTONE; massive	10/10"		
46	LB2-3							
				CH	Hard, damp, dark reddish brown to pinkish brown, bentonitic CLAYSTONE; massive, weakly to moderately fissured with polished and striated parting surfaces, occasional pockets of highly fissured claystone and weakly remolded clay			
48								
50								
52								
54				SM	Very dense, damp, grayish brown, Silty, fine to coarse SANDSTONE; massive			
56								
58								

Figure A-2,
Log of Boring LB 2, Page 2 of 4

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)	
▩ ... DISTURBED OR BAG SAMPLE	◪ ... CHUNK SAMPLE	▼ ... WATER TABLE OR	▽ ... SEEPAGE

PROJECT NO. G2755-42-01

BORING LB 2

ELEV. (MSL.) **199'** DATE COMPLETED **07-30-2021**

EQUIPMENT BY: **R. ADAMS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
60	LB2-4 ■			SM		12/8"		
62					At 62 feet: becomes moist			
64								
66								
68								
					At 69 feet: 4" thick subrounded gravel layer, bedding horizontal			
70	LB2-5 ■				At 70 feet: becomes moist to wet	15/10"		
72								
74								
76								
78			▽		At 78 feet: moderate of heavy seepage			
80								
82								
84								
86								
			▼		At 87 feet: standing water			
88								

Figure A-2,
Log of Boring LB 2, Page 3 of 4

G2755-42-01.GPJ

SAMPLE SYMBOLS			
	☐ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
	☒ ... DISTURBED OR BAG SAMPLE	◩ ... CHUNK SAMPLE	▼ ... WATER TABLE OR ▽ ... SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2755-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	**BORING LB 2** ELEV. (MSL.) **199'** DATE COMPLETED **07-30-2021** EQUIPMENT BY: **R. ADAMS**	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
					BORING TERMINATED AT 90 FEET Groundwater encountered at 87 Backfilled on 07-30-2021			

Figure A-2,
Log of Boring LB 2, Page 4 of 4

G2755-42-01.GPJ

SAMPLE SYMBOLS			
	☐ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
	☒ ... DISTURBED OR BAG SAMPLE	◪ ... CHUNK SAMPLE	▼ ... WATER TABLE OR ▽ ... SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. G2755-42-01

BORING LB 3

ELEV. (MSL.) **194'** DATE COMPLETED **07-30-2021**

EQUIPMENT BY: **R. ADAMS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				CL	**TOPSOIL** Stiff, damp, reddish brown, Sandy CLAY; some gravel, few roots			
2				SM	**TERRACE DEPOSITS (Qt)** Dense, dry to damp, orangish brown, Silty, medium to coarse SAND; some subrounded gravel and cobble up to 12-inch diameter			
	LB3-1 ⊠							
4								
6				CH	**OTAY FORMATION (To)** Hard, dry, reddish brown, CLAYSTONE; numerous sub horizontal to undulatory remolded moderately fissured soft plastic 1/8" thick clay films			
8								
				ML	Hard, dry to damp, grayish brown to pinkish brown, very fine grained Sandy SILTSTONE; massive; few subvertical clay filled fractures			
10								
12								
14								
				CH	Hard, damp, pinkish brown to reddish brown, bentonitic CLAYSTONE; moderately to well fissured with numerous polished parting surfaces			
16								
18					At 18 feet: transitions to fine grained sandy claystone			
20								
				ML	Hard, dry to damp, pale whitish brow to pinkish brown, fine grained Sandy SILTSTONE; minor caliche along top contact; massive, few of reddish brown sandy claystone interbeds			
22								
24								
26								
28								

Figure A-3,
Log of Boring LB 3, Page 1 of 3

G2755-42-01.GPJ

SAMPLE SYMBOLS			
	☐ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
	⊠ ... DISTURBED OR BAG SAMPLE	◪ ... CHUNK SAMPLE	▼ ... WATER TABLE OR ▽ ... SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2755-42-01

BORING LB 3

ELEV. (MSL.) **194'** DATE COMPLETED **07-30-2021**

EQUIPMENT BY: **R. ADAMS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30				ML				
32								
34								
					At 35-38 feet: Few high-angle clay filled fractures			
36								
38								
40				CH	Stiff to hard, damp, reddish brown, bentonitic CLAYSTONE; friable in places, weakly fissured, top contact is transitional over 18", no obvious remolding or plastic clay films			
42					At 42 feet: thin band of caliche cementation			
44								
46								
					At 47 feet: becomes moderately fissured			
48								
				ML	Hard, damp, pinkish brown to grayish white, very fine grained Sandy SILTSTONE; massive			
50								
52				SM	Very dense, damp, grayish white to pinkish white, Silty, fine to coarse SANDSTONE; massive			
54								
56								
58								

Figure A-3,
Log of Boring LB 3, Page 2 of 3

G2755-42-01.GPJ

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
☒ ... DISTURBED OR BAG SAMPLE	◪ ... CHUNK SAMPLE	▼ ... WATER TABLE OR ▽ ... SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2755-42-01

BORING LB 3

ELEV. (MSL.) **194'** DATE COMPLETED **07-30-2021**

EQUIPMENT BY: **R. ADAMS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
60				SM				
62								
64								
					At 65 feet: becomes damp to moist			
66								
68								
70								
					At 71 feet: 6-inch subrounded cobble bed; N70E/3°S			
72			∇		At 72 feet: light seepage			
74								
					BORING TERMINATED AT 75 FEET Groundwater not encountered Backfilled on 07-30-2021			

Figure A-3,
Log of Boring LB 3, Page 3 of 3

G2755-42-01.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ☒ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR ∇ ... SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2755-42-01

BORING LB 4

ELEV. (MSL.) **216'** DATE COMPLETED **08-02-2021**

EQUIPMENT BY: **R. ADAMS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SC	**TERRACE DEPOSITS (Qt)** Dense, dry to moist, orangish brown, Clayey, medium to coarse SAND with gravel and cobble, subrounded gravel and cobble up to 18-inch diameter			
2								
4								
6								
8								
	LB4-1 ☒							
10								
12								
14								
16								
18								
20								
22								
24								
				GW	Loose to medium dense, damp, orangish brown, Sandy GRAVEL; low cohesions present in cave zone, caving to 72-inch diameter, cobble and boulders up to 36 inches			
26								
28								

Figure A-4,
Log of Boring LB 4, Page 1 of 3

G2755-42-01.GPJ

SAMPLE SYMBOLS

- ▢ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ☒ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR ▽ ... SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

BORING LB 4

ELEV. (MSL.) **216'** DATE COMPLETED **08-02-2021**

EQUIPMENT BY: **R. ADAMS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	LB4-2 ■	▨		CH	**OTAY FORMATION (To)** Firm to stiff, damp, dark reddish brown, bentonitic CLAYSTONE; weakly to moderately fissured with some polished and slanted parting surfaces, little to no remolding or soft plastic zones, massive	8/8"		
32								
34								
36								
38								
				CL	Hard, damp, dark reddish brown, Sandy CLAYSTONE			
40	LB4-3 ■			SW	Very dense, damp, reddish brown, very coarse SANDSTONE (gritstone bed); cemented, few rounded gravel	10		
42								
				ML	Stiff to hard, damp to moist, pale reddish brown to olive brown, SILTSTONE, Clayey SILTSTONE and Sandy SILTSTONE (interbedded); massive			
44								
46								
48								
50	LB4-4 ■					12		
52								
54								
56								
58								

Figure A-4,
Log of Boring LB 4, Page 2 of 3

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL
◧ ... STANDARD PENETRATION TEST
■ ... DRIVE SAMPLE (UNDISTURBED)
⊠ ... DISTURBED OR BAG SAMPLE
◪ ... CHUNK SAMPLE
▼ ... WATER TABLE OR ▽ ... SEEPAGE

GEOCON

BORING LB 4

ELEV. (MSL.) **216'** DATE COMPLETED **08-02-2021**

EQUIPMENT ________ BY: **R. ADAMS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
60	LB4-5 ■					15		
				CH	Very stiff to hard, damp, dark reddish brown, bentonitic CLAYSTONE; weakly to moderately fissured, blocky texture, no remolding			
62								
64								
66								
68								
				ML	Stiff to hard, damp, reddish brown, Clayey SILTSTONE; massive			
70	LB4-6 ■					15		
				SM	Dense to very dense, damp, reddish brown to pinkish white, Silty, fine to coarse SANDSTONE; trace clay, massive			
72								
74								
76								
78								
80	LB4-7 ■					20/6"		

BORING TERMINATED AT 81 FEET
Groundwater not encountered
Backfilled on 08-02-2021

Figure A-4,
Log of Boring LB 4, Page 3 of 3

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)	
⊠ ... DISTURBED OR BAG SAMPLE	◪ ... CHUNK SAMPLE	▼ ... WATER TABLE OR	▽ ... SEEPAGE

PROJECT NO. G2755-42-01

BORING LB 5

ELEV. (MSL.) **218'** DATE COMPLETED **08-03-2021**

EQUIPMENT BY: **R. ADAMS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				CL	**TOPSOIL** Stiff, dry, dark brown, Sandy CLAY; trace gravel			
				GW	**TERRACE DEPOSITS (Qt)** Medium dense to dense, damp, brown to orangish brown, Silty, medium coarse SAND; trace clay, some subrounded gravel and cobble up to 8-inch diameter			
2								
4								
6								
8								
10								
12								
14								
16								
18								
20								
22								
24								
26								
28					At 26-32 feet: hole belled out to 60-inch diameter with abundant loose cobble and overhanging areas. Hole logged from cuttings below 32 feet			

Figure A-5,
Log of Boring LB 5, Page 1 of 3

G2755-42-01.GPJ

SAMPLE SYMBOLS			
	☐ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
	☒ ... DISTURBED OR BAG SAMPLE	◪ ... CHUNK SAMPLE	▼ ... WATER TABLE OR ▽ ... SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2755-42-01

BORING LB 5

ELEV. (MSL.) **218'** DATE COMPLETED **08-03-2021**

EQUIPMENT BY: **R. ADAMS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30				GW				
32				ML	**OTAY FORMATION (To)** Hard, damp, grayish brown, Clayey SILTSTONE			
34	LB5-1			CH	Hard, damp, reddish brown, bentonitic CLAYSTONE; blocky, weakly fissured			
36								
38				ML/CL	Hard, damp, brown to olive brown, interbedded SILTSTONE, Clayey SILTSTONE, and Silty CLAYSTONE			
40	LB5-2							
42								
44								
46								
48								
50	LB5-3		▽		At 50 feet: light to moderate seepage			
52								
54								
56								
58								

Figure A-5,
Log of Boring LB 5, Page 2 of 3

G2755-42-01.GPJ

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL
◧ ... STANDARD PENETRATION TEST
■ ... DRIVE SAMPLE (UNDISTURBED)
☒ ... DISTURBED OR BAG SAMPLE
◪ ... CHUNK SAMPLE
▼ ... WATER TABLE OR ▽ ... SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2755-42-01

BORING LB 5

ELEV. (MSL.) 218' DATE COMPLETED 08-03-2021

EQUIPMENT BY: R. ADAMS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
60	LB5-4 ■			ML/CL				
62								
64				CH	Hard, damp, reddish brown, bentonitic CLAYSTONE; massive, blocky and weakly fissured			
	LB5-5 ■		▼					
66								
68								
70	LB5-6 ■							
72								
				SM	Dense, damp, pale yellowish brown, Silty, fine to coarse SANDSTONE; massive			
74								
76								
78								
80					BORING TERMINATED AT 80 FEET Groundwater encountered at 65 Backfilled on 08-04-2021			

Figure A-5,
Log of Boring LB 5, Page 3 of 3

G2755-42-01.GPJ

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL
◧ ... STANDARD PENETRATION TEST
■ ... DRIVE SAMPLE (UNDISTURBED)
☒ ... DISTURBED OR BAG SAMPLE
◪ ... CHUNK SAMPLE
▼ ... WATER TABLE OR ▽ ... SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2755-42-01

TEST PIT TP 1

ELEV. (MSL.) +/-150' DATE COMPLETED 08-05-2021

EQUIPMENT CAT 430L BACKHOE BY: R. ADAMS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SC	**SLOPEWASH** Loose, dry, brown, Clayey, fine to coarse SAND with subrounded gravel and cobble			
2				CL	**OTAY FORMATION (To)** Hard, dry, reddish brown, bentonitic CLAYSTONE; dessicated and fractured with blocky texture, some caliche; Bedding: <2º dip/sub-horizontal			
4								
6								
					TRENCH TERMINATED AT 7 FEET Groundwater not encountered Backfilled on 08-05-2021			

Figure A-6,
Log of Test Pit TP 1, Page 1 of 1

G2755-42-01.GPJ

SAMPLE SYMBOLS

▢ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
⊠ ... DISTURBED OR BAG SAMPLE	◪ ... CHUNK SAMPLE	▼ ... WATER TABLE OR ▽ ... SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2755-42-01

TEST PIT TP 2

ELEV. (MSL.) **+/-145'** DATE COMPLETED **08-05-2021**

EQUIPMENT **CAT 430L BACKHOE** BY: **R. ADAMS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SC	**SLOPEWASH** Loose, dry, light brown, Clayey, fine to coarse SAND with gravel			
2 4				SM	**OTAY FORMATION (To)** Dense, dry to damp, pinkish brown, Silty, fine to coarse SANDSTONE; massive			
					TRENCH TERMINATED AT 5 FEET Groundwater not encountered Backfilled on 08-05-2021			

Figure A-7,
Log of Test Pit TP 2, Page 1 of 1

G2755-42-01.GPJ

SAMPLE SYMBOLS			
	☐ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
	⊠ ... DISTURBED OR BAG SAMPLE	◩ ... CHUNK SAMPLE	▼ ... WATER TABLE OR ▽ ... SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2755-42-01

TEST PIT TP 3

ELEV. (MSL.) **+/-145'** DATE COMPLETED **08-05-2021**

EQUIPMENT **CAT 430L BACKHOE** BY: **R. ADAMS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0		▨		SC	**SLOPEWASH** Loose, dry, brown, Clayey, fine to coarse SAND with subrounded gravel and cobble			
		▨		CL	**OTAY FORMATION (To)** Hard, dry, dark reddish brown, bentonitic CLAYSTONE; dessicated and fractured with blocky texture, abundant caliche			
2		▨						
4		▨						
		⁘		SM	Dense, dry to damp, pinkish brown, Silty, fine to coarse SANDSTONE; massive			

TRENCH TERMINATED AT 5 FEET
Groundwater not encountered
Backfilled on 08-05-2021

Figure A-8,
Log of Test Pit TP 3, Page 1 of 1

G2755-42-01.GPJ

SAMPLE SYMBOLS
- ▢ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◩ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR ▽ ... SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2755-42-01

TEST PIT TP 4

ELEV. (MSL.) **+/-145'** DATE COMPLETED **08-05-2021**

EQUIPMENT **CAT 430L BACKHOE** BY: **R. ADAMS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SC	**SLOPEWASH** Loose, dry, brown, Clayey, fine to coarse SAND with subrounded gravel and cobble			
				CL	**OTAY FORMATION (To)** Hard, dry, dark reddish brown, bentonitic CLAYSTONE			
2								
4								
				SM	Dense, dry, pale yellowish brown, Silty, medium grained SANDSTONE			
6					TRENCH TERMINATED AT 6 FEET Groundwater not encountered Backfilled on 08-05-2021			

Figure A-9,
Log of Test Pit TP 4, Page 1 of 1

G2755-42-01.GPJ

SAMPLE SYMBOLS			
	☐ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
	☒ ... DISTURBED OR BAG SAMPLE	◪ ... CHUNK SAMPLE	▼ ... WATER TABLE OR ▽ ... SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2755-42-01

TEST PIT TP 5

ELEV. (MSL.) **+/-145'** DATE COMPLETED **08-05-2021**

EQUIPMENT **CAT 430L BACKHOE** BY: **R. ADAMS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0		▨		SM	**OTAY FORMATION (To)** Dense, dry, pale whitish brown, Silty, fine to coarse SANDSTONE; fractured, some caliche			
2		▨						
4		▨						
6		▨						
					TRENCH TERMINATED AT 7 FEET Groundwater not encountered Backfilled on 08-05-2021			

Figure A-10,
Log of Test Pit TP 5, Page 1 of 1

G2755-42-01.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ☒ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR ▽ ... SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2755-42-01

TEST PIT TP 6

ELEV. (MSL.) **+/-140'** DATE COMPLETED **08-05-2021**

EQUIPMENT **CAT 430L BACKHOE** BY: **R. ADAMS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**OTAY FORMATION (To)** Dense, dry to damp, pale whitish yellow to pinkish white, Silty, fine to coarse SANDSTONE; fractured, trace caliche			
2								
4								
6					TRENCH TERMINATED AT 6 FEET Groundwater not encountered Backfilled on 08-05-2021			

Figure A-11,
Log of Test Pit TP 6, Page 1 of 1

G2755-42-01.GPJ

SAMPLE SYMBOLS

- ▢ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ☒ ... DISTURBED OR BAG SAMPLE
- ◩ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR ▽ ... SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2755-42-01

TEST PIT TP 7

ELEV. (MSL.) **+/-150'** DATE COMPLETED **08-05-2021**

EQUIPMENT **CAT 430L BACKHOE** BY: **R. ADAMS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SC	**SLOPEWASH** Loose, dry, brown, Clayey, fine to coarse SAND with subrounded gravel and cobble			
2 4 6 8				CL	**OTAY FORMATION (To)** Hard, dry to damp, dark reddish brown, bentonitic CLAYSTONE; friable, weathered			
10				SM	Dense, dry to damp, pale yellowish brown, Silty, fine to coarse SANDSTONE; massive			
					TRENCH TERMINATED AT 11 FEET Groundwater not encountered Backfilled on 08-05-2021			

Figure A-12,
Log of Test Pit TP 7, Page 1 of 1

G2755-42-01.GPJ

SAMPLE SYMBOLS			
	☐ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
	☒ ... DISTURBED OR BAG SAMPLE	◪ ... CHUNK SAMPLE	▼ ... WATER TABLE OR ▽ ... SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. G2755-42-01

TEST PIT TP 8

ELEV. (MSL.) **+/-145'** DATE COMPLETED **08-05-2021**

EQUIPMENT **CAT 430L BACKHOE** BY: **R. ADAMS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0		▨		CL	**OTAY FORMATION (To)** Hard, dry, dark reddish brown, bentonitic CLAYSTONE; friable, some caliche			
2		▨						
4		▨						
6					TRENCH TERMINATED AT 6 FEET Groundwater not encountered Backfilled on 08-05-2021			

Figure A-13,
Log of Test Pit TP 8, Page 1 of 1

G2755-42-01.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ☒ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR ▽ ... SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

APPENDIX B

APPENDIX B

LABORATORY TESTING

Laboratory tests were performed in accordance with generally accepted test methods of the American Society for Testing and Materials (ASTM) or other suggested procedures. Selected samples were tested for in-situ dry density and moisture content, maximum dry density and optimum moisture content, expansion potential, gradation, Atterberg limits, soluble sulfate content, chloride content, pH and resistivity, and shear strength. The results of these tests are summarized on the following tables and figures.

SUMMARY OF LABORATORY MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT TEST RESULTS
ASTM D 1557-02

Sample No.	Description	Maximum Dry Density (pcf)	Optimum Moisture Content (% dry wt.)
LB3-1	Brown clayey fine to coarse SAND; some gravel (SC)	127.2	10.4
LB4-1	Brown fine to coarse sandy GRAVEL; little silt (GW)	135.8	7.0

SUMMARY OF LABORATORY EXPANSION INDEX TEST RESULTS
ASTM D 4829-03

Sample No.	Moisture Content		Dry Density (pcf)	Expansion Index
	Before Test (%)	After Test (%)		
LB2-3	14.8	33.6	91.8	55
LB4-1	7.7	14.1	117.8	1

SUMMARY OF LABORATORY WATER-SOLUBLE SULFATE TEST RESULTS
CALIFORNIA TEST NO. 417

Sample No.	Water-Soluble Sulfate (%)	Sulfate Exposure
LB4-1	0.028	S0

SUMMARY OF LABORATORY WATER-SOLUBLE CHLORIDE ION CONTENT TEST RESULTS
AASHTO TEST NO. T 291

Sample No.	Chloride Ion Content ppm (%)
LB4-1	937 (0.094)

SUMMARY OF LABORATORY POTENTIAL OF HYDROGEN (PH) AND RESISTIVITY TEST RESULTS
CALIFORNIA TEST METHOD 643

Sample No.	Geologic Unit	pH	Minimum Resistivity (ohm-centimeters)
LB4-1	Qt	7.56	460

SUMMARY OF LABORATORY ATTERBERG LIMITS TEST RESULTS
ASTM D 4318

Sample No.	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index
LB2-3	57	26	31
LB3-1	50	18	32
LB4-1	30	19	11
LB5-1	56	24	32

SAMPLE NO.: **LB1-3**
SAMPLE DEPTH (FT): **20'**
GEOLOGIC UNIT: **Qt**
NATURAL/REMOLDED: **N**

INITIAL CONDITIONS

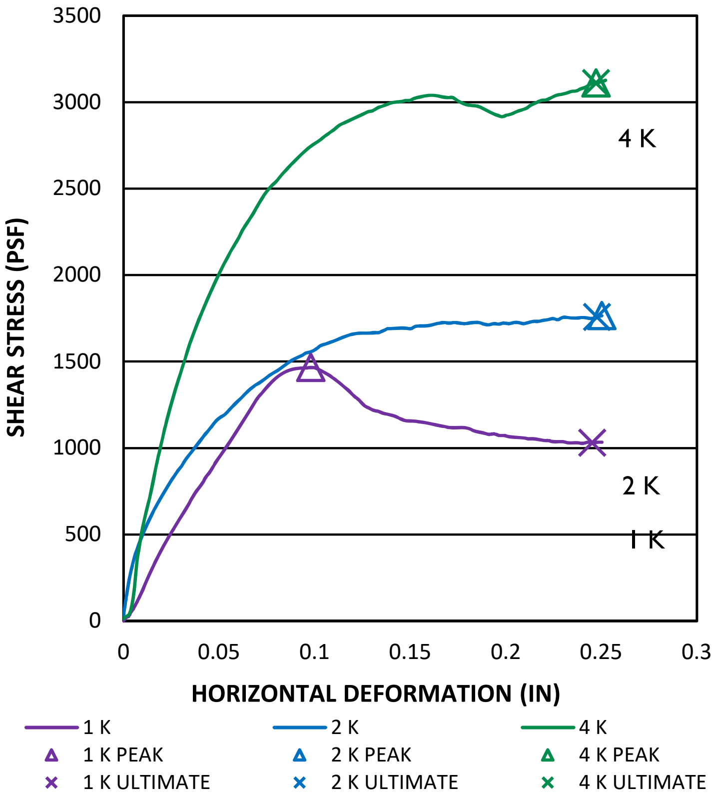
NORMAL STRESS TEST LOAD	1 K	2 K	4 K	AVERAGE
ACTUAL NORMAL STRESS (PSF):	1000	2000	4000	--
WATER CONTENT (%):	11.6	10.5	9.1	10.4
DRY DENSITY (PCF):	114.6	107.2	109.0	110.3

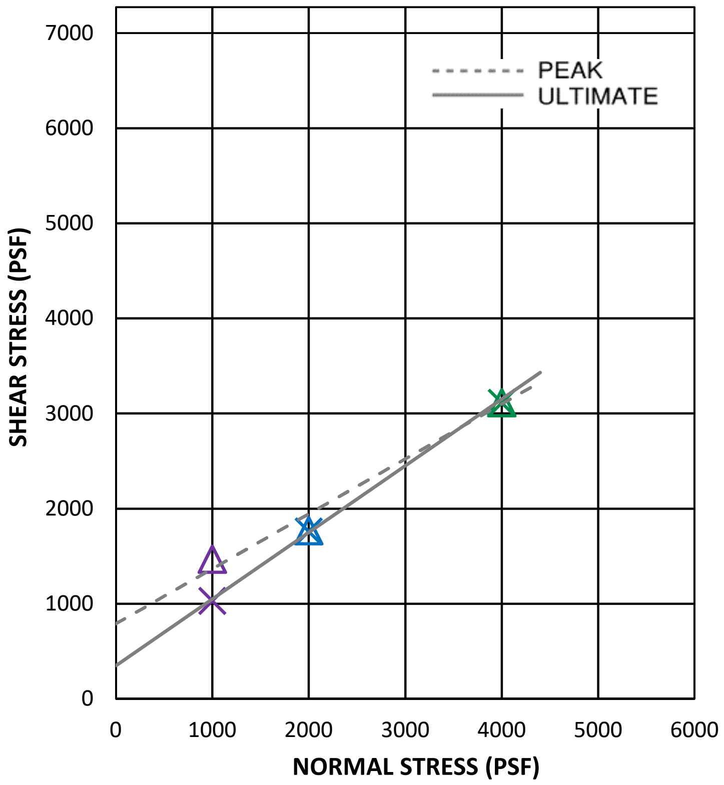
AFTER TEST CONDITIONS

NORMAL STRESS TEST LOAD	1 K	2 K	4 K	AVERAGE
WATER CONTENT (%):	16.8	19.5	17.7	18.0
PEAK SHEAR STRESS (PSF):	1466	1765	3111	--
ULT.-E.O.T. SHEAR STRESS (PSF):	1030	1759	3111	--

RESULTS

PEAK	COHESION, C (PSF)	790
	FRICTION ANGLE (DEGREES)	30
ULTIMATE	COHESION, C (PSF)	350
	FRICTION ANGLE (DEGREES)	35





GEOCON
INCORPORATED
GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121-2974
PHONE 858 558-6900 - FAX 858 558-6159

DIRECT SHEAR - ASTM D 3080

NIRVANA

PROJECT NO.: G2755-42-01

SAMPLE NO.:	**LB3-1**	GEOLOGIC UNIT:	**Qt**
SAMPLE DEPTH (FT):	**3'**	NATURAL/REMOLDED:	**R**

INITIAL CONDITIONS

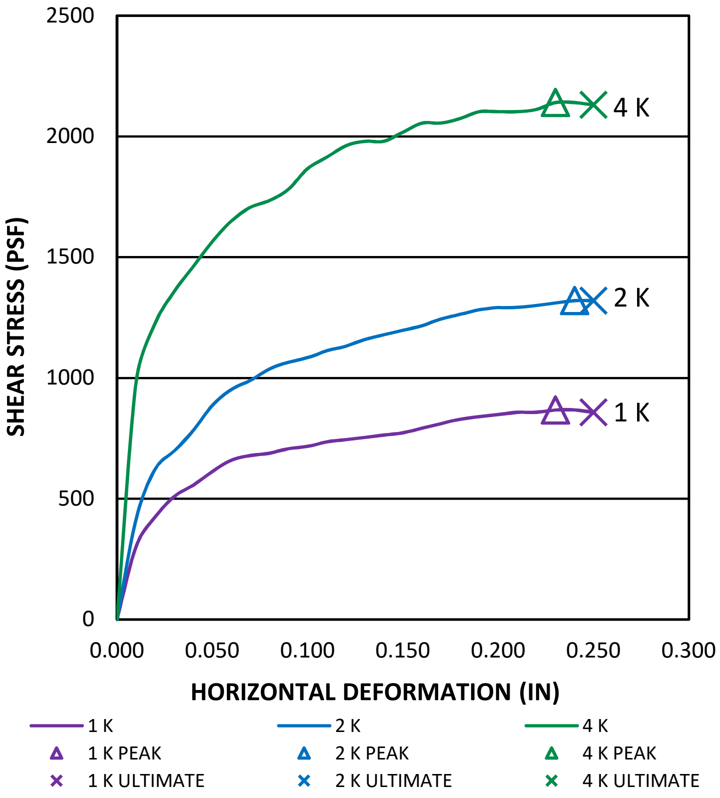
NORMAL STRESS TEST LOAD	1 K	2 K	4 K	AVERAGE
ACTUAL NORMAL STRESS (PSF):	890	2030	4300	--
WATER CONTENT (%):	10.8	11.2	10.5	10.8
DRY DENSITY (PCF):	114.1	114.1	114.6	114.3

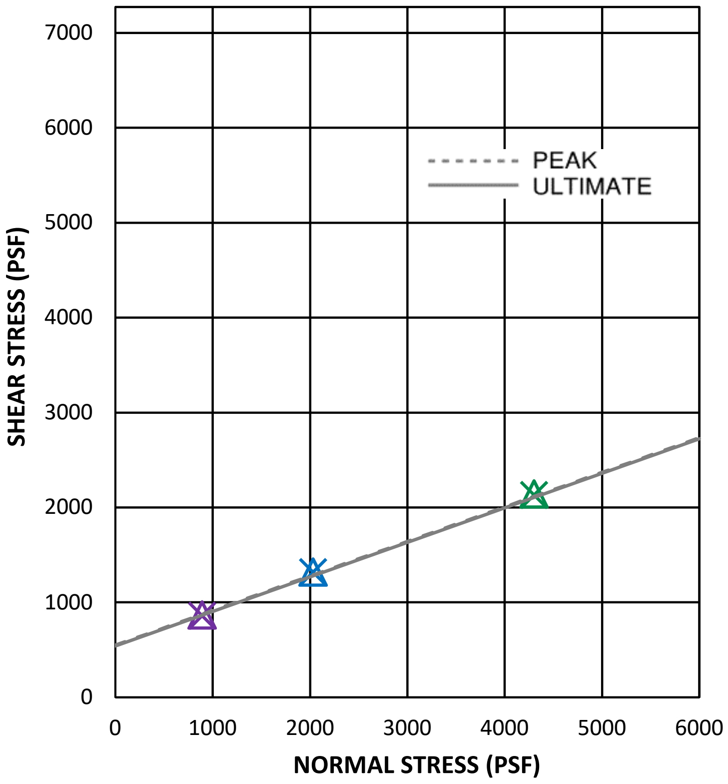
AFTER TEST CONDITIONS

NORMAL STRESS TEST LOAD	1 K	2 K	4 K	AVERAGE
WATER CONTENT (%):	20.3	20.9	21.3	20.8
PEAK SHEAR STRESS (PSF):	867	1320	2140	--
ULT.-E.O.T. SHEAR STRESS (PSF):	858	1320	2131	--

RESULTS

PEAK	COHESION, C (PSF)	550
	FRICTION ANGLE (DEGREES)	20
ULTIMATE	COHESION, C (PSF)	540
	FRICTION ANGLE (DEGREES)	20





GEOCON
INCORPORATED
GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

DIRECT SHEAR - ASTM D 3080

NIRVANA

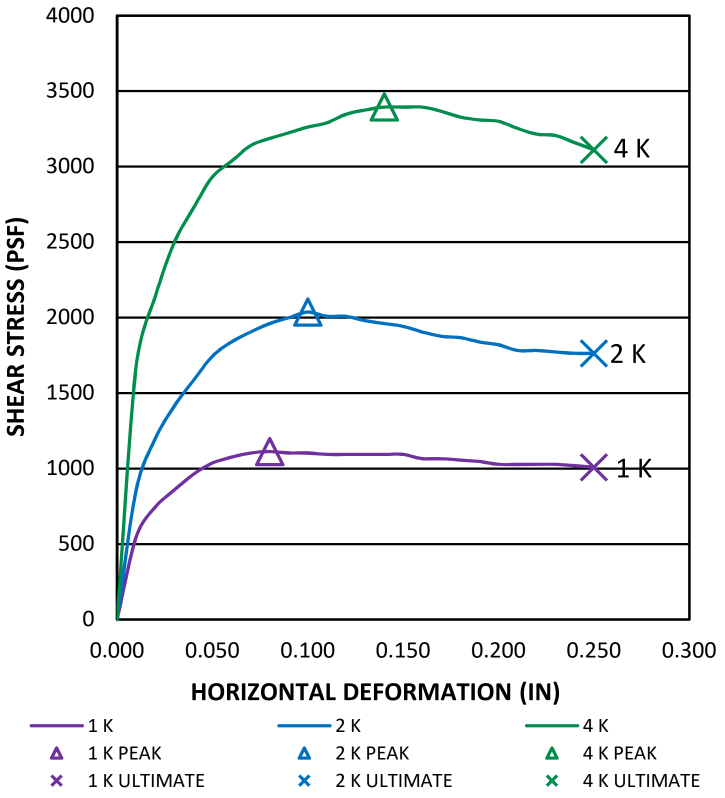
PROJECT NO.: G2755-42-01

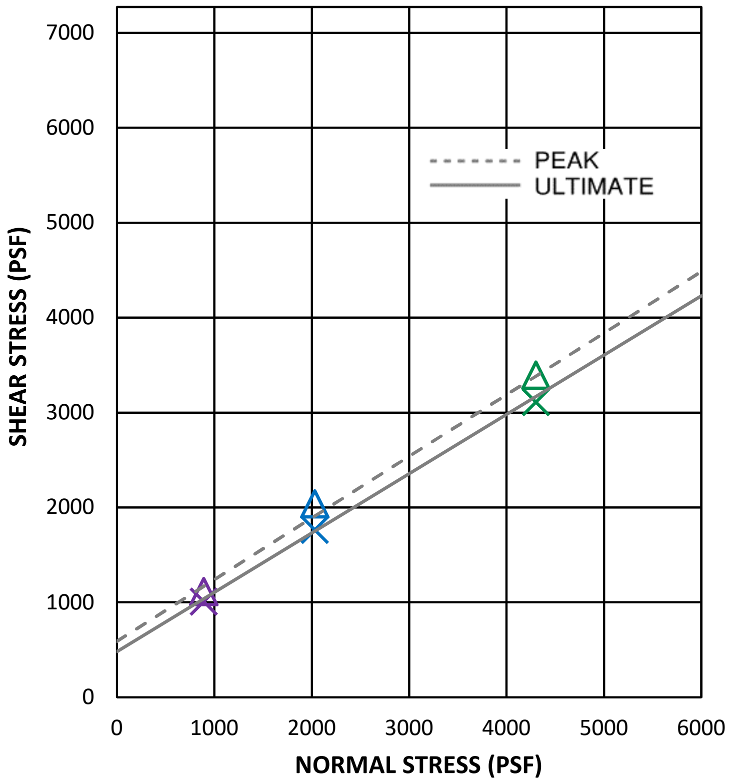
SAMPLE NO.: **LB4-1** GEOLOGIC UNIT: **Qt**
SAMPLE DEPTH (FT): **9'** NATURAL/REMOLDED: **R**

INITIAL CONDITIONS				
NORMAL STRESS TEST LOAD	**1 K**	**2 K**	**4 K**	**AVERAGE**
ACTUAL NORMAL STRESS (PSF):	890	2030	4300	--
WATER CONTENT (%):	6.2	6.5	6.2	6.3
DRY DENSITY (PCF):	122.9	123.4	123.5	123.3

AFTER TEST CONDITIONS				
NORMAL STRESS TEST LOAD	**1 K**	**2 K**	**4 K**	**AVERAGE**
WATER CONTENT (%):	11.5	12.1	12.6	12.1
PEAK SHEAR STRESS (PSF):	1112	2036	3394	--
ULT.-E.O.T. SHEAR STRESS (PSF):	1009	1763	3111	--

RESULTS		
PEAK	COHESION, C (PSF)	590
	FRICTION ANGLE (DEGREES)	33
ULTIMATE	COHESION, C (PSF)	480
	FRICTION ANGLE (DEGREES)	32





GEOCON
INCORPORATED
GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121-2974
PHONE 858 558-6900 - FAX 858 558-6159

DIRECT SHEAR - ASTM D 3080

NIRVANA

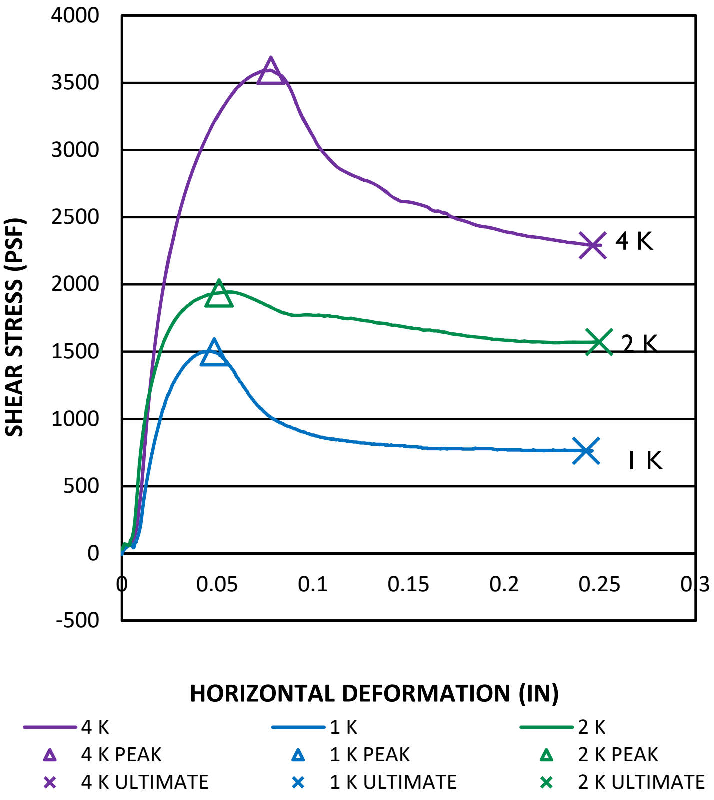
PROJECT NO.: G2755-42-01

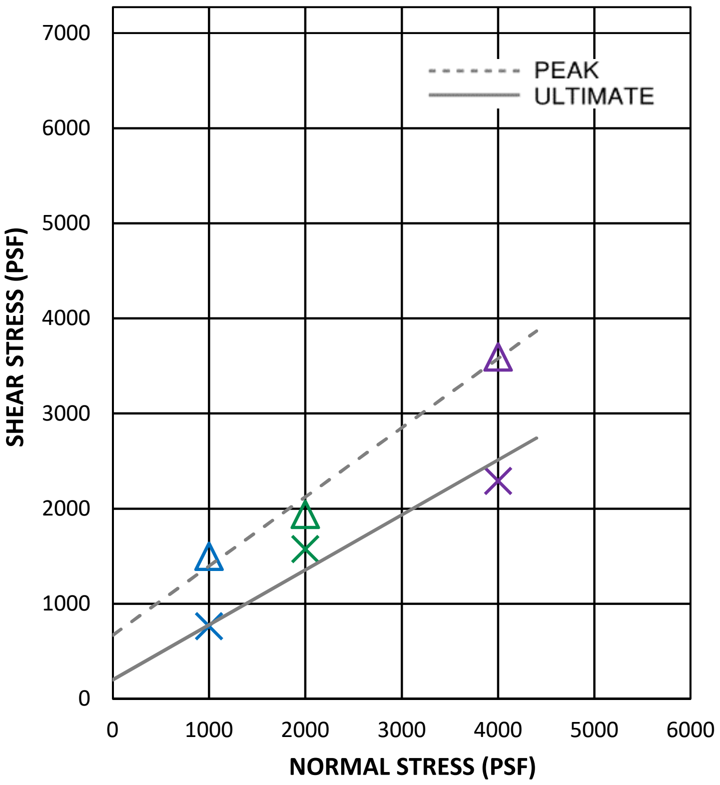
SAMPLE NO.: **LB4-2**
SAMPLE DEPTH (FT): **30.5'**
GEOLOGIC UNIT: **To**
NATURAL/REMOLDED: **N**

INITIAL CONDITIONS				
NORMAL STRESS TEST LOAD	**4 K**	**1 K**	**2 K**	**AVERAGE**
ACTUAL NORMAL STRESS (PSF):	4000	1000	2000	--
WATER CONTENT (%):	21.0	20.0	21.0	20.7
DRY DENSITY (PCF):	109.8	108.4	104.7	107.7

AFTER TEST CONDITIONS				
NORMAL STRESS TEST LOAD	**4 K**	**1 K**	**2 K**	**AVERAGE**
WATER CONTENT (%):	24.5	23.5	25.1	24.4
PEAK SHEAR STRESS (PSF):	3592	1498	1937	--
ULT.-E.O.T. SHEAR STRESS (PSF):	2292	764	1573	--

RESULTS		
PEAK	COHESION, C (PSF)	670
	FRICTION ANGLE (DEGREES)	36
ULTIMATE	COHESION, C (PSF)	200
	FRICTION ANGLE (DEGREES)	30





GEOCON
INCORPORATED
GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

DIRECT SHEAR - ASTM D 3080

NIRVANA

PROJECT NO.: G2755-42-01

SAMPLE NO.:	**LB5-3**	GEOLOGIC UNIT:	**To**
SAMPLE DEPTH (FT):	**50'**	NATURAL/REMOLDED:	**N**

INITIAL CONDITIONS

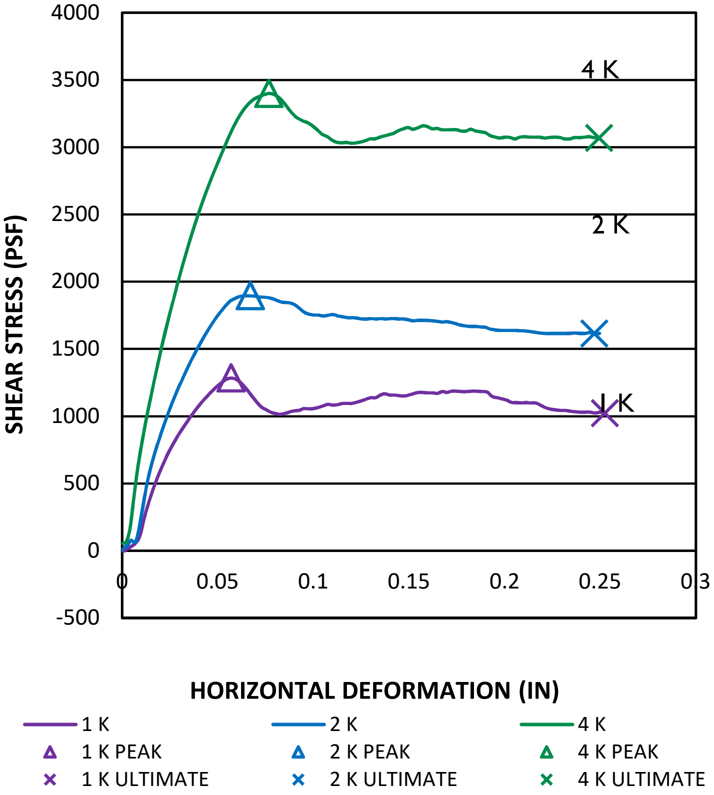
NORMAL STRESS TEST LOAD	**1 K**	**2 K**	**4 K**	**AVERAGE**
ACTUAL NORMAL STRESS (PSF):	1000	2000	4000	--
WATER CONTENT (%):	14.0	13.8	13.5	13.8
DRY DENSITY (PCF):	119.4	121.1	120.4	120.3

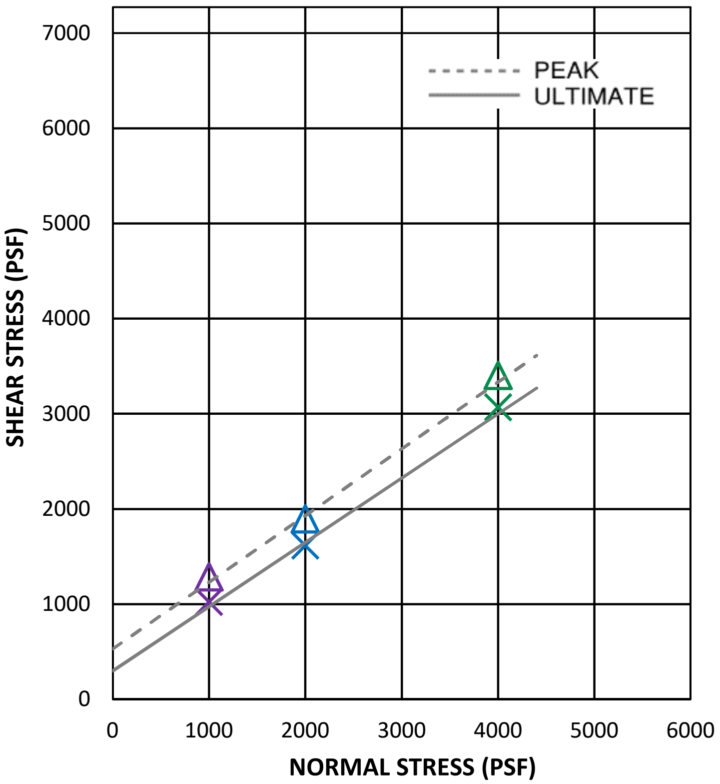
AFTER TEST CONDITIONS

NORMAL STRESS TEST LOAD	**1 K**	**2 K**	**4 K**	**AVERAGE**
WATER CONTENT (%):	19.8	19.6	19.3	19.6
PEAK SHEAR STRESS (PSF):	1284	1895	3400	--
ULT.-E.O.T. SHEAR STRESS (PSF):	1024	1615	3068	--

RESULTS

PEAK	COHESION, C (PSF)	530
	FRICTION ANGLE (DEGREES)	35
ULTIMATE	COHESION, C (PSF)	300
	FRICTION ANGLE (DEGREES)	34





GEOCON
INCORPORATED

GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

DIRECT SHEAR - ASTM D 3080

NIRVANA

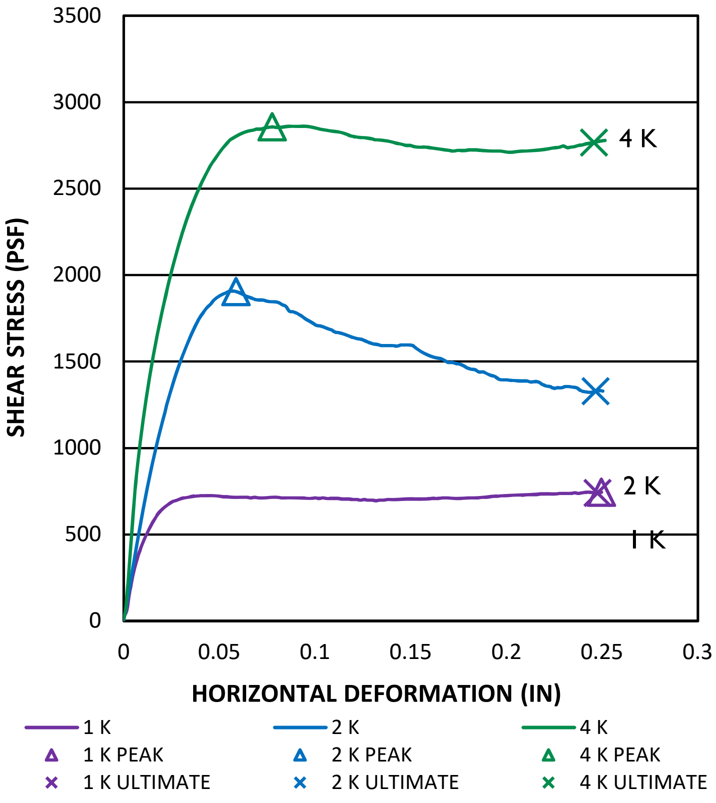
PROJECT NO.: G2755-42-01

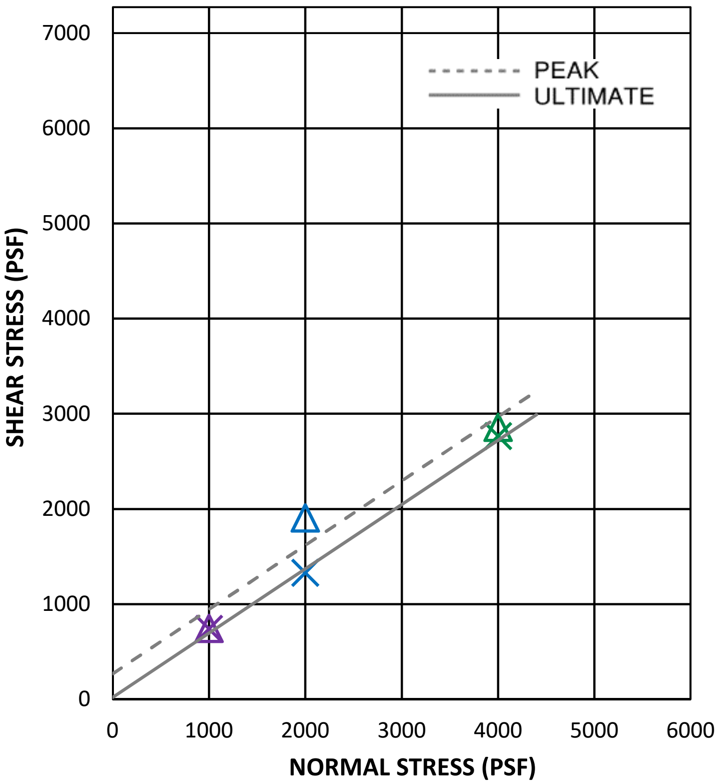
SAMPLE NO.: **LB5-5**
SAMPLE DEPTH (FT): **65'**
GEOLOGIC UNIT: **To**
NATURAL/REMOLDED: **N**

INITIAL CONDITIONS				
NORMAL STRESS TEST LOAD	**1 K**	**2 K**	**4 K**	**AVERAGE**
ACTUAL NORMAL STRESS (PSF):	1000	2000	4000	--
WATER CONTENT (%):	17.3	18.0	17.5	17.6
DRY DENSITY (PCF):	112.1	113.3	112.4	112.6

AFTER TEST CONDITIONS				
NORMAL STRESS TEST LOAD	**1 K**	**2 K**	**4 K**	**AVERAGE**
WATER CONTENT (%):	23.0	23.5	23.1	23.2
PEAK SHEAR STRESS (PSF):	744	1905	2857	--
ULT.-E.O.T. SHEAR STRESS (PSF):	741	1329	2766	--

RESULTS		
PEAK	COHESION, C (PSF)	270
	FRICTION ANGLE (DEGREES)	34
ULTIMATE	COHESION, C (PSF)	22
	FRICTION ANGLE (DEGREES)	34





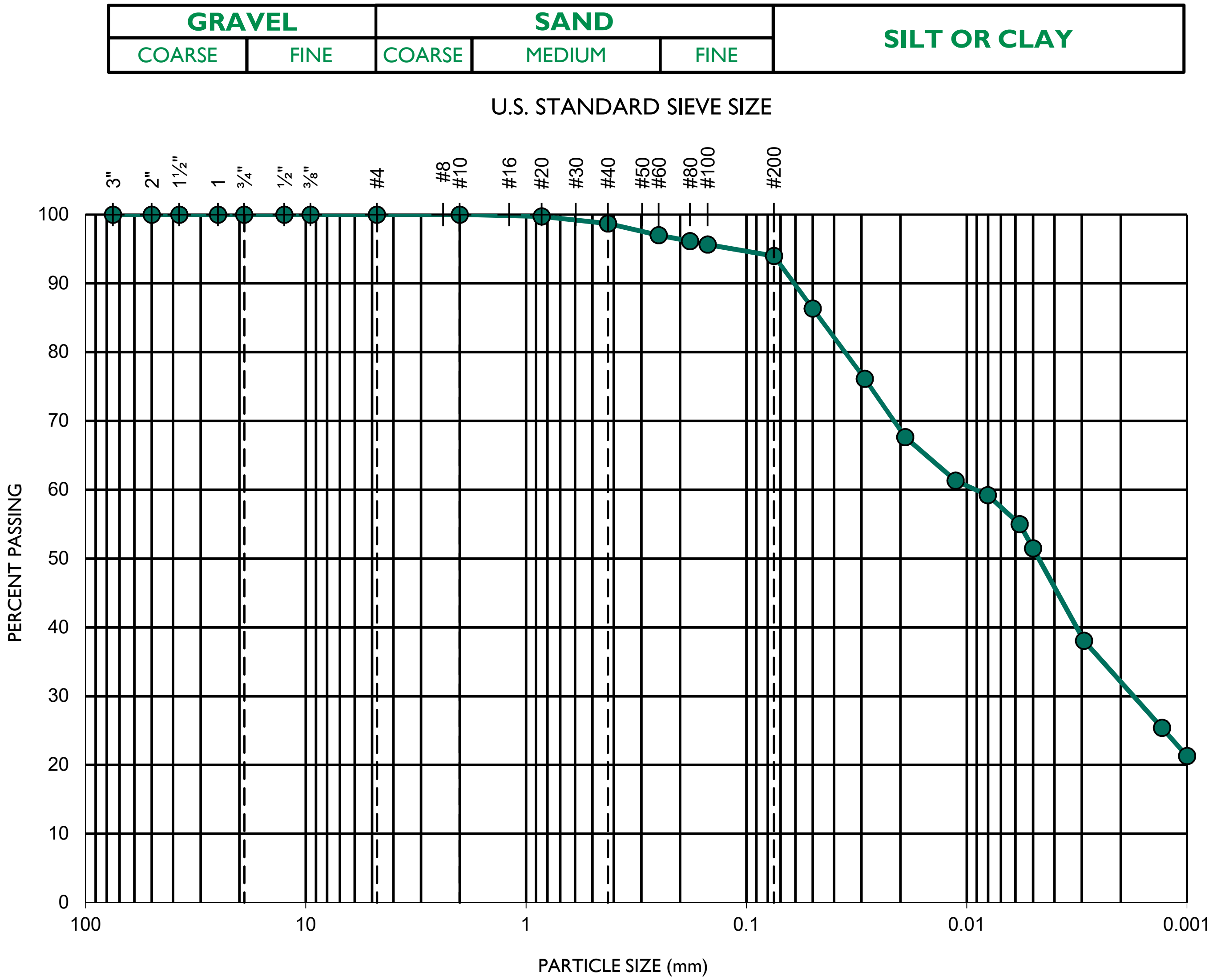
GEOCON
INCORPORATED
GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121-2974
PHONE 858 558-6900 - FAX 858 558-6159

DIRECT SHEAR - ASTM D 3080

NIRVANA

PROJECT NO.: G2755-42-01

SAMPLE NO.: **LB2-3**
SAMPLE DEPTH (FT.): **46'**
GEOLOGIC UNIT: **To**



TEST DATA					
D_{10} (mm)	D_{30} (mm)	D_{60} (mm)	C_c	C_u	SOIL DESCRIPTION
0.00017	0.00189	0.00921	2.3	53.7	CLAY

GEOCON
INCORPORATED
GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

SIEVE ANALYSES - ASTM D 135 & D 422

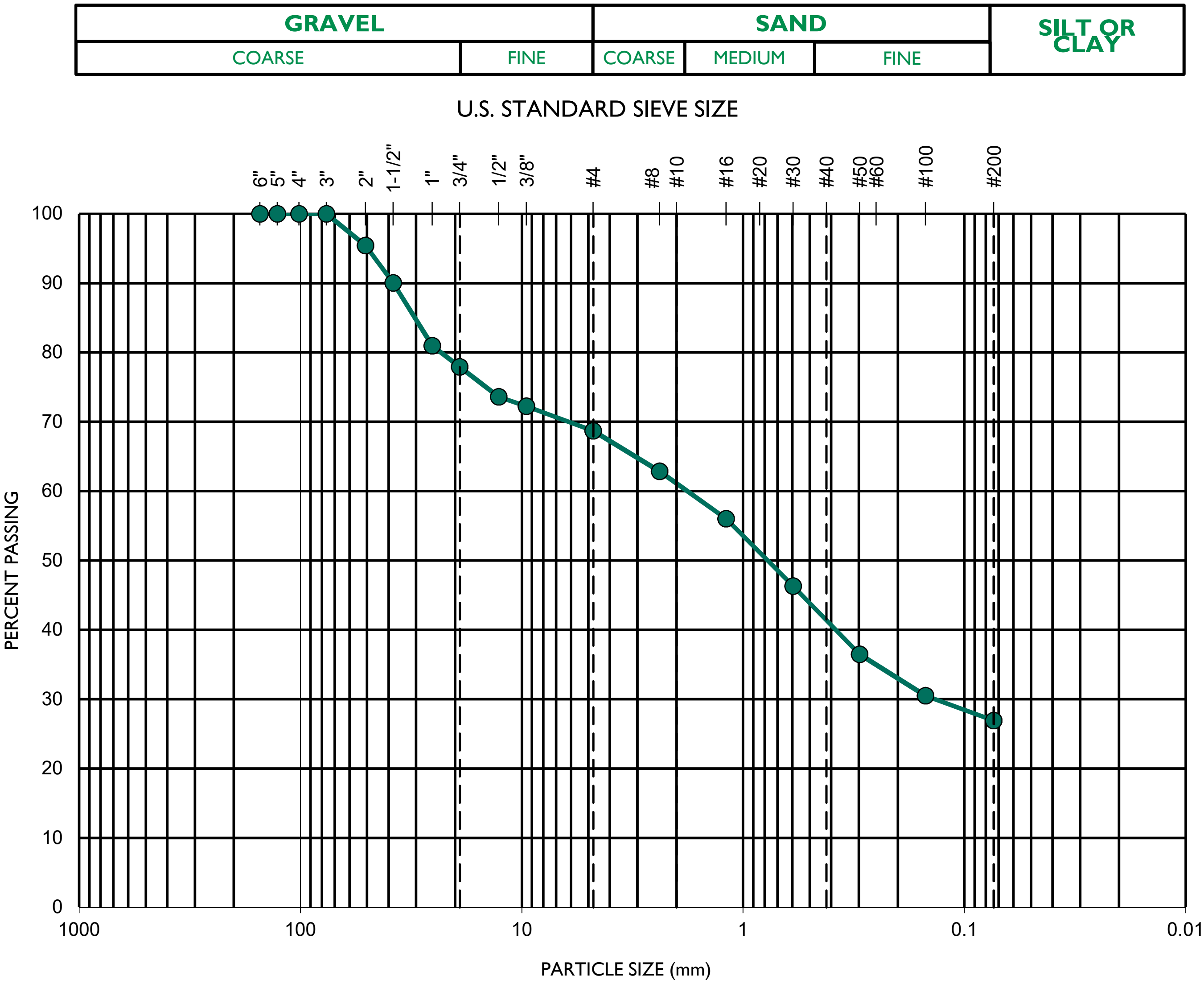
NIRVANA

PROJECT NO.: G2755-42-01

SAMPLE NO.: **LB3-1**

SAMPLE DEPTH (FT.): **3**

GEOLOGIC UNIT: **Qt**



TEST DATA					
D_{10} (mm)	D_{30} (mm)	D_{60} (mm)	C_c	C_u	SOIL DESCRIPTION
0.027	0.139	1.882	0.4	68.6	SC - Clayey SAND with gravel

GEOCON
INCORPORATED
GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

SIEVE ANALYSES - ASTM D 135

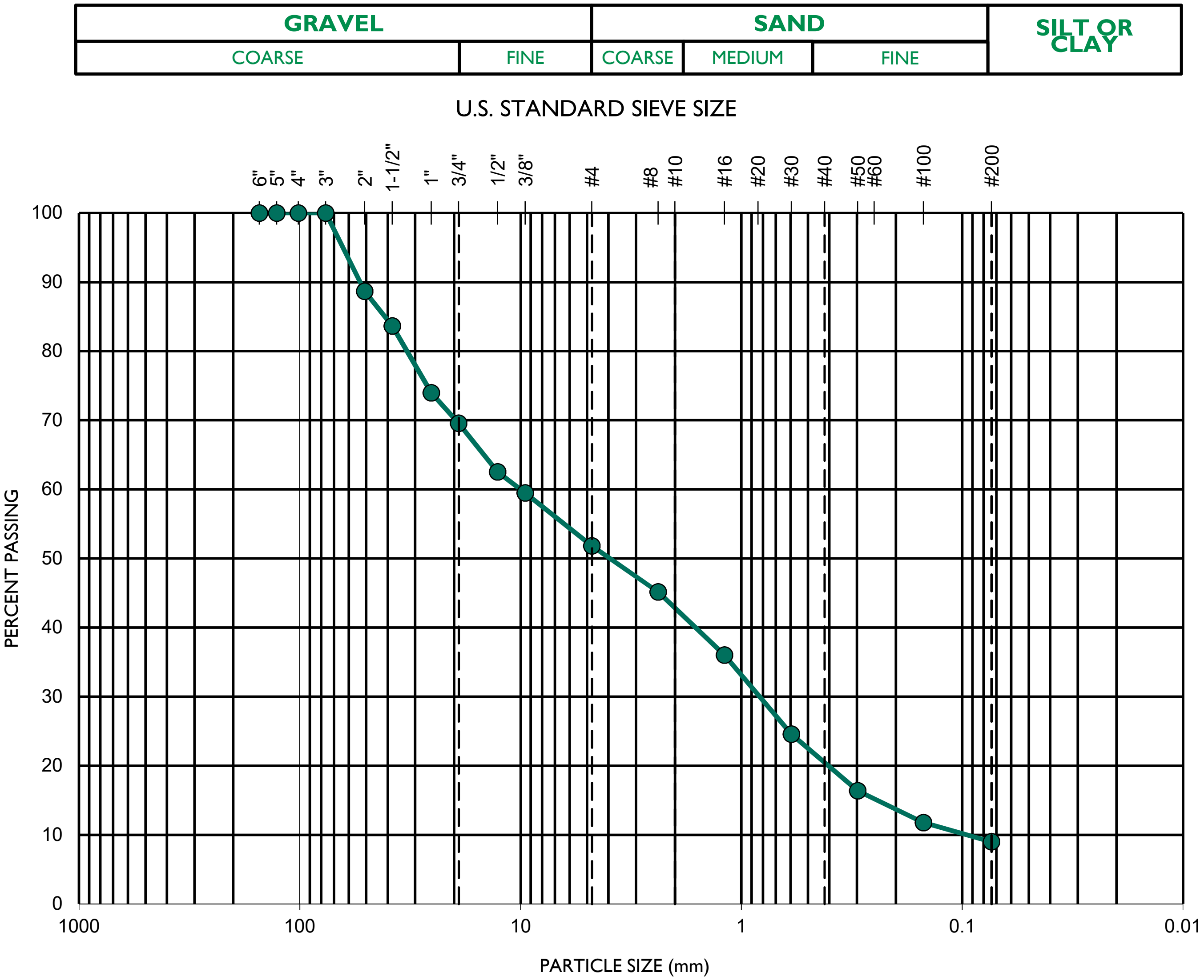
NIRVANA

PROJECT NO.: G2755-42-01

SAMPLE NO.: **LB4-1**

SAMPLE DEPTH (FT.): **9'**

GEOLOGIC UNIT: **Qt**



TEST DATA					
D_{10} (mm)	D_{30} (mm)	D_{60} (mm)	C_c	C_u	SOIL DESCRIPTION
0.101	0.878	10.066	0.8	99.6	GP-GC - Poorly graded GRAVEL with clay and sand

GEOCON
INCORPORATED
GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

SIEVE ANALYSES - ASTM D 135

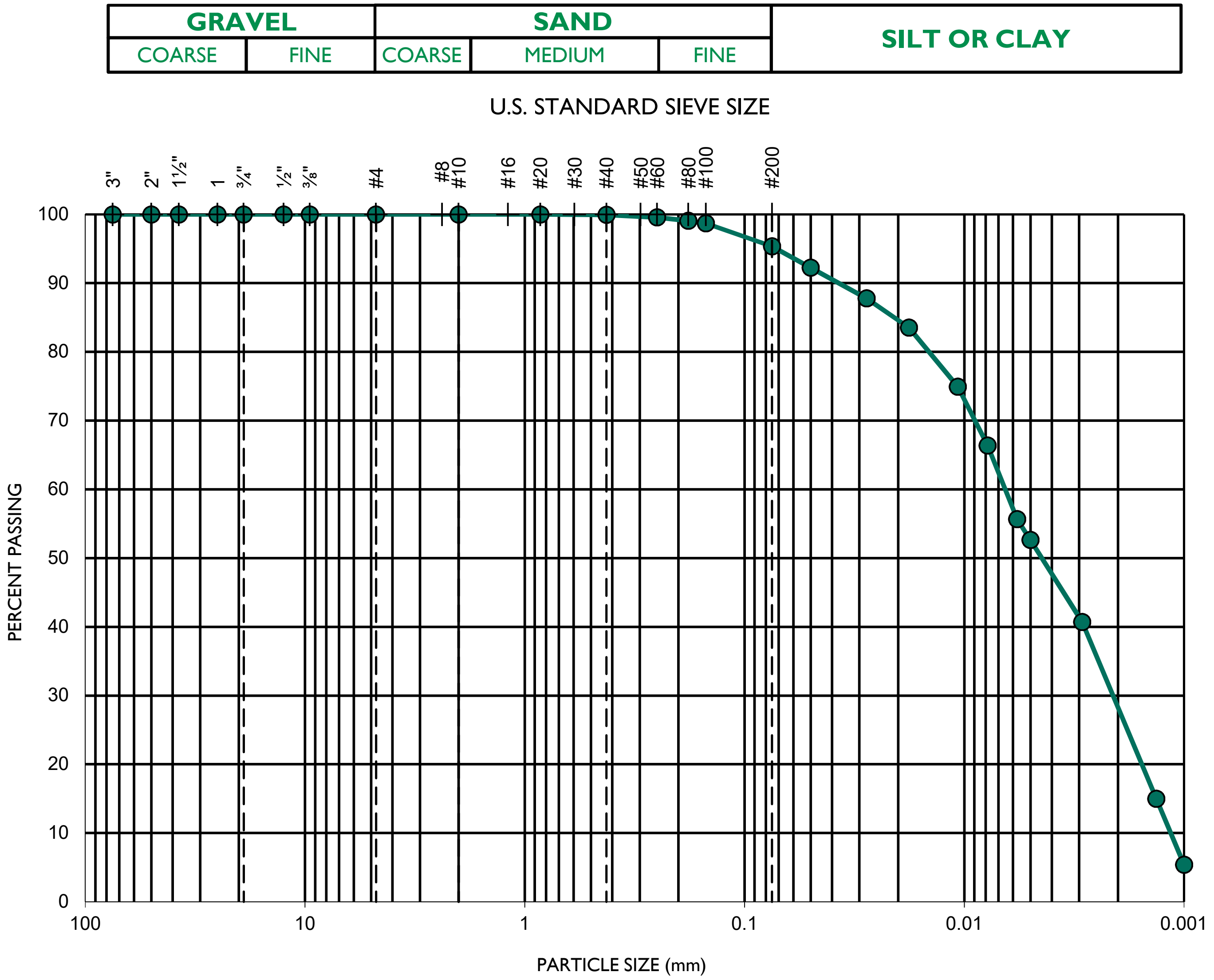
NIRVANA

PROJECT NO.: G2755-42-01

SAMPLE NO.: **LB5-1**

SAMPLE DEPTH (FT.): **35'**

GEOLOGIC UNIT: **To**



TEST DATA					
D_{10} (mm)	**D_{30} (mm)**	**D_{60} (mm)**	**C_c**	**C_u**	**SOIL DESCRIPTION**
0.00116	0.00226	0.00658	0.7	5.7	CLAY

GEOCON
INCORPORATED
GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

SIEVE ANALYSES - ASTM D 135 & D 422

NIRVANA

PROJECT NO.: G2755-42-01

APPENDIX C

APPENDIX C

EXPLORATORY BORINGS, TRENCHES AND LABORATORY PERFORMED BY OTHERS

FOR

NIRVANA INDUSTRIAL BUILDINGS AND SELF STORAGE COMPLEX

821 MAIN STREET
CHULA VISTA, CALIFORNIA

PROJECT NO. G2755-42-01

Project Chula Vista Energy Park
Date Excavated 8/12/2014
Logged by PWM
Equipment Cat 330C Trackhoe

LOG OF TEST PITS

Test Pit No.	Depth (ft.)	USCS	Description
TP-1	0.0 – 3.0	SC	**Topsoil:** CLAYEY SAND, fine to coarse grained, grayish brown, dry, loose; some gravel and cobbles up to 10 in. diameter; white carbonate development from 2 to 3 ft. bgs.
	3.0 – 11.0	CL	**Older Alluvium (Qoal):** SILTY CLAY, grayish brown to gray, slightly moist, very stiff. @4.5 ft. abundant cobbles and small boulders; hard. @ 7.5 ft. CLAYEY SAND, fine to medium grained, pale brown to olive gray, slightly moist, moderately hard; highly weathered; carbonate development. @8.5 ft. becomes pale yellowish brown, slightly moist, moderately hard to hard; with occasional gravel to small cobble. @10.0 ft. becomes hard; tight digging. TOTAL DEPTH 11.0 FT. NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
TP-2	0.0 – 1.5	SC	**Topsoil:** CLAYEY SAND with silt, fine to medium grained, grayish brown, dry, loose.
	1.5 – 14.0	CL	**Older Alluvium (Qoal):** SILTY to SANDY CLAY, brown to reddish brown, slightly moist, stiff; porous; occasional subrounded to subangular cobbles; white carbonate development; root hairs.
	6.0 – 16.0	SC	@ 6.0 ft. CLAYEY SAND, fine grained, pale yellowish brown, slightly moist, loose to moderately dense; highly weathered; carbonate development; iron oxide development; occasional subrounded to subangular cobbles.
			@ 7.0 ft. SILTY to CLAYEY SAND, fine grained, pale yellowish brown, slightly moist, moderately dense; weakly cemented, hand friable, abundant iron oxide staining, occasional small cobbles to 6 in. diameter.
			@ 11.0 ft. becomes fine to coarse grained, grayish brown, dense, slightly moist; occasional brown claystone clasts, weakly cemented.
			@ 13.0 ft. abundant cobbles to 10 in. diameter.
		CL	@ 14.0 ft. SANDY CLAY, fine grained, olive brown, grayish brown, and brown, hard; manganese and iron oxide development; occasional thin interbedded sandstone lenses.
			TOTAL DEPTH 16.0 FT. NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
TP-3	0.0 – 1.0	SC	**Topsoil:** CLAYEY SAND with silt, fine to medium grained, grayish brown, dry, loose.
	1.0 – 12.0	CL	**Older Alluvium (Qoal):** SILTY CLAY, dark brown, slightly moist, firm; abundant white carbonate development, root hairs, porous.
		SP	@ 3.0 ft. SAND, fine grained, brown, slightly moist, medium dense; abundant carbonate development, root hairs.
		CL	@ 7.0 ft. SANDY CLAY, fine to coarse grained, brown, slightly moist, stiff; carbonate development.
			@9.0 ft. Cobble lense with sandy clay matrix, dense; cobbles up to 8 inch diameter.
		SC	@10.0 ft. CLAYEY SAND, fine to medium grained, brown to reddish brown, moist, medium dense; occasional cobbles.
			TOTAL DEPTH 12.0 FT. NO WATER, NO CAVING
- - - - - -	- - - - - -	- - - - - -	- -
TP-4	0.0 – 1.5	SC	**Topsoil:** CLAYEY SAND with silt, fine to medium grained, grayish brown, dry, loose; slight white carbonate development; occasional cobbles to 6 in. diameter.
	1.5 – 13.0	CL	**Older Alluvium (Qoal):** SANDY CLAY, fine grained, reddish brown, stiff, slightly moist.
		SC	@ 6.5 ft. CLAYEY SAND, fine to coarse grained, reddish brown, slightly moist, medium dense to dense; manganese and iron oxide development, occasional gravel and cobbles to 8 in. diameter
		SP	@10.0 ft. POORLY GRADED SAND, fine to medium grained, light gray, slightly moist, medium dense.
		SC	@11.5 ft. CLAYEY SAND, fine to coarse grained, reddish brown, slightly moist, medium dense to dense; occasional gravel and cobbles.
			TOTAL DEPTH 13.0 FT. NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
TP-5	0.0 – 1.0	SM	**Topsoil:** SILTY SAND, fine to medium grained, brown, dry, loose; abundant subrounded gravel; occasional cobbles.
	1.0 – 20.0	SC	**Older Alluvium (Qoal):** CLAYEY SAND, fine to coarse grained, red, slightly moist, medium dense to dense; abundant subrounded gravel. @3.0 ft. abundant subangular to subrounded cobble and occasional boulder.
		SW	@8.5 ft. WELL GRADED SAND, fine to coarse grained, reddish brown, slightly moist, dense; abundant subangular to subrounded cobbles to 6 in. diameter; about 60% sand, 40% cobble. @18.0 ft. becomes sandier; about 75 sand, 25% cobble. TOTAL DEPTH 20.0 FT. NO WATER, NO CAVING
TP-6	0.0 – 1.0	SC	**Topsoil:** CLAYEY SAND with silt, fine to medium grained, brown, dry, loose; abundant subrounded gravel; occasional cobbles to 6 in. diameter.
	1.0 – 9.0	CL	**Older Alluvium (Qoal):** SANDY CLAY, fine to coarse grained with subangular gravel and occasional small cobble, dark brown, slightly moist, firm; root hairs.
		SC	@ 2.5 ft. CLAYEY SAND, fine to coarse grained, red to reddish brown, slightly moist, medium dense; abundant carbonate and iron oxide development; occasional subangular to subrounded cobble to 8 in. diameter. @5 ft. becomes dense. TOTAL DEPTH 9.0 FT. NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
TP-7	0.0 – 0.5	SC	**Topsoil:** CLAYEY SAND with silt, fine to medium grained, brown, dry, loose; occasional gravel to small cobble.
	0.5 – 12.0	CL	**Older Alluvium (Qoal):** SANDY CLAY, fine to coarse grained, dark brown, slightly moist, firm; occasional gravel to small cobble.
		SC	CLAYEY SAND, fine to coarse grained, red to reddish brown, slightly moist, medium dense; moderate carbonate development to 7.0 ft. bgs., abundant gravel and cobbles to 8 in. diameter; about 30% cobble. @10 ft. becomes dense; tighter digging. TOTAL DEPTH 12.0 FT. NO WATER, NO CAVING

TRENCH LOG SHEET

TRENCH NO. 1
ELEV. 151' msl

FT.	DESCRIPTION		SOIL TYPE
0	Brown, dry, loose to slightly dense		SILTY FINE SAND (SM)
1	Fractured rocks to 6" dia. (alluvium)	6*	
2		8*	
3	①	12*	
4		10*	
	Reddish brown, moist,		SILTSTONE (SM)
5	dense (Terrace deposits)	31*	
6	②	38*	
7		41*	
8		48*	
9	Very dense	55*	

Bottom of Trench (No Refusal)

LEGEND

○ - Indicates representative sample
* - Indicates blowcount/10 cm/Triggs penetrometer

Granular		Cohesive	
0	Very loose	0	Very soft
5	Loose	2	Soft
11	Medium dense	5	Medium stiff
31	Dense	9	Stiff
51	Very dense	16	Very stiff
		31	Hard

Project No. 08-1331A5

Figure No. 3

TRENCH LOG SHEET

TRENCH NO. 2
Elev. 152' msl

FT.	DESCRIPTION		SOIL TYPE
0	Brown, dry, loose to slightly dense (alluvium)		SILTY FINE SAND (SM)
1	20% to 30% cobbles 6" to 8" dia.	8*	
2		12*	
3	①	9*	
4		18*	
5		10*	
6	Reddish brown, moist, medium dense	25*	SILTY FINE SANDS (SM)
7	Some cobbles to 4" dia. (Terrace deposits)	35*	
8	②	41*	

Bottom of Trench (No Refusal)

Project No. 08-1331A5

Figure No. 4

TRENCH LOG SHEET

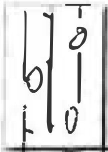
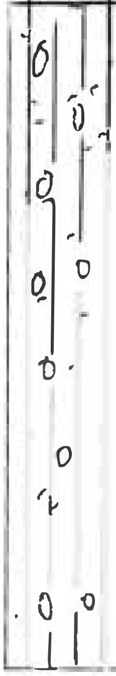
TRENCH NO. 3
Elev. 183' msl

FT.	DESCRIPTION		SOIL TYPE
0	Brown, dry, loose (residual/topsoils)		SILTY SANDS (SM)
1		5*	
2	Dark brown, damp, medium dense (Terrace deposits)	25*	CLAYEY SANDS (SC)
3	① 20% cobbles 2" to 4" dia.		
4	Tan, damp, medium dense 15% cobbles	30*	CLAYEY SANDS (SC)
5			
6	Light brown, moist, medium dense	21*	SILTY SANDS (SM)
7	5% cobbles		
8	②	28*	
9			
10	Dense	35*	
11			
12			

Bottom of Trench (No refusal)

TRENCH LOG SHEET

TRENCH NO. 4
Elev. 200' msl

	FT.		DESCRIPTION		SOIL TYPE
	0		Brown, dry, loose (residual/topsoil)		SILTY SANDS (SM)
	1		60% cobbles to 12" dia.		
	2		Brown, damp, medium dense 50% cobbles to 12" dia.		SILTY SANDS (SM)
	3	①	(Terrace deposits)		
	4			29*	
	5				
	6		30% cobbles to 3" dia.	28*	
	7				
	8	②	Dense	35*	
	9				
	10				

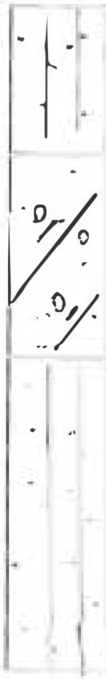
Bottom of Trench (No Refusal)

Project No. 08-1331A5

Figure No. 6

TRENCH LOG SHEET

TRENCH NO. 5
Elev. 200' msl



FT.		DESCRIPTION	SOIL TYPE
0 1		Light brown, dry, loose (residual/topsoils)	SILTY SANDS (SM)
2 3 4	①	Dark brown, dry, dense (Terrace deposits) 30% cobbles to 4" dia. 52*	CLAYEY SAND (SC)
5 6 7 8	②	Tan, moist, dense 51*	SILTY SANDS (SM)

Bottom of Trench (No Refusal)

Project No. 08-1331A5

Figure No. 7

TRENCH LOG SHEET

TRENCH NO. 6
Elev. 180' msl

FT.		DESCRIPTION		SOIL TYPE
0		Light brown,dry, loose (residual/topsoils)		SILTY SANDS (SM)
1	①			
2		Dark brown, damp, medium dense (Terrace deposits) 30% cobbles to 3" dia.		CLAYEY SANDS (SC)
3				
4	②			
5			25*	
6				
7		Dense	33*	

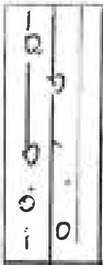
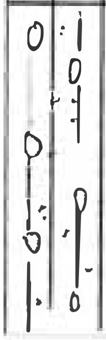
Bottom of Trench (No refusal)

Project No. 08-1331A5

Figure No. 8

BORING LOG SHEET

BORING NO. 1
Elev. 198' msl

	FT.		DESCRIPTION		SOIL TYPE
	0 1 2 3	①	Grayish brown, dry, loose (residual/topsoils) 40% cobbles to 6" dia	8*	SILTY SANDS (SM)
	4 5 6 7	②	Brown, moist, medium dense 50% cobbles to 8" dia. (Terrace deposits) Dense	28* 33*	SILTY SANDS (SM)

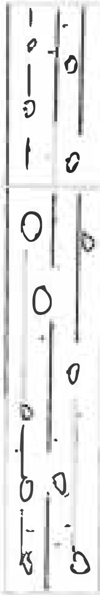
Bottom of Boring (No refusal)

Project No. 08-1331A5

Figure No. 9

BORING LOG SHEET

BORING NO. 2
Elev. 201' msl



FT.	DESCRIPTION		SOIL TYPE
0	Grayish brown, dry, loose (residual/topsoils) 40% cobbles to 6" dia		SILTY SANDS (SM)
1			
2			
3	Brown, damp, medium dense 50% cobbles to 8" dia. (Terrace deposits)		SILTY SANDS (SM)
4			
5	Dense	35*	
6			
7			

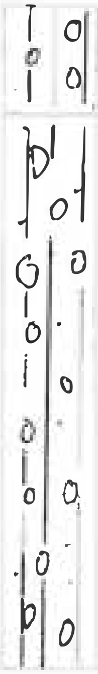
Bottom of Boring (No refusal)

Project No. 08-1331A5

Figure No. 10

CUT SLOPE LOG SHEET

WEST SIDE OF PROPERTY



FT.	DESCRIPTION	SOIL TYPE
0 5	Gray, dry, loose 40% cobbles to 6" dia (residual/topsoils)	SILTY SANDS (SM)
10 15	Brown, damp, medium dense 50% cobbles to 8" dia. (Terrace deposits)	SILTY SANDS
20 25 30	Light brown, damp, medium dense 30% cobbles to 5" dia.	
35	Brown/gray, damp, medium dense 40% cobbles to 4" dia.	
40	Brown, damp, medium dense 30% cobbles to 6" dia.	

Bottom of Cut Slope @ 42'

Project No. 08-1331A5

Figure No. 11

APPENDIX C

LABORATORY DATA

AGS Inc.
Chula Vista Engery Park
AGS Inc. Project No:1404-05

August 29, 2014
GF13811

Expansion Index
(ASTM D4829)

G Force Lab No.	10124	Sample No:	T-1
Date Sampled:	08/12/14	By:	PWM
Date Submitted:	08/15/14	By:	PJ
Sample Location:	T-1		
Sample Depth:	3-4'		
Sample Description:	Tan Silty Clay (CL)		

Initial Water Content, %	11.6%
Dry Density, pcf	105.8
Saturation, %	52.9%
Initial Dial Reading, in.	0.0000
Final Dial Reading, in.	0.1477
Final Water Content, %	26.3%
Expansion Index	**151**
Potential Expansion	**Very High**

Reviewed by:
Joseph Bouknight, P.E., C81517

AGS Inc. | **August 29, 2014**
Chula Vista Engery Park | **GF13811**
AGS Inc. Project No:1404-05

Expansion Index
(ASTM D4829)

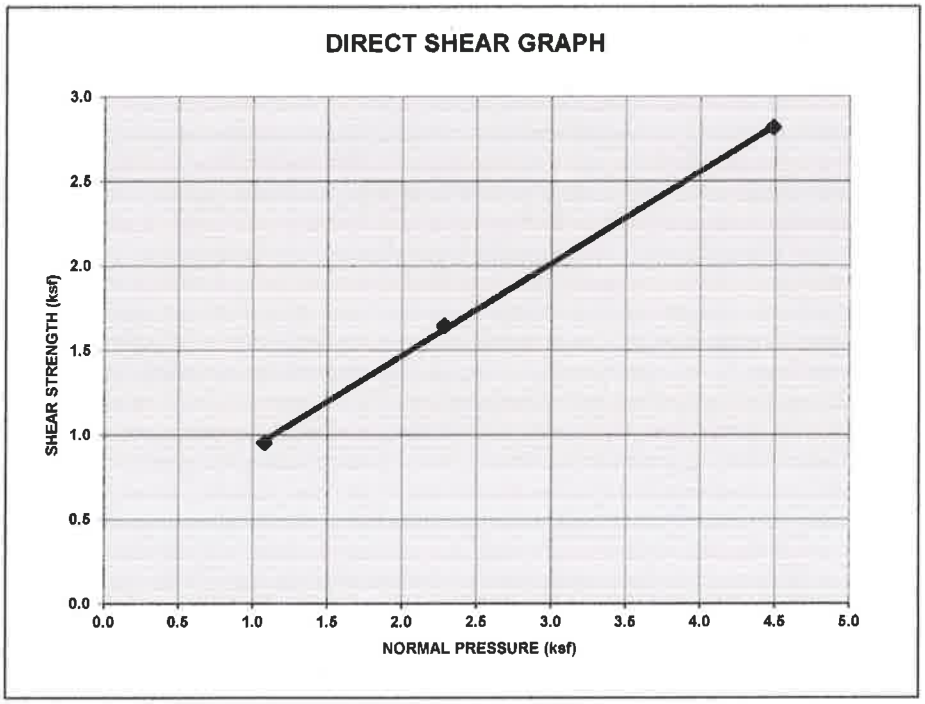
G Force Lab No.	10127	Sample No:	T-6
Date Sampled:	08/12/14	By:	PWM
Date Submitted:	08/15/14	By:	PJ
Sample Location:	T-6		
Sample Depth:	0.5- 1.5		
Sample Description:	Brown Sandy Clay (CL)		

Initial Water Content, %	12.4%
Dry Density, pcf	101.7
Saturation, %	50.8%
Initial Dial Reading, in.	0.0000
Final Dial Reading, in.	0.1864
Final Water Content, %	32.4%
Expansion Index	**188**
Potential Expansion	**Very High**

Reviewed by: Joe Bouknight
Joseph Bouknight, P.E., C81517

DIRECT SHEAR TEST REPORT

G-FORCE LAB NO.:	10125
SAMPLE LOCATION:	T-2 15 - 16'
SOIL TYPE:	Tan Sandy Clay (CL)
SAMPLE TYPE:	Remolded @ 114.8 @ 14.5 M.C. (90%RC)



CALCULATED DATA

INITIAL					
	WET DENSITY	pcf	119.5	118.9	120.6
	DRY DENSITY	pcf	104.4	103.8	105.3
	MOISTURE	%	14.5	14.5	14.5
FINAL, at failure					
	MOISTURE	%	25.9	25.0	26.5

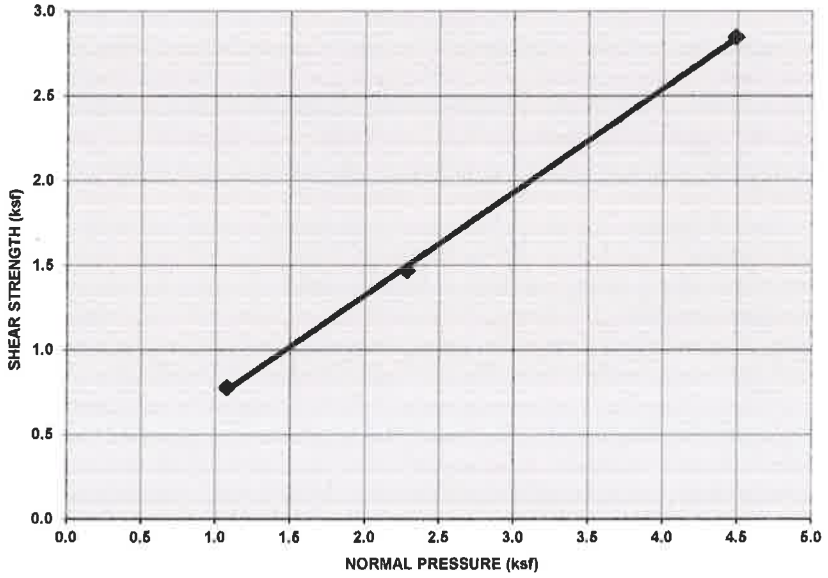
NORMAL PRESSURE, ksf	1.08	2.28	4.49
SHEAR STRENGTH, ksf	0.95	1.65	2.82
FRICTION ANGLE, degrees		**28.6**	
COHESION, ksf		**0.38**	

Reviewed by: Joe Bouknight
Joseph Bouknight, P.E., C61517

DIRECT SHEAR TEST REPORT

G-FORCE LAB NO.:	**10126**
SAMPLE LOCATION:	**T-4 @ 7 - 9'**
SOIL TYPE:	**Brown Sandy Clay W Gravel (SC)**
SAMPLE TYPE:	**Remolded @ 128.5 @ 9.0 M.C. (90%RC)**

DIRECT SHEAR GRAPH



CALCULATED DATA

INITIAL					
	WET DENSITY	pcf	125.9	128.7	124.2
	DRY DENSITY	pcf	115.5	118.1	113.9
	MOISTURE	%	9.0	9.0	9.0
FINAL, at failure					
	MOISTURE	%	18.0	17.1	16.3

NORMAL PRESSURE, ksf	1.08	2.28	4.49
SHEAR STRENGTH, ksf	0.78	1.47	2.85
FRICTION ANGLE, degrees		**31.4**	
COHESION, ksf		**0.11**	

Reviewed by: ______________________
Joseph Bouknight, P.E., C81517

AGS Inc. **August 29, 2014**
Chula Vista Energy Park **GF13811**
Ags Inc Project No: 1404-05

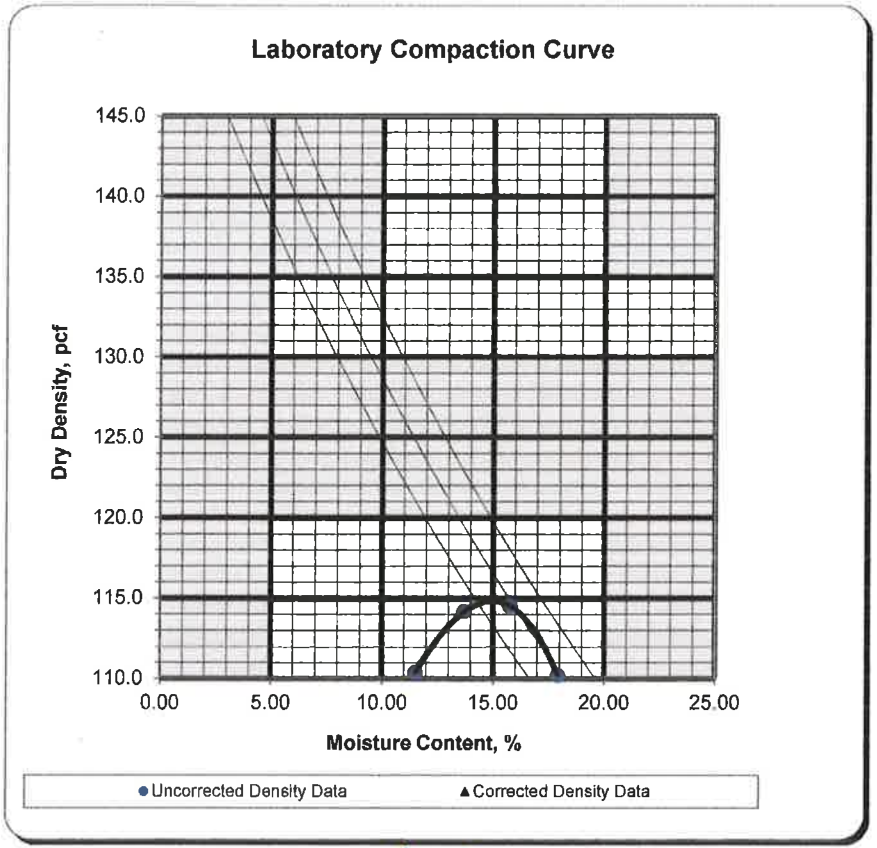
LABORATORY COMPACTION CURVE

G Force Lab No.: **10125**
Sample Location: **T-2**
Soil Description: **Light Tan Sandy Clay (CL)**
Source of Soil: **On Site**

Depth, ft.: **15-16'**
Sampled By: **PJ**
Date Sampled: **8/12/2014**

Test Designation: **ASTM_D1557**
Method **A**
% +3/4"
% +3/8"
% +#4
Oversize Correction Applied? **No**
Method of Sample Preparation: **Dry**
Type of Hammer Used: **Manual**

M/D Curve No. T-2



Test Results

Maximum Density, pcf	**114.8**
Optimum Moisture, %	**14.9**

Oversize Corrected Results

Maximum Density, pcf	**N/A**
Optimum Moisture, %	**N/A**

Reviewed by: Joe Bouknight
Joseph Bouknight, P.E., C81517

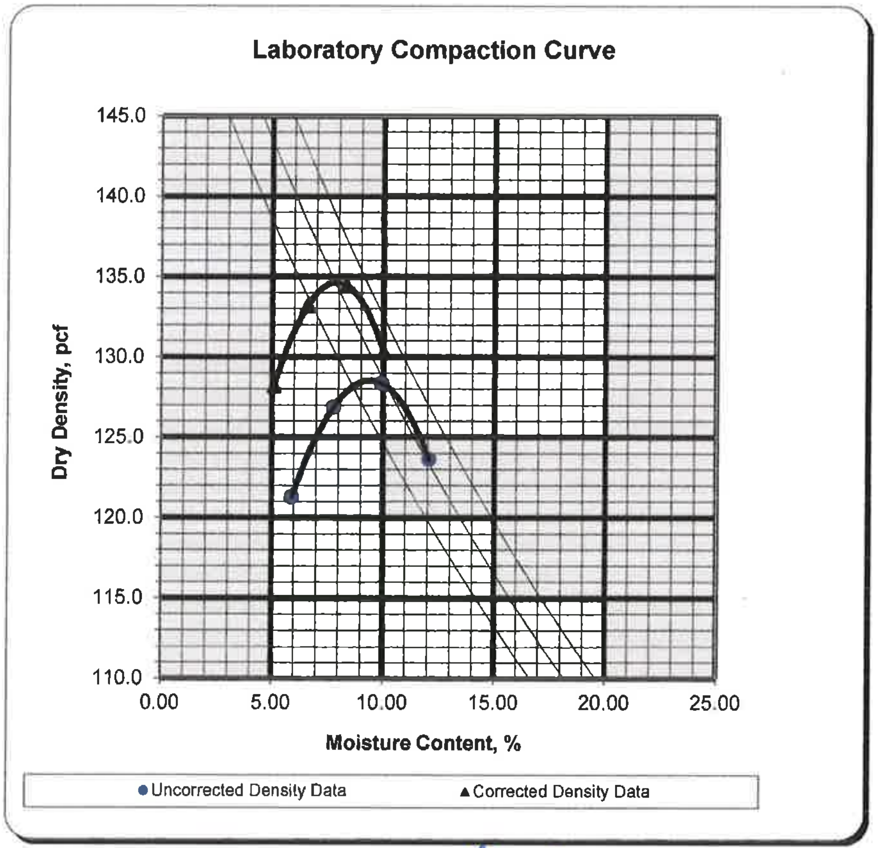
LABORATORY COMPACTION CURVE

G Force Lab No.: **10126**
Sample Location: **T-4**
Soil Description: **Brown Sandy Clay W/ Gravel (SC)**
Source of Soil: **On Site**

Depth, ft.: **7-9'**
Sampled By: **PJ**
Date Sampled: **8/12/2014**

Test Designation: **ASTM_D1557** **ASTM D4718, & ASTM C127** Method **B**
% +3/4" **12.7** % +3/8" **19.7** % +#4 **27.4**
Oversize Correction Applied? **Yes**
Method of Sample Preparation: **Dry**
Type of Hammer Used: **Manual**

M/D Curve No. T-4



Test Results

Maximum Density, pcf	128.5
Optimum Moisture, %	9.3

Oversize Corrected Results

Maximum Density, pcf	134.6
Optimum Moisture, %	7.8

Reviewed by: Joe Bouknight
Joseph Bouknight, P.E., C81517

AGS Inc. Project No. 1404-05

Soil Corrosivity

(ASTM D4972,CTM 417,CTM 422)

Lab Number	Boring No.	Depth	Sulfate %	Chloride %	PH	Resistivity (OHM-cm)
10127	T-6	.5-1.5	0.001	0.025	7.13	412

Lab Number	Boring No.	Depth	Sulfate %	Chloride %	PH	Resistivity (OHM-cm)
10124	T-1	3-4'	0.292	0.198	6.86	169

Sulfate and Chloride content test were performed by So. Cal. Soils & Testing Inc.

Date Sampled: 8/12/2014
Sampled By: PWM/FE
Date Submitted: 8/15/2014
Submitted By: PJD

Reviewed by: Joe Bouknight
Joseph Bouknight, P.E., C81517

APPENDIX D

APPENDIX D

SLOPE STABILITY EVALUATION

FOR

NIRVANA INDUSTRIAL BUILDINGS AND SELF STORAGE COMPLEX
821 MAIN STREET
CHULA VISTA, CALIFORNIA

PROJECT NO. G2755-42-01

APPENDIX D

SLOPE STABILITY EVALUATION

General

Slope stability analyses were performed on Cross-Sections A-A', B-B' C-C', E-E', F-F', and G-G' shown on Figures 1 and 2. The slope stability analyzes utilized the information on the preliminary grading study plans provided by PLSA with respect to proposed site conditions. Slope stability was evaluated for the MSE walls constructed along the south property margin and the natural hillside descending slope along the eastern property margin. Stability analysis for the soil nail wall along the northern property margin should be performed once preliminary wall design is performed and coordination with the wall designer occurs. Slope geometry, geologic structure, and calculated factors of safety for each cross section analyzed are presented on the figures in this Appendix. Additional analysis will be needed once preliminary wall designs are complete.

The computer program, *Slope/W* from GeoSlope 2018, distributed by Geo-Slope International, was utilized to perform slope stability analyses. This program uses conventional slope stability equations and a two-dimensional limit-equilibrium method to calculate the factor of safety against deep-seated failure. For our analyses, Spencer’s Method with block failure mode within the claystone beds was used. Spencer’s Method satisfies both moment and force equilibrium. Circular failure method was also utilized at some of the cross section locations.

The computer program searches for the most critical failure surface based on geometry and soil strength parameters. The computer program searches for the critical failure surface based on parameters inputted, including the location of the “left” and “right” sliding blocks and the failure plane entrance and exit locations. The critical failure surface for each analysis is shown on computer generated output directly above the failure surface (which is shown as the hatched area on the figure).

Shear Strength Parameters

Shear strength parameters used in the analyses are based on laboratory direct shear testing performed for our investigation, investigations and grading for the adjacent Otay Ranch Village 3 project, and our experience with similar soil conditions. Table D-1 summarizes the shear strength tests performed by Geocon Incorporated during this geotechnical investigation.

Table D-2 summarize residual and fully softened values for the bentonitic claystone bed. The residual and fully softened shear strength values were determined following the procedure presented in Stark, Choi, McCone (2005) and GeoInstitute (2016).

Shear strength values used in our analyses are shown on Table D-3. The shear strength values are also shown on stability output figures.

TABLE D-1
SUMMARY OF DIRECT SHEAR STRENGTH TEST RESULTS

Soil/Geologic Unit	Sample No.	Angle of Shear Resistance (degrees)	Unit Cohesion (psf)
Terrace Deposits	LB1-3	30 (peak) 35 (ultimate)	790 (peak) 350 (ultimate)
	LB3-1*	20 (peak) 20 (ultimate)	550 (peak) 540 (ultimate)
	LB4-1*	33 (peak) (32 ultimate)	590 (peak) 480 (ultimate)
Otay Formation	LB4-2 (Claystone Bed)	36 (peak) 30 (ultimate)	670 (peak) 200 (ultimate)
	LB5-3 (Siltstone)	35 (peak) 34 (ultimate)	530 (peak) 300 (ultimate)
	LB5-5 (Claystone Bed)	34 (peak) 34 (ultimate)	270 (peak) 22 (ultimate)

*Sample remolded to approximately 90 percent of maximum dry density near optimum moisture content.

TABLE D-2
RESIDUAL AND FULLY SOFTENED SHEAR STRENGTH VALUES FOR CLAYSTONE BED BASED ON STARK, CHOI, MCCONE (2005)

Sample No.	Liquid Limit	Percent Clay	Residual Values		Fully Softened Values	
			Angle of Internal Friction (degrees)	Cohesion (psf)	Angle of Internal Friction (degrees)	Cohesion (psf)
LB2-3	57	32	14	50	24	60
LB5-1	56	29	15	55	25	60

TABLE D-3
SHEAR STRENGTH USED IN SLOPE STABILITY ANALYSES

Soil Type	Angle of Internal Friction (degrees)	Cohesion (psf)
Qcf (Compacted Fill)	28	250
Qt (Terrace Deposits)	35	350
To (Otay Formation)	34	300
To (Claystone Bed)	18	50

With respect to the claystone bed shear strength, we utilized a value that corresponds to a mid-range value between residual and fully softened values determined using the Stark, Choi, McCone (2005) and GeoInstitute (2016) procedures. In our opinion this value is conservative as no shearing or remolding was observed in the claystone bed.

Slope Stability — Bentonitic Claystone Beds

Stability analysis were performed to evaluate the impacts the observed bentonitic claystone beds have on slope stability. The following two conditions were analyzed: 1) MSE Wall along the south side of the property with the backcut for the reinforcing grid equal to the height of the retaining wall; and 2) the bentonitic claystone exposed near the toe of the natural hillside slope on the east side of the property. We have also assumed that perched groundwater is present on the lower claystone bed.

For condition number one, we have assumed the backcut for the MSE retaining wall along the south side of the property will remove the claystone bed to a horizontal distance (measured from the back of the wall) equal to the height of the retaining wall. If the claystone bed is removed to this horizontal limit, the proposed retaining wall and backfill will create a stabilizing buttress that provides a factor of safety greater than 1.5. Cross Sections A-A', B-B', and C-C' show the slope stability analysis after construction of the proposed MSE wall. The wall backcut has been assumed to extend up from the excavation bottom at a 1:1 plane to the proposed finish grade surface. If the final wall design has shorter wall grids and/or backcut dimensions, additional analysis should be performed to evaluate if the proposed condition will have a factor of safety greater than 1.5 after construction of the wall.

As shown on Figure 2 and the stability figures in this Appendix, the buttress should start in front of the wall and down to a depth of at least 5 feet below the claystone bed and sloped back into the slope as shown on Figure 3. Buttress drains as shown on Figure 3 should be installed and outlet to the storm drain system or in front of the retaining wall.

For condition number two, Cross Sections E-E', F-F', and G-G' have been drawn through the eastern facing hillside slope. At Cross Section G-G', the proposed MSE retaining wall is located approximately mid-height of the slope. As such, the wall backcut will not extend deep enough to intercept the lower claystone bed. Based on our analysis, a buttress will be needed to provide a factor of safety of at least 1.5. The buttress should start near the toe of the hillside slope and extend back into the slope a distance of at least 50 feet measured from the toe of the slope. The buttress backcut should extend up at a 1:1 plane to proposed pad grade. The approximate buttress/clay bed front removal limit is shown on Figure 2.

The upper clay near the top of the slope will require a stability fill. The clay bed should be removed to a horizontal distance of at least 15 feet back into the slope as shown on Cross Sections E-E' and F-F'.

The stability fill should include a back drain that outlets to the slope face. Subdrain cut off and head walls as shown in Section 7.7 of this report should be constructed. An outlet should be provided every approximately 100 feet of the stability fill.

Stability analysis for the soil nail wall along the northern property margin can be performed once preliminary wall design is performed and coordination with the wall designer occurs.

Our analyses assumes select material derived from excavations in the Terrace Deposits or sandstone portions of the Otay Formation will be used for the buttress fill. Minimum shear strength parameters to produce a factor of safety in excess of 1.5 are 28 degree friction angle and 250 psf cohesion.

Summary of Stability Analyses

Table D-4 summarizes the stability analyses performed for this study. The calculated factor-of-safety for proposed slopes and recommended stabilization method is included on the table. Analyses for the soil nail wall will need to be performed once preliminary design of the wall is complete.

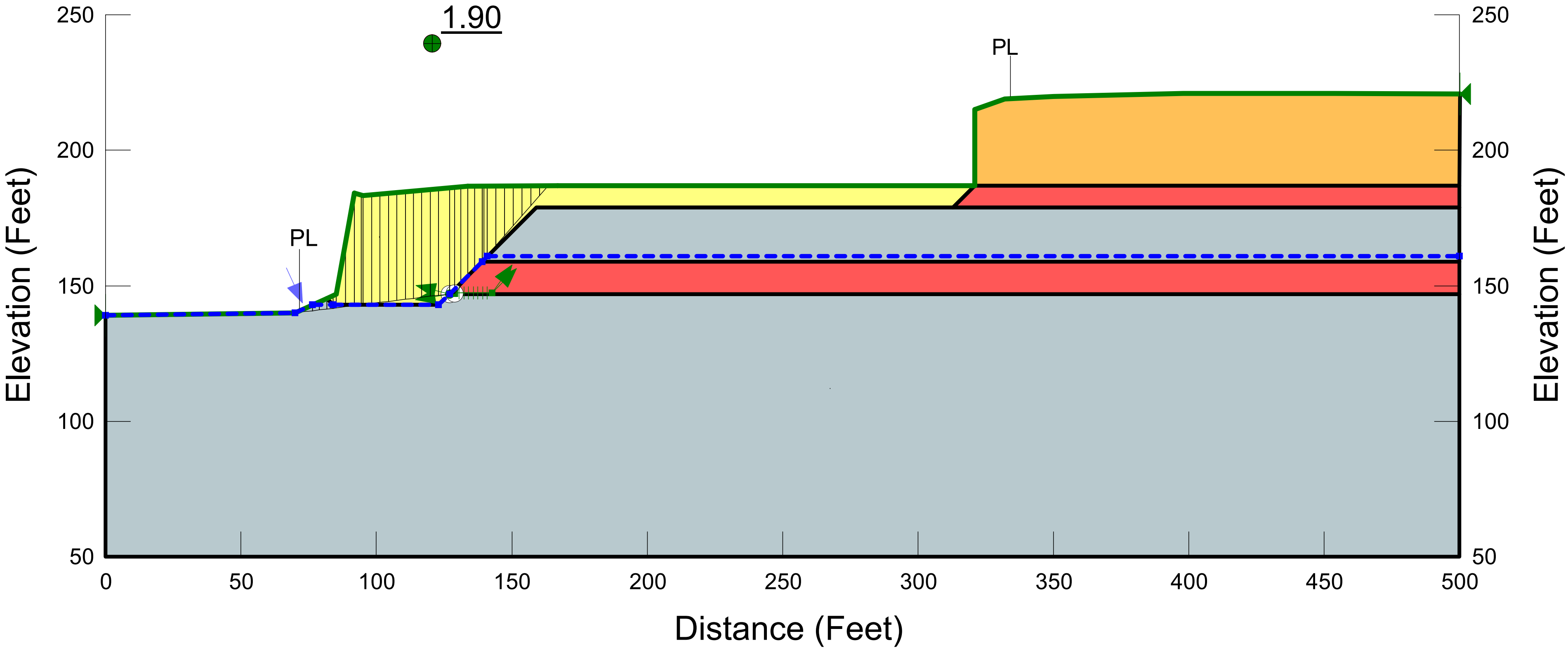
TABLE D-4
SUMMARY OF STABILITY ANALYSES AND RECOMMENDED STABILIZATION METHOD

Cross Section	Location	Proposed Graded Factor-of-Safety	Stabilization Method
A-A', B-B', and C-C'	Southern Slope with MSE Wall Construction	1.7 to 2.1	Claystone bed removed during wall backcut excavation
E-E' and F-F'	Eastern Slope	1.5 to 2.0	15 foot-wide stability fill
G-G'	Southeast Slope Area	1.5 to 1.6	50 foot wide buttress at toe of slope

NIRVANA
Project No. G2755-42-01
File Name: A-A (Proposed) Fully Softened with Groundwater.gsz
Date: 09/14/2021

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Piezometric Line
🟥	Claystone Bed (CL/CH)	130	50	18	1
🟨	Qcf	130	250	28	1
🟧	Qt	130	325	33	1
▨	To	130	325	33	1

CROSS SECTION A-A'

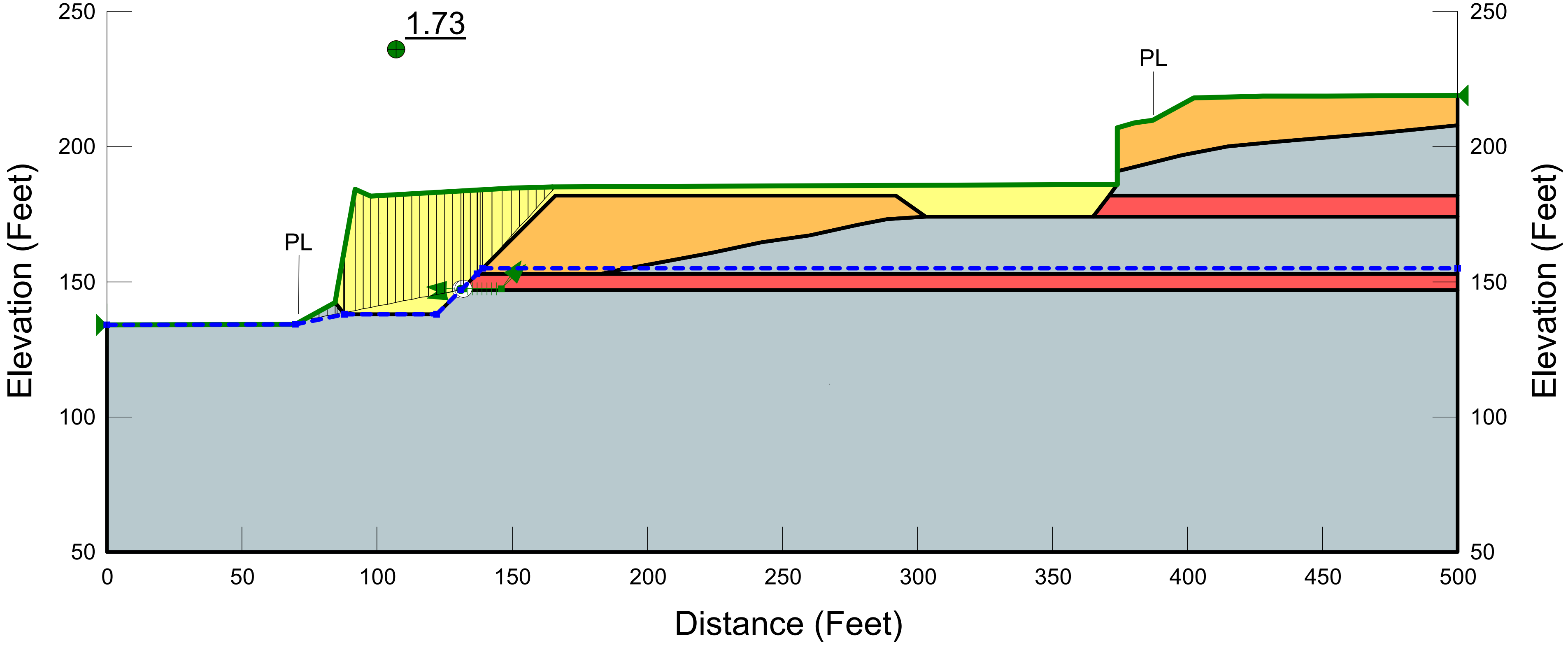


Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G2755-42-01\

NIRVANA
Project No. G2755-42-01
File Name: B-B (Proposed) Fully Softened with Groundwater.gsz
Date: 09/14/2021

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Piezometric Line
🟥	Claystone Bed (CL/CH)	130	50	18	1
🟨	Qcf	130	250	28	1
🟧	Qt	130	325	33	1
⬜	To	130	325	33	1

CROSS SECTION B-B'

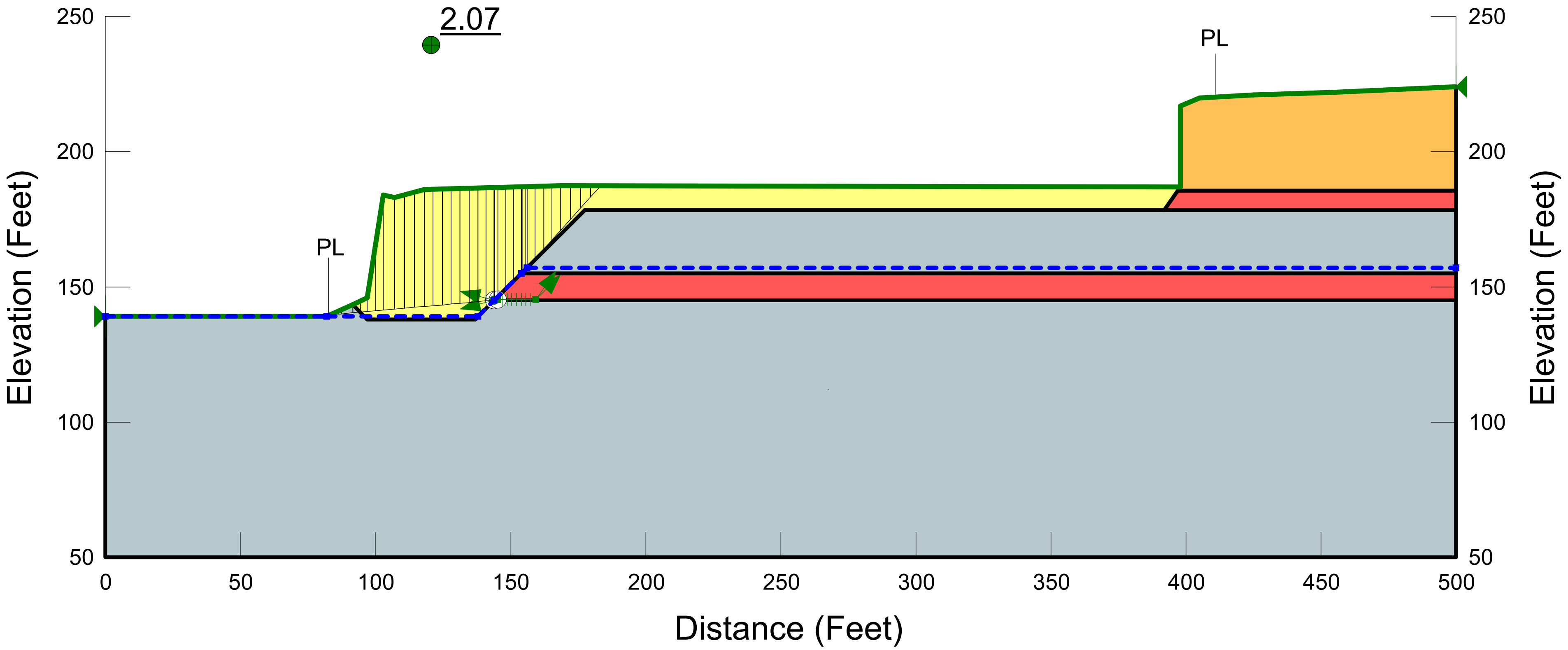


Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G2755-42-01\

NIRVANA
Project No. G2755-42-01
File Name: C-C (Proposed) Fully Softened with Groundwater.gsz
Date: 09/14/2021

CROSS SECTION C-C'

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Piezometric Line
🟥	Claystone Bed (CL/CH)	130	50	18	1
🟨	Qcf	130	250	28	1
🟧	Qt	130	325	33	1
⬜	To	130	325	33	1

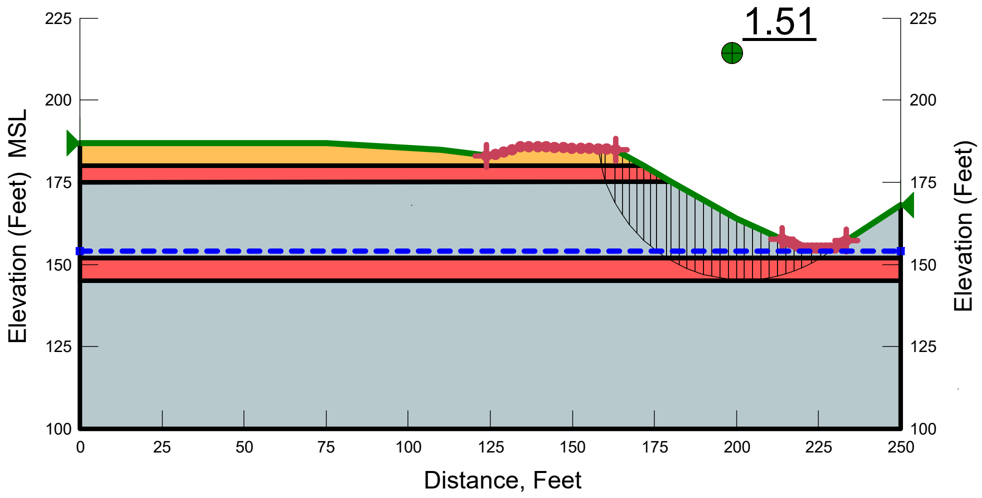


Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G2755-42-01\

NIRVANA
Project No. G2755-42-01
File Name: E-E (Proposed) Circular - Fully Softened (Groundwater).gsz
Date: 09/14/2021

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Piezometric Line
🟥	Claystone Bed (CL/CH)	130	50	18	1
🟧	Qt	130	350	35	1
⬜	To	130	300	34	1

CROSS SECTION E-E'

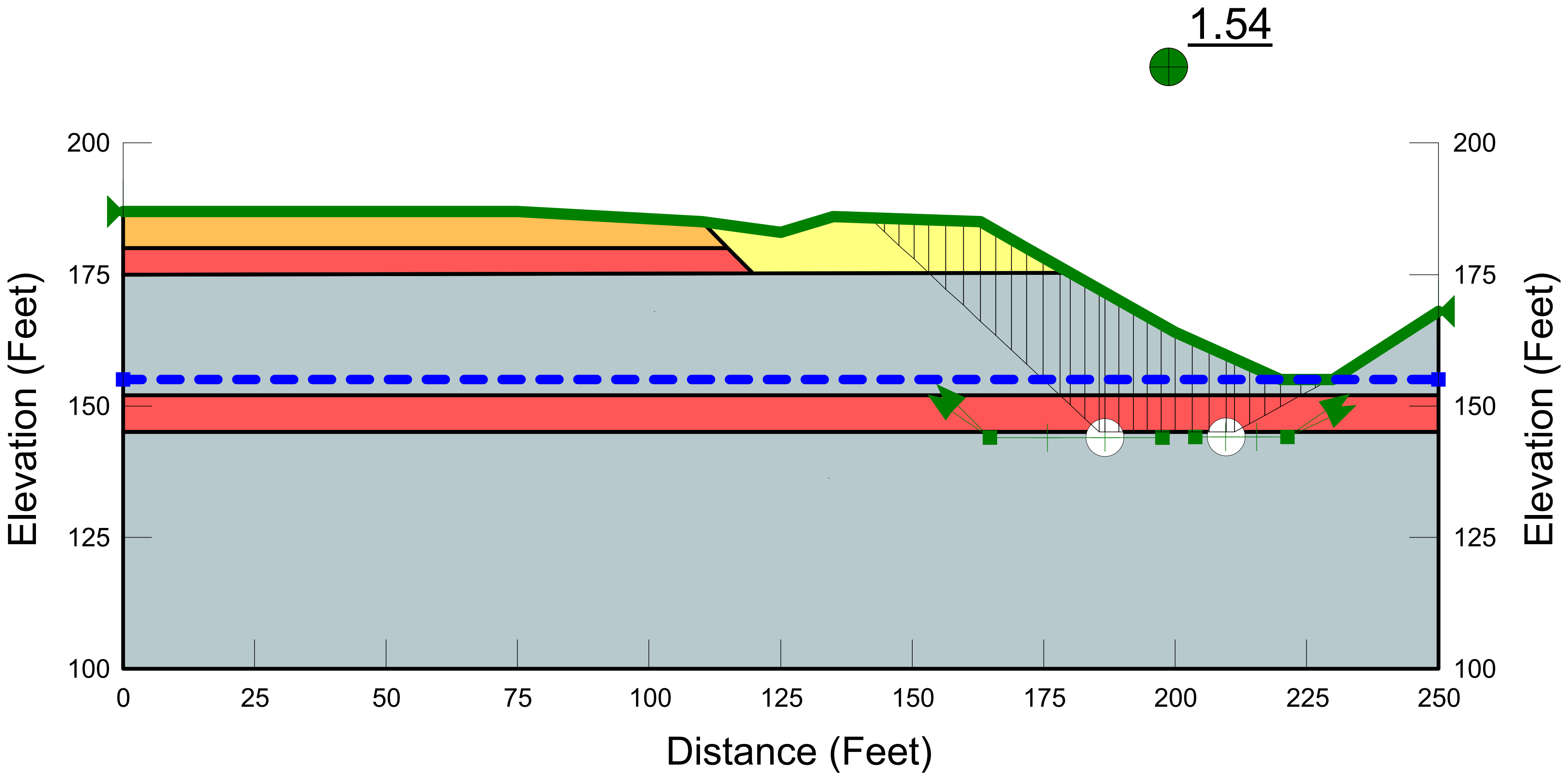


Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G2755-42-01\

NIRVANA
Project No. G2755-42-01
File Name: E-E (Proposed) Fully Softened - Upper Clay Removed with Groundwater.gsz
Date: 09/14/2021

CROSS SECTION E-E'

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Piezometric Line
🟥	Claystone Bed (CL/CH)	130	50	18	1
🟨	Qcf	130	250	28	1
🟧	Qt	130	350	35	1
▨	To	130	300	34	1
▨	To (2)				1

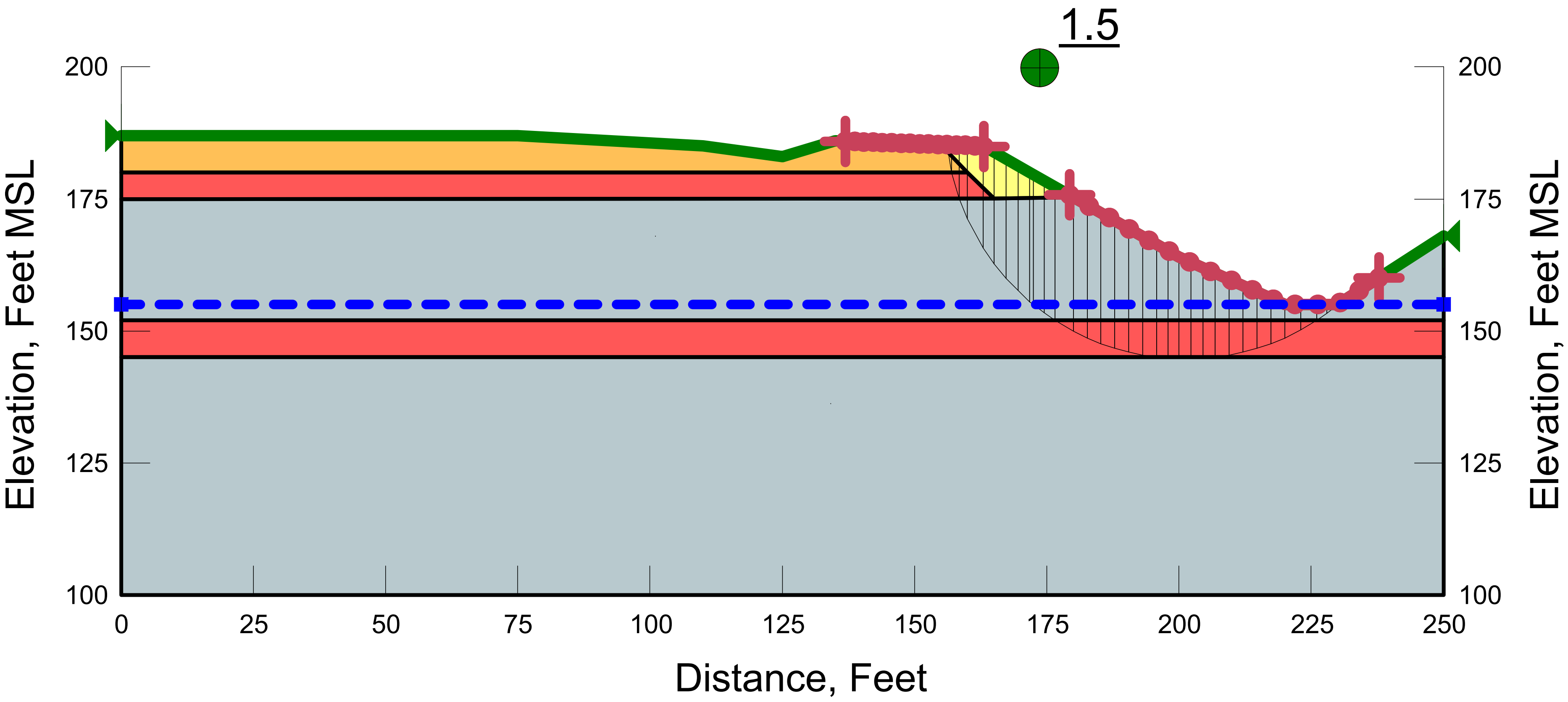


Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G2755-42-01\

NIRVANA
Project No. G2755-42-01
File Name: E-E (Upper Clay Bed) Fully Softened - Circular.gsz
Date: 09/13/2021

CROSS SECTION E-E'

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Piezometric Line
🟥	Claystone Bed (CL/CH)	130	50	18	1
🟨	Qcf	130	250	28	1
🟧	Qt	130	350	35	1
▨	To	130	300	34	1
▨	To (2)				1

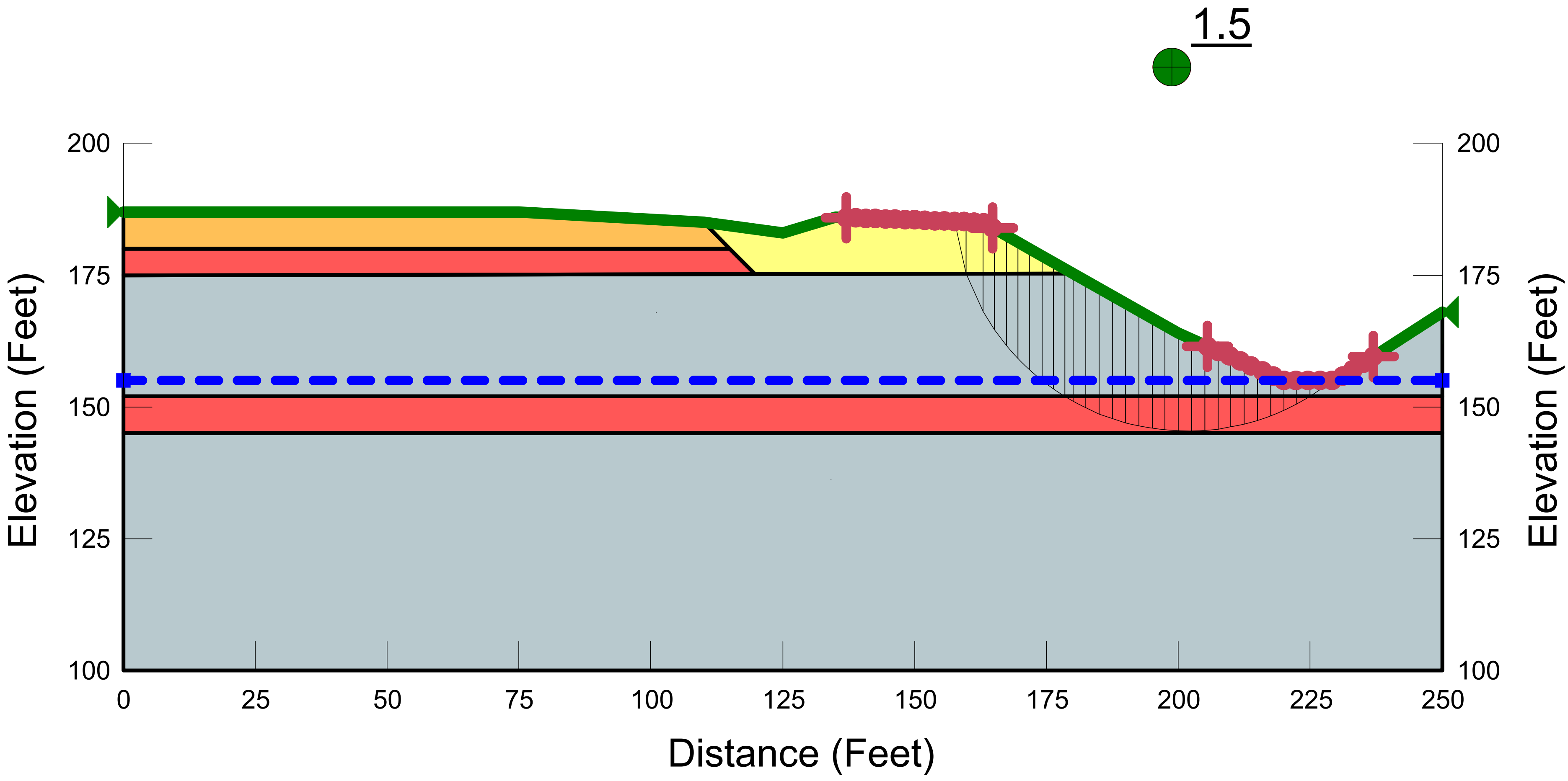


Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G2755-42-01\

NIRVANA
Project No. G2755-42-01
File Name: E-E (Proposed) Fully Softened with Ground Water-Upper Clay Removed.gsz
Date: 09/14/2021

Color	**Name**	**Unit Weight (pcf)**	**Cohesion' (psf)**	**Phi' (°)**	**Piezometric Line**
🟥	Claystone Bed (CL/CH)	130	50	18	1
🟨	Qcf	130	250	28	1
🟧	Qt	130	350	35	1
▨	To	130	300	34	1

CROSS SECTION E-E'

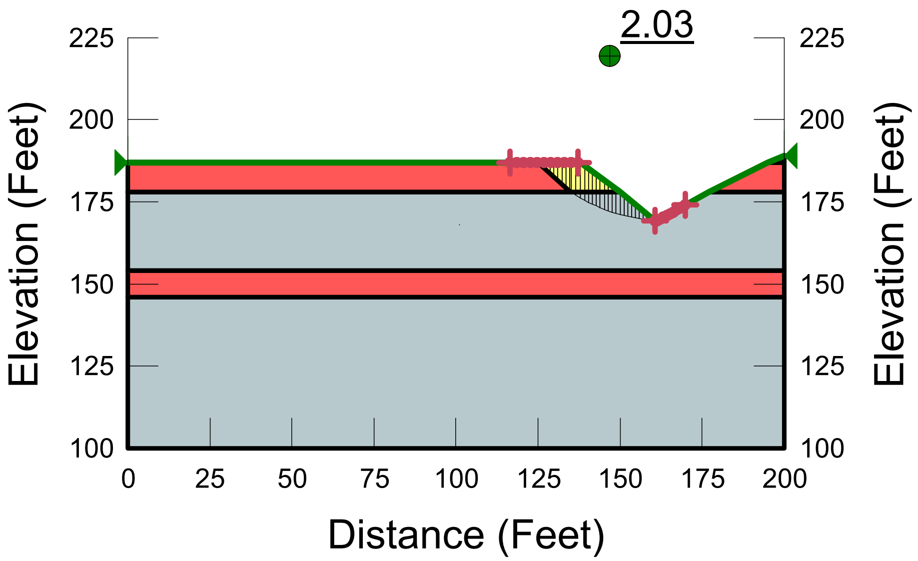


Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G2755-42-01\

NIRVANA
Project No. G2755-42-01
File Name: F-F (Proposed) Fully Softened - Stability Fill, Circular.gsz
Date: 09/14/2021

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
🟥	Claystone Bed (CL/CH)	130	50	18
🟨	Qcf	130	250	28
🟧	Qt	130	350	35
▨	To	130	300	34

CROSS SECTION F-F'

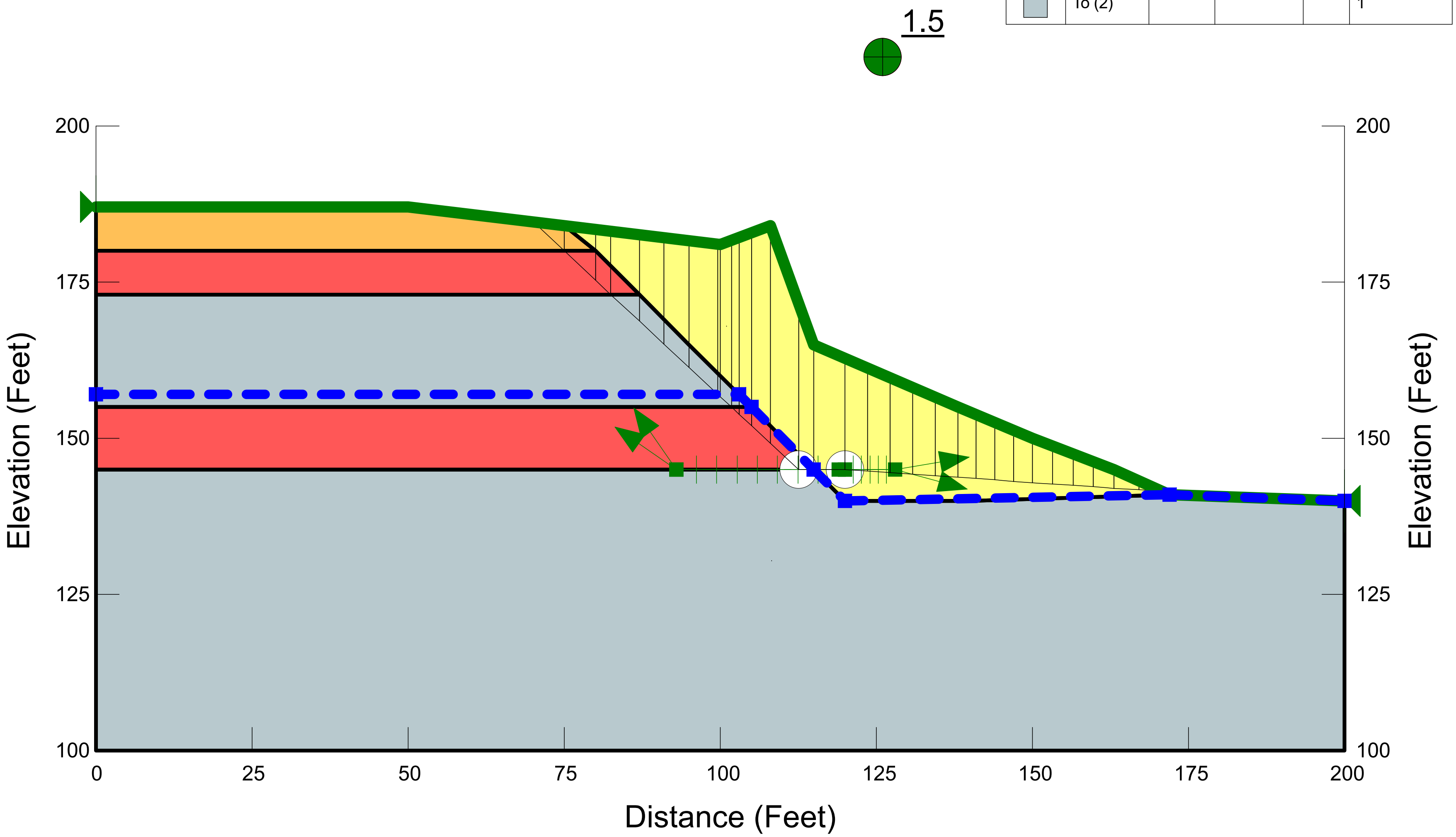


Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G2755-42-01\

NIRVANA
Project No. G2755-42-01
File Name: G-G (Proposed) Buttress (Fully Softened with Groundwater).gsz
Date: 09/14/2021

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Piezometric Line
🟥	Claystone Bed (CL/CH)	130	50	18	1
🟨	Qcf	130	250	28	1
🟧	Qt	130	350	35	1
⬜	To	130	300	34	1
⬜	To (2)				1

CROSS SECTION G-G'

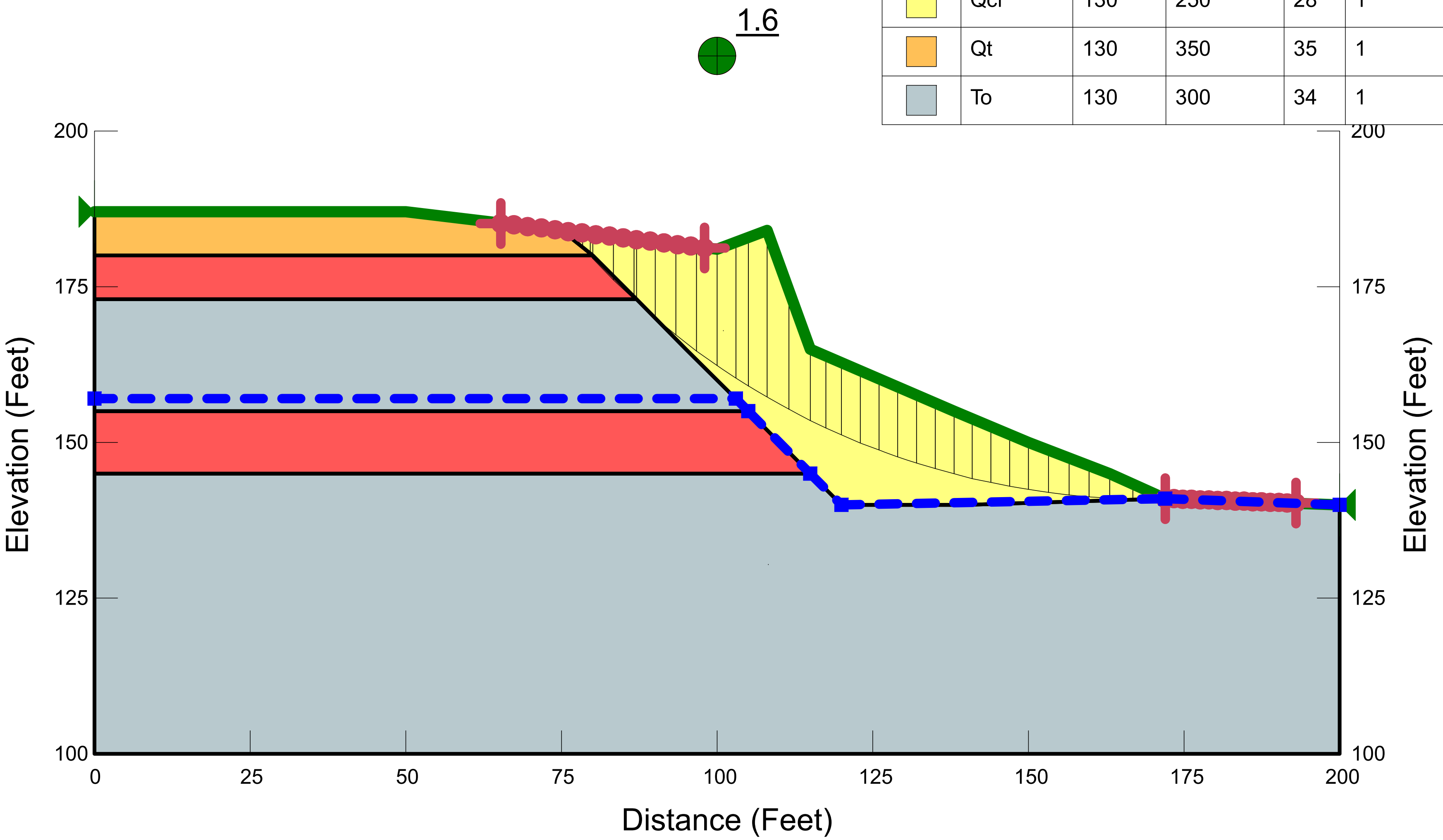


Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G2755-42-01\

NIRVANA
Project No. G2755-42-01
File Name: G-G (Proposed) Buttress - Circular (Fully Softened with Groundwater).gsz
Date: 09/14/2021

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Piezometric Line
🟥	Claystone Bed (CL/CH)	130	50	18	1
🟨	Qcf	130	250	28	1
🟧	Qt	130	350	35	1
⬜	To	130	300	34	1

CROSS SECTION G-G'



Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G2755-42-01\

APPENDIX E

APPENDIX E

RECOMMENDED GRADING SPECIFICATIONS

FOR

NIRVANA INDUSTRIAL BUILDINGS AND SELF STORAGE COMPLEX
821 MAIN STREET
CHULA VISTA, CALIFORNIA

PROJECT NO. G2755-42-01

RECOMMENDED GRADING SPECIFICATIONS

1. GENERAL

1.1 These Recommended Grading Specifications shall be used in conjunction with the Geotechnical Report for the project prepared by Geocon. The recommendations contained in the text of the Geotechnical Report are a part of the earthwork and grading specifications and shall supersede the provisions contained hereinafter in the case of conflict.

1.2 Prior to the commencement of grading, a geotechnical consultant (Consultant) shall be employed for the purpose of observing earthwork procedures and testing the fills for substantial conformance with the recommendations of the Geotechnical Report and these specifications. The Consultant should provide adequate testing and observation services so that they may assess whether, in their opinion, the work was performed in substantial conformance with these specifications. It shall be the responsibility of the Contractor to assist the Consultant and keep them apprised of work schedules and changes so that personnel may be scheduled accordingly.

1.3 It shall be the sole responsibility of the Contractor to provide adequate equipment and methods to accomplish the work in accordance with applicable grading codes or agency ordinances, these specifications and the approved grading plans. If, in the opinion of the Consultant, unsatisfactory conditions such as questionable soil materials, poor moisture condition, inadequate compaction, and/or adverse weather result in a quality of work not in conformance with these specifications, the Consultant will be empowered to reject the work and recommend to the Owner that grading be stopped until the unacceptable conditions are corrected.

2. DEFINITIONS

2.1 **Owner** shall refer to the owner of the property or the entity on whose behalf the grading work is being performed and who has contracted with the Contractor to have grading performed.

2.2 **Contractor** shall refer to the Contractor performing the site grading work.

2.3 **Civil Engineer** or **Engineer of Work** shall refer to the California licensed Civil Engineer or consulting firm responsible for preparation of the grading plans, surveying and verifying as-graded topography.

2.4 **Consultant** shall refer to the soil engineering and engineering geology consulting firm retained to provide geotechnical services for the project.

2.5 **Soil Engineer** shall refer to a California licensed Civil Engineer retained by the Owner, who is experienced in the practice of geotechnical engineering. The Soil Engineer shall be responsible for having qualified representatives on-site to observe and test the Contractor's work for conformance with these specifications.

2.6 **Engineering Geologist** shall refer to a California licensed Engineering Geologist retained by the Owner to provide geologic observations and recommendations during the site grading.

2.7 **Geotechnical Report** shall refer to a soil report (including all addenda) which may include a geologic reconnaissance or geologic investigation that was prepared specifically for the development of the project for which these Recommended Grading Specifications are intended to apply.

3. MATERIALS

3.1 Materials for compacted fill shall consist of any soil excavated from the cut areas or imported to the site that, in the opinion of the Consultant, is suitable for use in construction of fills. In general, fill materials can be classified as *soil* fills, *soil-rock* fills or *rock* fills, as defined below.

3.1.1 **Soil fills** are defined as fills containing no rocks or hard lumps greater than 12 inches in maximum dimension and containing at least 40 percent by weight of material smaller than ¾ inch in size.

3.1.2 **Soil-rock fills** are defined as fills containing no rocks or hard lumps larger than 4 feet in maximum dimension and containing a sufficient matrix of soil fill to allow for proper compaction of soil fill around the rock fragments or hard lumps as specified in Paragraph 6.2. **Oversize rock** is defined as material greater than 12 inches.

3.1.3 **Rock fills** are defined as fills containing no rocks or hard lumps larger than 3 feet in maximum dimension and containing little or no fines. Fines are defined as material smaller than ¾ inch in maximum dimension. The quantity of fines shall be less than approximately 20 percent of the rock fill quantity.

3.2 Material of a perishable, spongy, or otherwise unsuitable nature as determined by the Consultant shall not be used in fills.

3.3 Materials used for fill, either imported or on-site, shall not contain hazardous materials as defined by the California Code of Regulations, Title 22, Division 4, Chapter 30, Articles 9 and 10; 40CFR; and any other applicable local, state or federal laws. The Consultant shall not be responsible for the identification or analysis of the potential presence of hazardous materials. However, if observations, odors or soil discoloration cause Consultant to suspect the presence of hazardous materials, the Consultant may request from the Owner the termination of grading operations within the affected area. Prior to resuming grading operations, the Owner shall provide a written report to the Consultant indicating that the suspected materials are not hazardous as defined by applicable laws and regulations.

3.4 The outer 15 feet of *soil-rock* fill slopes, measured horizontally, should be composed of properly compacted *soil* fill materials approved by the Consultant. *Rock* fill may extend to the slope face, provided that the slope is not steeper than 2:1 (horizontal:vertical) and a soil layer no thicker than 12 inches is track-walked onto the face for landscaping purposes. This procedure may be utilized provided it is acceptable to the governing agency, Owner and Consultant.

3.5 Samples of soil materials to be used for fill should be tested in the laboratory by the Consultant to determine the maximum density, optimum moisture content, and, where appropriate, shear strength, expansion, and gradation characteristics of the soil.

3.6 During grading, soil or groundwater conditions other than those identified in the Geotechnical Report may be encountered by the Contractor. The Consultant shall be notified immediately to evaluate the significance of the unanticipated condition.

4. CLEARING AND PREPARING AREAS TO BE FILLED

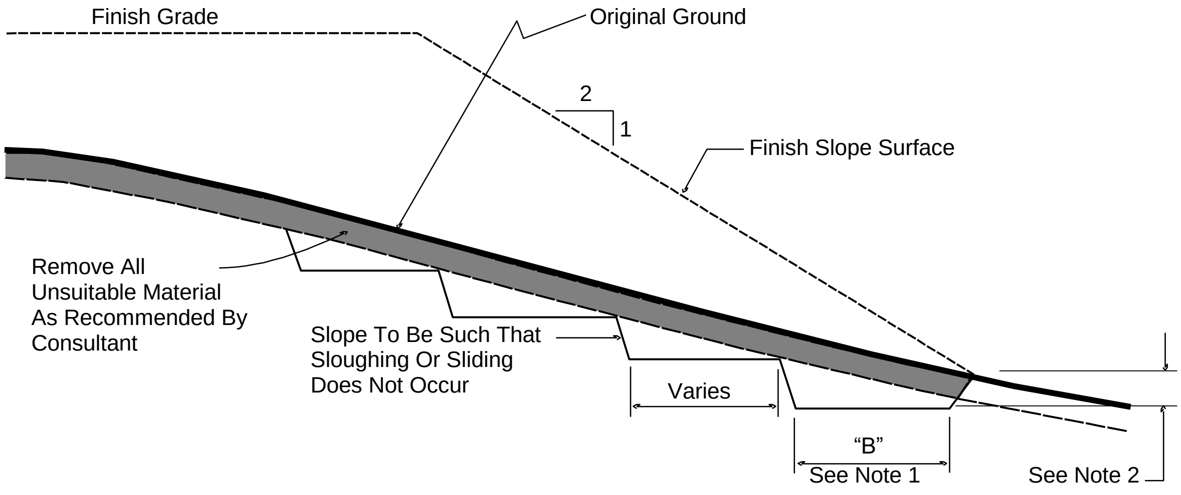
4.1 Areas to be excavated and filled shall be cleared and grubbed. Clearing shall consist of complete removal above the ground surface of trees, stumps, brush, vegetation, man-made structures, and similar debris. Grubbing shall consist of removal of stumps, roots, buried logs and other unsuitable material and shall be performed in areas to be graded. Roots and other projections exceeding 1½ inches in diameter shall be removed to a depth of 3 feet below the surface of the ground. Borrow areas shall be grubbed to the extent necessary to provide suitable fill materials.

4.2 Asphalt pavement material removed during clearing operations should be properly disposed at an approved off-site facility or in an acceptable area of the project evaluated by Geocon and the property owner. Concrete fragments that are free of reinforcing steel may be placed in fills, provided they are placed in accordance with Section 6.2 or 6.3 of this document.

4.3 After clearing and grubbing of organic matter and other unsuitable material, loose or porous soils shall be removed to the depth recommended in the Geotechnical Report. The depth of removal and compaction should be observed and approved by a representative of the Consultant. The exposed surface shall then be plowed or scarified to a minimum depth of 6 inches and until the surface is free from uneven features that would tend to prevent uniform compaction by the equipment to be used.

4.4 Where the slope ratio of the original ground is steeper than 5:1 (horizontal:vertical), or where recommended by the Consultant, the original ground should be benched in accordance with the following illustration.

TYPICAL BENCHING DETAIL



No Scale

DETAIL NOTES: (1) Key width "B" should be a minimum of 10 feet, or sufficiently wide to permit complete coverage with the compaction equipment used. The base of the key should be graded horizontal, or inclined slightly into the natural slope.

(2) The outside of the key should be below the topsoil or unsuitable surficial material and at least 2 feet into dense formational material. Where hard rock is exposed in the bottom of the key, the depth and configuration of the key may be modified as approved by the Consultant.

4.5 After areas to receive fill have been cleared and scarified, the surface should be moisture conditioned to achieve the proper moisture content, and compacted as recommended in Section 6 of these specifications.

5. COMPACTION EQUIPMENT

5.1 Compaction of *soil* or *soil-rock* fill shall be accomplished by sheepsfoot or segmented-steel wheeled rollers, vibratory rollers, multiple-wheel pneumatic-tired rollers, or other types of acceptable compaction equipment. Equipment shall be of such a design that it will be capable of compacting the *soil* or *soil-rock* fill to the specified relative compaction at the specified moisture content.

5.2 Compaction of *rock* fills shall be performed in accordance with Section 6.3.

6. PLACING, SPREADING AND COMPACTION OF FILL MATERIAL

6.1 *Soil* fill, as defined in Paragraph 3.1.1, shall be placed by the Contractor in accordance with the following recommendations:

6.1.1 *Soil* fill shall be placed by the Contractor in layers that, when compacted, should generally not exceed 8 inches. Each layer shall be spread evenly and shall be thoroughly mixed during spreading to obtain uniformity of material and moisture in each layer. The entire fill shall be constructed as a unit in nearly level lifts. Rock materials greater than 12 inches in maximum dimension shall be placed in accordance with Section 6.2 or 6.3 of these specifications.

6.1.2 In general, the *soil* fill shall be compacted at a moisture content at or above the optimum moisture content as determined by ASTM D 1557.

6.1.3 When the moisture content of *soil* fill is below that specified by the Consultant, water shall be added by the Contractor until the moisture content is in the range specified.

6.1.4 When the moisture content of the *soil* fill is above the range specified by the Consultant or too wet to achieve proper compaction, the *soil* fill shall be aerated by the Contractor by blading/mixing, or other satisfactory methods until the moisture content is within the range specified.

6.1.5 After each layer has been placed, mixed, and spread evenly, it shall be thoroughly compacted by the Contractor to a relative compaction of at least 90 percent. Relative compaction is defined as the ratio (expressed in percent) of the in-place dry density of the compacted fill to the maximum laboratory dry density as determined in accordance with ASTM D 1557. Compaction shall be continuous over the entire area, and compaction equipment shall make sufficient passes so that the specified minimum relative compaction has been achieved throughout the entire fill.

6.1.6 Where practical, soils having an Expansion Index greater than 50 should be placed at least 3 feet below finish pad grade and should be compacted at a moisture content generally 2 to 4 percent greater than the optimum moisture content for the material.

6.1.7 Properly compacted *soil* fill shall extend to the design surface of fill slopes. To achieve proper compaction, it is recommended that fill slopes be over-built by at least 3 feet and then cut to the design grade. This procedure is considered preferable to track-walking of slopes, as described in the following paragraph.

6.1.8 As an alternative to over-building of slopes, slope faces may be back-rolled with a heavy-duty loaded sheepsfoot or vibratory roller at maximum 4-foot fill height intervals. Upon completion, slopes should then be track-walked with a D-8 dozer or similar equipment, such that a dozer track covers all slope surfaces at least twice.

6.2 *Soil-rock* fill, as defined in Paragraph 3.1.2, shall be placed by the Contractor in accordance with the following recommendations:

6.2.1 Rocks larger than 12 inches but less than 4 feet in maximum dimension may be incorporated into the compacted *soil* fill, but shall be limited to the area measured 15 feet minimum horizontally from the slope face and 5 feet below finish grade or 3 feet below the deepest utility, whichever is deeper.

6.2.2 Rocks or rock fragments up to 4 feet in maximum dimension may either be individually placed or placed in windrows. Under certain conditions, rocks or rock fragments up to 10 feet in maximum dimension may be placed using similar methods. The acceptability of placing rock materials greater than 4 feet in maximum dimension shall be evaluated during grading as specific cases arise and shall be approved by the Consultant prior to placement.

6.2.3 For individual placement, sufficient space shall be provided between rocks to allow for passage of compaction equipment.

6.2.4 For windrow placement, the rocks should be placed in trenches excavated in properly compacted *soil* fill. Trenches should be approximately 5 feet wide and 4 feet deep in maximum dimension. The voids around and beneath rocks should be filled with approved granular soil having a Sand Equivalent of 30 or greater and should be compacted by flooding. Windrows may also be placed utilizing an "open-face" method in lieu of the trench procedure, however, this method should first be approved by the Consultant.

6.2.5 Windrows should generally be parallel to each other and may be placed either parallel to or perpendicular to the face of the slope depending on the site geometry. The minimum horizontal spacing for windrows shall be 12 feet center-to-center with a 5-foot stagger or offset from lower courses to next overlying course. The minimum vertical spacing between windrow courses shall be 2 feet from the top of a lower windrow to the bottom of the next higher windrow.

6.2.6 Rock placement, fill placement and flooding of approved granular soil in the windrows should be continuously observed by the Consultant.

6.3 *Rock* fills, as defined in Section 3.1.3, shall be placed by the Contractor in accordance with the following recommendations:

6.3.1 The base of the *rock* fill shall be placed on a sloping surface (minimum slope of 2 percent). The surface shall slope toward suitable subdrainage outlet facilities. The *rock* fills shall be provided with subdrains during construction so that a hydrostatic pressure buildup does not develop. The subdrains shall be permanently connected to controlled drainage facilities to control post-construction infiltration of water.

6.3.2 *Rock* fills shall be placed in lifts not exceeding 3 feet. Placement shall be by rock trucks traversing previously placed lifts and dumping at the edge of the currently placed lift. Spreading of the *rock* fill shall be by dozer to facilitate *seating* of the rock. The *rock* fill shall be watered heavily during placement. Watering shall consist of water trucks traversing in front of the current rock lift face and spraying water continuously during rock placement. Compaction equipment with compactive energy comparable to or greater than that of a 20-ton steel vibratory roller or other compaction equipment providing suitable energy to achieve the required compaction or deflection as recommended in Paragraph 6.3.3 shall be utilized. The number of passes to be made should be determined as described in Paragraph 6.3.3. Once a *rock* fill lift has been covered with *soil* fill, no additional *rock* fill lifts will be permitted over the *soil* fill.

6.3.3 Plate bearing tests, in accordance with ASTM D 1196, may be performed in both the compacted *soil* fill and in the *rock* fill to aid in determining the required minimum number of passes of the compaction equipment. If performed, a minimum of three plate bearing tests should be performed in the properly compacted *soil* fill (minimum relative compaction of 90 percent). Plate bearing tests shall then be performed on areas of *rock* fill having two passes, four passes and six passes of the compaction equipment, respectively. The number of passes required for the *rock* fill shall be determined by comparing the results of the plate bearing tests for the *soil* fill and the *rock* fill and by evaluating the deflection variation with number of passes. The required number of passes of the compaction equipment will be performed as necessary until the plate bearing deflections are equal to or less than that determined for the properly compacted *soil* fill. In no case will the required number of passes be less than two.

6.3.4 A representative of the Consultant should be present during *rock* fill operations to observe that the minimum number of “passes” have been obtained, that water is being properly applied and that specified procedures are being followed. The actual number of plate bearing tests will be determined by the Consultant during grading.

6.3.5 Test pits shall be excavated by the Contractor so that the Consultant can state that, in their opinion, sufficient water is present and that voids between large rocks are properly filled with smaller rock material. In-place density testing will not be required in the *rock* fills.

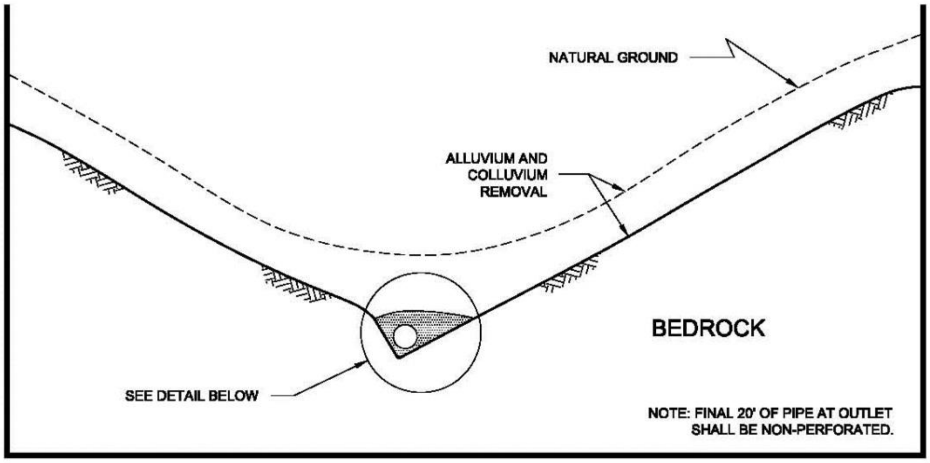
6.3.6 To reduce the potential for “piping” of fines into the *rock* fill from overlying *soil* fill material, a 2-foot layer of graded filter material shall be placed above the uppermost lift of *rock* fill. The need to place graded filter material below the *rock* should be determined by the Consultant prior to commencing grading. The gradation of the graded filter material will be determined at the time the *rock* fill is being excavated. Materials typical of the *rock* fill should be submitted to the Consultant in a timely manner, to allow design of the graded filter prior to the commencement of *rock* fill placement.

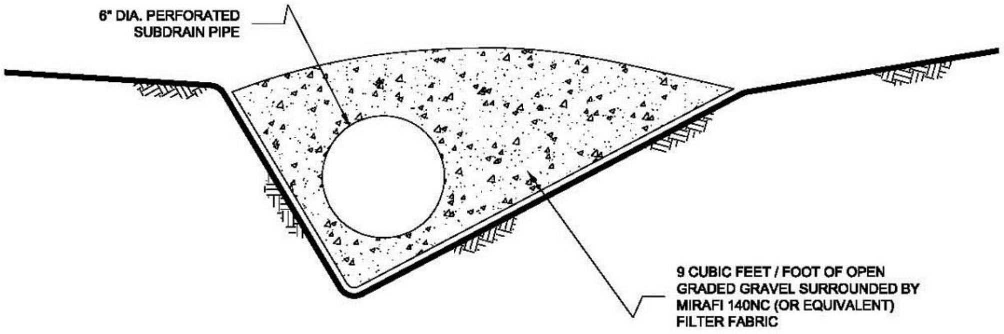
6.3.7 *Rock* fill placement should be continuously observed during placement by the Consultant.

7. SUBDRAINS

7.1 The geologic units on the site may have permeability characteristics and/or fracture systems that could be susceptible under certain conditions to seepage. The use of canyon subdrains may be necessary to mitigate the potential for adverse impacts associated with seepage conditions. Canyon subdrains with lengths in excess of 500 feet or extensions of existing offsite subdrains should use 8-inch-diameter pipes. Canyon subdrains less than 500 feet in length should use 6-inch-diameter pipes.

TYPICAL CANYON DRAIN DETAIL





NOTES:

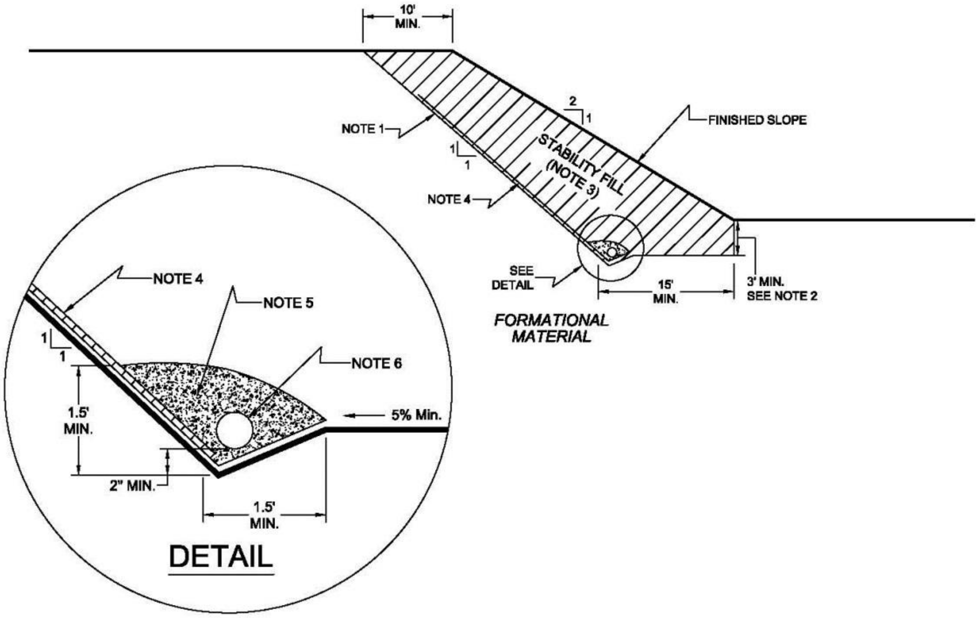
1......6-INCH DIAMETER, SCHEDULE 80 PVC PERFORATED PIPE FOR FILLS
IN EXCESS OF 100-FEET IN DEPTH OR A PIPE LENGTH OF LONGER THAN 500 FEET.

2......6-INCH DIAMETER, SCHEDULE 40 PVC PERFORATED PIPE FOR FILLS
LESS THAN 100-FEET IN DEPTH OR A PIPE LENGTH SHORTER THAN 500 FEET.

NO SCALE

7.2 Slope drains within stability fill keyways should use 4-inch-diameter (or lager) pipes.

TYPICAL STABILITY FILL DETAIL



NOTES:

1.....EXCAVATE BACKCUT AT 1:1 INCLINATION (UNLESS OTHERWISE NOTED).

2.....BASE OF STABILITY FILL TO BE 3 FEET INTO FORMATIONAL MATERIAL, SLOPING A MINIMUM 5% INTO SLOPE.

3.....STABILITY FILL TO BE COMPOSED OF PROPERLY COMPACTED GRANULAR SOIL.

4.....CHIMNEY DRAINS TO BE APPROVED PREFABRICATED CHIMNEY DRAIN PANELS (MIRADRAIN G200N OR EQUIVALENT) SPACED APPROXIMATELY 20 FEET CENTER TO CENTER AND 4 FEET WIDE. CLOSER SPACING MAY BE REQUIRED IF SEEPAGE IS ENCOUNTERED.

5.....FILTER MATERIAL TO BE 3/4-INCH, OPEN-GRADED CRUSHED ROCK ENCLOSED IN APPROVED FILTER FABRIC (MIRAFI 140NC).

6.....COLLECTOR PIPE TO BE 4-INCH MINIMUM DIAMETER, PERFORATED, THICK-WALLED PVC SCHEDULE 40 OR EQUIVALENT, AND SLOPED TO DRAIN AT 1 PERCENT MINIMUM TO APPROVED OUTLET.

NO SCALE

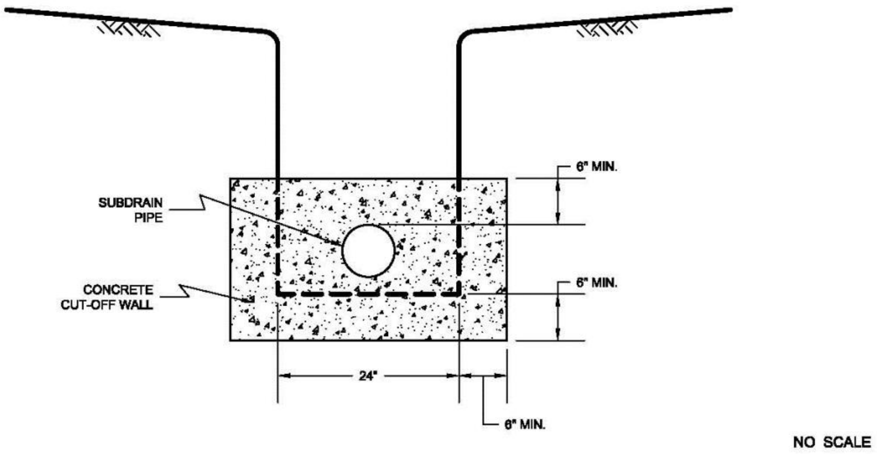
7.3 The actual subdrain locations will be evaluated in the field during the remedial grading operations. Additional drains may be necessary depending on the conditions observed and the requirements of the local regulatory agencies. Appropriate subdrain outlets should be evaluated prior to finalizing 40-scale grading plans.

7.4 *Rock* fill or *soil-rock* fill areas may require subdrains along their down-slope perimeters to mitigate the potential for buildup of water from construction or landscape irrigation. The subdrains should be at least 6-inch-diameter pipes encapsulated in gravel and filter fabric. *Rock* fill drains should be constructed using the same requirements as canyon subdrains.

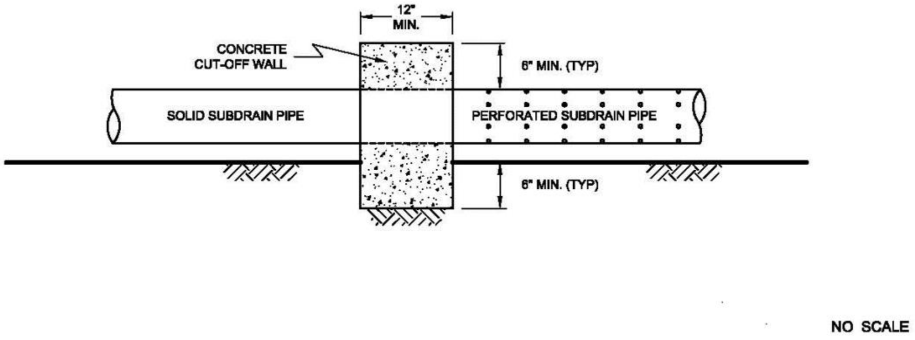
7.5 Prior to outletting, the final 20-foot segment of a subdrain that will not be extended during future development should consist of non-perforated drainpipe. At the non-perforated/ perforated interface, a seepage cutoff wall should be constructed on the downslope side of the pipe.

TYPICAL CUT OFF WALL DETAIL

FRONT VIEW

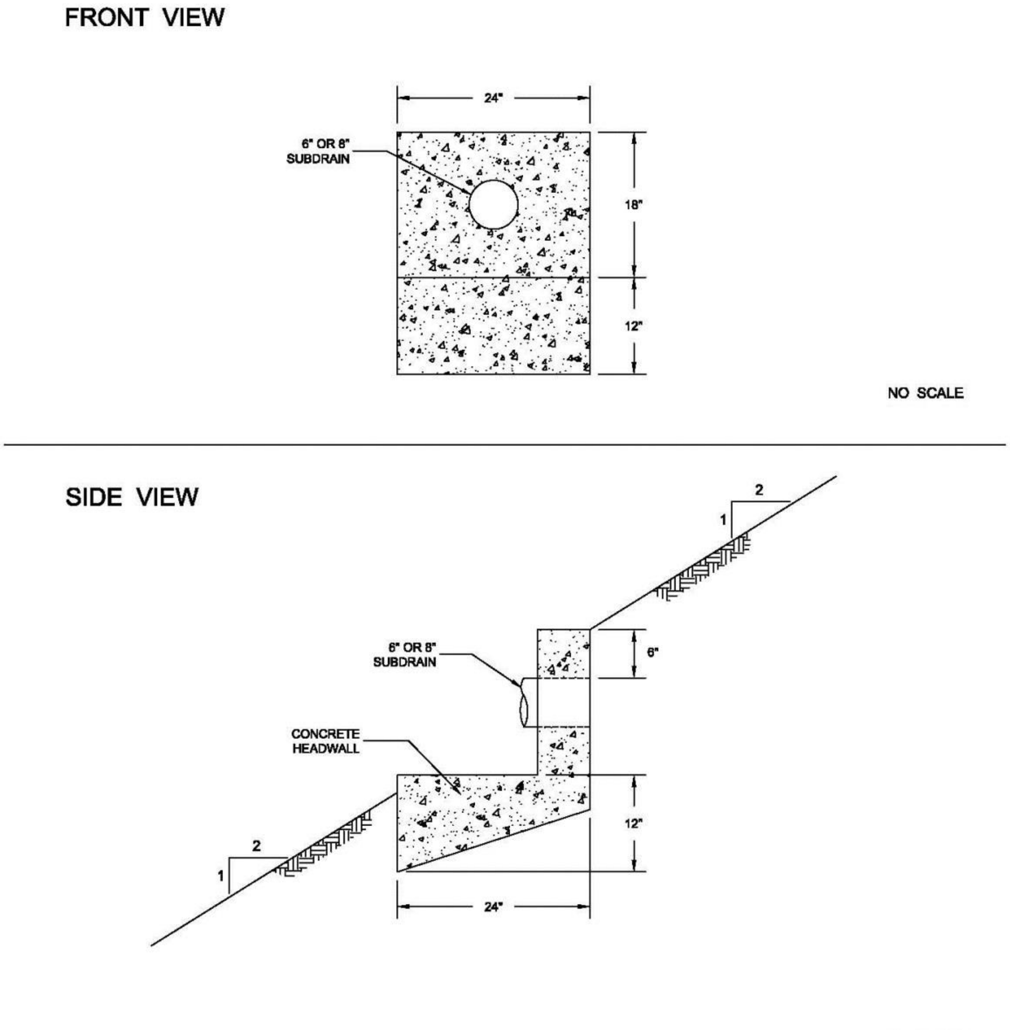


SIDE VIEW



7.6 Subdrains that discharge into a natural drainage course or open space area should be provided with a permanent headwall structure.

TYPICAL HEADWALL DETAIL



NOTE: HEADWALL SHOULD OUTLET AT TOE OF FILL SLOPE
OR INTO CONTROLLED SURFACE DRAINAGE

7.7 The final grading plans should show the location of the proposed subdrains. After completion of remedial excavations and subdrain installation, the project civil engineer should survey the drain locations and prepare an “as-built” map showing the drain locations. The final outlet and connection locations should be determined during grading operations. Subdrains that will be extended on adjacent projects after grading can be placed on formational material and a vertical riser should be placed at the end of the subdrain. The grading contractor should consider videoing the subdrains shortly after burial to check proper installation and functionality. The contractor is responsible for the performance of the drains.

8. OBSERVATION AND TESTING

8.1 The Consultant shall be the Owner's representative to observe and perform tests during clearing, grubbing, filling, and compaction operations. In general, no more than 2 feet in vertical elevation of *soil* or *soil-rock* fill should be placed without at least one field density test being performed within that interval. In addition, a minimum of one field density test should be performed for every 2,000 cubic yards of *soil* or *soil-rock* fill placed and compacted.

8.2 The Consultant should perform a sufficient distribution of field density tests of the compacted *soil* or *soil-rock* fill to provide a basis for expressing an opinion whether the fill material is compacted as specified. Density tests shall be performed in the compacted materials below any disturbed surface. When these tests indicate that the density of any layer of fill or portion thereof is below that specified, the particular layer or areas represented by the test shall be reworked until the specified density has been achieved.

8.3 During placement of *rock* fill, the Consultant should observe that the minimum number of passes have been obtained per the criteria discussed in Section 6.3.3. The Consultant should request the excavation of observation pits and may perform plate bearing tests on the placed *rock* fills. The observation pits will be excavated to provide a basis for expressing an opinion as to whether the *rock* fill is properly seated and sufficient moisture has been applied to the material. When observations indicate that a layer of *rock* fill or any portion thereof is below that specified, the affected layer or area shall be reworked until the *rock* fill has been adequately seated and sufficient moisture applied.

8.4 A settlement monitoring program designed by the Consultant may be conducted in areas of *rock* fill placement. The specific design of the monitoring program shall be as recommended in the Conclusions and Recommendations section of the project Geotechnical Report or in the final report of testing and observation services performed during grading.

8.5 We should observe the placement of subdrains, to check that the drainage devices have been placed and constructed in substantial conformance with project specifications.

8.6 Testing procedures shall conform to the following Standards as appropriate:

8.6.1 Soil and Soil-Rock Fills:

8.6.1.1 Field Density Test, ASTM D 1556, *Density of Soil In-Place By the Sand-Cone Method.*

8.6.1.2 Field Density Test, Nuclear Method, ASTM D 6938, *Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth).*

8.6.1.3 Laboratory Compaction Test, ASTM D 1557, *Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-Pound Hammer and 18-Inch Drop*.

8.6.1.4. Expansion Index Test, ASTM D 4829, *Expansion Index Test*.

9. PROTECTION OF WORK

9.1 During construction, the Contractor shall properly grade all excavated surfaces to provide positive drainage and prevent ponding of water. Drainage of surface water shall be controlled to avoid damage to adjoining properties or to finished work on the site. The Contractor shall take remedial measures to prevent erosion of freshly graded areas until such time as permanent drainage and erosion control features have been installed. Areas subjected to erosion or sedimentation shall be properly prepared in accordance with the Specifications prior to placing additional fill or structures.

9.2 After completion of grading as observed and tested by the Consultant, no further excavation or filling shall be conducted except in conjunction with the services of the Consultant.

10. CERTIFICATIONS AND FINAL REPORTS

10.1 Upon completion of the work, Contractor shall furnish Owner a certification by the Civil Engineer stating that the lots and/or building pads are graded to within 0.1 foot vertically of elevations shown on the grading plan and that all tops and toes of slopes are within 0.5 foot horizontally of the positions shown on the grading plans. After installation of a section of subdrain, the project Civil Engineer should survey its location and prepare an *as-built* plan of the subdrain location. The project Civil Engineer should verify the proper outlet for the subdrains and the Contractor should ensure that the drain system is free of obstructions.

10.2 The Owner is responsible for furnishing a final as-graded soil and geologic report satisfactory to the appropriate governing or accepting agencies. The as-graded report should be prepared and signed by a California licensed Civil Engineer experienced in geotechnical engineering and by a California Certified Engineering Geologist, indicating that the geotechnical aspects of the grading were performed in substantial conformance with the Specifications or approved changes to the Specifications.

LIST OF REFERENCES

1. Advanced Geotechnical Solutions, Inc. (AGS), *Update Geotechnical Report and Grading Plan Review, Energy Park, Chula Vista, California*, dated September 29, 2014 (Report No. 1404-05-B-2);

2. FEMA (2012), *Flood Map Service Center*, FEMA website, https://msc.fema.gov/portal/home, flood map numbers 06073C2156G and 06073C2157G, effective May 16, 2012, accessed August 29, 2021;

3. Geocon Incorporated, *Final Report of Testing and Observation Services Performed During Site Grading, Otay Ranch Village 3, Chula Vista, California*, dated November 25, 2020 (Project No. 06930-52-06);

4. Stark, Choi, McCone (2005), *Journal of Geotechnical and Geoenvironmental Engineering, Drained Shear Strength Parameters for Analysis of Landslides*.

5. Geo Institute (2016), *Development and Use of Fully Softened Shear Strength in Slope Stability Analyses, Geo Institute*, dated February 12, 2016.

6. Kennedy, M. P. and S. S Tan, Geologic Map of the San Diego 30’x60’ Quadrangle,, California, California Geologic Survey, 2008.

7. Magellan Architecture, Chula Vista Self Storage, Chula Vista, CA, Scheme B, dated May 12, 2021;

8. Pasco Laret Suiter & Associates, Preliminary Grading Study, Nirvana Self Storage, 821 Main Street, Chula Vista, CA, dated July 23, 2021.

9. SEAOC (2019), *OSHPD Seismic Design Maps:* Structural Engineers Association of California website, http://seismicmaps.org/, accessed August 29, 2021;

10. USGS (2019), *Quaternary Fault and Fold Database of the United States*: U.S. Geological Survey website, https://www.usgs.gov/natural-hazards/earthquake-hazards/faults, accessed August 29, 2021;

11. Unpublished reports and maps on file with Geocon Incorporated.