CITY OF CHULA VISTA

PDP SWQMP

PRIORITY DEVELOPMENT PROJECT (PDP) STORM WATER QUALITY MANAGEMENT PLAN

FOR

Sharp Chula Vista Ocean View Tower

641-010-28-00

[Insert Permit Application Number]

[Insert Drawing Numbers]

ENGINEER OF WORK:

REGISTERED PROFESSIONAL ENGINEER RICHARD S. TOMLINSON, JR. No. 59276 EXP. 6/30/17 CIVIL STATE OF CALIFORNIA

Richard S Tomlinson, Jr. PE

C-59276

PREPARED FOR:

Sharp HealthCare

8520 Tech Way

San Diego, CA 92123

858-499-4702

PREPARED BY:

Michael Baker International

9755 Clairemont Mesa Blvd.

San Diego, CA 82124

858-614-2000

DATE:

May 2, 2016

Approved By: City of Chula Vista **Date: May 2, 2016**

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TABLE OF CONTENTS

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: Sharp Chula Vista Ocean View Tower
Permit Application Number:

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.

[signature] C59276, 6/30/17
Engineer of Work's Signature, PE Number & Expiration Date

Richard S. Tomlinson Jr
Print Name

Michael Baker International
Company

MAY 3, 2016
Date

REGISTERED PROFESSIONAL ENGINEER
RICHARD S. TOMLINSON, JR.
No. 59276
EXP. 6/30/17
CIVIL
STATE OF CALIFORNIA
Engineer's Seal

PDP SWQMP Date:
PDP SWQMP Template Date: December 2015

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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	5-2-2016	☐ Preliminary Design / Planning/ CEQA ☐ Final Design	Initial Submittal
2		☐ Preliminary Design / Planning/ CEQA ☐ Final Design	
3		☐ Preliminary Design / Planning/ CEQA ☐ Final Design	
4		☐ Preliminary Design / Planning/ CEQA ☐ Final Design	

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PROJECT VICINITY MAP

Project Name: Sharp Chula Vista Ocean View Tower
Permit Application Number:

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Complete and attach Storm Water Requirements Applicability Checklist (Intake Form) included in Appendix A.1

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Site Information Checklist For PDPs	Form I-3B (for PDPs)
Project Summary Information	
Project Name	Sharp Chula Vista Ocean View Tower
Project Address	751 Medical Center Court
Assessor's Parcel Number(s) (APN(s))	641-010-28-00
Permit Application Number	
Project Hydrologic Unit	Select One: ☐ Pueblo San Diego 908 ☐ Sweetwater 909 ☐ Otay 910 X Tijuana 911
Project Watershed (Complete Hydrologic Unit, Area, and Subarea Name with Numeric Identifier)	911.00
Parcel Area (total area of Assessor's Parcel(s) associated with the project)	2.54 Acres (110642 Square Feet)
Area to be Disturbed by the Project (Project Area)	2.17 Acres (94525 Square Feet)
Project Proposed Impervious Area (subset of Project Area)	1.84 Acres (80150 Square Feet)
Project Proposed Pervious Area (subset of Project Area)	.33 Acres (14374 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.	+568 %

Form I-3B Page 2 of 10
Description of Existing Site Condition and Drainage Patterns
Current Status of the Site (select all that apply): X 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 site is currently home to a parking lot
Existing Land Cover Includes (select all that apply): X Vegetative Cover ☐ Non-Vegetated Pervious Areas X Impervious Areas Description / Additional Information: The center on the site is existing parking lot. The surrounding slopes are lightly vegetated.
Underlying Soil belongs to Hydrologic Soil Group (select all that apply): ☐ NRCS Type A ☐ NRCS Type B ☐ NRCS Type C X NRCS Type D
Approximate Depth to Groundwater (GW): ☐ GW Depth < 5 feet ☐ 5 feet < GW Depth < 10 feet X 10 feet < GW Depth < 20 feet ☐ GW Depth > 20 feet
Existing Natural Hydrologic Features (select all that apply): ☐ Watercourses ☐ Seeps ☐ Springs ☐ Wetlands X None Description / Additional Information: The site has been previously developed no natural hydrologic features exist.

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

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.

Description / Additional Information:

The site currently utilizes an urban drainage system consisting of two discharge points. In the existing condition a 12" storm drain pipe runs across the site flowing west to east, and discharges into an existing channel that flows north/south along the eastern property line. This system handles a flow of 8.89 CFS. The north portion of the site drains east to one of two water quality basins. This system handles a flow of 1.28 CFS. The site does not receive any offsite runoff.

Form I-3B Page 4 of 10
Description of Proposed Site Development and Drainage Patterns
Project Description / Proposed Land Use and/or Activities: The proposed project is a 13 room hospital tower
List/describe proposed impervious features of the project (e.g., buildings, roadways, parking lots, courtyards, athletic courts, other impervious features): The project impervious area will feature the hospital tower and surrounding hardscape
List/describe proposed pervious features of the project (e.g., landscape areas): The surrounding slopes on the north and east edges of the site will be pervious
Does the project include grading and changes to site topography? X Yes ☐ No Description / Additional Information: Rough grading is required on the slopes on the north and east edges of the project site. The building footprint will require a graded pad

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:: This project features four distinct drainage management areas. DMA-1 This area is a mix of pervious and impervious area on the northern edge of the project site. This area drains to the bioretention basin A and exits the site to the north. DMA-2 This area drains to bioretention basin B and afterwards flows to tank 2. After being held in tank 2 runoff flows through a storm drain system to an outfall point on the eastern edge of the site. DMA-3 This area flows through a modular wetlands system to tank 1. From here the tank drains to the eastern discharge point. DMA-4 This area drains to bioretention basin C and also flows into tank 2.

Form I-3B Page 6 of 10
Identify whether any of the following features, activities, and/or pollutant source areas will be present (select all that apply): X On-site storm drain inlets X 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 X Refuse areas ☐ Industrial processes ☐ Outdoor storage of equipment or materials ☐ Vehicle and Equipment Cleaning ☐ Vehicle/Equipment Repair and Maintenance ☐ Fuel Dispensing Areas ☐ Loading Docks X Fire Sprinkler Test Water X Miscellaneous Drain or Wash Water ☐ Plazas, sidewalks, and parking lots Description / Additional Information: The project will feature a hospital tower and surrounding hardscape that will require on-site storm drain inlets. The tower will require refuse areas and a fire sprinkler system.

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):

Runoff from the site discharges in to a grassy channel on the east edge of the project boundary. The channel flows to Telegraph Canyon Creek, which flows into the San Diego Bay.

List any 303(d) impaired water bodies within the path of storm water from the project site to the Pacific Ocean (or bay, lagoon, lake or reservoir, as applicable), identify the pollutant(s)/stressor(s) causing impairment, and identify any TMDLs and/or Highest Priority Pollutants from the WQIP for the impaired water bodies:

303(d) Impaired Water Body	**Pollutant(s)/Stressor(s)**	**TMDLs / WQIP Highest Priority Pollutant**
Telegraph Canyon Creek	Benthic Community Effects, Nitrogen, Selenium,	Selenium
San Diego Bay	Copper, PCBs	PCBs

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 anticipated 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**	**Anticipated from the Project Site**	**Also a Receiving Water Pollutant of Concern**
Sediment		X	
Nutrients			
Heavy Metals		X	X
Organic Compounds		X	
Trash & Debris		X	
Oxygen Demanding Substances			
Oil & Grease		X	
Bacteria & Viruses			
Pesticides			

Hydromodification Management Requirements

Do hydromodification management requirements apply (see Section 1.6 of the BMP Design Manual)?

X 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):

Critical Coarse Sediment Yield Areas*

***This Section only required if hydromodification management requirements apply**

Based on the maps provided within the WMAA, do potential critical coarse sediment yield areas exist within the project drainage boundaries?

☐ Yes

X No, No critical coarse sediment yield areas to be protected based on WMAA maps

If yes, have any of the optional analyses presented in Section 6.2 of the BMP Design Manual been performed?

☐ 6.2.1 Verification of Geomorphic Landscape Units (GLUs) Onsite

☐ 6.2.2 Downstream Systems Sensitivity to Coarse Sediment

☐ 6.2.3 Optional Additional Analysis of Potential Critical Coarse Sediment Yield Areas Onsite

☐ No optional analyses performed, the project will avoid critical coarse sediment yield areas identified based on WMAA maps

If optional analyses were performed, what is the final result?

X No critical coarse sediment yield areas to be protected based on verification of GLUs onsite

☐ Critical coarse sediment yield areas exist but additional analysis has determined that protection is not required. Documentation attached in Attachment 2.b of the SWQMP.

☐ Critical coarse sediment yield areas exist and require protection. The project will implement management measures described in Sections 6.2.4 and 6.2.5 as applicable, and the areas are identified on the SWQMP Exhibit.

Discussion / Additional Information:

Form I-3B Page 9 of 10
Flow Control for Post-Project Runoff* ***This Section only required if hydromodification management requirements apply**
List and describe point(s) of compliance (POCs) for flow control for hydromodification management (see Section 6.3.1). For each POC, provide a POC identification name or number correlating to the project's HMP Exhibit and a receiving channel identification name or number correlating to the project's HMP Exhibit. The project features one POC at the outfall of the pipe on the eastern edge of the site
Has a geomorphic assessment been performed for the receiving channel(s)? X 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)

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.

Source Control BMP Checklist for All Development Projects (Standard Projects and PDPs)

Form I-4

Project Identification			
Project Name Sharp Chula Vista Ocean View Tower			
Permit Application Number			

Source Control BMPs

All development projects must implement source control BMPs SC-1 through SC-6 where applicable and feasible. See Chapter 4 and Appendix E of the manual for information to implement source control BMPs shown in this checklist.

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 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?		
SC-1 Prevention of Illicit Discharges into the MS4	X Yes	☐ No	☐ N/A
Discussion / justification if SC-1 not implemented:			
SC-2 Storm Drain Stenciling or Signage	X Yes	☐ No	☐ N/A
Discussion / justification if SC-2 not implemented:			
SC-3 Protect Outdoor Materials Storage Areas from Rainfall, Run-On, Runoff, and Wind Dispersal	☐ Yes	☐ No	X N/A
Discussion / justification if SC-3 not implemented:			
SC-4 Protect Materials Stored in Outdoor Work Areas from Rainfall, Run-On, Runoff, and Wind Dispersal	X Yes	☐ No	☐ N/A
Discussion / justification if SC-4 not implemented:			

Form I-4 Page 2 of 2			
Source Control Requirement	**Applied?**		
SC-5 Protect Trash Storage Areas from Rainfall, Run-On, Runoff, and Wind Dispersal	X Yes	☐ No	☐ N/A
Discussion / justification if SC-5 not implemented:			
SC-6 Additional BMPs Based on Potential Sources of Runoff Pollutants (must answer for each source listed below)			
☐ Onsite storm drain inlets	X Yes	☐ No	☐ N/A
☐ Interior floor drains and elevator shaft sump pumps	X Yes	☐ No	☐ N/A
☐ Interior parking garages	☐ Yes	X No	☐ N/A
☐ Need for future indoor & structural pest control	X Yes	☐ No	☐ N/A
☐ Landscape/outdoor pesticide use	X Yes	☐ No	☐ N/A
☐ Pools, spas, ponds, decorative fountains, and other water features	☐ Yes	☐ No	X N/A
☐ Food service	☐ Yes	☐ No	X N/A
☐ Refuse areas	☐ Yes	☐ No	X N/A
☐ Industrial processes	X Yes	☐ No	☐ N/A
☐ Outdoor storage of equipment or materials	☐ Yes	☐ No	☐ N/A
☐ Vehicle and equipment cleaning	☐ Yes	☐ No	X N/A
☐ Vehicle/equipment repair and maintenance	☐ Yes	☐ No	X N/A
☐ Fuel dispensing areas	☐ Yes	☐ No	X N/A
☐ Loading docks	☐ Yes	☐ No	X N/A
☐ Fire sprinkler test water	X Yes	☐ No	☐ N/A
☐ Miscellaneous drain or wash water	X Yes	☐ No	☐ N/A
☐ Plazas, sidewalks, and parking lots	☐ Yes	☐ No	X N/A
Discussion / justification if SC-6 not implemented. Clearly identify which sources of runoff pollutants are discussed. Justification must be provided for <u>all</u> "No" answers shown above.			

Site Design BMP Checklist for All Development Projects (Standard Projects and PDPs)

Form I-5

Project Identification			
Project Name Sharp Chula Vista Ocean View Tower			
Permit Application Number			

Site Design BMPs
All development projects must implement site design BMPs SD-1 through SD-8 where applicable and feasible. See Chapter 4 and Appendix E of the manual for information to implement site design BMPs shown in this checklist. 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?		
SD-1 Maintain Natural Drainage Pathways and Hydrologic Features	X Yes	☐ No	☐ N/A
Discussion / justification if SD-1 not implemented:			
SD-2 Conserve Natural Areas, Soils, and Vegetation	X Yes	☐ No	☐ N/A
Discussion / justification if SD-2 not implemented:			
SD-3 Minimize Impervious Area	X Yes	☐ No	☐ N/A
Discussion / justification if SD-3 not implemented:			
SD-4 Minimize Soil Compaction	X Yes	☐ No	☐ N/A
Discussion / justification if SD-4 not implemented:			

Form I-5 Page 2 of 2			
Site Design Requirement	**Applied?**		
SD-5 Impervious Area Dispersion	☐ Yes	X No	☐ N/A
Discussion / justification if SD-5 not implemented: Site layout does not allow for impervious area dispersion			
SD-6 Runoff Collection	☐ Yes	X No	☐ N/A
Discussion / justification if SD-6 not implemented: Runoff collection not feasible			
SD-7 Landscaping with Native or Drought Tolerant Species	X Yes	☐ No	☐ N/A
Discussion / justification if SD-7 not implemented:			
SD-8 Harvesting and Using Precipitation	☐ Yes	X No	☐ N/A
Discussion / justification if SD-8 not implemented: Rainwater harvesting not feasible			

Summary of PDP Structural BMPs	Form I-6 (For PDPs)

Project Identification
Project Name Sharp Chula Vista Ocean View Tower
Permit Application Number
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 the local jurisdiction 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, and the local jurisdiction must confirm the maintenance (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 this site infiltration was not a feasible option due to the underlying soil type. For DMAs 1, 2, and 4 there was adequate space to put in bioretention basins. For DMAs 2 and 4 an additional underground tank is needed for hydromodification. Available pervious space was an issue for DMA-3 so a bioreention basin could not be used. For this reason a modular wetlands system coupled with an underground tank was chosen for pollutant and hydromodification management. (Continue on page 2 as necessary.)

Form I-6 Page 2 of 14
(Page reserved for continuation of description of general strategy for structural BMP implementation at the site)
(Continued from page 1)

Form I-6 Page 3 of 14 (Copy as many as needed)	
Structural BMP Summary Information **(Copy this page as needed to provide information for each individual proposed structural BMP)**	
Structural BMP ID No. BASIN-A	
Construction Plan Sheet No.	
Type of structural BMP: ☐ Retention by harvest and use (HU-1) ☐ Retention by infiltration basin (INF-1) X 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 X 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)	Richard Tomlinson Jr. P.E.
Who will be the final owner of this BMP?	Sharp HealthCare
Who will maintain this BMP into perpetuity?	Sharp HealthCare
What is the funding mechanism for maintenance?	Owners on-going maintenance funding.
Discussion (as needed):	

Form I-6 Page 4 of 14 (Copy as many as needed)
Structural BMP ID No. BASIN-A
Construction Plan Sheet No.
Discussion (as needed):

Form I-6 Page 5 of 14 (Copy as many as needed)	
Structural BMP Summary Information **(Copy this page as needed to provide information for each individual proposed structural BMP)**	
Structural BMP ID No. BASIN-B	
Construction Plan Sheet No.	
Type of structural BMP: ☐ Retention by harvest and use (HU-1) ☐ Retention by infiltration basin (INF-1) X 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 X 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)	Richard Tomlinson Jr. P.E.
Who will be the final owner of this BMP?	Sharp HealthCare
Who will maintain this BMP into perpetuity?	Sharp HealthCare
What is the funding mechanism for maintenance?	Owners on-going maintenance funding.
Discussion (as needed):	

Form I-6 Page 6 of 14 (Copy as many as needed)
Structural BMP ID No. BASIN-B
Construction Plan Sheet No.
Discussion (as needed):

Form I-6 Page 7 of 14 (Copy as many as needed)	
Structural BMP Summary Information (Copy this page as needed to provide information for each individual proposed structural BMP)	
Structural BMP ID No. BASIN-C	
Construction Plan Sheet No.	
Type of structural BMP: ☐ Retention by harvest and use (HU-1) ☐ Retention by infiltration basin (INF-1) X 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 X 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)	Richard Tomlinson Jr. P.E.
Who will be the final owner of this BMP?	Sharp HealthCare
Who will maintain this BMP into perpetuity?	Sharp HealthCare
What is the funding mechanism for maintenance?	Owners on-going maintenance funding.
Discussion (as needed):	

Form I-6 Page 8 of 14 (Copy as many as needed)
Structural BMP ID No. BASIN-C
Construction Plan Sheet No.
Discussion (as needed):

Form I-6 Page 9 of 14 (Copy as many as needed)	
Structural BMP Summary Information **(Copy this page as needed to provide information for each individual proposed structural BMP)**	
Structural BMP ID No. MODULAR WETLANDS	
Construction Plan Sheet No.	
Type of structural BMP: ☐ Retention by harvest and use (HU-1) ☐ 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) X 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: X 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)	Richard Tomlinson Jr. P.E.
Who will be the final owner of this BMP?	Sharp HealthCare
Who will maintain this BMP into perpetuity?	Sharp HealthCare
What is the funding mechanism for maintenance?	Owners on-going maintenance funding.
Discussion (as needed):	

Form I-6 Page 10 of 14 (Copy as many as needed)
Structural BMP ID No. MODULAR WETLANDS
Construction Plan Sheet No.
Discussion (as needed): This BMP is fed from tank 1. Tank 1, has a maximum volume of 10,752 cf prior to overflowing, and 8,960 before the tank starts to bypass. Therefore, the project is able to store and treat the 8,960 cf, which is far in excess of the required DCV volume (factored) of 3,111. The hydromod tank will discharge at a rate of up to 0.205 cfs to the level of the DCV. Therefore, we are proposing a MWS 8-8. This BMP can flow over 0.230 cfs so it is sized greater than the discharge from the tank.

Form I-6 Page 11 of 14 (Copy as many as needed)	
Structural BMP Summary Information **(Copy this page as needed to provide information for each individual proposed structural BMP)**	
Structural BMP ID No. TANK-1	
Construction Plan Sheet No.	
Type of structural BMP: ☐ Retention by harvest and use (HU-1) ☐ 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 X 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)	Richard Tomlinson Jr. P.E.
Who will be the final owner of this BMP?	Sharp HealthCare
Who will maintain this BMP into perpetuity?	Sharp HealthCare
What is the funding mechanism for maintenance?	Owners on-going maintenance funding.
Discussion (as needed):	

Form I-6 Page 12 of 14 (Copy as many as needed)
Structural BMP ID No. TANK-1
Construction Plan Sheet No.
Discussion (as needed):

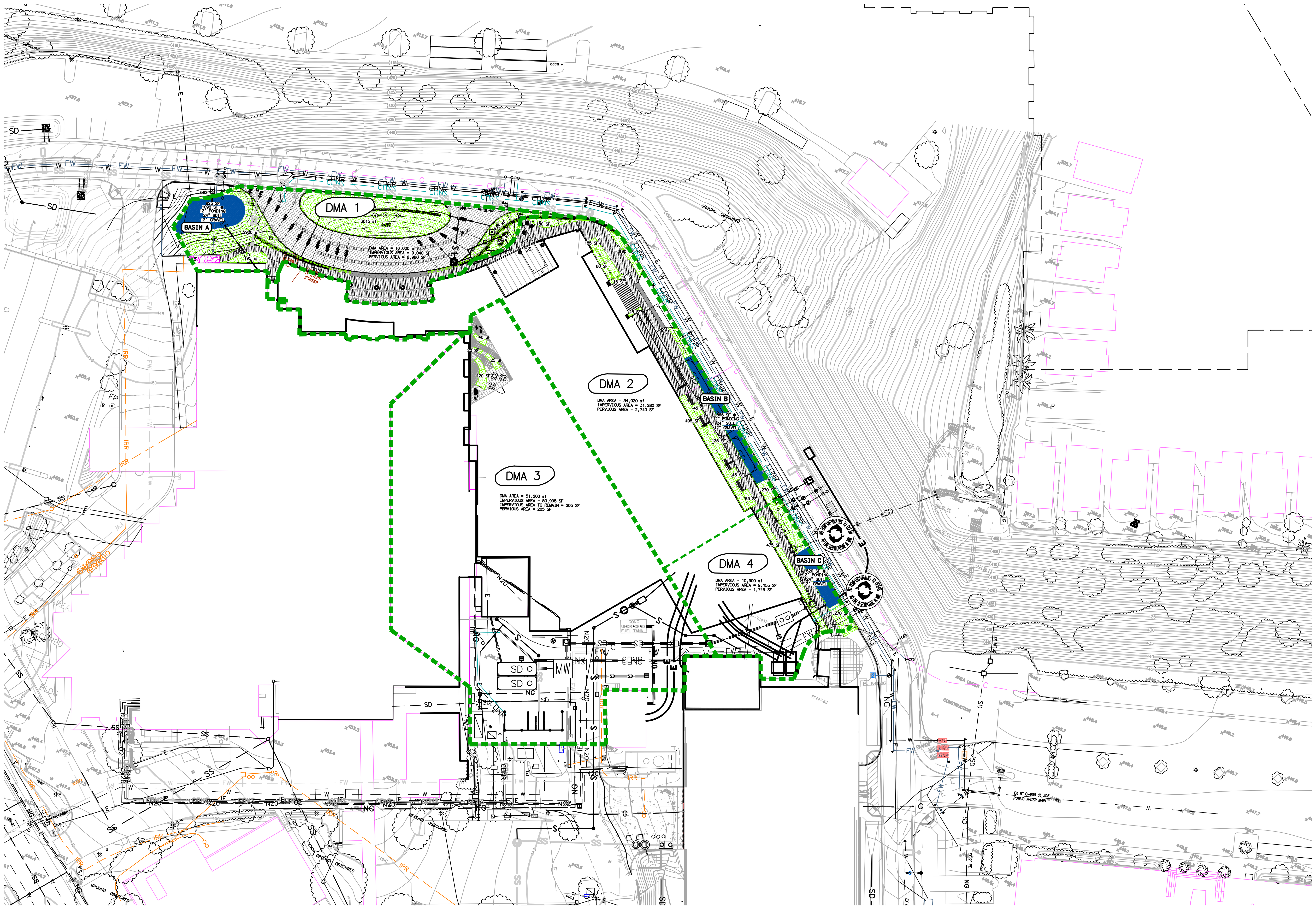
Form I-6 Page 13 of 14 (Copy as many as needed)	
Structural BMP Summary Information **(Copy this page as needed to provide information for each individual proposed structural BMP)**	
Structural BMP ID No. TANK-2	
Construction Plan Sheet No.	
Type of structural BMP: ☐ Retention by harvest and use (HU-1) ☐ 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 X 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)	Richard Tomlinson Jr. P.E.
Who will be the final owner of this BMP?	Sharp HealthCare
Who will maintain this BMP into perpetuity?	Sharp HealthCare
What is the funding mechanism for maintenance?	Owners on-going maintenance funding.
Discussion (as needed):	

Form I-6 Page 14 of 14 (Copy as many as needed)
Structural BMP ID No. TANK-2
Construction Plan Sheet No.
Discussion (as needed):

ATTACHMENT 1

BACKUP FOR PDP POLLUTANT CONTROL BMPS

This is the cover sheet for Attachment 1.



LEGEND

BASIN BOUNDARY

MODULAR WETLANDS — MW

STORM DRAIN STENCILING

PERVIOUS AREA

BIORETENTION BASIN

NOTE:
ALL SOILS URBAN LANDS SOIL TYPE "D"

GROUNDWATER DEPTH > 50FT

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

DMA SUMMARY		
DMA-ID	AREA	TYPE
1	16,000	DRAINS TO BMP
2	34,020	DRAINS TO BMP
3	51,200	DRAINS TO BMP
4	10,900	DRAINS TO BMP

SHARP MEDICAL CENTER
CHULA VISTA, CA
DMA EXHIBIT

04 / 20 / 16

Michael Baker
INTERNATIONAL
9755 Clairemont Mesa Boulevard
San Diego, CA 92124
Phone: (858) 614-5000 · MBAKERINTL.COM

Harvest and Use Feasibility Checklist		Form I-7
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:__________ No demand for landscape irrigation. No demand for havested water since the hospital does not use recycled water.		
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]		
3. Calculate the DCV using worksheet B-2.1. DCV = __________ (cubic feet)		
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.
Is harvest and use feasible based on further evaluation? ☐ Yes, refer to Appendix E to select and size harvest and use BMPs. ☐ No, select alternate BMPs.		

Categorization of Infiltration Feasibility Condition	Form I-8

Part 1 - Full Infiltration Feasibility Screening Criteria

Would infiltration of the full design volume be feasible from a physical perspective without any undesirable consequences that cannot be reasonably mitigated?

Criteria	Screening Question	Yes	No
1	**Is the estimated reliable infiltration rate below proposed facility locations greater than 0.5 inches per hour?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.		

Provide basis:

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.

Criteria	Screening Question	Yes	No
2	**Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.		No

Provide basis:

Per Geotech report the underlying soil is prone to perched water conditions and alternating permeable and impermeable layers. Infiltration not recommended.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.

Form I-8 Page 2 of 4			
Criteria	Screening Question	**Yes**	**No**
3	**Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of groundwater contamination (shallow water table, storm water pollutants or other factors) that cannot be mitigated to an acceptable level?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.		
Provide basis: Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
4	**Can infiltration greater than 0.5 inches per hour be allowed without causing potential water balance issues such as change of seasonality of ephemeral streams or increased discharge of contaminated groundwater to surface waters?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.		
Provide basis: Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
Part 1 Result *	If all answers to rows 1 - 4 are "**Yes**" a full infiltration design is potentially feasible. The feasibility screening category is **Full Infiltration** If any answer from row 1-4 is "**No**", infiltration may be possible to some extent but would not generally be feasible or desirable to achieve a "full infiltration" design. Proceed to Part 2	No	

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by Agency/Jurisdictions to substantiate findings

Form I-8 Page 3 of 4

Part 2 – Partial Infiltration vs. No Infiltration Feasibility Screening Criteria

Would infiltration of water in any appreciable amount be physically feasible without any negative consequences that cannot be reasonably mitigated?

Criteria	Screening Question	Yes	No
5	**Do soil and geologic conditions allow for infiltration in any appreciable rate or volume?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.		

Provide basis:

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.

Criteria	Screening Question	Yes	No
6	**Can Infiltration in any appreciable quantity be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.		No

Provide basis:

Per Geotech report infiltration is not recommended due to unusual ground water transmittal in San Diego and Otay soil formations

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.

Form I-8 Page 4 of 4			
Criteria	Screening Question	Yes	No
7	**Can Infiltration in any appreciable quantity be allowed without posing significant risk for groundwater related concerns (shallow water table, storm water pollutants or other factors)?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.		

Provide basis:

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.

8	**Can infiltration be allowed without violating downstream water rights?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.		

Provide basis:

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.

Part 2 Result*	If all answers from row 5-8 are yes then partial infiltration design is potentially feasible. The feasibility screening category is **Partial Infiltration.** If any answer from row 5-8 is no, then infiltration of any volume is considered to be **infeasible** within the drainage area. The feasibility screening category is **No Infiltration.**	no Infiltraton

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by Agency/Jurisdictions to substantiate findings

April 20th, 2016

Project: All Related

Subject: MWS Linear BMP Classification Per San Diego Manual

To Whom It May Concern:

It is the intention of this document to use the MWS Linear as a biofiltration BMP. Based upon definitions of Biofiltration as found in Section 2.2.1 and Appendix F of the manual the MWS Linear meets the criteria to be classified as biofiltration and therefore is not flow through treatment and thus does not trigger the need for alternative compliance. The MWS Linear has GULD approval for basic, phosphorus and enhanced treatment under the TAPE approval. The system is certified under the TAPE approval at a loading rate of 1 gpm/sq ft for all three pollutant categories. This is consistent with the performance criteria related to the performance of Appendix F.

Let us first address the comment regarding the MWS (referring to the Modular Wetland System Linear) being flow through treatment. To do so let us look at the definition of biofiltration as provided by the Design Manual which states:

> *"For situations where onsite retention of the 85th percentile storm volume is not feasible, biofiltration must be provided to satisfy specific "biofiltration standards" i.e. a set of selection, sizing, design and operation and maintenance (O&M) criteria that must be met for a BMP to be considered a "biofiltration BMP" – see Section 2.2.1 and Appendix F."*

If we look at section 2.2.2 Storm Water Pollutant Control Performance Standard it states:

> *"(i) If it is not technically feasible to implement retention BMPs for the full DCV onsite for a PDP, then the PDP shall utilize biofiltration BMPs for the remaining volume not reliably retained. Biofiltration BMPs must be designed as described in Appendix F to have an appropriate hydraulic loading rate to maximize storm water retention and pollutant removal, as well as to prevent erosion, scour, and channeling within the BMP, and must be sized to:*
>
> > *[a]. Treat 1.5 times the DCV not reliably retained onsite, OR*
> >
> > *[b]. Treat the DCV not reliably retained onsite with a flow-thru design that has a total volume, including pore spaces and pre-filter detention volume, sized to hold at least 0.75 times the portion of the DCV not reliably retained onsite."*

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As the manual states Biofiltration BMPs must be designed as described in Appendix F which states:

> *"A project applicant must be able to affirmatively demonstrate that a given BMP is designed and sized in a manner consistent with this definition to be considered as a "biofiltration BMP" as part of a compliant storm water management plan."*
>
> *"This appendix contains a checklist of the key underlying criteria that must be met for a BMP to be considered a biofiltration BMP. The purpose of this checklist is to facilitate consistent review and approval of biofiltration BMPs that meet the "biofiltration standard" defined by the MS4 Permit."*
>
> *"This checklist includes specific design criteria that are essential to defining a system as a biofiltration BMP; however it does not present a complete design basis. This checklist was used to develop BMP Fact Sheets for PR-1 biofiltration with partial retention and BF-1 biofiltration, which do present a complete design basis. Therefore, biofiltration BMPs that substantially meet all aspects of the Fact sheets PR-1 or BF-1 should be able to complete this checklist without additional documentation beyond what would already be required for a project submittal."*
>
> *"Other biofiltration BMP designs (including both non-proprietary and proprietary designs) may also meet the underlying MS4 Permit requirements to be considered biofiltration BMPs. These BMPs may be classified as biofiltration BMPs if they (1) meet the minimum design criteria listed in this appendix, including the pollutant treatment performance standard in Appendix F.1, (2) are designed and maintained in a manner consistent with their performance certifications (See explanation in Appendix F.2), if applicable, and (3) are acceptable at the discretion of the [City Engineer]. The applicant may be required to provide additional studies and/or required to meet additional design criteria beyond the scope of this document in order to demonstrate that these criteria are met."*

As stated the Biofiltration BMP must meet three objectives. The following outlines how the Modular Wetland System Linear meets these criteria.

Minimum Design Criteria

1. Biofiltration BMPs shall be allowed only as described in the BMP selection process in this manual (i.e., retention feasibility hierarchy).
    a. The Modular Wetland System Linear (MWS Linear) is only being proposed on plans when retention via infiltration or reuse is proven infeasible. Conditions such as soils with little to no infiltration rate or sites in which insufficient landscaping warrant to successful implementation of reuse systems.

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2. Biofiltration BMPs must be sized using acceptable sizing methods described in this manual.

   a. Section B.5.2 Basis for Minimum Sizing Factor for Biofiltration BMPs states:

      "The MS4 Permit describes conceptual performance goals for biofiltration BMPs and specifies numeric criteria for sizing biofiltration BMPs (See Section 2.2.1 of this Manual). However, the MS4 Permit does not define a specific footprint sizing factor or design profile that must be provided for the BMP to be considered "biofiltration."

      "Additionally, it does not apply to alternative biofiltration designs that utilize the checklist in Appendix F (Biofiltration Standard and Checklist). Acceptable alternative designs (such as proprietary systems meeting Appendix F criteria) typically include design features intended to allow acceptable performance with a smaller footprint and have undergone field scale testing to evaluate performance and required O&M frequency."

      As stated in the Manual alternative biofiltration designs are allowed. The MWS Linear therefore qualifies as a biofiltration BMP under this definition as it has both undergone field scale testing (TAPE tested and approved with a GULD) and provides requirements on O&M frequency. In addition, the MWS Linear can be sized to treat either 1.5 times the DCV not reliably retained onsite OR 1.0 times the portion of the DCV not reliably retained onsite; and additionally check that the system has a total static (i.e. non-routed) storage volume, including pore spaces and pre-filter detention volume to at least 0.75 times the portion of the DCV not reliably retained onsite.

3. Biofiltration BMPs must be sited and designed to achieve maximum feasible infiltration and evapotranspiration.

   a. The MWS Linear is utilized and placed in the same manner as other types of biofiltration systems. As with other biofiltration systems the MWS Linear includes and underdrain for the remaining portion of the DCV that is not retained via incidental infiltration (as biofiltration if infiltration is not feasible due to poor soils) and evapotranspiration. The MWS Linear can be designed with an open bottom to maximize this incidental infiltration. The only exception to this, as with other biofiltration BMPs, is when the geotechnical consultant recommends an impervious liner be used due to specific soil conditions such as expansive clays. Additionally, the MWS Linear utilizes an amended media that is much more porous than the standard prescribed biofiltration media which is a mix of sand and compost. 100% of the media used in the MWS Linear has interparticle voids of 48% plus and 24% internal void space for each media particle. This is much greater than the sand which has interparticle voids of 35% and internal voids of 0%. As such, the MWS Linear retains greater moisture which allows for greater volume retention and ultimately evapotranspiration via respiration of the contained vegetation.

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4. Biofiltration BMPs must be designed with a hydraulic loading rate to maximize pollutant retention, preserve pollutant control/sequestration processes, and minimize potential for pollutant washout.

    a. The manual states:

    "Alternatively, for proprietary designs and custom media mixes not meeting the media specifications contained in the City or County LID Manual, field scale testing data are provided to demonstrate that proposed media meets the pollutant treatment performance criteria in Section F.1 below."

    The MWS Linear has been tested under the Washington State TAPE protocol which is full scale field testing and has received General Use Level Designation under that protocol. Table F.1-1, as shown below, requires a biofiltration BMP to have Basic Treatment, Phosphorus Treatment, and Enhanced Treatment under this protocol. The MWS Linear has GULD approval for all three and therefore meets this minimum requirement 4. A copy of the TAPE approval has been attached to this document.

Table F.1-1: Required Technology Acceptance Protocol-Ecology Certifications for Polltuants of Concern for Biofiltration Performance Standard

Project Pollutant of Concern	Required Technology Acceptance Protocol-Ecology Certification for Biofiltration Performance Standard
Trash	Basic Treatment, Phosphorus Treatment, Enhanced Treatment
Sediments	Basic Treatment, Phosphorus Treatment, Enhanced Treatment
Oil and Grease	Basic Treatment, Phosphorus Treatment, Enhanced Treatment
Nutrients	Phosphorus Treatment[1]
Metals	Enhanced Treatment
Pesticides	Basic Treatment (including filtration)[2] Phosphorus Treatment, Enhanced Treatment
Organics	Basic Treatment (including filtration)[2] Phosphorus Treatment, Enhanced Treatment
Bacteria and Viruses	Basic Treatment (including bacteria removal processes)[3] , Phosphorus Treatment, Enhanced Treatment
Basic Treatment (including filtration)[2] Phosphorus Treatment, Enhanced Treatment	Basic Treatment (including filtration)[2] Phosphorus Treatment, Enhanced Treatment

5. Biofiltration BMPs must be designed to promote appropriate biological activity to support and maintain treatment processes.

    a. The MWS Linear an advanced vegetated biofiltration promotes biological processes found in both upland bioretention systems and wetlands. The system utilizes an advanced horizontal flow design to ensure maximum contact with the vegetation root mass. Bacterial growth, supported by the root system in the wetland chamber, performs a number of treatment processes. These vary as a function of moisture, temperature, pH, salinity, and pollutant concentrations. Biologically available forms of nitrogen, phosphorus, and carbon are actively taken into the cells of vegetation and bacteria, and used for metabolic processes (i.e., energy production and growth). Nitrogen and phosphorus are actively taken up as nutrients that are vital for a number of cell functions, growth, and energy production. These processes remove metabolites from the media during and between storm events, making the media available to capture more nutrients from subsequent storms.

    b. Soil organisms in the wetland chamber can break down a wide array of organic compounds into less toxic forms or completely break them down into carbon dioxide and water (Means and Hinchee 1994). Bacteria can also cause metals to precipitate out as salts, bind them within organic material, and accumulate metals in nodules within the cells. Finally, plant growth may metabolize many pollutants, sequester them or rendering them less toxic (Reeves and Baker 2000).

    c. Following are pictures from the plants pulled from a MWS Linear after only 14 months of growth. The media used in the system is designed to maximize biological activity:


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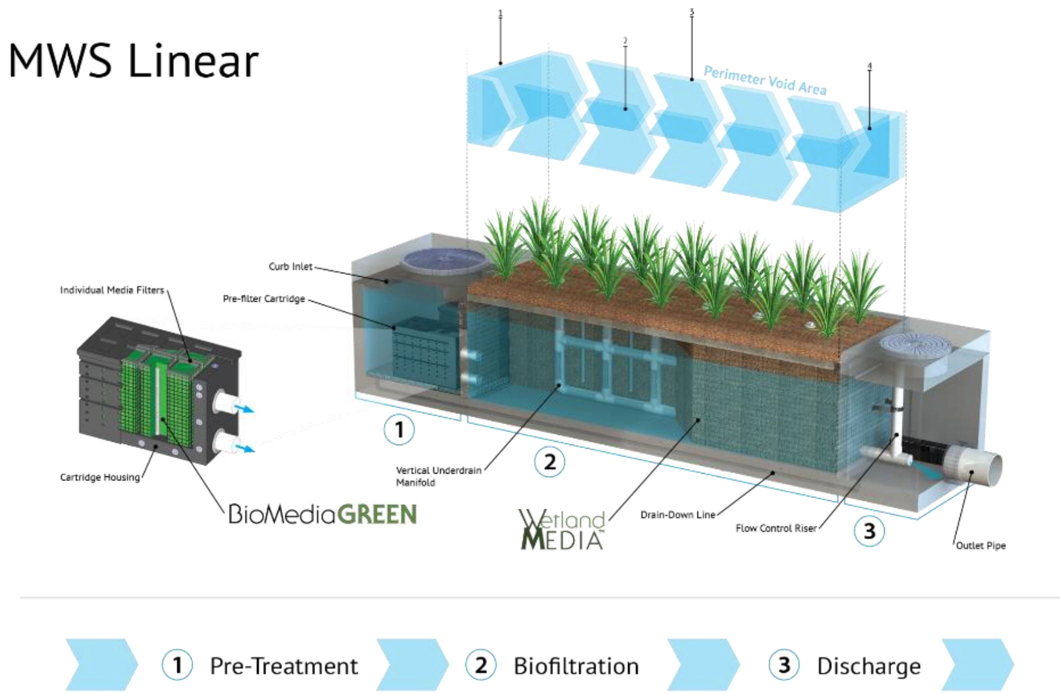
6. Biofiltration BMPs must be designed to prevent erosion, scour, and channeling within the BMP.

    a. The MWS Linear is a self-contained system with a pre-treatment chamber. Unlike other biofiltration BMPs erosion, scour, and channeling with in the BMP is not an issue. Following is a diagram of the BMP. The system pre-treatment chamber prevent any erosion or scour. The system downstream orifice control prevents channeling of the media:



7. Biofiltration BMP must include operations and maintenance design features and planning considerations to provide for continued effectiveness of pollutant and flow control functions.

    a. The MWS Linear provides activation along with the first year of maintenance and inspection free on all installation in the county of San Diego. Unlike other biofiltration BMPs the City and Co-permitees can be assured the system is being properly installed and maintained. The first year of inspections is used to gauge the amount of loading in the system and this information is used to set appropriate maintenance interval for subsequent years. Attached is a copy of the maintenance manual for the MWS Linear.

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Designed & Maintained Consistent with their Performance Certifications

We are in agreement that all BMPs should be designed in a manner consistent with the TAPE certification. The MWS Linear is sized in accordance with the TAPE GULD approval which provides certification at a loading rate of 1 gpm/sq ft (100 in/hr) for Basic, Phosphorus and Enhanced treatment. In addition, as stated previously, Modular Wetland System, Inc. provide activation of all system installed in San Diego County along with the first year of inspections and maintenance to ensure appropriate function. As previously stated, a copy of the TAPE GULD approval is attached to support this claim.

Additionally, it should be noted that the manual allows for biofiltration BMPs to be sized in either volume based (DCV) or flow based design. The manual states in section F.2.2 Sizing of Flow-Based Biofiltration *BMPs:*

> *"This sizing method is only available when the BMP meets the pollutant treatment performance standard in Appendix F.1."*
>
> *"Proprietary biofiltration BMPs are typically designed as a flow-based BMPs (i.e., a constant treatment capacity with negligible storage volume). Additionally, proprietary biofiltration is only acceptable if no infiltration is feasible and where site-specific documentation demonstrates that the use of larger footprint biofiltration BMPs would be infeasible. The applicable sizing method for biofiltration is therefore reduced to: Treat 1.5 times the DCV."*
>
> *"The following steps should be followed to demonstrate that the system is sized to treat 1.5 times the DCV."*
>
> *1. Calculate the flow rate required to meet the pollutant treatment performance standard without scaling for the 1.5 factor. Options include either:*
>
> - *Calculate the runoff flow rate from a 0.2 inch per hour uniform intensity precipitation event (See methodology Appendix B.6.3), or*
>
> - *Conduct a continuous simulation analysis to compute the size required to capture and treat 80 percent of average annual runoff; for small catchments, 5-minute precipitation data should be used to account for short time of concentration. Nearest rain gage with 5-minute precipitation data is allowed for this analysis.*

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2. Multiply the flow rate from Step 1 by 1.5 to compute the design flow rate for the biofiltration system.

3. Based on the conditions of certification/verification (discussed above), establish the design capacity, as a flow rate, of a given sized unit.

4. Demonstrates that an appropriate unit size and number of units is provided to provide a flow rate that meets the required flow rate from Step 2.

In conclusion, we have closely followed the process and protocol for showing the MWS Linear meets all the criteria to be accepted as Biofiltration as found in Appendix F.

If you have any questions please feel free to contact us directly.

Sincerely,

Zachariha J. Kent

Director of Engineering

Bio Clean Environmental Services, Inc.

WASHINGTON STATE DEPARTMENT OF ECOLOGY

April 2014

GENERAL USE LEVEL DESIGNATION FOR BASIC, ENHANCED, AND PHOSPHORUS TREATMENT

For the

MWS-Linear Modular Wetland

Ecology's Decision:

Based on Modular Wetland Systems, Inc. application submissions, including the Technical Evaluation Report, dated April 1, 2014, Ecology hereby issues the following use level designation:

1. General use level designation (GULD) for the MWS-Linear Modular Wetland Stormwater Treatment System for Basic treatment

   - Sized at a hydraulic loading rate of 1 gallon per minute (gpm) per square foot (sq ft) of wetland cell surface area. For moderate pollutant loading rates (low to medium density residential basins), size the Prefilters at 3.0 gpm/sq ft of cartridge surface area. For high loading rates (commercial and industrial basins), size the Prefilters at 2.1 gpm/sq ft of cartridge surface area.

2. General use level designation (GULD) for the MWS-Linear Modular Wetland Stormwater Treatment System for Phosphorus treatment

   - Sized at a hydraulic loading rate of 1 gallon per minute (gpm) per square foot (sq ft) of wetland cell surface area. For moderate pollutant loading rates (low to medium density residential basins), size the Prefilters at 3.0 gpm/sq ft of cartridge surface area. For high loading rates (commercial and industrial basins), size the Prefilters at 2.1 gpm/sq ft of cartridge surface area.

3. General use level designation (GULD) for the MWS-Linear Modular Wetland Stormwater Treatment System for Enhanced treatment

   - Sized at a hydraulic loading rate of 1 gallon per minute (gpm) per square foot (sq ft) of wetland cell surface area. For moderate pollutant loading rates (low to medium density residential basins), size the Prefilters at 3.0 gpm/sq ft of cartridge surface area. For high loading rates (commercial and industrial basins), size the Prefilters at 2.1 gpm/sq ft of cartridge surface area.

4. Ecology approves monitoring for the MWS - Linear Modular Wetland Stormwater Treatment System units for Basic, Phosphorus, and Enhanced treatment at the hydraulic

loading rate listed above. Designers shall calculate the water quality design flow rates using the following procedures:

- Western Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using the latest version of the Western Washington Hydrology Model or other Ecology-approved continuous runoff model.
- Eastern Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using one of the three methods described in Chapter 2.2.5 of the Stormwater Management Manual for Eastern Washington (SWMMEW) or local manual.
- Entire State: For treatment installed downstream of detention, the water quality design flow rate is the full 2-year release rate of the detention facility.

5. These use level designations have no expiration date but may be revoked or amended by Ecology, and are subject to the conditions specified below.

Ecology's Conditions of Use:

Applicants shall comply with the following conditions:

1. Design, assemble, install, operate, and maintain the MWS – Linear Modular Wetland Stormwater Treatment System units, in accordance with Modular Wetland Systems, Inc. applicable manuals and documents and the Ecology Decision.
2. Each site plan must undergo Modular Wetland Systems, Inc. review and approval before site installation. This ensures that site grading and slope are appropriate for use of a MWS – Linear Modular Wetland Stormwater Treatment System unit.
3. MWS – Linear Modular Wetland Stormwater Treatment System media shall conform to the specifications submitted to, and approved by, Ecology.
4. Maintenance: The required maintenance interval for stormwater treatment devices is often dependent upon the degree of pollutant loading from a particular drainage basin. Therefore, Ecology does not endorse or recommend a "one size fits all" maintenance cycle for a particular model/size of manufactured filter treatment device.

- Typically, Modular Wetland Systems, Inc. designs MWS - Linear Modular Wetland systems for a target prefilter media life of 6 to 12 months.
- Indications of the need for maintenance include effluent flow decreasing to below the design flow rate or decrease in treatment below required levels.
- Owners/operators must inspect MWS - Linear Modular Wetland systems for a minimum of twelve months from the start of post-construction operation to determine site-specific maintenance schedules and requirements. You must conduct inspections monthly during the wet season, and every other month during the dry season. (According to the SWMMWW, the wet season in western Washington is October 1 to April 30. According to SWMMEW, the wet season in eastern Washington is October 1 to June 30). After the first year of operation, owners/operators must conduct inspections based on the findings during the first year of inspections.

- Conduct inspections by qualified personnel, follow manufacturer's guidelines, and use methods capable of determining either a decrease in treated effluent flowrate and/or a decrease in pollutant removal ability.
- When inspections are performed, the following findings typically serve as maintenance triggers:
    - Standing water remains in the vault between rain events, or
    - Bypass occurs during storms smaller than the design storm.
    - If excessive floatables (trash and debris) are present (but no standing water or excessive sedimentation), perform a minor maintenance consisting of gross solids removal, not prefilter media replacement.
    - Additional data collection will be used to create a correlation between pretreatment chamber sediment depth and pre-filter clogging (see *Issues to be Addressed by the Company* section below)

6. Discharges from the MWS - Linear Modular Wetland Stormwater Treatment System units shall not cause or contribute to water quality standards violations in receiving waters.

Applicant: Modular Wetland Systems, Inc.
Applicant's Address: *PO. Box 869*
Oceanside, CA 92054

Application Documents:

- *Original Application for Conditional Use Level Designation*, Modular Wetland System, Linear Stormwater Filtration System Modular Wetland Systems, Inc., January 2011
- *Quality Assurance Project Plan*: Modular Wetland system – Linear Treatment System performance Monitoring Project, draft, January 2011.
- *Revised Application for Conditional Use Level Designation*, Modular Wetland System, Linear Stormwater Filtration System Modular Wetland Systems, Inc., May 2011
- *Memorandum: Modular Wetland System-Linear GULD Application Supplementary Data, April 2014*
- *Technical Evaluation Report: Modular Wetland System Stormwater Treatment System Performance Monitoring, April 2014.*

Applicant's Use Level Request:

General use level designation as a Basic, Enhanced, and Phosphorus treatment device in accordance with Ecology's Guidance for Evaluating Emerging Stormwater Treatment Technologies Technology Assessment Protocol – Ecology (TAPE) January 2011 Revision.

Applicant's Performance Claims:

- The MWS – Linear Modular wetland is capable of removing a minimum of 80-percent of TSS from stormwater with influent concentrations between 100 and 200 mg/l.

- The MWS – Linear Modular wetland is capable of removing a minimum of 50-percent of Total Phosphorus from stormwater with influent concentrations between 0.1 and 0.5 mg/l.
- The MWS – Linear Modular wetland is capable of removing a minimum of 30-percent of dissolved Copper from stormwater with influent concentrations between 0.005 and 0.020 mg/l.
- The MWS – Linear Modular wetland is capable of removing a minimum of 60-percent of dissolved Zinc from stormwater with influent concentrations between 0.02 and 0.30 mg/l.

Ecology Recommendations:

- Modular Wetland Systems, Inc. has shown Ecology, through laboratory and field-testing, that the MWS - Linear Modular Wetland Stormwater Treatment System filter system is capable of attaining Ecology's Basic, Total phosphorus, and Enhanced treatment goals.

Findings of Fact:

Laboratory Testing

The MWS-Linear Modular wetland has the:

- Capability to remove 99 percent of total suspended solids (using Sil-Co-Sil 106) in a quarter-scale model with influent concentrations of 270 mg/L.
- Capability to remove 91 percent of total suspended solids (using Sil-Co-Sil 106) in laboratory conditions with influent concentrations of 84.6 mg/L at a flow rate of 3.0 gpm per square foot of media.
- Capability to remove 93 percent of dissolved Copper in a quarter-scale model with influent concentrations of 0.757 mg/L.
- Capability to remove 79 percent of dissolved Copper in laboratory conditions with influent concentrations of 0.567 mg/L at a flow rate of 3.0 gpm per square foot of media.
- Capability to remove 80.5-percent of dissolved Zinc in a quarter-scale model with influent concentrations of 0.95 mg/L at a flow rate of 3.0 gpm per square foot of media.
- Capability to remove 78-percent of dissolved Zinc in laboratory conditions with influent concentrations of 0.75 mg/L at a flow rate of 3.0 gpm per square foot of media.

Field Testing

- Modular Wetland Systems, Inc. conducted monitoring of an MWS-Linear (Model # MWS-L-4-13) from April 2012 through May 2013, at a transportation maintenance facility in Portland, Oregon. The manufacturer collected flow-weighted composite samples of the system’s influent and effluent during 28 separate storm events. The system treated approximately 75 percent of the runoff from 53.5 inches of rainfall during the monitoring period. The applicant sized the system at 1 gpm/sq ft. (wetland media) and 3gpm/sq ft. (prefilter).

- Influent TSS concentrations for qualifying sampled storm events ranged from 20 to 339 mg/L. Average TSS removal for influent concentrations greater than 100 mg/L (n=7) averaged 85 percent. For influent concentrations in the range of 20-100 mg/L (n=18), the upper 95 percent confidence interval about the mean effluent concentration was 12.8 mg/L.
- Total phosphorus removal for 17 events with influent TP concentrations in the range of 0.1 to 0.5 mg/L averaged 65 percent. A bootstrap estimate of the lower 95 percent confidence limit (LCL95) of the mean total phosphorus reduction was 58 percent.
- The lower 95 percent confidence limit of the mean percent removal was 60.5 percent for dissolved zinc for influent concentrations in the range of 0.02 to 0.3 mg/L (n=11). The lower 95 percent confidence limit of the mean percent removal was 32.5 percent for dissolved copper for influent concentrations in the range of 0.005 to 0.02 mg/L (n=14) at flow rates up to 28 gpm (design flow rate 41 gpm). Laboratory test data augmented the data set, showing dissolved copper removal at the design flow rate of 41 gpm (93 percent reduction in influent dissolved copper of 0.757 mg/L).

Issues to be addressed by the Company:

1. Modular Wetland Systems, Inc. should collect maintenance and inspection data for the first year on all installations in the Northwest in order to assess standard maintenance requirements for various land uses in the region. Modular Wetland Systems, Inc. should use these data to establish required maintenance cycles.
2. Modular Wetland Systems, Inc. should collect pre-treatment chamber sediment depth data for the first year of operation for all installations in the Northwest. Modular Wetland Systems, Inc. will use these data to create a correlation between sediment depth and pre-filter clogging.

Technology Description:
Download at http://www.modularwetlands.com/

Contact Information:

Applicant: Greg Kent
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P.O. Box 869
Oceanside, CA 92054
gkent@biocleanenvironmental.net

Applicant website: http://www.modularwetlands.com/

Ecology web link: http://www.ecy.wa.gov/programs/wg/stormwater/newtech/index.html

Ecology: Douglas C. Howie, P.E.
Department of Ecology
Water Quality Program
(360) 407-6444
douglas.howie@ecy.wa.gov

Revision History

Date	Revision
June 2011	Original use-level-designation document
September 2012	Revised dates for TER and expiration
January 2013	Modified Design Storm Description, added Revision Table, added maintenance discussion, modified format in accordance with Ecology standard
December 2013	Updated name of Applicant
April 2014	Approved GULD designation for Basic, Phosphorus, and Enhanced treatment

TAPE PERFORMANCE SUMMARY

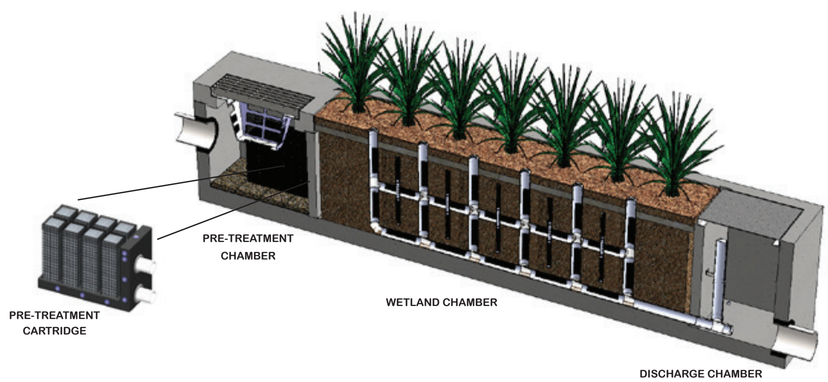
MWS-LINEAR 2.0

Application: Stand Alone Stormwater Treatment Best Management Practice
Type of Treatment: High Flow Rate Media Filtration and Biofiltration (dual-stage)

DESCRIPTION

Modular Wetland System Linear 2.0 (MWS-L 2.0) is an advanced dual-stage high flow rate media and biofiltration system for the treatment of urban stormwater runoff. Superior pollutant removal efficiencies are achieved by treating runoff through a pre-treatment chamber containing a screening device for trash and larger debris, a separation chamber for larger TSS and a series of media filter cartridges for removal of fine TSS and other particulate pollutants. Pre-treated runoff is transferred to the biofiltration chamber which contains an engineered ion exchange media designed to support an abundant plant and microbe community that captures, absorbs, transforms and uptakes pollutants through an array of physical, chemical, and biological mechanisms.

MWS-L 2.0 is a self-contained treatment train that is supplied to the job site completely assembled and ready for use. Once installed, stormwater runoff drains directly from impervious surfaces through an built-in curb inlet, drop in, or via pipe from upstream inlets or downspouts. Treated runoff is discharged from the system through an orifice control riser to assure the proper amount of flow is treated. The treated water leaving the system is connected to the storm drain system, infiltration basins, or to be re-used on site for irrigation or other uses.



TAPE PERFORMANCE

Modular Wetland System Linear 2.0 (MWS-L 2.0) completed its TAPE field testing in the spring of 2013. The Washington DOE has approved the system under the TAPE protocol. The MWS-Linear has met the performance benchmarks for the three major pollutant categories as defined by TAPE: Basic Treatment (TSS), Phosphorus and Enhanced (dissolved zinc and copper). It is the first system tested under the protocol to meet the benchmarks for all three categories.

Pollutant	Avg. Influent (mg/L)	Avg. Effluent (mg/L)	Removal Efficiency	Notes
Total Suspended Solids	75.0	15.7	85%	Summary of all data meeting TAPE parameters pertaining to this pollutant. Mean of 8 microns.
Total Phosphorus	0.227	0.074	64%	Summary of all data meeting TAPE parameters pertaining to this pollutant.
Ortho Phosphorus	0.093	0.031	67%	Summary of all data meeting TAPE parameters for total phosphorus.
Nitrogen	1.40	0.77	45%	Utilizing the Kjeldahl method (Total Kjeldahl nitrogen). Summary of all data during testing.
Dissolved Zinc	0.062	0.024	66%	Summary of all data meeting TAPE parameters pertaining to this pollutant.
Dissolved Copper	0.0086	0.0059	38%	Summary of all data meeting TAPE parameters pertaining to this pollutant.
Total Zinc	0.120	0.038	69%	Summary of all data during testing.
Total Copper	0.017	0.009	50%	Summary of all data during testing.
Motor Oil	24.157	1.133	95%	Summary of all data during testing.

NOTES:
1. The MWS-Linear was proven effective at infiltration rates of up to 121 in/hr.
2. A minimum of 10 aliquots were collected for each event.
3. Sampling was targeted to capture at least 75 percent of the hydrograph.

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PERFORMANCE SUMMARY

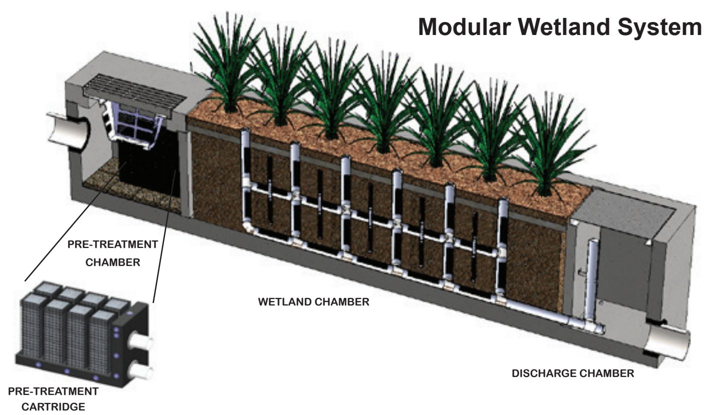
MWS-LINEAR 2.0

Application: Stand Alone Stormwater Treatment Best Management Practice
Type of Treatment: High Flow Rate Media Filtration and Biofiltration (dual-stage)

DESCRIPTION

Modular Wetland System Linear 2.0 (MWS-L 2.0) is an advanced dual-stage high flow rate media and biofiltration system for the treatment of urban stormwater runoff. Superior pollutant removal efficiencies are achieved by treating runoff through a pre-treatment chamber containing a screening device for trash and larger debris, a separation chamber for larger TSS and a series of media filter cartridges for removal of fine TSS and other particulate pollutants. Pre-treated runoff is transferred to the biofiltration chamber which contains an engineered ion exchange media designed to support an abundant plant and microbe community that captures, absorbs, transforms and uptakes pollutants through an array of physical, chemical, and biological mechanisms.

MWS-L 2.0 is a self-contained treatment train that is supplied to the job site completely assembled and ready for use. Once installed, stormwater runoff drains directly from impervious surfaces through an built-in curb inlet, drop in, or via pipe from upstream inlets or downspouts. Treated runoff is discharged from the system through an orifice control riser to assure the proper amount of flow is treated. The treated water leaving the system is connected to the storm drain system, infiltration basins, or to be re-used on site for irrigation or other uses.



Modular Wetland System Linear 2.0 (MWS-L 2.0) has been independently tested in laboratory and field conditions since 2008.

Oceanside Test Site

Portland Test Site

HEAVY METALS: Copper / Zinc

Description	Type	Avg. Influent (mg/L)	Avg. Effluent (mg/L)	Removal Efficiency	Notes
Waves Environmental - 1/4 Scale Lab Testing - 2007	Lab	.76 / .95	.06 / .19	92% / 80%	Majority Dissolved Fraction
City of Oceanside Boat Wash / Waves Environmental - 2008	Field	.04 / .24	< .02 / < .05	>50% / >79%	Effluent Concentrations Below Detectable Limits
Recycling Facility, Kileen, TX / CERL - 2011-2012	Field	.058 / .425	.032 / .061	44% / 86%	Test Unit 2
TAPE Field Testing / Portland, OR 2011/2012	Field	.017/ .120	.009 / .038	50% / 69%	Total Metals

TOTAL SUSPENDED SOLIDS:

Description	Type	Avg. Influent (mg/L)	Avg. Effluent (mg/L)	Removal Efficiency	Notes
Waves Environmental - 1/4 Scale Lab Testing - 2007	Lab	270	3	99%	Sil-co-sil 106 - 20 micron mean particle size
City of Oceanside Boat Wash / Waves Environmental - 2008	Field	45.67	8.24	82%	Mean Particle Size by Count < 8 Microns
Recycling Facility, Kileen, TX / CERL - 2011-2012	Field	676	39	94%	Test Unit 2
TAPE Field Testing / Portland, OR 2011/2012	Field	75.0	15.7	85%	Means particle size of 8 microns

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PERFORMANCE SUMMARY

MWS-LINEAR 2.0

PHOSPHORUS:

Description	Type	Avg. Influent (mg/L)	Avg. Effluent (mg/L)	Removal Efficiency	Notes
TAPE Field Testing / Portland, OR 2011/2012	Field	.227	.074	64%	TOTAL P
TAPE Field Testing / Portland, OR 2011/2012	Field	.093	.031	67%	ORTHO P

BACTERIA:

Description	Type	Avg. Influent (MPN)	Avg. Effluent (MPN)	Removal Efficiency	Notes
Waves Environmental - 1/4 Scale Lab Testing - 2007	Lab	1600 / 1600	535 / 637	67% / 60%	Fecal / E. Coli
City of Oceanside Boat Wash / Waves Environmental - 2008	Field	31666 / 6280	8667 / 1058	73% / 83%	Fecal / E. Coli

LEAD:

Description	Type	Avg. Influent (mg/L)	Avg. Effluent (mg/L)	Removal Efficiency	Notes
Waves Environmental - 1/4 Scale Lab Testing - 2007	Lab	.54	.10	82%	Total
Recycling Facility, Kileen, TX / CERL - 2011-2012	Field	.01 / .043	.004 / .014	60% / 68%	Both Test Units
TAPE Field Testing / Portland, OR 2011/2012	Field	.011	.003	70%	Total

All removal efficiencies and concentrations rounded up for easy viewing. Please call us for more information, including full copies of the reports reference above.

NITROGEN:

Description	Type	Avg. Influent (mg/L)	Avg. Effluent (mg/L)	Removal Efficiency	Notes
City of Oceanside Boat Wash / Waves Environmental - 2008	Field	.85	.21	75%	NITRATE
TAPE Field Testing / Portland, OR 2011/2012	Field	1.40	0.77	45%	TKN

HYDROCARBONS:

Description	Type	Avg. Influent (mg/L)	Avg. Effluent (mg/L)	Removal Efficiency	Notes
Waves Environmental - 1/4 Scale Lab Testing - 2007	Lab	10	1.625	84%	Oils & Grease
City of Oceanside Boat Wash / Waves Environmental - 2008	Field	.83	0	100%	TPH Motor Oil
TAPE Field Testing / Portland, OR 2011/2012	Field	24.157	1.133	95%	Motor Oil

TURBIDITY:

Description	Type	Avg. Influent (NTU)	Avg. Effluent (NTU)	Removal Efficiency	Notes
Waves Environmental - 1/4 Scale Lab Testing - 2007	Lab	21	1.575	93%	Field Measurement
City of Oceanside Boat Wash / Waves Environmental - 2008	Field	21	6	71%	Field Measurement

COD:

Description	Type	Avg. Influent (mg/L)	Avg. Effluent (mg/L)	Removal Efficiency	Notes
Recycling Facility, Kileen, TX / CERL - 2011-2012	Field	516 / 1450	90 / 356	83% / 75%	Both Test Units

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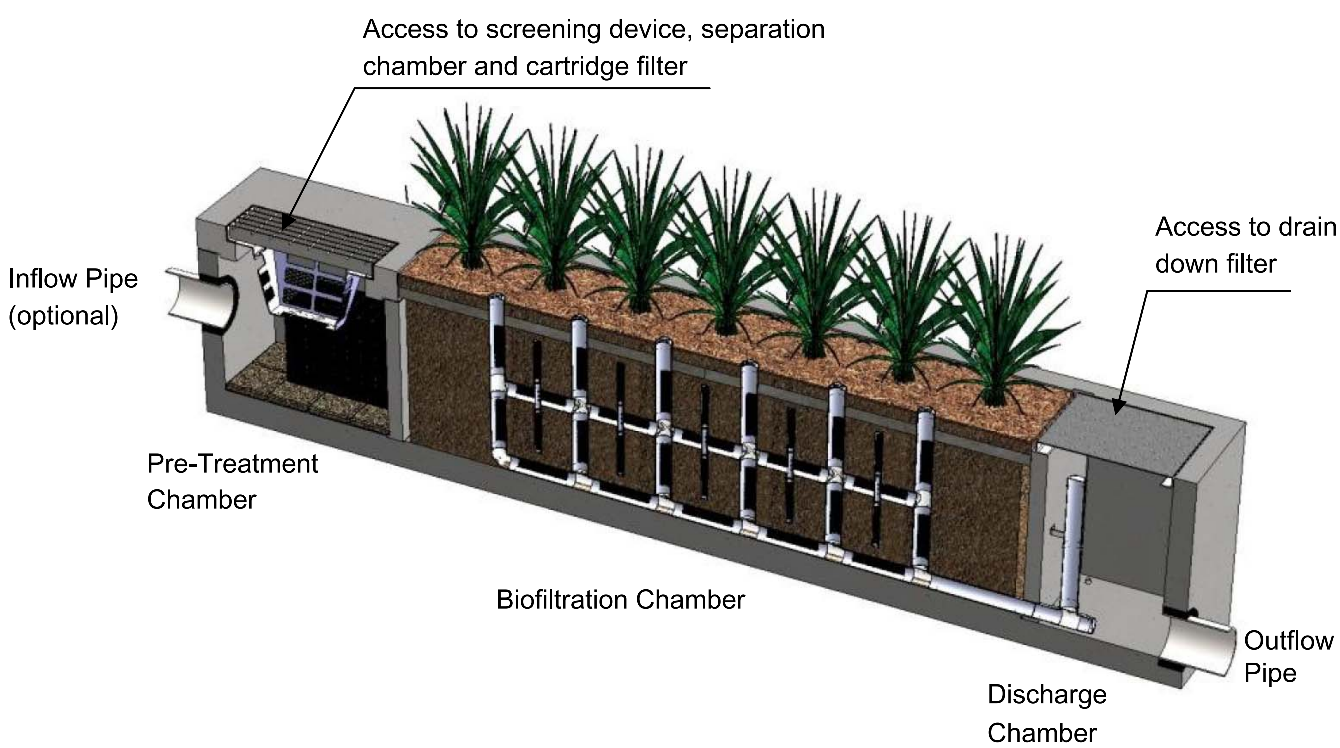
Maintenance Guidelines for Modular Wetland System - Linear

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.

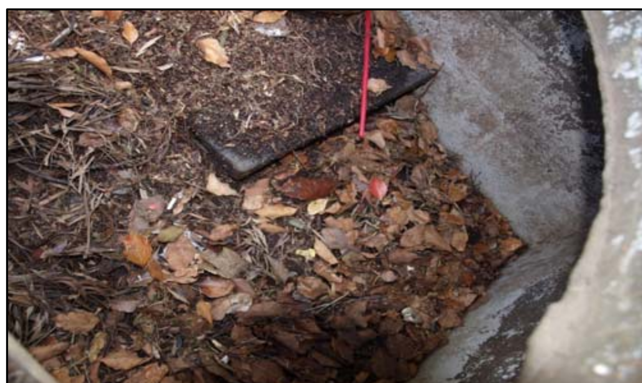
Maintenance Procedure Illustration

<u>**Screening Device**</u>

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.

<u>**Separation Chamber**</u>

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



Cartridge Filters

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

Drain Down Filter

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

Trim Vegetation

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

Inspection Form

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

www.modularwetlands.com

Inspection Report
Modular Wetlands System

Project Name ______________________________

Project Address ______________________________
(city) (Zip Code)

Owner / Management Company ______________________________

Contact ______________________ Phone ( ) –

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

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

Weather Condition ______________________ Additional Notes ______________________

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

Inspection Checklist

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

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

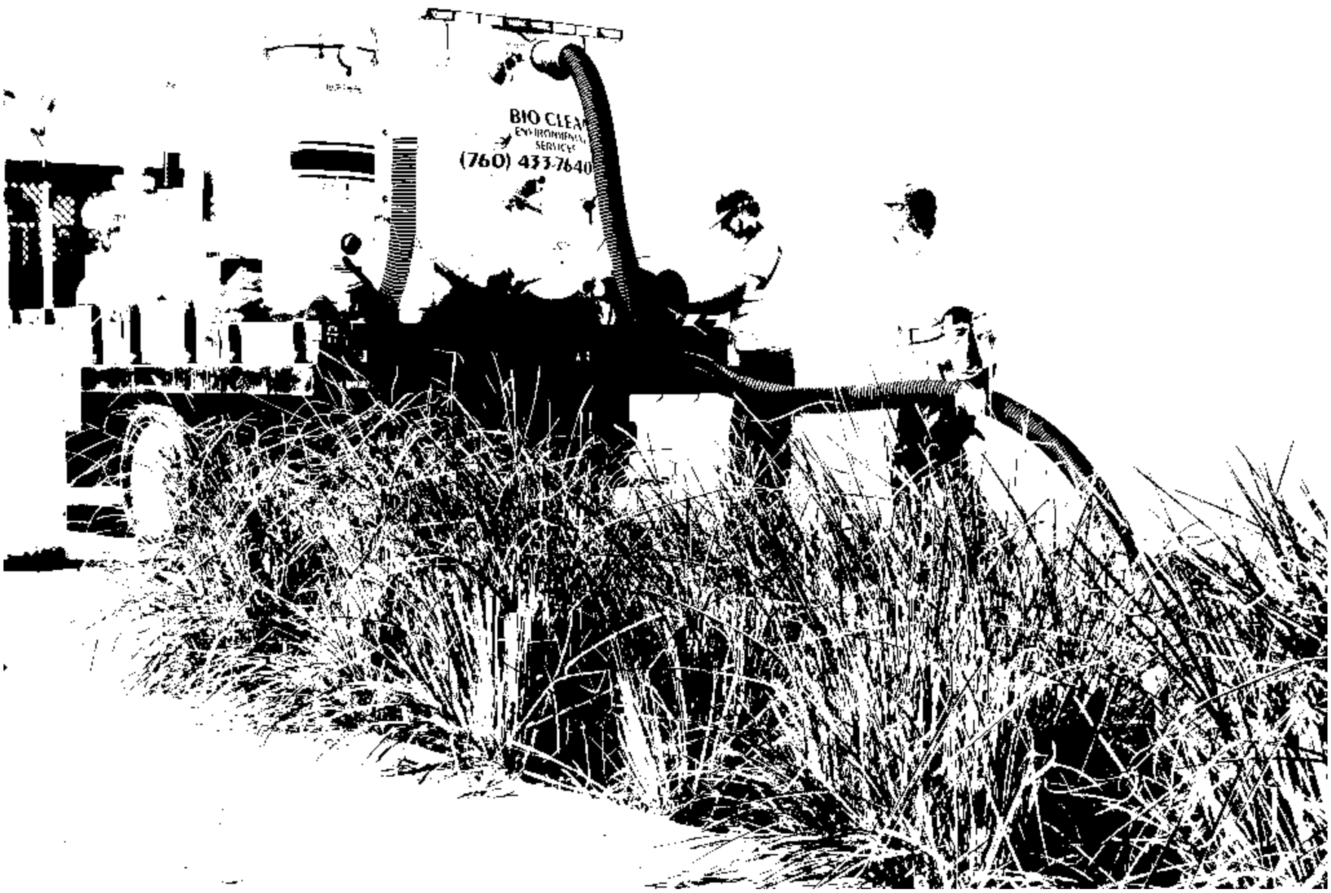
Waste:	Yes	No
Sediment / Silt / Clay		
Trash / Bags / Bottles		
Green Waste / Leaves / Foliage		

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

Plant Information	
Damage to Plants	
Plant Replacement	
Plant Trimming	

Additional Notes: ______________________________

Maintenance Report



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Cleaning and Maintenance Report
Modular Wetlands System

BIO CLEAN ENVIRONMENTAL SERVICES, INC.

MODULAR WETLANDS

Project Name ______	For Office Use Only
Project Address ______ (city) (Zip Code)	(Reviewed By)
Owner / Management Company ______	(Date) Office personnel to complete section to the left.

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:

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User Input
Regional Value
Cells updated automatically

Basin A

Simple Sizing Method for Biofiltration		
1 Remaining DCV after implementing retention BMPs	397	ft^3
Partial Retention		
2 Infiltration rate from Worksheet D.5-1 is partial infiltration is feasbile	0	in/hr
3 Allowable drawdown time for aggregate storage below underdrain	36	hours
4 Depth of runoff that can be infiltrated [Line 2 x Line 3]	0	inches
5 Aggregate pore space	0.4	in/in
6 Required depth of gravel below the underdrain [Line 4 / Line 5]	0	inches
7 Assumed surface area of the bioretention BMP	1,090	ft^2
8 Media retained pore space	0.1	in/in
9 Volume retained by BMP [[Line 4 + (Line 12 x Line 8)]/12] x Line 7	218	ft^3
10 DCV that requires biofiltration [Line 1 - Line 9]	179	ft^3
BMP Parameters		
11 Surface Ponding [6 inch minimum, 12 inch maximum]	12	inches
12 Media Thickness [18 inches minimum]	24	inches
13 Aggregate Storage above underdrain invert (12 inches typical): use 0 inches for sizing if the aggregate is not over the entire bottom surface area	12	inches
14 Media available pore space	0.2	in/in
15 Media filtration rate to be used for sizing	5	in/hr
Baseline Calculations		
16 Allowable Routing Time for sizing	6	hours
17 Depth filtered during storm [Line 15 x Line 16]	30	inches
18 Depth of Detention Storage [Line 11 + (Line 12 x Line 14) + (Line 13 x Line 5)]	22	inches
19 Total Depth Treated [Line 17 + Line 18]	52	inches
Option 1 - Biofilter 1.5 times the DCV		
20 Required biofiltered volume [1.5 x Line 10]	269	ft^3
21 Required Footprint [Line 20 / Line 19] x 12	63	ft^2
Option 2 - Store 0.75 of remaining DCV in pores and ponding		
22 Required Storage (surface + pores) Volume [0.75 x Line 10]	135	ft^3
23 Required Footprint [Line 22 / Line 18] x 12	75	ft^2
Footprint of the BMP		
24 Area draining to the BMP	16,000	ft^2
25 Adjusted Runoff Factor for drainage area (Refer to Appendix B.1 & B.2)	1	n/a
26 Minimum BMP Footprint [Line 24 x Line 25 x 0.03]	265	ft^2
27 Footprint of the BMP = Maximum(Minimum(Line 21, Line 23, Line 26)	265	ft^2

***Note** : Line 7 is used to estimate the amount of volume retained by the BMP. Update assumed surface area in Line 7 until it's equivalent to the required biofiltration footprint (either Line 21 or Line 23)*

Is BMP adequately sized **Yes**

User Input
Regional Value
Cells updated automatically

Basin B

Simple Sizing Method for Biofiltration

1	Remaining DCV after implementing retention BMPs	1,279	ft^3
Partial Retention			
2	Infiltration rate from Worksheet D.5-1 is partial infiltration is feasbile	0	in/hr
3	Allowable drawdown time for aggregate storage below underdrain	36	hours
4	Depth of runoff that can be infiltrated [Line 2 x Line 3]	0	inches
5	Aggregate pore space	0.4	in/in
6	Required depth of gravel below the underdrain [Line 4 / Line 5]	0	inches
7	Assumed surface area of the bioretention BMP	865	ft^2
8	Media retained pore space	0.1	in/in
9	Volume retained by BMP [[Line 4 + (Line 12 x Line 8)]/12] x Line 7	173	ft^3
10	DCV that requires biofiltration [Line 1 - Line 9]	1,106	ft^3
BMP Parameters			
11	Surface Ponding [6 inch minimum, 12 inch maximum]	12	inches
12	Media Thickness [18 inches minimum]	24	inches
13	Aggregate Storage above underdrain invert (12 inches typical): use 0 inches for sizing if the aggregate is not over the entire bottom surface area	12	inches
14	Media available pore space	0.2	in/in
15	Media filtration rate to be used for sizing	5	in/hr
Baseline Calculations			
16	Allowable Routing Time for sizing	6	hours
17	Depth filtered during storm [Line 15 x Line 16]	30	inches
18	Depth of Detention Storage [Line 11 + (Line 12 x Line 14) + (Line 13 x Line 5)]	22	inches
19	Total Depth Treated [Line 17 + Line 18]	52	inches
Option 1 - Biofilter 1.5 times the DCV			
20	Required biofiltered volume [1.5 x Line 10]	1,659	ft^3
21	Required Footprint [Line 20 / Line 19] x 12	386	ft^2
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
22	Required Storage (surface + pores) Volume [0.75 x Line 10]	830	ft^3
23	Required Footprint [Line 22 / Line 18] x 12	461	ft^2
Footprint of the BMP			
24	Area draining to the BMP	34,020	ft^2
25	Adjusted Runoff Factor for drainage area (Refer to Appendix B.1 & B.2)	0.84	n/a
26	Minimum BMP Footprint [Line 24 x Line 25 x 0.03]	853	ft^2
27	Footprint of the BMP = Maximum(Minimum(Line 21, Line 23, Line 26)	853	ft^2

***Note** : Line 7 is used to estimate the amount of volume retained by the BMP. Update assumed surface area in Line 7 until it's equivalent to the required biofiltration footprint (either Line 21 or Line 23)*

Is BMP adequately sized **Yes**

User Input
Regional Value
Cells updated automatically

Basin C

Simple Sizing Method for Biofiltration

1	Remaining DCV after implementing retention BMPs	379	ft^3
Partial Retention			
2	Infiltration rate from Worksheet D.5-1 is partial infiltration is feasbile	0	in/hr
3	Allowable drawdown time for aggregate storage below underdrain	36	hours
4	Depth of runoff that can be infiltrated [Line 2 x Line 3]	0	inches
5	Aggregate pore space	0.4	in/in
6	Required depth of gravel below the underdrain [Line 4 / Line 5]	0	inches
7	Assumed surface area of the bioretention BMP	520	ft^2
8	Media retained pore space	0.1	in/in
9	Volume retained by BMP [[Line 4 + (Line 12 x Line 8)]/12] x Line 7	104	ft^3
10	DCV that requires biofiltration [Line 1 - Line 9]	275	ft^3
BMP Parameters			
11	Surface Ponding [6 inch minimum, 12 inch maximum]	12	inches
12	Media Thickness [18 inches minimum]	24	inches
13	Aggregate Storage above underdrain invert (12 inches typical): use 0 inches for sizing if the aggregate is not over the entire bottom surface area	12	inches
14	Media available pore space	0.2	in/in
15	Media filtration rate to be used for sizing	5	in/hr
Baseline Calculations			
16	Allowable Routing Time for sizing	6	hours
17	Depth filtered during storm [Line 15 x Line 16]	30	inches
18	Depth of Detention Storage [Line 11 + (Line 12 x Line 14) + (Line 13 x Line 5)]	22	inches
19	Total Depth Treated [Line 17 + Line 18]	52	inches
Option 1 - Biofilter 1.5 times the DCV			
20	Required biofiltered volume [1.5 x Line 10]	412	ft^3
21	Required Footprint [Line 20 / Line 19] x 12	96	ft^2
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
22	Required Storage (surface + pores) Volume [0.75 x Line 10]	206	ft^3
23	Required Footprint [Line 22 / Line 18] x 12	114	ft^2
Footprint of the BMP			
24	Area draining to the BMP	10,900	ft^2
25	Adjusted Runoff Factor for drainage area (Refer to Appendix B.1 & B.2)	1	n/a
26	Minimum BMP Footprint [Line 24 x Line 25 x 0.03]	252	ft^2
27	Footprint of the BMP = Maximum(Minimum(Line 21, Line 23, Line 26)	252	ft^2

***Note** : Line 7 is used to estimate the amount of volume retained by the BMP. Update assumed surface area in Line 7 until it's equivalent to the required biofiltration footprint (either Line 21 or Line 23)*

Is BMP adequately sized **Yes**

Surface Type	Runoff Factor	Surface Area	Factored Area
Roofs	0.9	1.1753	1.05777
Concrete or Asphalt	0.9		0
Unit Pavers (Grouted)	0.9		0
Decomposed Granite	0.3		0
Cobbles or Crushed Aggregate	0.3		0
Amended, Mulched Soils or Landscape	0.1	0.0047	0.00047
Compacted Soils	0.3		0

Total Factored Area		1.05824
Total Area	51400.8	1.18
Factored 'C' VaLue	0.896814	0.896814

Design Capture Volume — Worksheet B-2.1

1	85th Percentile 24-hr storm depth from Figure B.1-1	1.1753	0.54	inches
2	Areas tributary to BMP(s)	A=	51400.8	acres
3	Area weighted runoff factor (estimated using Appendix B.1.1 and B.2.1)	C=	0.896814	unitless
4	Street Trees Reduction Volume	TCV=		cubic-feet
5	Rain Barrels Reduction Volume	RCV=		cubic-feet
6	Calculated DCV	0.0047	2074.362	cubic-feet
		1.5*DCV=	3111.543	

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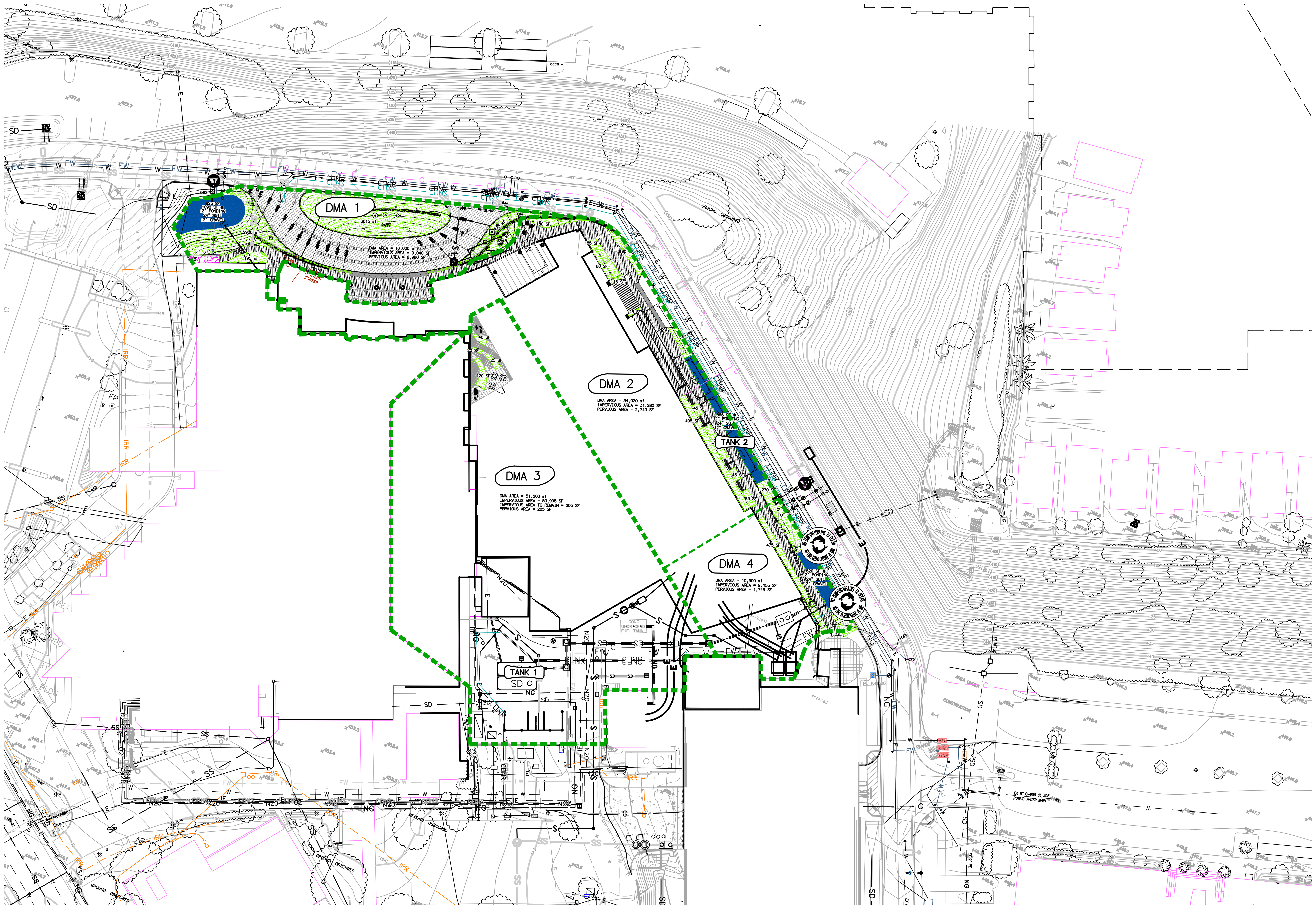
Indicate which Items are Included behind this cover sheet:

Attachment Sequence	Contents	Checklist
Attachment 1a	DMA Exhibit (Required) See DMA Exhibit Checklist on the back of this Attachment cover sheet.	☐ 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	Form I-8, Categorization of Infiltration Feasibility Condition (Required unless the project will use harvest and use BMPs) Refer to Appendices C and D of the BMP Design Manual to complete Form I-8.	☐ 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

ATTACHMENT 2

BACKUP FOR PDP HYDROMODIFICATION CONTROL MEASURES

This is the cover sheet for Attachment 2.



LEGEND

BASIN BOUNDARY

STORM DRAIN STENCILING

POINT OF COMPLIANCE

PERVIOUS AREA

BIORETENTION BASIN

NOTE:
ALL SOILS URBAN LANDS SOIL TYPE "D"

GROUNDWATER DEPTH > 50FT

SCALE: 1"=40'

HYDROMODIFICATION SUMMARY	
TANK-ID	SIZE
1	1800 SF, 6 FT DEPTH
2	1030 SF, 6 FT DEPTH

SHARP MEDICAL CENTER CHULA VISTA, CA HYDROMODIFICATION EXHIBIT

04 / 20 / 16

Michael Baker INTERNATIONAL
9755 Clairemont Mesa Boulevard
San Diego, CA 92124
Phone: (858) 614-5000 · MBAKERINTL.COM

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SDHM

PROJECT REPORT

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

The DMA 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 and impervious areas
- ☐ Existing and proposed site drainage network and connections to drainage offsite
- ☐ Proposed demolition
- ☐ 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)

General Model Information

Project Name:	Sharp Chula2
Site Name:	Sharp Chula Vista
Site Address:	3rd Avenue
City:	Chula Vista Ca
Report Date:	4/18/2016
Gage:	LINDBERG
Data Start:	10/01/1959
Data End:	09/30/2004
Timestep:	Hourly
Precip Scale:	1.00
Version Date:	2015/12/15

POC Thresholds

Low Flow Threshold for POC1:	10 Percent of the 2 Year
High Flow Threshold for POC1:	10 Year
Low Flow Threshold for POC2:	10 Percent of the 2 Year
High Flow Threshold for POC2:	10 Year

Landuse Basin Data
Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
D,Grass,STEEP(10-20	0.367
Pervious Total	0.367
Impervious Land Use	acre
IMPERVIOUS-FLAT	0.005
Impervious Total	0.005
Basin Total	0.372

Element Flows To:

Surface	Interflow	Groundwater

Basin 2

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
D,Grass,FLAT(0-5%)	1.947
Pervious Total	1.947
Impervious Land Use	acre
IMPERVIOUS-FLAT	0.344
Impervious Total	0.344
Basin Total	2.291

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
D,Grass,FLAT(0-5%)	0.16
Pervious Total	0.16
Impervious Land Use	acre
IMPERVIOUS-FLAT	0.208
Impervious Total	0.208
Basin Total	0.368

Element Flows To:

Surface	Interflow	Groundwater
Surface Basin A	Surface Basin A	

Basin 2

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
D,Grass,FLAT(0-5%)	0.063
Pervious Total	0.063
Impervious Land Use	acre
IMPERVIOUS-FLAT	0.718
Impervious Total	0.718
Basin Total	0.781

Element Flows To:

Surface	Interflow	Groundwater
Surface Basin B	Surface Basin B	

Basin 3

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
D,Grass,FLAT(0-5%)	0.05
Pervious Total	0.05
Impervious Land Use	acre
IMPERVIOUS-FLAT	1.17
Impervious Total	1.17
Basin Total	1.22

Element Flows To:

Surface	Interflow	Groundwater
Vault 2	Vault 2	

Basin 4

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
D,Grass,FLAT(0-5%)	0.04
Pervious Total	0.04
Impervious Land Use	acre
IMPERVIOUS-FLAT	0.25
Impervious Total	0.25
Basin Total	0.29

Element Flows To:

Surface	Interflow	Groundwater
Surface Basin C	Surface Basin C	

Mitigated Routing

Basin B

Bottom Length:	86.50 ft.
Bottom Width:	10.00 ft.
Material thickness of first layer:	1
Material type for first layer:	Amended 5 in/hr
Material thickness of second layer:	2
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (feet):	0.5
Orifice Diameter (in.):	0.44
Offset (in.):	0
Flow Through Underdrain (ac-ft.):	14.657
Total Outflow (ac-ft.):	19.684
Percent Through Underdrain:	74.46

Discharge Structure
Riser Height: 1 ft.
Riser Diameter: 12 in.
Element Flows To:
Outlet 1 Outlet 2
Vault 3

Landscape Swale Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0199	0.0000	0.0000	0.0000
0.0549	0.0199	0.0005	0.0000	0.0000
0.1099	0.0199	0.0009	0.0000	0.0000
0.1648	0.0199	0.0014	0.0001	0.0000
0.2198	0.0199	0.0018	0.0005	0.0000
0.2747	0.0199	0.0023	0.0012	0.0000
0.3297	0.0199	0.0027	0.0015	0.0000
0.3846	0.0199	0.0032	0.0018	0.0000
0.4396	0.0199	0.0037	0.0020	0.0000
0.4945	0.0199	0.0041	0.0022	0.0000
0.5495	0.0199	0.0046	0.0023	0.0000
0.6044	0.0199	0.0050	0.0025	0.0000
0.6593	0.0199	0.0055	0.0026	0.0000
0.7143	0.0199	0.0060	0.0028	0.0000
0.7692	0.0199	0.0064	0.0029	0.0000
0.8242	0.0199	0.0069	0.0030	0.0000
0.8791	0.0199	0.0073	0.0032	0.0000
0.9341	0.0199	0.0078	0.0033	0.0000
0.9890	0.0199	0.0082	0.0034	0.0000
1.0440	0.0199	0.0087	0.0035	0.0000
1.0989	0.0199	0.0092	0.0036	0.0000
1.1538	0.0199	0.0096	0.0037	0.0000
1.2088	0.0199	0.0101	0.0038	0.0000
1.2637	0.0199	0.0105	0.0039	0.0000
1.3187	0.0199	0.0110	0.0040	0.0000
1.3736	0.0199	0.0114	0.0041	0.0000
1.4286	0.0199	0.0119	0.0042	0.0000
1.4835	0.0199	0.0123	0.0043	0.0000
1.5385	0.0199	0.0128	0.0044	0.0000

1.5934	0.0199	0.0132	0.0045	0.0000
1.6484	0.0199	0.0137	0.0046	0.0000
1.7033	0.0199	0.0141	0.0046	0.0000
1.7582	0.0199	0.0146	0.0047	0.0000
1.8132	0.0199	0.0150	0.0048	0.0000
1.8681	0.0199	0.0155	0.0049	0.0000
1.9231	0.0199	0.0159	0.0050	0.0000
1.9780	0.0199	0.0164	0.0052	0.0000
2.0330	0.0199	0.0169	0.0053	0.0000
2.0879	0.0199	0.0173	0.0054	0.0000
2.1429	0.0199	0.0178	0.0056	0.0000
2.1978	0.0199	0.0182	0.0057	0.0000
2.2527	0.0199	0.0187	0.0059	0.0000
2.3077	0.0199	0.0191	0.0060	0.0000
2.3626	0.0199	0.0196	0.0061	0.0000
2.4176	0.0199	0.0200	0.0062	0.0000
2.4725	0.0199	0.0205	0.0064	0.0000
2.5275	0.0199	0.0209	0.0065	0.0000
2.5824	0.0199	0.0214	0.0066	0.0000
2.6374	0.0199	0.0218	0.0067	0.0000
2.6923	0.0199	0.0223	0.0068	0.0000
2.7473	0.0199	0.0227	0.0069	0.0000
2.8022	0.0199	0.0232	0.0070	0.0000
2.8571	0.0199	0.0236	0.0072	0.0000
2.9121	0.0199	0.0241	0.0073	0.0000
2.9670	0.0199	0.0245	0.0074	0.0000
3.0000	0.0199	0.0248	0.0075	0.0000

Landscape Swale Hydraulic Table

Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**To Amended(cfs)**	**Infilt(cfs)**
3.0000	0.0199	0.0248	0.0000	0.1081	0.0000
3.0549	0.0199	0.0259	0.0000	0.1081	0.0000
3.1099	0.0199	0.0270	0.0000	0.1137	0.0000
3.1648	0.0199	0.0281	0.0000	0.1194	0.0000
3.2198	0.0199	0.0292	0.0000	0.1250	0.0000
3.2747	0.0199	0.0303	0.0000	0.1306	0.0000
3.3297	0.0199	0.0314	0.0000	0.1363	0.0000
3.3846	0.0199	0.0325	0.0000	0.1419	0.0000
3.4396	0.0199	0.0335	0.0000	0.1475	0.0000
3.4945	0.0199	0.0346	0.0000	0.1532	0.0000
3.5495	0.0199	0.0357	0.0000	0.1588	0.0000
3.6044	0.0199	0.0368	0.0000	0.1644	0.0000
3.6593	0.0199	0.0379	0.0000	0.1701	0.0000
3.7143	0.0199	0.0390	0.0000	0.1757	0.0000
3.7692	0.0199	0.0401	0.0000	0.1813	0.0000
3.8242	0.0199	0.0412	0.0000	0.1869	0.0000
3.8791	0.0199	0.0423	0.0000	0.1926	0.0000
3.9341	0.0199	0.0434	0.0000	0.1982	0.0000
3.9890	0.0199	0.0445	0.0000	0.2038	0.0000
4.0440	0.0199	0.0456	0.0977	0.2095	0.0000
4.0989	0.0199	0.0466	0.3281	0.2151	0.0000
4.1538	0.0199	0.0477	0.6273	0.2207	0.0000
4.2088	0.0199	0.0488	0.9624	0.2264	0.0000
4.2637	0.0199	0.0499	1.3006	0.2320	0.0000
4.3187	0.0199	0.0510	1.6096	0.2376	0.0000
4.3736	0.0199	0.0521	1.8629	0.2433	0.0000
4.4286	0.0199	0.0532	2.0472	0.2489	0.0000
4.4835	0.0199	0.0543	2.1721	0.2545	0.0000

4.5385	0.0199	0.0554	2.3112	0.2601	0.0000
4.5934	0.0199	0.0565	2.4263	0.2658	0.0000
4.6484	0.0199	0.0576	2.5361	0.2714	0.0000
4.7033	0.0199	0.0586	2.6414	0.2770	0.0000
4.7582	0.0199	0.0597	2.7426	0.2827	0.0000
4.8132	0.0199	0.0608	2.8402	0.2883	0.0000
4.8681	0.0199	0.0619	2.9346	0.2939	0.0000
4.9231	0.0199	0.0630	3.0261	0.2996	0.0000
4.9780	0.0199	0.0641	3.1148	0.3052	0.0000
5.0000	0.0199	0.0645	3.2011	0.3074	0.0000

Surface Basin B

Element Flows To:

Outlet 1	Outlet 2
Vault 3	Basin B

Basin C

Bottom Length: 52.00 ft.
Bottom Width: 10.00 ft.
Material thickness of first layer: 1
Material type for first layer: Amended 5 in/hr
Material thickness of second layer: 2
Material type for second layer: GRAVEL
Material thickness of third layer: 0
Material type for third layer: GRAVEL
Underdrain used
Underdrain Diameter (feet): 0.5
Orifice Diameter (in.): 0.44
Offset (in.): 0
Flow Through Underdrain (ac-ft.): 6.537
Total Outflow (ac-ft.): 6.878
Percent Through Underdrain: 95.04
Discharge Structure
Riser Height: 1 ft.
Riser Diameter: 12 in.
Element Flows To:
Outlet 1 Outlet 2
Vault 3

Landscape Swale Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0119	0.0000	0.0000	0.0000
0.0549	0.0119	0.0003	0.0000	0.0000
0.1099	0.0119	0.0006	0.0000	0.0000
0.1648	0.0119	0.0008	0.0001	0.0000
0.2198	0.0119	0.0011	0.0003	0.0000
0.2747	0.0119	0.0014	0.0008	0.0000
0.3297	0.0119	0.0017	0.0012	0.0000
0.3846	0.0119	0.0019	0.0015	0.0000
0.4396	0.0119	0.0022	0.0018	0.0000
0.4945	0.0119	0.0025	0.0020	0.0000
0.5495	0.0119	0.0028	0.0022	0.0000
0.6044	0.0119	0.0030	0.0023	0.0000
0.6593	0.0119	0.0033	0.0025	0.0000
0.7143	0.0119	0.0036	0.0026	0.0000
0.7692	0.0119	0.0039	0.0028	0.0000
0.8242	0.0119	0.0041	0.0029	0.0000
0.8791	0.0119	0.0044	0.0030	0.0000
0.9341	0.0119	0.0047	0.0032	0.0000
0.9890	0.0119	0.0050	0.0033	0.0000
1.0440	0.0119	0.0052	0.0034	0.0000
1.0989	0.0119	0.0055	0.0035	0.0000
1.1538	0.0119	0.0058	0.0036	0.0000
1.2088	0.0119	0.0060	0.0037	0.0000
1.2637	0.0119	0.0063	0.0038	0.0000
1.3187	0.0119	0.0066	0.0039	0.0000
1.3736	0.0119	0.0069	0.0040	0.0000
1.4286	0.0119	0.0071	0.0041	0.0000
1.4835	0.0119	0.0074	0.0042	0.0000
1.5385	0.0119	0.0077	0.0043	0.0000
1.5934	0.0119	0.0080	0.0044	0.0000
1.6484	0.0119	0.0082	0.0045	0.0000

1.7033	0.0119	0.0085	0.0046	0.0000
1.7582	0.0119	0.0088	0.0046	0.0000
1.8132	0.0119	0.0090	0.0047	0.0000
1.8681	0.0119	0.0093	0.0049	0.0000
1.9231	0.0119	0.0096	0.0050	0.0000
1.9780	0.0119	0.0099	0.0052	0.0000
2.0330	0.0119	0.0101	0.0053	0.0000
2.0879	0.0119	0.0104	0.0054	0.0000
2.1429	0.0119	0.0107	0.0056	0.0000
2.1978	0.0119	0.0109	0.0057	0.0000
2.2527	0.0119	0.0112	0.0059	0.0000
2.3077	0.0119	0.0115	0.0060	0.0000
2.3626	0.0119	0.0118	0.0061	0.0000
2.4176	0.0119	0.0120	0.0062	0.0000
2.4725	0.0119	0.0123	0.0064	0.0000
2.5275	0.0119	0.0126	0.0065	0.0000
2.5824	0.0119	0.0129	0.0066	0.0000
2.6374	0.0119	0.0131	0.0067	0.0000
2.6923	0.0119	0.0134	0.0068	0.0000
2.7473	0.0119	0.0137	0.0069	0.0000
2.8022	0.0119	0.0139	0.0070	0.0000
2.8571	0.0119	0.0142	0.0072	0.0000
2.9121	0.0119	0.0145	0.0073	0.0000
2.9670	0.0119	0.0148	0.0074	0.0000
3.0000	0.0119	0.0149	0.0075	0.0000

Landscape Swale Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
3.0000	0.0119	0.0149	0.0000	0.0650	0.0000
3.0549	0.0119	0.0156	0.0000	0.0650	0.0000
3.1099	0.0119	0.0162	0.0000	0.0684	0.0000
3.1648	0.0119	0.0169	0.0000	0.0718	0.0000
3.2198	0.0119	0.0175	0.0000	0.0751	0.0000
3.2747	0.0119	0.0182	0.0000	0.0785	0.0000
3.3297	0.0119	0.0189	0.0000	0.0819	0.0000
3.3846	0.0119	0.0195	0.0000	0.0853	0.0000
3.4396	0.0119	0.0202	0.0000	0.0887	0.0000
3.4945	0.0119	0.0208	0.0000	0.0921	0.0000
3.5495	0.0119	0.0215	0.0000	0.0955	0.0000
3.6044	0.0119	0.0221	0.0000	0.0988	0.0000
3.6593	0.0119	0.0228	0.0000	0.1022	0.0000
3.7143	0.0119	0.0234	0.0000	0.1056	0.0000
3.7692	0.0119	0.0241	0.0000	0.1090	0.0000
3.8242	0.0119	0.0248	0.0000	0.1124	0.0000
3.8791	0.0119	0.0254	0.0000	0.1158	0.0000
3.9341	0.0119	0.0261	0.0000	0.1192	0.0000
3.9890	0.0119	0.0267	0.0000	0.1225	0.0000
4.0440	0.0119	0.0274	0.0977	0.1259	0.0000
4.0989	0.0119	0.0280	0.3281	0.1293	0.0000
4.1538	0.0119	0.0287	0.6273	0.1327	0.0000
4.2088	0.0119	0.0294	0.9624	0.1361	0.0000
4.2637	0.0119	0.0300	1.3006	0.1395	0.0000
4.3187	0.0119	0.0307	1.6096	0.1428	0.0000
4.3736	0.0119	0.0313	1.8629	0.1462	0.0000
4.4286	0.0119	0.0320	2.0472	0.1496	0.0000
4.4835	0.0119	0.0326	2.1721	0.1530	0.0000
4.5385	0.0119	0.0333	2.3112	0.1564	0.0000
4.5934	0.0119	0.0339	2.4263	0.1598	0.0000

4.6484	0.0119	0.0346	2.5361	0.1632	0.0000
4.7033	0.0119	0.0353	2.6414	0.1665	0.0000
4.7582	0.0119	0.0359	2.7426	0.1699	0.0000
4.8132	0.0119	0.0366	2.8402	0.1733	0.0000
4.8681	0.0119	0.0372	2.9346	0.1767	0.0000
4.9231	0.0119	0.0379	3.0261	0.1801	0.0000
4.9780	0.0119	0.0385	3.1148	0.1835	0.0000
5.0000	0.0119	0.0388	3.2011	0.1848	0.0000

Surface Basin C

Element Flows To:

Outlet 1	Outlet 2
Vault 3	Basin C

Basin A

Bottom Length:	33.00 ft.
Bottom Width:	33.00 ft.
Material thickness of first layer:	2
Material type for first layer:	Amended 5 in/hr
Material thickness of second layer:	3
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (feet):	0.5
Orifice Diameter (in.):	0.2
Offset (in.):	0
Flow Through Underdrain (ac-ft.):	5.563
Total Outflow (ac-ft.):	5.704
Percent Through Underdrain:	97.54

Discharge Structure

Riser Height: 1 ft.

Riser Diameter: 12 in.

Element Flows To:

Outlet 1 Outlet 2

Landscape Swale Hydraulic Table

Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
0.0000	0.0250	0.0000	0.0000	0.0000
0.0769	0.0250	0.0008	0.0000	0.0000
0.1538	0.0250	0.0016	0.0001	0.0000
0.2308	0.0250	0.0024	0.0001	0.0000
0.3077	0.0250	0.0032	0.0003	0.0000
0.3846	0.0250	0.0040	0.0003	0.0000
0.4615	0.0250	0.0048	0.0004	0.0000
0.5385	0.0250	0.0057	0.0005	0.0000
0.6154	0.0250	0.0065	0.0005	0.0000
0.6923	0.0250	0.0073	0.0005	0.0000
0.7692	0.0250	0.0081	0.0006	0.0000
0.8462	0.0250	0.0089	0.0006	0.0000
0.9231	0.0250	0.0097	0.0007	0.0000
1.0000	0.0250	0.0105	0.0007	0.0000
1.0769	0.0250	0.0113	0.0007	0.0000
1.1538	0.0250	0.0121	0.0008	0.0000
1.2308	0.0250	0.0129	0.0008	0.0000
1.3077	0.0250	0.0137	0.0008	0.0000
1.3846	0.0250	0.0145	0.0008	0.0000
1.4615	0.0250	0.0153	0.0009	0.0000
1.5385	0.0250	0.0162	0.0009	0.0000
1.6154	0.0250	0.0170	0.0009	0.0000
1.6923	0.0250	0.0178	0.0009	0.0000
1.7692	0.0250	0.0186	0.0010	0.0000
1.8462	0.0250	0.0194	0.0010	0.0000
1.9231	0.0250	0.0202	0.0010	0.0000
2.0000	0.0250	0.0210	0.0010	0.0000
2.0769	0.0250	0.0218	0.0011	0.0000
2.1538	0.0250	0.0226	0.0011	0.0000
2.2308	0.0250	0.0234	0.0011	0.0000
2.3077	0.0250	0.0242	0.0011	0.0000

2.3846	0.0250	0.0250	0.0011	0.0000
2.4615	0.0250	0.0258	0.0012	0.0000
2.5385	0.0250	0.0266	0.0012	0.0000
2.6154	0.0250	0.0274	0.0012	0.0000
2.6923	0.0250	0.0282	0.0012	0.0000
2.7692	0.0250	0.0290	0.0012	0.0000
2.8462	0.0250	0.0298	0.0013	0.0000
2.9231	0.0250	0.0306	0.0013	0.0000
3.0000	0.0250	0.0314	0.0013	0.0000
3.0769	0.0250	0.0322	0.0013	0.0000
3.1538	0.0250	0.0330	0.0013	0.0000
3.2308	0.0250	0.0338	0.0013	0.0000
3.3077	0.0250	0.0346	0.0014	0.0000
3.3846	0.0250	0.0354	0.0014	0.0000
3.4615	0.0250	0.0362	0.0014	0.0000
3.5385	0.0250	0.0370	0.0014	0.0000
3.6154	0.0250	0.0378	0.0014	0.0000
3.6923	0.0250	0.0386	0.0014	0.0000
3.7692	0.0250	0.0394	0.0015	0.0000
3.8462	0.0250	0.0402	0.0015	0.0000
3.9231	0.0250	0.0410	0.0015	0.0000
4.0000	0.0250	0.0418	0.0015	0.0000
4.0769	0.0250	0.0425	0.0016	0.0000
4.1538	0.0250	0.0433	0.0016	0.0000
4.2308	0.0250	0.0441	0.0016	0.0000
4.3077	0.0250	0.0449	0.0016	0.0000
4.3846	0.0250	0.0457	0.0017	0.0000
4.4615	0.0250	0.0465	0.0017	0.0000
4.5385	0.0250	0.0473	0.0017	0.0000
4.6154	0.0250	0.0481	0.0018	0.0000
4.6923	0.0250	0.0489	0.0018	0.0000
4.7692	0.0250	0.0497	0.0018	0.0000
4.8462	0.0250	0.0505	0.0018	0.0000
4.9231	0.0250	0.0513	0.0019	0.0000
5.0000	0.0250	0.0521	0.0019	0.0000
5.0000	0.0250	0.0521	0.0019	0.0000

Landscape Swale Hydraulic Table

Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**To Amended(cfs)**	**Infilt(cfs)**
5.0000	0.0250	0.0521	0.0000	0.1340	0.0000
5.0769	0.0250	0.0540	0.0000	0.1340	0.0000
5.1538	0.0250	0.0560	0.0000	0.1389	0.0000
5.2308	0.0250	0.0579	0.0000	0.1439	0.0000
5.3077	0.0250	0.0598	0.0000	0.1489	0.0000
5.3846	0.0250	0.0617	0.0000	0.1538	0.0000
5.4615	0.0250	0.0637	0.0000	0.1588	0.0000
5.5385	0.0250	0.0656	0.0000	0.1638	0.0000
5.6154	0.0250	0.0675	0.0000	0.1687	0.0000
5.6923	0.0250	0.0694	0.0000	0.1737	0.0000
5.7692	0.0250	0.0714	0.0000	0.1786	0.0000
5.8462	0.0250	0.0733	0.0000	0.1836	0.0000
5.9231	0.0250	0.0752	0.0000	0.1886	0.0000
6.0000	0.0250	0.0771	0.0000	0.1935	0.0000
6.0769	0.0250	0.0790	0.2257	0.1985	0.0000
6.1538	0.0250	0.0810	0.6273	0.2035	0.0000
6.2308	0.0250	0.0829	1.0991	0.2084	0.0000
6.3077	0.0250	0.0848	1.5516	0.2134	0.0000
6.3846	0.0250	0.0867	1.9054	0.2183	0.0000

6.4615	0.0250	0.0887	2.1274	0.2233	0.0000
6.5385	0.0250	0.0906	2.3112	0.2283	0.0000
6.6154	0.0250	0.0925	2.4708	0.2332	0.0000
6.6923	0.0250	0.0944	2.6207	0.2382	0.0000
6.7692	0.0250	0.0964	2.7624	0.2432	0.0000
6.8462	0.0250	0.0983	2.8972	0.2481	0.0000
6.9231	0.0250	0.1002	3.0261	0.2531	0.0000
7.0000	0.0250	0.1021	3.1496	0.2580	0.0000

Surface Basin A

Element Flows To:

Outlet 1	Outlet 2
	Basin A

Vault 2

Width: 32 ft.
Length: 56 ft.
Depth: 6 ft.
Discharge Structure
Riser Height: 5.5 ft.
Riser Diameter: 12 in.
Orifice 1 Diameter: 0.4375 in. Elevation:0 ft.
Orifice 2 Diameter: 1 in. Elevation:5 ft.
Element Flows To:
Outlet 1 Outlet 2

Vault Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.041	0.000	0.000	0.000
0.0667	0.041	0.002	0.001	0.000
0.1333	0.041	0.005	0.001	0.000
0.2000	0.041	0.008	0.002	0.000
0.2667	0.041	0.011	0.002	0.000
0.3333	0.041	0.013	0.003	0.000
0.4000	0.041	0.016	0.003	0.000
0.4667	0.041	0.019	0.003	0.000
0.5333	0.041	0.021	0.003	0.000
0.6000	0.041	0.024	0.004	0.000
0.6667	0.041	0.027	0.004	0.000
0.7333	0.041	0.030	0.004	0.000
0.8000	0.041	0.032	0.004	0.000
0.8667	0.041	0.035	0.004	0.000
0.9333	0.041	0.038	0.005	0.000
1.0000	0.041	0.041	0.005	0.000
1.0667	0.041	0.043	0.005	0.000
1.1333	0.041	0.046	0.005	0.000
1.2000	0.041	0.049	0.005	0.000
1.2667	0.041	0.052	0.005	0.000
1.3333	0.041	0.054	0.006	0.000
1.4000	0.041	0.057	0.006	0.000
1.4667	0.041	0.060	0.006	0.000
1.5333	0.041	0.063	0.006	0.000
1.6000	0.041	0.065	0.006	0.000
1.6667	0.041	0.068	0.006	0.000
1.7333	0.041	0.071	0.006	0.000
1.8000	0.041	0.074	0.007	0.000
1.8667	0.041	0.076	0.007	0.000
1.9333	0.041	0.079	0.007	0.000
2.0000	0.041	0.082	0.007	0.000
2.0667	0.041	0.085	0.007	0.000
2.1333	0.041	0.087	0.007	0.000
2.2000	0.041	0.090	0.007	0.000
2.2667	0.041	0.093	0.007	0.000
2.3333	0.041	0.096	0.007	0.000
2.4000	0.041	0.098	0.008	0.000
2.4667	0.041	0.101	0.008	0.000
2.5333	0.041	0.104	0.008	0.000
2.6000	0.041	0.107	0.008	0.000
2.6667	0.041	0.109	0.008	0.000

2.7333	0.041	0.112	0.008	0.000
2.8000	0.041	0.115	0.008	0.000
2.8667	0.041	0.117	0.008	0.000
2.9333	0.041	0.120	0.008	0.000
3.0000	0.041	0.123	0.009	0.000
3.0667	0.041	0.126	0.009	0.000
3.1333	0.041	0.128	0.009	0.000
3.2000	0.041	0.131	0.009	0.000
3.2667	0.041	0.134	0.009	0.000
3.3333	0.041	0.137	0.009	0.000
3.4000	0.041	0.139	0.009	0.000
3.4667	0.041	0.142	0.009	0.000
3.5333	0.041	0.145	0.009	0.000
3.6000	0.041	0.148	0.009	0.000
3.6667	0.041	0.150	0.009	0.000
3.7333	0.041	0.153	0.010	0.000
3.8000	0.041	0.156	0.010	0.000
3.8667	0.041	0.159	0.010	0.000
3.9333	0.041	0.161	0.010	0.000
4.0000	0.041	0.164	0.010	0.000
4.0667	0.041	0.167	0.010	0.000
4.1333	0.041	0.170	0.010	0.000
4.2000	0.041	0.172	0.010	0.000
4.2667	0.041	0.175	0.010	0.000
4.3333	0.041	0.178	0.010	0.000
4.4000	0.041	0.181	0.010	0.000
4.4667	0.041	0.183	0.011	0.000
4.5333	0.041	0.186	0.011	0.000
4.6000	0.041	0.189	0.011	0.000
4.6667	0.041	0.192	0.011	0.000
4.7333	0.041	0.194	0.011	0.000
4.8000	0.041	0.197	0.011	0.000
4.8667	0.041	0.200	0.011	0.000
4.9333	0.041	0.203	0.011	0.000
5.0000	0.041	0.205	0.011	0.000
5.0667	0.041	0.208	0.018	0.000
5.1333	0.041	0.211	0.021	0.000
5.2000	0.041	0.213	0.024	0.000
5.2667	0.041	0.216	0.025	0.000
5.3333	0.041	0.219	0.027	0.000
5.4000	0.041	0.222	0.029	0.000
5.4667	0.041	0.224	0.030	0.000
5.5333	0.041	0.227	0.096	0.000
5.6000	0.041	0.230	0.366	0.000
5.6667	0.041	0.233	0.738	0.000
5.7333	0.041	0.235	1.150	0.000
5.8000	0.041	0.238	1.546	0.000
5.8667	0.041	0.241	1.872	0.000
5.9333	0.041	0.244	2.098	0.000
6.0000	0.041	0.246	2.243	0.000
6.0667	0.041	0.249	2.411	0.000
6.1333	0.000	0.000	2.548	0.000

Vault 3

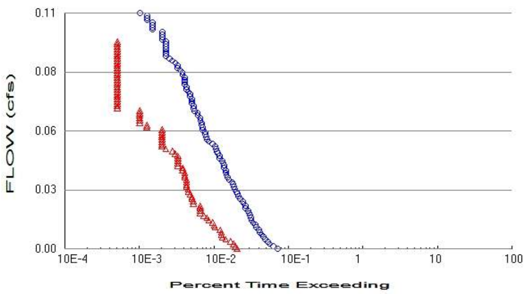
Width: 16 ft.
Length: 64 ft.
Depth: 6 ft.
Discharge Structure
Riser Height: 5.5 ft.
Riser Diameter: 12 in.
Orifice 1 Diameter: 0.4375 in. Elevation:0 ft.
Orifice 2 Diameter: 1 in. Elevation:5 ft.
Element Flows To:
Outlet 1 Outlet 2

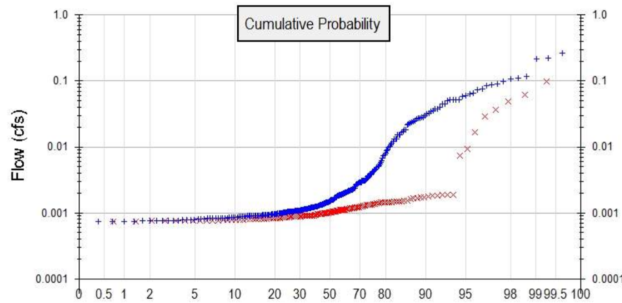
Vault Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.023	0.000	0.000	0.000
0.0667	0.023	0.001	0.001	0.000
0.1333	0.023	0.003	0.001	0.000
0.2000	0.023	0.004	0.002	0.000
0.2667	0.023	0.006	0.002	0.000
0.3333	0.023	0.007	0.003	0.000
0.4000	0.023	0.009	0.003	0.000
0.4667	0.023	0.011	0.003	0.000
0.5333	0.023	0.012	0.003	0.000
0.6000	0.023	0.014	0.004	0.000
0.6667	0.023	0.015	0.004	0.000
0.7333	0.023	0.017	0.004	0.000
0.8000	0.023	0.018	0.004	0.000
0.8667	0.023	0.020	0.004	0.000
0.9333	0.023	0.021	0.005	0.000
1.0000	0.023	0.023	0.005	0.000
1.0667	0.023	0.025	0.005	0.000
1.1333	0.023	0.026	0.005	0.000
1.2000	0.023	0.028	0.005	0.000
1.2667	0.023	0.029	0.005	0.000
1.3333	0.023	0.031	0.006	0.000
1.4000	0.023	0.032	0.006	0.000
1.4667	0.023	0.034	0.006	0.000
1.5333	0.023	0.036	0.006	0.000
1.6000	0.023	0.037	0.006	0.000
1.6667	0.023	0.039	0.006	0.000
1.7333	0.023	0.040	0.006	0.000
1.8000	0.023	0.042	0.007	0.000
1.8667	0.023	0.043	0.007	0.000
1.9333	0.023	0.045	0.007	0.000
2.0000	0.023	0.047	0.007	0.000
2.0667	0.023	0.048	0.007	0.000
2.1333	0.023	0.050	0.007	0.000
2.2000	0.023	0.051	0.007	0.000
2.2667	0.023	0.053	0.007	0.000
2.3333	0.023	0.054	0.007	0.000
2.4000	0.023	0.056	0.008	0.000
2.4667	0.023	0.058	0.008	0.000
2.5333	0.023	0.059	0.008	0.000
2.6000	0.023	0.061	0.008	0.000
2.6667	0.023	0.062	0.008	0.000

2.7333	0.023	0.064	0.008	0.000
2.8000	0.023	0.065	0.008	0.000
2.8667	0.023	0.067	0.008	0.000
2.9333	0.023	0.069	0.008	0.000
3.0000	0.023	0.070	0.009	0.000
3.0667	0.023	0.072	0.009	0.000
3.1333	0.023	0.073	0.009	0.000
3.2000	0.023	0.075	0.009	0.000
3.2667	0.023	0.076	0.009	0.000
3.3333	0.023	0.078	0.009	0.000
3.4000	0.023	0.079	0.009	0.000
3.4667	0.023	0.081	0.009	0.000
3.5333	0.023	0.083	0.009	0.000
3.6000	0.023	0.084	0.009	0.000
3.6667	0.023	0.086	0.009	0.000
3.7333	0.023	0.087	0.010	0.000
3.8000	0.023	0.089	0.010	0.000
3.8667	0.023	0.090	0.010	0.000
3.9333	0.023	0.092	0.010	0.000
4.0000	0.023	0.094	0.010	0.000
4.0667	0.023	0.095	0.010	0.000
4.1333	0.023	0.097	0.010	0.000
4.2000	0.023	0.098	0.010	0.000
4.2667	0.023	0.100	0.010	0.000
4.3333	0.023	0.101	0.010	0.000
4.4000	0.023	0.103	0.010	0.000
4.4667	0.023	0.105	0.011	0.000
4.5333	0.023	0.106	0.011	0.000
4.6000	0.023	0.108	0.011	0.000
4.6667	0.023	0.109	0.011	0.000
4.7333	0.023	0.111	0.011	0.000
4.8000	0.023	0.112	0.011	0.000
4.8667	0.023	0.114	0.011	0.000
4.9333	0.023	0.116	0.011	0.000
5.0000	0.023	0.117	0.011	0.000
5.0667	0.023	0.119	0.018	0.000
5.1333	0.023	0.120	0.021	0.000
5.2000	0.023	0.122	0.024	0.000
5.2667	0.023	0.123	0.025	0.000
5.3333	0.023	0.125	0.027	0.000
5.4000	0.023	0.126	0.029	0.000
5.4667	0.023	0.128	0.030	0.000
5.5333	0.023	0.130	0.096	0.000
5.6000	0.023	0.131	0.366	0.000
5.6667	0.023	0.133	0.738	0.000
5.7333	0.023	0.134	1.150	0.000
5.8000	0.023	0.136	1.546	0.000
5.8667	0.023	0.137	1.872	0.000
5.9333	0.023	0.139	2.098	0.000
6.0000	0.023	0.141	2.243	0.000
6.0667	0.023	0.142	2.411	0.000
6.1333	0.000	0.000	2.548	0.000

Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.367
Total Impervious Area: 0.005

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.16
Total Impervious Area: 0.208

Flow Frequency Method: Cunnane

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.044415
5 year	0.087232
10 year	0.111573
25 year	0.221241

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.001487
5 year	0.001892
10 year	0.029302
25 year	0.057711

Duration Flows

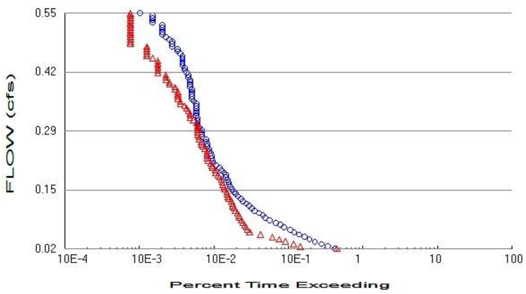
The Facility PASSED

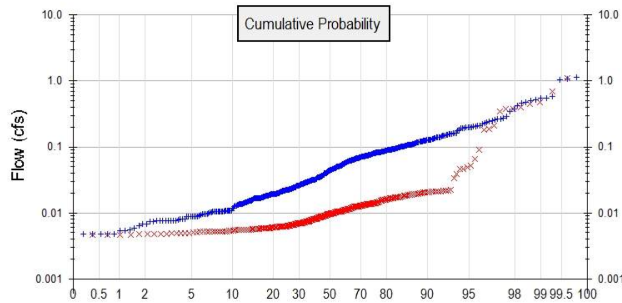
Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0044	283	81	28	Pass
0.0055	248	77	31	Pass
0.0066	223	73	32	Pass
0.0077	208	66	31	Pass
0.0088	192	57	29	Pass
0.0099	182	51	28	Pass
0.0109	173	50	28	Pass
0.0120	165	50	30	Pass
0.0131	160	48	30	Pass
0.0142	147	41	27	Pass
0.0153	141	40	28	Pass
0.0163	133	38	28	Pass
0.0174	126	34	26	Pass
0.0185	123	32	26	Pass
0.0196	120	29	24	Pass
0.0207	117	26	22	Pass
0.0218	114	26	22	Pass
0.0228	106	26	24	Pass
0.0239	105	26	24	Pass
0.0250	98	21	21	Pass
0.0261	96	21	21	Pass
0.0272	90	20	22	Pass
0.0282	85	20	23	Pass
0.0293	82	19	23	Pass
0.0304	79	18	22	Pass
0.0315	76	18	23	Pass
0.0326	74	17	22	Pass
0.0337	71	17	23	Pass
0.0347	69	17	24	Pass
0.0358	63	17	26	Pass
0.0369	60	16	26	Pass
0.0380	58	16	27	Pass
0.0391	57	16	28	Pass
0.0402	57	15	26	Pass
0.0412	54	15	27	Pass
0.0423	54	13	24	Pass
0.0434	53	13	24	Pass
0.0445	51	13	25	Pass
0.0456	47	13	27	Pass
0.0466	47	13	27	Pass
0.0477	45	12	26	Pass
0.0488	43	11	25	Pass
0.0499	42	9	21	Pass
0.0510	41	8	19	Pass
0.0521	38	8	21	Pass
0.0531	34	8	23	Pass
0.0542	32	8	25	Pass
0.0553	31	8	25	Pass
0.0564	30	8	26	Pass
0.0575	30	8	26	Pass
0.0585	28	8	28	Pass
0.0596	28	5	17	Pass
0.0607	27	5	18	Pass

0.0618	27	4	14	Pass
0.0629	26	4	15	Pass
0.0640	26	4	15	Pass
0.0650	24	4	16	Pass
0.0661	24	4	16	Pass
0.0672	22	4	18	Pass
0.0683	21	2	9	Pass
0.0694	21	2	9	Pass
0.0705	20	2	10	Pass
0.0715	20	2	10	Pass
0.0726	20	2	10	Pass
0.0737	19	2	10	Pass
0.0748	19	2	10	Pass
0.0759	18	2	11	Pass
0.0769	17	2	11	Pass
0.0780	17	2	11	Pass
0.0791	16	2	12	Pass
0.0802	16	2	12	Pass
0.0813	16	2	12	Pass
0.0824	16	2	12	Pass
0.0834	15	2	13	Pass
0.0845	15	2	13	Pass
0.0856	14	2	14	Pass
0.0867	13	2	15	Pass
0.0878	13	2	15	Pass
0.0888	12	2	16	Pass
0.0899	11	2	18	Pass
0.0910	10	2	20	Pass
0.0921	9	2	22	Pass
0.0932	9	2	22	Pass
0.0943	9	2	22	Pass
0.0953	9	2	22	Pass
0.0964	9	2	22	Pass
0.0975	9	2	22	Pass
0.0986	9	2	22	Pass
0.0997	8	0	0	Pass
0.1008	8	0	0	Pass
0.1018	8	0	0	Pass
0.1029	8	0	0	Pass
0.1040	6	0	0	Pass
0.1051	6	0	0	Pass
0.1062	6	0	0	Pass
0.1072	6	0	0	Pass
0.1083	5	0	0	Pass
0.1094	5	0	0	Pass
0.1105	5	0	0	Pass
0.1116	4	0	0	Pass

Water Quality

POC 2





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #2
Total Pervious Area: 1.947
Total Impervious Area: 0.344

Mitigated Landuse Totals for POC #2
Total Pervious Area: 0.153
Total Impervious Area: 2.138

Flow Frequency Method: Cunnane

Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	**Flow(cfs)**
2 year	0.22308
5 year	0.46961
10 year	0.548148
25 year	1.056186

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	**Flow(cfs)**
2 year	0.02146
5 year	0.199616
10 year	0.401824
25 year	0.624357

Duration Flows
The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0223	1656	1770	106	Pass
0.0276	1345	571	42	Pass
0.0329	1110	461	41	Pass
0.0382	893	361	40	Pass
0.0436	757	297	39	Pass
0.0489	651	241	37	Pass
0.0542	548	166	30	Pass
0.0595	473	120	25	Pass
0.0648	417	112	26	Pass
0.0701	346	108	31	Pass
0.0754	309	102	33	Pass
0.0807	270	97	35	Pass
0.0860	223	93	41	Pass
0.0914	195	88	45	Pass
0.0967	180	86	47	Pass
0.1020	158	82	51	Pass
0.1073	140	77	55	Pass
0.1126	127	74	58	Pass
0.1179	117	71	60	Pass
0.1232	107	70	65	Pass
0.1285	97	68	70	Pass
0.1338	91	62	68	Pass
0.1392	83	61	73	Pass
0.1445	78	60	76	Pass
0.1498	74	59	79	Pass
0.1551	70	55	78	Pass
0.1604	66	54	81	Pass
0.1657	63	52	82	Pass
0.1710	62	51	82	Pass
0.1763	61	50	81	Pass
0.1817	57	47	82	Pass
0.1870	57	45	78	Pass
0.1923	54	42	77	Pass
0.1976	50	41	82	Pass
0.2029	47	38	80	Pass
0.2082	42	37	88	Pass
0.2135	39	36	92	Pass
0.2188	38	33	86	Pass
0.2241	37	32	86	Pass
0.2295	37	32	86	Pass
0.2348	36	32	88	Pass
0.2401	34	32	94	Pass
0.2454	34	30	88	Pass
0.2507	32	28	87	Pass
0.2560	32	27	84	Pass
0.2613	31	27	87	Pass
0.2666	31	25	80	Pass
0.2719	27	25	92	Pass
0.2773	27	24	88	Pass
0.2826	27	24	88	Pass
0.2879	27	24	88	Pass
0.2932	25	24	96	Pass
0.2985	24	24	100	Pass

0.3038	24	23	95	Pass
0.3091	24	21	87	Pass
0.3144	24	19	79	Pass
0.3198	23	19	82	Pass
0.3251	23	19	82	Pass
0.3304	23	18	78	Pass
0.3357	23	17	73	Pass
0.3410	23	16	69	Pass
0.3463	23	14	60	Pass
0.3516	21	14	66	Pass
0.3569	20	13	65	Pass
0.3622	20	13	65	Pass
0.3676	20	13	65	Pass
0.3729	20	13	65	Pass
0.3782	20	12	60	Pass
0.3835	19	12	63	Pass
0.3888	19	10	52	Pass
0.3941	19	10	52	Pass
0.3994	19	9	47	Pass
0.4047	18	9	50	Pass
0.4100	18	9	50	Pass
0.4154	17	7	41	Pass
0.4207	16	7	43	Pass
0.4260	16	7	43	Pass
0.4313	15	7	46	Pass
0.4366	15	7	46	Pass
0.4419	15	7	46	Pass
0.4472	15	6	40	Pass
0.4525	15	5	33	Pass
0.4579	14	5	35	Pass
0.4632	13	5	38	Pass
0.4685	13	5	38	Pass
0.4738	11	5	45	Pass
0.4791	11	3	27	Pass
0.4844	11	3	27	Pass
0.4897	10	3	30	Pass
0.4950	9	3	33	Pass
0.5003	8	3	37	Pass
0.5057	8	3	37	Pass
0.5110	8	3	37	Pass
0.5163	8	3	37	Pass
0.5216	8	3	37	Pass
0.5269	6	3	50	Pass
0.5322	6	3	50	Pass
0.5375	6	3	50	Pass
0.5428	6	3	50	Pass
0.5481	4	3	75	Pass

Water Quality

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

No PERLND changes have been made.

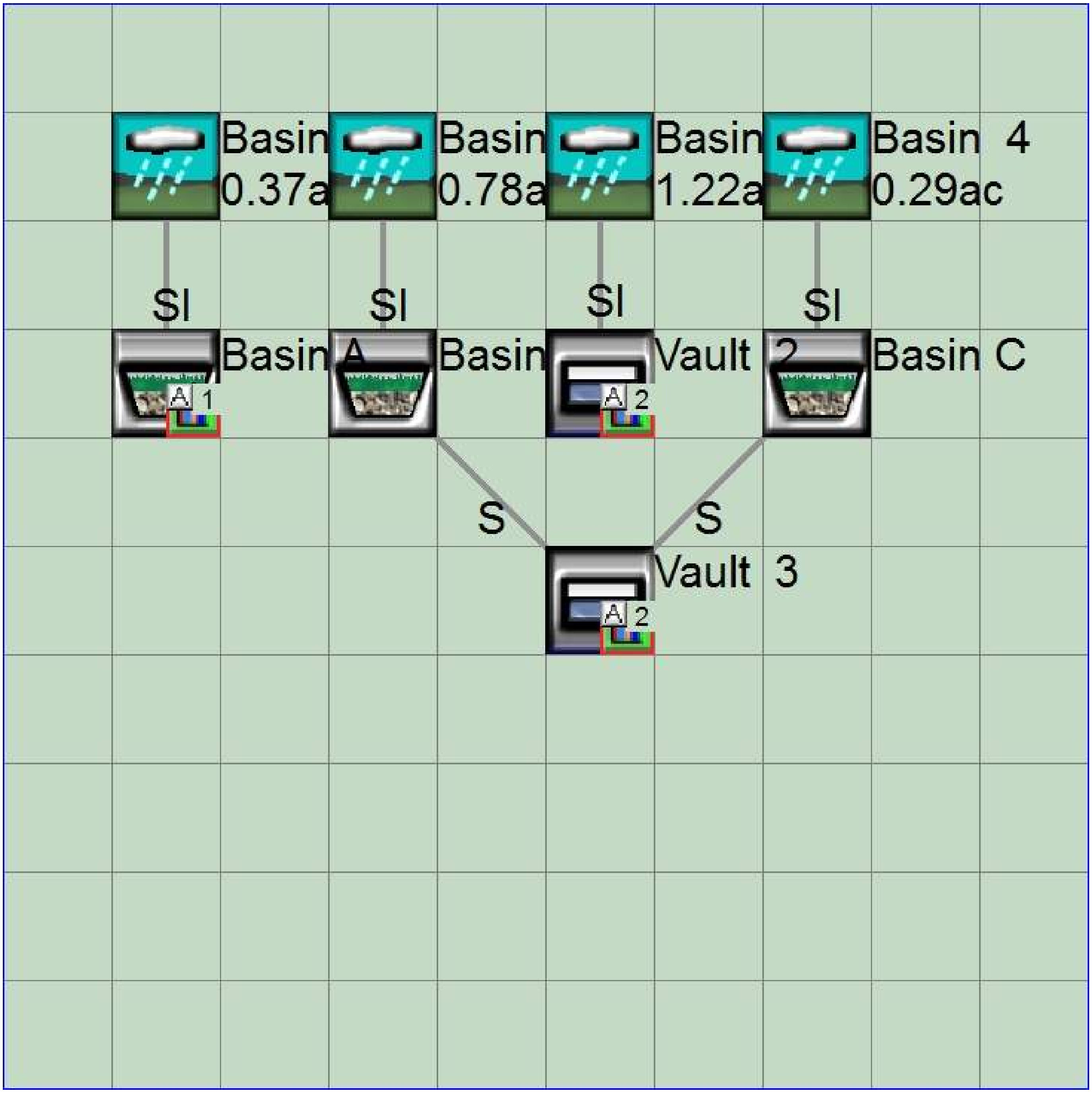
IMPLND Changes

No IMPLND changes have been made.

Appendix

Predeveloped Schematic

Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1959 10 01        END    2004 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM        26   Sharp Chula2.wdm
MESSU      25   PreSharp Chula2.MES
           27   PreSharp Chula2.L61
           28   PreSharp Chula2.L62
           30   POCSharp Chula21.dat
           31   POCSharp Chula22.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:60
      PERLND      30
      IMPLND       1
      PERLND      28
      COPY       501
      COPY       502
      DISPLY       1
      DISPLY       2
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                    MAX                          1    2   30    9
    2        Basin  2                    MAX                          1    2   31    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  502         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                           in  out           ***
   30      D,Grass,STEEP(10-20    1    1    1    1   27    0
   28      D,Grass,FLAT(0-5%)     1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   30         0    0    1    0    0    0    0    0    0    0    0    0
```

```
  28          0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   30         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   28         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   30         0    1    1    1    0    0    0    0    1    1    0
   28         0    1    1    1    0    0    0    0    1    1    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   30              0       4.2      0.02       200      0.15         3      0.92
   28              0       4.8      0.04       200      0.05         3      0.92
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   30             35        30         2         2       0.4      0.05      0.05
   28             35        30         2         2       0.4      0.05      0.05
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   30           0.08       0.6       0.2       1.5       0.7       0.5
   28           0.08       0.6       0.2       1.5       0.7       0.5
  END PWAT-PARM4
  MON-LZETPARM
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   30       0.4  0.4  0.4  0.4  0.6  0.6  0.6  0.6  0.6  0.4  0.4  0.4
   28       0.4  0.4  0.4  0.4  0.6  0.6  0.6  0.6  0.6  0.4  0.4  0.4
  END MON-LZETPARM
  MON-INTERCEP
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   30       0.1  0.1  0.1  0.1 0.06 0.06 0.06 0.06 0.06  0.1  0.1  0.1
   28       0.1  0.1  0.1  0.1 0.06 0.06 0.06 0.06 0.06  0.1  0.1  0.1
  END MON-INTERCEP

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   30              0         0      0.15         0         4      0.05         0
   28              0         0      0.15         0         4      0.05         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out          ***
     1      IMPERVIOUS-FLAT       1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
```

```
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    1
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            100     0.035      0.05       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                <--Area-->     <-Target->   MBLK   ***
<Name>   #                <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  30                     0.367     COPY   501     12
PERLND  30                     0.367     COPY   501     13
IMPLND   1                     0.005     COPY   501     15
Basin  2***
PERLND  28                     1.947     COPY   502     12
PERLND  28                     1.947     COPY   502     13
IMPLND   1                     0.344     COPY   502     15

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   12.1        DISPLY   1     INPUT  TIMSER 1
COPY   502 OUTPUT MEAN   1 1   12.1        DISPLY   2     INPUT  TIMSER 1


<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                           in  out                           ***
  END GEN-INFO
  *** Section RCHRES***
```

```
  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                     ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible   exit *** possible   exit     possible   exit
             *  *  *  *     *  *  *  *  *        *  *  *  *  *        ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50        ***
  <------><--------><--------><--------><--------><--------><-------->        ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                          ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     12.1      WDM    501 FLOW     ENGL      REPL
COPY   502 OUTPUT MEAN   1 1     12.1      WDM    502 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK
```

```
END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1959 10 01        END    2004 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                             ***
WDM        26   Sharp Chula2.wdm
MESSU      25   MitSharp Chula2.MES
           27   MitSharp Chula2.L61
           28   MitSharp Chula2.L62
           30   POCSharp Chula21.dat
           31   POCSharp Chula22.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:60
      PERLND      28
      IMPLND       1
      GENER        2
      RCHRES       1
      RCHRES       2
      GENER        4
      RCHRES       3
      RCHRES       4
      GENER        6
      RCHRES       5
      RCHRES       6
      RCHRES       7
      RCHRES       8
      COPY         1
      COPY       501
      COPY         2
      COPY       502
      DISPLY       1
      DISPLY       2
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Surface Basin A             MAX                        1    2   30    9
    2        Vault  2                    MAX                        1    2   31    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
    2         1    1
  502         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
    2        24
    4        24
    6        24
  END OPCODE
  PARM
    #    #         K ***
```

```
    2             0.
    4             0.
    6             0.
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                         User  t-series Engl Metr ***
                                          in  out           ***
   28      D,Grass,FLAT(0-5%)     1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   28         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   28         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   28         0    1    1    1    0    0    0    0    1    1    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2          ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   28             0       4.8      0.04       200      0.05         3      0.92
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3          ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   28            35        30         2         2       0.4      0.05      0.05
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   28           0.08       0.6       0.2       1.5       0.7       0.5
  END PWAT-PARM4
  MON-LZETPARM
    <PLS >      PWATER input info: Part 3          ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   28       0.4  0.4  0.4  0.4  0.6  0.6  0.6  0.6  0.6  0.4  0.4  0.4
  END MON-LZETPARM
  MON-INTERCEP
    <PLS >      PWATER input info: Part 3          ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   28       0.1  0.1  0.1  0.1 0.06 0.06 0.06 0.06 0.06  0.1  0.1  0.1
  END MON-INTERCEP

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   28              0         0      0.15         0         4      0.05         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
```

```
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out            ***
    1      IMPERVIOUS-FLAT        1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    1
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            100     0.035      0.05       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  28                        0.16     RCHRES   5      2
PERLND  28                        0.16     RCHRES   5      3
IMPLND   1                       0.208     RCHRES   5      5
Basin  2***
PERLND  28                       0.063     RCHRES   1      2
PERLND  28                       0.063     RCHRES   1      3
IMPLND   1                       0.718     RCHRES   1      5
Basin  3***
PERLND  28                        0.05     RCHRES   7      2
PERLND  28                        0.05     RCHRES   7      3
IMPLND   1                        1.17     RCHRES   7      5
Basin  4***
PERLND  28                        0.04     RCHRES   3      2
PERLND  28                        0.04     RCHRES   3      3
IMPLND   1                        0.25     RCHRES   3      5

******Routing******
PERLND  28                        0.16     COPY     1     12
IMPLND   1                       0.208     COPY     1     15
PERLND  28                        0.16     COPY     1     13
PERLND  28                        0.05     COPY     2     12
```

```
IMPLND   1                        1.17     COPY     2      15
PERLND  28                        0.05     COPY     2      13
RCHRES   2                           1     RCHRES   8       6
RCHRES   2                                 COPY     2      16
RCHRES   1                           1     RCHRES   8       7
RCHRES   1                                 COPY     2      17
RCHRES   1                           1     RCHRES   2       8
RCHRES   4                           1     RCHRES   8       6
RCHRES   4                                 COPY     2      16
RCHRES   3                           1     RCHRES   8       7
RCHRES   3                                 COPY     2      17
RCHRES   3                           1     RCHRES   4       8
RCHRES   5                           1     RCHRES   6       8
RCHRES   6                           1     COPY   501      16
RCHRES   5                           1     COPY   501      17
RCHRES   7                           1     COPY   502      16
RCHRES   8                           1     COPY   502      16
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   12.1        DISPLY   1     INPUT  TIMSER 1
COPY   502 OUTPUT MEAN   1 1   12.1        DISPLY   2     INPUT  TIMSER 1
GENER    2 OUTPUT TIMSER      .0002778     RCHRES   1     EXTNL  OUTDGT 1
GENER    4 OUTPUT TIMSER      .0002778     RCHRES   3     EXTNL  OUTDGT 1
GENER    6 OUTPUT TIMSER      .0002778     RCHRES   5     EXTNL  OUTDGT 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                          in  out                            ***
    1     Surface Basin B        3    1    1    1   28    0    1
    2     Basin B                1    1    1    1   28    0    1
    3     Surface Basin C        3    1    1    1   28    0    1
    4     Basin C                1    1    1    1   28    0    1
    5     Surface Basin A        3    1    1    1   28    0    1
    6     Basin A                1    1    1    1   28    0    1
    7     Vault  2               1    1    1    1   28    0    1
    8     Vault  3               1    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
    3         1    0    0    0    0    0    0    0    0    0
    4         1    0    0    0    0    0    0    0    0    0
    5         1    0    0    0    0    0    0    0    0    0
    6         1    0    0    0    0    0    0    0    0    0
    7         1    0    0    0    0    0    0    0    0    0
    8         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
    3         4    0    0    0    0    0    0    0    0    0    1    9
    4         4    0    0    0    0    0    0    0    0    0    1    9
```

```
    5         4    0    0    0    0    0    0    0    0    0    1    9
    6         4    0    0    0    0    0    0    0    0    0    1    9
    7         4    0    0    0    0    0    0    0    0    0    1    9
    8         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                   ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
    1        0  1  0  0    4  5  6  0  0       0  1  0  0  0       2  1  2  2  2
    2        0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
    3        0  1  0  0    4  5  6  0  0       0  1  0  0  0       2  1  2  2  2
    4        0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
    5        0  1  0  0    4  5  6  0  0       0  1  0  0  0       2  1  2  2  2
    6        0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
    7        0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
    8        0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1             1      0.01       0.0       0.0       0.5       0.0
    2             2      0.02       0.0       0.0       0.5       0.0
    3             3      0.01       0.0       0.0       0.5       0.0
    4             4      0.01       0.0       0.0       0.5       0.0
    5             5      0.01       0.0       0.0       0.5       0.0
    6             6      0.01       0.0       0.0       0.5       0.0
    7             7      0.01       0.0       0.0       0.5       0.0
    8             8      0.01       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                      ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit       for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1           0          4.0  5.0  6.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2           0          4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    3           0          4.0  5.0  6.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    4           0          4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    5           0          4.0  5.0  6.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    6           0          4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    7           0          4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    8           0          4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
*** User-Defined Variable Quantity Lines
***                          addr
***                        <------>
*** kwd   varnam optyp  opn  vari  s1 s2 s3 tp multiply  lc ls ac as agfn ***
  <****> <----> <----> <-> <----><-><-><-><-><--------> <><-> <><-> <--> ***
  UVQUAN vol2   RCHRES   2 VOL               4
  UVQUAN v2m2   GLOBAL     WORKSP  1         3
  UVQUAN vpo2   GLOBAL     WORKSP  2         3
  UVQUAN v2d2   GENER    2 K       1         3
*** User-Defined Variable Quantity Lines
***                          addr
***                        <------>
*** kwd   varnam optyp  opn  vari  s1 s2 s3 tp multiply  lc ls ac as agfn ***
  <****> <----> <----> <-> <----><-><-><-><-><--------> <><-> <><-> <--> ***
  UVQUAN vol4   RCHRES   4 VOL               4
  UVQUAN v2m4   GLOBAL     WORKSP  3         3
  UVQUAN vpo4   GLOBAL     WORKSP  4         3
  UVQUAN v2d4   GENER    4 K       1         3
*** User-Defined Variable Quantity Lines
***                          addr
```

```
***                        <------>
*** kwd   varnam optyp  opn  vari  s1 s2 s3 tp multiply  lc ls ac as agfn ***
  <****> <----> <----> <-> <----><-><-><-><-><--------> <><-> <><-> <--> ***
  UVQUAN vol6   RCHRES   6 VOL                 4
  UVQUAN v2m6   GLOBAL     WORKSP  5           3
  UVQUAN vpo6   GLOBAL     WORKSP  6           3
  UVQUAN v2d6   GENER    6 K       1           3
*** User-Defined Target Variable Names
***                    addr or                        addr or
***                   <------>                       <------>
*** kwd   varnam ct  vari  s1 s2 s3  frac oper     vari  s1 s2 s3  frac oper
  <****>  <----><-> <----><-><-><-> <---> <-->    <----><-><-><-> <---> <-->
  UVNAME  v2m2    1 WORKSP  1         1.0 QUAN
  UVNAME  vpo2    1 WORKSP  2         1.0 QUAN
  UVNAME  v2d2    1 K       1         1.0 QUAN
*** User-Defined Target Variable Names
***                    addr or                        addr or
***                   <------>                       <------>
*** kwd   varnam ct  vari  s1 s2 s3  frac oper     vari  s1 s2 s3  frac oper
  <****>  <----><-> <----><-><-><-> <---> <-->    <----><-><-><-> <---> <-->
  UVNAME  v2m4    1 WORKSP  3         1.0 QUAN
  UVNAME  vpo4    1 WORKSP  4         1.0 QUAN
  UVNAME  v2d4    1 K       1         1.0 QUAN
*** User-Defined Target Variable Names
***                    addr or                        addr or
***                   <------>                       <------>
*** kwd   varnam ct  vari  s1 s2 s3  frac oper     vari  s1 s2 s3  frac oper
  <****>  <----><-> <----><-><-><-> <---> <-->    <----><-><-><-> <---> <-->
  UVNAME  v2m6    1 WORKSP  5         1.0 QUAN
  UVNAME  vpo6    1 WORKSP  6         1.0 QUAN
  UVNAME  v2d6    1 K       1         1.0 QUAN
*** opt foplop dcdts  yr mo dy hr mn d t   vnam  s1 s2 s3 ac quantity  tc  ts rp
  <****><-><--><><-><--> <> <> <> <><><>  <----><-><-><-><-><---------> <> <-><->
  GENER   2                               v2m2             =  1016.
*** Compute remaining available pore space
  GENER   2                               vpo2             =  v2m2
  GENER   2                               vpo2            -=  vol2
*** Check to see if VPORA goes negative; if so set VPORA = 0.0
IF (vpo2 < 0.0) THEN
  GENER   2                               vpo2             =  0.0
END IF
*** Infiltration volume
  GENER   2                               v2d2             =  vpo2
*** opt foplop dcdts  yr mo dy hr mn d t   vnam  s1 s2 s3 ac quantity  tc  ts rp
  <****><-><--><><-><--> <> <> <> <><><>  <----><-><-><-><-><---------> <> <-><->
  GENER   4                               v2m4             =  610.
*** Compute remaining available pore space
  GENER   4                               vpo4             =  v2m4
  GENER   4                               vpo4            -=  vol4
*** Check to see if VPORA goes negative; if so set VPORA = 0.0
IF (vpo4 < 0.0) THEN
  GENER   4                               vpo4             =  0.0
END IF
*** Infiltration volume
  GENER   4                               v2d4             =  vpo4
*** opt foplop dcdts  yr mo dy hr mn d t   vnam  s1 s2 s3 ac quantity  tc  ts rp
  <****><-><--><><-><--> <> <> <> <><><>  <----><-><-><-><-><---------> <> <-><->
  GENER   6                               v2m6             =  2157.
*** Compute remaining available pore space
  GENER   6                               vpo6             =  v2m6
  GENER   6                               vpo6            -=  vol6
*** Check to see if VPORA goes negative; if so set VPORA = 0.0
IF (vpo6 < 0.0) THEN
  GENER   6                               vpo6             =  0.0
END IF
*** Infiltration volume
  GENER   6                               v2d6             =  vpo6
END SPEC-ACTIONS
FTABLES
  FTABLE      2
```

56 4

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.019858	0.000000	0.000000		
0.054945	0.019858	0.000458	0.000000		
0.109890	0.019858	0.000917	0.000000		
0.164835	0.019858	0.001375	0.000143		
0.219780	0.019858	0.001833	0.000521		
0.274725	0.019858	0.002291	0.001215		
0.329670	0.019858	0.002750	0.001508		
0.384615	0.019858	0.003208	0.001751		
0.439560	0.019858	0.003666	0.001962		
0.494505	0.019858	0.004124	0.002152		
0.549451	0.019858	0.004583	0.002326		
0.604396	0.019858	0.005041	0.002488		
0.659341	0.019858	0.005499	0.002639		
0.714286	0.019858	0.005957	0.002781		
0.769231	0.019858	0.006416	0.002917		
0.824176	0.019858	0.006874	0.003046		
0.879121	0.019858	0.007332	0.003170		
0.934066	0.019858	0.007790	0.003289		
0.989011	0.019858	0.008249	0.003404		
1.043956	0.019858	0.008701	0.003515		
1.098901	0.019858	0.009154	0.003623		
1.153846	0.019858	0.009607	0.003727		
1.208791	0.019858	0.010060	0.003829		
1.263736	0.019858	0.010513	0.003928		
1.318681	0.019858	0.010965	0.004024		
1.373626	0.019858	0.011418	0.004118		
1.428571	0.019858	0.011871	0.004210		
1.483516	0.019858	0.012324	0.004300		
1.538462	0.019858	0.012777	0.004389		
1.593407	0.019858	0.013229	0.004475		
1.648352	0.019858	0.013682	0.004560		
1.703297	0.019858	0.014135	0.004643		
1.758242	0.019858	0.014588	0.004725		
1.813187	0.019858	0.015041	0.004805		
1.868132	0.019858	0.015493	0.004884		
1.923077	0.019858	0.015946	0.005008		
1.978022	0.019858	0.016399	0.005158		
2.032967	0.019858	0.016852	0.005304		
2.087912	0.019858	0.017305	0.005446		
2.142857	0.019858	0.017757	0.005585		
2.197802	0.019858	0.018210	0.005720		
2.252747	0.019858	0.018663	0.005853		
2.307692	0.019858	0.019116	0.005982		
2.362637	0.019858	0.019569	0.006108		
2.417582	0.019858	0.020021	0.006232		
2.472527	0.019858	0.020474	0.006354		
2.527473	0.019858	0.020927	0.006474		
2.582418	0.019858	0.021380	0.006591		
2.637363	0.019858	0.021833	0.006706		
2.692308	0.019858	0.022285	0.006820		
2.747253	0.019858	0.022738	0.006932		
2.802198	0.019858	0.023191	0.007043		
2.857143	0.019858	0.023644	0.007152		
2.912088	0.019858	0.024097	0.007261		
2.967033	0.019858	0.024549	0.007377		
3.000000	0.019858	0.052124	0.007460		

END FTABLE 2
FTABLE 1
38 6

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Outflow2 (cfs)	outflow 3 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.019858	0.000000	0.000000	0.000000	0.000000		
0.054945	0.019858	0.001091	0.000000	0.108112	0.000000		
0.109890	0.019858	0.002182	0.000000	0.113742	0.000000		
0.164835	0.019858	0.003273	0.000000	0.119373	0.000000		

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0.219780  0.019858  0.004364  0.000000  0.125004  0.000000
0.274725  0.019858  0.005455  0.000000  0.130635  0.000000
0.329670  0.019858  0.006546  0.000000  0.136266  0.000000
0.384615  0.019858  0.007638  0.000000  0.141896  0.000000
0.439560  0.019858  0.008729  0.000000  0.147527  0.000000
0.494505  0.019858  0.009820  0.000000  0.153158  0.000000
0.549451  0.019858  0.010911  0.000000  0.158789  0.000000
0.604396  0.019858  0.012002  0.000000  0.164420  0.000000
0.659341  0.019858  0.013093  0.000000  0.170050  0.000000
0.714286  0.019858  0.014184  0.000000  0.175681  0.000000
0.769231  0.019858  0.015275  0.000000  0.181312  0.000000
0.824176  0.019858  0.016366  0.000000  0.186943  0.000000
0.879121  0.019858  0.017457  0.000000  0.192574  0.000000
0.934066  0.019858  0.018548  0.000000  0.198205  0.000000
0.989011  0.019858  0.019639  0.000000  0.203835  0.000000
1.043956  0.019858  0.020731  0.097690  0.209466  0.000000
1.098901  0.019858  0.021822  0.328096  0.215097  0.000000
1.153846  0.019858  0.022913  0.627270  0.220728  0.000000
1.208791  0.019858  0.024004  0.962367  0.226359  0.000000
1.263736  0.019858  0.025095  1.300589  0.231989  0.000000
1.318681  0.019858  0.026186  1.609623  0.237620  0.000000
1.373626  0.019858  0.027277  1.862893  0.243251  0.000000
1.428571  0.019858  0.028368  2.047214  0.248882  0.000000
1.483516  0.019858  0.029459  2.172110  0.254513  0.000000
1.538462  0.019858  0.030550  2.311197  0.260143  0.000000
1.593407  0.019858  0.031641  2.426251  0.265774  0.000000
1.648352  0.019858  0.032732  2.536091  0.271405  0.000000
1.703297  0.019858  0.033823  2.641368  0.277036  0.000000
1.758242  0.019858  0.034915  2.742606  0.282667  0.000000
1.813187  0.019858  0.036006  2.840238  0.288298  0.000000
1.868132  0.019858  0.037097  2.934624  0.293928  0.000000
1.923077  0.019858  0.038188  3.026067  0.299559  0.000000
1.978022  0.019858  0.039279  3.114826  0.305190  0.000000
2.000000  0.019858  0.039715  3.201126  0.307442  0.000000
END FTABLE  1
FTABLE      4
 56    4
   Depth      Area    Volume  Outflow1 Velocity  Travel Time***
    (ft)   (acres) (acre-ft)    (cfs)   (ft/sec)    (Minutes)***
0.000000  0.011938  0.000000  0.000000
0.054945  0.011938  0.000275  0.000000
0.109890  0.011938  0.000551  0.000000
0.164835  0.011938  0.000826  0.000086
0.219780  0.011938  0.001102  0.000313
0.274725  0.011938  0.001377  0.000766
0.329670  0.011938  0.001653  0.001215
0.384615  0.011938  0.001928  0.001508
0.439560  0.011938  0.002204  0.001751
0.494505  0.011938  0.002479  0.001962
0.549451  0.011938  0.002755  0.002152
0.604396  0.011938  0.003030  0.002326
0.659341  0.011938  0.003306  0.002488
0.714286  0.011938  0.003581  0.002639
0.769231  0.011938  0.003857  0.002781
0.824176  0.011938  0.004132  0.002917
0.879121  0.011938  0.004408  0.003046
0.934066  0.011938  0.004683  0.003170
0.989011  0.011938  0.004959  0.003289
1.043956  0.011938  0.005231  0.003404
1.098901  0.011938  0.005503  0.003515
1.153846  0.011938  0.005775  0.003623
1.208791  0.011938  0.006047  0.003727
1.263736  0.011938  0.006320  0.003829
1.318681  0.011938  0.006592  0.003928
1.373626  0.011938  0.006864  0.004024
1.428571  0.011938  0.007136  0.004118
1.483516  0.011938  0.007409  0.004210
1.538462  0.011938  0.007681  0.004300
1.593407  0.011938  0.007953  0.004389
1.648352  0.011938  0.008225  0.004475
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1.703297	0.011938	0.008497	0.004560
1.758242	0.011938	0.008770	0.004643
1.813187	0.011938	0.009042	0.004725
1.868132	0.011938	0.009314	0.004852
1.923077	0.011938	0.009586	0.005008
1.978022	0.011938	0.009858	0.005158
2.032967	0.011938	0.010131	0.005304
2.087912	0.011938	0.010403	0.005446
2.142857	0.011938	0.010675	0.005585
2.197802	0.011938	0.010947	0.005720
2.252747	0.011938	0.011219	0.005853
2.307692	0.011938	0.011492	0.005982
2.362637	0.011938	0.011764	0.006108
2.417582	0.011938	0.012036	0.006232
2.472527	0.011938	0.012308	0.006354
2.527473	0.011938	0.012580	0.006474
2.582418	0.011938	0.012853	0.006591
2.637363	0.011938	0.013125	0.006706
2.692308	0.011938	0.013397	0.006820
2.747253	0.011938	0.013669	0.006932
2.802198	0.011938	0.013941	0.007043
2.857143	0.011938	0.014214	0.007152
2.912088	0.011938	0.014486	0.007261
2.967033	0.011938	0.014758	0.007377
3.000000	0.011938	0.031335	0.007460

END FTABLE 4
FTABLE 3
38 6

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Outflow2 (cfs)	outflow 3 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.011938	0.000000	0.000000	0.000000	0.000000		
0.054945	0.011938	0.000656	0.000000	0.064992	0.000000		
0.109890	0.011938	0.001312	0.000000	0.068377	0.000000		
0.164835	0.011938	0.001968	0.000000	0.071762	0.000000		
0.219780	0.011938	0.002624	0.000000	0.075147	0.000000		
0.274725	0.011938	0.003280	0.000000	0.078532	0.000000		
0.329670	0.011938	0.003935	0.000000	0.081917	0.000000		
0.384615	0.011938	0.004591	0.000000	0.085302	0.000000		
0.439560	0.011938	0.005247	0.000000	0.088687	0.000000		
0.494505	0.011938	0.005903	0.000000	0.092072	0.000000		
0.549451	0.011938	0.006559	0.000000	0.095457	0.000000		
0.604396	0.011938	0.007215	0.000000	0.098842	0.000000		
0.659341	0.011938	0.007871	0.000000	0.102227	0.000000		
0.714286	0.011938	0.008527	0.000000	0.105612	0.000000		
0.769231	0.011938	0.009183	0.000000	0.108997	0.000000		
0.824176	0.011938	0.009839	0.000000	0.112382	0.000000		
0.879121	0.011938	0.010495	0.000000	0.115767	0.000000		
0.934066	0.011938	0.011150	0.000000	0.119152	0.000000		
0.989011	0.011938	0.011806	0.000000	0.122537	0.000000		
1.043956	0.011938	0.012462	0.097690	0.125922	0.000000		
1.098901	0.011938	0.013118	0.328096	0.129307	0.000000		
1.153846	0.011938	0.013774	0.627270	0.132692	0.000000		
1.208791	0.011938	0.014430	0.962367	0.136077	0.000000		
1.263736	0.011938	0.015086	1.300589	0.139462	0.000000		
1.318681	0.011938	0.015742	1.609623	0.142847	0.000000		
1.373626	0.011938	0.016398	1.862893	0.146232	0.000000		
1.428571	0.011938	0.017054	2.047214	0.149617	0.000000		
1.483516	0.011938	0.017710	2.172110	0.153002	0.000000		
1.538462	0.011938	0.018365	2.311197	0.156387	0.000000		
1.593407	0.011938	0.019021	2.426251	0.159772	0.000000		
1.648352	0.011938	0.019677	2.536091	0.163157	0.000000		
1.703297	0.011938	0.020333	2.641368	0.166542	0.000000		
1.758242	0.011938	0.020989	2.742606	0.169927	0.000000		
1.813187	0.011938	0.021645	2.840238	0.173312	0.000000		
1.868132	0.011938	0.022301	2.934624	0.176697	0.000000		
1.923077	0.011938	0.022957	3.026067	0.180082	0.000000		
1.978022	0.011938	0.023613	3.114826	0.183467	0.000000		
2.000000	0.011938	0.023875	3.201126	0.184821	0.000000		

END FTABLE 3
FTABLE 6
67 4

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.025000	0.000000	0.000000		
0.076923	0.025000	0.000808	0.000000		
0.153846	0.025000	0.001615	0.000072		
0.230769	0.025000	0.002423	0.000135		
0.307692	0.025000	0.003231	0.000258		
0.384615	0.025000	0.004038	0.000338		
0.461538	0.025000	0.004846	0.000402		
0.538462	0.025000	0.005654	0.000456		
0.615385	0.025000	0.006462	0.000504		
0.692308	0.025000	0.007269	0.000548		
0.769231	0.025000	0.008077	0.000589		
0.846154	0.025000	0.008885	0.000627		
0.923077	0.025000	0.009692	0.000663		
1.000000	0.025000	0.010500	0.000696		
1.076923	0.025000	0.011308	0.000729		
1.153846	0.025000	0.012115	0.000760		
1.230769	0.025000	0.012923	0.000789		
1.307692	0.025000	0.013731	0.000818		
1.384615	0.025000	0.014538	0.000845		
1.461538	0.025000	0.015346	0.000872		
1.538462	0.025000	0.016154	0.000898		
1.615385	0.025000	0.016962	0.000923		
1.692308	0.025000	0.017769	0.000947		
1.769231	0.025000	0.018577	0.000971		
1.846154	0.025000	0.019385	0.000994		
1.923077	0.025000	0.020192	0.001017		
2.000000	0.025000	0.021000	0.001039		
2.076923	0.025000	0.021798	0.001061		
2.153846	0.025000	0.022596	0.001082		
2.230769	0.025000	0.023394	0.001103		
2.307692	0.025000	0.024192	0.001124		
2.384615	0.025000	0.024990	0.001144		
2.461538	0.025000	0.025788	0.001163		
2.538462	0.025000	0.026587	0.001183		
2.615385	0.025000	0.027385	0.001202		
2.692308	0.025000	0.028183	0.001221		
2.769231	0.025000	0.028981	0.001239		
2.846154	0.025000	0.029779	0.001258		
2.923077	0.025000	0.030577	0.001276		
3.000000	0.025000	0.031375	0.001293		
3.076923	0.025000	0.032173	0.001311		
3.153846	0.025000	0.032971	0.001328		
3.230769	0.025000	0.033769	0.001345		
3.307692	0.025000	0.034567	0.001362		
3.384615	0.025000	0.035365	0.001379		
3.461538	0.025000	0.036163	0.001395		
3.538462	0.025000	0.036962	0.001411		
3.615385	0.025000	0.037760	0.001427		
3.692308	0.025000	0.038558	0.001443		
3.769231	0.025000	0.039356	0.001459		
3.846154	0.025000	0.040154	0.001474		
3.923077	0.025000	0.040952	0.001505		
4.000000	0.025000	0.041750	0.001535		
4.076923	0.025000	0.042548	0.001564		
4.153846	0.025000	0.043346	0.001593		
4.230769	0.025000	0.044144	0.001622		
4.307692	0.025000	0.044942	0.001650		
4.384615	0.025000	0.045740	0.001677		
4.461538	0.025000	0.046538	0.001704		
4.538462	0.025000	0.047337	0.001731		
4.615385	0.025000	0.048135	0.001757		
4.692308	0.025000	0.048933	0.001783		
4.769231	0.025000	0.049731	0.001809		
4.846154	0.025000	0.050529	0.001834		
4.923077	0.025000	0.051327	0.001860		

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    5.000000  0.025000  0.052125  0.001892
    5.000000  0.025000  0.109463  0.001892
    END FTABLE  6
    FTABLE      5
     27    6
       Depth      Area    Volume  Outflow1  Outflow2  outflow 3 Velocity  Travel
  Time***
        (ft)   (acres) (acre-ft)   (cfs)      (cfs)     (cfs)   (ft/sec)
  (Minutes)***
    0.000000  0.025000  0.000000  0.000000  0.000000  0.000000
    0.076923  0.025000  0.001923  0.000000  0.133981  0.000000
    0.153846  0.025000  0.003846  0.000000  0.138944  0.000000
    0.230769  0.025000  0.005769  0.000000  0.143906  0.000000
    0.307692  0.025000  0.007692  0.000000  0.148868  0.000000
    0.384615  0.025000  0.009615  0.000000  0.153831  0.000000
    0.461538  0.025000  0.011538  0.000000  0.158793  0.000000
    0.538462  0.025000  0.013462  0.000000  0.163755  0.000000
    0.615385  0.025000  0.015385  0.000000  0.168717  0.000000
    0.692308  0.025000  0.017308  0.000000  0.173680  0.000000
    0.769231  0.025000  0.019231  0.000000  0.178642  0.000000
    0.846154  0.025000  0.021154  0.000000  0.183604  0.000000
    0.923077  0.025000  0.023077  0.000000  0.188566  0.000000
    1.000000  0.025000  0.025000  0.000000  0.193529  0.000000
    1.076923  0.025000  0.026923  0.225672  0.198491  0.000000
    1.153846  0.025000  0.028846  0.627270  0.203453  0.000000
    1.230769  0.025000  0.030769  1.099144  0.208416  0.000000
    1.307692  0.025000  0.032692  1.551565  0.213378  0.000000
    1.384615  0.025000  0.034615  1.905359  0.218340  0.000000
    1.461538  0.025000  0.036538  2.127417  0.223302  0.000000
    1.538462  0.025000  0.038462  2.311197  0.228265  0.000000
    1.615385  0.025000  0.040385  2.470773  0.233227  0.000000
    1.692308  0.025000  0.042308  2.620651  0.238189  0.000000
    1.769231  0.025000  0.044231  2.762408  0.243151  0.000000
    1.846154  0.025000  0.046154  2.897238  0.248114  0.000000
    1.923077  0.025000  0.048077  3.026067  0.253076  0.000000
    2.000000  0.025000  0.050000  3.149630  0.258038  0.000000
    END FTABLE  5
    FTABLE      7
     92    4
       Depth      Area    Volume  Outflow1 Velocity  Travel Time***
        (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
    0.000000  0.041139  0.000000  0.000000
    0.066667  0.041139  0.002743  0.001341
    0.133333  0.041139  0.005485  0.001897
    0.200000  0.041139  0.008228  0.002323
    0.266667  0.041139  0.010970  0.002682
    0.333333  0.041139  0.013713  0.002999
    0.400000  0.041139  0.016455  0.003285
    0.466667  0.041139  0.019198  0.003548
    0.533333  0.041139  0.021941  0.003793
    0.600000  0.041139  0.024683  0.004023
    0.666667  0.041139  0.027426  0.004241
    0.733333  0.041139  0.030168  0.004448
    0.800000  0.041139  0.032911  0.004646
    0.866667  0.041139  0.035654  0.004835
    0.933333  0.041139  0.038396  0.005018
    1.000000  0.041139  0.041139  0.005194
    1.066667  0.041139  0.043881  0.005364
    1.133333  0.041139  0.046624  0.005530
    1.200000  0.041139  0.049366  0.005690
    1.266667  0.041139  0.052109  0.005846
    1.333333  0.041139  0.054852  0.005998
    1.400000  0.041139  0.057594  0.006146
    1.466667  0.041139  0.060337  0.006290
    1.533333  0.041139  0.063079  0.006432
    1.600000  0.041139  0.065822  0.006570
    1.666667  0.041139  0.068564  0.006706
    1.733333  0.041139  0.071307  0.006838
    1.800000  0.041139  0.074050  0.006969
    1.866667  0.041139  0.076792  0.007097
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1.933333	0.041139	0.079535	0.007222
2.000000	0.041139	0.082277	0.007346
2.066667	0.041139	0.085020	0.007467
2.133333	0.041139	0.087762	0.007587
2.200000	0.041139	0.090505	0.007704
2.266667	0.041139	0.093248	0.007820
2.333333	0.041139	0.095990	0.007934
2.400000	0.041139	0.098733	0.008047
2.466667	0.041139	0.101475	0.008158
2.533333	0.041139	0.104218	0.008267
2.600000	0.041139	0.106961	0.008375
2.666667	0.041139	0.109703	0.008482
2.733333	0.041139	0.112446	0.008587
2.800000	0.041139	0.115188	0.008691
2.866667	0.041139	0.117931	0.008794
2.933333	0.041139	0.120673	0.008896
3.000000	0.041139	0.123416	0.008997
3.066667	0.041139	0.126159	0.009096
3.133333	0.041139	0.128901	0.009194
3.200000	0.041139	0.131644	0.009292
3.266667	0.041139	0.134386	0.009388
3.333333	0.041139	0.137129	0.009483
3.400000	0.041139	0.139871	0.009578
3.466667	0.041139	0.142614	0.009671
3.533333	0.041139	0.145357	0.009764
3.600000	0.041139	0.148099	0.009855
3.666667	0.041139	0.150842	0.009946
3.733333	0.041139	0.153584	0.010036
3.800000	0.041139	0.156327	0.010125
3.866667	0.041139	0.159069	0.010214
3.933333	0.041139	0.161812	0.010301
4.000000	0.041139	0.164555	0.010388
4.066667	0.041139	0.167297	0.010475
4.133333	0.041139	0.170040	0.010560
4.200000	0.041139	0.172782	0.010645
4.266667	0.041139	0.175525	0.010729
4.333333	0.041139	0.178268	0.010812
4.400000	0.041139	0.181010	0.010895
4.466667	0.041139	0.183753	0.010978
4.533333	0.041139	0.186495	0.011059
4.600000	0.041139	0.189238	0.011140
4.666667	0.041139	0.191980	0.011221
4.733333	0.041139	0.194723	0.011301
4.800000	0.041139	0.197466	0.011380
4.866667	0.041139	0.200208	0.011459
4.933333	0.041139	0.202951	0.011537
5.000000	0.041139	0.205693	0.011614
5.066667	0.041139	0.208436	0.018698
5.133333	0.041139	0.211178	0.021677
5.200000	0.041139	0.213921	0.023980
5.266667	0.041139	0.216664	0.025934
5.333333	0.041139	0.219406	0.027663
5.400000	0.041139	0.222149	0.029233
5.466667	0.041139	0.224891	0.030682
5.533333	0.041139	0.227634	0.096576
5.600000	0.041139	0.230376	0.366832
5.666667	0.041139	0.233119	0.737953
5.733333	0.041139	0.235862	1.150711
5.800000	0.041139	0.238604	1.546453
5.866667	0.041139	0.241347	1.872375
5.933333	0.041139	0.244089	2.098905
6.000000	0.041139	0.246832	2.243195
6.066667	0.041139	0.249575	2.411776

END FTABLE 7
FTABLE 8
92 4

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.023508	0.000000	0.000000		
0.066667	0.023508	0.001567	0.001341		

0.133333	0.023508	0.003134	0.001897
0.200000	0.023508	0.004702	0.002323
0.266667	0.023508	0.006269	0.002682
0.333333	0.023508	0.007836	0.002999
0.400000	0.023508	0.009403	0.003285
0.466667	0.023508	0.010970	0.003548
0.533333	0.023508	0.012537	0.003793
0.600000	0.023508	0.014105	0.004023
0.666667	0.023508	0.015672	0.004241
0.733333	0.023508	0.017239	0.004448
0.800000	0.023508	0.018806	0.004646
0.866667	0.023508	0.020373	0.004835
0.933333	0.023508	0.021941	0.005018
1.000000	0.023508	0.023508	0.005194
1.066667	0.023508	0.025075	0.005364
1.133333	0.023508	0.026642	0.005530
1.200000	0.023508	0.028209	0.005690
1.266667	0.023508	0.029777	0.005846
1.333333	0.023508	0.031344	0.005998
1.400000	0.023508	0.032911	0.006146
1.466667	0.023508	0.034478	0.006290
1.533333	0.023508	0.036045	0.006432
1.600000	0.023508	0.037612	0.006570
1.666667	0.023508	0.039180	0.006706
1.733333	0.023508	0.040747	0.006838
1.800000	0.023508	0.042314	0.006969
1.866667	0.023508	0.043881	0.007097
1.933333	0.023508	0.045448	0.007222
2.000000	0.023508	0.047016	0.007346
2.066667	0.023508	0.048583	0.007467
2.133333	0.023508	0.050150	0.007587
2.200000	0.023508	0.051717	0.007704
2.266667	0.023508	0.053284	0.007820
2.333333	0.023508	0.054852	0.007934
2.400000	0.023508	0.056419	0.008047
2.466667	0.023508	0.057986	0.008158
2.533333	0.023508	0.059553	0.008267
2.600000	0.023508	0.061120	0.008375
2.666667	0.023508	0.062687	0.008482
2.733333	0.023508	0.064255	0.008587
2.800000	0.023508	0.065822	0.008691
2.866667	0.023508	0.067389	0.008794
2.933333	0.023508	0.068956	0.008896
3.000000	0.023508	0.070523	0.008997
3.066667	0.023508	0.072091	0.009096
3.133333	0.023508	0.073658	0.009194
3.200000	0.023508	0.075225	0.009292
3.266667	0.023508	0.076792	0.009388
3.333333	0.023508	0.078359	0.009483
3.400000	0.023508	0.079927	0.009578
3.466667	0.023508	0.081494	0.009671
3.533333	0.023508	0.083061	0.009764
3.600000	0.023508	0.084628	0.009855
3.666667	0.023508	0.086195	0.009946
3.733333	0.023508	0.087762	0.010036
3.800000	0.023508	0.089330	0.010125
3.866667	0.023508	0.090897	0.010214
3.933333	0.023508	0.092464	0.010301
4.000000	0.023508	0.094031	0.010388
4.066667	0.023508	0.095598	0.010475
4.133333	0.023508	0.097166	0.010560
4.200000	0.023508	0.098733	0.010645
4.266667	0.023508	0.100300	0.010729
4.333333	0.023508	0.101867	0.010812
4.400000	0.023508	0.103434	0.010895
4.466667	0.023508	0.105002	0.010978
4.533333	0.023508	0.106569	0.011059
4.600000	0.023508	0.108136	0.011140
4.666667	0.023508	0.109703	0.011221
4.733333	0.023508	0.111270	0.011301

```
    4.800000  0.023508  0.112837  0.011380
    4.866667  0.023508  0.114405  0.011459
    4.933333  0.023508  0.115972  0.011537
    5.000000  0.023508  0.117539  0.011614
    5.066667  0.023508  0.119106  0.018698
    5.133333  0.023508  0.120673  0.021677
    5.200000  0.023508  0.122241  0.023980
    5.266667  0.023508  0.123808  0.025934
    5.333333  0.023508  0.125375  0.027663
    5.400000  0.023508  0.126942  0.029233
    5.466667  0.023508  0.128509  0.030682
    5.533333  0.023508  0.130077  0.096576
    5.600000  0.023508  0.131644  0.366832
    5.666667  0.023508  0.133211  0.737953
    5.733333  0.023508  0.134778  1.150711
    5.800000  0.023508  0.136345  1.546453
    5.866667  0.023508  0.137912  1.872375
    5.933333  0.023508  0.139480  2.098905
    6.000000  0.023508  0.141047  2.243195
    6.066667  0.023508  0.142614  2.411776
  END FTABLE  8
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC      ENGL    1             PERLND   1 999 EXTNL  PREC
WDM      2 PREC      ENGL    1             IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP      ENGL    1             PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP      ENGL    1             IMPLND   1 999 EXTNL  PETINP
WDM      2 PREC      ENGL    1             RCHRES   1     EXTNL  PREC
WDM      2 PREC      ENGL    1             RCHRES   3     EXTNL  PREC
WDM      2 PREC      ENGL    1             RCHRES   5     EXTNL  PREC
WDM      1 EVAP      ENGL    0.5           RCHRES   1     EXTNL  POTEV
WDM      1 EVAP      ENGL    0.7           RCHRES   2     EXTNL  POTEV
WDM      1 EVAP      ENGL    0.5           RCHRES   3     EXTNL  POTEV
WDM      1 EVAP      ENGL    0.7           RCHRES   4     EXTNL  POTEV
WDM      1 EVAP      ENGL    0.5           RCHRES   5     EXTNL  POTEV
WDM      1 EVAP      ENGL    0.7           RCHRES   6     EXTNL  POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   6 HYDR   RO      1 1        1     WDM   1018 FLOW     ENGL      REPL
RCHRES   6 HYDR   STAGE   1 1        1     WDM   1019 STAG     ENGL      REPL
RCHRES   5 HYDR   STAGE   1 1        1     WDM   1020 STAG     ENGL      REPL
RCHRES   5 HYDR   O       1 1        1     WDM   1021 FLOW     ENGL      REPL
COPY     1 OUTPUT MEAN    1 1     12.1     WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN    1 1     12.1     WDM    801 FLOW     ENGL      REPL
RCHRES   7 HYDR   RO      1 1        1     WDM   1022 FLOW     ENGL      REPL
RCHRES   7 HYDR   STAGE   1 1        1     WDM   1023 STAG     ENGL      REPL
COPY     2 OUTPUT MEAN    1 1     12.1     WDM    702 FLOW     ENGL      REPL
COPY   502 OUTPUT MEAN    1 1     12.1     WDM    802 FLOW     ENGL      REPL
RCHRES   8 HYDR   RO      1 1        1     WDM   1024 FLOW     ENGL      REPL
RCHRES   8 HYDR   STAGE   1 1        1     WDM   1025 STAG     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        2
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    3
```

```
  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK        6
RCHRES     ROFLOW                          RCHRES         INFLOW
  END MASS-LINK    6

  MASS-LINK        7
RCHRES     OFLOW  OVOL   1                 RCHRES         INFLOW IVOL
  END MASS-LINK    7

  MASS-LINK        8
RCHRES     OFLOW  OVOL   2                 RCHRES         INFLOW IVOL
  END MASS-LINK    8

  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15

  MASS-LINK       16
RCHRES     ROFLOW                          COPY           INPUT  MEAN
  END MASS-LINK   16

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK   17

END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

```
ERROR/WARNING ID:   238   1

The continuity error reported below is greater than 1 part in 1000 and is
therefore considered high.

Did you specify any "special actions"?  If so, they could account for it.

Relevant data are:
DATE/TIME: 1979/ 7/31 24: 0

RCHRES :    1

RELERR       STORS        STOR       MATIN      MATDIF
-1.000E+00     0.00000  0.0000E+00     0.00000  2.5841E-12

Where:

RELERR is the relative error (ERROR/REFVAL).
ERROR  is (STOR-STORS) - MATDIF.
REFVAL is the reference value (STORS+MATIN).
STOR   is the storage of material in the processing unit (land-segment or
reach/reservior) at the end of the present interval.
STORS  is the storage of material in the pu at the start of the present
printout reporting period.
MATIN  is the total inflow of material to the pu during the present printout
reporting period.
MATDIF is the net inflow (inflow-outflow) of material to the pu during the
present printout reporting period.
```

```
ERROR/WARNING ID:   238   1

The continuity error reported below is greater than 1 part in 1000 and is
therefore considered high.

Did you specify any "special actions"?  If so, they could account for it.

Relevant data are:
DATE/TIME: 1979/ 7/31 24: 0

RCHRES :    3

RELERR       STORS        STOR       MATIN      MATDIF
-1.000E+00     0.00000  0.0000E+00     0.00000  1.6407E-12

Where:

RELERR is the relative error (ERROR/REFVAL).
ERROR  is (STOR-STORS) - MATDIF.
REFVAL is the reference value (STORS+MATIN).
STOR   is the storage of material in the processing unit (land-segment or
reach/reservior) at the end of the present interval.
STORS  is the storage of material in the pu at the start of the present
printout reporting period.
MATIN  is the total inflow of material to the pu during the present printout
reporting period.
MATDIF is the net inflow (inflow-outflow) of material to the pu during the
present printout reporting period.
```

```
ERROR/WARNING ID:   238   1

The continuity error reported below is greater than 1 part in 1000 and is
therefore considered high.

Did you specify any "special actions"?  If so, they could account for it.

Relevant data are:
```

DATE/TIME: 1979/ 7/31 24: 0

RCHRES : 7

RELERR	STORS	STOR	MATIN	MATDIF
-1.000E+00	0.00000	0.0000E+00	0.00000	2.0509E-12

Where:

RELERR is the relative error (ERROR/REFVAL).
ERROR is (STOR-STORS) - MATDIF.
REFVAL is the reference value (STORS+MATIN).
STOR is the storage of material in the processing unit (land-segment or reach/reservior) at the end of the present interval.
STORS is the storage of material in the pu at the start of the present printout reporting period.
MATIN is the total inflow of material to the pu during the present printout reporting period.
MATDIF is the net inflow (inflow-outflow) of material to the pu during the present printout reporting period.

Disclaimer

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

Indicate which Items are Included behind this cover sheet:

Attachment Sequence	**Contents**	**Checklist**
Attachment 2a	Hydromodification Management Exhibit (Required)	☐ Included See Hydromodification Management Exhibit Checklist on the back of this Attachment cover sheet.
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, including Structural BMP Drawdown Calculations and Overflow Design Summary (Required) See Chapter 6 and Appendix G of the BMP Design Manual	☐ Included ☐ Submitted as separate stand-alone document
Attachment 2e	Vector Control Plan (Required when structural BMPs will not drain in 96 hours)	☐ Included ☐ Not required because BMPs will drain in less than 96 hours

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
- ☐ 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, and size/detail)

ATTACHMENT 3

Structural BMP Maintenance Information

This is the cover sheet for Attachment 3.

MAINTENANCE

MWS – Linear

Hybrid Stormwater Filtration System

Modular Wetland Systems, Inc.
P.O. Box 869
Oceanside, CA 92049

www.modularwetlands.com
P 760-433-7640
F 760-433-3179

MAINTENANCE

Maintenance Summary –

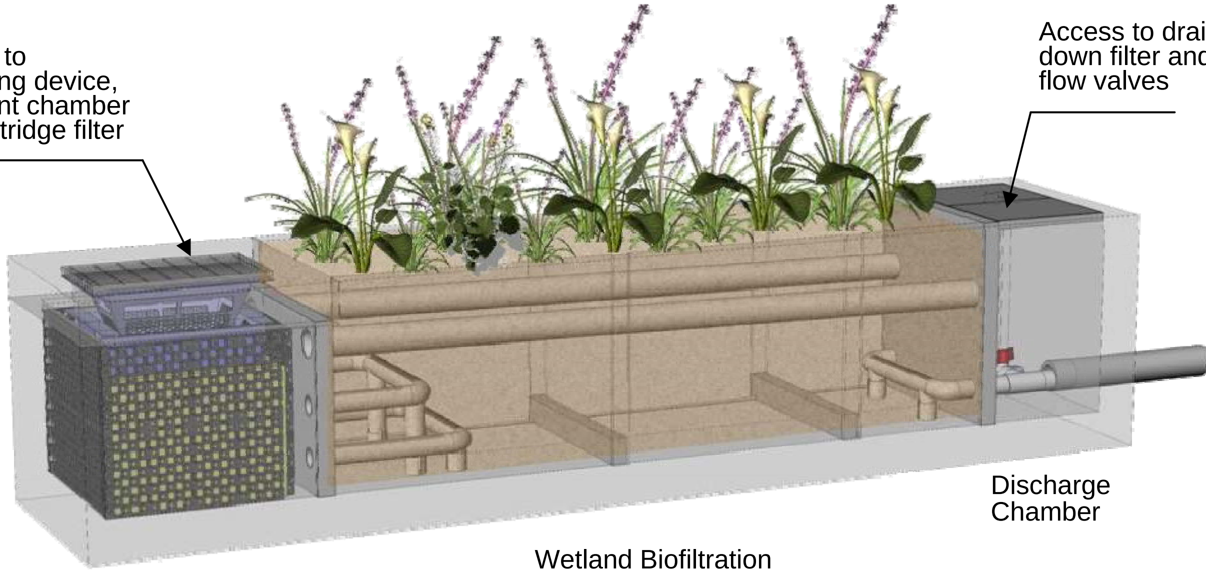
- **<u>Clean Bio Clean® Catch Basin Filter</u> – average maintenance interval is 3 to 6 months.**
    - ***(15 minute service time).***
- **<u>Clean Separation (sediment) Chamber</u> – average maintenance interval is 6 to 18 months.**
    - ***(30 minute service time).***
- **<u>Replace Cartridge Filter Media (BioMediaGREEN™)</u> – average maintenance interval 6 – 12 months.**
    - ***(45 minute service time).***
- **<u>Replace Drain Down Filter Media (BioMediaGREEN™)</u> – average maintenance interval is 6 to 12 months.**
    - ***(5 minute service time).***
- **<u>Trim Vegetations</u> – average maintenance interval is 3 to 6 months.**
    - ***(15 minute service time).***
- **<u>Evaluate Wetland Media Flow Hydraulic Conductivity</u> – average inspection interval is once per year.**
    - ***(5 minute inspection time).***
- **<u>Wetland Media Replacement</u> – average maintenance interval is 5 to 20 years.**
    - ***(6 hours).***

For more information on maintenance procedures, to order replacement media or find an authorized service company please contact:

Modular Wetland Systems, Inc
2972 San Luis Rey Road
Oceanside, CA 92058

Phone: 760-433-7640
Fax: 760-433-3176
Email: info@modularwetlands.com

System Diagram –



Maintenance Overview –

A. Every installed MWS – Linear unit is to be maintained by the Supplier, or a Supplier approved contractor. The cost of this service varies among providers.

B. The MWS – Linear is a multi-stage self-contained treatment train for stormwater treatment. Each stage protects subsequent stages from clogging. Stages include: screening, separation, cartridge media filtration, and biofiltration. The biofiltration stage contains various types of vegetation which will require annual evaluation and trimming.

> **1. <u>Clean Bio Clean® Catch Basin Filter</u> –** Screening is provided by well proven catch basin filter. The filter has a trash and sediment capacity of 2 (curb type) and 4 (grate type) cubic feet. The filter removes gross solids, including litter, and sediments greater than 200 microns. This procedure is easily done by hand or with a small industrial vacuum device. This filter is located directly under the manhole or grate access cover.
>
> **2. <u>Clean Separation (sediment) Chamber</u> –** separation occurs in the pre-treatment chamber located directly under the curb or grated inlet. This chamber has a capacity of approximately 21 cubic feet for trash, debris and sediments. This chamber targets TSS, and particulate metals and nutrients. This procedure can be performed with a standard vacuum truck. This chamber is located directly under the manhole or grate access cover.

3. Replace Cartridge Filter Media (BioMediaGREEN™) – Primary filtration is provided by a horizontal flow cartridge filter utilizing BioMediaGREEN blocks. Each cartridge has a media surface area of 35 square feet. The large surface area will insure long term operation without clogging. The cartridge filter with BioMediaGREEN targets fine TSS, metals, nutrients, hydrocarbons, turbidity and bacteria. Media life depends on local loading conditions and can easily be replaced and disposed of without any equipment. The filters are located in the pre-treatment chamber. Entry into chamber required to replace BioMediaGREEN blocks. Each cartridge contain 14 pieces of 20" tall BioMediaGREEN.

4. Replace Drain Down Filter Media (BioMediaGREEN™) – A drain down filter, similar in function to the perimeter filter is located in the discharge chamber. This filter allows standing water to be drained and filtered out of the separation chamber. This addresses any vector issues, by eliminating all standing water within this system. Replacement of media takes approximately 5 minutes and is performed without any equipment.

5. Trim Vegetations – The system utilizes multiple plants in the biofiltration chamber to provide enhanced treatment for dissolved pollutants including nutrients and metals. The vegetation will need to be maintained (trimmed) as needed. This can be done as part of the project normal landscape maintenance. **NO FERTILIZER SHALL BE USED IN THIS CHAMBER.**

6. Evaluate Wetland Media Flow Hydraulic Conductivity – The systems flow can be assessed from the discharge chamber. This should be done during a rain event. By viewing into the discharge chamber the flow out of the system can be observed. If little to know flow is observed from the lower valve or orifice plate this is a sign of potential wetland media (biofiltration) maintenance needs.

7. Wetland Media Replacement – biofiltration is provided by an advance horizontal flow vegetated wetland. This natural filter contains a mix of sorptive media that supports abundant plant life. This biofilter targets the finest TSS, dissolved nutrients, dissolved metals, organics, pesticides, oxygen demanding substances and bacteria. This filter provides the final polishing step of treatment. If prior treatment stages are properly maintained, the life of this media can be up to 20 years. Replacement of the media is simple. Removal of spent media can be done with a shovel of a vacuum truck.

C. The MWS – Linear catch basin filter, separation chamber, cartridge filter media and wetland media are designed to allow for the use of vacuum removal of captured pollutants and spent filter media by centrifugal compressor vacuum units without causing damage to the filter or during normal cleaning and maintenance. Filter and chambers can be cleaned from finish surface through standard manhole or grate access.

Maintenance Procedures –

1. <u>Clean Bio Clean® Catch Basin Filter</u> – Modular Wetland Systems, Inc. recommends the **catch basin filter** be inspected and cleaned a minimum of once every six months and replacement of hydrocarbon booms once a year. The procedure is easily done with the use of any standard vacuum truck. *This procedure takes approximately 15 minutes.*

1. Remove grate or manhole to gain access to catch basin filter insert. Remove the deflector shield (grate type only) with the hydrocarbon boom attached. Where possible the maintenance should be performed from the ground surface. Note: entry into an underground stormwater vault such as an inlet vault requires certification in confined space training.
2. Remove all trash, debris, organics, and sediments collected by the inlet filter insert. Removal of the trash and debris can be done manually or with the use of a vacuum truck. The hose of the vacuum truck will not damage the screen of the filter.
3. Evaluation of the hydrocarbon boom shall be performed at each cleaning. If the boom is filled with hydrocarbons and oils it should be replaced. Attach new boom to basket with plastic ties through pre-drilled holes in basket. Place the deflector shield (grate type only) back into the filter.
4. Transport all debris, trash, organics and sediments to approved facility for disposal in accordance with local and state requirements.
5. The hydrocarbon boom may be classified as hazardous material and will have to be picked up and disposed of as hazardous waste. Hazardous material can only be handled by a certified hazardous waste trained person (minimum 24-hour hazwoper).

2. <u>Clean Separation (sediment) Chamber</u> – Modular Wetland Systems, Inc. recommends the **separation chamber** be inspected and cleaned a minimum of once a year. The procedure is easily done with the use of any standard vacuum truck. *This procedure takes approximately 30 minutes.*

1. Remove grate or manhole to gain access to the catch basin filter.
2. Remove catch basin filter. Where possible the maintenance should be performed from the ground surface. Note: entry into an underground stormwater vault such as an inlet vault requires certification in confined space training.
3. With a pressure washer spray down pollutants accumulated on walls and cartridge filters.
4. Vacuum out separation chamber and remove all accumulated debris and sediments.
5. Replace catch basin filter, replace grate or manhole cover.
6. Transport all debris, trash, organics and sediments to approved facility for disposal in accordance with local and state requirements.

3. <u>Replace Cartridge Filter Media (BioMediaGREEN™)</u> – Modular Wetland Systems, Inc. recommends the **cartridge filters** media be inspected and cleaned a minimum of once a year. The procedure will require prior maintenance of separation chamber. *Replacement of media takes approximately 45 minutes.*

1. Remove grate or manhole to gain access to the catch basin filter.
2. Remove catch basin filter. Where possible the maintenance should be performed from the ground surface. Note: entry into an underground stormwater vault such as an inlet vault requires certification in confined space training.
3. Enter separation chamber.
4. Unscrew the two ½" diameter bolts holding the lid on each cartridge filter and remove lid and place outside of unit.
5. Remove each of the 14 BioMediaGREEN filter blocks in each cartridge and remove from chamber for disposal.
6. Spray down the outside and inside of the cartridge filter to remove any accumulated sediments.
7. Replace with new BioMediaGREEN filter blocks insuring the blocks are properly lined up and seated in the bottom.
8. Replace the lid and tighten down bolts.
9. Replace catch basin filter, replace grate or manhole cover.
10. Transport all debris, trash, organics, spent media and sediments to approved facility for disposal in accordance with local and state requirements.

4. <u>Replace Drain Down Filter Media (BioMediaGREEN™)</u> – Modular Wetland Systems, Inc. recommends the **drain down filter** be inspected and maintained a minimum of once a year. *Replacement of media takes approximately 5 minutes.*

1. Open hatch of discharge chamber
2. Enter chamber, unlatch drain down filter cover.
3. Remove BioMediaGREEN filter block
4. Replace with new block, replace and latch cover.
5. Exit chamber, close and lock down the hatch.
6. Transport spent media to approved facility for disposal in accordance with local and state requirements.

5. <u>Trim Vegetations</u> – Modular Wetland Systems, Inc. recommends the plants/vegetation be inspected and maintained a minimum of once a year. It is also recommended that the plants receive the same care as other landscaped areas. **Note: No fertilizer is to be used on this area.** *Trimming of vegetation takes approximately 15 minutes.*

<u>6. Evaluate Wetland Media Flow Hydraulic Conductivity</u> – Modular Wetland Systems, Inc. recommends system flow be inspected and observed a minimum of once a year. This needs to be done during a rain event. *Inspection and Observation takes approximately 5 minutes.*

1. Open hatch of discharge chamber
2. Observe the level of flow from the bottom valve or orifice plate.
3. If flow is steady and high the system is operating normally.

4. If little or no flow is observed exiting the valve possible maintenance to the biofiltration wetland chamber may be needed. Contact Modular Wetlands for further assistance.
5. Exit chamber, close and lock down the hatch.

7. Wetland Media Replacement – Modular Wetland Systems, Inc. recommends the wetland media be replaced a minimum of one every 20 years. *Inspection takes approximately 15 minutes. Replacement of rock media takes approximately 6 hours and requires a vacuum truck.*

1. Remove plants from the wetland chamber.
2. Use a vacuum truck or shovel to remove all wetland media.
3. Spray down the walls and floor of the chamber and vacuum out any accumulated pollutants.
4. Spray down perforated piping and netting of flow matrix and the inflow and outflow end to remove any accumulated pollutants.
5. Vacuum out any standing water from the media removal and insure the chamber is cleaning.
6. Use a small backhoe to fill chamber with new media. Call Modular Wetland Systems, Inc. for media delivery information.
7. Install BioMediaGREEN filter blocks across over the entire filter bed. Fill with media until 9” from top. The install filter blocks which are 3” thick. Fill the top 6” inches with wetland media.
8. Plant new vegetation in the same configuration and quantity as old vegetation. Dig down until the BioMediaGREEN is exposed. Cut out a small circle of the BioMediaGREEN. Remove plant from container including soil ball and place in the whole cut out of the BioMediaGREEN. Cover up with wetland media.
9. Spray down the plants and media with water to saturate.
10. Continue supplemental irrigation (spray or drip) for at lest 90 days.

7. Other Maintenance Notes –

1. Following maintenance and/or inspection, the maintenance operator shall prepare a maintenance/inspection record. The record shall include any maintenance activities performed, amount and description of debris collected, and condition of the system and its various filter mechanism. .
2. The owner shall retain the maintenance/inspection record for a minimum of five years from the date of maintenance. These records shall be made available to the governing municipality for inspection upon request at any time.
3. Any person performing maintenance activities must have completed a minimum of OSHA 24-hour hazardous waste worker (hazwoper) training.
4. Remove access manhole lid or grate to gain access to filter screens and sediment chambers. Where possible the maintenance should be performed from the ground surface. Note: entry into an underground stormwater vault such as an inlet vault requires certification in confined space training.
5. Transport all debris, trash, organics and sediments to approved facility for disposal in accordance with local and state requirements.
6. The hydrocarbon boom is classified as hazardous material and will have to be picked up and disposed of as hazardous waste. Hazardous material can only be handled by a certified hazardous waste trained person (minimum 24-hour hazwoper).

Maintenance Sequence –

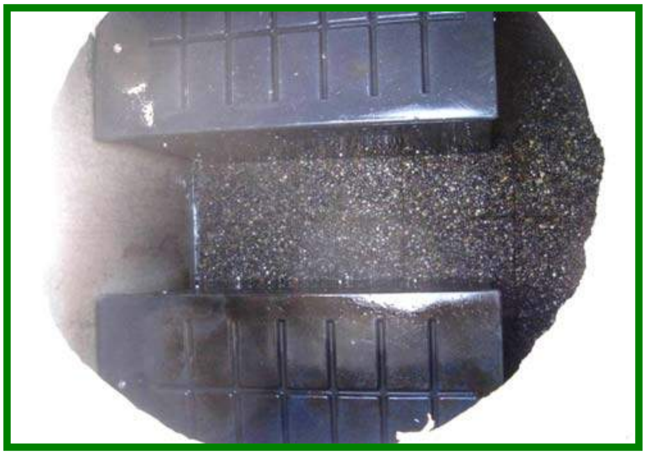
Access Pre-Treatment Chamber by Removing Manhole or Grate Cover

Assess Pollutant Loading in Catch Basin Filter and Sediment Chamber

Vacuum Catch Basin Filter

Remove Catch Basin Filter

Vacuum out the Sediment Chamber



Enter Chamber Remove Lids of Cartridge Filters

Remove Spent BioMediaGREEN Filter Blocks

Spray Down and Clean Cartridge Filter Housing

Replace with New BioMediaGREEN Filter Blocks and Replace Lid, then Catch Basin Filter and Replace Manhole or Grate

Open Discharge Chamber Lid to Asses Wetland Media Flow Rate and Replace Drain Down Filter Near Bottom

Evaluate Vegetation and Trim if Needed. Maintenance Complete.

Please Contact Modular Wetland Systems, Inc. for More Information:

760-433-7640

info@modularwetlands.com

Stormwater Management Fact Sheet: Bioretention

Description

Bioretention areas are landscaping features adapted to treat stormwater runoff on the development site. They are commonly located in parking lot islands or within small pockets in residential land uses. Surface runoff is directed into shallow, landscaped depressions. These depressions are designed to incorporate many of the pollutant removal mechanisms that operate in forested ecosystems. During storms, runoff ponds above the mulch and soil in the system. Runoff from larger storms is generally diverted past the facility to the storm drain system. The remaining runoff filters through the mulch and prepared soil mix. Typically, the filtered runoff is collected in a perforated underdrain and returned to the storm drain system. For more information see *Bioretention as a Water Quality Best Management Practice*, Article 110 in the Practice of Watershed Protection.

Applicability

Bioretention systems are generally applied to small sites, but can be applied to a wide range of development. Bioretention can be applied in many climate and geologic situations, with some minor design modifications.

Regional Applicability
Bioretention systems are applicable almost everywhere in the United States. In arid or cold climates, however, some minor design modifications may be needed.

Ultra Urban Areas
Ultra urban areas are densely developed urban areas in which little pervious surface exists. Bioretention facilities are ideally suited to many ultra urban areas, such as parking lots. While they consume a fairly large amount of space (approximately 5% of the area that drains to them), they can fit into existing parking lot islands or other landscaped areas.

Stormwater Hotspots
Stormwater hotspots are areas where land use or activities generate highly contaminated runoff, with concentrations of pollutants in excess of those typically found in stormwater. A typical example is a gas station or convenience store parking lot. Bioretention areas can be used to treat stormwater hotspots as long as an impermeable liner is used at the bottom of the filter bed.

Stormwater Retrofit
A stormwater retrofit is a stormwater management practice (usually structural) put into place after development has occurred, to improve water quality, protect downstream channels, reduce flooding, or meet other objectives. Bioretention can be used as a stormwater retrofit, by modifying existing landscaped areas, or if a parking lot is being resurfaced. In highly urban watersheds, they are one of the few retrofit options that can be employed. However, it is very expensive to retrofit an entire watershed using bioretention areas since they treat small sites.

Cold Water (Trout) Streams
The species in cold water streams, notably trout, are extremely sensitive to changes in temperature. In order to protect these resources, designers should avoid treatment practices that increase the temperature of the stormwater runoff they treat. Bioretention is a good option in cold water streams because water ponds in them for only a short time, decreasing the potential for stream warming.

Siting and Design Considerations

Designers need to consider conditions at the site level and must incorporate design features to improve the longevity and performance of the practice, while minimizing the maintenance burden.

Siting
Some considerations selecting a stormwater treatment practice are the drainage area the practice will need to treat, the slopes both at the location of the practice and draining to it, soil and subsurface conditions, and the depth of the seasonably high groundwater table. Bioretention can be applied on many sites, with its primary restriction being the need to apply the practice on small sites.

Drainage Area

Bioretention areas should usually be used on small sites (i.e., five acres or less). When used to treat larger areas, they tend to clog. In addition, it is difficult to convey flow from a large area to a bioretention area.

Slope

Bioretention areas are best applied to relatively shallow slopes (usually about 5%). Sufficient slope is needed at the site to ensure that the runoff that enters a bioretention area can be connected with the storm drain system. It is important to note, however, that these bioretention areas are most often applied to parking lots or residential landscaped areas, which generally have gentle slopes.

Soils /Topography

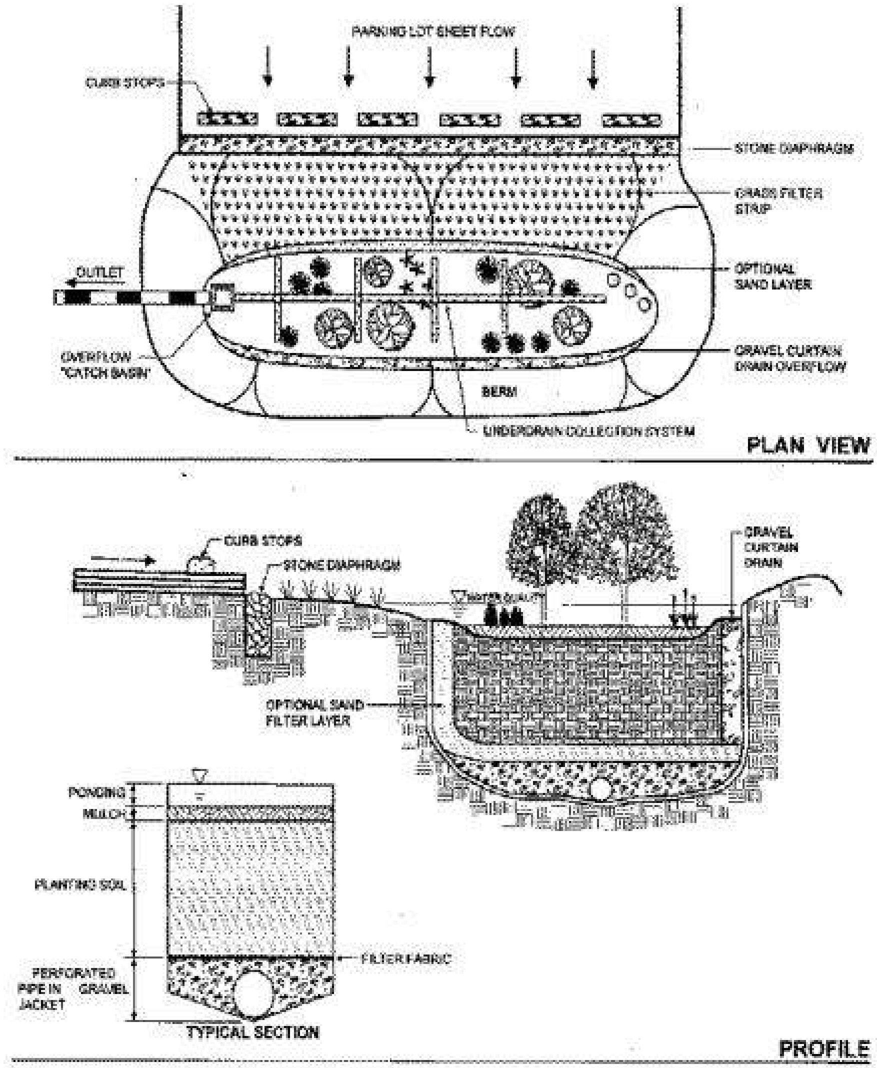
Bioretention areas can be applied in almost any soils or topography, since runoff percolates through a made soil bed, and is returned to the stormwater system.

Groundwater

Bioretention should be separated from the watertable to ensure that the groundwater never intersects with the bottom of the bioretention area, which prevents possible groundwater contamination and practice failure.

Design Considerations

Specific designs may vary considerably, depending on site constraints or preferences of the designer or community, but some features, should be incorporated into all bioretention areas. These design features can be divided into five basic categories: *pretreatment, treatment*, *conveyance*, *maintenance reduction*, and *landscaping (*for more information see the Manual Builder Category) (see Figure 1).



Pretreatment

Pretreatment refers to features of a bioretention area that capture and remove coarse sediment particles. Incorporating pretreatment helps to reduce the maintenance burden of bioretention, and reduces the likelihood that the soil bed will clog over time. Several different mechanisms are used to provide pretreatment in bioretention areas. Runoff can be directed to a grass channel or filter strip to settle out coarse sediments before the runoff flows into the filter bed of the bioretention area. Other features may include a pea gravel diaphragm, which acts to spread flow evenly and drop out larger particles.

Treatment

Treatment features enhance the ability of a stormwater treatment practice to remove pollutants. Several basic features should be incorporated into bioretention areas to enhance their pollutant removal rates. The bioretention system should be sized be between 5% and 10% of the impervious area draining to it. The practice should be designed with a soil bed that is a sand/ soil matrix with a mulch layer above the soil bed. The bioretention area should be designed to pond a small depth of water (6" to 9") above the filter bed.

Conveyance

Conveyance of stormwater runoff into and through a stormwater practice is a critical component of any stormwater treatment practice. Stormwater should be conveyed to and from the practice safely and minimize erosion potential.

Bioretention areas are designed with an underdrain system to collect filtered runoff at the bottom of the filter bed and direct it to the storm drain system. An underdrain is a perforated pipe in a gravel bed, installed along the bottom of filter bed. Stormwater management practices, and used to collect and remove filtered runoff. Designers should also provide an overflow structure to convey flow from large storms (that are not treated by the bioretention area) to the storm drain system.

Maintenance Reduction

In addition to regular maintenance, bioretention areas should incorporate design features to reduce the long term maintenance of a bioretention area. Designers should ensure that the bioretention area is easily accessible for maintenance.

Landscaping

Landscaping is critical to the function and appearance of bioretention areas. It is preferred that native vegetation is used for landscaping, where possible. Plants should be selected that can withstand the hydrologic regime they will experience (i.e., plants that tolerate both wet and dry conditions). At the edges, which will remain primarily dry, upland species will be the most resilient. Finally, it is best to select a combination of trees, shrubs, and herbaceous materials.

Design Variations

One design alternative to bioretention areas is the use of a "partial exfiltration" system, which promotes greater groundwater recharge (see below).

Partial Exfiltration

In this design variation, the underdrain of a bioretention area only is only installed on part of the bottom of the system. This design allows for greater infiltration of stormwater runoff, with the underdrain acting as more of an overflow. This system can be applied only when the soils and other characteristics are appropriate for infiltration (for more information see the Infiltration Trench and Infiltration Basin Fact Sheet in the Fact Sheet Category).

Arid Climates

In arid climates, bioretention areas should be landscaped with drought tolerant plant species.

Cold Climates

In cold climates, bioretention areas can be used as a snow storage area. When used for this purpose, or if used to treat parking lot runoff, the bioretention area should be planted with salt tolerant, and non-woody plant species.

Limitations

Bioretention areas have a few limitations. Bioretention areas cannot be used to treat large drainage areas, limiting their usefulness for some sites. Although bioretention areas do not consume a large amount of space, incorporating bioretention into a parking lot design may reduce the number of parking spaces available. Finally, the construction cost of bioretention areas relatively high compared with other stormwater treatment practices. (See *Cost Considerations* for a more detailed explanation).

Maintenance Considerations

Bioretention requires seasonal landscaping maintenance. In many cases, bioretention areas require intense maintenance initially to establish the plants, but less maintenance is required in the long term. In many cases, maintenance tasks can be completed by a landscaping contractor, who may already be hired at the site.

Table 1. Typical Maintenance Activities for Bioretention Areas

Activity	Schedule
• Remulch void areas • Treat diseased trees and shrubs	As needed
• Water plants daily for two weeks	At project completion
• Inspect soil and repair eroded areas • Remove litter and debris	Monthly
• Remove and replace dead and diseased vegetation	Twice per year
• Add additional mulch • Replace tree stakes and wire	Once per year

Effectiveness

Structural stormwater management practices can be used to achieve four broad resource protection goals. These include: *Flood Control, Channel Protection, Groundwater Recharge,* and *Pollutant Removal*. In general, bioretention areas can only provide pollutant removal.

Groundwater Recharge
Bioretention areas do not usually recharge the groundwater, except in the case of the partial exfiltration design (see *Design Variations*).

Pollutant Removal
Little pollutant removal data has been collected on the pollutant removal effectiveness of bioretention areas. In fact only one study has been conducted (Davis *et al*., 1998). The data from this study is presented in Table 2.

Table 2. Typical Pollutant Removal Rates of Bioretention Systems

Pollutant	Pollutant Removal (%)
TSS	81
TP	29
TN	49
NOx	38
Metals	51-71
Bacteria	-58

Assuming that bioretention systems perform similarly to swales, their removal rates are relatively high (for more information, see *Comparative Pollutant Removal Capability of Stormwater Treatment Practices*, Article 64 in The Practice of Watershed Protection).

Cost Considerations

Bioretention areas are relatively expensive. The following cost equation was developed by Brown and Schueler (1997), adjusting for inflation:

$C = 7.30\ V^{0.99}$

Where:
C = Construction, Design and Permitting Cost ($)
V = Volume of water treated by the facility (cubic feet)
This amounts to about $6.80 per cubic foot of water storage.

An important consideration when evaluating the costs of bioretention is that it often replaces area that would likely be landscaped anyway. Thus, the true cost of the bioretention area may be less than the construction cost reported. Similarly, maintenance costs for bioretention areas are not very different from normal landscaping maintenance. Land consumed by bioretention areas is relatively high compared with other practices (about 5% of the drainage area). However, this land should not be considered lost, since it is often fits with existing setbacks and landscaping requirements.

References

Brown, W. and T. Schueler. 1997. The Economics of Stormwater BMPs in the Mid-Atlantic Region. Prepared for: Chesapeake Research Consortium. Edgewater, MD. Center for Watershed Protection. Ellicott City, MD.

Center for Watershed Protection (CWP), Environmental Quality Resources and Loiederman Associates. 1998. Maryland Stormwater Design Manual. Prepared for: Maryland Department of the Environment. Baltimore, MD. http://www.mde.state.md.us/environment/wma/stormwatermanual/mdswmanual.html

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Davis, A., M. Shokouhian, H. Sharma, and C. Henderson. 1998. Optimization of Bioretention Design for Water Quality and Hydrologic Characteristics. Department of Civil Engineering, University of Maryland, College Park.

Engineering Technologies Associates and Biohabitats. 1993. Design Manual for Use of Bioretention in Stormwater Management. Prepared for: Prince George's County Government; Watershed Protection Branch. Landover, MD.

Prince George's County Department of Environmental Resources. 1997. Low Impact Development. Laurel, MD

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Indicate which Items are Included behind this cover sheet:

Attachment Sequence	**Contents**	**Checklist**
Attachment 3a	Structural BMP Maintenance Thresholds and Actions (Required)	☐ Included See Structural BMP Maintenance Information Checklist on the back of this Attachment cover sheet.
Attachment 3b	Draft Maintenance Agreement (when applicable)	☐ Included ☐ Not Applicable

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

☐ **Preliminary Design / Planning / CEQA level submittal:**

Attachment 3a must identify:

- ☐ Typical maintenance indicators and actions for proposed structural BMP(s) based on Section 7.7 of the BMP Design Manual

Attachment 3b is not required for preliminary design / planning / CEQA level submittal.

☐ **Final Design level submittal:**

Attachment 3a must identify:

- ☐ Specific maintenance indicators and actions for proposed structural BMP(s). This shall be based on Section 7.7 of the BMP Design Manual and enhanced to reflect actual proposed components of the structural BMP(s)
- ☐ 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

Attachment 3b: For private entity operation and maintenance, Attachment 3b shall include a draft maintenance agreement in the local jurisdiction's standard format (PDP applicant to contact the City Engineer to obtain the current maintenance agreement forms).

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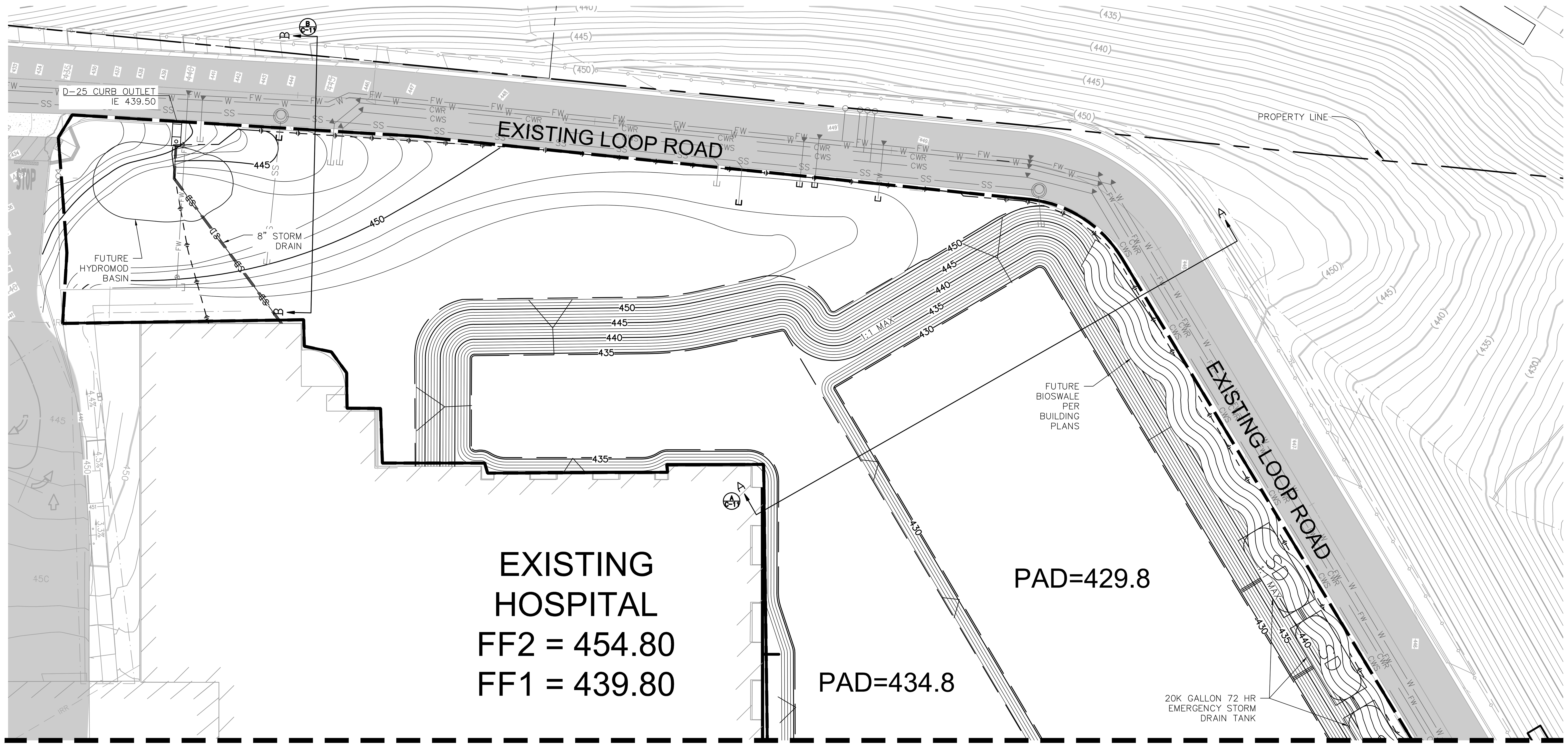
ATTACHMENT 4

Copy of Plan Sheets Showing Permanent Storm Water BMPs

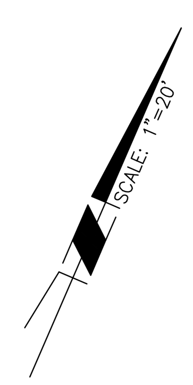
This is the cover sheet for Attachment 4.

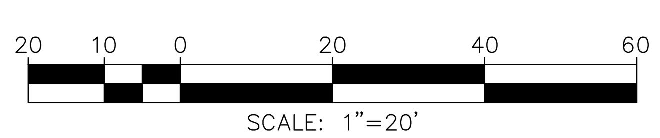


MACTCHLINE SEE SHT. C-07

LEGEND

ITEM	STANDARD DRAWING	SYMBOL
EXISTING MINOR CONTOUR		
EXISTING MAJOR CONTOUR		100
MAJOR CONTOUR		(100)
MINOR CONTOUR		99
PROPERTY BOUNDARY		
TOP/TOE OF SLOPE		
LIMIT OF GRADING		
LIMIT OF WORK		
EXISTING SIDEWALK		
EXISTING ASPHALT		
EXISTING WALL		
EXISTING BUILDING		
EXISTING SEWER LINE		SS
EXISTING NATURAL GAS LINE		NG
EXISTING NITRIS OXIDE		N2O
EXISTING CONDENSATE SUPPLY		CONS
EXISTING CONDENSATE RETURN		CONR
EXISTING STORM DRAIN LINE		SD
EXISTING IRRIGATION LINE		IRR
EXISTING FIRE WATER MAIN		FW
EXISTING WATER MAIN		W
EXISTING FIRE HYDRANT		
EXISTING VALVE (GATE/BUTTERFLY)		





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Printed Name ______ P.E. No. ______

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UTILITY NOTE

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TOTAL NUMBER OF SHEETS = 12

CONSTRUCTION RECORD	REFERENCES	BY	REVISIONS	Date	App'd
Contractor ______	DWG NO. 14009				
Inspector ______					
Date Completed ______					

BENCH MARK

DESCRIPTION:
CITY OF CHULA VISTA BM #5101 ELEV = 322.020 NAVD 88 WELL MONUMENT WITH 3" BRASS DISC AT C/L, BC TELEGRAPH CANYON RD. ± 500' NELY OF BEGINNING OF STAMPED CONC, CENTER MEDIAN. PER ROS 14841 POINT 5101

SCALE
Horizontal
Vertical

Designed By	Drawn By	Checked By

Plans Prepared Under Supervision Of ______ Date ______ R.C.E. No. ______

Submitted ______ By ______ Office

Approved ______ By ______ City Engineer

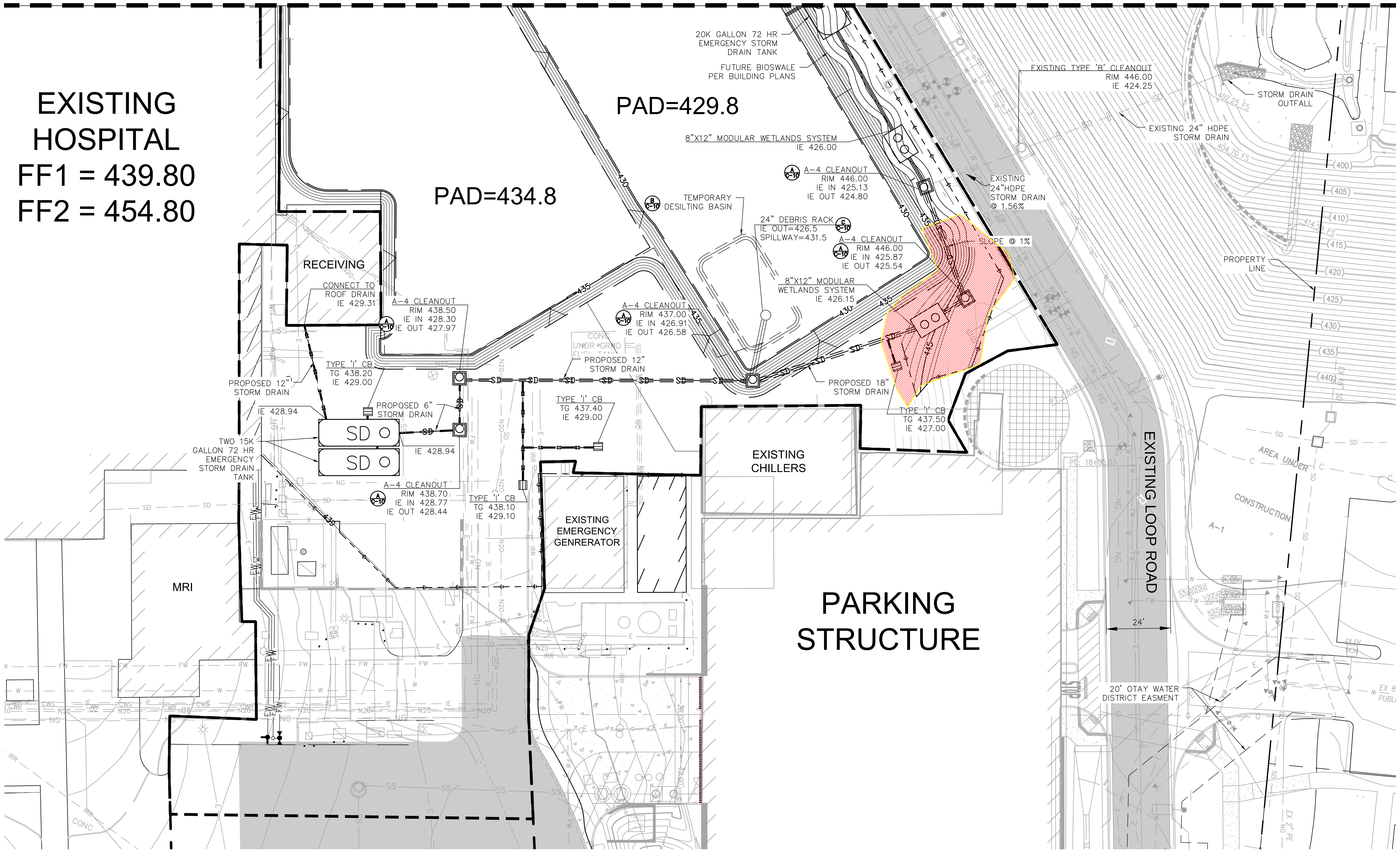
CITY OF CHULA VISTA DEVELOPMENT SERVICES DEPARTMENT

SHARP CHULA VISTA MEDICAL CENTER
OCEAN VIEW TOWER
GRADING PLAN

Drawing No. 16016-06

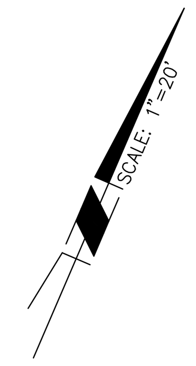
W.O. No. PG 892

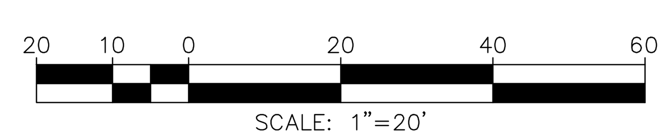
MACTCHLINE SEE SHT. C-06



LEGEND

ITEM	STANDARD DRAWING	SYMBOL
EXISTING MINOR CONTOUR		
EXISTING MAJOR CONTOUR		100
MAJOR CONTOUR		(100)
MINOR CONTOUR		99
TOP/TOE OF SLOPE		
PROPERTY BOUNDARY		
LIMIT OF GRADING		
LIMIT OF WORK		
MODULAR WETLANDS SYSTEM		
EXISTING SIDEWALK		
EXISTING ASPHALT		
EXISTING WALL		
EXISTING BUILDING		
EXISTING SEWER LINE		SS
EXISTING NATURAL GAS LINE		NG
EXISTING NITRIS OXIDE		N2O
EXISTING CHILLED WATER SUPPLY		CONS
EXISTING CHILLED WATER RETURN		CONR
EXISTING STORM DRAIN LINE		SD
EXISTING IRRIGATION LINE		IRR
EXISTING FIRE WATER MAIN		FW
EXISTING WATER MAIN		W
EXISTING FIRE HYDRANT		
EXISTING VALVE (GATE/BUTTERFLY)		





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P.E. No. ______

Printed Name

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TOTAL NUMBER OF SHEETS = 12

CONSTRUCTION RECORD	REFERENCES	BY	REVISIONS	Date	App'd	BENCH MARK	SCALE	Designed By	Drawn By	Checked By
Contractor	DWG NO. 14009					DESCRIPTION: CITY OF CHULA VISTA BM #5101 ELEV = 322.020 NAVD 88 WELL MONUMENT WITH 3" BRASS DISC AT C/L, BC TELEGRAPH CANYON RD. ± 500' NELY OF BEGINNING OF STAMPED CONC. CENTER MEDIAN. PER ROS 14841 POINT 5101	Horizontal	Plans Prepared Under Supervision Of		
Inspector								Date		
Date Completed							Vertical	R.C.E. No.		

Submitted ______ Approved ______

By ______ By ______ City Engineer

Office

CITY OF CHULA VISTA DEVELOPMENT SERVICES DEPARTMENT

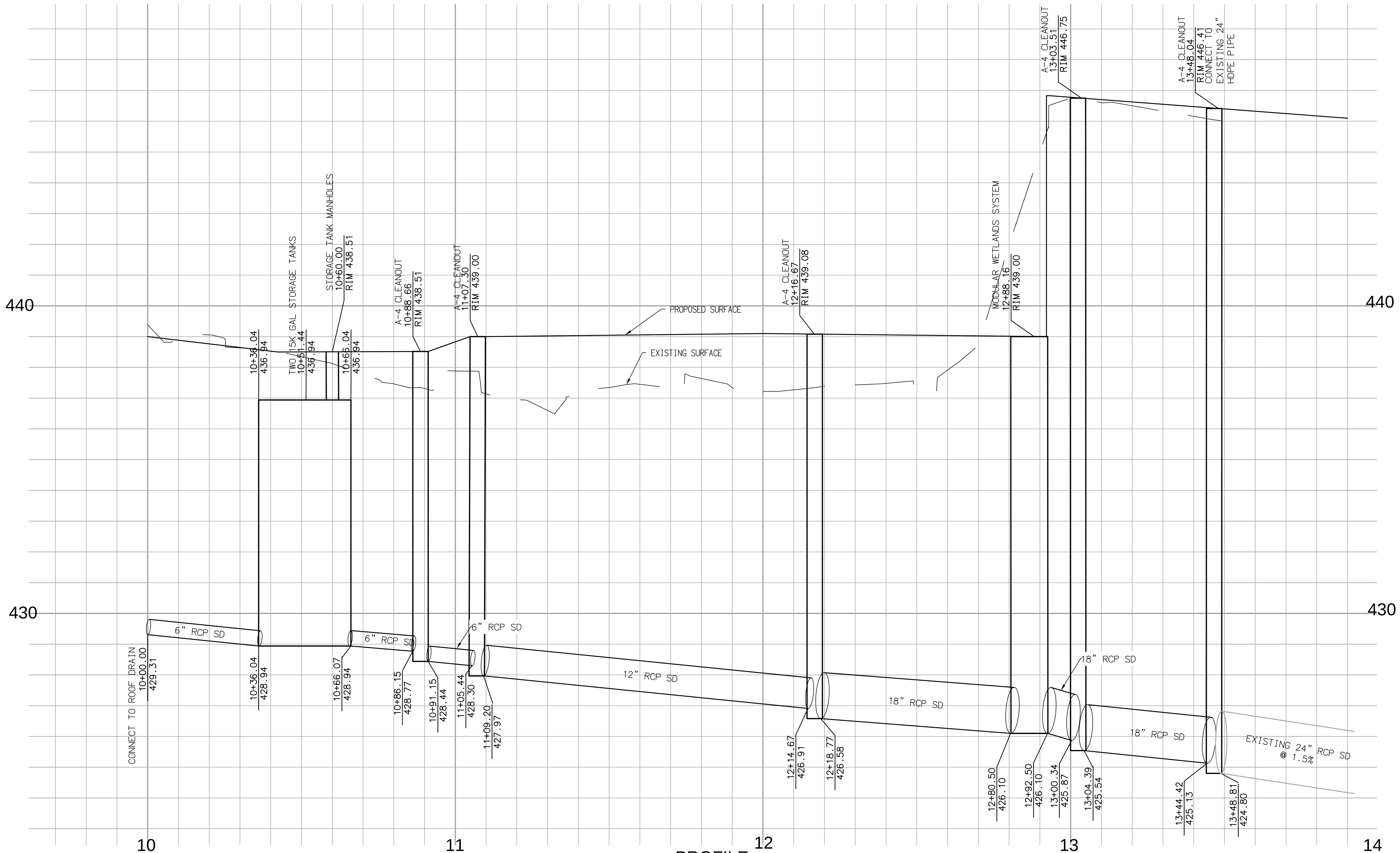
SHARP CHULA VISTA MEDICAL CENTER

OCEAN VIEW TOWER

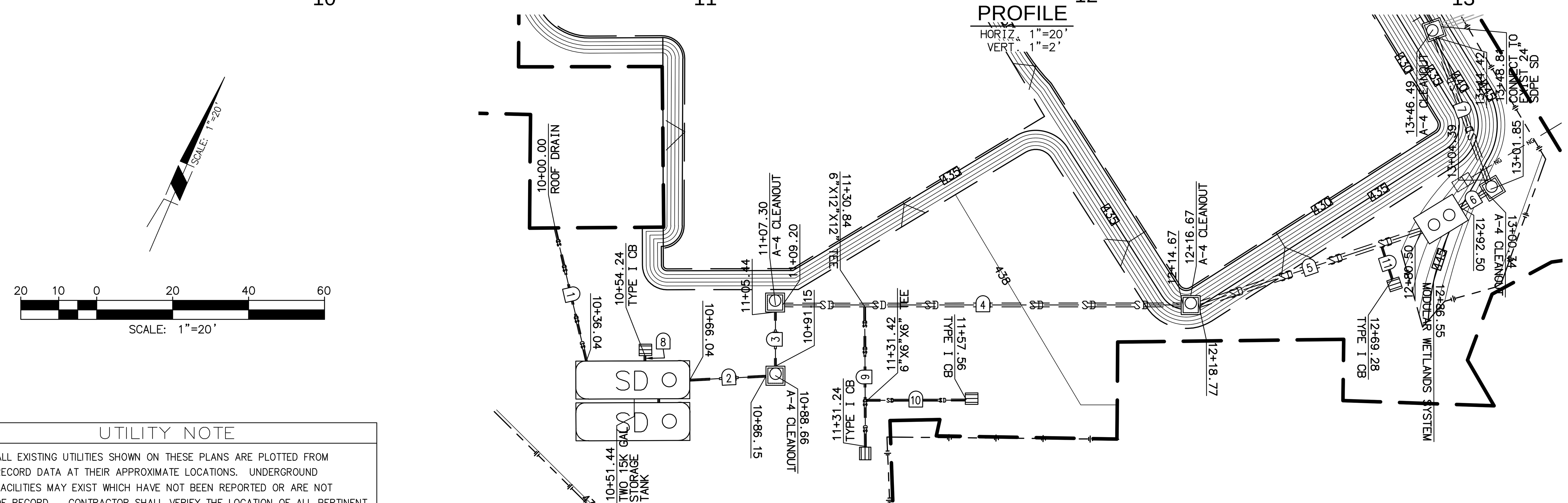
GRADING PLAN

Drawing No. 16016-07

W.O. No. PG 892



PROFILE
HORIZ. 1"=20'
VERT. 1"=2'



PRIVATE STORM DRAIN DATA TABLE				
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2	N63°41'57"E	--	20.60'	6" RCP
3	N23°18'34"W	--	15.13'	6" RCP
4	N66°42'01"E	--	105.62'	12" RCP
5	N48°15'40"E	--	61.92'	18" RCP
6	N35°38'20"E	--	7.84'	18" RCP
7	N43°18'25"W	--	40.54'	18" RCP
8	N23°33'18"W	--	1.40'	6" RCP
9	N23°33'18"W	--	36.97'	6" RCP
10	N66°34'32"E	--	26.17'	6" RCP
11	N41°11'15"W	--	9.03'	6" RCP

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Printed Name ________ P.E. No. ________

My Registration Expires ________ Discipline ________

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TOTAL NUMBER OF SHEETS = 12

CONSTRUCTION RECORD	REFERENCES	BY	REVISIONS	Date	App'd
Contractor ________	DWG NO. 14009				
Inspector ________					
Date Completed ________					

BENCH MARK

DESCRIPTION:
CITY OF CHULA VISTA BM #5101 ELEV = 322.020 NAVD 88 WELL MONUMENT WITH 3" BRASS DISC AT C/L, BC TELEGRAPH CANYON RD. ± 500' NELY OF BEGINNING OF STAMPED CONC, CENTER MEDIAN. PER ROS 14841 POINT 5101

SCALE
Horizontal
Vertical

Designed By | Drawn By | Checked By

Plans Prepared Under Supervision Of
Date ________
R.C.E. No. ________

Submitted ________
By ________
Office

Approved ________
By ________
City Engineer

CITY OF CHULA VISTA DEVELOPMENT SERVICES DEPARTMENT

SHARP CHULA VISTA MEDICAL CENTER
OCEAN VIEW TOWER
STORM DRAIN PROFILE

Drawing No.
C-12

W.O. No. 149517

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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. Photocopies of general brochures are not acceptable.

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ATTACHMENT 5
Copy of Project's Drainage Report

Hydrology and Hydraulic Study

For

Sharp Health Chula Vista Medical Center

Prepared For:

Sharp Healthcare
8695 Spectrum Center Drive
San Diego, CA 92123

Prepared By:

Michael Baker International
9755 Clairemont Mesa Blvd
San Diego, CA 92124
858.614.5000
Richard S. Tomlinson, Jr. PE,
QSP, QSD, CPSWQ

RBF Job Number:

149517

Prepared:

December 6, 2015

Revised:

January 28, 2016

Table of Contents

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Section 1 Project Description and Scope

1.1. Project Data

Project Owner: Sharp Healthcare
8695 Spectrum Center Blvd.
San Diego, CA 92123

Project Site Address: 751 Medical Center Court

APN Number(s): 641-010-28-00

Project Location: Latitude: 32.618918°
Longitude: -117.02252°

Project Site Area: 2.54 acres

Adjacent Streets:
North: Telegraph Canyon Road
South: East Palomar Road
East: Paseo Ladera
West: Medical Center Drive

Adjacent Land Uses:
North: Residential
South: Residential
East: Residential
West: Residential

1.2. Scope of Report

This report addresses the Hydrologic and Hydraulic aspects of the project. This report does not discuss required water quality measures to be implemented on a permanent basis, nor does it address construction storm water issues. Post construction storm water issue discussions can be found under separate cover in the project “Water Quality Technical Report.”

In addition, because this project proposes to disturb over one acre, a Storm Water Pollution Protection Plan for construction activities has been prepared and an NOI will be filed with the State of California prior to the start of construction.

1.3. Project Site Information

1.3.1 Project Location

The project is located in the Chula Vista are of the San Diego County. The project lies south of Telegraph Canyon Road and north of Palomar Rd. The project lies approximately 4.25 miles east of the San Diego Bay Please refer to below Figure 1: Vicinity Map for a Vicinity Map.

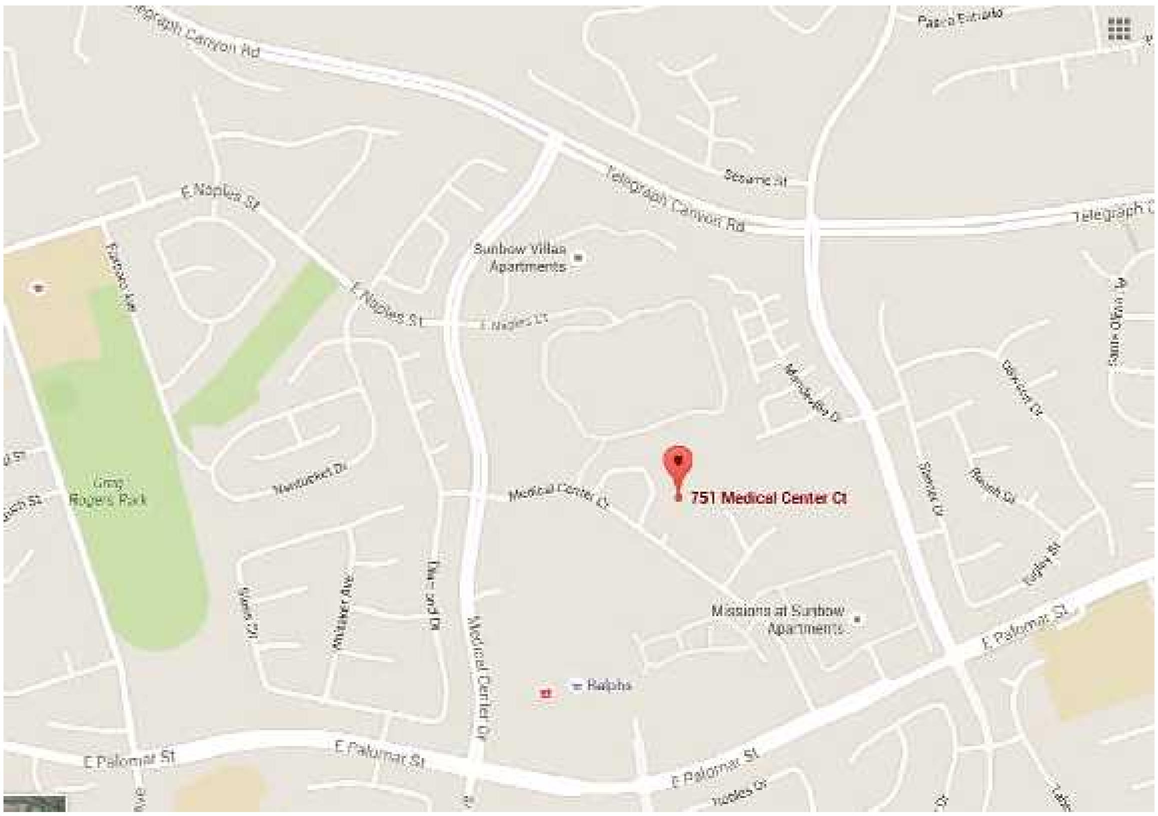


Figure 2: Vicinity Map

1.3.2 Project Description

The project is a proposed 138 room hospital tower. The project includes new on-site and relocated water, sewer and storm drain. This portion of the project is for rough grading only and no structures are proposed at this time. All surface improvements and impervious surfaces will be created as part of the future building improvements to be submitted at a later date.

1.3.3 Site Topography

Currently topography is a flat parking lot with some surrounding slopes. Post project topography will be a building located on a fully graded site.

1.3.4 Land Use and Vegetation

The current land use is a medical complex. The site is currently fully developed. The project has ornamental landscaping spread around the perimeter of the site.

1.3.5 FEMA Information

The project does not lie within any mapped floodplain (FIRM Panel 06073C2157G. The project lies within Zone X Unshaded which is outside of the 500-year floodplain.

a) Flood Zone Definitions

Zone A -- Areas subject to inundation by the 1-percent-annual-chance flood event generally determined using approximate methodologies. Because detailed hydraulic analyses have not been performed, no Base Flood Elevations (BFEs) or flood depths are shown. Mandatory flood insurance purchase requirements and floodplain management standards apply.

Zone AE -- Areas subject to inundation by the 1-percent-annual-chance flood event determined by detailed methods. Base Flood Elevations (BFEs) are shown. Mandatory flood insurance purchase requirements and floodplain management standards apply.

Zone X (Shaded) – Areas between the limits of the base flood and the 0.2-percent-annual-chance (or 500-year) flood.

Zone X (Unshaded) Areas of minimal flood hazard, which are the areas outside the SFHA and higher than the elevation of the 0.2-percent-annual-chance flood

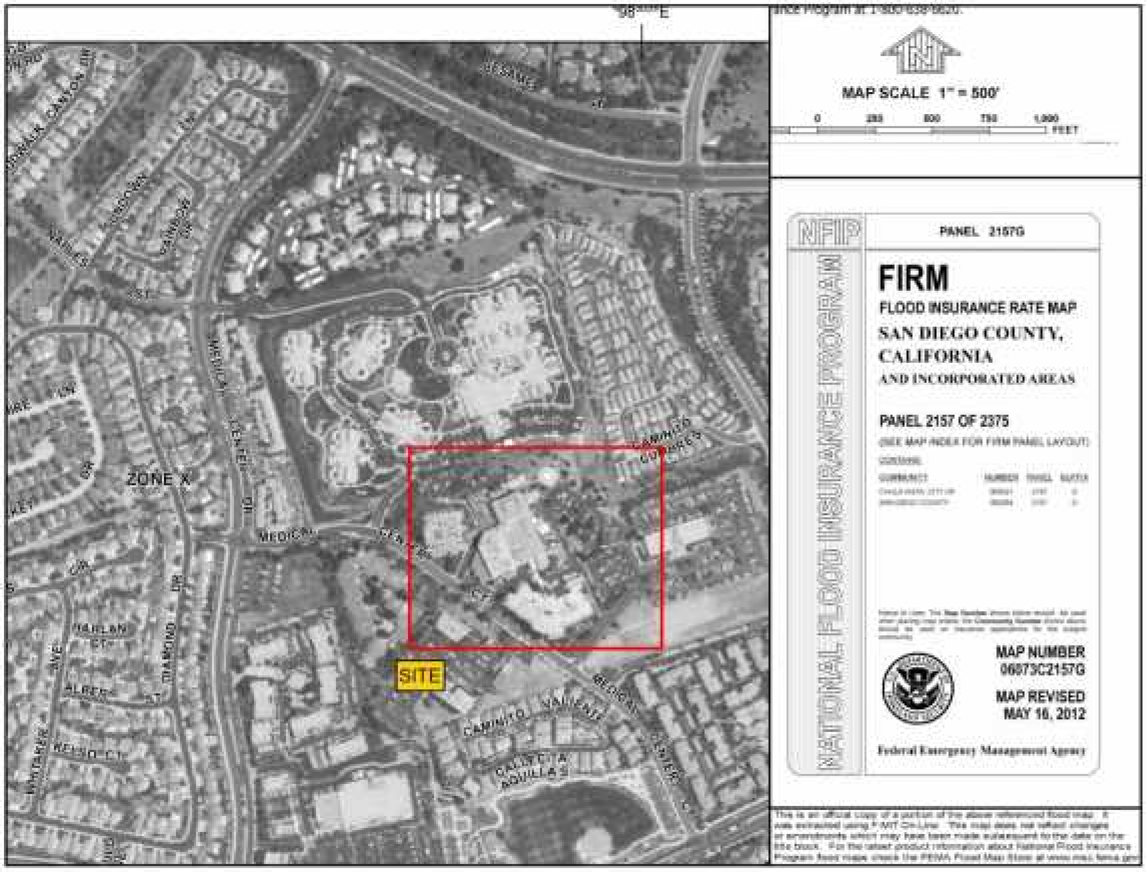


Figure 3: FEMA Firmette

1.3.6 Existing Drainage Improvements

Drainage from the site runs from west to east. The existing storm drain pipe runs under the proposed building site, across the existing access road, down the slope to the east before discharging into the existing channel that flows north/south along the easterly property line.

The northerly portion of the project flows to east to one of two water quality basins. These basins are to remain in the interim condition.

1.3.7 Proposed Improvements

In the proposed condition, drainage flows in the same general direction. However, the existing storm drain is being routed around the building, to the south of the existing building.

The proposed project includes new water, sewer and dry utilities as well as the new building and site improvements. The project proposes the construction of two Modular Wetland Systems BF-3's to treat the storm water as well as two 9,750 cf cisterns to store the storm water. The storm water is metered out of the tanks to achieve the required Hydromodification Management.

Impervious areas in the pre-project condition and the post-project condition are nearly the same. However, for the hydromodification plan, any impervious areas that are being replaced have been treated as pervious areas for the analysis.

Section 2 Study Objectives

The specific objectives of this study are as follows:

- To provide hydrologic analysis of the project site for the 100-year, 6-hour storm event under existing and proposed conditions,
- To provide a hydraulic analysis of the project to ensure that the correct sizes of pipes and inlets have been chosen,
- And to ensure that no additional runoff or downstream impacts occur due to this project.

Section 3 Methodology

3.1. Hydrology

Hydrologic analysis has been completed using the Rational Method (Q = CIA). Whereas,

Q = rate of flow in cubic feet per second

C = Coefficient of runoff,

I = intensity of rainfall based on the time of concentration and the 6-hour, 100-year precipitation

A=Area of the basin.

For this project, a composite coefficient of runoff was used. Data was entered into an Excel Spreadsheet which calculates the runoff based on the County of San Diego methodology electronically, therefore reducing errors.

The following software packages were used in the analysis of the project:

- Microsoft Excel (Rational Method Hydrology)
- AutoCAD Civil 3d Hydraflow Hydragraph Extension 2013 (Storm Routing)
- RatHydro (Rational Method Hydragraphs)
- Flowmaster (Hydraulic Analysis for Open Channels and Pipes for Storm Routing)

3.2. Hydraulics

Proposed improvements include new grated storm drain inlets in paved areas, and a new underground storm drain system. Private underground storm drain will consist of PVC or HDPE pipe with watertight joints. Public storm drain, if applicable, will consist of reinforced concrete pipe, with a minimum strength of 2000-D.

Runoff will ultimately be discharged from the project site at the same location as the existing condition, to the existing cleanout at the southwest corner of the project site.

Proposed improvements will not increase the total peak flow runoff, as compared to existing conditions, through the use of two large cisterns.

Manning's equation will be used to calculate the depth of flow being conveyed through proposed pipes and for existing pipes which experience additional flows as a result of the proposed improvements. Proposed pipes with diameters of less than 12 inches will not be individually calculated for depth and velocity, however, the capacity was verified against tables showing the maximum flow in the smaller pipes.

The following software packages were used in the analysis of the project:

- Hydraflow Hydragraph Extension for AutoCAD Civil 3d 2013 (Storm Routing)
- Hydraflow Storm Sewer Extension for AutoCAD Civil 3d 2013 (Hydraulic and Energy Grade Lines)
- Hydraflow Express Extensions Extension for AutoCAD Civil 3d 2013 (Storm Routing)
- RatHydro (Rational Method Hydrographs)
- Bentley Flowmaster (Hydraulic Analysis for Open Channels and Pipes for Storm Routing)

Section 4 Results

4.1. Hydrologic Results

The following tables summarize the hydrologic analysis of the project.

- **Table 1 – Existing Condition**, summarizes the existing hydrologic properties of the project site.
- **Table 2 – Proposed Condition (Unmitigated)**, summarizes the proposed condition hydrology of the site in the unmitigated condition.
- **Table 3 – Comparison of Existing to Proposed Flows**, compares existing flows to the proposed flows.

Table 1 – Existing Condition

Sub Basin No.	Runoff Coefficient	Basin Intensity	Basin Area (acres)	Runoff (cfs)
Basin A	0.85	6.85	1.18	6.84
Basin B	0.85	5.18	1.37	6.02
TOTALS			2.55	12.86

Table 2 – Proposed Condition (Unmitigated)

Sub Basin No.	Runoff Coefficient	Basin Intensity	Basin Area (acres)	Runoff (cfs)
Basin A	0.85	6.85	1.18	6.84
Basin B	0.85	5.18	1.37	6.02
TOTALS			2.55	12.86

Table 3 – Comparison of Existing to Proposed Flows 2, 10 and 25 year

Frequency*	Existing Condition (cfs)	Proposed Condition (cfs)	Difference
2-Year	0.23	0.02	-0.21
10-Year	0.43	0.37	-0.06
25-year	0.95	0.65	-0.30

*See SDHM Results for calculations of existing and proposed calculations.

Section 5 Conclusions

As indicated in the Table of Hydrologic Results, the proposed improvements will not increase the total 100-year, 6-hour peak flow rate. This is because no hardscape is being created by the project, the grading is for future improvements only.

There is not a significant concern for erosion as the site is previously developed. Potential for erosion for the proposed condition shall be minimized by following items listed in the Erosion Control Plan (part of the Rough Grading Plans). Runoff shall flow over relatively flat areas where scour is not a concern. Runoff is not proposed over any sloped areas.

Section 6 Certification

This Hydrology and Hydraulics report has been prepared under the direction of the following Registered Civil Engineer. The Registered Civil Engineer attests to the technical information contained herein and the engineering data upon which recommendations, conclusions, and decisions are based. The plans and specifications in this Hydrology and Hydraulics report are not for construction purposes; the contractor shall refer to final approved construction documents for plans and specifications.

Richard S. Tomlinson, Jr. RCE 59276 January 28, 2016

Section 7 References

County of San Diego, 2012. Grading Ordinance (October 2012)

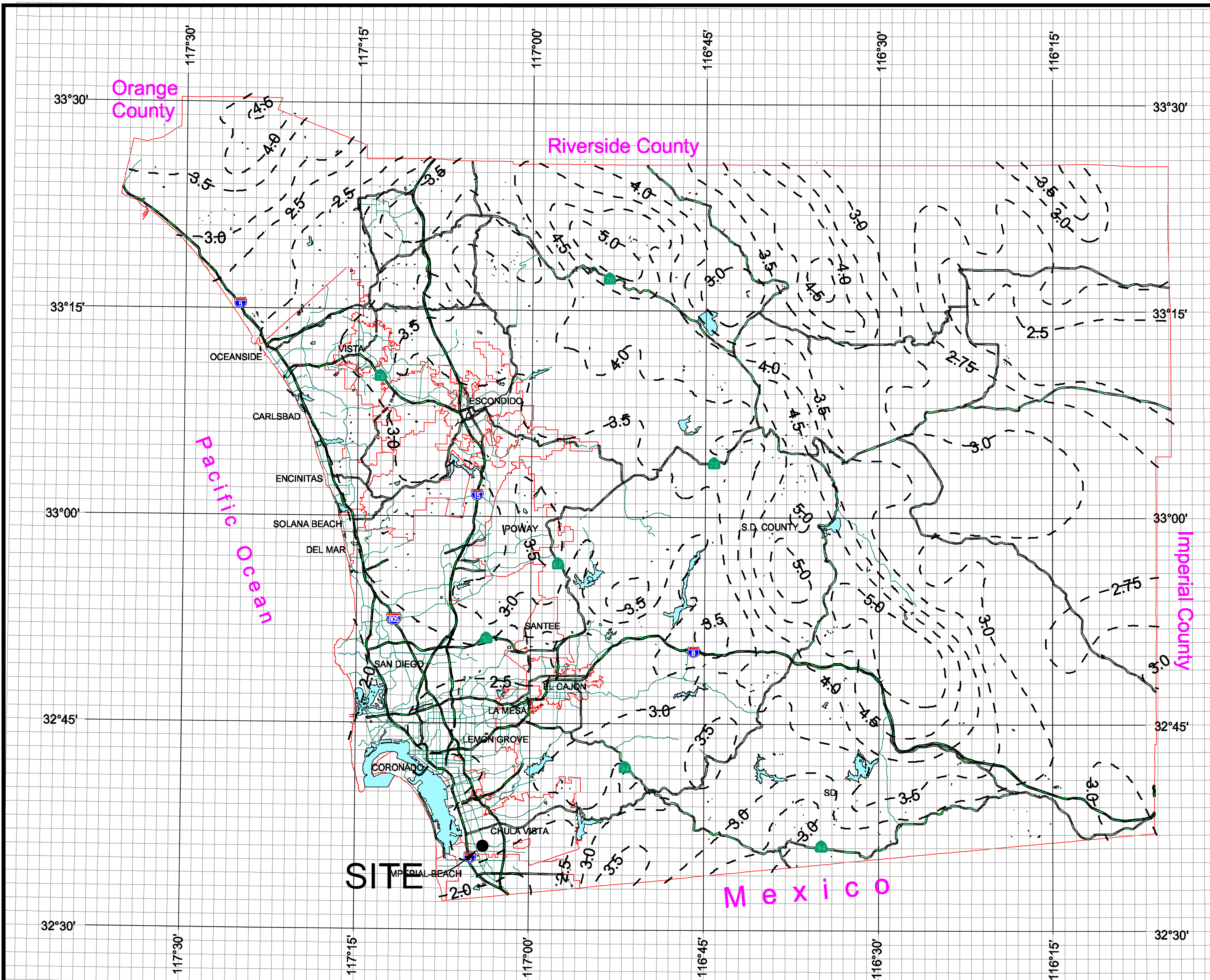
County of San Diego, 2003. Hydrology Manual (June 2003)

County of San Diego, 2014, Hydraulic Design Manual (September 2014)

FEMA, 1997. FEMA. (June 17, 1997). Flood Insurance Study, San Diego County.

Michael Baker INTERNATIONAL

Appendix A
Rainfall Isopluvials



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

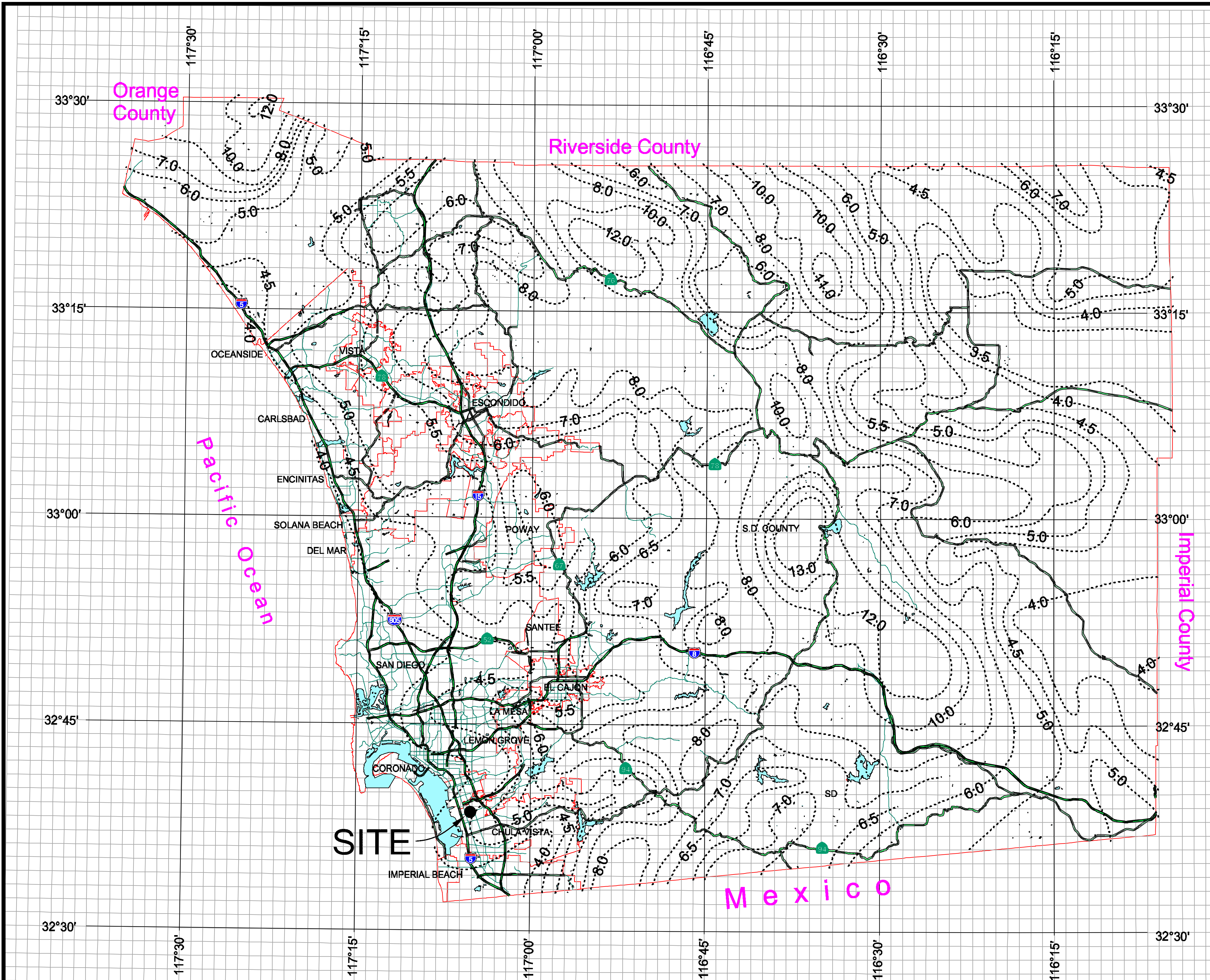
Isopluvial (inches)

Department of Public Works Geographic Information Services

We Have San Diego Covered!

N S E W

3 0 3 Miles



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

Isopluvial (inches)

N
W E
S

3 0 3 Miles

Appendix B
FEMA Flood Plain Maps

Michael Baker
INTERNATIONAL

rance Program at 1-800-638-6620.

N

MAP SCALE 1" = 500'

0 250 500 750 1,000 FEET

NFIP

PANEL 2157G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

SAN DIEGO COUNTY, CALIFORNIA

AND INCORPORATED AREAS

PANEL 2157 OF 2375

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CHULA VISTA, CITY OF	065021	2157	G
SAN DIEGO COUNTY	060284	2157	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER 06073C2157G

MAP REVISED MAY 16, 2012

U.S. DEPARTMENT OF HOMELAND SECURITY

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

Appendix C

Existing Condition Hydrologic Work Map & Calculations

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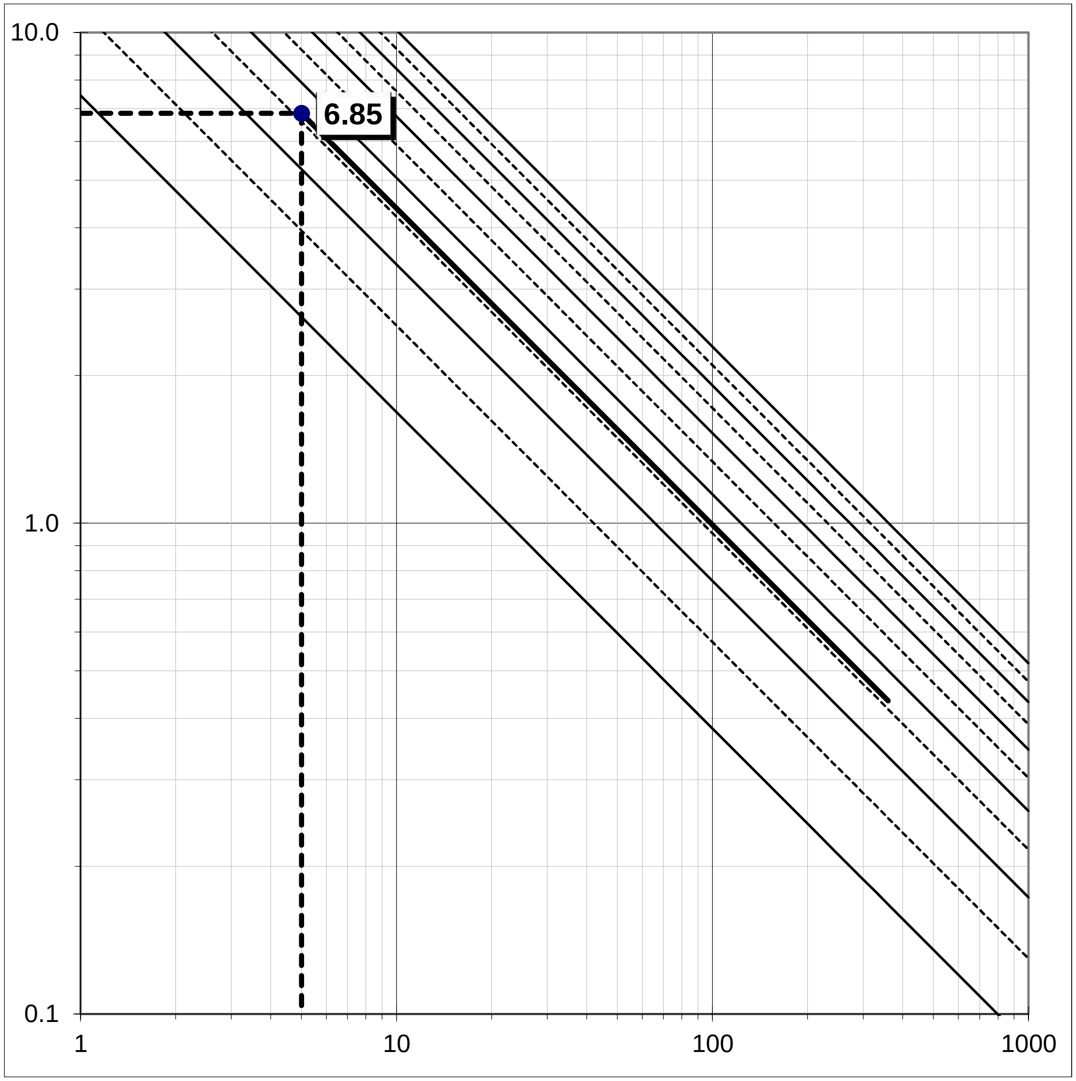


Sharp Chula Vista

Existing Basin 1

Time of Concentration Calculations

Natural Areas

Land Use =	Commercial	
C =	0.85	
Dist. =	390.00	ft.
slope =	8.000	%
T_c =	5.00	min.

$$T_C = \frac{1.8(1.1 - C)\sqrt{D}}{\sqrt[3]{s}}$$

* Minimum T_c = 5 Minutes

Basin Intensity Calculations

Selected Frequency,	**100**	year	
P_6 =	2.6	in.	P_6 must be within
P_{24} =	4.5	in.	45% to 65% of P_{24}.
P_6 / P_{24} =	58%		Adjust P_6 as needed.
Adjusted $\mathbf{P_6}$=	2.60	in.	
T_c (**D**) =	5.00	min.	
I =	6.85	in/hr	

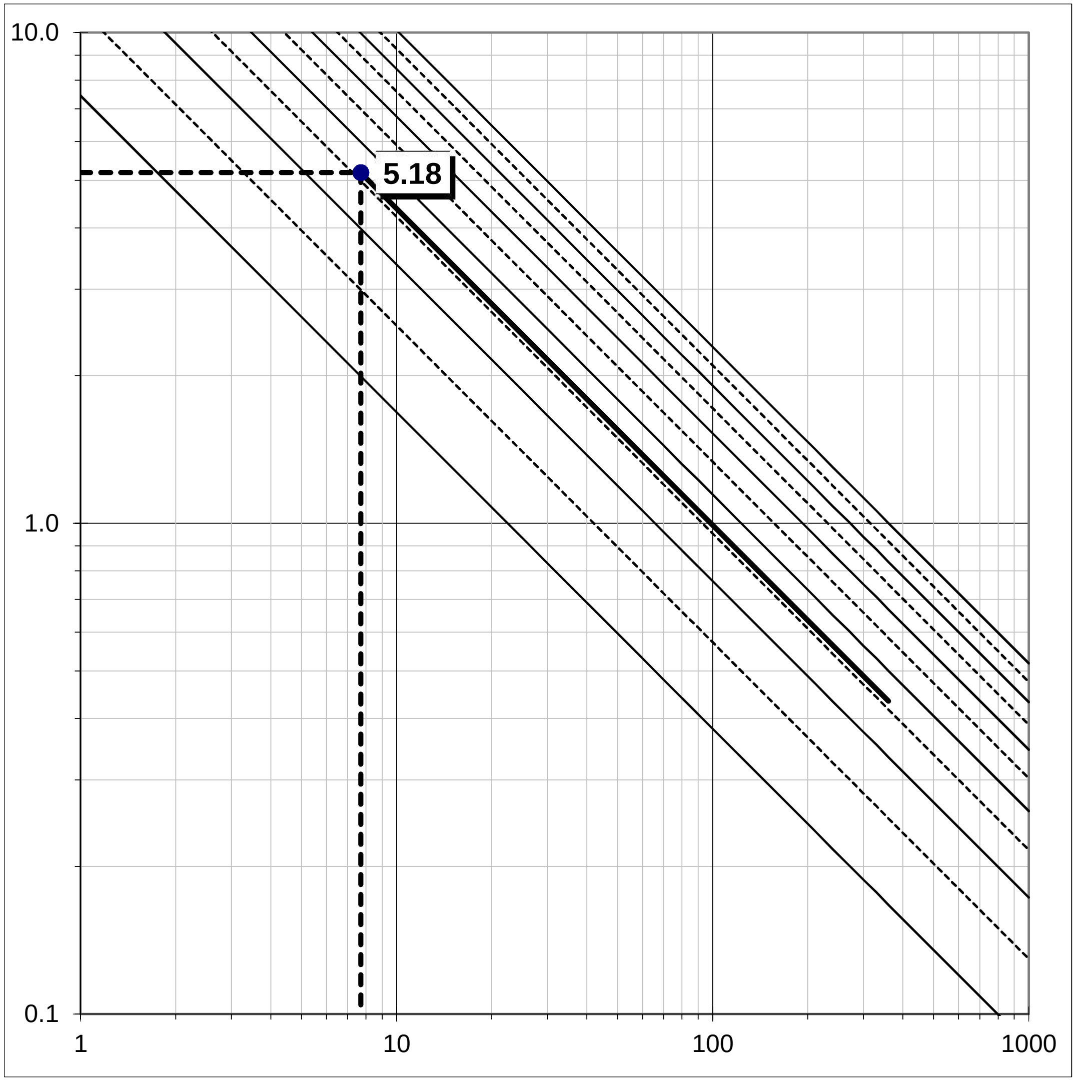
$$I = 7.44 P_6 D^{-0.645}$$

Basin Flow Calculations

Q =	**6.842**	**cfs**
C =	0.85	
I =	6.85	in/hr
A =	1.175	ac.

$$Q = C * I * A$$

RBF Job No. 149517



Sharp Chula Vista

Existing Basin 2

Time of Concentration Calculations

Natural Areas

Land Use = Commercial
C = 0.85
Dist. = 465.00 ft.
slope = 2.000 %
T_c = 7.70 min.

* Minimum T_c = 5 Minutes

$$T_C = \frac{1.8(1.1 - C)\sqrt{D}}{\sqrt[3]{s}}$$

Basin Intensity Calculations

Selected Frequency, **100** year

P_6 = 2.6 in.

P_{24} = 4.5 in.

P_6 / P_{24} = 58%

Adjusted $\mathbf{P_6}$ = 2.60 in.

T_c (**D**) = 7.70 min.

I = 5.18 in/hr

P_6 must be within 45% to 65% of P_{24}. Adjust P_6 as needed.

$$I = 7.44 P_6 D^{-0.645}$$

Basin Flow Calculations

Q = 6.020 cfs

C = 0.85

I = 5.18 in/hr

A = 1.366 ac.

$$Q = C * I * A$$

RBF Job No. 149517

LEGEND

LIMITS OF OVERALL DRAINAGE BASIN

DRAINAGE BASIN

FLOW PATH

POINT COMPLIANCE

SHARP CHULA VISTA

EXISTING DRAINAGE MAP

1 / 28 / 16

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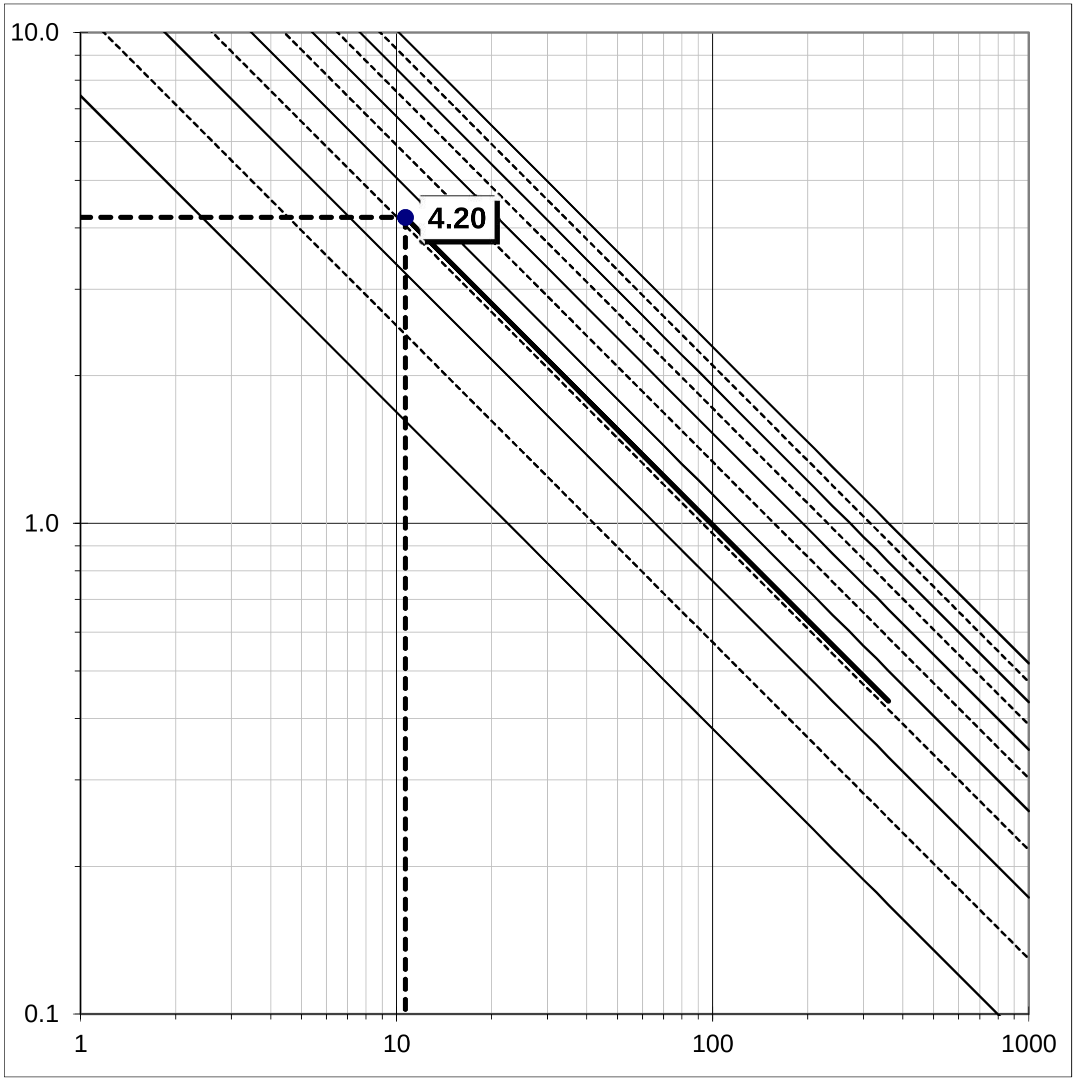
Phoenix Plaza Tower II, Phoenix, AZ 85012
Phone: (858) 614-5000 · MBAKERINTL.COM

Michael Baker
INTERNATIONAL

Appendix D
Proposed Condition Hydrologic Work Map & Calculations



Sharp Chula Vista

Proposed Basin 1

Time of Concentration Calculations

Natural Areas

Land Use =	Commercial	
C =	0.50	
Dist. =	390.00	ft.
slope =	8.000	%
T_c =	10.66	min.

$$T_C = \frac{1.8(1.1-C)\sqrt{D}}{\sqrt[3]{s}}$$

* Minimum T_c = 5 Minutes

Basin Intensity Calculations

Selected Frequency,	**100**	year	
P_6 =	2.6	in.	P_6 must be within
P_{24} =	4.5	in.	45% to 65% of P_{24}.
P_6 / P_{24} =	58%		Adjust P_6 as needed.
Adjusted $\mathbf{P_6}$=	2.60	in.	
T_c (**D**) =	10.66	min.	
I =	4.20	in/hr	

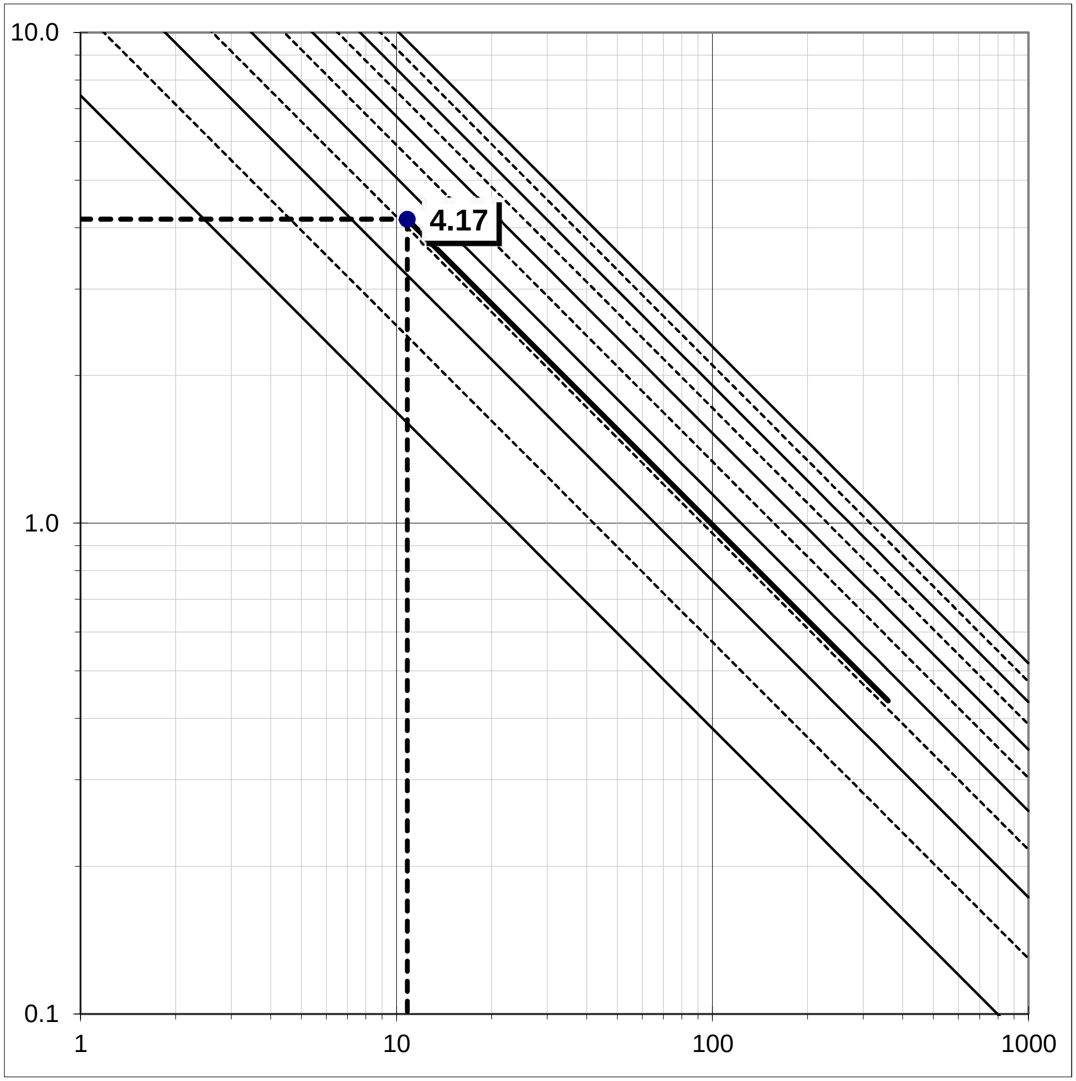
$$I = 7.44 P_6 D^{-0.645}$$

Basin Flow Calculations

Q =	**2.469**	**cfs**
C =	0.50	
I =	4.20	in/hr
A =	1.175	ac.

$$Q = C * I * A$$

RBF Job No. 149517



Sharp Chula Vista

Proposed Basin 2

Time of Concentration Calculations

Natural Areas

Land Use =	Commercial	
C =	0.50	
Dist. =	465.00	ft.
slope =	10.000	%
$\mathbf{T_c}$ =	10.81	min.

$$T_C = \frac{1.8(1.1-C)\sqrt{D}}{\sqrt[3]{s}}$$

* Minimum T_c = 5 Minutes

Basin Intensity Calculations

Selected Frequency,	**100**	year	
P_6 =	2.6	in.	P_6 must be within
P_{24} =	4.5	in.	45% to 65% of P_{24}.
P_6 / P_{24} =	58%		Adjust P_6 as needed.
Adjusted $\mathbf{P_6}$=	2.60	in.	
T_c (**D**) =	10.81	min.	
I =	4.17	in/hr	

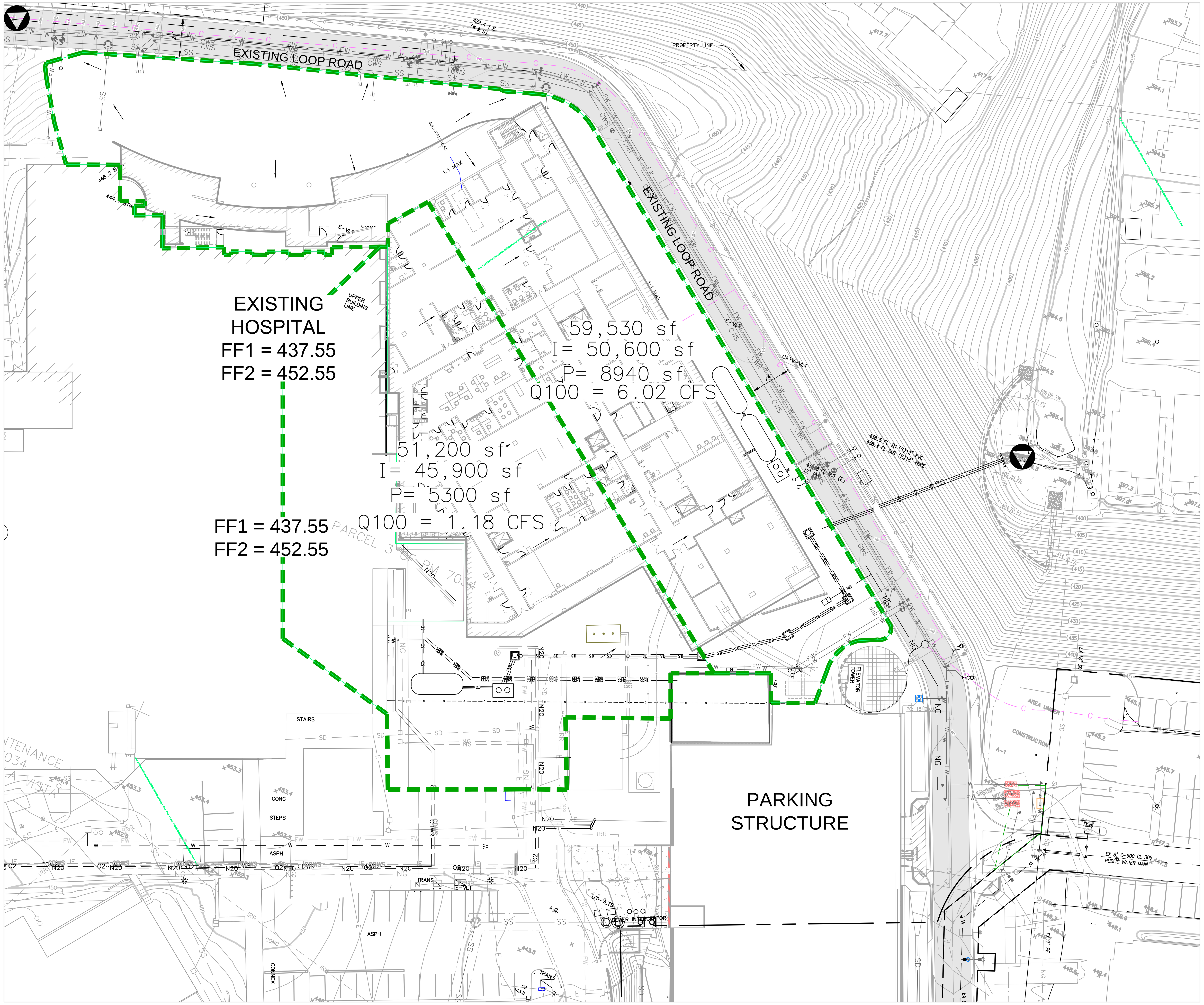
$$I = 7.44 P_6 D^{-0.645}$$

Basin Flow Calculations

Q =	**2.845**	**cfs**
C =	0.50	
I =	4.17	in/hr
A =	1.366	ac.

$$Q = C * I * A$$

RBF Job No. 149517



LEGEND

LIMITS OF OVERALL DRAINAGE BASIN

DRAINAGE BASIN

FLOW PATH

POINT COMPLIANCE

NOTE:
ALL SOILS URBAN LANDS
SOIL TYPE "D"

SCALE: 1"=40'

SCALE: 1"=##'

SHARP CHULA VISTA

PROPOSED DRAINAGE MAP

1 / 28 / 16

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Phone: (858) 614-5000 · MBAKERINTL.COM

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ATTACHMENT 6

Copy of 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.

GEOTECHNICAL INVESTIGATION, SHARP CHULA VISTA MEDICAL CENTER MASTER PLAN, CHULA VISTA, CALIFORNIA

Prepared For:

SHARP HEALTHCARE
8695 Spectrum Center Boulevard
San Diego, California 92123

Project No. 603541-002

July 18, 2013

Leighton Consulting, Inc.
A LEIGHTON GROUP COMPANY

Leighton Consulting, Inc.
A LEIGHTON GROUP COMPANY

July 18, 2013

Project No. 603541-002

To: Sharp HealthCare
8695 Spectrum Center Boulevard
San Diego, California 92123

Attention: Ms. Pat Nemeth

Subject: Geotechnical Investigation, Sharp Chula Vista Medical Center Master Plan, Chula Vista, California

In accordance with your request and authorization, we have conducted a geotechnical study for the proposed Master Plan of the Sharp Chula Vista Medical Center located in Chula Vista, California. Based on the results of our study, it is our opinion that the proposed Master Plan of the site is feasible provided the geotechnical recommendations contained in this report are implemented during design and construction. In particular, mitigation of existing undocumented fill will be necessary. Specifically, undocumented fill having a thickness up to approximately 15 feet is located within the proposed East Patient Care Building footprint and up to approximately 22 feet within the proposed Central Plant footprint. This report provides recommendations for the mitigation of the compressible materials relative to the proposed improvements, and provides a summary of the current investigation and general geotechnical conclusions and recommendations for the Master Plan.

If you have any questions regarding our report, please do not hesitate to contact this office. We appreciate this opportunity to be of service.

Respectfully submitted,

LEIGHTON CONSULTING, INC.

PROFESSIONAL GEOLOGIST ROBERT C. STROH NO. 2099 CERTIFIED ENGINEERING GEOLOGIST EXP. 10/31/13 STATE OF CALIFORNIA

Robert C. Stroh, CEG 2099
Senior Engineering Geologist

REGISTERED PROFESSIONAL ENGINEER SEAN A. COLORADO No. 2507 Exp: 12/31/13 GEOTECHNICAL STATE OF CALIFORNIA

Sean Colorado, GE 2507
Principal Engineer

Distribution: (1) Addressee
(1) McCarthy Building Companies Inc., Attention: Mr. Randy Burns
(1) NTD Architecture, Inc., Attention: Mr. Wayne Hunter
(1) KPFF Consulting Engineers, Attention: Mr. Aaron Reynolds

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PLATES

APPENDICES

Leighton

1.0 INTRODUCTION

In accordance with your authorization we have performed a geotechnical investigation of the site to assist in the preparation of the Sharp Chula Vista Medical Center Master Plan (Figure 1). This report presents our findings, conclusions and recommendations for the site with regard to geotechnical conditions.

1.1 Purpose and Scope

Specifically, the purpose of our investigation was to identify and evaluate the geologic hazards and significant geotechnical conditions present at the site in order to provide geotechnical recommendations for the proposed structures and associated site improvements. Taking into consideration previously completed geotechnical work at the site, our scope of services included:

- Prior to our subsurface exploration, we notified Underground Service Alert (USA) to screen the proposed exploration locations for the presence of subsurface utilities.
- In accordance with the County of San Diego Department of Environmental Health (DEH) requirements, we obtained boring permit waivers for our subsurface excavations.
- We performed a subsurface evaluation consisting of drilling, logging, and sampling of twenty (20) exploratory borings. At the completion of drilling, the borings were backfilled with bentonite grout (per DEH standards) and patched as appropriate. Drill cuttings were stored temporarily in 55-gallon drums on the site and were later disposed of at a proper disposal facility by an approved hauling subcontractor.
- We conducted geotechnical laboratory testing on selected soil samples. We performed lab testing consisting of dry unit weights, moisture contents, direct shear, grain size, plasticity, expansion, R-value, sand equivalent, and corrosivity tests including - minimum electrical resistivity, pH, and water soluble sulfates and chlorides content tests.
- Preparation of this report presenting our findings, conclusions, and geotechnical recommendations with respect to the proposed geotechnical design, site grading and general construction considerations. Specifically, this report provides the following:

- Vicinity map and site plan showing approximate locations of soil borings;
- Logs of soil borings, and laboratory test results;
- Discussion of the site and subsurface conditions;
- Discussion of field exploration methods and laboratory test procedures;
- Discussion of faulting and seismicity in the region;
- Discussion of potential geologic hazards, which may impact the site;
- Site Classification type and Site Coefficients based on 2010 California Building Code (CBC). In addition, for planning purposes, we have also provided seismic parameters in accordance with the 2012 International Building Code (IBC).
- Discussion of anticipated excavation conditions;
- Soil parameters and recommendations for design of temporary shoring;
- Discussion of groundwater conditions, need for temporary dewatering, if any, and preliminary dewatering information, if any;
- Guidelines for earthwork construction, including recommendations for site preparation, fill and backfill placement, and compaction;
- Discussion of the possible foundation types;
- Soil parameters for foundation design;
- Estimated foundation settlements;
- Lateral earth pressures for design of permanent basement walls; and
- A preliminary screening of the soil properties affecting corrosion of concrete and steel;
- Preliminary pavement design;

1.2 Site Location and Description

The Master Plan area is located at 751 Medical Center Court (APN 641-010-28) and is currently occupied with the existing hospital, subsidiary structures, parking deck structure, and other site improvements (Figure 1). Specifically, the hospital is located in the central portion of the site and consists of the Main Tower, the Main Hospital, the West Tower, Administration, the O.R. Addition, and the MRI addition (Figure 2). A parking deck is located west of the hospital and surface paved parking lots are located easterly and south easterly of the hospital. A helicopter pad is located in the upper portion of the property in the northeastern corner of the site. To the south of the hospital is the Birch Patrick Convalescent Facility. Other medical office buildings are located to the east of the hospital parking lot and across Medical Center Court to the southwest.

With regard to site topography, the upper portion of property is situated along the top of a hill at a topographic elevation of approximately 460 feet above mean sea level (msl). The topographically lowest portion of the site is located in the eastern portion of the site at the toe of the fill slope with an elevation of approximately 390 feet msl. The lowest western portion of the site, west of the parking deck area, is approximately 405 feet msl. In addition, another low area is located just east of the Birch Patrick Convalescent Facility within the existing surface pavement parking area, at approximately 445 feet msl.

The site is bound along the north by a moderately sloping descending cut slope. Based on our review of the topographic data the cut slope is approximately 33-feet high at an inclination of approximately 2.2:1 (horizontal:vertical). Along the eastern portion of the site a descending natural slope that transitions into a fill slope is also present having a height of approximately 40 feet at an inclination of approximately 4:1 (horizontal:vertical).

Total topographic relief across the property is approximately 60 feet, with an average elevation difference across the portion of the campus proposed for improvements at approximately 30 feet. In general, the overall property is located on a topographic hill and descends southward and westward toward existing medical office facilities and the Birch Patrick Convalescent Facility.

Site Coordinates:
Latitude: 32.6191º N
Longitude: 117.0228º W

1.3 Project Description

Based on our review of conceptual plans by NTD Healthcare, Cuningham Group, dated 2013, we understand that new site development associated with the Master Plan consists of generally three phases (Figure 2 and Plate 1).

Phase I – Make-Ready Phase:

The Make-Ready phase of the Master Plan is proposed to consist of the construction of a new 40,000 square-foot, six level parking structure located along the eastern boundary of the Master Plan area. In addition, a proposed new loop access road and utility corridor is proposed along the periphery of the Master Plan area. To accommodate employee and customer parking during the Make-Ready phase and construction of the parking structure, two temporary surface parking lots, located southwest of the Master Plan area, are proposed off-site, and one surface parking lot is proposed in the southwestern portion of the Master Plan area.

Phase II – New East Patient Care Building

Phase II of the Master Plan includes the proposed construction of a new East Patient Care Building located adjacent to the current surgery on the east side of the existing East Tower. The new building is proposed to consist of 4 floors of 36 bed nursing units (144 beds), expansion of the surgery area which will be attached to the existing surgery, and the expansion of kitchen facilities which will be attached to the existing kitchen. Also proposed is a new Central Plant with chillers located southeast of the new East Patient Care Building. Although, not indicated on the conceptual plans nor included in the scope of this report, we also understand that the Main Hospital (East Podium) is also intended to be upgraded to a Structural Performance Category 5 (SPC-5), as part of the Master Plan.

Phase III – Future West Patient Care Building

Although not included in the scope of this report, the Phase III portion of the Master Plan includes long term planning to the year 2030 and a possible future West Patient Care Building located in the location of the existing parking deck in the northwestern portion of the hospital campus.

2.0 SUBSURFACE EXPLORATION AND LABORATORY TESTING

The subsurface exploration performed for this geotechnical investigation consisted of the excavation, logging, and sampling of twenty (20) exploratory hollow-stem borings (Borings B-1 through B-20). The approximate locations of the exploration borings are shown on Figure 2 and Plate 1. The purpose of the borings was to investigate the underlying stratigraphy, physical characteristics, and specific engineering properties of the soils within the area of the proposed improvements. In addition we have also plotted the locations of borings from a Woodward-Clyde study dated April 25, 1989, covering the northeastern portion of the site.

2.1 Exploratory Borings

Borings were excavated to depths between approximately 4.5 feet to 101 feet below the existing ground surface (bgs). The boring explorations were generally performed using a heavy duty truck mounted hollow-stem auger drill rig, with 8-inch diameter continuous flight auger. During the exploration operations, a Certified Engineering Geologist from our firm prepared geologic logs and collected bulk and relatively undisturbed samples for laboratory testing and evaluation. After logging, the excavations were backfilled with bentonite grout and patched where appropriate. In addition for reference, we have included boring logs from Woodward-Clyde dated April 25, 1989, covering the northeastern portion of the site. The boring logs are provided in Appendix B.

2.2 Exploratory Trenches

Leighton (2013) previously excavated six trenches to provide coverage for potential faulting within portions of the Master Plan area. The trenches totaled approximately 1,100 lineal feet. Trench depths ranged between 7 and 15 feet with an average depth of approximately 7 feet. In addition, two additional fault studies have been completed at the site. Specifically, the existing Main Hospital facility was relocated to a position where minor faults did not transect the new facility footprint (Woodward-Gizenski & Associates, 1973), and a Geocon (1998) study indicated the presence of minor faults located in the southeastern parking area west of the existing medical office building (MOB) prompting relocation of that new MOB facility to avoid the mapped minor faults. The locations of these previously completed trenches are depicted in Leighton (2013).

2.3 Previous Exploration

Previous geotechnical reports have been performed within the site area and for nearby parcels to the north and southwest of the subject site. The following reports (ordered chronologically) were reviewed as part of our background study for the project:

- Leighton and Associates, 2008, Fault Hazard Study, Proposed Senior Care Campus at Vista Hill, 730 Medical Center Court, Chula Vista, California, dated June 23.
- URS, 2006, Updated Geotechnical Evaluation, Sharp Chula Vista Medical Center, Chula Vista, California, dated August 10, revised February 8, 2007
- Geocon, 1998, Geotechnical Investigation, Chula Vista Medical Plaza Medical Office Building, Chula Vista, California, dated November 19.
- Leighton and Associates, 1996, Evaluation of Faulting and Seismicity, Proposed Veteran's Home, Chula Vista, California, dated July 2.
- Woodward-Clyde, 1989, Geotechnical Investigation for the Proposed Additions to the Main Hospital and Overhead Parking Deck, Community Hospital of Chula Vista, Chula Vista, California, dated April 25.
- Robert Prater Associates, 1988, Fault Location Study, Vista Hill Hospital Expansion, RTC, CDU, and Support Buildings, Chula Vista, California, dated September 21.
- Robert Prater Associates, 1988, Radiocarbon Dating Analysis, Vista Hill Hospital Expansion, RTC, CDU, and Support Buildings, Chula Vista, California, dated October 20.
- Woodward-Clyde Consultants, 1986, Fault and Geologic Hazards Investigation, Proposed Vista Hill Hospital Expansion, San Diego County, California, dated September 2.
- Woodward-Clyde, 1984, Geotechnical Investigation for the Proposed South Bay Community Convalescent Hospital of Chula Vista, California, dated April 20.
- Woodward-Gizenski & Associates, 1973, Additional Engineering and Geological Study, General Hospital Facility, Community Hospital of Chula Vista, California, dated March 15.

Our review of the consultant reports referenced above, along with our review of available geologic literature, indicates that the general site area is transected by northeasterly trending minor faults. In addition, our review indicates that the site has localized fill within the northwestern and eastern portions of the site with thicknesses on the order of up to 35 feet.

2.4 Geotechnical Laboratory Testing

Laboratory testing performed on soil samples representative of on-site soils obtained during the recent subsurface exploration included tests of moisture and density, shear strength, grain size, plasticity, maximum density and optimum moisture content, R-value, and a screening geochemical analysis for corrosion. A discussion of the laboratory tests performed and a summary of the laboratory test results are presented in Appendix C. In-situ moisture and density test results are provided on the boring logs (Appendix B). In addition for reference, we have included laboratory testing from Woodward-Clyde dated April 25, 1989, covering the northwestern portion of the site.

3.0 SUMMARY OF GEOLOGIC CONDITIONS

3.1 Geologic and Tectonic Setting

The site is located in the coastal section of the Peninsular Range Province, a geomorphic province with a long and active geologic history throughout Southern California (Norris and Webb, 1990). Throughout the last 54 million years, the area known as the "San Diego Embayment" has undergone several episodes of marine inundation and subsequent marine regression, resulting in the deposition of a thick sequence of marine and nonmarine sedimentary rocks (Figure 3) on the basement rock of the Southern California batholith (Kennedy and Tan, 2008).

The Peninsular Ranges Province is traversed by a group of sub-parallel faults and fault zones trending roughly northwest (Jennings, 2010). Several of these faults are major active faults. The Whittier-Elsinore, San Jacinto, and San Andreas faults are major active fault systems located northeast of the study area and the Agua Blanca-Coronado Bank and San Clemente faults are active faults located west of the project area (Figure 4). Major tectonic activity associated with these and other faults within this regional tectonic framework consists primarily of right-lateral, strike-slip movement.

3.2 Local Geologic Setting

During Eocene time, sediments located east of the site were eroded and then deposited in a westerly direction within deep-water fan and delta environments, while uplift of basement materials to the west resulted in deposition of coarse-grained sediments eastward. Simultaneously, additional uplift along the east then resulted in continued deposition of alluvial fan deposits westward. The site is located near the western limits of a broad structural trough formed by downwarping and normal faulting along the Rose Canyon fault system and the La Nacion Fault Zone (LNFZ) see Figure 5.

Gradual emergence of the region from the sea occurred in Pleistocene time, and numerous wave-cut platforms, most of which were covered by relatively thin marine and nonmarine terrace deposits, formed as the sea receded from the land. Specifically, the site is located in an area where deep-water fan and delta environments have now been exposed due to continued uplift, faulting and erosion. Accelerated fluvial erosion during periods of heavy rainfall, coupled with the lowering of the base sea level during Quaternary times, resulted in the rolling hills, mesas, and deeply incised canyons which characterize the landforms we see in the general site area today

3.3 Site-Specific Geology

Based on the site specific subsurface exploration, and our review of pertinent geologic literature and maps, the site is generally underlain by a thin layer of undifferentiated fill, topsoil, colluvium, pedogenic soil horizons, Oligocene-age Otay Formation and Pliocene-age San Diego Formation. A brief generalized description of each of these units as encountered in the exploration borings are presented below. Detailed descriptions are presented on the exploration boring logs (Appendix B). The lateral and vertical extent of the geology underlying the site are depicted on Plates 1 and 2.

3.3.1 Undocumented Fill (Afu)

Fill soils were placed during the initial mass grading of the site in the 1970s, and later in the 1980s and 1990s. Where fills are generally less than 5 feet in thickness they are not depicted on the Geotechnical Map (Plate 1). Fills deeper than 5 feet are located in the northwestern portion of the site, northwest of the parking deck, the northeastern portion of the site parking lot and as retaining wall backfill. As encountered in the borings, the fill soils generally consisted of brown to dark brown, dry to moist, loose to medium dense, silty sands.

3.3.2 Topsoil and Colluvium (not mapped)

Although not encountered in our boring explorations, localized occurrences of these units were noted in our fault exploration trenching (Leighton, 2013). As encountered, these units were generally light brown and ranged to dark brown, dry to wet, loose to medium dense, porous, silty sands with abundant rootlets. Generally the contact of either the topsoil or colluvial units with the underlying bedrock units was sharp and irregular in character. Thicknesses for the unit ranged from less than a foot to up to 5 feet. Based on the generally brown to light colors, lack of consolidation and cementation.

3.3.3 Very Old Paralic Deposits (Qvop)

As encountered in our boring excavations, these deposits generally consisted of light to medium brown silty sandstone with scattered interbedded cobble-gravel conglomerate and coarse-grained sandstone, dry to damp, very dense. Locally light reddish brown zones were present. This unit was encountered in the upper portions of the site only near the helicopter pad (Boring B-19). The Very Old Paralic Deposits are middle to early Pleistocene in age and correlate to the Lindavista Formation.

3.3.4 San Diego Formation (Tsdss)

As encountered in our boring excavations, the San Diego Formation generally consisted of fine- to locally medium-grained sandstones. The sandstones encountered during our study were generally light brown to light olive brown, damp to moist, dense to very dense, slightly cemented and friable to very friable. Typically, the unit was micaceous, contained various amounts of iron oxide staining, scattered zones of abundant carbonate blebs, stringers, and infilled fractures. Locally the San Diego Formation contains very dense siltstone and hard claystone interbedded layers. The San Diego Formation is early Pleistocene to Pliocene in age.

3.3.5 Otay Formation (To)

As encountered in our boring excavations, the Otay Formation generally consisted of fine- to locally medium-grained sandstones and locally silty claystone. The sandstones encountered during our study were generally light brown to light olive brown, damp to moist, dense to very dense, slightly cemented and friable to very friable. Where the unit becomes more clayey the coloration typically darkens to gray. Typically, the unit was micaceous, contained various amounts of iron oxide staining. Locally the Otay Formation contains very dense siltstone and hard claystone interbedded layers. Claystone interbedded layers often consist of waxy bentonite. The Otay Formation is late Oligocene in age.

3.4 Geologic Structure

Based on our field observations and subsurface exploration, the site is underlain by favorably oriented geologic structure consisting of generally massive fine-grained sandstone of the San Diego and Otay Formations. Specifically, our review of pertinent geologic references (Appendix A), and the results of our previous subsurface exploration (Leighton, 2013), bedding within the San Diego and Otay Formation is generally flat lying with localized dips of between 3 to 5 degrees south to southwest.

3.5 Landslides

Several formations within the San Diego region are particularly prone to landsliding. These formations generally have high clay content and mobilize when they become saturated with water. Other factors, such as steeply dipping bedding that project out of the face of the slope and/or the presence of fracture planes, will also increase the potential for landsliding.

No landslides or indications of deep-seated landsliding were indicated at the site during our field exploration or our review of available geologic literature, topographic maps, and stereoscopic aerial photographs (Appendix A). Furthermore, our field reconnaissance, review of City of Chula Vista hazard maps (Figure 6), and review of Soil-Slip Susceptibility Maps (USGS, 2003), indicate the site is mapped has having a low susceptibility to soil slip. However, based on CGS, 1995, Open-File Report 95-03, the site is mapped has “3-1 – Generally Susceptible” to landslides. Therefore, we have performed slope stability analysis for the site slopes. Additional discussion of slope stability is discussed in the following sections of this report. It should be noted that the closest mapped landslide is approximately 2,000 feet northeast of the site along the very steep northerly descending slope of Telegraph Canyon (CGS, 1995; and Kennedy and Tan 2008).

3.6 Slope Stability

Based on topographic data provided, the site is bound along the north by a moderately sloping cut slope within the San Diego and Otay Formation. Based on our review of the topographic data the cut slope is approximately 33-feet high at an inclination of approximately 2.2:1 (horizontal:vertical). Along the eastern portion of the site a descending natural slope within the San Diego and Otay Formation is also present having a height of approximately 40 feet at an inclination of approximately 4:1 (horizontal:vertical). Based on our observations of the cut and natural slopes within this portion of the site and elsewhere across the site, we

observed no indication of slope failures. In addition, we observed only slight sloughing along the toes of any of these slopes. Elsewhere, slightly sloping to moderately sloping natural topography also had no indication of slope failures.
In addition to the native cut slope and natural slope described above, an approximately 2.3:1 (horizontal:vertical) approximately 35-foot high fill slope is located along the eastern portion of the site. Based on our observation of this fill slope, we observed no indication of slope failures. In addition, we observed only slight sloughing along the toe of this slope.

At the time of drafting this report, proposed grading plans for the site were not available for our review. However, based on the proposed locations of site improvements and structure types, we anticipate that proposed grading will consist of minor cuts and fills between 5 feet and 10 feet. Updated analysis should be performed based on Final designs. Our slope stability analysis for the site considered only the existing site conditions. The slope stability calculations are presented in Appendix D.

Table 1
Soil Strength Parameters

Soil Type	Friction Angle (degrees)	Cohesion (psf)
Artificial Fill	28	350
San Diego Formation	39	100
Otay Formation	36	200
Anisotropic	12	150

Our deep-stability search routines considered surfaces analyzed using Spencer's Method of limit equilibrium analysis. In addition, the Otay Formation is generally considered a slide-prone formation in the San Diego area. Therefore, we have modeled presumptive clay seams within the Otay Formation based on observed and referenced data. Our model includes presumptive clay seams are oriented into the analyzed sections (having southwest dips) between 3 and 5 degrees.

Pseudostatic slope stability analysis was performed using a seismic coefficient of 0.26 determined using the methods of Bray and Travasarou (2009). The coefficient determination was based on a 5 cm median seismic displacement threshold and site spectral acceleration based on the 2010 CBC design spectra. A 20 percent increase was considered for dynamic strengths for surfaces along presumptive clay seams. The slope stability calculations are presented in Appendix D. Our analysis indicated a static factor of safety of 1.5, or greater and pseudostatic slope stability of 1.0, or greater.

3.7 Expansive Soils

Based on our field observations, subsurface investigation, and laboratory testing, highly expansive soils were not observed at the site. However, localized more clayey expansive soils were observed at boring B-1 at a depth between 10 and 15 feet below the ground surface. An expansion index test performed on representative clayey soils at the site indicated an Expansion Index of 62 and is classified as Medium. Therefore, measures to mitigate expansion potential are considered necessary during design and construction.

3.8 Hydrocollapse and Compressible Soils

Based on the results of our subsurface exploration, the potential for hydro-collapse of the underlying San Diego and Otay Formation is considered low at the site. Our opinion is supported by our observation of in-place drive samples which indicated a dense to hard, non-porous character for the underlying sandstone, siltstone, and claystone materials. Based on generally low sampler blow counts and visual observations, fill materials exhibit a potential for settlement under loading. As a result, where settlement sensitive improvements are planned, existing fill soils at the site are considered compressible. Therefore, measures to mitigate settlement potential are considered necessary during design and construction.

3.9 Soil Corrosivity

A screening of the onsite materials for corrosivity was performed to evaluate their potential effect on concrete and ferrous metals. The corrosion potential was evaluated using the results of laboratory testing on a representative soil sample obtained during our subsurface evaluation.

Laboratory testing was performed to evaluate pH, minimum electrical resistivity, and chloride and soluble sulfate content. Two representative samples were tested. The samples tested had a measured pH of 7.71 and 8.01, and measured minimum electrical resistivity of 878 and 3,044 ohm-cm, respectively. Test results also indicated that the samples had a chloride contents of 24 and 12 ppm, and soluble sulfate contents of 0.0375 and 0.0150 percent (by weight in soil).

3.10 Surface and Ground Water

Ground water was not encountered during our subsurface exploration. Based on site topography and Department of Water Resources well data, we estimate ground water is greater than 150 feet in depth (elevation 300 feet above msl) below the site. Based on site topography, surface water likely drains in various directions away from the center of the site which is generally located at the top of a topographic high. Perched ground water may develop on less permeable layers such as between the existing fill unit and the underlying San Diego and Otay Formation at the site, and on interbedded less permeable units such as claystone. It should be noted that ground water levels may fluctuate during periods of precipitation. Nevertheless, based on the above information, we do not anticipate ground water will be a constraint to the construction of the project.

3.11 Infiltration

The results of our subsurface exploration and laboratory testing indicate that on-site fill soils are of a generally silty sandy nature having relatively good infiltration rates. However, sites located in areas underlain by the San Diego and Otay Formations are known to contain both permeable and impermeable layers which can transmit and perch ground water in unpredictable ways and some LID measures may not be appropriate for the site.

3.12 Flood Hazard

According to a Federal Emergency Management Agency (FEMA) flood insurance rate map (FEMA, 1997), the site is not located within a flood zone (Figure 7). In addition, based on our review of dam inundation and topographic maps, the site is not located within a dam inundation area (Figure 8).

3.13 Exceptional Geologic Conditions

Exceptional geologic items are items that are present across the State of California, and occur on a site by site basis. We have addressed the presence or non-presence of these items typically present across the State in the sections below.

3.13.1 Hazardous Materials

Our scope of work has not included evaluation of the site for hazardous materials and we are not aware of any such reports that pertain to the site.

3.13.2 Regional Subsidence

Due to the depth of ground water and the dense nature of the underlying Eocene-age deposits combined with the close proximity of Mesozoic rock, the possibility of regional subsidence is considered to be nil.

3.13.3 Non-Tectonic Faulting

Surface expressions of differential settlement, such as ground fissures, can develop in areas affected by ground water withdrawal or banking activities, including geothermal production. The site location is not within an area affected by differential settlement caused by non-tectonic sources.

3.13.4 Volcanic Eruption

The proposed site is not located within or near a mapped area of potential volcanic hazards (Miller, C.D., 1989). The nearest volcanic activity is located in the Salton Sea area of southern California. Therefore, volcanic activity is not considered a hazard at the site.

3.13.5 Asbestos

Due to the lack of proximal sources of serpentinic or ultramafic rock bodies, naturally-occurring asbestos is not considered a hazard at the site.

3.13.6 Radon-222 Gas

Historically, Radon-222 gas has not typically been recognized as an environmental consideration in San Diego County. In particular the site area is not mapped as containing organic rich marine shales commonly characterized to potentially contain Radon-222 gas. Therefore, based on our review of the referenced literature, and our site exploration, the potential for the occurrence of Radon-222 gas at the site is considered low.

4.0 FAULTING AND SEISMICITY

4.1 Faulting

The California Mining and Geology Board (now referred to as the California Geologic Survey or CGS) defines an active fault as a fault which has had surface displacement within Holocene time (about the last 11,000 years). The Rose Canyon fault for example is considered active. Furthermore, the State Geologist has defined a potentially active fault as any fault considered to have been active during Quaternary time (last 1,600,000 years). This definition is used in delineating Special Studies Zones as mandated by the Alquist-Priolo Geologic Hazards Zones Act of 1972 and as subsequently revised (Hart, and Bryant, 2007). The intent of this act is to assure that unwise urban development does not occur across the traces of active faults.

Although similar to the State definition, the City of San Diego (1999) defines a Potentially Active fault, as a fault that has had activity within the last 1.6 million years (Quaternary Period) and can be demonstrated to be inactive during the last 11,000 years (Holocene Epoch). For the purpose of this report, we utilize the City of San Diego definition when referring to fault activity levels.

The primary seismic risk to the San Diego metropolitan area is the Rose Canyon fault zone located approximately 7.5 miles west of the site (Appendix E). The Rose Canyon fault zone consists predominantly of right-lateral strike-slip faults that extend south-southeast bisecting the San Diego metropolitan area (Figure 4). Various fault strands display strike-slip, normal, oblique, or reverse components of displacement. The Rose Canyon fault zone extends offshore at La Jolla and continues north-northwest subparallel to the coastline. The offshore segments are poorly constrained regarding location and character. South of downtown, the fault zone splits into several splays that underlie San Diego Bay, Coronado, and the ocean floor south of Coronado (Treiman, 1993; Kennedy and Clarke, 1999). Portions of the fault zone in the Mount Soledad, Rose Canyon, and downtown San Diego areas have been designated by the State of California (CGS, 2000 and 2003a) as being Earthquake Fault Zones.

A geologic map covering the Imperial Beach Quadrangle (Kennedy and Tan, 1977), an updated geologic map by Kennedy and Tan (2008), and fault maps by

Treiman (1984 and 1993) indicate the site is east of the main La Nacion Fault trace and within a right step-over and associated zone of deformation. As previously mentioned, the LNFZ extends approximately 20 miles (32 kilometers) from the United States/Mexico border along the east side of Chula Vista and National City northward to the Mission Valley area. The fault zone comprises a series of parallel to subparallel, closely spaced west dipping, normal faults which include the La Nacion, Sweetwater and Chula Vista fault strands. The fault strands within the LNFZ generally dip 60 to 75 degrees west and appear to have had predominantly dip-slip movement throughout their history (west side down). The Pliocene-aged San Diego Formation has been displaced a minimum of 256 feet while early Pleistocene deposits have been displaced a minimum of 224 feet (Artim and Pickney, 1973). Fault strands of the LNFZ typically juxtapose the San Diego Formation and Otay Formation and often separate the Lindavista Formation and San Diego Formation. The nearest active fault is the Rose Canyon fault located approximately 7.5 miles west of the site (Figure 4).

4.1.1 Surface Rupture

Based on the results of our previous fault study (Leighton, 2013), the subject site is transected by several minor and discontinuous northeast trending (N10ºE to N45ºE) faults associated with the La Nacion Fault zone. The faults generally dip northwest at 30º to 45º, with a few faults dipping with similar inclination southeast creating zones of down-dropped San Diego Formation (Plate 1 and 2). Of the faults encountered at the site, only one fault was interpreted to be more than 200 feet in length. The remaining faults, including previously mapped faults by others, all appear less than 200 feet in length and do not extend to the overlapping trenches.

Based on the results of our previous study (Leighton, 2013), we conclude that the faults transecting the site, as observed in our exploration trenches, do not constitute a surface rupture hazard. Therefore, the potential for ground rupture due to faulting at the site is considered low. However, based on previously contrasting results concerning the recency of movement along the LNFZ, we recommend that essential facilities maintain a setback distance from the mapped fault traces as previously identified (Leighton, 2013), see Plate 1.

Ground lurching is defined as movement of low density materials on a bluff, steep slope, or embankment due to earthquake shaking. Since the site is relatively flat and removed from any over-steepened slopes (slopes steeper than 2:1 horizontal to vertical inclination), lurching or cracking of the ground surface as a result of nearby or distant seismic events is unlikely.

4.2 Historical Seismicity

Historically, the San Diego region has been spared major destructive earthquakes. The most recent earthquake on the Rose Canyon fault in San Diego occurred after A.D. 1523 but before the Spanish arrived in 1769. Studies by Rockwell and Murbach (1999) indicate that the earthquake occurred at A.D. 1650 ± 125. Two additional earthquakes, the 1800 M6.5 and 1862 M5.9, may have also occurred in the Rose Canyon fault zone. However, no direct evidence of ground rupture within the Rose Canyon fault zone for those events was recorded.

The site location with respect to significant past earthquakes (≥M5.0) is shown on the Historical Seismicity Map in Appendix E. The historic seismicity for the site has been tabulated utilizing the computer software EQSEARCH (Blake, 2000). The results are presented in Appendix E. The results indicate that the maximum historical site acceleration from 1800 to present has been estimated to be 0.16g.

4.3 Seismicity

The site can be considered to lie within a seismically active region, as can all of Southern California. Specifically, the Rose Canyon fault zone located approximately 7.5 miles west of the site is the 'active' fault considered having the most significant effect at the site from a design standpoint.

4.3.1 Site Class

Utilizing 2010 California Building Code (CBC) procedures, we have characterized the site soil profile to be Site Class D based on our experience with similar sites in the project area and the results of our subsurface evaluation that indicate existing site fills on the order of up to 25 feet in thickness underlie the site.

4.3.2 2010 CBC Mapped Spectral Acceleration Parameters

The effect of seismic shaking may be mitigated by adhering to the California Building Code and state-of-the-art seismic design practices of the Structural Engineers Association of California. Provided below in Table 2 are the spectral acceleration parameters for the project determined in accordance with the 2010 CBC (CBSC, 2010a) and the USGS Worldwide Seismic Design Values tool (Version 3.1.0).

Table 2
2010 CBC Mapped Spectral Acceleration Parameters

Site Class	D		
Site Coefficients	F_a	=	1.084
	F_v	=	1.631
Mapped MCE Spectral Accelerations	S_S	=	1.041g
	S_1	=	0.385g
Site Modified MCE Spectral Accelerations	S_{MS}	=	1.128g
	S_{M1}	=	0.627g
Design Spectral Accelerations	S_{DS}	=	0.752g
	S_{D1}	=	0.418g

The peak horizontal ground acceleration associated with the Maximum Considered Earthquake Ground Motion is 0.45g. The peak horizontal ground acceleration associated with the Design Earthquake Ground Motion is 0.30g.

Since the mapped spectral response at 1-second period (S_1) is less than 0.75g, then all structures are subject to the criteria in Section 1613A of the 2010 CBC are considered to fall within Seismic Design Category D.

4.3.3 2012 IBC Risk-Targeted Mapped Spectral Acceleration Parameters

Risk-targeted mapped spectral accelerations will be adopted in the 2013 California Building Code. For consideration in planning, we are providing the following parameters based on the 2012 International Building Code. As previously discussed, the effect of seismic shaking may be mitigated by adhering to the California Building Code and state-of-the-art seismic design practices of the Structural Engineers Association of California. Provided below in Table 3 are the risk-targeted spectral acceleration parameters for the project determined in accordance with the 2012 International Building Code (IBC, 2012) and the USGS Worldwide Seismic Design Values tool (Version 3.1.0).

Table 3
2012 IBC Risk-Targeted Mapped Spectral Acceleration Parameters

Site Class	D		
Site Coefficients	F_{PGA}	=	1.149
	F_a	=	1.149
	F_v	=	1.730
Mapped MCE_R Spectral Accelerations	S_S	=	0.878g
	S_1	=	0.335g
Site Modified MCE_R Spectral Accelerations	S_{MS}	=	1.009g
	S_{M1}	=	0.580g
Design Spectral Accelerations	S_{DS}	=	0.673g
	S_{D1}	=	0.387g

Utilizing ASCE Standard 7-10, in accordance with Section 11.8.3, the following additional parameters for the peak horizontal ground acceleration are associated with the Risk-Targeted Maximum Considered Earthquake (MCE_R) and the Maximum Considered Earthquake Geometric Mean (MCE_G). For a Site Class D, the peak horizontal ground acceleration (PGA) is 0.35g and the probabilistic geometric mean peak ground acceleration adjusted for Site Class effects (PGA_M) is 0.40g.

It is noted that the formalized California amendments are not yet published and the 2013 California Building Code will not be adopted until January 1, 2014. As such, further review and updating of the parameters in Table 3 should be performed if these are to be utilized for design. Additionally, although response spectra are less than those determined by the 2010 CBC, based on ASCE 7-10 it is anticipated that the ground motion considered in geotechnical analysis will be the Site Modified MCE instead on two-thirds of that ground motion event as required in the current 2010 CBC. That change could affect seismic loading on retaining walls and psuedostatic slope stability analyses. These parameters and analyses should be revisited once the 2013 CBC becomes available if the 2013 CBC is tube utilized in design.

4.3.4 Site-Specific Ground Motion Analysis

The site is not located in a Seismic Hazard Zone, an Alquist-Priolo Earthquake Fault Zone or in a seismic hazard zone designated in the Safety Element for the City of Chula Vista. Therefore, per Section 4-317(e) of the California Administrative Code the development of a site-specific ground motion analysis is not required per Section 1615A.1.2A of the 2010 CBC.

4.4 Secondary Seismic Hazards

Seismic hazard analysis has been performed considering seismicity prescribed by the 2010 CBC. In general, secondary seismic hazards can include soil liquefaction, seismically-induced settlement, lateral displacement, surface manifestations of liquefaction, landsliding, seiches, and tsunamis. A summary of those potential hazards is presented in the table below:

Table 4
Summary of Secondary Seismic Hazards

Improvement	Soil Liquefaction and Surface Manifestations	Seismically Induced Settlement	Lateral Displacement	Landsliding	Seiches and Tsunamis
Parking Structure	Low	Low	Low	Low	Low
Loop Roadway/Utility Corridor	Low	Yes	Low	Low	Low
East Patient Care Building	Low	Yes	Low	Low	Low
Central Plant	Low	Yes	Low	Low	Low
Future West Patient Care Building	Low	Yes	Low	Low	Low

Specifically, the potential for secondary seismic hazards at the subject site is discussed below.

4.4.1 Liquefaction Potential

Liquefaction is the loss of soil strength or stiffness due to a buildup of excess pore-water pressure during strong ground shaking. Liquefaction is associated primarily with loose (low density), granular, saturated soil. Effects of severe liquefaction can include sand boils, excessive settlement, bearing capacity failures, and lateral spreading.

Due to an absence of a shallow ground water table and the presence of loose to medium dense fine-grained silty sandy and clayey fill materials underlain by very dense San Diego and Otay sandstone and claystone materials, the potential for liquefaction at the site is low. In addition, the site is not located within a mapped liquefaction hazard zone (Figure 9).

4.4.2 Seismically-Induced Settlement

Dynamic settlement of soils can occur as a result of strong vibratory ground shaking. Due to the dense nature of the underlying San Diego and Otay Formation, the potential for dynamic settlement is considered to be low within these units.

The potential for dynamic settlement of the existing fill was evaluated using the procedures of Tokimatsu and Seed (1987) as adapted by Pradel (1998). Specifically, these areas are located within the southwestern portion of the proposed East Patient Care Building and across the footprint of the proposed new Central Plant. In addition, portions of the proposed loop roadway and utility corridor located along the eastern boundary of the Master Plan area are subject to dynamic settlement. Based on our analysis, up to approximately 1/2 inch of dynamic settlement is estimated where fills are deepest (Appendix E).

4.4.3 Surface Manifestation of Liquefaction and Dynamic Settlement

Due to absence of a shallow groundwater table and the generally fine-grained silty and sandy fill materials in turn underlain by dense San Diego and Otay Formations, the surface manifestation of dynamic settlement is anticipated to be minor.

- The site is transected by several potentially active faults. Based on the results of our previous fault study (Leighton, 2013), we conclude that the faults transecting the site, as observed in our previous exploration trenches, do not constitute a surface rupture hazard. Therefore, the potential for ground rupture due to faulting at the site is considered low. However, based on previously contrasting results concerning the recency of movement along the LNFZ, we recommend that essential facilities maintain a setback distance from the mapped fault traces as previously identified, see Plate 1.
- The peak horizontal ground acceleration associated with the Maximum Considered Earthquake Ground Motion is 0.45g. The peak horizontal ground acceleration associated with the Design Earthquake Ground Motion is 0.30g.
- The potential for liquefaction at the site is considered to be low. Differential seismic settlement of less than 1/2 inch is estimated considering the existing site conditions.
- The potential for slope instability at the site is considered to be low.
- Based on the subsurface exploration of the soils underlying the site, we anticipate that fill materials can be excavated with conventional heavy-duty earthwork equipment. Where excavations or borings are proposed into the San Diego and Otay Formation, sloughing within zones of friable sands should be anticipated.
- Laboratory test results indicate the granular onsite soils have a negligible potential for sulfate exposure on concrete and a high corrosion potential to buried uncoated ferrous metals.

4.4.4 Lateral Spreading or Flow Failure

Due to the low potential for liquefaction, and dense nature of the onsite materials, the potential for lateral spreading flow failure is low.

4.4.5 Tsunamis or Seiches

Tsunamis are long wavelength seismic sea waves (long compared to the ocean depth) generated by sudden movements of the ocean bottom during submarine earthquakes, landslides, or volcanic activity. A seiche is an oscillation (wave) of a body of water in an enclosed or semi-enclosed basin that varies in period, depending on the physical dimensions of the basin, from a few minutes to several hours, and in height from several inches to several feet. Based on the elevation (approximately 450 feet msl) and inland location of the site, the potential for damage due to either a tsunami or seiche is low.

5.0 CONCLUSIONS

Based on the results of our investigation of the site, it is our opinion that the proposed Sharp Chula Vista Medical Center Master Plan is feasible from a geotechnical standpoint, provided the following conclusions and recommendations are incorporated into the project plans and specifications. The following is a summary of the significant geotechnical factors that we expect may affect development of the site. Our conclusions and recommendations were derived based on the current 2010 CBC and should be revisited if design is proposed under other Codes.

- Existing compacted fill thickness across the site ranges up to approximately 30 feet in localized areas. Specifically, the proposed location of the new east patient care building has existing undocumented fill up to approximately 15 feet thick within the southeast portion of the proposed building footprint. Locally, existing fills are present in Boring B-10 near the west side of the addition. The proposed new central plant has existing undocumented fill up to approximately 22 feet thick within the eastern portion of the proposed building footprint. Based on our document review (Appendix A) and the results of our study, the existing fill soils are considered to be potentially compressible.
- Due to the generally dense sandy character of formational materials underlying the site and lack of adverse geologic conditions, landsliding and mass movement is considered to be unlikely.
- Ground water was not encountered during our investigation and is not anticipated to be a constraint to construction of the proposed structure or site improvements.
- Localized onsite soils were found to have a very low to medium potential for expansion.
- The San Diego and Otay Formation appear to provide moderate infiltration of surface water. However, due to the potential for encountering less permeable interbedded claystone and cemented sandstone within the San Diego and Otay Formation, they are not considered suitable for storm water management strategies that utilize infiltration.
- Exceptional geologic hazards are not anticipated to impact the site or the proposed site development.
- Active faults do not transect or project toward the site. The closest active fault is the Rose Canyon fault located approximately 7.5 miles to the west.

6.0 PRELIMINARY RECOMMENDATIONS

6.1 Earthwork

We anticipate that earthwork at the site will consist of site preparation, excavation, and fill operations. We recommend that earthwork on the site be performed in accordance with the following recommendations and the General Earthwork and Grading Specifications for Rough Grading included in Appendix G. In case of conflict, the following recommendations shall supersede those in Appendix G.

6.1.1 Site Preparation

Prior to grading, all areas to receive structural fill, engineered structures, or hardscape should be cleared of surface and subsurface obstructions, including any existing debris and undocumented, loose, or unsuitable fill soils, and stripped of vegetation. Removed vegetation and debris should be properly disposed off site. All areas to receive fill and/or other surface improvements should be scarified to a minimum depth of 8 inches, brought to optimum or above-optimum moisture conditions, and recompacted to at least 90 percent relative compaction based on ASTM Test Method D1557.

6.1.2 Removals of Compressible Soils in Building Pad Areas

Potentially compressible fill soils that may settle as a result of wetting or settle under the surcharge of engineered fill and/or foundation loads should be removed and placed as moisture conditioned engineered fill. Based on the results of our subsurface exploration, we anticipate fill removal depths on the order of between 5 to 25 feet will be necessary within building pad areas of the East Patient Care Building and Central Plant. The deepest removals will be located in the far northeastern portions of the site near the descending fill slope. The lateral limits of the bottom of the remedial removals should extend to outside the structure footprint a distance of 10 feet. The bottom of the removals should be evaluated by a Certified Engineering Geologist to confirm conditions are as anticipated.

Although not a part of the scope of this study, it should be noted that, based on our review of pre-grading and post-grading topography, and previously completed geotechnical reports for the design of the existing parking deck (Appendix A), removals on the order of 35 feet or deep foundations should be anticipated at the location of the future West Patient Care Building within the northwestern portion of the site.

In general, the old fill and native soil that is removed may be reused and placed as fill provided the material is moisture conditioned to above optimum moisture content, and then recompacted prior to additional fill placement or construction. Soil with an expansion index greater than 50 should not be used within 5 feet of finish grade in the building pad. The actual depth and extent of the required removals should be confirmed during grading operations by the geotechnical consultant.

Table 5
Structure Bearing Condition and Anticipated Maximum Remedial Grading

Location	Bearing Condition	Remedial Grading Depth (bgs)
Parking Structure	Cut/Fill	5 feet
East Patient Care Building	Cut/Fill	15 feet
Central Plant	Fill	25 feet
Future West Patient Care Building	Fill	35 feet

As an alternative to the above recommended removals and fill recompaction, deep foundations may be considered. Additional recommendations are provided in subsequent sections of this report regarding the design of deep foundations.

6.1.3 <u>Cut/Fill Transition Mitigation</u>

Although grading plans were not available at the time of this report, the proposed Parking structure and East Patient Care structure are situated where a cut/fill transition beneath the structure is anticipated. The lateral limits of the bottom of the remedial removals should extend to outside the structure footprint a distance of 10 feet.

Parking Structure

To mitigate the impact of the underlying cut/fill transition condition beneath the Parking structure, the shallow formational materials should be over-excavated to at least 5 feet below finish grade, or 3 feet below the bottoms of proposed foundations, whichever is deeper. Alternatively, all footings for the proposed structure can be extended through the engineered fill and a minimum of 6 inches into competent formational material. The additional depth can be filled with concrete or controlled low-strength material (CLSM) prior to placement of foundation reinforcing steel and concrete.

East Patient Care Building

To mitigate the impact of the underlying cut/fill transition condition beneath the East Patient Care Building structure, the shallow formational materials should be over-excavated to at least 10 feet below finish grade, or 5 feet below the bottoms of proposed foundations, whichever is deeper.

To accomplish the proposed transition over-excavation adjacent to existing structures, we recommend that a temporary 4:1 (horizontal:vertical) slope be excavated from 1 foot above the bottom of the existing foundation depth outward until to at least 10 feet below finish grade, or 5 feet below the bottoms of proposed foundations within the formational material. Should this approach leave existing fills in place under new foundations, deeper excavation should be performed locally.

The over-excavated material should be replaced with properly compacted fill. Where the material is being placed against the 4:1 temporary cut slope, the slope should be benched (Appendix G). Where not bound by existing structures, the over-excavation should laterally extend at least 10 feet beyond the building pad area and associated settlement-sensitive structures.

6.1.4 Excavations and Oversize Material

Excavations of the onsite materials may generally be accomplished with conventional heavy-duty earthwork equipment. Temporary excavations less than 4 feet in depth, such as utility trenches with vertical sides, should remain stable for the short period required to construct the utility, provided they are free of adverse geologic conditions and friable dry soils.

It should be noted that the site is underlain by dense and moderately cemented materials of the San Diego and Otay Formation. The excavatability of the San Diego and Otay Formation material with conventional heavy-duty construction equipment is expected to require normal effort. It should be noted that heavy ripping and possible rock breaking may be needed in locally cemented and concretionary zones within the formational units. If oversize material (typically over 6 inches in maximum dimension) is generated, it should be placed in non-structural areas or hauled off-site.

In accordance with OSHA requirements, excavations deeper than 5 feet should be shored or be laid back if workers are to enter such excavations. Temporary sloping gradients should be determined in the field by a “competent person” as defined by OSHA. For preliminary planning, sloping of fill soils at 1:1 (horizontal to vertical) may be assumed where surcharge loading is not present. Excavations greater than 20 feet in height will require an alternative sloping plan or shoring plan prepared by a California registered civil engineer.

6.1.5 Engineered Fill

In areas proposed to receive engineered fill, the existing upper 8 inches of subgrade soils should be scarified then moisture conditioned to moisture content at or above the optimum content and compacted to 90 percent or more of the maximum laboratory dry density, as evaluated by ASTM D 1557. Soil materials utilized as fill should be free of oversized rock, organic materials, and deleterious debris. Rocks greater than 6 inches in diameter should not be placed within 2 feet of finished grade. Fill should be moisture conditioned to at least 2 percent above the optimum moisture content and compacted to 90 percent or more relative compaction, in accordance with ASTM D 1557. Although the optimum lift thickness for fill soils will be dependent on the type of compaction equipment utilized, fill should generally be placed in uniform lifts not exceeding approximately 8 inches in loose thickness.

In pavement roadway areas the upper 12 inches of subgrade soils should be scarified then moisture conditioned to a moisture content at or above optimum content and compacted to 95 percent or more of the maximum laboratory dry density, as evaluated by ASTM D 1557.

Placement and compaction of fill should be performed in general accordance with the current City of Chula Vista grading ordinances, California Building Code, sound construction practice, these recommendations and the General Earthwork and Grading Specifications for Rough Grading presented in Appendix G.

6.1.6 Earthwork Shrinkage/Bulking

The volume change of excavated onsite materials upon recompaction as fill is expected to vary with material and location. Typically, the surficial soils and formational sandstone materials vary significantly in natural and compacted density, and therefore, accurate earthwork shrinkage/bulking estimates cannot be determined. However, based on the results of our geotechnical analysis and our experience, a 5 percent shrinkage factor is considered appropriate for the existing fill and a 0 to 5 percent bulking factor is considered appropriate for the San Diego and Otay Formation.

6.1.7 Import Soils

Although not anticipated, if import soils are necessary to bring the site up to the proposed grades, these soils should be granular in nature, and have an expansion index less than 50 (per ASTM Test Method D4829) and have a low corrosion impact to the proposed improvements. Import soils and/or the borrow site location should be evaluated by the geotechnical consultant prior to import. The contractor should provide evidence that all import materials comply with DTSC requirements for import materials.

6.1.8 Removal and Recompaction

Excluding the settlement sensitive building pad areas discussed above in Section 6.1.2, existing fill and disturbed soils within the limits of proposed improvements should also be partially removed, moisture conditioned, and recompacted. Removal depths may be limited to 3 feet below site improvements. Where utilities and pipes are planned in existing fills, the trench subgrade should be scarified at least 8 inches; moisture conditioned and re-compacted to at least 90 percent prior to placement of bedding materials.

6.1.9 Expansive Soils and Selective Grading

Based on our laboratory testing and observations we anticipate the onsite soil materials will generally possess a low expansion potential. It should be noted however that more highly expansive materials may be locally encountered as observed in Boring B-1. Therefore, should more expansive materials be encountered selective grading may need to be performed. In addition, to accommodate conventional foundation design, the upper 5 feet of materials within building pads and 10 feet outside the limits of the building foundations should have a very low to low expansion potential (EI<50).

6.2 Foundation and Slab Considerations

The proposed structures may be constructed with conventional foundations. Foundations and slabs should be designed in accordance with structural considerations and the following recommendations. These recommendations assume that the soils encountered within 5 feet of pad grade have a very low to medium potential for expansion (EI<50). If more expansive materials are encountered and selective grading cannot be accomplished, revised foundation recommendations may be necessary. The foundation recommendations below assume that the all building foundations will be underlain by properly compacted fill.

6.2.1 Shallow Spread Footing Foundations

Where soils within 5 feet of pad grade have a very low to low expansion potential (EI <50), proposed structures may be supported by spread footings. Footings should extend a minimum of 18 inches beneath the lowest adjacent finish grade. At these depths, footings may be designed for a maximum allowable (FS>3) bearing pressure of 4,000 pounds per square foot when founded in properly compacted fill. Considering that the ultimate bearing capacity is at least 14,000 psf, the allowable pressures may be increased by one-third when considering loads of short duration such as wind or seismic forces. The minimum recommended width of footings is 18 inches for continuous footings and 18 inches for square or round footings. Continuous footings should be designed in accordance with the structural engineer's requirements and have a minimum reinforcement of four No. 5 reinforcing bars (two top and two bottom). Reinforcement of individual column footings should be per the structural requirements.

6.2.2 Drilled Pile Foundations

If more heavily loaded elements are planned or deep foundations are desired to bypass existing undocumented fill materials, support of those elements on cast-in-drilled hole (CIDH) piles may be considered. Allowable (FS ≥3) axial capacities for CIDH piles were developed using the computer program SHAFT (Version 6.07) produced by Ensoft, Inc. The preliminary analyses considered site conditions, with up to 25 feet of fill underlain by dense formational material. Appendix F presents the applicable preliminary design curves for 2 to 3 foot diameter CIDH piles. Upward capacity equal to one-half the total axial/compressive value may be utilized to resist tensile loads. Pier settlement is anticipated to be less than 1/4 inch under design loads and normal service conditions. The design graph in Appendix F is based on center to center pile spacings of at least 3 pile diameters. Where piles are spaced more closely, reduction in pile capacity is necessary. Construction of piles should be sequenced such that the concrete of constructed piles are allowed to setup prior to construction of piles within 3 diameters. Lateral loads on the face of caissons/piers in areas of level ground surface may be resisted by using a lateral bearing of 300 psf/foot elevation. Where piles are situated closer than 5 diameters (center to center) apart, reduction in lateral bearing is needed and should be reviewed by the geotechnical consultant on a case-by-case basis. More rigorous analysis can also be performed if piles are elected.

All pile installation should be performed under the observation of the geotechnical consultant and consistent with standard practice. Drilling equipment should be powerful enough to drill into the dense to very dense/cemented formational material with cobbles to the design penetration depths. Once a pile excavation has been started, it should be completed within 8 hours, which includes inspection, placement of the reinforcement, and placement of the concrete.

Due to the friable character of the formational materials underlying the site, caving of soils is possible at the site. If caving occurs, a starter casing should be used to protect the top of the borehole to mitigate caving conditions. In addition, the contractor should also be prepared to employ casing or other methods of advancing the drilled pile excavation to mitigate caving. Use of casing should be at the contractor’s discretion. If pile excavations become bell-shaped and cannot be advanced due to severe caving, the caved region may be filled with a sand/cement slurry and redrilled. Redrilling may continue when the slurry has reached suitable set and strength. In this case, it may be prudent to utilize casing or other special methods to facilitate continued drilling after the slurry has set.

6.2.3 Foundation Setback

We recommend a minimum horizontal setback distance from the face of slopes for all structural foundations, footings, and other settlement-sensitive structures as indicated on the Table 6 below. The minimum recommended setback distance from the face of retaining wall is equal to 1.5 times the height of the retaining wall. This distance is measured from the outside bottom edge of the footing, horizontally to the slope or retaining wall face, and is based on the slope or wall height. However, the foundation setback distance may be revised by the geotechnical consultant on a case-by-case basis if the geotechnical conditions are different than anticipated.

Table 6 Minimum Foundation Setback from Slope Faces	
Slope Height	Minimum Recommended Foundation Setback
Less than 5 feet	7 feet
Greater than 5 feet	10 feet

Please note that the soils within the structural setback area possess poor lateral stability, and improvements (such as retaining walls, sidewalks, fences, pavements, etc.) constructed within this setback area may be subject to lateral movement and/or differential settlement. Potential distress to such improvements may be mitigated by providing a deepened footing or a grade beam foundation system to support the improvement.

In addition, open or backfilled utility trenches that parallel or nearly parallel structure footings should not encroach within an imaginary 2:1 (horizontal to vertical) downward sloping line starting 9 inches above the bottom edge of the footing and should also not be located closer than 18 inches from the face of the footing. Deepened footings should meet the setbacks as described above. Also, over-excavation should be accomplished such that deepening of footings to accomplish the setback will not introduce a cut/fill transition bearing condition.

Where pipes cross under footings, the footings should be specially designed. Pipe sleeves should be provided where pipes cross through footings or footing walls and sleeve clearances should provide for possible footing settlement, but not less than 1 inch around the pipe.

6.2.4 Floor Slabs

Slab-on-grade should be at least 5 inches thick and be reinforced with No. 4 rebars 18 inches on center each way (minimum) placed at mid-height in the slab. We recommend control joints be provided across the slab at appropriate intervals as designed by the project architect. Where moisture-sensitive finishes are planned, underslab moisture protection should be designed by the project architect in accordance with Section

4.505 of the 2010 California Green Building Standards Code (CBSC, 2010).

The potential for slab cracking may be reduced by careful control of water/cement ratios. The contractor should take appropriate curing precautions during the pouring of concrete in hot weather to minimize cracking of the slabs. We recommend that a slipsheet (or equivalent) be utilized if grouted tile, marble tile, or other crack-sensitive floor covering is planned directly on concrete slabs. All slabs should be designed in accordance with structural considerations. If heavy vehicle or equipment loading is proposed for the slabs, greater thickness and increased reinforcing may be required. The additional measures should be designed by the structural engineer using a modulus of subgrade reaction of 150 pounds per cubic inch. Additional moisture/waterproofing measures that may be needed to accomplish desired serviceability of the building finishes and should be designed by the project architect.

6.2.5 Settlement

For conventional footings, the recommended allowable-bearing capacity is based on a maximum total and differential static settlement of 3/4 inch and 1/2 inch. Since settlements are a function of footing size and contact bearing pressures, some differential settlement can be expected where a large differential loading condition exists. Pile settlements are expected to be less than 1/4 inch.

6.2.6 Moisture Conditioning

The building pad and site flatwork subgrade soils should be maintained at a moisture content at least 2 percent above optimum. Testing to confirm the moisture content should be performed prior to placing building slab underlayment and site flatwork.

6.3 Lateral Earth Pressures and Retaining Wall Design

Should retaining walls be included in the project, Table 7 presents the lateral earth pressure values for level or sloping backfill for walls backfilled with fully drained soils of very low to low expansion potential (less than 50 per ASTM D4829).

Table 7 Static Equivalent Fluid Weight (pcf)		
Conditions	Level	2:1 Slope
Active	35	55
At-Rest	55	65
Passive	300 (Maximum of 3 ksf)	100 (slopping down)

Unrestrained (yielding) cantilever walls up to 10 feet in height should be designed for an active equivalent pressure value provided above. If conditions other than those covered herein are anticipated, the equivalent fluid pressure values should be provided on an individual case-by-case basis by the geotechnical engineer. A surcharge load for a restrained or unrestrained wall resulting from automobile traffic may be assumed to be equivalent to a uniform lateral pressure of 75 psf which is in addition to the equivalent fluid pressure given above. For other uniform surcharge loads, a uniform pressure equal to 0.35q should be applied to the wall. The wall pressures assume walls are backfilled with free draining materials and water is not allowed to accumulate behind walls. A typical drainage design is contained in Appendix F. Wall backfill should be compacted by mechanical methods to at least 90 percent relative compaction (based on ASTM D1557). If foundations are planned over the backfill, the backfill should be compacted to 95 percent. Wall footings should be designed in accordance with the foundation design recommendations and reinforced in accordance with structural considerations. For all retaining walls, we recommend a minimum horizontal distance from the outside base of the footing to daylight as outlined in Table 6.

Lateral soil resistance developed against lateral structural movement can be obtained from the passive pressure value provided above. Further, for sliding resistance, the friction coefficient of 0.4 may be used at the concrete and soil interface. These values may be increased by one-third when considering loads of short duration including wind or seismic loads. The total resistance may be taken as the sum of the frictional and passive resistance provided that the passive portion does not exceed two-thirds of the total resistance.

To account for potential redistribution of forces during a seismic event, retaining walls providing lateral support where exterior grades on opposites sides differ by more than 6 feet fall under the requirements of 2010 CBC Section 1615A.1.6 and/or ASCE 7-05 Section 15.6.1 and should also be analyzed for seismic loading. For that analysis, an additional uniform lateral seismic force of $8H^2$ pounds per foot acting at 0.6H should be considered for the design of the retaining walls with level backfill, where H is the height of the wall. This value should be increased by 150% for restrained walls.

6.4 Shoring of Excavations

We anticipate excavations in the northeastern portion of the site to be on the order of 20 feet bgs for the proposed Master Plan. Accordingly, and because of the limited space, temporary shoring of vertical excavations will be required. We recommend that cuts be retained by a soldier beam and lagging shoring system deriving passive support from cast-in-place soldier piles and (lagging-shoring system) with tie-backs. Specialty engineers and contractors with local knowledge of the downtown San Diego area soil conditions typically perform shoring of excavations of this size should be utilized for structural design and construction of the system.

Based on our experience with nearby projects, it is our opinion that the caving potential of the on-site soils is moderate. To accommodate installation of the shoring in the dense to hard underlying geologic units, wide-flange sections may be installed into pre-drilled holes surrounded by concrete. If caving of the drilled holes occurs, drilling slurry or casing may be required. In addition, caving of drilled holes for the tieback anchors may be encountered.

For design of temporary tie-back shoring we recommend a restrained active pressure of 20H assuming a rectangular distribution. All shoring systems should consider adjacent surcharging (such as the presence of construction equipment). The above pressures do not include hydrostatic pressures. A uniform horizontal pressure of equivalent to 2 additional feet of soil should be exerted against the walls that are adjacent to vehicular traffic. Additional surcharge loading from the adjacent buildings should also be considered and shoring elements designed to minimize deflection and preserve the necessary factor of safety for existing footings.

For design of tie-backs, we recommend a concrete-soil bond stress of 1,000 psf of the concrete-soil interface area for straight shaft anchors installed by a competent contractor. This value should be considered only behind the 30 degree line (measured from the vertical) up from the base of the excavation. Temporary tie-back anchors should be individually proof-tested to 150 percent of design capacity. Further details and design criteria for tie-backs can be provided as appropriate. Since design of retaining systems is sensitive to surcharge pressures behind the excavation, we recommend that this office be consulted if unusual load conditions are anticipated. Care should be exercised when excavating into the on-site soils since caving or sloughing of these materials is possible. We recommend that the void space behind lagging be filled with sand/cement slurry. Field testing of tie-backs and observation of soldier pile excavations should be performed during construction.

6.5 Design Ground Water Elevation

As previously discussed in Section 3.3, ground water was not observed in our exploration borings. Based on the results of our subsurface explorations and our experience with similar projects in the site area, we anticipate ground water to be at a depth of 100 feet or more. We do not anticipate that the static ground water will be encountered during the construction of the proposed project. Ground water levels may fluctuate during periods of precipitation.

6.6 Monitoring of Shoring

Settlement monitoring of adjacent sidewalks and structures should be performed to evaluate the performance of the shoring. Shoring of the excavation is the responsibility of the contractor. Extreme caution should be used to minimize damage to existing pavement, utilities, and/or structures caused by settlement or reduction of lateral support. Sequencing of underpinning, shoring installation, excavation and dewatering will be critical to control of deflections and settlement. Once the shoring contractor is selected, a detail excavation phasing plan should be submitted and reviewed by the shoring designer and geotechnical engineer.

The shoring should be surveyed for vertical and horizontal deflection by the Civil Engineer at the top, mid-point, and bottom of each wall face (4 faces) at 50-foot intervals along the wall length. Vertical settlements should be surveyed along an alignment behind the wall at each of the mid-wall monitoring points to a distance behind the wall equal to 1/2 times the wall height. The survey points should be established prior to the start of construction and continued on a weekly basis as the construction proceeds and while the excavation remains open. After completion of the excavation, the survey interval may be extended based on evaluation by the geotechnical consultant.

6.7 Dewatering

We do not anticipate that ground water will be encountered during construction and subterranean levels and foundation excavations will not extend below the ground water table. Therefore, dewatering during construction is not anticipated.

6.8 Preliminary Pavement Design Considerations

Based on R-value and SE test results, we have utilized an R-value of 40 for preliminary design of surface pavements at parking lot locations and an R-value of 30 for pavements associated with the loop driveway. Actual subgrade R Value results should be verified during grading and adjustment made to the base thicknesses as appropriate. If more clayey materials with lower R-value are placed as subgrade in proposed pavement areas, increased base thickness will be necessary.

6.8.1 Flexible Pavement Section

It is our understanding that three types of vehicular traffic are to be considered for pavement design; those are auto parking, auto driveway and fire lane/industrial. Table 8 below provides the traffic indices we have considered in our analysis. For the purposes of developing a traffic index for the project, we have utilized the City of Chula Vista, Subdivision Manual, Section 3, General Design Criteria, dated March 13, 2012.

Table 8 Design Traffic Index Values	
Traffic	Traffic Index
Auto Parking	5.0
Auto Driveway	6.0
Fire Lane/Industrial	9.0

Flexible pavement sections have been evaluated in general accordance with the Caltrans method for flexible pavement design and are summarized below in Table 9.

Table 9 AC over Aggregate Base Pavement Sections				
Traffic	*R-Value	TI	AC (in)	Aggregate Base (in)
Auto Parking	40	5.0	3	4
Auto Driveway	30	6.0	3	9
Fire Lane / Industrial Driveway	30	9.0	5	13

*assumed value based on preliminary laboratory testing

6.8.2 Rigid Pavement Section

Where Portland Cement Concrete pavements are planned, Table 10 presents PCC pavements sections.

Table 10 PCC Pavement Sections				
Traffic	*R-Value	TI	PCCP (in)	Aggregate Base (in)
Auto Parking	40	5.0	5.5	--
Auto Driveway	30	6.0	7	--
Fire Lane / Industrial Driveway	30	9.0	8	--

*assumed value based on preliminary laboratory testing

Regular crack control joints should be provided for PCC pavement to mitigate the potential for adverse cracking. We recommend that sections be as nearly square as possible. A mix that provides a minimum 600 psi modulus of rupture should be utilized. The actual pavement design should also be in accordance with City of Chula Vista and ACI criteria. All pavement section materials should conform to and be placed in accordance with the latest revision of the Greenbook and American Concrete Institute (ACI) codes and guidelines.

For trash truck aprons, we recommend a full depth of Portland Cement Concrete section of 7 inches with No. 4 bars at 24 inches on center, each way steel and crack-control joints as designed by the project civil or structural engineer. We recommend that jointed sections be as nearly square as possible.

6.8.3 Pavement Section Materials

Prior to placement of the aggregate base material, the upper 12 inches of subgrade soils (including beneath the curb and gutter and 6-inches behind the curb and gutter) should be scarified, moisture-conditioned (or dried back) as necessary to 2 percent above optimum moisture content and compacted to a minimum 95 percent relative compaction based on ASTM Test Method D1557. Aggregate base should be compacted to a minimum 95 percent relative compaction in accordance with ASTM Test Method D1557. Flexible pavements should be constructed in accordance with current Greenbook Specifications. Crushed aggregate base should have a minimum sand equivalent of 40.

Actual pavement recommendations should be based on R-value tests performed on bulk samples of the soils that are exposed at the finished subgrade elevations across the site at the completion of the mass grading operations.

6.9 Geochemical Considerations

Concrete in direct contact with soil or water that contains a high concentration of soluble sulfates can be subject to chemical deterioration commonly known as "sulfate attack." Soluble sulfate results (Appendix C) indicated a negligible soluble sulfate content. We recommend that concrete in contact with earth materials be designed in accordance with Section 4 of ACI 318-11 (ACI, 2011).

Minimum resistivity and pH tests were performed on representative samples of subgrade soils (Appendix C). Based on our results, the site soils have a high corrosion potential to buried uncoated metal conduits (Caltrans, 2003). We recommend measures to mitigate corrosion be implemented during design and construction.

6.10 Concrete Flatwork

Concrete sidewalks and other flatwork (including construction joints) should be designed by the project civil engineer and should have a minimum thickness of 4 inches. For all concrete flatwork, the upper 12 inches of subgrade soils should be moisture conditioned to at least 3 percent or above optimum moisture content and compacted to at least 90 percent relative compaction based on ASTM Test Method D1557 prior to the concrete placement.

6.11 Control of Ground Water and Surface Waters

Regarding Low Impact Development (LID) measures, we are of the opinion that infiltration basins, and other onsite storm water retention and infiltration systems can potentially create adverse perched ground water conditions. Therefore, given the site geologic conditions and project type, infiltration type LID measures are not considered to be appropriate for this site and project.

Surface drainage should be controlled at all times and carefully taken into consideration during precise grading, landscaping, and construction of site improvements. Positive drainage (e.g., roof gutters, downspouts, area drains, etc.) should be provided to direct surface water away from structures and improvements and towards the street or suitable drainage devices. Ponding of water adjacent to structures or pavements should be avoided. Roof gutters, downspouts, and area drains should be aligned so as to transport surface water to a minimum distance of 5 feet away from structures. The performance of structural foundations is dependent upon maintaining adequate surface drainage away from structures.

Water should be transported off the site in approved drainage devices or unobstructed swales. We recommend a minimum flow gradient for unpaved drainage within 5 feet of structures of 2 percent sloping away.

The impact of heavy irrigation or inadequate runoff gradient can create perched water conditions, resulting in seepage or shallow ground water conditions where previously none existed. Maintaining adequate surface drainage and controlled irrigation will significantly reduce the potential for nuisance-type moisture problems. To reduce differential earth movements such as heaving and shrinkage due to the change in moisture content of foundation soils, which may cause distress to a structure and improvements, moisture content of the soils surrounding the structure should be kept as relatively constant as possible. Below grade planters should not be situated adjacent to structures or pavements unless provisions for drainage such as catch basins and drains are made.

All area drain inlets should be maintained and kept clear of debris in order to function properly. In addition, landscaping should not cause any obstruction to site drainage. Rerouting of drainage patterns and/or installation of area drains should be performed, if necessary, by a qualified civil engineer or a landscape architect.

6.12 Construction Observation

The recommendations provided in this report are based on preliminary design information and subsurface conditions disclosed by widely spaced excavations. The interpolated subsurface conditions should be checked by Leighton Consulting, Inc. in the field during construction. Construction observation of all onsite excavations and field density testing of all compacted fill should be performed by a representative of this office. We recommend that all excavations be mapped by the geotechnical consultant during grading to determine if any potentially adverse geologic conditions exist at the site.

6.13 Plan Review

Final project grading and foundation plans should be reviewed by Leighton Consulting as part of the design development process to ensure that recommendations in this report are incorporated in project plans.

7.0 LIMITATIONS

The recommendations contained in this report are based on available project information. Changes made during design development, should be reviewed by Leighton Consulting, Inc. to determine if recommendations are still applicable. Any questions regarding the contents of this report should be directed to the attention of Robert Stroh, CEG, (858) 300-4090 of Leighton Consulting, Inc.

The field evaluations, and geologic analyses presented in this fault hazard report have been conducted in general accordance with current practice and the standard of care exercised by geologic consultants performing similar tasks in the project area. No other warranty, expressed or implied, is made regarding the conclusions, recommendations, and opinions presented in this report.

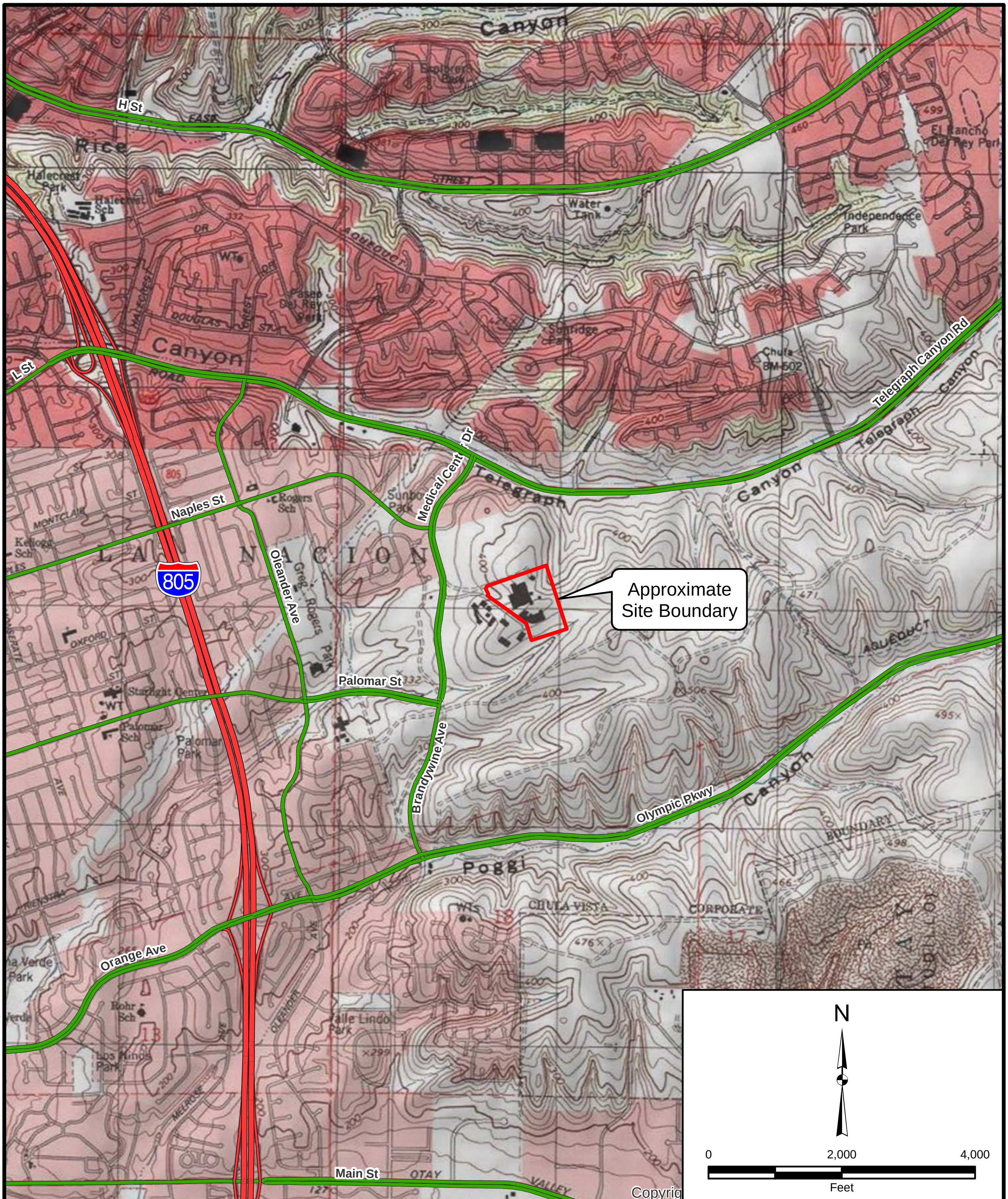
The nature of many sites is such that differing geological conditions can occur over small areal distances and under varying climatic conditions. The conclusions and recommendations in this report are based in part upon data that were obtained from a limited number of observations, site visits, excavations, samples, and tests. Such information is by necessity incomplete and therefore preliminary. The findings, conclusions, and recommendations presented in this report are considered preliminary and can be relied upon only if Leighton has the opportunity to observe the subsurface conditions during grading and construction in order to confirm that our preliminary findings are representative for the site.

IMPORTANT: As stipulated in Section 1803A.1 of the 2010 California Building Code, recommendations in this report are not valid until the report is reviewed and approved by OSHPD. Anyone using this report before OSHPD approval does so at their own risk.

This report was prepared for the sole use of Sharp HealthCare for use with the Sharp Chula Vista Medical Center Master Plan in accordance with generally accepted California licensed geological practices at this time in California.

Please note that our evaluation was limited to assessment of the geologic aspects of the project, and did not include evaluation of structural issues, environmental concerns or the presence of hazardous materials. Our conclusions, recommendations and opinions are based on an analysis of the observed site conditions. If geologic conditions different from those described in this report are encountered, our office should be notified and additional recommendations, if warranted, will be provided upon request.

Figures



Project: 603541-002	Eng/Geol: SAC/RCS
Scale: 1 " = 2,000 '	Date: July 2013

Thematic Info: ESRI Resources Center, 2013

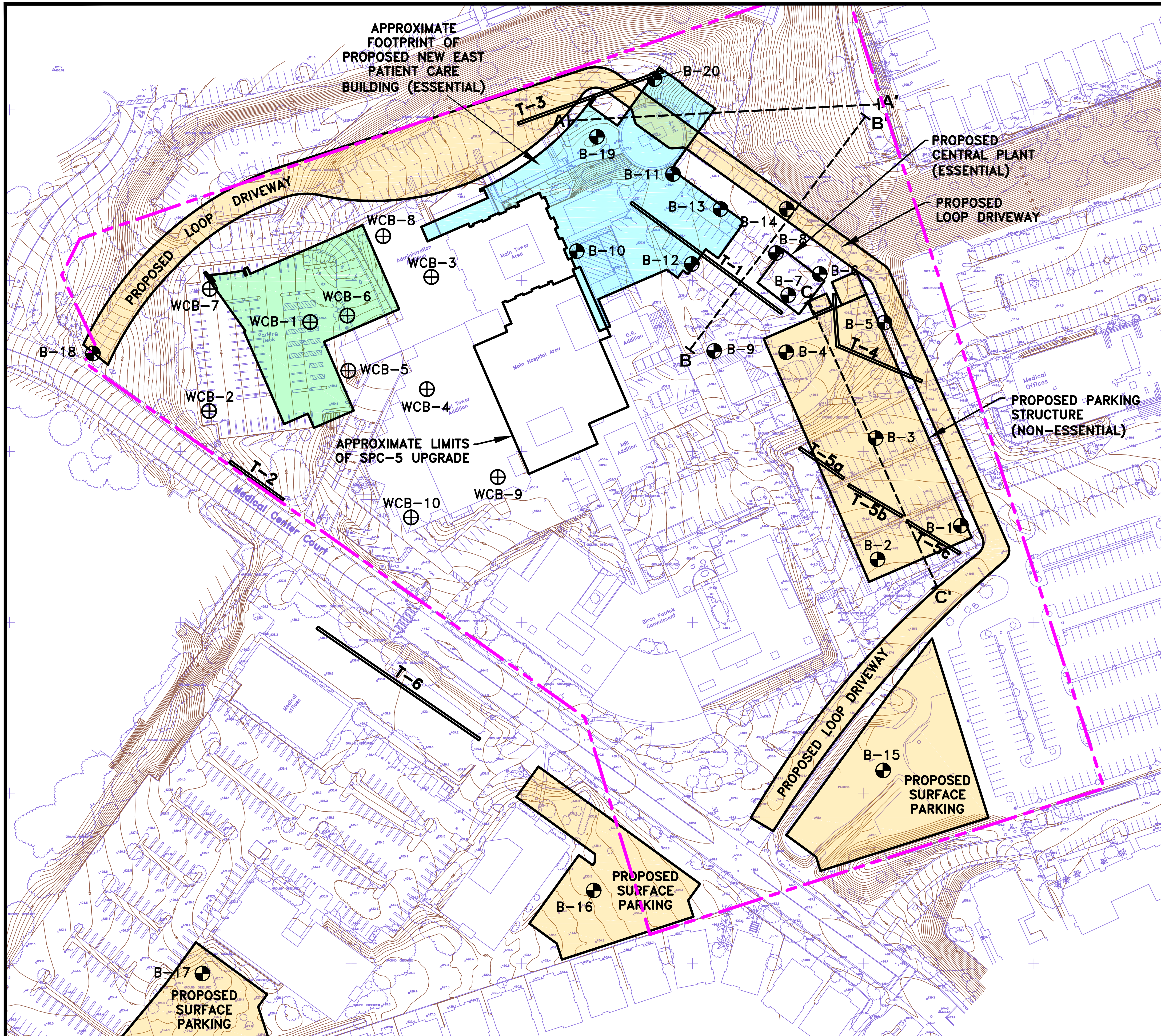
Author: MAM

SITE LOCATION MAP

SHARP CHULA VISTA MEDICAL CENTER MASTER PLAN
CHULA VISTA, CALIFORNIA

Figure 1

Leighton



LEGEND

- B-20 — APPROXIMATE EXPLORATION BORING LOCATION (THIS STUDY)
- WCB-10 — APPROXIMATE BORING LOCATION (WOODWARD-CLYDE, 1989)
- T-6 — APPROXIMATE FAULT EXPLORATION TRENCH LOCATION (LEIGHTON, 2013)
- APN 641-010-28
- A — A' — APPROXIMATE LOCATION OF GEOLOGIC CROSS SECTION
- PHASE I – LOOP DRIVEWAY, PARKING STRUCTURE AND SURFACE PARKING
- PHASE II – NEW EAST PATIENT CARE BUILDING
- PHASE III – FUTURE WEST PATIENT CARE BUILDING

N

SCALE 0 120 240 FEET

REFERENCE: BASE MAP BY NTD HEALTHCARE, CUNINGHAM GROUP, 2013

EXPLORATION MAP

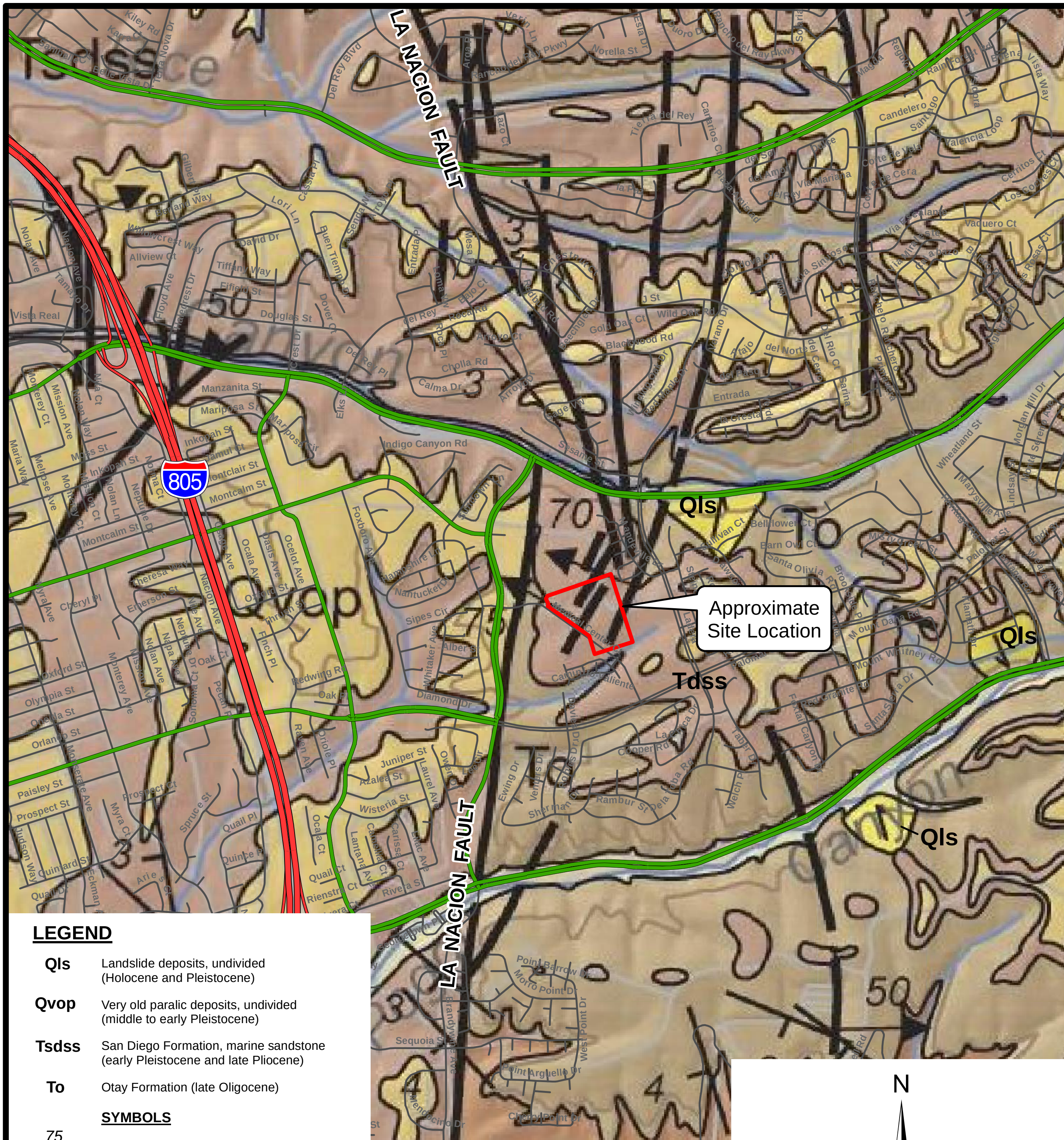
SHARP CHULA VISTA MEDICAL CENTER MASTER PLAN
CHULA VISTA, CALIFORNIA

FIGURE 2

Proj: 603541-002	Eng/Geol: SAC/RCS
Scale: 1"=120'	Date: July 2013

Leighton

Drafted By: MAM Checked By:



LEGEND

Qls	Landslide deposits, undivided (Holocene and Pleistocene)
Qvop	Very old paralic deposits, undivided (middle to early Pleistocene)
Tsdss	San Diego Formation, marine sandstone (early Pleistocene and late Pliocene)
To	Otay Formation (late Oligocene)

SYMBOLS

75 — Fault - Solid where accurately located; dashed where approximately located; dotted where concealed. Arrow and number indicate direction and angle of dip of fault plane

3 — Strike and dip of beds

Contact - Contact between geologic units

Project: 603541-002	Eng/Geol: SAC/RCS
Scale: 1 " = 2,000 '	Date: July 2013

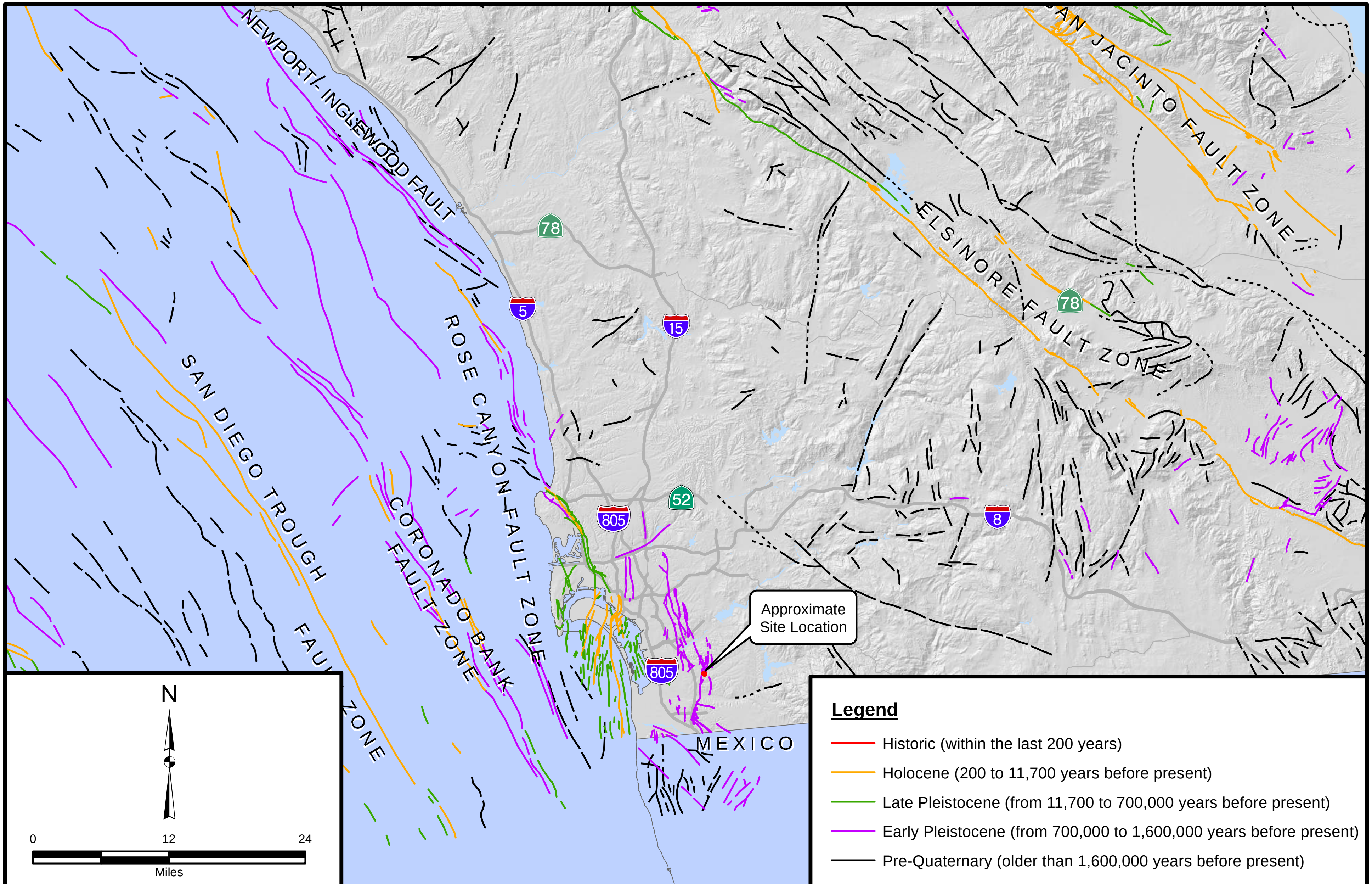
Plate 1 of 2 IN:
Kennedy, M.P. and Tan, S.S., 2008, Geologic map of the San Diego 30' x 60' quadrangle, California: California Geological Survey, Regional Geologic Map No. 3, scale 1:100000
Author: MAM

REGIONAL GEOLOGY MAP

SHARP CHULA VISTA MEDICAL CENTER MASTER PLAN
CHULA VISTA, CALIFORNIA

Figure 3

Leighton



Project: 603548-002	Eng/Geol: SAC/RCS
Scale: 1 " = 12 miles	Date: July 2013

Reference: Jennings and Bryant, 2010 (CGS)

Author: MAM

REGIONAL FAULT MAP

SHARP CHULA VISTA MEDICAL CENTER MASTER PLAN
CHULA VISTA, CALIFORNIA

Figure 4

Leighton

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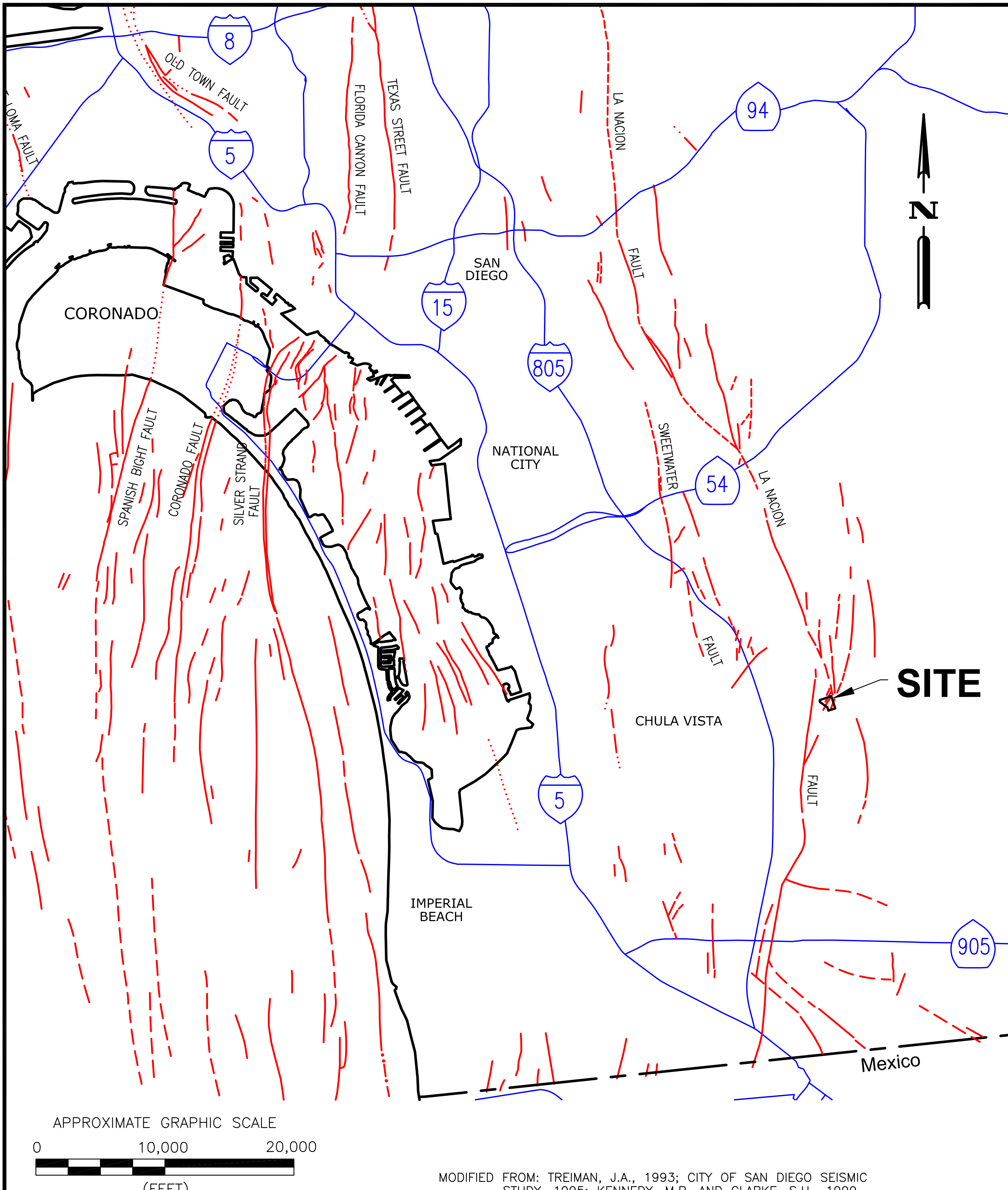


MODIFIED FROM: TREIMAN, J.A., 1993; CITY OF SAN DIEGO SEISMIC STUDY, 1995; KENNEDY, M.P. AND CLARKE, S.H., 1999.

Proj: 603541-002	Eng/Geol: SAC/RCS
Scale: 1"=10,000'	Date: July 2013
Drafted By: MAM	Checked By: RCS

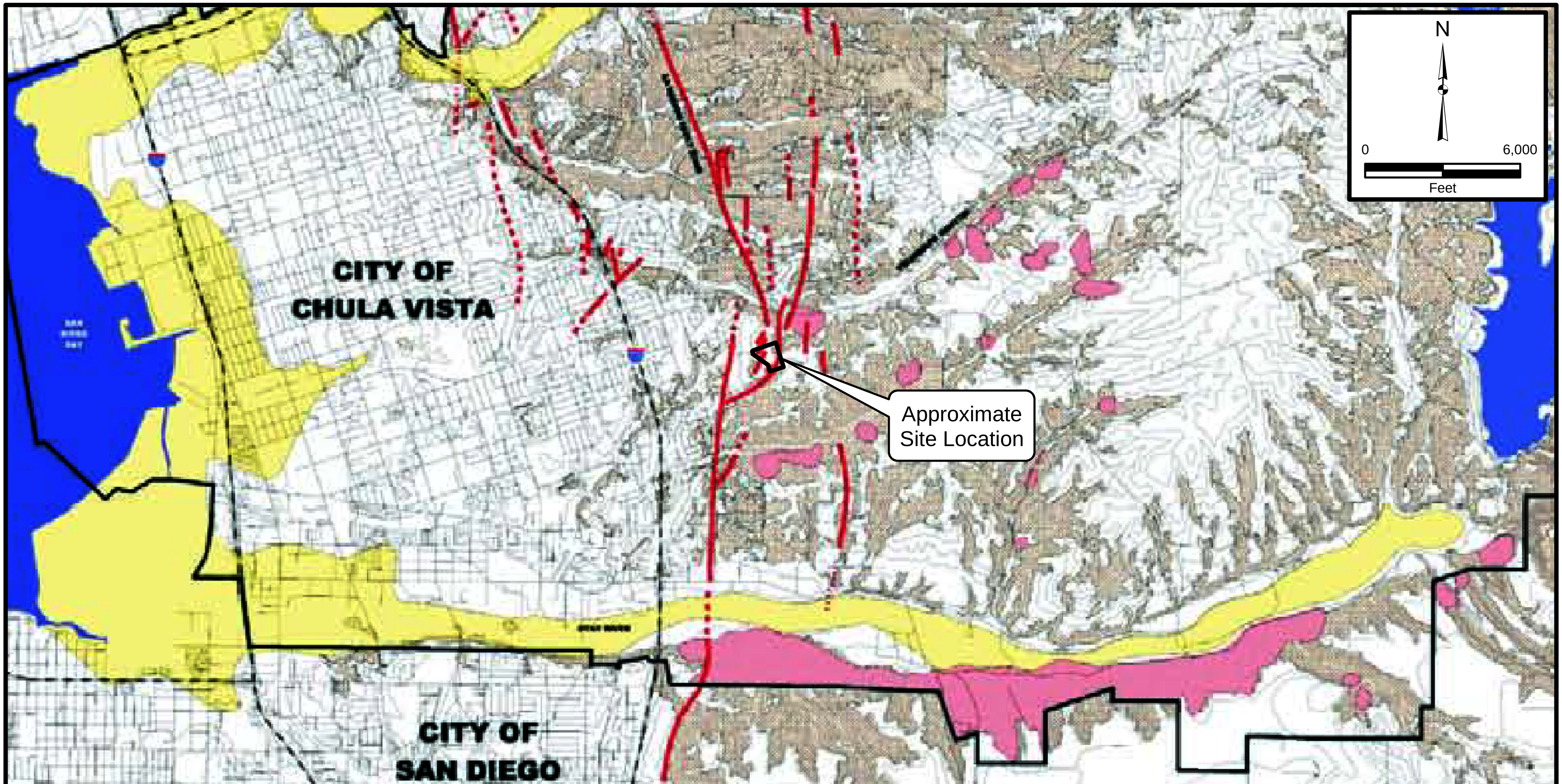
P:\DRAFTING\603541\002\OF_2013-06-13\OF_2013-05-24\FIGURE5.DWG (07-18-13 11:23:02AM) Plotted by: mmurphy

ROSE CANYON FAULT MAP

SHARP CHULA VISTA MEDICAL CENTER MASTER PLAN
CHULA VISTA, CALIFORNIA

FIGURE 5

Leighton



- General Plan Area
- Water bodies

Fault locations*

- Fault trace
- Approximate or inferred fault
- Concealed fault

*Mapped fault locations have been compiled from those presented in Farrand (1977), Kennedy and Tan (1977), Treiman (1984), and from information provided by the City of Chula Vista. The La Nacion fault zone is considered potentially active by the criteria of the State of California.

Landslide hazard areas
Areas containing active landslide-prone terrain. Such areas typically contain incompetent sedimentary rocks, slopes generally steeper than 25 degrees, and factors of safety less than 1.5.

Steep slope areas
Areas with slopes 25 degrees or steeper. Such areas may be prone to hazards such as slope instability, debris flow, rock falls, erosion, and slope creep.

Liquefaction hazard areas
Areas with shallow groundwater tables and poorly consolidated granular sediments potentially subject to hazards associated with seismically-induced liquefaction. Detailed geotechnical liquefaction analysis is encouraged.

RECON
M:\JOBS2\3776\env\graphics\GPU_EIR fig3.5-2.ai 08/27/04

Project: 603541-002	Eng/Geol:SAC/RCS
Scale: 1 " = 6,000 feet	Date: July 2013

Base Map: City of Chula Vista, The Chula Vista City General Plan, 2003.

Author: mmurphy (mmurphy)

GEOLOGIC HAZARDS MAP

SHARP CHULA VISTA MEDICAL CENTER MASTER PLAN
CHULA VISTA, CALIFORNIA

Figure 6

Leighton

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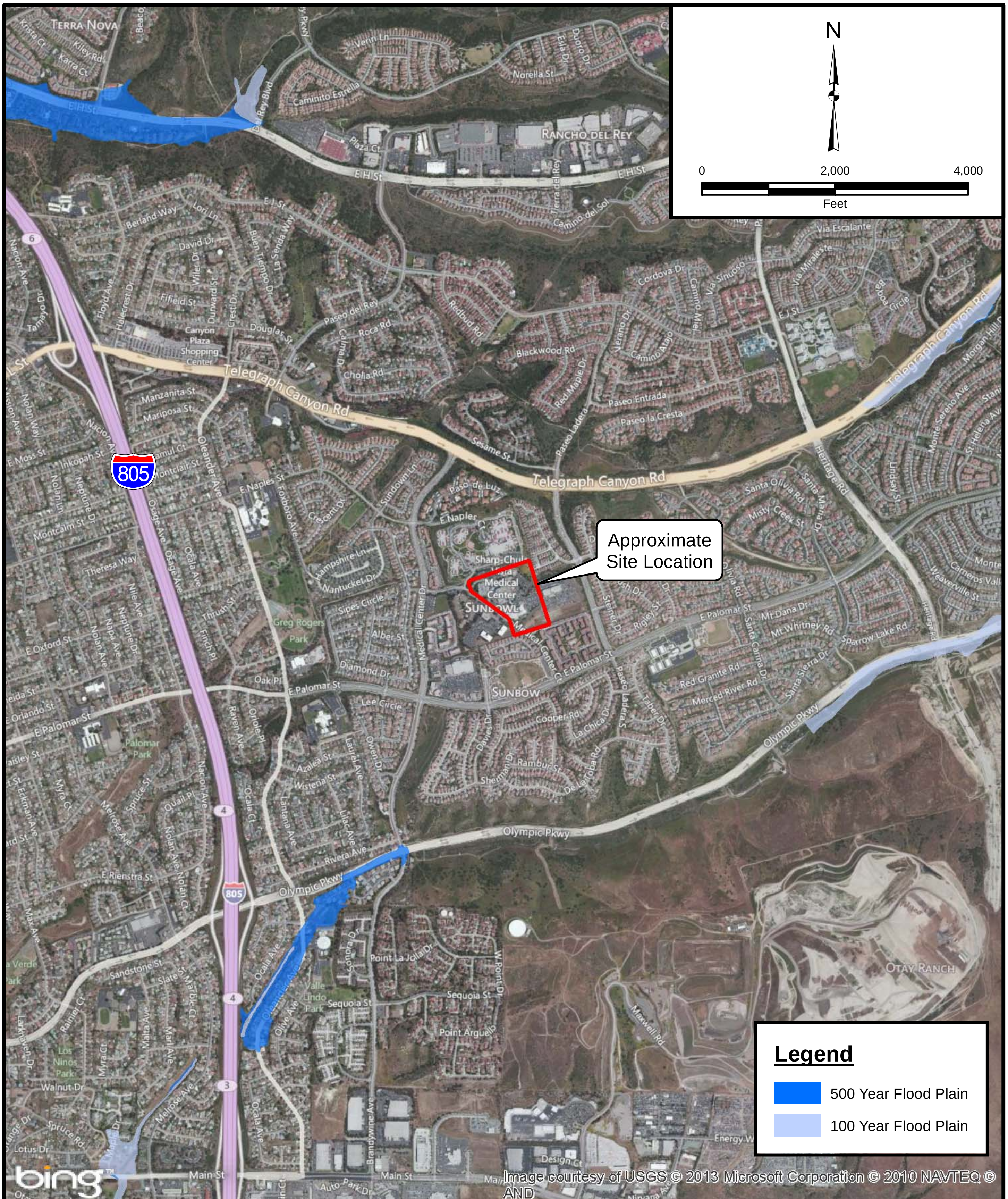

Project: 603541-002	Eng/Geol: SAC/RCS
Scale: 1 " = 2,000 '	Date: July 2013

Reference: FEMA Q3 Flood Data, San Diego County

Thematic Info: Leighton
Author: Mmurphy

FLOOD HAZARD MAP

SHARP CHULA VISTA MEDICAL CENTER MASTER PLAN
CHULA VISTA, CALIFORNIA

Figure 7

Leighton

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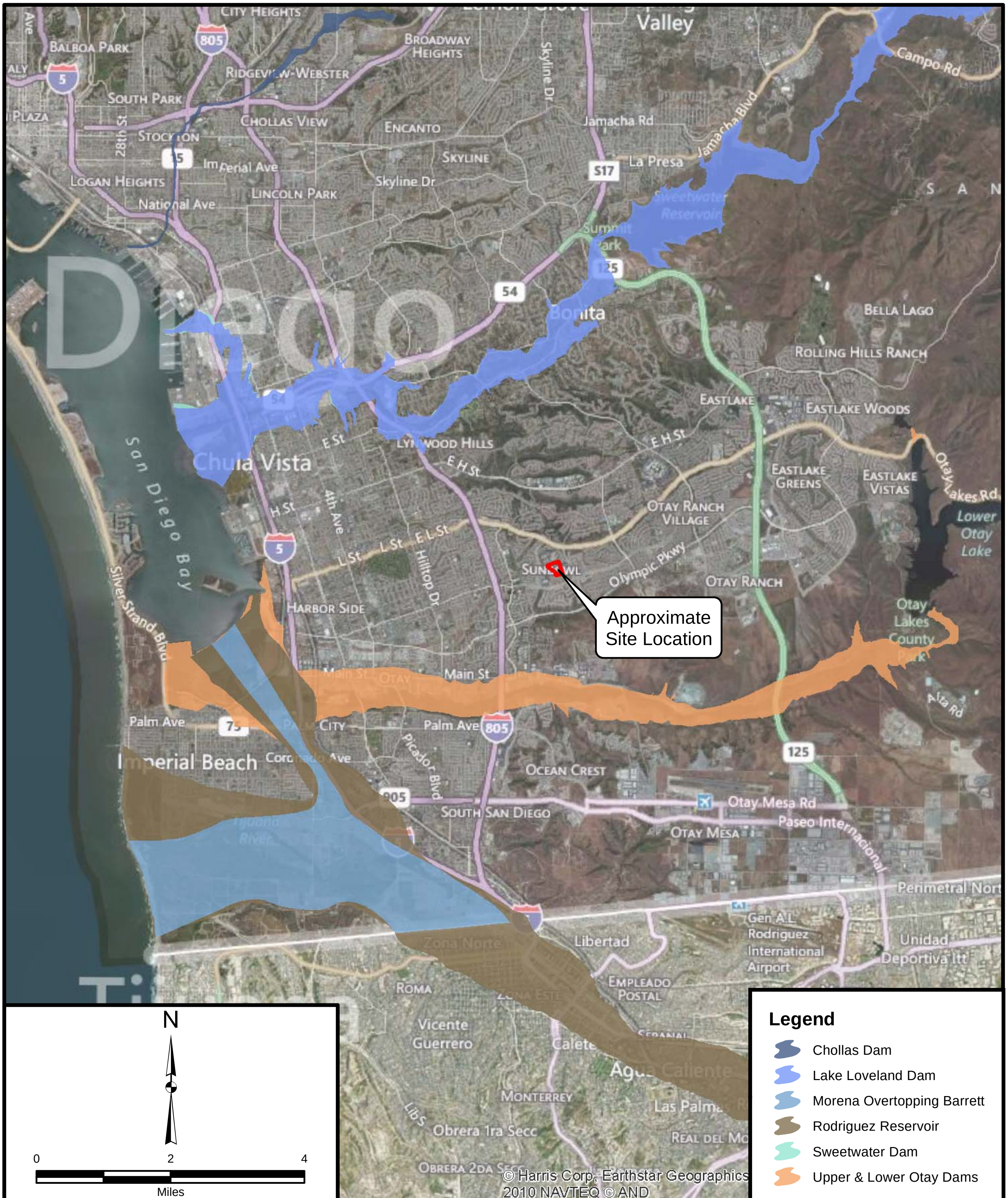

Project: 603541-002	Eng/Geol: SAC/RCS
Scale: 1 " = 2 miles	Date: July 2013

Base Map: ESRI Resource Center 2013
Thematic Info: Leighton, San Diego County (Multi-Agency Hazard Mitigation Plan)
Author: (mmurphy)

DAM INUNDATION HAZARD ZONE MAP

SHARP CHULA VISTA MEDICAL CENTER MASTER PLAN
CHULA VISTA, CALIFORNIA

Figure 8

Leighton

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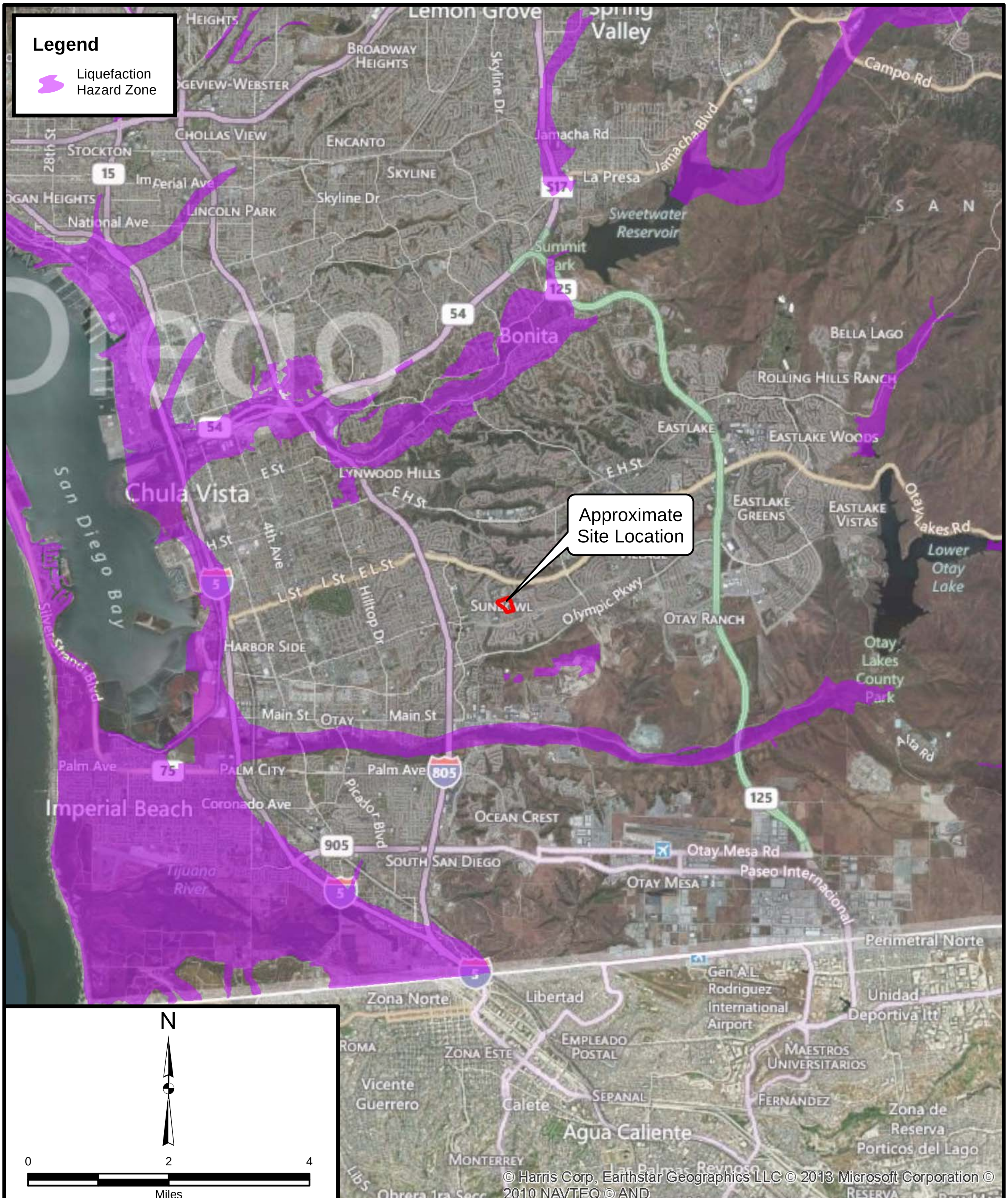


Project: 603541-002	Eng/Geol: SAC/RCS
Scale: 1 " = 2 miles	Date: July 2013

Base Map: ESRI Resource Center 2013
Thematic Info: Leighton, San Diego County (Multi-Agency Hazard Mitigation Plan)
Author: (mmurphy)

LIQUEFACTION HAZARD ZONE MAP

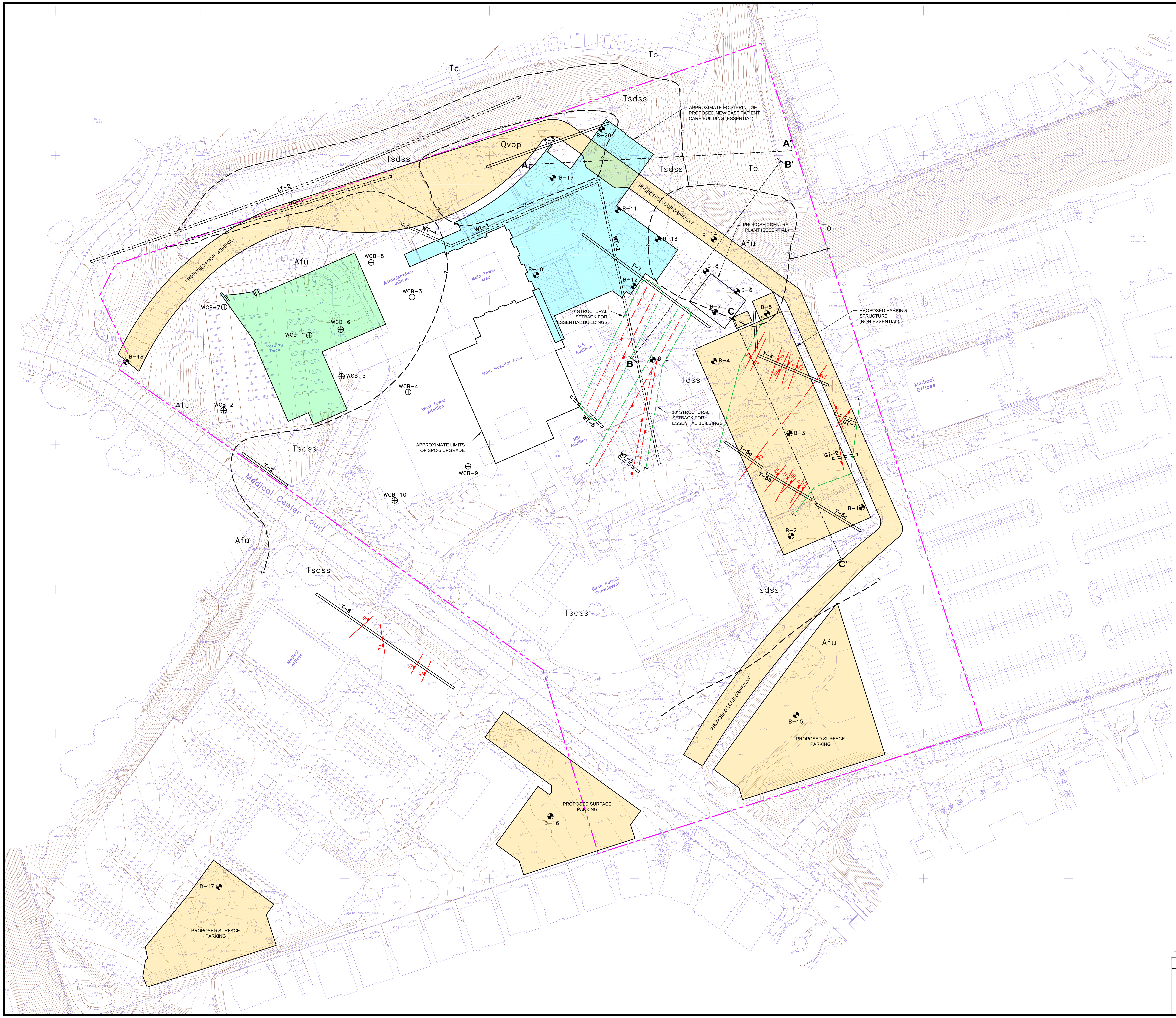
SHARP CHULA VISTA MEDICAL CENTER MASTER PLAN
CHULA VISTA, CALIFORNIA

Figure 9

Leighton

Map Saved as P:\drafting\603541\002\GIS\of_2013-06-13\Figure9.mxd on 7/18/2013 10:21:58 AM

Plates



LEGEND

B-20	APPROXIMATE BORING LOCATION
WCB-10	APPROXIMATE BORING LOCATION (WOODWARD–CLYDE, 1989)
T-6	APPROXIMATE FAULT EXPLORATION TRENCH LOCATION (THIS STUDY)
WT-5	APPROXIMATE FAULT EXPLORATION TRENCH LOCATION (WOODWARD–GIZIENSKI & ASSOCIATES, MARCH 15, 1973)
GT-2	APPROXIMATE FAULT EXPLORATION TRENCH LOCATION (GEOCON INC, NOVEMBER 19, 1998)
LT-2	APPROXIMATE FAULT EXPLORATION TRENCH (LEIGHTON AND ASSOCIATES, 1996)
WC-1	APPROXIMATE FAULT EXPLORATION TRENCH LOCATION (WOODWARD–CLYDE, APRIL 25, 1989, REVISED (SEPTEMBER 7, 1989)
	APN 641–010–28
78	MINOR FAULT – POTENTIALLY ACTIVE (11k–1.6k YEARS bp), DASHED WHERE APPROXIMATE, BOX AND NUMBER INDICATE DIRECTION AND AMOUNT OF DIP, WHERE KNOWN
?	APPROXIMATE GEOLOGIC CONTACT, QUERIED WHERE ASSUMED
A A'	CROSS SECTION LINE
	10' STRUCTURAL SETBACK FOR ESSENTIAL BUILDINGS
Afu	UNDOCUMENTED FILL (GREATER THAN 5' IN THICKNESS)
Qvop	UNDIFFERENTIATED LATE PLEISTOCENE–AGE VERY OLD PARALIC DEPOSITS
Tsdss	SAN DIEGO FORMATION – EARLY PLEISTOCENE AND LATE PLIOCENE, MARINE SANDSTONE
To	OTAY FORMATION – LATE OLIGOCENE, MARINE SANDSTONE/CLAYSTONE
	PHASE I – LOOP DRIVEWAY, PARKING STRUCTURE AND SURFACE PARKING
	PHASE II – NEW EAST PATIENT CARE BUILDING
	PHASE III – FUTURE WEST PATIENT CARE BUILDING

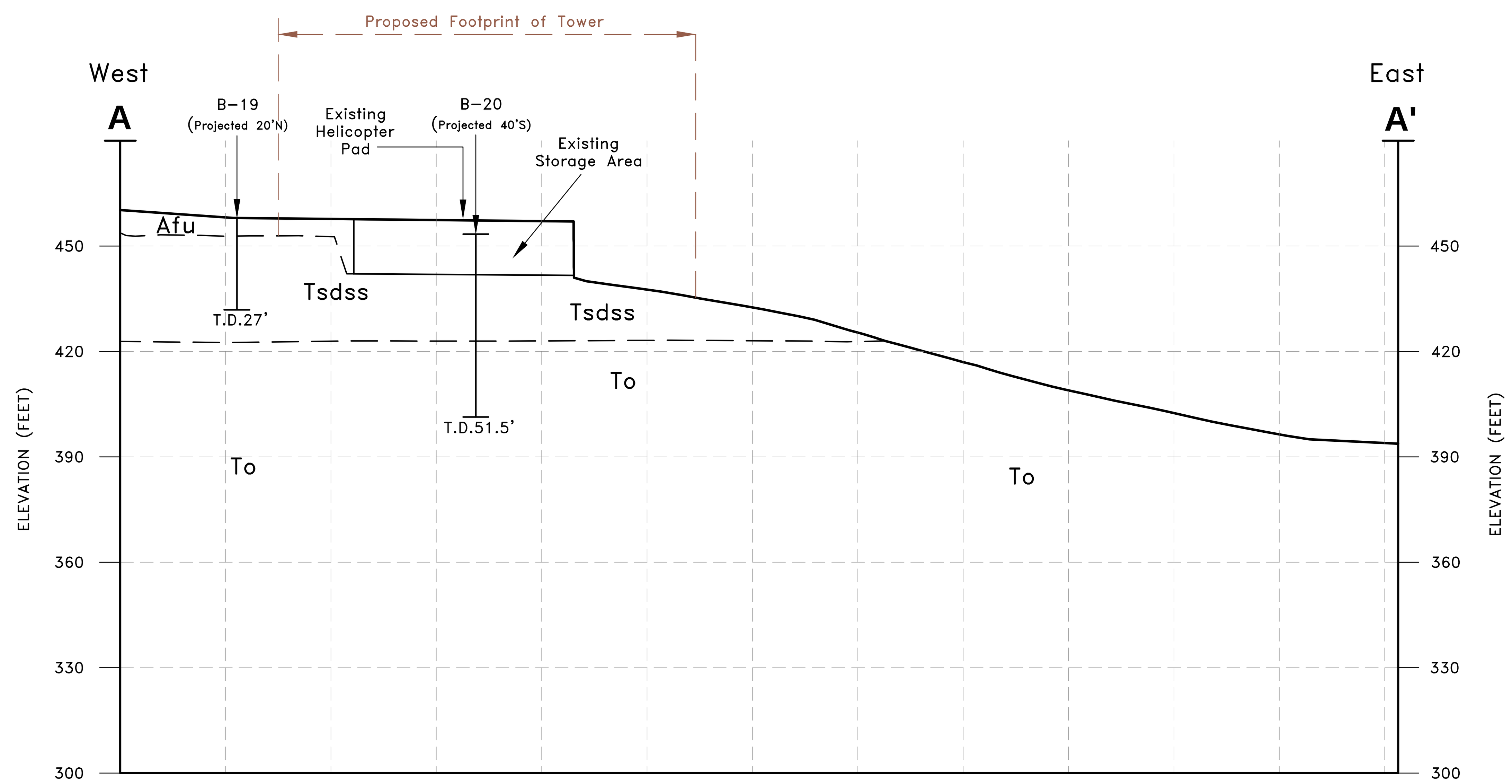
N

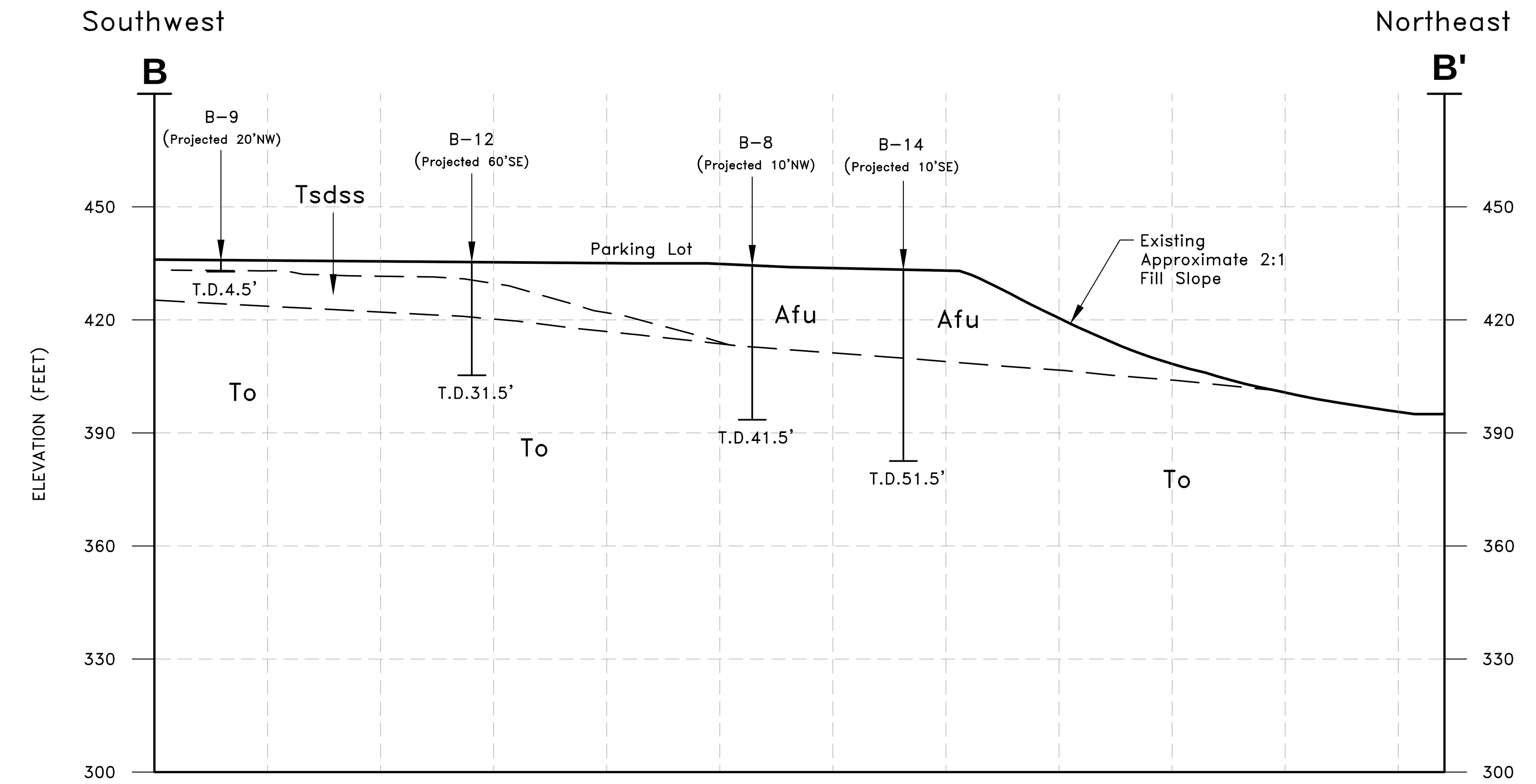
0 40 80
SCALE FEET

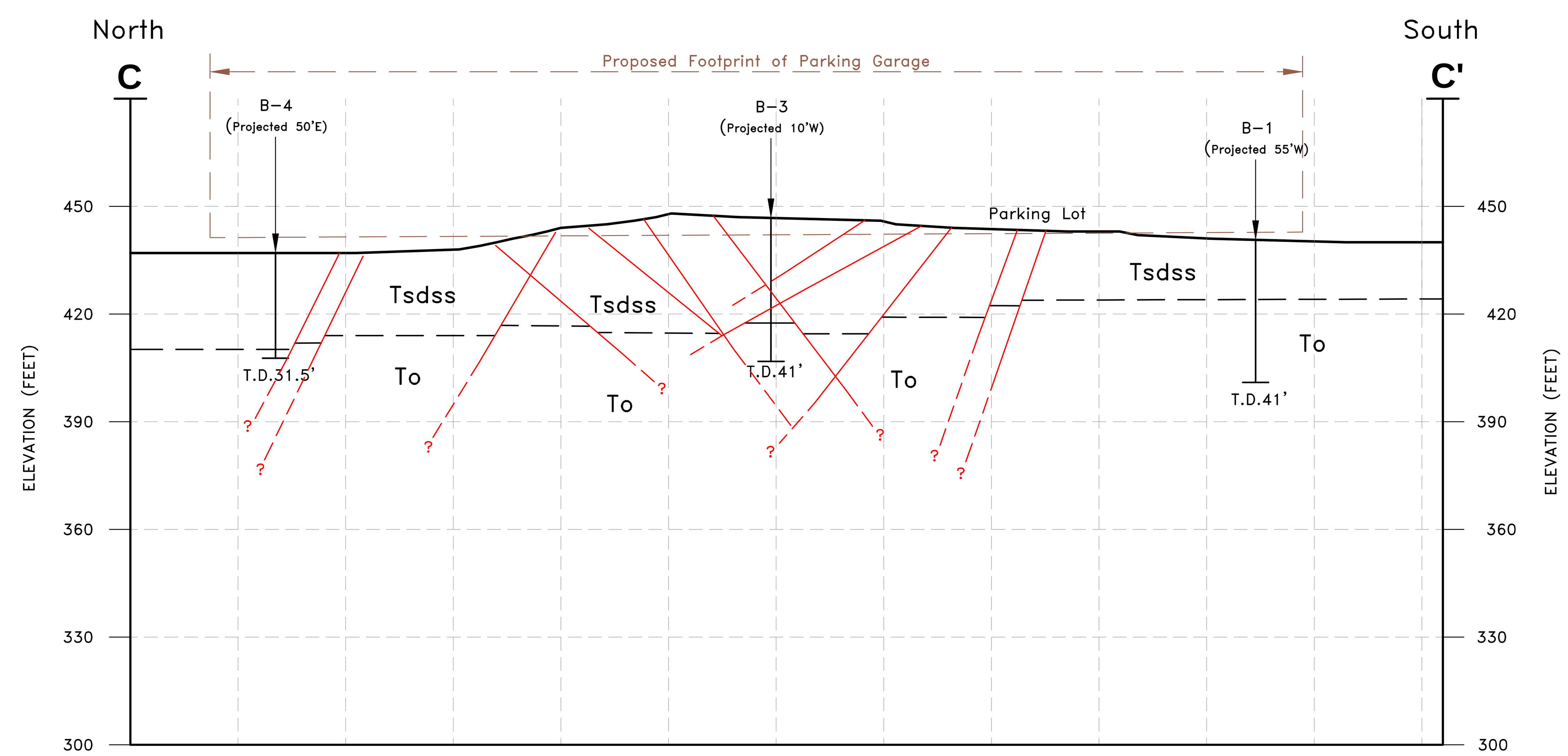
REFERENCE: BASE MAP BY NTD HEALTHCARE, CUNINGHAM GROUP, 2013

PLATE 1	GEOTECHNICAL MAP SHARP CHULA VISTA MEDICAL CENTER MASTER PLAN CHULA VISTA, CALIFORNIA
Leighton	Proj: 603541-001 — Eng/Geol: SAC/RCS
	Scale: 1"=40' — Date: 07/2013

Drafted By: MAM | Checked By: RCS | P:\DRAFTING\603541\002\OF_2013-06-13\OF_2013-05-24\PLATE1.DWG (07-18-13 11:39:18AM) Plotted by: mmurphy







LEGEND

— —	Geologic Contact
— — (red)	Approximate Location of Minor Fault - Potentially Active (11K-1.6K Years B.P.)
Afu	Undocumented Fill
Qvop	Very Old Paralic Deposits
Tsdss	San Diego Formation
To	Otay Formation
B-20 / T.D.41'	Approximate Boring Location With Total Depth

GEOTECHNICAL CROSS SECTIONS
A-A' THROUGH C-C'
SHARP CHULA VISTA MEDICAL CENTER MASTER PLAN
CHULA VISTA, CALIFORNIA

PLATE 2

Proj: 603541-002	Eng/Geol: SAC/RCS
Scale: 1"=30'	Date: 07/2013

Drafted By: BQT Checked By: RCS

Leighton

Appendix A

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APPENDIX A

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URS, 2006, Updated Geotechnical Evaluation, Sharp Chula Vista Medical Center, Chula Vista, California, dated August 10, revised February 8, 2007

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Woodward-Clyde Consultants, 1986, Fault and Geologic Hazards Investigation, Proposed Vista Hill Hospital Expansion, San Diego County, California, dated September 2.

Woodward-Clyde, 1984, Geotechnical Investigation for the Proposed South Bay Community Convalescent Hospital of Chula Vista, California, dated April 20.

Woodward-Gizenski & Associates, 1973, Additional Engineering and Geological Study, General Hospital Facility, Community Hospital of Chula Vista, California, dated March 15.

Appendix B

Boring Logs

GEOTECHNICAL BORING LOG KEY

Project No.		**Date Drilled**	
Project	KEY TO BORING LOG GRAPHICS	**Logged By**	
Drilling Co.		**Hole Diameter**	
Drilling Method		**Ground Elevation**	
Location		**Sampled By**	

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
									This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
	0								Asphaltic concrete	
									Portland cement concrete	
								CL	Inorganic clay of low to medium plasticity; gravelly clay; sandy clay; silty clay; lean clay	
								CH	Inorganic clay; high plasticity, fat clays	
								OL	Organic clay; medium to plasticity, organic silts	
	5							ML	Inorganic silt; clayey silt with low plasticity	
								MH	Inorganic silt; diatomaceous fine sandy or silty soils; elastic silt	
								ML-CL	Clayey silt to silty clay	
								GW	Well-graded gravel; gravel-sand mixture, little or no fines	
								GP	Poorly graded gravel; gravel-sand mixture, little or no fines	
	10							GM	Silty gravel; gravel-sand-silt mixtures	
								GC	Clayey gravel; gravel-sand-clay mixtures	
								SW	Well-graded sand; gravelly sand, little or no fines	
								SP	Poorly graded sand; gravelly sand, little or no fines	
								SM	Silty sand; poorly graded sand-silt mixtures	
	15							SC	Clayey sand; sand-clay mixtures	
									Bedrock	
									Ground water encountered at time of drilling	
				B-1					Bulk Sample	
	20			C-1					Core Sample	
				G-1					Grab Sample	
				R-1					Modified California Sampler (3" O.D., 2.5 I.D.)	
				SH-1					Shelby Tube Sampler (3" O.D.)	
				S-1					Standard Penetration Test SPT (Sampler (2" O.D., 1.4" I.D.)	
	25			PUSH					Sampler Penetrates without Hammer Blow	
	30									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING
AL	ATTERBERG LIMITS
CN	CONSOLIDATION
CO	COLLAPSE
CR	CORROSION
CU	UNDRAINED TRIAXIAL
DS	DIRECT SHEAR
EI	EXPANSION INDEX
H	HYDROMETER
MD	MAXIMUM DENSITY
PP	POCKET PENETROMETER
RV	R VALUE
SA	SIEVE ANALYSIS
SE	SAND EQUIVALENT
TR	THERMAL RESISTIVITY
UC	UNCONFINED COMPRESSIVE STRENGTH

* * * This log is a part of a report by Leighton and should not be used as a stand-alone document. * * *

GEOTECHNICAL BORING LOG B-1

Project No.	603541-002	**Date Drilled**	5-1-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	441'
Location	See Boring Location Map	**Sampled By**	FJW

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
	0								0-3" Asphalt Concrete	
440								SM	3"-7" Class II Aggregate Base	
								SC	ARTIFICIAL FILL (Afu) @ 7"-1': Light brown silty SAND, moist, medium dense, fine to medium grained	
									SAN DIEGO FORMATION (Tsdss) @ 1': Light olive to light brown clayey SANDSTONE, moist, very dense, fine grained, trace gravel	
435	5									
430	10			R-1 B-1 @10'-15'	28 50/5"	103	12	CL	@ 10': Light brown to light olive-brown sandy CLAYSTONE with some interbedded sandstone, moist, hard	EI, SA, AL
425	15			S-1	14 24 35					
									OTAY FORMATION (To) @ 18': Light brown silty CLAYSTONE, moist, hard, with trace fine sand	
420	20			R-2	15 50/6"			CL		
415	25			S-1	15 25 26			SC-SM	@ 25': Light brown to gray silty clayey SANDSTONE, moist, very dense, fine grained, trace gravel	
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG B-1

Project No.	603541-002	**Date Drilled**	5-1-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	441'
Location	See Boring Location Map	**Sampled By**	FJW

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
	30			R-3	21 50/6"			SC-SM CL	@ 30.5': Light brown to reddish brown, sandy silty CLAYSTONE, damp to moist, hard, trace gravel	
410										
	35			S-3	14 25 36			SM	@ 35': Gray silty SANDSTONE, dry to damp, very dense, friable	
405										
	40			R-4	18 50/5"					
400									**Total Depth = 41 Feet** **No groundwater encountered at time of drilling** **Backfilled with bentonite grout on 5/1/13**	
	45									
395										
	50									
390										
	55									
385										
	60									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG B-2

Project No.	603541-002	**Date Drilled**	5-1-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	440'
Location	See Boring Location Map	**Sampled By**	FJW

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
440	0							SM SC-ML	0-2" Asphalt Concrete 2"-5" Class II Aggregate Base ARTIFICIAL FILL (Afu) @ 5"-1': Light brown silty SAND, moist, medium dense SAN DIEGO FORMATION (Tsdss) @ 1': Olive to light brown clayey SANDSTONE to clayey SILTSTONE, damp to moist, dense, friable, micaceous	
435	5									
430	10			R-1	22 50/6"	98	24		@ 10': Moist, very dense	
425	15			S-1	9 22 29			SC	@ 15': Olive to light brown clayey SANDSTONE, moist, very dense, friable, micaceous	
								CL	OTAY FORMATION (To) @ 18': Brown, sandy silty CLAYSTONE, damp to moist, very stiff	
420	20			R-2	29 50/5"			SC	@ 20': Brown clayey SANDSTONE with SILTSTONE, moist, very dense, micaceous	
415	25			S-2	11 25 40			CL	@ 25': Red-brown to light brown sandy CLAYSTONE, moist, hard, micaceous	
410	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG B-2

Project No.	603541-002	**Date Drilled**	5-1-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	440'
Location	See Boring Location Map	**Sampled By**	FJW

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
410	30			R-3	30 50/4"			SC-SM	@ 30.5': Gray silty clayey SANDSTONE, moist, very dense, micaceous	
405	35			S-3					@ 35': Partial sample	
400	40			R-4	50/5"					
									Total Depth = 41 Feet **No groundwater encountered at time of drilling** **Backfilled with bentonite grout on 5/1/13**	
395	45									
390	50									
385	55									
380	60									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG B-3

Project No.	603541-002	**Date Drilled**	5-1-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	447'
Location	See Boring Location Map	**Sampled By**	FJW

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
	0								0-3" Asphalt Concrete	
									3"-6" Class II Aggregate Base	
445								SM SM-SC	ARTIFICIAL FILL (Afu) @ 6"-1': Gray silty SAND fine grained, dry to damp, friable, micaceous	
									SAN DIEGO FORMATION (Tsdss) @ 1': Grayish to olive-brown, silty clayey SANDSTONE, dense, micaceous, friable	
	5									
440										
	10			R-1	25 50/5"				@ 10': Very dense	DS
435										
	15			S-1	11 14 16				@ 15': Dense	
430										
	20			R-2 B-1 @20'-25'	16 18 23	91	15	SM	@ 20': Light brown to olive silty SANDSTONE, moist, dense, micaceous	
425										
	25			S-2	16 19 21				@ 25': Light brown silty SANDSTONE, moist, very dense	
420										
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG B-3

Project No.	603541-002	**Date Drilled**	5-1-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	447'
Location	See Boring Location Map	**Sampled By**	FJW

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
									This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
	30			R-3	22 50/8"			SC	OTAY FORMATION (To) @ 30': Light brown to olive silty clayey SANDSTONE, moist, very dense, micaceous, friable	
415										
	35			S-3	10 11 14				@ 35': Light brown, silty clayey SANDSTONE, moist, dense	
410										
	40			R-4	36 50/4"				@ 40': Very dense	
405									**Total Depth = 41 Feet** **No groundwater encountered at time of drilling** **Backfilled with bentonite grout on 5/1/13**	
	45									
400										
	50									
395										
	55									
390										
	60									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG B-4

Project No.	603541-002	**Date Drilled**	5-2-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	438'
Location	See Boring Location Map	**Sampled By**	FJW

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
	0								0-2" Asphalt Concrete	
								SM	2"-5" Class II Aggregate Base	
									SAN DIEGO FORMATION (Tsdss) @ 5": Light gray silty SANDSTONE, damp to dry, dense, friable, fine gained	
435										
	5			R-1 B-1 @5'-10'	11 16 31	92	8		@ 5': Light gray to light brown silty SANDSTONE, damp to moist, dense, micaceous, friable	DS
430										
	10			S-1	8 16 17					
425										
	15			R-2	11 15 21					
420										
	20			S-2	8 10 11				@ 20': Medium dense to dense	
415										
	25			R-3	12 21 30				@ 25': Dense	
410								SC	OTAY FORMATION (To) @ 28': Light brown with interbedded orange clayey SANDSTONE, damp, dense to very dense, friable, micaceous	
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG B-4

Project No.	603541-002	**Date Drilled**	5-2-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	438'
Location	See Boring Location Map	**Sampled By**	FJW

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	30			S-3	16 17 21			SC		
405									**Total Depth = 31.5 Feet** **No groundwater encountered at time of drilling** **Backfilled with bentonite grout and concrete on 5/2/13**	
	35									
400										
	40									
395										
	45									
390										
	50									
385										
	55									
380										
	60									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG B-5

Project No.	603541-002	**Date Drilled**	5-2-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	436'
Location	See Boring Location Map	**Sampled By**	FJW

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0								0-3" Asphalt Concrete	
435				B-1 @1'-4'				SM	3"-7" Class II Aggregate Base ARTIFICIAL FILL (Afu) @ 7"-4': Brown silty SAND with gravel, dry to damp, dense, friable	CR
430	5			R-1	10 17 26			SM	SAN DIEGO FORMATION (Tsdss) @ 4': Gray to light brown silty SANDSTONE, damp, dense, friable, micaceous	
425	10			S-1	11 14 15					
420	15			R-2	30 50/5"	97	4		@ 15': Very dense	
415	20			S-2	10 13 17				@ 20': Dense	
410	25			R-3	9 20 34					
								SM-SC	OTAY FORMATION (To) @ 27': Gray to light brown to orange clayey to silty SANDSTONE, damp to moist, dense, friable, micaceous	
	30									

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG B-5

Project No.	603541-002	**Date Drilled**	5-2-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	436'
Location	See Boring Location Map	**Sampled By**	FJW

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
405	30			S-3	15 15 17			SM-SC		
									Total Depth = 31.5 Feet **No groundwater encountered at time of drilling** **Backfilled with bentonite grout and concrete on 5/2/13**	
400	35									
395	40									
390	45									
385	50									
380	55									
	60									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

*** * * This log is a part of a report by Leighton and should not be used as a stand-alone document. * * ***

GEOTECHNICAL BORING LOG B-6

Project No.	603541-002	**Date Drilled**	5-2-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	435'
Location	See Boring Location Map	**Sampled By**	FJW

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
435	0								0-2" Asphalt Concrete	
								SM	2"-5" Class II Aggregate Base ARTIFICIAL FILL (Afu) @ 5"-6': Medium brown silty SAND with gravel, moist, medium dense	
430	5			R-1	8 15 17					
								SM	@ 6': Gray to brown with orange silty SAND with trace gravel, moist, medium dense	
425	10			S-1	8 9 12					
420	15			R-3	10 14 20	108	13			
415	20			S-2	7 7 8					
									SAN DIEGO FORMATION (Tsdss) @ 22': Light brown to reddish brown silty SANDSTONE, moist, medium dense, micaceous, fine grained	
410	25			R-3	10 16 23			SM		
405	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

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GEOTECHNICAL BORING LOG B-6

Project No.	603541-002	**Date Drilled**	5-2-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	435'
Location	See Boring Location Map	**Sampled By**	FJW

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
405	30			S-3	7 8 9			SM	@ 30': Light brown to gray silty SANDSTONE, damp, medium dense, fine grained, friable	
400	35			R-4	8 20 26				@ 35': Dense	
395	40			S-4	10 12 13				@ 40': Dense	
									Total Depth = 41.5 Feet **No groundwater encountered at time of drilling** **Backfilled with bentonite grout and concrete on 5/2/13**	
390	45									
385	50									
380	55									
375	60									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG B-7

Project No.	603541-002	**Date Drilled**	5-7-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	435'
Location	See Boring Location Map	**Sampled By**	FJW

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
435	0								0-4" Asphalt Concrete	
									4"-8" Class II Aggregate Base	
								SM	ARTIFICIAL FILL (Afu) @ 8": Medium brown silty SAND, damp to moist, medium dense, with trace gravel	
430	5			R-1	7 16 31	114	14	SM-ML	SAN DIEGO FORMATION (Tsdss) @ 5': Olive to light brown silty SANDSTONE to sandy SILTSTONE, damp, dense, friable, micaceous, fine	
425	10			S-1 B-1 @10'-13'	7 16 18			SC-CL	@ 10': Gray sandy silty CLAYSTONE to clayey SANDSTONE, moist, dense to very dense, hard	
420	15			R-2	12 26 50			SC	@ 15': Gray to light brown clayey SANDSTONE, moist, very dense, friable, micaceous	
415	20			S-2	10 13 11			SC-SM	@ 20': Gray to light reddish brown clayey to silty SANDSTONE, moist, medium dense, micaceous, friable	
									Total Depth = 21.5 Feet **No groundwater encountered at time of drilling** **Backfilled with bentonite grout and concrete on 5/7/13**	
410	25									
405	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG B-8

Project No.	603541-002	**Date Drilled**	5-2-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	435'
Location	See Boring Location Map	**Sampled By**	FJW

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
435	0								0-2" Asphalt Concrete	
								SM	2"-5" Class II Aggregate Base	
									ARTIFICIAL FILL (Afu) @ 5": Medium brown silty SAND with clay and trace gravel, moist, medium dense	
430	5			R-1	8 14 16	102	13			
								SC	@ 6': Medium brown to dark gray clayey SAND with trace gravel, moist, medium dense, micaceous	
425	10			S-1	7 8 9			SM	@ 10': Gray to medium brown silty SAND with trace gravel, moist, medium dense, micaceous, friable	
420	15			R-2	3 4 4	108	15		@ 15': Loose	
415	20			S-2 B-1 @20'-25'	3 2 2					
								SM	OTAY FORMATION (To)	EI
410	25			R-3	7 11 16				@ 26': Light brown silty SANDSTONE with trace gravel, moist, medium dense, micaceous, friable	
405	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG B-8

Project No.	603541-002	**Date Drilled**	5-2-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	435'
Location	See Boring Location Map	**Sampled By**	FJW

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
									This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
405	30			S-3	8 8 8			SM		
400	35			R-4	15 27 33				@ 35': Gray to light brown silty SANDSTONE, moist, dense, micaceous, friable, fine grained	
395	40			S-4	8 14 16					
									Total Depth = 41.5 Feet **No groundwater encountered at time of drilling** **Backfilled with bentonite grout and concrete on 5/8/13**	
390	45									
385	50									
380	55									
375	60									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG B-9

Project No.	603541-002	**Date Drilled**	5-8-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	438'
Location	See Boring Location Map	**Sampled By**	FJW

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
									This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
	0								0-4" Asphalt Concrete	
									4-9" Class II Aggregate Base	
								SM	ARTIFICIAL FILL (Afu)	
				B-1 @1.5'-2'					@ 9"-1.5': Medium brown silty SAND with gravel, damp, medium dense	
435									@ 1.5': Gray silty SAND, damp to moist, micaceous, friable, trace clay and gravel	
									@ 4.5': Refusal on concrete	
	5								**Total Depth = 4.5 Feet** **No groundwater encountered at time of drilling** **Backfilled with bentonite grout and concrete on 5/8/13**	
430										
	10									
425										
	15									
420										
	20									
415										
	25									
410										
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG B-10

Project No.	603541-002	**Date Drilled**	5-7-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	439'
Location	See Boring Location Map	**Sampled By**	FJW

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0							SM	0-5" Asphalt Concrete 5"-9" Class II Aggregate Base ARTIFICIAL FILL (Afu) @ 9": Medium to dark brown silty SAND with gravel and cobbles, crushed aggregate, damp to moist, loose (trench or wall backfill)	
435	5			R-1	3 3 3	94	9			
430	10			S-1 B-1 @10'-12'	9 17 20			SM	SAN DIEGO FORMATION (Tsdss) @ 10': Olive to light brown fine silty SANDSTONE, damp, medium dense, friable, micaceous	SA, CR
425	15			R-2	34 37 50/5"	114	5		@ 15': Very dense	
420	20			S-2	9 11 13				@ 20': Dense	
415	25			R-3	26 50/6"			SM/CL	OTAY FORMATION (To) @ 25': Olive to light brown to gray silty SANDSTONE to sandy silty CLAYSTONE, moist, very dense to hard, micaceous	
410	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG B-10

Project No.	603541-002	**Date Drilled**	5-7-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	439'
Location	See Boring Location Map	**Sampled By**	FJW

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	30			S-3	8 16 22			SM/CL	@ 30': Very dense to hard	
405	35								**Total Depth = 31.5 Feet** **No groundwater encountered at time of drilling** **Backfilled with bentonite grout and concrete on 5/7/13**	
400	40									
395	45									
390	50									
385	55									
380	60									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG B-11

Project No.	603541-002	**Date Drilled**	5-6-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	436'
Location	See Boring Location Map	**Sampled By**	FJW

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0								0-5" Asphalt Concrete	
435									5"-9" Class II Aggregate Base	
								SM	ARTIFICIAL FILL (Afu) @ 9"-2.5': Medium brown, silty SAND with gravel, damp, medium dense @ 2.5'-4': Medium brown to olive silty SAND, damp to moist, medium dense, trace gravel, fine grained	
								SM	SAN DIEGO FORMATION (Tsdss) @ 4': Olive to light brown silty SANDSTONE, damp to moist, very dense, micaceous	
	5			R-1	21 50/4"					
430										
				B-1 @8'-10'						
	10			S-1	13 13 18					
425									@ 11': Olive to gray to light brown silty SANDSTONE, moist, dense, calcite deposits, fine grained, friable	
	15			R-2	11 29 50/4"	98	13		@ 15': Very dense	
420										
	20			S-2	13 16 20				@ 20': Very dense	
415										
	25			R-3	19 33 50/3"	98	13	SM	@ 25': Olive to light brown silty SANDSTONE, moist, very dense, micaceous, friable, fine grained, with some interbedded SILTSTONE	
410										
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG B-11

Project No.	603541-002	**Date Drilled**	5-6-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	436'
Location	See Boring Location Map	**Sampled By**	FJW

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
	30			S-3	14 28 40			SM	OTAY FORMATION (To) @ 30': Gray silty SANDSTONE, moist, very dense, friable, fine grained	
405										
	35			R-4	18 50/5"	93	12		@ 35': Gray to light brown	
400										
	40			S-4	13 25 31					
395										
	45			R-5	13 43 50/2"	95	7		@ 45': Gray silty SANDSTONE, damp to moist, very dense, micaceous, friable, fine grained	
390										
	50			S-5 B-2 @50'-55'	14 20 26				@ 50': Gray to light brown, fine to medium grained	
385										
	55			S-6	16 22 27				@ 55': Interbedded gray to light brown to orange, silty SANDSTONE, damp to moist, very dense, friable, fine grained	
380										
	60									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG B-11

Project No.	603541-002	**Date Drilled**	5-6-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	436'
Location	See Boring Location Map	**Sampled By**	FJW

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
375	60			S-7	12 20 22			SM		
370	65			S-8	16 19 34					
365	70			S-9	10 19 19				@ 70': Gray to yellowish brown silty SANDSTONE with trace of interbedded sandy CLAYSTONE, moist, very dense to hard, friable	
360	75			S-10	15 20 20					
355	80			S-11	15 25 50/6"			CL	@ 80': Gray sandy silty CLAYSTONE, moist, hard	
350	85			S-12	50/2"				@ 85': No sample recovered	
									@ 88': Harder drilling	
	90									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG B-11

Project No.	603541-002	**Date Drilled**	5-6-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	436'
Location	See Boring Location Map	**Sampled By**	FJW

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
345	90			S-13	38 50/4"			SM	@ 90': Reddish brown to orange-brown silty SANDSTONE, moist, very dense, fine to medium grained	
340	95			S-14	39 50/3"			CL	@ 95': Gray to reddish brown CLAYSTONE, moist, hard	
335	100			S-15	30 50/3"					
									Total Depth = 101 Feet **No groundwater encountered at time of drilling** **Backfilled with bentonite grout and cement on 5/6/13**	
330	105									
325	110									
320	115									
	120									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

***** This log is a part of a report by Leighton and should not be used as a stand-alone document. *****

GEOTECHNICAL BORING LOG B-12

Project No.	603541-002	**Date Drilled**	5-7-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	436'
Location	See Boring Location Map	**Sampled By**	FJW

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N–S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
	0								0-4" Asphalt Concrete	
435									4"-8" Class II Aggregate Base	
								SM	ARTIFICIAL FILL (Afu) @ 8"-5': Medium brown silty SAND with gravel, dry to moist, medium dense	
430	5			R-1 B-1 @5'-10'	19 41 32	115	9	ML	SAN DIEGO FORMATION (Tsdss) @ 5': Light brown to gray sandy SILTSTONE, with trace gravel, dense to very dense , micaceous	SA
425	10			S-1	7 11 11			SM-ML	@ 10': Gray to olive fine silty SANDSTONE to sandy SILTSTONE, dry to damp, dense, micaceous	
420	15			R-2	16 25 50			SM	OTAY FORMATION (To) @ 15': Gray silty SANDSTONE, moist, very dense, micaceous	
415	20			S-2	13 22 25					
410	25			R-3	19 50/6"					
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG B-12

Project No.	603541-002	**Date Drilled**	5-7-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	436'
Location	See Boring Location Map	**Sampled By**	FJW

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
405	30			S-3	16 22 20			SM	@ 30': Gray to light brown, silty clayey SANDSTONE, moist, very dense, fine grained	
									Total Depth = 31.5 Feet **No groundwater encountered at time of drilling** **Backfilled with bentonite grout and concrete on 5/7/13**	
400	35									
395	40									
390	45									
385	50									
380	55									
	60									

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG B-13

Project No.	603541-002	**Date Drilled**	5-2-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	436'
Location	See Boring Location Map	**Sampled By**	FJW

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
									This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
	0								0-2" Asphalt Concrete	
435									2"-6" Class II Aggregate Base	
								SM	ARTIFICIAL FILL (Afu) @ 6": Medium brown silty SAND with trace gravel, moist micaceous, medium dense	
430	5			R-1	7 13 22	111	14			
425	10			R-2	7 5 7	110	10		@ 10': Loose	
420	15			S-1	11 10 7			SM	OTAY FORMATION (To) @ 15': Gray to light medium brown silty SANDSTONE, moist, medium dense	
415	20			R-3	10 22 40				@ 20': Gray to light brown, silty SANDSTONE with trace clay, dense to very dense, moist, micaceous, friable, fine-grained	
410	25			S-2	10 17 18				@ 25': Very dense	
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

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GEOTECHNICAL BORING LOG B-13

Project No.	603541-002	**Date Drilled**	5-2-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	436'
Location	See Boring Location Map	**Sampled By**	FJW

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
405	30			R-4	50/5"			SM	@ 30': Gray to light brown silty SANDSTONE, moist, very dense, micaceous, friable	
400	35			S-3	10 19 22				@ 35': Very dense	
395	40			R-5	13 36 50/5"				@ 40': Very dense	
390	45								**Total Depth = 41.5 Feet** **No groundwater encountered at time of drilling** **Backfilled with bentonite grout and concrete on 5/2/13**	
385	50									
380	55									
	60									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG B-14

Project No.	603541-002	**Date Drilled**	5-7-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	435'
Location	See Boring Location Map	**Sampled By**	FJW

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
435	0								0-4" Topsoil	
								SM	ARTIFICIAL FILL (Afu) @ 4"-5': Medium brown silty SAND with gravel, moist, medium dense	
430	5			R-1	26 41 50/3"				@ 5': Gray to light brown silty SAND with gravel, moist, very dense, micaceous	DS
425	10			S-1	10 12 16				@ 10': Dense	
				B-1 @12'-15'						MD
420	15			R-2	12 28 43	102	10		@ 15': Very dense	
415	20			S-2	1 2 2				@ 20': Light to medium reddish brown, silty SAND with trace gravel, moist, loose, micaceous	AL, SA, H
410	25			R-3	5 9 18	96	8	SM	OTAY FORMATION (To) @ 25': Light brown to olive silty SANDSTONE, damp, medium dense	DS
405	30									

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG B-14

Project No.	603541-002	**Date Drilled**	5-7-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	435'
Location	See Boring Location Map	**Sampled By**	FJW

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
405	30			S-3	9 15 15			SM	@ 30.5': Light brown to gray clayey silty SANDSTONE, damp, dense	
400	35			R-4 B-2 @35'-40'	8 16 28					
395	40			S-4	10 14 19				@ 40': Light brown to gray silty SANDSTONE, damp to moist, dense, micaceous	
390	45			R-5	18 32 50/3"				@ 45': Light brown to olive, very dense	
385	50			S-5	16 19 22				@ 50': Very dense	
									Total Depth = 51.5 Feet **No groundwater encountered at time of drilling** **Backfilled with bentonite grout and concrete on 5/7/13**	
380	55									
375	60									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG B-15

Project No.	603541-002	**Date Drilled**	5-8-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	443'
Location	See Boring Location Map	**Sampled By**	FJW

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0								0-2" Topsoil with organics	
								SM	ARTIFICIAL FILL (Afu) @ 2": Olive to light brown to gray, fine silty SAND with clay, damp, dense, micaceous, friable	
440				B-1 @2'-5'						SE
	5			R-1	12 17 29					
435									**Total Depth = 6.5 Feet** **No groundwater encountered at time of drilling** **Backfilled with bentonite grout and concrete on 5/8/13**	
	10									
430										
	15									
425										
	20									
420										
	25									
415										
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG B-16

Project No.	603541-002	**Date Drilled**	5-8-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	436'
Location	See Boring Location Map	**Sampled By**	FJW

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0								0-3" Topsoil	
435								SM	SAN DIEGO FORMATION (Tsdss) @ 3": Olive to light brown to gray silty SANDSTONE, very dense, fine grained, micaceous, friable	
				B-1 @2'-5'						RV, SE
	5			R-1	15 32 50/5"					
430										
									Total Depth = 6.5 Feet **No groundwater encountered at time of drilling** **Backfilled with bentonite grout and concrete on 5/8/13**	
	10									
425										
	15									
420										
	20									
415										
	25									
410										
	30									

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG B-17

Project No.	603541-002	**Date Drilled**	5-8-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	426'
Location	See Boring Location Map	**Sampled By**	FJW

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
	0								0-3" Topsoil	
425								SM	SAN DIEGO FORMATION (Tsdss) @ 3": Olive to light brown silty SANDSTONE, damp, dense, micaceous, friable, fine grained	
				B-1 @2'-5'						SE
	5			R-1	12 15 26					
420										
									Total Depth = 6.5 Feet **No groundwater encountered at time of drilling** **Backfilled with bentonite grout and concrete on 5/8/13**	
	10									
415										
	15									
410										
	20									
405										
	25									
400										
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

* * * This log is a part of a report by Leighton and should not be used as a stand-alone document. * * *

GEOTECHNICAL BORING LOG B-18

Project No.	603541-002	**Date Drilled**	5-8-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	407'
Location	See Boring Location Map	**Sampled By**	FJW

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
	0								0-3" Asphalt Concrete	
									3"-6" Class II Aggregate Base	
405				B-1 @2'-5'				SM	ARTIFICIAL FILL (Afu) @ 6': Olive to light brown silty SAND, damp to moist, medium dense, with clay chunks, trace gravel	SE
	5			R-1	7 9 17				@ 5': Olive to gray silty SAND, damp to moist, medium dense, micaceous, trace gravel	
400									**Total Depth = 6.5 Feet** **No groundwater encountered at time of drilling** **Backfilled with bentonite grout and concrete on 5/8/13**	
	10									
395										
	15									
390										
	20									
385										
	25									
380										
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG B-19

Project No.	603541-002	**Date Drilled**	5-3-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	456'
Location	See Boring Location Map	**Sampled By**	FJW

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
455	0							SM	VERY OLD PARALIC DEPOSITS (Qvop) @ 0': Light to medium brown silty SANDSTONE with GRAVEL-COBBLE CONGLOMERATE, dry to damp, very dense, micaceous, medium grained	
	5			B-1 @4'-8' R-1	50/3"	76	7			
450								SM	SAN DIEGO FORMATION (Tsdss) @ 6': Gray to light brown silty SANDSTONE, damp to moist, very dense, micaceous, friable, fine-grained	
445	10			S-1	24 50/5"					
440	15			R-2	50/6"	93	11		@ 15': Moist	
435	20			S-2	50/6"					
430	25			R-3	24 50/6"				@ 27': Refusal on very dense SANDSTONE	
	30								**Total Depth = 27 Feet** **No groundwater encountered at time of drilling** **Backfilled with bentonite grout and concrete on 5/3/13**	

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG B-20

Project No.	603541-002	**Date Drilled**	5-3-13
Project	Sharp Chula Vista/Geotechnical Investigation	**Logged By**	FJW
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	452'
Location	See Boring Location Map	**Sampled By**	FJW

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
	0								0-6" Topsoil	
								SM	SAN DIEGO FORMATION (Tsdss) @ 6": Light brown to grayish brown silty SANDSTONE with trace gravel, dry to damp, very dense, friable, micaceous	
450										
	5			R-1	50/5"				@ 5': Damp to moist	
445										
	10			S-1 B-1 @10'-15'	28 50/5"					
440										
	15			R-2	28 50/1"					DS
435										
	20			S-2	15 21 27					
430										
	25			R-3	30 50/3"	97	2		@ 25': Dry	
425										
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG B-20

Project No.	603541-002		**Date Drilled**	5-3-13
Project	Sharp Chula Vista/Geotechnical Investigation		**Logged By**	FJW
Drilling Co.	Baja Exploration		**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop		**Ground Elevation**	452'
Location	See Boring Location Map		**Sampled By**	FJW

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	30			S-3	20 29 50/5"			SM	OTAY FORMATION (To) @ 30': Light brown to olive fine silty SANDSTONE with trace clay, damp to moist, very dense, friable, micaceous	
420										
	35			R-4	16 23 30				@ 35': Gray to olive to light brown	
415										
	40			S-4	11 20 28					
410										
	45			R-5	16 23 50	98	12		@ 45': Gray to olive fine silty SANDSTONE, moist, very dense, micaceous, friable	
405										
	50			S-5	15 18 20					
400									**Total Depth = 51.5 Feet** **No groundwater encountered at time of drilling** **Backfilled with bentonite grout on 5/3/13**	
	55									
395										
	60									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

Appendix B

Woodward-Clyde Borings, 1989

Project: CHULA VISTA HOSPITAL	**KEY TO LOGS**

Date Drilled:	Water Depth:	Measured:
Type of Boring:	Type of Drill Rig:	Hammer:

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
			Surface Elevation:			
0			DISTURBED SAMPLE LOCATION Sample was obtained by collecting auger cuttings in a plastic bag.			
			DRIVE SAMPLE LOCATION Sample with recorded blows per foot was obtained by using a Modified California drive sampler (2" inside diameter, 2.5" outside diameter). The sampler was driven into the soil at the bottom of the hole with a 140 pound hammer falling 30 inches.			
5						
			Fill			
10			Sand			
			Clay			
			Silt			
15			Sand/Clay			
20			*GS - Grain Size Distribution Analysis DS - Direct Shear Test 'R' - R-Value Test			
25						
30						

Project No: 8951127W-SI01 | **Woodward-Clyde Consultants** | Figure A-1

Project: CHULA VISTA HOSPITAL	Log of Boring No: 1

Date Drilled: 3-27-89	Water Depth:Dry	Measured:At time of drilling
Type of Boring: 8" HSA	Type of Drill Rig: CME-55	Hammer: 140 lbs at 30" drop

* see Key to Logs, Fig. A-1

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
			Surface Elevation: Approximately 431.5'			
0			**FILL** 1.5" Asphalt concrete over moist, greenish gray, very silty fine sand with some gravel			
	1-1					
5	1-2	25	Increased gravels	17	100	
			Moist, greenish gray and brown mottled, silty fine sand			
10	1-3	28		13	106	
			Some gravels			
15	1-4	24		21	103	
20	1-5	35		19	100	
			RESIDUAL SOIL Very stiff to hard, moist, dark brown, sandy lean clay (CL) with some gravels and roots (porous)			
25	1-6	13		15	107	UCS= 1466psf
			SAN DIEGO FORMATION Very dense, moist, yellowish brown, silty fine sand with orange laminated staining (SM)			
30	1-7	59		13	107	

Project No: 8951127W-SI01 | Woodward-Clyde Consultants | Figure A-2

Project: CHULA VISTA HOSPITAL	Log of Boring No: 1 (Cont'd)

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
30	1-7	59	(Continued) very dense, moist, yellowish brown, silty fine sand with orange laminated staining (SM)			
35	1-8	82				
			Bottom of Boring at 36.5 feet			
40						
45						
50						
55						
60						
65						

Project No: 8951127W-SI01	Woodward-Clyde Consultants	Figure: A-8

The data developed and conclusions and recommendations resulted in this/these correspondence(s) was/were for a specific project. Additionally, we wish to advise you that since this/these correspondence(s) was/were issued, there have been substantial changes in the state of the art and state of practice of the profession, as well as in the degree of risk considered acceptable by society and the profession. Thus, the opinion, recommendations, and conclusions contained therein must be reevaluated. We recommend that you retain a qualified firm to do this before proceeding with any plans that might be influenced by the contents of this/these correspondence(s).

Project: CHULA VISTA HOSPITAL	Log of Boring No: 2

Date Drilled: 3-27-89 | Water Depth: Dry | Measured: At time of drilling

Type of Boring: 8" HSA | Type of Drill Rig: CME-55 | Hammer: 140 lbs at 30" drop

* see Key to Logs, Fig. A-1

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
			Surface Elevation: Approximately 426.5'			
0			**FILL** 1.5" Asphalt concrete over moist, dark brown to red brown, silty fine sand with some gravels			
5	2-1	24	Moist, greenish brown, silty fine sand (micaceous)	11	97	
10	2-2	57/6"	Moist, brown-gray, silty fine sand with gravels and localized pockets of rusty brown silty sand	12	94	
15	2-3	29	Moist, red-brown and green-brown mottled, silty to clayey sand with gravel	16	110	
20	2-4	28	Moist, yellowish brown and dark brown mottled, silty sand	21	98	
25	2-5	36	Moist, yellow-brown, silty sand (mottled)	13	95	
30			**SAN DIEGO FORMATION** Very dense, moist, yellow- brown, silty fine sand (SM) with orange laminated staining			

Project No: 8951127W-SI01 | **Woodward-Clyde Consultants** | Figure: A-4

The data developed and conclusions and recommendations reached in this/these correspondence(s) was/were for a specific project. Additionally, we wish to advise you that since this/these correspondence(s) was/were issued, there have been substantial changes in the state of the art and state of practice of the profession, as well as in the degree of risk considered acceptable by society and the profession. Thus, the opinion, recommendations, and conclusions contained therein must be reevaluated. We recommend that you retain a qualified firm to do this before proceeding with any plans that might be influenced by the contents of this/these correspondence(s).

Project: CHULA VISTA HOSPITAL	Log of Boring No: 2 (Cont'd)

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
30	2-6	92	(Continued) very dense, moist, yellowish brown, silty fine sand with orange laminated staining (SM)	11	94	
35	2-7	83				
			Bottom of Boring at 36.5 feet			
40						
45						
50						
55						
60						
65						

Project No: 8951[illegible]W-0101 | **Woodward-Clyde Consultants** | Figure A-5

Project: CHULA VISTA HOSPITAL | **Log of Boring No: 3**

Date Drilled: 3-27-89 | Water Depth:Dry | Measured:At time of drilling

Type of Boring: 8" HSA | Type of Drill Rig: CME-55 | Hammer: 140 lbs at 30" drop

* see Key to Logs, Fig. A-1

Surface Elevation: Approximately 450.5'

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
0			**FILL** Moist, red-brown and gray mottled, silty sand with gravels			
	3-1					GS
5	3-2	29		15	102	
10	3-3	24		11	100	
15	3-4	25		13	103	
			- - - - - - - - - - - -			
			Moist, yellow brown to gray, poorly graded medium sand with gravel and localized clay balls			
20	3-5	12				
25	3-6	58	Increased gravel	14	85	
			Refusal on gravel at 25.5 feet			
30						

Project No: 8951127W-SI01 | **Woodward-Clyde Consultants** | Figure: A-6

The data developed and conclusions and recommendations reached in this/these correspondence(s) was/were for a specific project. Additionally, we wish to advise you that since this/these correspondence(s) was/were issued, there have been substantial changes in the state of the art and state of practice of the profession, as well as in the degree of risk considered acceptable by society and the profession. Thus, the opinion, recommendations, and conclusions contained therein must be reevaluated. We recommend that you retain a qualified firm to do this before proceeding with any plans that might be influenced by the contents of this/these correspondence(s).

Project: CHULA VISTA HOSPITAL	**Log of Boring No: 4**

Date Drilled: 3-27-89	Water Depth:Dry	Measured:At time of drilling
Type of Boring: 8" HSA	Type of Drill Rig: CME-55	Hammer: 140 lbs at 30" drop

* see Key to Logs, Fig. A-1

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
			Surface Elevation: Approximately 450'			
0			**FILL** Moist, yellow brown and dark brown mottled, silty fine sand with gravels and mica			
			Increased gravel			
5	4-1	24		14	102	
			Moist, greenish gray and dark brown, silty sand with localized black, clay balls and gravel			
10	4-2	15		13	99	
			Moist, yellowish brown, silty sand with gravel			
15	4-3	41		10	106	
20	4-4	32	Moist, greenish brown, silty sand with mica and poorly graded sand pockets and gravels	16	104	
25	4-5	15	**RESIDUAL SOIL** Hard, moist, dark brown, clayey fine sand to lean clay with some gravels (SC-CL)	18	110	UNC= 384psf
30			**SAN DIEGO FORMATION** Dense, moist, greenish gray, silty sand with yellow gray staining (SM), micaceous			

Project No: 8951127W-SI01 | **Woodward-Clyde Consultants** | Figure: A-7

Project: CHULA VISTA HOSPITAL	Log of Boring No: 4 (Cont'd)

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
30	4-6	30	(Continued) dense, moist, greenish gray, silty sand with yellow gray staining (SM), micaceous			
35	4-7	32				
40	4-8	55	Very dense, moist, greenish gray, silty fine sand (SM) with mica and calcium carbonates			
	4-9	68	Gravel			
45			Bottom of Boring at 44 feet			
50						
55						
60						
65						

[illegible] developed and c[illegible] recommendations [illegible] correspondence(s) [illegible] specific project. Additionally, we wish to advise you that since this/these correspondence(s) was/were issued, there have been substantial changes in the state of the art and state of practice of the profession, as well as in the degree of risk considered acceptable by society and the profession. Thus, the opinion, recommendations, and conclusions contained therein must be reevaluated. We recommend that you retain a qualified firm to do this before proceeding with any plans that might be influenced by the contents of this/these correspondence(s).

Project: CHULA VISTA HOSPITAL	**Log of Boring No: 5**

Date Drilled: 3-28-89 | Water Depth:Dry | Measured:At time of drilling

pe of Boring: 8" HSA | Type of Drill Rig: CME-55 | Hammer: 140 lbs at 30" drop

* see Key to Logs, Fig. A-1

Surface Elevation: Approximately 446'

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
0			**FILL** Moist, yellow brown and dark brown mottled, silty fine sand with gravels			
	5-1					GS,"R'
5	5-2	39		10	101	
			Moist, green brown and green gray, silty fine sand with medium grained sand pockets, gravel and mica			
10	5-3	44		13	106	
15	5-4	35		13	98	
			Moist, green gray, light and dark brown mottled, silty fine sand with gravels, orange staining and mica			
20	5-5	34		12	100	
25	5-6	36		16	99	
			Very moist to wet, green gray and brown, silty fine sand with gravels and orange stained			
30						

Project No: 8951127M-SI01 | **Woodward-Clyde Consultants** | Figure: A-9

This was developed and conclusions and recommendations reached in this/these correspondence(s) was/were for a specific project. Additionally, we wish to advise you that since this/these correspondence(s) was/were issued, there have been substantial changes in the state of the art and state of practice of the profession, as well as in the degree of risk considered acceptable by society and the profession. Thus, the opinion, recommendations, and conclusions contained therein must be reevaluated. We recommend that you retain a qualified firm to do this before proceeding with any plans that might be influenced by the contents of this/these correspondence(s).

Project: CHULA VISTA HOSPITAL	Log of Boring No: 5 (Cont'd)

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
30	5-7	52	(Continued) very moist to wet, green gray and brown, silty fine sand with gravels and orange stained	18	104	
			Moist, dark brown, silty fine sand with wood debris and organic odor and gravels			
35	5-8	9				
			RESIDUAL SOIL Hard, moist, dark gray brown, sandy lean clay (CL) some gravels			
	5-9	50/5.5"	**SAN DIEGO FORMATION** Very dense, moist, gray green, silty fine sand (SM) with abundant gravel and some orange staining			
40						
			Dense to very dense yellow brown silty fine sand (micaceous)			
45	5-10	40				
	5-11	68				
50			Bottom of Boring at 50.5 feet			
55						
60						
65						

Project No: 8951127W-SI01 | Woodward-Clyde Consultants | Figure A-10

The data developed and conclusions and recommendations reached in this/these correspondence(s) was/were for a specific project. Additionally, we wish to advise you that since this/these correspondence(s) was/were issued, there have been substantial changes in the state of the art and state of practice of the profession, as well as in the degree of risk considered acceptable by society and the profession. Thus, the opinion, recommendations, and conclusions contained therein must be reevaluated. We recommend that you retain a qualified firm to do this before proceeding with any plans that might be influenced by the contents of this/these correspondence(s).

Project: CHULA VISTA HOSPITAL	**Log of Boring No: 6**

Date Drilled: 3-28-89 | Water Depth: 24' (perched) | Measured: At time of drilling

Type of Boring: 8" HSA | Type of Drill Rig: CME-55 | Hammer: 140 lbs at 30" drop

* see Key to Logs, Fig. A-1

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
			Surface Elevation: Approximately 441'			
0			**FILL** Moist, dark and light brown and gray mottled, silty fine sand with orange sandy pockets and some gravels, micaceous			
5	6-1	48		12	100	
10	6-2	36		12	95	
15	6-3	33	Moist, yellow brown, light brown mottled, silty fine sand with gravels and orange pockets(micaceous)	10	97	
20	6-4	38	Moist, light yellow and dark brown, silty sand with dark brown, clayey sand pockets, gravel and micas	16	104	
			▼ increased gravels	20	105	
25	6-5	26	Wet, green-gray and brown mottled, silty sand with dark brown and green pockets, some gravels and wood			
30			**RESIDUAL SOIL** Dense, moist, dark brown, clayey fine sand with gravel and root fibers (SC)			

Project: CHULA VISTA HOSPITAL	Log of Boring No: 6 (Cont'd)

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
30	6-6	34	(Continued) dense, moist, dark brown, clayey fine sand with gravel and root fibers (SC)	15	105	UCS= 1002psf
			SAN DIEGO FORMATION Dense, moist, yellow brown, sandy silt with brown staining (ML)			
35	6-7	37	Very hard drilling at 37 feet			
			Medium dense, moist, green-gray, silty fine sand (SM). (micaceous)			
40	6-8	24		22	95	
45	6-9	80				
			Bottom of Boring at 46.5 feet			
50						
55						
60						
65						

Project: CHULA VISTA HOSPITAL	**Log of Boring No: 7**

Date Drilled: 3-28-89 | Water Depth: Dry | Measured: At time of drilling

Type of Boring: 8" HSA | Type of Drill Rig: CME-55 | Hammer: 140 lbs at 30" drop

* see Key to Logs, Fig. A-1

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
			Surface Elevation: Approximately 423'			
0			**FILL** 1.5" asphalt concrete over moist yellow-gray, silty sand with gravels and shell fragments (micaceous)			
5	7-1	40				
			Grading to Moist, greenish brown and yellow brown mottled, silty fine sand with orange medium grained sand pockets, gravel and shell fragments			
10	7-2	30		18	99	
			Moist, yellow brown, silty fine sand with gravel, mica and shell fragments			
15	7-3	27		15	100	
			Moist, green-brown and yellow brown, silty sand with dark brown, lean clay pockets with gravel and wood			
20	7-4	44		16	103	
			Moist, red-brown, silty fine sand to sandy silt	20	105	
25	7-5	42	Becomes very hard drilling at 26.5 feet			
	7-6	65/6"	**SAN DIEGO FORMATION** Very dense, moist, yellow brown silt with orange staining (ML)			
30			Refusal at 28.5 feet			

Project: CHULA VISTA HOSPITAL | **Log of Boring No: 8**

Date Drilled: 3-29-89 | Water Depth: Dry | Measured: At time of drilling

Type of Boring: 8" HSA | Type of Drill Rig: CME-55 | Hammer: 140 lbs at 30" drop

* see Key to Logs, Fig. A-1

Surface Elevation: Approximately 441'

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
0			**FILL** Moist, green-brown and brown mottled, silty sand with orange medium grained sand pockets and gravels			
5	8-1	24		13	103	
10	8-2	29		15	105	
			RESIDUAL SOIL Stiff to hard, moist, dark brown, sandy lean clay (CL) with gravels			
15	8-3	23	**TERRACE DEPOSITS** Medium dense, moist, red-brown, poorly graded medium sand with silt (SM/ML)			
			Dense gravels			
20	8-4	76/5.5"				
			SAN DIEGO FORMATION Very dense, moist, gray, silty very fine sand with cemented zones and micas (SM) with some orange staining			
25	8-5	53				
30						

Project: CHULA VISTA HOSPITAL	Log of Boring No: 8 (Cont'd)

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
30	8-6	53	(Continued) very dense, moist, gray, silty very fine sand with cemented zones and mica (SM)			
35	8-7	51				
40	8-8	52				
			Bottom of Boring at 41.5 feet			
45						
50						
55						
60						
65						

Project No: 8951127W-SI01 | Woodward-Clyde Consultants | Figure: A-15

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Project: CHULA VISTA HOSPITAL	**Log of Boring No: 9**

Date Drilled: 3-29-89 | Water Depth:Dry | Measured:At time of drilling

Type of Boring: 8" HSA | Type of Drill Rig: CME-55 | Hammer: 140 lbs at 30" drop

* see Key to Logs, Fig. A-1

Surface Elevation: Approximately 451'

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
0			**FILL** Moist, dark brown, clayey fine sand with roots and gravel			
	9-1					GS
5	9-2	35		17	106	
			Moist, brown, silty sand with yellow-brown pockets and gravel			
10	9-3	33		12	99	
			Moist, green-gray, silty fine sand with some gravels and micas			
15	9-4	32		8	93	
			Very hard drilling at 17.5 feet			
			TERRACE DEPOSITS Very dense, moist, reddish brown, medium to coarse poorly graded sand (SP)	4	109	
20	9-5	63				
25	9-6	93				
			SAN DIEGO FORMATION Dense, moist, gray, silty fine sand with some orange staining and micas (SM)			
30						

Project No: 8951127W-SI01 | **Woodward-Clyde Consultants** | Figure: A-16

Project: CHULA VISTA HOSPITAL	Log of Boring No: 9 (Cont'd)

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
30	9-7	42	(Continued) dense, moist, gray, silty fine sand some orange staining and micas (SM)			
35	9-8	40				
40	9-9	34				
45	9-10	60				
			Bottom of Boring at 46.5 feet			
50						
55						
60						
65						

Project: CHULA VISTA HOSPITAL	Log of Boring No: 10

Date Drilled: 3-29-89 | Water Depth:DRY | Measured:AT TIME OF DRILLING

Type of Boring: 8" HSA | Type of Drill Rig: CME-55 | Hammer: 140 lbs at 30" drop

* see Key to Logs, Fig. A-1

Surface Elevation: Approximately 446'

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
0			**FILL** Moist, yellow brown and red brown mottled, silty sand with black spots			
5	10-1	53		11	93	
			Moist, green brown, silty fine sand, micaceous			
10	10-2	20		12	91	
			TERRACE DEPOSITS Very dense, moist, reddish brown, medium to coarse poorly graded sand with gravel (SP)			
15	10-3	69				
			SAN DIEGO FORMATION Very dense, moist, yellow brown, silty fine sand with micas (SM)			
20	10-4	99				
			Grades to			
			Very dense, moist, green gray, silty fine sand with micas (SM)			
25	10-5	53				
			Bottom of Boring at 26.5 feet			
30						

Project: CHULA VISTA HOSPITAL	Log of Boring No: 11

Date Drilled: 3-29-89 | Water Depth: Dry | Measured: At time of drilling

Type of Boring: 8" HSA | Type of Drill Rig: CME-55 | Hammer: 140 lbs at 30" drop

* see Key to Logs, Fig. A-1

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
			Surface Elevation: Approximately 450.5'			
0			**FILL** Moist, yellow brown, silty fine sand with gravels			
5						
10						
15						
			RESIDUAL SOIL Dense, moist, dark brown, sandy lean clay (CL) with gravels			
			TERRACE DEPOSITS Very dense, moist, red brown, poorly graded medium sand (SP) with gravels			
20	11-1	36				
	11-2	71				
25			**SAN DIEGO FORMATION** Very dense, moist, yellow brown, silty fine sand with orange staining and calcium carbonate and micas (SM)			
	11-3	80				
			Very dense, moist, green gray, silty fine sand with cemented zones and micas (SM)			
30						

Project No: 8951127W-SI01 | Woodward-Clyde Consultants | Figure A-19

The data developed and conclusions and recommendations reached in this/these correspondence(s) was/were for a specific project. Additionally, we wish to advise you that since this/these correspondence(s) was/were issued, there have been substantial changes in the state of the art and state of practice of the profession, as well as in the degree of risk considered acceptable by society and the profession. Thus, the opinion, recommendations, and conclusions contained therein must be reevaluated. We recommend that you retain a qualified firm to do this before proceeding with any plans that might be influenced by the contents of this/these correspondence(s).

Project: CHULA VISTA HOSPITAL	Log of Boring No: 11 (Cont'd)

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
30	10-4	83	(Continued) very dense, moist, green gray, silty fine sand with cemented zones and micas (SM)			
	10-5	74				
35			Bottom of Boring at 34.5 feet			
40						
45						
50						
55						
60						
65						

Project No: 8951127W-SI01 — Woodward-Clyde Consultants — Figure: A-20

Appendix C

Laboratory Testing Procedures and Test Results

APPENDIX C

Laboratory Testing Procedures and Test Results

Moisture Determination Tests: Moisture content determinations were performed on relatively undisturbed samples obtained from the boring excavations. The results of these tests are presented on the boring logs.

Expansion Index Tests: The expansion potential of selected materials was evaluated by the Expansion Index Text, ASTM Test Method 4829. Specimens are molded under a given compactive energy to approximately 50 percent saturation. The prepared 1-inch thick by 4-inch diameter specimens are loaded to an equivalent 144 psf surcharge and are inundated with water until volumetric equilibrium is reached. The results of these tests are presented in the table below:

Sample Location	Description	Expansion Index	Expansion Potential
B-1, 10-15 feet	Light Brown to Light Olive Brown to sandy lean CLAY	62	Medium
B-8, 20-25 feet	Medium Brown to Brown silty SAND with a trace of GRAVEL	9	Very Low

Maximum Dry Density and Optimum Moisture Content Tests: The maximum dry density and optimum moisture content of selected representative soil samples were evaluated in general accordance with ASTM D 1557. The test results are presented in the table below and the plotted curve is presented in the test data.

Sample Location	Description	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
B-14, 12-15 feet	Light Brown to Medium Reddish Brown clayey silty SAND with a trace of GRAVEL	123.2	12.0

Direct Shear/Soil Strength Tests: Direct shear test was performed on selected remolded sample which was soaked for a minimum of 24 hours under a surcharge equal to the applied normal force during testing. After transfer of the sample to the shear box, and reloading the sample, pore pressures set up in the sample due to the transfer were allowed to dissipate for a period of approximately 1 hour prior to application of shearing

APPENDIX C (Continued)

force. The samples were tested under various normal loads, using a motor-driven, strain-controlled, direct-shear testing apparatus. The test results are presented in the test data.

Sample			Peak Shear		Ultimate Shear	
Sample Location	Unit	Sample Description	Friction Angle (degrees)	Apparent Cohesion (psf)	Friction Angle (degrees)	Apparent Cohesion (psf)
B-3 @ 10-11 feet	Tsdss	Grayish to Olive-Brown silty clayey SANDSTONE	37.0	158.5	32.5	157.5
B-4 @ 5-6 feet	Tsdss	Light Gray to Light Brown silty SANDSTONE	37.4	47	36.8	0
B-14 @ 5-6 feet	Afu	Gray to Light Brown silty SAND	42.6	3.5	28.1	390
B-14 @ 25-26 feet	To	Light Brown to Olive silty SANDSTONE	38.3	639	35.8	130.5
B-20 @ 15-16 feet	Tsdss	Light Brown to Grayish Brown silty SANDSTONE	40.4	105	39.5	114.5

<u>Soluble Sulfates</u>: The soluble contents of selected samples were determined by standard geochemical methods. The test results are presented in the table below:

Sample Location	Sulfate Content (%)
B-5 @ 1 to 4 feet	0.0375
B-10 @ 10 to 12 feet	0.0150

APPENDIX C (Continued)

Chloride Content: Chloride content was tested in accordance with DOT Test Method No. 422. The results are presented below:

Sample Location	Chloride Content, ppm
B-5 @ 1 to 4 feet	24
B-10 @ 10 to 12 feet	12

Minimum Resistivity and pH Tests: Minimum resistivity and pH tests were performed in general accordance with California Test Method 643. The results are presented in the table below:

Sample Location	pH	Minimum Resistivity (ohms-cm)
B-5 @ 1 to 4 feet	7.71	878
B-10 @ 10 to 12 feet	8.01	3,044

Particle/Grain Size Analysis (ASTM D422): Particle size analysis was performed by mechanical sieving, wash sieving, and hydrometer methods according to ASTM D422, D 1140, D4318, and D6913. The percent fine particles from these analyses are summarized below. Plots of the sieve and hydrometer results are provided on the figures at the end of this Appendix.

Sample	Percent Passing No. 200 Sieve
B-1 @ 10-15 feet	60
B-10 @ 10-12 feet	27
B-12 @ @ 5-10 feet	52
B-14 @ 20-21 feet	45

APPENDIX C (Continued)

Atterberg Limits (ASTM D 4318): The Atterberg Limits were determined in accordance with ASTM Test Method D4318 for engineering classification of the fine-grained materials and presented in the table below:

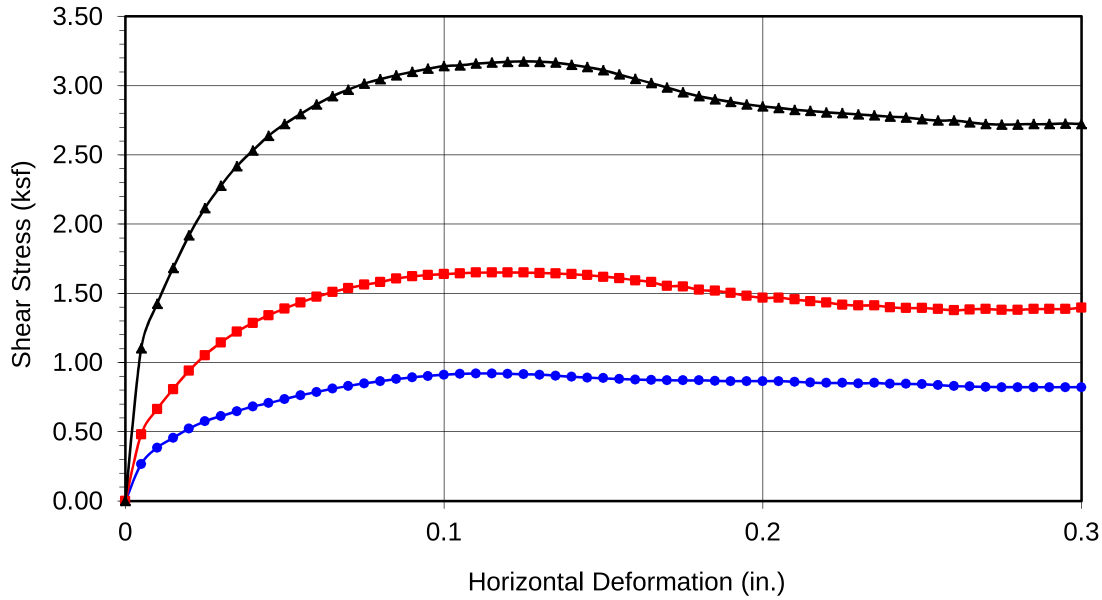
Sample	Plasticity Index	Liquid Limit (%)	Plastic Limit (%)	USCS Soil Classification
B-1 @ 10-15 feet	17	31	14	CL
B-14 @ 20-21.5 feet	3	23	20	ML

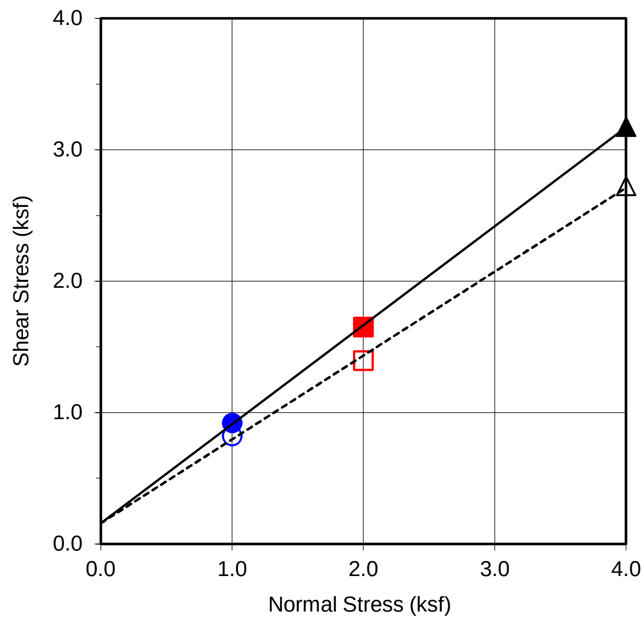
"R"-Value: The resistance "R"-value was determined by the California Materials Method CT301 for base, subbase, and basement soils. The samples were prepared and exudation pressure and "R"-value determined. The graphically determined "R"-value at exudation pressure of 300 psi is reported.

Sample Location	Sample Description	R-Value
B-16 @ 2 to 5 feet	Olive to Light Brown to Gray silty SANDSTONE	63

Sand Equivalent Test (ASTM D 2419): Sand equivalent (SE) tests were performed on selected representative samples. The SE value is the ratio of the coarse- to fine-grained particles in the selected samples.

Sample	Average SE
B-15 @ 2 to 5 feet	25
B-16 @ 2 to 5 feet	34
B-17 @ 2 to 5 feet	45
B-18 @ 2 to 5 feet	18





Boring No.	**B-3**
Sample No.	**R-1**
Depth (ft)	**10-11**
Sample Type:	Ring

Soil Identification:
Pale olive silty sand (SM)

Strength Parameters

	C (psf)	ϕ (°)
Peak	158.5	37.0
Ultimate	157.5	32.5

Normal Stress (kip/ft²)	1.000	2.000	4.000
Peak Shear Stress (kip/ft²)	● 0.921	■ 1.650	▲ 3.175
Shear Stress @ End of Test (ksf)	○ 0.821	□ 1.396	△ 2.723
Deformation Rate (in./min.)	0.0033	0.0033	0.0033
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	6.47	6.47	6.47
Dry Density (pcf)	84.7	90.1	88.6
Saturation (%)	17.6	20.0	19.3
Soil Height Before Shearing (in.)	0.9883	0.9862	0.9780
Final Moisture Content (%)	30.7	30.2	30.0

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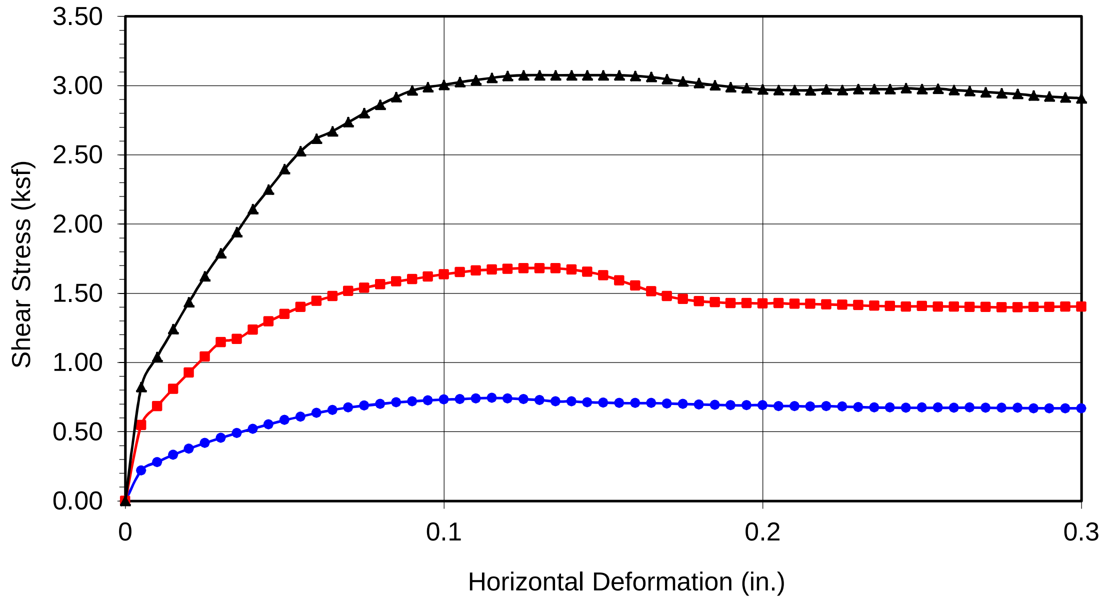
DIRECT SHEAR TEST RESULTS

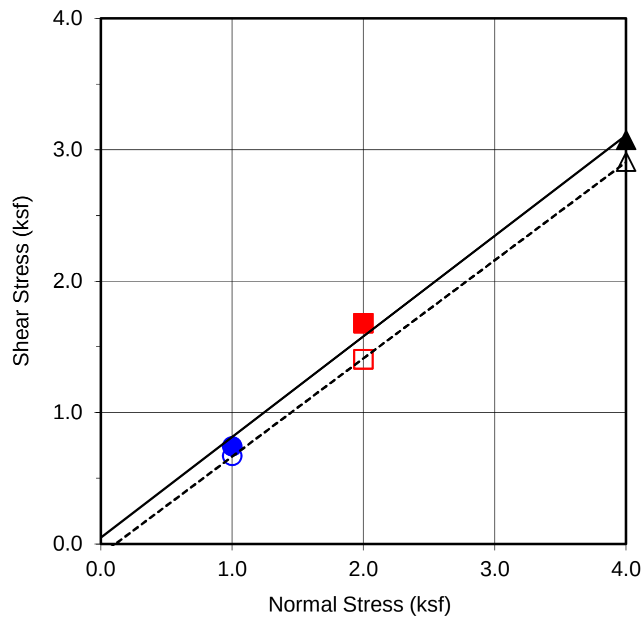
Consolidated Drained - ASTM D 3080

Project No.: 603541-002

SHARP CHULA VISTA MEDICAL CENTER
MASTER PLAN

05-13





Boring No.	**B-4**
Sample No.	**R-1**
Depth (ft)	**5-6.0**
Sample Type:	RING
Soil Identification: POORLY GRADED SAND WITH SILT (SP-SM), light grayish brown.	

Strength Parameters

	C (psf)	ϕ (°)
Peak	47.0	37.4
Ultimate	-83.5	36.8

Normal Stress (kip/ft²)	1.000	2.000	4.000
Peak Shear Stress (kip/ft²)	● 0.744	■ 1.681	▲ 3.075
Shear Stress @ End of Test (ksf)	○ 0.669	□ 1.404	△ 2.909
Deformation Rate (in./min.)	0.0033	0.0033	0.0033
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	10.78	10.86	10.33
Dry Density (pcf)	91.1	90.4	87.7
Saturation (%)	34.2	33.9	30.3
Soil Height Before Shearing (in.)	0.9824	0.9825	0.9618
Final Moisture Content (%)	29.4	28.5	29.0

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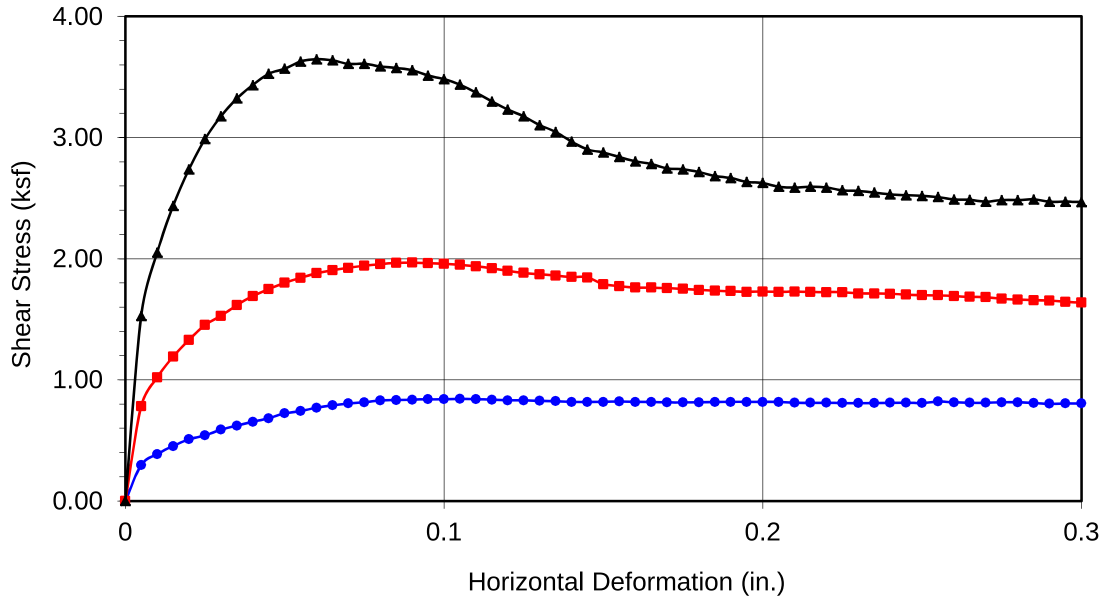
DIRECT SHEAR TEST RESULTS

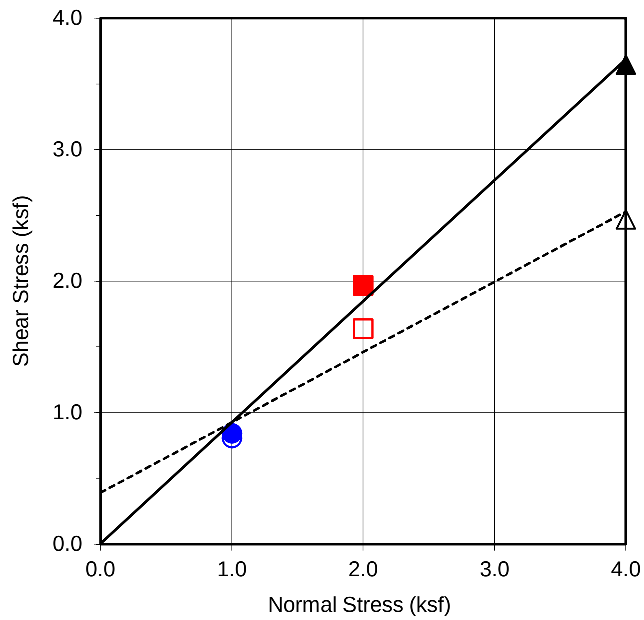
Consolidated Drained ASTM D-3080

Project No.: 603541-002

SHARP CHULA VISTA MEDICAL CENTER
MASTER PLAN

05-13





Boring No.	**B-14**
Sample No.	**R-1**
Depth (ft)	**5-6**
Sample Type:	Ring

Soil Identification:
Yellowish brown silty, clayey sand with gravel (SC-SM)g

Strength Parameters

	C (psf)	ϕ (°)
Peak	3.5	42.6
Ultimate	390.0	28.1

Normal Stress (kip/ft²)	1.000	2.000	4.000
Peak Shear Stress (kip/ft²)	● 0.843	■ 1.968	▲ 3.647
Shear Stress @ End of Test (ksf)	○ 0.805	□ 1.638	△ 2.468
Deformation Rate (in./min.)	0.0025	0.0025	0.0025
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	7.50	7.50	7.50
Dry Density (pcf)	99.2	105.2	112.7
Saturation (%)	29.0	33.6	40.9
Soil Height Before Shearing (in.)	0.9646	0.9775	0.9861
Final Moisture Content (%)	17.3	18.6	17.6

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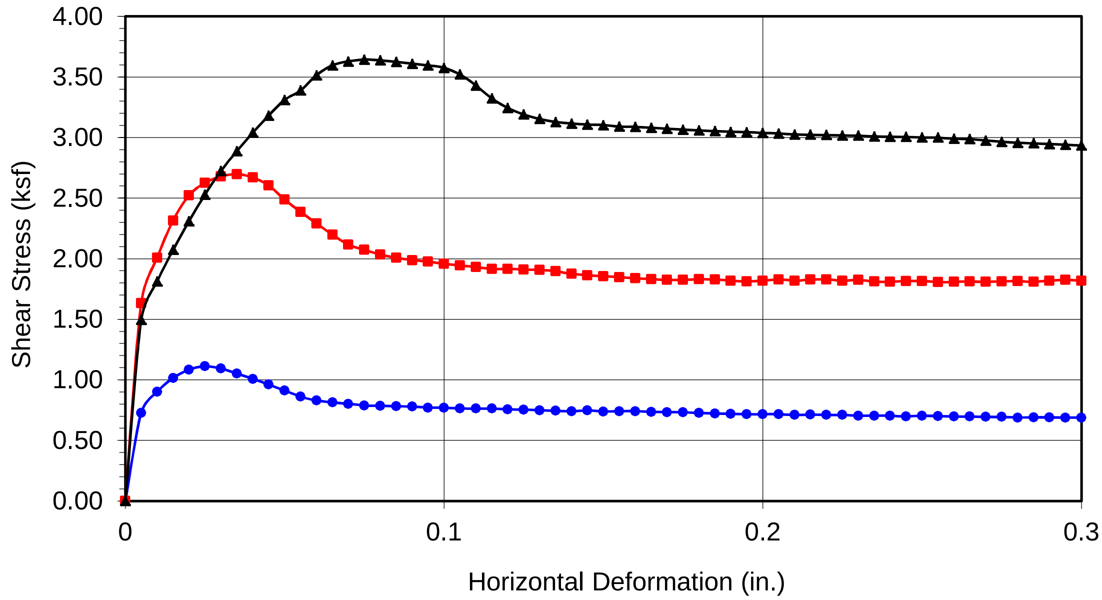
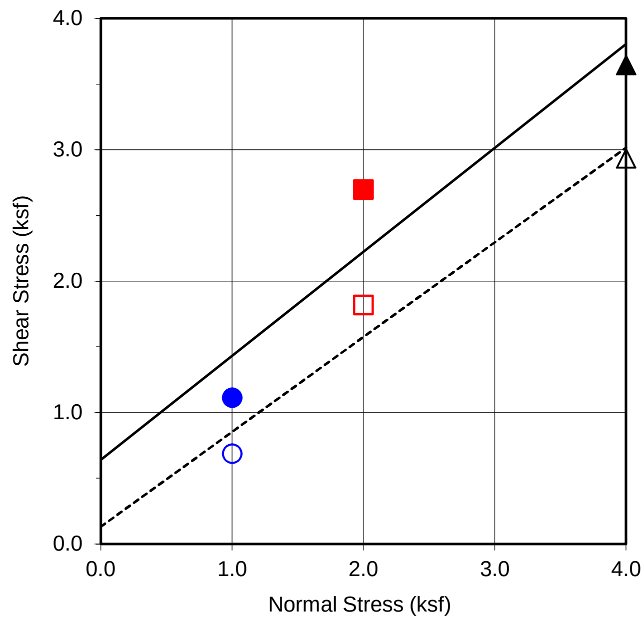
DIRECT SHEAR TEST RESULTS
Consolidated Drained - ASTM D 3080

Project No.: 603541-002
SHARP CHULA VISTA MEDICAL CENTER
MASTER PLAN
05-13





Boring No.	**B-14**
Sample No.	**R-3**
Depth (ft)	**25-26.0**
Sample Type:	RING

Soil Identification:
POORLY GRADED SAND WITH SILT (SP-SM), light grayish brown.

Strength Parameters

	C (psf)	ϕ (°)
Peak	639.0	38.3
Ultimate	130.5	35.8

Normal Stress (kip/ft²)	1.000	2.000	4.000
Peak Shear Stress (kip/ft²)	● 1.112	■ 2.698	▲ 3.644
Shear Stress @ End of Test (ksf)	○ 0.688	□ 1.819	△ 2.934
Deformation Rate (in./min.)	0.0033	0.0033	0.0033
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	13.29	14.01	11.03
Dry Density (pcf)	93.2	95.6	91.2
Saturation (%)	44.4	49.5	35.1
Soil Height Before Shearing (in.)	0.9962	0.9935	0.9706
Final Moisture Content (%)	29.3	26.8	28.3

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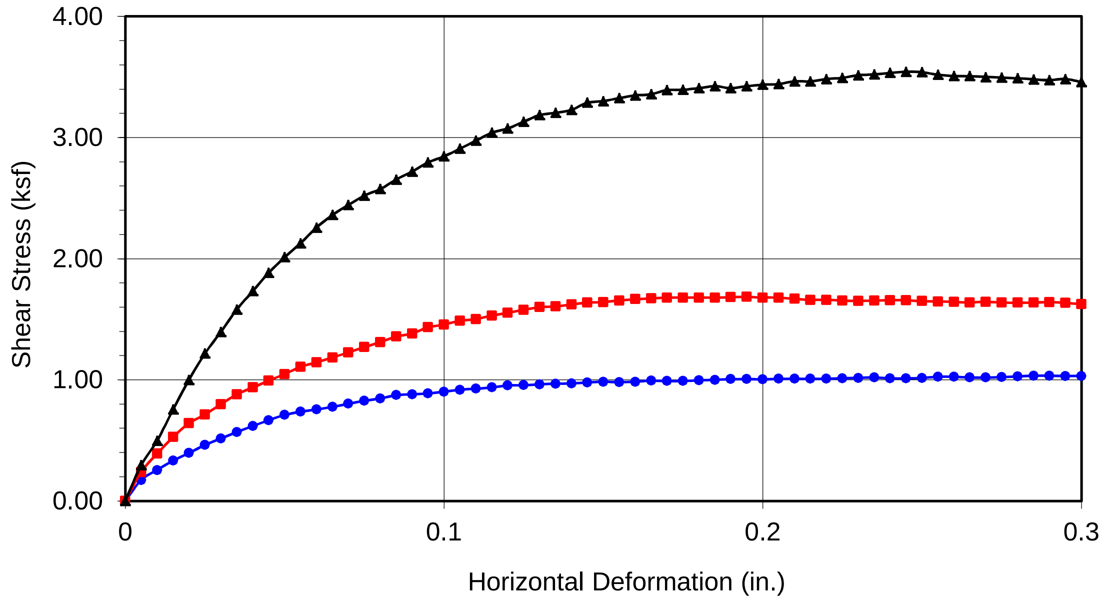
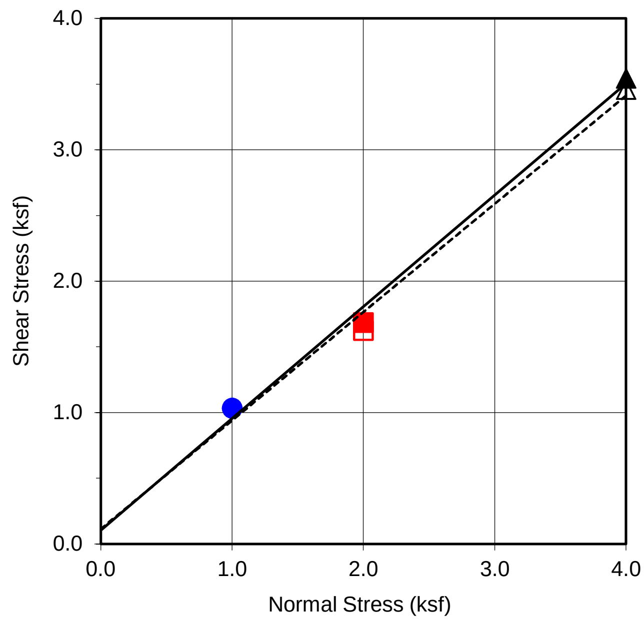
DIRECT SHEAR TEST RESULTS
Consolidated Drained ASTM D-3080

Project No.: 603541-002
SHARP CHULA VISTA MEDICAL CENTER
MASTER PLAN

06-13





Boring No.	**B-20**
Sample No.	**R-2**
Depth (ft)	**15-16**
Sample Type:	Ring

Soil Identification:
Light olive brown sandy silt
s(ML)

Strength Parameters

	C (psf)	ϕ (°)
Peak	105.0	40.4
Ultimate	114.5	39.5

Normal Stress (kip/ft²)	1.000	2.000	4.000
Peak Shear Stress (kip/ft²)	● 1.034	■ 1.685	▲ 3.543
Shear Stress @ End of Test (ksf)	○ 1.031	□ 1.625	△ 3.458
Deformation Rate (in./min.)	0.0025	0.0025	0.0025
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	7.39	7.39	7.39
Dry Density (pcf)	86.5	86.4	87.9
Saturation (%)	21.0	21.0	21.7
Soil Height Before Shearing (in.)	0.9773	0.9539	0.9584
Final Moisture Content (%)	24.5	25.5	24.9

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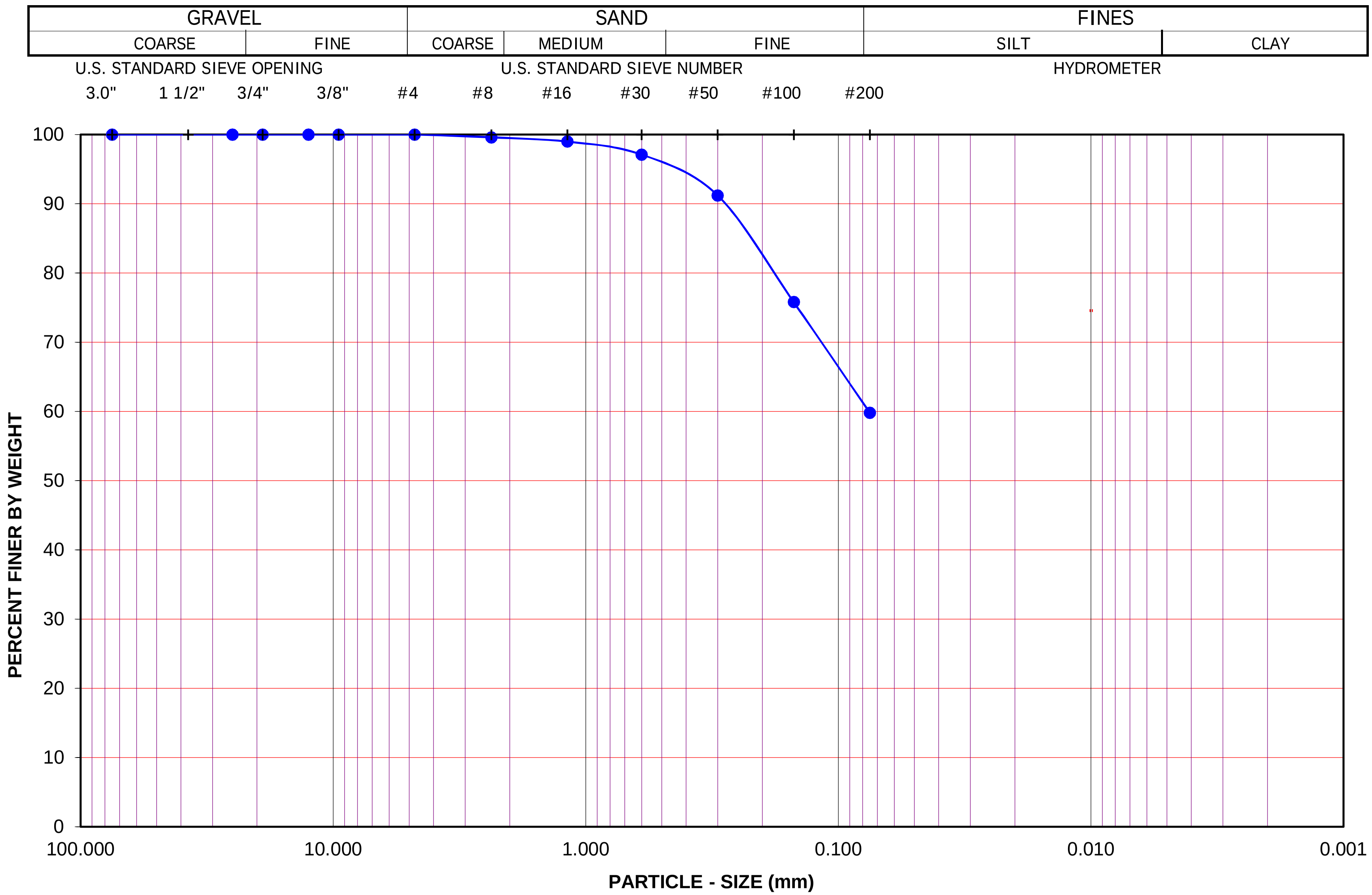
DIRECT SHEAR TEST RESULTS

Consolidated Drained - ASTM D 3080

Project No.: 603541-002

SHARP CHULA VISTA MEDICAL CENTER
MASTER PLAN

05-13



Project Name: SHARP CHULA VISTA MEDICAL CENTER MASTER PLAN

Project No.: 603541-002

Exploration No.: B-1 Sample No.: B-1

Depth (feet): 10-15.0 Soil Type : s(CL)

Soil Identification: SANDY LEAN CLAY s(CL), light olive brown.

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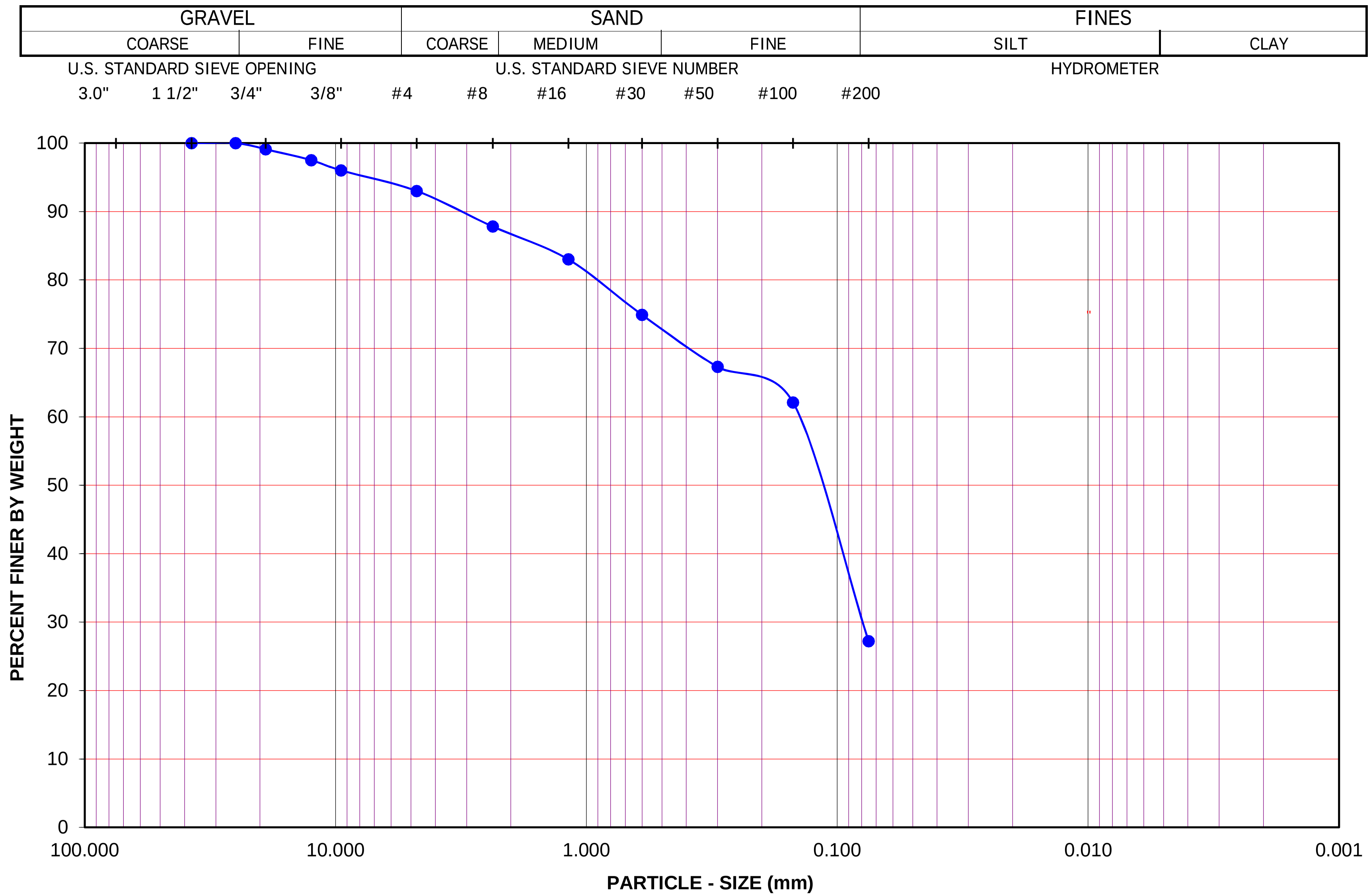
PARTICLE - SIZE DISTRIBUTION ASTM D 6913

GR:SA:FI : (%) 0 : 40 : 60

May-13



Project Name: SHARP CHULA VISTA MEDICAL CENTER MASTER PLAN

Project No.: 603541-002

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PARTICLE - SIZE DISTRIBUTION ASTM D 6913

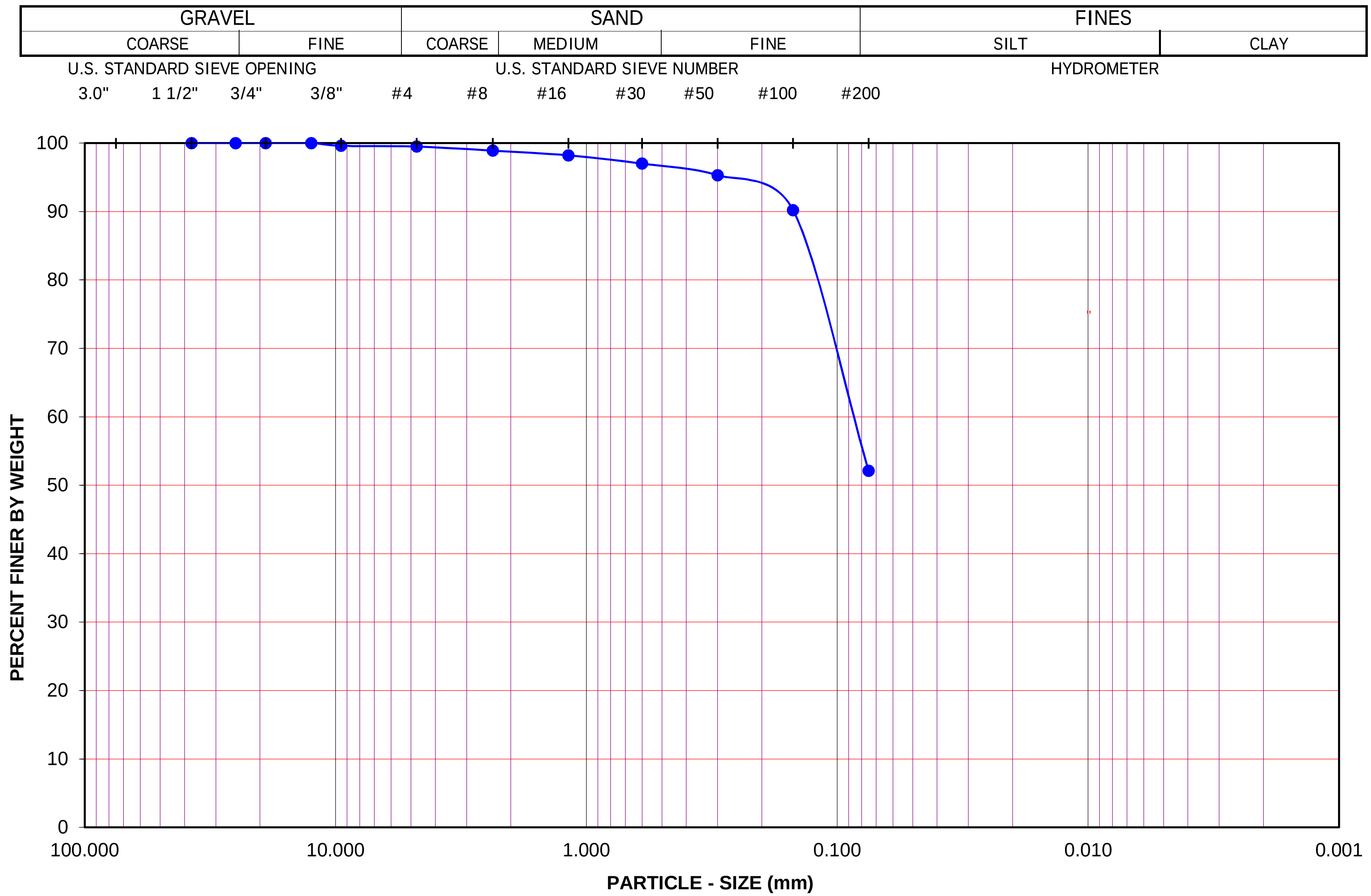
Exploration No.:	B-10	Sample No.:	B-1
Depth (feet):	10-12.0	Soil Type :	SM

Soil Identification: SILTY SAND WITH FEW GRAVEL (SM), olive brown.

GR:SA:FI : (%) 7 : 66 : 27

May-13

Split Sieve Landscape; B-10, B-1 (5-1-13)



Project Name: SHARP CHULA VISTA MEDICAL CENTER MASTER PLAN

Project No.: 603541-002

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PARTICLE - SIZE DISTRIBUTION
ASTM D 6913

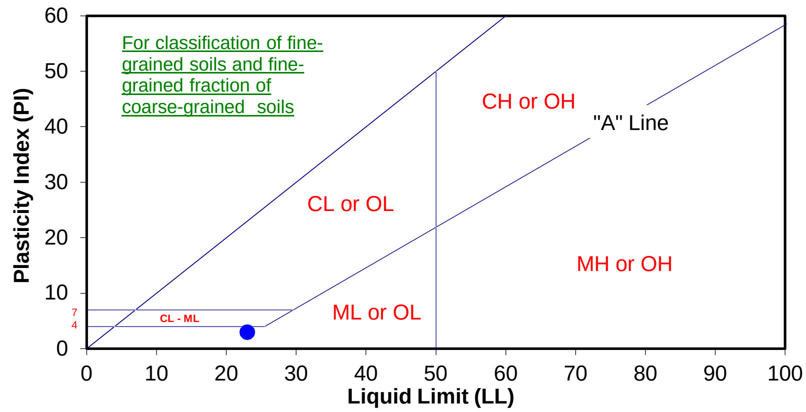
Exploration No.: B-12 Sample No.: B-1

Depth (feet): 5-10.0 Soil Type : s(ML)

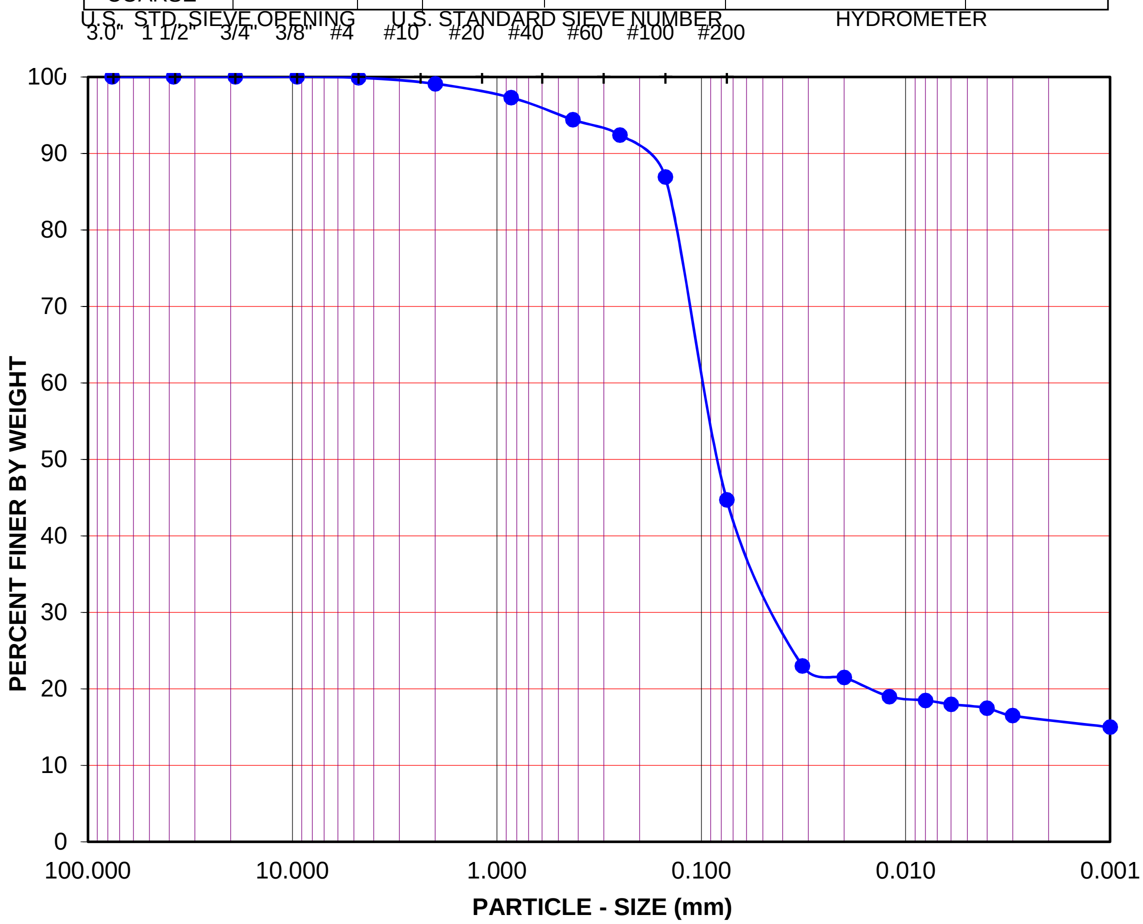
Soil Identification: SANDY SILT WITH TRACE GRAVEL s(ML), yellowish brown.

GR:SA:FI : (%) 1 : 47 : 52

May-13



GRAVEL		SAND			FINES	
COARSE	FINE	CRSE	MEDIUM	FINE	SILT	CLAY



Boring No.	Sample No.	Depth (ft.)	Soil Type	GR:SA:FI (%)	LL,PL,PI
B-14	**S-2**	20-21.5	SM	0:55:45	23,20,3

Sample Description:
SILTY SAND WITH TRACE GRAVEL (SM), brown.

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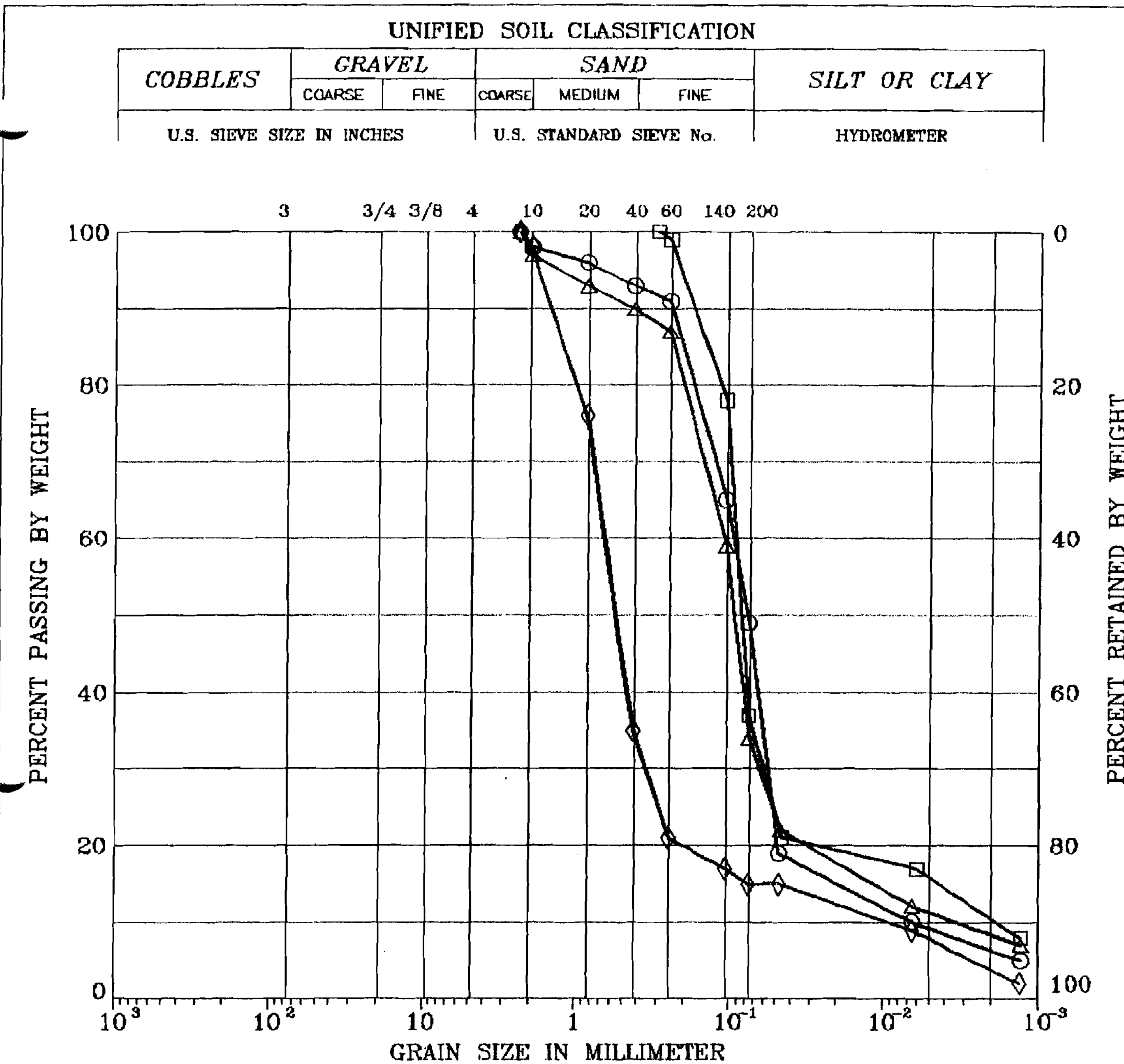
Project No.: 603541-002
SHARP CHULA VISTA MEDICAL CENTER MASTER PLAN

ATTERBERG LIMITS, PARTICLE - SIZE CURVE
ASTM D 4318, D 422

Rev. 08-04

Appendix C

Woodward-Clyde Laboratory Testing, 1989



SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
○	3-1				SILTY FINE SAND (SM)
□	4-6-4				SILTY FINE SAND (SM)
△	5-1				SILTY FINE SAND (SM)
◊	8-3-4				SILTY SAND (SM)

Remark :

?951127W SI01

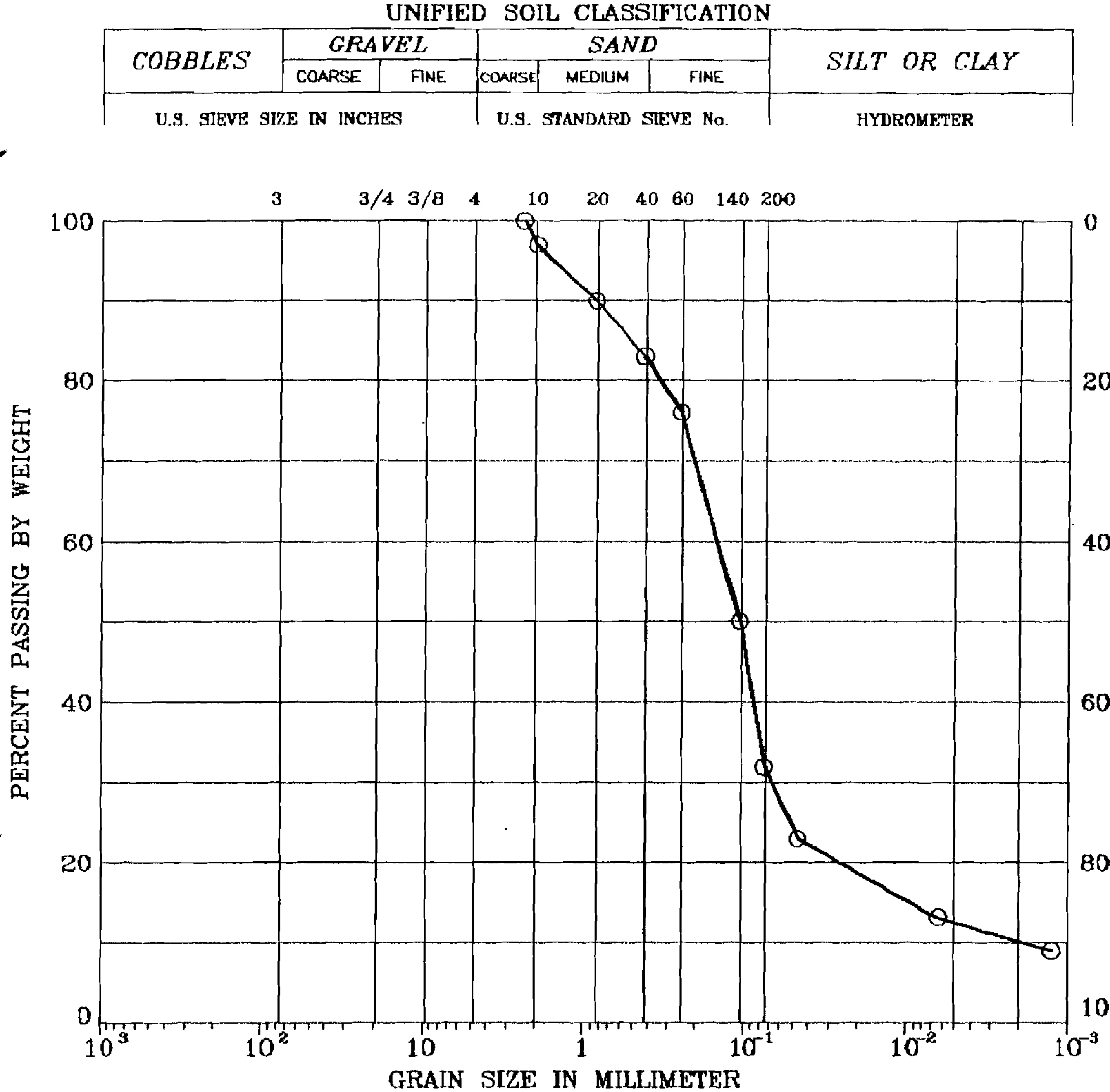
CHULA VISTA COMMUNITY HOSPITAL

Woodward Clyde Consultants
San Diego, CA

GRAIN SIZE DISTRIBUTION

Figure No. B-1

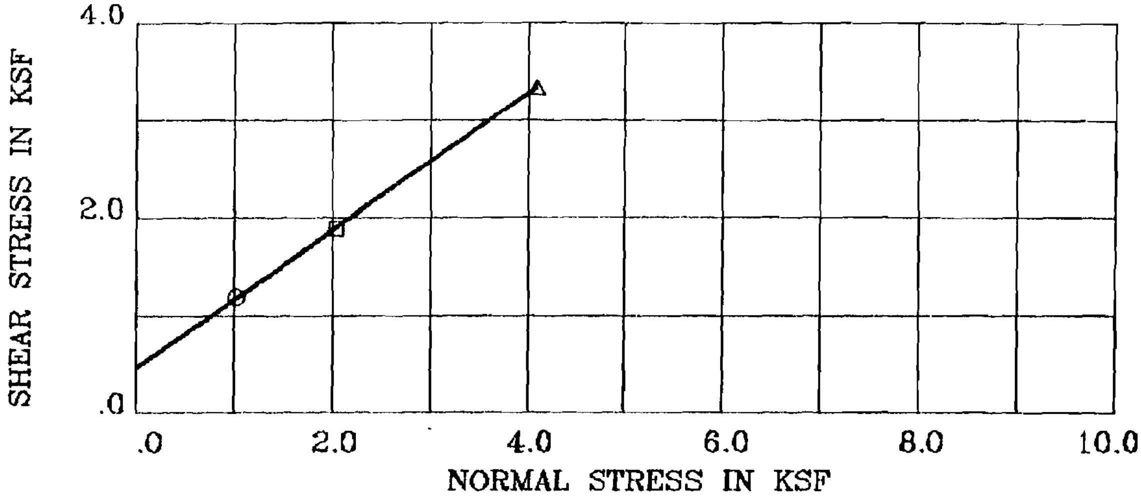
The data developed and conclusions and recommendations reached in this/these correspondence(s) was/were for a specific project. Additionally, we wish to advise you that since this/these correspondence(s) was/were issued, there have been substantial changes in the state of the art and state of practice of the profession, as well as in the degree of risk considered acceptable by society and the profession. Thus, the opinion, recommendations, and conclusions contained therein must be reevaluated. We recommend that you retain a qualified firm to do this before proceeding with any plans that might be influenced by the contents of this/these correspondence(s).

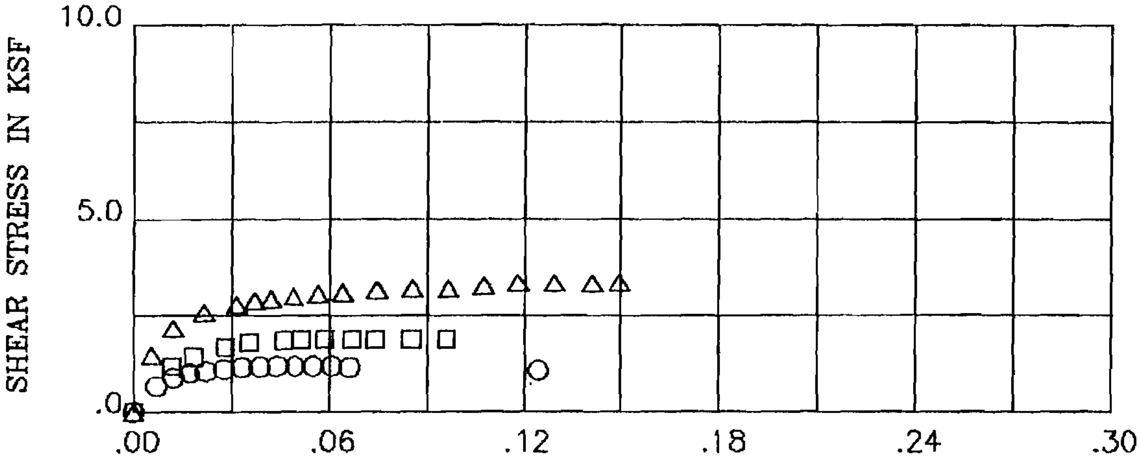


SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
O	9-1				SILTY FINE SAND (SM)

Remark :

8951127W SI01	CHULA VISTA COMMUNITY HOSPITAL
Woodward Clyde Consultants San Diego, CA	**GRAIN SIZE DISTRIBUTION** Figure No. B-2





BORING/SAMPLE : 4-6-4 DEPTH (ft) :

DESCRIPTION : SILTY FINE SAND (SM)

STRENGTH INTERCEPT (C) : .467 KSF

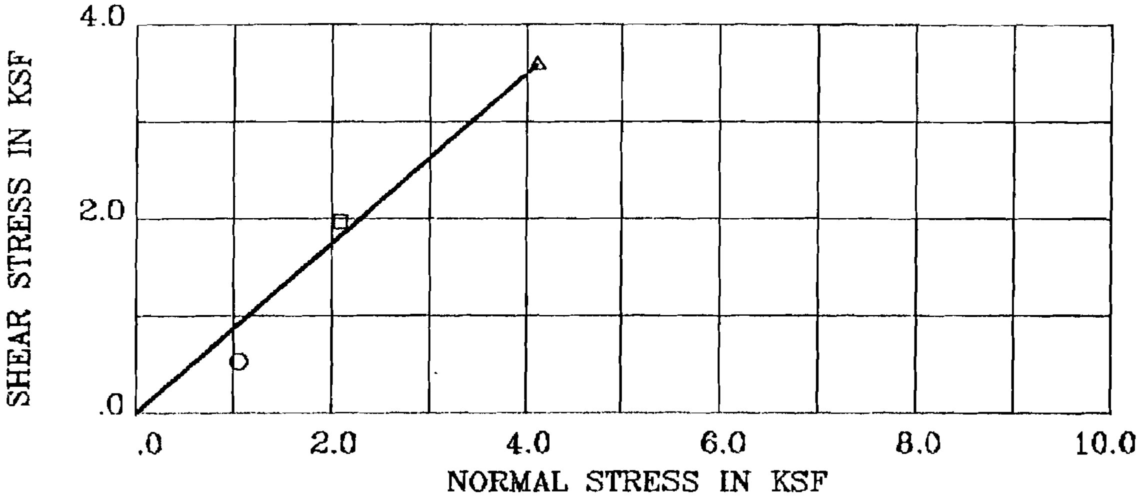
FRICTION ANGLE (PHI) : 35.0 DEG

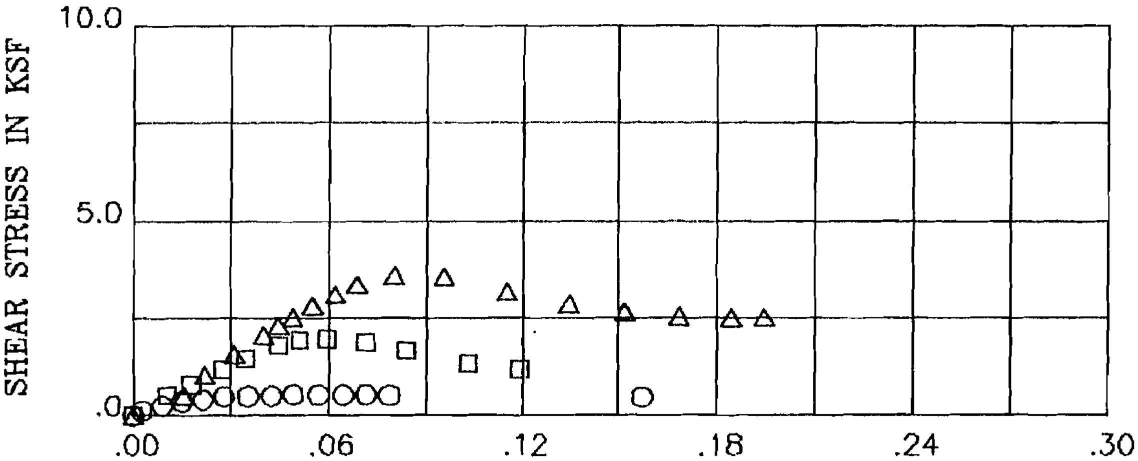
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
O	27.8	96.3	.724	1.02	1.19	1.07
□	25.6	98.4	.687	2.05	1.89	1.87
△	28.3	95.8	.732	4.10	3.34	3.32

Remark : AVERAGE;INITIAL MC : 18.6 %; INITIAL DD : 96.2 PCF

8951127W SI01	CHULA VISTA COMMUNITY HOSPITAL
Woodward Clyde Consultants San Diego, CA	**DIRECT SHEAR TEST** Figure No. B-3





BORING/SAMPLE : 8-3-4 DEPTH (ft) :

DESCRIPTION : SILTY SAND (SM)

STRENGTH INTERCEPT (C) : .000 KSF

FRICTION ANGLE (PHI) : 41.1 DEG

(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	17.0	114.4	.446	1.05	.53	.46
□	16.0	112.4	.471	2.09	1.97	1.19
△	16.3	113.0	.463	4.12	3.61	2.50

Remark : AVERAGE;INITIAL MC : 8.1%; INITIAL DD : 111.4PCF

3951127W SI01	CHULA VISTA COMMUNITY HOSPITAL
Woodward Clyde Consultants San Diego, CA	DIRECT SHEAR TEST Figure No. B-4

The data developed and conclusions and recommendations reached in this/these correspondence(s) was/were for a specific project. Additionally, we wish to advise you that since this/these correspondence(s) was/were issued, there have been substantial changes in the state of the art and state of practice of the profession, as well as in the degree of risk considered acceptable by society and the profession. Thus, the opinion, recommendations, and conclusions contained therein must be reevaluated. We recommend that you retain a qualified firm to do this before proceeding with any plans that might be influenced by the contents of this/these correspondence(s).

Testing Engineers—San Diego
3467 Kurtz Street, P.O. Box 80985, San Diego, CA 92138 (619) 225-9641
2956 Industry St., Oceanside, CA 92054 (619) 757-0248

Job No: 001285 00
Job Name: WOODWARD - CLYDE CONSUL.
Job Address: 1550 HOTEL CIRCLE NORTH
SAN DIEGO
CA 92108

WOODWARD - CLYDE CONSUL.
1550 HOTEL CIRCLE NORTH
SAN DIEGO
CA 92108

WOODWARD - CLYDE CONSUL.
Testing Engineers - San Diego

Project: WOODWARD - CLYDE CONSUL.
Engineer: RENDINI, DAVID

Report: 56243
Date: 4/11/89

R VALUE DATA

	A	B	C	D
Compactor Pressure - P.S.I.	350	350	350	
Moisture @ Compaction - Percent	13.4	13.8	14.2	
Density - Pounds/Cubic Foot	117.9	116.0	116.2	
R-Value - Stabilometer	70	59	52	
Exude. Pressure - P.S.I.	430	270	220	
Stabilometer Thickness - Feet	.43	.59	.69	
Expansion Pressure Thickness - Feet	0	0	0	
T. I. (Assumed)	4.5			
By Stabilometer @ 300 PSI, Exud.	61			
By Expansion Pressure	/			
At Equilibrium	61			
Sand Equivalent	/			

Material Supplied by: Client

Submitted to Laboratory On: 4/04/89

Described As: Medium brown fine silty sand
R-Value #254/Lab #89-420

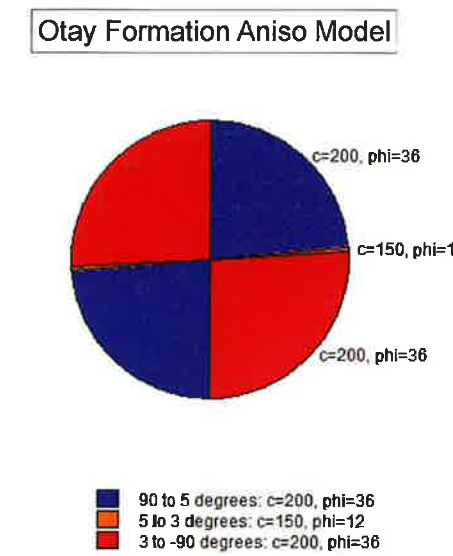
Sampled From: Sample #SAK/ 5-1 Depth 0.5
PROJECT: Chula vista Community Hospital 8955127W SI01

Figure E-5

Appendix D

Slope Stability Calculations

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Anisotropic Function	Water Surface
To	(green)	110	Anisotropic function			Otay Formation Aniso	None
Tsdss	(light blue)	100	Mohr-Coulomb	100	39		None
Afu	(orange)	120	Mohr-Coulomb	350	28		None



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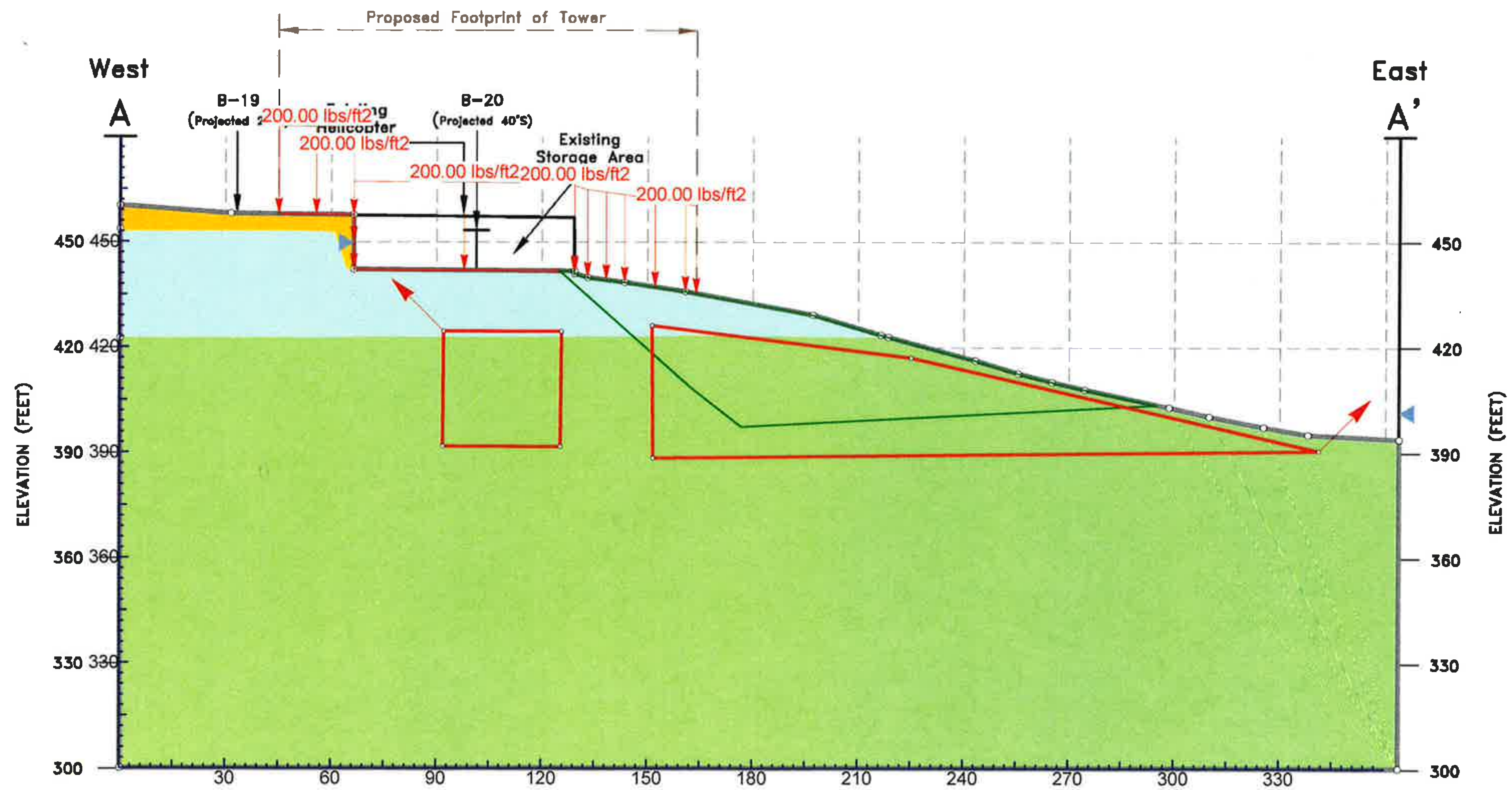
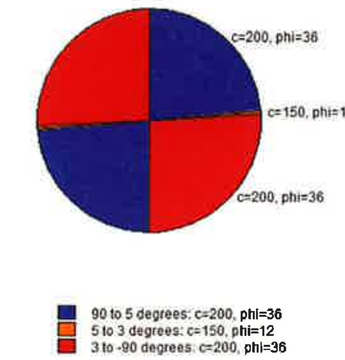


Leighton	Project	Sharp CV Medical Center Section A-A'	
	Analysis Description	Proj No. 603541-002	
	Drawn By: FJW	Scale: 1:500	Company: Leighton Consulting
	Date: 7/15/2013, 11:00:43 AM		File Name: A-A' Static.slim

SLIDEINTERPRET 6.023

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Anisotropic Function	Water Surface
To		110	Anisotropic function			Otay Formation Aniso	None
Tsdss		100	Mohr-Coulomb	100	39		None
Afu		120	Mohr-Coulomb	350	28		None

Otay Formation Aniso Model



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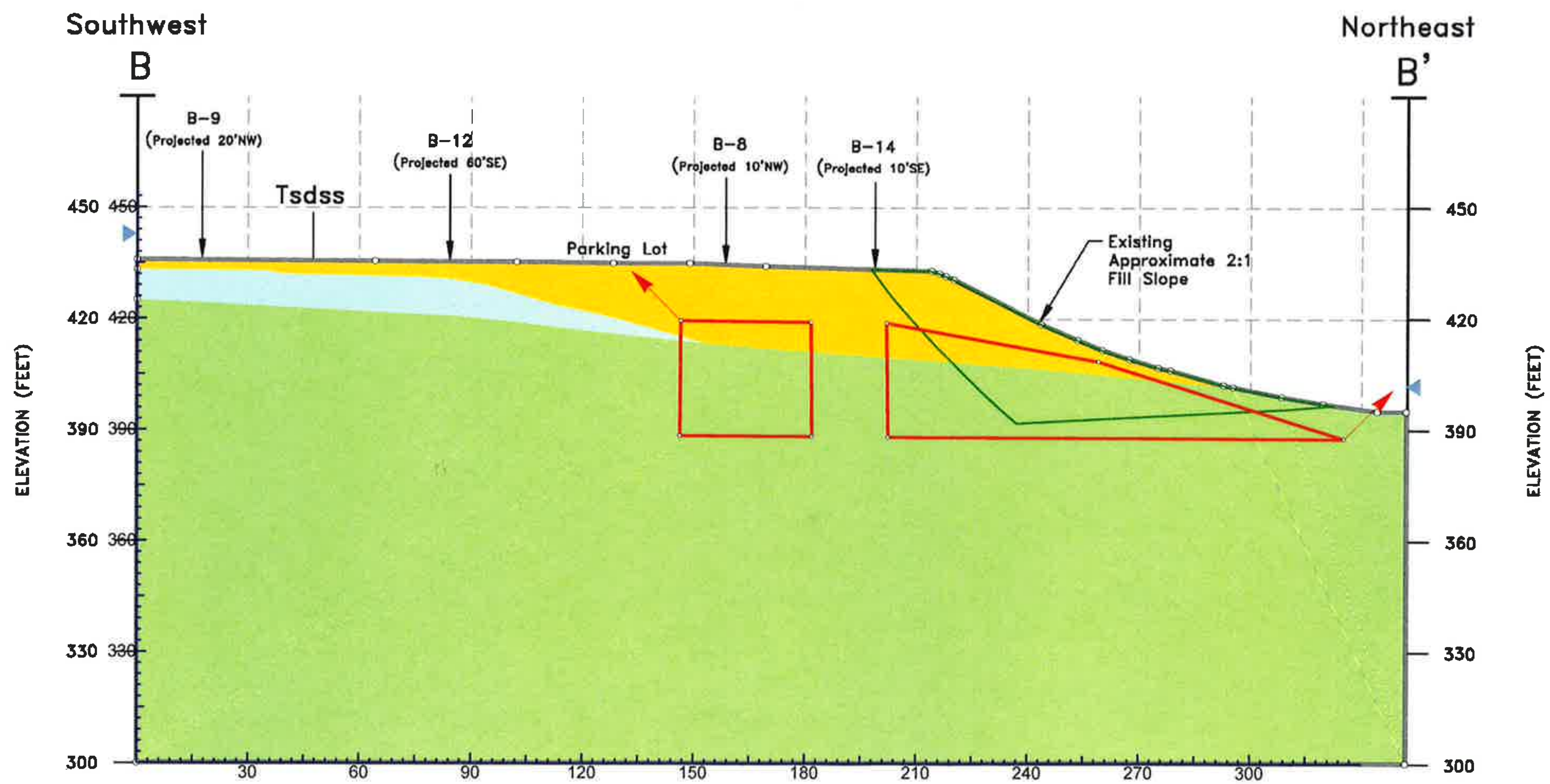


Leighton	Project: Sharp CV Medical Center Section B-B'		
	Analysis Description: Proj No. 603541-002		
	Drawn By: FJW	Scale: 1:500	Company: Leighton Consulting
SLIDEINTERPRET 6.023	Date: 7/15/2013, 2:00:37 PM		File Name: Section B-B' Static.slim

Simplified Procedure for Estimating Earthquake Induced Deviatoric Slope Displacements
by Jonathan D. Bray and Thaleia Travasarou
Journal of Geotechnical and Geonvironmental Engineering, ASCE, V. 133(4), pp. 381-392, April 2007

SEE NOTES BELOW FOR GUIDANCE IN THE USE OF SPREADSHEET

Input Parameters			
Yield Coefficient (ky)	0.262		Based on pseudostatic analysis
Initial Fundamental Period (Ts)	0.14	seconds	1D: Ts=4H/Vs 2D: Ts=2.6H/Vs
Degraded Period (1.5Ts)	0.21	seconds	
Moment Magnitude (M_w)	6.9		
Spectral Acceleration (Sa(1.5Ts))	0.752	g	

Additional Input Parameters		
Probability of Exceedance #1 (P1)	84	%
Probability of Exceedance #2 (P2)	50	%
Probability of Exceedance #3 (P3)	16	%
Displacement Threshold (d_threshold)	5	cm

Intermediate Calculated Parameters			
Non-Zero Seismic Displacement Est (D)	4.98	cm	eq. (5) or (6)
Standard Deviation of Non-Zero Seismic D	0.66		

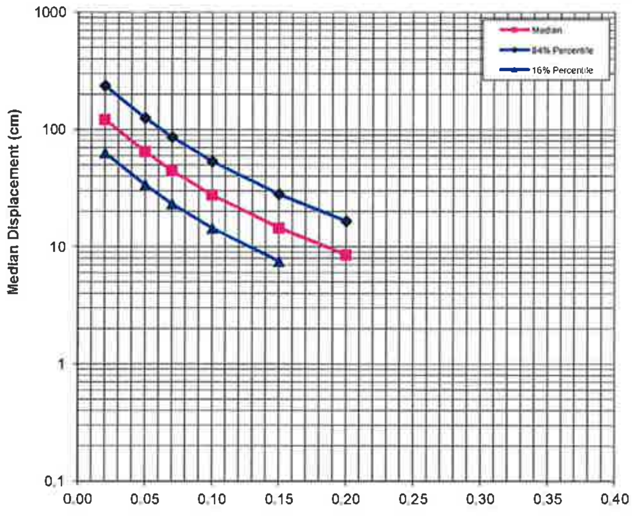
Results			
Probability of Negligible Displ. (P(D=0))	0.051		eq. (3)
D1	2.26	cm	calc. using eq. (7)
D2	4.77	cm	calc. using eq. (7)
D3	9.39	cm	calc. using eq. (7)
P(D>d_threshold)	0.473		eq. (7)

Notes

1. Values highlighted in blue are input parameters
2. Probability of Exceedance is the desired probability of exceeding a particular displacement value.
3. Displacements D1, D2, and D3 correspond to P1, P2, and P3, respectively
   (e.g., the probability of exceeding displacement D1 is P1)
4. Calculated seismic displacements are due to deviatoric deformation only (add in volumetrically induced movement).
5. ky may range between 0.01 and 0.5, Ts between 0 and 2 s, Sa between 0.002 and 2.7 g, M between 4.5 and 9
6. Rigid slope is assumed for Ts < 0.05 s
7. When a value for D is not calculated, D is < 1cm
8. ky may be estimated using the simplified equations shown below.
9. Examples of how Ts is estimated are shown below.
10. Vs = weighted avg. shear wave velocity for the sliding mass, e.g., for 2 layers, Vs = [(h1)(Vs1) + (h2)(Vs2)]/(h1 + h2)

Dependence on ky

ky	P(D="0")	D (cm)	Dmedian (cm)	D1 (cm)	D3 (cm)
0.020	0.00	121.9	121.9	234.9	63.2
0.05	0.00	64.7	64.7	124.7	33.6
0.07	0.00	44.6	44.6	85.9	23.1
0.1	0.00	27.6	27.6	53.3	14.3
0.15	0.00	14.5	14.5	27.9	7.5
0.2	0.01	8.6	8.5	16.5	4.4
0.3	0.12	3.7	3.3	6.8	1.3
0.4	0.40	1.9	1.0	2.9	<1



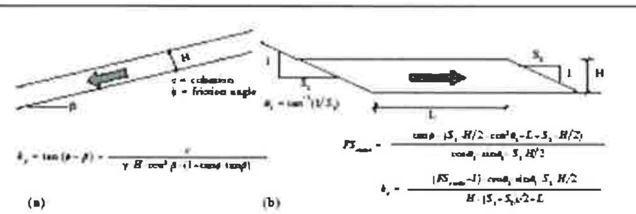


Fig. 14.1. Simplified estimates of the yield coefficient: (a) shallow sliding and (b) deep sliding

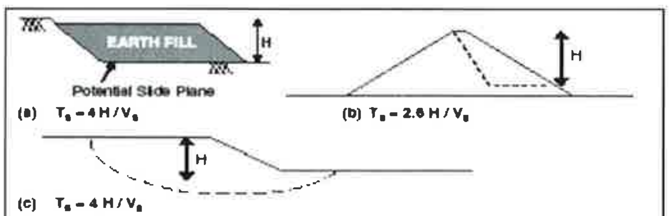
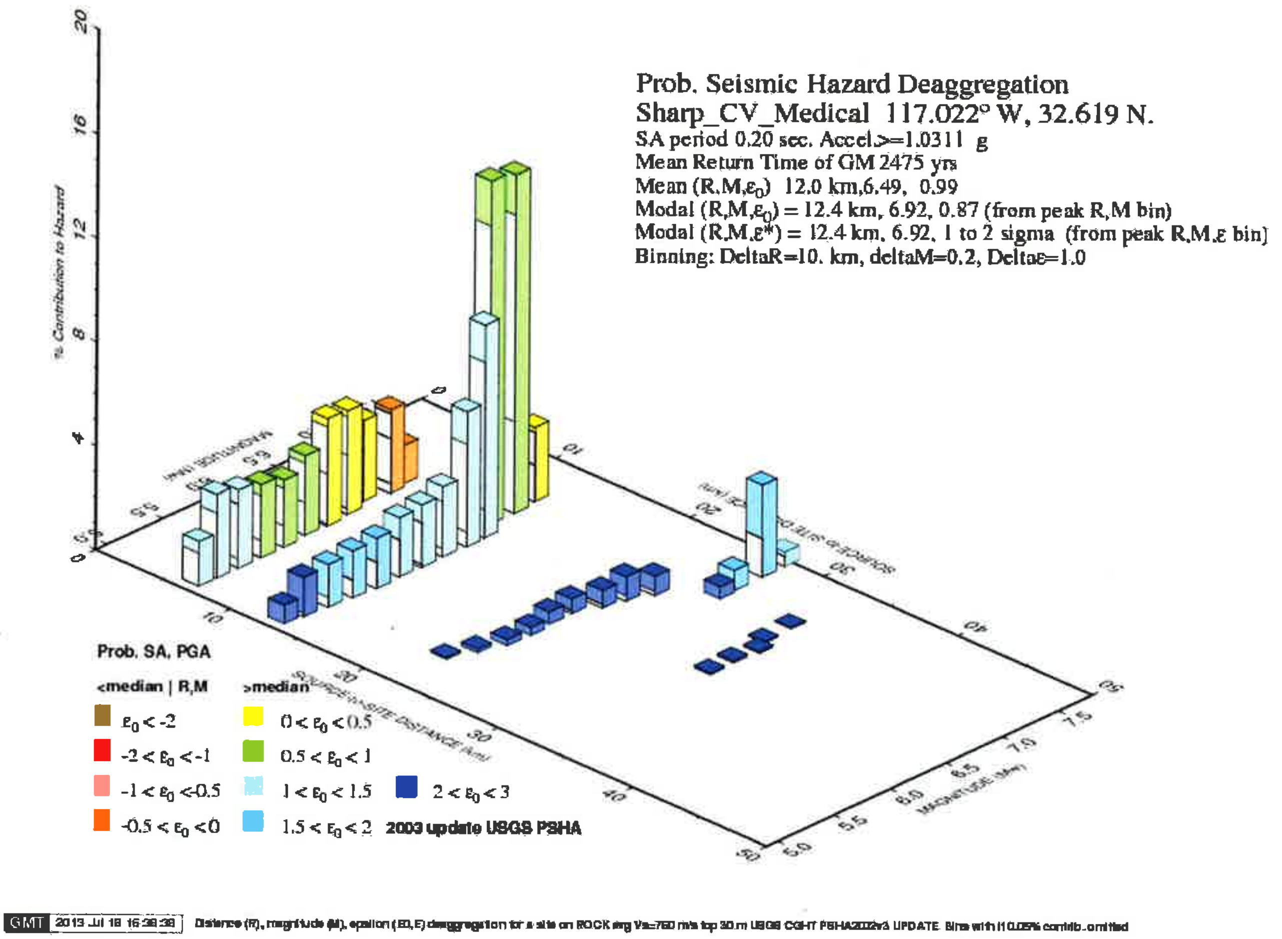


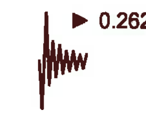
Fig. 14.4. Estimating the initial fundamental period of potential sliding blocks

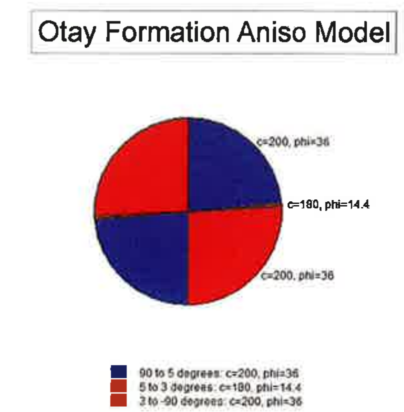
Figures from Bray, J.D. (2007) "Chapter 14: Simplified Seismic Slope Displacement Procedures," Earthquake Geotechnical Engineering, 4th Inter. Conf. on Earthquake Geotechnical Engineering - Invited Lectures, in Geotechnical, Geological, and Earthquake Engineering Series, Vol. 6, Pitilakis, Kyriazis D., Ed., Springer, Vol. 6, pp. 327-353.

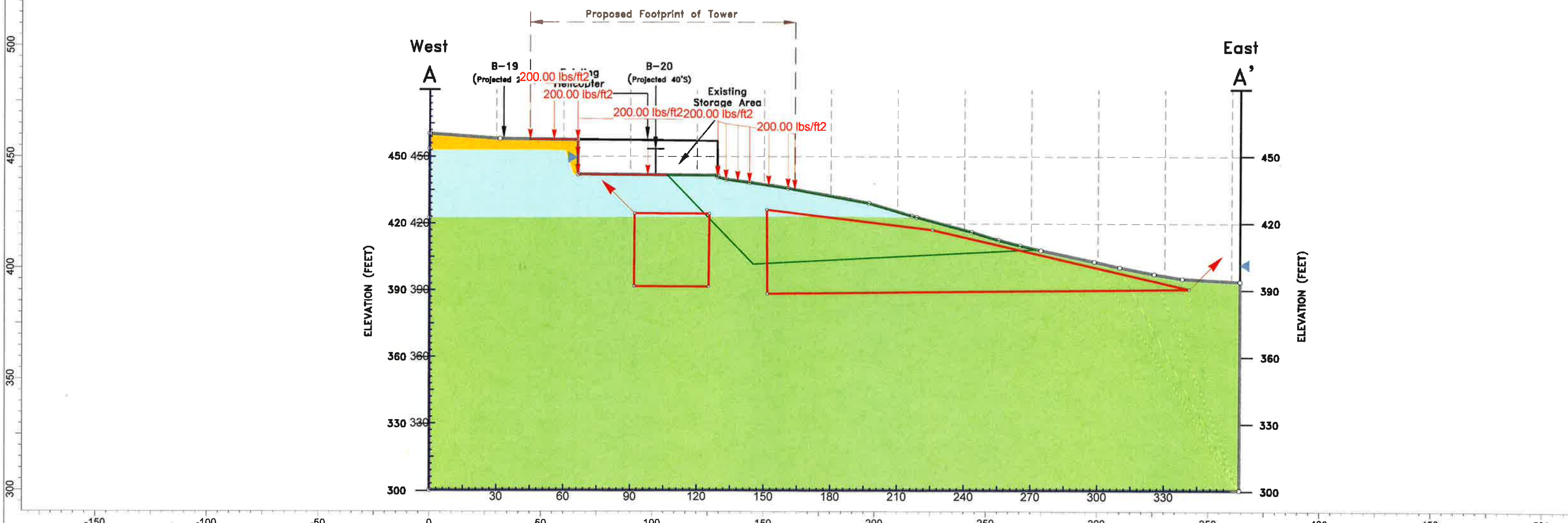
Simplified Procedure for Estimating Earthquake Induced Deviatoric Slope Displacements
by Jonathan D. Bray and Thaleia Travasarou
Journal of Geotechnical and Geonvironmental Engineering, Vol 133, No. 4, pp. 381-392, April 2007


Prob. Seismic Hazard Deaggregation
Sharp_CV_Medical 117.022° W, 32.619 N.
SA period 0.20 sec. Accel.>=1.0311 g
Mean Return Time of GM 2475 yrs
Mean (R,M,ε0) 12.0 km,6.49, 0.99
Modal (R,M,ε0) = 12.4 km, 6.92, 0.87 (from peak R,M bin)
Modal (R,M,ε*) = 12.4 km, 6.92, 1 to 2 sigma (from peak R,M,ε bin)
Binning: DeltaR=10. km, deltaM=0.2, Deltaε=1.0
% Contribution to Hazard
SOURCE-TO-SITE DISTANCE (km)
MAGNITUDE (Mw)
Prob. SA, PGA
<median | R,M
>median
ε0 < -2
-2 < ε0 < -1
-1 < ε0 <-0.5
-0.5 < ε0 < 0
0 < ε0 < 0.5
0.5 < ε0 < 1
1 < ε0 < 1.5
1.5 < ε0 < 2
2 < ε0 < 3
2003 update USGS PSHA
GMT 2013 Jul 18 16:38:38
Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on ROCK avg Vs=760 m/s top 30 m USGS CGHT PSHA2002v3 UPDATE. Bins with lt 0.05% contrib. omitted

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Anisotropic Function	Water Surface
To		110	Anisotropic function			Otay Formation Aniso	None
Tsdss		100	Mohr-Coulomb	100	39		None
Afu		120	Mohr-Coulomb	350	28		None



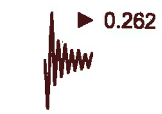




Leighton

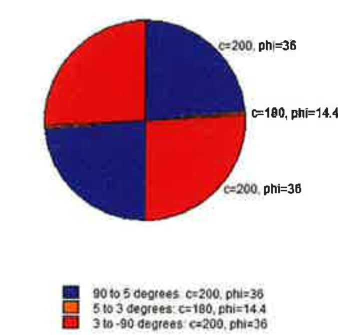
SLIDEINTERPRET 6.023

Project	Sharp CV Medical Center Section A-A'
Analysis Description	Proj No. 603541-002
Drawn By	FJW
Scale	1:500
Company	Leighton Consulting
Date	7/15/2013, 11:00:43 AM
File Name	A-A' Seismic a.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Anisotropic Function	Water Surface	Ru
To		110	Anisotropic function			Otay Formation Aniso	None	0
Tsdss		100	Mohr-Coulomb	100	39		None	0
Afu		120	Mohr-Coulomb	350	28		None	0

Otay Formation Aniso Model



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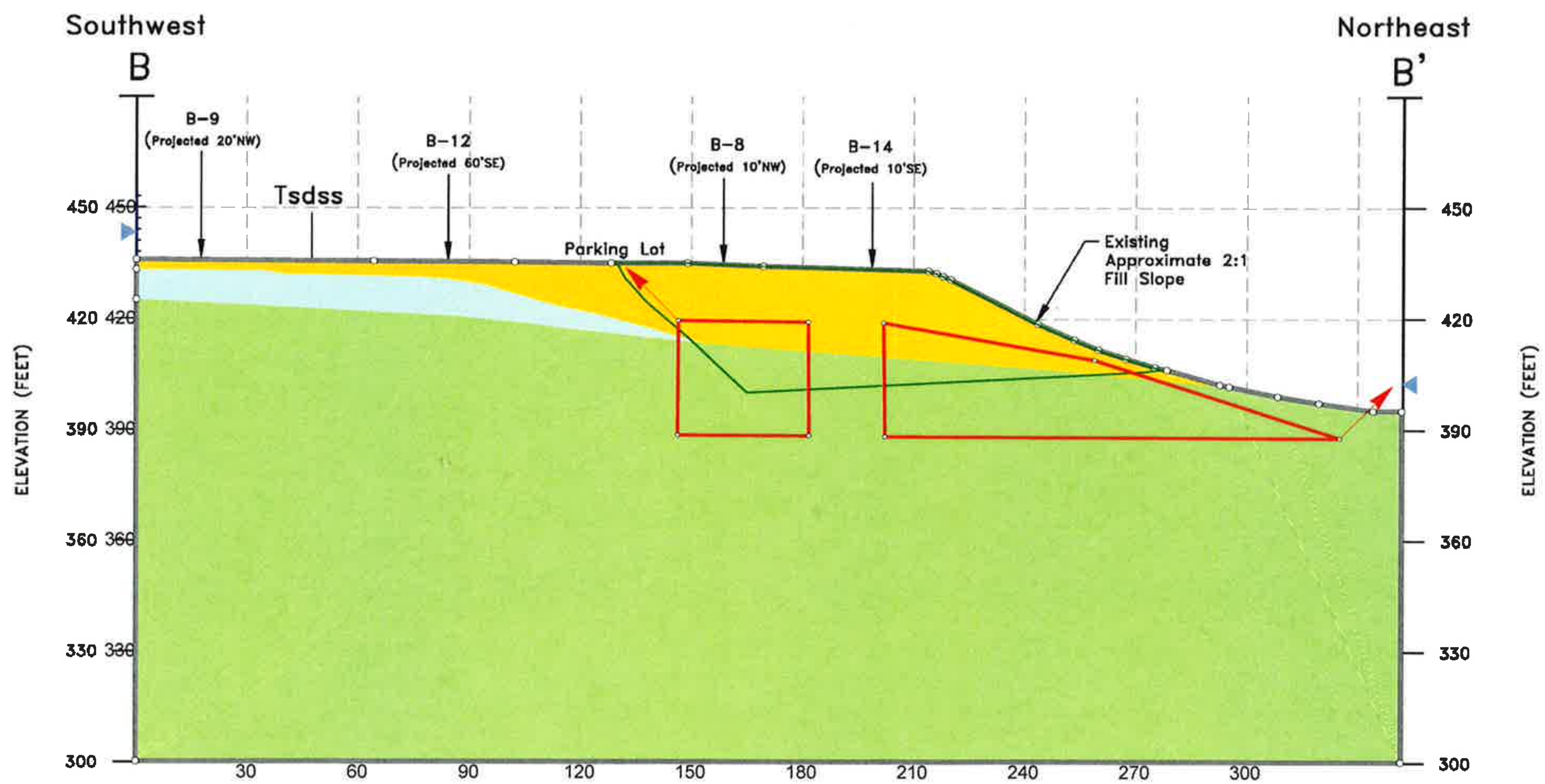

Project	Sharp CV Medical Center Section B-B'		
Analysis Description	Proj No. 603541-002		
Drawn By	FJW	Scale	1:500
Company	Leighton Consulting		
Date	7/15/2013, 2:00:37 PM	File Name	Section B-B' Seismic.slim

Leighton

SLIDEINTERPRET 6.023

Appendix E

Seismic Hazard Analysis

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***********************
*                     *
*    E Q F A U L T    *
*                     *
*    Version 3.00     *
*                     *
***********************
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DETERMINISTIC ESTIMATION OF
PEAK ACCELERATION FROM DIGITIZED FAULTS

JOB NUMBER: 603541-002

DATE: 07-12-2013

JOB NAME: Sharp Chula Vista Master Plan

CALCULATION NAME: Test Run Analysis

FAULT-DATA-FILE NAME: C:\Program Files\EQFAULT1\CGSFLTE.DAT

SITE COORDINATES:
SITE LATITUDE: 32.6191
SITE LONGITUDE: 117.0228

SEARCH RADIUS: 100 mi

ATTENUATION RELATION: 3) Boore et al. (1997) Horiz. - NEHRP D (250)
UNCERTAINTY (M=Median, S=Sigma): M Number of Sigmas: 0.0
DISTANCE MEASURE: cd_2drp
SCOND: 0
Basement Depth: 5.00 km Campbell SSR: Campbell SHR:
COMPUTE PEAK HORIZONTAL ACCELERATION

FAULT-DATA FILE USED: C:\Program Files\EQFAULT1\CGSFLTE.DAT

MINIMUM DEPTH VALUE (km): 0.0

EQFAULT SUMMARY

DETERMINISTIC SITE PARAMETERS

Page 1

ABBREVIATED FAULT NAME	APPROXIMATE DISTANCE mi (km)	ESTIMATED MAX. EARTHQUAKE EVENT: MAXIMUM EARTHQUAKE MAG.(Mw)	PEAK SITE ACCEL. g	EST. SITE INTENSITY MOD.MERC.
ROSE CANYON	7.5(12.1)	7.2	0.347	IX
CORONADO BANK	16.8(27.0)	7.6	0.244	IX
ELSINORE (JULIAN)	42.2(67.9)	7.1	0.093	VII
NEWPORT-INGLEWOOD (Offshore)	44.0(70.8)	7.1	0.090	VII
ELSINORE (COYOTE MOUNTAIN)	45.3(72.9)	6.8	0.075	VII
EARTHQUAKE VALLEY	45.7(73.6)	6.5	0.063	VI
ELSINORE (TEMECULA)	52.4(84.3)	6.8	0.067	VI
SAN JACINTO-COYOTE CREEK	62.4(100.4)	6.6	0.053	VI
SAN JACINTO - BORREGO	62.8(101.0)	6.6	0.052	VI
SAN JACINTO-ANZA	65.3(105.1)	7.2	0.070	VI
LAGUNA SALADA	66.8(107.5)	7.0	0.062	VI
SUPERSTITION MTN. (San Jacinto)	69.1(111.2)	6.6	0.049	VI
PALOS VERDES	70.3(113.2)	7.3	0.069	VI
ELSINORE (GLEN IVY)	73.3(117.9)	6.8	0.052	VI
ELMORE RANCH	73.7(118.6)	6.6	0.046	VI
SUPERSTITION HILLS (San Jacinto)	74.1(119.3)	6.6	0.046	VI
SAN JOAQUIN HILLS	75.4(121.3)	6.6	0.055	VI
SAN JACINTO-SAN JACINTO VALLEY	77.7(125.0)	6.9	0.052	VI
NEWPORT-INGLEWOOD (L.A.Basin)	86.1(138.5)	7.1	0.053	VI
IMPERIAL	87.1(140.2)	7.0	0.050	VI
CHINO-CENTRAL AVE. (Elsinore)	88.3(142.1)	6.7	0.051	VI
SAN ANDREAS - SB-Coach. M-1b-2	89.4(143.9)	7.7	0.071	VI
SAN ANDREAS - Whole M-1a	89.4(143.9)	8.0	0.083	VII
SAN ANDREAS - Coachella M-1c-5	89.4(143.9)	7.2	0.055	VI
SAN ANDREAS - SB-Coach. M-2b	89.4(143.9)	7.7	0.071	VI
BRAWLEY SEISMIC ZONE	90.3(145.3)	6.4	0.036	V
WHITTIER	92.5(148.9)	6.8	0.043	VI
SAN ANDREAS - San Bernardino M-1	95.2(153.2)	7.5	0.061	VI
SAN JACINTO-SAN BERNARDINO	97.4(156.7)	6.7	0.039	V
BURNT MTN.	98.1(157.8)	6.5	0.035	V

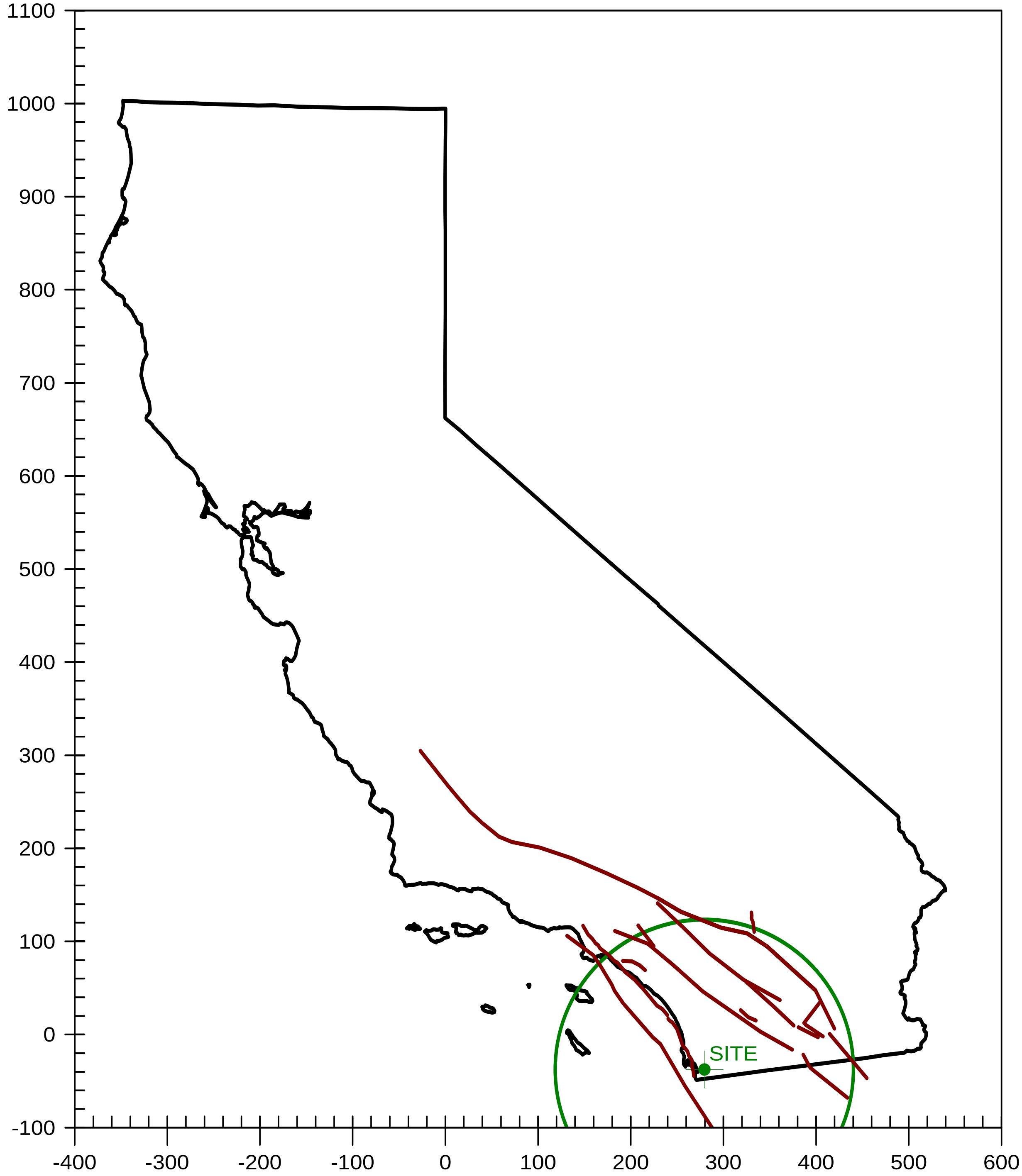
-END OF SEARCH- 30 FAULTS FOUND WITHIN THE SPECIFIED SEARCH RADIUS.

THE ROSE CANYON FAULT IS CLOSEST TO THE SITE.
IT IS ABOUT 7.5 MILES (12.1 km) AWAY.

LARGEST MAXIMUM-EARTHQUAKE SITE ACCELERATION: 0.3475 g

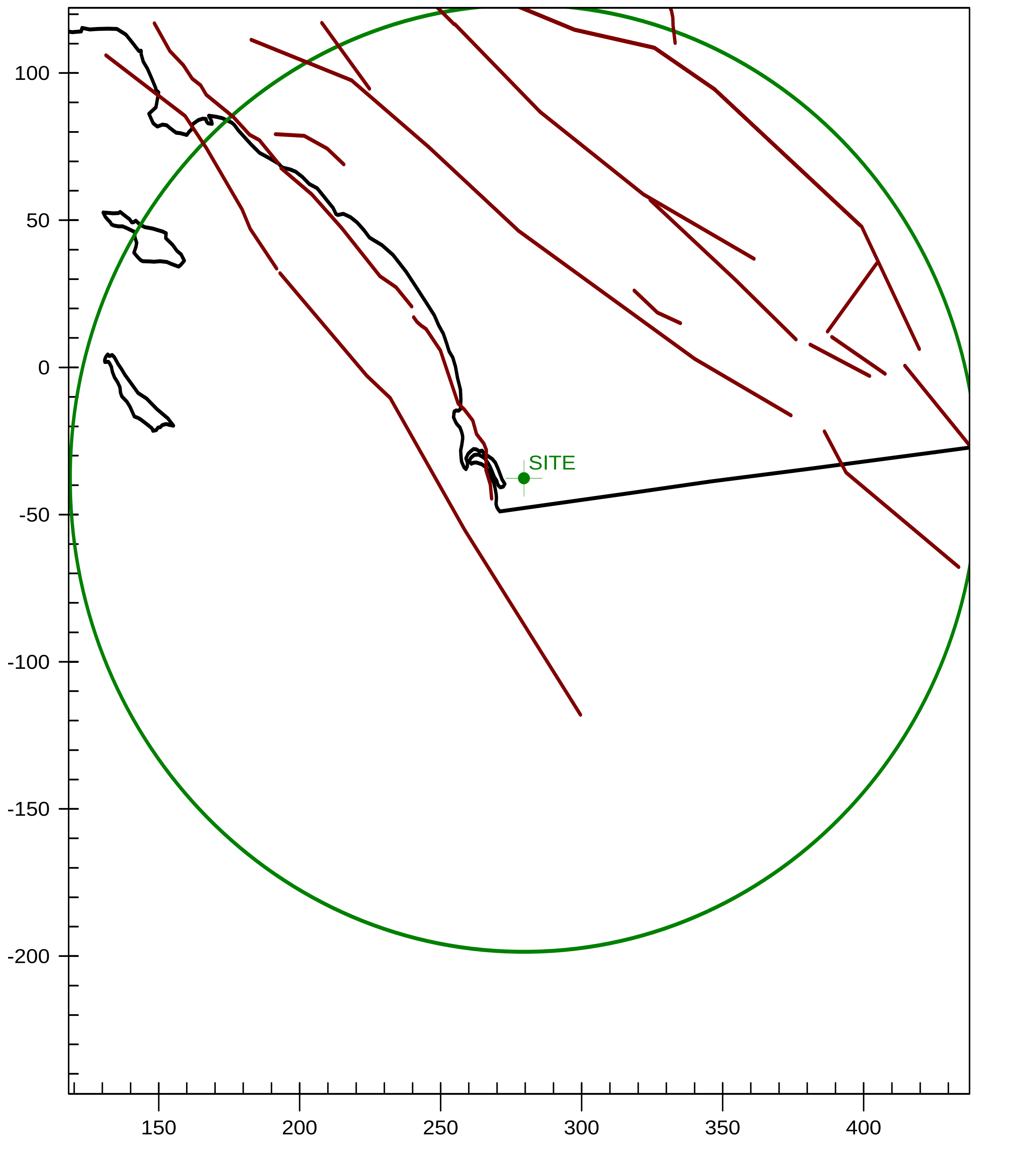
CALIFORNIA FAULT MAP

Sharp Chula Vista Master Plan



CALIFORNIA FAULT MAP

Sharp Chula Vista Master Plan



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*                       *
*     E Q S E A R C H   *
*                       *
*      Version 3.00     *
*                       *
*************************
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ESTIMATION OF
PEAK ACCELERATION FROM
CALIFORNIA EARTHQUAKE CATALOGS

JOB NUMBER: 603541-002

DATE: 07-15-2013

JOB NAME: Sharp Chula Vista Master Plan

EARTHQUAKE-CATALOG-FILE NAME: ALLQUAKE.DAT

MAGNITUDE RANGE:
   MINIMUM MAGNITUDE: 5.00
   MAXIMUM MAGNITUDE: 9.00

SITE COORDINATES:
   SITE LATITUDE: 32.6191
   SITE LONGITUDE: 117.0228

SEARCH DATES:
   START DATE: 1800
   END DATE: 2013

SEARCH RADIUS:
   100.0 mi
   160.9 km

ATTENUATION RELATION: 3) Boore et al. (1997) Horiz. - NEHRP D (250)
   UNCERTAINTY (M=Median, S=Sigma): M   Number of Sigmas: 0.0
   ASSUMED SOURCE TYPE: DS [SS=Strike-slip, DS=Reverse-slip, BT=Blind-thrust]
   SCOND: 0 Depth Source: A
   Basement Depth: 5.00 km   Campbell SSR: Campbell SHR:
   COMPUTE PEAK HORIZONTAL ACCELERATION

MINIMUM DEPTH VALUE (km): 0.0

EARTHQUAKE SEARCH RESULTS

FILE CODE	LAT. NORTH	LONG. WEST	DATE	TIME (UTC) H M Sec	DEPTH (km)	QUAKE MAG.	SITE ACC. g	SITE MM INT.	APPROX. DISTANCE mi [km]
T-A	32.6700	117.1700	10/21/1862	0 0 0.0	0.0	5.00	0.116	VII	9.2(14.9)
T-A	32.6700	117.1700	12/00/1856	0 0 0.0	0.0	5.00	0.116	VII	9.2(14.9)
T-A	32.6700	117.1700	05/24/1865	0 0 0.0	0.0	5.00	0.116	VII	9.2(14.9)
DMG	32.7000	117.2000	05/27/1862	20 0 0.0	0.0	5.90	0.157	VIII	11.7(18.8)
MGI	32.8000	117.1000	05/25/1803	0 0 0.0	0.0	5.00	0.090	VII	13.3(21.3)
DMG	32.8000	116.8000	10/23/1894	23 3 0.0	0.0	5.70	0.103	VII	18.0(28.9)
MGI	33.0000	117.0000	09/21/1856	730 0.0	0.0	5.00	0.054	VI	26.3(42.4)
DMG	33.0000	117.3000	11/22/1800	2130 0.0	0.0	6.50	0.105	VII	30.8(49.6)
T-A	32.2500	117.5000	01/13/1877	20 0 0.0	0.0	5.00	0.041	V	37.7(60.7)
DMG	32.2000	116.5500	11/05/1949	43524.0	0.0	5.10	0.041	V	40.0(64.3)
DMG	32.2000	116.5500	11/04/1949	204238.0	0.0	5.70	0.056	VI	40.0(64.3)
DMG	32.7000	116.3000	02/24/1892	720 0.0	0.0	6.70	0.091	VII	42.4(68.2)
DMG	32.0830	116.6670	11/25/1934	818 0.0	0.0	5.00	0.037	V	42.4(68.3)
DMG	33.0000	116.4330	06/04/1940	1035 8.3	0.0	5.10	0.039	V	43.2(69.5)
DMG	33.2000	116.7000	01/01/1920	235 0.0	0.0	5.00	0.036	V	44.3(71.2)
MGI	33.2000	116.6000	10/12/1920	1748 0.0	0.0	5.30	0.040	V	47.0(75.6)
DMG	32.0000	117.5000	06/24/1939	1627 0.0	0.0	5.00	0.032	V	51.0(82.1)
DMG	32.0000	117.5000	05/01/1939	2353 0.0	0.0	5.00	0.032	V	51.0(82.1)
PAS	32.9710	117.8700	07/13/1986	1347 8.2	6.0	5.30	0.036	V	54.8(88.3)
GSP	32.3290	117.9170	06/15/2004	222848.2	10.0	5.30	0.035	V	55.8(89.8)
DMG	31.8110	117.1310	12/22/1964	205433.2	2.3	5.60	0.041	V	56.1(90.4)
DMG	31.8670	116.5710	02/27/1937	12918.4	10.0	5.00	0.029	V	58.2(93.7)
DMG	33.2000	116.2000	05/28/1892	1115 0.0	0.0	6.30	0.055	VI	62.3(100.3)
GSG	33.4200	116.4890	07/07/2010	235333.5	14.0	5.50	0.035	V	63.3(101.9)
DMG	33.3430	116.3460	04/28/1969	232042.9	20.0	5.80	0.041	V	63.5(102.2)
DMG	32.9670	116.0000	10/22/1942	181326.0	0.0	5.00	0.027	V	64.0(103.1)
DMG	32.9670	116.0000	10/21/1942	162654.0	0.0	5.00	0.027	V	64.0(103.1)
DMG	32.9670	116.0000	10/21/1942	162519.0	0.0	5.00	0.027	V	64.0(103.1)
DMG	32.9670	116.0000	10/21/1942	162213.0	0.0	6.50	0.059	VI	64.0(103.1)
GSG	32.7000	115.9210	06/15/2010	042658.5	5.0	5.80	0.041	V	64.3(103.5)
DMG	33.1900	116.1290	04/09/1968	22859.1	11.1	6.40	0.056	VI	65.1(104.8)
DMG	32.9830	115.9830	05/23/1942	154729.0	0.0	5.00	0.027	V	65.4(105.2)
DMG	33.2170	116.1330	08/15/1945	175624.0	0.0	5.70	0.038	V	66.1(106.3)
DMG	33.1130	116.0370	04/09/1968	3 353.5	5.0	5.20	0.029	V	66.6(107.1)
DMG	33.2830	116.1830	03/19/1954	95429.0	0.0	6.20	0.049	VI	66.8(107.6)
DMG	33.2830	116.1830	03/23/1954	41450.0	0.0	5.10	0.027	V	66.8(107.6)
DMG	33.2830	116.1830	03/19/1954	102117.0	0.0	5.50	0.034	V	66.8(107.6)
DMG	33.2830	116.1830	03/19/1954	95556.0	0.0	5.00	0.026	V	66.8(107.6)
DMG	31.7500	116.5000	04/29/1935	20 8 0.0	0.0	5.00	0.026	V	67.3(108.4)
PAS	33.5010	116.5130	02/25/1980	104738.5	13.6	5.50	0.034	V	67.7(108.9)
DMG	33.5000	116.5000	09/30/1916	211 0.0	0.0	5.00	0.026	V	67.9(109.3)
GSP	33.5290	116.5720	06/12/2005	154146.5	14.0	5.20	0.029	V	68.0(109.5)
GSP	33.5080	116.5140	10/31/2001	075616.6	15.0	5.10	0.027	V	68.1(109.5)
DMG	33.4000	116.3000	02/09/1890	12 6 0.0	0.0	6.30	0.051	VI	68.2(109.8)
GSP	32.6520	115.8350	05/19/2010	003900.0	7.0	5.10	0.027	V	69.1(111.2)
DMG	33.4080	116.2610	03/25/1937	1649 1.8	10.0	6.00	0.043	VI	70.1(112.8)
GSG	32.6750	115.8060	05/08/2010	183311.0	6.0	5.00	0.025	V	70.8(114.0)
GSP	32.6400	115.8010	04/05/2010	133305.4	0.0	5.10	0.026	V	71.1(114.3)
DMG	31.7960	116.2690	06/11/1963	152338.3	-2.0	5.80	0.038	V	71.9(115.7)
GSP	32.6340	115.7820	04/05/2010	031525.2	3.0	5.00	0.025	V	72.2(116.1)
DMG	33.2310	116.0040	05/26/1957	155933.6	15.1	5.00	0.024	V	72.6(116.8)
GSG	32.6160	115.7730	05/22/2010	173058.8	3.0	5.10	0.026	V	72.7(117.0)
PAS	33.0130	115.8390	11/24/1987	131556.5	2.4	6.00	0.041	V	73.9(118.9)

EARTHQUAKE SEARCH RESULTS

FILE CODE	LAT. NORTH	LONG. WEST	DATE	TIME (UTC) H M Sec	DEPTH (km)	QUAKE MAG.	SITE ACC. g	SITE MM INT.	APPROX. DISTANCE mi [km]
DMG	33.0000	115.8330	01/08/1946	185418.0	0.0	5.40	0.030	V	73.9(118.9)
DMG	33.0330	115.8210	09/30/1971	224611.3	8.0	5.10	0.025	V	75.4(121.3)
DMG	33.7100	116.9250	09/23/1963	144152.6	16.5	5.00	0.024	IV	75.5(121.5)
GSG	31.8060	116.1280	03/23/1994	025916.2	22.0	5.00	0.023	IV	76.7(123.4)
DMG	33.7000	117.4000	05/13/1910	620 0.0	0.0	5.00	0.023	IV	77.7(125.1)
DMG	33.7000	117.4000	04/11/1910	757 0.0	0.0	5.00	0.023	IV	77.7(125.1)
DMG	33.7000	117.4000	05/15/1910	1547 0.0	0.0	6.00	0.039	V	77.7(125.1)
DMG	33.7500	117.0000	06/06/1918	2232 0.0	0.0	5.00	0.023	IV	78.1(125.7)
DMG	33.7500	117.0000	04/21/1918	223225.0	0.0	6.80	0.060	VI	78.1(125.7)
DMG	31.8000	116.1000	10/10/1953	1849 6.0	0.0	5.00	0.023	IV	78.1(125.7)
DMG	32.8170	118.3500	12/26/1951	04654.0	0.0	5.90	0.037	V	78.3(126.0)
DMG	33.1830	115.8500	04/25/1957	222412.0	0.0	5.10	0.024	V	78.3(126.1)
DMG	32.2500	115.7500	12/01/1958	6 2 0.0	0.0	5.50	0.030	V	78.4(126.2)
DMG	32.2500	115.7500	12/01/1958	350 0.0	0.0	5.00	0.023	IV	78.4(126.2)
DMG	32.2500	115.7500	12/01/1958	32118.0	0.0	5.80	0.035	V	78.4(126.2)
DMG	32.9830	115.7330	01/24/1951	717 2.6	0.0	5.60	0.031	V	79.0(127.1)
PAS	33.0820	115.7750	11/24/1987	15414.5	4.9	5.80	0.035	V	79.1(127.3)
DMG	32.9500	115.7170	06/14/1953	41729.9	0.0	5.50	0.030	V	79.2(127.4)
DMG	32.9000	115.7000	10/02/1928	19 1 0.0	0.0	5.00	0.023	IV	79.2(127.5)
DMG	33.6990	117.5110	05/31/1938	83455.4	10.0	5.50	0.030	V	79.7(128.3)
DMG	31.8330	116.0000	05/10/1956	114854.0	0.0	5.00	0.023	IV	80.7(129.9)
DMG	33.8000	117.0000	12/25/1899	1225 0.0	0.0	6.40	0.047	VI	81.5(131.2)
DMG	33.2160	115.8080	04/25/1957	215738.7	-0.3	5.20	0.025	V	81.6(131.3)
DMG	31.5000	116.5000	10/17/1954	225718.0	0.0	5.70	0.032	V	83.1(133.7)
DMG	31.6250	116.2110	06/10/1969	34132.7	-2.0	5.00	0.022	IV	83.4(134.3)
DMG	33.5750	117.9830	03/11/1933	518 4.0	0.0	5.20	0.024	IV	86.3(138.8)
PAS	31.8900	115.8210	05/08/1985	234020.8	6.0	5.00	0.021	IV	86.4(139.0)
DMG	33.2330	115.7170	10/22/1942	15038.0	0.0	5.50	0.028	V	86.7(139.6)
PAS	31.9270	115.7770	07/17/1975	182447.0	17.3	5.00	0.021	IV	87.0(140.0)
PAS	33.0980	115.6320	04/26/1981	12 928.4	3.8	5.70	0.031	V	87.2(140.3)
DMG	33.6170	117.9670	03/11/1933	154 7.8	0.0	6.30	0.042	VI	87.9(141.5)
MGI	33.8000	117.6000	04/22/1918	2115 0.0	0.0	5.00	0.021	IV	88.1(141.8)
DMG	31.7500	115.9170	02/10/1956	15 929.0	0.0	5.00	0.021	IV	88.2(141.9)
DMG	31.7500	115.9170	02/09/1956	165953.0	0.0	5.70	0.030	V	88.2(141.9)
DMG	31.7500	115.9170	03/09/1956	03240.0	0.0	5.00	0.021	IV	88.2(141.9)
DMG	31.7500	115.9170	02/09/1956	152426.0	0.0	6.10	0.038	V	88.2(141.9)
DMG	31.7500	115.9170	02/11/1956	25746.0	0.0	5.10	0.022	IV	88.2(141.9)
DMG	31.7500	115.9170	02/09/1956	184845.0	0.0	5.70	0.030	V	88.2(141.9)
DMG	31.7500	115.9170	02/11/1956	61124.0	0.0	5.00	0.021	IV	88.2(141.9)
DMG	31.7500	115.9170	02/09/1956	143238.0	0.0	6.80	0.054	VI	88.2(141.9)
DMG	31.7500	115.9170	02/10/1956	181254.0	0.0	5.50	0.027	V	88.2(141.9)
GSP	33.1600	115.6370	09/02/2005	012719.8	9.0	5.10	0.022	IV	88.6(142.6)
PAS	32.9270	115.5400	10/16/1979	54910.2	10.4	5.10	0.022	IV	88.7(142.7)
DMG	31.6000	116.1000	11/26/1955	1736 0.0	0.0	5.40	0.026	V	88.7(142.7)
MGI	32.7000	115.5000	01/01/1927	13 0 0.0	0.0	5.30	0.025	V	88.7(142.7)
PAS	32.9280	115.5390	10/16/1979	61948.7	9.2	5.10	0.022	IV	88.7(142.8)
DMG	32.7330	115.5000	05/19/1940	43640.9	0.0	6.70	0.051	VI	88.8(143.0)
DMG	32.5000	115.5000	11/05/1923	22 7 0.0	0.0	5.00	0.021	IV	89.0(143.2)
DMG	32.5000	115.5000	04/19/1906	030 0.0	0.0	6.00	0.035	V	89.0(143.2)
DMG	32.5000	115.5000	09/08/1921	1924 0.0	0.0	5.00	0.021	IV	89.0(143.2)
DMG	32.5000	115.5000	11/07/1923	2357 0.0	0.0	5.50	0.027	V	89.0(143.2)
DMG	32.5000	115.5000	05/01/1918	432 0.0	0.0	5.00	0.021	IV	89.0(143.2)
MGI	32.5000	115.5000	04/16/1925	520 0.0	0.0	5.30	0.024	V	89.0(143.2)

EARTHQUAKE SEARCH RESULTS

FILE CODE	LAT. NORTH	LONG. WEST	DATE	TIME (UTC) H M Sec	DEPTH (km)	QUAKE MAG.	SITE ACC. g	SITE MM INT.	APPROX. DISTANCE mi [km]
DMG	32.5000	115.5000	01/01/1927	91330.0	0.0	5.50	0.027	V	89.0(143.2)
DMG	32.5000	115.5000	01/01/1927	81645.0	0.0	5.75	0.031	V	89.0(143.2)
MGI	32.5000	115.5000	04/16/1925	330 0.0	0.0	5.00	0.021	IV	89.0(143.2)
DMG	33.9000	117.2000	12/19/1880	0 0 0.0	0.0	6.00	0.035	V	89.0(143.3)
DMG	32.5000	118.5500	02/24/1948	81510.0	0.0	5.30	0.024	V	89.2(143.6)
DMG	32.8000	115.5000	06/23/1915	359 0.0	0.0	6.25	0.040	V	89.3(143.8)
DMG	32.8000	115.5000	06/23/1915	456 0.0	0.0	6.25	0.040	V	89.3(143.8)
PAS	33.0140	115.5550	10/16/1979	65842.8	9.1	5.50	0.027	V	89.4(143.9)
DMG	33.6170	118.0170	03/14/1933	19 150.0	0.0	5.10	0.022	IV	89.7(144.4)
DMG	32.7670	115.4830	05/19/1940	63320.0	0.0	5.00	0.021	IV	90.0(144.9)
DMG	32.7670	115.4830	05/19/1940	63540.0	0.0	5.50	0.027	V	90.0(144.9)
DMG	32.7670	115.4830	05/19/1940	455 0.0	0.0	5.50	0.027	V	90.0(144.9)
DMG	32.7670	115.4830	05/19/1940	55134.0	0.0	5.50	0.027	V	90.0(144.9)
GSP	31.7030	115.9100	12/03/1991	175435.8	5.0	5.30	0.024	V	90.7(146.0)
DMG	33.1170	115.5670	07/28/1950	175048.0	0.0	5.40	0.025	V	91.2(146.7)
DMG	33.1170	115.5670	07/29/1950	143632.0	0.0	5.50	0.027	V	91.2(146.7)
DMG	31.7000	115.9000	02/09/1956	1434 0.0	0.0	5.60	0.028	V	91.3(146.9)
DMG	31.7000	115.9000	02/11/1956	519 0.0	0.0	5.00	0.020	IV	91.3(146.9)
DMG	33.0000	115.5000	12/17/1955	6 729.0	0.0	5.40	0.025	V	92.2(148.4)
DMG	33.0000	115.5000	02/26/1930	230 0.0	0.0	5.00	0.020	IV	92.2(148.4)
DMG	32.2500	115.5000	12/30/1934	1352 0.0	0.0	6.50	0.045	VI	92.3(148.6)
T-A	33.5000	115.8200	05/00/1868	0 0 0.0	0.0	6.30	0.040	V	92.4(148.7)
DMG	33.9500	116.8500	09/28/1946	719 9.0	0.0	5.00	0.020	IV	92.4(148.7)
PAS	32.7660	115.4410	10/15/1979	231930.0	9.3	5.20	0.023	IV	92.5(148.8)
DMG	33.6830	118.0500	03/11/1933	658 3.0	0.0	5.50	0.026	V	94.5(152.0)
DMG	33.9760	116.7210	06/12/1944	104534.7	10.0	5.10	0.021	IV	95.3(153.3)
DMG	33.7000	118.0670	03/11/1933	85457.0	0.0	5.10	0.021	IV	96.0(154.5)
DMG	33.7000	118.0670	03/11/1933	51022.0	0.0	5.10	0.021	IV	96.0(154.5)
DMG	33.1670	115.5000	12/20/1935	745 0.0	0.0	5.00	0.020	IV	96.0(154.6)
DMG	34.0000	117.2500	07/23/1923	73026.0	0.0	6.25	0.038	V	96.2(154.9)
PAS	31.7130	115.7670	01/25/1988	131710.6	6.0	5.60	0.027	V	96.4(155.2)
DMG	33.9940	116.7120	06/12/1944	111636.0	10.0	5.30	0.023	IV	96.6(155.5)
GSP	33.8760	116.2670	06/29/1992	160142.8	1.0	5.20	0.022	IV	97.1(156.3)
DMG	31.5000	116.0000	10/24/1954	944 8.0	0.0	6.00	0.033	V	97.7(157.3)
DMG	31.5000	116.0000	11/12/1954	131642.0	0.0	5.00	0.019	IV	97.7(157.3)
DMG	31.5000	116.0000	11/14/1954	53619.0	0.0	5.40	0.024	V	97.7(157.3)
DMG	31.5000	116.0000	10/24/1954	112124.0	0.0	5.40	0.024	V	97.7(157.3)
DMG	31.5000	116.0000	11/12/1954	122647.0	0.0	6.30	0.039	V	97.7(157.3)
PAS	32.0840	115.4710	01/10/1976	125815.8	12.3	5.00	0.019	IV	97.8(157.3)
DMG	33.9330	116.3830	12/04/1948	234317.0	0.0	6.50	0.043	VI	97.9(157.6)
PAS	33.9980	116.6060	07/08/1986	92044.5	11.7	5.60	0.027	V	98.2(158.0)
GSP	33.9020	116.2840	07/24/1992	181436.2	9.0	5.00	0.019	IV	98.3(158.2)
GSG	32.4680	115.3340	02/12/2008	043237.9	13.0	5.00	0.019	IV	98.8(159.1)
PAS	32.6140	115.3180	10/15/1979	231653.4	12.3	6.60	0.045	VI	99.1(159.5)
MGI	34.0000	117.5000	12/16/1858	10 0 0.0	0.0	7.00	0.055	VI	99.2(159.7)
DMG	33.7500	118.0830	03/11/1933	323 0.0	0.0	5.00	0.019	IV	99.2(159.7)
DMG	33.7500	118.0830	03/11/1933	230 0.0	0.0	5.10	0.020	IV	99.2(159.7)
DMG	33.7500	118.0830	03/11/1933	2 9 0.0	0.0	5.00	0.019	IV	99.2(159.7)
DMG	33.7500	118.0830	03/13/1933	131828.0	0.0	5.30	0.022	IV	99.2(159.7)
DMG	33.7500	118.0830	03/11/1933	910 0.0	0.0	5.10	0.020	IV	99.2(159.7)
GSG	32.4120	115.3330	11/20/2008	192303.3	3.0	5.30	0.022	IV	99.4(160.0)
GSG	32.4680	115.3170	02/19/2008	224130.7	10.0	5.10	0.020	IV	99.8(160.6)

****

-END OF SEARCH- 158 EARTHQUAKES FOUND WITHIN THE SPECIFIED SEARCH AREA.

TIME PERIOD OF SEARCH: 1800 TO 2013

LENGTH OF SEARCH TIME: 214 years

THE EARTHQUAKE CLOSEST TO THE SITE IS ABOUT 9.2 MILES (14.9 km) AWAY.

LARGEST EARTHQUAKE MAGNITUDE FOUND IN THE SEARCH RADIUS: 7.0

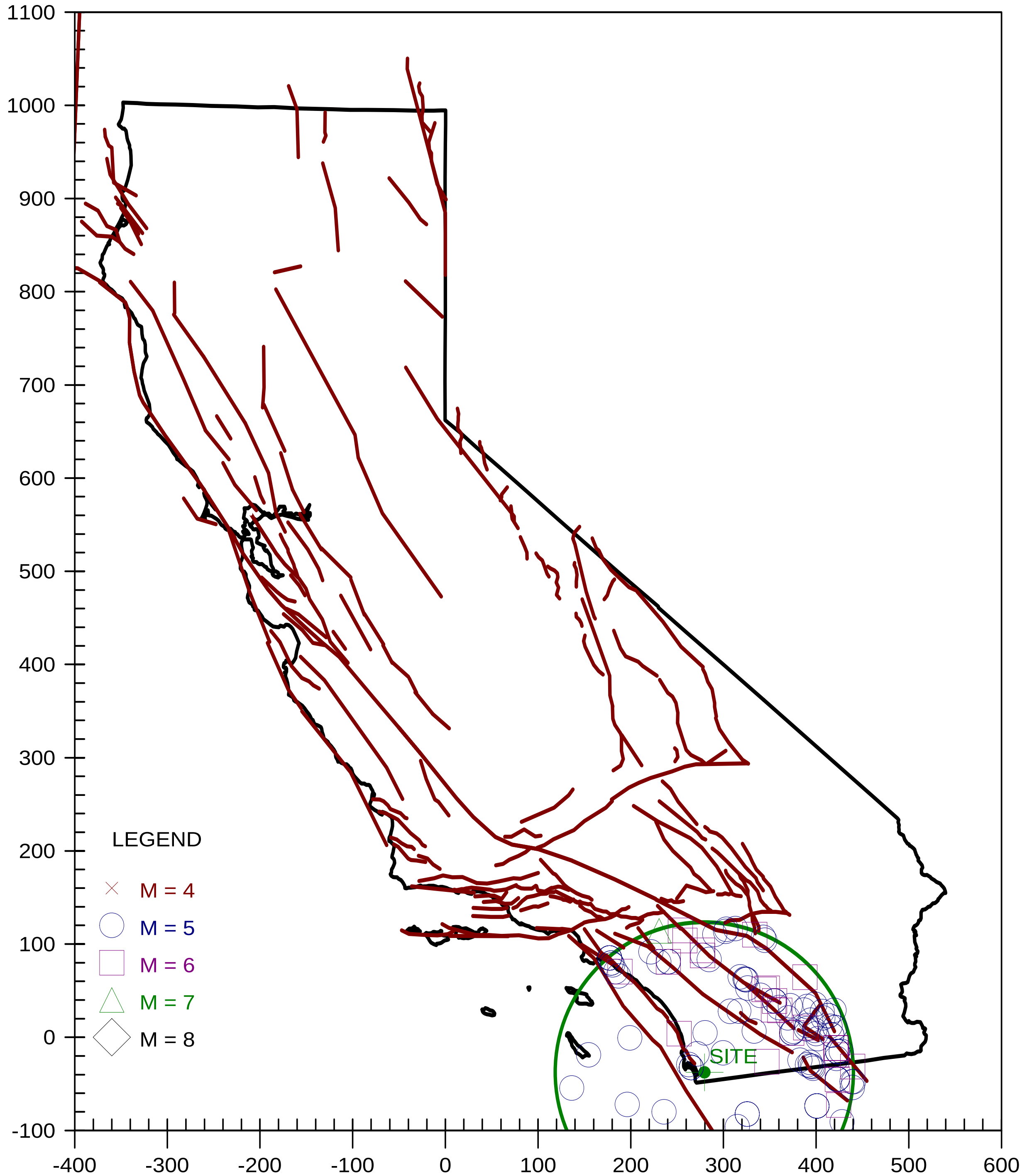
LARGEST EARTHQUAKE SITE ACCELERATION FROM THIS SEARCH: 0.157 g

COEFFICIENTS FOR GUTENBERG & RICHTER RECURRENCE RELATION:
a-value= 1.535
b-value= 0.379
beta-value= 0.873

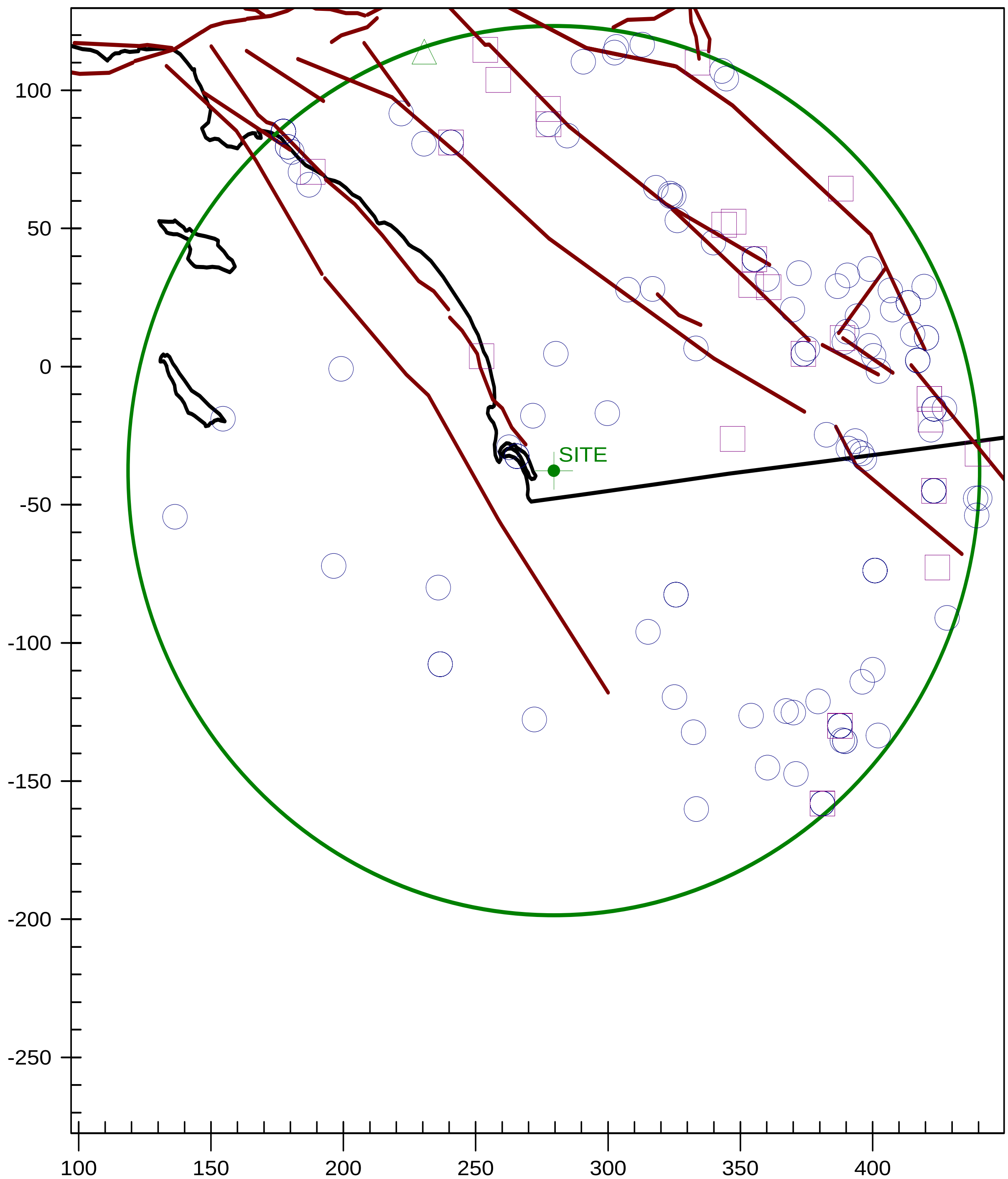
TABLE OF MAGNITUDES AND EXCEEDANCES:

Earthquake Magnitude	Number of Times Exceeded	Cumulative No. / Year
4.0	158	0.74178
4.5	158	0.74178
5.0	158	0.74178
5.5	64	0.30047
6.0	28	0.13146
6.5	10	0.04695
7.0	1	0.00469

EARTHQUAKE EPICENTER MAP



EARTHQUAKE EPICENTER MAP

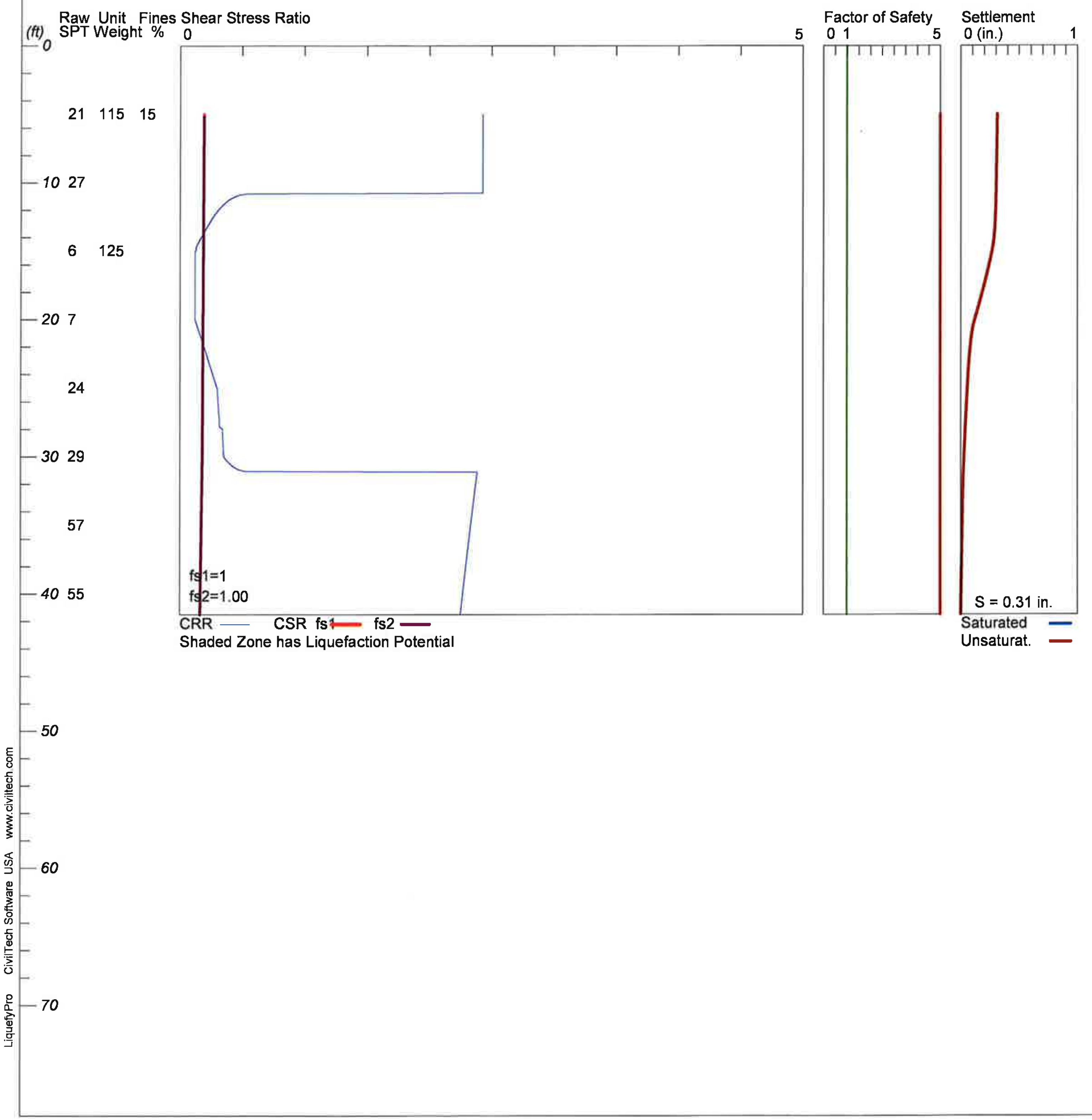


LIQUEFACTION ANALYSIS

Sharp CV Medical Center

Hole No.=B-8 Water Depth=150 ft Surface Elev.=435

Magnitude=6.95
Acceleration=.3g

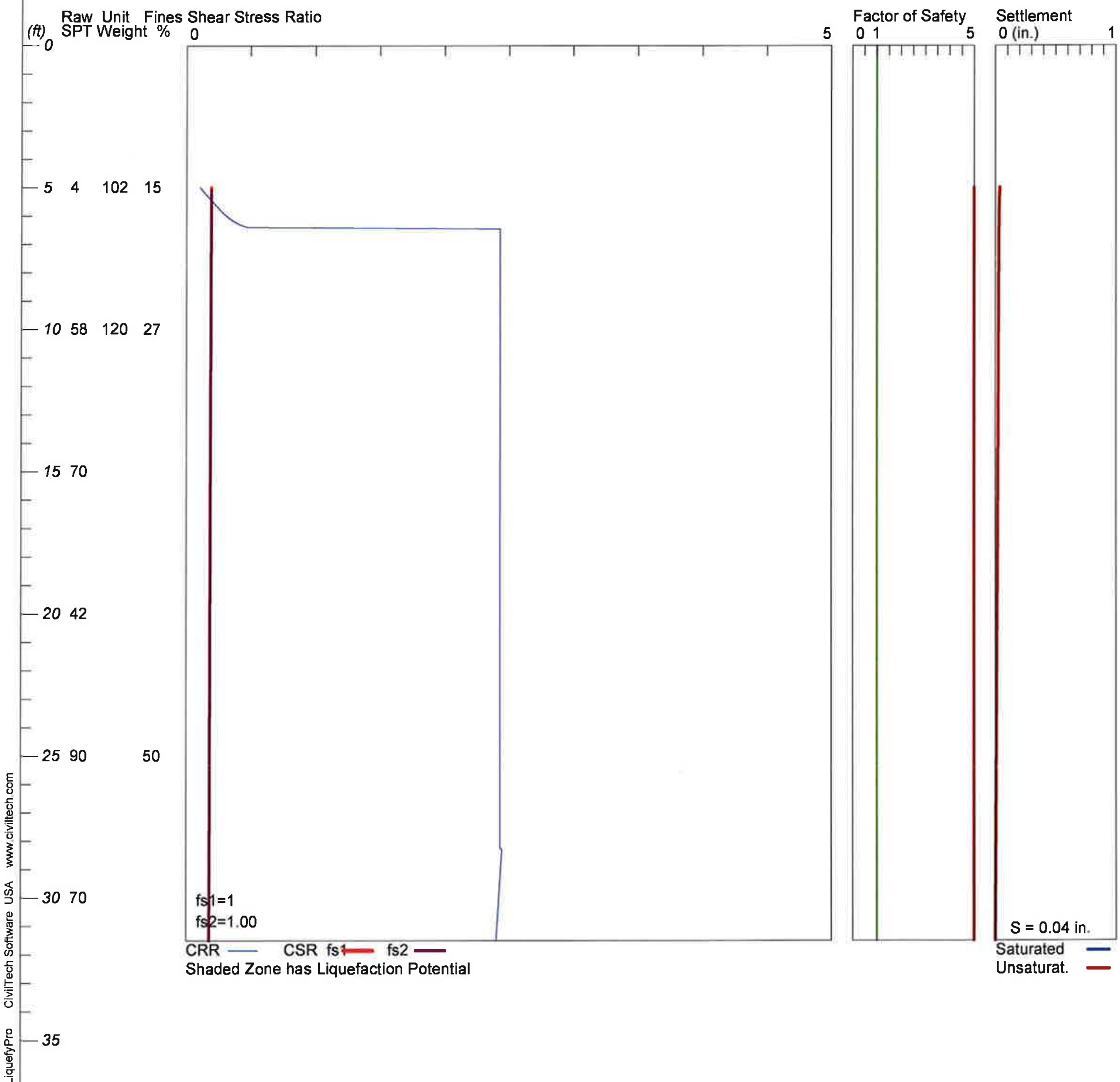


LIQUEFACTION ANALYSIS

Sharp CV Medical Center

Hole No.=B-10 Water Depth=150 ft Surface Elev.=439

Magnitude=6.95
Acceleration=.3g

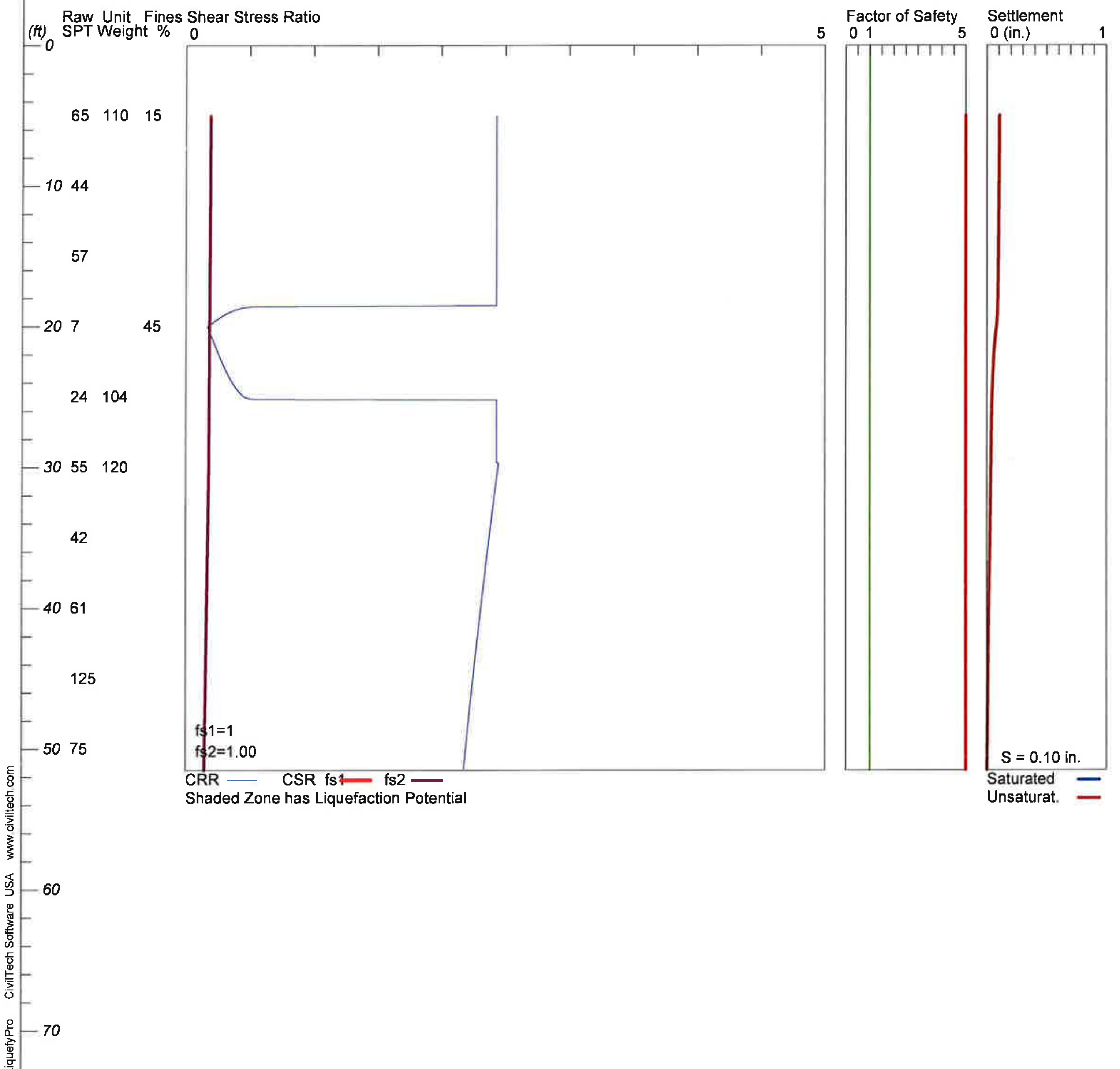


LIQUEFACTION ANALYSIS

Sharp CV Medical Center

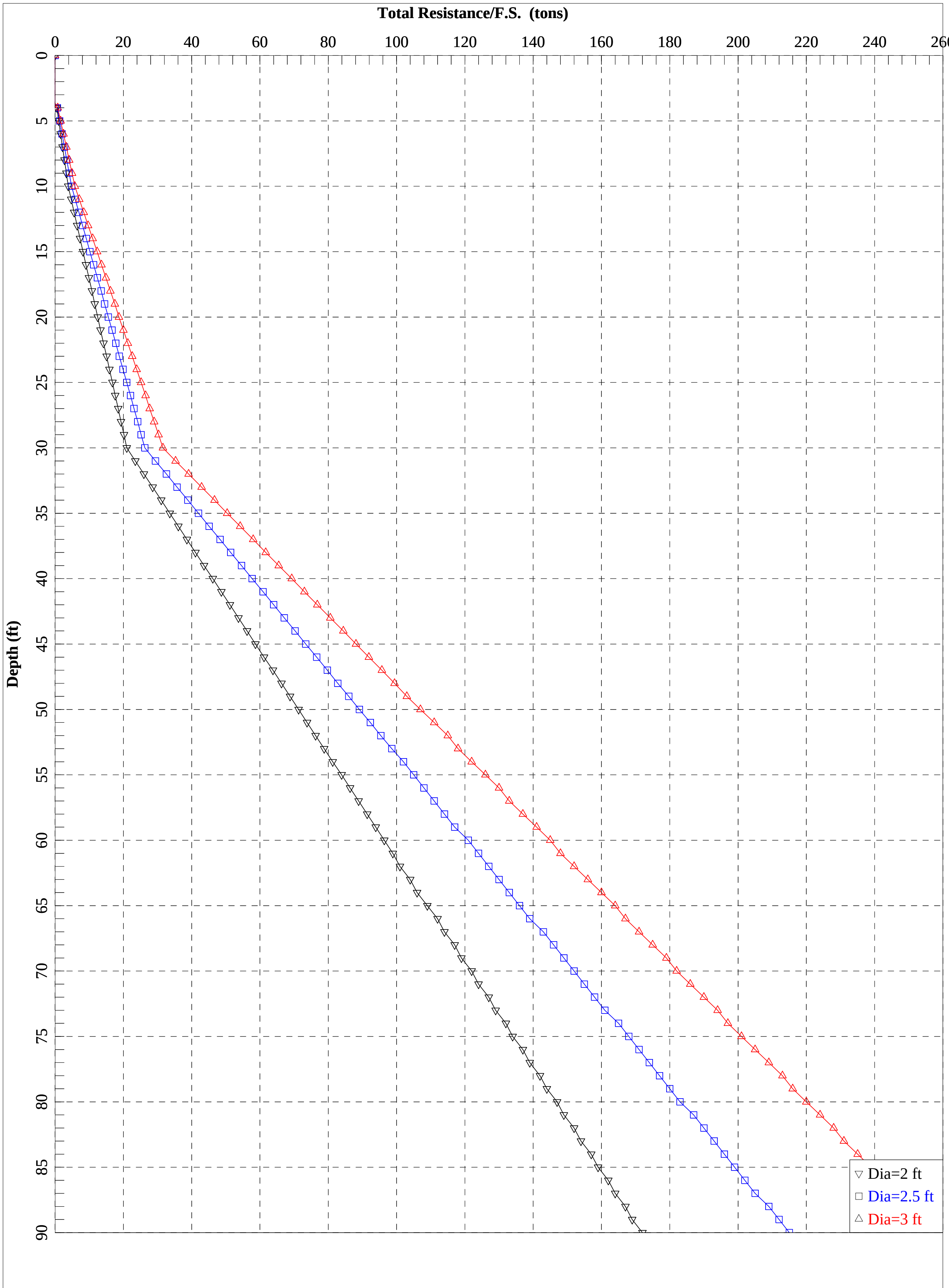
Hole No.=B-14   Water Depth=150 ft   Surface Elev.=435

Magnitude=6.95
Acceleration=.3g



Appendix F

Design Curves for CIDH Piles



Sharp CV Medical Center - CIDH Piles, Axial Capacity

Appendix G

General Earthwork and Grading Specifications

1.0 General

1.1 Intent

These General Earthwork and Grading Specifications are for the grading and earthwork shown on the approved grading plan(s) and/or indicated in the geotechnical report(s). These Specifications are a part of the recommendations contained in the geotechnical report(s). In case of conflict, the specific recommendations in the geotechnical report shall supersede these more general Specifications. Observations of the earthwork by the project Geotechnical Consultant during the course of grading may result in new or revised recommendations that could supersede these specifications or the recommendations in the geotechnical report(s).

1.2 The Geotechnical Consultant of Record

Prior to commencement of work, the owner shall employ the Geotechnical Consultant of Record (Geotechnical Consultant). The Geotechnical Consultants shall be responsible for reviewing the approved geotechnical report(s) and accepting the adequacy of the preliminary geotechnical findings, conclusions, and recommendations prior to the commencement of the grading.

Prior to commencement of grading, the Geotechnical Consultant shall review the "work plan" prepared by the Earthwork Contractor (Contractor) and schedule sufficient personnel to perform the appropriate level of observation, mapping, and compaction testing.

During the grading and earthwork operations, the Geotechnical Consultant shall observe, map, and document the subsurface exposures to verify the geotechnical design assumptions. If the observed conditions are found to be significantly different than the interpreted assumptions during the design phase, the Geotechnical Consultant shall inform the owner, recommend appropriate changes in design to accommodate the observed conditions, and notify the review agency where required. Subsurface areas to be geotechnically observed, mapped, elevations recorded, and/or tested include natural ground after it has been cleared for receiving fill but before fill is placed, bottoms of all "remedial removal" areas, all key bottoms, and benches made on sloping ground to receive fill.

The Geotechnical Consultant shall observe the moisture-conditioning and processing of the subgrade and fill materials and perform relative compaction testing of fill to determine the attained level of compaction. The Geotechnical Consultant shall provide the test results to the owner and the Contractor on a routine and frequent basis.

1.3 The Earthwork Contractor

The Earthwork Contractor (Contractor) shall be qualified, experienced, and knowledgeable in earthwork logistics, preparation and processing of ground to receive fill, moisture-conditioning and processing of fill, and compacting fill. The Contractor shall review and accept the plans, geotechnical report(s), and these Specifications prior to commencement of grading. The Contractor shall be solely responsible for performing the grading in accordance with the plans and specifications.

The Contractor shall prepare and submit to the owner and the Geotechnical Consultant a work plan that indicates the sequence of earthwork grading, the number of "spreads" of work and the estimated quantities of daily earthwork contemplated for the site prior to commencement of grading. The Contractor shall inform the owner and the Geotechnical Consultant of changes in work schedules and updates to the work plan at least 24 hours in advance of such changes so that appropriate observations and tests can be planned and accomplished. The Contractor shall not assume that the Geotechnical Consultant is aware of all grading operations.

The Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish the earthwork in accordance with the applicable grading codes and agency ordinances, these Specifications, and the recommendations in the approved geotechnical report(s) and grading plan(s). If, in the opinion of the Geotechnical Consultant, unsatisfactory conditions, such as unsuitable soil, improper moisture condition, inadequate compaction, insufficient buttress key size, adverse weather, etc., are resulting in a quality of work less than required in these specifications, the Geotechnical Consultant shall reject the work and may recommend to the owner that construction be stopped until the conditions are rectified.

2.0 Preparation of Areas to be Filled

2.1 Clearing and Grubbing

Vegetation, such as brush, grass, roots, and other deleterious material shall be sufficiently removed and properly disposed of in a method acceptable to the owner, governing agencies, and the Geotechnical Consultant.

The Geotechnical Consultant shall evaluate the extent of these removals depending on specific site conditions. Earth fill material shall not contain more than 1 percent of organic materials (by volume). No fill lift shall contain more than 5 percent of organic matter. Nesting of the organic materials shall not be allowed.

If potentially hazardous materials are encountered, the Contractor shall stop work in the affected area, and a hazardous material specialist shall be informed immediately for proper evaluation and handling of these materials prior to continuing to work in that area.

As presently defined by the State of California, most refined petroleum products (gasoline, diesel fuel, motor oil, grease, coolant, etc.) have chemical constituents that are considered to be hazardous waste. As such, the indiscriminate dumping or spillage of these fluids onto the ground may constitute a misdemeanor, punishable by fines and/or imprisonment, and shall not be allowed.

2.2 Processing

Existing ground that has been declared satisfactory for support of fill by the Geotechnical Consultant shall be scarified to a minimum depth of 6 inches. Existing ground that is not satisfactory shall be overexcavated as specified in the following section. Scarification shall continue until soils are broken down and free of large clay lumps or clods and the working surface is reasonably uniform, flat, and free of uneven features that would inhibit uniform compaction.

2.3 Overexcavation

In addition to removals and overexcavations recommended in the approved geotechnical report(s) and the grading plan, soft, loose, dry, saturated, spongy, organic-rich, highly fractured or otherwise unsuitable ground shall be overexcavated to competent ground as evaluated by the Geotechnical Consultant during grading.

2.4 Benching

Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical units), the ground shall be stepped or benched. Please see the Standard Details for a graphic illustration. The lowest bench or key shall be a minimum of 15 feet wide and at least 2 feet deep, into competent material as evaluated by the Geotechnical Consultant. Other benches shall be excavated a minimum height of 4 feet into competent material or as otherwise recommended by the Geotechnical Consultant. Fill placed on ground sloping flatter than 5:1 shall also be benched or otherwise overexcavated to provide a flat subgrade for the fill.

2.5 Evaluation/Acceptance of Fill Areas

All areas to receive fill, including removal and processed areas, key bottoms, and benches, shall be observed, mapped, elevations recorded, and/or tested prior to being accepted by the Geotechnical Consultant as suitable to receive fill. The Contractor shall obtain a written acceptance from the Geotechnical Consultant prior to fill placement. A licensed surveyor shall provide the survey control for determining elevations of processed areas, keys, and benches.

3.0 Fill Material

3.1 General

Material to be used as fill shall be essentially free of organic matter and other deleterious substances evaluated and accepted by the Geotechnical Consultant prior to placement. Soils of poor quality, such as those with unacceptable gradation, high expansion potential, or low strength shall be placed in areas acceptable to the Geotechnical Consultant or mixed with other soils to achieve satisfactory fill material.

3.2 Oversize

Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 8 inches, shall not be buried or placed in fill unless location, materials, and placement methods are specifically accepted by the Geotechnical Consultant. Placement operations shall be such that nesting of oversized material does not occur and such that oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 vertical feet of finish grade or within 2 feet of future utilities or underground construction.

3.3 Import

If importing of fill material is required for grading, proposed import material shall meet the requirements of Section 3.1. The potential import source shall be given to the Geotechnical Consultant at least 48 hours (2 working days) before importing begins so that its suitability can be determined and appropriate tests performed.

4.0 Fill Placement and Compaction

4.1 Fill Layers

Approved fill material shall be placed in areas prepared to receive fill (per Section 3.0) in near-horizontal layers not exceeding 8 inches in loose thickness. The Geotechnical Consultant may accept thicker layers if testing indicates the grading procedures can adequately compact the thicker layers. Each layer shall be spread evenly and mixed thoroughly to attain relative uniformity of material and moisture throughout.

4.2 Fill Moisture Conditioning

Fill soils shall be watered, dried back, blended, and/or mixed, as necessary to attain a relatively uniform moisture content at or slightly over optimum. Maximum density and optimum soil moisture content tests shall be performed in accordance with the American Society of Testing and Materials (ASTM Test Method D1557).

4.3 Compaction of Fill

After each layer has been moisture-conditioned, mixed, and evenly spread, it shall be uniformly compacted to not less than 90 percent of maximum dry density (ASTM Test Method D1557). Compaction equipment shall be adequately sized and be either specifically designed for soil compaction or of proven reliability to efficiently achieve the specified level of compaction with uniformity.

4.4 Compaction of Fill Slopes

In addition to normal compaction procedures specified above, compaction of slopes shall be accomplished by backrolling of slopes with sheepsfoot rollers at increments of 3 to 4 feet in fill elevation, or by other methods producing satisfactory results acceptable to the Geotechnical Consultant. Upon completion of grading, relative compaction of the fill, out to the slope face, shall be at least 90 percent of maximum density per ASTM Test Method D1557.

4.5 Compaction Testing

Field-tests for moisture content and relative compaction of the fill soils shall be performed by the Geotechnical Consultant. Location and frequency of tests shall be at the Consultant's discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to inadequate compaction (such as close to slope faces and at the fill/bedrock benches).

4.6 Frequency of Compaction Testing

Tests shall be taken at intervals not exceeding 2 feet in vertical rise and/or 1,000 cubic yards of compacted fill soils embankment. In addition, as a guideline, at least one test shall be taken on slope faces for each 5,000 square feet of slope face and/or each 10 feet of vertical height of slope. The Contractor shall assure that fill construction is such that the testing schedule can be accomplished by the Geotechnical Consultant. The Contractor shall stop or slow down the earthwork construction if these minimum standards are not met.

4.7 Compaction Test Locations

The Geotechnical Consultant shall document the approximate elevation and horizontal coordinates of each test location. The Contractor shall coordinate with the project surveyor to assure that sufficient grade stakes are established so that the Geotechnical Consultant can determine the test locations with sufficient accuracy. At a minimum, two grade stakes within a horizontal distance of 100 feet and vertically less than 5 feet apart from potential test locations shall be provided.

5.0 Subdrain Installation

Subdrain systems shall be installed in accordance with the approved geotechnical report(s), the grading plan, and the Standard Details. The Geotechnical Consultant may recommend additional subdrains and/or changes in subdrain extent, location, grade, or material depending on conditions encountered during grading. All subdrains shall be surveyed by a land surveyor/civil engineer for line and grade after installation and prior to burial. Sufficient time should be allowed by the Contractor for these surveys.

6.0 Excavation

Excavations, as well as over-excavation for remedial purposes, shall be evaluated by the Geotechnical Consultant during grading. Remedial removal depths shown on geotechnical plans are estimates only. The actual extent of removal shall be determined by the Geotechnical Consultant based on the field evaluation of exposed conditions during grading. Where fill-over-cut slopes are to be graded, the cut portion of the slope shall be made, evaluated, and accepted by the Geotechnical Consultant prior to placement of materials for construction of the fill portion of the slope, unless otherwise recommended by the Geotechnical Consultant.

7.0 Trench Backfills

7.1 Safety

The Contractor shall follow all OSHA and Cal/OSHA requirements for safety of trench excavations.

7.2 Bedding and Backfill

All bedding and backfill of utility trenches shall be performed in accordance with the applicable provisions of Standard Specifications of Public Works Construction. Bedding material shall have a Sand Equivalent greater than 30 (SE>30). The bedding shall be placed to 1 foot over the top of the conduit and densified. Backfill shall be placed and densified to a minimum of 90 percent of relative compaction from 1 foot above the top of the conduit to the surface.

The Geotechnical Consultant shall test the trench backfill for relative compaction. At least one test should be made for every 300 feet of trench and 2 feet of fill.

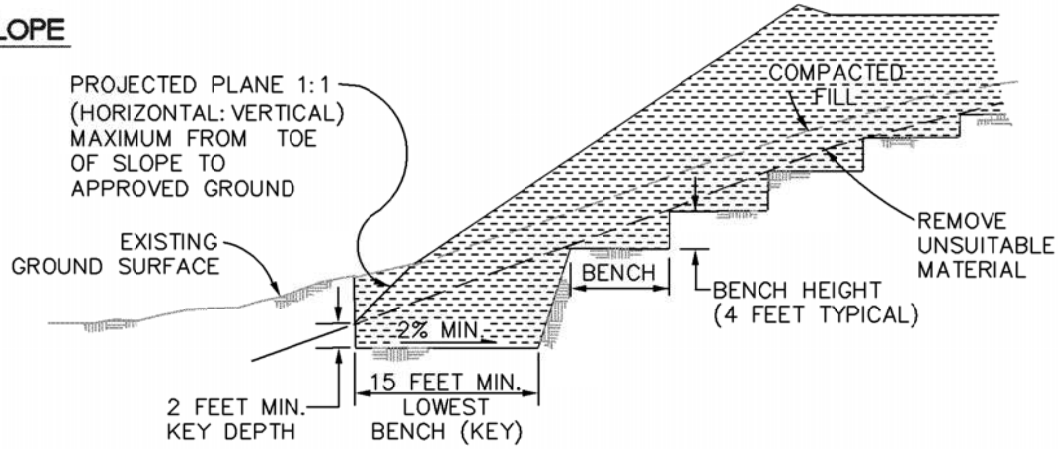
7.3 Lift Thickness

Lift thickness of trench backfill shall not exceed those allowed in the Standard Specifications of Public Works Construction unless the Contractor can demonstrate to the Geotechnical Consultant that the fill lift can be compacted to the minimum relative compaction by his alternative equipment and method.

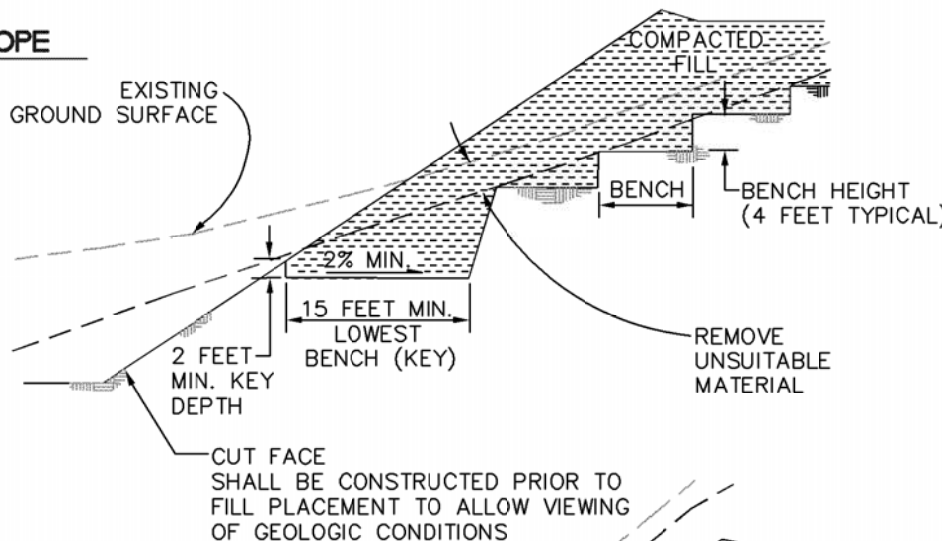
7.4 Observation and Testing

The densification of the bedding around the conduits shall be observed by the Geotechnical Consultant.

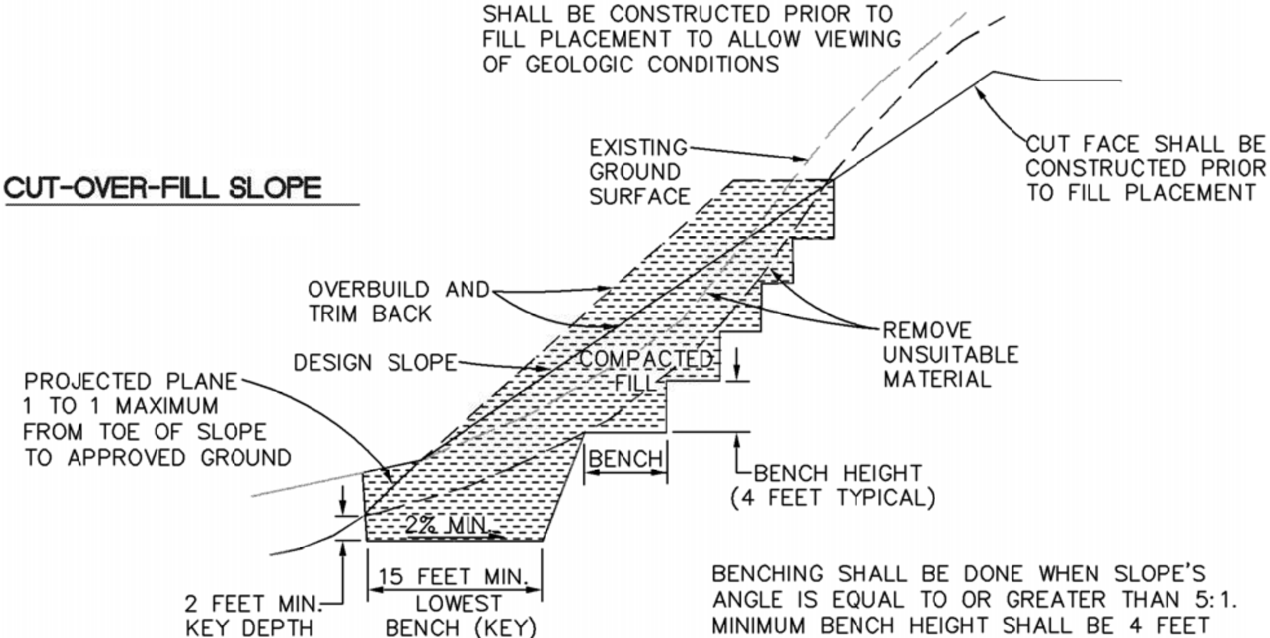
FILL SLOPE



FILL-OVER-CUT SLOPE



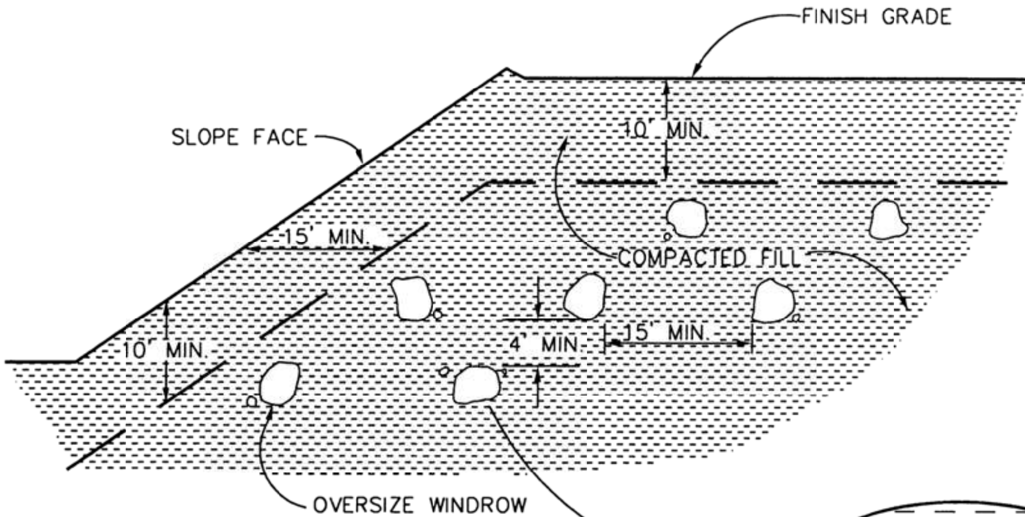
CUT-OVER-FILL SLOPE

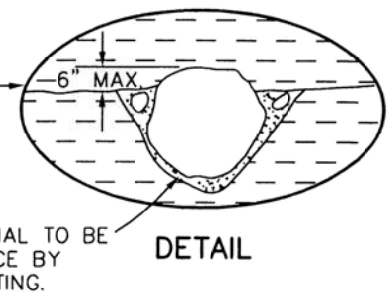


BENCHING SHALL BE DONE WHEN SLOPE'S ANGLE IS EQUAL TO OR GREATER THAN 5:1. MINIMUM BENCH HEIGHT SHALL BE 4 FEET AND MINIMUM FILL WIDTH SHALL BE 9 FEET.

KEYING AND BENCHING

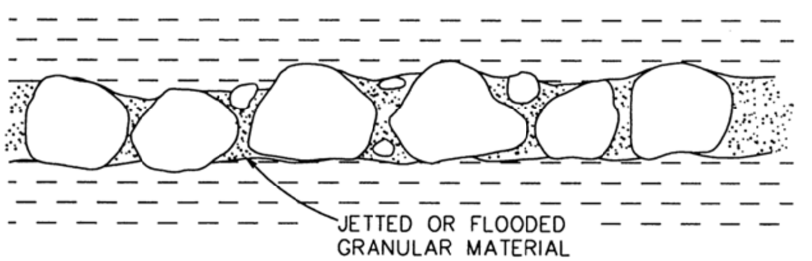
GENERAL EARTHWORK AND GRADING SPECIFICATIONS
STANDARD DETAIL A





DETAIL

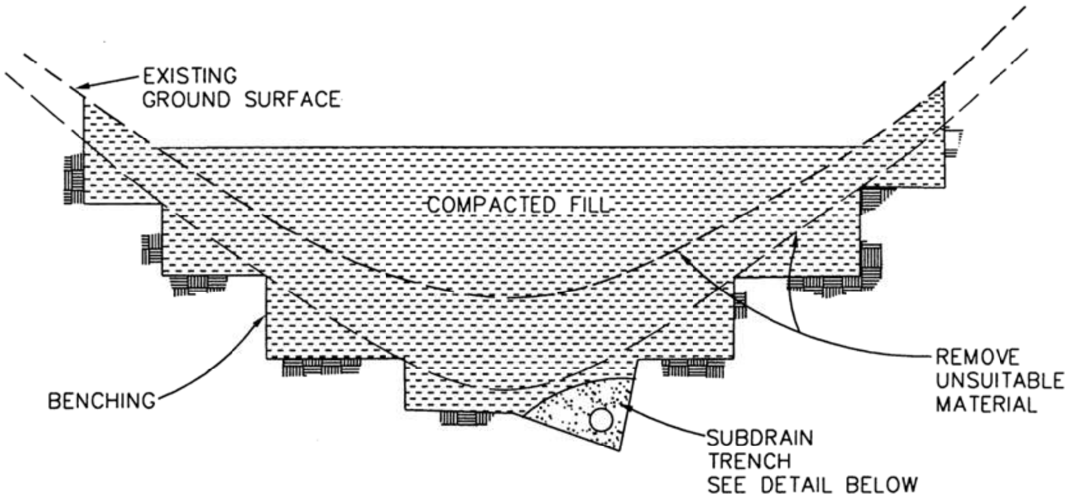
- OVERSIZE ROCK IS LARGER THAN 8 INCHES IN LARGEST DIMENSION.
- EXCAVATE A TRENCH IN THE COMPACTED FILL DEEP ENOUGH TO BURY ALL THE ROCK.
- BACKFILL WITH GRANULAR SOIL JETTED OR FLOODED IN PLACE TO FILL ALL THE VOIDS.
- DO NOT BURY ROCK WITHIN 10 FEET OF FINISH GRADE.
- WINDROW OF BURIED ROCK SHALL BE PARALLEL TO THE FINISHED SLOPE.

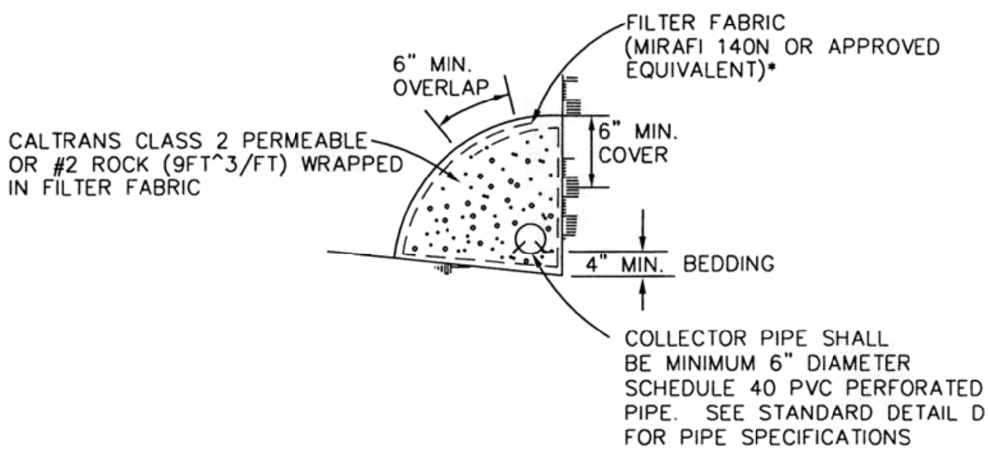


TYPICAL PROFILE ALONG WINDROW

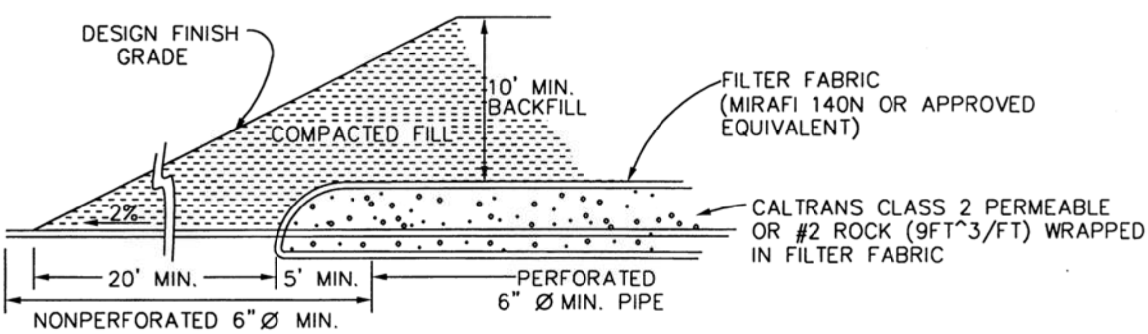
OVERSIZE ROCK DISPOSAL

GENERAL EARTHWORK AND
GRADING SPECIFICATIONS
STANDARD DETAIL B





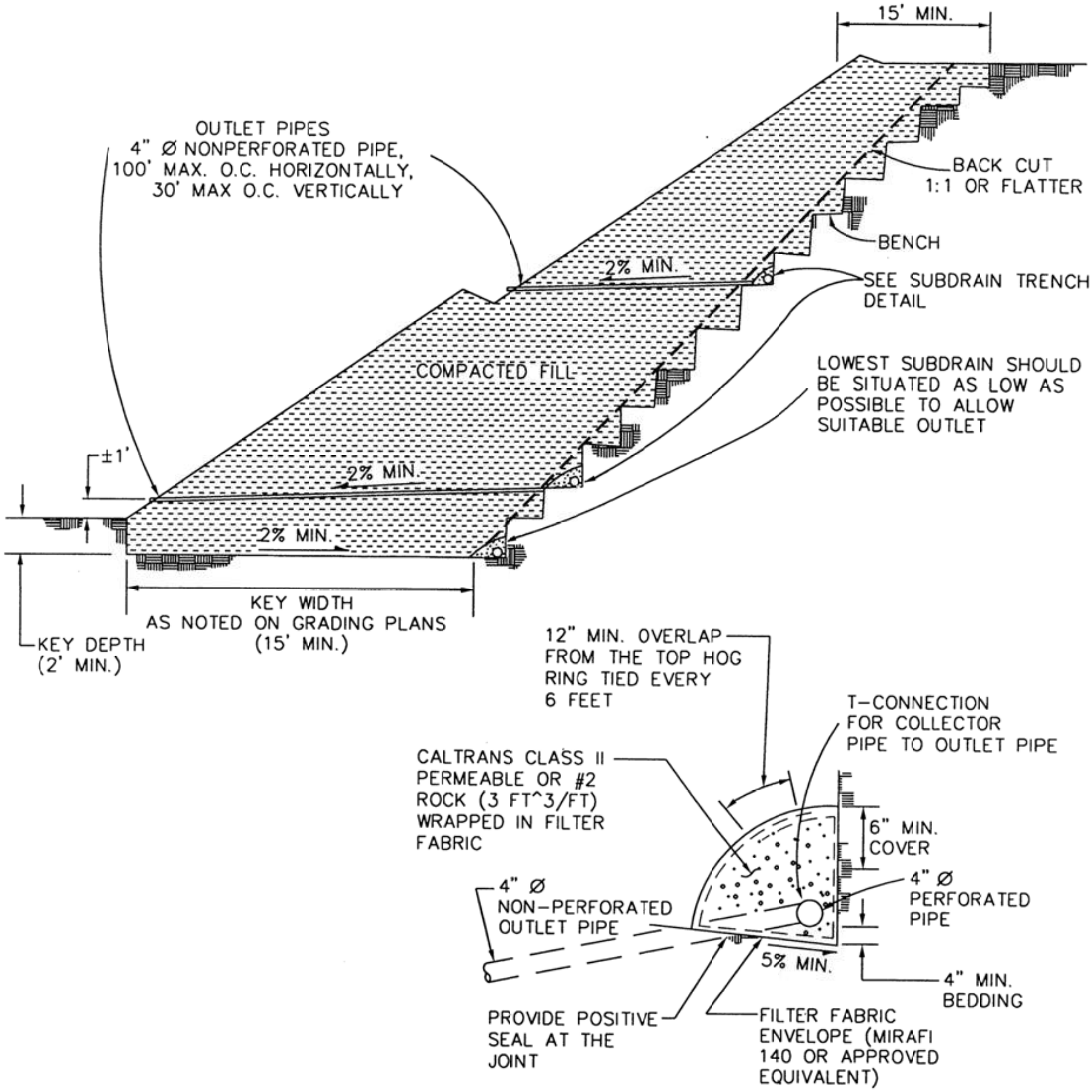
SUBDRAIN DETAIL



DETAIL OF CANYON SUBDRAIN OUTLET

CANYON SUBDRAINS

GENERAL EARTHWORK AND
GRADING SPECIFICATIONS
STANDARD DETAIL C



SUBDRAIN TRENCH DETAIL

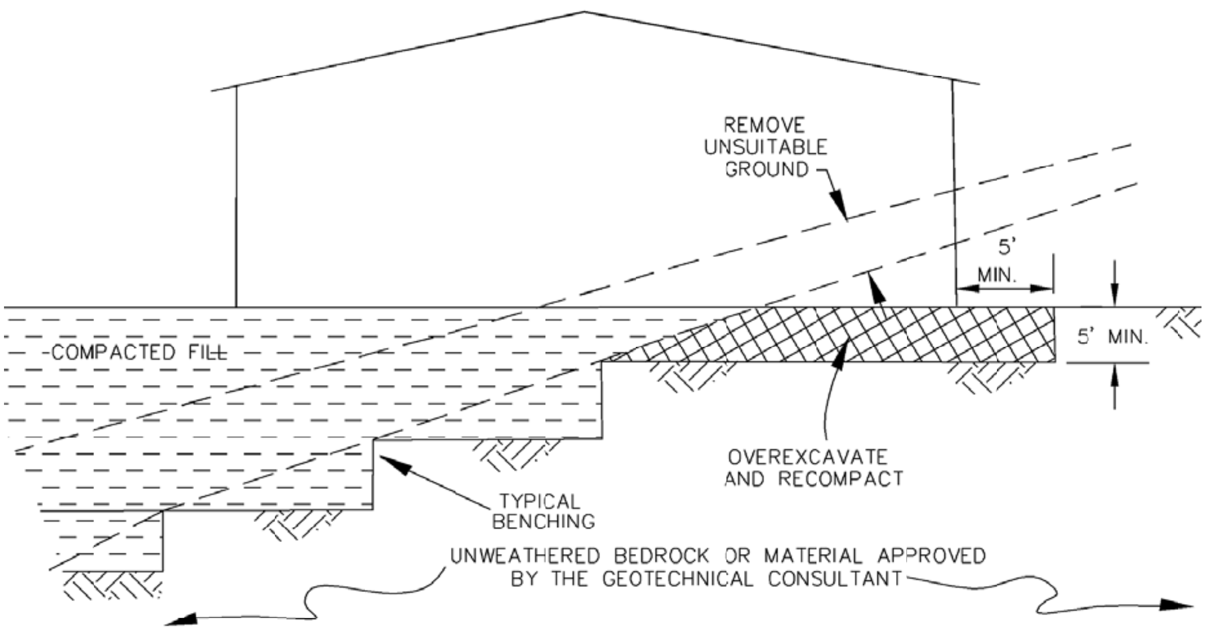
SUBDRAIN INSTALLATION – subdrain collector pipe shall be installed with perforation down or, unless otherwise designated by the geotechnical consultant. Outlet pipes shall be non-perforated pipe. The subdrain pipe shall have at least 8 perforations uniformly spaced per foot. Perforation shall be 1/4" to 1/2" if drill holes are used. All subdrain pipes shall have a gradient of at least 2% towards the outlet.

SUBDRAIN PIPE – Subdrain pipe shall be ASTM D2751, SDR 23.5 or ASTM D1527, Schedule 40, or ASTM D3034, SDR 23.5, Schedule 40 Polyvinyl Chloride Plastic (PVC) pipe.

All outlet pipe shall be placed in a trench no wider than twice the subdrain pipe.

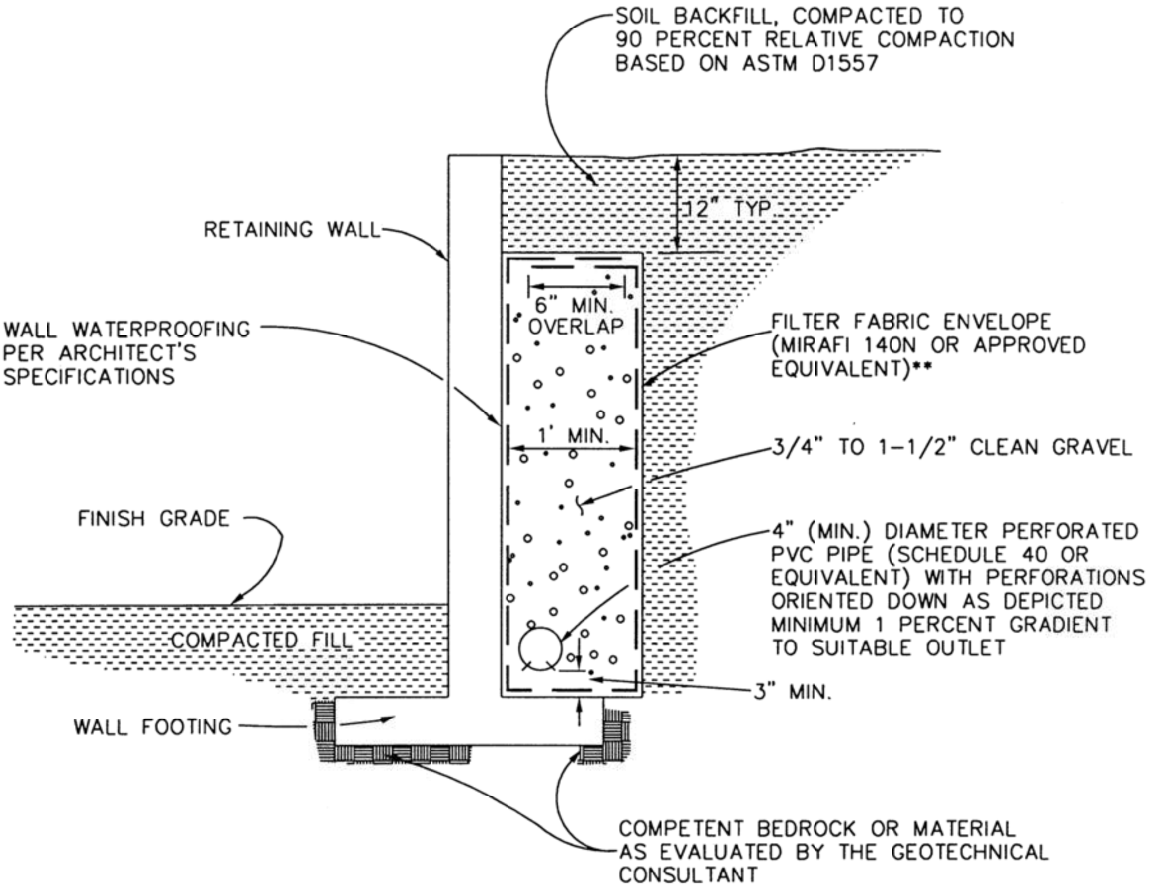
BUTTRESS OR REPLACEMENT FILL SUBDRAINS	GENERAL EARTHWORK AND GRADING SPECIFICATIONS STANDARD DETAIL D

CUT-FILL TRANSITION LOT OVEREXCAVATION



TRANSITION LOT FILLS

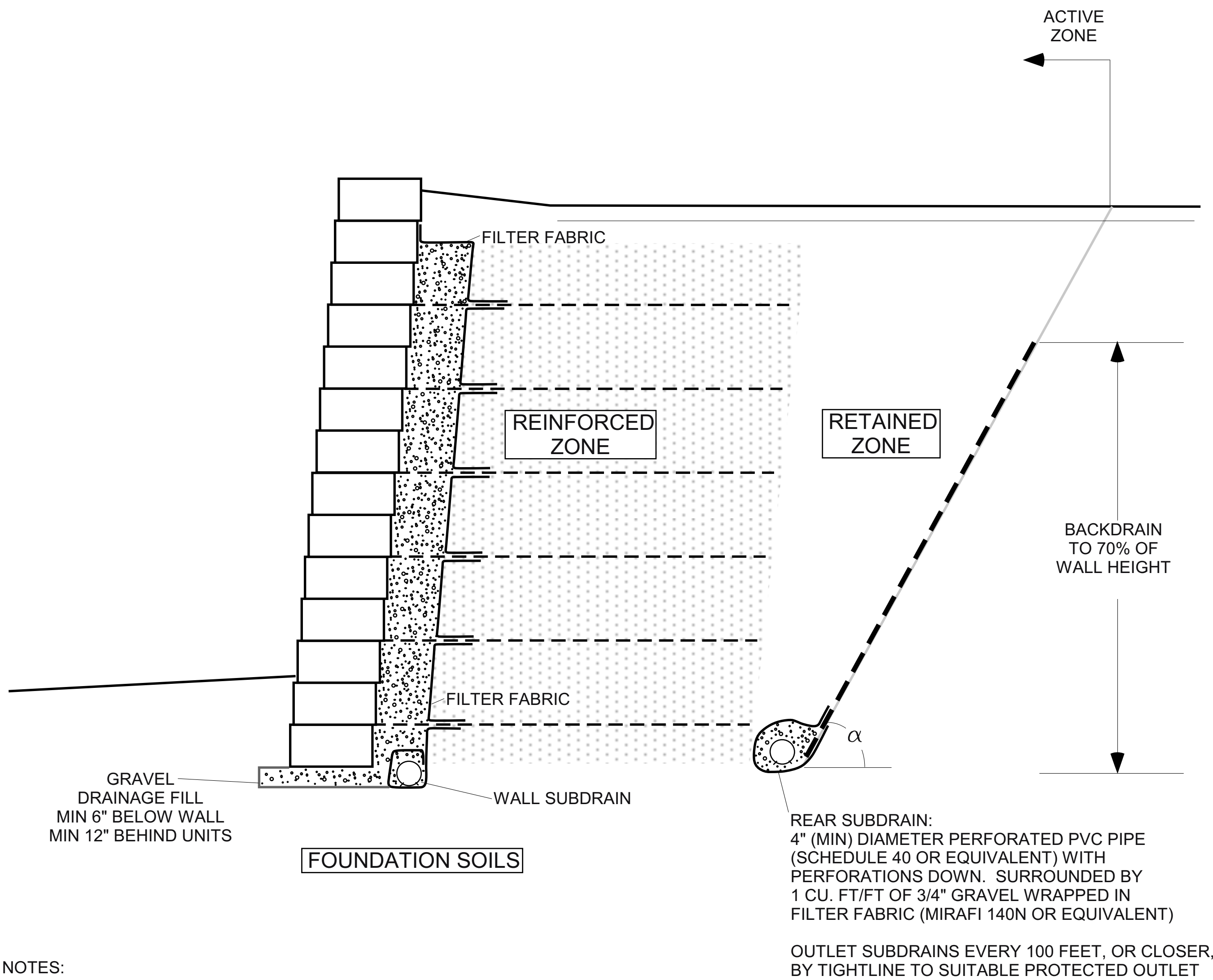
GENERAL EARTHWORK AND
GRADING SPECIFICATIONS
STANDARD DETAIL E



NOTE: UPON REVIEW BY THE GEOTECHNICAL CONSULTANT, COMPOSITE DRAINAGE PRODUCTS SUCH AS MIRADRAIN OR J-DRAIN MAY BE USED AS AN ALTERNATIVE TO GRAVEL OR CLASS 2 PERMEABLE MATERIAL. INSTALLATION SHOULD BE PERFORMED IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS.

RETAINING WALL DRAINAGE

GENERAL EARTHWORK AND
GRADING SPECIFICATIONS
STANDARD DETAIL F



NOTES:

1) MATERIAL GRADATION AND PLASTICITY

REINFORCED ZONE:

SIEVE SIZE	% PASSING
1 INCH	100
NO. 4	20-100
NO. 40	0-60
NO. 200	0-35

FOR WALL HEIGHT < 10 FEET, PLASTICITY INDEX < 20
FOR WALL HEIGHT 10 TO 20 FEET, PLASTICITY INDEX < 10
FOR TIERED WALLS, USE COMBINED WALL HEIGHTS
WALL DESIGNER TO REQUEST SITE-SPECIFIC CRITERIA FOR WALL HEIGHT > 20 FEET

GRAVEL DRAINAGE FILL:

SIEVE SIZE	% PASSING
1 INCH	100
3/4 INCH	75-100
NO. 4	0-60
NO. 40	0-50
NO. 200	0-5

2) CONTRACTOR TO USE SOILS WITHIN THE RETAINED AND REINFORCED ZONES THAT MEET THE STRENGTH REQUIREMENTS OF WALL DESIGN.

3) GEOGRID REINFORCEMENT TO BE DESIGNED BY WALL DESIGNER CONSIDERING INTERNAL, EXTERNAL, AND COMPOUND STABILITY.

3) GEOGRID TO BE PRETENSIONED DURING INSTALLATION.

4) IMPROVEMENTS WITHIN THE ACTIVE ZONE ARE SUSCEPTIBLE TO POST-CONSTRUCTION SETTLEMENT. ANGLE $\alpha = 45 + \phi/2$, WHERE ϕ IS THE FRICTION ANGLE OF THE MATERIAL IN THE RETAINED ZONE.

5) BACKDRAIN SHOULD CONSIST OF J-DRAIN 302 (OR EQUIVALENT) OR 6-INCH THICK DRAINAGE FILL WRAPPED IN FILTER FABRIC. PERCENT COVERAGE OF BACKDRAIN TO BE PER GEOTECHNICAL REVIEW.

SEGMENTAL RETAINING WALLS

GENERAL EARTHWORK AND GRADING SPECIFICATIONS
STANDARD DETAIL G

Important Information about Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely on Your ASFE-Member Geotechnical Engineer for Additional Assistance

Membership in ASFE/The Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.

ASFE THE GEOPROFESSIONAL BUSINESS ASSOCIATION

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