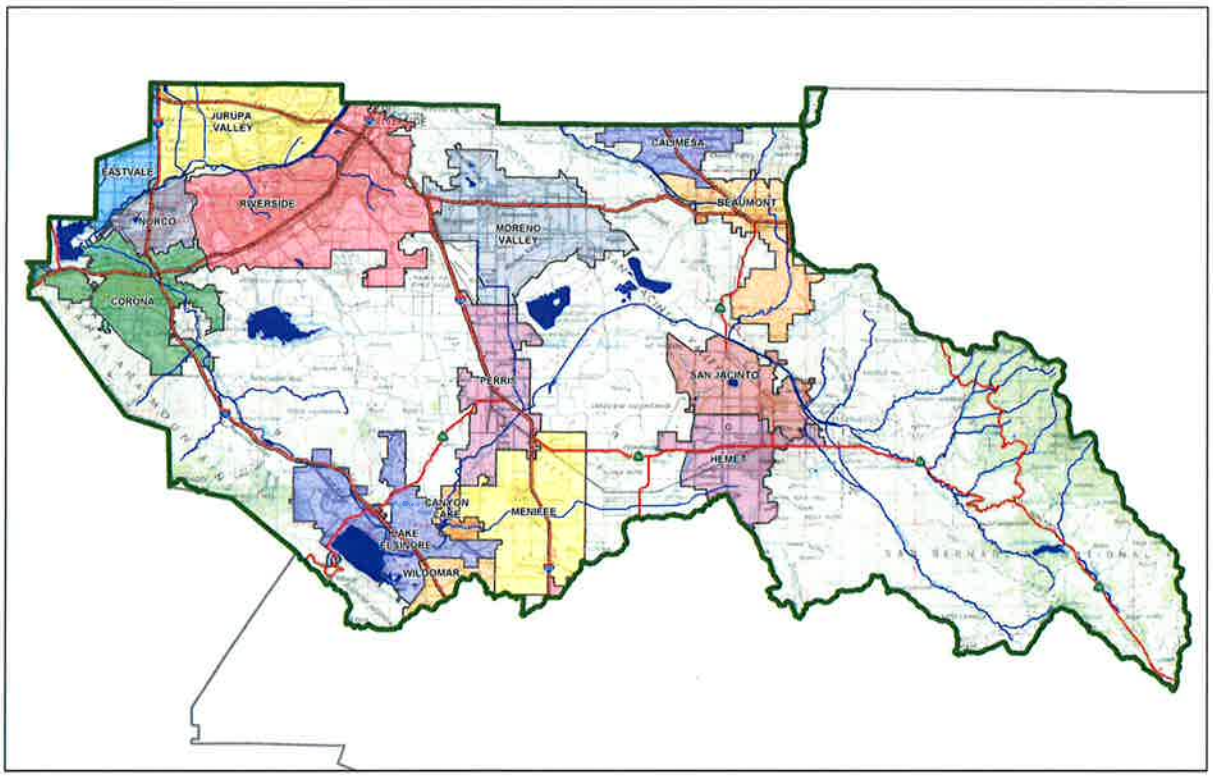
# Preliminary Specific Water Quality Management Plan

*Projects located within the **Santa Ana Watershed** Region of Riverside County*

Project Title: **Nichols South Specific Plan**

Development No: **TRACT 37305**

**Design Review/Case :** PWQMP 2018-00006




☒ **Preliminary**

☐ **Final**

**Original Date Prepared: November, 2018**
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JN: 382-663A

*Prepared for Compliance with*
*Regional Board Order No.* **R8-2010-0033**

**Contact Information:**

**Prepared for: Nichols Road Partners**
P.O. Box 77850
Corona, CA 92877
Mr. Eric Werner
(951) 277-3900

**Prepared by:**

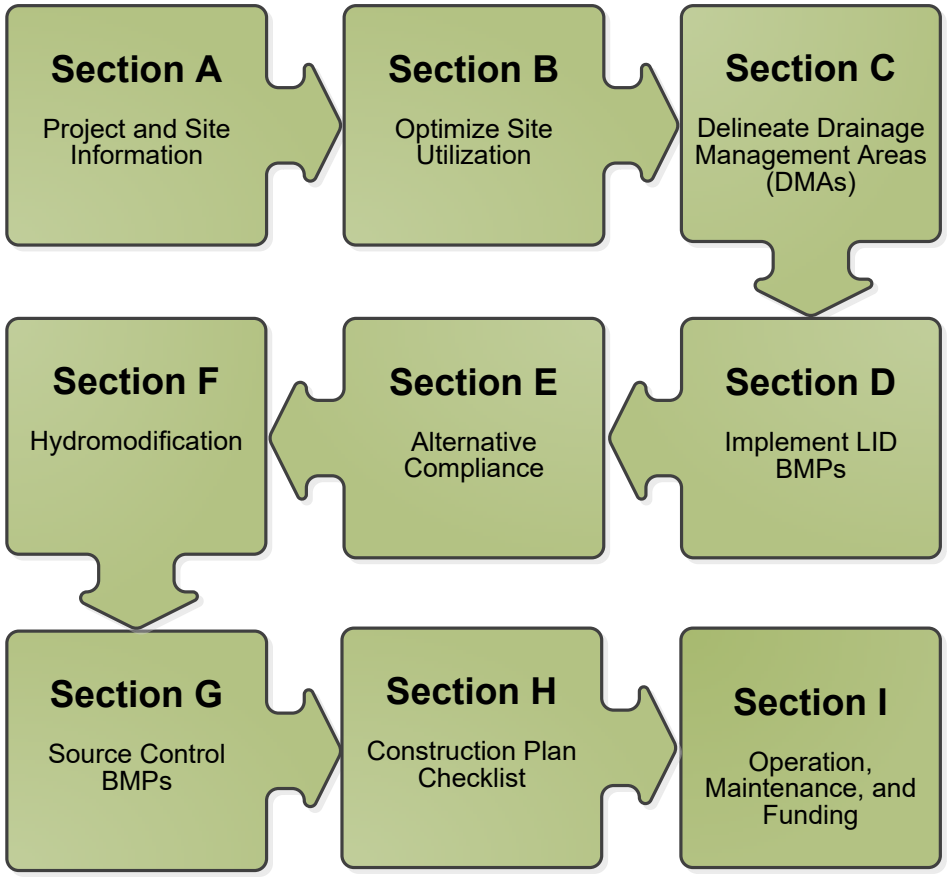
REGISTERED PROFESSIONAL ENGINEER
KEITH G. OSBORN
No. 36996
CIVIL
STATE OF CALIFORNIA

11-20-18


K&A Engineering, Inc.
357 N. Sheridan Street, Suite 117
Corona, CA 92880
Phone: (951) 279-1800
Fax: (951) 279-4380
Contact: Keith Osborn, P.E.

## INTRODUCTION

This Preliminary Project-Specific Nichols Road WQMP for the **Santa Ana Region** has been prepared to help guide in documenting compliance for this project. Below is a flowchart for the layout of this WQMP that will provide the steps required to document compliance.



## OWNER'S CERTIFICATION

This Preliminary Project-Specific Water Quality Management Plan (PWQMP) has been prepared for **Nichols Road Partners** by **K&A Engineering, Inc.** for the **Tract 37305 - Nichols South Specific Plan** Development project.

This PWQMP is intended to comply with the requirements of **City of Lake Elsinore** for Ordinance No. 1296 which includes the requirement for the preparation and implementation of a Project-Specific WQMP.

The undersigned, while owning the property/project described in the preceding paragraph, shall be responsible for the implementation and funding of this WQMP and will ensure that this WQMP is amended as appropriate to reflect up-to-date conditions on the site. In addition, the property owner accepts responsibility for interim operation and maintenance of Stormwater BMPs until such time as this responsibility is formally transferred to a subsequent owner. This WQMP will be reviewed with the facility operator, facility supervisors, employees, tenants, maintenance and service contractors, or any other party (or parties) having responsibility for implementing portions of this WQMP. At least one copy of this WQMP will be maintained at the project site or project office in perpetuity. The undersigned is authorized to certify and to approve implementation of this WQMP. The undersigned is aware that implementation of this WQMP is enforceable under **City of Lake Elsinore**, Water Quality Ordinance (Municipal Code Section 14.08).

"I, the undersigned, certify under penalty of law that the provisions of this WQMP have been reviewed and accepted and that the WQMP will be transferred to future successors in interest."

| | |
|---|---|
| Owner's Signature | Date: 10/17/18 |
| Owner's Printed Name: Eric Werner | Owner's Title/Position: Managing Member |

## PREPARER'S CERTIFICATION

"The selection, sizing and design of stormwater treatment and other stormwater quality and quantity control measures in this plan meet the requirements of Regional Water Quality Control Board Order No. **R8-2010-0033** and any subsequent amendments thereto."

| | |
|---|---|
| Preparer's Signature | Date: 10/17/18 |
| Keith Osborn, P.E.<br>Preparer's Printed Name | Principal<br>Preparer's Title/Position |

Preparer's Licensure:

REGISTERED PROFESSIONAL ENGINEER
KEITH G. OSBORN
No 36996
CIVIL
STATE OF CALIFORNIA

## Table of Contents


Section A: Project and Site Information ..... - 1 -

A.1 Maps and Site Plans ..... - 3 -

A.2 Identify Receiving Waters ..... - 3 -

A.3 Additional Permits/Approvals required for the Project: ..... - 6 -

Section B: Optimize Site Utilization (LID Principles) ..... - 7 -

Section C: Delineate Drainage Management Areas (DMAs) ..... - 9 -

Section D: Implement LID BMPs ..... - 12 -

D.1 Infiltration Applicability ..... - 12 -

D.2 Harvest and Use Assessment ..... - 13 -

D.3 Bioretention and Biotreatment Assessment ..... - 19 -

D.4 Feasibility Assessment Summaries ..... - 20 -

D.5 LID BMP Sizing ..... - 22 -

Section E: Alternative Compliance (LID Waiver Program) ..... - 24 -

E.1 Identify Pollutants of Concern ..... - 24 -

E.2 Stormwater Credits ..... - 25 -

E.3 Sizing Criteria ..... - 25 -

E.4 Treatment Control BMP Selection ..... - 26 -

Section F: Hydromodification ..... - 27 -

F.1 Hydrologic Conditions of Concern (HCOC) Analysis ..... - 27 -

F.2 HCOC Mitigation ..... - 29 -

Section G: Source Control BMPs ..... - 31 -

Section H: Construction Plan Checklist ..... - 34 -

Section I: Operation, Maintenance and Funding ..... - 35 -

## List of Tables

Table A.1 Identification of Receiving Waters ..... - 3 -
Table A.2 Other Applicable Permits ..... - 6 -
Table C.1 DMA Classifications ..... - 9 -
Table C.2 Type 'A', Self-Treating Areas ..... - 9 -
Table C.3 Type 'B', Self-Retaining Areas ..... - 9 -
Table C.4 Type 'C', Areas that Drain to Self-Retaining Areas ..... - 10 -
Table C.5 Type 'D', Areas Draining to BMPs ..... - 10 -
Table D.1 Infiltration Feasibility ..... - 12 -
Table D.2 LID Prioritization Summary Matrix ..... - 20 -
Table D.3 DCV Calculations for LID BMPs ..... - 22 -
Table E.1 Potential Pollutants by Land Use Type ..... - 24 -
Table E.2 Water Quality Credits ..... - 25 -
Table E.3 Treatment Control BMP Sizing ..... - 25 -
Table E.4 Treatment Control BMP Selection ..... - 26 -
Table F.1 Hydrologic Conditions of Concern Summary ..... - 27 -
Table G.1 Permanent and Operational Source Control Measures ..... - 31 -
Table H.1 Construction Plan Cross-reference ..... - 34 -

## List of Appendices

Appendix 1: Maps and Site Plans ..... 1-1
Appendix 2: Construction Plans ..... 2-1
Appendix 3: Soils Information ..... 3-1
Appendix 4: Historical Site Conditions ..... 4-1
Appendix 5: LID Infeasibility ..... 5-1
Appendix 6: BMP Design Details ..... 6-1
Appendix 7: Hydromodification ..... 7-1
Appendix 8: Source Control ..... 8-1
Appendix 9: O&M ..... 9-1
Appendix 10: Educational Materials ..... 10-1

# Section A: Project and Site Information

| | |
|---|---|
| **PROJECT INFORMATION** | |
| Type of Project: | Residential/Commercial Development |
| Planning Area: | Lake Elsinore |
| Community Name: | Riverside County |
| Development Name: | Tract 37305 - Nichols South Specific Plan |
| **PROJECT LOCATION** | |
| Latitude & Longitude (DMS): 33.705967° & -117.351590° | |
| Project Watershed and Sub-Watershed: Santa Ana River Watershed, Middle Santa Ana Sub-Watershed. | |
| APN(s): 389-200-037, 389-210-008, 389-210-032, 389-210-034, and 389-210-036 | |
| Map Book and Page No.: Thomas Brothers – Riverside (2006), Page 836 Grid B-7 | |
| **PROJECT CHARACTERISTICS** | |
| Proposed or Potential Land Use(s) | Residential and Commercial Dev. |
| Proposed or Potential SIC Code(s) | TBD |
| Area of Impervious Project Footprint (SF) | Residential (BMP A) areas: 38 ac, Imp = 1,031,283 sf<br>Commercial (BMP A) area 13.4 ac, Imp = 525,333 sf<br>Residential (BMP B) areas: 8.4 ac, Imp = 215,186 sf |
| Total Area of <u>proposed</u> Impervious Surfaces within the Project Limits (SF)/or Replacement | 1,771,802 sf |
| Does the project consist of offsite road improvements? | ☒ Y ☐ N |
| Does the project propose to construct unpaved roads? | ☐ Y ☒ N |
| Is the project part of a larger common plan of development (phased project)? | ☐ Y ☒ N |
| **EXISTING SITE CHARACTERISTICS** | |
| Total area of <u>existing</u> Impervious Surfaces within the project limits (SF) | 130,680 sf (ex. road) |
| Is the project located within any MSHCP Criteria Cell? | ☐ Y ☒ N |
| If so, identify the Cell number: | |
| Are there any natural hydrologic features on the project site? | ☒ Y ☐ N |
| Is a Geotechnical Report attached? | ☒ Y ☐ N |
| If no Geotech. Report, list the NRCS soils type(s) present on the site | See attached Geotech Report |
| What is the Water Quality Design Storm Depth for the project? | D85 = 0.67 inches |

TTM 37305 (Nichols South Specific Plan) is located south of Nichols Road, east of and adjacent to interstate 15, west of El Toro Road, and north of Temescal Canyon High School in the City of Lake Elsinore.

Stovepipe Canyon Creek bisects the project site from the east enters the property via two 24" pipes and over the concrete spillway and exits the property along the westerly property line via existing Caltrans 6'x14' RCB culvert.

The subject property is located within Sections 24 and 25, Township 5 South, Range 5 West, near the community of Lake Elsinore.

TTM 37305 is a 74 acre development consisting of 168 single family residential homes, a 14.5 acre commercial site along with a park and open space areas. TTM 37305 is located within the Nichols South Specific Plan which is being processed concurrently with TTM 37305.

The grading and drainage design of Tract 37305 has been developed to maintain the natural drainage patterns as much as practical. The roadway system and the proposed storm drain system will intercept runoff from the development and safely convey these flows to one of the two proposed mitigation basins within the development. The residential lots north of the Stovepipe Canyon Creek, Drainage Area "A", will flow to WQ Basin "A-1" which is an extended detention basin. Treated flows from WQ Basin "A-1" will then flow into Detention Basin "A", which is a peak flow mitigation basin, before discharge into the existing Stovepipe Canyon Creek.

The commercial development, Drainage Areas "C-1" and "C-2, will initially discharge into Detention Basin "A", after water quality flows are bifurcated into WQ Basin "A-2". In conjunction with the future commercial development much of the storm flows will be directed to the existing 24" culverts associated with the existing freeway ramp while water quality flows will be bifurcated and directed in a private storm drain into WQ Basin "A-2" which is a sand filter facility. Treated flows will then be discharged into Detention Basin "A" and then discharged into the existing Stovepipe Canyon Creek. Peak storm flows discharged into the two 24" culverts, as well as from Detention Basin "A", will be reduced to, or below, the existing condition flows.

The residential lots located to the South of the Stovepipe Canyon Creek, Drainage Area "B" will drain to WQ Basin "B" which is a Sand Filter basin with peak flow mitigation. This basin will discharge to a parkway culvert drain into existing El Toro Road. The flows from WQ Basin "B" will be reduced to below the existing condition flows.

The project takes its primary access from Nichols Road.

Following is a list of potential wastes/pollutants that may be generated on this site based upon the described use: Bacterial Indicators, Metals,

Nutrients, Possible pesticides - fertilizers from landscape maintenance activities, Toxic Organic Compounds, Sediments, Trash and debris, Oil and grease.

## A.1 Maps and Site Plans

When completing your Project-Specific WQMP, include a map of the local vicinity and existing site. In addition, include all grading, drainage, landscape/plant palette and other pertinent construction plans in Appendix 2. At a **minimum**, your WQMP Site Plan should include the following:

- Drainage Management Areas
- Proposed Structural BMPs
- Drainage Path
- Drainage Infrastructure, Inlets, Overflows
- Source Control BMPs
- Buildings, Roof Lines, Downspouts
- Impervious Surfaces
- Standard Labeling

Use your discretion on whether or not you may need to create multiple sheets or can appropriately accommodate these features on one or two sheets. Keep in mind that the Co-Permittee plan reviewer must be able to easily analyze your project utilizing this template and its associated site plans and maps.

## A.2 Identify Receiving Waters

Using Table A.1 below, list in order of upstream to downstream, the receiving waters that the project site is tributary to. Continue to fill each row with the Receiving Water's 303(d) listed impairments (if any), designated beneficial uses, and proximity, if any, to a RARE beneficial use. Include a map of the receiving waters in Appendix 1.

**Table A.1** Identification of Receiving Waters

| Receiving Waters | EPA Approved 303(d) List Impairments | Designated Beneficial Uses | Proximity to RARE Beneficial Use |
|---|---|---|---|
| | | | |
| Stovepipe Canyon Creek | None | | None |
| Temescal Creek Reach 5/6 | Bacteria | MUN, REC1, REC2, WARM, WILD, AGR, RARE, GWR. | 11 miles |
| Santa Ana River Reach 3 (HU# 801.21) | Copper, Lead, Pathogens | AGR, GWR, REC1, REC2, WARM, WILD, RARE, SPWN | 18 miles |
| Santa Ana River Reach 2 (HU# 801.13) | Indicator Bacteria | AGR, GWR, REC1, REC2, WARM, WILD, RARE, MUN, SPWN | 20 miles |

## 2010 Integrated Report (Clean Water Act Section 303(d) List / 305(b) Report) — Statewide

2010 Integrated Report | Map | 303(d) List | Admin. Record | Data Download | Past Reports | Contact Us

### 2010 INTEGRATED REPORT — ALL ASSESSED WATERS

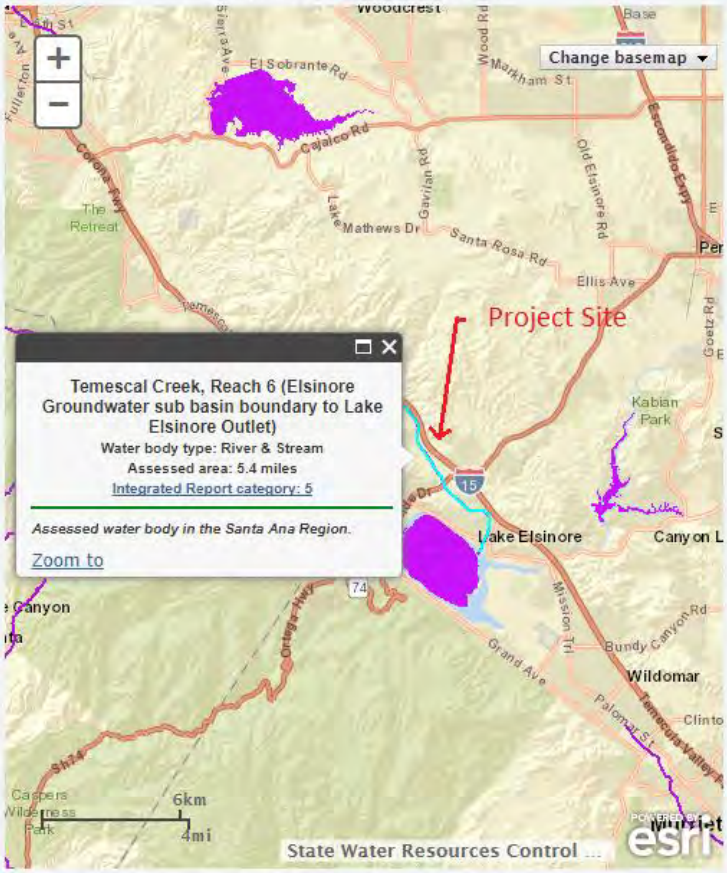
Zoom to county: All — Show county

Zoom to Regional Board: All — Show Regional Board

Map Help

Zoom to water body: *(Filter: All)*

Filter list by: | Reset list



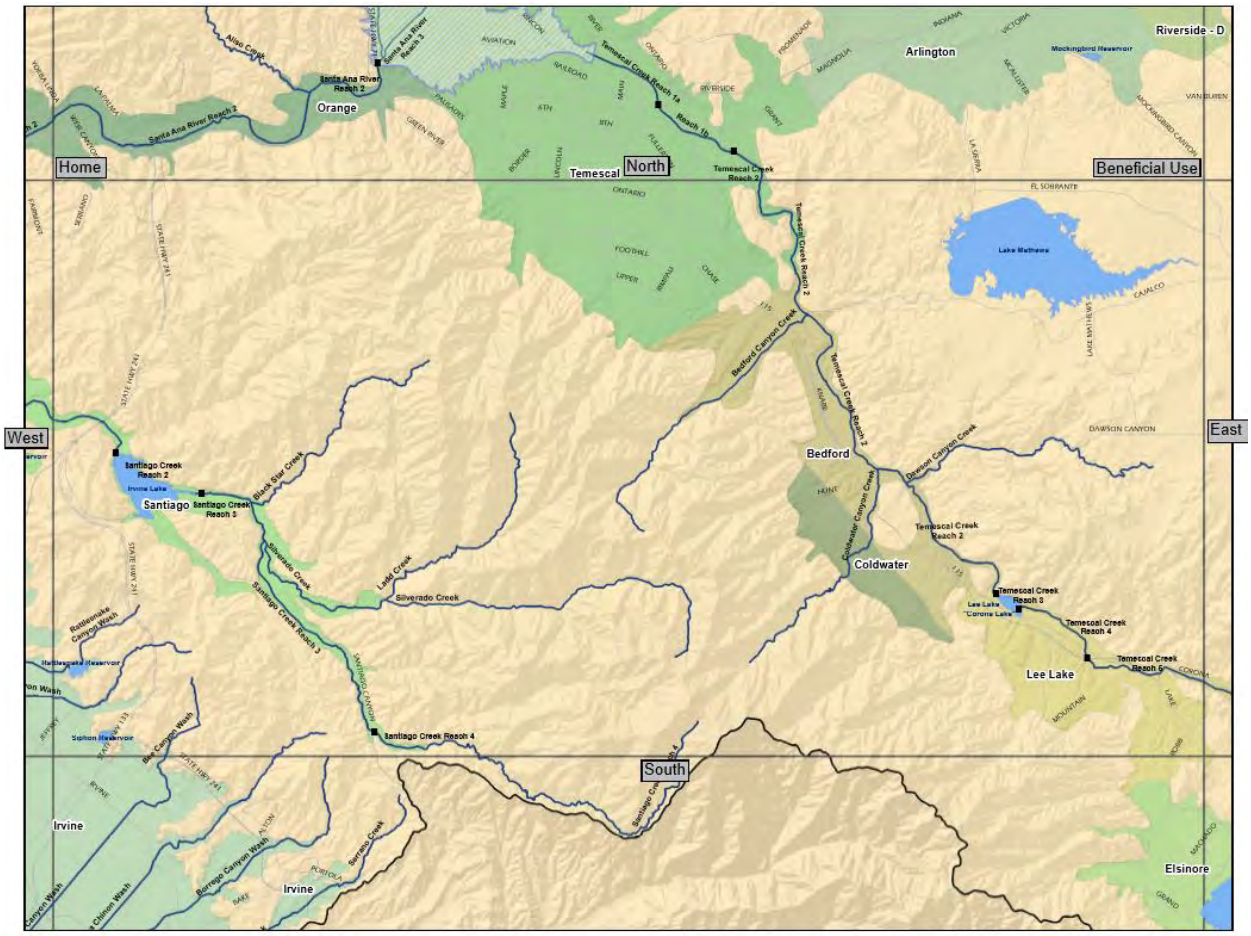

Temescal Creek, Reach 6 (Elsinore Groundwater sub basin boundary to Lake Elsinore Outlet) — Close

*Pollutant assessments*

| | |
|---|---|
| Pollutants | Listing Decision |
| | Report Link |
| | Potential Sources |
| | Schedule |
| | *Comments* |
| Indicator Bacteria | List on 303(d) list (TMDL required list) |
| | 28667 |
| | n/a |
| | Est. TMDL completion: 2021 |

This Webinar walks the user through the Integrated Report and its geospatial information s

- Geographical Information Systems (GIS) Files
  Update 12/23/11: The information presented on this map reflects the final USEPA-approved 2010 303(d) list. If you have any questions regarding the Integrated Report data and information, please email Lisa Holmes or call 916-341-5557. For any GIS-related questions, please email Stephanie Bucknam or call 916-558-1708.




**RWQCB – Region 8 Basin Plan Map – Beneficial Uses**

| | | | |
|---|---|---|---|
| | | REC1 | X |
| | | REC2 | X |
| | | WARM | X |
| | | WILD | X |
| **13** | Temescal Creek Reach 4 | AGR | X |
| | | GWR | X |
| | | MUN | + |
| | | RARE | X |
| | | REC1 | X |
| | | REC2 | X |
| | | WARM | X |
| | | WILD | X |
| **13** | Temescal Creek Reach 5 | AGR | X |
| | | GWR | X |
| | | MUN | + |
| | | RARE | X |
| | | REC1 | X |

| | | | |
|---|---|---|---|
| 9 | Santa Ana River Reach 2 | GWR | X |
| | | AGR | X |
| | | REC2 | X |
| | | REC1 | X |
| | | RARE | X |
| | | MUN | + |
| | | WILD | X |
| | | WARM | X |
| 9 | Santa Ana River Reach 3 | AGR | X |
| | | GWR | X |
| | | MUN | + |
| | | RARE | X |
| | | REC1 | X |
| | | REC2 | X |
| | | SPWN | X |
| | | WARM | X |
| | | WILD | X |

## A.3 Additional Permits/Approvals required for the Project:

**Table A.2** Other Applicable Permits

| Agency | Permit Required | |
|---|---|---|
| State Department of Fish and Wildlife, 1602 Streambed Alteration Agreement | ☒ Y | ☐ N |
| State Water Resources Control Board, Clean Water Act (CWA) Section 401 Water Quality Cert. | ☐ Y | ☒ N |
| US Army Corps of Engineers, CWA Section 404 Permit | ☐ Y | ☒ N |
| US Fish and Wildlife, Endangered Species Act Section 7 Biological Opinion | ☐ Y | ☒ N |
| Statewide Construction General Permit Coverage *(2009-0009-DWQ as amended by 2010-0014-DWQ)* | ☒ Y | ☐ N |
| Statewide Industrial General Permit Coverage *(Order No. 1997-0003-DWQ)* | ☐ Y | ☒ N |
| Western Riverside MSHCP Consistency Approval (e.g., JPR, DBESP) | ☒ Y | ☐ N |
| Other *(please list in the space below as required)*<br>City of Lake Elsinore Grading Permit and Building Permit, Encroachment Permit<br>State Water Resources Control Board, CWA Waste Discharge Requirements. | ☒ Y | ☐ N |

If yes is answered to any of the questions above, the Co-Permittee may require proof of approval/coverage from those agencies as applicable including documentation of any associated requirements that may affect this Project-Specific WQMP.

**All applicable permits will be included in this WQMP.**

# Section B: Optimize Site Utilization (LID Principles)

Review of the information collected in Section 'A' will aid in identifying the principal constraints on site design and selection of LID BMPs as well as opportunities to reduce imperviousness and incorporate LID Principles into the site and landscape design. For example, **constraints** might include impermeable soils, high groundwater, groundwater pollution or contaminated soils, steep slopes, geotechnical instability, high-intensity land use, heavy pedestrian or vehicular traffic, utility locations or safety concerns. **Opportunities** might include existing natural areas, low areas, oddly configured or otherwise unbuildable parcels, easements and landscape amenities including open space and buffers (which can double as locations for bioretention BMPs), and differences in elevation (which can provide hydraulic head). Prepare a brief narrative for each of the site optimization strategies described below. This narrative will help you as you proceed with your LID design and explain your design decisions to others.

The 2010 Santa Ana MS4 Permit further requires that LID Retention BMPs (Infiltration Only or Harvest and Use) be used unless it can be shown that those BMPs are infeasible. Therefore, it is important that your narrative identify and justify if there are any constraints that would prevent the use of those categories of LID BMPs. Similarly, you should also note opportunities that exist which will be utilized during project design. Upon completion of identifying Constraints and Opportunities, include these on your WQMP Site plan in Appendix 1.

The 2010 Santa Ana MS4 Permit further requires that LID Retention BMPs (Infiltration Only or Harvest and Use) be used unless it can be shown that those BMPs are infeasible

In addition to requiring implementation of LID BMPs, the MS4s Permit also prioritizes which LID BMPs should be used first.

1. Infiltrate,
2. Harvest and Use,
3. Evapotranspire,
4. Bio-Treatment and/or

Within the permits it is recognized that LID principles are not universally applicable throughout Riverside County and that they are dependent on factors such as:

1. Soil conditions including soil compaction and permeability,
2. Groundwater levels,
3. Soil contaminants (Brownfield development),
4. Space restrictions (in-fill projects, redevelopment projects, high density development),
5. Highest and best use of Urban Runoff (to support downstream uses)

## Site Optimization

The following questions are based upon Section 3.2 of the WQMP Guidance Document. Review of the WQMP Guidance Document will help you determine how best to optimize your site and subsequently identify opportunities and/or constraints, and document compliance.

**Did you identify and preserve existing drainage patterns? If so, how? If not, why?**

*Stovepipe Canyon bisects the project site from the east enters the property and exits the property along the westerly property line via existing Caltrans 6'x14' RCB culvert..*

*The grading and drainage design of Tract 37305 has been developed to maintain the natural discharge patterns as much as practical. The proposed drainage plan will provide for construction of inlets with the storm drain system. The project design directs all flows from within the developed residential lots into the proposed Sand Filter Basins and Extended Detention Basin.*

**Did you identify and protect existing vegetation? If so, how? If not, why?**

*Preservation of natural areas containing significant vegetation was considered and is maintained within natural drainage courses within areas allocated for open space. The project is in compliance with the this City's General Plan with respect to preservation of natural areas.*

*The grading and drainage design of Tract 37305 project has been developed to maintain the natural drainage discharge patterns as much as practical.*

**Did you identify and preserve natural infiltration capacity? If so, how? If not, why?**

*Per Riverside County Flood Control soils mapping the total project site is on mix Type A thru D soil, from potentially yielding a relatively low to high soil runoff potential and from good to bad infiltration rate. The majority of the proposed development is in Type Soil C. Also confirm per Infiltration Test results, the infiltration rates range 0.1-0.2 in/hr (by CHJ Consultants – a Terracon Company soil report dated March 31, 2017).*

*Based on LID BMP Prioritization, Sand Filter Basin will be the preferred BMPs for alternate BMPs situated in sites with poor infiltration rates; Sand Filter Basins were selected as the most appropriate treatment BMPs for tributary area up to 25 acres and Extended Detention Basin for area larger than 25 acres.*

**Did you identify and minimize impervious area? If so, how? If not, why?**

*The project is proposed as a subdivision per City ordinances resulting in narrower streets and the option to minimize or eliminate sidewalks through most of the project. The open space lots within Tract 37305 will include natural open spaces, landscaped slopes, proposed BMPs: Sand Filter Basins and Extended Detention Basin, a park in an effort to reduce urban runoff and maintain the natural landscape of the area.*

**Did you identify and disperse runoff to adjacent pervious areas? If so, how? If not, why?**

*The building roof drains will be routed into adjacent landscape areas.*
*The proposed on-site drainage project disperses runoff into Sand Filter Basins and Extended Detention Basin as structural BMPs. With the proposed development draining into Sand Filter Basins and Extended Detention Basin capable of treating the total Vbmp from proposed project site.*

# Section C: Delineate Drainage Management Areas (DMAs)

Utilizing the procedure in Section 3.3 of the WQMP Guidance Document which discusses the methods of delineating and mapping your project site into individual DMAs, the Table C.1 below was completed to appropriately categorize the types of classification (e.g., Type A, Type B, etc.) per DMA for your project site. This information will then be used to populate and tabulate the corresponding tables for their respective DMA classifications.

**Table C.1** DMA Classifications

| DMA Name or ID | Surface Type(s)[1] | Area (Ac) | DMA Type |
|---|---|---|---|
| | | | |
| DMA A-1a | Residential (Mix surfaces) | 27.03 | "D", to BMP A-1 |
| | | | |
| DMA A-1b | Basin A | 3.5 | "A", to Basin A |
| | | | |
| DMA A-2a | Street | 5.0 | "D", to BMP A-2 |
| DMA A-2b | Commercial | 19.37 | "D", to BMP A-2 |
| | | | |
| DMA B-1a | Residential (Mix surfaces) | 7.6 | "D", to BMP B |
| DMA B-1b | Basin B | 0.8 | "A", to BMP B |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

[1]*Reference Table 2-1 in the WQMP Guidance Document to populate this column*

**Table C.2** Type 'A', Self-Treating Areas

| DMA Name or ID | Area (Ac.) | Stabilization Type | Irrigation Type (if any) |
|---|---|---|---|
| Basin A | 3.5 | Native grass | yes |
| Basin B | 0.8 | Native grass | yes |
| | | | |
| | | | |
| | | | |

**Table C.3** Type 'B', Self-Retaining Areas

| **Self-Retaining Area** | | | | **Type 'C' DMAs that are draining to the Self-Retaining Area** | | |
|---|---|---|---|---|---|---|
| DMA Name/ ID | Post-project surface type | Area (square feet) | Storm Depth (inches) | DMA Name / ID | [C] from Table C.4 = | Required Retention Depth (inches) |
| | | [A] | [B] | | [C] | [D] |

| | | | | | | |
|---|---|---|---|---|---|---|
| N/A | | | | | | |
| | | | | | | |

$$[D] = [B] + \frac{[B] \cdot [C]}{[A]}$$

**Table C.4** Type 'C', Areas that Drain to Self-Retaining Areas

| **DMA** | | | | | **Receiving Self-Retaining DMA** | | |
|---|---|---|---|---|---|---|---|
| DMA Name/ ID | Area (square feet) [A] | Post-project surface type | Runoff factor [B] | Product [C] = [A] x [B] | DMA name /ID | Area (square feet) [D] | Ratio [C]/[D] |
| N/A | | | | | | | |
| | | | | | | | |
| | | | | | | | |

**Table C.5** Type 'D', Areas Draining to BMPs

| DMA Name or ID | BMP Name or ID |
|---|---|
| | |
| DMA A-1a | BMP A-1: Extended Detention Basin A-1 |
| | |
| DMA A-2a and DMA A-2b | BMP A-2: Sand Filter Basin A-2 |
| | |
| DMA B-1a and B-1b | BMP B: Sand Filter Basin B |
| | |
| | |

*Note: More than one drainage management area can drain to a single LID BMP, however, one drainage management area may not drain to more than one BMP.*

ACTUAL IMPERVIOUS COVER

| Land Use (1) | Range-Percent | Recommended Value For Average Conditions-Percent(2) |
|---|---|---|
| Natural or Agriculture | 0 - 10 | 0 |
| Single Family Residential: (3) | | |
| 40,000 S. F. (1 Acre) Lots | 10 - 25 | 20 |
| 20,000 S. F. (½ Acre) Lots | 30 - 45 | 40 |
| 7,200 - 10,000 S. F. Lots | 45 - 55 | 50 |
| Multiple Family Residential: | | |
| Condominiums | 45 - 70 | 65 |
| Apartments | 65 - 90 | 80 |
| Mobile Home Park | 60 - 85 | 75 |
| Commercial, Downtown Business or Industrial | 80 -100 | 90 |

Notes:

1. Land use should be based on ultimate development of the watershed. Long range master plans for the County and incorporated cities should be reviewed to insure reasonable land use assumptions.

2. Recommended values are based on average conditions which may not apply to a particular study area. The percentage impervious may vary greatly even on comparable sized lots due to differences in dwelling size, improvements, etc. Landscape practices should also be considered as it is common in some areas to use ornamental gravels underlain by impervious plastic materials in place of lawns and shrubs. A field investigation of a study area should always be made, and a review of aerial photos, where available may assist in estimating the percentage of impervious cover in developed areas.

3. For typical horse ranch subdivisions increase impervious area 5 percent over the values recommended in the table above.

**RCFC & WCD**
HYDROLOGY MANUAL

IMPERVIOUS COVER FOR DEVELOPED AREAS

PLATE D-5.6

For conservative Residential Nichols Road Project, I = 0.55 ➔ use 0.65 in preliminary

# Section D: Implement LID BMPs

## D.1 Infiltration Applicability

Is there an approved downstream 'Highest and Best Use' for stormwater runoff (see discussion in Chapter 2.4.4 of the WQMP Guidance Document for further details)? ☐ Y ☒ N

If yes has been checked, Infiltration BMPs shall not be used for the site. If no, continue working through this section to implement your LID BMPs. It is recommended that you contact your Co-Permittee to verify whether or not your project discharges to an approved downstream 'Highest and Best Use' feature.

### Geotechnical Report

A Geotechnical Report or Phase I Environmental Site Assessment may be required by the Co-Permittee to confirm present and past site characteristics that may affect the use of Infiltration BMPs. In addition, the Co-Permittee, at their discretion, may not require a geotechnical report for small projects as described in Chapter 2 of the WQMP Guidance Document. If a geotechnical report has been prepared, include it in Appendix 3. In addition, if a Phase I Environmental Site Assessment has been prepared, include it in Appendix 4.

Is this project classified as a small project consistent with the requirements of Chapter 2 of the WQMP Guidance Document? ☐ Y ☒ N

### Infiltration Feasibility

Table D.1 below is meant to provide a simple means of assessing which DMAs on your site support Infiltration BMPs and is discussed in the WQMP Guidance Document in Chapter 2.4.5. Check the appropriate box for each question and then list affected DMAs as applicable. If additional space is needed, add a row below the corresponding answer.

**Table D.1** Infiltration Feasibility

| Does the project site… | YES | NO |
|---|---|---|
| …have any DMAs with a seasonal high groundwater mark shallower than 10 feet? | | X |
| If Yes, list affected DMAs: | | |
| …have any DMAs located within 100 feet of a water supply well? | | X |
| If Yes, list affected DMAs: | | |
| …have any areas identified by the geotechnical report as posing a public safety risk where infiltration of stormwater could have a negative impact? | | X |
| If Yes, list affected DMAs: | | |
| …have measured in-situ infiltration rates of less than 1.6 inches / hour? *) see below | X | |
| If Yes, list affected DMAs: **All DMAs in the project.** | | |
| …have significant cut and/or fill conditions that would preclude in-situ testing of infiltration rates at the final infiltration surface? | | X |
| If Yes, list affected DMAs: | | |
| …geotechnical report identify other site-specific factors that would preclude effective and safe infiltration? | | X |
| Describe here: *Per Infiltration Test results, the infiltration rates range 0.1-0.2 in/hr (by CHJ Consultants – a Terracon Company soil report dated March 31, 2017).* | | |

If you answered "Yes" to any of the questions above for any DMA, Infiltration BMPs should not be used for those DMAs and you should proceed to the assessment for Harvest and Use below.

## D.2 Harvest and Use Assessment

Please check what applies*:*

- ☐ Reclaimed water will be used for the non-potable water demands for the project.
- ☐ Downstream water rights may be impacted by Harvest and Use as approved by the Regional Board (verify with the Copermittee).
- ☐ The Design Capture Volume will be addressed using Infiltration Only BMPs. In such a case, Harvest and Use BMPs are still encouraged, but it would not be required if the Design Capture Volume will be infiltrated or evapotranspired.

If any of the above boxes have been checked, Harvest and Use BMPs need not be assessed for the site. If neither of the above criteria applies, follow the steps below to assess the feasibility of irrigation use, toilet use and other non-potable uses (e.g., industrial use).

### Irrigation Use Feasibility

Complete the following steps to determine the feasibility of harvesting stormwater runoff for Irrigation Use BMPs on your site:

Step 1: Identify the total area of irrigated landscape on the site, and the type of landscaping used.

*Total Area of Irrigated Landscape*: **6 Ac**

*Type of Landscaping (Conservation Design or Active Turf)*: **Active Turf Area**

Step 2: Identify the planned total of all impervious areas on the proposed project from which runoff might be feasibly captured and stored for irrigation use. Depending on the configuration of buildings and other impervious areas on the site, you may consider the site as a whole, or parts of the site, to evaluate reasonable scenarios for capturing and storing runoff and directing the stored runoff to the potential use(s) identified in Step 1 above.

*Total Area of Impervious Surfaces:* **49.3 Ac**

Step 3: Cross reference the Design Storm depth for the project site (see Exhibit A of the WQMP Guidance Document) with the left column of Table 2-3 in Chapter 2 to determine the minimum area of Effective Irrigated Area per Tributary Impervious Area (EIATIA).

*Enter your EIATIA factor*: **0.66 (Design Capture Storm depth = 0.67 in. for Active Turf Area)**

Step 4: Multiply the unit value obtained from Step 3 by the total of impervious areas from Step 2 to develop the minimum irrigated area that would be required.

*Minimum required irrigated area***: 0.66 x 49.3 = 32.54**

Step 5: Determine if harvesting stormwater runoff for irrigation use is feasible for the project by comparing the total area of irrigated landscape (Step 1) to the minimum required irrigated area (Step 4).

| Minimum required irrigated area (Step 4) | Available Irrigated Landscape (Step 1) |
|---|---|
| **32.54** | **6** |

***Therefore Harvest and Use based on Landscape Irrigation Use is not feasible for Tract 37305.***

TABLE 2-3. Harvest and Use Data for Irrigation Use[A, B]

| General Landscape Type | Conservation Design: $K_L$=0.35 | Active Turf Areas: $K_L$[C]=0.70 |
|---|---|---|
| Design Capture Storm Depth, in | Minimum Required Effective Irrigated Area per Tributary Impervious Acre for partial capture (ac/ac) | |
| 0.50 | 0.26 | 0.22 |
| 0.55 | 0.52 | 0.35 |
| 0.60 | 0.79 | 0.47 |
| 0.65 | 1.05 | 0.60 |
| 0.70 | 1.32 | 0.72 |
| 0.75 | 1.59 | 0.85 |
| 0.80 | 1.85 | 0.98 |
| 0.85 | 2.12 | 1.10 |
| 0.90 | 2.38 | 1.23 |
| 0.95 | 2.65 | 1.35 |
| 1.00 | 2.92 | 1.48 |
| 1.05 | 3.18 | 1.60 |
| 1.10 | 3.45 | 1.73 |
| 1.15 | 3.71 | 1.85 |
| 1.20 | 3.98 | 1.98 |

[A] *ET data from the CIMIS station at U.C. Riverside used for this analysis.*

[B] *To use this table, select the Design Storm for your project area. Then select the planting/irrigation management type (i.e., conservation versus active turf). The resulting value gives the minimum required irrigated area per tributary area for stormwater capture which will be used in Step 3 of D.2 in the Template.*

[C] *$K_L$ = Landscape Coefficient, $K_L$ = Ks × Kd × Kmc where Ks = species factor, Kd = density factor and Kmc = microclimate factor. The landscape coefficient ($K_L$) incorporates plant species, microclimate and water management/irrigation practices as adapted from Appendix X of the 2011 Orange County Technical Guidance Document located here:* ***http://www.ocwatershed.com/WQMP.aspx***

*For the table above, the lower value corresponds to water conservation practices and the higher value corresponds to traditional irrigation practices for grass turf.*

*Each Co-Permittee has a model ordinance based on AB 1881. Specifying certain high water use plants contradicts the intent of AB 1881.*

## Toilet Use Feasibility

Complete the following steps to determine the feasibility of harvesting stormwater runoff for toilet flushing uses on your site:

Step 1: Identify the projected total number of daily toilet users during the wet season, and account for any periodic shut downs or other lapses in occupancy:

*Projected Number of Daily Toilet Users:* **(168 x 2 people x 9.3) + (14.4 x 10 x 7) = 4132**

*Project Type:* **Residential and Commercial**

Step 2: Identify the planned total of all impervious areas on the proposed project from which runoff might be feasibly captured and stored for toilet use. Depending on the configuration of buildings and other impervious areas on the site, you may consider the site as a whole, or parts of the site, to evaluate reasonable scenarios for capturing and storing runoff and directing the stored runoff to the potential use(s) identified in Step 1 above.

*Total Area of Impervious Surfaces:* **49.3 Ac**

Step 3: Enter the Design Storm depth for the project site (see Exhibit A) into the left column of Table 2-1 in Chapter 2 to determine the minimum number or toilet users per tributary impervious acre (TUTIA).

*Enter your TUTIA factor:* **105/Ac. (Design Capture Storm depth = 0.67 in. for Residential)**

**136.5/Ac. (Design Capture Storm depth = 0.67 in. for Commercial)**

Step 4: Multiply the unit value obtained from Step 3 by the total of impervious areas from Step 2 to develop the minimum number of toilet users that would be required.

*Minimum number of toilet users:* **(36.3 x 105) + (13 x 136.5) = 5587**

Step 5: Determine if harvesting stormwater runoff for toilet flushing use is feasible for the project by comparing the Number of Daily Toilet Users (Step 1) to the minimum required number of toilet users (Step 4).

| Minimum required Toilet Users (Step 4) | Projected number of toilet users (Step 1) |
|---|---|
| **5587** | **4132** |

***Therefore Harvest and Use based on Toilet Use is not feasible for Tract 37305.***

**Table X.1: Toilet and Urinal Water Usage per Resident or Employee**

| Land Use Type | Toilet User Unit of Normalization | Per Capita Use per Day | | Visitor Factor[4] | Water Efficiency Factor | Total Use |
|---|---|---|---|---|---|---|
| | | Toilet Flushing [1,2] | Urinals[3] | | | |
| Residential | Resident | 18.5 | NA | NA | 0.5 | 9.3 |
| Office | Employee (non-visitor) | 9.0 | 2.27 | 1.1 | 0.5 | 7 (avg) |
| Retail | Employee (non-visitor) | 9.0 | 2.11 | 1.4 | 0.5 | |
| Schools | Employee (non-student) | 6.7 | 3.5 | 6.4 | 0.5 | 33 |
| Various Industrial Uses (excludes process water) | Employee (non-visitor) | 9.0 | 2 | 1 | 0.5 | 5.5 |

1- Based on American Waterworks Association Research Foundation,1999. Residential End Uses of Water. Denver, CO: AWWARF

2 - Based on use of 3.45 gallons per flush and average number of per employee flushes per subsector, Table D-1 for MWD (Pacific Institute, 2003)

3 - Based on use of 1.6 gallons per flush, Table D-4 and average number of per employee flushes per subsector, Appendix D (Pacific Institute, 2003)

4 - Multiplied by the demand for toilet and urinal flushing for the project to account for visitors. Based on proportion of annual use allocated to visitors and others (includes students for schools; about 5 students per employee) for each subsector in Table D-1 and D-4 (Pacific Institute, 2003)

5 – Accounts for requirements to use ultra low flush toilets in new development projects; assumed that requirements will reduce toilet and urinal flushing demand by half on average compared to literature estimates. Ultra low flush (ULF) toilets are required in all new construction in California as of January 1, 1992. ULF toilets must use no more than 1.6 gallons per flush (gpf) and ULF urinals must use no more than 1 gpf. (http://www.fypower.org/com/tools/products_results.html?id=100139) Note: If zero flush urinals are being used, adjust accordingly.

TABLE 2-2. Harvest and Use Data for Toilet Use

| **Project type** | **Residential** | **Retail / Office Commercial** | **Industrial** | **Schools** |
|---|---|---|---|---|
| *Basis of Use Type* | *Resident* | *Employee (non-visitor)* | *Employee (non-visitor)* | *Employee (non-student)* |
| **Design Capture Storm depth, in** | **Minimum toilet users per tributary impervious acre for partial capture (tu/ac)** | | | |
| 0.50 | 85 | 114 | 142 | 24 |
| 0.55 | 93 | 123 | 158 | 26 |
| 0.60 | 101 | 132 | 172 | 29 |
| 0.65 | 108 | 141 | 185 | 31 |
| 0.70 | 116 | 150 | 198 | 33 |
| 0.75 | 123 | 159 | 208 | 35 |
| 0.80 | 131 | 167 | 219 | 37 |
| 0.85 | 138 | 176 | 229 | 39 |
| 0.90 | 145 | 184 | 238 | 40 |
| 0.95 | 152 | 193 | 247 | 42 |
| 1.00 | 159 | 201 | 255 | 43 |
| 1.05 | 166 | 209 | 263 | 44 |
| 1.10 | 172 | 217 | 271 | 45 |
| 1.15 | 179 | 225 | 278 | 46 |
| 1.20 | 185 | 233 | 285 | 47 |

[A] *Unit demands used in analysis:*

*Residential = 9.3 gal/resident/day*
*Retail/office = 7 gal/employee/day*
*Industrial = 5.5 gal/employee/day*
*Schools = 33 gal/employee/day*

## Other Non-Potable Use Feasibility – Not Applicable

Are there other non-potable uses for stormwater runoff on the site (e.g. industrial use)? See Chapter 2 of the Guidance for further information. If yes, describe below. If no, write N/A.

Insert narrative description here.

Step 1: Identify the projected average daily non-potable demand, in gallons per day, during the wet season and accounting for any periodic shut downs or other lapses in occupancy or operation.

*Average Daily Demand: Projected Average Daily Use (gpd)*

Step 2: Identify the planned total of all impervious areas on the proposed project from which runoff might be feasibly captured and stored for the identified non-potable use. Depending on the configuration of buildings and other impervious areas on the site, you may consider the site as a whole, or parts of the site, to evaluate reasonable scenarios for capturing and storing runoff and directing the stored runoff to the potential use(s) identified in Step 1 above.

*Total Area of Impervious Surfaces: Insert Area (Acres)*

Step 3: Enter the Design Storm depth for the project site (see Exhibit A) into the left column of Table 2-3 in Chapter 2 to determine the minimum demand for non-potable uses per tributary impervious acre.

*Enter the factor from Table 2-3: Enter Value*

Step 4: Multiply the unit value obtained from Step 4 by the total of impervious areas from Step 3 to develop the minimum number of gallons per day of non-potable use that would be required.

*Minimum required use: Minimum use required (gpd)*

Step 5: Determine if harvesting stormwater runoff for other non-potable use is feasible for the project by comparing the Number of Daily Toilet Users (Step 1) to the minimum required number of toilet users (Step 4).

| **Minimum required non-potable use (Step 4)** | **Projected average daily use (Step 1)** |
|---|---|
| Minimum use required (gpd) | Projected Average Daily Use (gpd) |

If Irrigation, Toilet and Other Use feasibility anticipated demands are less than the applicable minimum values, Harvest and Use BMPs are not required and you should proceed to utilize LID Bioretention and Biotreatment, unless a site-specific analysis has been completed that demonstrates technical infeasibility as noted in D.3 below.

## D.3 Bioretention and Biotreatment Assessment

Other LID Bioretention and Biotreatment BMPs as described in Chapter 2.4.7 of the WQMP Guidance Document are feasible on nearly all development sites with sufficient advance planning.

Select one of the following:

- ✓ LID Bioretention/Biotreatment BMPs will be used for some or all DMAs of the project as noted below in Section D.4 (note the requirements of Section 3.4.2 in the WQMP Guidance Document).
- ☐ A site-specific analysis demonstrating the technical infeasibility of all LID BMPs has been performed and is included in Appendix 5. If you plan to submit an analysis demonstrating the technical infeasibility of LID BMPs, request a pre-submittal meeting with the Copermittee to discuss this option. Proceed to Section E to document your alternative compliance measures.

## D.4 Feasibility Assessment Summaries

From the Infiltration, Harvest and Use, Bioretention and Biotreatment Sections above, complete Table D.2 below to summarize which LID BMPs are technically feasible, and which are not, based upon the established hierarchy.

**Table D.2** LID Prioritization Summary Matrix

| DMA Name/ID | LID BMP Hierarchy | | | | No LID (Alternative Compliance) |
|---|---|---|---|---|---|
| | 1. Infiltration | 2. Harvest and use | 3. Bioretention | 4. Biotreatment | |
| A-1a | ☐ | ☐ | ☐ | ☒ | ☐ |
| A-2a and A-2b | ☐ | ☐ | ☐ | ☒ | ☐ |
| B-1a and B-1b | ☐ | ☐ | ☐ | ☒ | ☐ |
| | ☐ | ☐ | ☐ | ☐ | ☐ |
| | ☐ | ☐ | ☐ | ☐ | ☐ |
| | ☐ | ☐ | ☐ | ☐ | ☐ |
| | ☐ | ☐ | ☐ | ☐ | ☐ |
| | ☐ | ☐ | ☐ | ☐ | ☐ |
| | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | | | | |

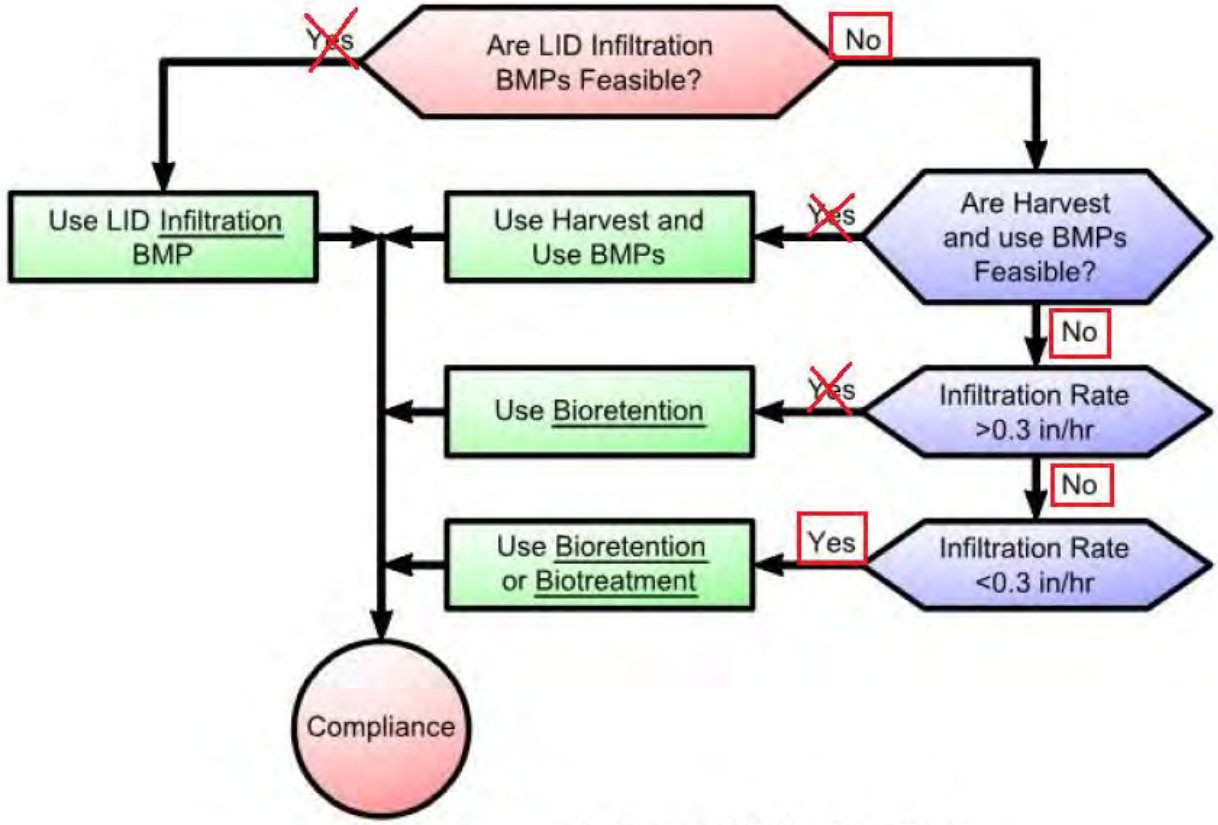
For those DMAs where LID BMPs are not feasible, provide a brief narrative below summarizing why they are not feasible, include your technical infeasibility criteria in Appendix 5, and proceed to Section E below to document Alternative Compliance measures for those DMAs. Recall that each proposed DMA must pass through the LID BMP hierarchy before alternative compliance measures may be considered.

DMA A-1a (27.03 Ac) – Type D, Mix Surface - Residential areas drain to proposed BMP A-1, Extended Detention Basin A-1.

DMA A-1b (3.5 Ac) – Type A, Detention Basin A – Self treating areas.

DMA A-2a (5.0 Ac) – Type D, Mix Surface - Street and A-2b (19.37 Ac) – Type D, Commercial Site areas drain to proposed BMP A-2, Sand Filter Basin A-2.

DMA B-1a (7.6 Ac) – Type D, Mix Surface – Residential and B-1b, (0.8 Ac) – Type A, Basin B areas drain to proposed BMP B, Sand Filter Basin B.




LID BMP Feasibility Flow Chart

LID BMP Feasibility Flow Chart

**Drainage areas A and B**

*Based on LID BMP Prioritization, for alternate BMPs situated in poor or no infiltration rate; Extended Detention Basin and Sand Filter Basins were selected as the most appropriate treatment BMPs.*

***The project site infiltration rate is < 0.3 in/hr. Therefore Biotreatment BMPs are selected: Extended Detention and Sand Filter Basins.***

# D.5 LID BMP Sizing

Each LID BMP must be designed to ensure that the Design Capture Volume will be addressed by the selected BMPs. First**,** calculate the Design Capture Volume for each LID BMP using the $V_{BMP}$ worksheet in Appendix F of the LID BMP Design Handbook. Second**,** design the LID BMP to meet the required $V_{BMP}$ using a method approved by the Copermittee. Utilize the worksheets found in the LID BMP Design Handbook or consult with your Copermittee to assist you in correctly sizing your LID BMPs. Complete Table D.3 below to document the Design Capture Volume and the Proposed Volume for each LID BMP. Provide the completed design procedure sheets for each LID BMP in Appendix 6. You may add additional rows to the table below as needed.

**Table D.3** DCV Calculations for LID BMPs

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type | Effective Impervious Fraction, $I_f$ | DMA Runoff Factor | DMA Areas x Runoff Factor | *Enter BMP Name / Identifier Here "BMP A-1"* | | |
|---|---|---|---|---|---|---|---|---|
| | [A] | | [B] | [C] | [A] x [C] | | | |
| ***A-1a (Residential)*** | *1,177,427* | *Mix Surface* | *0.65* | *0.45* | *528874.6* | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | $A_T = \Sigma[A]$ | | | | $\Sigma = [D]$ | [E] | $[F] = \frac{[D]x[E]}{12}$ | [G] |
| | 1,177,427 | | | | 528,874.6 | 0.67 | 29,528.8 | 29,530 |

DMA A-1b (3.5 Ac) – Type A, Detention Basin A – Self treating areas.

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type | Effective Impervious Fraction, $I_f$ | DMA Runoff Factor | DMA Areas x Runoff Factor | *Enter BMP Name / Identifier Here "BMP A-2"* | | |
|---|---|---|---|---|---|---|---|---|
| | [A] | | [B] | [C] | [A] x [C] | | | |
| | | | | | | | | |
| ***A-2a (Street)*** | *217,800* | *Mix Surface* | *0.9* | *0.73* | *159,055.4* | | | |
| ***A-2b (Commercial)*** | *843,757* | *Mix Surface* | *0.9* | *0.73* | *616,180.5* | | | |
| | | | | | | *Design Storm Depth (in)* | *Design Capture Volume, $V_{BMP}$ (cubic feet)* | *Proposed Volume on Plans (cubic feet)* |
| | | | | | | | | |
| | | | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | $A_T = \Sigma[A]$<br><br>1,061,557 | | $\Sigma = [D]$<br><br>775,235.9 | [E]<br><br>0.67 | $[F] = \frac{[D]x[E]}{12}$<br><br>43,284 | [G]<br><br>43,300 |

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type | Effective Impervious Fraction, $I_f$ | DMA Runoff Factor | DMA Areas x Runoff Factor | *Enter BMP Name / Identifier Here*<br>*"BMP B"* | | |
|---|---|---|---|---|---|---|---|---|
| | [A] | | [B] | [C] | [A] x [C] | | | |
| | | | | | | | | |
| ***B-1a (Residential)*** | *331,056* | *Mix Surface* | *0.65* | *0.45* | *148,703.2* | | | |
| ***B-1b (Basin)*** | *34,848* | *Ornamental Landscape* | *0.1* | *0.11* | *3,849.2* | | | |
| | | | | | | *Design Storm Depth (in)* | *Design Capture Volume,* $\mathbf{V_{BMP}}$ *(cubic feet)* | *Proposed Volume on Plans (cubic feet)* |
| | | | | | | | | |
| | | | | | | | | |
| | $A_T = \Sigma[A]$<br><br>365,904 | | | $\Sigma = [D]$<br><br>152,552.4 | [E]<br><br>0.67 | $[F] = \frac{[D]x[E]}{12}$<br><br>8,517.5 | [G]<br><br>8,520 | |

[B], [C] is obtained as described in Section 2.3.1 of the WQMP Guidance Document
[E] is obtained from Exhibit A in the WQMP Guidance Document
[G] is obtained from a design procedure sheet, such as in LID BMP Design Handbook and placed in Appendix 6

<u>See complete calculations in Appendix 6</u>

# Section E: Alternative Compliance (LID Waiver Program)

LID BMPs are expected to be feasible on virtually all projects. Where LID BMPs have been demonstrated to be infeasible as documented in Section D, other Treatment Control BMPs must be used (subject to LID waiver approval by the Copermittee). Check one of the following Boxes:

✓ LID Principles and LID BMPs have been incorporated into the site design to fully address all Drainage Management Areas. No alternative compliance measures are required for this project and thus **this Section is not required to be completed.**

Or -

☐ The following Drainage Management Areas are unable to be addressed using LID BMPs. A site-specific analysis demonstrating technical infeasibility of LID BMPs has been approved by the Co-Permittee and included in Appendix 5. Additionally, no downstream regional and/or sub-regional LID BMPs exist or are available for use by the project. The following alternative compliance measures on the following pages are being implemented to ensure that any pollutant loads expected to be discharged by not incorporating LID BMPs, are fully mitigated.

## E.1 Identify Pollutants of Concern

Utilizing Table A.1 from Section A above which noted your project's receiving waters and their associated EPA approved 303(d) listed impairments, cross reference this information with that of your selected Priority Development Project Category in Table E.1 below. If the identified General Pollutant Categories are the same as those listed for your receiving waters, then these will be your Pollutants of Concern and the appropriate box or boxes will be checked on the last row. The purpose of this is to document compliance and to help you appropriately plan for mitigating your Pollutants of Concern in lieu of implementing LID BMPs.

**Table E.1** Potential Pollutants by Land Use Type

| Priority Development Project Categories and/or Project Features (check those that apply) | General Pollutant Categories | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Bacterial Indicators | Metals | Nutrients | Pesticides | Toxic Organic Compounds | Sediments | Trash & Debris | Oil & Grease |
| ☒ Detached Residential Development | P | N | P | P | N | P | P | P |
| ☐ Attached Residential Development | P | N | P | P | N | P | P | P(2) |
| ☒ Commercial/Industrial Development | P(3) | P | P(1) | P(1) | P(5) | P(1) | P | P |
| ☐ Automotive Repair Shops | N | P | N | N | P(4, 5) | N | P | P |
| ☐ Restaurants (>5,000 ft$^2$) | P | N | N | N | N | N | P | P |
| ☐ Hillside Development (>5,000 ft$^2$) | P | N | P | P | N | P | P | P |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ☒ | Parking Lots (>5,000 ft$^2$) | P[6] | P | P[1] | P[1] | P[4] | P[1] | P | P |
| ☐ | Retail Gasoline Outlets | N | P | N | N | P | N | P | P |
| **Project Priority Pollutant(s) of Concern** | | ☒ | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

*P = Potential*

*N = Not Potential*

*(1) A potential Pollutant if non-native landscaping exists or is proposed onsite; otherwise not expected*

*(2) A potential Pollutant if the project includes uncovered parking areas; otherwise not expected*

*(3) A potential Pollutant is land use involving animal waste*

*(4) Specifically petroleum hydrocarbons*

*(5) Specifically solvents*

*(6) Bacterial indicators are routinely detected in pavement runoff*

## E.2 Stormwater Credits

Projects that cannot implement LID BMPs but nevertheless implement smart growth principles are potentially eligible for Stormwater Credits. Utilize Table 3-8 within the WQMP Guidance Document to identify your Project Category and its associated Water Quality Credit. If not applicable, write N/A.

**Table E.2** Water Quality Credits

| Qualifying Project Categories | Credit Percentage[2] |
|---|---|
| N/A | |
| | |
| | |
| *Total Credit Percentage*[1] | |

[1]*Cannot Exceed 50%*

[2]*Obtain corresponding data from Table 3-8 in the WQMP Guidance Document*

## E.3 Sizing Criteria

After you appropriately considered Stormwater Credits for your project, utilize Table E.3 below to appropriately size them to the DCV, or Design Flow Rate, as applicable. Please reference Chapter 3.5.2 of the WQMP Guidance Document for further information.

For DMA A-1 thru A-15, see Appendix 6.

**Table E.3** Treatment Control BMP Sizing

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type | Effective Impervious Fraction, $I_f$ | DMA Runoff Factor | DMA Area x Runoff Factor | | ***BMP B-1 and BMP B-2*** | | |
|---|---|---|---|---|---|---|---|---|---|
| | [A] | | [B] | [C] | [A] x [C] | | | | |
| **N/A** | | | | | | *Design Storm Depth (in)* | *Minimum Design Capture Volume or* | *Total Storm* | *Proposed Volume or Flow on Plans* |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

| | | | | | | | *Design Flow Rate (cubic feet or cfs)* | *Water Credit % Reduction* | *(cubic feet or cfs)* |
|---|---|---|---|---|---|---|---|---|---|
| | $A_T$ = Σ[A] | | | Σ= [D] | [E] | $[F] = \frac{[D]x[E]}{[G]}$ | [F] X (1-[H]) | [I] | |

[B], [C] is obtained as described in Section 2.3.1 from the WQMP Guidance Document
[E] is obtained from Exhibit A in the WQMP Guidance Document
[G] is for Flow-Based Treatment Control BMPs [G] = 43,560, for Volume-Based Control Treatment BMPs, [G] = 12
[H] is from the Total Credit Percentage as Calculated from Table E.2 above
[I] as obtained from a design procedure sheet from the BMP manufacturer and should be included in Appendix 6

## E.4 Treatment Control BMP Selection

Treatment Control BMPs typically provide proprietary treatment mechanisms to treat potential pollutants in runoff, but do not sustain significant biological processes. Treatment Control BMPs must have a removal efficiency of a medium or high effectiveness as quantified below:

- **High**: equal to or greater than 80% removal efficiency
- **Medium**: between 40% and 80% removal efficiency

Such removal efficiency documentation (e.g., studies, reports, etc.) as further discussed in Chapter 3.5.2 of the WQMP Guidance Document, must be included in Appendix 6. In addition, ensure that proposed Treatment Control BMPs are properly identified on the WQMP Site Plan in Appendix 1.

**Table E.4** Treatment Control BMP Selection

| Selected Treatment Control BMP Name or ID[1] | Priority Pollutant(s) of Concern to Mitigate[2] | Removal Efficiency Percentage[3] |
|---|---|---|
| ***N/A*** | | |
| | | |
| | | |
| | | |

[1] *Treatment Control BMPs must not be constructed within Receiving Waters. In addition, a proposed Treatment Control BMP may be listed more than once if they possess more than one qualifying pollutant removal efficiency.*
[2] *Cross Reference Table E.1 above to populate this column.*
[3] *As documented in a Co-Permittee Approved Study and provided in Appendix 6.*

# Section F: Hydromodification

## F.1 Hydrologic Conditions of Concern (HCOC) Analysis

Once you have determined that the LID design is adequate to address water quality requirements, you will need to assess if the proposed LID Design may still create a HCOC. Review Chapters 2 and 3 (including Figure 3-7) of the WQMP Guidance Document to determine if your project must mitigate for Hydromodification impacts. If your project meets one of the following criteria which will be indicated by the check boxes below, you do not need to address Hydromodification at this time. However, if the project does not qualify for Exemptions 1, 2 or 3, then additional measures must be added to the design to comply with HCOC criteria. This is discussed in further detail below in Section F.2.

**HCOC EXEMPTION 1**: The Priority Development Project disturbs less than one acre. The Copermittee has the discretion to require a Project-Specific WQMP to address HCOCs on projects less than one acre on a case by case basis. The disturbed area calculation should include all disturbances associated with larger common plans of development.

Does the project qualify for this HCOC Exemption? ☐ Y ☒ N

If Yes, HCOC criteria do not apply.

**HCOC EXEMPTION 2**: The volume and time of concentration[1] of storm water runoff for the post-development condition is not significantly different from the pre-development condition for a 2-year return frequency storm (a difference of 5% or less is considered insignificant) using one of the following methods to calculate:

- **Riverside County Hydrology Manual**
- Technical Release 55 (TR-55): Urban Hydrology for Small Watersheds (NRCS 1986), or derivatives thereof, such as the Santa Barbara Urban Hydrograph Method
- Other methods acceptable to the Co-Permittee

Does the project qualify for this HCOC Exemption? ☐ Y ☒ N

If Yes, report results in Table F.1 below and provide your substantiated hydrologic analysis in Appendix 7.

**Table F.1** Hydrologic Conditions of Concern Summary

| | 2 year – 24 hour | | |
|---|---|---|---|
| | **Pre-condition** | **Post-condition** | **% Difference** |
| **Time of Concentration (hr)** | See Appendix 7 | | |
| **Peak Runoff (cfs)** | | | |
| **Volume (Acre Feet)** | | | |

[1] Time of concentration is defined as the time after the beginning of the rainfall when all portions of the drainage basin are contributing to flow at the outlet.

**Drainage Area A – existing (51.4 Ac), proposed (51.4 Ac)**

| Storm Frequency | Existing $Q_2$ (cfs) **[1]** | Proposed $Q_2$ (cfs) | Det. Basin Outlet $Q_2$ (cfs) **[2]** | Different **[2] – [1]** (cfs) | Different **[2] – [1]** (%) |
|---|---|---|---|---|---|
| | | | | | |
| 2-year 24-hour | 9.37 | 13.12 | 6.75 | -2.62 | -28% |
| | | | | | |

**Drainage Area B – existing (8.4 Ac), proposed (8.4 Ac)**

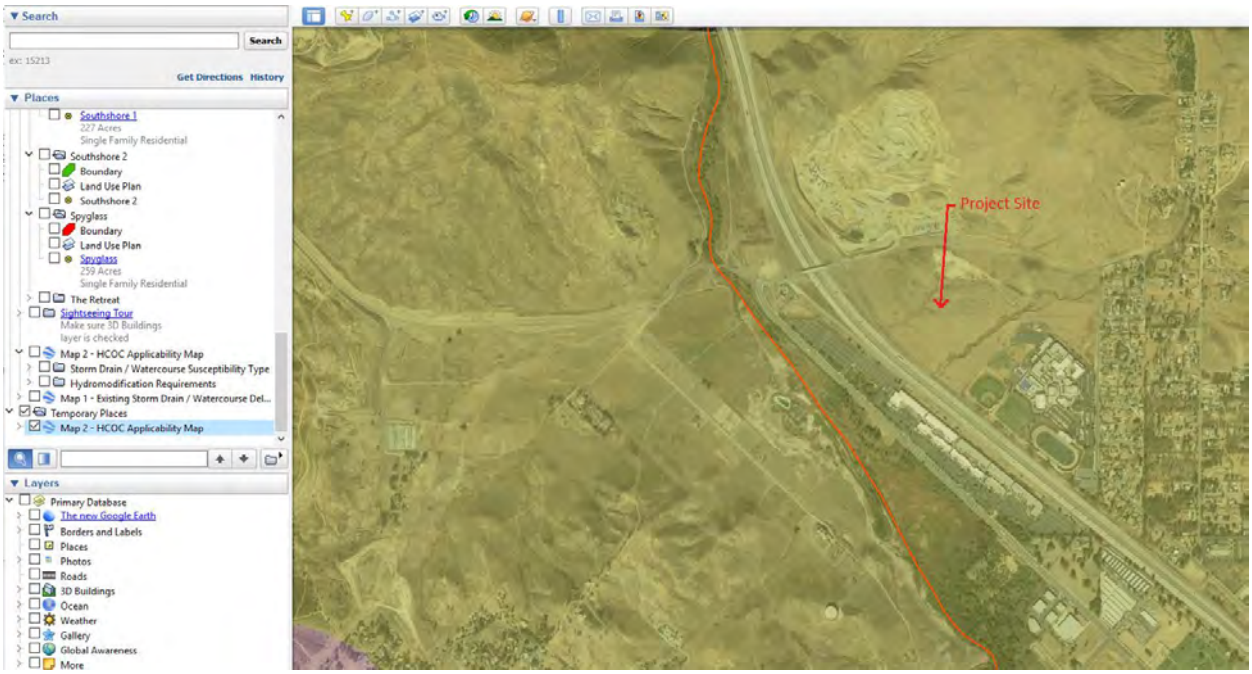
| Storm Frequency | Existing $Q_2$ (cfs) **[1]** | Proposed $Q_2$ (cfs) | Det. Basin Outlet $Q_2$ (cfs) **[2]** | Different **[2] – [1]** (cfs) | Different **[2] – [1]** (%) |
|---|---|---|---|---|---|
| | | | | | |
| 2-year 24-hour | 1.52 | 1.97 | 0.95 | -0.57 | -37.5% |
| | | | | | |

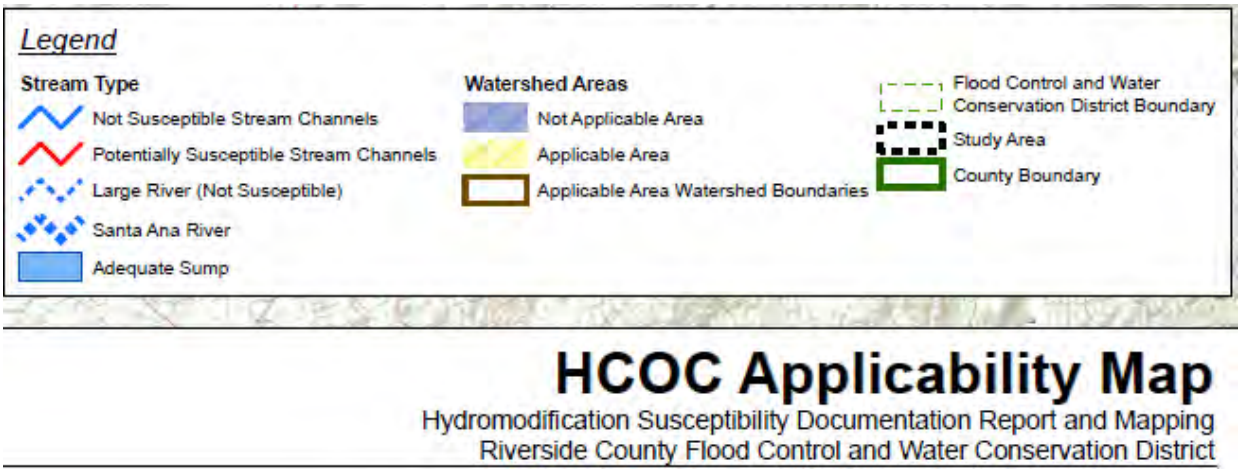
***See Appendix 7 for HCOC mitigation***

**HCOC EXEMPTION 3**: All downstream conveyance channels to an adequate sump (for example, Prado Dam, Lake Elsinore, Canyon Lake, Santa Ana River, or other lake, reservoir or naturally erosion resistant feature) that will receive runoff from the project are engineered and regularly maintained to ensure design flow capacity; no sensitive stream habitat areas will be adversely affected; or are not identified on the Co-Permittees Hydromodification Sensitivity Maps.

Does the project qualify for this HCOC Exemption? ☐ Y ☒ N

If Yes, HCOC criteria do not apply and note below which adequate sump applies to this HCOC qualifier:




**The project site is within an Applicable Area with the downstream being a potentially Susceptible Stream Channel, therefore HCOC mitigation will be provided.**

## F.2 HCOC Mitigation

If none of the above HCOC Exemption Criteria are applicable, HCOC criteria is considered mitigated if they meet one of the following conditions:

a. Additional LID BMPS are implemented onsite or offsite to mitigate potential erosion or habitat impacts as a result of HCOCs. This can be conducted by an evaluation of site-specific conditions utilizing accepted professional methodologies published by entities such as the California Stormwater Quality Association (CASQA), the Southern California Coastal Water Research Project (SCCRWP), or other Co-Permittee approved methodologies for site-specific HCOC analysis.

b. The project is developed consistent with an approved Watershed Action Plan that addresses HCOC in Receiving Waters.

c. Mimicking the pre-development hydrograph with the post-development hydrograph, for a 2-year return frequency storm. Generally, the hydrologic conditions of concern are not significant, if the post-development hydrograph is no more than 10% greater than pre-development hydrograph. In cases where excess volume cannot be infiltrated or captured and reused, discharge from the site must be limited to a flow rate no greater than 110% of the pre-development 2-year peak flow.

Based on the information provided above, this project meets the requirements of **Condition C** and **will not** create a hydrologic condition of concern in the proximate or downstream receiving waters. The post-development hydrograph for the 2-year, 24-hour rainfall event will be mitigated by the implementation of Site Design BMPs to limit discharges to a flow rate no greater than 110% of pre-development 2-year flow.
Project development and street improvements include local storm drain systems which convey developed flows and street runoff to a number of proposed Extended Detention Basin and Sand Filter Basins. For Hydromodification, the proposed Sand Filter Basins include sufficient volume above the proposed water quality volume within Sand Filter Basin, that will satisfy the requirement of post-development peak discharge, volume and time of concentration for the 2-year 24-hour storm that DOES NOT exceed the pre-development peak runoff by more than 10 percent.

The proposed project Sand Filter and Extended Detention Basins are capable of all of the following:

1. Releasing the post-development hydrograph for 2-year, 24-hour at flow rates less than or equal to the pre-development 2-year, 24-hour peak flow rates.
2. Passing the 100-year storm event without damage to the BMP.
3. Controlling outlet velocities such that downstream erosion and habitat loss are minimized.

**Supporting calculations can be found in the reference locations provided in Appendix 7 of this report.**

With proposed mitigation, this project **is not** potentially susceptible to hydromodification impacts, an HCOC does not exist and hydromodification **does not** need to be considered further.

# Section G: Source Control BMPs

Source control BMPs include permanent, structural features that may be required in your project plans — such as roofs over and berms around trash and recycling areas — and Operational BMPs, such as regular sweeping and "housekeeping", that must be implemented by the site's occupant or user. The MEP standard typically requires both types of BMPs. In general, Operational BMPs cannot be substituted for a feasible and effective permanent BMP. Using the Pollutant Sources/Source Control Checklist in Appendix 8, review the following procedure to specify Source Control BMPs for your site:

1. ***Identify Pollutant Sources*:** Review Column 1 in the Pollutant Sources/Source Control Checklist. Check off the potential sources of Pollutants that apply to your site.

2. ***Note Locations on Project-Specific WQMP Exhibit*:** Note the corresponding requirements listed in Column 2 of the Pollutant Sources/Source Control Checklist. Show the location of each Pollutant source and each permanent Source Control BMP in your Project-Specific WQMP Exhibit located in Appendix 1.

3. ***Prepare a Table and Narrative*:** Check off the corresponding requirements listed in Column 3 in the Pollutant Sources/Source Control Checklist. In the left column of Table G.1 below, list each potential source of runoff Pollutants on your site (from those that you checked in the Pollutant Sources/Source Control Checklist). In the middle column, list the corresponding permanent, Structural Source Control BMPs (from Columns 2 and 3 of the Pollutant Sources/Source Control Checklist) used to prevent Pollutants from entering runoff. **Add additional narrative** in this column that explains any special features, materials or methods of construction that will be used to implement these permanent, Structural Source Control BMPs.

4. ***Identify Operational Source Control BMPs:*** To complete your table, refer once again to the Pollutant Sources/Source Control Checklist. List in the right column of your table the Operational BMPs that should be implemented as long as the anticipated activities continue at the site. Copermittee stormwater ordinances require that applicable Source Control BMPs be implemented; the same BMPs may also be required as a condition of a use permit or other revocable Discretionary Approval for use of the site.

**Table G.1** Permanent and Operational Source Control Measures

| Potential Sources of Runoff pollutants | Permanent Structural Source Control BMPs | Operational Source Control BMPs |
|---|---|---|
| On-site storm drain inlets | Storm drain markers – Only Rain Down the Storm Drain. | Maintain and periodically repaint or replace inlet marking.<br>Provide stormwater pollution prevention information to new site owners, lessees, or operators.<br>See applicable operational BMPs in Fact Sheet SC-44, "Drainage System Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com<br>Include the following in lease |

| | | |
|---|---|---|
| | | agreements: "Tenant shall not allow anyone to discharge anything to storm drains or to store or deposit materials so as to create a potential discharge to storm drains." |
| Landscape / Outdoor Pesticide Use | Show locations of native trees or areas of shrubs and ground cover to be undisturbed and retained. Proposed native trees or areas of shrubs and ground cover | Maintain landscaping using minimum or no pesticides Irrigation System and Landscape Management (N3) See applicable operational BMPs in "What you should know for…..Landscape and Gardening" |
| Pools, spas, ponds, decorative fountains, and other water features. | Show location of water feature and a sanitary sewer cleanout in an accessible area within 10 feet. | See applicable operational BMPs in "Guidelines for Maintaining Your Swimming Pool, Jacuzzi and Garden Fountain" |
| Refuse areas | Site refuse and recycled materials will be handled and stored for pickup regularly.<br><br>Refuse areas for commercial shall include trash enclosures, covered, gated, walled, bermed to prevent runoff from the area. | Common Area Litter Control (N4) Provide adequate number of receptacles. Inspect receptacles regularly; repair or replace leaky receptacles. Keep receptacles covered. Prohibit/prevent dumping of liquid or hazardous wastes. Post "no hazardous materials" signs. Inspect and pick up litter daily and clean up spills immediately. Keep spill control materials available on-site. See Fact Sheet SC-34, "Waste Handling and Disposal" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com |
| Residential Lots<br>Roofing, gutters and trim | Roofs designed to runoff into adjoining landscaping.<br>Avoid roofing, gutters and trim made of copper or other unprotected metals that may leach into runoff.<br>Driveways of minimal widths | Activity Restrictions (N2) |
| Fire Sprinkler Test Water | | See the note in Fact Sheet SC-41, "Building and Grounds Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com |
| Man-made & irrigated slopes and landscaped areas | Protect slopes and channels (S5)<br>Hillside Landscaping (S12) | Irrigation System and Landscape Management (N3) |

| Park Site / Basin areas | Efficient Irrigation (S4) | Common Area Litter Control (N4) |
|---|---|---|
| Plazas, sidewalks, and parking lots. | | Sweep plazas, sidewalks, and parking lots regularly to prevent accumulation of litter and debris. Collect debris from pressure washing to prevent entry into the storm drain system. Collect washwater containing any cleaning agent or degreaser and discharge to the sanitary sewer not to a storm drain. |
| Loading Docks (Maybe proposed in the Commercial Site – TBD). | Loading docks will not be covered and are 4 feet above finished pavement surface. | Inspect for accumulated trash and debris. Implement good housekeeping procedures on a regular basis. Sweep areas clean instead of using wash water. Loading docks will be kept in a clean and orderly condition, through a regular program of sweeping and litter control, and immediate clean up of any spills or broken containers. The POA will ensure that loading docks will be swept as needed. Cleanup procedures will not include the use of wash-down water. POA will be responsible for implementation of loading dock housekeeping procedures (see CASQA SC-30 BMP Fact Sheet in Appendix 10). |
| | | |

*See additional information on Source Control BMPs and their operation and maintenance in Appendix 8 and Appendix 9.*

# Section H: Construction Plan Checklist

Populate Table H.1 below to assist the plan checker in an expeditious review of your project. The first two columns will contain information that was prepared in previous steps, while the last column will be populated with the corresponding plan sheets. This table is to be completed with the submittal of your final Project-Specific WQMP.

**Table H.1** Construction Plan Cross-reference

| BMP No. or ID | BMP Identifier and Description | Corresponding Plan Sheet(s) |
|---|---|---|
| BMP A-1 | WQ Extended Detention Basin "A-1" | BMP Site Plan (Construction Plan will be included in the FWQMP) |
| BMP A-2 | WQ Sand Filter Basin "A-2" | BMP Site Plan (Construction Plan will be included in the FWQMP) |
| BMP B | WQ Sand Filter Basin "B" | BMP Site Plan (Construction Plan will be included in the FWQMP) |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Note that the updated table — or Construction Plan WQMP Checklist — is **only a reference tool** to facilitate an easy comparison of the construction plans to your Project-Specific WQMP. Co-Permittee staff can advise you regarding the process required to propose changes to the approved Project-Specific WQMP.

# Section I: Operation, Maintenance and Funding

The Copermittee will periodically verify that Stormwater BMPs on your site are maintained and continue to operate as designed. To make this possible, your Copermittee will require that you include in Appendix 9 of this Project-Specific WQMP:

1. A means to finance and implement facility maintenance in perpetuity, including replacement cost.
2. Acceptance of responsibility for maintenance from the time the BMPs are constructed until responsibility for operation and maintenance is legally transferred. A warranty covering a period following construction may also be required.
3. An outline of general maintenance requirements for the Stormwater BMPs you have selected.
4. Figures delineating and designating pervious and impervious areas, location, and type of Stormwater BMP, and tables of pervious and impervious areas served by each facility. Geo-locating the BMPs using a coordinate system of latitude and longitude is recommended to help facilitate a future statewide database system.
5. A separate list and location of self-retaining areas or areas addressed by LID Principles that do not require specialized O&M or inspections but will require typical landscape maintenance as noted in Chapter 5, pages 85-86, in the WQMP Guidance. Include a brief description of typical landscape maintenance for these areas.

Your local Co-Permittee will also require that you prepare and submit a detailed Stormwater BMP Operation and Maintenance Plan that sets forth a maintenance schedule for each of the Stormwater BMPs built on your site. An agreement assigning responsibility for maintenance and providing for inspections and certification may also be required.

Details of these requirements and instructions for preparing a Stormwater BMP Operation and Maintenance Plan are in Chapter 5 of the WQMP Guidance Document.

**Maintenance Mechanism:**

The City of Lake Elsinore will maintain the Detention and Water Quality Basins within Tract 37305. The funding of the Detention Basin “A”, WQ Basins “A-1”, “A-2”, and “B” will be through a CFD which covers both the Residential and Commercial Areas of the Nichols South Specific Plan.

When the Commercial Site is developed, the FWQMP for Nichols South will be modified to incorporate the Commercial Site’s specific water quality BMPs, including necessary source control BMPs, in accordance with the requirements, the City of Lake Elsinore.

Upon development, the Commercial Site will annex into the CFD and then the Commercial Site will contribute to the funding for the maintenance of the Nichols South Specific Plan water quality facilities.

Will the proposed BMPs be maintained by a Home Owners’ Association (HOA) or Property Owners Association (POA)?

☒ Y (Commercial) ☐ N

## LID AND TREATMENT CONTROL BMPS

Extended Detention Basin and Sand Filter Basins

- Construction and Initial Funding until acceptance will be provided by the project Developer or Builder.
- The City of Lake Elsinore will maintain the Detention and Water Quality Basins within Tract 37305 with respect to the site facilities which include the inlets, outlets, drainage and water quality improvements, access and fencing, etc. This maintenance will be funded through a City LMD.
- The Tract 37305 Homeowner's Association (HOA) will provide maintenance of the landscaping components within these basins
- Recorded CFD/LLMD, and BMPs maintenance exhibits will be provided in Final WQMP

Project owner:

**Nichols Road Partners**
P.O. Box 77850
25555 Maitri Road
Corona, CA. 92883

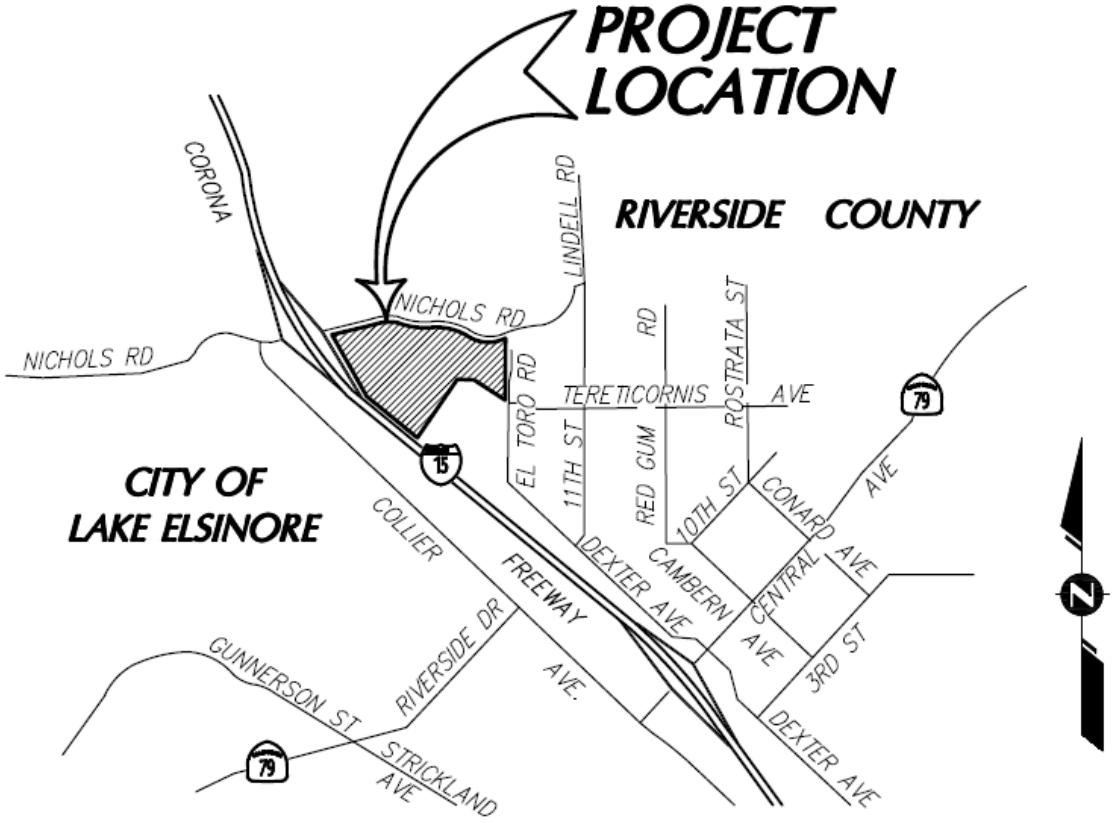
Telephone: (951) 277 -3900

Contact person: Todd Pendergrass

Include your Operation and Maintenance Plan and Maintenance Mechanism in Appendix 9. Additionally, include all pertinent forms of educational materials for those personnel that will be maintaining the proposed BMPs within this Project-Specific WQMP in Appendix 10.

# Appendix 1: Maps and Site Plans

*Location Map, WQMP Site Plan and Receiving Waters Map*



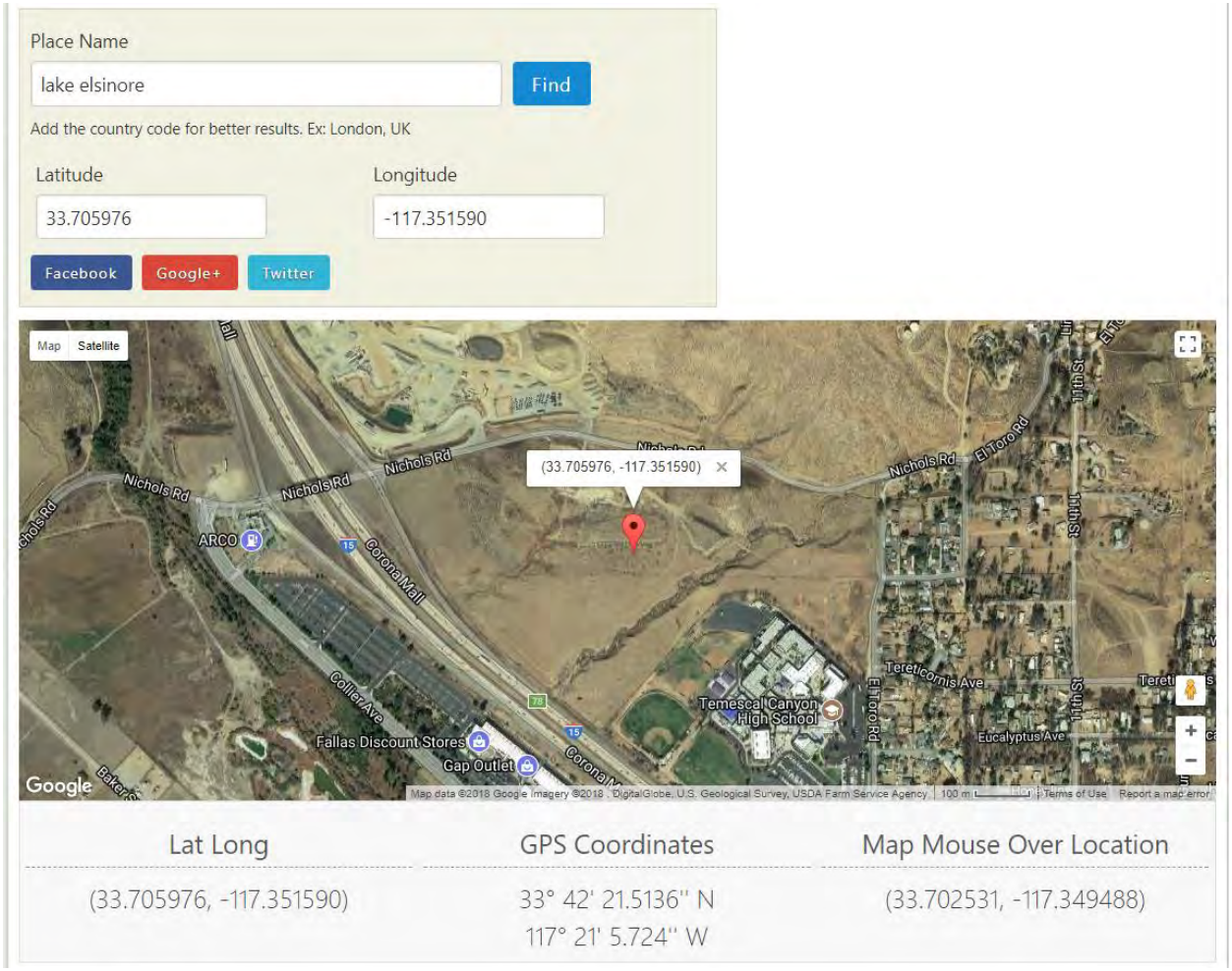

## VICINITY MAP

NOT TO SCALE

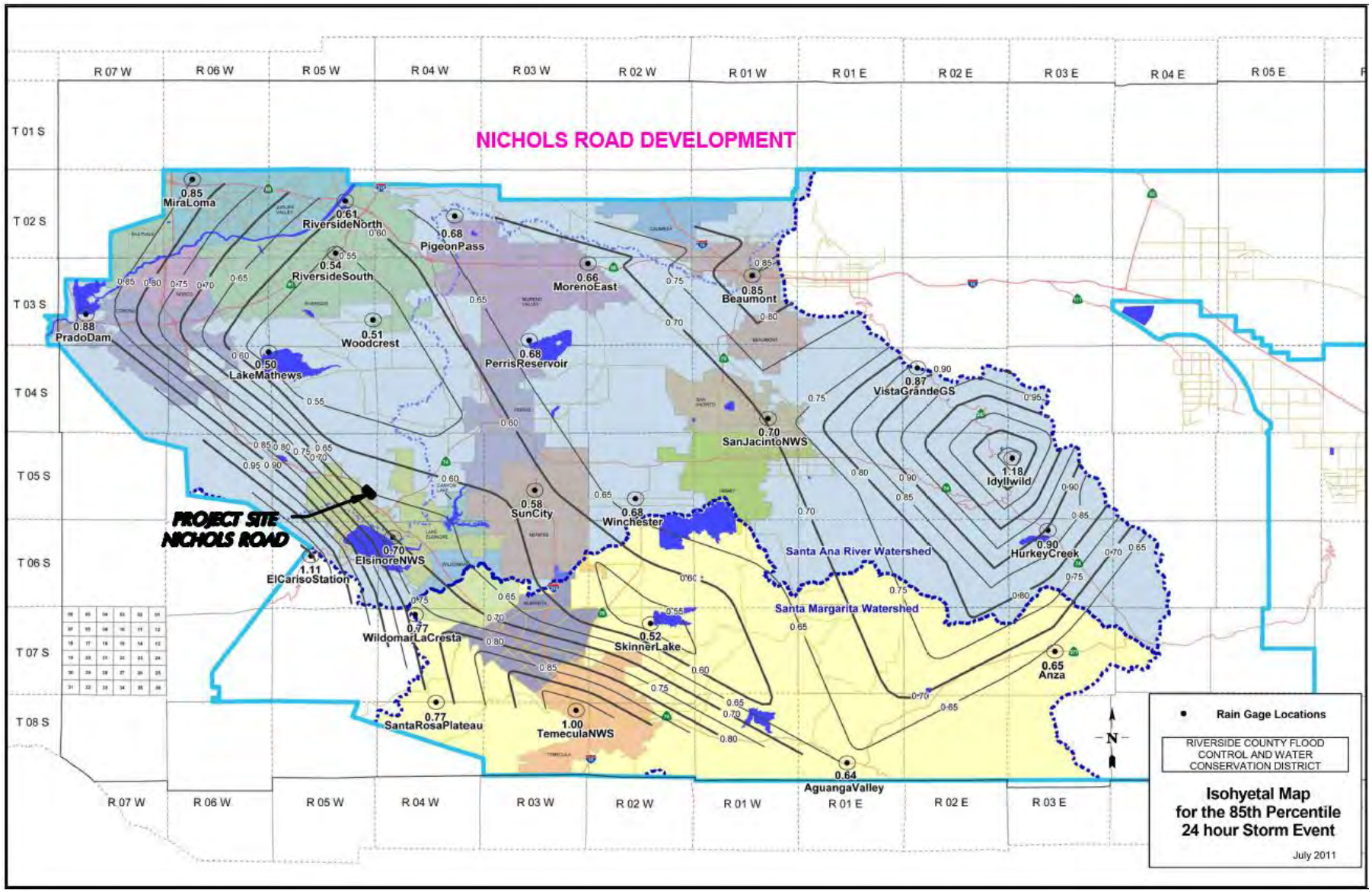
THOMAS GUIDE, PAGE 836, GRID B7, 2006
SAN BERNARDINO & RIVERSIDE COUNTY EDITION

**Vicinity Map**
**(NTS)**

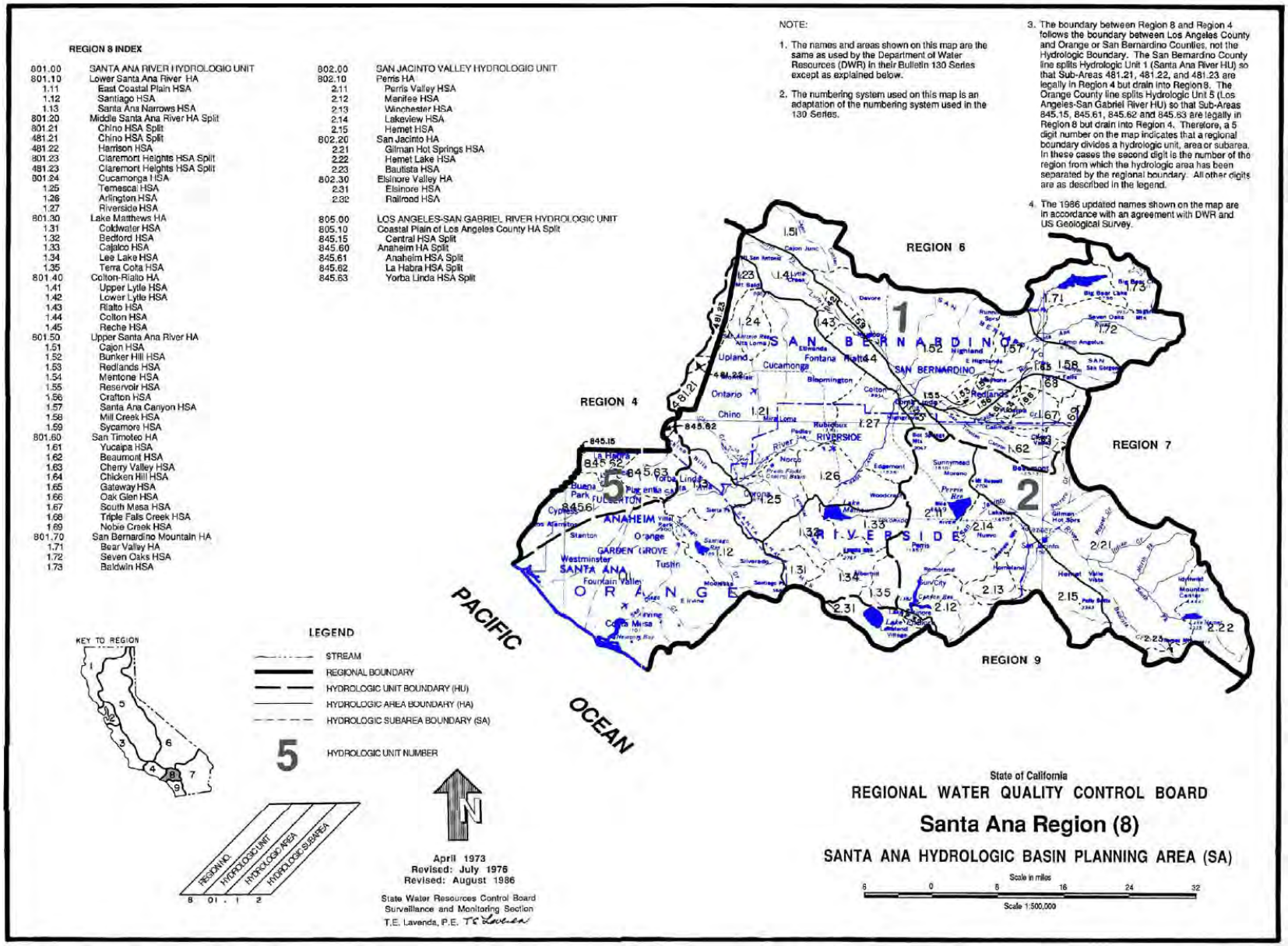
**Location Map**
**(NTS)**



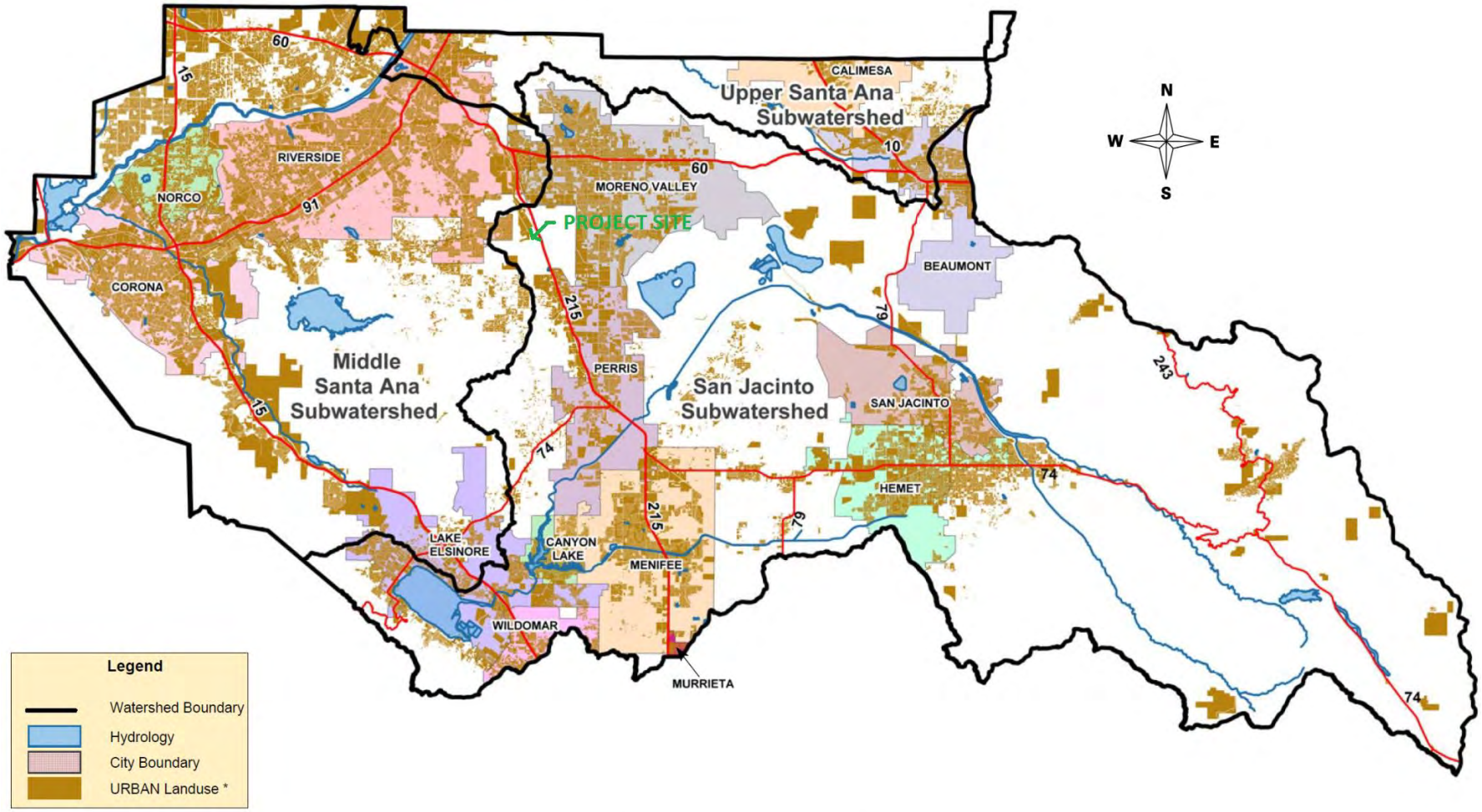

**Latitude Longitude**



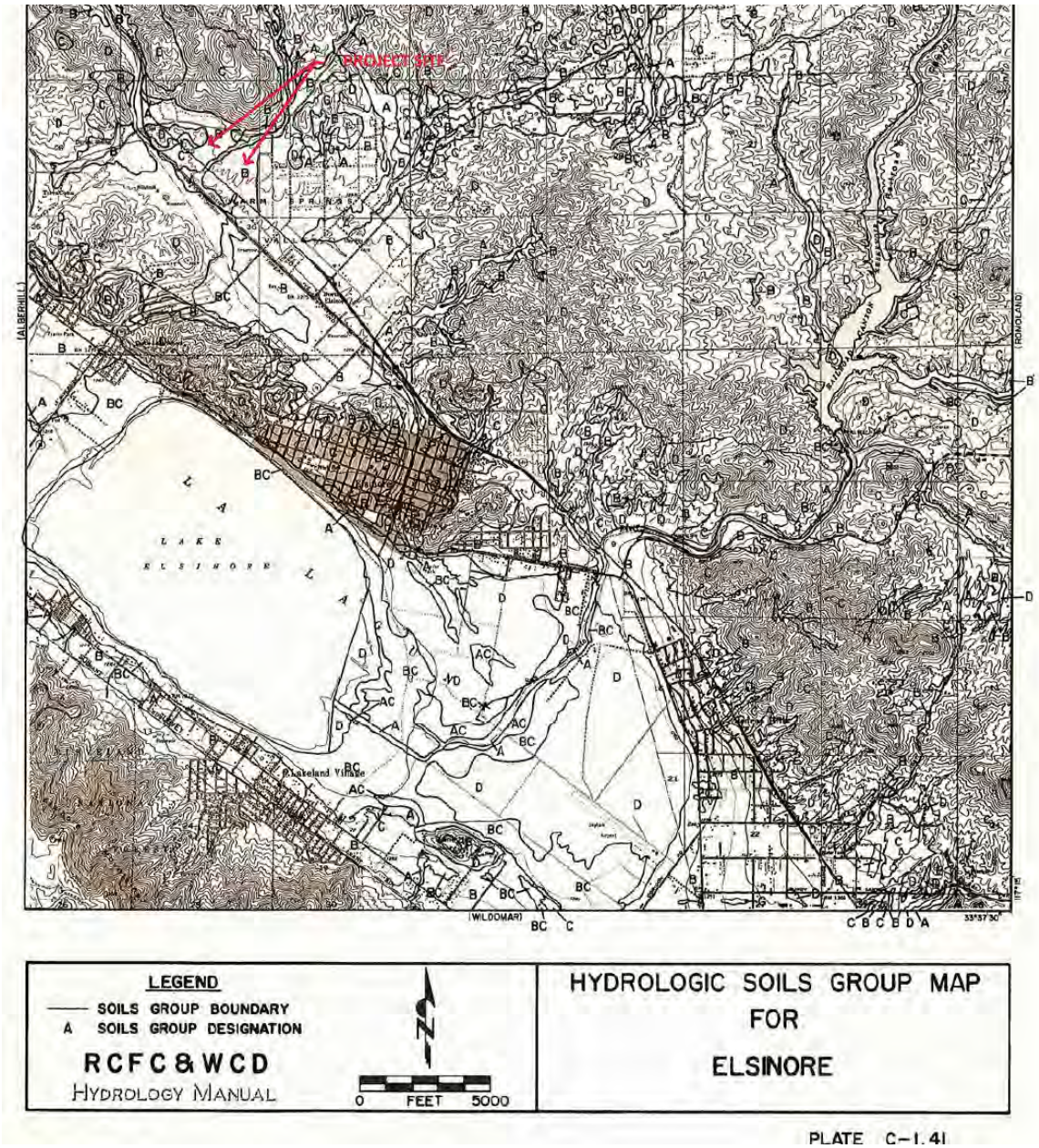

**Isohyetal Map**




**Receiving Water Map**

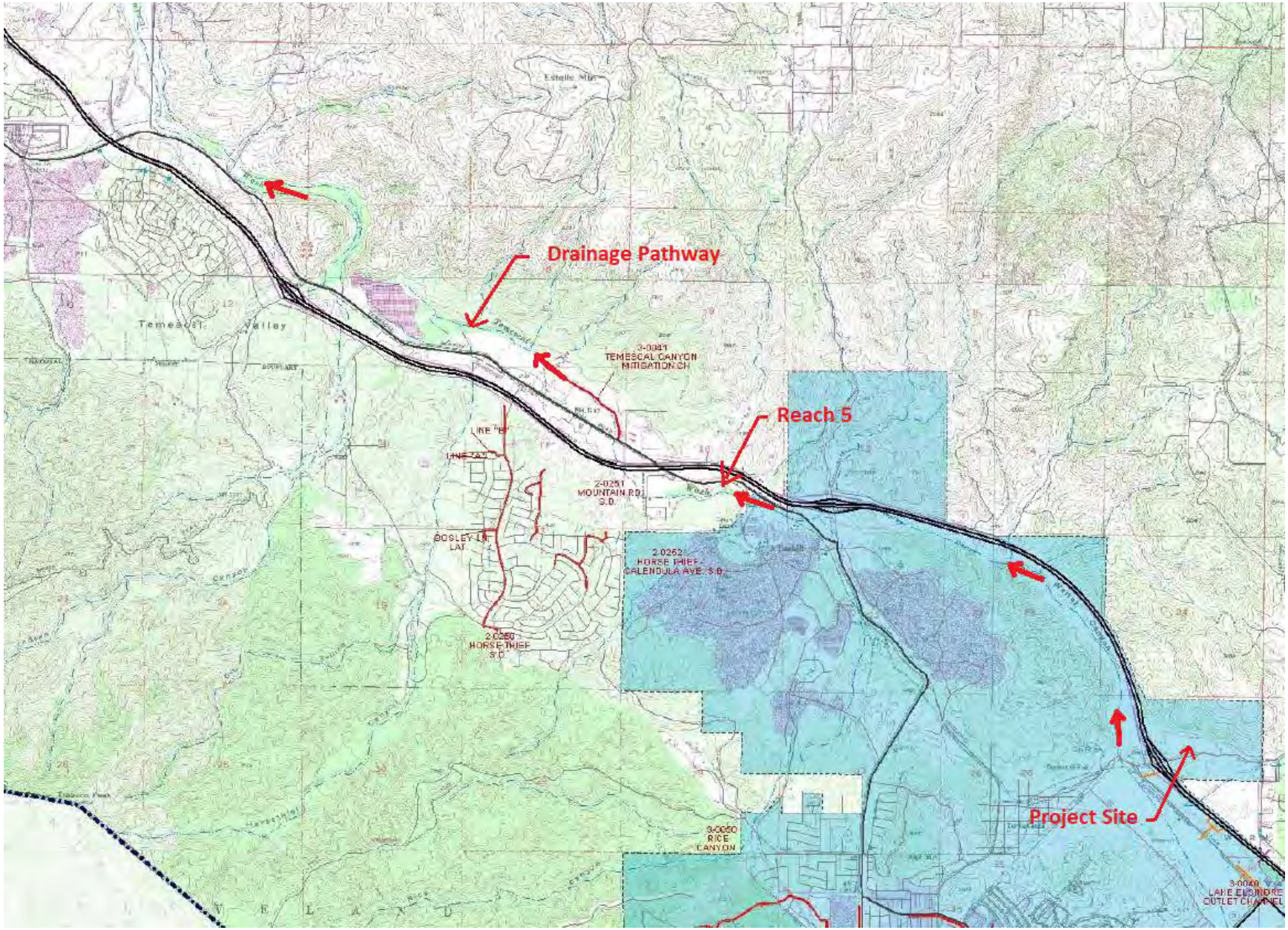



* Areas not in URBAN: Agricultural, State, Federal, Tribal, Preserves & Open Space, Rural-Residential, Highways/Freeways

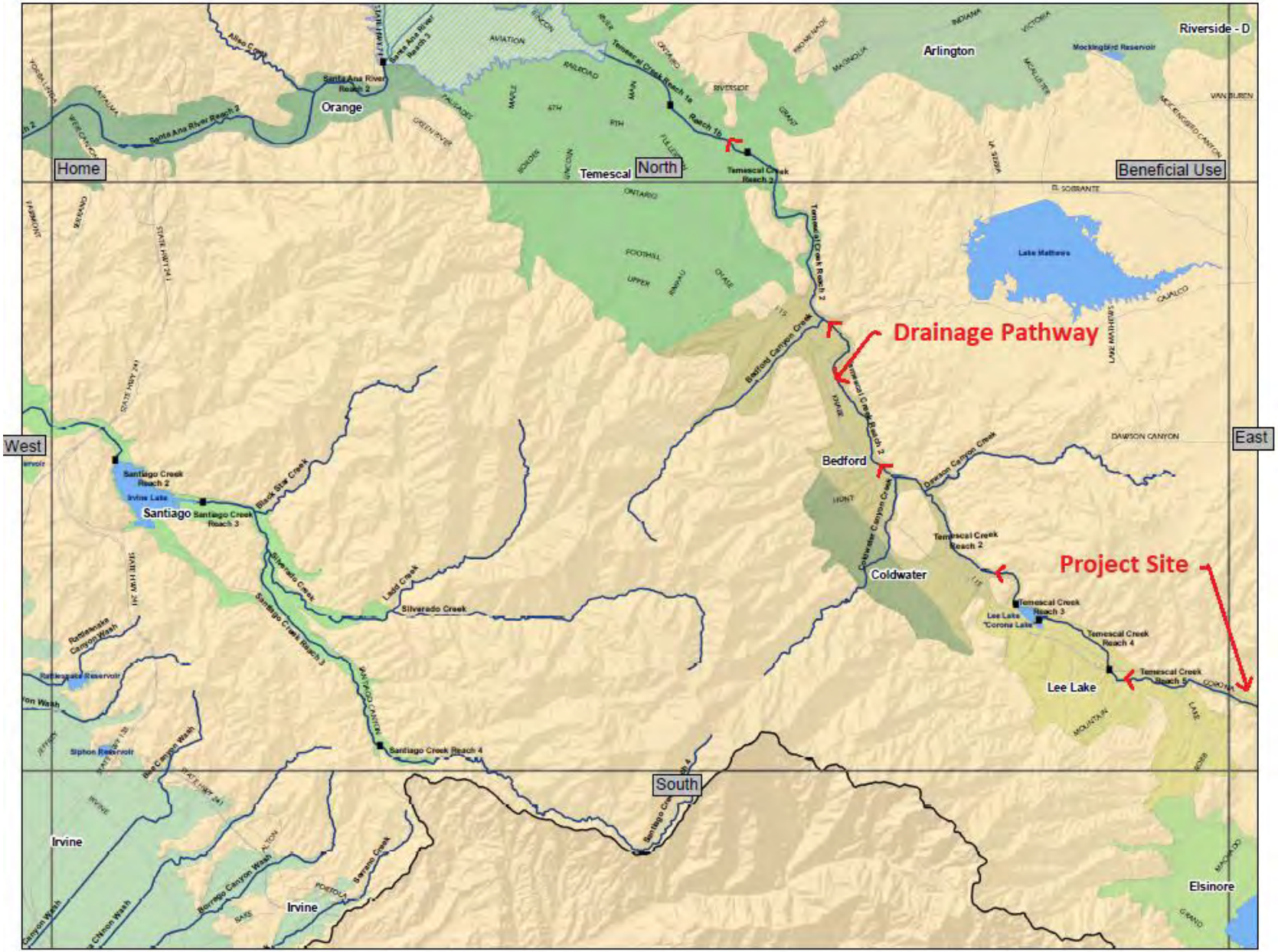



**Hydrologic Soils Group for the project site**

**(NTS)**




**RECEIVING WATERS (for path of water see below map)**




**RECEIVING WATERS**

NICHOLS ROAD

DMA Area A-2
A = 24.37 Ac
COMMERCIAL SITE

DMA Area A-1
A = 27.03 Ac

AREA "A"
A = 31.4 Ac
L = 3463'
Lca = 834'
h = 77'

WQ Basin "A1"
Extended Detention Basin

AREA "B"
A = 8.4 Ac
L = 1015'
Lca = 444'
h = 34'

WQ Basin "A2"
Sand Filter Basin

DETENTION Basin "A"

WQ Basin "B"
Sand Filter Basin

SCALE: 1"=100'
0 100 200 300

## OTHER PROJECT BMPs LIST:

- EROSION CONTROL / RIPRAP
- VEGETATION/DETENTION BASIN
- CATCH BASIN – MS4 STENCILING AND SIGNAGE
- LANDSCAPE AND IRRIGATION SYSTEM
- ROOFED TRASH ENCLOSURE
- STREET TREES AND PARKWAY

LID PRACTICES TO BE IMPLEMENTED FOR THIS PROJECT:

- CONSERVATION DESIGN
- RUNOFF CONVEYANCE
- ROOF DOWNSPOUT DISCONNECTION
- EFFICIENT / LOW IMPACT LANDSCAPING
- NON STORMWATER DISCHARGES

## BMPs DMA:

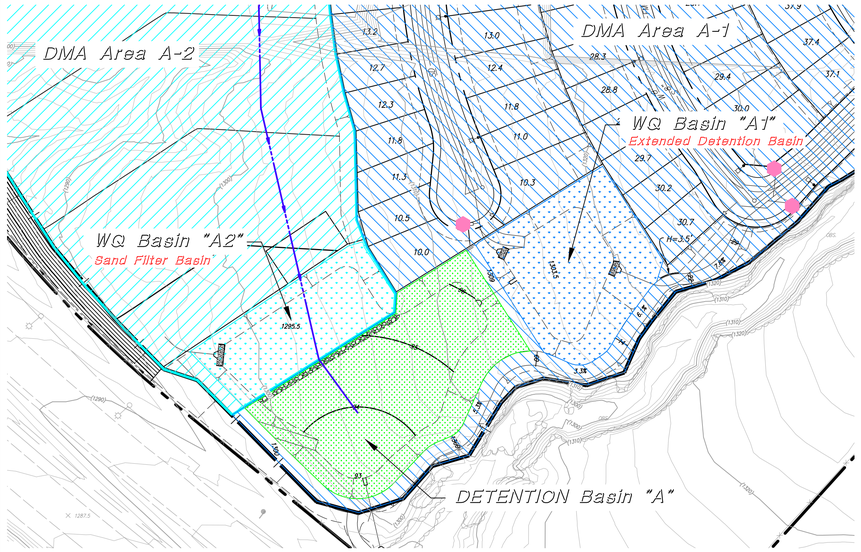
- DMA–A1
- DMA–A2
- DMA–B

## BMPs LEGEND:

- BMP–A1, EXTENDED DETENTION BASIN A1
- BMP–A2, SAND FILTER BASIN A2
- DETENTION BASIN A
- BMP–B, SAND FILTER/DETENTION BASIN B

K&A Engineering, Inc.
ENGINEERING
LAND PLANNING
SURVEYING
357 N. SHERIDAN STREET
SUITE 117
CORONA, CALIFORNIA 92880
TEL. (951) 279-1800
FAX (951) 279-4380

# NICHOLS SOUTH SPECIFIC PLAN
# TRACT 37305
## WQMP - BMPs SITE PLAN



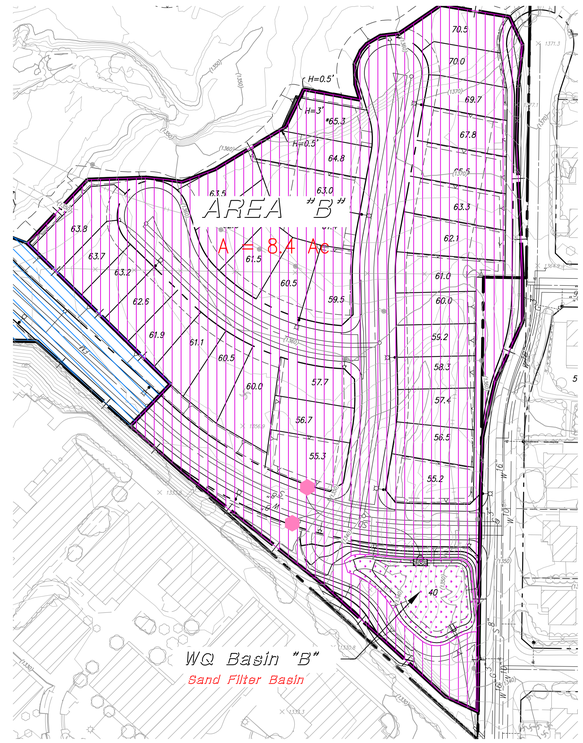

**Extended Detention Basin A-1:**

Bottom area basin A-1 = 17,526 sf at elevation 1303.5

Vbmp Area A-1 = 29,530 cf

| Area A-1 | | | | | |
|---|---|---|---|---|---|
| Extended Detention Basin A-1 | | | | | |
| Elev. | Depth | Area (sf) | Vol. inc. (cf) | Vol. Accum. (cf) | Vol. Accum. (Acft) |
| 1303.5 | 0 | 0 | 0 | 0 | 0.00 |
| 1304.5 | 1 | 19910 | 9955 | 9955 | 0.23 |
| 1305.5 | 2 | 22129 | 21019.5 | 30974.5 | 0.71 |
| 1306.5 | 3 | 24447 | 23288 | 54262.5 | 1.25 |
| 1307.5 | 4 | 26867 | 25657 | 79919.5 | 1.83 |
| 1308.5 | 5 | 29388 | 28127.5 | 108047 | 2.48 |

**WQ Basin A-1 emergency outlet is above 1305.5 to capture full Design Capture Volume.**




Bottom area basin A-2 = 19,692 sf at elevation 1295.5
Average Soil Media (replacing 18" sand filter) is 22" deep.
Volume soil media void (30%) = 19,692 x 22/12 x 0.3 = 10,830 cf

Vbmp Area A-2 = 45,260 cf (1.04 Acft)
Required surface volume = 45,260 – 10,830 = 34,430 cf.

| Area A-2 | | | | | |
|---|---|---|---|---|---|
| Sand Filter Basin A-2 | | | | | |
| Elev. | Depth | Area (sf) | Vol. inc. (cf) | Vol. Accum. (cf) | Vol. Accum. (Acft) |
| 1293.5 | Soil Media | 19626 | 0 | 0 | 0.00 |
| 1294.5 | Soil Media | 19626 | 4906.5 | 4906.5 | 0.11 |
| 1295.5 | 0 | 19626 | 5887.8 | 10794.3 | 0.25 |
| 1296.5 | 1 | 22206 | 20916 | 31710.3 | 0.73 |
| 1297.5 | 2 | 24853 | 23529.5 | 55239.8 | 1.27 |

**WQ Basin A-2 outlet is above 1297 to capture full Design Capture Volume.**
**Proposed top of wall to Detention Basin A is 1297.0**

## Nichols Road Project - Tr. 37305
## Drainage Area A
## WQ/Detention Basin A

| Elev. | Depth | Area (sf) | Vol. inc. (cf) | Vol. Accum. (cf) | Vol. Accum. (Acft) | Orifice 12" opening at 1293 | Weir L=20' @ 1297.5 | Basin Outflow (cfs) |
|---|---|---|---|---|---|---|---|---|
| 1293 | 0 | 0 | | | 0 | 0 | | 0 |
| 1294 | 1 | 9900 | 4950 | 4950 | 0.11 | 2.98 | | 2.98 |
| 1295 | 2 | 33985 | 21942.5 | 26892.5 | 0.62 | 5.17 | | 5.17 |
| 1296 | 3 | 46355 | 40170 | 67062.5 | 1.54 | 6.67 | | 6.67 |
| 1297 | 4 | 71020 | 58687.5 | 125750 | 2.89 | 7.9 | | 7.9 |
| 1298 | 5 | 73600 | 72310 | 198060 | 4.55 | 8.95 | 10.61 | 19.56 |
| 1299 | 6 | 88081 | 80840.5 | 278900.5 | 6.40 | 9.9 | 55.11 | 65.01 |
| 1300 | 7 | 92000 | 90040.5 | 368941 | 8.47 | 10.76 | 118.59 | 129.35 |

## Nichols Road project - Tract 37305
## City of Lake Elsinore
## Proposed Sand Filter/Detention Basin Area B

| Elev (ft) | Depth (ft) | Vol (ac-ft) | Headwater Stage 1 Depth (ft) | Stage 1 Orifice A=0.05 sf 2ea-3" Opening 1338 | Stage 1 Orifice A=0.09 sf 2ea-4" Opening 1341 | Spillway 5' Opening 1343 | HCOC Det. Basin Depth (ft) | HCOC Det. Basin Vol (ac-ft) | Emergency Spillway 10' Opening 1344 | Total Outflow Q total (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1338 | 0 | 0 | 0 | 0 | 0 | 0 | | | Enhanced SF | **0.00** |
| 1339 | 1 | 0.05 | 1 | 0.48 | 0 | 0 | | | Enhanced SF | **0.48** |
| 1340 | 2 | 0.103 | 2 | 0.7 | 0 | 0 | | | Enhanced SF | **0.70** |
| **Water Quality Volume = 8,520 cu-ft, Soil Media Void (30%) volume = 4,4905 cu-ft < Vbmp** | | | | | | | | | | |
| **WQ surface volume = 8,520 - 4,490 = 4,030 cu-ft (0.09 Ac-ft)** | | | | | | | | | | |
| 1340 | 0 | 0.000 | 2 | 0.7 | 0 | 0 | | | | **0.70** |
| 1340.5 | 0.5 | 0.196 | 2.5 | 0.78 | 0 | 0 | 0 | 0 | | **0.78** |
| 1341 | 1 | 0.288 | 3 | 0.86 | 0 | 0 | 0.5 | 0.093 | | **0.86** |
| 1342 | 2 | 0.502 | 4 | 1 | 0 | 0 | 1.5 | 0.306 | | **1.00** |
| 1343 | 3 | 0.748 | 5 | 1.14 | 0.82 | 0 | 2.5 | 0.552 | | **1.96** |
| 1344 | 4 | 1.027 | 6 | 1.24 | 1.2 | 15 | 3.5 | 0.832 | | **17.44** |
| 1345 | 5 | 1.341 | 7 | 1.34 | 1.5 | 42.43 | 4.5 | 1.145 | 30.00 | **75.27** |
| **HCOC Detention Basin is above Water Quality volume @ elev = 1340.5** | | | | | | | | | | |

## OTHER PROJECT BMPs LIST:

- EROSION CONTROL / RIPRAP
- VEGETATION/DETENTION BASIN
- CATCH BASIN – MS4 STENCILING AND SIGNAGE
- LANDSCAPE AND IRRIGATION SYSTEM
- ROOFED TRASH ENCLOSURE
- STREET TREES AND PARKWAY

LID PRACTICES TO BE IMPLEMENTED FOR THIS PROJECT:

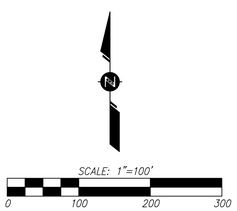
- CONSERVATION DESIGN
- RUNOFF CONVEYANCE
- ROOF DOWNSPOUT DISCONNECTION
- EFFICIENT / LOW IMPACT LANDSCAPING
- NON STORMWATER DISCHARGES

## BMPs DMA:

- DMA–A1
- DMA–A2
- DMA–B

## BMPs LEGEND:

- BMP–A1, EXTENDED DETENTION BASIN A1
- BMP–A2, SAND FILTER BASIN A2
- DETENTION BASIN A
- BMP–B, SAND FILTER/DETENTION BASIN B




K&A Engineering, Inc.
ENGINEERING
LAND PLANNING
SURVEYING
357 N. SHERIDAN STREET
SUITE 117
CORONA, CALIFORNIA 92880
TEL. (951) 279-1800
FAX (951) 279-4380

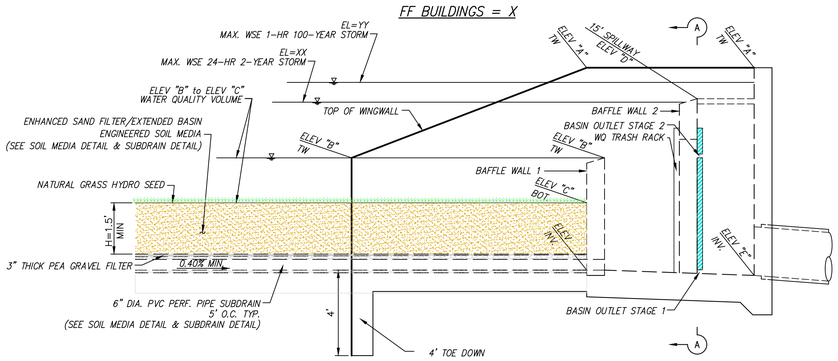
**Sand Filter - Detention Basin Outletwork**
**Nichols Road Project - Tract 37305**

| Basin | Elev "A" | Elev "B" | Elev "C" | Elev "D" | Elev "E" | Elev "XX" | Elev "YY" |
|---|---|---|---|---|---|---|---|
| A-2 | 1309.0 | 1297.0 | 1295.5 | 1297.0 | 1292.0 | xxx | yyy |
| B | 1345.0 | 1340.5 | 1340.0 | 1448.0 | 1433.0 | xxx | yyy |

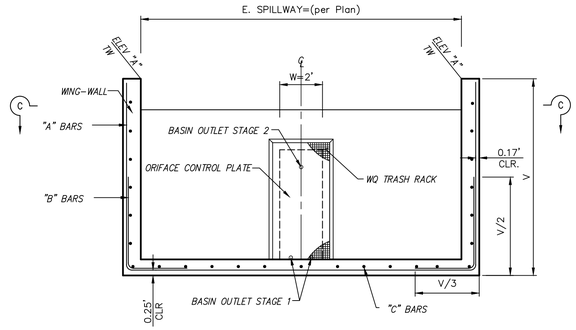
Elev "A" = Top of Basin Outlet Wall
Elev "B" = Top of Baffle Wall 1 - Top of Water Quality Volume
Elev "C" = Top of Soil Media - Bio-retention Basin bottom elevation
Elev "D" = Top of Baffle Wall 2 - Emergency Spillway Elevation = Elev "XX"
Elev "E" = Pipe outlet invert elevation
Elev "XX" = Maximum WSE 24-hour 2-year storm (Det. Basin routing)
Elev "YY" = Maximum WSE 1-hour 100-year storm (Elev "XX" + Spillway headwater)

# NICHOLS SOUTH SPECIFIC PLAN TRACT 37305

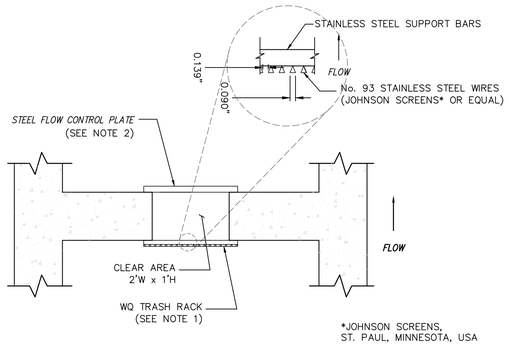
## WQMP - BMPs SITE PLAN



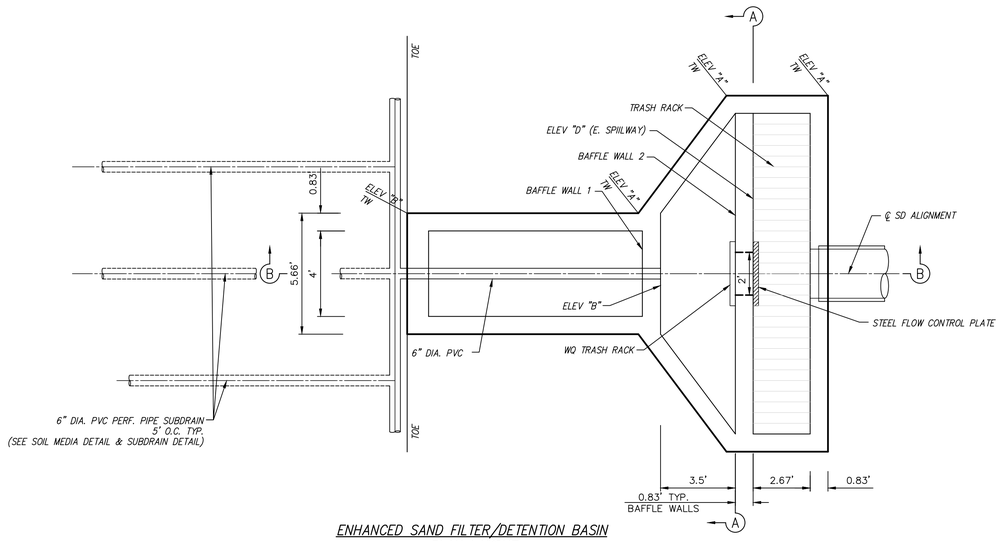

SECTION B–B
N.T.S.



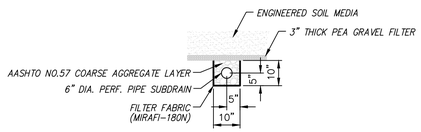

SECTION A–A
BAFFLE WALL



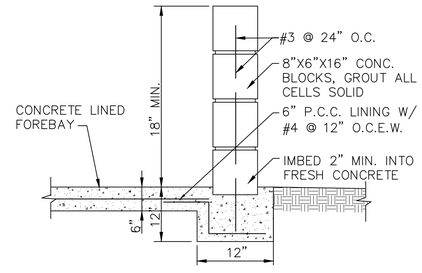

SECTION C–C
N.T.S.



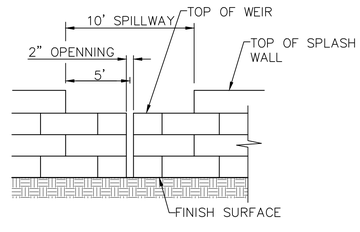

ENHANCED SAND FILTER/DETENTION BASIN PLAN LAYOUT
N.T.S.



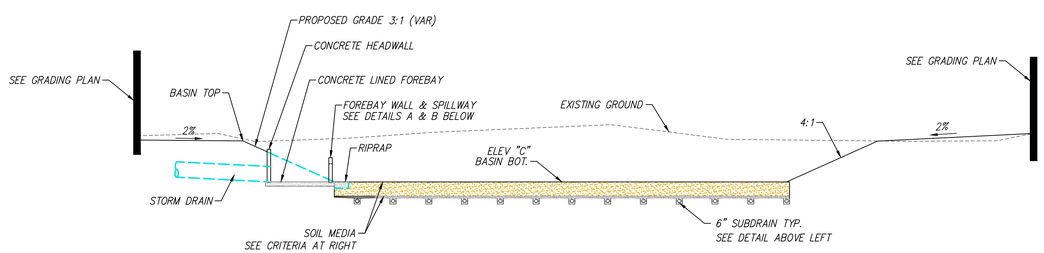

SOIL MEDIA & SUBDRAIN DETAIL
N.T.S.




A FOREBAY WALL
N.T.S.




B 2" WIDE WALL OPENNING
N.T.S.




SCHEMATIC ENHANCED SAND FILTER BASIN SECTION
NTS

***REINFORCEMENT SCHEDULE***

| MAX V | WALL THICKNESS | "A" & "B" BARS | "C" BARS |
|---|---|---|---|
| 6' | 9" | No.4 at 18" O.C. | No. 4 |
| 10' | 10" | No.4 at 12" O.C. | at 18" O.C. |

***WQ TRASH RACK NOTES:***

1. *WQ WELL–SCREEN TRASH RACKS SHALL BE STAINLESS STEEL AND SHALL BE ATTACHED BY STAINLESS STEEL HARDWARE ALONG THE EDGE OF THE MOUNTING FRAME.*
2. *STEEL FLOW CONTROL PLATE SHALL BE SHALL BE ATTACHED BY STAINLESS STEEL HARDWARE ALONG THE EDGE OF PLATE.*
3. *BAR GRATE TRASH RACKS SHALL BE ALUMINUM AND SHALL BE BOLTED USING STAINLESS STEEL HARDWARE.*
4. *TRASH RACK WIDTHS ARE FOR SPECIFIED TRASH RACK MATERIAL. FINER WELL–SCREEN OR MESH SIZE THAN SPECIFIED IS ACCEPTABLE, HOWEVER, TRASH RACK DIMENSIONS NEED TO BE ADJUSTED FOR MATERIALS HAVING A DIFFERENT OPEN AREA/GROSS AREA RATIO (R VALUE)*
5. *RECOMMENDED R–VALUE = 0.60*

***E.D.B. OUTLET NOTE:***

*REFERENCE: RIVERSIDE COUNTY FLOOD CONTROL DISTRICT E.D.B. OUTLET STANDARDS WQ501–E*

**Sand Filter - Detention Basin Outletwork**
**Nichols Road Project - Tract 37305**

| Basin | Elev "A" | Elev "B" | Elev "C" | Elev "D" | Elev "E" | Elev "XX" | Elev "YY" |
|---|---|---|---|---|---|---|---|
| A-2 | 1309.0 | 1297.0 | 1295.5 | 1297.0 | 1292.0 | xxx | yyy |
| B | 1345.0 | 1340.5 | 1340.0 | 1448.0 | 1433.0 | xxx | yyy |

Elev "A" = Top of Basin Outlet Wall
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Elev "XX" = Maximum WSE 24-hour 2-year storm (Det. Basin routing)
Elev "YY" = Maximum WSE 1-hour 100-year storm (Elev "XX" + Spillway headwater)

## BIORETENTION FACILITY BMP FACT SHEET

**Engineered Soil Media Requirements**

The engineered soil media shall be comprised of 85 percent mineral component and 15 percent organic component, by volume, drum mixed prior to placement. The mineral component shall be a Class A sandy loam topsoil that meets the range specified in Table 1 below. The organic component shall be nitrogen stabilized compost[1], such that nitrogen does not leach from the media.

**Table 1: Mineral Component Range Requirements**

| Percent Range | Component |
|---|---|
| 70-80 | Sand |
| 15-20 | Silt |
| 5-10 | Clay |

The trip ticket, or certificate of compliance, shall be made available to the inspector to prove the engineered mix meets this specification.

K&A Engineering, Inc.
ENGINEERING
LAND PLANNING
SURVEYING
357 N. SHERIDAN STREET
SUITE 117
CORONA, CALIFORNIA 92880
TEL. (951) 279–1800
FAX (951) 279–4380

# NICHOLS SOUTH SPECIFIC PLAN TRACT 37305

## WQMP - BMPs SITE PLAN

SHEET 3 OF 3

Drawing: R:\38266\Final\Design\Working\hr\water quality\05181\663 - EXH - BMP3-0618.dwg Layout: 24x36 L2 Saved: 6/4/2018 7:07 AM Plotted: 6/4/2018 7:07 AM By: Johannes Yostanto

# Appendix 2: Construction Plans

*Grading and Drainage Plans*

*Insert Improvement Plans*

# Appendix 3: Soils Information

*Geotechnical Study and Other Infiltration Testing Data*

Terracon GeoReport

# Geotechnical Investigation and Geologic Evaluation Report

**Tentative Tract No. 37305**
**Lake Elsinore, California**

February 2, 2018
Terracon Project No. CB175281

**Prepared for:**
Nichols Road Partners

**Prepared by:**
Terracon Consultants, Inc.
Colton, California

February 2, 2018

Nichols Road Partners
25555 Maitri Road
Corona, California 92877

Attn: Mr. Todd Pendergrass
P: (951) 277 -3900
E: tpendergrass@wenercorp.net

Re: Geotechnical Investigation and Geologic Evaluation Report
Tentative Tract No. 37305
Nichols Road and Interstate 15
Lake Elsinore, California
Terracon Project No. CB175281

Dear Mr. Pendergrass:

We have completed the Geotechnical Investigation and Geologic Evaluation services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. PCB175281 dated December 22, 2017, and other written and verbal communications. As noted in our proposal, this report includes the previous geotechnical investigation prepared by this firm and adds the CEQA items. We expect your consultant will use the findings and recommendations from our Geotechnical/Geologic Evaluation report to prepare a CEQA document.

Our report includes data from the U.S. Department of Agriculture for the soils found on site, as well as a discussion of the mineral resource potential for the area of your project. Although the site is not within a state- or county-designated earthquake fault zone, nonetheless the site is within a seismically active region. The report therefore summarizes important faults in the area of your project and discusses potential geotechnical/geologic concerns, such as fault rupture, liquefaction and erosion.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
**Terracon Consultants, Inc.**

REGISTERED PROFESSIONAL ENGINEER FENG YI No. GE2967 GEOTECHNICAL STATE OF CALIFORNIA

Fred Yi, Ph.D., G.E. 2967
Senior Associate

Jay J. Martin, Principal for
Patrick Dell, G.E.
Authorized Project Reviewer

# REPORT TOPICS


REPORT SUMMARY ..... i
INTRODUCTION ..... 1
PROJECT DESCRIPTION ..... 2
GEOTECHNICAL OVERVIEW ..... 4
SITE CONDITIONS ..... 4
GEOTECHNICAL CHARACTERIZATION ..... 5
CEQA STUDY CONCLUSIONS ..... 7
MITIGATION MEASURES FOR POTENTIAL GEOTECHNICAL HAZARDS ..... 9
SITE GEOLOGY ..... 11
SEISMIC CONSIDERATIONS ..... 15
LIQUEFACTION AND SEISMIC SETTLEMENT ..... 16
SHALLOW FOUNDATIONS ..... 18
LATERAL EARTH PRESSURES ..... 20
SLABS-ON-GRADE ..... 22
PAVEMENTS ..... 23
EARTHWORK ..... 26
CORROSIVITY ..... 32
STORMWATER MANAGEMENT ..... 33
GENERAL COMMENTS ..... 34
REFERENCES ..... 36


**Note:** This report was originally delivered in a web-based format. **Orange Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the Terracon GeoReport logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

## ATTACHMENTS


EXPLORATION AND TESTING PROCEDURES
SITE LOCATION AND EXPLORATION PLANS
EXPLORATION RESULTS (Boring Logs and Laboratory Data)
SUPPORTING INFORMATION (General Notes and Unified Soil Classification System)

# REPORT SUMMARY

| Topic [1] | Overview Statement [2] |
|---|---|
| **Project Description** | The project consists of approximately 71 acres that includes the Nichols Road grading project previously investigated by CHJ Consultants. Grading observation and compaction test of the Nichols Road grading project is in progress by CHJ Consultants, a Terracon Company. TTM 37305 generally includes the Nichols Road grading project and some additional acreage located to the south. The project consists of approximately 9 acres of commercial property, including a hotel, single-family residential lots, a recreational area, three Water Quality Management Plan (WQMP) basins, and an open space (recreation) area. Temescal Canyon High School is located southeast and southwest of the site. |
| **Geotechnical Characterization** | The north portion of the subject site has been graded. The geotechnical characterization of the south portion (ungraded) of the subject site is as followings.<br>■ No undocumented fill encountered<br>■ Loose sandy soils to 5 feet deep locally<br>■ Medium dense to very dense silty sand and sandy silt encountered up to 10 to 51.5 feet<br>■ Bedrock encountered at depths between approximately 20 and 51.5 feet<br>■ Groundwater not encountered |
| **Earthwork** | ■ Mandatorily remove 12 inches existing soils in all areas to be graded<br>■ Remove all existing fill where encountered.<br>■ Remove all loose native soils with relative compaction less than 85% |
| **Shallow Foundations** | Shallow foundations will be sufficient<br>■ Allowable bearing pressure = 2,500 lbs/sq ft<br>■ Minimum footing size = 18"×18"<br>■ Minimum footing depth = 12"<br>Expected settlements: < 1 inch total, < ½ inch differential<br>Detect and remove zones of fill and loose soils as noted in **Earthwork** |
| **Deep Foundations** | Deep foundations are not necessary for this site |
| **Free-Standing Retaining Walls** | Retaining walls up to approximately 25 feet high may be utilized |
| **Pavements** | With subgrade prepared as noted in **Earthwork**<br>Asphalt for graded area:<br>■ Auto Parking Areas: 0.25' HMA[3]/0.35' Class 2 AB[4]<br>■ Auto Roads: 0.25' HMA/0.50' Class 2 AB<br>■ Truck Parking Areas: 0.30' HMA/0.50' Class 2 AB<br>■ Truck Ramps and Roads: 0.40' HMA/0.75' Class 2 AB<br>Asphalt for non-graded area:<br>■ Auto Parking Areas: 0.25' HMA[3]/0.45' Class 2 AB[4]<br>■ Auto Roads: 0.25' HMA/0.55' Class 2 AB<br>■ Truck Parking Areas: 0.30' HMA/0.60' Class 2 AB<br>■ Truck Ramps and Roads: 0.40' HMA/0.90' Class 2 AB<br>Concrete for all areas: |

| | |
|---|---|
| | ■ Light Duty: 4.5" PCC/Compacted Fill<br>■ Medium Duty: 5.5" PCC/Compacted Fill<br>■ Dumpster Pad: 7.0" PCC/Compacted Fill |
| **General Comments** | This section contains important information about the limitations of this geotechnical engineering report. |

1. If the reader is reviewing this report as a pdf, the topics above can be used to access the appropriate section of the report by simply clicking on the topic itself.
2. This summary is for convenience only. It should be used in conjunction with the entire report for design purposes.
3. HMA = hot mix asphalt
4. AB = aggregate base

# Geotechnical Investigation and Geologic Evaluation Report

## Tentative Tract No. 37305
## Nichols Road and Interstate 15
## Lake Elsinore, California

**Terracon Project No. CB175281**

**February 2, 2018**

## INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed Tentative Tract No. 37305 to be located at Nichols Road and Interstate 15 in Lake Elsinore, California. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions and historical high groundwater
- 2016 California Building Code (CBC) seismic design parameters
- Items required by the California Environmental Quality Act (CEQA) for Geology and Soils and Mineral Resources
- Liquefaction potential
- Seismic settlement
- Recommendations for foundation design and concrete slab-on-grade
- Lateral earth pressures
- Subgrade preparation/earthwork recommendations
- Recommendations to mitigate unusual soil conditions encountered
- Recommendations for preliminary pavement section design
- Recommendation for on-site infiltration rate

The geotechnical engineering scope of services for this project included the advancement of 12 additional test borings to depths ranging from approximately 5.0 to 51.5 feet below existing site grades in the south portion of the site. Eight test borings were drilled to depths ranging from approximately 25.5 to 51.5 feet below existing site grades in the north portion of the site during 2016 investigation.

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs in the **Exploration Results** section of this report.

# PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed in the project planning stage. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

| Item | Description |
|---|---|
| **Information Provided** | Preliminary Lotting Study received on December 15, 2017 prepared by K & A Engineering, supplemented with requested test locations (subsequently revised by email on December 21), and conversations with representatives of K & A and Nichols Road Partners<br>We have not identified some of the parameters listed as assumed or unknown in our proposal. Those remain highlighted in this table. |
| **Project Description** | The project consists of approximately 71 acres that includes the Nichols Road grading project previously investigated by CHJ Consultants. Grading observation and compaction test of the Nichols Road grading project is in progress by CHJ Consultants, a Terracon Company. TTM 37305 generally includes the Nichols Road grading project and some additional acreage located to the south. The project consists of approximately 9 acres of commercial property, including a hotel, single-family residential lots, a recreational area, three Water Quality Management Plan (WQMP) basins, and an open space (recreation) area. Temescal Canyon High School is located southeast and southwest of the site. |
| **Proposed Structures** | The hotel will be four stories; one and/or two-story commercial structures are also expected. Most of the site will be developed with wood-frame single-family residential structures of one- or two-story construction with slabs on grade |
| **Building Construction** | Wood-frame with slab-on--grade |
| **Finished Floor Elevation** | Variable, unknown |
| **Maximum Loads** | ■ Columns: 30 to 100 kips<br>■ Walls: 1 kips per linear foot (klf)<br>■ Slabs: 150 pounds per square foot (psf) |
| **Grading/Slopes** | Up to 25 feet of cut and 25 feet of fill will be required to develop final grade.<br>Final slope angles of as steep as 2H:1V (Horizontal: Vertical) are expected. |
| **WQMP Basins** | Three storm water infiltration basins are anticipated. Depths shown require testing at depths of 7-14 feet below existing grade, depending on the basin finished grade |
| **Free-Standing Retaining Walls** | Retaining walls up to approximately 25 feet high may be utilized |

| Item | Description |
|---|---|
| **Pavements** | Paved driveway and parking will be constructed on site.<br>We assume both rigid (concrete) and flexible (asphalt) pavement sections should be considered. Please confirm this assumption.<br>Anticipated traffic indices (TIs) are as follows:<br>■ Auto Parking Areas: TI=5.0<br>■ Auto Roads: TI=5.5<br>■ Truck Parking Areas: TI=6.0<br>■ Truck Ramps and Roads: TI=8.0<br>■ The pavement design period is 20 years.<br>Anticipated average daily truck traffic (ADTT) is as follows for concrete pavement:<br>■ Light Duty: ADTT=1 (Category A)<br>■ Medium Duty: ADTT=25 (Category B)<br>■ Dumpster Pad: ADTT=700 (Category C) |
| **Estimated Start of Construction** | Unknown |

## Previous Investigations

A Preliminary Geotechnical Investigation was performed on a larger parcel that includes the entire site by Geotechnics, Incorporated in 2005. That report addressed geologic hazards including faulting, surface rupture, liquefaction and landslides. That report was utilized where possible during our investigation. Geotechnics, Inc. concluded that the potential for surface rupture, landsliding, liquefaction, flooding or other geologic hazards is low. We are in general agreement with the assessment of geologic hazards presented in their report.

In May 2016, CHJ Consultants, A Terracon Company (currently Colton office of Terracon Consultants Inc.) performed a geotechnical investigation (CHJ Jon No. 16164-3) on approximately 46 acres generally located in the northerly portion of the tract, known as the Nichols Road Grading Project (See **Exploration Plan**). The 2016 report was updated to include CEQA study in May 2017 by Terracon (Terracon Job No. CB175164). The results and recommendations of that report are utilized in this report as needed.

In April 2017 grading of the western portion of the 46 acres (See **Exploration Plan**) began on the site and was in progress during preparation of this report. CHJ Consultants, A Terracon Company, provided observation and compaction testing services during grading.

## GEOTECHNICAL OVERVIEW

The CEQA study is summarized in **CEQA Study Conclusions**. Measures mitigating potential hazards are discussed in **Mitigation Measures for Potential Geotechnical Hazards**.

The subsurface soils of the site are described in the **Geotechnical Characterization** section. Based upon our field investigation and test data, it is our opinion that the upper existing soils will not, in their present condition, provide uniform or adequate support for the proposed structure. Based on review of our exploratory boring logs, variable in situ conditions may be present. These conditions may cause unacceptable differential and/or overall settlement upon application of the anticipated foundation loads.

Because of site conditions, it will be necessary to remove the upper 12 inches of soils in all areas to be graded. All existing undocumented fill if encountered should then be completely removed. Additional site preparation recommendations including subgrade improvement and fill placement are provided in the **Earthwork** section.

The **Shallow Foundations** section addresses support of the building structures bearing on engineered fill or competent native soils. The **Slabs-On-Grade** section addresses slab-on-grade support of the buildings. Recommendations for preliminary pavement designs including asphalt concrete pavement and Portland cement concrete pavement are provided in the **Pavements** section.

The **General Comments** section provides an understanding of the report limitations.

## SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

| Item | Description |
|---|---|
| **Parcel Information** | The project is located southeast of Nichols Road and Interstate 15, in Lake Elsinore, California.<br>Approximately 71 Acres<br>See **Site Location** |

| Item | Description |
|---|---|
| **Existing Improvements** | The northern portion of the site was graded and fill had been placed prior to this investigation. The fill was observed during placement and has been tested by this firm (CHJ Consultants, a Terracon Company, Project No, CB171111, testing ongoing). Excavation of bedrock hills in the northern portion of the site was ongoing during this investigation. The approximate limits of the existing fill are marked on our **Exploration Plan**. The southern portion of the site had no other existing improvements. |
| **Current Ground Cover** | The southern portion of the site is lightly- moderately vegetated with low-lying shrubs and grass; the graded area in the northern portion of the site is devoid of vegetation |
| **Existing Topography** | The site generally slopes toward Stovepipe Wash |

### Historic Aerial Photo Examination

Aerial imagery dated from 1938 to 2017 were examined for indications of past site usage and potential geologic hazards as part of this investigation. The images examined between 1938 and 2005 show the site undeveloped except for dirt roads, which crossed the site. Stockpiles in the northern portion of the site that were present during our previous investigation were first observed in the 2009 aerial image. These stockpiles primarily consisted of revegetation plots prepared for the Chandler Aggregates Nichols Road mine located north of the site. No other pertinent features were observed on the aerial images examined. Indications of geologic hazards such as faulting or landslides were not observed in the aerial imagery examined.

## GEOTECHNICAL CHARACTERIZATION

### Regional Site Geology

The site is situated in an uplifted and dissected bedrock terrain in the Peninsular Ranges geomorphic province. The Peninsular Ranges include plutonic and metamorphic crystalline rocks of Cretaceous and older age. The crystalline basement rocks are locally mantled by colluvial soils and older sediments. Geologic units in the site area include Mesozoic age metasedimentary and metavolcanic rocks coeval with the plutonic rocks of the Peninsular Ranges batholith and younger alluvial fan sediments of Holocene and late-Pleistocene age.

As mapped by Morton and Weber (2003) and Morton and Miller (2006), the surficial soils of the site are younger alluvial deposits that are underlain by crystalline bedrock units including Mesozoic-age metavolcanics. The **Geologic Index Map** depicts the geologic units in the site region.

## Subsurface Profile

We have developed a general characterization of the subsurface soil and groundwater conditions based upon our review of the data and our understanding of the geologic setting and planned construction. The north portion of the subject site has been graded in accordance with our recommendations provide in previous report (CHJ Job No. 16164-3 and Terracon Job No. CB175164). The following table provides our geotechnical characterization on the south portion (ungraded) of the subject site.

The geotechnical characterization forms the basis of our geotechnical calculations and evaluation of site preparation, foundation options and pavement options. As noted in **General Comments**, the characterization is based upon widely spaced exploration points across the site, and variations are likely.

| Stratum | Approximate Depth to Bottom of Stratum (feet) | Material Description | Consistency/Density |
|---|---|---|---|
| Surface | | No top soil was encountered | N/A |
| 1 | 5 (locally) | Silty sand | Loose |
| 2 | 10 to 51.5 | Silty sand, sand, and sandy silt | Medium dense to very dense |
| 3 | 20 to 51.5 | Bedrock recovered as sandy gravel | Very dense |
| 4 | Undetermined: Borings terminated within this stratum at depths of approximately 20.2 to 51.5 feet | Bedrock | -- |

Conditions encountered at each boring location are indicated on the individual boring logs shown in the **Exploration Results** section and are attached to this report. Stratification boundaries on the boring logs represent the approximate location of changes in native soil types; in situ, the transition between materials may be gradual.

## Groundwater Conditions

The boreholes were observed while drilling and after completion for the presence and level of groundwater. Groundwater was not encountered within the maximum 51-1/2-foot depth reached in the borings.

## Historic Groundwater Conditions

The site is located in Section 25 of Township 5 South, Range 5 West, northeast of the Elsinore Groundwater Basin (DWR, 2017). The nearest known well is greater than 1.5 miles south of the

site and is situated in valley sediments. The site is underlain at relatively shallow depth by crystalline bedrock. We observed no seepage, springs or other evidence for a groundwater table within the site boundary during geologic mapping. Groundwater was not encountered within the 51-1/2-foot depth of the current borings. Previous investigations by Geotechnics, Incorporated (2005) reported groundwater as seepage in bedrock or perched on clay layers at depths ranging from 18 to 35 feet bgs. The depth to groundwater on the site is likely to vary seasonally, and perched groundwater may occur at the soil-bedrock contact. For this investigation we have estimated the historic high groundwater level to be 40 feet bgs. The 40-foot historic high is consistent with the depth to groundwater of approximately 40 feet (1915 contours) depicted by Waring (1919).

### Hydroconsolidation

The previous investigation performed by Geotechnics, Incorporated indicates some potential for hydroconsolidation of the on-site soils. Hydroconsolidation tests performed by CHJ Consultants in 2016 for samples obtained in north portion of the site indicate a hydroconsolidation strain of 6.5 percent (Enclosures "C-3" through "C-6" in **Previous Exploration Results** section). The hydrocollapsible soils have been removed and recompacted during grading performed in 2017.

On the south portion of the site, the soils encountered are generally granular and in a dense state. Hydroconsolidation potential is considered low.

## CEQA STUDY CONCLUSIONS

### Subsidence

Portions of the site are located in areas identified as potentially susceptible to subsidence associated with groundwater or petroleum fluid withdrawal, peat oxidation or hydroconsolidation according to the County of Riverside (2017).

Due to the lack of peat or petroleum-associated deposits, petroleum withdrawal and peat oxidation do not appear to be hazards. Based on observations made during grading, the alluvial materials on the site are classified as late Pleistocene in age; therefore, the hazard of subsidence due to groundwater withdrawal appears to be minimal. It is our understanding that the County subsidence zone in this area refers to hydrocollapse potential, which is low in the site's post-grading condition.

### Mineral Resources

The aggregate resource potential for the area of the site is addressed in a report titled, "Update of Mineral Land Classification for Portland Cement Concrete-Grade Aggregate in the Temescal

Valley Production Area, Riverside County, California" (CDMG/CGS, 2014). This report addresses the sand and gravel resource potential according to the presence or absence of significant sand and gravel deposits for use in construction-grade aggregate. The resource quality of surrounding lands was reported according to the following Mineral Resource Zone (MRZ) classification system:

**MRZ-1:** Areas where available geologic information indicates that little likelihood exists for the presence of significant mineral resources.

**MRZ-2:** Areas where adequate information indicates that significant mineral deposits are present, or where it is judged that a high likelihood for their presence exists.

**MRZ-3:** Areas containing mineral occurrences of undetermined mineral resource significance.

**MRZ-4:** Areas where available information is inadequate for assignment to any other MRZ.

The site is situated in primarily alluvial and colluvial terrain underlain by crystalline metamorphic bedrock. No economically significant sources of aggregate material were observed within the site. The project site is placed near an MRZ-2 zone. Aggregate mining is currently occurring in bedrock outcrops immediately north of the site. The site was examined by geologists from this firm and the site owner and no commercially viable aggregate resources were observed.

As the project area is not presently used for mineral resource extraction and does not contain identified sources of aggregate materials, the proposed project will not result in the loss of availability of any known mineral resources. Thus, no significant impacts are anticipated.

## Erosion

The native soils mantling the site are considered moderately to severely susceptible to erosion, based on data available from the USDA (2017). Surficial erosion can be addressed by site development and inclusion/repair of drainage improvements.

## Expansive Soils

Plasticity index values available from the USDA (2017) indicate non-plastic soils. All soils materials encountered during this investigation were sufficiently granular to be non-critically expansive; the need for specialized construction procedures to specifically resist expansive soil forces is not anticipated at this time. Requirements for reinforcing steel to satisfy structural criteria are not affected by this recommendation. Additional evaluation of soils for expansion potential should be conducted by the soils engineer during the grading operation.

### Volcanic Hazards

The nearest volcanic center to the site is the Lavic Lake Field, which includes Pisgah Crater, located approximately 88 miles to the northeast. The estimated age of last activity within the Lavic Field is 10,000 years before present. The threat potential as listed by USGS (2015) is "low to very low". Volcanic hazards are not expected to affect the site.

### Wastewater

The use of septic tanks or other wastewater disposal systems may not be feasible to service the subject project. It is anticipated that the site will be serviced using a sewer system.

### Off-Site Impacts

Potential geotechnical impacts to off-site areas are not anticipated due to requirements regarding grading permitting, erosion control and avoidance of non-permitted disturbance to off-site areas required by local regulations. The flat-lying character of site and adjacent topography precludes slope effects to off-site or adjacent properties.

## MITIGATION MEASURES FOR POTENTIAL GEOTECHNICAL HAZARDS

### General

As a part of mitigation for the project on a general basis, existing and proposed structures and site infrastructure and improvements will be designed and constructed in compliance with applicable building codes. The County of Riverside will require that local building code requirements and project considerations be met prior to issuing a building permit. Proper design and construction in conformance with the recommendations of project geotechnical reports, and compliance with applicable building codes, will reduce the potential adverse impacts of identified geotechnical hazards.

### Seismicity and Ground Shaking

The potential for strong ground shaking at the site during the design life of the proposed project is moderate to high. The proposed improvements and structures will be designed according to seismic design parameters and procedures presented in the applicable building code for earthquake ground motions that are expected to occur in the site region. While potential impacts of ground shaking that could affect the proposed development will be reduced with proper design and construction, adverse effects due to ground shaking can occur.

## Surface Fault Rupture Potential

For planning purposes, faults in California are generally classified as active, potentially active or inactive. Active faults are those that exhibit surface displacement within Holocene time (about the last 11,000 years). Potentially active faults are those that exhibit evidence of surface displacement during Quaternary time (last 1.6 million years) but not Holocene displacement. Inactive faults have not shown evidence of movement in the last 1.6 million years.

The site does not lie within or immediately adjacent to an Alquist Priolo Earthquake Fault Zone designated by the State of California to include traces of suspected active faulting. The closest APZs are designated for the Elsinore fault zone, located approximately 1.5 miles southwest of the site. According to the County of Riverside (2017), the site is not located in a County-designated Earthquake Fault Zone.

## Slope Stability

The relatively flat-lying topography of the site and surrounding area precludes the potential for instability of natural slopes. Site development will include geotechnical evaluation of existing fill slopes and, if required, engineered grading or foundation designs that reduce the potential for slope instability of fill slopes. The potential for landslide or slope instability is considered low.

## Erosion

The native soils mantling the site are considered moderately to severely susceptible to erosion, based on data available from the USDA (2017). Positive drainage should be provided, and water should not be allowed to pond anywhere on the site. Water should not be allowed to flow over any graded or natural areas in such a way as to cause erosion. Finish graded areas should be protected from the effects of runoff so as to reduce the potential impact from erosion to a less than significant level.

## Expansive or Corrosive Soils

The on-site soils are granular and are not considered critically expansive. Soils utilized beneath structures should consist of granular, non-clay-bearing soils.

Chemical tests performed for the prior site investigation indicates that the soil tested are considered potentially "mildly" corrosive to ferrous metals at as-received condition and "moderately" corrosive at saturated condition. Ammonium and nitrate levels did not indicate a concern as to corrosion of buried copper. Results of the soluble sulfate testing indicate a "not applicable" (Class S0) anticipated exposure to sulfate attack.

### Subsidence

Portions of the site are located in areas identified as susceptible to subsidence according to the County of Riverside (2017). Due to the lack of associated deposits, petroleum withdrawal and peat oxidation do not appear to be hazards. Based on observations made during grading, the alluvial materials on the site are classified as late Pleistocene in age; therefore, the hazard of subsidence due to groundwater withdrawal appears to be minimal. It is our understanding that the County subsidence zone in this area refers to hydrocollapse potential, which is low in the site's post-grading condition.

### Mineral Resources

The project area is not presently used for mineral extraction, and as no documented mineral resources have been identified on or adjacent to the project area, the proposed project will not result in the loss of availability of any known mineral resources. Thus, no significant impacts are anticipated.

## SITE GEOLOGY

### Fault Rupture Potential

The site is not located within an Alquist-Priolo Earthquake Fault Zone (APZ) designated by the State of California for active faults. The closest APZ boundary, designated for the Elsinore fault zone, is located approximately 1.5 miles southwest of the site. According to the County of Riverside (2017), the site is not located in a County-designated Earthquake Fault Zone. Known faults or fault-related features are not located within the site; therefore, the potential for fault rupture within the site is considered low.

### Regional Faults

**Elsinore Fault Zone**

The Glen Ivy North segment of the Elsinore fault zone is the nearest major active fault, about 1.6 miles southwest of the site. The Elsinore fault zone is typified by multiple en echelon and diverging faults. To the north, it splays into the Whittier and Chino faults. The Elsinore is primarily a strike-slip fault zone; however, transtentional features such as the graben of the Elsinore and Temecula Valleys also occur. Most Elsinore fault traces are demonstrably active (Holocene) as documented by Saul (1978), Rockwell and others (1986) and Wills (1988).

The southern segment of the northwest-trending Chino-Central Avenue fault, a northern splay of the Elsinore fault zone, is approximately 22 miles northwest of the site and is assigned a 6.8 magnitude by Petersen and others (2008).

The west- to northwest-trending Whittier fault is approximately 23 miles northwest of the site. The Whittier fault exhibits almost pure right-lateral strike slip (Rockwell and others, 1986). Evidence for activity includes offset of Holocene sediments (Hannan and Lung, 1979) and historic microseismicity (Yerkes, 1985). The Working Group on California Earthquake Probabilities (1995) tentatively assigned a 5 percent probability of a major earthquake on the Whittier fault for the 30-year interval from 1994 to 2024.

**San Jacinto Fault Zone**

The San Jacinto fault zone is a system of northwest-trending, right-lateral, strike-slip faults. The San Jacinto Valley segment is approximately 18.5 miles northeast of the site. More large historic earthquakes have occurred on the San Jacinto fault than any other fault in Southern California (Working Group on California Earthquake Probabilities, 1988).

Based on the data of Matti and others (1992), a portion of the San Jacinto fault may accommodate most of the slip between the Pacific and the North American plates. Matti and others (1992) suggest this motion is transferred to the San Andreas fault in the Cajon Pass region by "stepping over" to parallel fault strands that include the Glen Helen fault.

**San Andreas Fault Zone**

The San Andreas fault zone is located along the southwest margin of the San Bernardino Mountains, approximately 30 miles north-northeast of the site. The mountain front in the San Bernardino area approximately marks the active trace of the San Andreas fault, here characterized by youthful fault scarps, vegetation lineaments, springs and offset drainages. Field and others (2008) assigned a 53 percent probability to a magnitude 6.7 or greater earthquake occurring on the southern segment of the San Andreas fault between 2014 and 2044.

**Blind Thrust Faults**

The San Joaquin Hills Thrust (SJHT) fault is an inferred blind thrust beneath the San Joaquin Hills in coastal Orange County, southern California. The vertical surface projection of the San Joaquin Hills blind thrust is approximately 20 miles west-southwest of the site. The SJHT is southwest dipping and presumably gave rise to uplift of the San Joaquin Hills. Measurement of uplifted back-bay shorelines and fossil dating suggests an uplift rate of 0.24 meter per 1,000 years and an average earthquake recurrence of 2,500 years on the SJHT (Grant and others, 1999). The SJHT has a postulated potential to produce earthquakes with magnitudes up to Mw 7.3. A latest large event may have occurred in 1769 A.D. based on radiocarbon dating of uplifted marsh sediments (Grant and others, 1999).

The Puente Hills Blind-Thrust (PHBT), located approximately 32 miles to the west-southwest, is a system of buried thrust fault ramps that extend from beneath Los Angeles to the Puente Hills of eastern Los Angeles County and Orange County. The PHBT is identified in the subsurface by

seismic reflection profiles, petroleum well data and precisely located seismicity and at the surface by a series of contractional folds. Fault segments of the PHBT are the Los Angeles, Santa Fe Springs and Coyote Hills (Shaw and Shearer, 1999). This buried fault system is capable of producing estimated earthquakes of Mw 6.5 to 6.6 on individual segments or an Mw 7.1 earthquake as a group (Shaw and others, 2002). A study utilizing borehole data collected from sediments overlying the central segment of the PHBT indicates that subtle folding locally extends to the near surface and that four fault slip events occurred in the past 11,000 years (Dolan and others, 2003).

**Local Faults**

No active faults were identified within the site area during our review of published and unpublished literature and maps, stereoscopic aerial photographs or field mapping. Accordingly, ground fault rupture is not anticipated.

Weber (1977) mapped a postulated north-west trending fault at the contact between bedrock and alluvium along the base of site slopes. Examination of exposures along this trend did not indicate a fault at the mapped location. The occurrence of the Mzu unit north and south of Nichols Road suggests continuity (unfaulted) bedrock.

### Historical Earthquakes

A map of recorded earthquake epicenters is included as the **Earthquake Epicenter Map**. The epicenters and magnitudes are based on data from a USGS earthquake catalog. This enclosure presents circles as epicenters of earthquakes with magnitude equal to or greater than magnitude 4.5 recorded from 1918 through 2017. From a ground-shaking standpoint the most significant fault for the site is the Elsinore fault, about 1.6 miles to the southwest.

The site is located within the seismically-active southern California region. The following table summarizes the historic seismic events in the site region.

| Summary of Historic Seismicity | | | | |
|---|---|---|---|---|
| **Event ID** | **Date** | **Magnitude** | **Distance from LLU Campus (miles)** | **Direction from Site** |
| Whittier Narrows | 10/1/1987 | 5.9 | 47 | W |
| Upland | 2/28/1990 | 5.4 | 26 | NW |
| Sierra Madre | 6/28/1991 | 5.8 | 45 | NW |
| Landers | 6/28/1992 | 7.3 | 48 | NE |
| Big Bear | 6/28/1992 | 6.4 | 27 | NE |
| Northridge | 1/17/1994 | 6.7 | 75 | NW |
| Hector Mine | 10/16/1999 | 7.1 | 69 | NE |
| Yucaipa (14155260 [1]) | 6/16/2005 | 4.9 | 8.7 | E |
| 14355252 | 3/8/2008 | 3.9 | 13 | NW |
| Chino Hills | 7/29/2008 | 5.4 | 29 | SW |
| 11006189 [1] | 9/14/2011 | 4.2 | 13 | SE |
| 15141521 [1] | 4/28/2012 | 3.8 | 16 | NW |

1. SCSN earthquake catalog

Any of the active faults of the Inland Empire area are capable of producing strong ground shaking during earthquakes. Construction of site improvements according to applicable building codes can mitigate the potential for damage to site facilities.

## Tsunamis, Inundation, Seiche, and Flooding Potential

The site is not located in a coastal area; therefore, tsunamis are not considered a hazard at the site.

According to the County of Riverside (2017), the site is not located within a potential inundation area for seismically induced dam/reservoir failure. Open reservoirs are not located up gradient from the site; therefore, inundation or seiches are not considered hazards at the site.

The majority of the site is not located in an area designated by the Federal Emergency Management Agency (2008) as a flood hazard zone. Stovepipe Canyon Creek, which crosses the site, is considered to be in a 100-year flood zone. The County of Riverside (2017) notes the same area as a zone of "flooding sensitivity." A more accurate determination of the flood hazard to the site and the adequacy of existing flood and drainage improvements near the site is not within the scope of this investigation. Based on the anticipated grading planned at the site, flooding is not considered a significant hazard.

# SEISMIC CONSIDERATIONS

The tectonics of the Southern California area are dominated by the interaction of the North American and Pacific tectonic plates, which are sliding past each other in transform motion. Although some of the motion may be accommodated by rotation of crustal blocks such as the western Transverse Ranges (Dickinson, 1996), the San Andreas fault zone is thought to represent the major surface expression of the tectonic boundary and to accommodate most of the slip between the Pacific and North American plates. Some of the slip is accommodated by other northwest-trending strike-slip faults that are related to the San Andreas system, such as the San Jacinto and Elsinore faults. Local compressional or extensional strain resulting from the transform motion along this boundary is accommodated by left-lateral, normal and reverse faults such as the Cucamonga fault

## Seismic Design Parameters

The seismic design requirements for buildings and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The seismic design parameters, according to the 2016 California Building Code (CBC) are provided in the following table.

| Description | Value |
|---|---|
| **2016 California Building Code Site Classification (IBC)** [1] | D [2] |
| **Site Latitude** | 33.7055° |
| **Site Longitude** | -117.3524° |
| Mapped Spectral Acceleration Parameters [3] | $S_S$ = 2.25 and $S_1$ = 0.89 |
| Site Coefficients [3] | $F_A$ = 1.0 and $F_V$ = 1.5 |
| Adjusted Maximum Considered Earthquake Spectral Response Parameters Design Spectral Acceleration Parameters [3] | $SM_S$ = 2.25 and $SM_1$ = 1.34 |
| Design Spectral Acceleration Parameters [3] | $SD_S$ = 1.50 and $SD_1$ = 0.89 |
| Peak Ground Acceleration [3] | 0.87g |
| De-aggregated Magnitude | 6.77 |

| Description | Value |
|---|---|
| 1. Seismic site classification in general accordance with the *2016 California Building Code*, which refers to ASCE 7-10.<br>2. The 2016 California Building Code (CBC) uses a site profile extending to a depth of 100 feet for seismic site classification. Borings at this site were extended to a maximum depth of 51.5 feet. The site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area. Additional deeper borings or geophysical testing may be performed to confirm the conditions below the current boring depth.<br>3. These values were obtained using online seismic design maps and tools provided by the USGS (http://earthquake.usgs.gov/hazards/designmaps/). | |

# LIQUEFACTION AND SEISMIC SETTLEMENT

## Liquefaction Potential

Liquefaction is a process in which strong ground shaking causes saturated soils to lose their strength and behave as a fluid. Ground failure associated with liquefaction can result in severe damage to structures. Soil types susceptible to liquefaction include sand, silty sand, sandy silt, and silt, as well as soils having a plasticity index (PI) less than 7 (Boulanger and Idriss, 2006). Loose soils with a PI less than 12 and moisture content greater than 85 percent of the liquid limit are also susceptible to liquefaction (Bray and Sancio, 2006). For sandy soils, the geologic conditions for increased susceptibility to liquefaction are: 1) shallow groundwater (generally less than 50 feet in depth), 2) the presence of unconsolidated sandy alluvium, typically Holocene in age, and 3) strong ground shaking. All three of these conditions must be present for liquefaction to occur. The site is located within an area identified as having a moderate potential for liquefaction by the City of Lake Elsinore (2011) and the County of Riverside (2017).

Due to the potential for shallow groundwater beneath the site, the liquefaction potential of the site has been evaluated based on the SPT data obtained and using the simplified procedure described by Seed and Idriss (1982), Seed and others (1985), modified in the 1996 National Center for Earthquake Engineering Research (NCEER) and 1998 NCEER/National Science Foundation (NSF) workshops (Youd and Idriss, 2001), and as recently summarized by Idriss and Boulanger (2008). The method of evaluating liquefaction potential consists of comparing the cyclic stress ratio (CSR) developed in the soil by the earthquake motion to cyclic resistance ratio (CRR), which will cause liquefaction of the soil for a given number of cycles. In the simplified procedure, the CSR developed in the soil is calculated from a formula that incorporates ground surface acceleration, total and effective stresses in the soil at different depths (which in turn are related to the location of the groundwater table), non-rigidity of the soil column and a number of simplifying assumptions.

For sandy soils, the CRR that will cause liquefaction is related to the relative density of the soil, expressed in terms of SPT blowcounts $(N_1)_{60}$ (Seed and Idriss, 1982; Seed and others, 1985;

Youd and Idriss, 2001; Idriss and Boulanger, 2008), cone penetration resistance ($q_{c1N}$) (Robertson and Wride, 1998; Youd and Idriss, 2001; Idriss and Boulanger, 2008) or shear wave velocity ($V_{s1}$) (Andrus and Stokoe, 2000; Youd and Idriss, 2001; Andrus and others, 2004), all normalized for an effective overburden pressure of 1 ton per square foot and corrected to equivalent clean sand resistance. For clayey soils, the CRR is related to cyclic undrained shear strength ratio, $s_u/\sigma_{vc}'$ (Idriss and Boulanger, 2008). For this investigation, SPT blowcounts were obtained and utilized in the analysis. The project groundwater depth of 40 feet bgs was utilized to calculate the liquefaction potential in the area. The recommended design PGA of 0.87g and a deaggregated earthquake magnitude ($M_w$) of 6.77 were utilized as input into the liquefaction analysis program GeoSuite©, version 2.4 (Yi, 2016).

For the subject site, liquefaction potential was evaluated based on the Idriss and Boulanger (2008) method.

Liquefaction potential was evaluated for the soil profiles encountered in Exploratory Boring Nos. 3, 6 and 8. Seismic settlement was estimated for the same soil profiles utilized in the liquefaction analyses. The results of liquefaction potential and seismic settlement evaluations are shown in Enclosures "D-1" through "D-3" (**Previous Exploration Results** section) and Exhibit D-1 for existing site conditions. The liquefaction potential was also evaluated for post-grading conditions. The results are shown in Enclosure "D-4" (**Previous Exploration Results** section) for 2016 Exploratory Boring No. 3.

Our calculations indicate that liquefaction could occur within thin localized layers in Exploratory Boring No. 3 (2016).

### Seismic Settlement

Prediction of seismic-induced settlement is also important. Seismic-induced settlement includes settlement that occurs both in dry sands and saturated sands (California Geological Survey, 2008). Severe seismic shaking may cause dry sands to densify, resulting in settlement expressed at the ground surface. Seismic settlement in dry soils generally occurs in loose sands and silty sands, with cohesive and fine-grained soils being less prone to significant settlement. For saturated soils, significant settlement is anticipated if the soils exhibit liquefaction during seismic shaking.

The methods for evaluating seismic settlement in saturated sands can generally be classified into two groups. The method for the first group was developed during the 1970s and 1980s, generally based on the relationship between cyclic stress ratio, $(N_1)_{60}$, and volumetric strain (Silver and Seed, 1971; Lee and Albaisa, 1974; and Tokimatsu and Seed, 1987). The method for the second group was developed in the early 1990s with the paper by Ishihara and Yoshimine (1992) as the first publication in the category, modified and improved by various researchers (Robertson and Wride, 1998; Yoshimine et al., 2006; Idriss and Boulanger, 2008; and Yi, 2010), and is generally

based on the relationship between volumetric strain and the factor of safety for liquefaction. Idriss and Boulanger (2008) modified the methods to incorporate both SPT and CPT data. Yi (2010) modified the methods to incorporate shear wave velocity data.

Research related to the estimation of dry sand settlement during earthquake excitation was initiated in the early 1970s by Silver and Seed (1971), followed by the works of several researchers (Seed and Silver, 1972; Pyke et al., 1975; Tokimatsu and Seed, 1987; and Pradel, 1998). A simplified method of evaluating earthquake-induced settlements in dry, sandy soils based on the Tokimatsu and Seed procedure has been developed by Pradel (1998) and is recommended by Martin and Lew (1999) as one of the standard methods for the estimation of earthquake-induced settlements of dry sands in California. In recent years, research was performed by the University of California, Los Angeles (Duku et al., 2008; Yee et al., 2014; Stewart, 2014), and a new volumetric strain material model (VSMM) was proposed. The new UCLA VSMM was developed based on a series of laboratory test results and is able to consider the effects of overburden pressure, fines contents and degree of saturation. This new model was utilized for hospital projects and approved by OSHPD. All of these methods including the latest UCLA method were incorporated into a liquefaction and seismic settlement program, GeoSuite©, version 2.4 (Yi, 2016).

For the subject site, liquefaction-induced settlement was evaluated based on the Idriss and Boulanger (2008) method, and the seismic settlement of dry sands was evaluated based on UCLA method (Duku et al., 2008; Yee et al., 2014; Stewart, 2014).

Our analysis indicates that seismic settlement (including liquefaction-induced settlement and dry sand settlement) could range from approximately 0.0 to 1.3 inches for existing conditions, and the maximum seismic settlement is anticipated to be 1.6 inches. However, due to the thin liquefiable layer and thick, upper non-liquefiable layer, the potential for surface manifestation after grading is limited. We expect the maximum seismic settlement for post-grading condition of less than 1/2 inch considering the non-uniformity of soil layers of the site. The impact of seismic settlement on the project is considered to be low.

## SHALLOW FOUNDATIONS

If the site has been prepared in accordance with the requirements noted in **Earthwork**, conventional spread foundations, either individual spread footings and/or continuous wall footings, may be utilized for the proposed building structures. The following design parameters are applicable for shallow foundations.

## Design Parameters – Compressive Loads

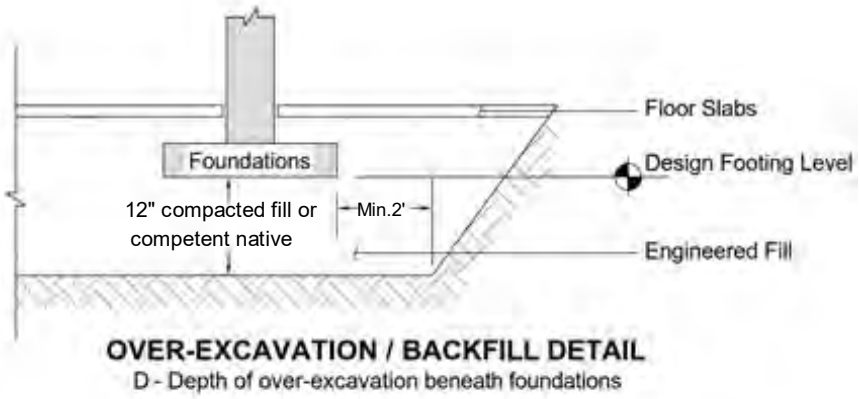
| Item | Description |
|---|---|
| **Maximum Net Allowable Bearing Pressure** [1, 2] | 3,500 psf for isolated footing<br>1,800 psf for continuous footing |
| **Required Bearing Stratum** [3] | 12" compacted fill or competent native soil |
| **Minimum Foundation Dimensions** | 24" for isolated footing<br>12" for continuous footing |
| **Minimum Footing Depth** [4] | 12" below finish grade |
| **Ultimate Passive Resistance** [5]<br>**(equivalent fluid pressures)** | 430 psf/ft |
| **Ultimate Coefficient of Sliding Friction** [6] | 0.39 (on-site material) |
| **Estimated Total Settlement from Structural Loads** [2] | Less than about 1" |
| **Estimated Differential Settlement** [2, 8] | About 1/2 of total settlement |

1. The net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation and the pressure for the minimum footing size and embedded depth. An appropriate factor of safety has been applied. These bearing pressures can be increased by 1/3 for transient loads unless those loads have been factored to account for transient conditions. Values assume that exterior grades are no steeper than 20% within 10 feet of structure.
2. The maximum net allowable bearing pressure is the pressure for maximum loads noted in **Project Description**.
3. Unsuitable or loose soils should be over-excavated and replaced according to the recommendations presented in the **Earthwork**.
4. Minimum depth below finish grade refers to the lowest adjacent grade within 5 feet of the perimeter of the structure.
5. Use of passive earth pressures require the sides of the excavation for the spread footing foundation to be nearly vertical and the concrete placed neat against these vertical faces or that the footing forms be removed and compacted structural fill be placed against the vertical footing face. A factor of safety of 2.0 is recommended.
6. Can be used to compute sliding resistance where foundations are placed on suitable soil/materials. Should be neglected for foundations subject to net uplift conditions. A factor of safety of 1.5 is recommended.
7. Embedment necessary to minimize the effects of frost and/or seasonal water content variations. For sloping ground, maintain depth below the lowest adjacent exterior grade within 5 horizontal feet of the structure.
8. Differential settlements are as measured over a span of 50 feet.

## Foundation Construction Considerations

As noted in **Earthwork**, the footing excavations should be evaluated under the direction of the geotechnical engineer. The base of all foundation excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed.

Over-excavation for structural fill placement below footings should be conducted as shown below. The over-excavation should be backfilled up to the footing base elevation as recommended in the **Earthwork** section.

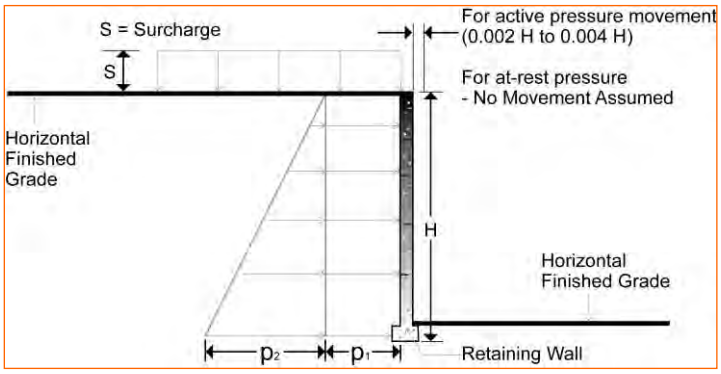



**OVER-EXCAVATION / BACKFILL DETAIL**
D - Depth of over-excavation beneath foundations

## LATERAL EARTH PRESSURES

### Design Parameters

Structures with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to values indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. Two wall restraint conditions are shown. Active earth pressure is commonly used for design of free-standing cantilever retaining walls and assumes wall movement. The "at-rest" condition assumes no wall movement and is commonly used for basement walls, loading dock walls, or other walls restrained at the top. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls (unless stated).




| Lateral Earth Pressure Design Parameters | | | | |
|---|---|---|---|---|
| **Earth Pressure Condition** [1] | **Coefficient for Backfill Type** [2] | **Surcharge Pressure $p_1$ (psf)** [3, 4, 5] | **Effective Fluid Pressures (psf)** [2, 4, 5] | |
| | | | **Unsaturated** [6] | **Submerged** [6] |
| Active ($K_a$) | 0.30 | (0.30)S | (40)H | --- |
| At-Rest ($K_o$) | 0.47 | (0.47)S | (62)H | --- |
| Passive ($K_p$) | 3.26 | --- | (430)H | --- |

1. For active earth pressure, wall must rotate about base, with top lateral movements 0.002 H to 0.004 H, where H is wall height. For passive earth pressure, wall must move horizontally to mobilize resistance.
2. Uniform, horizontal backfill using on-site material, compacted to at least 90 percent of the ASTM D 1557 maximum dry density, rendering a maximum unit weight of 114 pcf.
3. Uniform surcharge, where S (psf) is surcharge pressure.
4. Loading from heavy compaction equipment is not included.
5. No safety factor is included in these values.
6. In order to achieve "Unsaturated" conditions, follow guidelines in **Subsurface Drainage for Below Grade Walls** below. "Submerged" conditions are recommended when drainage behind walls is not incorporated into the design.

Backfill placed against structures should consist of granular soils or low plasticity cohesive soils. For the granular values to be valid, the granular backfill must extend out and up from the base of the wall at an angle of at least 45 and 60 degrees from vertical for the active and passive cases, respectively.

## Subsurface Drainage for Below Grade Walls

Backfill behind retaining walls should consist of a soil of sufficient granularity that the backfill will properly drain. The granular soil should be classified per the USCS as GW, GP, SW, SP, SW-SM or SP-SM. Surface drainage should be provided to prevent ponding of water behind walls. A drainage system consisting of either or both of the following should be installed behind all retaining walls:

- A 4-inch-diameter perforated PVC (Schedule 40) pipe or equivalent at the base of the stem encased in 2 cubic feet of granular drain material per linear foot of pipe or

- Synthetic drains such as Enkadrain, Miradrain, Hydraway 300 or equivalent.

Perforations in the PVC pipe should be 3/8 inch in diameter and should be placed facing down. Granular drain material should be wrapped with filter cloth such as Mirafi 140 or equivalent to prevent clogging of the drains with fines. Walls should be waterproofed to prevent nuisance seepage and damage. Water should outlet to an approved drain.

## SLABS-ON-GRADE

To provide adequate support, floor slabs (or concrete slabs-on-grade) should bear on compacted fills or competent native soils. The thickness of the slab-on-grade shall be determined by the designer based on the use and design requirements for the concrete slab-on-grade. For slabs bearing on compacted fill, the top 12 inches of soil should be compacted to 95 percent relative compaction. Finish-graded surfaces should be rolled to provide smooth and dense surfaces.

Slabs to receive moisture-sensitive coverings should be provided with a vapor retarder/barrier. We recommend that a vapor retarder/barrier be designed and constructed according to the American Concrete Institute 302.1R, Concrete Floor and Slab Construction, which addresses moisture vapor retarder/barrier construction. At a minimum, the vapor retarder/barrier should comply with ASTM E1745 and have a nominal thickness of at least 10 mils. The vapor retarder/barrier should be properly sealed, per the manufacturer's recommendations, and protected from punctures and other damage. Per the Portland Cement Association, for slabs with vapor-sensitive coverings, a layer of dry, granular material (sand), minimum of 4 inches thick, should be placed under the vapor retarder/barrier. For slabs in humidity-controlled areas, a layer of dry, granular material (sand), minimum of 4 inches thick, should be placed above the vapor retarder/barrier.

For the subject project, it is also acceptable to place the vapor barrier directly on the compacted soil and then place a layer of dry sand, minimum of 4 inches thick, on top of the vapor barrier.

A modulus of vertical subgrade reaction of 350 ksf/ft can be utilized in the design of slabs-on-grade for the proposed structures.

# PAVEMENTS

## General Pavement Comments

Pavement designs are provided for the traffic conditions and pavement life conditions as noted in **Project Description** and in the following sections of this report. A critical aspect of pavement performance is site preparation. Pavement designs, noted in this section, must be applied to the site, which has been prepared as recommended in the **Earthwork** section.

## Pavement Design Parameters

Design of asphalt concrete (AC) pavements is based on the procedures outlined in the Caltrans "Highway Design Manual for Safety Roadside Rest Areas" (Caltrans, 2016). Design of Portland cement concrete (PCC) pavements are based upon American Concrete Institute (ACI) 330R-08; "Guide for Design and Construction of Concrete Parking Lots."

R-value tests were performed on samples mixed from near surface bulk samples from boring Nos. B-9 thru B-11 from graded area (Mixture 1) and B-12 from non-graded area (Mixture 2). Additional R-value bulk samples were obtained (RV-1 thru RV-4 from graded area and RV-5 from non-graded area). Our visual classifications indicate that Mixture 1 is generally identical with mixture from RV-1 thru RV-4 samples and Mixture 2 is identical with RV-5. Test result indicates R-values of 37 (Exhibit C-7) and 32 (Exhibit C-8), respectively. R-values of 37 and 32 were used for the AC pavement and moduli of subgrade reaction of 145 and 161 pound per cubic inch (pci) for PCC pavement designs. A modulus of rupture of 600 psi was used for pavement concrete. The structural sections are predicated upon proper compaction of the utility trench backfills and the subgrade soils as prescribed by in **Earthwork**, with the upper 12 inches of subgrade soils and all aggregate base material brought to a minimum relative compaction of 95 percent in accordance with ASTM D1557 prior to paving. The aggregate base should meet Caltrans requirements for Class 2 base.

It should be noted that the pavement designs were based upon the results of preliminary sampling and testing and should be verified by additional sampling and testing during construction when the actual subgrade soils are exposed.

## Pavement Section Thicknesses

The following table provides options for AC and PCC Sections for graded area:

| Asphaltic Concrete Design | | | |
|---|---|---|---|
| **Usage** | **Traffic Index** | **R-Value** | **Recommended Structural Section** |
| Auto Parking Areas | 5.0 | 37 | 0.25' HMA[1]/0.35' Class 2 AB[2] |
| Auto Roads | 5.5 | 37 | 0.25' HMA[1]/0.50' Class 2 AB[2] |
| Truck Parking Areas | 6.0 | 37 | 0.30' HMA[1]/0.50' Class 2 AB[2] |
| Truck Ramps and Roads | 8.0 | 37 | 0.40' HMA[1]/0.75' Class 2 AB[2] |

1. HMA = hot mix asphalt
2. AB = aggregate base

| Portland Cement Concrete Design | | | |
|---|---|---|---|
| **Layer** | **Thickness (inches)** | | |
| | **Light Duty[1]** | **Medium Duty[2]** | **Dumpster Pad[3]** |
| PCC | 4.5 | 5.5 | 7.0 |
| Aggregate Base [4] | -- | -- | -- |

1. Car Parking and Access Lanes, Average Daily Truck Traffic (ADTT) = 1 (Category A).
2. Truck Parking Areas, Multiple Units, ADTT = 25 (Category B)
3. In areas of anticipated heavy traffic, fire trucks, delivery trucks, or concentrated loads (e.g., dumpster pads), and areas with repeated turning or maneuvering of heavy vehicles, ADTT = 700 (Category C).
4. Aggregate base is not required. Compacted on-site material is considered competent.

The following table provides options for AC and PCC Sections for non-graded area:

| Asphaltic Concrete Design | | | |
|---|---|---|---|
| **Usage** | **Traffic Index** | **R-Value** | **Recommended Structural Section** |
| Auto Parking Areas | 5.0 | 32 | 0.25' HMA[1]/0.45' Class 2 AB[2] |
| Auto Roads | 5.5 | 32 | 0.25' HMA[1]/0.55' Class 2 AB[2] |
| Truck Parking Areas | 6.0 | 32 | 0.30' HMA[1]/0.60' Class 2 AB[2] |
| Truck Ramps and Roads | 8.0 | 32 | 0.40' HMA[1]/0.90' Class 2 AB[2] |

3. HMA = hot mix asphalt
4. AB = aggregate base

| Portland Cement Concrete Design | | | |
|---|---|---|---|
| Layer | Thickness (inches) | | |
| | Light Duty[1] | Medium Duty[2] | Dumpster Pad[3] |
| PCC | 4.5 | 5.5 | 7.0 |
| Aggregate Base [4] | -- | -- | -- |

5. Car Parking and Access Lanes, Average Daily Truck Traffic (ADTT) = 1 (Category A).
6. Truck Parking Areas, Multiple Units, ADTT = 25 (Category B)
7. In areas of anticipated heavy traffic, fire trucks, delivery trucks, or concentrated loads (e.g., dumpster pads), and areas with repeated turning or maneuvering of heavy vehicles, ADTT = 700 (Category C).
8. Aggregate base is not required. Compacted on-site material is considered competent.

Recommended structural sections were calculated based on assumed TIs and our preliminary sampling and testing. For other TIs, the structural sections provided in Exhibits C-9 and C-10 should provide satisfactory AC pavement.

Terracon does not practice traffic engineering. We recommend that the project civil engineer or traffic engineer verify that the TIs and ADTT traffic indices used are appropriate for this project.

## Pavement Drainage

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be graded to provide positive drainage within the granular base section. Appropriate sub-drainage or connection to a suitable daylight outlet should be provided to remove water from the granular subbase.

## Pavement Maintenance

The pavement sections represent minimum recommended thicknesses and, as such, periodic maintenance should be anticipated. Therefore, preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Maintenance consists of both localized maintenance (e.g. crack and joint sealing and patching) and global maintenance (e.g. surface sealing). Preventive maintenance is usually the priority when implementing a pavement maintenance program. Additional engineering observation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur and repairs may be required.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Final grade adjacent to paved areas should slope down from the edges at a minimum 2%.
- Subgrade and pavement surfaces should have a minimum 2% slope to promote proper surface drainage.
- Install below pavement drainage systems surrounding areas anticipated for frequent wetting.
- Install joint sealant and seal cracks immediately.
- Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils.
- Place compacted, low permeability backfill against the exterior side of curb and gutter.
- Place curb, gutter and/or sidewalk directly on clay subgrade soils rather than on unbound granular base course materials.

# EARTHWORK

Earthwork will include clearing and grubbing, excavations and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria as necessary to render the site in the state considered in our geotechnical engineering evaluation for foundations, floor slabs, and pavements.

## General Site Grading

It is imperative that no grading operations including subexcavation and backfill recompaction be performed without the presence of a representative of the geotechnical engineer. An on-site, pre-job meeting with the developer, the contractor and the geotechnical engineer should occur prior to all grading-related operations. Observation, testing, documenting and reporting of the grading operation should be performed by the geotechnical engineer of record. A final compaction report should be issued by the geotechnical engineer of record at the completion of the grading operation. Operations undertaken at the site without the geotechnical engineer present may result in exclusions of affected areas from the final compaction report for the project.

Grading of the subject site should be performed, at a minimum, in accordance with these recommendations and with applicable portions of the CBC. The following recommendations are presented for your assistance in establishing proper grading criteria.

## Initial Site Preparation

All areas to be graded should be stripped of significant vegetation and other deleterious materials. These materials should be removed from the site for disposal. Any existing utility lines should be traced, removed and rerouted from the structural areas.

Any existing undocumented fills and loose native materials encountered during grading should be completely removed from all areas to be graded and cleaned of significant deleterious materials; they may be reused as compacted fill.

To assist in identification and removal of undocumented fill and/or loose native soil, it is our opinion that all areas to be graded should be subexcavated to a minimum depth of 12 inches bgs. The undocumented fill and local, loose, native soil should be completely removed and recompacted. The maximum removal depth could be on order of *5 feet* bgs or deeper. A relative compaction of *at least 85 percent* may be utilized as a preliminary quantitative criterion to supplement the engineering geologist's qualitative evaluation of the suitable base of the excavation. An engineering geologist from this firm should be present during the subexcavation operation prior to scarification and refilling in order to identify existing fills or loose soils extending below this depth. The bottoms of all excavations should be observed and approved by the engineering geologist.

## Preparation of Fill Areas

The bottoms of the excavations should be observed by the engineering geologist to verify the complete removal of undocumented fill material and loose/disturbed native soils. Following approval, the bottoms should be scarified to a depth of approximately 6 inches, brought to near optimum moisture content and recompacted to at least 93 percent relative compaction (ASTM D1557).

## Overexcavation For Structure Areas

The structure type, size and layout are not available at the time of this investigation. The topographic information before and after grading should be filed and available for future planning.

Footings for any structures should not be allowed to span from cut to fill or from shallow fill to deep fill soil conditions. Should grading result in a situation where footings bear on more than 8 feet of compacted fill, such as along transition areas and canyons, the subexcavation of the building pad should be deepened as necessary so as to provide a uniform fill mat below bottom of footing. This deepening of the subexcavation will involve additional removals of older alluvium or bedrock. The uniform fill mat should not vary in thickness from one side of the building pad area to the other by more than 50 percent, 10 feet maximum. The "building pad area" includes

the structure footprint and the zone of influence consisting of a 1(h):1(v) downward projection from the structure footing.

## Preparation of Footing Areas

All footings should rest entirely upon competent native soils or minimum of 12 inches of properly compacted fill material. This subexcavation should extend at least 2 feet laterally beyond the footing lines, where possible. The bottoms of all excavations should be observed and approved by an engineering geologist from this firm. Upon the approval of the excavation bottom by geologist, the bottom of this excavation should then be scarified to a depth of approximate 6 inches, brought to near optimum moisture content, and recompacted to a minimum of 93 percent relative compaction in accordance with ASTM D1557 prior to refilling the excavation to the required grade as properly compacted fill.

Foundation concrete should be placed in neat excavations with vertical sides, or the concrete should be formed and the excavations properly backfilled as recommended for compacted fill.

## Compacted Fills

The on-site soils should provide adequate quality fill material, provided they are free from roots, other organic matter and deleterious materials. Unless approved by the geotechnical engineer, rock or similar irreducible material with a maximum dimension greater than 6 inches should not be buried or placed within the top 10 feet of fills.

Import fill should be inorganic, non-expansive, granular soil free from rocks or lumps greater than 6 inches in maximum dimension. The contractor shall notify the geotechnical engineer of import sources sufficiently ahead of their use so that the sources can be observed and approved as to the physical characteristic of the import material. For all import material, the contractor shall also submit current verified reports from a recognized analytical laboratory indicating that the import has a "not applicable" (Class S0) potential for sulfate attack based upon current American Concrete Institute (ACI) criteria and is not corrosive to ferrous metal and copper. The reports shall be accompanied by a written statement from the contractor that the laboratory test results are representative of all import material that will be brought to the job.

Fill should be spread in near-horizontal layers, approximately 8 inches in thickness. Thicker lifts may be approved by the geotechnical engineer if testing indicates that the grading procedures are adequate to achieve the required compaction. Each lift should be spread evenly, thoroughly mixed during spreading to attain uniformity of the material and moisture in each layer, brought to at least optimum moisture content and compacted to a minimum relative compaction of 93 percent in accordance with the current version of ASTM D1557. Fills deeper than 5 feet in vertical extent should be compacted to a minimum of 95 percent relative compaction.

## Shrinkage

Based upon the relative compaction of the native soils tested during this investigation and the relative compaction anticipated for compacted fill soils, we estimate compaction shrinkage of approximately 5 to 15 percent. Therefore, 1.05 to 1.15 cubic yards of in-place soil material would be necessary to yield 1 cubic yard of properly compacted fill material. These values are exclusive of losses due to stripping, tree removal or the removal of other subsurface obstructions, if encountered, and may vary due to differing conditions within the project boundaries and the limitations of this investigation.

Values presented for shrinkage are estimates only. Contractors should make their own investigations and estimates of shrinkage. Final grades should be adjusted and/or contingency plans to import or export material should be made to accommodate possible variations in actual quantities during site grading.

It is crucial that the geotechnical engineer be present to observe these operations. Further recommendations may be made in the field, depending on the actual conditions encountered.

## Rippability

Two hills consisting primarily of metamorphic bedrock were removed during grading of the Nichols Road grading project, located in the northern portion of the site. Difficulty in ripping of the larger, western hill was encountered during grading. Jack hammering of hard marble exposures in this area was ongoing during this investigation. The grading in progress on the Nichols Road grading project is currently intended to provide mass graded commercial pads with minor undercut from rough grade pad elevations. Future development may require additional cutting and/or excavation such as utility and footing trenches in the bedrock area. Portions will encounter non-rippable bedrock with a D-9 and bedrock that is non-trenchable with large excavators. Oversize rock has already been generated, reduced in size when necessary, and transported to the Nichols Road quarry to the north.

The Nichols Road grading project is intended to reach mass grade elevations only. When final development plans are available, a seismic refraction (rippability/excavation potential) investigation should be conducted to better determine the rippability and trenchability conditions for the proposed development.

## Oversized Material

It is anticipated that significant quantities of oversized material (boulders larger than 12 inches and portions of concrete structures from possible demolition work) requiring special handling for disposal may be generated during the grading operation. While site-specific recommendations may be developed during the grading plan preparation or in the field during construction, we are providing general methods for disposing of oversized rock and concrete on site for preliminary

consideration.

Materials between approximately 12 and 48 inches in size may be placed in areas of fill depth greater than approximately 20 feet below finish grade with the approval of the building official. Areas should be designated on plans as rock disposal areas.

The oversized rock should be placed in windrows and adequately spaced to prevent nesting. Then, sandy matrix material should be flooded between the rocks to fill any void spaces. Continuous observation of the rock placement and flooding operation should be conducted by the geotechnical engineer.

Again, these recommendations are preliminary. Further recommendations may be made in the field depending on the actual conditions encountered.

## Settlement Monitoring

Although not anticipated, if grading results in fills greater than 40 feet deep, such fills should be monitored for settlement. To verify substantial completion of compression of the fill, an initial reading of the settlement monitors should be taken immediately after construction. The fill should then be monitored at least four additional times at an interval determined by this firm for both horizontal and vertical movement. The criteria for a determination of the completion of significant settlement will be established by this firm after analysis of at least five readings. A typical settlement monitor detail is included as Enclosure "E-1" in **Previous Exploration Results** section. Location and installation of settlement monitors should be performed immediately after construction. Settlement monitors should be clearly marked and readily visible (red flagged) to avoid disturbance. Clearance should be maintained from heavy equipment operations.

## Grading and Drainage

All grades must provide effective drainage away from the buildings during and after construction and should be maintained throughout the life of the structures. Water retained next to the buildings can result in soil movements greater than those discussed in this report. Greater movements can result in unacceptable differential floor slab and/or foundation movements, cracked slabs and walls, and roof leaks. The roofs should have gutters/drains with downspouts that discharge onto splash blocks at a distance of at least 10 feet from the buildings.

We recommend a minimum horizontal setback distance of 10 feet from the perimeter of any building and the high-water elevation of the nearest storm-water retention basin.

Portions of Stovepipe Wash include steep and high slopes. The southwesterly portion of the wash includes existing slopes up to approximately 25 feet in height and relatively steep (1 horizontal to 1 vertical and locally steeper). Setbacks for structures should be maintained from the steep

slopes in Stovepipe Wash. We recommended that a minimum horizontal distance equivalent to 1.5 times the height of the slope be maintained for all structures from the top of the slope. The term structures as used here includes human occupancy structures (residential and commercial) as well as pools and gazebos. This recommendation is intended to apply to a static condition in Stovepipe Wash for the lifetime of the proposed structures. If significant erosion/scour is expected to occur along Stovepipe Wash, greater setbacks could be necessary. An evaluation of the future erosion/scour potential along Stovepipe Wash falls under the purview of the project hydrological professionals.

Exposed ground should be sloped and maintained at a minimum 3 percent away from the buildings for at least 10 feet beyond the perimeter of the buildings. Locally, flatter grades may be necessary to transition to ADA access requirements for flatwork. After building construction and landscaping, final grades should be verified to document effective drainage has been achieved. Grades around the structures should also be periodically inspected and adjusted as necessary as part of the structures' maintenance program. Where paving or flatwork abuts the structure, a maintenance program should be established to effectively seal and maintain joints and prevent surface water infiltration.

## Earthwork Construction Considerations

Shallow excavations, for the proposed building structures, are anticipated to be accomplished with conventional construction equipment except for the area of hard bedrock in the west portion of the Nichols Road grading project (discussed in the Rippability section of this report). Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of floor slabs. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over, or adjacent to, construction areas should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted, prior to floor slab or pavement construction.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local, and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

### Construction Observation and Testing

The earthwork efforts should be monitored under the direction of the geotechnical engineer. Monitoring should include documentation of adequate removal of vegetation and top soil, proof-rolling and mitigation of areas delineated by the proof-roll to require mitigation.

Each lift of compacted fill should be tested, evaluated, and reworked as necessary until approved by the geotechnical engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 2,500 square feet of compacted fill in the structure areas and 5,000 square feet in pavement areas. One density and water content test should be performed for each 1-foot of backfill, for every 250 linear feet of compacted utility trench backfill.

In areas of foundation excavations, the bearing subgrade should be evaluated under the direction of the geotechnical engineer. In the event unanticipated conditions are encountered, the geotechnical engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the geotechnical engineer into the construction phase of the project enables the geotechnical engineer to evaluate subsurface conditions, including assessing variations and associated design changes.

## CORROSIVITY

Selected samples of materials were delivered to HDR, Inc. for preliminary soil corrosivity testing. Laboratory testing consisted of pH, resistivity and major soluble salts commonly found in soils. The results of the laboratory tests performed by HDR, Inc. appear in Exhibit C-6.

These tests have been performed to screen the site for potentially corrosive soils. Values from the soil tested are considered potentially "mildly corrosive" and "moderately corrosive" to ferrous metals both at as-received condition and saturated conditions, respectively. Specific corrosion control measures, such as coating of the pipe with non-corrosive material or alternative non-metallic pipe material, will be needed if there is a potential of soil saturation.

Ammonium and nitrate levels did not indicate a concern as to corrosion of buried copper.

Results of the soluble sulfate testing indicate a "not applicable" (Class S0) anticipated exposure to sulfate attack. Based on the criteria from Table 4.3.1. of the American Concrete Institute "Manual of Concrete Practice" (2011), no special measures, such as specific cement types or water-cement ratios, will be needed for this "not applicable" exposure to sulfate attack.

The soluble chloride content of the soils tested was not at levels high enough to be of concern with respect to corrosion of reinforcing steel. The results should be considered in combination with the soluble chloride content of the hardened concrete in determining the effect of chloride on the corrosion of reinforcing steel.

Terracon does not practice corrosion engineering. If further information concerning the corrosion characteristics, or interpretation of the results submitted herein, is required, then a competent corrosion engineer could be consulted.

## STORMWATER MANAGEMENT

Preliminary percolation tests were performed following the procedures described in Shallow Percolation Test (less than 10 feet), Section 2.3, of Riverside County LID BMP. Five-gallon water bottles were used. The soil at the percolation test locations was classified in the field using a visual/manual procedure. The infiltration velocity is presented as the infiltration rate corrected for rock backfill, if used, and is summarized in the following table. The infiltration rates provided do not include safety factors.

| Test Boring | Test | Test Depth (ft)[1] | Soil Type | Infiltration Rate[2] | |
|---|---|---|---|---|---|
| | | | | in./hr. | cm./hr. |
| 1 | P-1 | 10 | SM | 0.51 | 1.3 |
| | | | | | |
| 2 | P-2 | 10 | SM | 0.59 | 1.5 |
| | | | | | |
| 3 | P-3 | 6 | SM | 0.47 | 1.2 |
| | P-4 | 9 | SM | 0.64 | 1.6 |

1. Below existing ground surface
2. Corrected for rock backfill, if used

The above infiltration rates determined by the shallow percolation test method are based on field test results utilizing clear water. Infiltration rates can be affected by silt buildup, debris, degree of soil saturation, site variability and other factors. The rate obtained at a specific location and depth is representative of the location and depth tested and may not be representative of the entire site. Based on the test results, a measured infiltration rate of 0.5 in./hr. is recommended to be used in the design of a detention basin, provided an appropriate safety factor is applied to this value. Application of an appropriate safety factor is prudent to account for subsoil inconsistencies,

possible compaction related to site grading, and potential silting of the percolating soils, depending on the application.

The design engineer should also check with the local agency for the limitation of the infiltration rate allowed in the design. If the maximum allowable design infiltration rate is lower than the above recommended rate, the maximum allowable design infiltration rate should be used. The designer of the basins should also consider other possible site variability in the design.

The above percolation tests should be considered as preliminary. At the time that the locations and depths of detention basins are determined, additional percolation tests may be needed. The designer should confirm with Riverside County for the requirements of additional tests.

The results of the previous double-ring infiltration testing are presented below. These test locations are indicated in yellow as P-1 through P-4 on the **Exploration Plan**. For a description of the double-ring infiltrometer method, see the report by CHJ Consultants, a Terracon Company, Project No. 17110-2 dated March 31, 2017.

| Test Excavation | Test | Test Depth (ft)[3] | Soil Type | Infiltration Rate | |
|---|---|---|---|---|---|
| | | | | in./hr. | cm./hr. |
| 1 | P-1 | 0.5 | SM | 0.1 | 0.3 |
| 2 | P-2 | 1.5 | SM | 0.1 | 0.3 |
| 3 | P-3 | 3.0 | SM | 0.2 | 0.4 |
| 4 | P-4 | 2.0 | SM | 0.1 | 0.3 |

3. Below existing ground surface

## GENERAL COMMENTS

As the project progresses, we address assumptions by incorporating information provided by the design team, if any. Revised project information that reflects actual conditions important to our services is reflected in the final report. The design team should collaborate with Terracon to confirm these assumptions and to prepare the final design plans and specifications. This facilitates the incorporation of our opinions related to implementation of our geotechnical recommendations. Any information conveyed prior to the final report is for informational purposes only and should not be considered or used for decision-making purposes.

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in the final report, to

provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our scope of services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third party beneficiaries intended. Any third party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

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# ATTACHMENTS

# EXPLORATION AND TESTING PROCEDURES

## Previous Field Exploration

| Number of Borings [1] | Planned Boring Depth (feet) [2] | Location |
|---|---|---|
| 8 | 25.5 to 51.5 | North portion of the track<br>See **Exploration Plan** |

1. Drilled on May 2016 (CHJ Job No. 16164-3)
2. Below ground surface

| Number of Double-Ring Infiltrometer Tests[3] | Test Depth (feet) [4] | Location |
|---|---|---|
| 4 | 0.5 to 3.0 | Proposed basin locations in southern portion of graded property<br>See **Exploration Plan** |

3. Excavated on March 24, 2017 (CHJ, a Terracon Company, Project No. 17110-2)
4. Below ground surface

## Current Field Exploration

| Number of Borings | Planned Boring Depth (feet) [1] | Location [2] |
|---|---|---|
| 8 Borings | 20.2 to 51.5 | Planned residential and hotel areas<br>See **Exploration Plan** |
| 4 Borings | 5.0 to 10.0 | Street improvements<br>See **Exploration Plan** |
| 5 Surface Samples | 0 to 2 | Street improvements<br>See **Exploration Plan** |

1. Below ground surface
2. See **Exploration Plan**

**Boring Layout and Elevations:** Unless otherwise noted, Terracon personnel provide the boring layout. Coordinates are obtained with a handheld GPS unit (estimated horizontal accuracy of about ±20 feet). If a more precise boring layout are desired, we recommend borings be surveyed following completion of fieldwork.

**Subsurface Exploration Procedures:** We advance the borings with a truck-mounted drill rig using hollow stem augers. Both a standard penetration test (SPT) sampler (2-inch outer diameter and 1-3/8-inch inner diameter) and a modified California ring-lined sampler (3-inch outer diameter and 2-

3/8-inch inner diameter) are utilized in our investigation. The penetration resistance is recorded on the boring logs as the number of hammer blows used to advance the sampler in 6-inch increments (or less if noted). The samplers are driven with an automatic hammer that drops a 140-pound weight 30 inches for each blow. After the required seating, samplers are advanced up to 18 inches, providing up to three sets of blowcounts at each sampling interval. The sampling depths, penetration distances, and other sampling information are recorded on the field boring logs. The recorded blows are raw numbers without any corrections for hammer type (automatic vs. manual cathead) or sampler size (ring sampler vs. SPT sampler). Relatively undisturbed and bulk samples of the soils encountered are placed in sealed containers and returned to the laboratory for testing and evaluation.

We observe and record groundwater levels during drilling and sampling. For safety purposes, all borings are backfilled with auger cuttings after their completion. Pavements, if encountered, are patched with cold-mix asphalt and/or pre-mixed concrete, as appropriate.

Our exploration team prepares field boring logs as part of the drilling operations. These field logs include visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Final boring logs are prepared from the field logs. The final boring logs represent the geotechnical engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

## Laboratory Testing

The project engineer reviews the field data and assigns various laboratory tests to better understand the engineering properties of the various soil strata as necessary for this project. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods are applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

- ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil by Mass
- ASTM D7263 Standard Test Methods for Laboratory Determination of Density (Unit Weight) of Soil Specimens
- ASTM D6913 Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis
- ASTM D1140 Standard Test Methods for Determining the Amount of Material Finer than 75-µm (No. 200) Sieve in Soils by Washing
- ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
- ASTM D4546 Standard Test Methods for One-Dimensional Swell or Collapse of Soils

- ASTM D3080/D3080M Standard Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions
- ASTM D2419 Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
- ASTM D2844 Standard Test Method for Resistance R-Value and Expansion Pressure of Compacted Soils
- Soil Resistivity and chemical analysis per ASTM G187, ASTM D6919, ASTM D4327, and APHA 2320-B, etc.

The laboratory testing program often includes examination of soil samples by an engineer. Based on the material's texture and plasticity, we describe and classify the soil samples in accordance with the Unified Soil Classification System.

## Percolation Tests

The field percolation test program consists of the following:

| Number of Test Borings | Number of Tests | Test Depth (ft)[1] | Location |
|---|---|---|---|
| 3 | 3 | 4 to 10 | See **Exploration Plan** |

1. Below existing ground surface (bgs)

Tests are performed in accordance with Shallow Percolation Test (less than 10 feet) procedures described in Section 2.3 of Riverside County – "Design Handbook for Low Impact Development Best Management Practices (LID BMP)". LID BMP requires four tests minimum with at least two per BMP location. LID BMP also requires that the soils located at a depth of 10 feet below the proposed basin bottom be explored in order to ensure that a non-permeable soil or rock layer is not present. We utilize the soil boring data from this investigation to satisfy this requirement.

The detailed procedures are described in Shallow Percolation Test (less than 10 feet) of Section 2.3, of Riverside County LID BMP.

# SITE LOCATION AND EXPLORATION PLANS

## SITE LOCATION MAP

Tentative Tract No. 37305 ■ Lake Elsinore, CA
January 24, 2018 ■ Terracon Project No. CB175281

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

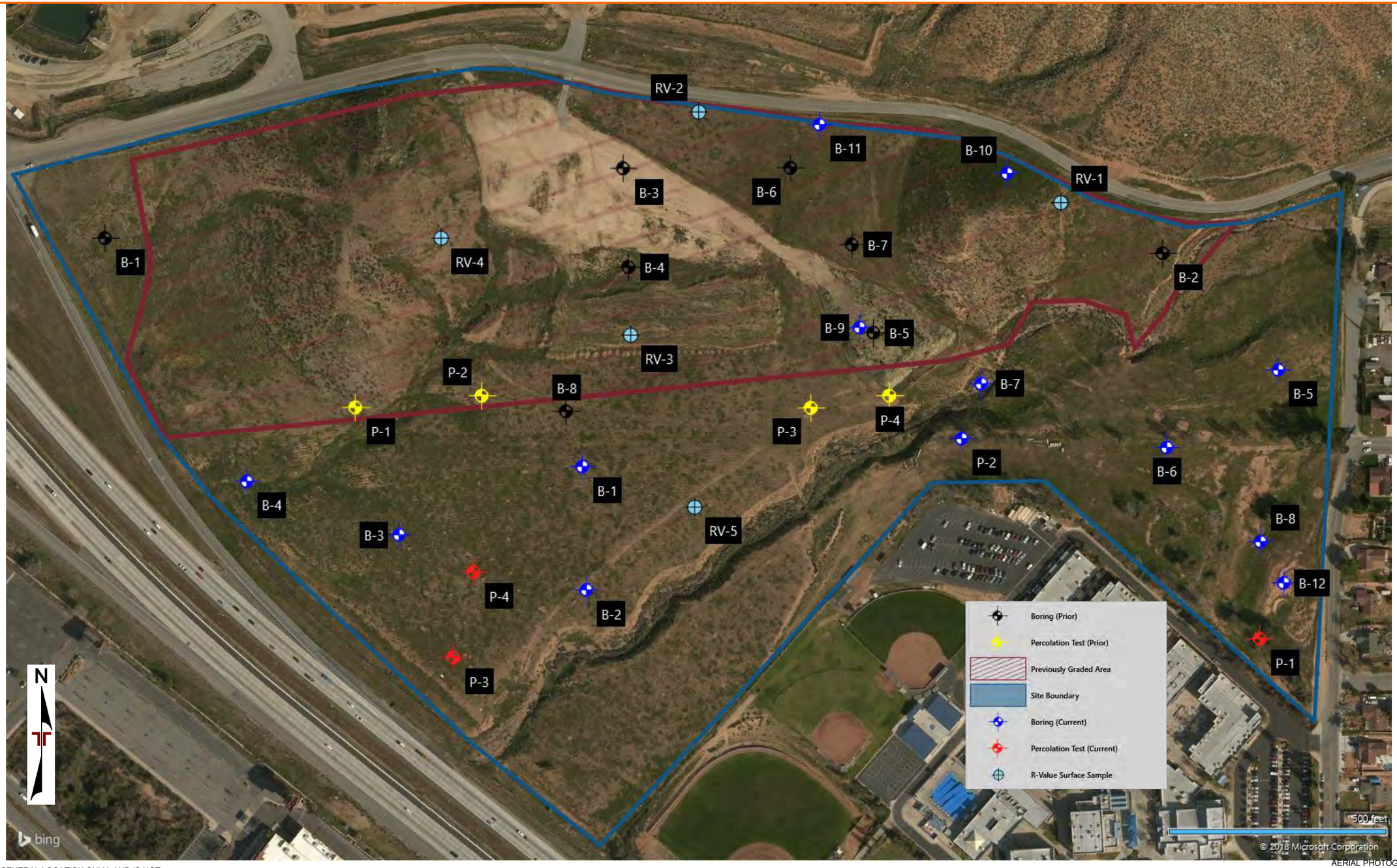



DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

# BORING LOG NO. B-1



**PROJECT:** Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

**CLIENT:** Nichols Road Partners Corona, CA

**SITE:**

LOCATION See Exploration Plan

Latitude: 33.7055° Longitude: -117.3524°

| DEPTH | GRAPHIC LOG | | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | FIELD TEST RESULTS | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|---|
| | | **SANDY SILT WITH GRAVEL (ML)**, fine to medium grained, light brown, gravel to 1" maximum diameter | | | | | | | |
| | | | | | | 44-50/2" | 4 | 108 | |
| | | | | | | | 5 | | |
| | | | 5 | | | 50/6" | 5 | 115 | |
| 10.0 | | | | | | | | | |
| | | **SILTY SAND WITH GRAVEL (SM)**, fine to coarse grained, brown, gravel to 1" maximum diameter | 10 | | | 27-30-50/6" | 2 | 116 | |
| | | | | | | | 4 | | |
| | | | 15 | | | 21-32-40 | 3 | 116 | |
| | | | 20 | | | 30-41-50/3" | 5 | 116 | |
| | | | 25 | | | 20-21-26 | 4 | 115 | |
| 26.5 | | | | | | | | | |
| | | ***Boring Terminated at 26.5 Feet*** | | | | | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./3.25" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

Auger samples combined from B-1 and B-3.

**WATER LEVEL OBSERVATIONS**

*Groundwater not encountered*

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-02-2018 | Boring Completed: 01-02-2018

Drill Rig: CME 55 | Driller: 2R

Project No.: CB175281

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL CB175281 GEOTECHNICAL, INF.GPJ TERRACON_DATATEMPLATE.GDT 1/24/18

# BORING LOG NO. B-2



**PROJECT:** Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

**SITE:**

**CLIENT:** Nichols Road Partners Corona, CA

LOCATION See Exploration Plan

Latitude: 33.7047° Longitude: -117.3524°

| DEPTH | GRAPHIC LOG | | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | FIELD TEST RESULTS | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|---|
| | | **SILTY SAND (SM)**, fine to coarse grained, brown | | | | | | | |
| | | | | | | 16-22-23 N=45 | | | |
| | | | | | | | 3 | | 36 |
| 5.0 | | **SILTY SAND WITH GRAVEL (SM)**, fine to coarse grained, brown, gravel to 1" maximum diameter | 5 | | | 19-16-17 N=33 | | | |
| | | | | | | | | | |
| | | | 10 | | | 12-14-11 N=25 | | | |
| | | | | | | | 3 | | |
| | | | 15 | | | 11-14-18 N=32 | | | 26 |
| | | | | | | | | | |
| | | | 20 | | | 9-12-13 N=25 | | | |
| | | | | | | | | | |
| | | | 25 | | | 8-8-9 N=17 | | | 43 |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./2.0" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

**WATER LEVEL OBSERVATIONS**

*Groundwater not encountered*

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-02-2018 | Boring Completed: 01-02-2018

Drill Rig: CME 55 | Driller: 2R

Project No.: CB175281

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL CB175281 GEOTECHNICAL, INF.GPJ TERRACON_DATATEMPLATE.GDT 1/24/18

# BORING LOG NO. B-2



**PROJECT:** Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

**CLIENT:** Nichols Road Partners Corona, CA

**SITE:**

LOCATION See Exploration Plan

Latitude: 33.7047° Longitude: -117.3524°

| DEPTH | GRAPHIC LOG | | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | FIELD TEST RESULTS | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|---|
| | | **SILTY SAND WITH GRAVEL (SM)**, fine to coarse grained, brown, gravel to 1" maximum diameter *(continued)* | | | | | | | |
| | | | 30 | | X | 6-8-9 N=17 | | | |
| | | | 35 | | X | 14-23-18 N=41 | | | |
| 36.0 | | **SILT WITH SAND (ML)**, fine grained, dark brown, tight driling | | | | | | | |
| | | | 40 | | X | 7-12-17 N=29 | | | |
| | | | 45 | | X | 7-14-14 N=28 | | | |
| 50.0 | | **SILTY SAND (SM)**, fine to coarse grained, brown | 50 | | X | 14-36-30 N=66 | | | |
| 51.5 | | ***Boring Terminated at 51.5 Feet*** | | | | | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./2.0" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

**WATER LEVEL OBSERVATIONS**

*Groundwater not encountered*

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-02-2018 | Boring Completed: 01-02-2018

Drill Rig: CME 55 | Driller: 2R

Project No.: CB175281

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL CB175281 GEOTECHNICAL, INF.GPJ TERRACON_DATATEMPLATE.GDT 1/24/18

# BORING LOG NO. B-3



**PROJECT:** Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

**CLIENT:** Nichols Road Partners Corona, CA

**SITE:**

LOCATION See Exploration Plan

Latitude: 33.705° Longitude: -117.3538°

| DEPTH | GRAPHIC LOG | | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | FIELD TEST RESULTS | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|
| | | **SANDY SILT (ML)**, fine to medium grained, light brown | | | | | | |
| | | | | | 32-50/3" | 4 | 105 | |
| | | | | | | 3 | | |
| 5 | | | | | 50/6" | 6 | | |
| 10.0 | | | | | | | | |
| | | **SILTY SAND WITH GRAVEL (SM)**, fine to medium grained, brown, gravel to 1" maximum diameter | | | 14-30-39 | 3 | 114 | |
| | | | | | | 4 | | |
| 15 | | | | | 15-41-50/5" | 7 | 117 | |
| | | | | | | | | |
| 20 | | | | | 22-50/5" | 6 | 126 | |
| | | | | | | | | |
| 25 | | | | | 8-13-21 | 12 | 116 | |
| 26.5 | | ***Boring Terminated at 26.5 Feet*** | | | | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./3.25" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

**WATER LEVEL OBSERVATIONS**

*Groundwater not encountered*

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-02-2018 | Boring Completed: 01-02-2018

Drill Rig: CME 55 | Driller: 2R

Project No.: CB175281

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL CB175281 GEOTECHNICAL_INF.GPJ TERRACON_DATATEMPLATE.GDT 1/24/18

# BORING LOG NO. B-4



**PROJECT:** Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

**CLIENT:** Nichols Road Partners Corona, CA

**SITE:**

LOCATION See Exploration Plan

Latitude: 33.7054° Longitude: -117.355°

| DEPTH | GRAPHIC LOG | DESCRIPTION | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | FIELD TEST RESULTS | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|---|
| | | **SANDY SILT WITH GRAVEL (ML)**, fine to medium grained, brown, gravel to 1" maximum diameter | | | | | | | |
| | | | | | | 6-14-18 N=32 | | | |
| | | | | | | | 5 | | |
| | | | 5 | | | 9-12-16 N=28 | | | |
| 10.0 | | **SILT (ML)**, fine grained, brown | 10 | | | 8-11-16 N=27 | | | |
| | | | | | | | 19 | | |
| | | | 15 | | | 7-11-16 N=27 | | | |
| | | | 20 | | | 5-8-12 N=20 | | | |
| | | | 25 | | | 7-12-14 N=26 | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./2.0" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

**WATER LEVEL OBSERVATIONS**

*Groundwater not encountered*

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-11-2018 | Boring Completed: 01-11-2018

Drill Rig: CME 75 Track Rig | Driller: 2R

Project No.: CB175281

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL CB175281 GEOTECHNICAL, INF.GPJ TERRACON_DATATEMPLATE.GDT 1/24/18

# BORING LOG NO. B-4



**PROJECT:** Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

**CLIENT:** Nichols Road Partners Corona, CA

**SITE:**

LOCATION See Exploration Plan

Latitude: 33.7054° Longitude: -117.355°

| DEPTH | GRAPHIC LOG | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | FIELD TEST RESULTS | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|
| | **SILT (ML)**, fine grained, brown *(continued)* | | | | | | | |
| 31.0 | | 30 | | | 7-12-16 N=28 | | | |
| | **METAMORPHIC BEDROCK**, brown to gray, recovered as (ML) silt, with clay and sand (fine grained) | 35 | | | 27-50/5" | | | |
| 40.5 | | 40 | | | 50 | | | |
| | ***Boring Terminated at 40.5 Feet*** | | | | | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./2.0" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

**WATER LEVEL OBSERVATIONS**

*Groundwater not encountered*

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-11-2018 | Boring Completed: 01-11-2018

Drill Rig: CME 75 Track Rig | Driller: 2R

Project No.: CB175281

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL CB175281 GEOTECHNICAL, INF.GPJ TERRACON_DATATEMPLATE.GDT 1/24/18

# BORING LOG NO. B-5



**PROJECT:** Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

**SITE:**

**CLIENT:** Nichols Road Partners
Corona, CA

LOCATION See Exploration Plan

Latitude: 33.7061° Longitude: -117.3472°

| DEPTH | GRAPHIC LOG | | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | FIELD TEST RESULTS | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|---|
| | | **SILTY SAND (SM)**, fine to coarse grained, light brown | | | | | | | |
| | | | | | | 50/5" | 5 | 100 | |
| | | | | | | | 4 | | 37 |
| | | | 5 | | | 50/6" | 4 | 115 | |
| 10.0 | | | | | | | | | |
| | | **METAMORPHIC BEDROCK**, olive brown, highly weathered, recovered as (SM) Silty Sand with gravel, fine to coarse-grained, gravel to 1" maximum diameter | 10 | | | 50/6" | 10 | 113 | |
| | | | | | | | 7 | | |
| | | | 15 | | | 50/4" | 9 | | |
| 20.3 | | | | | | | | | |
| | | ***Boring Terminated at 20.25 Feet*** | 20 | | | 50/3" | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic
Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./3.25" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

**WATER LEVEL OBSERVATIONS**

*Groundwater not encountered*

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-02-2018 | Boring Completed: 01-02-2018

Drill Rig: CME 55 | Driller: 2R

Project No.: CB175281

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL CB175281 GEOTECHNICAL, INF.GPJ TERRACON_DATATEMPLATE.GDT 1/24/18

# BORING LOG NO. B-6



**PROJECT:** Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

**CLIENT:** Nichols Road Partners Corona, CA

**SITE:**

LOCATION See Exploration Plan

Latitude: 33.7056° Longitude: -117.348°

| DEPTH | GRAPHIC LOG | DESCRIPTION | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | FIELD TEST RESULTS | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|---|
| | | **SILTY SAND WITH GRAVEL (SM)**, fine to coarse grained, light brown, gravel to 1" maximum diameter | | | | | | | |
| | | | | | | 24-44-46 N=90 | | | |
| | | | | | | | 5 | | |
| 5.0 | | **SILTY SAND WITH GRAVEL (SM)**, fine to coarse grained, light brown, gravel to 2" maximum diameter | 5 | | | 14-17-15 N=32 | | | |
| | | | | | | | 4 | | |
| | | | 10 | | | 10-16-20 N=36 | | | |
| | | | 15 | | | 21-27-41 N=68 | | | |
| | | | 20 | | | 17-20-22 N=42 | | | |
| 25.0 | | **SILTY SAND (SM)**, fine to medium grained, light yellowish brown, no gravel | 25 | | | 20-26-23 N=49 | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./2.0" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

**WATER LEVEL OBSERVATIONS**

*Groundwater not encountered*

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-11-2018 | Boring Completed: 01-11-2018

Drill Rig: CME 75 Track Rig | Driller: 2R

Project No.: CB175281

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL CB175281 GEOTECHNICAL, INF.GPJ TERRACON_DATATEMPLATE.GDT 1/24/18

# BORING LOG NO. B-6



**PROJECT:** Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

**CLIENT:** Nichols Road Partners Corona, CA

**SITE:**

LOCATION See Exploration Plan

Latitude: 33.7056° Longitude: -117.348°

| DEPTH | GRAPHIC LOG | | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | FIELD TEST RESULTS | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|---|
| | | **SILTY SAND (SM)**, fine to medium grained, light yellowish brown, no gravel *(continued)* | | | | | | | |
| 30.0 | | **SILTY SAND WITH GRAVEL (SM)**, fine to coarse grained, light yellowish brown, gravel up to 2" maximum diameter | 30 | | X | 21-24-22 N=46 | | | |
| | | | 35 | | X | 19-20-21 N=41 | | | |
| 40.0 | | **SILTY SAND (SM)**, fine to medium grained, light yellowish brown | 40 | | X | 17-22-27 N=49 | | | |
| | | | 45 | | X | 18-24-22 N=46 | | | |
| 51.5 | | | 50 | | X | 17-25-25 N=50 | | | |
| | | ***Boring Terminated at 51.5 Feet*** | | | | | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./2.0" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

**WATER LEVEL OBSERVATIONS**

*Groundwater not encountered*

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-11-2018 | Boring Completed: 01-11-2018

Drill Rig: CME 75 Track Rig | Driller: 2R

Project No.: CB175281

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL CB175281 GEOTECHNICAL, INF.GPJ TERRACON_DATATEMPLATE.GDT 1/24/18

# BORING LOG NO. B-7



**PROJECT:** Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

**SITE:**

**CLIENT:** Nichols Road Partners
Corona, CA

LOCATION See Exploration Plan

Latitude: 33.706° Longitude: -117.3494°

| DEPTH | GRAPHIC LOG | | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | FIELD TEST RESULTS | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|---|
| | | **SILTY SAND (ML)**, with clay, fine to medium grained, brown | | | | | | | |
| | | | | | | 23-23-22 | 4 | 107 | |
| | | | | | | | 6 | | |
| 5.0 | | | 5 | | | | | | |
| | | **CLAYEY SAND (SC)**, fine to medium grained, brown | | | | 12-18-24 | 11 | | |
| | | | | | | | 9 | | |
| 10.0 | | | 10 | | | | | | |
| | | **METAMORPHIC BEDROCK (CL)**, with sand and gravel, recovered as (CL) with sand and gravel up to 1" | | | | 39-35-50 | 14 | 118 | |
| | | | 15 | | | 17-31-50/4" | 23 | 106 | |
| 20.2 | | | 20 | | | 50/2" | | | |
| | | ***Boring Terminated at 20.2 Feet*** | | | | | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic
Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./3.25" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

**WATER LEVEL OBSERVATIONS**

*Groundwater not encountered*

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-11-2018 | Boring Completed: 01-11-2018

Drill Rig: CME 75 Track Rig | Driller: 2R

Project No.: CB175281

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL CB175281 GEOTECHNICAL_INF.GPJ TERRACON_DATATEMPLATE.GDT 1/24/18

# BORING LOG NO. B-8



**PROJECT:** Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

**CLIENT:** Nichols Road Partners Corona, CA

**SITE:**

LOCATION See Exploration Plan

Latitude: 33.705° Longitude: -117.3473°

| DEPTH | GRAPHIC LOG | | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | FIELD TEST RESULTS | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|---|
| | | **SILTY SAND WITH GRAVEL (SM)**, fine to coarse grained, brown, gravel to 2" maximum diameter | | | | | | | |
| | | | | | | 10-8-6 | 19 | 103 | |
| | | | | | | | 10 | | |
| | | | 5 | | | 7-11-13 | 11 | 117 | |
| 12.0 | | | | | | | | | |
| | | **CLAYEY SAND (SC)**, fine to coarse grained, brown | | | | | | | |
| | | | 10 | | | 13-18-20 | 12 | 119 | |
| | | | | | | | 11 | | |
| | | | 15 | | | 15-21-30 | 10 | 127 | |
| 20.0 | | | | | | | | | |
| | | **SILTY SAND (SM)**, with clay, fine to medium grained, brown | 20 | | | 10-21-26 | 9 | 122 | |
| 25.0 | | | | | | | | | |
| | | **SANDY SILT (ML)**, with clay, fine to medium grained, brown | 25 | | | 10-14-18 | 10 | 123 | |
| 26.5 | | | | | | | | | |
| | | ***Boring Terminated at 26.5 Feet*** | | | | | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./3.25" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

**WATER LEVEL OBSERVATIONS**

*Groundwater not encountered*

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-11-2018 | Boring Completed: 01-11-2018

Drill Rig: CME 75 Track Rig | Driller: 2R

Project No.: CB175281

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL CB175281 GEOTECHNICAL_INF.GPJ TERRACON_DATATEMPLATE.GDT 1/24/18

# BORING LOG NO. B-9



**PROJECT:** Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

**CLIENT:** Nichols Road Partners Corona, CA

**SITE:**

LOCATION See Exploration Plan

Latitude: 33.7063° Longitude: -117.3503°

| GRAPHIC LOG | DEPTH | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | FIELD TEST RESULTS | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|
| | **SILTY SAND WITH GRAVEL (SM)**, fine to coarse grained, brown, gravel to 2" maximum diameter | | | | | 5 | | |
| | 5.0 | 5 | | | | | | |
| | ***Boring Terminated at 5 Feet*** | | | | | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./3.25" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

**WATER LEVEL OBSERVATIONS**

*Groundwater not encountered*

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-02-2018 | Boring Completed: 01-02-2018

Drill Rig: CME 55 | Driller: 2R

Project No.: CB175281

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL CB175281 GEOTECHNICAL, INF.GPJ TERRACON_DATATEMPLATE.GDT 1/24/18

# BORING LOG NO. B-10



**PROJECT:** Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

**CLIENT:** Nichols Road Partners Corona, CA

**SITE:**

| GRAPHIC LOG | LOCATION See Exploration Plan<br>Latitude: 33.7074° Longitude: -117.3491°<br>DEPTH | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | FIELD TEST RESULTS | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|
| | **SILTY SAND WITH GRAVEL (SM)**, fine to coarse grained, brown, gravel to 2" maximum diameter | | | | | 7 | | |
| | 5.0 | 5 | | | | | | |
| | ***Boring Terminated at 5 Feet*** | | | | | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic
Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./3.25" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

**WATER LEVEL OBSERVATIONS**

*Groundwater not encountered*

Terracon
1355 E Cooley Dr Ste C
Colton, CA

| | |
|---|---|
| Boring Started: 01-02-2018 | Boring Completed: 01-02-2018 |
| Drill Rig: CME 55 | Driller: 2R |
| Project No.: CB175281 | |

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL CB175281 GEOTECHNICAL, INF.GPJ TERRACON_DATATEMPLATE.GDT 1/24/18

# BORING LOG NO. B-11



**PROJECT:** Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

**CLIENT:** Nichols Road Partners Corona, CA

**SITE:**

| GRAPHIC LOG | LOCATION See Exploration Plan<br>Latitude: 33.7076° Longitude: -117.3506°<br>DEPTH | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | FIELD TEST RESULTS | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|
| | **SILTY SAND WITH GRAVEL (SM)**, fine to coarse grained, brown, gravel to 2" maximum diameter | | | | | 2 | | |
| | 5.0 | 5 | | | | | | |
| | ***Boring Terminated at 5 Feet*** | | | | | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic
Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./3.25" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

**WATER LEVEL OBSERVATIONS**

*Groundwater not encountered*

Terracon
1355 E Cooley Dr Ste C
Colton, CA

| | |
|---|---|
| Boring Started: 01-02-2018 | Boring Completed: 01-02-2018 |
| Drill Rig: CME 55 | Driller: 2R |
| Project No.: CB175281 | |

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL CB175281 GEOTECHNICAL, INF.GPJ TERRACON_DATATEMPLATE.GDT 1/24/18

# BORING LOG NO. B-12



**PROJECT:** Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

**CLIENT:** Nichols Road Partners Corona, CA

**SITE:**

| GRAPHIC LOG | LOCATION See Exploration Plan<br>Latitude: 33.7047° Longitude: -117.3471°<br>DEPTH | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | FIELD TEST RESULTS | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|
| | **SILTY SAND (SM)**, fine to medium grained, light brown | 5 | | | | 5 | | |
| 10.0 | ***Boring Terminated at 10 Feet*** | 10 | | | | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic
Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./3.25" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

**WATER LEVEL OBSERVATIONS**

*Groundwater not encountered*

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-11-2018 | Boring Completed: 01-11-2018

Drill Rig: CME 75 Track Rig | Driller: 2R

Project No.: CB175281

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL CB175281 GEOTECHNICAL, INF.GPJ TERRACON_DATATEMPLATE.GDT 1/24/18

# BORING LOG NO. P-1



**PROJECT:** Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

**CLIENT:** Nichols Road Partners Corona, CA

**SITE:**

| GRAPHIC LOG | LOCATION See Exploration Plan<br>Latitude: 33.7044° Longitude: -117.3473°<br>DEPTH | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | FIELD TEST RESULTS | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|
| | **SILTY SAND (SM)**, trace gravel, fine to medium grained, brown | | | | | | | |
| | | | | | | 9 | | 32 |
| | 4.0 | | | | | | | |
| | ***Boring Terminated at 4 Feet*** | | | | | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic
Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./3.25" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

**WATER LEVEL OBSERVATIONS**

*Groundwater not encountered*

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-11-2018 | Boring Completed: 01-11-2018

Drill Rig: CME 75 Track Rig | Driller: 2R

Project No.: CB175281

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL CB175281 GEOTECHNICAL, INF.GPJ TERRACON_DATATEMPLATE.GDT 1/24/18

# BORING LOG NO. P-2



**PROJECT:** Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

**CLIENT:** Nichols Road Partners Corona, CA

**SITE:**

LOCATION See Exploration Plan

Latitude: 33.7056° Longitude: -117.3496°

| GRAPHIC LOG | DEPTH | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | FIELD TEST RESULTS | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|
| | **SILTY SAND WITH GRAVEL (SM)**, fine to coarse grained, brown, gravel to 2" maximum diameter | | | | | | | |
| | | 5 | | | | 5 | | 27 |
| | 6.5 | | | | | | | |
| | ***Boring Terminated at 6.5 Feet*** | | | | | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./3.25" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

**WATER LEVEL OBSERVATIONS**

*Groundwater not encountered*

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-02-2018 | Boring Completed: 01-02-2018

Drill Rig: CME 55 | Driller: 2R

Project No.: CB175281

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL CB175281 GEOTECHNICAL, INF.GPJ TERRACON_DATATEMPLATE.GDT 1/24/18

# BORING LOG NO. P-3



**PROJECT:** Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

**CLIENT:** Nichols Road Partners Corona, CA

**SITE:**

LOCATION See Exploration Plan

Latitude: 33.7043° Longitude: -117.3534°

| GRAPHIC LOG | DEPTH | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | FIELD TEST RESULTS | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|
| | **SILTY SAND WITH GRAVEL (SM)**, fine to coarse grained, brown, gravel to 2" maximum diameter | 5 | | | | | | |
| | | | | | | 4 | | 39 |
| | 10.0 | 10 | | | | | | |
| | ***Boring Terminated at 10 Feet*** | | | | | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./3.25" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

**WATER LEVEL OBSERVATIONS**

*Groundwater not encountered*

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-02-2018 | Boring Completed: 01-02-2018

Drill Rig: CME 55 | Driller: 2R

Project No.: CB175281

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL CB175281 GEOTECHNICAL, INF.GPJ TERRACON_DATATEMPLATE.GDT 1/24/18

# BORING LOG NO. P-4



**PROJECT:** Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

**CLIENT:** Nichols Road Partners Corona, CA

**SITE:**

LOCATION See Exploration Plan

Latitude: 33.7048° Longitude: -117.3532°

| GRAPHIC LOG | DEPTH | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | FIELD TEST RESULTS | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|
| | **SILTY SAND WITH GRAVEL (SM)**, fine to medium grained, gravel to 1" maximum diameter | 5 | | | | | | |
| | 9.0 | | | | | 5 | | 37 |
| | ***Boring Terminated at 9 Feet*** | | | | | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./3.25" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

**WATER LEVEL OBSERVATIONS**

*Groundwater not encountered*

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-11-2018 | Boring Completed: 01-11-2018

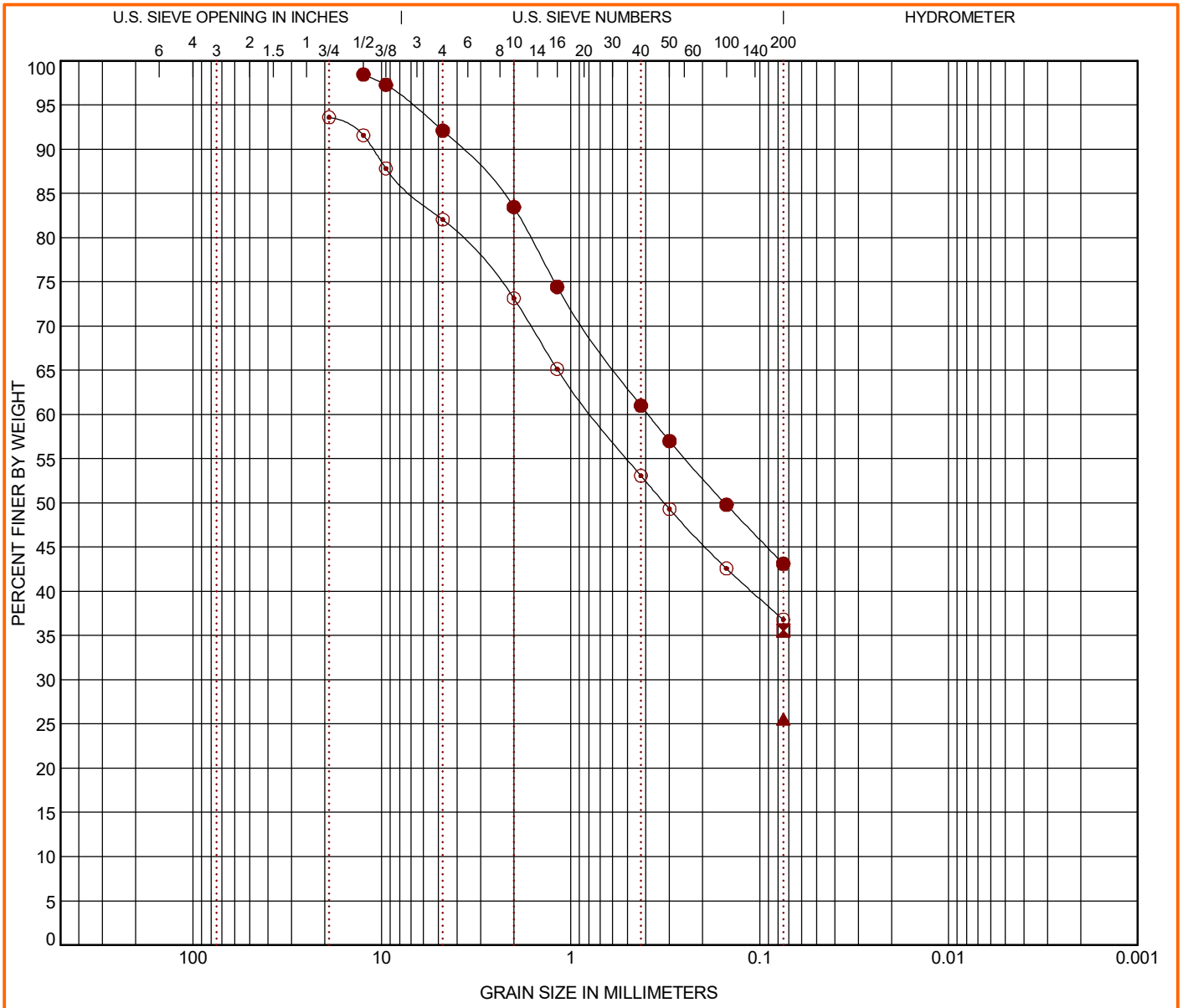
Drill Rig: CME 75 Track Rig | Driller: 2R

Project No.: CB175281

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL CB175281 GEOTECHNICAL, INF.GPJ TERRACON_DATATEMPLATE.GDT 1/24/18

# GRAIN SIZE DISTRIBUTION

**ASTM D422 / ASTM C136**




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Boring ID | Depth | USCS Classification | WC (%) | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| COMBINED SAMPLE 0 - 1 | | SILTY SAND (SM) | | NP | NP | NP | | |
| B-2 | 1.001 - 5 | | 3 | | | | | |
| B-2 | 10.002 - 20 | | | | | | | |
| B-2 | 25 - 26.5 | | | | | | | |
| B-5 | 1.001 - 5 | SILTY SAND with GRAVEL (SM) | 4 | NP | NP | NP | | |

| Boring ID | Depth | $D_{100}$ | $D_{60}$ | $D_{30}$ | $D_{10}$ | %Gravel | %Sand | %Silt | %Fines | %Clay |
|---|---|---|---|---|---|---|---|---|---|---|
| COMBINED SAMPLE 0 - 1 | | 12.5 | 0.39 | | | 6.4 | 49.0 | | 43.1 | |
| B-2 | 1.001 - 5 | 0.075 | | | | 0.0 | 0.0 | | 35.6 | |
| B-2 | 10.002 - 20 | 0.075 | | | | 0.0 | 0.0 | | 25.6 | |
| B-2 | 25 - 26.5 | 0.075 | | | | 0.0 | 0.0 | | 43.1 | |
| B-5 | 1.001 - 5 | 19 | 0.764 | | | 11.6 | 45.2 | | 36.8 | |

PROJECT: Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

SITE:

Terracon
1355 E Cooley Dr Ste C
Colton, CA

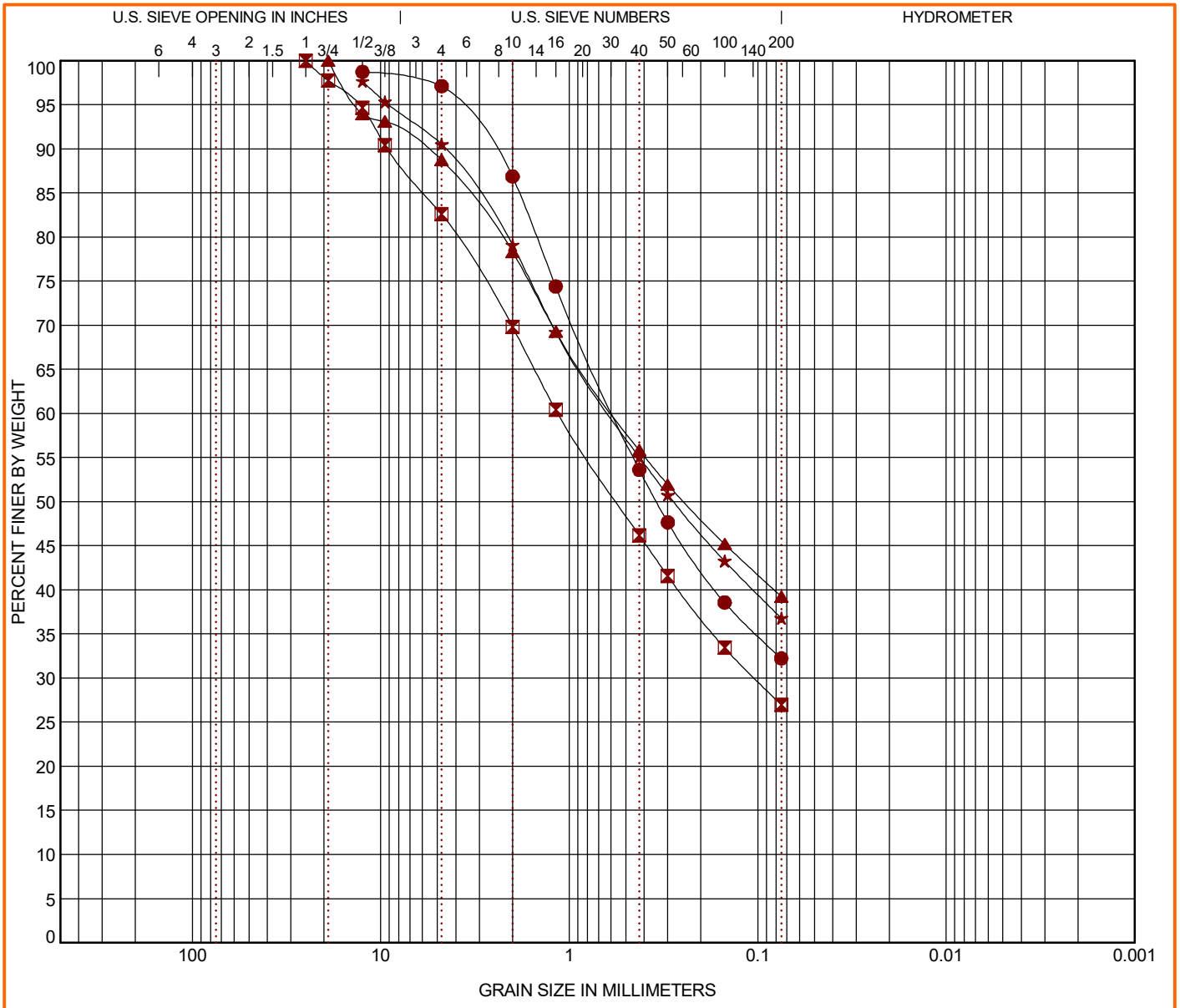
PROJECT NUMBER: CB175281

CLIENT: Nichols Road Partners
Corona, CA

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 CB175281 GEOTECHNICAL, INF.GPJ TERRACON_DATATEMPLATE.GDT 1/19/18

# GRAIN SIZE DISTRIBUTION

**ASTM D422 / ASTM C136**




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Boring ID | | Depth | USCS Classification | WC (%) | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|---|
| ● | P-1 | 2 - 4 | SILTY SAND (SM) | 9 | NP | NP | NP | | |
| ⊠ | P-2 | 4 - 6.5 | SILTY SAND with GRAVEL (SM) | 5 | NP | NP | NP | | |
| ▲ | P-3 | 8 - 10 | SILTY SAND (SM) | 4 | NP | NP | NP | | |
| ★ | P-4 | 7 - 9 | SILTY SAND (SM) | 5 | NP | NP | NP | | |

| Boring ID | | Depth | $D_{100}$ | $D_{60}$ | $D_{30}$ | $D_{10}$ | %Gravel | %Sand | %Silt | %Fines | %Clay |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ● | P-1 | 2 - 4 | 12.5 | 0.582 | | | 1.6 | 64.9 | | 32.2 | |
| ⊠ | P-2 | 4 - 6.5 | 25 | 1.145 | 0.104 | | 17.4 | 55.6 | | 27.0 | |
| ▲ | P-3 | 8 - 10 | 19 | 0.583 | | | 11.3 | 49.5 | | 39.3 | |
| ★ | P-4 | 7 - 9 | 12.5 | 0.606 | | | 7.2 | 53.7 | | 36.8 | |

PROJECT: Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

SITE:

Terracon
1355 E Cooley Dr Ste C
Colton, CA

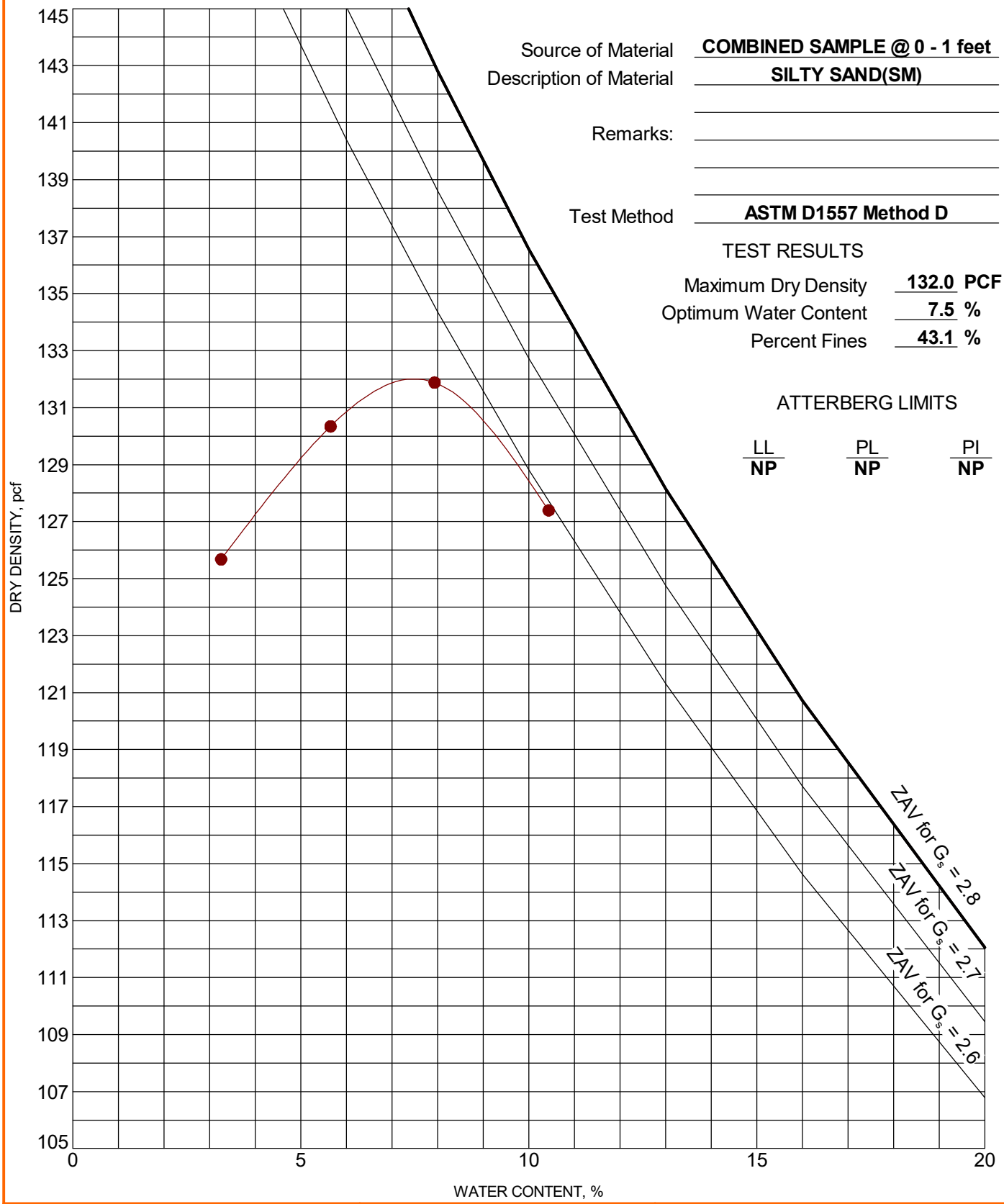
PROJECT NUMBER: CB175281

CLIENT: Nichols Road Partners
Corona, CA

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 CB175281 GEOTECHNICAL, INF.GPJ TERRACON_DATATEMPLATE.GDT 1/19/18

# MOISTURE-DENSITY RELATIONSHIP

**ASTM D698/D1557**




| | |
|---|---|
| Source of Material | **COMBINED SAMPLE @ 0 - 1 feet** |
| Description of Material | **SILTY SAND(SM)** |
| Remarks: | |
| Test Method | **ASTM D1557 Method D** |

TEST RESULTS

| | | |
|---|---|---|
| Maximum Dry Density | **132.0** | **PCF** |
| Optimum Water Content | **7.5** | **%** |
| Percent Fines | **43.1** | **%** |

ATTERBERG LIMITS

| LL | PL | PI |
|---|---|---|
| **NP** | **NP** | **NP** |

PROJECT: Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

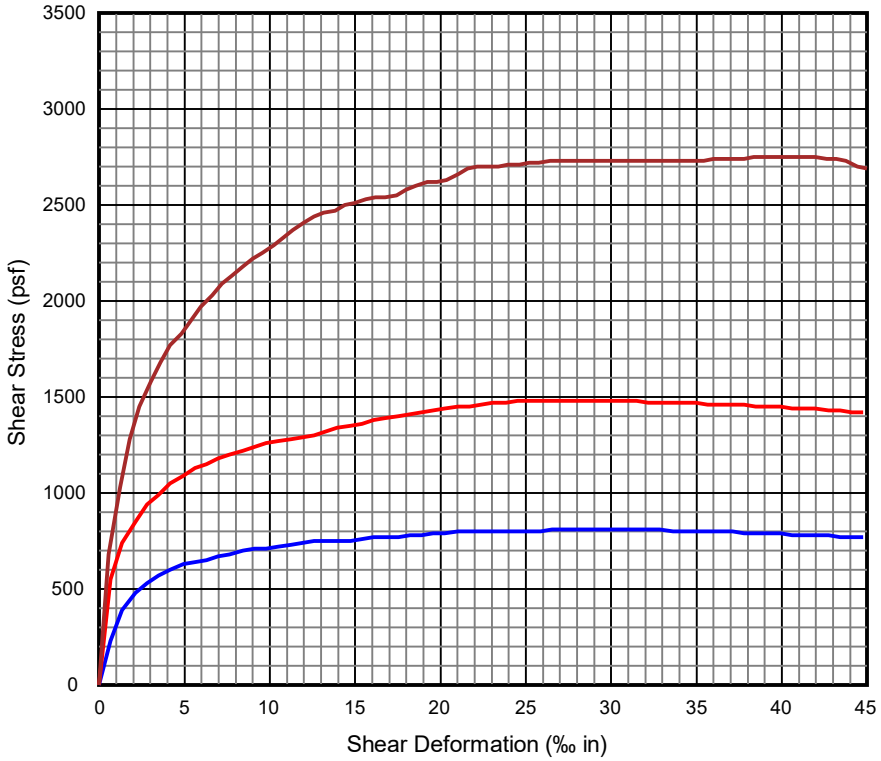
SITE:

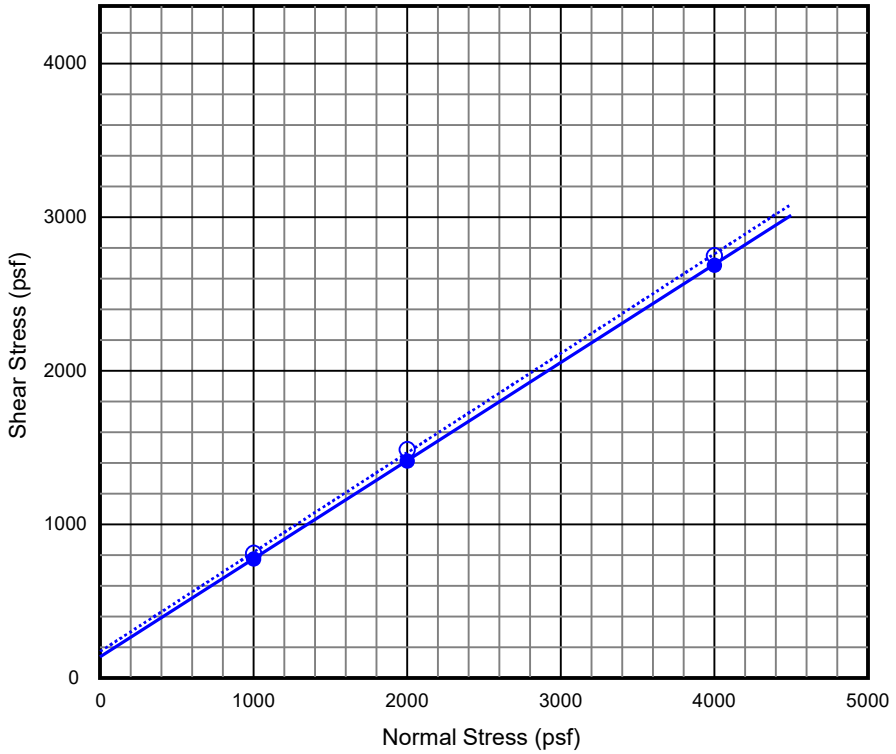
Terracon
1355 E Cooley Dr Ste C
Colton, CA

PROJECT NUMBER: CB175281

CLIENT: Nichols Road Partners
Corona, CA

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. COMPACTION - V1 CB175281 GEOTECHNICAL, INF.GPJ TERRACON_DATATEMPLATE.GDT 1/19/18




| | Boring No. | Depth (ft) | USCS | $\gamma_d$ (pcf) | w (%) | $C_{pk}$ (psf) | $\phi_{pk}$ (°) | $C_{rs}$ (psf) | $\phi_{rs}$ (°) |
|---|---|---|---|---|---|---|---|---|---|
| ● | 1A+3A | 1 - 5 | (SM) Silty sand, fine / Remolded (RC=90%) | 118.8 | 7.5 | 177.4 | 32.8 | 133.5 | 32.6 |

Terracon

**DIRECT SHEAR TESTS (ASTM D3080)**

| | | | | | |
|---|---|---|---|---|---|
| Project: | Tentative Tract No. 37305 | | | | |
| Location: | Nichols Road and Interstate 15, Lake Elsinore, California | | | | |
| Job Number: | CB175281 | Engineer: | | Exhibit: | C-4 |

J:\2017\CB175281\Working Files\Laboratory-Field Data-Boring Logs\LabSuite_CB175281.csv

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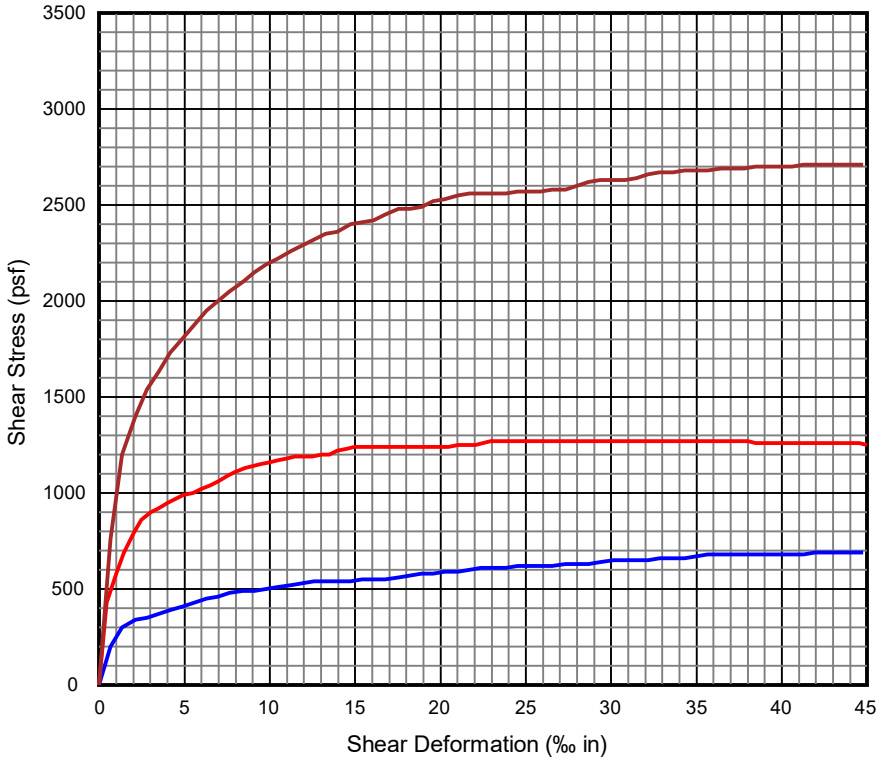
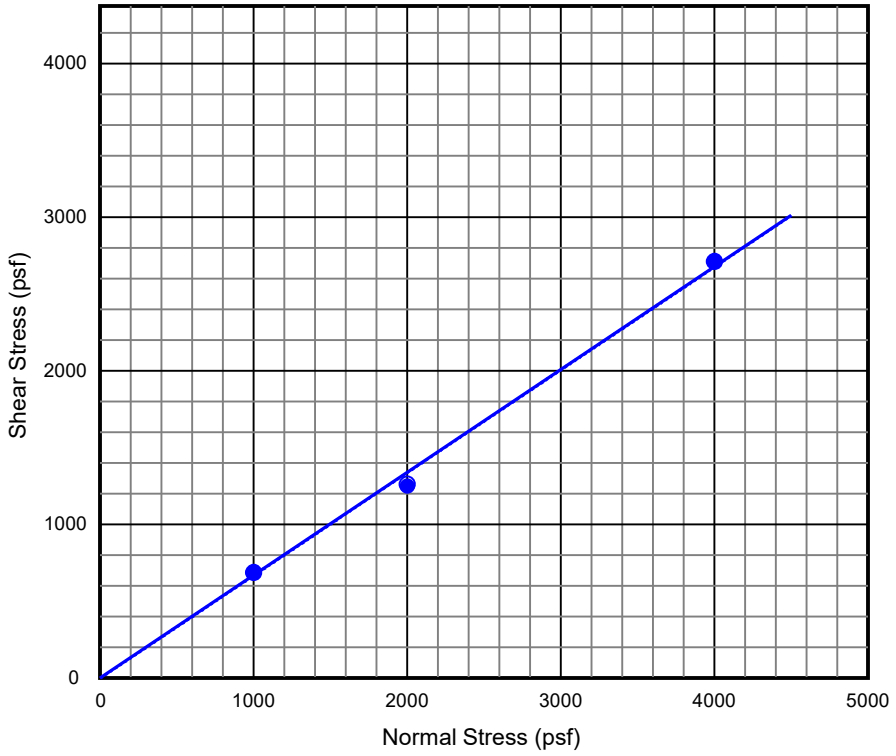
Prepared at 1/11/2018 10:08:47 AM




| | Boring No. | Depth (ft) | USCS | $\gamma_d$ (pcf) | w (%) | $C_{pk}$ (psf) | $\phi_{pk}$ (°) | $C_{rs}$ (psf) | $\phi_{rs}$ (°) |
|---|---|---|---|---|---|---|---|---|---|
| ● | 3 | 1 | (ML) Sandy silt / Undisturbed | 105.3 | 3.5 | 0.0 | 33.8 | 0.0 | 33.8 |

Terracon

**DIRECT SHEAR TESTS (ASTM D3080)**

| | | | | | |
|---|---|---|---|---|---|
| Project: | Tentative Tract No. 37305 | | | | |
| Location: | Nichols Road and Interstate 15, Lake Elsinore, California | | | | |
| Job Number: | CB175281 | Engineer: | | Exhibit: | C-5 |

J:\2017\CB175281\Working Files\Laboratory-Field Data-Boring Logs\LabSuite_CB175281.csv

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Prepared at 1/11/2018 10:08:47 AM

# Table 1 - Laboratory Tests on Soil Samples

***CHJ Consultants***
***Nichols RD & I-215***
***Your #CB175281, HDR Lab #18-0012LAB***
***10-Jan-18***

| **Sample ID** | | | 1A+3A |
|---|---|---|---|
| **Resistivity** | | **Units** | |
| as-received | | ohm-cm | 232,000 |
| saturated | | ohm-cm | 6,400 |
| **pH** | | | 6.9 |
| **Electrical Conductivity** | | mS/cm | 0.02 |
| **Chemical Analyses** | | | |
| **Cations** | | | |
| calcium | $Ca^{2+}$ | mg/kg | 13 |
| magnesium | $Mg^{2+}$ | mg/kg | 6.8 |
| sodium | $Na^{1+}$ | mg/kg | 10 |
| potassium | $K^{1+}$ | mg/kg | 11 |
| **Anions** | | | |
| carbonate | $CO_3^{2-}$ | mg/kg | ND |
| bicarbonate | $HCO_3^{1-}$ | mg/kg | 46 |
| fluoride | $F^{1-}$ | mg/kg | ND |
| chloride | $Cl^{1-}$ | mg/kg | 5.4 |
| sulfate | $SO_4^{2-}$ | mg/kg | 4.4 |
| phosphate | $PO_4^{3-}$ | mg/kg | 5.2 |
| **Other Tests** | | | |
| ammonium | $NH_4^{1+}$ | mg/kg | ND |
| nitrate | $NO_3^{1-}$ | mg/kg | 8.4 |
| sulfide | $S^{2-}$ | qual | na |
| Redox | | mV | na |

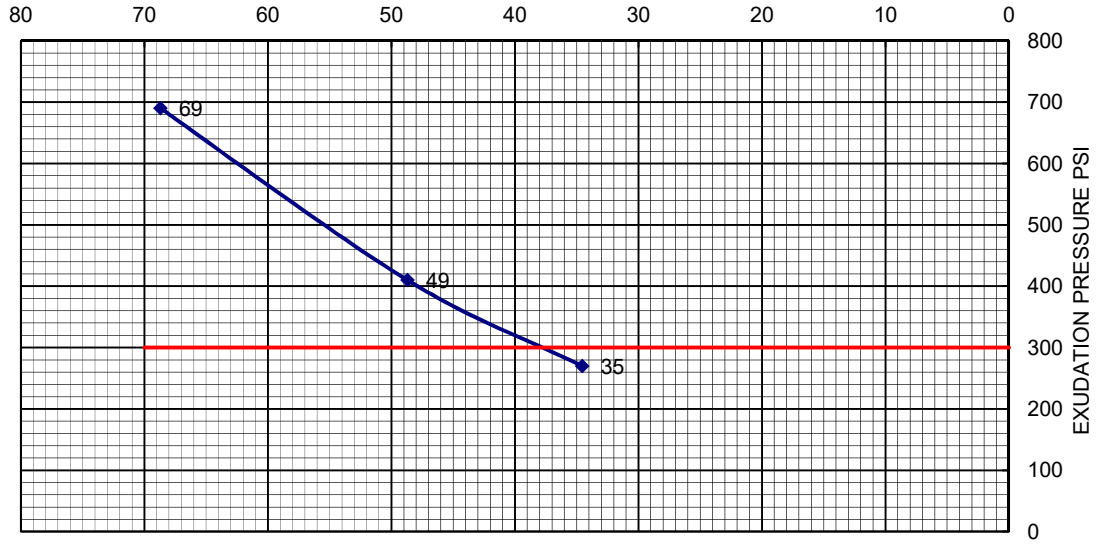
Resistivity per ASTM G187, Cations per ASTM D6919, Anions per ASTM D4327, and Alkalinity per APHA 2320-B.
Electrical conductivity in millisiemens/cm and chemical analyses were made on a 1:5 soil-to-water extract.
mg/kg = milligrams per kilogram (parts per million) of dry soil.
Redox = oxidation-reduction potential in millivolts
ND = not detected
na = not analyzed

431 West Baseline Road · Claremont, CA 91711
Phone: 909.962.5485 · Fax: 909.626.3316

| Traffic Index (T.I.) 5.0 | A | B | C | D |
|---|---|---|---|---|
| COMPACTOR AIR PRESSURE P.S.I. | 200 | 250 | 350 | |
| INITIAL MOISTURE % | 4.9 | 4.9 | 4.9 | |
| WATER ADDED, ML | 60 | 50 | 40 | |
| WATER ADDED % | 5.4 | 4.6 | 3.6 | |
| MOISTURE AT COMPACTION % | 10.3 | 9.5 | 8.5 | |
| HEIGHT OF BRIQUETTE | 2.50 | 2.45 | 2.52 | |
| WET WEIGHT OF BRIQUETTE | 1173 | 1147 | 1171 | |
| DENSITY LB. PER CU.FT. | 128.9 | 129.6 | 129.8 | |
| STABILOMETER PH AT 1000 LBS. | 48 | 35 | 20 | |
| 2000 LBS. | 92 | 71 | 43 | |
| DISPLACEMENT | 3.50 | 3.30 | 3.10 | |
| R-VALUE | 35 | 49 | 69 | |
| EXUDATION PRESSURE | 270 | 410 | 690 | |
| THICK. INDICATED BY STAB. | 1.05 | 0.82 | 0.50 | |
| EXPANSION PRESSURE | 0 | 5 | 24 | |
| THICK. INDICATED BY E.P. | 0.00 | 0.17 | 0.80 | |

EXUDATION CHART

R-VALUE




R-Value: 37

| Sample No. | Depth (ft) | Soil/Sample Type | SE | $w_0$(%) |
|---|---|---|---|---|
| 9A+10A+11A | 0 - 5 | (SM) Silty sand | 18 | 4.9 |

Terracon

R-VALUE TEST

| | | | |
|---|---|---|---|
| Project: | Tentative Tract No. 37305 | | |
| Location: | Nichols Road and Interstate 15, Lake Elsinore, California | | |
| Job No.: | CB175281 | Exhibit: | C-7 |

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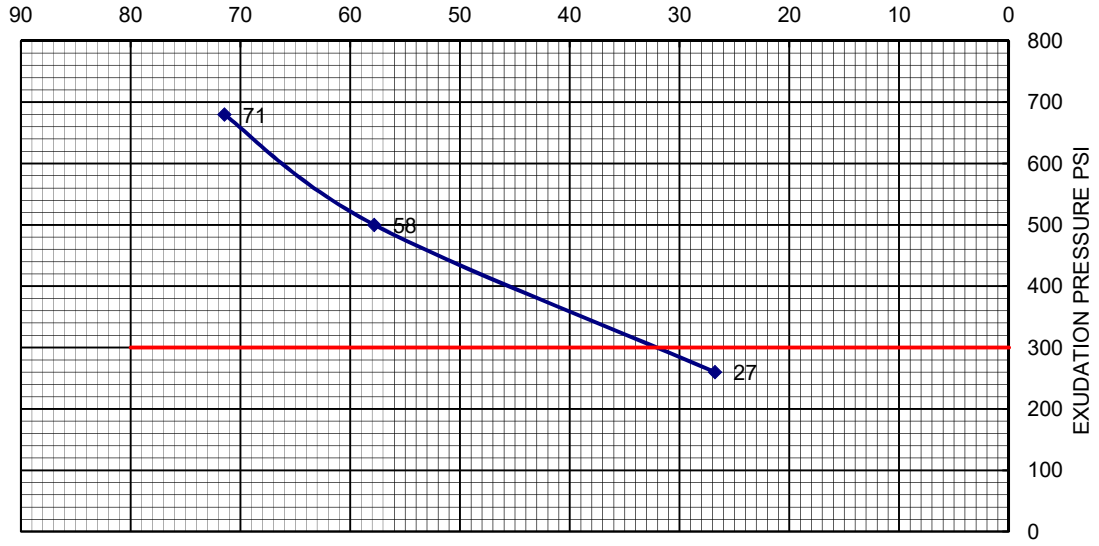
Prepared at 1/25/2018

| Traffic Index (T.I.) 5.0 | A | B | C | D |
|---|---|---|---|---|
| COMPACTOR AIR PRESSURE P.S.I. | 75 | 200 | 350 | |
| INITIAL MOISTURE % | 5.1 | 5.1 | 5.1 | |
| WATER ADDED, ML | 55 | 45 | 35 | |
| WATER ADDED % | 5.1 | 4.1 | 3.2 | |
| MOISTURE AT COMPACTION % | 10.2 | 9.2 | 8.3 | |
| HEIGHT OF BRIQUETTE | 2.45 | 2.47 | 2.49 | |
| WET WEIGHT OF BRIQUETTE | 1129 | 1149 | 1147 | |
| DENSITY LB. PER CU.FT. | 126.7 | 129.1 | 128.9 | |
| STABILOMETER PH AT 1000 LBS. | 44 | 27 | 20 | |
| 2000 LBS. | 100 | 51 | 34 | |
| DISPLACEMENT | 4.10 | 3.90 | 3.70 | |
| R-VALUE | 27 | 58 | 71 | |
| EXUDATION PRESSURE | 260 | 500 | 680 | |
| THICK. INDICATED BY STAB. | 1.17 | 0.68 | 0.46 | |
| EXPANSION PRESSURE | 0 | 6 | 19 | |
| THICK. INDICATED BY E.P. | 0.00 | 0.20 | 0.63 | |

EXUDATION CHART

R-VALUE




R-Value: 32

| Sample No. | Depth (ft) | Soil/Sample Type | SE | $w_0$ (%) |
|---|---|---|---|---|
| 12A | 5 - 10 | (SM) Silty sand | 23 | 5.1 |

Terracon

R-VALUE TEST

| | | | |
|---|---|---|---|
| Project: | Tentative Tract No. 37305 | | |
| Location: | Nichols Road and Interstate 15, Lake Elsinore, California | | |
| Job No.: | CB175281 | Exhibit: | C-8 |

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Prepared at 1/25/2018

## ASPHALT CONCRETE STRUCTURAL SECTION DESIGN

| R-Value used | 32 |
|---|---|

| Traffic Index (T.I.) | Recommended Street Sections | |
|---|---|---|
| 5.00 | 0.25' AC / 0.45' AB Class 2 | 0.50' AC / Native |
| 5.50 | 0.25' AC / 0.55' AB Class 2 | 0.55' AC / Native |
| 6.00 | 0.30' AC / 0.60' AB Class 2 | 0.65' AC / Native |
| 6.50 | 0.30' AC / 0.70' AB Class 2 | 0.70' AC / Native |
| 7.00 | 0.35' AC / 0.75' AB Class 2 | 0.80' AC / Native |
| 7.50 | 0.40' AC / 0.75' AB Class 2 | 0.85' AC / Native |
| 8.00 | 0.40' AC / 0.90' AB Class 2 | 0.95' AC / Native |
| 8.50 | 0.45' AC / 0.90' AB Class 2 | 1.05' AC / Native |
| 9.00 | 0.45' AC / 1.05' AB Class 2 | 1.10' AC / Native |
| 9.50 | 0.50' AC / 1.05' AB Class 2 | 1.20' AC / Native |
| 10.00 | 0.55' AC / 1.10' AB Class 2 | 1.30' AC / Native |
| 10.50 | 0.55' AC / 1.25' AB Class 2 | 1.40' AC / Native |
| 11.00 | 0.60' AC / 1.25' AB Class 2 | 1.45' AC / Native |
| 11.50 | 0.60' AC / 1.35' AB Class 2 | 1.55' AC / Native |
| 12.00 | 0.65' AC / 1.40' AB Class 2 | 1.60' AC / Native |
| | | |
| | | |
| | | |
| | | |

NOTE: MIN. A.C. THICKNESS IS 0.25' MIN. A.B. THICKNESS IS 0.35'

All thicknesses arerounded to the nearest 0.05 foot.

The above values may not reflect applicable county or city minimum standards.

A safety factor of 0.20 for the G.E. of the A.C. is included as per Caltrans.

The values also include a safety factor of 0.10 for A.C./ native soil.

Some agencies do not permit placing A.C. over native soil.

## PARKING LOT PCC SECTION DESIGN

| R-Value | Concrete Compressive Strength, $f_c$ (psi) | Flexural Strength, $M_r$ (psi) |
|---|---|---|
| *32* | *3600* | *600* |
| **Traffic Category** | **ADTT** | **PCC Section (in)*** |
| A | 1 | 4.5 |
| A | 10 | 5 |
| B | 25 | 5.5 |
| B | 300 | 6 |
| C | 100 | 6.5 |
| C | 300 | 6.5 |
| C | 700 | 7 |
| D | 700 | 8 |
| Modulus of subgrade reaction, k (pci) | | 145 |

* Rough-textured, angular-shaped aggregates

Terracon

AC & PCC STRUCTURAL SECTION DESIGN

| | | | |
|---|---|---|---|
| Project: | Tentative Tract No. 37305 | | |
| Location: | Nichols Road and Interstate 15, Lake Elsinore, California | | |
| Job No.: | CB175281 | Exhibit: | C-9 |

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## ASPHALT CONCRETE STRUCTURAL SECTION DESIGN

| R-Value used | 37 |
|---|---|

| Traffic Index (T.I.) | Recommended Street Sections | |
|---|---|---|
| 5.00 | 0.25' AC / 0.35' AB Class 2 | 0.45' AC / Native |
| 5.50 | 0.25' AC / 0.50' AB Class 2 | 0.50' AC / Native |
| 6.00 | 0.30' AC / 0.50' AB Class 2 | 0.60' AC / Native |
| 6.50 | 0.30' AC / 0.60' AB Class 2 | 0.65' AC / Native |
| 7.00 | 0.35' AC / 0.65' AB Class 2 | 0.75' AC / Native |
| 7.50 | 0.40' AC / 0.65' AB Class 2 | 0.80' AC / Native |
| 8.00 | 0.40' AC / 0.75' AB Class 2 | 0.90' AC / Native |
| 8.50 | 0.45' AC / 0.80' AB Class 2 | 0.95' AC / Native |
| 9.00 | 0.45' AC / 0.90' AB Class 2 | 1.05' AC / Native |
| 9.50 | 0.50' AC / 0.95' AB Class 2 | 1.10' AC / Native |
| 10.00 | 0.55' AC / 0.95' AB Class 2 | 1.20' AC / Native |
| 10.50 | 0.55' AC / 1.05' AB Class 2 | 1.30' AC / Native |
| 11.00 | 0.60' AC / 1.10' AB Class 2 | 1.35' AC / Native |
| 11.50 | 0.60' AC / 1.20' AB Class 2 | 1.45' AC / Native |
| 12.00 | 0.65' AC / 1.20' AB Class 2 | 1.50' AC / Native |
| | | |
| | | |
| | | |
| | | |

NOTE: MIN. A.C. THICKNESS IS 0.25' MIN. A.B. THICKNESS IS 0.35'

All thicknesses arerounded to the nearest 0.05 foot.

The above values may not reflect applicable county or city minimum standards.

A safety factor of 0.20 for the G.E. of the A.C. is included as per Caltrans.

The values also include a safety factor of 0.10 for A.C./ native soil.

Some agencies do not permit placing A.C. over native soil.

## PARKING LOT PCC SECTION DESIGN

| R-Value | Concrete Compressive Strength, $f_c$ (psi) | Flexural Strength, $M_r$ (psi) |
|---|---|---|
| *37* | *3600* | *600* |
| **Traffic Category** | **ADTT** | **PCC Section (in)*** |
| A | 1 | 4.5 |
| A | 10 | 5 |
| B | 25 | 5.5 |
| B | 300 | 6 |
| C | 100 | 6.5 |
| C | 300 | 6.5 |
| C | 700 | 7 |
| D | 700 | 7.5 |
| Modulus of subgrade reaction, k (pci) | | 160.6 |

* Rough-textured, angular-shaped aggregates

Terracon

AC & PCC STRUCTURAL SECTION DESIGN

| | | | |
|---|---|---|---|
| Project: | Tentative Tract No. 37305 | | |
| Location: | Nichols Road and Interstate 15, Lake Elsinore, California | | |
| Job No.: | CB175281 | Exhibit: | C-10 |

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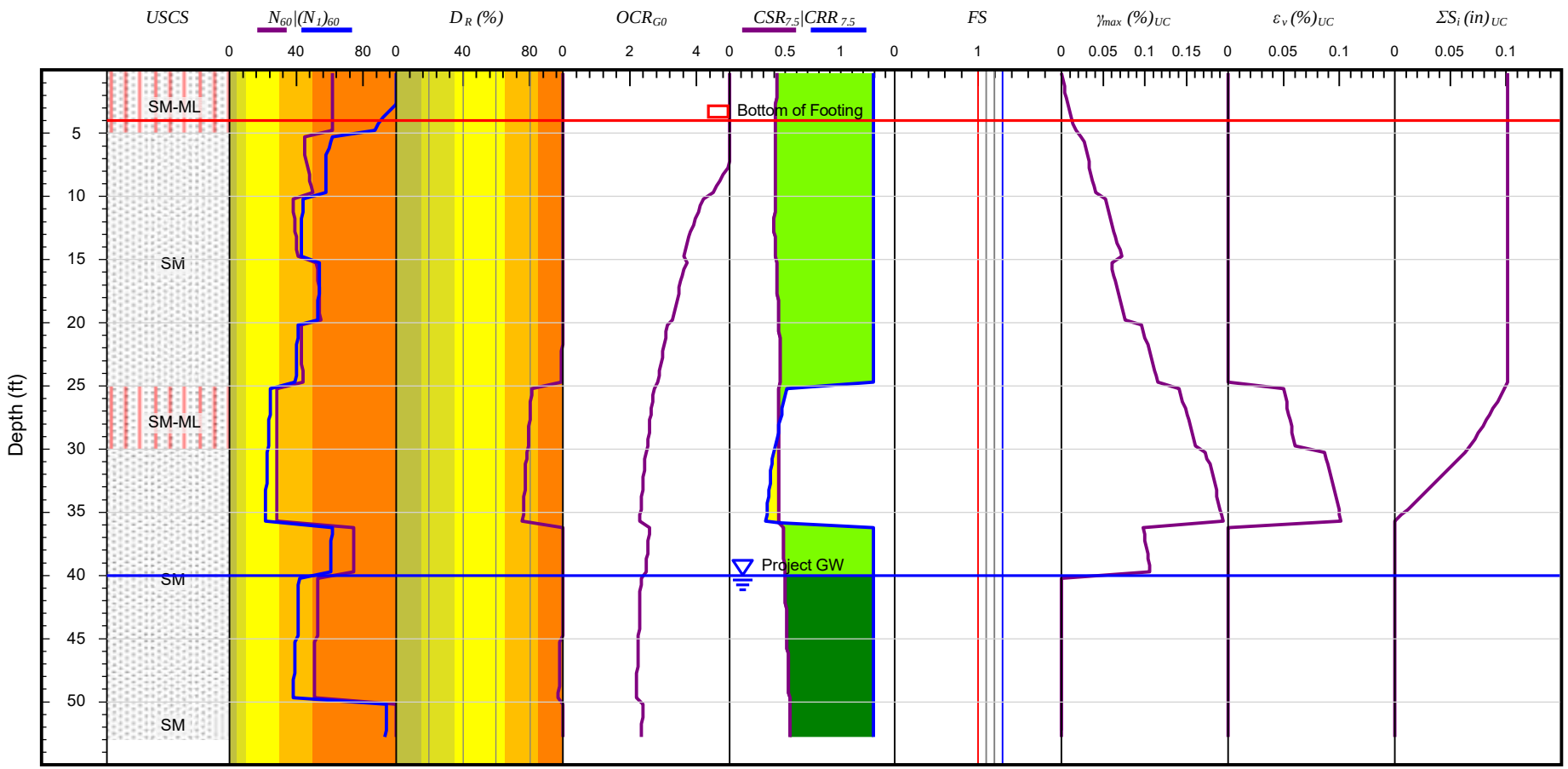
# GEOTECHNICAL CALCULATIONS




SM-ML

SM

Earthquake & Groundwater Information:
Magnitude = 6.77
Max. Acceleration = 0.865 g
Project GW = 40 ft
Maximum Settlement = 0.10 in
Settl. at Bottom of Footing = 0.10 in

Liquefaction: Idriss & Boulanger (2008)
Settl.: [dry] UCLA (2008-14); [sat] Idriss & Boulanger (2008)
Lateral spreading: Idriss & Boulanger (2008)
M correction: [Sand] Boulanger & Idriss(2004)
σv correction: Idriss & Boulanger (2008)
Stress reduction: Idriss & Boulanger (2008)

Terracon

## Seismic Settlement Potential - SPT Data

| | | | | | |
|---|---|---|---|---|---|
| Project: | Tentative Tract No. 37305 | | | | |
| Location: | Nichols Road and Interstate 215, Lake Elsinore, California | | | | |
| Job Number: | CB175281 | Boring No.: | B-2 (2018) | Exhibit: | D-1 |

J:\2017\CB175281\Working Files\Calculations-Analyses\GeoSuite_CB175281_B-2.csv

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Prepared at 2/2/2018 3:03:41 PM

# PREVIOUS EXPLORATION RESULTS

Previous Exploratory Borings

# APPENDIX "B"

# EXPLORATORY LOGS

# KEY TO LOGS

LEGEND OF LAB/FIELD TESTS:

| | |
|---|---|
| Blows | A measure of the penetration resistance of soil expressed as the number of hammer blows required to advance the indicated sampler 6 inches (or less if noted). Samplers are driven with an automatic hammer that drops a 140-pound weight 30 inches for each blow. After the required seating, samplers are advanced up to 18 inches ahead of the boring, providing up to three sets of blows per drive. |
| Bulk | Indicates Bulk Sample |
| Consol. | Consolidation Test (ASTM D2435/4546) |
| Cor. | Chemical/Corrosivity Tests (ASTM G187, D4327, D4972) |
| Dist. | Indicates Disturbed Sample |
| DS | Direct Shear Test (ASTM D3080) |
| MDC | Maximum Density Optimum Moisture Test (ASTM D1557) |
| N.R. | Indicates No Recovery of Sample |
| Pass #200 | Wash through #200 Screen (ASTM D422) |
| Ring | Indicates Relatively Undisturbed Ring Sample. The number of blows per 6 inches required to drive a California sampler (3-1/4" O.D. and 2-3/8" I.D.) 18 inches using a 140-pound weight falling 30 inches was recorded. |
| SA | Sieve Analysis (ASTM D422) |
| SPT | Indicates Sample Obtained with an Unlined Standard Penetration Test Sampler (2" O.D. and 1-3/8" I.D.) |

# UNIFIED SOIL CLASSIFICATION SYSTEM

## UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

| | | | |
|---|---|---|---|
| COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size) | | | |
| GRAVELS More than 50% of coarse fraction larger than No.4 sieve size | Clean Gravels (Less than 5% fines) | GW | Well-graded gravels, gravel-sand mixtures, little or no fines |
| | | GP | Poorly-graded gravels, gravel-sand mixtures, little or no fines |
| | Gravels with fines (More than 12% fines) | GM | Silty gravels, gravel-sand-silt mixtures |
| | | GC | Clayey gravels, gravel-sand-clay mixtures |
| SANDS 50% or more of coarse fraction smaller than No.4 sieve size | Clean Sands (Less than 5% fines) | SW | Well-graded sands, gravelly sands, little or no fines |
| | | SP | Poorly graded sands, gravelly sands, little or no fines |
| | Sands with fines (More than 12% fines) | SM | Silty sands, sand-silt mixtures |
| | | SC | Clayey sands, sand-clay mixtures |
| FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size) | | | |
| SILTS AND CLAYS Liquid limit less than 50% | | ML | Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts with slight plasticity |
| | | CL | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays |
| | | OL | Organic silts and organic silty clays of low plasticity |
| SILTS AND CLAYS Liquid limit 50% or greater | | MH | Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts |
| | | CH | Inorganic clays of high plasticity, fat clays |
| | | OH | Organic clays of medium to high plasticity, organic silts |
| HIGHLY ORGANIC SOILS | | PT | Peat and other highly organic soils |

## LABORATORY CLASSIFICATION CRITERIA

GW $C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}^2}{D_{10} \times D_{60}}$ between 1 and 3

GP Not meeting all gradation requirements for GW

| | | |
|---|---|---|
| GM | Atterberg limits below "A" line or P.I. less than 4 | Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols. |
| GC | Atterberg limits above "A" line with P.I. greater than 7 | |

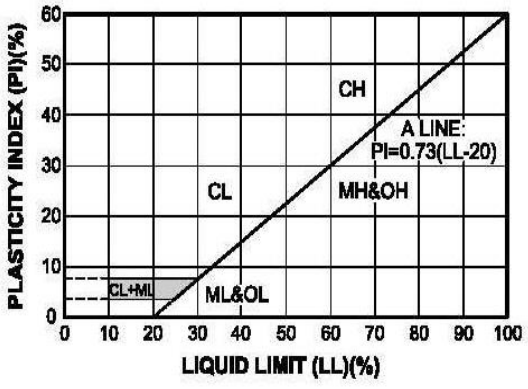
SW $C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{D_{30}^2}{D_{10} \times D_{60}}$ between 1 and 3

SP Not meeting all gradation requirements for SW

| | | |
|---|---|---|
| SM | Atterberg limits below "A" line or P.I. less than 4 | Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols. |
| SC | Atterberg limits above "A" line with P.I. greater than 7 | |

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size).
Coarse-grained soils are classified as follows:
Less than 5 percent.....GW, GP, SW, SP
More than 12 percent.....GM, GC, SM, SC
5 to 12 percent.....Borderline cases requiring dual symbols

## PLASTICITY CHART



# EXPLORATORY BORING NO. 1

Date Drilled: 4/15/16 | Client: Nichols Road Partners

Equipment: CME75 Track Rig | Driving Weight / Drop / Sampler Size: 140lbs./30in./3.25" O.D.

Surface Elevation(ft): 1298 | Logged by: GA | Measured Depth to Water(ft): N/A

| DEPTH (ft) | GRAPHIC LOG | VISUAL CLASSIFICATION | REMARKS | SAMPLES: DRIVE | SAMPLES: BULK | BLOWS/6 IN. | FIELD MOISTURE (%) | DRY UNIT WT. (pcf) | LAB/FIELD TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | (SM) Silty Sand, fine to coarse, with gravel to 3", brown | Native | X | | 22<br>32<br>40 | 8.1 | 103 | Ring |
| | | | | | ▨ | | 6.3 | | |
| 5 | | (SM) Silty Sand, fine to coarse, with clay and gravel to 2", yellowish brown | | X | | 50 | 9.2 | 116 | Ring |
| | | | | | ▨ | | 9.5 | | |
| 10 | | Metamorphic bedrock, dark gray, weathered | Bedrock | X | | 50/5" | 7.8 | 109 | Ring |
| | | | | | ▨ | | 5.0 | | |
| 15 | | | | X | | 50/2" | 5.3 | Dist. | Ring |
| 20 | | | | X | | 50/4" | 6.5 | 104 | Ring |
| | | | Harder Drilling | | | | | | |
| 25 | | END OF BORING | | X | | 50/3" | 4.1 | 109 | Ring |
| | | REFUSAL ON BEDROCK AT 25'<br>NO GROUNDWATER<br>NO CAVING, NO FILL | | | | | | | |
| 30 | | | | | | | | | |

10331-3 16164-3.GPJ CHJ.GDT 5/4/16

CHJ

SOUTH NICHOLS GRADING PROJECT
SOUTH OF NICHOLS ROAD, EAST OF I-15, LAKE ELSINORE, CA

Job No. 16164-3

Enclosure B-1

# EXPLORATORY BORING NO. 2

Date Drilled: 4/15/16 | Client: Nichols Road Partners

Equipment: CME75 Track Rig | Driving Weight / Drop / Sampler Size: 140lbs./30in./3.25" O.D.

Surface Elevation(ft): 1355 | Logged by: GA | Measured Depth to Water(ft): N/A

| DEPTH (ft) | GRAPHIC LOG | VISUAL CLASSIFICATION | REMARKS | SAMPLES: DRIVE | SAMPLES: BULK | BLOWS/6 IN. | FIELD MOISTURE (%) | DRY UNIT WT. (pcf) | LAB/FIELD TESTS |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | (SM) Silty Sand, fine to coarse, with gravel to 1", yellowish brown | Native | | | | | | |
| | | | Debris on surface | X | | 6<br>7<br>9 | 3.1 | 106 | Ring |
| 5 | | | | X | | 8<br>10<br>11 | 3.2 | 106 | Ring |
| | | | | | X | | 2.5 | | |
| | | | Auger Chatter | | | | | | |
| 10 | | | | X | | 17<br>35<br>40 | 4.0 | 115 | Ring |
| | | Metamorphic bedrock recovered as (GM) Sandy Gravel, fine, with silt, gravel to 2", yellowish brown, weathered | Bedrock | | X | | 3.4 | | |
| | | | Hard Drilling | | | | | | |
| 15 | | | | X | | 50/5" | 8.1 | 105 | Ring |
| 20 | | | | X | | 50 | 11.3 | 112 | Ring |
| 25 | | | | | | 50/1" | 3.9 | 107 | Ring |
| | | | Smoky Auger | | X | | 4.0 | | |
| 30 | | END OF BORING<br><br>REFUSAL ON BEDROCK AT 30'<br>NO GROUNDWATER<br>NO CAVING, NO FILL | | | | 50/1" | N.R. | N.R. | Ring |

10331-3 16164-3.GPJ CHJ.GDT 5/4/16

CHJ

SOUTH NICHOLS GRADING PROJECT
SOUTH OF NICHOLS ROAD, EAST OF I-15, LAKE ELSINORE, CA

Job No. 16164-3

Enclosure B-2

# EXPLORATORY BORING NO. 3

Date Drilled: 4/18/16 | Client: Nichols Road Partners

Equipment: CME75 Truck Rig | Driving Weight / Drop / Sampler Size: 140lbs./30in./3.25" O.D.

Surface Elevation(ft): 1315 | Logged by: GA | Measured Depth to Water(ft): N/A

| DEPTH (ft) | GRAPHIC LOG | VISUAL CLASSIFICATION | REMARKS | SAMPLES: DRIVE | SAMPLES: BULK | BLOWS/6 IN. | FIELD MOISTURE (%) | DRY UNIT WT. (pcf) | LAB/FIELD TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | (SM) Silty Sand, fine to coarse, with gravel to 2", dark yellowish brown | Fill | X | | 11<br>37<br>50/5" | 4.1 | 114 | Ring |
| | | | | | ▨ | | 4.4 | | |
| | | (SM) Silty Sand, fine to coarse, with gravel to 2", dark yellowish brown | Native | | | | | | |
| 5 | | | | X | | 26<br>36<br>43 | 3.7 | 117 | Consol., Ring |
| 10 | | | | X | | 16<br>24<br>26 | 4.4 | 116 | Pass #200, Ring |
| | | | | | ▨ | | 3.5 | | Cor., DS, MDC, SA |
| 15 | | (SM) Silty Sand, fine to coarse, with gravel to 1/4", light yellowish brown | | X | | 19<br>33<br>40 | 3.4 | 121 | Pass #200, Ring |
| 20 | | | | X | | 30<br>37<br>38 | 3.2 | 118 | Pass #200, Ring |
| 25 | | (SP-SM) Sand, fine to coarse, with silt and gravel to 1/4", yellowish brown | | X | | 23<br>28<br>32 | 2.2 | 114 | Pass #200, Ring |
| 30 | | (ML) Sandy Silt, fine to coarse, with gravel to 1/2", yellowish brown | Hard Drilling | X | | 20<br>17<br>20 | 4.1 | 118 | Pass #200, Ring |

10331-3 16164-3.GPJ CHJ.GDT 5/4/16

CHJ

SOUTH NICHOLS GRADING PROJECT
SOUTH OF NICHOLS ROAD, EAST OF I-15, LAKE ELSINORE, CA

Job No. 16164-3

Enclosure B-3a

# EXPLORATORY BORING NO. 3

Date Drilled: 4/18/16 | Client: Nichols Road Partners

Equipment: CME75 Truck Rig | Driving Weight / Drop / Sampler Size: 140lbs./30in./3.25" O.D.

Surface Elevation(ft): 1315 | Logged by: GA | Measured Depth to Water(ft): N/A

| DEPTH (ft) | GRAPHIC LOG | VISUAL CLASSIFICATION | REMARKS | SAMPLES DRIVE | SAMPLES BULK | BLOWS/6 IN. | FIELD MOISTURE (%) | DRY UNIT WT. (pcf) | LAB/FIELD TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | (SM) Silty Sand, fine to coarse, with gravel to 1/2", yellowish brown | | X | | 17<br>23<br>24 | 7.2 | 115 | Pass #200, Ring |
| 40 | | | | X | | 16<br>20<br>22 | 10.5 | 118 | Pass #200, Ring |
| | | | Added Water | | | | | | |
| 45 | | (SM) Silty Sand, fine to coarse, with clay and gravel to 1/4", yellowish brown | | X | | 14<br>32<br>50/5" | 8.4 | 120 | Pass #200, Ring |
| | | | Very Hard Drilling | | | | | | |
| 50 | | | | X | | 20<br>31<br>34 | 11.4 | 122 | Pass #200, Ring |
| | | END OF BORING<br><br>NO REFUSAL, NO BEDROCK<br>NO GROUNDWATER<br>NO CAVING, FILL TO 4' | | | | | | | |
| 55 | | | | | | | | | |
| 60 | | | | | | | | | |
| 65 | | | | | | | | | |

10331-3 16164-3.GPJ CHJ.GDT 5/4/16

CHJ

SOUTH NICHOLS GRADING PROJECT
SOUTH OF NICHOLS ROAD, EAST OF I-15, LAKE ELSINORE, CA

Job No. 16164-3

Enclosure B-3b

# EXPLORATORY BORING NO. 4

Date Drilled: 4/18/16 | Client: Nichols Road Partners

Equipment: CME75 Truck Rig | Driving Weight / Drop / Sampler Size: 140lbs./30in./3.25" O.D.

Surface Elevation(ft): 1325 | Logged by: GA | Measured Depth to Water(ft): N/A

| DEPTH (ft) | GRAPHIC LOG | VISUAL CLASSIFICATION | REMARKS | SAMPLES: DRIVE | SAMPLES: BULK | BLOWS/6 IN. | FIELD MOISTURE (%) | DRY UNIT WT. (pcf) | LAB/FIELD TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | (ML) Sandy Silt, fine to coarse, with gravel to 1", dark yellowish brown | Fill | X | | 32<br>50/5" | 20.0 | 104 | Ring |
| | | (SM) Silty Sand, fine to coarse, with clay and gravel to 2", yellowish brown | Native | | ▨ | | 5.0 | | |
| 5 | | | | X | | 23<br>35<br>42 | 5.4 | 124 | Ring |
| 10 | | | | X | | 17<br>13<br>16 | 6.1 | 119 | Consol., Ring |
| | | | | | ▨ | | 6.9 | | Cor., DS, MDC, SA |
| 15 | | | | X | | 14<br>16<br>22 | 7.5 | 125 | Ring |
| 20 | | | | X | | 12<br>23<br>24 | 4.4 | 116 | Ring |
| 25 | | | Hard Drilling | X | | 16<br>17<br>17 | 8.0 | 126 | Ring |
| 30 | | (SM) Silty Sand, fine to coarse, with gravel to 1", yellowish brown | Added Water | X | | 10<br>12<br>15 | 6.2 | 123 | Ring |

10331-3 16164-3.GPJ CHJ.GDT 5/4/16

CHJ

SOUTH NICHOLS GRADING PROJECT
SOUTH OF NICHOLS ROAD, EAST OF I-15, LAKE ELSINORE, CA

Job No. 16164-3

Enclosure B-4a

# EXPLORATORY BORING NO. 4

Date Drilled: 4/18/16

Client: Nichols Road Partners

Equipment: CME75 Truck Rig

Driving Weight / Drop / Sampler Size: 140lbs./30in./3.25" O.D.

Surface Elevation(ft): 1325

Logged by: GA

Measured Depth to Water(ft): N/A

| DEPTH (ft) | GRAPHIC LOG | VISUAL CLASSIFICATION | REMARKS | SAMPLES DRIVE | SAMPLES BULK | BLOWS/6 IN. | FIELD MOISTURE (%) | DRY UNIT WT. (pcf) | LAB/FIELD TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | (SM) Silty Sand, fine to coarse, with gravel to 1", yellowish brown | Added Water | X | | 14<br>18<br>16 | 6.5 | 112 | Ring |
| 40 | | | Added Water | X | | 10<br>16<br>20 | 8.6 | 124 | Ring |
| 45 | | | Added Water | X | | 15<br>25<br>31 | 7.8 | 124 | Ring |
| 50 | | (ML) Sandy Silt, fine, with clay, brown | | X | | 18<br>24<br>44 | 10.8 | 124 | Ring |
| | | END OF BORING<br><br>NO REFUSAL, NO BEDROCK<br>NO GROUNDWATER<br>NO CAVING, FILL TO 3' | | | | | | | |
| 55 | | | | | | | | | |
| 60 | | | | | | | | | |
| 65 | | | | | | | | | |

10331-3 16164-3.GPJ CHJ.GDT 5/4/16

CHJ

SOUTH NICHOLS GRADING PROJECT
SOUTH OF NICHOLS ROAD, EAST OF I-15, LAKE ELSINORE, CA

Job No. 16164-3

Enclosure B-4b

# EXPLORATORY BORING NO. 5

Date Drilled: 4/15/16 | Client: Nichols Road Partners

Equipment: CME75 Track Rig | Driving Weight / Drop / Sampler Size: 140lbs./30in./3.25" O.D.

Surface Elevation(ft): 1356 | Logged by: GA | Measured Depth to Water(ft): N/A

| DEPTH (ft) | GRAPHIC LOG | VISUAL CLASSIFICATION | REMARKS | SAMPLES DRIVE | SAMPLES BULK | BLOWS/6 IN. | FIELD MOISTURE (%) | DRY UNIT WT. (pcf) | LAB/FIELD TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | (SM) Silty Sand, fine to coarse, with gravel to 1", light yellowish brown | Fill | X | | 7<br>7<br>9 | 2.8 | 102 | Ring |
| | | | | | ▨ | | 2.8 | | |
| 5 | | | | X | | 8<br>7<br>7 | 4.1 | 105 | Ring |
| 10 | | | | X | | 23<br>16<br>12 | 4.9 | 114 | Ring |
| 15 | | | | X | | 9<br>29<br>31 | 3.9 | Dist. | Ring |
| | | | | | ▨ | | 3.7 | | |
| 20 | | (SP-SM) Sand, fine to coarse, with silt and gravel to 1", yellowish brown | Native | X | | 10<br>18<br>15 | 1.7 | 119 | Ring |
| 25 | | (SM) Silty Sand, fine to coarse, with gravel to 1/2", dark yellowsih brown | Auger Chatter | X | | 7<br>9<br>16 | 4.1 | 109 | Ring |
| 30 | | | | X | | 24<br>16<br>29 | 3.5 | 115 | Ring |

10331-3 16164-3.GPJ CHJ.GDT 5/4/16

CHJ

SOUTH NICHOLS GRADING PROJECT
SOUTH OF NICHOLS ROAD, EAST OF I-15, LAKE ELSINORE, CA

Job No. 16164-3

Enclosure B-5a

# EXPLORATORY BORING NO. 5

Date Drilled: 4/15/16

Client: Nichols Road Partners

Equipment: CME75 Track Rig

Driving Weight / Drop / Sampler Size: 140lbs./30in./3.25" O.D.

Surface Elevation(ft): 1356

Logged by: GA

Measured Depth to Water(ft): N/A

| DEPTH (ft) | GRAPHIC LOG | VISUAL CLASSIFICATION | REMARKS | SAMPLES DRIVE | SAMPLES BULK | BLOWS/6 IN. | FIELD MOISTURE (%) | DRY UNIT WT. (pcf) | LAB/FIELD TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | Metamorphic bedrock, greenish gray, weathered | Bedrock | X | | 50 | 8.6 | 108 | Ring |
| | | | | | | | 8.8 | | |
| 40 | | | | X | | 50 | 10.6 | 104 | Ring |
| | | | Harder Drilling | | | | | | |
| 45 | | | | X | | 50/4" | 7.9 | 104 | Ring |
| | | END OF BORING | | | | | | | |
| | | REFUSAL ON BEDROCK AT 47' | | | | | | | |
| 50 | | NO GROUNDWATER | | | | | | | |
| | | NO CAVING, FILL TO 20.5' | | | | | | | |
| 55 | | | | | | | | | |
| 60 | | | | | | | | | |
| 65 | | | | | | | | | |

10331-3 16164-3.GPJ CHJ.GDT 5/4/16

CHJ

SOUTH NICHOLS GRADING PROJECT
SOUTH OF NICHOLS ROAD, EAST OF I-15, LAKE ELSINORE, CA

Job No. 16164-3

Enclosure B-5b

# EXPLORATORY BORING NO. 6

Date Drilled: 4/18/16 | Client: Nichols Road Partners

Equipment: CME75 Truck Rig | Driving Weight / Drop / Sampler Size: 140lbs./30in./3.25" O.D.

Surface Elevation(ft): 1325 | Logged by: GA | Measured Depth to Water(ft): N/A

| DEPTH (ft) | GRAPHIC LOG | VISUAL CLASSIFICATION | REMARKS | SAMPLES DRIVE | SAMPLES BULK | BLOWS/6 IN. | FIELD MOISTURE (%) | DRY UNIT WT. (pcf) | LAB/FIELD TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | (SM) Silty Sand, fine with medium to coarse, with gravel to 2", yellowish brown | Native | X | | 5<br>6<br>7 | 3.4 | 104 | Consol., Ring |
| | | | | | ▨ | | 3.4 | | Cor., DS, MDC, SA |
| 5 | | (GP) Sandy Gravel, fine to coarse, with cobbles to 4", yellowish brown | Auger Chatter | X | | 12<br>16<br>14 | 2.7 | 116 | Consol., Ring |
| | | | | | ▨ | | 2.6 | | |
| 10 | | | | X | | 27<br>38<br>35 | 5.5 | 125 | Consol., Ring |
| | | (SM) Silty Sand, fine to coarse, with clay and gravel to 1", brown | Less Chatter | | | | | | |
| 15 | | | | X | | 15<br>28<br>36 | 10.8 | 126 | Consol., Ring |
| 20 | | | | X | | 15<br>22<br>30 | 6.8 | 126 | Consol., Ring |
| 25 | | | | X | | 22<br>24<br>30 | 7.6 | 121 | Consol., Ring |
| 30 | | (SC) Clayey Sand, fine to coarse, with silt and gravel to 1", brown | Added Water | X | | 14<br>22<br>29 | 11.3 | 122 | Consol., Ring |

10331-3 16164-3.GPJ CHJ.GDT 5/4/16

# EXPLORATORY BORING NO. 6

Date Drilled: 4/18/16

Client: Nichols Road Partners

Equipment: CME75 Truck Rig

Driving Weight / Drop / Sampler Size: 140lbs./30in./3.25" O.D.

Surface Elevation(ft): 1325

Logged by: GA

Measured Depth to Water(ft): N/A

| DEPTH (ft) | GRAPHIC LOG | VISUAL CLASSIFICATION | REMARKS | SAMPLES DRIVE | SAMPLES BULK | BLOWS/6 IN. | FIELD MOISTURE (%) | DRY UNIT WT. (pcf) | LAB/FIELD TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | (SM) Silty Sand, fine to coarse, with gravel to 1/2", brown | | X | | 13<br>24<br>34 | 10.1 | 120 | Ring |
| | | Metamorphic Bedrock, gray, weathered | Bedrock | | | | | | |
| | | | | | | | 2.2 | | |
| 40 | | | | | | 50/2" | N.R. | N.R. | Ring |
| | | END OF BORING | | | | | | | |
| | | REFUSAL ON BEDROCK AT 40.5' | | | | | | | |
| | | NO GROUNDWATER | | | | | | | |
| | | NO CAVING, NO FILL | | | | | | | |
| 45 | | | | | | | | | |
| 50 | | | | | | | | | |
| 55 | | | | | | | | | |
| 60 | | | | | | | | | |
| 65 | | | | | | | | | |

10331-3 16164-3.GPJ CHJ.GDT 5/4/16

CHJ

SOUTH NICHOLS GRADING PROJECT
SOUTH OF NICHOLS ROAD, EAST OF I-15, LAKE ELSINORE, CA

Job No. 16164-3

Enclosure B-6b

# EXPLORATORY BORING NO. 7

Date Drilled: 4/18/16 | Client: Nichols Road Partners

Equipment: CME75 Truck Rig | Driving Weight / Drop / Sampler Size: 140lbs./30in./2.0" O.D.

Surface Elevation(ft): 1333 | Logged by: GA | Measured Depth to Water(ft): N/A

| DEPTH (ft) | VISUAL CLASSIFICATION | REMARKS | SAMPLES: DRIVE | SAMPLES: BULK | BLOWS/6 IN. | FIELD MOISTURE (%) | DRY UNIT WT. (pcf) | LAB/FIELD TESTS |
|---|---|---|---|---|---|---|---|---|
| | (SM) Silty Sand, fine to coarse, with gravel to 3", yellowish brown | Native | X | | 3<br>6<br>7 | | | SPT |
| | | | | ▨ | | 2.7 | | Cor., DS, MDC, SA |
| 5 | (ML) Sandy Silt, fine to coarse, with gravel to 1/2", yellowish brown | | X | | 4<br>4<br>5 | | | Pass #200, SPT |
| 10 | (SP-SM) Sand, fine to coarse, with silt and gravel to 2", light brown | Gravel lenses | X | | 10<br>24<br>12 | | | Pass #200, SPT |
| | | | | ▨ | | 3.2 | | |
| | (SM) Silty Sand, fine to coarse, with clay and gravel to 1/2", brown | Less Gravel | | | | | | |
| 15 | | | X | | 11<br>15<br>18 | | | SPT |
| 20 | | | X | | 10<br>19<br>30 | | | SPT |
| 25 | | | X | | 29<br>50/5" | | | SPT |
| | Metamorphic Bedrock, gray, weathered | | | | | | | |
| | END OF BORING | | | | | | | |
| 30 | REFUSAL ON BEDROCK AT 25.5'<br>NO GROUNDWATER<br>NO CAVING, NO FILL | | | | | | | |

10331-3 16164-3.GPJ CHJ.GDT 5/4/16

CHJ

SOUTH NICHOLS GRADING PROJECT
SOUTH OF NICHOLS ROAD, EAST OF I-15, LAKE ELSINORE, CA

Job No. 16164-3

Enclosure B-7

# EXPLORATORY BORING NO. 8

Date Drilled: 4/15/16 | Client: Nichols Road Partners

Equipment: CME75 Track Rig | Driving Weight / Drop / Sampler Size: 140lbs./30in./2.0" O.D.

Surface Elevation(ft): 1310 | Logged by: GA | Measured Depth to Water(ft): N/A

| DEPTH (ft) | GRAPHIC LOG | VISUAL CLASSIFICATION | REMARKS | SAMPLES: DRIVE | SAMPLES: BULK | BLOWS/6 IN. | FIELD MOISTURE (%) | DRY UNIT WT. (pcf) | LAB/FIELD TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | (SM) Silty Sand, fine with medium to coarse, with gravel to 2", light yellowish brown | Native | X | | 26<br>35<br>46 | | | Pass #200, SPT |
| | | | | | ▨ | | 4.5 | | Cor., DS, MDC, SA |
| 5 | | (SM) Silty Sand, fine to coarse, with gravel to 1/2", yellowish brown | | X | | 16<br>18<br>18 | | | Pass #200, SPT |
| 10 | | | | X | | 11<br>14<br>15 | | | Pass #200, SPT |
| 15 | | | | X | | 11<br>15<br>20 | | | Pass #200, SPT |
| | | (SM) Silty Sand, fine with medium to coarse, with gravel to 1", yellowish brown | | | ▨ | | 3.4 | | |
| 20 | | | | X | | 18<br>20<br>21 | | | Pass #200, SPT |
| 25 | | | | X | | 9<br>7<br>8 | | | Pass #200, SPT |
| 30 | | (SM) Silty Sand, fine to coarse, with gravel to 1/2", yellowish brown | | X | | 16<br>28<br>30 | | | Pass #200, SPT |

10331-3 16164-3.GPJ CHJ.GDT 5/4/16

CHJ

SOUTH NICHOLS GRADING PROJECT
SOUTH OF NICHOLS ROAD, EAST OF I-15, LAKE ELSINORE, CA

Job No. 16164-3

Enclosure B-8a

# EXPLORATORY BORING NO. 8

Date Drilled: 4/15/16

Client: Nichols Road Partners

Equipment: CME75 Track Rig

Driving Weight / Drop / Sampler Size: 140lbs./30in./2.0" O.D.

Surface Elevation(ft): 1310

Logged by: GA

Measured Depth to Water(ft): N/A

| DEPTH (ft) | VISUAL CLASSIFICATION | REMARKS | SAMPLES: DRIVE | SAMPLES: BULK | BLOWS/6 IN. | FIELD MOISTURE (%) | DRY UNIT WT. (pcf) | LAB/FIELD TESTS |
|---|---|---|---|---|---|---|---|---|
| | (SP-SM) Sand, fine to coarse, with silt, | Interbedded Sand and Silt Hard Drilling | X | | 14<br>12<br>17 | 11.6 | | Pass #200, SPT |
| | (ML) Sandy Silt, fine to coarse, with clay, brown | | | | | | | |
| 40 | | | X | | 19<br>22<br>14 | | | Pass #200, SPT |
| 45 | | | X | | 9<br>11<br>23 | | | Pass #200, SPT |
| 50 | Metamorphic Bedrock, gray, weathered | | X | | 50 | 3.0 | | SPT |
| | END OF BORING | | | | | | | |
| | BEDROCK AT 50'<br>NO GROUNDWATER<br>NO CAVING, NO FILL | | | | | | | |
| 55 | | | | | | | | |
| 60 | | | | | | | | |
| 65 | | | | | | | | |

10331-3 16164-3.GPJ CHJ.GDT 5/4/16

CHJ

SOUTH NICHOLS GRADING PROJECT
SOUTH OF NICHOLS ROAD, EAST OF I-15, LAKE ELSINORE, CA

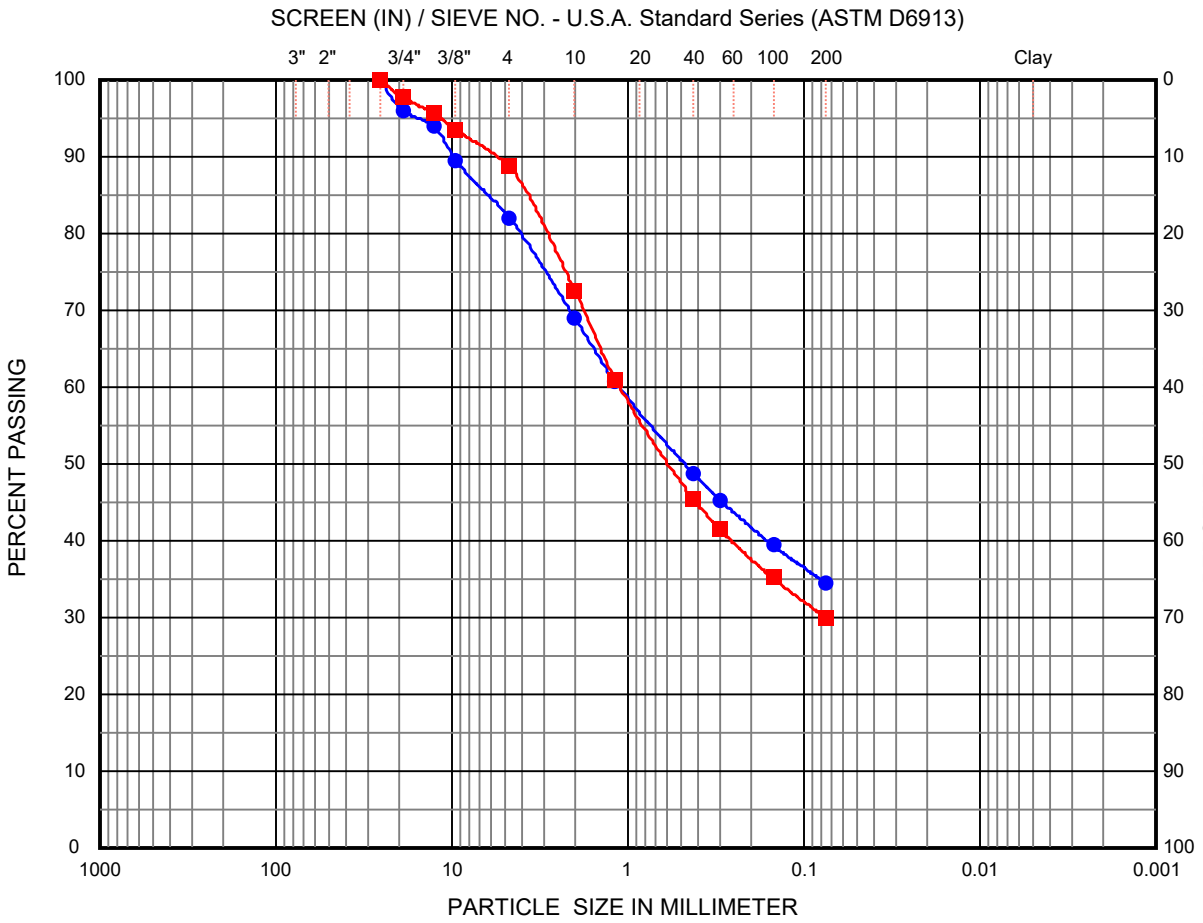
Job No. 16164-3

Enclosure B-8b

Previous Laboratory Test Results

# APPENDIX "C"

# LABORATORY TESTING




| Cobbles & Boulders | Gravel | | Sand | | | Silt | Clay |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | | |

| | Sample No. | Gravel | Sand | Fines | Clay | $D_{10}$ | $D_{30}$ | $D_{50}$ | $D_{60}$ | $C_u$ | $C_c$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ● | 1A+2A (3 - 7 ft) | 17.9 | 47.5 | 34.6 | | | 0.039 | 0.476 | 1.119 | | |
| | (SM) Silty sand with gravel | | | | | | | | | | |
| ■ | 3B+4B+6A+7A+8A (2 - 12 ft) | 11.3 | 58.7 | 30.0 | | | 0.075 | 0.593 | 1.116 | | |
| | (SM) Silty sand, fine to coarse with gravel | | | | | | | | | | |

**PARTICLE SIZE DISTRIBUTION (ASTM D6913)**

| | | | | | |
|---|---|---|---|---|---|
| Project: | Proposed South Nichols Grading Project | | | | |
| Location: | South of Nichols Road, East of Interstate 15, Lake Elsinore, California | | | | |
| Job Number: | 16164-3 | Engineer: | fy | Enclosure: | C-1 |

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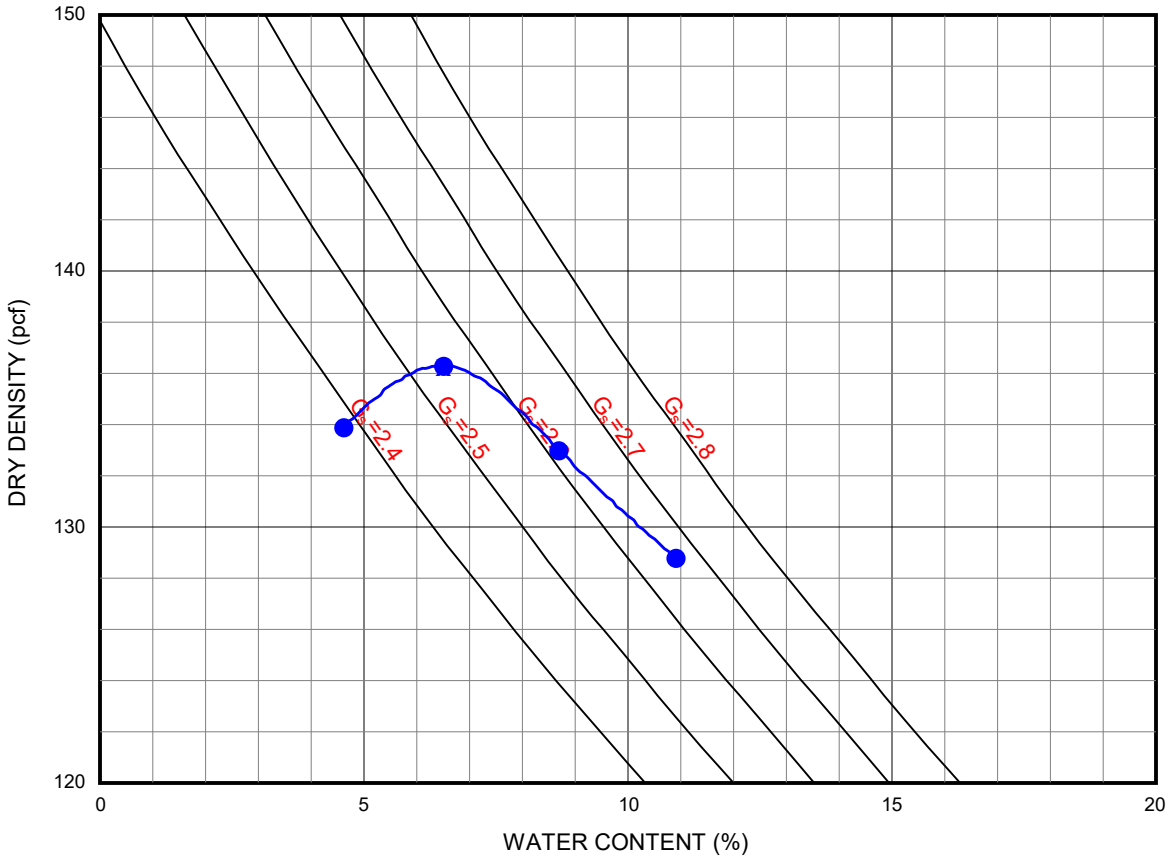


| | Sample No. | USCS Classification | $\gamma_{dmax}$ (pcf) | $w_o$ (%) |
|---|---|---|---|---|
| ● | 3B+4B+6A+7A+8A (2 - 12 ft) | (SM) Silty sand, fine to coarse with gravel | 136.0 | 6.5 |

## COMPACTION CURVES (ASTM D1557)

| | | | | | |
|---|---|---|---|---|---|
| Project: | Proposed South Nichols Grading Project | | | | |
| Location: | South of Nichols Road, East of Interstate 15, Lake Elsinore, California | | | | |
| Job Number: | 16164-3 | Engineer: | fy | Enclosure: | C-2 |

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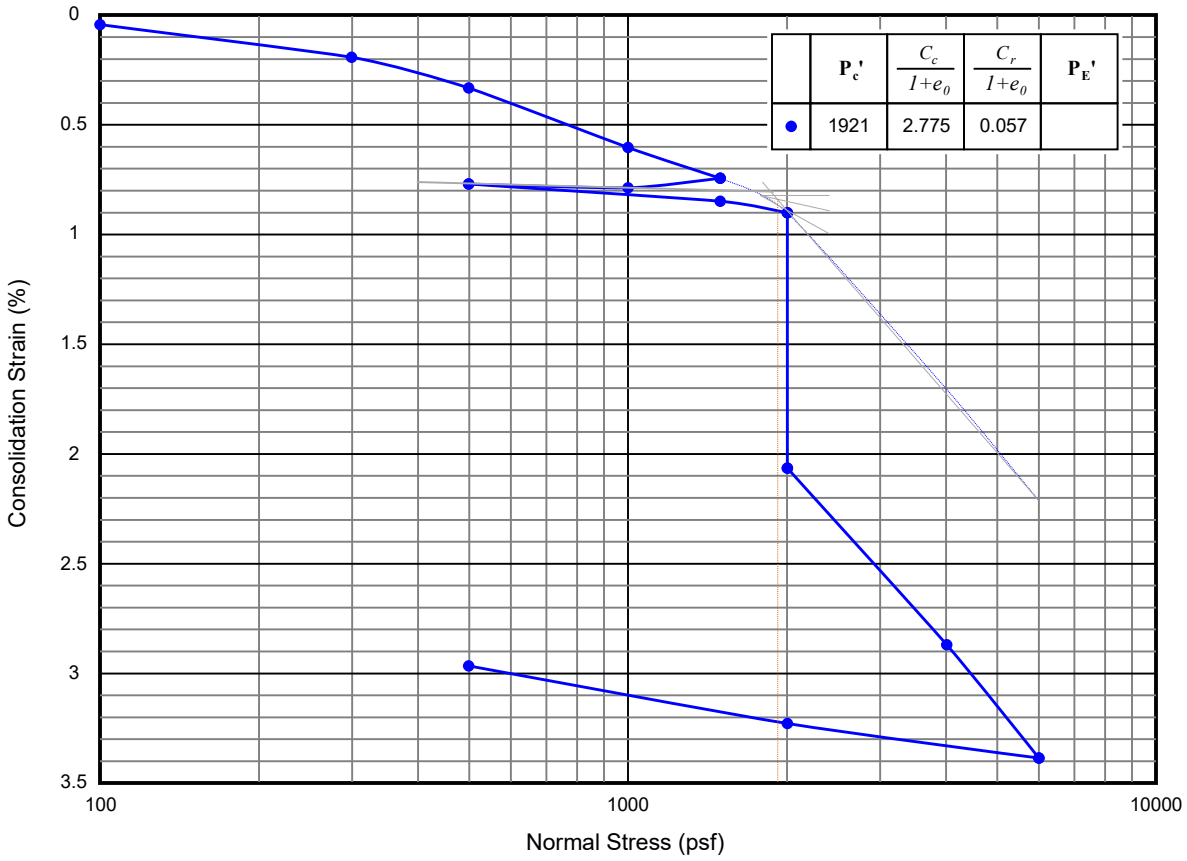


| | Boring No. | Depth (ft) | USCS Classification | $\gamma_d$ (pcf) | w (%) | HCS (%) |
|---|---|---|---|---|---|---|
| ● | 3 | 5 | (SM) Silty sand, fine to coarse | 110.9 | 4.7 | 1.2 |

**CONSOLIDATION TESTS (ASTM D2435/4546)**

| | | | | | |
|---|---|---|---|---|---|
| Project: | Proposed South Nichols Grading Project | | | | |
| Location: | South of Nichols Road, East of Interstate 15, Lake Elsinore, California | | | | |
| Job Number: | 16164-3 | Engineer: | fy | Enclosure: | C-3 |

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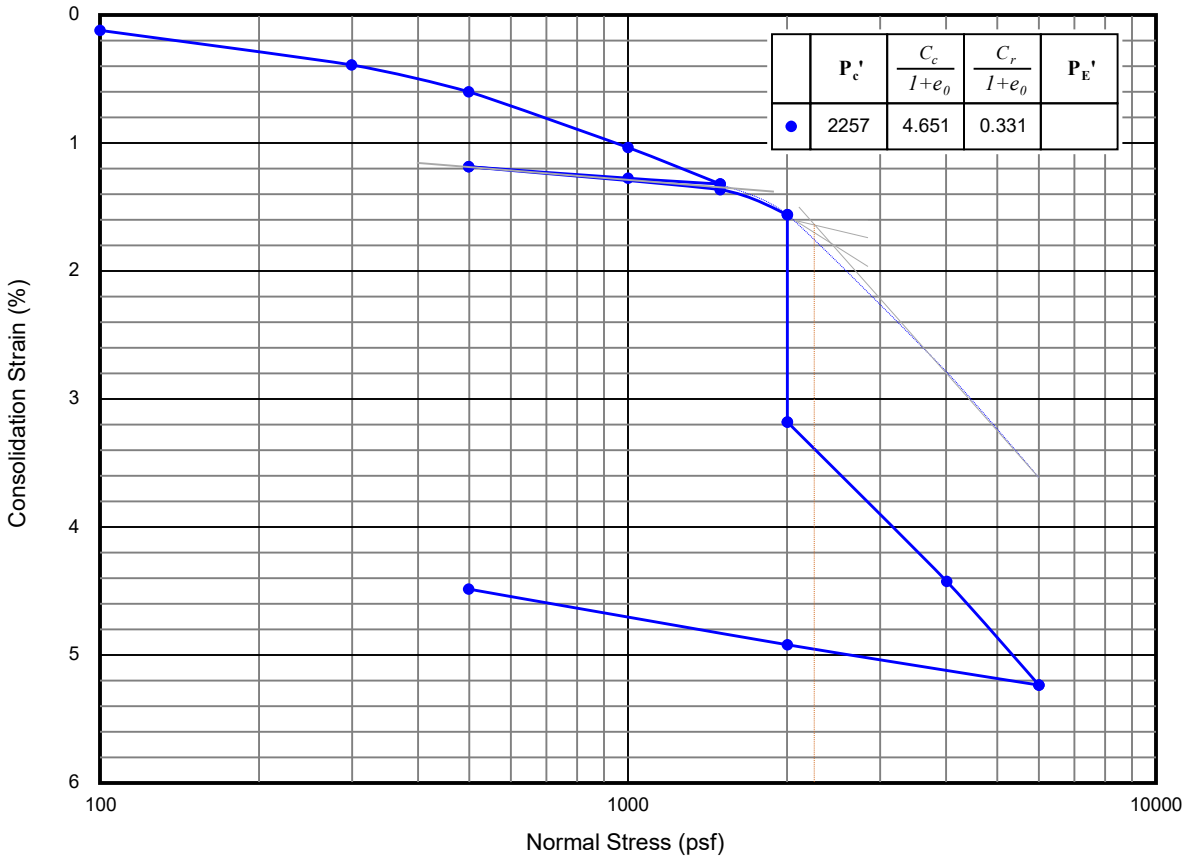


| | Boring No. | Depth (ft) | USCS Classification | $\gamma_d$ (pcf) | w (%) | HCS (%) |
|---|---|---|---|---|---|---|
| ● | 4 | 10 | (SM) Silty sand, fine to coarse | 113.5 | 6.3 | 1.6 |

**CONSOLIDATION TESTS (ASTM D2435/4546)**

| | | | | | |
|---|---|---|---|---|---|
| Project: | Proposed South Nichols Grading Project | | | | |
| Location: | South of Nichols Road, East of Interstate 15, Lake Elsinore, California | | | | |
| Job Number: | 16164-3 | Engineer: | fy | Enclosure: | C-4 |

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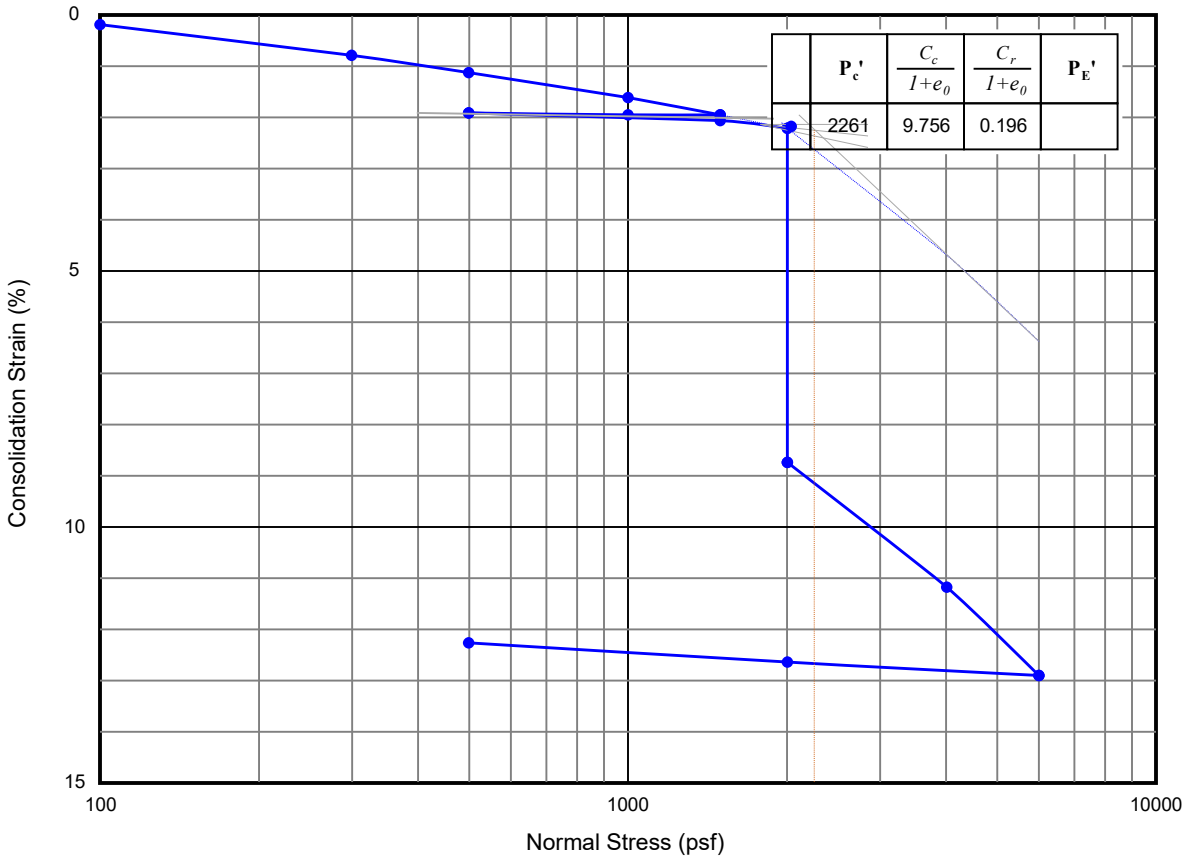


| | Boring No. | Depth (ft) | USCS Classification | $\gamma_d$ (pcf) | w (%) | HCS (%) |
|---|---|---|---|---|---|---|
| ● | 6 | 1 | (SM) Silty sand, fine with medium to coarse | 97.0 | 4.6 | 6.5 |

**CONSOLIDATION TESTS (ASTM D2435/4546)**

| | | | | | |
|---|---|---|---|---|---|
| Project: | Proposed South Nichols Grading Project | | | | |
| Location: | South of Nichols Road, East of Interstate 15, Lake Elsinore, California | | | | |
| Job Number: | 16164-3 | Engineer: | fy | Enclosure: | C-5 |

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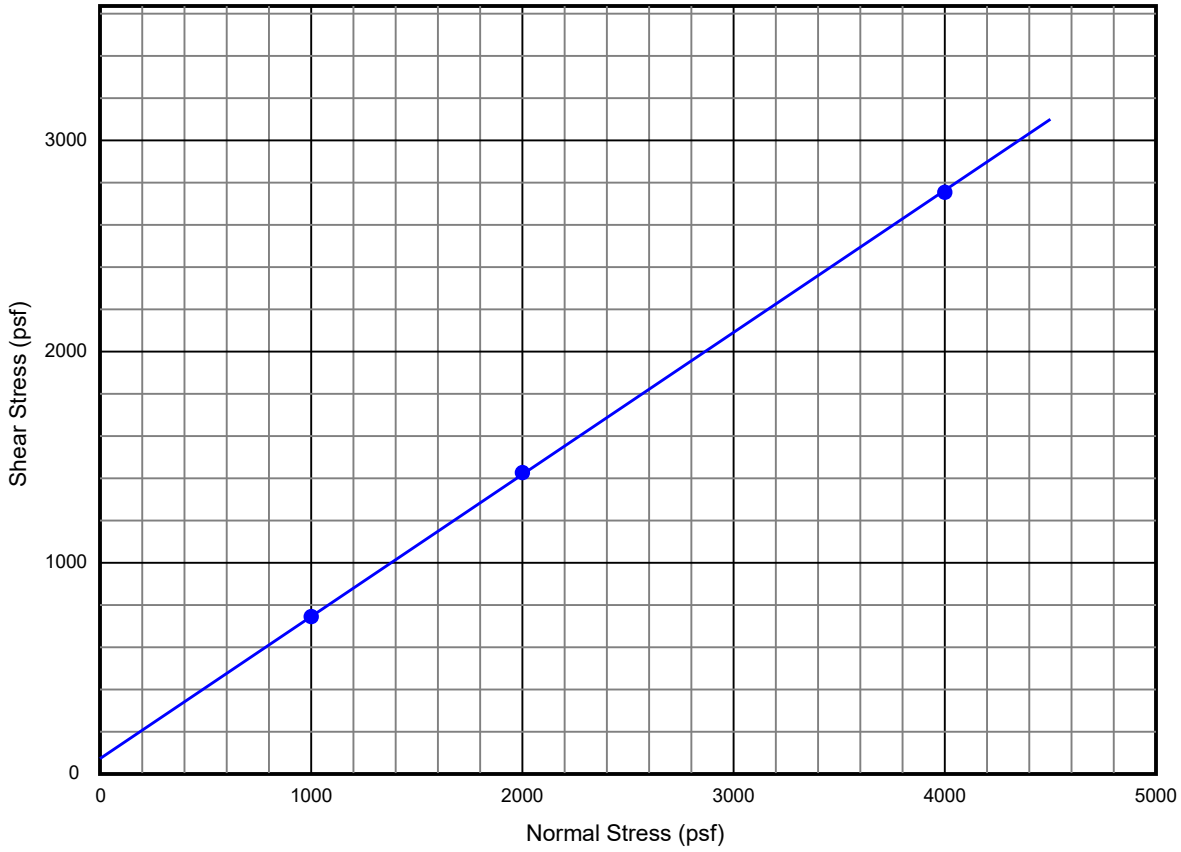


| | Sample No. | $\gamma_d$ (pcf) | w (%) | $C_{pk}$ (psf) | $\phi_{pk}$ (°) | $C_{rs}$ (psf) | $\phi_{rs}$ (°) |
|---|---|---|---|---|---|---|---|
| ● | 3B+4B+6A+7A+8A (2 - 12 ft) | 123.3 | 7.5 | 91.4 | 33.8 | 77.2 | 33.9 |
| | (SM) Silty sand, fine to coarse with gravel / Remolded (RC=90%) | | | | | | |

**DIRECT SHEAR TESTS (ASTM D3080)**

| | | | | | |
|---|---|---|---|---|---|
| Project: | Proposed South Nichols Grading Project | | | | |
| Location: | South of Nichols Road, East of Interstate 15, Lake Elsinore, California | | | | |
| Job Number: | 16164-3 | Engineer: | fy | Enclosure: | C-6 |

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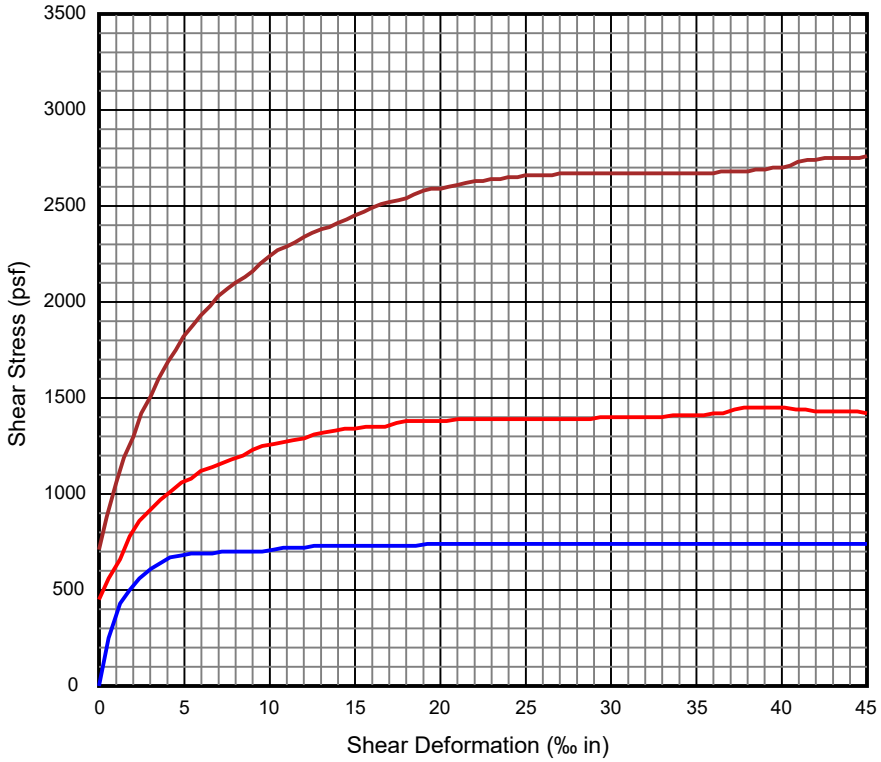


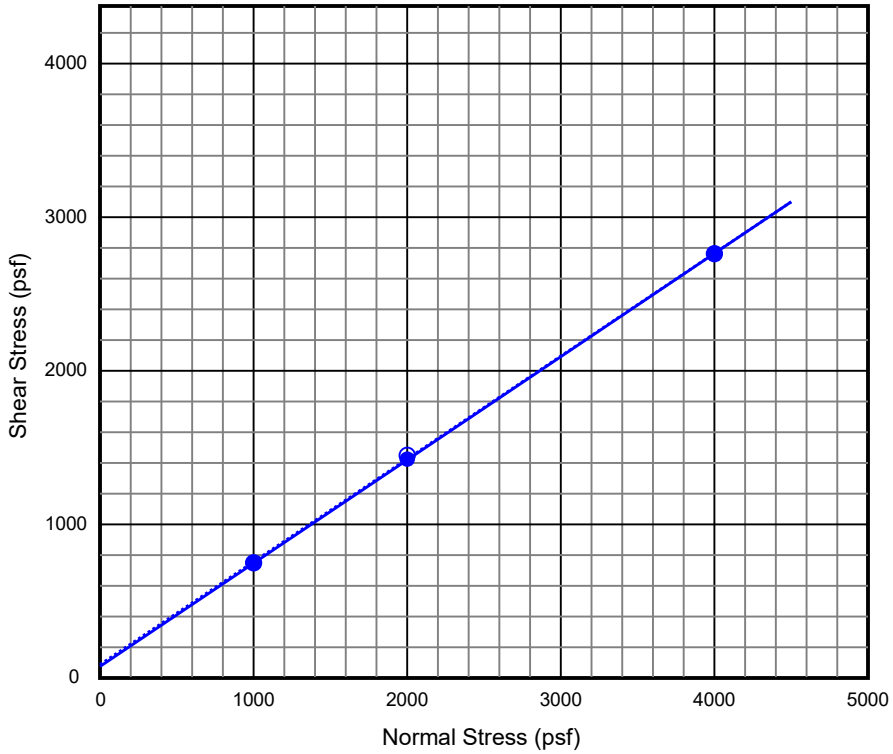


| | Sample No. | USCS | $\gamma_d$ (pcf) | w (%) | $C_{pk}$ (psf) | $\phi_{pk}$ (°) | $C_{rs}$ (psf) | $\phi_{rs}$ (°) |
|---|---|---|---|---|---|---|---|---|
| ● | 3B+4B+6A+7A+8A (2 - 12 ft) | (SM) Silty sand, fine to coarse with gravel / Remolded (RC=90%) | 123.3 | 7.5 | 91.4 | 33.8 | 77.2 | 33.9 |

CHJ Consultants

**DIRECT SHEAR TESTS (ASTM D3080)**

| | | | | | |
|---|---|---|---|---|---|
| Project: | Proposed South Nichols Grading Project | | | | |
| Location: | South of Nichols Road, East of Interstate 15, Lake Elsinore, California | | | | |
| Job Number: | 16164-3 | Engineer: | fy | Enclosure: | C-7 |

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## FINES CONTENT (ASTM D1140)

| Boring No. | 3 | 3 | 3 | 3 | 3 | 3 | 6 | 6 |
|---|---|---|---|---|---|---|---|---|
| Depth (ft) | 10 - 15 | 15 - 25 | 25 - 30 | 30 - 35 | 35 - 45 | 45 - 55 | 5 - 12 | 12 - 30 |
| Original Dry Mass | 195.3 | 200.3 | 210.6 | 200.6 | 202.2 | 200.4 | 217.7 | 206.4 |
| Dry Mass after Washing | 137.9 | 164.7 | 190.3 | 143.4 | 127.8 | 119.7 | 198.2 | 143.5 |
| Fine Contents (%) | 29.4 | 17.8 | 9.6 | 28.5 | 36.8 | 40.3 | 9.0 | 30.5 |
| Classification | SM | SM | SP-SM | SM | SM | SM | SP-SM | SM |
| Boring No. | 6 | 7 | 7 | 8 | 8 | 8 | 8 | 8 |
| Depth (ft) | 30 - 35 | 5 - 10 | 10 - 14 | 0 - 5 | 5 - 17 | 17 - 30 | 30 - 35 | 37 - 50 |
| Original Dry Mass | 196.9 | 210.7 | 227 | 209.7 | 196.6 | 189.8 | 187.3 | 176.3 |
| Dry Mass after Washing | 110.7 | 139.2 | 205.5 | 127.7 | 149.9 | 119.7 | 125.8 | 77.8 |
| Fine Contents (%) | 43.8 | 33.9 | 9.5 | 39.1 | 23.8 | 36.9 | 32.8 | 55.9 |
| Classification | SC | SM | SP-SM | SM | SM | SM | SM | ML |

## CONSOLIDATION TESTS (ASTM D2435/4546)

| Boring No. | Depth (ft) | USCS | $\gamma_d$ (pcf) | w (%) | Pc' (psf) |
|---|---|---|---|---|---|
| 3 | 5 | | 110.9 | 4.7 | 1921 |
| 4 | 10 | | 113.5 | 6.3 | 2257 |
| 6 | 1 | | 97.0 | 4.6 | 2261 |
| **Boring No.** | **$C_c/(1+e_0)$(%)** | **$C_r/(1+e_0)$(%)** | **PE' (psf)** | **HCS (%)** | |
| 3 | 2.775 | 0.057 | | 1.2 | |
| 4 | 4.651 | 0.331 | | 1.6 | |
| 6 | 9.756 | 0.196 | | 6.5 | |

## DIRECT SHEAR TESTS (ASTM D3080)

| Sample No. | Depth (ft) | USCS | $\gamma_d$ (pcf) | w (%) | $C_{pk}$ (psf) | $\phi_{pk}$ (°) | $C_{rs}$ (psf) | $\phi_{rs}$ (°) |
|---|---|---|---|---|---|---|---|---|
| 3B+4B+6A+7A+8A | 2 - 12 | SM | 123.3 | 7.5 | 91.4 | 33.8 | 77.2 | 33.9 |

## COMPACTION CURVES (ASTM D1557)

| Sample No. | Depth (ft) | USCS | $\gamma_{dmax}$ (pcf) | $w_o$ (%) |
|---|---|---|---|---|
| 3B+4B+6A+7A+8A | 2 - 12 | SM | 136.0 | 6.5 |

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**TEST DATA SUMMARY**

| | | | | | |
|---|---|---|---|---|---|
| Project: | Proposed South Nichols Grading Project | | | | |
| Location: | South of Nichols Road, East of Interstate 15, Lake Elsinore, California | | | | |
| Job Number: | 16164-3 | Engineer: | fy | Enclosure: | C-8 |

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# Table 1 - Laboratory Tests on Soil Samples

***CHJ Consultants***
***South Nichols Grading***
***Your #16164-3, HDR Lab #16-0304LAB***
***22-Apr-16***

| Sample ID | | | 3B+4B+6A+ 7A+8A |
|---|---|---|---|
| **Resistivity** | | **Units** | |
| as-received | | ohm-cm | 34,400 |
| saturated | | ohm-cm | 6,400 |
| **pH** | | | 6.5 |
| **Electrical Conductivity** | | mS/cm | 0.03 |
| **Chemical Analyses** | | | |
| **Cations** | | | |
| calcium | $Ca^{2+}$ | mg/kg | 12 |
| magnesium | $Mg^{2+}$ | mg/kg | 7.2 |
| sodium | $Na^{1+}$ | mg/kg | 24 |
| potassium | $K^{1+}$ | mg/kg | 4.7 |
| **Anions** | | | |
| carbonate | $CO_3^{2-}$ | mg/kg | ND |
| bicarbonate | $HCO_3^{1-}$ | mg/kg | 79 |
| fluoride | $F^{1-}$ | mg/kg | 0.8 |
| chloride | $Cl^{1-}$ | mg/kg | ND |
| sulfate | $SO_4^{2-}$ | mg/kg | 8.8 |
| phosphate | $PO_4^{3-}$ | mg/kg | 6.6 |
| **Other Tests** | | | |
| ammonium | $NH_4^{1+}$ | mg/kg | ND |
| nitrate | $NO_3^{1-}$ | mg/kg | 17 |
| sulfide | $S^{2-}$ | qual | na |
| Redox | | mV | na |

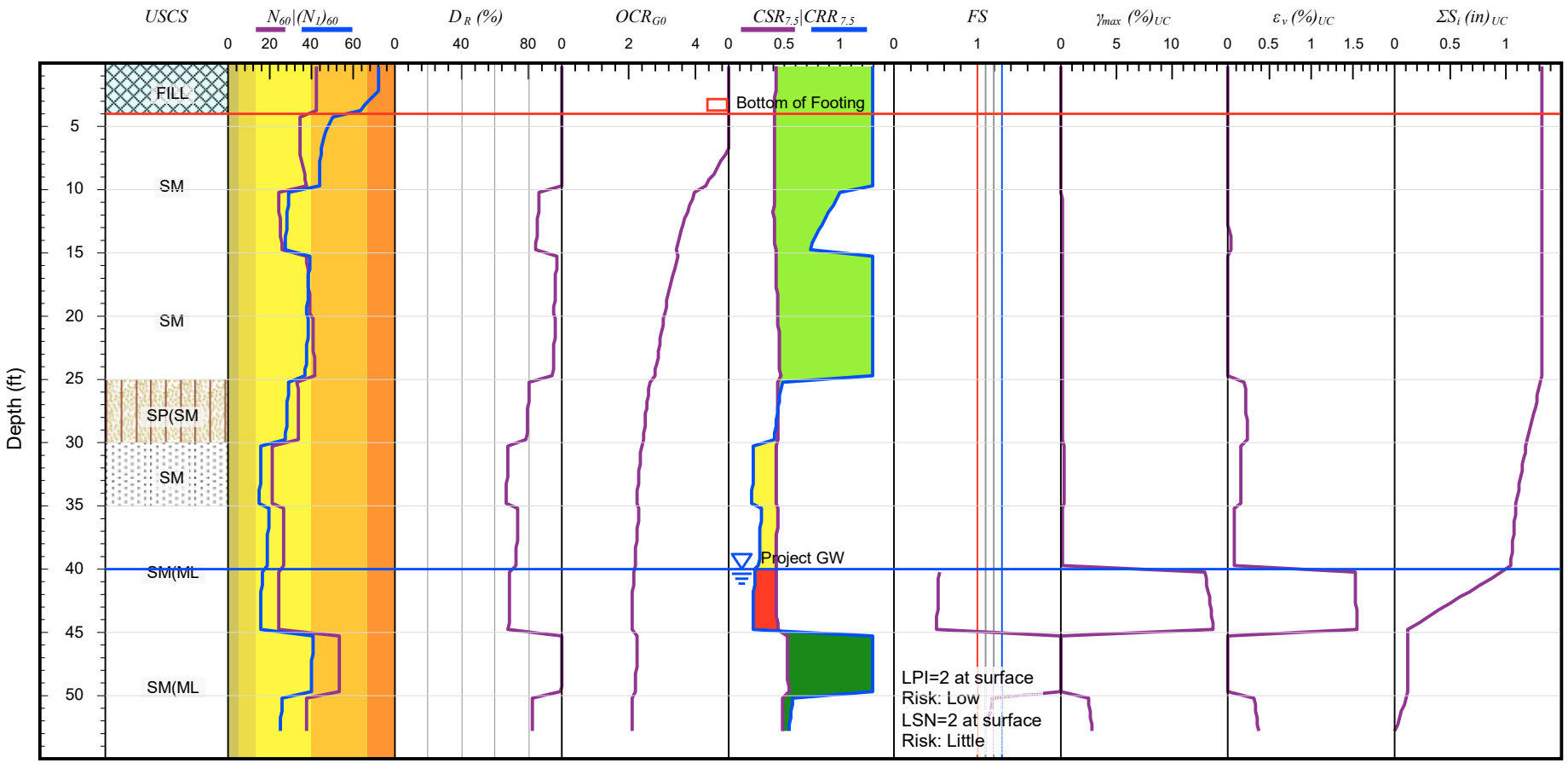
Resistivity per ASTM G187, Cations per ASTM D6919, Anions per ASTM D4327, and Alkalinity per APHA 2320-B.
Electrical conductivity in millisiemens/cm and chemical analyses were made on a 1:5 soil-to-water extract.
mg/kg = milligrams per kilogram (parts per million) of dry soil.
Redox = oxidation-reduction potential in millivolts
ND = not detected
na = not analyzed

431 West Baseline Road · Claremont, CA 91711
Phone: 909.962.5485 · Fax: 909.626.3316

Previous Geotechnical Calculations

# APPENDIX "D"

# GEOTECHNICAL CALCULATIONS




FILL
SP(SM
SM
SM(ML

Earthquake & Groundwater Information:
Magnitude = 6.77
Max. Acceleration = 0.865 g
Project GW = 40 ft
Maximum Settlement = 1.33 in
Settlement at Bottom of Footing = 1.33 in

Liquefaction: Idriss & Boulanger (2008)
Settl.: [dry] UCLA (2008(14); [sat] Idriss & Boulanger (2008)
Lateral spreading: Idriss & Boulanger (2008)
M correction: [Sand] Boulanger & Idriss(2004)
σv correction: Idriss & Boulanger (2008)
Stress reduction: Idriss & Boulanger (2008)

CHJ Consultants

## Seismic Settlement Potential - SPT Data

| | | | | | |
|---|---|---|---|---|---|
| Project: | Proposed South Nichols Grading Project | | | | |
| Location: | South of Nichols Road, East of Interstate 15, Lake Elsinore, California | | | | |
| Job Number: | 16164(3 | Boring No.: | B(3 | Enclosure: | D(1 |

G:\2016\16164-3 Nichols Rd Partners - S Nichols Grading - Lk Elsinore\Liqu\GeoSuite_16164-3_B-3.csv

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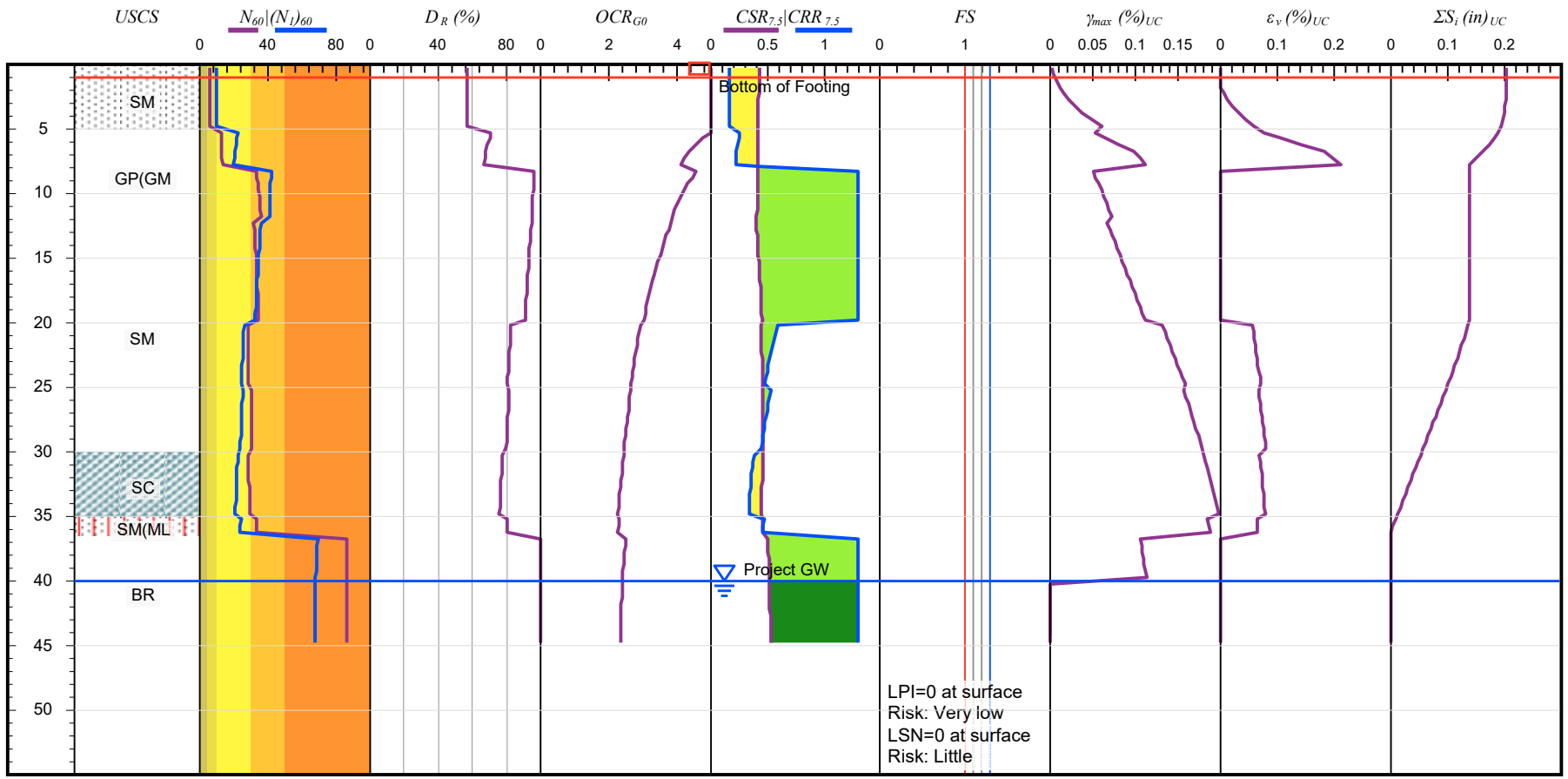


SM SC BR

GP(GM SM(ML

Earthquake & Groundwater Information:
Magnitude = 6.77
Max. Acceleration = 0.865 g
Project GW = 40 ft
Maximum Settlement = 0.20 in
Settlement at Bottom of Footing = 0.20 in

Liquefaction: Idriss & Boulanger (2008)
Settl.: [dry] UCLA (2008(14); [sat] Idriss & Boulanger (2008)
Lateral spreading: Idriss & Boulanger (2008)
M correction: [Sand] Boulanger & Idriss(2004)
σv correction: Idriss & Boulanger (2008)
Stress reduction: Idriss & Boulanger (2008)

CHJ Consultants

## Seismic Settlement Potential - SPT Data

| | | | | | |
|---|---|---|---|---|---|
| Project: | Proposed South Nichols Grading Project | | | | |
| Location: | South of Nichols Road, East of Interstate 15, Lake Elsinore, California | | | | |
| Job Number: | 16164(3 | Boring No.: | B(6 | Enclosure: | D(2 |

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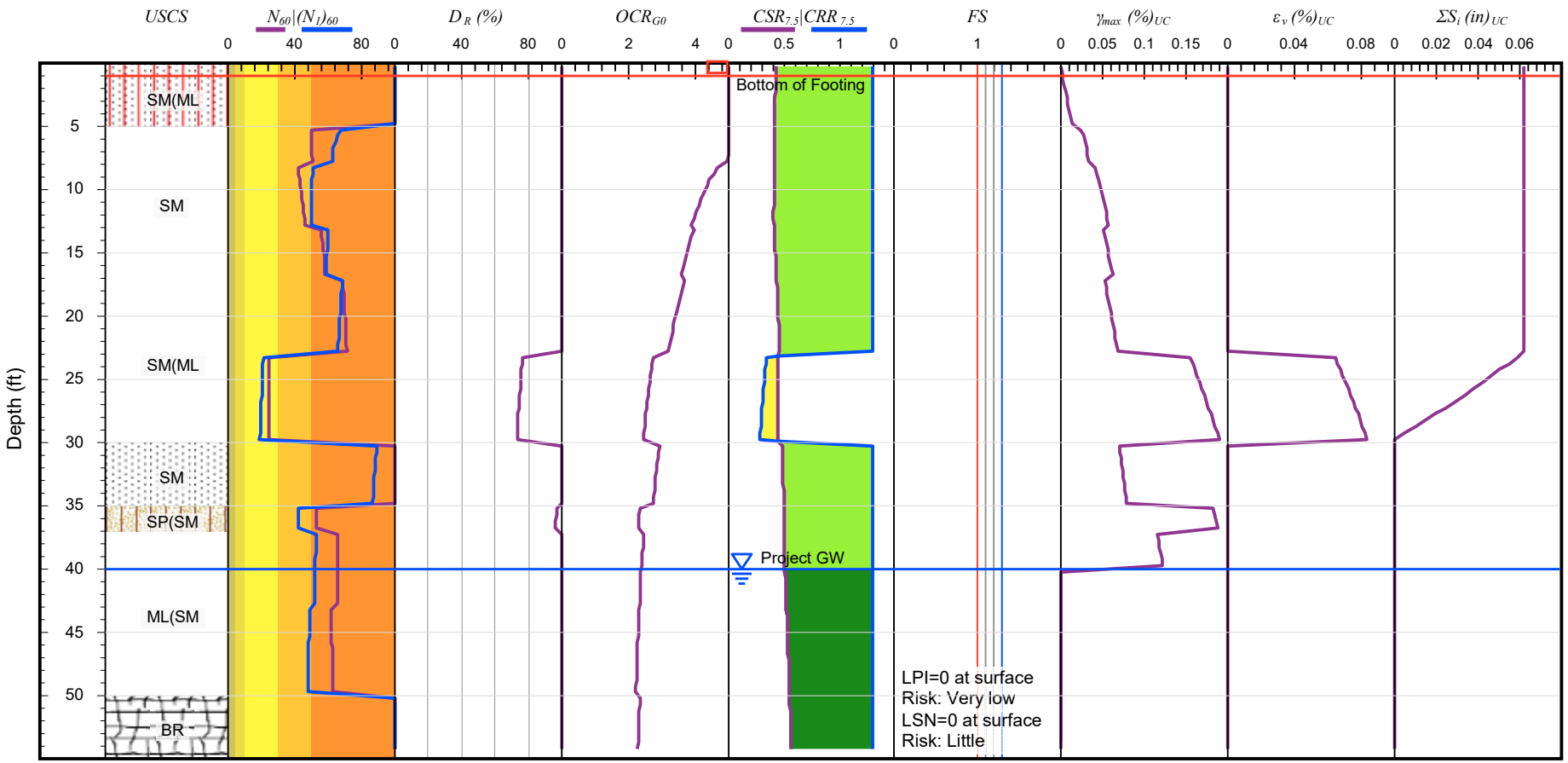


SM(ML SP(SM BR

SM ML(SM

Earthquake & Groundwater Information:
Magnitude = 6.77
Max. Acceleration = 0.865 g
Project GW = 40 ft
Maximum Settlement = 0.06 in
Settlement at Bottom of Footing = 0.06 in

Liquefaction: Idriss & Boulanger (2008)
Settl.: [dry] UCLA (2008(14); [sat] Idriss & Boulanger (2008)
Lateral spreading: Idriss & Boulanger (2008)
M correction: [Sand] Boulanger & Idriss(2004)
σv correction: Idriss & Boulanger (2008)
Stress reduction: Idriss & Boulanger (2008)

CHJ Consultants

## Seismic Settlement Potential - SPT Data

| | | | | | |
|---|---|---|---|---|---|
| Project: | Proposed South Nichols Grading Project | | | | |
| Location: | South of Nichols Road, East of Interstate 15, Lake Elsinore, California | | | | |
| Job Number: | 16164(3 | Boring No.: | B(8 | Enclosure: | D(3 |

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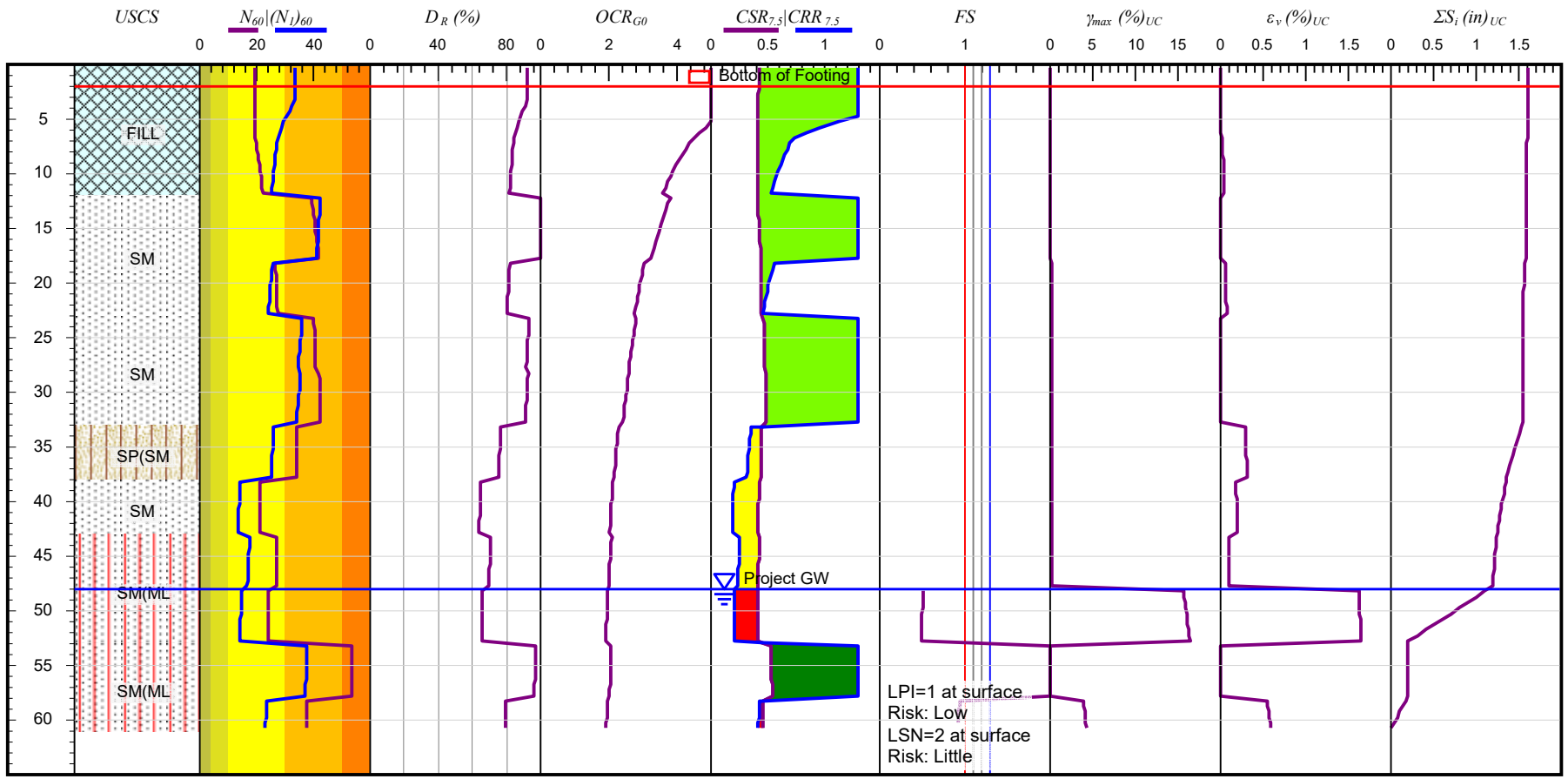


FILL
SP(SM
SM
SM(ML

Earthquake & Groundwater Information:
Magnitude = 6.77
Max. Acceleration = 0.865 g
Project GW = 48 ft
Maximum Settlement = 1.60 in
Settlement at Bottom of Footing = 1.60 in

Liquefaction: Idriss & Boulanger (2008)
Settl.: [dry] UCLA (2008(14); [sat] Idriss & Boulanger (2008)
Lateral spreading: Idriss & Boulanger (2008)
M correction: [Sand] Boulanger & Idriss(2004)
σv correction: Idriss & Boulanger (2008)
Stress reduction: Idriss & Boulanger (2008)

CHJ Consultants

## Seismic Settlement Potential - SPT Data

| | | | | | |
|---|---|---|---|---|---|
| Project: | Proposed South Nichols Grading Project | | | | |
| Location: | South of Nichols Road, East of Interstate 15, Lake Elsinore, California | | | | |
| Job Number: | 16164(3 | Boring No.: | B(3 (Post Grading) | Enclosure: | D(4 |

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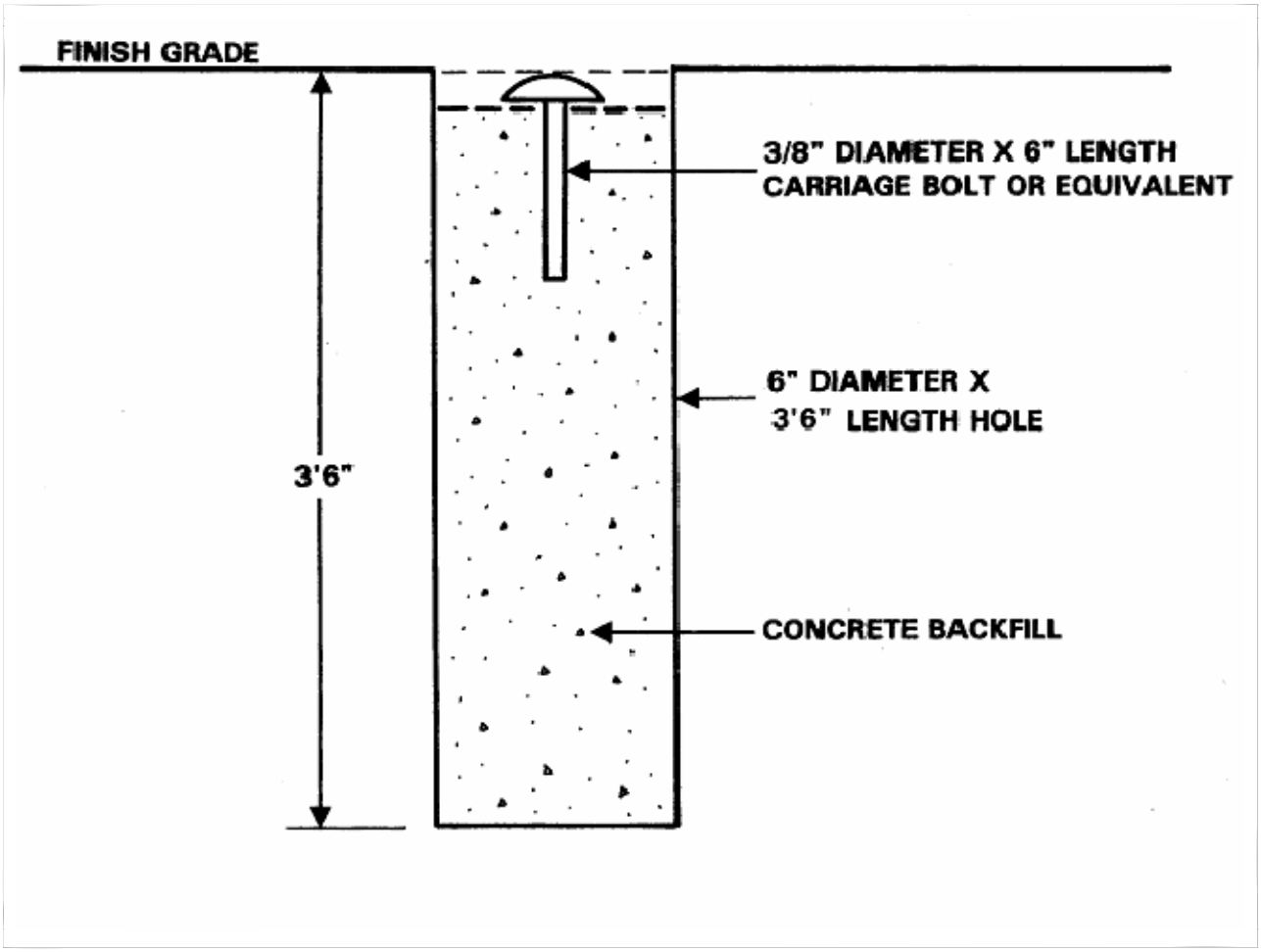
Geotechnical Details

# APPENDIX "E"

# GEOTECHNICAL DETAILS




# SETTLEMENT MONUMENT DETAIL

| | | |
|---|---|---|
| FOR: NICHOLS ROAD PARTNERS | GEOTECHNICAL INVESTIGATION<br>PROPOSED SOUTH NICHOLS GRADING PROJECT<br>SOUTH OF NICHOLS ROAD, EAST OF INTERSTATE 15<br>LAKE ELSINORE, CALIFORNIA | ENCLOSURE "E-1" |
| DATE: MAY 2016 | | JOB NUMBER 16164-3 |

CHJ Consultants

# SUPPORTING INFORMATION

# GENERAL NOTES

## DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

**Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA ■ , 1/23/2018 ■ Terracon Project No. CB175281**

Terracon GeoReport

### SAMPLING

- Auger Cuttings
- Modified California Ring Sampler
- Standard Penetration Test

### WATER LEVEL

- **Water Initially Encountered**
- **Water Level After a Specified Period of Time**
- **Water Level After a Specified Period of Time**

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

### FIELD TESTS

| | |
|---|---|
| **N** | **Standard Penetration Test Resistance (Blows/Ft.)** |
| **(HP)** | **Hand Penetrometer** |
| **(T)** | **Torvane** |
| **(DCP)** | **Dynamic Cone Penetrometer** |
| **UC** | **Unconfined Compressive Strength** |
| **(PID)** | **Photo-Ionization Detector** |
| **(OVA)** | **Organic Vapor Analyzer** |

### DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

### LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

### STRENGTH TERMS

| RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance | | | CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance | | | | BEDROCK | | |
|---|---|---|---|---|---|---|---|---|---|
| **Descriptive Term (Density)** | **Standard Penetration or N-Value Blows/Ft.** | **Ring Sampler Blows/Ft.** | **Descriptive Term (Consistency)** | **Unconfined Compressive Strength Qu, (tsf)** | **Standard Penetration or N-Value Blows/Ft.** | **Ring Sampler Blows/Ft.** | **Ring Sampler Blows/Ft.** | **Standard Penetration or N-Value Blows/Ft.** | **Descriptive Term (Consistency)** |
| Very Loose | 0 - 3 | 0 - 6 | Very Soft | less than 0.25 | | < 3 | < 30 | < 20 | Weathered |
| Loose | 4 - 9 | 7 - 18 | Soft | 0.25 to 0.50 | 2 - 4 | 3 - 4 | 30 - 49 | 20 - 29 | Firm |
| Medium Dense | 10 - 29 | 19 - 58 | Medium Stiff | 0.50 to 1.00 | | 5 - 9 | 50 - 89 | 30 - 49 | Medium Hard |
| Dense | 30 - 50 | 59 - 98 | Stiff | 1.00 to 2.00 | 8 - 15 | 10 - 18 | 90 - 119 | 50 - 79 | Hard |
| Very Dense | > 50 | ≥ 99 | Very Stiff | 2.00 to 4.00 | 15 - 30 | 19 - 42 | > 119 | >79 | Very Hard |
| | | | Hard | > 4.00 | > 30 | > 42 | | | |

| RELATIVE PROPORTIONS OF SAND AND GRAVEL | | RELATIVE PROPORTIONS OF FINES | |
|---|---|---|---|
| **Descriptive Term(s) of other constituents** | Percent of Dry Weight | **Descriptive Term(s) of other constituents** | **Percent of Dry Weight** |
| Trace | <15 | Trace | <5 |
| With | 15-29 | With | 5-12 |
| Modifier | >30 | Modifier | >12 |

| GRAIN SIZE TERMINOLOGY | | PLASTICITY DESCRIPTION | |
|---|---|---|---|
| **Major Component of Sample** | **Particle Size** | **Term** | **Plasticity Index** |
| Boulders | Over 12 in. (300 mm) | Non-plastic | 0 |
| Cobbles | 12 in. to 3 in. (300mm to 75mm) | Low | 1 - 10 |
| Gravel | 3 in. to #4 sieve (75mm to 4.75 mm) | Medium | 11 - 30 |
| Sand | #4 to #200 sieve (4.75mm to 0.075mm | High | > 30 |
| Silt or Clay | Passing #200 sieve (0.075mm) | | |

# UNIFIED SOIL CLASSIFICATION SYSTEM

Tentative Tract No. 37305 ■ Lake Elsinore, California

February 2, 2018 ■ Terracon Project No. CB175281

| Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A] | | | | | Soil Classification | |
|---|---|---|---|---|---|---|
| | | | | | Group Symbol | Group Name [B] |
| **Coarse-Grained Soils:** More than 50% retained on No. 200 sieve | **Gravels:** More than 50% of coarse fraction retained on No. 4 sieve | **Clean Gravels:** Less than 5% fines [C] | Cu ≥ 4 and 1 ≤ Cc ≤ 3 [E] | | GW | Well-graded gravel [F] |
| | | | Cu < 4 and/or 1 > Cc > 3 [E] | | GP | Poorly graded gravel [F] |
| | | **Gravels with Fines:** More than 12% fines [C] | Fines classify as ML or MH | | GM | Silty gravel [F, G, H] |
| | | | Fines classify as CL or CH | | GC | Clayey gravel [F, G, H] |
| | **Sands:** 50% or more of coarse fraction passes No. 4 sieve | **Clean Sands:** Less than 5% fines [D] | Cu ≥ 6 and 1 ≤ Cc ≤ 3 [E] | | SW | Well-graded sand [I] |
| | | | Cu < 6 and/or 1 > Cc > 3 [E] | | SP | Poorly graded sand [I] |
| | | **Sands with Fines:** More than 12% fines [D] | Fines classify as ML or MH | | SM | Silty sand [G, H, I] |
| | | | Fines classify as CL or CH | | SC | Clayey sand [G, H, I] |
| **Fine-Grained Soils:** 50% or more passes the No. 200 sieve | **Silts and Clays:** Liquid limit less than 50 | **Inorganic:** | PI > 7 and plots on or above "A" | | CL | Lean clay [K, L, M] |
| | | | PI < 4 or plots below "A" line [J] | | ML | Silt [K, L, M] |
| | | **Organic:** | Liquid limit - oven dried / Liquid limit - not dried | < 0.75 | OL | Organic clay [K, L, M, N] / Organic silt [K, L, M, O] |
| | **Silts and Clays:** Liquid limit 50 or more | **Inorganic:** | PI plots on or above "A" line | | CH | Fat clay [K, L, M] |
| | | | PI plots below "A" line | | MH | Elastic Silt [K, L, M] |
| | | **Organic:** | Liquid limit - oven dried / Liquid limit - not dried | < 0.75 | OH | Organic clay [K, L, M, P] / Organic silt [K, L, M, Q] |
| **Highly organic soils:** | Primarily organic matter, dark in color, and organic odor | | | | PT | Peat |

[A] Based on the material passing the 3-inch (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

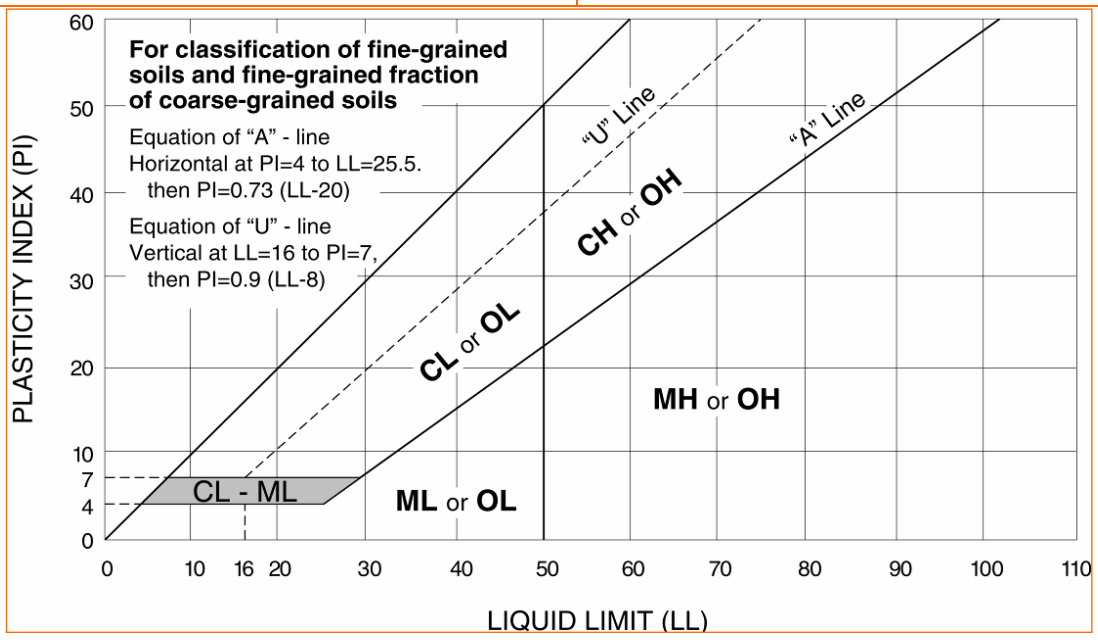
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



# Appendix 4: Historical Site Conditions

*Phase I Environmental Site Assessment or Other Information on Past Site Use*

# Phase I Environmental Site Assessment

**Tentative Tract No. 37305**

**South of Nichols Road and East of Interstate 15**

**APNS 389-200-037, 389-210-008, and 389-210-032**

**Lake Elsinore, Riverside County, California**

**December 27, 2017**

Terracon Project No. 60177386

**Prepared for:**

Nichols Road Partners
Corona, California

**Prepared by:**

Terracon Consultants, Inc.
Tustin, California

terracon.com

Terracon

Environmental • Facilities • Geotechnical • Materials

December 27, 2017

Nichols Road Partners
PO Box 77850
25555 Maitri Road
Corona, CA 92877

Attn: Todd Pendergrass
P: (951) 277-3900
E: tpendergrass@wernercorp.net

Re: Phase I Environmental Site Assessment
Tentative Tract No. 37305
South of Nichols Road and East of Interstate 15
APNs 389-200-037, 389-210-008, and 389-210-032
Lake Elsinore, Riverside County, California 92532
Terracon Project No. 60177386

Dear Mr. Pendergrass:

Terracon Consultants, Inc. (Terracon) is pleased to submit the enclosed Phase I Environmental Site Assessment (ESA) report for the above-referenced site. This assessment was performed in accordance with Terracon Proposal Number P60177386 dated, November 22, 2017.

We appreciate the opportunity to be of service to you on this project. In addition to Phase I services, our professionals provide geotechnical, environmental, construction materials, and facilities services on a wide variety of projects locally, regionally and nationally. For more detailed information on all of Terracon's services please visit our website at www.terracon.com. If there are any questions regarding this report or if we may be of further assistance, please do not hesitate to contact us.

Sincerely,
**Terracon Consultants, Inc.**

Jeremy R. Rosenthal
Field Scientist

Carl A Parten
Principal / Office Manager II

Attachments

## TABLE OF CONTENTS


**Page No.**

**EXECUTIVE SUMMARY ..... i**
Findings and Opinions ..... i
Significant Data Gaps ..... ii
Conclusions ..... ii
Recommendations ..... ii
**1.0 INTRODUCTION ..... 1**
1.1 Site Description ..... 1
1.2 Scope of Services ..... 1
1.3 Standard of Care ..... 2
1.4 Additional Scope Limitations, ASTM Deviations and Data Gaps ..... 2
1.5 Reliance ..... 3
1.6 Client Provided Information ..... 3
**2.0 PHYSICAL SETTING ..... 4**
**3.0 HISTORICAL USE INFORMATION ..... 5**
3.1 Historical Topographic Maps, Aerial Photographs, Sanborn Maps ..... 5
3.2 Historical City Directories ..... 6
3.3 Site Ownership ..... 7
3.4 Title Search ..... 7
3.5 Environmental Liens and Activity and Use Limitations ..... 7
3.6 Interviews Regarding Current and Historical Site Uses ..... 7
3.7 Prior Report Review ..... 8
**4.0 RECORDS REVIEW ..... 9**
4.1 Federal and State/Tribal Databases ..... 9
4.2 Local Agency Inquiries ..... 11
4.3 Local Area Knowledge ..... 12
**5.0 SITE RECONNAISSANCE ..... 12**
5.1 General Site Information ..... 12
5.2 Overview of Current Site Occupants and Operations ..... 13
5.3 Site Observations ..... 13
**6.0 ADJOINING PROPERTY RECONNAISSANCE ..... 16**
**7.0 ADDITIONAL SERVICES ..... 16**
**8.0 DECLARATION ..... 17**

## APPENDICES

APPENDIX A Exhibit 1 - Topographic Map, Exhibit 2 - Site Diagram

APPENDIX B Site Photographs

APPENDIX C Historical Documentation and User Questionnaire

APPENDIX D Environmental Database Information

APPENDIX E Credentials

APPENDIX F Description of Terms and Acronyms

# EXECUTIVE SUMMARY

This Phase I Environmental Site Assessment (ESA) was performed in accordance with Terracon Proposal Number P60177386 dated, November 22, 2017, and was conducted consistent with the procedures included in ASTM E1527-13, *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process*. The ESA was conducted under the supervision or responsible charge of Carl A. Parten, Environmental Professional. Jeremy R. Rosenthal and Carl A. Parten performed the site reconnaissance on December 12, 2017.

## Findings and Opinions

A summary of findings is provided below. It should be recognized that details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein.

Site Description and Use

The site is located adjacent to the south of Nichols Road and to the east of the Interstate-15 Nichols Road off ramp in Lake Elsinore, San Bernardino County, California. The site consists of approximately 68.7-acres of Assessor Parcel Numbers (APNs) 389-200-037, 389-210-008, and 389-210-032. At the time of the site reconnaissance, the area west of the wash was in the process of being mass graded. The area east of the wash was generally vacant and undeveloped with a moderate growth of weeds and natural vegetation. Overhead power lines crossed the site from the near the southeastern corner to a point along Nichols Road in the west-central portion of the site.

Historical Information

Based on a review of historical information, the site was vacant and undeveloped until approximately 1961 when a structure was developed on the southeast portion of the site. By the late-1960s, additional structures were developed on the southeast portion of the site and an apparent landing strip was developed on the southern portion of the site. By 1978, the landing strip was removed. By 2005, the structures on the southeast portion of the site were removed and site was utilized to stockpile topsoil from the adjacent gravel mining area. Based on the site reconnaissance conducted during this Phase I ESA, the north portion of the site has been filled and graded.

The properties surround the site consisted of undeveloped land from as early as 1901 through the mid-1960s, when several structures and an apparent landing strip were developed to the adjoining south. The apparent landing strip and structures to the adjoining south were removed by the late-1980s and grading operations for Temescal Canyon High School were underway. Additionally, the existing single-family residences were developed to the adjoining east of the site in the late-1980s. Development of Temescal Canyon High School to the adjoining south of the site was completed by the mid-2000s. By the late 2000's, Nichols Road Mine began operations

to the adjoining north. The properties surrounding the site have remained relatively unchanged through the present.

Records Review

Selected federal and state environmental regulatory databases as well as responses from state and local regulatory agencies were reviewed. The site was not identified in the regulatory databases. Documents related to the site were not provided by governmental agencies. Facilities identified within the specified search distances do not represent recognized environmental conditions (RECs).

Site Reconnaissance

At the time of site reconnaissance, remnants of an apparent cistern, one pole-mounted transformer, *de minimis* soil staining, dumped native fill dirt, construction/demolition debris, construction equipment tires, outcrop rock mixed with stock pile of on-site material, boulders, two chain-link fence enclosures with metal lock boxes, a box culvert, heavy construction vehicles, and overhead powerlines were observed. RECs were not observed with the on-site observations.

Adjoining Properties

Nichols Road abuts the site to the north followed by the Nichols Road Mine (active production of sand and gravel) and undeveloped land. El Toro Road and Wood Mesa Court abut the site to the east followed by single-family residences. The property to the adjoining south of the site consists of Intertate-15, Temescal Canyon High School, and undeveloped land. The property to the adjoining west of the site consist of a vacant parcel and the Nichols Road off-ramp from Interstate-15. RECs were not observed with the adjoining properties.

## Significant Data Gaps

Significant data gaps were not identified.

## Conclusions

We have performed a Phase I ESA consistent with the procedures included in ASTM Practice E1527-13 at South of Nichols Road East of Interstate 15, Lake Elsinore, Riverside County, California, the site. RECs or Controlled RECs (CREC) were not identified in connection with the site.

## Recommendations

Based on the scope of services, limitations, and conclusions of this assessment, Terracon did not identify RECs or CRECs. As such, no additional investigation is warranted at this time.

# 1.0 INTRODUCTION

## 1.1 Site Description

| | |
|---|---|
| **Site Name** | Tentative Tract No. 37305 |
| **Site Location/Address** | South of Nichols Road and East of Interstate-15 in Lake Elsinore, Riverside County, California. APNs 389-200-037, 389-210-008, and 389-210-032. |
| **Land Area** | The site consists of approximately 68.7-acres |
| **Site Improvements** | Mass grading in progress on site area west of wash |
| **Anticipated Future Site Use** | Redevelopment for mixed-use, commercial and residential |
| **Purpose of the ESA** | Permitting requirements for site redevelopment |

The location of the site is depicted on Exhibit 1 of Appendix A, which was reproduced from a portion of the USGS 7.5-minute series topographic map. The site and adjoining properties are depicted on the Site Diagram, which is included as Exhibit 2 of Appendix A. Acronyms and terms used in this report are described in Appendix F.

## 1.2 Scope of Services

This Phase I ESA was performed in accordance with Terracon Proposal Number P60177386 dated, November 22, 2017, and was conducted consistent with the procedures included in ASTM E1527-13, *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process*. The purpose of this ESA was to assist the client in developing information to identify RECs in connection with the site as reflected by the scope of this report. This purpose was undertaken through user-provided information, a regulatory database review, historical and physical records review, interviews, including local government inquiries, as applicable, and a visual noninvasive reconnaissance of the site and adjoining properties. Limitations, ASTM deviations, and significant data gaps (if identified) are noted in the applicable sections of the report.

ASTM E1527-13 contains a new definition of "migrate/migration," which refers to “the movement of hazardous substances or petroleum products in any form, including, for example, solid and liquid at the surface or subsurface, and vapor in the subsurface.” By including this explicit reference to migration in ASTM E1527-13, the Standard clarifies that the potential for vapor migration should be addressed as part of a Phase I ESA. This Phase I ESA has considered vapor migration in evaluation of RECs associated with the site.

## 1.3 Standard of Care

This ESA was performed in accordance with generally accepted practices of this profession, undertaken in similar studies at the same time and in the same geographical area. We have endeavored to meet this standard of care, but may be limited by conditions encountered during performance, a client-driven scope of work, or inability to review information not received by the report date. Where appropriate, these limitations are discussed in the text of the report, and an evaluation of their significance with respect to our findings has been conducted.

Phase I ESAs, such as the one performed at this site, are of limited scope, are noninvasive, and cannot eliminate the potential that hazardous, toxic, or petroleum substances are present or have been released at the site beyond what is identified by the limited scope of this ESA. In conducting the limited scope of services described herein, certain sources of information and public records were not reviewed. It should be recognized that environmental concerns may be documented in public records that were not reviewed. No ESA can wholly eliminate uncertainty regarding the potential for RECs in connection with a property. Performance of this practice is intended to reduce, but not eliminate, uncertainty regarding the potential for RECs. No warranties, express or implied, are intended or made. The limitations herein must be considered when the user of this report formulates opinions as to risks associated with the site or otherwise uses the report for any other purpose. These risks may be further evaluated – but not eliminated – through additional research or assessment. We will, upon request, advise you of additional research or assessment options that may be available and associated costs.

## 1.4 Additional Scope Limitations, ASTM Deviations and Data Gaps

Based upon the agreed-on scope of services, this ESA did not include subsurface or other invasive assessments, vapor intrusion assessments or indoor air quality assessments (i.e. evaluation of the presence of vapors within a building structure), business environmental risk evaluations, or other services not particularly identified and discussed herein. Credentials of the company (Statement of Qualifications) have not been included in this report but are available upon request. Pertinent documents are referred to in the text of this report, and a separate reference section has not been included. Reasonable attempts were made to obtain information within the scope and time constraints set forth by the client; however, in some instances, information requested is not, or was not, received by the issuance date of the report. Information obtained for this ESA was received from several sources that we believe to be reliable; nonetheless, the authenticity or reliability of these sources cannot and is not warranted hereunder. This ESA was further limited by the following:

- Terracon attempted to contact the local regulatory agencies in regards to records for the site. At the issuance of this report, a response from the Lake Elsinore City Clerk's Office and County of Riverside Building and Safety Department have not been received. Based on the available information, the absence of these responses do not constitute a significant data gap.

An evaluation of the significance of limitations and missing information with respect to our findings has been conducted, and where appropriate, significant data gaps are identified and discussed in the text of the report. However, it should be recognized that an evaluation of significant data gaps is based on the information available at the time of report issuance, and an evaluation of information received after the report issuance date may result in an alteration of our conclusions, recommendations, or opinions. We have no obligation to provide information obtained or discovered by us after the issuance date of the report, or to perform any additional services, regardless of whether the information would affect any conclusions, recommendations, or opinions in the report. This disclaimer specifically applies to any information that has not been provided by the client.

This report represents our service to you as of the report date and constitutes our final document; its text may not be altered after final issuance. Findings in this report are based upon the site's current utilization, information derived from the most recent reconnaissance and from other activities described herein; such information is subject to change. Certain indicators of the presence of hazardous substances or petroleum products may have been latent, inaccessible, unobservable, or not present during the most recent reconnaissance and may subsequently become observable (such as after site renovation or development). Further, these services are not to be construed as legal interpretation or advice.

## 1.5 Reliance

This ESA report is prepared for the exclusive use and reliance of Nichols Road Partners. Use or reliance by any other party is prohibited without the written authorization of Nichols Road Partners and Terracon Consultants, Inc. (Terracon).

Reliance on the ESA by the client and all authorized parties will be subject to the terms, conditions and limitations stated in the proposal, ESA report, and Terracon's Agreement. The limitation of liability defined in the Agreement is the aggregate limit of Terracon's liability to the client and all relying parties.

Continued viability of this report is subject to ASTM E1527-13 Sections 4.6 and 4.8. If the ESA will be used by a different user (third party) than the user for whom the ESA was originally prepared, the third party must also satisfy the user's responsibilities in Section 6 of ASTM E1527-13.

## 1.6 Client Provided Information

Prior to the site visit, Mr. Todd Pendergrass, client's representative, was asked to provide the following user questionnaire information as described in ASTM E1527-13 Section 6.

**Client Questionnaire Responses**

| Client Questionnaire Item | Client Did Not Respond | Client's Response | |
|---|---|---|---|
| | | Yes | No |
| Specialized Knowledge or Experience that is material to a REC in connection with the site. | | | X |
| Actual Knowledge of Environmental Liens or Activity Use Limitations (AULs) that may encumber the site. | | | X |
| Actual Knowledge of a Lower Purchase Price because contamination is known or believed to be present at the site. | | | X |
| Commonly Known or Reasonably Ascertainable Information that is material to a REC in connection with the site. | | | X |
| Obvious Indicators of Contamination at the site. | | | X |

Terracon's consideration of the client provided information did not identify RECs. A copy of the questionnaire is included in Appendix C.

## 2.0 PHYSICAL SETTING

| Physical Setting Information | | Source |
|---|---|---|
| **Topography** | | |
| Site Elevation | Approximately 1,330 feet above sea level | USGS Topographic Map, Lake Elsinore Quadrangle, Dated 2012 (Appendix A) |
| Topographic Gradient | Gently sloping towards the west and south | |
| Closest Surface Water | An unnamed intermittent stream abuts the site to the southeast. | |
| **Soil Characteristics** | | |
| Soil Type | Arbuckle, Garretson, Lodo, Cortina, Cieneba, Hanford, Escondido | Riverside County, CA USDA, Soil Conservation Services Soil, issued 2016 |
| Description | Soils include gravelly loam, gravelly very fine sandy loam, gravelly loamy sand, sandy loam, coarse sandy loam, and fine sandy loam | |
| **Geology/Hydrogeology** | | |
| Formation | Quaternary Deposits (Q) | Geologic Map of California, 2010 |
| Description | Young alluvial fan deposits; crystalline basement outcrops of metasedimentary rock and phyllite Mesozoic basement complex of | |

| Physical Setting Information | | Source |
|---|---|---|
| | undifferentiated metasedimentary rocks and fissile black phyllite mantled by Holocene and late Pleistocene alluvial fan deposits. | |
| Estimated Depth to First Occurrence of Groundwater | Groundwater was not encountered onsitein 8 borings 25 to 51 ½ feet below grade surface (bgs), perched groundwater may be seasonal and exist at the soil/bedrock contact. | CHJ Consultants, 2016 |
| *Hydrogeologic Gradient | Not known - may be inferred to be parallel to topographic gradient (primarily to the southwest). | |

* The groundwater flow direction and the depth to shallow, unconfined groundwater, if present, would likely vary depending upon seasonal variations in rainfall and other hydrogeological features. Without the benefit of on-site groundwater monitoring wells surveyed to a datum, groundwater depth and flow direction beneath the site cannot be directly ascertained.

# 3.0 HISTORICAL USE INFORMATION

Terracon reviewed the following historical sources to develop a history of the previous uses of the site and surrounding area, in order to help identify RECs associated with past uses. Copies of selected historical documents are included in Appendix C.

## 3.1 Historical Topographic Maps, Aerial Photographs, Sanborn Maps

Readily available historical USGS topographic maps, selected historical aerial photographs (at approximately 10 to 15 year intervals) and historical fire insurance maps produced by the Sanborn Map Company were reviewed to evaluate land development and obtain information concerning the history of development on and near the site. Reviewed historical topographic maps, aerial photographs and Sanborn maps are summarized below.

Historical fire insurance maps produced by the Sanborn Map Company were requested from Environmental Data Resources (EDR) to evaluate past uses and relevant characteristics of the site and surrounding properties. Based upon inquiries to the above-listed Sanborn provider, Sanborn maps were not available for the site.

- Topographic map: Elsinore, California, published in **1901** (1:125,000)
- Topographic map: Elsinore, California, published in 1953 from aerial photographs; photo revised in **1973** (1:24,000)
- Topographic maps: Lake Elsinore, California, photo revised in **1978**; photo revised in 1982 from **1980** aerial photographs; photo revised in 1988 from **1985** aerial photographs, photo revised in 1997 from **1994** aerial photographs (1:24,000)
- Aerial photograph: USDA, **1938, 1949, 1953, 1961, 1967, 1978, 1985, 1989, 1990, 1"=500'**

- Aerial photograph: USGS, **1994,** 1"=500'
- Aerial photograph: USDA, **2005, 2009, 2010,** and **2012** 1"=500'

**Historical Topographic Maps and Aerial Photographs**

| Direction | Description |
|---|---|
| Site | Undeveloped land, wash across southeastern portion of the site, north central portion of the site cleared of vegetation (1901-1953); developed on the southeast portion with a structure (1961); developed on the southeast portion with two additional structures and an apparent landing strip on the southern portion of the site (1967); landing strip removed (1978-1994); structures on the southeast portion of the site removed (2005); rectangular shaped soil stockpile from adjacent Nichols Mine noted on central portion of the site; overhead powerlines noted across the site, southeast to approximately north-central portion (2009-2014). |
| North | A road in the general alignment of Nichols Road, vacant and undeveloped beyond (1901-2005); *Nichols Road Mine*, primarily north of the western portion of the site (2009-2012) |
| East | Vacant and undeveloped land; the wash continued toward the east; a road was mappedfurther to the east (1901-1978); residential development (1985-2012) |
| South | Undeveloped land (1901-1953); developed on the east portion with several structures (1961); developed with additional structures and an apparent landing strip (1967); landing strip removed, redeveloped with several small structures (1978); clearing beginning for Temescal Canyon High School (1985); small structures removed, grading underway for high school (1989); construction of high school underway (1990); high school appeared to be open (1994); all land surrounding high school vacant (2005-2012) |
| West | Vacant and undeveloped land with a road and railroad mapped further to the west (1901-1953); a northwest to southeast trending road mapped as Highway 71 was developed in the approximate alignment of Interstate 15 (1961-1978); dirt road/trail activity (1978); Interstate 15 developed; NAP portion remained vacant and undeveloped (1985-2012) |

Nichols Road Mine, identified in the historical aerial photographs from 2009 through 2012 was identified in the regulatory database and is discussed further in Section 4.1.

## 3.2 Historical City Directories

The Cole Information Services and Haines Criss-Cross city directories used in this study were made available through EDR (selected years reviewed 1975-2013) and were reviewed at approximate five-year intervals, if readily available. Street listings not available prior to 1975. Addresses were not identified for the site. A historical address of 28551 El Toro Road was identified for the southeast portion of the site.

**Historical City Directories**

| Direction | Description |
|---|---|
| Site | **28551 El Toro Road:** Not listed (1975-2013). |

| Direction | Description |
|---|---|
| North | **Unaddressed / Nichols Road Mine** |
| East | **28392-28484 Wood Mesa Court:** Not listed (1975-2013).<br>**28525-28600 El Toro Road:** Not listed (1975-2013). |
| South | **28755 El Toro Road:** Not listed (1975-2013). |
| West | **Unaddressed / Interstate-15** |

## 3.3 Site Ownership

Based on title information reviewed in the CHJ, a Terracon Company July 17, 2017 Phase I ESA and client provided information, the current site owner is Nichols Road Partners.

## 3.4 Title Search

At the direction of the client, a title search was not included as part of the scope of services. Unless notified otherwise, we assume that the client is evaluating this information outside the scope of this report.

## 3.5 Environmental Liens and Activity and Use Limitations

The EDR regulatory database report included a review of both Federal and State Engineering Control (EC) and Institutional Control (IC) databases. Based on a review of the database report, the site was not listed on the EC or IC databases. Please note that in addition to these federal and state listings, AULs can be recorded at the county and municipal level that may not be listed in the regulatory database report. Environmental lien and activity and use limitation records recorded against the site were not provided by the client. At the direction of the client, performance of a review of these records was not included as part of the scope of services and unless notified otherwise, we assume that the client is evaluating this information outside the scope of this report.

## 3.6 Interviews Regarding Current and Historical Site Uses

The following individual was interviewed regarding the current and historical use of the site.

**Interview**

| Interviewer | Name / Phone # | Title | Date/Time |
|---|---|---|---|
| Jeremy Rosenthal | Mr. Todd Pendergrass<br>(651) 277-3900 | Technical Services Manager | December 11, 2017<br>1:15pm |

Prior to the site reconnaissance, Terracon interviewed Mr. Todd Pendergrass, Technical Services Manager. Mr. Pendergrass indicated that he has been familiar with the site since November of 2013. Mr. Pendergrass indicated that there are no current USTs on the site and he is not aware of a history of USTs associated with the site. Mr. Pendergrass is not aware of environmental

concerns associated with the site or in the site vicinity. In addition, Mr. Pendergrass is not aware of any pending, threatened or past environmental litigation, proceedings or notices of possible violations of environmental laws or liability or potential environmental concerns in connection with the site.

## 3.7 Prior Report Review

Terracon requested the client provide any previous geotechnical and environmental reports they are aware of for the site. Terracon reviewed the following were provided by the client to CHJ for review.

- Geotechnical Investigation Proposed South Nichols Grading Project
  South of Nichols Road, East of Interstate 15
  Lake Elsinore, California
  Dated: May 6, 2016
  Prepared by: CHJ Consultants
  For: Nichols Road Partners

The CHJ 2016 geotechnical investigation reported the site to consist of undeveloped land. Two fill stockpiles, ranging from approximately 5 to 20 feet in height, were located in the central portion of the site. The stockpiles consisted of topsoil from the adjacent mining operation north of Nichols Road. Small hills consisting of bedrock outcrops were located on the eastern and western portions of the site. The topography of the remainder of the site generally sloped to the south. A drainage channel was present across the southeast portion of the site. Several areas in the southern portion of the site appeared to have been disturbed and were free of vegetation. The remainder of the site was covered in a moderate growth of annual grasses and weeds. Groundwater was not identified in 8 exploratory borings up to 51 1/2 feet bgs.

- Phase I Environmental Site Assessment
  South Nichols Project Lake Elsinore, CA
  July 17, 2017
  Prepared by CHJ, a Terracon Company
  CHJ Project No. CB177171
  For: Nichols Road Partners

Subsequent to the CHJ 2016 geotechnical report investigation, CHJ, a Terracon Company, conducted a Phase I ESA in July, 2017 on the north-most portion of the site. The property was reported to consist of 45.4-acre tract of vacant land, APN 389-200-038. At the time of the site reconnaissance, the area west of the wash was in the process of being mass graded. Eight scrapers, one water pull, two water towers, and various miscellaneous equipment were located on the property. The area east of the wash was generally vacant and undeveloped with a moderate growth of weeds and natural vegetation. Overhead power lines crossed the property

from the near the southeastern corner to a point along Nichols Road in the west-central portion of the property. RECs were not identified and recommendations were not provided.

# 4.0 RECORDS REVIEW

Regulatory database information was provided by EDR, a contract information services company. The purpose of the records review was to identify RECs in connection with the site. Information in this section is subject to the accuracy of the data provided by the information services company and the date at which the information is updated. The scope herein did not include confirmation of facilities listed as "unmappable" by regulatory databases.

In some of the following subsections, the words up-gradient, cross-gradient and down-gradient refer to the topographic gradient in relation to the site. As stated previously, the groundwater flow direction and the depth to shallow groundwater, if present, would likely vary depending upon seasonal variations in rainfall and the depth to the soil/bedrock interface. Without the benefit of on-site groundwater monitoring wells surveyed to a datum, groundwater depth and flow direction beneath the site cannot be directly ascertained.

## 4.1 Federal and State/Tribal Databases

Listed below are the facility listings identified on federal and state/tribal databases within the ASTM-required search distances from the approximate site boundaries. Database definition, descriptions, and the database search report are included in Appendix D.

**Federal Databases**

| Database | Description | Distance (miles) | Listings |
|---|---|---|---|
| SEMS | Superfund Enterprise Management System | 0.5 | 0 |
| SEMS / NFRAP | Superfund Enterprise Management System/No Further Remedial Action Planned | 0.5 | 0 |
| ERNS | Emergency Response Notification System | Site | 0 |
| IC / EC | Institutional Control/Engineering Control | Site | 0 |
| NPL | National Priorities List | 1 | 0 |
| NPL (Delisted) | National Priorities Delisted List | 0.5 | 0 |
| RCRA CORRACTS/ TSD | RCRA Corrective Action Activity | 1 | 0 |
| RCRA Generators | Resource Conservation and Recovery Act | Site and adjoining | 1 |
| RCRA Non-CORRACTS/ TSD | RCRA Non-Corrective Action Activity | 0.5 | 0 |

## State/Tribal Databases

| Database | Description | Distance (miles) | Listings |
|---|---|---|---|
| AST | Above Ground Storage Tank Facilities | 0.25 | 0 |
| CA FID UST | Facility Inventory Database | 0.25 | 0 |
| CA LUST | | | 0 |
| CALSITES | CalSites Database | 1.0 | 0 |
| CALSITES (AWP) | Active Annual Workplan Sites | 1.0 | 0 |
| CHMIRS | California Hazardous Material Incident Report System | Site | 0 |
| DOD | Department of Defense Sites | 1.0 | 0 |
| DRYCLEANERS | Drycleaner related facilities | 0.25 | 0 |
| EDR HIST AUTO | EDR Exclusive Historic Gas Stations | 0.125 | 0 |
| EDR HIST CLEANER | EDR Exclusive Historic Dry Cleaners | 0.125 | 0 |
| EMI | Emissions Inventory Data | Site | 0 |
| ENVIROSTOR | The Department of Toxic Substances Control's (DTSC's) Site Mitigation and Brownfields Reuse Program | 1.0 | 0 |
| FINDS | Facility Index System | Site | 0 |
| HAZNET | Facility and Manifest Data | Site | 0 |
| HIST CORTESE | Hazardous Waste & Substance Site List | 0.5 | 0 |
| HIST UST | Hazardous Substance Storage Container Database | 1.0 | 0 |
| HWP | EnviroStor Permitted Facilities Listing | 1.0 | 0 |
| LUST | Leaking Underground Storage Tanks | 0.5 | 0 |
| MINES | Mines Site Location Listing | 0.25 | 1 |
| RCRA NONGEN / NLR | RCRA – Non Generators / No Longer Regulated | 0.25 | 0 |
| RGA LUST | Recovered Government Archive Leaking Underground Storage Tank | Site | 0 |
| RESPONSE | State and Tribal Equivalent NPL | 1.0 | 0 |
| ROD | Records of Decision | | 0 |
| SLIC | Spills, Leaks, Investigations and Cleanup | 0.5 | 0 |
| SWEEPS UST | Statewide Environmental Evaluation & Planning System | 0.25 | 0 |
| SWF/LF | Solid Waste Facilities/Landfills | 0.5 | 0 |
| SWRCY | Recycler Database | 0.5 | 0 |
| UST | Underground Storage Tank Facilities | Site and adjoining | 0 |
| VCP | Voluntary Cleanup Program | 0.5 | 0 |

In addition to the above ASTM-required listings, Terracon reviewed other federal, state, local, and proprietary databases provided by the database firm. A list of the additional reviewed databases is included in the regulatory database report included in Appendix D.

The following table summarizes the site-specific information provided by the database and/or gathered by this office for identified facilities. Facilities are listed in order of proximity to the site. Additional discussion for selected facilities follows the summary table.

**Listed Facilities**

| Facility Name And Location | Estimated Distance / Direction/Gradient | Database Listings | Is a REC, CREC, or HREC to the Site |
|---|---|---|---|
| Nichols Canyon Mine<br>25555 Maitri Road | Adjoining / North / Cross-gradient | Mines | No, discussed below |

Nichols Canyon Mine (25555 Maitri Road)
Nichols Canyon Mine, located to the adjoining north of the site and in a topographically cross-gradient position relative to the site, is identified in the regulatory database Mines listing. Based on a review of this listing, this open pit mine primarily produces sand and gravel. This mine is currently in operation and mine reclamation has not started. Based on waste streams identified and gradient, Nichols Canyon Mine does not constitute a REC to the site.

The remaining facilities listed in the database report do not appear to represent RECs to the site at this time based upon regulatory status, apparent topographic gradient, and/or distance from the site.

Unmapped facilities are those that do not contain sufficient address or location information to evaluate the facility listing locations relative to the site. The report listed seventeen facilities in the unmapped section. Determining the location of unmapped facilities is beyond the scope of this assessment; however, none of these facilities were identified as the site or adjacent properties. These facilities are listed in the database report in Appendix D.

## 4.2 Local Agency Inquiries

| Agency Contacted/ Contact Method | Response |
|---|---|
| Riverside County Department of Environmental Heatlh Hazardarous Materials Management Division / Email: DEHRecordsMgmt@rivco.org | Terracon received records via standard mail dated December 12, 2017 from the Riverside County Environmental Health Department, based on a review of the provided documents, records cannot be searched by APN. |
| Department of Toxic Substances Control / | According to Ms. Ruth Saroian with the DTSC, records were not found for the site address. |

| Agency Contacted/ Contact Method | Response |
|---|---|
| Email: pubreqact@dtsc.ca.gov | |
| South Coast Air Quality Management District (SCAQMD) / EMail: PublicRecordsRequest@aqmd.gov | According to Ms. Melanie Foster with the SCAQMD, records were not found for the site. |
| Lake Elsinore City Clerk's Office / Fax: (951) 674-3124 | At the issuance of this report, a response has not been received. |
| Santa Ana Regional Water Quality Control Board (SARWQCB) / Email: Filereview8@waterboards.ca.gov | According to Ms. Paloma (Surname not provided) with the SARWQCB, records cannot be searched by APN. Terracon requested an additional search of the historical address (28551 El Toro Road) associated with the southeast portion of the site; however, at the issuance of this report the additional request has not been received. |
| County of Riverside Building and Safety Department / Email records@rctlma.org | At the issuance of this report, a response has not been received. |

### 4.3 Local Area Knowledge

Terracon researched on-line at the California Department of Conservation Division of Oil, Gas and Geothermal Resources Well Finder and oil/gas wells were not identified on-site and the site was not identified within an oil field.

## 5.0 SITE RECONNAISSANCE

### 5.1 General Site Information

Information contained in this section is based on a visual reconnaissance conducted while walking through the site and the accessible interior areas of structures, if any, located on the site. The site and adjoining properties are depicted on the Site Diagram, which is included in Exhibit 2 of Appendix A. Photo documentation of the site at the time of the visual reconnaissance is provided in Appendix B. Credentials of the individuals planning and conducting the site visit are included in Appendix E.

**General Site Information**

| Site Reconnaissance | |
|---|---|
| Field Personnel | Jeremy R. Rosenthal and Carl A. Parten |
| Reconnaissance Date | December 12, 2017 |
| Weather Conditions | 75 F/ Sunny |
| Site Contact/Title | Mr. Todd Pendergrass / Technical Services Manager |

## 5.2 Overview of Current Site Occupants and Operations

The site is located adjacent to the south of Nichols Road and to the east of the Interstate-15 Nichols Road off ramp in Lake Elsinore, San Bernardino County, California. The site consists of approximately 68.7-acres of Assessor Parcel Numbers (APNs) 389-200-037, 389-210-008, and 389-210-032. At the time of the site reconnaissance, the area west of the wash was in the process of being mass graded. The area east of the wash was generally vacant and undeveloped with a moderate growth of weeds and natural vegetation. Overhead power lines crossed the site from the near the southeastern corner to a point along Nichols Road in the west-central portion of the site.

## 5.3 Site Observations

The following table summarizes site observations and interviews. Affirmative responses (designated by an "X") are discussed in more detail following the table.

**Site Characteristics**

| Category | Item or Feature | Observed or Identified |
|---|---|---|
| Site Operations, Processes, and Equipment | Emergency generators | |
| | Elevators | |
| | Air compressors | |
| | Hydraulic lifts | |
| | Dry cleaning | |
| | Photo processing | |
| | Ventilation hoods and/or incinerators | |
| | Waste treatment systems and/or water treatment systems | |
| | Heating and/or cooling systems | |
| | Paint booths | |
| | Sub-grade mechanic pits | |
| | Wash-down areas or carwashes | |

| Category | Item or Feature | Observed or Identified |
|---|---|---|
| | Pesticide/herbicide production or storage | |
| | Printing operations | |
| | Metal finishing (e.g., electroplating, chrome plating, galvanizing, etc.) | |
| | Salvage operations | |
| | Oil, gas or mineral production | |
| | Other processes or equipment | |
| Aboveground Chemical or Waste Storage | Aboveground storage tanks | |
| | Drums, barrels and/or containers ≥ 5 gallons | |
| | MSDS or SDS | |
| Underground Chemical or Waste Storage, Drainage or Collection Systems | Underground storage tanks or ancillary UST equipment | |
| | Sumps, cisterns, French drains, catch basins and/or dry wells | X |
| | Grease traps | |
| | Septic tanks and/or leach fields | |
| | Oil/water separators, clarifiers, sand traps, triple traps, interceptors | |
| | Pipeline markers | |
| | Interior floor drains | |
| Electrical Transformers/ PCBs | Transformers and/or capacitors | X |
| | Other equipment | |
| Releases or Potential Releases | Stressed vegetation | |
| | Stained soil | X |
| | Stained pavement or similar surface | |
| | Leachate and/or waste seeps | |
| | Trash, debris and/or other waste materials | |
| | Dumping or disposal areas | |
| | Construction/demolition debris and/or dumped fill dirt | X |
| | Surface water discoloration, odor, sheen, and/or free floating product | |
| | Strong, pungent or noxious odors | |
| | Exterior pipe discharges and/or other effluent discharges | |
| Other Notable Site Features | Surface water bodies | |
| | Quarries or pits | |
| | Wastewater lagoons | |
| | Wells | |

## Underground Chemical or Waste Storage, Drainage or Collection Systems

Sumps, cisterns, French drains, catch basins and/or dry wells

Remnants of an apparent cisterns was observed on the south central portion of the site during reconaissance. Staining and or releases were not observed in the vicinity of the cisterns during the site reconnaissance. Based on site observations, the cisterns do not constitute a REC to the site.

## Electrical Transformers/PCBs

Transformers and/or capacitors

During Terracon's site visit, one pole-mounted transformer, owned and serviced by SCE, was observed on one of the power poles in the southeastern portion of the site however, no information with regard to PCB content of the transformer fluids was observed. Some transformers contain mineral oil which may contain PCBs. SCE maintains responsibility for the transformer, and if the transformer was SCE is not required to replace the transformer fluids until a release is identified. However, evidence of current or prior releases was not observed in the vicinity of the electrical equipment during the site reconnaissance. Based on site observations, the pole-mounted transformer does not appear to constitute a REC to the site.

## Releases or Potential Releases

Stained soil

De minimis stained soil was observed on the north portion of the site. The total area of visibly stained soil was approximately 10 to 12 square feet. The potential cause of stained soil appears to be dripping from heavy equipment or spillage from plastic open-top bins. The stained soil areas do not appear to represent a REC in connection with the site.

Construction/demolition debris and/or dumped fill dirt

Dumped fill dirt was observed on the south central portion of the site during the site reconnaissance. The amount of dirt was approximately 300 cubic yards. Based on visual surface observations, no other materials appeared within this dumped dirt. Additionally, the dumped fill dirt appeared to be native. Notable odors were not apparent from this area at the time of the site reconnaissance. Based on site observations, the dumped filled dirt does not appear to constitute a REC to the site.

Construction/demolition debris was observed on the southeast portion of the site during reconnaissance. The materials consisted of concrete pipes, concrete traffic barriers, and concrete blocks, and did not appear hazardous in nature. Leakage, spills or releases from these materials were not observed during the visual reconnaissance. Based on site observations, the construction/demolition debris do not appear to constitute a REC to the site.

Additionally, three construction equipment tires, outcrop rock mixed with stock pile of on-site material, boulders, two chain-link fence enclosures with metal lock boxes, a box culvert, heavy construction vehicles, and overhead powerlines were observed during site reconnaissance. RECs were not observed with the on-site observations.

## 6.0 ADJOINING PROPERTY RECONNAISSANCE

Visual observations of adjoining properties (from site boundaries) are summarized below.

**Adjoining Properties**

| Direction | Description |
|---|---|
| North | Nichols Road abuts the site to the north followed by the Nichols Road Mine and undeveloped land. |
| East | El Toro Road and Wood Mesa Court abut the site to the east followed by single-family residences. |
| South | The property to the adjoining south of the site consists of Intertate-15, Temescal Canyon High School, and undeveloped land. |
| West | The property to the adjoining west of the site consist of a vacant parcel and the Nichols Road off-ramp from Interstate-15. |

RECs were not observed with the adjoining properties.

## 7.0 ADDITIONAL SERVICES

Per the agreed scope of services specified in the proposal, additional services (e.g. asbestos sampling, lead-based paint sampling, wetlands evaluation, lead in drinking water testing, radon testing, vapor encroachment screening, etc.) were not conducted.

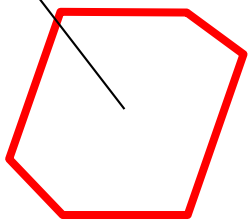
# 8.0 DECLARATION

I, Carl A. Parten declare that, to the best of my professional knowledge and belief, I meet the definition of Environmental Professional as defined in Section 312.10 of 40 CFR 312; and I have the specific qualifications based on education, training, and experience to assess a property of the nature, history, and setting of the site. I have developed and performed the All Appropriate Inquiries in conformance with the standards and practices set forth in 40 CFR Part 312.

Carl A. Parten
Principal / Office Manager II

# APPENDIX A
# EXHIBIT 1 – TOPOGRAPHIC MAP
# EXHIBIT 2 – SITE DIAGRAM

APPROXIMATE
SITE BOUNDARY



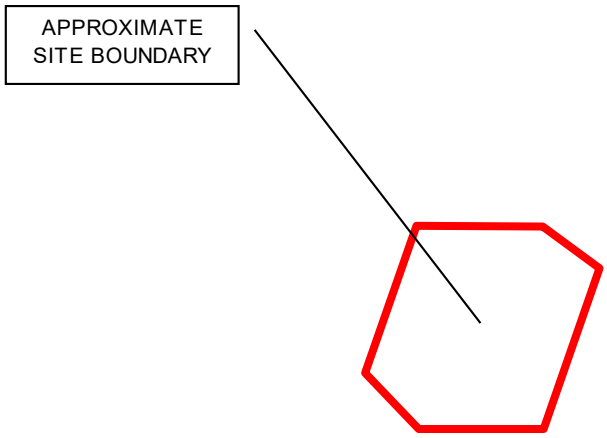
- right-click shape
- click **Edit Points**
- add or move points
- hold Ctrl key to delete a point

USGS 7.5 MINUTE SERIES TOPOGRAPHIC MAP

STATE OF California QUADRANGLES

(QUADRANGLES)

| | | | | |
|---|---|---|---|---|
| Project Mgr TER<br>Approved by RRA<br>Checked by DOC<br>Drawn by SSS | Project No 60177386<br>Scale 1" = 2000'<br>Date<br>File No. | Terracon<br>1421 Edinger Ave Ste C Tustin, CA 92780-6287<br>Ph: 949-261-0051 Fax: 949-261-6110 | TOPOGRAPHIC MAP<br>Tentative Tract No. 37305 Project<br>South of Nichols Road and East of Interstate 15<br>Lake Elsinore, California | EXHIBIT<br>1 |




- right-click shape
- click **Edit Points**
- add or move points
- hold Ctrl key to delete a point

| | | | | |
|---|---|---|---|---|
| Project Mgr TER<br>Approved by RRA<br>Checked by DOC<br>Drawn by SSS | Project No 60177386<br>Scale 1" = 2000'<br>Date<br>File No. | Terracon<br>1421 Edinger Ave Tustin, CA 92780-6287<br>Ste C<br>Ph: 949-261-0051 Fax: 949-261-6110 | SITE DIAGRAM<br>Tentative Tract No. 37305 Project<br>South of Nichols Road and East of Interstate 15<br>Lake Elsinore, California | EXHIBIT<br>2 |

# APPENDIX B
# SITE PHOTOGRAPHS

# APPENDIX C
# HISTORICAL DOCUMENTATION AND USER QUESTIONNAIRE

**insert PDFs below:**

# APPENDIX D
# ENVIRONMENTAL DATABASE INFORMATION

**insert PDFs below:**

# APPENDIX E
# CREDENTIALS

**insert PDFs below:**

# APPENDIX F
# DESCRIPTION OF TERMS AND ACRONYMS

## Description of Selected General Terms and Acronyms

| *Term/Acronym* | *Description* |
|---|---|
| ACM | Asbestos Containing Material. Asbestos is a naturally occurring mineral, three varieties of which (chrysotile, amosite, crocidolite) have been commonly used as fireproofing or binding agents in construction materials. Exposure to asbestos, as well as ACM, has been documented to cause lung diseases including asbestosis (scarring of the lung), lung cancer and mesothelioma (a cancer of the lung lining).<br><br>Regulatory agencies have generally defined ACM as a material containing greater that one (1) percent asbestos, however some states (e.g. California) define ACM as materials having 0.1% asbestos. In order to define a homogenous material as non-ACM, a minimum number of samples must be collected from the material dependent upon its type and quantity. Homogenous materials defined as non-ACM must either have 1) no asbestos identified in all of its samples or 2) an identified asbestos concentration below the appropriate regulatory threshold. Asbestos concentrations are generally determined using polarized light microscopy or transmission electron microscopy. Point counting is an analytical method to statistically quantify the percentage of asbestos in a sample. The asbestos component of ACM may either be friable or non-friable. Friable materials, when dry, can be crumbled, pulverized, or reduced to powder by hand pressure and have a higher potential for a fiber release than non-friable ACM. Non-friable ACM are materials that are firmly bound in a matrix by plastic, cement, etc. and, if handled carefully, will not become friable.<br><br>Federal and state regulations require that either all suspect building materials be presumed ACM or that an asbestos survey be performed prior to renovation, dismantling, demolition, or other activities that may disturb potential ACM. Notifications are required prior to demolition and/or renovation activities that may impact the condition of ACM in a building. ACM removal may be required if the ACM is likely to be disturbed or damaged during the demolition or renovation. Abatement of friable or potentially friable ACM must be performed by a licensed abatement contractor in accordance with state rules and NESHAP. Additionally, OSHA regulations for work classification, worker training and worker protection will apply. |
| AHERA | Asbestos Hazard Emergency Response Act |
| AST | Aboveground Storage Tanks. ASTs are generally described as storage tanks less than 10% of which are below ground (i.e., buried). Tanks located in a basement, but not buried, are also considered ASTs. Whether, and the extent to which, an AST is regulated, is determined on a case-by-case basis and depends upon tank size, its contents and the jurisdiction of its location. |
| BGS | Below Ground Surface |
| Brownfields | State and/or tribal listing of Brownfield properties addressed by Cooperative Agreement Recipients or Targeted Brownfields Assessments. |
| BTEX | Benzene, Toluene, Ethylbenzene, and Xylenes. BTEX are VOC components found in gasoline and commonly used as analytical indicators of a petroleum hydrocarbon release. |
| CERCLA | Comprehensive Environmental Response, Compensation and Liability Act (a.k.a. Superfund). CERCLA is the federal act that regulates abandoned or uncontrolled hazardous waste sites. Under this Act, joint and several liability may be imposed on potentially responsible parties for cleanup-related costs. |
| CERCLIS | Comprehensive Environmental Response, Compensation and Liability Information System. An EPA compilation of sites having suspected or actual releases of hazardous substances to the environment. CERCLIS also contains information on site inspections, preliminary assessments and remediation of hazardous waste sites. These sites are typically reported to EPA by states and municipalities or by third parties pursuant to CERCLA Section 103. |
| CESQG | Conditionally Exempt Small Quantity Generators |
| CFR | Code of Federal Regulations |

## Description of Selected General Terms and Acronyms

| *Term/Acronym* | *Description* |
|---|---|
| CREC | Controlled Recognized Environmental Condition is defined in ASTM E1527-13 as "a recognized environmental condition resulting from a past release of hazardous substances or petroleum products that has been addressed to the satisfaction of the applicable regulatory authority (for example, as evidenced by the issuance of a no further action letter or equivalent, or meeting risk-based criteria established by regulatory authority) , with hazardous substances or petroleum products allowed to remain in place subject to the implementation of required controls (for example, property use restrictions, activity and use limitations, institutional controls, or engineering controls). A condition considered by the environmental professional to be a controlled recognized environmental condition shall be listed in the findings section of the Phase I Environmental Site Assessment report, and as a recognized environmental condition in the conclusions section of the Phase I Environmental Site Assessment report." |
| DOT | U.S. Department of Transportation |
| EPA | U.S. Environmental Protection Agency |
| ERNS | Emergency Response Notification System. An EPA-maintained federal database which stores information on notifications of oil discharges and hazardous substance releases in quantities greater than the applicable reportable quantity under CERCLA. ERNS is a cooperative data-sharing effort between EPA, DOT, and the National Response Center. |
| ESA | Environmental Site Assessment |
| FRP | Fiberglass Reinforced Plastic |
| Hazardous Substance | As defined under CERCLA, this is (A) any substance designated pursuant to section 1321(b)(2)(A) of Title 33, (B) any element, compound, mixture, solution, or substance designated pursuant to section 9602 of this title; (C) any hazardous waste having characteristics identified under or listed pursuant to section 3001 of the Solid Waste Disposal Act (with some exclusions); (D) any toxic pollutant listed under section 1317(a) of Title 33; (E) any hazardous air pollutant listed under section 112 of the Clean Air Act; and (F) any imminently hazardous chemical substance or mixture with respect to which the EPA Administrator has taken action under section 2606 of Title 15. This term does not include petroleum, including crude oil or any fraction thereof which is not otherwise listed as a hazardous substance under subparagraphs (A) through (F) above, and the term include natural gas, or synthetic gas usable for fuel (or mixtures of natural gas and such synthetic gas). |
| Hazardous Waste | This is defined as having characteristics identified or listed under section 3001 of the Solid Waste Disposal Act (with some exceptions). RCRA, as amended by the Solid Waste Disposal Act of 1980, defines this term as a "solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may (A) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness; or (B) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed." |
| HREC | Historical Recognized Environmental Condition is defined in ASTM E1527-13 as "a past release of any hazardous substances or petroleum products that has occurred in connection with the property and has been addressed to the satisfaction of the applicable regulatory authority or meeting unrestricted residential use criteria established by a regulatory authority, without subjecting the property to any required controls (for example, property use restrictions, activity and use limitations, institutional controls, or engineering controls). Before calling the past release a historical recognized environmental condition, the environmental professional must determine whether the past release is a recognized environmental condition at the time of the Phase I Environmental Site Assessment is conducted (for example, if there has been a change in the regulatory criteria). If the EP considers the past release to be a recognized environmental condition at the time the Phase I ESA is conducted, the condition shall be included in the conclusions section of the report as a recognized environmental condition." |
| IC/EC | A listing of sites with institutional and/or engineering controls in place. IC include administrative measures, such as groundwater use restrictions, construction restrictions, property use restrictions, and post remediation care requirements intended to prevent exposure to contaminants remaining on site. Deed restrictions are generally required as part of the institutional controls. EC include various forms of caps, building foundations, liners, and treatment methods to create pathway elimination for regulated substances to enter environmental media or effect human health. |
| ILP | Innocent Landowner/Operator Program |
| LQG | Large Quantity Generators |
| LUST | Leaking Underground Storage Tank. This is a federal term set forth under RCRA for leaking USTs. Some states also utilize this term. |

## Description of Selected General Terms and Acronyms

| *Term/Acronym* | *Description* |
|---|---|
| MCL | Maximum Contaminant Level. This Safe Drinking Water concept (and also used by many states as a ground water cleanup criteria) refers to the limit on drinking water contamination that determines whether a supplier can deliver water from a specific source without treatment. |
| MSDS | Material Safety Data Sheets. Written/printed forms prepared by chemical manufacturers, importers and employers which identify the physical and chemical traits of hazardous chemicals under OSHA's Hazard Communication Standard. |
| NESHAP | National Emissions Standard for Hazardous Air Pollutants (Federal Clean Air Act). This part of the Clean Air Act regulates emissions of hazardous air pollutants. |
| NFRAP | Facilities where there is "No Further Remedial Action Planned," as more particularly described under the Records Review section of this report. |
| NOV | Notice of Violation. A notice of violation or similar citation issued to an entity, company or individual by a state or federal regulatory body indicating a violation of applicable rule or regulations has been identified. |
| NPDES | National Pollutant Discharge Elimination System (Clean Water Act). The federal permit system for discharges of polluted water. |
| NPL | The NPL is the EPA's database of uncontrolled or abandoned hazardous waste facilities that have been listed for priority remedial actions under the Superfund Program. |
| OSHA | Occupational Safety and Health Administration or Occupational Safety and Health Act |
| PACM | Presumed Asbestos-Containing Material. A material that is suspected of containing or presumed to contain asbestos but which has not been analyzed to confirm the presence or absence of asbestos. |
| PCB | Polychlorinated Biphenyl. A halogenated organic compound commonly in the form of a viscous liquid or resin, a flowing yellow oil, or a waxy solid. This compound was historically used as dielectric fluid in electrical equipment (such as electrical transformers and capacitors, electrical ballasts, hydraulic and heat transfer fluids), and for numerous heat and fire sensitive applications. PCB was preferred due to its durability, stability (even at high temperatures), good chemical resistance, low volatility, flammability, and conductivity. PCBs, however, do not break down in the environment and are classified by the EPA as a suspected carcinogen. 1978 regulations, under the Toxic Substances Control Act, prohibit manufacturing of PCB-containing equipment; however, some of this equipment may still be in use today. |
| pCi/L | picoCuries per Liter of Air. Unit of measurement for Radon and similar radioactive materials. |
| PLM | Polarized Light Microscopy (see ACM section of the report, if included in the scope of services) |
| PST | Petroleum Storage Tank. An AST or UST that contains a petroleum product. |
| Radon | A radioactive gas resulting from radioactive decay of naturally-occurring radioactive materials in rocks and soils containing uranium, granite, shale, phosphate, and pitchblende. Radon concentrations are measured in picoCuries per Liter of Air. Exposure to elevated levels of radon creates a risk of lung cancer; this risk generally increases as the level of radon and the duration of exposure increases. Outdoors, radon is diluted to such low concentrations that it usually does not present a health concern. However, radon can accumulate in building basements or similar enclosed spaces to levels that can pose a risk to human health. Indoor radon concentrations depend primarily upon the building's construction, design and the concentration of radon in the underlying soil and ground water. The EPA recommended annual average indoor "action level" concentration for residential structures is 4.0 pCi/l. |
| RCRA | Resource Conservation and Recovery Act. Federal act regulating solid and hazardous wastes from point of generation to time of disposal ('cradle to grave"). 42 U.S.C. 6901 et seq. |
| RCRA Generators | The RCRA Generators database, maintained by the EPA, lists facilities that generate hazardous waste as part of their normal business practices. Generators are listed as either large (LQG), small (SQG), or conditionally exempt (CESQG). LQG produce at least 1000 kg/month of non-acutely hazardous waste or 1 kg/month of acutely hazardous waste. SQG produce 100-1000 kg/month of non-acutely hazardous waste. CESQG are those that generate less than 100 kg/month of non-acutely hazardous waste. |
| RCRA CORRACTS/TSDs | The USEPA maintains a database of RCRA facilities associated with treatment, storage, and disposal (TSD) of hazardous materials which are undergoing "corrective action". A "corrective action" order is issued when there is a release of hazardous waste or constituents into the environment from a RCRA facility. |
| RCRA Non-CORRACTS/TSDs | The RCRA Non-CORRACTS/TSD Database is a compilation by the USEPA of facilities which report storage, transportation, treatment, or disposal of hazardous waste. Unlike the RCRA CORRACTS/TSD database, the RCRA Non-CORRACTS/TSD database does not include RCRA facilities where corrective action is required. |

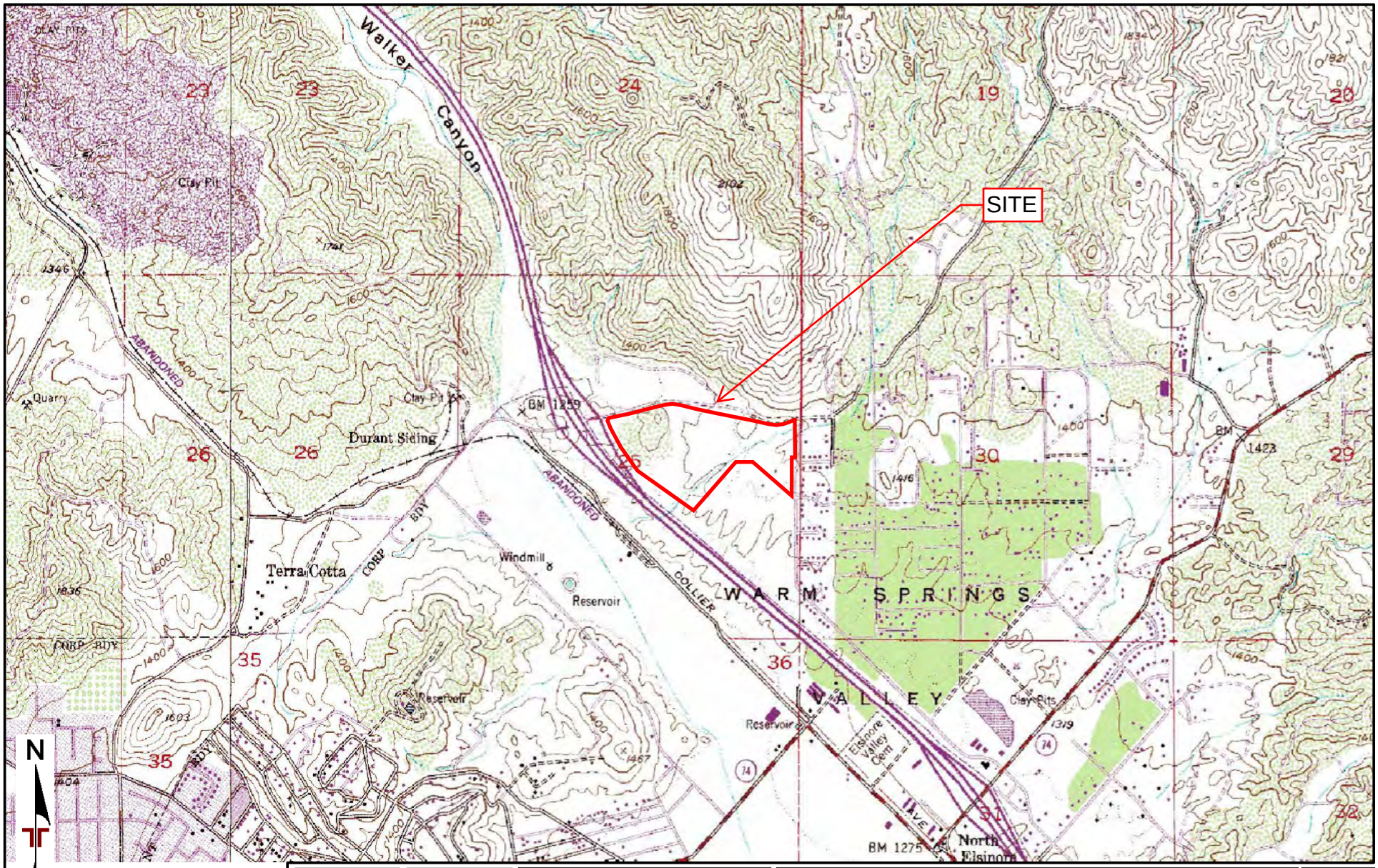
## Description of Selected General Terms and Acronyms

| *Term/Acronym* | *Description* |
|---|---|
| RCRA Violators List | RAATS. RCRA Administrative Actions Taken. RAATS information is now contained in the RCRIS database and includes records of administrative enforcement actions against facilities for noncompliance. |
| RCRIS | Resource Conservation and Recovery Information System, as defined in the Records Review section of this report. |
| REC | Recognized Environmental Conditions are defined by ASTM E1527-13 as "the presence or likely presence of any hazardous substances or petroleum products in, on, or at a property: 1) due to any release to the environment; 2) under conditions indicative of a release to the environment. *De minimis* conditions are not recognized environmental conditions." |
| SCL | State "CERCLIS" List (see SPL /State Priority List, below). |
| SPCC | Spill Prevention, Control and Countermeasures. SPCC plans are required under federal law (Clean Water Act and Oil Pollution Act) for any facility storing petroleum in tanks and/or containers of 55-gallons or more that when taken in aggregate exceed 1,320 gallons. SPCC plans are also required for facilities with underground petroleum storage tanks with capacities of over 42,000 gallons. Many states have similar spill prevention programs, which may have additional requirements. |
| SPL | State Priority List. State list of confirmed sites having contamination in which the state is actively involved in clean up activities or is actively pursuing potentially responsible parties for clean up. Sometimes referred to as a State "CERCLIS" List. |
| SQG | Small Quantity Generator |
| SWF/LF | State and/or Tribal database of Solid Waste/Landfill facilities. The database information may include the facility name, class, operation type, area, estimated operational life, and owner. |
| TPH | Total Petroleum Hydrocarbons |
| TRI | Toxic Release Inventory. Routine EPA report on releases of toxic chemicals to the environment based upon information submitted by entities subject to reporting under the Emergency Planning and Community Right to Know Act. |
| TSCA | Toxic Substances Control Act. A federal law regulating manufacture, import, processing and distribution of chemical substances not specifically regulated by other federal laws (such as asbestos, PCBs, lead-based paint and radon). 15 U.S.C 2601 et seq. |
| USACE | United States Army Corps of Engineers |
| USC | United States Code |
| USGS | United States Geological Survey |
| USNRCS | United States Department of Agriculture-Natural Resource Conservation Service |
| UST | Underground Storage Tank. Most federal and state regulations, as well as ASTM E1527-13, define this as any tank, incl., underground piping connected to the tank, that is or has been used to contain hazardous substances or petroleum products and the volume of which is 10% or more beneath the surface of the ground (i.e., buried). |
| VCP | State and/or Tribal facilities included as Voluntary Cleanup Program sites. |
| VOC | Volatile Organic Compound |

## Description of Selected General Terms and Acronyms

| *Term/Acronym* | *Description* |
|---|---|
| Wetlands | Areas that are typically saturated with surface or ground water that creates an environment supportive of wetland vegetation (i.e., swamps, marshes, bogs). The Corps of Engineers Wetlands Delineation Manual (Technical Report Y-87-1) defines wetlands as areas inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. For an area to be considered a jurisdictional wetland, it must meet the following criteria: more than 50 percent of the dominant plant species must be categorized as Obligate, Facultative Wetland, or Facultative on lists of plant species that occur in wetlands; the soil must be hydric; and, wetland hydrology must be present.<br><br>The federal Clean Water Act which regulates "waters of the US," also regulates wetlands, a program jointly administered by the USACE and the EPA. Waters of the U.S. are defined as: (1) waters used in interstate or foreign commerce, including all waters subject to the ebb and flow of tides; (2) all interstate waters including interstate wetlands; (3) all other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, etc., which the use, degradation, or destruction could affect interstate/ foreign commerce; (4) all impoundments of waters otherwise defined as waters of the U. S., (5) tributaries of waters identified in 1 through 4 above; (6) the territorial seas; and (7) wetlands adjacent to waters identified in 1 through 6 above. Only the USACE has the authority to make a final wetlands jurisdictional determination. |

# APPENDIX A
# EXHIBIT 1 – TOPOGRAPHIC MAP
# EXHIBIT 2 – SITE DIAGRAM




TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY QUADRANGLES INCLUDE: ALBERHILL, CA (1/1/1997) and LAKE ELSINORE, CA (1/1/1997).

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

| | |
|---|---|
| Project Manager: | JRR |
| Drawn by: | JRR |
| Checked by: | CAP |
| Approved by: | CAP |

| | |
|---|---|
| Project No. | 60177386 |
| Scale: | 1"=2,000' |
| File Name: | NA |
| Date: | 12-2017 |

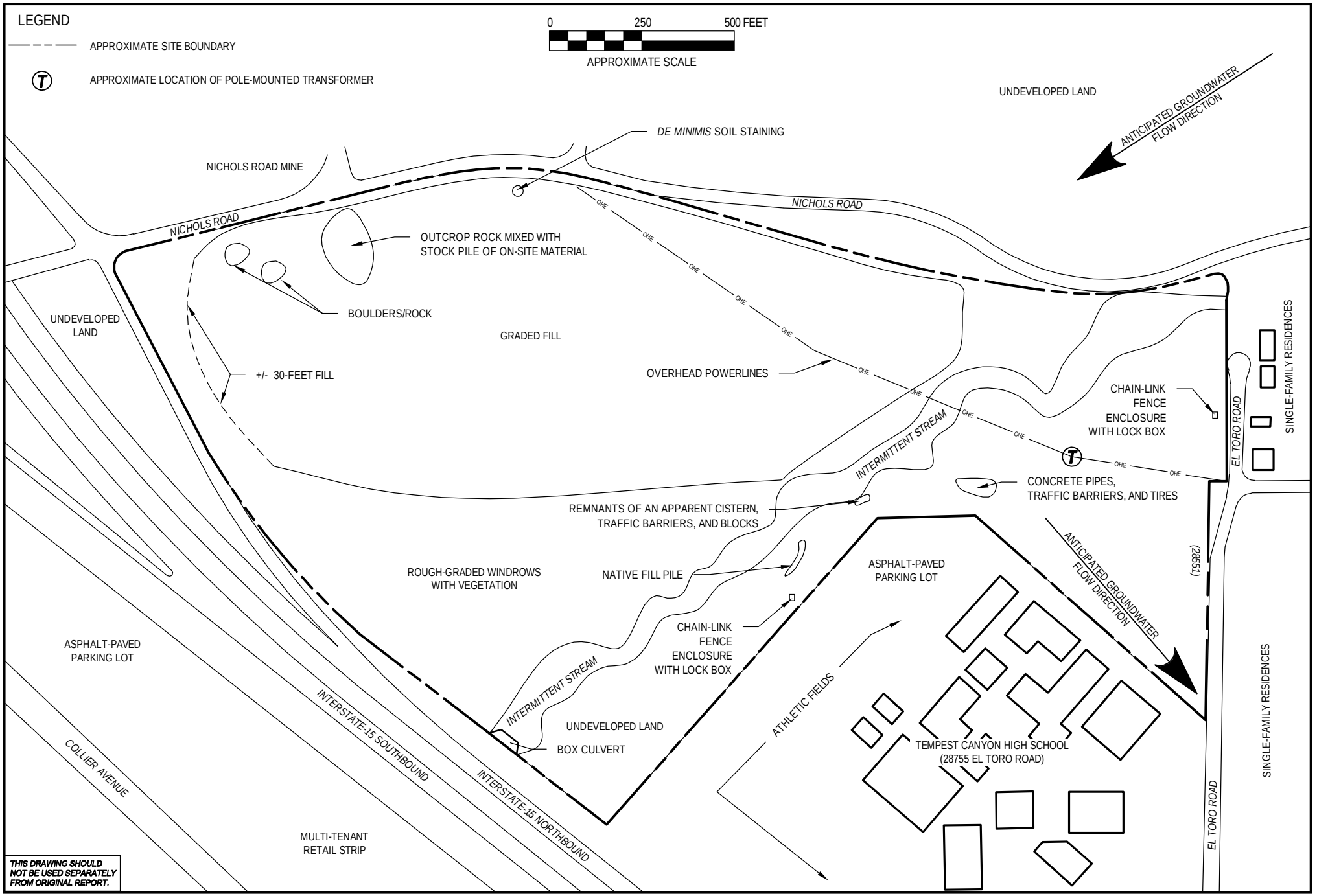
Terracon
1421 Edinger Avenue, Suite C
Tustin, California 92780

# TOPOGRAPHIC MAP

## TENTATIVE TRACT NO. 37305

APNs 389-200-037, 389-210-008, and 389-210-032
LAKE ELSINORE, RIVERSIDE COUNTY, CALIFORNIA

Exhibit 1




N

| | |
|---|---|
| Project Mngr: | JRR |
| Drawn By: | JRR |
| Checked By: | CAP |
| Approved By: | CAP |
| Project No. | 60177386 |
| Scale: | AS SHOWN |
| File No. | 60177386.dwg |
| Date: | 12-2017 |

Terracon
Consulting Engineers and Scientists
1421 EDINGER AVENUE SUITE C
TUSTIN, CALIFORNIA 92780
PH. (949) 261-0051 FAX. (949)261-6110

SITE DIAGRAM

# TENTATIVE TRACT NO. 37305

SOUTH OF NICHOLS ROAD AND EAST OF INTERSTATE 15
LAKE ELSINORE, RIVERSIDE COUNTY, CALIFORNIA

EXHIBIT

2

# APPENDIX B
# SITE PHOTOGRAPHS

**Photo #1** View of the north portion of the site looking south.

**Photo #2** View of the northeast portion of the site looking south.

**Photo #3** View of the northeast portion of the site looking southwest from the northeast site boundary.

**Photo #4** View of the east portion of the site looking west,

**Photo #5** View of the southeast portion of the site looking north.

**Photo #6** View of the central portion of the site east of the intermittent stream looking north.

**Photo #7** View of the south central portion of the site looking north near the athletic fields.

**Photo #8** View of the south portion of the site looking north.

**Photo #9** View of the southwest portion of the site looking northeast.

**Photo #10** View of the west portion of the site looking east.

**Photo #11** View of the northwest portion of the site looking south.

**Photo #12** View of the *de minimis* soil staining located on the north-central portion of the site.

**Photo #13** View of the pole-mounted transformer located on the east portion of the site.

**Photo #14** View of the construction equipment tires located on the eastern portion of the site.

**Photo #15** View of the concrete pipes located on the eastern portion of the site.

**Photo #16** View of the concrete blocks on the southeastern portion of the site.

**Photo #17** View of the concrete traffic barriers and a concrete cistern remnants located on the south central portion of the site.

**Photo #18** Typical view of the chain-link fence enclosure with metal lock box.

**Photo #19** View of the metal lock box located on the eastern portion of the site.

**Photo #20** View of the lock box located on the south central portion of the site. The lock box contained metal bars.

**Photo #21** View of the native fill pile located on the south central portion of the site.

**Photo #22** View of the box culvert located on the southern portion of the site.

**Photo #23** View of the ~30-feet of fill located on the western portion of the site looking south.

**Photo #24** View of the outcrop rock mixed with stock pile of on-site material located on the northwestern portion of the site.

**Photo #25** View of Nichols Road followed by Nichols Road Mine located to the adjoining northwest of the site.

**Photo #26** View of Nichols Road followed by undeveloped land located to the adjoining northeast of the site.

**Photo #27** View of the single-family residences located to the adjoining northeast and east of the site.

**Photo #28** View of Temescal Canyon High School (28755 El Toro Road) located to the adjoining south of the site.

**Photo #29** View of Temescal Canyon High School (28755 El Toro Road) athletic fields located to the adjoining southeast of the site.

**Photo #30** View of the undeveloped land, the Interstate-15 freeway, and the Nichols Road off-ramp to the adjoining south and west of the site.

# APPENDIX C
# HISTORICAL DOCUMENTATION AND USER QUESTIONNAIRE

# Client/User Required Questionnaire

Terracon

| | | |
|---|---|---|
| **Person Completing Questionnaire** | Name: Todd Pendergrass<br>Company: Werner Corp | Phone: 951 277 3900<br>Email: tpendergrass@wernercorp.net |
| **Site Name** | Nichols Road South | |
| **Site Address** | 10000 Nichols Road | |
| **Point of Contact for Access** | Name: Todd Pendergrass<br>Company: Werner Corporation | Phone: 951 277 3900<br>Email: |
| **Access Restrictions or Special Site Requirements?** | X No ___Yes (If yes, please explain) | |
| **Confidentiality Requirements?** | X No ___Yes (If yes, please explain) | |
| **Current Site Owner** | Name:<br>Company: Nichols Road Partners | Phone: 951 277 3900<br>Email: EWerner@wernercorp.net |
| **Current Site Operator** | Name:<br>Company: Nichols Road Partners | Phone:<br>Email: tpendergrass@wernercorp.net |
| **Reasons for ESA** (e.g., financing, acquisition, lease, etc.) | Entitlement | |
| **Anticipated Future Site Use** | Housing / commercial | |
| **Relevant Documents?** | Please provide Terracon copies of prior Phase I or II ESAs, Asbestos Surveys, Environmental Permits or Audit documents, Underground Storage Tank documents, Geotechnical Investigations, Site Surveys, Diagrams or Maps, or other relevant reports or documents. | |

**ASTM User Questionnaire**

In order to qualify for one of the Landowner Liability Protections (LLPs) offered by the Small Business Relief and Brownfields Revitalization Act of 2001 (the "Brownfields Amendments"), the user must respond to the following questions. Failure to provide this information to the environmental professional may result in significant data gaps, which may limit our ability to identify recognized environmental conditions resulting in a determination that "all appropriate inquiry" is not complete. This form represents a type of interview and as such, the user has an obligation to answer all questions in good faith, to the extent of their actual knowledge.

1) Did a search of recorded land title records (or judicial records where appropriate) identify any environmental liens filed or recorded against the property under federal, tribal, state, or local law (40 CFR 312.25)?
X No ___Yes ___Title search not completed (If yes, explain below and send Terracon a copy of the Chain of Title report.)

2) Did a search of recorded land title records (or judicial records where appropriate) identify any activity and use limitations (AULs), such as engineering controls, land use restrictions, or institutional controls that are in place at the property and/or have been filed or recorded against the property under federal, tribal, state, or local law (40 CFR 312.26)?
X No ___Yes ___Title search not completed (If yes, explain below and send Terracon a copy of the Chain of Title report.)

3) Do you have any specialized knowledge or experience related to the site or nearby properties? For example, are you involved in the same line of business as the current or former occupants of the site or an adjoining property so that you would have specialized knowledge of the chemicals and processes used by this type of business (40 CFR 312-28)?
___No X Yes (If yes, explain below)

4) Do you have actual knowledge of a lower purchase price because contamination is known or believed to be present at the site (40 CFR 312.29)?
X No ___Yes ___Not applicable (If yes, explain below)

5) Are you aware of commonly known or reasonably ascertainable information about the site that would help the environmental professional to identify conditions indicative of releases or threatened releases (40 CFR 312.30)?
X No ___Yes (If yes, explain below)

6) Based on your knowledge and experience related to the site, are there any obvious indicators that point to the presence or likely presence of contamination at the site (40 CFR 312.31)?
X No ___Yes (If yes, explain below)

Comments or explanations: Previous owner was a mining company, we are expanding mining.

Please return this form with the signed authorization to proceed. Proposal No. P60177386

BOWTIE

South of Nichols Road

Lake Elsinore, CA 92532

Inquiry Number: 4953892.4

June 01, 2017

# EDR Historical Topo Map Report

## with QuadMatch™

6 Armstrong Road, 4th floor
Shelton, CT 06484
Toll Free: 800.352.0050
www.edrnet.com

# EDR Historical Topo Map Report

06/01/17

| Site Name: | Client Name: |
|---|---|
| South Nichols Road Grading P | Terracon |
| APN 389-200-037 | 1421 Edinger Avenue |
| Lake Elsinore, CA 92532 | Tustin, CA 92780 |
| EDR Inquiry # 4953892.4 | Contact: Ann Laudermilk |

EDR Topographic Map Library has been searched by EDR and maps covering the target property location as provided by Terracon were identified for the years listed below. EDR's Historical Topo Map Report is designed to assist professionals in evaluating potential liability on a target property resulting from past activities. EDRs Historical Topo Map Report includes a search of a collection of public and private color historical topographic maps, dating back to the late 1800s.

| *Search Results:* | | *Coordinates:* | |
|---|---|---|---|
| **P.O.#** | NA | **Latitude:** | 33.706603 33° 42' 24" North |
| **Project:** | CB177171 | **Longitude:** | -117.35154 -117° 21' 6" West |
| | | **UTM Zone:** | Zone 11 North |
| | | **UTM X Meters:** | 467424.78 |
| | | **UTM Y Meters:** | 3729680.93 |
| | | **Elevation:** | 1328.31' above sea level |

**Maps Provided:**

2012
1997
1988
1982
1978
1973
1953
1901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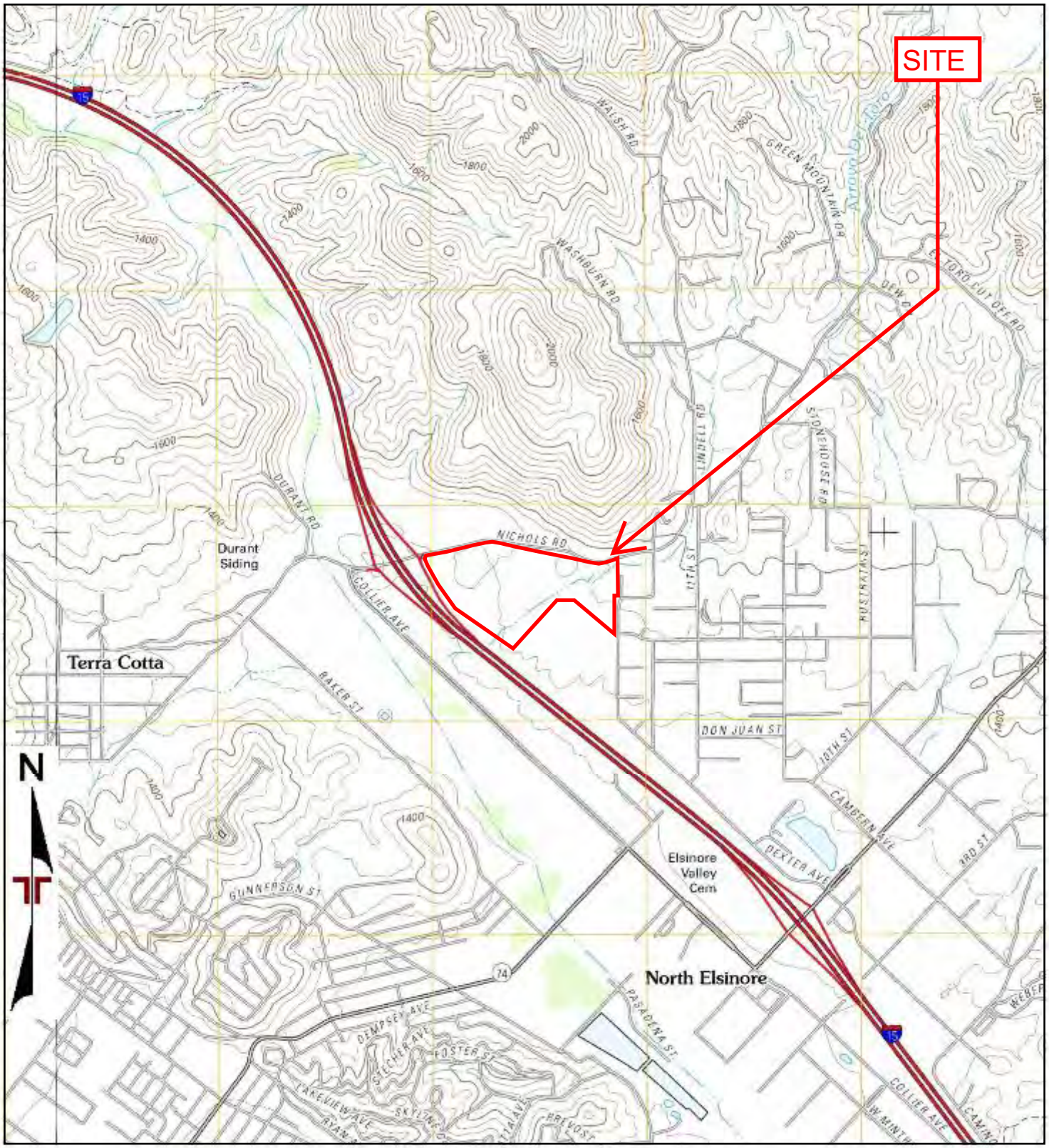



TP, Lake Elsinore, 2012, 7.5-minute
W, Alberhill, 2012, 7.5-minute

0 Miles 0.25 0.5 1 1.5

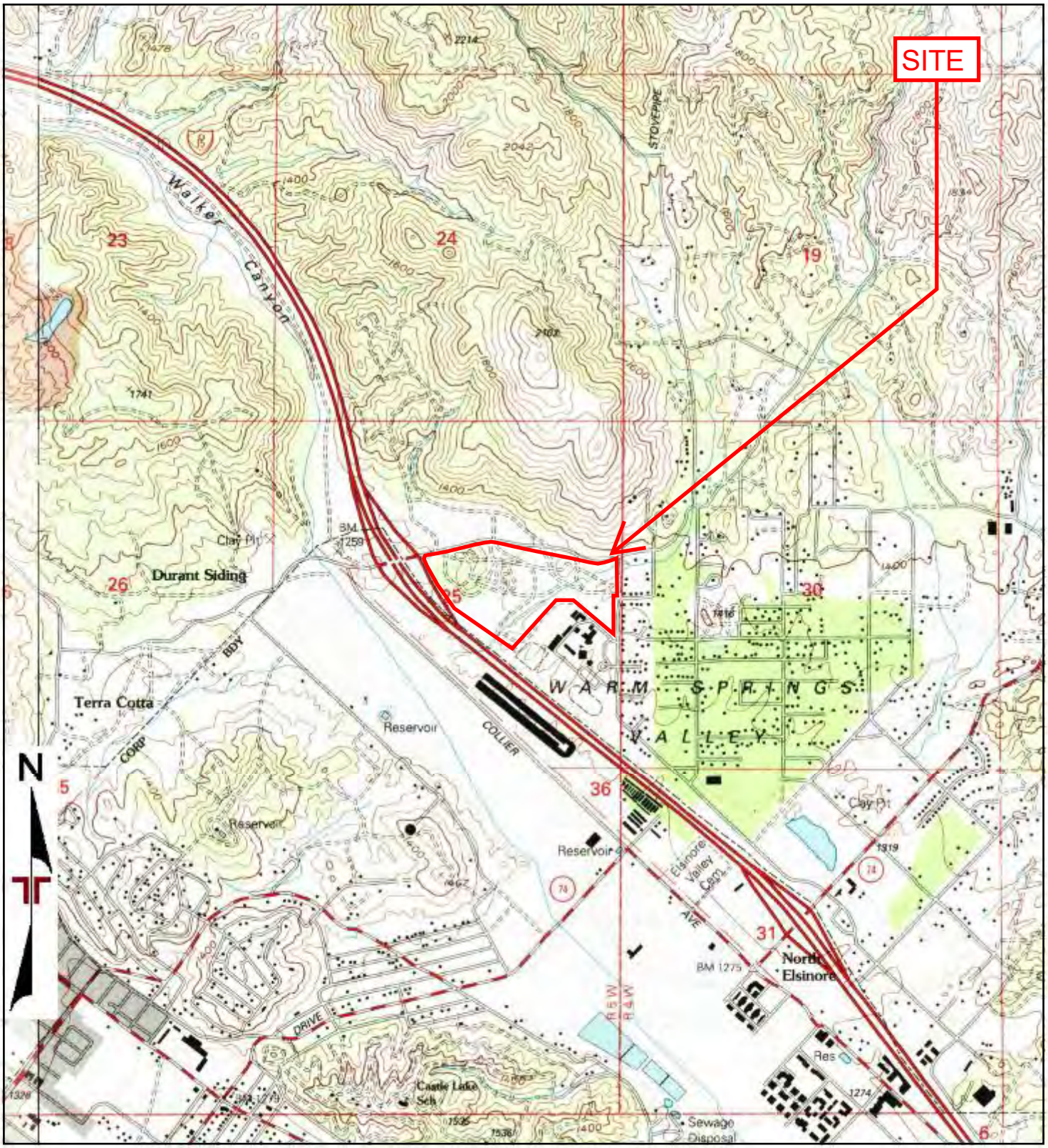
| | |
|---|---|
| Project Manager: JRR | Project No. 60177386 |
| Drawn by: JRR | Scale: As Shown |
| Checked by: CAP | File Name: TOPOS |
| Approved by: CAP | Date: 2012 |

Terracon
1421 Edinger Avenue, Suite C
Tustin, California 92780

2012 TOPOGRAPHIC MAP

TENTATIVE TRACT NO. 37305
APNs 389-200-037, 389-210-008, and 389-210-032
Lake Elsinore, Riverside County, California

Appendix C




TP, Lake Elsinore, 1997, 7.5-minute
W, Alberhill, 1997, 7.5-minute

0 Miles 0.25 0.5 1 1.5

| | |
|---|---|
| Project Manager: JRR | Project No. 60177386 |
| Drawn by: JRR | Scale: As Shown |
| Checked by: CAP | File Name: TOPOS |
| Approved by: CAP | Date: 1997 |

Terracon
1421 Edinger Avenue, Suite C
Tustin, California 92780

1997 TOPOGRAPHIC MAP

TENTATIVE TRACT NO. 37305
APNs 389-200-037, 389-210-008, and 389-210-032
Lake Elsinore, Riverside County, California

Appendix C

TP, Lake Elsinore, 1988, 7.5-minute
W, Alberhill, 1988, 7.5-minute

0 Miles 0.25 0.5 1 1.5

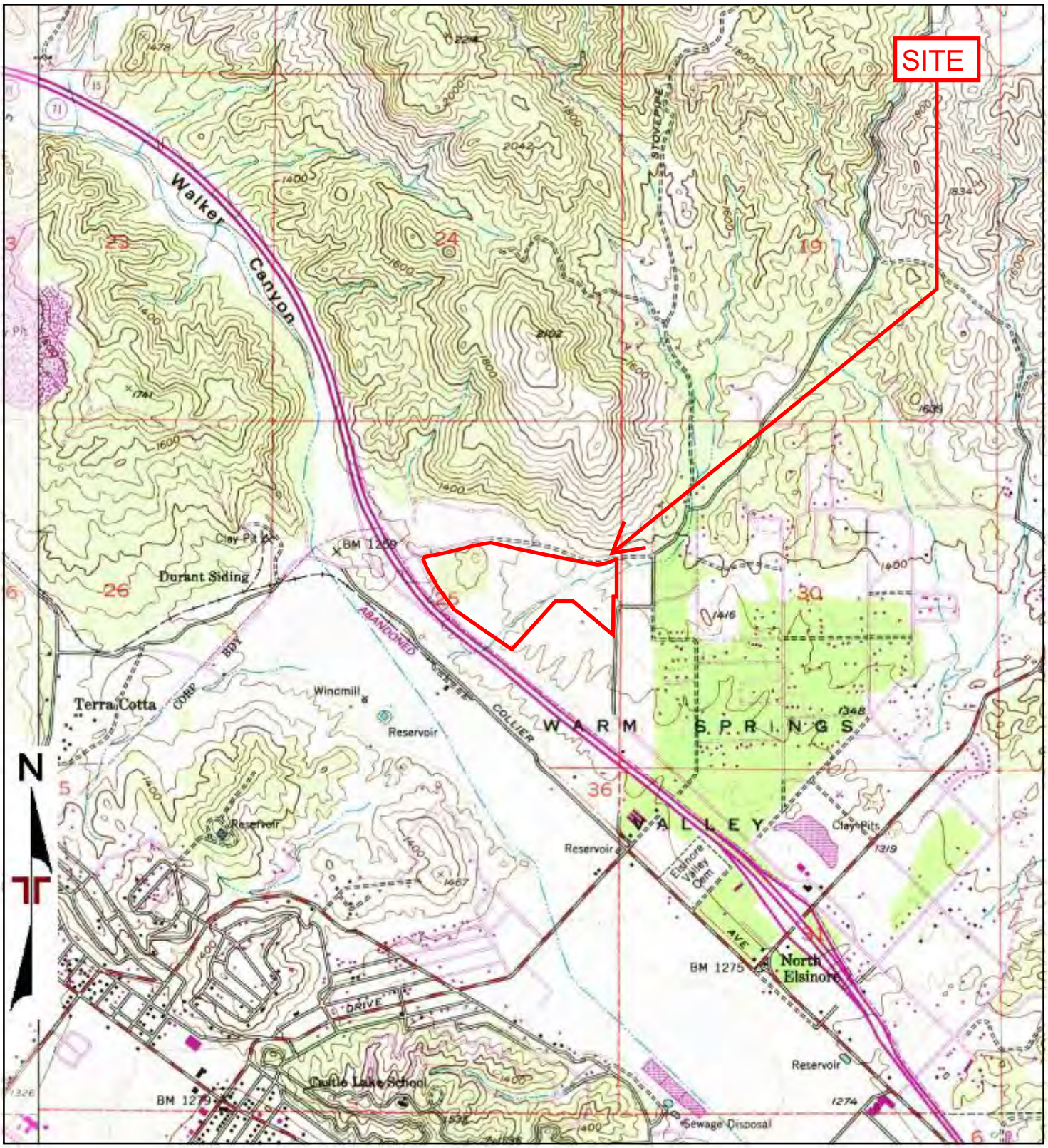
| | |
|---|---|
| Project Manager: JRR | Project No. 60177386 |
| Drawn by: JRR | Scale: As Shown |
| Checked by: CAP | File Name: TOPOS |
| Approved by: CAP | Date: 1988 |

Terracon
1421 Edinger Avenue, Suite C
Tustin, California 92780

1988 TOPOGRAPHIC MAP

TENTATIVE TRACT NO. 37305
APNs 389-200-037, 389-210-008, and 389-210-032
Lake Elsinore, Riverside County, California

Appendix C




TP, Lake Elsinore, 1982, 7.5-minute
W, Alberhill, 1982, 7.5-minute

0 Miles 0.25 0.5 1 1.5

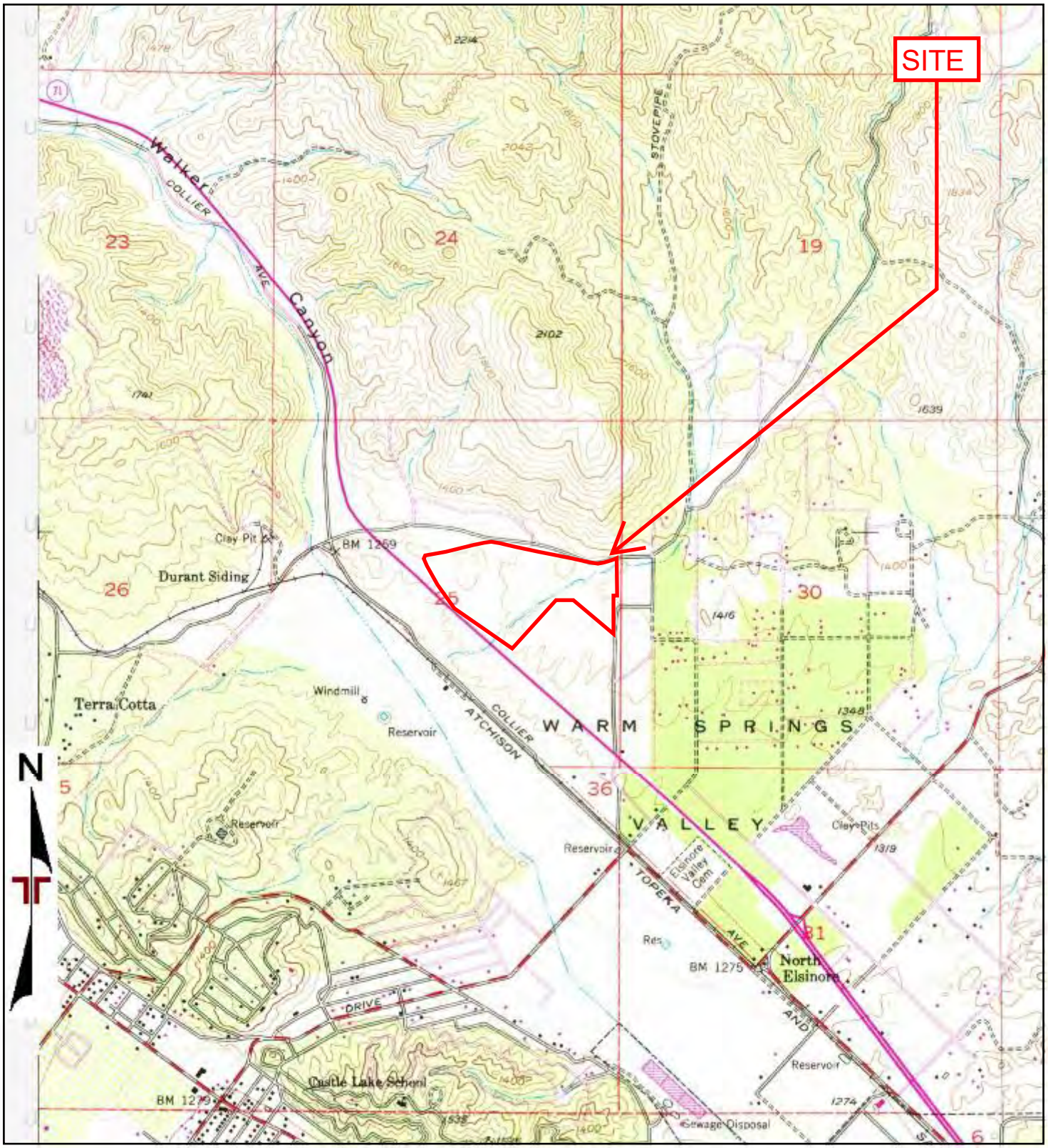
| | |
|---|---|
| Project Manager: JRR | Project No. 60177386 |
| Drawn by: JRR | Scale: As Shown |
| Checked by: CAP | File Name: TOPOS |
| Approved by: CAP | Date: 1982 |

Terracon
1421 Edinger Avenue, Suite C
Tustin, California 92780

1982 TOPOGRAPHIC MAP

TENTATIVE TRACT NO. 37305
APNs 389-200-037, 389-210-008, and 389-210-032
Lake Elsinore, Riverside County, California

Appendix C




TP, Lake Elsinore, 1978, 7.5-minute

0 Miles 0.25 0.5 1 1.5

| | |
|---|---|
| Project Manager: JRR | Project No. 60177386 |
| Drawn by: JRR | Scale: As Shown |
| Checked by: CAP | File Name: TOPOS |
| Approved by: CAP | Date: 1978 |

Terracon
1421 Edinger Avenue, Suite C
Tustin, California 92780

1978 TOPOGRAPHIC MAP

TENTATIVE TRACT NO. 37305
APNs 389-200-037, 389-210-008, and 389-210-032
Lake Elsinore, Riverside County, California

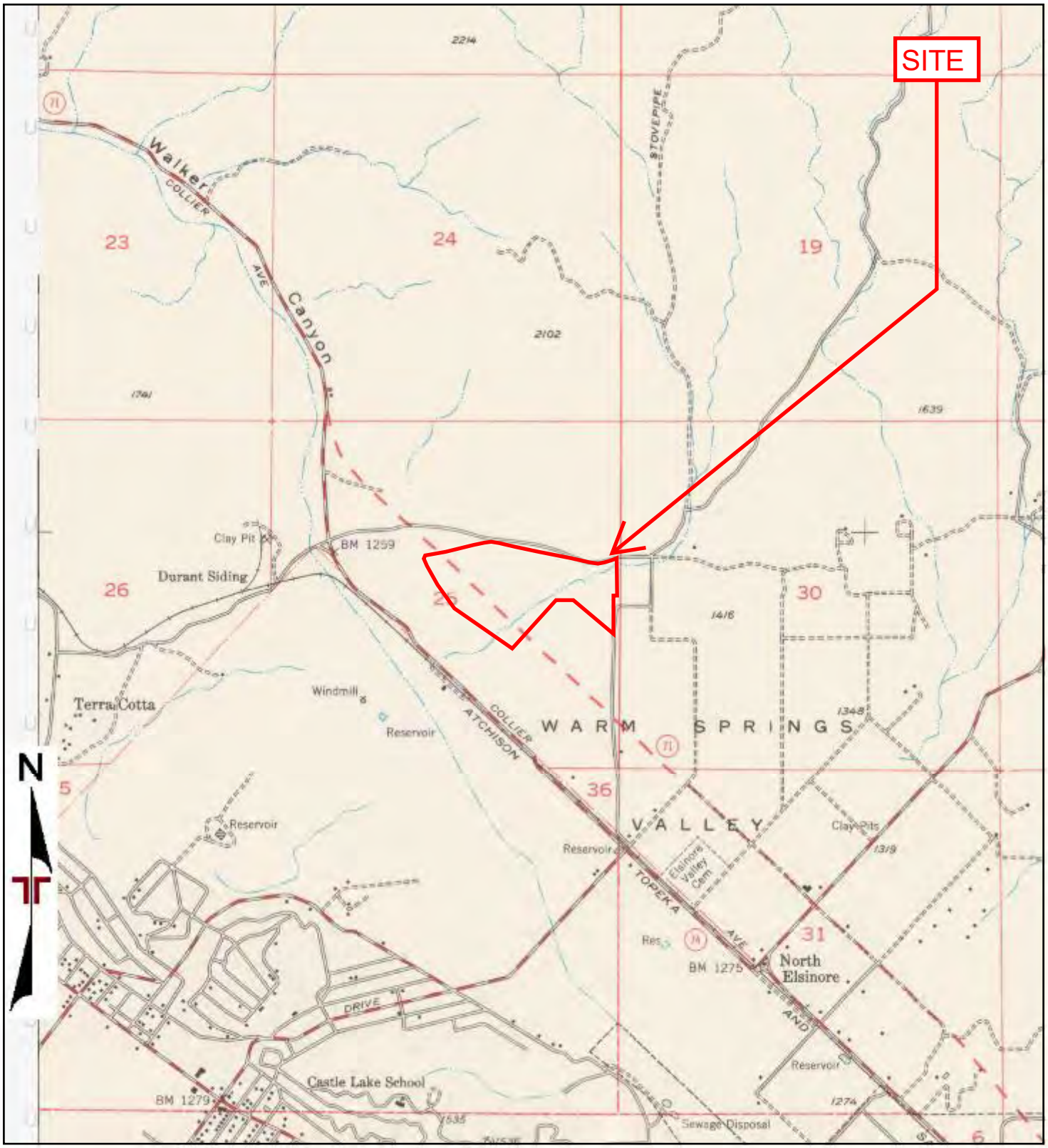
Appendix C

TP, Elsinore, 1973, 7.5-minute
W, Alberhill, 1973, 7.5-minute

0 Miles 0.25 0.5 1 1.5

| | | | |
|---|---|---|---|
| Project Manager: JRR | Project No. 60177386 | Terracon<br>1421 Edinger Avenue, Suite C<br>Tustin, California 92780 | 1973 TOPOGRAPHIC MAP<br>TENTATIVE TRACT NO. 37305<br>APNs 389-200-037, 389-210-008, and 389-210-032<br>Lake Elsinore, Riverside County, California |
| Drawn by: JRR | Scale: As Shown | | |
| Checked by: CAP | File Name: TOPOS | | |
| Approved by: CAP | Date: 1973 | | |

Appendix C




TP, Elsinore, 1953, 7.5-minute

0 Miles 0.25 0.5 1 1.5

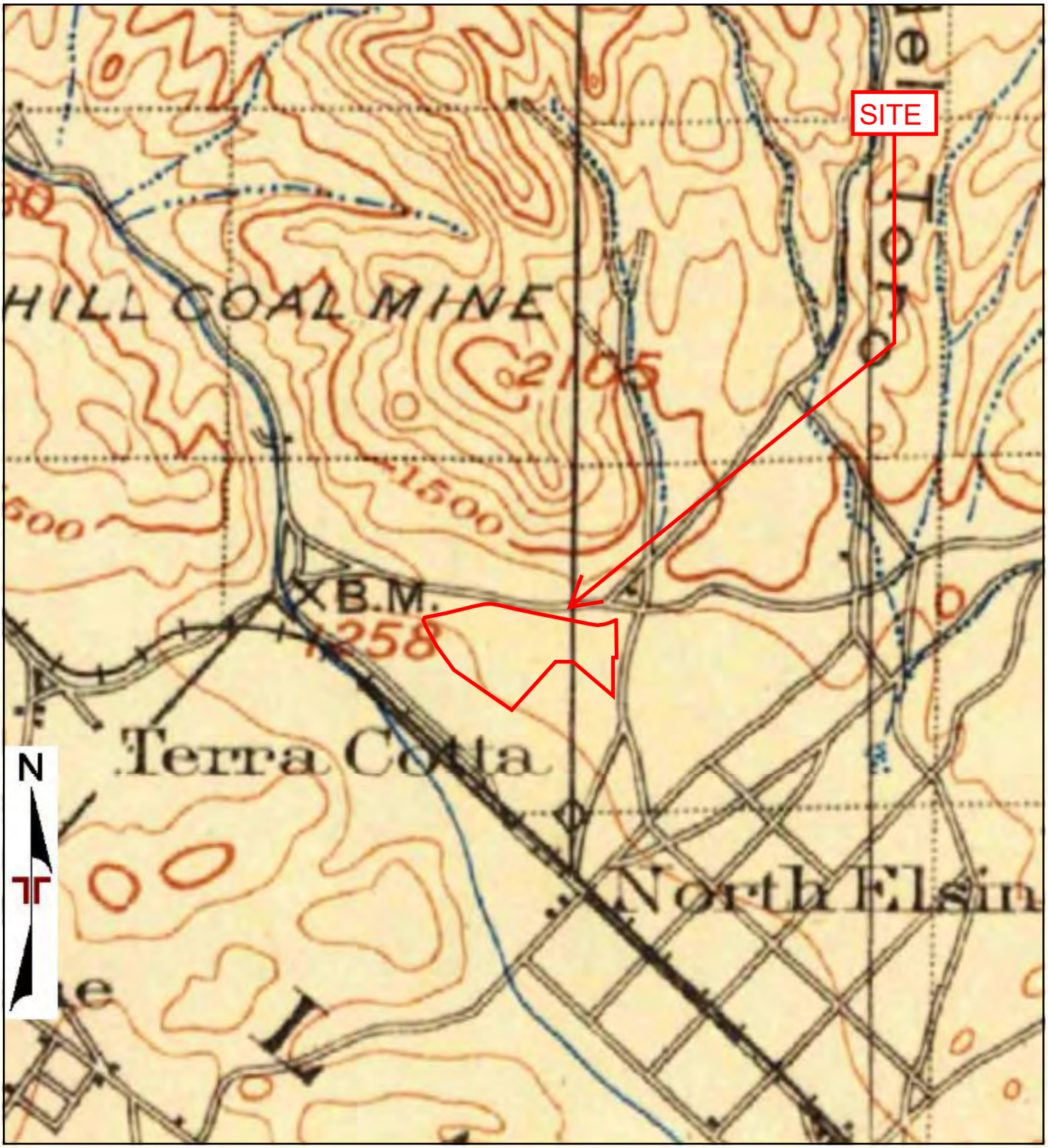
| | |
|---|---|
| Project Manager: JRR | Project No. 60177386 |
| Drawn by: JRR | Scale: As Shown |
| Checked by: CAP | File Name: TOPOS |
| Approved by: CAP | Date: 1953 |

Terracon
1421 Edinger Avenue, Suite C
Tustin, California 92780

1953 TOPOGRAPHIC MAP

TENTATIVE TRACT NO. 37305
APNs 389-200-037, 389-210-008, and 389-210-032
Lake Elsinore, Riverside County, California

Appendix C




TP, Elsinore, 1901, 30-minute

0 Miles 0.25 0.5 1 1.5

| | |
|---|---|
| Project Manager: JRR | Project No. 60177386 |
| Drawn by: JRR | Scale: As Shown |
| Checked by: CAP | File Name: TOPOS |
| Approved by: CAP | Date: 1901 |

Terracon
1421 Edinger Avenue, Suite C
Tustin, California 92780

1901 TOPOGRAPHIC MAP

TENTATIVE TRACT NO. 37305
APNs 389-200-037, 389-210-008, and 389-210-032
Lake Elsinore, Riverside County, California

Appendix C

TENTATIVE TRACT NO. 37305

Lake Elsinore, Riverside County, CA
92532

Inquiry Number: 4953892.9

June 02, 2017

# The EDR Aerial Photo Decade Package

6 Armstrong Road, 4th floor
Shelton, CT 06484
Toll Free: 800.352.0050
www.edrnet.com

# EDR Aerial Photo Decade Package

06/02/17

**Site Name:**

South Nichols Road Grading P
APN 389-200-037
Lake Elsinore, CA 92532
EDR Inquiry # 4953892.9

**Client Name:**

Terracon
1421 Edinger Avenue
Tustin, CA 92780
Contact: Ann Laudermilk

Environmental Data Resources, Inc. (EDR) Aerial Photo Decade Package is a screening tool designed to assist environmental professionals in evaluating potential liability on a target property resulting from past activities. EDR's professional researchers provide digitally reproduced historical aerial photographs, and when available, provide one photo per decade.

## Search Results:

| Year | Scale | Details | Source |
|---|---|---|---|
| 2012 | 1"=500' | Flight Year: 2012 | USDA/NAIP |
| 2010 | 1"=500' | Flight Year: 2010 | USDA/NAIP |
| 2009 | 1"=500' | Flight Year: 2009 | USDA/NAIP |
| 2005 | 1"=500' | Flight Year: 2005 | USDA/NAIP |
| 1994 | 1"=500' | Acquisition Date: June 01, 1994 | USGS/DOQQ |
| 1990 | 1"=500' | Flight Date: August 29, 1990 | USDA |
| 1989 | 1"=500' | Flight Date: August 15, 1989 | USDA |
| 1985 | 1"=500' | Flight Date: February 24, 1985 | USDA |
| 1978 | 1"=500' | Flight Date: September 20, 1978 | USDA |
| 1967 | 1"=500' | Flight Date: May 15, 1967 | USDA |
| 1961 | 1"=500' | Flight Date: June 15, 1961 | USDA |
| 1953 | 1"=500' | Flight Date: September 22, 1953 | USDA |
| 1949 | 1"=500' | Flight Date: May 06, 1949 | USDA |
| 1938 | 1"=500' | Flight Date: June 14, 1938 | USDA |

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0 Feet 500 1000 2000

| | | | |
|---|---|---|---|
| Project Manager: JRR | Project No. 60177386 | Terracon<br>1421 Edinger Avenue, Suite C<br>Tustin, California 92780 | 2012 AERIAL PHOTOGRAPH<br>TENTATIVE TRACT NO. 37305<br>APNs 389-200-037, 389-210-008, and 389-210-032<br>LAKE ELSINORE, RIVERSIDE COUNTY, CALIFORNIA |
| Drawn by: JRR | Scale: As Shown | | |
| Checked by: CAP | File Name: Aerials 1 | | |
| Approved by: CAP | Date: 2012 | | |

Appendix C

0 Feet 500 1000 2000

| | | | |
|---|---|---|---|
| Project Manager: JRR | Project No. 60177386 | Terracon<br>1421 Edinger Avenue, Suite C<br>Tustin, California 92780 | 2010 AERIAL PHOTOGRAPH<br>TENTATIVE TRACT NO. 37305<br>APNs 389-200-037, 389-210-008, and 389-210-032<br>LAKE ELSINORE, RIVERSIDE COUNTY, CALIFORNIA |
| Drawn by: JRR | Scale: As Shown | | |
| Checked by: CAP | File Name: NA | | |
| Approved by: CAP | Date: 2010 | | |

Appendix C

0 Feet 500 1000 2000

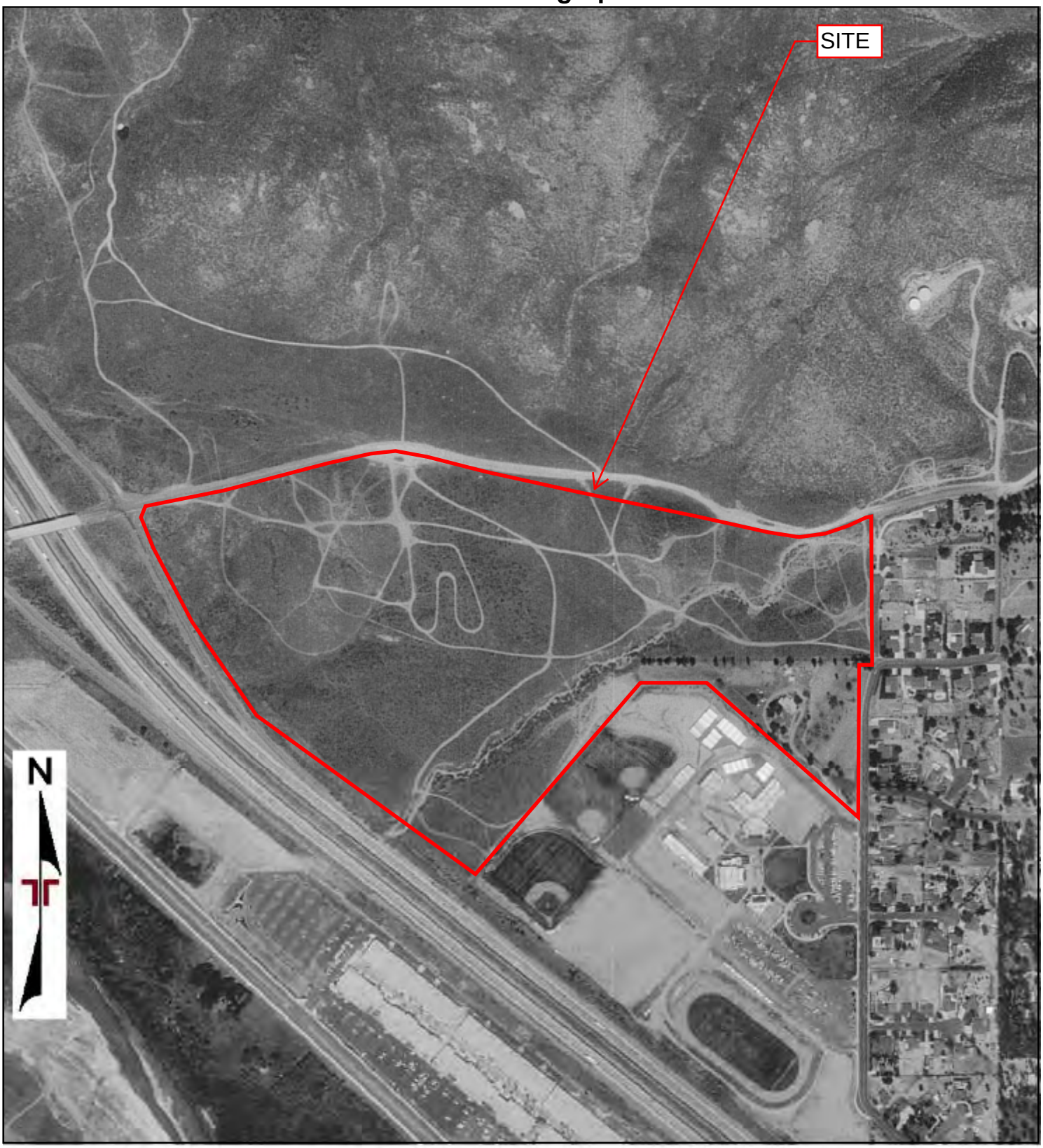
| | | | |
|---|---|---|---|
| Project Manager: JRR | Project No. 60177386 | Terracon | 2009 AERIAL PHOTOGRAPH |
| Drawn by: JRR | Scale: As Shown | 1421 Edinger Avenue, Suite C | TENTATIVE TRACT NO. 37305 |
| Checked by: CAP | File Name: NA | Tustin, California 92780 | APNs 389-200-037, 389-210-008, and 389-210-032 |
| Approved by: CAP | Date: 2009 | | LAKE ELSINORE, RIVERSIDE COUNTY, CALIFORNIA |

Appendix C

0 Feet 500 1000 2000

| | | | |
|---|---|---|---|
| Project Manager: JRR | Project No. 60177386 | Terracon<br>1421 Edinger Avenue, Suite C<br>Tustin, California 92780 | 2005 AERIAL PHOTOGRAPH<br>TENTATIVE TRACT NO. 37305<br>APNs 389-200-037, 389-210-008, and 389-210-032<br>LAKE ELSINORE, RIVERSIDE COUNTY, CALIFORNIA |
| Drawn by: JRR | Scale: As Shown | | |
| Checked by: CAP | File Name: NA | | |
| Approved by: CAP | Date: 2005 | | |

Appendix C




0 Feet 500 1000 2000

| | | | |
|---|---|---|---|
| Project Manager: JRR | Project No. 60177386 | Terracon<br>1421 Edinger Avenue, Suite C<br>Tustin, California 92780 | 1994 AERIAL PHOTOGRAPH<br>TENTATIVE TRACT NO. 37305<br>APNs 389-200-037, 389-210-008, and 389-210-032<br>LAKE ELSINORE, RIVERSIDE COUNTY, CALIFORNIA |
| Drawn by: JRR | Scale: As Shown | | |
| Checked by: CAP | File Name: NA | | |
| Approved by: CAP | Date: 1994 | | |

Appendix C

0 Feet 500 1000 2000

| | | | |
|---|---|---|---|
| Project Manager: JRR | Project No. 60177386 | Terracon | 1990 AERIAL PHOTOGRAPH |
| Drawn by: JRR | Scale: As Shown | 1421 Edinger Avenue, Suite C | TENTATIVE TRACT NO. 37305 |
| Checked by: CAP | File Name: NA | Tustin, California 92780 | APNs 389-200-037, 389-210-008, and 389-210-032 |
| Approved by: CAP | Date: 1990 | | LAKE ELSINORE, RIVERSIDE COUNTY, CALIFORNIA |

Appendix C

| | | | | |
|---|---|---|---|---|
| Project Manager: JRR | Project No. 60177386 | Terracon<br>1421 Edinger Avenue, Suite C<br>Tustin, California 92780 | 1989 AERIAL PHOTOGRAPHY<br>TENTATIVE TRACT NO. 37305<br>APNs 389-200-037, 389-210-008, and 389-210-032<br>LAKE ELSINORE, RIVERSIDE COUNTY, CALIFORNIA | Appendix<br>C |
| Drawn by: JRR | Scale: As Shown | | | |
| Checked by: CAP | File Name: NA | | | |
| Approved by: CAP | Date: 1989 | | | |

0 Feet 500 1000 2000

| | | | |
|---|---|---|---|
| Project Manager: JRR | Project No. 60177386 | Terracon | 1978 AERIAL PHOTOGRAPH |
| Drawn by: JRR | Scale: As Shown | 1421 Edinger Avenue, Suite C | TENTATIVE TRACT NO. 37305 |
| Checked by: CAP | File Name: NA | Tustin, California 92780 | APNs 389-200-037, 389-210-008, and 389-210-032 |
| Approved by: CAP | Date: 1978 | | LAKE ELSINORE, RIVERSIDE COUNTY, CALIFORNIA |

Appendix C

0 Feet 500 1000 2000

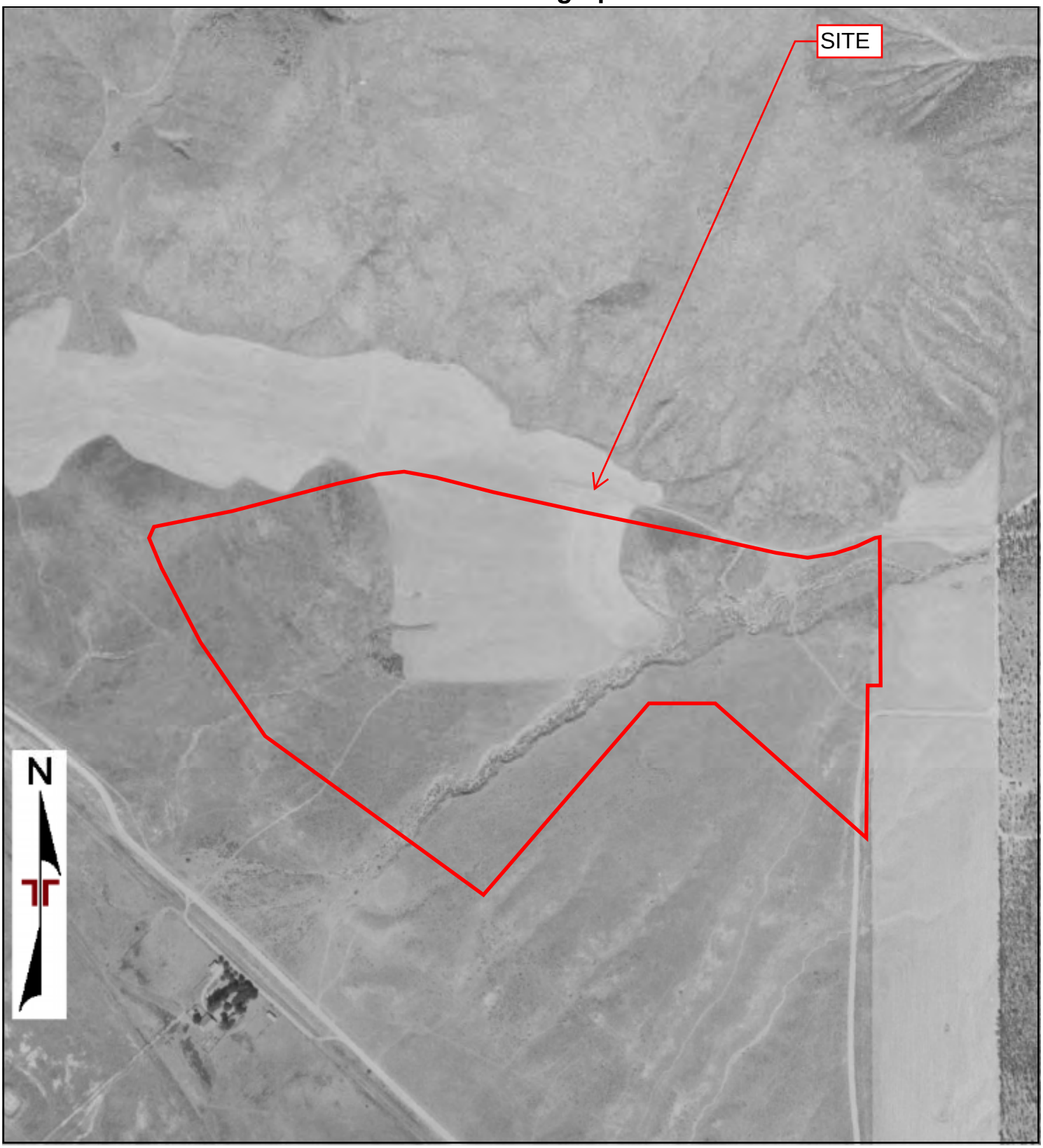
| | | | |
|---|---|---|---|
| Project Manager: JRR | Project No. 60177386 | Terracon<br>1421 Edinger Avenue, Suite C<br>Tustin, California 92780 | 1967 AERIAL PHOTOGRAPH<br>TENTATIVE TRACT NO. 37305<br>APNs 389-200-037, 389-210-008, and 389-210-032<br>LAKE ELSINORE, RIVERSIDE COUNTY, CALIFORNIA |
| Drawn by: JRR | Scale: As Shown | | |
| Checked by: CAP | File Name: NA | | |
| Approved by: CAP | Date: 1967 | | |

Appendix C

0 Feet 500 1000 2000

| | | | |
|---|---|---|---|
| Project Manager: JRR | Project No. 60177386 | Terracon<br>1421 Edinger Avenue, Suite C<br>Tustin, California 92780 | 1961 AERIAL PHOTOGRAPH<br>TENTATIVE TRACT NO. 37305<br>APNs 389-200-037, 389-210-008, and 389-210-032<br>LAKE ELSINORE, RIVERSIDE COUNTY, CALIFORNIA |
| Drawn by: JRR | Scale: As Shown | | |
| Checked by: CAP | File Name: NA | | |
| Approved by: CAP | Date: 1961 | | |

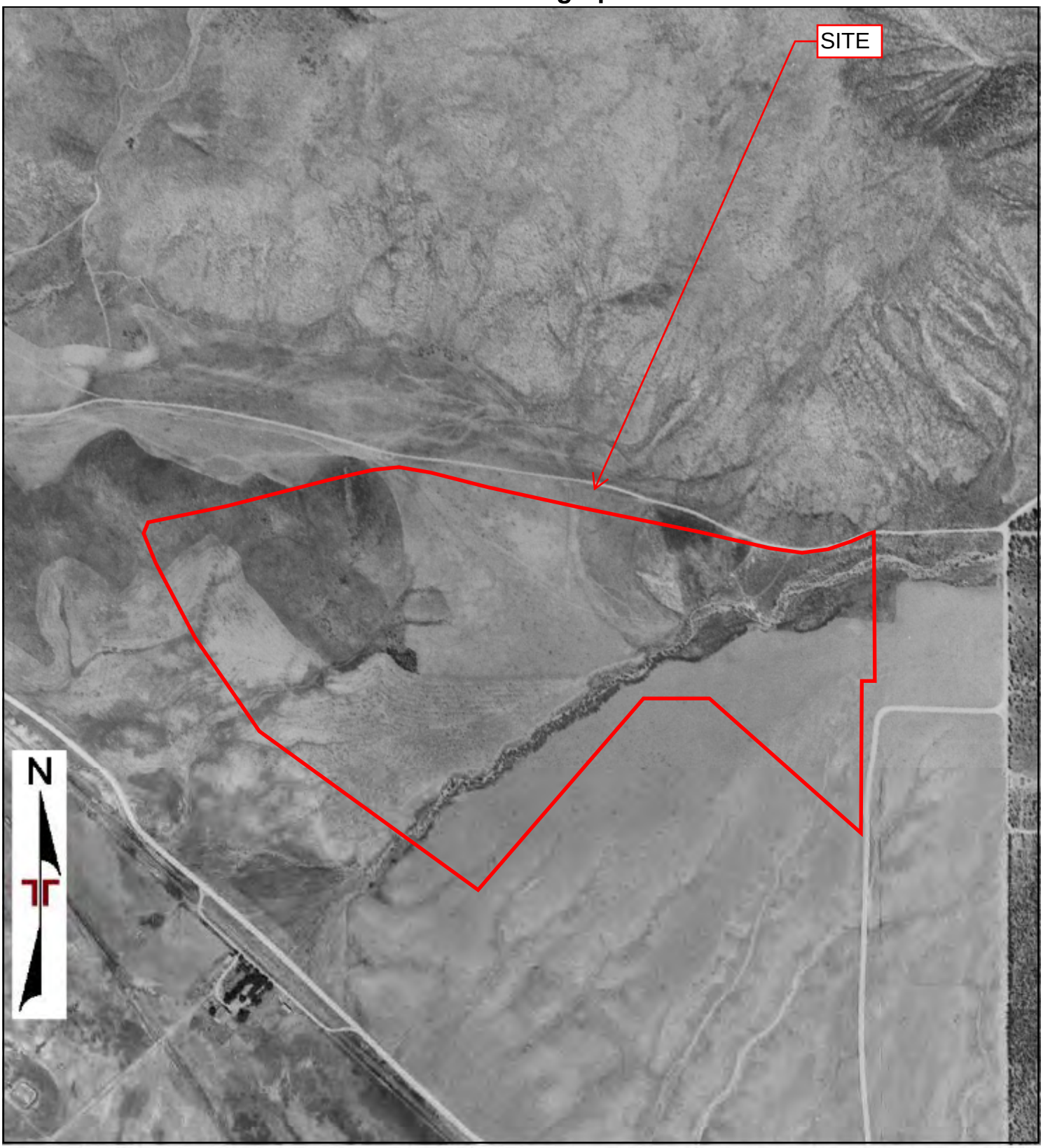
Appendix C




0 Feet 500 1000 2000

| | | | |
|---|---|---|---|
| Project Manager: JRR | Project No. 60177386 | Terracon<br>1421 Edinger Avenue, Suite C<br>Tustin, California 92780 | 1953 AERIAL PHOTOGRAPH<br>TENTATIVE TRACT NO. 37305<br>APNs 389-200-037, 389-210-008, and 389-210-032<br>LAKE ELSINORE, RIVERSIDE COUNTY, CALIFORNIA |
| Drawn by: JRR | Scale: As Shown | | |
| Checked by: CAP | File Name: NA | | |
| Approved by: CAP | Date: 1953 | | |

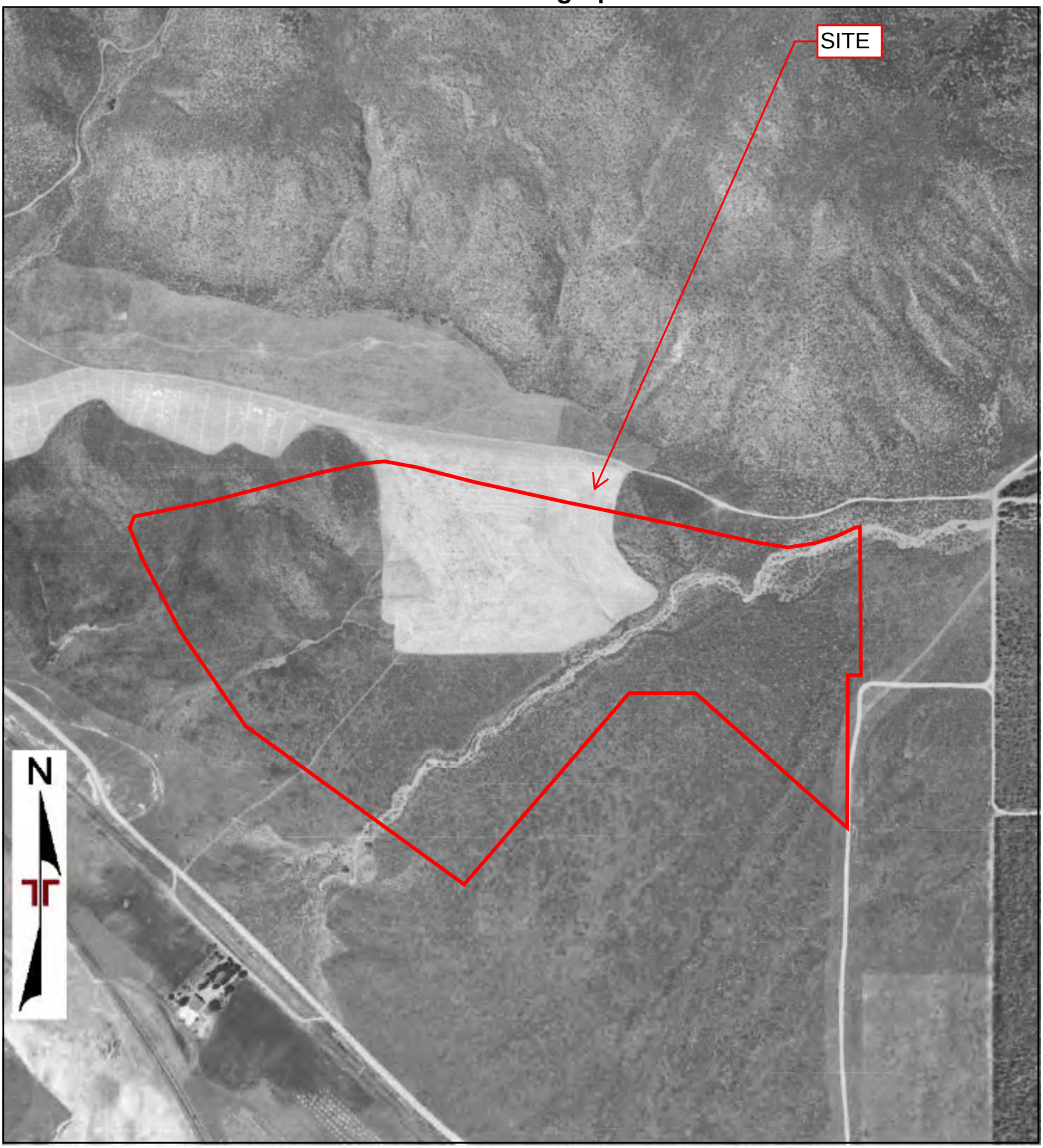
Appendix C




0 Feet 500 1000 2000

| | | | |
|---|---|---|---|
| Project Manager: JRR | Project No. 60177386 | Terracon<br>1421 Edinger Avenue, Suite C<br>Tustin, California 92780 | 1949 AERIAL PHOTOGRAPH<br>TENTATIVE TRACT NO. 37305<br>APNs 389-200-037, 389-210-008, and 389-210-032<br>LAKE ELSINORE, RIVERSIDE COUNTY, CALIFORNIA |
| Drawn by: JRR | Scale: As Shown | | |
| Checked by: CAP | File Name: NA | | |
| Approved by: CAP | Date: 1949 | | |

Appendix C




0 Feet 500 1000 2000

| | | | |
|---|---|---|---|
| Project Manager: JRR | Project No. 60177386 | Terracon<br>1421 Edinger Avenue, Suite C<br>Tustin, California 92780 | 1938 AERIAL PHOTOGRAPH<br>TENTATIVE TRACT NO. 37305<br>APNs 389-200-037, 389-210-008, and 389-210-032<br>LAKE ELSINORE, RIVERSIDE COUNTY, CALIFORNIA |
| Drawn by: JRR | Scale: As Shown | | |
| Checked by: CAP | File Name: NA | | |
| Approved by: CAP | Date: 1938 | | |

Appendix C

TENTATIVE TRACT NO. 37305
APN 389-200-037
Lake Elsinore, CA 92532

Inquiry Number: 4953892.5
June 05, 2017

# The EDR-City Directory Image Report

Environmental Data Resources Inc

6 Armstrong Road
Shelton, CT 06484
800.352.0050
www.edrnet.com

# TABLE OF CONTENTS

## SECTION

**Executive Summary**

**Findings**

**City Directory Images**

***Thank you for your business.***
Please contact EDR at 1-800-352-0050
with any questions or comments.

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# EXECUTIVE SUMMARY

## DESCRIPTION

Environmental Data Resources, Inc.'s (EDR) City Directory Report is a screening tool designed to assist environmental professionals in evaluating potential liability on a target property resulting from past activities. EDR's City Directory Report includes a search of available city directory data at 5 year intervals.

## RESEARCH SUMMARY

The following research sources were consulted in the preparation of this report. A check mark indicates where information was identified in the source and provided in this report.

| *Year* | *Target Street* | *Cross Street* | *Source* |
|---|---|---|---|
| 2013 | ☐ | ☐ | Cole Information Services |
| 2008 | ☑ | ☐ | Cole Information Services |
| 2003 | ☑ | ☐ | Cole Information Services |
| 1999 | ☑ | ☐ | Cole Information Services |
| 1995 | ☑ | ☐ | Cole Information Services |
| 1992 | ☑ | ☐ | Cole Information Services |
| 1990 | ☑ | ☐ | Haines Criss-Cross Directory |
| 1985 | ☑ | ☐ | Haines Criss-Cross Directory |
| 1980 | ☐ | ☐ | Haines Criss-Cross Directory |
| 1975 | ☐ | ☐ | Haines Criss-Cross Directory |

## RECORD SOURCES

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# FINDINGS

## TARGET PROPERTY STREET

APN 389-200-037
Lake Elsinore, CA 92532

| *Year* | *CD Image* | *Source* | |
|---|---|---|---|

## NICHOLS RD

| | | | |
|---|---|---|---|
| 2013 | - | Cole Information Services | Target and Adjoining not listed in Source |
| 2008 | pg A1 | Cole Information Services | |
| 2003 | pg A2 | Cole Information Services | |
| 1999 | pg A3 | Cole Information Services | |
| 1995 | pg A4 | Cole Information Services | |
| 1992 | pg A5 | Cole Information Services | |
| 1990 | pg A6 | Haines Criss-Cross Directory | |
| 1985 | pg A7 | Haines Criss-Cross Directory | |
| 1980 | - | Haines Criss-Cross Directory | Street not listed in Source |
| 1975 | - | Haines Criss-Cross Directory | Street not listed in Source |

# FINDINGS

## CROSS STREETS

No Cross Streets Identified

# City Directory Images

| Target Street | Cross Street | Source |
|---|---|---|
| ✓ | - | Cole Information Services |

# NICHOLS RD 2008

| | |
|---|---|
| 18975 | L S C PERFORMANCE |
| 29511 | SUA VICKERS |
| 29541 | OCCUPANT UNKNOWN |
| 29570 | MIRIT JARON |
| 29590 | OCCUPANT UNKNOWN |
| 29595 | DARYL BEATTIE |
| 29600 | JEFF HOLL |
| 29610 | WILLIAM MONTELEONE |

| Target Street | Cross Street | Source |
|---|---|---|
| ✓ | - | Cole Information Services |

# NICHOLS RD 2003

| | |
|---|---|
| 18975 | JACK SMEDLEY |
| | LSC ENGINEERING |
| 29492 | OCCUPANT UNKNOWN |
| 29511 | RONALD VINSON |
| 29541 | JOANN JAWOROSKI |
| 29570 | MARY SILVA-MONTANO |
| 29590 | GLEN BURCHFIELD |
| 29595 | BEBE BEATTIE |
| 29600 | MARY STAPLES |
| 29610 | WILLIAM MONTELEONE |

| Target Street | Cross Street | Source |
|---|---|---|
| ✓ | - | Cole Information Services |

## NICHOLS RD 1999

29570 OCCUPANT UNKNOWN
29595 OCCUPANT UNKNOWN
29600 OCCUPANT UNKNOWN

| Target Street | Cross Street | Source |
|---|---|---|
| ✓ | - | Cole Information Services |

# NICHOLS RD 1995

| | |
|---|---|
| 18938 | A LUA WOOD RECYCLING |
| | LUA TRUCKING |
| 18975 | C & S MACHINE INC |
| 19011 | MATSON PRODUCTS INC |
| 29511 | OCCUPANT UNKNOWNN |
| 29541 | GRIFFIN, MICKEY L |
| 29570 | MONTANO, ALFREDO P |
| 29600 | OCCUPANT UNKNOWNN |
| 29610 | MONTELEONE, HELEN |

| Target Street | Cross Street | Source |
|---|---|---|
| ✓ | - | Cole Information Services |

# NICHOLS RD 1992

| | |
|---|---|
| 18975 | C&S MACHINE INC |
| | CUNICO |
| | SILOXANE TECHS INC |
| 19011 | MATSON PRODUCTS INC |
| 29511 | JAWOROSKI, LEON F |
| 29570 | HOFREITER, ALLEN |
| 29600 | HOLL, JEFFREY |

| Target Street | Cross Street | Source |
|---|---|---|
| ✓ | - | Haines Criss-Cross Directory |

**NICHOLS RD 1990**

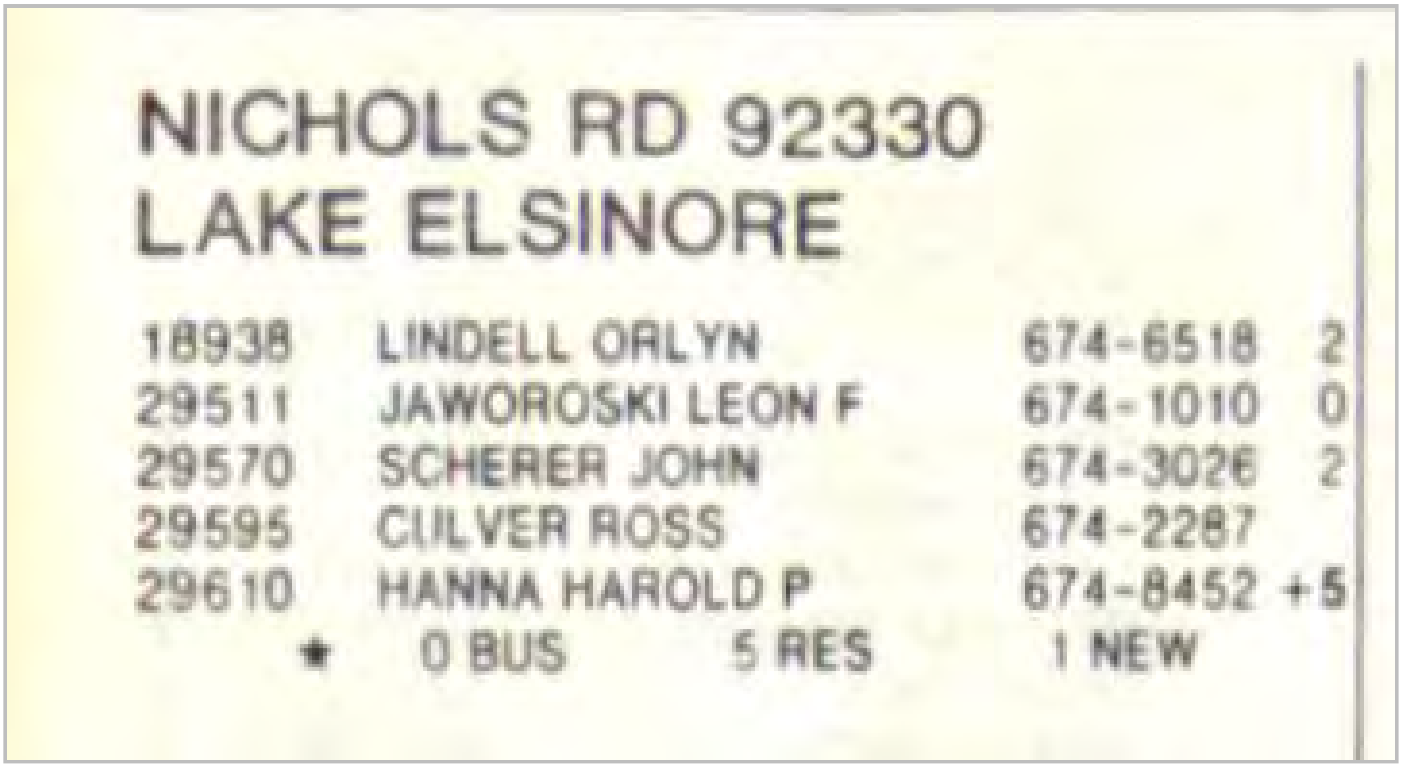
# NICHOLS RD (82) 92330
# LAKE ELSINORE

| | | | |
|---|---|---|---|
| 18938 | LINDELL Orlyn | 674-6518 | 2 |
| 18975 | *C&S MACHINE INC | 674-2196 | 9 |
| | *CUNICO | 674-2987 | 9 |
| | *J R W PRDCTNS&SONS | 674-3040 | +0 |
| | *SANDAL TECHNOLOGY | 674-1306 | +0 |
| | *SILOXANE TECHS INC | 674-0681 | 9 |
| 19011 | *CAL BRICK MTSN PRDS | 674-7791 | 9 |
| | *DESIGNER CABINT DRS | 674-8502 | 7 |
| | MATHIEU Robert | 00 | 4 |
| | *MATSON PRODUCTS INC | 674-7791 | 9 |
| 29511 | JAWOROSKI Leon F | 674-1010 | |
| 29541 | GRIFFIN Joann | 00 | 4 |
| 29570 | HOFREITER Allen | 674-4873 | +0 |
| 29610 | XXXX | 00 | |

* 8 BUS 6 RES 3 NEW

| Target Street | Cross Street | Source |
|---|---|---|
| ✓ | - | Haines Criss-Cross Directory |

**NICHOLS RD 1985**



NICHOLS RD 92330
LAKE ELSINORE

| | | | |
|---|---|---|---|
| 18938 | LINDELL ORLYN | 674-6518 | 2 |
| 29511 | JAWOROSKI LEON F | 674-1010 | 0 |
| 29570 | SCHERER JOHN | 674-3026 | 2 |
| 29595 | CULVER ROSS | 674-2287 | |
| 29610 | HANNA HAROLD P | 674-8452 | +5 |

★ 0 BUS 5 RES 1 NEW

# APPENDIX D
# ENVIRONMENTAL DATABASE INFORMATION

TENTATIVE TRACT NO. 37305
South of Nichols Road & East of I-15
Lake Elsinore, CA 92532

Inquiry Number: 5131747.2s
December 07, 2017

# The EDR Radius Map™ Report

6 Armstrong Road, 4th floor
Shelton, CT 06484
Toll Free: 800.352.0050
www.edrnet.com

# TABLE OF CONTENTS


| SECTION | PAGE |
|---|---|
| Executive Summary | ES1 |
| Overview Map | 2 |
| Detail Map | 3 |
| Map Findings Summary | 4 |
| Map Findings | 8 |
| Orphan Summary | 12 |
| Government Records Searched/Data Currency Tracking | GR-1 |

**GEOCHECK ADDENDUM**

**GeoCheck - Not Requested**


***Thank you for your business.***
Please contact EDR at 1-800-352-0050
with any questions or comments.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# EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc. (EDR).
The results of this search follow:

**TARGET PROPERTY ADDRESS**

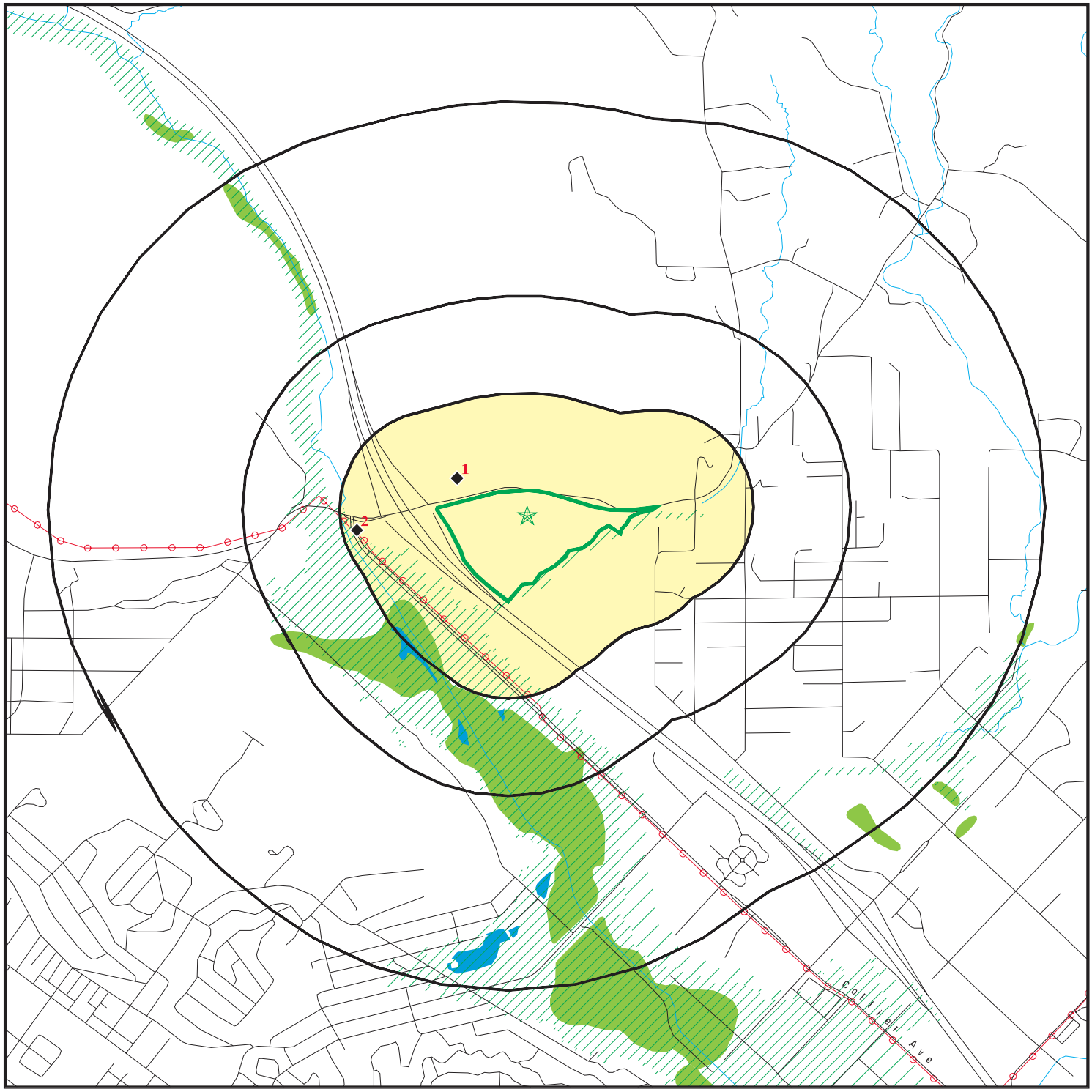
MIXED USE DEVELOPMENT
SOUTH OF NICHOLS ROAD & EAST OF I-15
LAKE ELSINORE, CA 92532
Elevation: 1324 ft.
EDR Inquiry Number: 5131747.2s

**TARGET PROPERTY SEARCH RESULTS**

Site

| Map ID | STANDARD ENVIRONMENTAL RECORDS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ADDITIONAL ENVIRONMENTAL RECORDS | | | | | | | | | | | | | | | | | | |

# OVERVIEW MAP - 5131747.2S




0 1/4 1/2 1 Miles

- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- National Priority List Sites
- Dept. Defense Sites
- Indian Reservations BIA
- Power transmission lines
- 100-year flood zone
- 500-year flood zone
- National Wetland Inventory
- State Wetlands
- Upgradient Area
- Areas of Concern

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

| | | | |
|---|---|---|---|
| SITE NAME: | Mixed Use Development | CLIENT: | Terracon |
| ADDRESS: | South of Nichols Road & East of I-15<br>Lake Elsinore CA 92532 | CONTACT: | Jeremy Rosenthal |
| LAT/LONG: | 33.706882 / 117.352422 | INQUIRY #: | 5131747.2s |
| | | DATE: | December 07, 2017 4:55 pm |

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# DETAIL MAP - 5131747.2S

Target Property
Sites at elevations higher than or equal to the target property
Sites at elevations lower than the target property
Manufactured Gas Plants
Sensitive Receptors
National Priority List Sites
Dept. Defense Sites

0 1/8 1/4 1/2 Miles

Indian Reservations BIA
Power transmission lines
100-year flood zone
500-year flood zone
National Wetland Inventory
State Wetlands

Areas of Concern

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

| | | | |
|---|---|---|---|
| SITE NAME: | Mixed Use Development | CLIENT: | Terracon |
| ADDRESS: | South of Nichols Road & East of I-15<br>Lake Elsinore CA 92532 | CONTACT: | Jeremy Rosenthal |
| LAT/LONG: | 33.706882 / 117.352422 | INQUIRY #: | 5131747.2s |
| | | DATE: | December 07, 2017 4:56 pm |

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# MAP FINDINGS SUMMARY

| Database | Search Distance (Miles) | Target Property | < 1/8 | 1/8 - 1/4 | 1/4 - 1/2 | 1/2 - 1 | > 1 | Total Plotted |
|---|---|---|---|---|---|---|---|---|
| **STANDARD ENVIRONMENTAL RECORDS** | | | | | | | | |
| ***Federal NPL site list*** | | | | | | | | |
| NPL | 1.000 | | 0 | 0 | 0 | 0 | NR | 0 |
| Proposed NPL | 1.000 | | 0 | 0 | 0 | 0 | NR | 0 |
| NPL LIENS | TP | | NR | NR | NR | NR | NR | 0 |
| ***Federal Delisted NPL site list*** | | | | | | | | |
| Delisted NPL | 1.000 | | 0 | 0 | 0 | 0 | NR | 0 |
| ***Federal CERCLIS list*** | | | | | | | | |
| FEDERAL FACILITY | 0.500 | | 0 | 0 | 0 | NR | NR | 0 |
| SEMS | 0.500 | | 0 | 0 | 0 | NR | NR | 0 |
| ***Federal CERCLIS NFRAP site list*** | | | | | | | | |
| SEMS-ARCHIVE | 0.500 | | 0 | 0 | 0 | NR | NR | 0 |
| ***Federal RCRA CORRACTS facilities list*** | | | | | | | | |
| CORRACTS | 1.000 | | 0 | 0 | 0 | 0 | NR | 0 |
| ***Federal RCRA non-CORRACTS TSD facilities list*** | | | | | | | | |
| RCRA-TSDF | 0.500 | | 0 | 0 | 0 | NR | NR | 0 |
| ***Federal RCRA generators list*** | | | | | | | | |
| RCRA-LQG | 0.250 | | 0 | 0 | NR | NR | NR | 0 |
| RCRA-SQG | 0.250 | | 0 | 1 | NR | NR | NR | 1 |
| RCRA-CESQG | 0.250 | | 0 | 0 | NR | NR | NR | 0 |
| ***Federal institutional controls / engineering controls registries*** | | | | | | | | |
| LUCIS | 0.500 | | 0 | 0 | 0 | NR | NR | 0 |
| US ENG CONTROLS | 0.500 | | 0 | 0 | 0 | NR | NR | 0 |
| US INST CONTROL | 0.500 | | 0 | 0 | 0 | NR | NR | 0 |
| ***Federal ERNS list*** | | | | | | | | |
| ERNS | TP | | NR | NR | NR | NR | NR | 0 |
| ***State- and tribal - equivalent NPL*** | | | | | | | | |
| RESPONSE | 1.000 | | 0 | 0 | 0 | 0 | NR | 0 |
| ***State- and tribal - equivalent CERCLIS*** | | | | | | | | |
| ENVIROSTOR | 1.000 | | 0 | 0 | 0 | 0 | NR | 0 |
| ***State and tribal landfill and/or solid waste disposal site lists*** | | | | | | | | |
| SWF/LF | 0.500 | | 0 | 0 | 0 | NR | NR | 0 |
| ***State and tribal leaking storage tank lists*** | | | | | | | | |
| LUST | 0.500 | | 0 | 0 | 0 | NR | NR | 0 |

# MAP FINDINGS SUMMARY

| Database | Search Distance (Miles) | Target Property | < 1/8 | 1/8 - 1/4 | 1/4 - 1/2 | 1/2 - 1 | > 1 | Total Plotted |
|---|---|---|---|---|---|---|---|---|
| INDIAN LUST | 0.500 | | 0 | 0 | 0 | NR | NR | 0 |
| SLIC | 0.500 | | 0 | 0 | 0 | NR | NR | 0 |
| ***State and tribal registered storage tank lists*** | | | | | | | | |
| FEMA UST | 0.250 | | 0 | 0 | NR | NR | NR | 0 |
| UST | 0.250 | | 0 | 0 | NR | NR | NR | 0 |
| AST | 0.250 | | 0 | 0 | NR | NR | NR | 0 |
| INDIAN UST | 0.250 | | 0 | 0 | NR | NR | NR | 0 |
| ***State and tribal voluntary cleanup sites*** | | | | | | | | |
| VCP | 0.500 | | 0 | 0 | 0 | NR | NR | 0 |
| INDIAN VCP | 0.500 | | 0 | 0 | 0 | NR | NR | 0 |
| ***State and tribal Brownfields sites*** | | | | | | | | |
| BROWNFIELDS | 0.500 | | 0 | 0 | 0 | NR | NR | 0 |
| **ADDITIONAL ENVIRONMENTAL RECORDS** | | | | | | | | |
| ***Local Brownfield lists*** | | | | | | | | |
| US BROWNFIELDS | 0.500 | | 0 | 0 | 0 | NR | NR | 0 |
| ***Local Lists of Landfill / Solid Waste Disposal Sites*** | | | | | | | | |
| WMUDS/SWAT | 0.500 | | 0 | 0 | 0 | NR | NR | 0 |
| SWRCY | 0.500 | | 0 | 0 | 0 | NR | NR | 0 |
| HAULERS | TP | | NR | NR | NR | NR | NR | 0 |
| INDIAN ODI | 0.500 | | 0 | 0 | 0 | NR | NR | 0 |
| DEBRIS REGION 9 | 0.500 | | 0 | 0 | 0 | NR | NR | 0 |
| ODI | 0.500 | | 0 | 0 | 0 | NR | NR | 0 |
| IHS OPEN DUMPS | 0.500 | | 0 | 0 | 0 | NR | NR | 0 |
| ***Local Lists of Hazardous waste / Contaminated Sites*** | | | | | | | | |
| US HIST CDL | TP | | NR | NR | NR | NR | NR | 0 |
| HIST Cal-Sites | 1.000 | | 0 | 0 | 0 | 0 | NR | 0 |
| SCH | 0.250 | | 0 | 0 | NR | NR | NR | 0 |
| CDL | TP | | NR | NR | NR | NR | NR | 0 |
| Toxic Pits | 1.000 | | 0 | 0 | 0 | 0 | NR | 0 |
| US CDL | TP | | NR | NR | NR | NR | NR | 0 |
| ***Local Lists of Registered Storage Tanks*** | | | | | | | | |
| SWEEPS UST | 0.250 | | 0 | 0 | NR | NR | NR | 0 |
| HIST UST | 0.250 | | 0 | 0 | NR | NR | NR | 0 |
| CA FID UST | 0.250 | | 0 | 0 | NR | NR | NR | 0 |
| ***Local Land Records*** | | | | | | | | |
| LIENS | TP | | NR | NR | NR | NR | NR | 0 |
| LIENS 2 | TP | | NR | NR | NR | NR | NR | 0 |
| DEED | 0.500 | | 0 | 0 | 0 | NR | NR | 0 |
| ***Records of Emergency Release Reports*** | | | | | | | | |
| HMIRS | TP | | NR | NR | NR | NR | NR | 0 |

# MAP FINDINGS SUMMARY

| Database | Search Distance (Miles) | Target Property | < 1/8 | 1/8 - 1/4 | 1/4 - 1/2 | 1/2 - 1 | > 1 | Total Plotted |
|---|---|---|---|---|---|---|---|---|
| CHMIRS | TP | | NR | NR | NR | NR | NR | 0 |
| LDS | TP | | NR | NR | NR | NR | NR | 0 |
| MCS | TP | | NR | NR | NR | NR | NR | 0 |
| SPILLS 90 | TP | | NR | NR | NR | NR | NR | 0 |
| ***Other Ascertainable Records*** | | | | | | | | |
| RCRA NonGen / NLR | 0.250 | | 0 | 0 | NR | NR | NR | 0 |
| FUDS | 1.000 | | 0 | 0 | 0 | 0 | NR | 0 |
| DOD | 1.000 | | 0 | 0 | 0 | 0 | NR | 0 |
| SCRD DRYCLEANERS | 0.500 | | 0 | 0 | 0 | NR | NR | 0 |
| US FIN ASSUR | TP | | NR | NR | NR | NR | NR | 0 |
| EPA WATCH LIST | TP | | NR | NR | NR | NR | NR | 0 |
| 2020 COR ACTION | 0.250 | | 0 | 0 | NR | NR | NR | 0 |
| TSCA | TP | | NR | NR | NR | NR | NR | 0 |
| TRIS | TP | | NR | NR | NR | NR | NR | 0 |
| SSTS | TP | | NR | NR | NR | NR | NR | 0 |
| ROD | 1.000 | | 0 | 0 | 0 | 0 | NR | 0 |
| RMP | TP | | NR | NR | NR | NR | NR | 0 |
| RAATS | TP | | NR | NR | NR | NR | NR | 0 |
| PRP | TP | | NR | NR | NR | NR | NR | 0 |
| PADS | TP | | NR | NR | NR | NR | NR | 0 |
| ICIS | TP | | NR | NR | NR | NR | NR | 0 |
| FTTS | TP | | NR | NR | NR | NR | NR | 0 |
| MLTS | TP | | NR | NR | NR | NR | NR | 0 |
| COAL ASH DOE | TP | | NR | NR | NR | NR | NR | 0 |
| COAL ASH EPA | 0.500 | | 0 | 0 | 0 | NR | NR | 0 |
| PCB TRANSFORMER | TP | | NR | NR | NR | NR | NR | 0 |
| RADINFO | TP | | NR | NR | NR | NR | NR | 0 |
| HIST FTTS | TP | | NR | NR | NR | NR | NR | 0 |
| DOT OPS | TP | | NR | NR | NR | NR | NR | 0 |
| CONSENT | 1.000 | | 0 | 0 | 0 | 0 | NR | 0 |
| INDIAN RESERV | 1.000 | | 0 | 0 | 0 | 0 | NR | 0 |
| FUSRAP | 1.000 | | 0 | 0 | 0 | 0 | NR | 0 |
| UMTRA | 0.500 | | 0 | 0 | 0 | NR | NR | 0 |
| LEAD SMELTERS | TP | | NR | NR | NR | NR | NR | 0 |
| US AIRS | TP | | NR | NR | NR | NR | NR | 0 |
| US MINES | 0.250 | | 0 | 0 | NR | NR | NR | 0 |
| ABANDONED MINES | 0.250 | | 0 | 0 | NR | NR | NR | 0 |
| FINDS | TP | | NR | NR | NR | NR | NR | 0 |
| UXO | 1.000 | | 0 | 0 | 0 | 0 | NR | 0 |
| ECHO | TP | | NR | NR | NR | NR | NR | 0 |
| DOCKET HWC | TP | | NR | NR | NR | NR | NR | 0 |
| FUELS PROGRAM | 0.250 | | 0 | 0 | NR | NR | NR | 0 |
| CA BOND EXP. PLAN | 1.000 | | 0 | 0 | 0 | 0 | NR | 0 |
| Cortese | 0.500 | | 0 | 0 | 0 | NR | NR | 0 |
| CUPA Listings | 0.250 | | 0 | 0 | NR | NR | NR | 0 |
| DRYCLEANERS | 0.250 | | 0 | 0 | NR | NR | NR | 0 |
| EMI | TP | | NR | NR | NR | NR | NR | 0 |
| ENF | TP | | NR | NR | NR | NR | NR | 0 |
| Financial Assurance | TP | | NR | NR | NR | NR | NR | 0 |
| HAZNET | TP | | NR | NR | NR | NR | NR | 0 |

# MAP FINDINGS SUMMARY

| Database | Search Distance (Miles) | Target Property | < 1/8 | 1/8 - 1/4 | 1/4 - 1/2 | 1/2 - 1 | > 1 | Total Plotted |
|---|---|---|---|---|---|---|---|---|
| ICE | TP | | NR | NR | NR | NR | NR | 0 |
| HIST CORTESE | 0.500 | | 0 | 0 | 0 | NR | NR | 0 |
| HWP | 1.000 | | 0 | 0 | 0 | 0 | NR | 0 |
| HWT | 0.250 | | 0 | 0 | NR | NR | NR | 0 |
| MINES | 0.250 | | 1 | 0 | NR | NR | NR | 1 |
| MWMP | 0.250 | | 0 | 0 | NR | NR | NR | 0 |
| NPDES | TP | | NR | NR | NR | NR | NR | 0 |
| PEST LIC | TP | | NR | NR | NR | NR | NR | 0 |
| PROC | 0.500 | | 0 | 0 | 0 | NR | NR | 0 |
| Notify 65 | 1.000 | | 0 | 0 | 0 | 0 | NR | 0 |
| UIC | TP | | NR | NR | NR | NR | NR | 0 |
| WASTEWATER PITS | 0.500 | | 0 | 0 | 0 | NR | NR | 0 |
| WDS | TP | | NR | NR | NR | NR | NR | 0 |
| WIP | 0.250 | | 0 | 0 | NR | NR | NR | 0 |
| **EDR HIGH RISK HISTORICAL RECORDS** | | | | | | | | |
| ***EDR Exclusive Records*** | | | | | | | | |
| EDR MGP | 1.000 | | 0 | 0 | 0 | 0 | NR | 0 |
| EDR Hist Auto | 0.125 | | 0 | NR | NR | NR | NR | 0 |
| EDR Hist Cleaner | 0.125 | | 0 | NR | NR | NR | NR | 0 |
| **EDR RECOVERED GOVERNMENT ARCHIVES** | | | | | | | | |
| ***Exclusive Recovered Govt. Archives*** | | | | | | | | |
| RGA LF | TP | | NR | NR | NR | NR | NR | 0 |
| RGA LUST | TP | | NR | NR | NR | NR | NR | 0 |
| - Totals -- | | 0 | 1 | 1 | 0 | 0 | 0 | 2 |

NOTES:

TP = Target Property

NR = Not Requested at this Search Distance

Sites may be listed in more than one database

**1**
**WNW**
**< 1/8**
**0.061 mi.**
**322 ft.**

**NICHOLS CANYON MINE**
**25555 MAITRI ROARD**
**, CA**

**MINES** **S117662195**
**N/A**

**Relative:**
**Lower**

**Actual:**
**1292 ft.**

MINES:

| | |
|---|---|
| Latitude: | 33.708333 |
| Longitude: | -117.355556 |
| Lead Agency identification code: | 33.15 |
| Lead Agency name: | City of Lake Elsinore |
| Year of the operator supplied annual report: | 2016 |
| Type of report submitted by operator: | 2 |
| Number of acres disturbed by the mine: | 80 |
| Status of mining operation: | ACTIVE |
| Status of mine reclamation: | RECLAMATION NOT STARTED |
| Mine operator: | CHANDLER AGGREGATES, INC. |
| Operator Address: | 25555 MAITRI ROAD |
| Operator City, State, Zip: | CORONA, CA 92883 |
| Mine owner: | NICHOLS ROAD PARTNERS, LLC |
| Owner Address: | 25555 MAITRI ROAD |
| Owner City, State, Zip: | CORONA, CA 92883 |
| Reclamation plan identification number: | 2418 |
| Primary product produced by the mine: | SAND AND GRAVEL |
| Type of mining utilized by mine: | OPEN PIT |
| Conditional use permit identification number: | 2006-1 |
| Number of acres permitted for mining disturbance: | 211 |
| Total amount of funds posted by the mine for reclamation: | 700000 |
| Financial Assurance Cost Estimate for reclamation: | 682697 |

---

**2**
**West**
**1/8-1/4**
**0.212 mi.**
**1118 ft.**

**HOME DEPOT USA INC 8988**
**13282 COLLIER AVE**
**LAKE ELSINORE, CA 92530**

**RCRA-SQG** **1009216674**
**HAZNET** **CAR000170894**

**Relative:**
**Lower**

**Actual:**
**1267 ft.**

RCRA-SQG:

| | |
|---|---|
| Date form received by agency: | 01/31/2006 |
| Facility name: | HOME DEPOT USA INC 8988 |
| Facility address: | 13282 COLLIER AVE<br>LAKE ELSINORE, CA 92530 |
| EPA ID: | CAR000170894 |
| Mailing address: | 1905 ASTON AVE<br>NO 100<br>CARLSBAD, CA 92008 |
| Contact: | ROBERT PERKINS |
| Contact address: | 1905 ASTON AVE NO 100<br>CARLSBAD, CA 92008 |
| Contact country: | US |
| Contact telephone: | 760-602-8700 |
| Contact email: | RPERKINS@3ECOMPANY.COM |
| EPA Region: | 09 |
| Classification: | Small Small Quantity Generator |
| Description: | Handler: generates more than 100 and less than 1000 kg of hazardous waste during any calendar month and accumulates less than 6000 kg of hazardous waste at any time; or generates 100 kg or less of hazardous waste during any calendar month, and accumulates more than 1000 kg of hazardous waste at any time |

**HOME DEPOT USA INC 8988 (Continued)** **1009216674**

Owner/Operator Summary:
Owner/operator name: HOME DEPOT USA INC
Owner/operator address: 2455 PACES FERRY RD D17
ATLANTA, GA 30339
Owner/operator country: US
Legal status: Private
Owner/Operator Type: Owner
Owner/Op start date: 01/26/2006

Owner/operator name: HOME DEPOT USA INC
Owner/operator country: US
Legal status: Private
Owner/Operator Type: Operator
Owner/Op start date: 01/26/2006

Handler Activities Summary:
U.S. importer of hazardous waste: No
Mixed waste (haz. and radioactive): No
Recycler of hazardous waste: No
Transporter of hazardous waste: No
Treater, storer or disposer of HW: No
Underground injection activity: No
On-site burner exemption: No
Furnace exemption: No
Used oil fuel burner: No
Used oil processor: No
User oil refiner: No
Used oil fuel marketer to burner: No
Used oil Specification marketer: No
Used oil transfer facility: No
Used oil transporter: No

. Waste code: D001
. Waste name: IGNITABLE WASTE

. Waste code: D002
. Waste name: CORROSIVE WASTE

. Waste code: D006
. Waste name: CADMIUM

. Waste code: D008
. Waste name: LEAD

. Waste code: D009
. Waste name: MERCURY

. Waste code: D011
. Waste name: SILVER

. Waste code: D016
. Waste name: 2,4-D (2,4-DICHLOROPHENOXYACETIC ACID)

. Waste code: D018
. Waste name: BENZENE

**HOME DEPOT USA INC 8988 (Continued)** **1009216674**

. Waste code: D035
. Waste name: METHYL ETHYL KETONE

. Waste code: F003
. Waste name: THE FOLLOWING SPENT NONHALOGENATED SOLVENTS: XYLENE, ACETONE, ETHYL ACETATE, ETHYL BENZENE, ETHYL ETHER, METHYL ISOBUTYL KETONE, N-BUTYL ALCOHOL, CYCLOHEXANONE, AND METHANOL; ALL SPENT SOLVENT MIXTURES/BLENDS CONTAINING, BEFORE USE, ONLY THE ABOVE SPENT NONHALOGENATED SOLVENTS; AND ALL SPENT SOLVENT MIXTURES/BLENDS CONTAINING, BEFORE USE, ONE OR MORE OF THE ABOVE NONHALOGENATED SOLVENTS, AND A TOTAL OF TEN PERCENT OR MORE (BY VOLUME) OF ONE OR MORE OF THOSE SOLVENTS LISTED IN F001, F002, F004, AND F005; AND STILL BOTTOMS FROM THE RECOVERY OF THESE SPENT SOLVENTS AND SPENT SOLVENT MIXTURES.

. Waste code: F005
. Waste name: THE FOLLOWING SPENT NONHALOGENATED SOLVENTS: TOLUENE, METHYL ETHYL KETONE, CARBON DISULFIDE, ISOBUTANOL, PYRIDINE, BENZENE, 2-ETHOXYETHANOL, AND 2-NITROPROPANE; ALL SPENT SOLVENT MIXTURES/BLENDS CONTAINING, BEFORE USE, A TOTAL OF TEN PERCENT OR MORE (BY VOLUME) OF ONE OR MORE OF THE ABOVE NONHALOGENATED SOLVENTS OR THOSE SOLVENTS LISTED IN F001, F002, OR F004; AND STILL BOTTOMS FROM THE RECOVERY OF THESE SPENT SOLVENTS AND SPENT SOLVENT MIXTURES.

Violation Status: No violations found

HAZNET:

envid: 1009216674
Year: 2010
GEPAID: CAR000170894
Contact: CHRIS BAKER
Telephone: 7136257015
Mailing Address: 5151 SAN FELIPE ST STE 1600
Mailing City,St,Zip: HOUSTON, TX 770563647
TSD EPA ID: CAD008364432
Waste Category: Hydrocarbon solvents (benzene, hexane, Stoddard, Etc.)
Disposal Method: Fuel Blending Prior To Energy Recovery At Another Site
Tons: 0.0355
Facility County: Riverside

envid: 1009216674
Year: 2010
GEPAID: CAR000170894
Contact: CHRIS BAKER
Telephone: 7136257015
Mailing Address: 5151 SAN FELIPE ST STE 1600
Mailing City,St,Zip: HOUSTON, TX 770563647
TSD EPA ID: CAD008364432
Waste Category: Off-specification, aged or surplus organics
Disposal Method: Storage, Bulking, And/Or Transfer Off Site--No Treatment/Reovery (H010-H129) Or (H131-H135)
Tons: 0.21
Facility County: Riverside

envid: 1009216674
Year: 2010
GEPAID: CAR000170894
Contact: CHRIS BAKER

**HOME DEPOT USA INC 8988 (Continued)** **1009216674**

| | |
|---|---|
| Telephone: | 7136257015 |
| Mailing Address: | 5151 SAN FELIPE ST STE 1600 |
| Mailing City,St,Zip: | HOUSTON, TX 770563647 |
| TSD EPA ID: | CAD008364432 |
| Waste Category: | Unspecified solvent mixture |
| Disposal Method: | Fuel Blending Prior To Energy Recovery At Another Site |
| Tons: | 0.237 |
| Facility County: | Riverside |
| | |
| envid: | 1009216674 |
| Year: | 2010 |
| GEPAID: | CAR000170894 |
| Contact: | CHRIS BAKER |
| Telephone: | 7136257015 |
| Mailing Address: | 5151 SAN FELIPE ST STE 1600 |
| Mailing City,St,Zip: | HOUSTON, TX 770563647 |
| TSD EPA ID: | CAD008364432 |
| Waste Category: | Waste oil and mixed oil |
| Disposal Method: | Storage, Bulking, And/Or Transfer Off Site--No Treatment/Reovery (H010-H129) Or (H131-H135) |
| Tons: | 1.026 |
| Facility County: | Riverside |
| | |
| envid: | 1009216674 |
| Year: | 2008 |
| GEPAID: | CAR000170894 |
| Contact: | MELANIE KOSKE - HRT SPECIALIST |
| Telephone: | 7606028700 |
| Mailing Address: | 1905 ASTON AVE # 100 |
| Mailing City,St,Zip: | CARLSBAD, CA 920087307 |
| TSD EPA ID: | CAD008364432 |
| Waste Category: | Waste oil and mixed oil |
| Disposal Method: | Storage, Bulking, And/Or Transfer Off Site--No Treatment/Reovery (H010-H129) Or (H131-H135) |
| Tons: | 1.311 |
| Facility County: | Riverside |

Click this hyperlink while viewing on your computer to access
36 additional CA_HAZNET: record(s) in the EDR Site Report.

Count: 17 records. ORPHAN SUMMARY

| City | EDR ID | Site Name | Site Address | Zip | Database(s) |
|---|---|---|---|---|---|
| ELSINORE | 1010558061 | SO CAL GAS/ELSINORE MGP | CNR OF RILEY,FLINT,SPRING, POT | 92530 | EDR MGP |
| ELSINORE CITY | S107540386 | | REINDEER PLACE, 1/4 MILE WEST | 92530 | CDL |
| LAKE ELSINORE | S107529909 | | 1800 BLOCK OF TERETICORNIS | 92530 | CDL |
| LAKE ELSINORE | S107539782 | | ON CORNER OF RED GUM RD AND AC | | CDL |
| LAKE ELSINORE | S107539605 | | NW CORNER OF WALNUT & LOOKOUT | 92530 | CDL |
| LAKE ELSINORE | S107539492 | | NE CORNER OF HWY 74 & CAMBERN | 92530 | CDL |
| LAKE ELSINORE | S107530464 | | 2 MI. E OF EL TORO RD/CHIPPEWA | | CDL |
| LAKE ELSINORE | S107537594 | | AT E END OF VIA DE LA VALLE | 92532 | CDL |
| LAKE ELSINORE | S107538456 | | END OF MAYHEW RD NR TEMESCAL R | | CDL |
| LAKE ELSINORE | S107539822 | | ON EVERGREEN, 500 YDS W OF GRA | 92530 | CDL |
| LAKE ELSINORE | S107538772 | | HIGWAY 74 & GREENWALD, CORNER | 92530 | CDL |
| LAKE ELSINORE | S107532451 | | 3 MILES UP DIRT RD, AT END OF | 92532 | CDL |
| LAKE ELSINORE | S107539954 | | ON MISSION TRAIL (200 YARDS IN | 92530 | CDL |
| LAKE ELSINORE | S107539966 | | ON MOUNTAIN STREET, 2 MILES WE | 92530 | CDL |
| LAKE ELSINORE | S107539557 | | NICHOLS ROAD, .5 MI EAST I-15 | | CDL |
| LAKE ELSINORE | S107540375 | | RED GUM DR,100 YD W OF CAMBERN | 92530 | CDL |
| RIVERSIDE COUNTY | S107541240 | | WINEVILLE, SW CORNER OF GAGELE | | CDL |

# GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

| St | Acronym | Full Name | Government Agency | Gov Date | Arvl. Date | Active Date |
|---|---|---|---|---|---|---|
| CA | AST | Aboveground Petroleum Storage Tank Facilities | California Environmental Protection Agency | 07/06/2016 | 07/12/2016 | 09/19/2016 |
| CA | BROWNFIELDS | Considered Brownfieds Sites Listing | State Water Resources Control Board | 09/21/2017 | 09/21/2017 | 11/09/2017 |
| CA | CA BOND EXP. PLAN | Bond Expenditure Plan | Department of Health Services | 01/01/1989 | 07/27/1994 | 08/02/1994 |
| CA | CA FID UST | Facility Inventory Database | California Environmental Protection Agency | 10/31/1994 | 09/05/1995 | 09/29/1995 |
| CA | CDL | Clandestine Drug Labs | Department of Toxic Substances Control | 06/30/2017 | 08/18/2017 | 09/21/2017 |
| CA | CHMIRS | California Hazardous Material Incident Report System | Office of Emergency Services | 05/09/2017 | 07/26/2017 | 09/21/2017 |
| CA | CORTESE | "Cortese" Hazardous Waste & Substances Sites List | CAL EPA/Office of Emergency Information | 09/21/2017 | 09/21/2017 | 10/13/2017 |
| CA | DEED | Deed Restriction Listing | DTSC and SWRCB | 09/05/2017 | 09/06/2017 | 11/08/2017 |
| CA | DRYCLEANERS | Cleaner Facilities | Department of Toxic Substance Control | 08/02/2017 | 08/08/2017 | 10/16/2017 |
| CA | EMI | Emissions Inventory Data | California Air Resources Board | 12/31/2015 | 03/21/2017 | 08/15/2017 |
| CA | ENF | Enforcement Action Listing | State Water Resoruces Control Board | 08/18/2017 | 08/22/2017 | 10/24/2017 |
| CA | ENVIROSTOR | EnviroStor Database | Department of Toxic Substances Control | 07/31/2017 | 08/01/2017 | 08/15/2017 |
| CA | Financial Assurance 1 | Financial Assurance Information Listing | Department of Toxic Substances Control | 07/21/2017 | 07/25/2017 | 10/17/2017 |
| CA | Financial Assurance 2 | Financial Assurance Information Listing | California Integrated Waste Management Board | 08/15/2017 | 08/22/2017 | 10/25/2017 |
| CA | HAULERS | Registered Waste Tire Haulers Listing | Integrated Waste Management Board | 05/30/2017 | 05/31/2017 | 08/15/2017 |
| CA | HAZNET | Facility and Manifest Data | California Environmental Protection Agency | 12/31/2016 | 07/12/2017 | 10/17/2017 |
| CA | HIST CAL-SITES | Calsites Database | Department of Toxic Substance Control | 08/08/2005 | 08/03/2006 | 08/24/2006 |
| CA | HIST CORTESE | Hazardous Waste & Substance Site List | Department of Toxic Substances Control | 04/01/2001 | 01/22/2009 | 04/08/2009 |
| CA | HIST UST | Hazardous Substance Storage Container Database | State Water Resources Control Board | 10/15/1990 | 01/25/1991 | 02/12/1991 |
| CA | HWP | EnviroStor Permitted Facilities Listing | Department of Toxic Substances Control | 08/21/2017 | 08/22/2017 | 10/25/2017 |
| CA | HWT | Registered Hazardous Waste Transporter Database | Department of Toxic Substances Control | 10/10/2017 | 10/10/2017 | 10/17/2017 |
| CA | ICE | ICE | Department of Toxic Subsances Control | 08/21/2017 | 08/22/2017 | 10/25/2017 |
| CA | LDS | Land Disposal Sites Listing (GEOTRACKER) | State Water Qualilty Control Board | 09/11/2017 | 09/12/2017 | 11/09/2017 |
| CA | LIENS | Environmental Liens Listing | Department of Toxic Substances Control | 08/31/2017 | 09/05/2017 | 11/08/2017 |
| CA | LUST | Leaking Underground Fuel Tank Report (GEOTRACKER) | State Water Resources Control Board | 09/11/2017 | 09/12/2017 | 11/09/2017 |
| CA | LUST REG 1 | Active Toxic Site Investigation | California Regional Water Quality Control Boa | 02/01/2001 | 02/28/2001 | 03/29/2001 |
| CA | LUST REG 2 | Fuel Leak List | California Regional Water Quality Control Boa | 09/30/2004 | 10/20/2004 | 11/19/2004 |
| CA | LUST REG 3 | Leaking Underground Storage Tank Database | California Regional Water Quality Control Boa | 05/19/2003 | 05/19/2003 | 06/02/2003 |
| CA | LUST REG 4 | Underground Storage Tank Leak List | California Regional Water Quality Control Boa | 09/07/2004 | 09/07/2004 | 10/12/2004 |
| CA | LUST REG 5 | Leaking Underground Storage Tank Database | California Regional Water Quality Control Boa | 07/01/2008 | 07/22/2008 | 07/31/2008 |
| CA | LUST REG 6L | Leaking Underground Storage Tank Case Listing | California Regional Water Quality Control Boa | 09/09/2003 | 09/10/2003 | 10/07/2003 |
| CA | LUST REG 6V | Leaking Underground Storage Tank Case Listing | California Regional Water Quality Control Boa | 06/07/2005 | 06/07/2005 | 06/29/2005 |
| CA | LUST REG 7 | Leaking Underground Storage Tank Case Listing | California Regional Water Quality Control Boa | 02/26/2004 | 02/26/2004 | 03/24/2004 |
| CA | LUST REG 8 | Leaking Underground Storage Tanks | California Regional Water Quality Control Boa | 02/14/2005 | 02/15/2005 | 03/28/2005 |
| CA | LUST REG 9 | Leaking Underground Storage Tank Report | California Regional Water Quality Control Boa | 03/01/2001 | 04/23/2001 | 05/21/2001 |
| CA | MCS | Military Cleanup Sites Listing (GEOTRACKER) | State Water Resources Control Board | 09/11/2017 | 09/12/2017 | 11/09/2017 |
| CA | MINES | Mines Site Location Listing | Department of Conservation | 09/11/2017 | 09/12/2017 | 11/01/2017 |
| CA | MWMP | Medical Waste Management Program Listing | Department of Public Health | 09/01/2017 | 09/06/2017 | 11/08/2017 |
| CA | NOTIFY 65 | Proposition 65 Records | State Water Resources Control Board | 06/16/2017 | 06/20/2017 | 10/17/2017 |
| CA | NPDES | NPDES Permits Listing | State Water Resources Control Board | 08/14/2017 | 08/17/2017 | 10/17/2017 |
| CA | PEST LIC | Pesticide Regulation Licenses Listing | Department of Pesticide Regulation | 09/05/2017 | 09/06/2017 | 11/08/2017 |
| CA | PROC | Certified Processors Database | Department of Conservation | 09/11/2017 | 09/12/2017 | 10/18/2017 |
| CA | RESPONSE | State Response Sites | Department of Toxic Substances Control | 07/31/2017 | 08/01/2017 | 08/15/2017 |
| CA | RGA LF | Recovered Government Archive Solid Waste Facilities List | Department of Resources Recycling and Recover | | 07/01/2013 | 01/13/2014 |
| CA | RGA LUST | Recovered Government Archive Leaking Underground Storage Tan | State Water Resources Control Board | | 07/01/2013 | 12/30/2013 |
| CA | SCH | School Property Evaluation Program | Department of Toxic Substances Control | 07/31/2017 | 08/01/2017 | 08/15/2017 |
| CA | SLIC | Statewide SLIC Cases (GEOTRACKER) | State Water Resources Control Board | 09/11/2017 | 09/12/2017 | 11/09/2017 |

# GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

| St | Acronym | Full Name | Government Agency | Gov Date | Arvl. Date | Active Date |
|---|---|---|---|---|---|---|
| CA | SLIC REG 1 | Active Toxic Site Investigations | California Regional Water Quality Control Boa | 04/03/2003 | 04/07/2003 | 04/25/2003 |
| CA | SLIC REG 2 | Spills, Leaks, Investigation & Cleanup Cost Recovery Listing | Regional Water Quality Control Board San Fran | 09/30/2004 | 10/20/2004 | 11/19/2004 |
| CA | SLIC REG 3 | Spills, Leaks, Investigation & Cleanup Cost Recovery Listing | California Regional Water Quality Control Boa | 05/18/2006 | 05/18/2006 | 06/15/2006 |
| CA | SLIC REG 4 | Spills, Leaks, Investigation & Cleanup Cost Recovery Listing | Region Water Quality Control Board Los Angele | 11/17/2004 | 11/18/2004 | 01/04/2005 |
| CA | SLIC REG 5 | Spills, Leaks, Investigation & Cleanup Cost Recovery Listing | Regional Water Quality Control Board Central | 04/01/2005 | 04/05/2005 | 04/21/2005 |
| CA | SLIC REG 6L | SLIC Sites | California Regional Water Quality Control Boa | 09/07/2004 | 09/07/2004 | 10/12/2004 |
| CA | SLIC REG 6V | Spills, Leaks, Investigation & Cleanup Cost Recovery Listing | Regional Water Quality Control Board, Victorv | 05/24/2005 | 05/25/2005 | 06/16/2005 |
| CA | SLIC REG 7 | SLIC List | California Regional Quality Control Board, Co | 11/24/2004 | 11/29/2004 | 01/04/2005 |
| CA | SLIC REG 8 | Spills, Leaks, Investigation & Cleanup Cost Recovery Listing | California Region Water Quality Control Board | 04/03/2008 | 04/03/2008 | 04/14/2008 |
| CA | SLIC REG 9 | Spills, Leaks, Investigation & Cleanup Cost Recovery Listing | California Regional Water Quality Control Boa | 09/10/2007 | 09/11/2007 | 09/28/2007 |
| CA | SPILLS 90 | SPILLS90 data from FirstSearch | FirstSearch | 06/06/2012 | 01/03/2013 | 02/22/2013 |
| CA | SWEEPS UST | SWEEPS UST Listing | State Water Resources Control Board | 06/01/1994 | 07/07/2005 | 08/11/2005 |
| CA | SWF/LF (SWIS) | Solid Waste Information System | Department of Resources Recycling and Recover | 08/14/2017 | 08/17/2017 | 09/21/2017 |
| CA | SWRCY | Recycler Database | Department of Conservation | 09/11/2017 | 09/12/2017 | 09/21/2017 |
| CA | TOXIC PITS | Toxic Pits Cleanup Act Sites | State Water Resources Control Board | 07/01/1995 | 08/30/1995 | 09/26/1995 |
| CA | UIC | UIC Listing | Deaprtment of Conservation | 01/20/2017 | 03/14/2017 | 05/03/2017 |
| CA | UST | Active UST Facilities | SWRCB | 09/11/2017 | 09/12/2017 | 11/08/2017 |
| CA | UST MENDOCINO | Mendocino County UST Database | Department of Public Health | 06/02/2017 | 06/06/2017 | 08/25/2017 |
| CA | VCP | Voluntary Cleanup Program Properties | Department of Toxic Substances Control | 07/31/2017 | 08/01/2017 | 08/15/2017 |
| CA | WASTEWATER PITS | Oil Wastewater Pits Listing | RWQCB, Central Valley Region | 04/15/2015 | 04/17/2015 | 06/23/2015 |
| CA | WDS | Waste Discharge System | State Water Resources Control Board | 06/19/2007 | 06/20/2007 | 06/29/2007 |
| CA | WIP | Well Investigation Program Case List | Los Angeles Water Quality Control Board | 07/03/2009 | 07/21/2009 | 08/03/2009 |
| CA | WMUDS/SWAT | Waste Management Unit Database | State Water Resources Control Board | 04/01/2000 | 04/10/2000 | 05/10/2000 |
| US | 2020 COR ACTION | 2020 Corrective Action Program List | Environmental Protection Agency | 04/22/2013 | 03/03/2015 | 03/09/2015 |
| US | ABANDONED MINES | Abandoned Mines | Department of Interior | 09/25/2017 | 09/26/2017 | 10/20/2017 |
| US | BRS | Biennial Reporting System | EPA/NTIS | 12/31/2015 | 02/22/2017 | 09/28/2017 |
| US | COAL ASH DOE | Steam-Electric Plant Operation Data | Department of Energy | 12/31/2005 | 08/07/2009 | 10/22/2009 |
| US | COAL ASH EPA | Coal Combustion Residues Surface Impoundments List | Environmental Protection Agency | 07/01/2014 | 09/10/2014 | 10/20/2014 |
| US | CONSENT | Superfund (CERCLA) Consent Decrees | Department of Justice, Consent Decree Library | 06/30/2017 | 08/03/2017 | 10/20/2017 |
| US | CORRACTS | Corrective Action Report | EPA | 09/13/2017 | 09/26/2017 | 10/06/2017 |
| US | DEBRIS REGION 9 | Torres Martinez Reservation Illegal Dump Site Locations | EPA, Region 9 | 01/12/2009 | 05/07/2009 | 09/21/2009 |
| US | DOCKET HWC | Hazardous Waste Compliance Docket Listing | Environmental Protection Agency | 02/13/2017 | 02/15/2017 | 11/03/2017 |
| US | DOD | Department of Defense Sites | USGS | 12/31/2005 | 11/10/2006 | 01/11/2007 |
| US | DOT OPS | Incident and Accident Data | Department of Transporation, Office of Pipeli | 07/31/2012 | 08/07/2012 | 09/18/2012 |
| US | Delisted NPL | National Priority List Deletions | EPA | 05/30/2017 | 06/09/2017 | 09/15/2017 |
| US | ECHO | Enforcement & Compliance History Information | Environmental Protection Agency | 09/02/2017 | 09/06/2017 | 10/20/2017 |
| US | EDR Hist Auto | EDR Exclusive Historical Auto Stations | EDR, Inc. | | | |
| US | EDR Hist Cleaner | EDR Exclusive Historical Cleaners | EDR, Inc. | | | |
| US | EDR MGP | EDR Proprietary Manufactured Gas Plants | EDR, Inc. | | | |
| US | EPA WATCH LIST | EPA WATCH LIST | Environmental Protection Agency | 08/30/2013 | 03/21/2014 | 06/17/2014 |
| US | ERNS | Emergency Response Notification System | National Response Center, United States Coast | 09/18/2017 | 09/21/2017 | 10/13/2017 |
| US | FEDERAL FACILITY | Federal Facility Site Information listing | Environmental Protection Agency | 11/07/2016 | 01/05/2017 | 04/07/2017 |
| US | FEDLAND | Federal and Indian Lands | U.S. Geological Survey | 12/31/2005 | 02/06/2006 | 01/11/2007 |
| US | FEMA UST | Underground Storage Tank Listing | FEMA | 05/15/2017 | 05/30/2017 | 10/13/2017 |
| US | FINDS | Facility Index System/Facility Registry System | EPA | 07/23/2017 | 09/06/2017 | 09/15/2017 |
| US | FTTS | FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fu | EPA/Office of Prevention, Pesticides and Toxi | 04/09/2009 | 04/16/2009 | 05/11/2009 |
| US | FTTS INSP | FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fu | EPA | 04/09/2009 | 04/16/2009 | 05/11/2009 |

# GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

| St | Acronym | Full Name | Government Agency | Gov Date | Arvl. Date | Active Date |
|---|---|---|---|---|---|---|
| US | FUDS | Formerly Used Defense Sites | U.S. Army Corps of Engineers | 01/31/2015 | 07/08/2015 | 10/13/2015 |
| US | FUELS PROGRAM | EPA Fuels Program Registered Listing | EPA | 08/17/2017 | 08/17/2017 | 09/15/2017 |
| US | FUSRAP | Formerly Utilized Sites Remedial Action Program | Department of Energy | 12/23/2016 | 12/27/2016 | 02/17/2017 |
| US | HIST FTTS | FIFRA/TSCA Tracking System Administrative Case Listing | Environmental Protection Agency | 10/19/2006 | 03/01/2007 | 04/10/2007 |
| US | HIST FTTS INSP | FIFRA/TSCA Tracking System Inspection & Enforcement Case Lis | Environmental Protection Agency | 10/19/2006 | 03/01/2007 | 04/10/2007 |
| US | HMIRS | Hazardous Materials Information Reporting System | U.S. Department of Transportation | 09/21/2017 | 09/21/2017 | 10/13/2017 |
| US | ICIS | Integrated Compliance Information System | Environmental Protection Agency | 11/18/2016 | 11/23/2016 | 02/10/2017 |
| US | IHS OPEN DUMPS | Open Dumps on Indian Land | Department of Health & Human Serivces, Indian | 04/01/2014 | 08/06/2014 | 01/29/2015 |
| US | INDIAN LUST R1 | Leaking Underground Storage Tanks on Indian Land | EPA Region 1 | 04/14/2017 | 07/27/2017 | 10/06/2017 |
| US | INDIAN LUST R10 | Leaking Underground Storage Tanks on Indian Land | EPA Region 10 | 10/07/2016 | 01/26/2017 | 05/05/2017 |
| US | INDIAN LUST R4 | Leaking Underground Storage Tanks on Indian Land | EPA Region 4 | 10/14/2016 | 01/27/2017 | 05/05/2017 |
| US | INDIAN LUST R5 | Leaking Underground Storage Tanks on Indian Land | EPA, Region 5 | 04/26/2017 | 07/27/2017 | 10/13/2017 |
| US | INDIAN LUST R6 | Leaking Underground Storage Tanks on Indian Land | EPA Region 6 | 04/24/2017 | 07/27/2017 | 10/06/2017 |
| US | INDIAN LUST R7 | Leaking Underground Storage Tanks on Indian Land | EPA Region 7 | 04/14/2017 | 07/27/2017 | 10/06/2017 |
| US | INDIAN LUST R8 | Leaking Underground Storage Tanks on Indian Land | EPA Region 8 | 05/01/2017 | 07/27/2017 | 10/13/2017 |
| US | INDIAN LUST R9 | Leaking Underground Storage Tanks on Indian Land | Environmental Protection Agency | 04/13/2017 | 07/27/2017 | 10/13/2017 |
| US | INDIAN ODI | Report on the Status of Open Dumps on Indian Lands | Environmental Protection Agency | 12/31/1998 | 12/03/2007 | 01/24/2008 |
| US | INDIAN RESERV | Indian Reservations | USGS | 12/31/2014 | 07/14/2015 | 01/10/2017 |
| US | INDIAN UST R1 | Underground Storage Tanks on Indian Land | EPA, Region 1 | 04/14/2017 | 07/27/2017 | 10/06/2017 |
| US | INDIAN UST R10 | Underground Storage Tanks on Indian Land | EPA Region 10 | 04/25/2017 | 07/27/2017 | 10/13/2017 |
| US | INDIAN UST R4 | Underground Storage Tanks on Indian Land | EPA Region 4 | 10/14/2016 | 01/27/2017 | 05/05/2017 |
| US | INDIAN UST R5 | Underground Storage Tanks on Indian Land | EPA Region 5 | 04/26/2017 | 07/27/2017 | 10/06/2017 |
| US | INDIAN UST R6 | Underground Storage Tanks on Indian Land | EPA Region 6 | 10/01/2016 | 01/26/2017 | 05/05/2017 |
| US | INDIAN UST R7 | Underground Storage Tanks on Indian Land | EPA Region 7 | 05/02/2017 | 07/27/2017 | 10/06/2017 |
| US | INDIAN UST R8 | Underground Storage Tanks on Indian Land | EPA Region 8 | 05/01/2017 | 07/27/2017 | 10/13/2017 |
| US | INDIAN UST R9 | Underground Storage Tanks on Indian Land | EPA Region 9 | 04/13/2017 | 07/27/2017 | 10/13/2017 |
| US | INDIAN VCP R1 | Voluntary Cleanup Priority Listing | EPA, Region 1 | 07/27/2015 | 09/29/2015 | 02/18/2016 |
| US | INDIAN VCP R7 | Voluntary Cleanup Priority Lisitng | EPA, Region 7 | 03/20/2008 | 04/22/2008 | 05/19/2008 |
| US | LEAD SMELTER 1 | Lead Smelter Sites | Environmental Protection Agency | 05/30/2017 | 06/09/2017 | 09/15/2017 |
| US | LEAD SMELTER 2 | Lead Smelter Sites | American Journal of Public Health | 04/05/2001 | 10/27/2010 | 12/02/2010 |
| US | LIENS 2 | CERCLA Lien Information | Environmental Protection Agency | 07/11/2017 | 07/26/2017 | 10/13/2017 |
| US | LUCIS | Land Use Control Information System | Department of the Navy | 05/22/2017 | 06/13/2017 | 09/15/2017 |
| US | MLTS | Material Licensing Tracking System | Nuclear Regulatory Commission | 08/30/2016 | 09/08/2016 | 10/21/2016 |
| US | NPL | National Priority List | EPA | 05/30/2017 | 06/08/2017 | 09/15/2017 |
| US | NPL LIENS | Federal Superfund Liens | EPA | 10/15/1991 | 02/02/1994 | 03/30/1994 |
| US | ODI | Open Dump Inventory | Environmental Protection Agency | 06/30/1985 | 08/09/2004 | 09/17/2004 |
| US | PADS | PCB Activity Database System | EPA | 06/01/2017 | 06/09/2017 | 10/13/2017 |
| US | PCB TRANSFORMER | PCB Transformer Registration Database | Environmental Protection Agency | 02/01/2011 | 10/19/2011 | 01/10/2012 |
| US | PRP | Potentially Responsible Parties | EPA | 10/25/2013 | 10/17/2014 | 10/20/2014 |
| US | Proposed NPL | Proposed National Priority List Sites | EPA | 05/30/2017 | 06/09/2017 | 09/15/2017 |
| US | RAATS | RCRA Administrative Action Tracking System | EPA | 04/17/1995 | 07/03/1995 | 08/07/1995 |
| US | RADINFO | Radiation Information Database | Environmental Protection Agency | 10/02/2017 | 10/05/2017 | 10/13/2017 |
| US | RCRA NonGen / NLR | RCRA - Non Generators / No Longer Regulated | Environmental Protection Agency | 09/13/2017 | 09/26/2017 | 10/06/2017 |
| US | RCRA-CESQG | RCRA - Conditionally Exempt Small Quantity Generators | Environmental Protection Agency | 09/13/2017 | 09/26/2017 | 10/06/2017 |
| US | RCRA-LQG | RCRA - Large Quantity Generators | Environmental Protection Agency | 09/13/2017 | 09/26/2017 | 10/06/2017 |
| US | RCRA-SQG | RCRA - Small Quantity Generators | Environmental Protection Agency | 09/13/2017 | 09/26/2017 | 10/06/2017 |
| US | RCRA-TSDF | RCRA - Treatment, Storage and Disposal | Environmental Protection Agency | 09/13/2017 | 09/26/2017 | 10/06/2017 |

# GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

| St | Acronym | Full Name | Government Agency | Gov Date | Arvl. Date | Active Date |
|---|---|---|---|---|---|---|
| US | RMP | Risk Management Plans | Environmental Protection Agency | 02/01/2017 | 02/09/2017 | 04/07/2017 |
| US | ROD | Records Of Decision | EPA | 09/27/2017 | 10/12/2017 | 10/20/2017 |
| US | SCRD DRYCLEANERS | State Coalition for Remediation of Drycleaners Listing | Environmental Protection Agency | 01/01/2017 | 02/03/2017 | 04/07/2017 |
| US | SEMS | Superfund Enterprise Management System | EPA | 07/11/2017 | 07/21/2017 | 10/06/2017 |
| US | SEMS-ARCHIVE | Superfund Enterprise Management System Archive | EPA | 07/11/2017 | 07/28/2017 | 10/06/2017 |
| US | SSTS | Section 7 Tracking Systems | EPA | 12/31/2009 | 12/10/2010 | 02/25/2011 |
| US | TRIS | Toxic Chemical Release Inventory System | EPA | 12/31/2014 | 11/24/2015 | 04/05/2016 |
| US | TSCA | Toxic Substances Control Act | EPA | 12/31/2012 | 01/15/2015 | 01/29/2015 |
| US | UMTRA | Uranium Mill Tailings Sites | Department of Energy | 06/23/2017 | 10/11/2017 | 11/03/2017 |
| US | US AIRS (AFS) | Aerometric Information Retrieval System Facility Subsystem ( | EPA | 10/12/2016 | 10/26/2016 | 02/03/2017 |
| US | US AIRS MINOR | Air Facility System Data | EPA | 10/12/2016 | 10/26/2016 | 02/03/2017 |
| US | US BROWNFIELDS | A Listing of Brownfields Sites | Environmental Protection Agency | 06/19/2017 | 06/20/2017 | 09/15/2017 |
| US | US CDL | Clandestine Drug Labs | Drug Enforcement Administration | 07/13/2017 | 09/06/2017 | 10/06/2017 |
| US | US ENG CONTROLS | Engineering Controls Sites List | Environmental Protection Agency | 08/10/2017 | 08/30/2017 | 10/13/2017 |
| US | US FIN ASSUR | Financial Assurance Information | Environmental Protection Agency | 05/10/2017 | 05/17/2017 | 09/15/2017 |
| US | US HIST CDL | National Clandestine Laboratory Register | Drug Enforcement Administration | 07/13/2017 | 09/06/2017 | 10/06/2017 |
| US | US INST CONTROL | Sites with Institutional Controls | Environmental Protection Agency | 08/10/2017 | 08/30/2017 | 10/13/2017 |
| US | US MINES | Mines Master Index File | Department of Labor, Mine Safety and Health A | 07/31/2017 | 08/30/2017 | 10/13/2017 |
| US | US MINES 2 | Ferrous and Nonferrous Metal Mines Database Listing | USGS | 12/05/2005 | 02/29/2008 | 04/18/2008 |
| US | US MINES 3 | Active Mines & Mineral Plants Database Listing | USGS | 04/14/2011 | 06/08/2011 | 09/13/2011 |
| US | UXO | Unexploded Ordnance Sites | Department of Defense | 10/25/2016 | 06/02/2017 | 10/13/2017 |
| CT | CT MANIFEST | Hazardous Waste Manifest Data | Department of Energy & Environmental Protecti | 07/28/2017 | 08/18/2017 | 11/14/2017 |
| NJ | NJ MANIFEST | Manifest Information | Department of Environmental Protection | 12/31/2016 | 04/11/2017 | 07/27/2017 |
| NY | NY MANIFEST | Facility and Manifest Data | Department of Environmental Conservation | 10/01/2017 | 11/01/2017 | 11/13/2017 |
| PA | PA MANIFEST | Manifest Information | Department of Environmental Protection | 12/31/2016 | 07/25/2017 | 09/25/2017 |
| RI | RI MANIFEST | Manifest information | Department of Environmental Management | 12/31/2013 | 06/19/2015 | 07/15/2015 |
| WI | WI MANIFEST | Manifest Information | Department of Natural Resources | 12/31/2016 | 04/13/2017 | 07/14/2017 |
| US | AHA Hospitals | Sensitive Receptor: AHA Hospitals | American Hospital Association, Inc. | | | |
| US | Medical Centers | Sensitive Receptor: Medical Centers | Centers for Medicare & Medicaid Services | | | |
| US | Nursing Homes | Sensitive Receptor: Nursing Homes | National Institutes of Health | | | |
| US | Public Schools | Sensitive Receptor: Public Schools | National Center for Education Statistics | | | |
| US | Private Schools | Sensitive Receptor: Private Schools | National Center for Education Statistics | | | |
| CA | Daycare Centers | Sensitive Receptor: Licensed Facilities | Department of Social Services | | | |
| US | Flood Zones | 100-year and 500-year flood zones | Emergency Management Agency (FEMA) | | | |
| US | NWI | National Wetlands Inventory | U.S. Fish and Wildlife Service | | | |
| CA | State Wetlands | Wetland Inventory | Department of Fish & Game | | | |
| US | Topographic Map | Current USGS 7.5 Minute Topographic Map | U.S. Geological Survey | | | |
| US | Oil/Gas Pipelines | | PennWell Corporation | | | |
| US | Electric Power Transmission Line Data | | PennWell Corporation | | | |

# GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

| St | Acronym | Full Name | Government Agency | Gov Date | Arvl. Date | Active Date |
|---|---|---|---|---|---|---|

**STREET AND ADDRESS INFORMATION**

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# APPENDIX E
# CREDENTIALS

# JEREMY R. ROSENTHAL
## ENVIRONMENTAL FIELD SCIENTIST

## PROFESSIONAL EXPERIENCE

Mr. Rosenthal is a Field Environmental Scientist in Terracon's Orange County, California office. His responsibilities include Phase I Environmental Site Assessments. He also has experience working on Phase II Site Investigations, computer-aided design, asbestos surveys, and Engineering Materials Testing and special inspections.

## PROJECT EXPERIENCE

**Environmental Site Assessments (ESA)**
Phase I ESA project support, historical researcher and site inspector on multiple office buildings, retail stores, warehouses, and telecommunications projects, mostly in the State of Arizona with a growing background in California. Mr. Rosenthal has offered support for Phase II ESAs and has been responsible for logging and describing soils and contaminants and properly collecting and transportiong soil and soil vapor samples.

**Hub II – Tucson, Arizona**
Performed various materials testing during project construction. Project activities include site reconnaissance, soil density testing, concrete analysis, and on-site observations

**Kneader's Bakery and Cafe – Tucson, Arizona**
Performed soil density and moisture tests on over 30 feet of imported fill material.

**Various Compliance Inspections and Testing – Arizona**
Performed on-site field work special inspections and laboratory testing for numerous projects in Arizona. Perform lab tests for further analysis by conducting sieve analysis, compaction tests, plasticity tests, and concrete and grout strength tests.

**Coronado National Forest Invasive Species Program – Tucson, Arizona**
Identifying and removing invasive non-native species within Sabino and Bear Canyon.

### Education
*Bachelor of Science, Natural Resources and the Environment, University of Arizona, 2014*

### Certifications
*OSHA 40-hour HazWoper*

*Asbestos Building Inspector Initial*

*ACI - Concrete Field Testing Technician - Grade I*

*CPR and First Aid Training*

### Affiliations
*Tierra Sec: Society for Rangeland Management,*

### Work History
*Terracon, Field Environmental Scientist, 2017-present*

*Terracon, Environmental Technician, 2016-2017*

*Terracon, Engineering Technician, 2015-2016*

*JPMorgan Chase Bank, Personal Banker/Teller, 2012-2015*

*University of Arizona, Mine-land reclamation Research Assistant 2013-2014*

# CARL A. PARTEN, P.G.
# OFFICE MANAGER

## PROFESSIONAL EXPERIENCE

Mr. Parten has over twenty-nine years of experience in environmental consulting in multiple regional regulatory districts throughout the United States. His professional experience includes comprehensive site investigations and remediation studies for Industrial and Hazardous Waste sites, municipal solid waste landfill sites and underground storage tank (UST) facilities.

He has successfully managed and obtained regulatory closure of over 30 Voluntary Cleanup Program (VCP) sites and leaking underground storage tank (LUST) facilities, and coordinated UST removal and closure for numerous facilities in multiple states throughout the United States. Mr. Parten continues to serve as a technical lead with Terracon and he possesses extensive experience in the installation of monitor wells, aquifer characterization, sensitive receptor surveys, risk-based assessments, vapor intrusion (VI) evaluations, and soil-gas assessments. Additionally, he has extensive experience in comprehensive soil and groundwater investigations on industrial facilities and municipal solid waste (MSW) landfill facilities, including evaluation of landfill gas/methane impacts. He has prepared and implemented corrective action work plans for remediation of chlorinated hydrocarbons at dry cleaner facilities and petroleum hydrocarbons at LUST facilities, MSW landfill facilities, and managed and implemented groundwater pump and treat, non-aqueous phase liquid (NAPL) recovery, and duel-phase vapor extraction systems for the recovery of petroleum hydrocarbons. Additionally, Mr. Parten developed work plans and implemented the remediation of heavy metals and poly-nuclear aromatic hydrocarbons (PAHs).

## PROJECT EXPERIENCE

**Industrial Facility – Union City, California**
Subsurface investigation and delineation of heavy metals and polynuclear aromatic hydrocarbons (PAHs) in soil to facilitate the development of response actions and waste characterization/disposal of impacted environmental media at a large industrial facility with over sixty years of operations. Consulting services included preparation of investigation reports, response action work plans, and client/regulatory interaction.

**Industrial Facility – Land-use Change/Private School, Los Angeles, CA**
Environmental consulting services including Phase I Environmental Site Assessments (ESA) due diligence support, subsurface investigation activities to evaluate environmental media including soil, groundwater, soil gas and indoor / outdoor air. Services included a land-use change from an industrial facility to a private school. Prepared environmental investigation reports, regulatory interaction, corrective action design and work plan for management of environmental media.

**USARC Facility – Mare Island, California**
Environmental team leader for evaluation of an existing 32-acre military facility, Mare Island in California. The teaming effort included the preparation of a Technical Assessment report on the facility to provide USAR a decision making and programming tool to establish future

## Education

*Bachelor of Science,* Geology, Sul Ross State University, Alpine, Texas, 1994

*Additional Courses:*
*University of Houston TCEQ Texas Risk Reduction Program: Mod. I, II, and III*

*Roadmap to Remediation*

*CAPM Refresher Course, Texas A&M University*

*TNRCC Hazardous Waste Seminar*

*TNRCC PST Risk Assessments Seminar*

*TNRCC Pollution Prevention Training Workshop*

*API Risk/Exposure Assessment*

*Contaminant Fate and Transport Modeling in Risk Assessment*

*Environmental Hydrology / Soil Science*

## Certifications

*Licensed Professional Geoscientist (P.G.), I.D. # 221, Texas Board of Professional Geoscientists 2003 (current)*

*Registered Professional Geologist (P.G.), I.D. # 004037; State of Tennessee, May 1996 (current)*

*TCEQ Corrective Action Project Manager, CAPM #01091 (current)*

*40 Hour OSHA Hazardous Waste Site & Waste Management Training*

## Affiliations

*BDA/Orange County*

*CMAA*

*Groundwater Resource Assoc.*

*Geological Society of America*

## Work History

*Terracon Consultants, Inc. (Irvine), Principal, Office Manager, July 2010 to Present*

*Terracon Consultants, Inc. (Dallas), Environmental Group Manager, August 1998 to July 2010*

*ATC (formerly ATEC) Associates, Inc. - Dallas, Texas, Senior Project Manager April 1990 to August 1998*

*Terratech, Inc. - San Jose, California, Environmental and Geotechnical Technician February 1989 to March 1990*

*Woodward-Clyde Consultants - San Jose, California, Environmental and Geotechnical Technician March 1987 to February 1989*

Terracon

restoration and replacement upgrades to the facility. The report included an evaluation of existing conditions of the site and facilities with respect to current mission and identified construction costs required to comply with USAR facility standards, Anti-Terrorism/Force Protection requirements, handicapped accessibility regulations, and current building codes. Conceptual costs for related improvements and environmental mitigation were presented.

**Major Department Store Commercial Retail Portfolio**
Environmental team lead for evaluating environmental site conditions and due diligence review, including overseeing Phase I Environmental Site Assessments and Phase II Environmental Site Investigations for over fifty retail facilities with automotive maintenance across California. Findings from subsurface investigations were used to support regulatory closure of select facilities to facilitate a real estate transaction across the United States.

**Automated Fuel Dispensing Facilities – Camp Pendleton, California**
Project scope included environmental and geotechnical investigations at six fueling existing/proposed facilities within Camp Pendleton, California. The project consisted of construction of new buildings, canopies, pavements, retaining walls, slopes, and installation of underground storage tanks (USTs), and other site facilities. Served as the primary client point of contact and environmental technical leader.

**Mixed-Use High-rise Building, West Hollywood, California**
Conducted comprehensive investigation and assisted the client through enrolling and interacting with the DTSC / VCP regarding chlorinated solvent and heavy metal-impacted soil and groundwater. Provided construction management oversight to manage impacted soils and assisted the client in waste disposition, permitting and regulatory compliance interaction. A total of 52,000 cubic yards of soil was removed from the site and disposed at an off-site facility, prior to the construction of a $170M high-rise multi-use complex. Terracon's support services allowed for significant savings in construction, on an expedited timeline in concert with the construction schedule.

**Underground Storage Tank and Soil Remediation – Regional Water Board, Squaw Valley, CA**
Terracon assisted a private developer with the regulatory closure of an underground storage tank (UST) site located in Squaw Valley, California. The abandoned 10,000-gallon UST was responsible for a release of heavy waste oils to the ground surface and banks of a creek. Following disposal of the UST, approximately 70 cubic yards of petroleum-impacted soils were excavated and properly disposed. Interaction with the Regional Water Board and Public Notification resulted in the issuance of case closure.

**Retail Shopping Center – Former Dry Cleaners Facility – DTSC, Fremont, CA**
Conducted extensive site investigation activities to evaluate the magnitude and extent of chlorinated solvents identified in the vicinity of a former dry cleaners facility, including an evaluation of groundwater, soil, soil-gas and indoor vapors as a result of a chlorinated solvent plume. Mr. Parten provided direct support and interaction with client, client legal team and DTSC representatives to manage the closure process, including the preparation of work plans and environmental investigation reports, risk-based human health evaluation, and response actions.

**Soil Remediation – Riverside County Regulatory Oversight, Telecommunications Site, Perris, CA**
Terracon assessed the magnitude and extent of a surficial release of petroleum hydrocarbons, developed a work plan, approved by overseeing agency, and conducted remediation, removal and legal disposal of 80 cubic yards of non-hazardous soil.

**Municipal Landfill – VCP Site**
Successfully oversaw and managed the engineering design and construction quality assurance for the closure and restoration of a high-profile MSW landfill in accordance with regulatory standards, subsequent to significant investigation activities. The remedy consisted of removal and consolidation of wastes and construction of LFG recovery trenches to prevent migration of landfill gas. The remedy utilized engineering controls and removal of impacted media. Project management responsibilities included coordination with Local, State and Federal officials, public/neighborhood communications, and interaction with attorneys, and management of project budgets that exceeded $4.5 million over seven years. Terracon continues to provide post closure care monitoring and O&M for the site.

**Department of Transportation Contract**
Successfully managed a two-year environmental services contract with the Texas Department of Transportation (TxDOT) and coordinated multiple Terracon offices to provide geographic coverage of environmental consulting service throughout Texas. Mr. Parten was the liaison to TxDOT for the performance of environmental consulting services, and provided senior technical review of environmental investigations, Phase I ESAs, removal of underground storage tanks, remediation of affected media and waste management, asbestos and lead-based paint investigations, and management of financial metrics and budgets in strict conformance with negotiated fees and procedures under a $2,000,000 contract.

## City-Operated LUST Facilities
Provided senior project management of 14 City operated LUST facilities through coordination of investigation, regulatory reporting and response actions in the pursuit of closure. Mr. Parten was responsible for managing all site activities, evaluation of data, reporting, communicating with local and state officials, and management of budget and schedule requirements.

## Municipal Property
Provided senior project management and technical review of several properties, including the remediation of metals and PAH-impacted soils, using a combination of excavation and removal and in-place stabilization. Work was performed under the EPA Brownfields Program and the Voluntary Cleanup Program. The $1.2 million dollar remediation project was part of a high-profile downtown parks and recreation redevelopment project that successfully established LEED Certified public parks in areas once occupied by commercial and industrial property. Mr. Parten was responsible for managing all site activities, evaluation of data, reporting, communicating with local and state officials, and management of budget and schedule requirements.

## 3.023-Acre Tract – VCP Site
Successfully managed a Phase I ESA and subsequent comprehensive site investigation to evaluate historical site activities and non-native fill material. Chemicals of concern included VOCs, TPH, metals and PAHs in on-site soil and groundwater. Subsequent to completion of a risk-based assessment, response actions including remediation of approximately 1,500 cubic yards of impacted soils was performed to obtain a voluntary cleanup program Certificate of Completion. Mr. Parten was responsible for managing all site activities, evaluation of data, reporting, and communication with state officials.

**Retail Shopping Center – VCP Site**
Conducted extensive site investigation activities to evaluate the magnitude and extent of chlorinated solvents identified in the vicinity of a former dry cleaners facility. The chlorinated solvent plume was defined to drinking water standards and was delineated to a creek channel nearly 1,200 feet from the source property. Based on site investigation results, assisted the property owner in entering the site into the VCP, and managed and implemented response actions and treatment of affected media utilizing a combination of source-removal/excavation (750 cubic yards) within the building interiors, hydrogen-releasing compound (HRC®) treatment of backfill, and HRC injection into the underlying soil and groundwater across the site. Treatment technology effectively remediated affected soils and significantly reduced contaminant levels within the on-site source areas. Additional response actions were conducted to reduce on-site groundwater contamination levels through HRC injection at over 250 locations. Monitored natural attenuation and groundwater monitoring was performed for a period of approximately four years. Mr. Parten assisted the client in the establishment of a deed restriction (Municipal Setting Designation) that restricted the use of groundwater on the site. Mr. Parten interacted with City and State officials and prepared and submitted multiple reports documenting site activities, and managed a project budget totaling $1,200,000.

**Additional Project Experience**
Under the direction and senior technical review by Mr. Parten, final site closure has been obtained for over thirty VCP, Innocent Owner/Operator Program, LUST, and Industrial and Hazardous Waste facilities in multiple states across the United States. Additionally, Mr. Parten has coordinated and managed the removal of dozens of underground storage tank (UST) systems and remediation of contaminated soil and groundwater. Mr. Parten has provided expert testimony on multiple projects, and is a primary point of contact interacting with environmental attorneys and regulatory agencies.

# APPENDIX F
# DESCRIPTION OF TERMS AND ACRONYMS

## Description of Selected General Terms and Acronyms

| *Term/Acronym* | *Description* |
|---|---|
| ACM | Asbestos Containing Material. Asbestos is a naturally occurring mineral, three varieties of which (chrysotile, amosite, crocidolite) have been commonly used as fireproofing or binding agents in construction materials. Exposure to asbestos, as well as ACM, has been documented to cause lung diseases including asbestosis (scarring of the lung), lung cancer and mesothelioma (a cancer of the lung lining).<br><br>Regulatory agencies have generally defined ACM as a material containing greater that one (1) percent asbestos, however some states (e.g. California) define ACM as materials having 0.1% asbestos. In order to define a homogenous material as non-ACM, a minimum number of samples must be collected from the material dependent upon its type and quantity. Homogenous materials defined as non-ACM must either have 1) no asbestos identified in all of its samples or 2) an identified asbestos concentration below the appropriate regulatory threshold. Asbestos concentrations are generally determined using polarized light microscopy or transmission electron microscopy. Point counting is an analytical method to statistically quantify the percentage of asbestos in a sample. The asbestos component of ACM may either be friable or non-friable. Friable materials, when dry, can be crumbled, pulverized, or reduced to powder by hand pressure and have a higher potential for a fiber release than non-friable ACM. Non-friable ACM are materials that are firmly bound in a matrix by plastic, cement, etc. and, if handled carefully, will not become friable.<br><br>Federal and state regulations require that either all suspect building materials be presumed ACM or that an asbestos survey be performed prior to renovation, dismantling, demolition, or other activities that may disturb potential ACM. Notifications are required prior to demolition and/or renovation activities that may impact the condition of ACM in a building. ACM removal may be required if the ACM is likely to be disturbed or damaged during the demolition or renovation. Abatement of friable or potentially friable ACM must be performed by a licensed abatement contractor in accordance with state rules and NESHAP. Additionally, OSHA regulations for work classification, worker training and worker protection will apply. |
| AHERA | Asbestos Hazard Emergency Response Act |
| AST | Aboveground Storage Tanks. ASTs are generally described as storage tanks less than 10% of which are below ground (i.e., buried). Tanks located in a basement, but not buried, are also considered ASTs. Whether, and the extent to which, an AST is regulated, is determined on a case-by-case basis and depends upon tank size, its contents and the jurisdiction of its location. |
| BGS | Below Ground Surface |
| Brownfields | State and/or tribal listing of Brownfield properties addressed by Cooperative Agreement Recipients or Targeted Brownfields Assessments. |
| BTEX | Benzene, Toluene, Ethylbenzene, and Xylenes. BTEX are VOC components found in gasoline and commonly used as analytical indicators of a petroleum hydrocarbon release. |
| CERCLA | Comprehensive Environmental Response, Compensation and Liability Act (a.k.a. Superfund). CERCLA is the federal act that regulates abandoned or uncontrolled hazardous waste sites. Under this Act, joint and several liability may be imposed on potentially responsible parties for cleanup-related costs. |
| CERCLIS | Comprehensive Environmental Response, Compensation and Liability Information System. An EPA compilation of sites having suspected or actual releases of hazardous substances to the environment. CERCLIS also contains information on site inspections, preliminary assessments and remediation of hazardous waste sites. These sites are typically reported to EPA by states and municipalities or by third parties pursuant to CERCLA Section 103. |
| CESQG | Conditionally exempt small quantity generators. |
| CFR | Code of Federal Regulations |

## Description of Selected General Terms and Acronyms (cont.)

| *Term/Acronym* | *Description* |
|---|---|
| CREC | Controlled Recognized Environmental Condition is defined in ASTM E1527-13 as "a recognized environmental condition resulting from a past release of hazardous substances or petroleum products that has been addressed to the satisfaction of the applicable regulatory authority (for example, as evidenced by the issuance of a no further action letter or equivalent, or meeting risk-based criteria established by regulatory authority) , with hazardous substances or petroleum products allowed to remain in place subject to the implementation of required controls (for example, property use restrictions, activity and use limitations, institutional controls, or engineering controls). A condition considered by the environmental professional to be a controlled recognized environmental condition shall be listed in the findings section of the Phase I Environmental Site Assessment report, and as a recognized environmental condition in the conclusions section of the Phase I Environmental Site Assessment report." |
| DOT | U.S. Department of Transportation |
| EPA | U.S. Environmental Protection Agency |
| ERNS | Emergency Response Notification System. An EPA-maintained federal database which stores information on notifications of oil discharges and hazardous substance releases in quantities greater than the applicable reportable quantity under CERCLA. ERNS is a cooperative data-sharing effort between EPA, DOT, and the National Response Center. |
| ESA | Environmental Site Assessment |
| FRP | Fiberglass Reinforced Plastic |
| Hazardous Substance | As defined under CERCLA, this is (A) any substance designated pursuant to section 1321(b)(2)(A) of Title 33, (B) any element, compound, mixture, solution, or substance designated pursuant to section 9602 of this title; (C) any hazardous waste having characteristics identified under or listed pursuant to section 3001 of the Solid Waste Disposal Act (with some exclusions); (D) any toxic pollutant listed under section 1317(a) of Title 33; (E) any hazardous air pollutant listed under section 112 of the Clean Air Act; and (F) any imminently hazardous chemical substance or mixture with respect to which the EPA Administrator has taken action under section 2606 of Title 15. This term does not include petroleum, including crude oil or any fraction thereof which is not otherwise listed as a hazardous substance under subparagraphs (A) through (F) above, and the term include natural gas, or synthetic gas usable for fuel (or mixtures of natural gas and such synthetic gas). |
| Hazardous Waste | This is defined as having characteristics identified or listed under section 3001 of the Solid Waste Disposal Act (with some exceptions). RCRA, as amended by the Solid Waste Disposal Act of 1980, defines this term as a "solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may (A) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness; or (B) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed." |
| HREC | Historical Recognized Environmental Condition is defined in ASTM E1527-13 as "a past release of any hazardous substances or petroleum products that has occurred in connection with the property and has been addressed to the satisfaction of the applicable regulatory authority or meeting unrestricted residential use criteria established by a regulatory authority, without subjecting the property to any required controls (for example, property use restrictions, activity and use limitations, institutional controls, or engineering controls). Before calling the past release a historical recognized environmental condition, the environmental professional must determine whether the past release is a recognized environmental condition at the time of the Phase I Environmental Site Assessment is conducted (for example, if there has been a change in the regulatory criteria). If the EP considers the past release to be a recognized environmental condition at the time the Phase I ESA is conducted, the condition shall be included in the conclusions section of the report as a recognized environmental condition." |

| | |
|---|---|
| IC/EC | A listing of sites with institutional and/or engineering controls in place. IC include administrative measures, such as groundwater use restrictions, construction restrictions, property use restrictions, and post remediation care requirements intended to prevent exposure to contaminants remaining on site. Deed restrictions are generally required as part of the institutional controls. EC include various forms of caps, building foundations, liners, and treatment methods to create pathway elimination for regulated substances to enter environmental media or effect human health. |
| ILP | Innocent Landowner/Operator Program |
| LQG | Large quantity generators. |
| LUST | Leaking Underground Storage Tank. This is a federal term set forth under RCRA for leaking USTs. Some states also utilize this term. |
| MCL | Maximum Contaminant Level. This Safe Drinking Water concept (and also used by many states as a ground water cleanup criteria) refers to the limit on drinking water contamination that determines whether a supplier can deliver water from a specific source without treatment. |
| MSDS | Material Safety Data Sheets. Written/printed forms prepared by chemical manufacturers, importers and employers which identify the physical and chemical traits of hazardous chemicals under OSHA's Hazard Communication Standard. |
| NESHAP | National Emissions Standard for Hazardous Air Pollutants (Federal Clean Air Act). This part of the Clean Air Act regulates emissions of hazardous air pollutants. |
| NFRAP | Facilities where there is "No Further Remedial Action Planned," as more particularly described under the Records Review section of this report. |
| NOV | Notice of Violation. A notice of violation or similar citation issued to an entity, company or individual by a state or federal regulatory body indicating a violation of applicable rule or regulations has been identified. |
| NPDES | National Pollutant Discharge Elimination System (Clean Water Act). The federal permit system for discharges of polluted water. |
| NPL | The NPL is the EPA's database of uncontrolled or abandoned hazardous waste facilities that have been listed for priority remedial actions under the Superfund Program. |
| OSHA | Occupational Safety and Health Administration or Occupational Safety and Health Act |
| PACM | Presumed Asbestos-Containing Material. A material that is suspected of containing or presumed to contain asbestos but which has not been analyzed to confirm the presence or absence of asbestos. |

## Description of Selected General Terms and Acronyms (cont.)

| *Term/Acronym* | *Description* |
|---|---|
| PCB | Polychlorinated Biphenyl. A halogenated organic compound commonly in the form of a viscous liquid or resin, a flowing yellow oil, or a waxy solid. This compound was historically used as dielectric fluid in electrical equipment (such as electrical transformers and capacitors, electrical ballasts, hydraulic and heat transfer fluids), and for numerous heat and fire sensitive applications. PCB was preferred due to its durability, stability (even at high temperatures), good chemical resistance, low volatility, flammability, and conductivity. PCBs, however, do not break down in the environment and are classified by the EPA as a suspected carcinogen. 1978 regulations, under the Toxic Substances Control Act, prohibit manufacturing of PCB-containing equipment; however, some of this equipment may still be in use today. |
| pCi/L | Pico Curies per Liter of Air. Unit of measurement for Radon and similar radioactive materials. |
| PLM | Polarized Light Microscopy (see ACM section of the report, if included in the scope of services) |
| PST | Petroleum Storage Tank. An AST or UST that contains a petroleum product. |
| Radon | A radioactive gas resulting from radioactive decay of naturally-occurring radioactive materials in rocks and soils containing uranium, granite, shale, phosphate, and pitchblende. Radon concentrations are measured in Pico Curies per Liter of Air. Exposure to elevated levels of radon creates a risk of lung cancer; this risk generally increases as the level of radon and the duration of exposure increases. Outdoors, radon is diluted to such low concentrations that it usually does not present a health concern. However, radon can accumulate in building basements or similar enclosed spaces to levels that can pose a risk to human health. Indoor radon concentrations depend primarily upon the building's construction, design and the concentration of radon in the underlying soil and ground water. The EPA recommended annual average indoor "action level" concentration for residential structures is 4.0 pCi/l. |
| RCRA | Resource Conservation and Recovery Act. Federal act regulating solid and hazardous wastes from point of generation to time of disposal ('cradle to grave"). 42 U.S.C. 6901 et seq. |
| RCRA Generators | The RCRA Generators database, maintained by the EPA, lists facilities that generate hazardous waste as part of their normal business practices. Generators are listed as either large (LQG), small (SQG), or conditionally exempt (CESQG). LQG produce at least 1000 kg/month of non-acutely hazardous waste or 1 kg/month of acutely hazardous waste. SQG produce 100-1000 kg/month of non-acutely hazardous waste. CESQG are those that generate less than 100 kg/month of non-acutely hazardous waste. |
| RCRA CORRACTS/TSDs | The USEPA maintains a database of RCRA facilities associated with treatment, storage, and disposal (TSD) of hazardous materials which are undergoing "corrective action". A "corrective action" order is issued when there is a release of hazardous waste or constituents into the environment from a RCRA facility. |
| RCRA Non-CORRACTS/TSDs | The RCRA Non-CORRACTS/TSD Database is a compilation by the USEPA of facilities which report storage, transportation, treatment, or disposal of hazardous waste. Unlike the RCRA CORRACTS/TSD database, the RCRA Non-CORRACTS/TSD database does not include RCRA facilities where corrective action is required. |
| RCRA Violators List | RAATS. RCRA Administrative Actions Taken. RAATS information is now contained in the RCRIS database and includes records of administrative enforcement actions against facilities for noncompliance. |
| RCRIS | Resource Conservation and Recovery Information System, as defined in the Records Review section of this report. |
| REC | Recognized Environmental Conditions are defined by ASTM E1527-13 as "the presence or likely presence of any hazardous substances or petroleum products in, on, or at a property: 1)due to any release to the environment; 2) under conditions indicative of a release to the environment. *De minimis* conditions are not recognized environmental conditions." |
| SCL | State "CERCLIS" List (see SPL /State Priority List, below). |

## Description of Selected General Terms and Acronyms (cont.)

| *Term/Acronym* | *Description* |
|---|---|
| SPCC | Spill Prevention, Control and Countermeasures. SPCC plans are required under federal law (Clean Water Act and Oil Pollution Act) for any facility storing petroleum in tanks and/or containers of 55-gallons or more that when taken in aggregate exceed 1,320 gallons. SPCC plans are also required for facilities with underground petroleum storage tanks with capacities of over 42,000 gallons. Many states have similar spill prevention programs, which may have additional requirements. |
| SPL | State Priority List. State list of confirmed sites having contamination in which the state is actively involved in clean up activities or is actively pursuing potentially responsible parties for clean up. Sometimes referred to as a State "CERCLIS" List. |
| SQG | Small quantity generator. |
| SWF/LF | State and/or Tribal database of solid waste/Landfill facilities. The database information may include the facility name, class, operation type, area, estimated operational life, and owner. |
| TPH | Total Petroleum Hydrocarbons |
| TRI | Toxic Release Inventory. Routine EPA report on releases of toxic chemicals to the environment based upon information submitted by entities subject to reporting under the Emergency Planning and Community Right to Know Act. |
| TSCA | Toxic Substances Control Act. A federal law regulating manufacture, import, processing and distribution of chemical substances not specifically regulated by other federal laws (such as asbestos, PCBs, lead-based paint and radon). 15 U.S.C 2601 et seq. |
| USACE | United States Army Corps of Engineers |
| USC | United States Code |
| USGS | United States Geological Survey |
| USNRCS | United States Department of Agriculture-Natural Resource Conservation Service |
| UST | Underground Storage Tank. Most federal and state regulations, as well as ASTM E1527-13, define this as any tank, incl., underground piping connected to the tank, that is or has been used to contain hazardous substances or petroleum products and the volume of which is 10% or more beneath the surface of the ground (i.e., buried). |
| VCP | State and/or Tribal facilities included as Voluntary Cleanup Program sites. |
| VOC | Volatile Organic Compound |
| Wetlands | Areas that are typically saturated with surface or ground water that creates an environment supportive of wetland vegetation (i.e., swamps, marshes, bogs). The Corps of Engineers Wetlands Delineation Manual (Technical Report Y-87-1) defines wetlands as areas inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. For an area to be considered a jurisdictional wetland, it must meet the following criteria: more than 50 percent of the dominant plant species must be categorized as Obligate, Facultative Wetland, or Facultative on lists of plant species that occur in wetlands; the soil must be hydric; and, wetland hydrology must be present.<br><br>The federal Clean Water Act which regulates "waters of the US," also regulates wetlands, a program jointly administered by the USACE and the EPA. Waters of the U.S. are defined as: (1) waters used in interstate or foreign commerce, including all waters subject to the ebb and flow of tides; (2) all interstate waters including interstate wetlands; (3) all other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, etc., which the use, degradation, or destruction could affect interstate/ foreign commerce; (4) all impoundments of waters otherwise defined as waters of the U. S., (5) tributaries of waters identified in 1 through 4 above; (6) the territorial seas; and (7) wetlands adjacent to waters identified in 1 through 6 above. Only the USACE has the authority to make a final wetlands jurisdictional determination. |

# Appendix 5: LID Infeasibility

*LID Technical Infeasibility Analysis*

# Appendix 6: BMP Design Details

*BMP Sizing, Design Details and other Supporting Documentation*

**PROJECT DESCRIPTION**

TTM 37305 (Nichols South Specific Plan) is located south of Nichols Road, east of and adjacent to interstate 15, west of El Toro Road, and north of Temescal Canyon High School in the City of Lake Elsinore.

Stovepipe Canyon Creek bisects the project site from the east enters the property via two 24" pipes and over the concrete spillway and exits the property along the westerly property line via existing Caltrans 6'x14' RCB culvert.

The subject property is located within Sections 24 and 25, Township 5 South, Range 5 West, near the community of Lake Elsinore.

TTM 37305 is a 74 acre development consisting of 168 single family residential homes, a 14.5 acre commercial site along with a park and open space areas. TTM 37305 is located within the Nichols South Specific Plan which is being processed concurrently with TTM 37305.

The grading and drainage design of Tract 37305 has been developed to maintain the natural drainage patterns as much as practical. The roadway system and the proposed storm drain system will intercept runoff from the development and safely convey these flows to one of the two proposed mitigation basins within the development. The residential lots north of the Stovepipe Canyon Creek, Drainage Area "A", will flow to WQ Basin "A-1" which is an extended detention basin. Treated flows from WQ Basin "A-1" will then flow into Detention Basin "A", which is a peak flow mitigation basin, before discharge into the existing Stovepipe Canyon Creek.

The commercial development, Drainage Areas "C-1" and "C-2, will initially discharge into Detention Basin "A", after water quality flows are bifurcated into WQ Basin "A-2". In conjunction with the future commercial development much of the storm flows will be directed to the existing 24" culverts associated with the existing freeway ramp while water quality flows will be bifurcated and directed in a private storm drain into WQ Basin "A-2" which is a sand filter facility. Treated flows will then be discharged into Detention Basin "A" and then discharged into the existing Stovepipe Canyon Creek. Peak storm flows discharged into the two 24" culverts, as well as from Detention Basin "A", will be reduced to, or below, the existing condition flows.

The residential lots located to the South of the Stovepipe Canyon Creek, Drainage Area "B" will drain to WQ Basin "B" which is a Sand Filter basin with peak flow mitigation. This basin will discharge to a parkway culvert drain into existing El Toro Road. The flows from WQ Basin "B" will be reduced to below the existing condition flows.

**Tabulation and Sizing Calculations**

BMPs Sizing Calculation:

These calculations are based on approved methodologies within the currently active Municipal Separate Storm Sewer System (MS4) permits for Santa Ana River Watershed regions of Riverside County. All included BMP designs are sized based on the design capture volume, $V_{BMP}$. However, there may be circumstances when flow based Treatment Control BMPs are utilized and therefore this section also includes the methodology for calculating the design flow rate, $Q_{BMP}$.

**Calculating $V_{BMP}$:**

Volume based BMPs, including all of the BMPs in this report, are sized to capture and treat the design capture volume, $V_{BMP}$. As the method for calculating and documenting the design capture volume varies by watershed. The watershed a particular project is within can be determined from the 'Locate my Watershed' tool available at: www.rcflood.org/npdes/. This project is within Santa Ana River watershed.

In order to meet Regional Water Quality Control Board (RWQCB) requirements, in the Santa Ana River Watershed the design capture volume ($V_{BMP}$) is based on capturing the volume of runoff generated from an 85th percentile, 24-hour storm event. Following the steps using the worksheet provided in the LID Handbook to calculate $V_{BMP}$ in the Santa Ana River Watershed.

The Design Storm Depth ($D_{85}$) is determined by locating the project site on the Isohyetal Map for the 85th Percentile 24-hour Storm Event. For the Lake Elsinore area project $D_{85}$ is 0.67 inches. See below Isohyetal Map.

**Project Site Design BMPs:**

DMA A-1a (27.03 Ac) – Type D, Mix Surface - Residential areas drain to proposed BMP A-1, Extended Detention Basin A-1.

DMA A-1b (3.5 Ac) – Type A, Detention Basin A – Self treating areas.

DMA A-2a (5.0 Ac) – Type D, Mix Surface - Street and A-2b (19.37 Ac) – Type D, Commercial Site areas drain to proposed BMP A-2, Sand Filter Basin A-2.

DMA B-1a (7.6 Ac) – Type D, Mix Surface – Residential areas drain to proposed BMP B, Sand Filter Basin B.

DMA B-1b (0.8 Ac) – Type A, Sand Filter Basin B – Self treating areas.

# Santa Ana Watershed

$V_{BMP}$ and $Q_{BMP}$ worksheets

These worksheets are to be used to determine the required

Design Capture Volume ($V_{BMP}$)
or the
Design Flow Rate ($Q_{BMP}$)

for BMPs in the Santa Ana Watershed

To verify which watershed your project is located within, visit

www.rcflood.org/npdes

and use the 'Locate my Watershed' tool

**If your project is not located in the Santa Ana Watershed,**

Do not use these worksheets! Instead visit

www.rcflood.org/npdes/developers.aspx

To access worksheets applicable to your watershed

**Use the tabs across the bottom**
**to access the worksheets for the Santa Ana Watershed**

Table 2-1: Impervious Fraction Based on Various Land Use Covers

| Surface Type | Effective Impervious Fraction, $I_f$ |
|---|---|
| Roofs | 1.00 |
| Concrete or Asphalt | 1.00 |
| Grouted or Gapless Paving Blocks | 1.00 |
| Compacted Soil (e.g. unpaved parking) | 0.40 |
| Decomposed Granite | 0.40 |
| Permeable Paving Blocks w/ Sand Filled Gap | 0.25 |
| Class 2 Base | 0.30 |
| Gravel or Class 2 Permeable Base | 0.10 |
| Pervious Concrete / Porous Asphalt | 0.10 |
| Open and Porous Pavers | 0.10 |
| Turf block | 0.10 |
| Ornamental Landscaping | 0.10 |
| Natural (A Soil) | 0.03 |
| Natural (B Soil) | 0.15 |
| Natural (C Soil) | 0.30 |
| Natural (D Soil) | 0.40 |

See below Impervious cover table from Hydrology Manual:

ACTUAL IMPERVIOUS COVER

| Land Use (1) | Range-Percent | Recommended Value For Average Conditions-Percent(2) |
|---|---|---|
| Natural or Agriculture | 0 – 10 | 0 |
| Single Family Residential: (3) | | |
| 40,000 S. F. (1 Acre) Lots | 10 – 25 | 20 |
| 20,000 S. F. (½ Acre) Lots | 30 – 45 | 40 |
| 7,200 – 10,000 S. F. Lots | 45 – 55 | 50 |
| Multiple Family Residential: | | |
| Condominiums | 45 – 70 | 65 |
| Apartments | 65 – 90 | 80 |
| Mobile Home Park | 60 – 85 | 75 |
| Commercial, Downtown Business or Industrial | 80 -100 | 90 |

Notes:

1. Land use should be based on ultimate development of the watershed. Long range master plans for the County and incorporated cities should be reviewed to insure reasonable land use assumptions.

2. Recommended values are based on average conditions which may not apply to a particular study area. The percentage impervious may vary greatly even on comparable sized lots due to differences in dwelling size, improvements, etc. Landscape practices should also be considered as it is common in some areas to use ornamental gravels underlain by impervious plastic materials in place of lawns and shrubs. A field investigation of a study area should always be made, and a review of aerial photos, where available may assist in estimating the percentage of impervious cover in developed areas.

3. For typical horse ranch subdivisions increase impervious area 5 percent over the values recommended in the table above.

**RCFC & WCD**
HYDROLOGY MANUAL

IMPERVIOUS COVER FOR DEVELOPED AREAS

PLATE D-5.6

For conservative Residential Nichols Road Project, I = 0.55 ➔ use 0.65 in preliminary

## DMA Classifications

| DMA Name or ID | Surface Type(s)[1] | Area (Ac) | DMA Type |
|---|---|---|---|
| | | | |
| DMA A-1a | Residential (Mix surfaces) | 27.03 | "D", to BMP A-1 |
| | | | |
| DMA A-1b | Basin A | 3.5 | "A", to Basin A |
| | | | |
| DMA A-2a | Street | 5.0 | "D", to BMP A-2 |
| DMA A-2b | Commercial | 19.37 | "D", to BMP A-2 |
| | | | |
| DMA B-1a | Residential (Mix surfaces) | 7.6 | "D", to BMP B |
| DMA B-1b | Basin B | 0.8 | "A", to BMP B |
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## Santa Ana Watershed - BMP Design Volume, $V_{BMP}$

(Rev. 10-2011)

Legend: Required Entries; Calculated Cells

*(Note this worksheet shall only be used in conjunction with BMP designs from the LID BMP Design Handbook)*

| | | | |
|---|---|---|---|
| Company Name | K&A Engineering, Inc. | Date | 2/1/2018 |
| Designed by | JY | Case No | |
| Company Project Number/Name | Nichols Road Partner | | |

### BMP Identification

BMP NAME / ID: DMA Area A-1 = 27.03 Ac, Residential

*Must match Name/ID used on BMP Design Calculation Sheet*

### Design Rainfall Depth

85th Percentile, 24-hour Rainfall Depth, from the Isohyetal Map in Handbook Appendix E

$D_{85}$= 0.67 inches

### Drainage Management Area Tabulation

*Insert additional rows if needed to accommodate all DMAs draining to the BMP*

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type | Effective Imperivous Fraction, $I_f$ | DMA Runoff Factor | DMA Areas x Runoff Factor | Design Storm Depth (in) | Design Capture Volume, $V_{BMP}$ (cubic feet) | Proposed Volume on Plans (cubic feet) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| | | | | | | | | |
| A-1a (27.03Ac) | 1177427 | Mixed Surface Types | 0.65 | 0.45 | 528874.6 | | | |
| | | | | | | | | |
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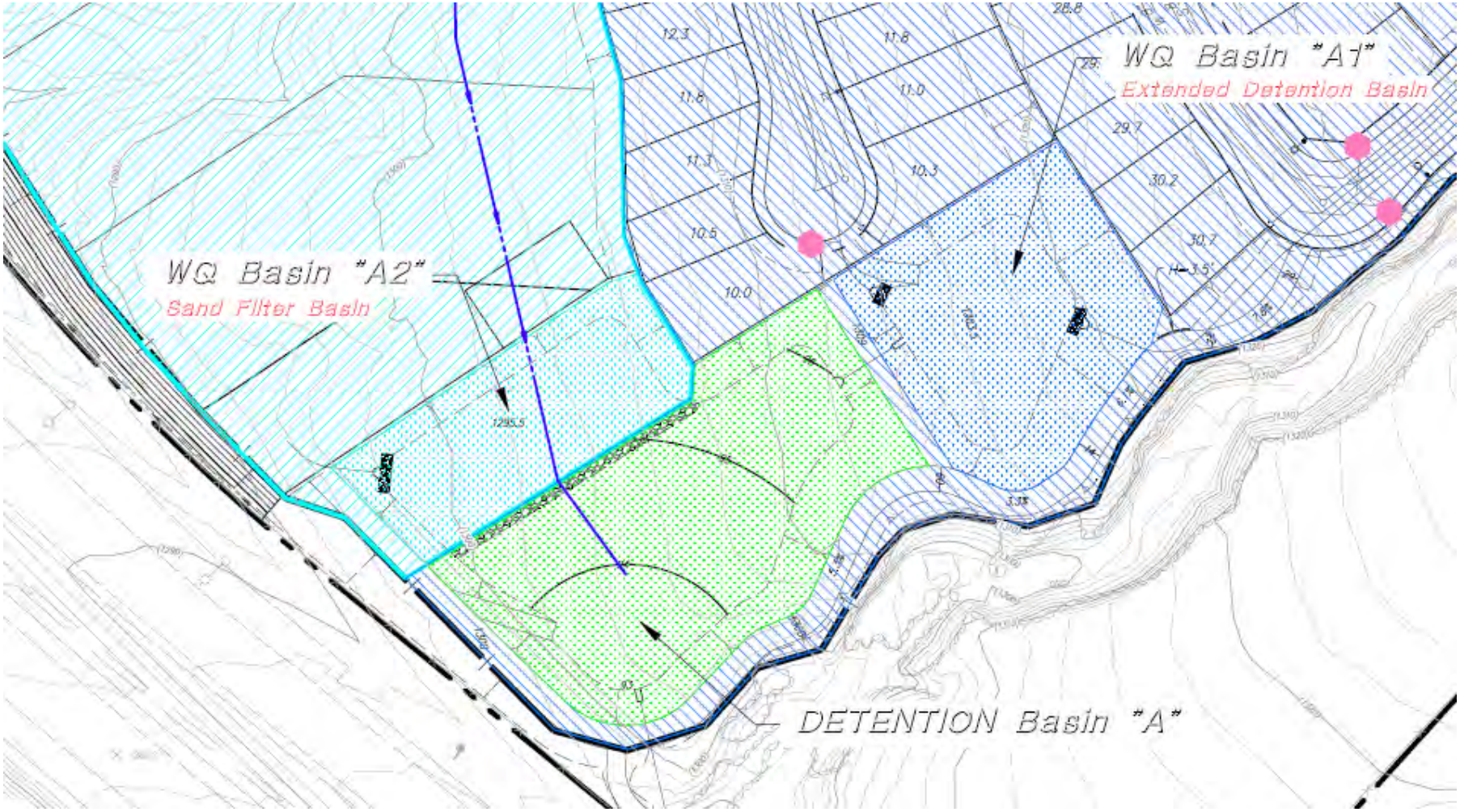
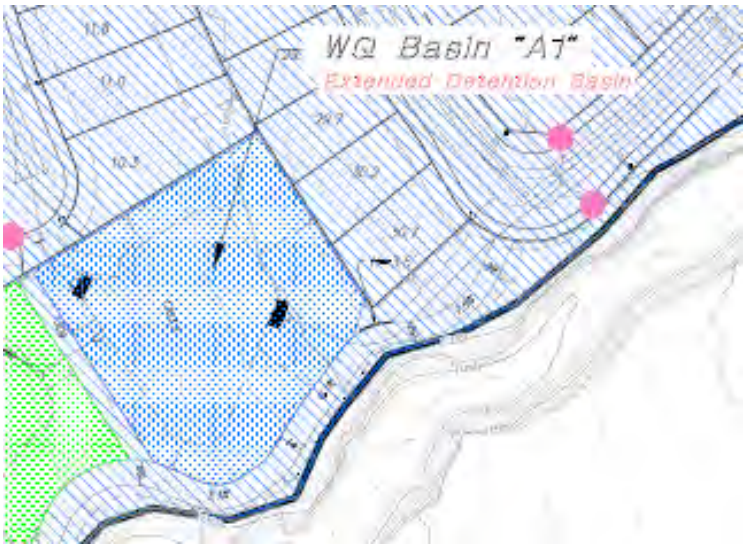
| | | | | |




**Extended Detention Basin "A-1", San Filter Basin "A-2" and Detention Basin "A"**




## Extended Detention Basin A-1:

Bottom area basin A-1 = 17,526 sf at elevation 1303.5

Vbmp Area A-1 = 29,530 cf

| Area A-1 | | | | | |
|---|---|---|---|---|---|
| Extended Detention Basin A-1 | | | | | |
| Elev. | Depth | Area (sf) | Vol. inc. (cf) | Vol. Accum. (cf) | Vol. Accum. (Acft) |
| | | | | | |
| 1303.5 | 0 | 0 | 0 | 0 | 0.00 |
| 1304.5 | 1 | 19910 | 9955 | 9955 | 0.23 |
| 1305.5 | 2 | 22129 | 21019.5 | 30974.5 | 0.71 |
| 1306.5 | 3 | 24447 | 23288 | 54262.5 | 1.25 |
| 1307.5 | 4 | 26867 | 25657 | 79919.5 | 1.83 |
| 1308.5 | 5 | 29388 | 28127.5 | 108047 | 2.48 |

**WQ Basin A-1 emergency outlet is above 1305.5 to capture full Design Capture Volume.**

## Santa Ana Watershed - BMP Design Volume, $V_{BMP}$

(Rev. 10-2011)

Legend: Required Entries; Calculated Cells

*(Note this worksheet shall only be used in conjunction with BMP designs from the LID BMP Design Handbook)*

| | | | |
|---|---|---|---|
| Company Name | K&A Engineering, Inc. | Date | 2/1/2018 |
| Designed by | JY | Case No | |
| Company Project Number/Name | Nichols Road Partner | | |

### BMP Identification

BMP NAME / ID: DMA Area A-2 = 24.37 Ac - Commercial - Nichols Road

*Must match Name/ID used on BMP Design Calculation Sheet*

### Design Rainfall Depth

85th Percentile, 24-hour Rainfall Depth, from the Isohyetal Map in Handbook Appendix E

$D_{85}$ = 0.67 inches

### Drainage Management Area Tabulation

*Insert additional rows if needed to accommodate all DMAs draining to the BMP*

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type | Effective Imperivous Fraction, $I_f$ | DMA Runoff Factor | DMA Areas x Runoff Factor | Design Storm Depth (in) | Design Capture Volume, $V_{BMP}$ (cubic feet) | Proposed Volume on Plans (cubic feet) |
|---|---|---|---|---|---|---|---|---|
| A-2a (5 Ac) | 217800 | Mixed Surface Types | 0.9 | 0.73 | 159055.4 | | | |
| A-2b (19.37 Ac) | 843757 | Mixed Surface Types | 0.9 | 0.73 | 616180.5 | | | |
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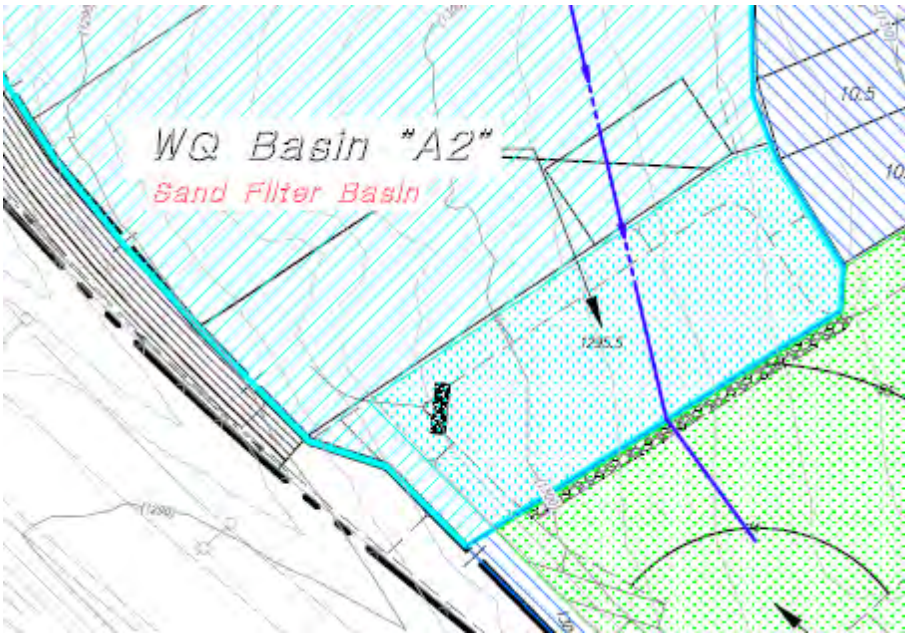
| | 1061557 | Total | | | 775235.9 | 0.67 | 43284 | 43300 |




**Sand Filter Basin A-2:**

Bottom area basin A-2 = 19,692 sf at elevation 1295.5
Average Soil Media (replacing 18" sand filter) is 22" deep.
Volume soil media void (30%) = 19,692 x 22/12 x 0.3 = 10,830 cf

Vbmp Area A-2 = 45,260 cf (1.04 Acft)
Required surface volume = 45,260 – 10,830 = 34,430 cf.

| **Area A-2** | | | | | |
|---|---|---|---|---|---|
| **Sand Filter Basin A-2** | | | | | |
| **Elev.** | **Depth** | **Area (sf)** | **Vol. inc. (cf)** | **Vol. Accum. (cf)** | **Vol. Accum. (Acft)** |
| | | | | | |
| 1293.5 | Soil Media | 19626 | 0 | 0 | 0.00 |
| 1294.5 | Soil Media | 19626 | 4906.5 | 4906.5 | 0.11 |
| 1295.5 | 0 | 19626 | 5887.8 | 10794.3 | 0.25 |
| 1296.5 | 1 | 22206 | 20916 | 31710.3 | 0.73 |
| 1297.5 | 2 | 24853 | 23529.5 | 55239.8 | 1.27 |

**WQ Basin A-2 outlet is above 1297 to capture full Design Capture Volume.**
**Proposed top of wall to Detention Basin A is 1297.0**

## Santa Ana Watershed - BMP Design Volume, $V_{BMP}$

(Rev. 10-2011)

Legend: Required Entries; Calculated Cells

*(Note this worksheet shall only be used in conjunction with BMP designs from the LID BMP Design Handbook)*

| | | | |
|---|---|---|---|
| Company Name | K&A Engineering, Inc. | Date | 1/29/2018 |
| Designed by | JY | Case No | |
| Company Project Number/Name | Nichols Road Partner | | |

### BMP Identification

BMP NAME / ID: DMA Area B = 8.4 Ac

*Must match Name/ID used on BMP Design Calculation Sheet*

### Design Rainfall Depth

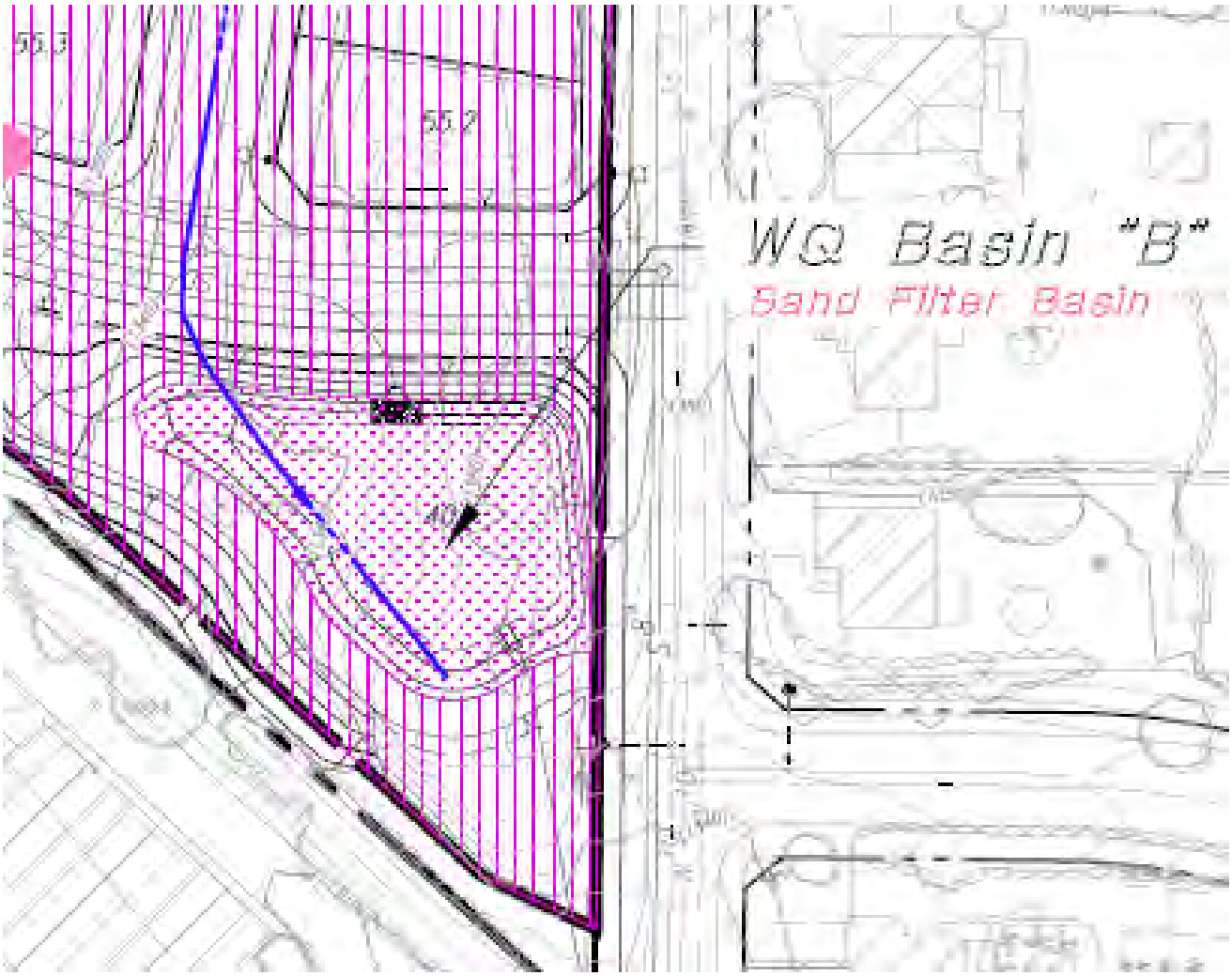
85th Percentile, 24-hour Rainfall Depth, from the Isohyetal Map in Handbook Appendix E

$D_{85}$= 0.67 inches

### Drainage Management Area Tabulation

*Insert additional rows if needed to accommodate all DMAs draining to the BMP*

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type | Effective Imperviousness Fraction, $I_f$ | DMA Runoff Factor | DMA Areas x Runoff Factor | Design Storm Depth (in) | Design Capture Volume, $V_{BMP}$ (cubic feet) | Proposed Volume on Plans (cubic feet) |
|---|---|---|---|---|---|---|---|---|
| B1 (0.8 Ac) | 34848 | Ornamental Landscaping | 0.1 | 0.11 | 3849.2 | | | |
| B2 (7.6 Ac) | 331056 | Mixed Surface Types | 0.65 | 0.45 | 148703.2 | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | |




**San Filter / Detention Basin B**

## Nichols Road project - Tract 37305

## City of Lake Elsinore

## Proposed Sand Filter/Detention Basin Area B

| Elev (ft) | Depth (ft) | Vol (ac-ft) | Headwater Stage 1 Depth (ft) | Stage 1 Orifice A=0.05 sf 2ea-3" Opening 1338 | Stage 1 Orifice A=0.09 sf 2ea-4" Opening 1341 | Spillway 5' Opening 1343 | HCOC Det. Basin Depth (ft) | HCOC Det. Basin Vol (ac-ft) | Emergency Spillway 10' Opening 1344 | Total Outflow **Q total** (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| 1338 | 0 | 0 | 0 | 0 | 0 | 0 | | | Enhanced SF | **0.00** |
| 1339 | 1 | 0.05 | 1 | 0.48 | 0 | 0 | | | Enhanced SF | **0.48** |
| 1340 | 2 | 0.103 | 2 | 0.7 | 0 | 0 | | | Enhanced SF | **0.70** |
| **Water Quality Volume = 8,520 cu-ft, Soil Media Void (30%) volume = 4,4905 cu-ft < Vbmp** | | | | | | | | | | |
| **WQ surface volume = 8,520 - 4,490 = 4,030 cu-ft (0.09 Ac-ft)** | | | | | | | | | | |
| 1340 | 0 | 0.000 | 2 | 0.7 | 0 | 0 | | | | **0.70** |
| 1340.5 | 0.5 | 0.196 | 2.5 | 0.78 | 0 | 0 | 0 | 0 | | **0.78** |
| 1341 | 1 | 0.288 | 3 | 0.86 | 0 | 0 | 0.5 | 0.093 | | **0.86** |
| 1342 | 2 | 0.502 | 4 | 1 | 0 | 0 | 1.5 | 0.306 | | **1.00** |
| 1343 | 3 | 0.748 | 5 | 1.14 | 0.82 | 0 | 2.5 | 0.552 | | **1.96** |
| 1344 | 4 | 1.027 | 6 | 1.24 | 1.2 | 15 | 3.5 | 0.832 | | **17.44** |
| 1345 | 5 | 1.341 | 7 | 1.34 | 1.5 | 42.43 | 4.5 | 1.145 | 30.00 | **75.27** |
| | | | | | | | | | | |
| **HCOC Detention Basin is above Water Quality volume @ elev = 1340.5** | | | | | | | | | | |

# Worksheet for Circular Orifice - 3" opening

## Project Description

| | |
|---|---|
| Solve For | Discharge |

## Input Data

| | | |
|---|---|---|
| Headwater Elevation | 6.02 | ft |
| Centroid Elevation | 0.13 | ft |
| Tailwater Elevation | 0.00 | ft |
| Discharge Coefficient | 0.65 | |
| Diameter | 0.25 | ft |

## Results

| | | |
|---|---|---|
| Discharge | 0.62 | $ft^3/s$ |
| Headwater Height Above Centroid | 5.90 | ft |
| Tailwater Height Above Centroid | -0.13 | ft |
| Flow Area | 0.05 | $ft^2$ |
| Velocity | 12.66 | ft/s |

# Rating Table for Circular Orifice - 3" opening

## Project Description

| | |
|---|---|
| Solve For | Discharge |

## Input Data

| | | |
|---|---|---|
| Headwater Elevation | 6.02 | ft |
| Centroid Elevation | 0.13 | ft |
| Tailwater Elevation | 0.00 | ft |
| Discharge Coefficient | 0.65 | |
| Diameter | 0.25 | ft |

| Headwater Elevation (ft) | Discharge (ft³/s) | Velocity (ft/s) |
|---|---|---|
| 1.00 | 0.24 | 4.88 |
| 1.50 | 0.30 | 6.11 |
| 2.00 | 0.35 | 7.14 |
| 2.50 | 0.39 | 8.04 |
| 3.00 | 0.43 | 8.84 |
| 3.50 | 0.47 | 9.58 |
| 4.00 | 0.50 | 10.26 |
| 4.50 | 0.54 | 10.91 |
| 5.00 | 0.57 | 11.51 |
| 5.50 | 0.59 | 12.09 |
| 6.00 | 0.62 | 12.64 |
| 6.50 | 0.65 | 13.17 |
| 7.00 | 0.67 | 13.67 |
| 7.50 | 0.70 | 14.16 |
| 8.00 | 0.72 | 14.63 |
| 8.50 | 0.74 | 15.09 |
| 9.00 | 0.76 | 15.53 |
| 9.50 | 0.78 | 15.96 |
| 10.00 | 0.80 | 16.39 |

# Worksheet for Circular Orifice - 4" opening

## Project Description

| | |
|---|---|
| Solve For | Discharge |

## Input Data

| | | |
|---|---|---|
| Headwater Elevation | 2.19 | ft |
| Centroid Elevation | 0.17 | ft |
| Tailwater Elevation | 0.00 | ft |
| Discharge Coefficient | 0.65 | |
| Diameter | 0.33 | ft |

## Results

| | | |
|---|---|---|
| Discharge | 0.63 | $ft^3/s$ |
| Headwater Height Above Centroid | 2.02 | ft |
| Tailwater Height Above Centroid | -0.17 | ft |
| Flow Area | 0.09 | $ft^2$ |
| Velocity | 7.42 | ft/s |

# Rating Table for Circular Orifice - 4" opening

## Project Description

| | |
|---|---|
| Solve For | Discharge |

## Input Data

| | | |
|---|---|---|
| Headwater Elevation | 2.19 | ft |
| Centroid Elevation | 0.17 | ft |
| Tailwater Elevation | 0.00 | ft |
| Discharge Coefficient | 0.65 | |
| Diameter | 0.33 | ft |

| Headwater Elevation (ft) | Discharge (ft³/s) | Velocity (ft/s) |
|---|---|---|
| 1.00 | 0.41 | 4.76 |
| 1.50 | 0.51 | 6.02 |
| 2.00 | 0.60 | 7.06 |
| 2.50 | 0.68 | 7.96 |
| 3.00 | 0.75 | 8.78 |
| 3.50 | 0.81 | 9.52 |
| 4.00 | 0.87 | 10.21 |
| 4.50 | 0.93 | 10.85 |
| 5.00 | 0.98 | 11.46 |

# Rating Table for Rectangular Weir - 5 LF Spillway

## Project Description

| | |
|---|---|
| Solve For | Discharge |

## Input Data

| | | |
|---|---|---|
| Headwater Elevation | 0.50 | ft |
| Crest Elevation | 0.00 | ft |
| Tailwater Elevation | 0.00 | ft |
| Weir Coefficient | 3.00 | US |
| Crest Length | 5.00 | ft |
| Number Of Contractions | 0 | |

| Headwater Elevation (ft) | Discharge (ft³/s) | Velocity (ft/s) |
|---|---|---|
| 0.50 | 5.30 | 2.12 |
| 0.60 | 6.97 | 2.32 |
| 0.70 | 8.78 | 2.51 |
| 0.80 | 10.73 | 2.68 |
| 0.90 | 12.81 | 2.85 |
| 1.00 | 15.00 | 3.00 |
| 1.10 | 17.31 | 3.15 |
| 1.20 | 19.72 | 3.29 |
| 1.30 | 22.23 | 3.42 |
| 1.40 | 24.85 | 3.55 |
| 1.50 | 27.56 | 3.67 |
| 1.60 | 30.36 | 3.79 |
| 1.70 | 33.25 | 3.91 |
| 1.80 | 36.22 | 4.02 |
| 1.90 | 39.28 | 4.14 |
| 2.00 | 42.43 | 4.24 |

# Rating Table for Rectangular Weir - 10 LF Spillway

## Project Description

| | |
|---|---|
| Solve For | Discharge |

## Input Data

| | | |
|---|---|---|
| Headwater Elevation | 0.50 | ft |
| Crest Elevation | 0.00 | ft |
| Tailwater Elevation | 0.00 | ft |
| Weir Coefficient | 3.00 | US |
| Crest Length | 10.00 | ft |
| Number Of Contractions | 0 | |

| Headwater Elevation (ft) | Discharge (ft³/s) | Velocity (ft/s) |
|---|---|---|
| 0.50 | 10.61 | 2.12 |
| 0.60 | 13.94 | 2.32 |
| 0.70 | 17.57 | 2.51 |
| 0.80 | 21.47 | 2.68 |
| 0.90 | 25.61 | 2.85 |
| 1.00 | 30.00 | 3.00 |
| 1.10 | 34.61 | 3.15 |
| 1.20 | 39.44 | 3.29 |
| 1.30 | 44.47 | 3.42 |
| 1.40 | 49.70 | 3.55 |
| 1.50 | 55.11 | 3.67 |
| 1.60 | 60.72 | 3.79 |
| 1.70 | 66.50 | 3.91 |
| 1.80 | 72.45 | 4.02 |
| 1.90 | 78.57 | 4.14 |
| 2.00 | 84.85 | 4.24 |

# Appendix 7: Hydromodification

*Supporting Detail Relating to Hydrologic Conditions of Concern*

# Inflow Hydrograph

# 2-year 24-hour storm

# Existing & Proposed Conditions

# Drainage Area A – 51.4 Acres

U n i t  H y d r o g r a p h  A n a l y s i s

Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2008, Version 8.1
Study date 01/29/18 File: nrareaaex2242.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 4029

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English (in-lb) Input Units Used
English Rainfall Data (Inches) Input Values Used

English Units used in output format

---

Tract 37305 - Nichols Road Development
Drainage Area A - 51.4 Ac
Existing Condition (for HCOC comparison)
2-year 24-hour storm

---

Drainage Area = 51.40(Ac.) = 0.080 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 51.40(Ac.) = 0.080 Sq. Mi.
Length along longest watercourse = 3463.00(Ft.)
Length along longest watercourse measured to centroid = 834.00(Ft.)
Length along longest watercourse = 0.656 Mi.
Length along longest watercourse measured to centroid = 0.158 Mi.
Difference in elevation = 77.00(Ft.)
Slope along watercourse = 117.4011 Ft./Mi.
Average Manning's 'N' = 0.034
Lag time = 0.139 Hr.
Lag time = 8.36 Min.
25% of lag time = 2.09 Min.
40% of lag time = 3.35 Min.
Unit time = 5.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

| Area(Ac.)[1] | Rainfall(In)[2] | Weighting[1*2] |
|---|---|---|
| 51.40 | 2.38 | 122.33 |

100 YEAR Area rainfall data:

| Area(Ac.)[1] | Rainfall(In)[2] | Weighting[1*2] |
|---|---|---|
| 51.40 | 6.35 | 326.39 |

STORM EVENT (YEAR) = 2.00
Area Averaged 2-Year Rainfall = 2.380(In)
Area Averaged 100-Year Rainfall = 6.350(In)

Point rain (area averaged) = 2.380(In)
Areal adjustment factor = 99.99 %
Adjusted average point rain = 2.380(In)

Sub-Area Data:

| Area(Ac.) | Runoff Index | Impervious % |
|---|---|---|
| 48.400 | 86.00 | 0.050 |
| 3.000 | 69.00 | 0.900 |

Total Area Entered = 51.40(Ac.)

| RI AMC2 | RI AMC-2 | Infil. Rate (In/Hr) | Impervious (Dec.%) | Adj. Infil. Rate (In/Hr) | Area% (Dec.) | F (In/Hr) |
|---|---|---|---|---|---|---|
| 86.0 | 86.0 | 0.176 | 0.050 | 0.168 | 0.942 | 0.158 |
| 69.0 | 69.0 | 0.373 | 0.900 | 0.071 | 0.058 | 0.004 |
| | | | | | Sum (F) = | 0.162 |

Area averaged mean soil loss (F) (In/Hr) = 0.162
Minimum soil loss rate ((In/Hr)) = 0.081
(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.860

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U n i t H y d r o g r a p h
FOOTHILL S-Curve

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Unit Hydrograph Data

| Unit time period (hrs) | | Time % of lag | Distribution Graph % | Unit Hydrograph (CFS) |
|---|---|---|---|---|
| 1 | 0.083 | 59.777 | 5.560 | 2.880 |
| 2 | 0.167 | 119.554 | 31.385 | 16.258 |
| 3 | 0.250 | 179.331 | 34.170 | 17.701 |
| 4 | 0.333 | 239.107 | 12.429 | 6.439 |
| 5 | 0.417 | 298.884 | 7.179 | 3.719 |
| 6 | 0.500 | 358.661 | 4.361 | 2.259 |
| 7 | 0.583 | 418.438 | 2.422 | 1.255 |
| 8 | 0.667 | 478.215 | 0.960 | 0.497 |
| 9 | 0.750 | 537.992 | 0.566 | 0.293 |
| 10 | 0.833 | 597.769 | 0.413 | 0.214 |
| 11 | 0.917 | 657.545 | 0.364 | 0.189 |
| 12 | 1.000 | 717.322 | 0.190 | 0.099 |
| | | | Sum = 100.000 | Sum= 51.802 |

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The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

| Unit | Time (Hr.) | Pattern Percent | Storm Rain (In/Hr) | Loss rate(In./Hr) Max | Low | Effective (In/Hr) |
|---|---|---|---|---|---|---|
| 1 | 0.08 | 0.07 | 0.019 | ( 0.287) | 0.016 | 0.003 |
| 2 | 0.17 | 0.07 | 0.019 | ( 0.286) | 0.016 | 0.003 |
| 3 | 0.25 | 0.07 | 0.019 | ( 0.285) | 0.016 | 0.003 |
| 4 | 0.33 | 0.10 | 0.029 | ( 0.284) | 0.025 | 0.004 |
| 5 | 0.42 | 0.10 | 0.029 | ( 0.283) | 0.025 | 0.004 |
| 6 | 0.50 | 0.10 | 0.029 | ( 0.282) | 0.025 | 0.004 |
| 7 | 0.58 | 0.10 | 0.029 | ( 0.281) | 0.025 | 0.004 |
| 8 | 0.67 | 0.10 | 0.029 | ( 0.280) | 0.025 | 0.004 |
| 9 | 0.75 | 0.10 | 0.029 | ( 0.278) | 0.025 | 0.004 |
| 10 | 0.83 | 0.13 | 0.038 | ( 0.277) | 0.033 | 0.005 |
| 11 | 0.92 | 0.13 | 0.038 | ( 0.276) | 0.033 | 0.005 |
| 12 | 1.00 | 0.13 | 0.038 | ( 0.275) | 0.033 | 0.005 |
| 13 | 1.08 | 0.10 | 0.029 | ( 0.274) | 0.025 | 0.004 |
| 14 | 1.17 | 0.10 | 0.029 | ( 0.273) | 0.025 | 0.004 |
| 15 | 1.25 | 0.10 | 0.029 | ( 0.272) | 0.025 | 0.004 |
| 16 | 1.33 | 0.10 | 0.029 | ( 0.271) | 0.025 | 0.004 |
| 17 | 1.42 | 0.10 | 0.029 | ( 0.270) | 0.025 | 0.004 |
| 18 | 1.50 | 0.10 | 0.029 | ( 0.269) | 0.025 | 0.004 |
| 19 | 1.58 | 0.10 | 0.029 | ( 0.268) | 0.025 | 0.004 |
| 20 | 1.67 | 0.10 | 0.029 | ( 0.267) | 0.025 | 0.004 |
| 21 | 1.75 | 0.10 | 0.029 | ( 0.265) | 0.025 | 0.004 |
| 22 | 1.83 | 0.13 | 0.038 | ( 0.264) | 0.033 | 0.005 |
| 23 | 1.92 | 0.13 | 0.038 | ( 0.263) | 0.033 | 0.005 |
| 24 | 2.00 | 0.13 | 0.038 | ( 0.262) | 0.033 | 0.005 |
| 25 | 2.08 | 0.13 | 0.038 | ( 0.261) | 0.033 | 0.005 |
| 26 | 2.17 | 0.13 | 0.038 | ( 0.260) | 0.033 | 0.005 |
| 27 | 2.25 | 0.13 | 0.038 | ( 0.259) | 0.033 | 0.005 |
| 28 | 2.33 | 0.13 | 0.038 | ( 0.258) | 0.033 | 0.005 |
| 29 | 2.42 | 0.13 | 0.038 | ( 0.257) | 0.033 | 0.005 |
| 30 | 2.50 | 0.13 | 0.038 | ( 0.256) | 0.033 | 0.005 |
| 31 | 2.58 | 0.17 | 0.048 | ( 0.255) | 0.041 | 0.007 |
| 32 | 2.67 | 0.17 | 0.048 | ( 0.254) | 0.041 | 0.007 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 33 | 2.75 | 0.17 | 0.048 | ( 0.253) | 0.041 | 0.007 |
| 34 | 2.83 | 0.17 | 0.048 | ( 0.252) | 0.041 | 0.007 |
| 35 | 2.92 | 0.17 | 0.048 | ( 0.251) | 0.041 | 0.007 |
| 36 | 3.00 | 0.17 | 0.048 | ( 0.250) | 0.041 | 0.007 |
| 37 | 3.08 | 0.17 | 0.048 | ( 0.249) | 0.041 | 0.007 |
| 38 | 3.17 | 0.17 | 0.048 | ( 0.248) | 0.041 | 0.007 |
| 39 | 3.25 | 0.17 | 0.048 | ( 0.247) | 0.041 | 0.007 |
| 40 | 3.33 | 0.17 | 0.048 | ( 0.246) | 0.041 | 0.007 |
| 41 | 3.42 | 0.17 | 0.048 | ( 0.245) | 0.041 | 0.007 |
| 42 | 3.50 | 0.17 | 0.048 | ( 0.244) | 0.041 | 0.007 |
| 43 | 3.58 | 0.17 | 0.048 | ( 0.242) | 0.041 | 0.007 |
| 44 | 3.67 | 0.17 | 0.048 | ( 0.241) | 0.041 | 0.007 |
| 45 | 3.75 | 0.17 | 0.048 | ( 0.240) | 0.041 | 0.007 |
| 46 | 3.83 | 0.20 | 0.057 | ( 0.239) | 0.049 | 0.008 |
| 47 | 3.92 | 0.20 | 0.057 | ( 0.238) | 0.049 | 0.008 |
| 48 | 4.00 | 0.20 | 0.057 | ( 0.237) | 0.049 | 0.008 |
| 49 | 4.08 | 0.20 | 0.057 | ( 0.236) | 0.049 | 0.008 |
| 50 | 4.17 | 0.20 | 0.057 | ( 0.235) | 0.049 | 0.008 |
| 51 | 4.25 | 0.20 | 0.057 | ( 0.234) | 0.049 | 0.008 |
| 52 | 4.33 | 0.23 | 0.067 | ( 0.233) | 0.057 | 0.009 |
| 53 | 4.42 | 0.23 | 0.067 | ( 0.232) | 0.057 | 0.009 |
| 54 | 4.50 | 0.23 | 0.067 | ( 0.231) | 0.057 | 0.009 |
| 55 | 4.58 | 0.23 | 0.067 | ( 0.230) | 0.057 | 0.009 |
| 56 | 4.67 | 0.23 | 0.067 | ( 0.229) | 0.057 | 0.009 |
| 57 | 4.75 | 0.23 | 0.067 | ( 0.228) | 0.057 | 0.009 |
| 58 | 4.83 | 0.27 | 0.076 | ( 0.227) | 0.065 | 0.011 |
| 59 | 4.92 | 0.27 | 0.076 | ( 0.226) | 0.065 | 0.011 |
| 60 | 5.00 | 0.27 | 0.076 | ( 0.225) | 0.065 | 0.011 |
| 61 | 5.08 | 0.20 | 0.057 | ( 0.225) | 0.049 | 0.008 |
| 62 | 5.17 | 0.20 | 0.057 | ( 0.224) | 0.049 | 0.008 |
| 63 | 5.25 | 0.20 | 0.057 | ( 0.223) | 0.049 | 0.008 |
| 64 | 5.33 | 0.23 | 0.067 | ( 0.222) | 0.057 | 0.009 |
| 65 | 5.42 | 0.23 | 0.067 | ( 0.221) | 0.057 | 0.009 |
| 66 | 5.50 | 0.23 | 0.067 | ( 0.220) | 0.057 | 0.009 |
| 67 | 5.58 | 0.27 | 0.076 | ( 0.219) | 0.065 | 0.011 |
| 68 | 5.67 | 0.27 | 0.076 | ( 0.218) | 0.065 | 0.011 |
| 69 | 5.75 | 0.27 | 0.076 | ( 0.217) | 0.065 | 0.011 |
| 70 | 5.83 | 0.27 | 0.076 | ( 0.216) | 0.065 | 0.011 |
| 71 | 5.92 | 0.27 | 0.076 | ( 0.215) | 0.065 | 0.011 |
| 72 | 6.00 | 0.27 | 0.076 | ( 0.214) | 0.065 | 0.011 |
| 73 | 6.08 | 0.30 | 0.086 | ( 0.213) | 0.074 | 0.012 |
| 74 | 6.17 | 0.30 | 0.086 | ( 0.212) | 0.074 | 0.012 |
| 75 | 6.25 | 0.30 | 0.086 | ( 0.211) | 0.074 | 0.012 |
| 76 | 6.33 | 0.30 | 0.086 | ( 0.210) | 0.074 | 0.012 |
| 77 | 6.42 | 0.30 | 0.086 | ( 0.209) | 0.074 | 0.012 |
| 78 | 6.50 | 0.30 | 0.086 | ( 0.208) | 0.074 | 0.012 |
| 79 | 6.58 | 0.33 | 0.095 | ( 0.207) | 0.082 | 0.013 |
| 80 | 6.67 | 0.33 | 0.095 | ( 0.206) | 0.082 | 0.013 |
| 81 | 6.75 | 0.33 | 0.095 | ( 0.205) | 0.082 | 0.013 |
| 82 | 6.83 | 0.33 | 0.095 | ( 0.205) | 0.082 | 0.013 |
| 83 | 6.92 | 0.33 | 0.095 | ( 0.204) | 0.082 | 0.013 |
| 84 | 7.00 | 0.33 | 0.095 | ( 0.203) | 0.082 | 0.013 |
| 85 | 7.08 | 0.33 | 0.095 | ( 0.202) | 0.082 | 0.013 |
| 86 | 7.17 | 0.33 | 0.095 | ( 0.201) | 0.082 | 0.013 |
| 87 | 7.25 | 0.33 | 0.095 | ( 0.200) | 0.082 | 0.013 |
| 88 | 7.33 | 0.37 | 0.105 | ( 0.199) | 0.090 | 0.015 |
| 89 | 7.42 | 0.37 | 0.105 | ( 0.198) | 0.090 | 0.015 |
| 90 | 7.50 | 0.37 | 0.105 | ( 0.197) | 0.090 | 0.015 |
| 91 | 7.58 | 0.40 | 0.114 | ( 0.196) | 0.098 | 0.016 |
| 92 | 7.67 | 0.40 | 0.114 | ( 0.195) | 0.098 | 0.016 |
| 93 | 7.75 | 0.40 | 0.114 | ( 0.194) | 0.098 | 0.016 |
| 94 | 7.83 | 0.43 | 0.124 | ( 0.194) | 0.106 | 0.017 |
| 95 | 7.92 | 0.43 | 0.124 | ( 0.193) | 0.106 | 0.017 |
| 96 | 8.00 | 0.43 | 0.124 | ( 0.192) | 0.106 | 0.017 |
| 97 | 8.08 | 0.50 | 0.143 | ( 0.191) | 0.123 | 0.020 |
| 98 | 8.17 | 0.50 | 0.143 | ( 0.190) | 0.123 | 0.020 |
| 99 | 8.25 | 0.50 | 0.143 | ( 0.189) | 0.123 | 0.020 |
| 100 | 8.33 | 0.50 | 0.143 | ( 0.188) | 0.123 | 0.020 |
| 101 | 8.42 | 0.50 | 0.143 | ( 0.187) | 0.123 | 0.020 |
| 102 | 8.50 | 0.50 | 0.143 | ( 0.186) | 0.123 | 0.020 |
| 103 | 8.58 | 0.53 | 0.152 | ( 0.186) | 0.131 | 0.021 |
| 104 | 8.67 | 0.53 | 0.152 | ( 0.185) | 0.131 | 0.021 |
| 105 | 8.75 | 0.53 | 0.152 | ( 0.184) | 0.131 | 0.021 |
| 106 | 8.83 | 0.57 | 0.162 | ( 0.183) | 0.139 | 0.023 |
| 107 | 8.92 | 0.57 | 0.162 | ( 0.182) | 0.139 | 0.023 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 108 | 9.00 | 0.57 | 0.162 | ( | 0.181) | 0.139 | | 0.023 |
| 109 | 9.08 | 0.63 | 0.181 | ( | 0.180) | 0.156 | | 0.025 |
| 110 | 9.17 | 0.63 | 0.181 | ( | 0.180) | 0.156 | | 0.025 |
| 111 | 9.25 | 0.63 | 0.181 | ( | 0.179) | 0.156 | | 0.025 |
| 112 | 9.33 | 0.67 | 0.190 | ( | 0.178) | 0.164 | | 0.027 |
| 113 | 9.42 | 0.67 | 0.190 | ( | 0.177) | 0.164 | | 0.027 |
| 114 | 9.50 | 0.67 | 0.190 | ( | 0.176) | 0.164 | | 0.027 |
| 115 | 9.58 | 0.70 | 0.200 | ( | 0.175) | 0.172 | | 0.028 |
| 116 | 9.67 | 0.70 | 0.200 | ( | 0.174) | 0.172 | | 0.028 |
| 117 | 9.75 | 0.70 | 0.200 | ( | 0.174) | 0.172 | | 0.028 |
| 118 | 9.83 | 0.73 | 0.209 | | 0.173 | ( 0.180) | | 0.037 |
| 119 | 9.92 | 0.73 | 0.209 | | 0.172 | ( 0.180) | | 0.037 |
| 120 | 10.00 | 0.73 | 0.209 | | 0.171 | ( 0.180) | | 0.038 |
| 121 | 10.08 | 0.50 | 0.143 | ( | 0.170) | 0.123 | | 0.020 |
| 122 | 10.17 | 0.50 | 0.143 | ( | 0.169) | 0.123 | | 0.020 |
| 123 | 10.25 | 0.50 | 0.143 | ( | 0.169) | 0.123 | | 0.020 |
| 124 | 10.33 | 0.50 | 0.143 | ( | 0.168) | 0.123 | | 0.020 |
| 125 | 10.42 | 0.50 | 0.143 | ( | 0.167) | 0.123 | | 0.020 |
| 126 | 10.50 | 0.50 | 0.143 | ( | 0.166) | 0.123 | | 0.020 |
| 127 | 10.58 | 0.67 | 0.190 | ( | 0.165) | 0.164 | | 0.027 |
| 128 | 10.67 | 0.67 | 0.190 | ( | 0.165) | 0.164 | | 0.027 |
| 129 | 10.75 | 0.67 | 0.190 | ( | 0.164) | 0.164 | | 0.027 |
| 130 | 10.83 | 0.67 | 0.190 | | 0.163 | ( 0.164) | | 0.027 |
| 131 | 10.92 | 0.67 | 0.190 | | 0.162 | ( 0.164) | | 0.028 |
| 132 | 11.00 | 0.67 | 0.190 | | 0.161 | ( 0.164) | | 0.029 |
| 133 | 11.08 | 0.63 | 0.181 | ( | 0.161) | 0.156 | | 0.025 |
| 134 | 11.17 | 0.63 | 0.181 | ( | 0.160) | 0.156 | | 0.025 |
| 135 | 11.25 | 0.63 | 0.181 | ( | 0.159) | 0.156 | | 0.025 |
| 136 | 11.33 | 0.63 | 0.181 | ( | 0.158) | 0.156 | | 0.025 |
| 137 | 11.42 | 0.63 | 0.181 | ( | 0.157) | 0.156 | | 0.025 |
| 138 | 11.50 | 0.63 | 0.181 | ( | 0.157) | 0.156 | | 0.025 |
| 139 | 11.58 | 0.57 | 0.162 | ( | 0.156) | 0.139 | | 0.023 |
| 140 | 11.67 | 0.57 | 0.162 | ( | 0.155) | 0.139 | | 0.023 |
| 141 | 11.75 | 0.57 | 0.162 | ( | 0.154) | 0.139 | | 0.023 |
| 142 | 11.83 | 0.60 | 0.171 | ( | 0.154) | 0.147 | | 0.024 |
| 143 | 11.92 | 0.60 | 0.171 | ( | 0.153) | 0.147 | | 0.024 |
| 144 | 12.00 | 0.60 | 0.171 | ( | 0.152) | 0.147 | | 0.024 |
| 145 | 12.08 | 0.83 | 0.238 | | 0.151 | ( 0.205) | | 0.087 |
| 146 | 12.17 | 0.83 | 0.238 | | 0.151 | ( 0.205) | | 0.087 |
| 147 | 12.25 | 0.83 | 0.238 | | 0.150 | ( 0.205) | | 0.088 |
| 148 | 12.33 | 0.87 | 0.247 | | 0.149 | ( 0.213) | | 0.098 |
| 149 | 12.42 | 0.87 | 0.247 | | 0.148 | ( 0.213) | | 0.099 |
| 150 | 12.50 | 0.87 | 0.247 | | 0.148 | ( 0.213) | | 0.100 |
| 151 | 12.58 | 0.93 | 0.267 | | 0.147 | ( 0.229) | | 0.120 |
| 152 | 12.67 | 0.93 | 0.267 | | 0.146 | ( 0.229) | | 0.121 |
| 153 | 12.75 | 0.93 | 0.267 | | 0.145 | ( 0.229) | | 0.121 |
| 154 | 12.83 | 0.97 | 0.276 | | 0.145 | ( 0.237) | | 0.131 |
| 155 | 12.92 | 0.97 | 0.276 | | 0.144 | ( 0.237) | | 0.132 |
| 156 | 13.00 | 0.97 | 0.276 | | 0.143 | ( 0.237) | | 0.133 |
| 157 | 13.08 | 1.13 | 0.324 | | 0.142 | ( 0.278) | | 0.181 |
| 158 | 13.17 | 1.13 | 0.324 | | 0.142 | ( 0.278) | | 0.182 |
| 159 | 13.25 | 1.13 | 0.324 | | 0.141 | ( 0.278) | | 0.183 |
| 160 | 13.33 | 1.13 | 0.324 | | 0.140 | ( 0.278) | | 0.183 |
| 161 | 13.42 | 1.13 | 0.324 | | 0.140 | ( 0.278) | | 0.184 |
| 162 | 13.50 | 1.13 | 0.324 | | 0.139 | ( 0.278) | | 0.185 |
| 163 | 13.58 | 0.77 | 0.219 | | 0.138 | ( 0.188) | | 0.081 |
| 164 | 13.67 | 0.77 | 0.219 | | 0.137 | ( 0.188) | | 0.082 |
| 165 | 13.75 | 0.77 | 0.219 | | 0.137 | ( 0.188) | | 0.082 |
| 166 | 13.83 | 0.77 | 0.219 | | 0.136 | ( 0.188) | | 0.083 |
| 167 | 13.92 | 0.77 | 0.219 | | 0.135 | ( 0.188) | | 0.084 |
| 168 | 14.00 | 0.77 | 0.219 | | 0.135 | ( 0.188) | | 0.084 |
| 169 | 14.08 | 0.90 | 0.257 | | 0.134 | ( 0.221) | | 0.123 |
| 170 | 14.17 | 0.90 | 0.257 | | 0.133 | ( 0.221) | | 0.124 |
| 171 | 14.25 | 0.90 | 0.257 | | 0.133 | ( 0.221) | | 0.124 |
| 172 | 14.33 | 0.87 | 0.247 | | 0.132 | ( 0.213) | | 0.116 |
| 173 | 14.42 | 0.87 | 0.247 | | 0.131 | ( 0.213) | | 0.116 |
| 174 | 14.50 | 0.87 | 0.247 | | 0.131 | ( 0.213) | | 0.117 |
| 175 | 14.58 | 0.87 | 0.247 | | 0.130 | ( 0.213) | | 0.118 |
| 176 | 14.67 | 0.87 | 0.247 | | 0.129 | ( 0.213) | | 0.118 |
| 177 | 14.75 | 0.87 | 0.247 | | 0.129 | ( 0.213) | | 0.119 |
| 178 | 14.83 | 0.83 | 0.238 | | 0.128 | ( 0.205) | | 0.110 |
| 179 | 14.92 | 0.83 | 0.238 | | 0.127 | ( 0.205) | | 0.111 |
| 180 | 15.00 | 0.83 | 0.238 | | 0.127 | ( 0.205) | | 0.111 |
| 181 | 15.08 | 0.80 | 0.228 | | 0.126 | ( 0.196) | | 0.103 |
| 182 | 15.17 | 0.80 | 0.228 | | 0.125 | ( 0.196) | | 0.103 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 183 | 15.25 | 0.80 | 0.228 | 0.125 | ( 0.196) | 0.104 |
| 184 | 15.33 | 0.77 | 0.219 | 0.124 | ( 0.188) | 0.095 |
| 185 | 15.42 | 0.77 | 0.219 | 0.123 | ( 0.188) | 0.096 |
| 186 | 15.50 | 0.77 | 0.219 | 0.123 | ( 0.188) | 0.096 |
| 187 | 15.58 | 0.63 | 0.181 | 0.122 | ( 0.156) | 0.059 |
| 188 | 15.67 | 0.63 | 0.181 | 0.121 | ( 0.156) | 0.059 |
| 189 | 15.75 | 0.63 | 0.181 | 0.121 | ( 0.156) | 0.060 |
| 190 | 15.83 | 0.63 | 0.181 | 0.120 | ( 0.156) | 0.061 |
| 191 | 15.92 | 0.63 | 0.181 | 0.120 | ( 0.156) | 0.061 |
| 192 | 16.00 | 0.63 | 0.181 | 0.119 | ( 0.156) | 0.062 |
| 193 | 16.08 | 0.13 | 0.038 | ( 0.118) | 0.033 | 0.005 |
| 194 | 16.17 | 0.13 | 0.038 | ( 0.118) | 0.033 | 0.005 |
| 195 | 16.25 | 0.13 | 0.038 | ( 0.117) | 0.033 | 0.005 |
| 196 | 16.33 | 0.13 | 0.038 | ( 0.117) | 0.033 | 0.005 |
| 197 | 16.42 | 0.13 | 0.038 | ( 0.116) | 0.033 | 0.005 |
| 198 | 16.50 | 0.13 | 0.038 | ( 0.115) | 0.033 | 0.005 |
| 199 | 16.58 | 0.10 | 0.029 | ( 0.115) | 0.025 | 0.004 |
| 200 | 16.67 | 0.10 | 0.029 | ( 0.114) | 0.025 | 0.004 |
| 201 | 16.75 | 0.10 | 0.029 | ( 0.114) | 0.025 | 0.004 |
| 202 | 16.83 | 0.10 | 0.029 | ( 0.113) | 0.025 | 0.004 |
| 203 | 16.92 | 0.10 | 0.029 | ( 0.113) | 0.025 | 0.004 |
| 204 | 17.00 | 0.10 | 0.029 | ( 0.112) | 0.025 | 0.004 |
| 205 | 17.08 | 0.17 | 0.048 | ( 0.111) | 0.041 | 0.007 |
| 206 | 17.17 | 0.17 | 0.048 | ( 0.111) | 0.041 | 0.007 |
| 207 | 17.25 | 0.17 | 0.048 | ( 0.110) | 0.041 | 0.007 |
| 208 | 17.33 | 0.17 | 0.048 | ( 0.110) | 0.041 | 0.007 |
| 209 | 17.42 | 0.17 | 0.048 | ( 0.109) | 0.041 | 0.007 |
| 210 | 17.50 | 0.17 | 0.048 | ( 0.109) | 0.041 | 0.007 |
| 211 | 17.58 | 0.17 | 0.048 | ( 0.108) | 0.041 | 0.007 |
| 212 | 17.67 | 0.17 | 0.048 | ( 0.108) | 0.041 | 0.007 |
| 213 | 17.75 | 0.17 | 0.048 | ( 0.107) | 0.041 | 0.007 |
| 214 | 17.83 | 0.13 | 0.038 | ( 0.106) | 0.033 | 0.005 |
| 215 | 17.92 | 0.13 | 0.038 | ( 0.106) | 0.033 | 0.005 |
| 216 | 18.00 | 0.13 | 0.038 | ( 0.105) | 0.033 | 0.005 |
| 217 | 18.08 | 0.13 | 0.038 | ( 0.105) | 0.033 | 0.005 |
| 218 | 18.17 | 0.13 | 0.038 | ( 0.104) | 0.033 | 0.005 |
| 219 | 18.25 | 0.13 | 0.038 | ( 0.104) | 0.033 | 0.005 |
| 220 | 18.33 | 0.13 | 0.038 | ( 0.103) | 0.033 | 0.005 |
| 221 | 18.42 | 0.13 | 0.038 | ( 0.103) | 0.033 | 0.005 |
| 222 | 18.50 | 0.13 | 0.038 | ( 0.102) | 0.033 | 0.005 |
| 223 | 18.58 | 0.10 | 0.029 | ( 0.102) | 0.025 | 0.004 |
| 224 | 18.67 | 0.10 | 0.029 | ( 0.101) | 0.025 | 0.004 |
| 225 | 18.75 | 0.10 | 0.029 | ( 0.101) | 0.025 | 0.004 |
| 226 | 18.83 | 0.07 | 0.019 | ( 0.100) | 0.016 | 0.003 |
| 227 | 18.92 | 0.07 | 0.019 | ( 0.100) | 0.016 | 0.003 |
| 228 | 19.00 | 0.07 | 0.019 | ( 0.099) | 0.016 | 0.003 |
| 229 | 19.08 | 0.10 | 0.029 | ( 0.099) | 0.025 | 0.004 |
| 230 | 19.17 | 0.10 | 0.029 | ( 0.099) | 0.025 | 0.004 |
| 231 | 19.25 | 0.10 | 0.029 | ( 0.098) | 0.025 | 0.004 |
| 232 | 19.33 | 0.13 | 0.038 | ( 0.098) | 0.033 | 0.005 |
| 233 | 19.42 | 0.13 | 0.038 | ( 0.097) | 0.033 | 0.005 |
| 234 | 19.50 | 0.13 | 0.038 | ( 0.097) | 0.033 | 0.005 |
| 235 | 19.58 | 0.10 | 0.029 | ( 0.096) | 0.025 | 0.004 |
| 236 | 19.67 | 0.10 | 0.029 | ( 0.096) | 0.025 | 0.004 |
| 237 | 19.75 | 0.10 | 0.029 | ( 0.095) | 0.025 | 0.004 |
| 238 | 19.83 | 0.07 | 0.019 | ( 0.095) | 0.016 | 0.003 |
| 239 | 19.92 | 0.07 | 0.019 | ( 0.095) | 0.016 | 0.003 |
| 240 | 20.00 | 0.07 | 0.019 | ( 0.094) | 0.016 | 0.003 |
| 241 | 20.08 | 0.10 | 0.029 | ( 0.094) | 0.025 | 0.004 |
| 242 | 20.17 | 0.10 | 0.029 | ( 0.093) | 0.025 | 0.004 |
| 243 | 20.25 | 0.10 | 0.029 | ( 0.093) | 0.025 | 0.004 |
| 244 | 20.33 | 0.10 | 0.029 | ( 0.092) | 0.025 | 0.004 |
| 245 | 20.42 | 0.10 | 0.029 | ( 0.092) | 0.025 | 0.004 |
| 246 | 20.50 | 0.10 | 0.029 | ( 0.092) | 0.025 | 0.004 |
| 247 | 20.58 | 0.10 | 0.029 | ( 0.091) | 0.025 | 0.004 |
| 248 | 20.67 | 0.10 | 0.029 | ( 0.091) | 0.025 | 0.004 |
| 249 | 20.75 | 0.10 | 0.029 | ( 0.091) | 0.025 | 0.004 |
| 250 | 20.83 | 0.07 | 0.019 | ( 0.090) | 0.016 | 0.003 |
| 251 | 20.92 | 0.07 | 0.019 | ( 0.090) | 0.016 | 0.003 |
| 252 | 21.00 | 0.07 | 0.019 | ( 0.089) | 0.016 | 0.003 |
| 253 | 21.08 | 0.10 | 0.029 | ( 0.089) | 0.025 | 0.004 |
| 254 | 21.17 | 0.10 | 0.029 | ( 0.089) | 0.025 | 0.004 |
| 255 | 21.25 | 0.10 | 0.029 | ( 0.088) | 0.025 | 0.004 |
| 256 | 21.33 | 0.07 | 0.019 | ( 0.088) | 0.016 | 0.003 |
| 257 | 21.42 | 0.07 | 0.019 | ( 0.088) | 0.016 | 0.003 |

```
258  21.50     0.07      0.019       (  0.087)       0.016        0.003
259  21.58     0.10      0.029       (  0.087)       0.025        0.004
260  21.67     0.10      0.029       (  0.087)       0.025        0.004
261  21.75     0.10      0.029       (  0.086)       0.025        0.004
262  21.83     0.07      0.019       (  0.086)       0.016        0.003
263  21.92     0.07      0.019       (  0.086)       0.016        0.003
264  22.00     0.07      0.019       (  0.086)       0.016        0.003
265  22.08     0.10      0.029       (  0.085)       0.025        0.004
266  22.17     0.10      0.029       (  0.085)       0.025        0.004
267  22.25     0.10      0.029       (  0.085)       0.025        0.004
268  22.33     0.07      0.019       (  0.084)       0.016        0.003
269  22.42     0.07      0.019       (  0.084)       0.016        0.003
270  22.50     0.07      0.019       (  0.084)       0.016        0.003
271  22.58     0.07      0.019       (  0.084)       0.016        0.003
272  22.67     0.07      0.019       (  0.083)       0.016        0.003
273  22.75     0.07      0.019       (  0.083)       0.016        0.003
274  22.83     0.07      0.019       (  0.083)       0.016        0.003
275  22.92     0.07      0.019       (  0.083)       0.016        0.003
276  23.00     0.07      0.019       (  0.083)       0.016        0.003
277  23.08     0.07      0.019       (  0.082)       0.016        0.003
278  23.17     0.07      0.019       (  0.082)       0.016        0.003
279  23.25     0.07      0.019       (  0.082)       0.016        0.003
280  23.33     0.07      0.019       (  0.082)       0.016        0.003
281  23.42     0.07      0.019       (  0.082)       0.016        0.003
282  23.50     0.07      0.019       (  0.082)       0.016        0.003
283  23.58     0.07      0.019       (  0.081)       0.016        0.003
284  23.67     0.07      0.019       (  0.081)       0.016        0.003
285  23.75     0.07      0.019       (  0.081)       0.016        0.003
286  23.83     0.07      0.019       (  0.081)       0.016        0.003
287  23.92     0.07      0.019       (  0.081)       0.016        0.003
288  24.00     0.07      0.019       (  0.081)       0.016        0.003
               (Loss Rate Not Used)
    Sum =     100.0                                    Sum =     7.7
      Flood volume = Effective rainfall      0.64(In)
       times area      51.4(Ac.)/[(In)/(Ft.)] =       2.7(Ac.Ft)
      Total soil loss =      1.74(In)
      Total soil loss =     7.458(Ac.Ft)
      Total rainfall =      2.38(In)
      Flood volume =      119132.2 Cubic Feet
      Total soil loss =      324888.4 Cubic Feet
      ---------------------------------------------------------------------
       Peak flow rate of this hydrograph =      9.372(CFS)
      ---------------------------------------------------------------------
      +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                          24 - H O U R    S T O R M
                     R u n o f f      H y d r o g r a p h
      ---------------------------------------------------------------------
                  Hydrograph in   5   Minute intervals ((CFS))

      ---------------------------------------------------------------------
 Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
 ---------------------------------------------------------------------------
   0+ 5       0.0001      0.01  Q         |         |         |         |
   0+10       0.0004      0.05  Q         |         |         |         |
   0+15       0.0011      0.10  Q         |         |         |         |
   0+20       0.0019      0.12  Q         |         |         |         |
   0+25       0.0029      0.15  Q         |         |         |         |
   0+30       0.0042      0.18  Q         |         |         |         |
   0+35       0.0055      0.19  Q         |         |         |         |
   0+40       0.0069      0.20  Q         |         |         |         |
   0+45       0.0083      0.20  Q         |         |         |         |
   0+50       0.0097      0.21  Q         |         |         |         |
   0+55       0.0113      0.23  Q         |         |         |         |
   1+ 0       0.0131      0.26  VQ        |         |         |         |
   1+ 5       0.0149      0.26  VQ        |         |         |         |
   1+10       0.0165      0.24  Q         |         |         |         |
   1+15       0.0181      0.22  Q         |         |         |         |
   1+20       0.0196      0.22  Q         |         |         |         |
   1+25       0.0210      0.21  Q         |         |         |         |
   1+30       0.0225      0.21  Q         |         |         |         |
   1+35       0.0239      0.21  Q         |         |         |         |
   1+40       0.0254      0.21  Q         |         |         |         |
   1+45       0.0268      0.21  Q         |         |         |         |
   1+50       0.0282      0.21  Q         |         |         |         |
   1+55       0.0298      0.23  Q         |         |         |         |
```

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2+ 0 | 0.0316 | 0.26 | VQ | \| | \| | \| | \| |
| 2+ 5 | 0.0334 | 0.26 | VQ | \| | \| | \| | \| |
| 2+10 | 0.0353 | 0.27 | VQ | \| | \| | \| | \| |
| 2+15 | 0.0372 | 0.27 | VQ | \| | \| | \| | \| |
| 2+20 | 0.0391 | 0.27 | VQ | \| | \| | \| | \| |
| 2+25 | 0.0410 | 0.28 | VQ | \| | \| | \| | \| |
| 2+30 | 0.0429 | 0.28 | VQ | \| | \| | \| | \| |
| 2+35 | 0.0448 | 0.28 | VQ | \| | \| | \| | \| |
| 2+40 | 0.0469 | 0.30 | VQ | \| | \| | \| | \| |
| 2+45 | 0.0491 | 0.33 | VQ | \| | \| | \| | \| |
| 2+50 | 0.0514 | 0.33 | VQ | \| | \| | \| | \| |
| 2+55 | 0.0537 | 0.34 | VQ | \| | \| | \| | \| |
| 3+ 0 | 0.0561 | 0.34 | VQ | \| | \| | \| | \| |
| 3+ 5 | 0.0585 | 0.34 | VQ | \| | \| | \| | \| |
| 3+10 | 0.0608 | 0.34 | VQ | \| | \| | \| | \| |
| 3+15 | 0.0632 | 0.34 | VQ | \| | \| | \| | \| |
| 3+20 | 0.0656 | 0.34 | VQ | \| | \| | \| | \| |
| 3+25 | 0.0680 | 0.35 | VQ | \| | \| | \| | \| |
| 3+30 | 0.0703 | 0.35 | \|Q | \| | \| | \| | \| |
| 3+35 | 0.0727 | 0.35 | \|Q | \| | \| | \| | \| |
| 3+40 | 0.0751 | 0.35 | \|Q | \| | \| | \| | \| |
| 3+45 | 0.0775 | 0.35 | \|Q | \| | \| | \| | \| |
| 3+50 | 0.0799 | 0.35 | \|Q | \| | \| | \| | \| |
| 3+55 | 0.0824 | 0.37 | \|Q | \| | \| | \| | \| |
| 4+ 0 | 0.0851 | 0.39 | \|Q | \| | \| | \| | \| |
| 4+ 5 | 0.0879 | 0.40 | \|Q | \| | \| | \| | \| |
| 4+10 | 0.0907 | 0.41 | \|Q | \| | \| | \| | \| |
| 4+15 | 0.0936 | 0.41 | \|Q | \| | \| | \| | \| |
| 4+20 | 0.0964 | 0.42 | \|Q | \| | \| | \| | \| |
| 4+25 | 0.0995 | 0.44 | \|Q | \| | \| | \| | \| |
| 4+30 | 0.1026 | 0.46 | \|Q | \| | \| | \| | \| |
| 4+35 | 0.1059 | 0.47 | \|Q | \| | \| | \| | \| |
| 4+40 | 0.1092 | 0.48 | \|Q | \| | \| | \| | \| |
| 4+45 | 0.1125 | 0.48 | \|Q | \| | \| | \| | \| |
| 4+50 | 0.1158 | 0.49 | \|Q | \| | \| | \| | \| |
| 4+55 | 0.1193 | 0.51 | \|VQ | \| | \| | \| | \| |
| 5+ 0 | 0.1230 | 0.53 | \|VQ | \| | \| | \| | \| |
| 5+ 5 | 0.1267 | 0.53 | \|VQ | \| | \| | \| | \| |
| 5+10 | 0.1301 | 0.49 | \|Q | \| | \| | \| | \| |
| 5+15 | 0.1332 | 0.45 | \|Q | \| | \| | \| | \| |
| 5+20 | 0.1362 | 0.44 | \|Q | \| | \| | \| | \| |
| 5+25 | 0.1393 | 0.45 | \|QV | \| | \| | \| | \| |
| 5+30 | 0.1425 | 0.47 | \|QV | \| | \| | \| | \| |
| 5+35 | 0.1458 | 0.48 | \|QV | \| | \| | \| | \| |
| 5+40 | 0.1493 | 0.50 | \| Q | \| | \| | \| | \| |
| 5+45 | 0.1530 | 0.53 | \| Q | \| | \| | \| | \| |
| 5+50 | 0.1567 | 0.54 | \| Q | \| | \| | \| | \| |
| 5+55 | 0.1605 | 0.55 | \| Q | \| | \| | \| | \| |
| 6+ 0 | 0.1642 | 0.55 | \| Q | \| | \| | \| | \| |
| 6+ 5 | 0.1680 | 0.55 | \| Q | \| | \| | \| | \| |
| 6+10 | 0.1720 | 0.58 | \| Q | \| | \| | \| | \| |
| 6+15 | 0.1762 | 0.60 | \| Q | \| | \| | \| | \| |
| 6+20 | 0.1804 | 0.61 | \| Q | \| | \| | \| | \| |
| 6+25 | 0.1846 | 0.62 | \| Q | \| | \| | \| | \| |
| 6+30 | 0.1889 | 0.62 | \| Q | \| | \| | \| | \| |
| 6+35 | 0.1931 | 0.62 | \| Q | \| | \| | \| | \| |
| 6+40 | 0.1976 | 0.65 | \| Q | \| | \| | \| | \| |
| 6+45 | 0.2022 | 0.67 | \| Q | \| | \| | \| | \| |
| 6+50 | 0.2069 | 0.68 | \| QV | \| | \| | \| | \| |
| 6+55 | 0.2116 | 0.68 | \| QV | \| | \| | \| | \| |
| 7+ 0 | 0.2163 | 0.69 | \| QV | \| | \| | \| | \| |
| 7+ 5 | 0.2211 | 0.69 | \| QV | \| | \| | \| | \| |
| 7+10 | 0.2258 | 0.69 | \| QV | \| | \| | \| | \| |
| 7+15 | 0.2306 | 0.69 | \| QV | \| | \| | \| | \| |
| 7+20 | 0.2354 | 0.69 | \| QV | \| | \| | \| | \| |
| 7+25 | 0.2403 | 0.72 | \| QV | \| | \| | \| | \| |
| 7+30 | 0.2454 | 0.74 | \| QV | \| | \| | \| | \| |
| 7+35 | 0.2506 | 0.75 | \|  Q | \| | \| | \| | \| |
| 7+40 | 0.2559 | 0.78 | \|  Q | \| | \| | \| | \| |
| 7+45 | 0.2615 | 0.81 | \|  Q | \| | \| | \| | \| |
| 7+50 | 0.2671 | 0.82 | \|  Q | \| | \| | \| | \| |
| 7+55 | 0.2730 | 0.85 | \|  Q | \| | \| | \| | \| |
| 8+ 0 | 0.2790 | 0.87 | \|  QV | \| | \| | \| | \| |
| 8+ 5 | 0.2851 | 0.89 | \|  QV | \| | \| | \| | \| |
| 8+10 | 0.2916 | 0.94 | \|  QV | \| | \| | \| | \| |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 8+15 | 0.2984 | 0.99 | QV | | | | |
| 8+20 | 0.3054 | 1.01 | Q | | | | |
| 8+25 | 0.3124 | 1.02 | Q | | | | |
| 8+30 | 0.3195 | 1.03 | Q | | | | |
| 8+35 | 0.3267 | 1.04 | Q | | | | |
| 8+40 | 0.3340 | 1.06 | Q | | | | |
| 8+45 | 0.3414 | 1.08 | Q | | | | |
| 8+50 | 0.3490 | 1.10 | QV | | | | |
| 8+55 | 0.3567 | 1.12 | QV | | | | |
| 9+ 0 | 0.3646 | 1.15 | QV | | | | |
| 9+ 5 | 0.3727 | 1.17 | QV | | | | |
| 9+10 | 0.3811 | 1.22 | QV | | | | |
| 9+15 | 0.3898 | 1.27 | Q | | | | |
| 9+20 | 0.3987 | 1.29 | Q | | | | |
| 9+25 | 0.4078 | 1.32 | Q | | | | |
| 9+30 | 0.4171 | 1.35 | QV | | | | |
| 9+35 | 0.4266 | 1.37 | QV | | | | |
| 9+40 | 0.4362 | 1.40 | QV | | | | |
| 9+45 | 0.4460 | 1.43 | QV | | | | |
| 9+50 | 0.4561 | 1.46 | QV | | | | |
| 9+55 | 0.4672 | 1.61 | Q | | | | |
| 10+ 0 | 0.4795 | 1.78 | Q | | | | |
| 10+ 5 | 0.4920 | 1.82 | Q | | | | |
| 10+10 | 0.5028 | 1.57 | QV | | | | |
| 10+15 | 0.5116 | 1.28 | Q V | | | | |
| 10+20 | 0.5197 | 1.17 | Q V | | | | |
| 10+25 | 0.5274 | 1.11 | Q V | | | | |
| 10+30 | 0.5348 | 1.08 | Q V | | | | |
| 10+35 | 0.5422 | 1.08 | Q V | | | | |
| 10+40 | 0.5503 | 1.18 | Q V | | | | |
| 10+45 | 0.5592 | 1.29 | Q V | | | | |
| 10+50 | 0.5684 | 1.33 | Q V | | | | |
| 10+55 | 0.5778 | 1.37 | Q V | | | | |
| 11+ 0 | 0.5875 | 1.41 | Q V | | | | |
| 11+ 5 | 0.5974 | 1.44 | Q V | | | | |
| 11+10 | 0.6071 | 1.41 | Q V | | | | |
| 11+15 | 0.6164 | 1.35 | Q V | | | | |
| 11+20 | 0.6256 | 1.34 | Q V | | | | |
| 11+25 | 0.6347 | 1.33 | Q V | | | | |
| 11+30 | 0.6438 | 1.32 | Q V | | | | |
| 11+35 | 0.6528 | 1.31 | Q V | | | | |
| 11+40 | 0.6615 | 1.26 | Q V | | | | |
| 11+45 | 0.6699 | 1.22 | Q V | | | | |
| 11+50 | 0.6782 | 1.20 | Q V | | | | |
| 11+55 | 0.6865 | 1.21 | Q V | | | | |
| 12+ 0 | 0.6950 | 1.23 | Q V | | | | |
| 12+ 5 | 0.7047 | 1.42 | Q V | | | | |
| 12+10 | 0.7216 | 2.44 | QV | | | | |
| 12+15 | 0.7461 | 3.57 | V Q | | | | |
| 12+20 | 0.7739 | 4.03 | V Q | | | | |
| 12+25 | 0.8046 | 4.45 | V Q | | | | |
| 12+30 | 0.8376 | 4.80 | V Q | | | | |
| 12+35 | 0.8722 | 5.03 | V Q | | | | |
| 12+40 | 0.9097 | 5.44 | V Q | | | | |
| 12+45 | 0.9501 | 5.86 | V Q | | | | |
| 12+50 | 0.9919 | 6.07 | V Q | | | | |
| 12+55 | 1.0356 | 6.35 | V Q | | | | |
| 13+ 0 | 1.0812 | 6.61 | V Q | | | | |
| 13+ 5 | 1.1285 | 6.87 | V Q | | | | |
| 13+10 | 1.1817 | 7.73 | V Q | | | | |
| 13+15 | 1.2412 | 8.64 | V Q | | | | |
| 13+20 | 1.3032 | 9.00 | V Q | | | | |
| 13+25 | 1.3667 | 9.22 | V Q | | | | |
| 13+30 | 1.4313 | 9.37 | V Q | | | | |
| 13+35 | 1.4944 | 9.17 | V Q | | | | |
| 13+40 | 1.5463 | 7.53 | V Q | | | | |
| 13+45 | 1.5857 | 5.73 | QV | | | | |
| 13+50 | 1.6208 | 5.10 | Q V | | | | |
| 13+55 | 1.6536 | 4.75 | Q V | | | | |
| 14+ 0 | 1.6850 | 4.56 | Q V | | | | |
| 14+ 5 | 1.7164 | 4.57 | Q V | | | | |
| 14+10 | 1.7521 | 5.17 | Q V | | | | |
| 14+15 | 1.7924 | 5.85 | Q V | | | | |
| 14+20 | 1.8343 | 6.09 | Q V | | | | |
| 14+25 | 1.8762 | 6.09 | Q V | | | | |

| | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 20+45 | 2.6903 | 0.21 | Q | \| | \| | \| | V\| |
| 20+50 | 2.6917 | 0.20 | Q | \| | \| | \| | V\| |
| 20+55 | 2.6930 | 0.18 | Q | \| | \| | \| | V\| |
| 21+ 0 | 2.6941 | 0.16 | Q | \| | \| | \| | V\| |
| 21+ 5 | 2.6951 | 0.15 | Q | \| | \| | \| | V\| |
| 21+10 | 2.6963 | 0.17 | Q | \| | \| | \| | V\| |
| 21+15 | 2.6976 | 0.19 | Q | \| | \| | \| | V\| |
| 21+20 | 2.6990 | 0.19 | Q | \| | \| | \| | V\| |
| 21+25 | 2.7002 | 0.18 | Q | \| | \| | \| | V\| |
| 21+30 | 2.7012 | 0.16 | Q | \| | \| | \| | V\| |
| 21+35 | 2.7023 | 0.15 | Q | \| | \| | \| | V\| |
| 21+40 | 2.7034 | 0.17 | Q | \| | \| | \| | V\| |
| 21+45 | 2.7048 | 0.19 | Q | \| | \| | \| | V\| |
| 21+50 | 2.7061 | 0.19 | Q | \| | \| | \| | V\| |
| 21+55 | 2.7073 | 0.18 | Q | \| | \| | \| | V\| |
| 22+ 0 | 2.7084 | 0.16 | Q | \| | \| | \| | V\| |
| 22+ 5 | 2.7094 | 0.15 | Q | \| | \| | \| | V\| |
| 22+10 | 2.7106 | 0.17 | Q | \| | \| | \| | V\| |
| 22+15 | 2.7119 | 0.19 | Q | \| | \| | \| | V\| |
| 22+20 | 2.7132 | 0.19 | Q | \| | \| | \| | V\| |
| 22+25 | 2.7144 | 0.18 | Q | \| | \| | \| | V\| |
| 22+30 | 2.7155 | 0.16 | Q | \| | \| | \| | V\| |
| 22+35 | 2.7165 | 0.15 | Q | \| | \| | \| | V\| |
| 22+40 | 2.7175 | 0.14 | Q | \| | \| | \| | V\| |
| 22+45 | 2.7185 | 0.14 | Q | \| | \| | \| | V\| |
| 22+50 | 2.7194 | 0.14 | Q | \| | \| | \| | V\| |
| 22+55 | 2.7204 | 0.14 | Q | \| | \| | \| | V\| |
| 23+ 0 | 2.7214 | 0.14 | Q | \| | \| | \| | V\| |
| 23+ 5 | 2.7223 | 0.14 | Q | \| | \| | \| | V\| |
| 23+10 | 2.7233 | 0.14 | Q | \| | \| | \| | V\| |
| 23+15 | 2.7242 | 0.14 | Q | \| | \| | \| | V\| |
| 23+20 | 2.7252 | 0.14 | Q | \| | \| | \| | V\| |
| 23+25 | 2.7261 | 0.14 | Q | \| | \| | \| | V\| |
| 23+30 | 2.7271 | 0.14 | Q | \| | \| | \| | V\| |
| 23+35 | 2.7280 | 0.14 | Q | \| | \| | \| | V\| |
| 23+40 | 2.7290 | 0.14 | Q | \| | \| | \| | V\| |
| 23+45 | 2.7299 | 0.14 | Q | \| | \| | \| | V\| |
| 23+50 | 2.7309 | 0.14 | Q | \| | \| | \| | V\| |
| 23+55 | 2.7318 | 0.14 | Q | \| | \| | \| | V\| |
| 24+ 0 | 2.7328 | 0.14 | Q | \| | \| | \| | V\| |
| 24+ 5 | 2.7337 | 0.13 | Q | \| | \| | \| | V\| |
| 24+10 | 2.7343 | 0.09 | Q | \| | \| | \| | V\| |
| 24+15 | 2.7346 | 0.04 | Q | \| | \| | \| | V\| |
| 24+20 | 2.7347 | 0.02 | Q | \| | \| | \| | V\| |
| 24+25 | 2.7348 | 0.01 | Q | \| | \| | \| | V\| |
| 24+30 | 2.7348 | 0.01 | Q | \| | \| | \| | V\| |
| 24+35 | 2.7349 | 0.00 | Q | \| | \| | \| | V\| |
| 24+40 | 2.7349 | 0.00 | Q | \| | \| | \| | V\| |
| 24+45 | 2.7349 | 0.00 | Q | \| | \| | \| | V\| |
| 24+50 | 2.7349 | 0.00 | Q | \| | \| | \| | V\| |
| 24+55 | 2.7349 | 0.00 | Q | \| | \| | \| | V\| |

```
       U n i t   H y d r o g r a p h   A n a l y s i s

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              Study date  01/29/18 File: nrareaapr2242.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 4029

----------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



----------------------------------------------------------------------
Tract 37305 - Nichols Road Development
Drainage Area A - 51.4 Ac
Proposed Condition
2-year 24-hour storm

----------------------------------------------------------------------
Drainage Area =      51.40(Ac.)  =      0.080 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =      51.40(Ac.)  =      0.080 Sq. Mi.
Length along longest watercourse =    3463.00(Ft.)
Length along longest watercourse measured to centroid =     834.00(Ft.)
Length along longest watercourse =      0.656 Mi.
Length along longest watercourse measured to centroid =      0.158 Mi.
Difference in elevation =      77.00(Ft.)
Slope along watercourse =    117.4011 Ft./Mi.
Average Manning's 'N' = 0.016
Lag time =    0.066 Hr.
Lag time =     3.94 Min.
25% of lag time =     0.98 Min.
40% of lag time =     1.57 Min.
Unit time =     5.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
       51.40           2.38                122.33

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
       51.40           6.35                326.39

STORM EVENT (YEAR) =    2.00
Area Averaged 2-Year Rainfall =    2.380(In)
Area Averaged 100-Year Rainfall =    6.350(In)

Point rain (area averaged) =    2.380(In)
Areal adjustment factor =   99.99 %
Adjusted average point rain =    2.380(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     3.500           69.00         0.050
    29.500           69.00         0.550
     5.000           69.00         0.900
    13.400           69.00         0.900
 Total Area Entered =     51.40(Ac.)
```

| RI AMC2 | RI AMC-3 | Infil. Rate (In/Hr) | Impervious (Dec.%) | Adj. Infil. Rate (In/Hr) | Area% (Dec.) | F (In/Hr) |
|---|---|---|---|---|---|---|
| 69.0 | 84.4 | 0.194 | 0.050 | 0.185 | 0.068 | 0.013 |
| 69.0 | 84.4 | 0.194 | 0.550 | 0.098 | 0.574 | 0.056 |
| 69.0 | 84.4 | 0.194 | 0.900 | 0.037 | 0.097 | 0.004 |
| 69.0 | 84.4 | 0.194 | 0.900 | 0.037 | 0.261 | 0.010 |
| | | | | | Sum (F) = | 0.082 |

Area averaged mean soil loss (F) (In/Hr) = 0.082
Minimum soil loss rate ((In/Hr)) = 0.041
(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.340

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U n i t H y d r o g r a p h
FOOTHILL S-Curve

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Unit Hydrograph Data

| Unit time period (hrs) | | Time % of lag | Distribution Graph % | Unit Hydrograph (CFS) |
|---|---|---|---|---|
| 1 | 0.083 | 127.026 | 23.707 | 12.281 |
| 2 | 0.167 | 254.052 | 55.790 | 28.900 |
| 3 | 0.250 | 381.077 | 14.636 | 7.582 |
| 4 | 0.333 | 508.103 | 4.252 | 2.202 |
| 5 | 0.417 | 635.129 | 1.082 | 0.561 |
| 6 | 0.500 | 762.155 | 0.533 | 0.276 |
| | | | Sum = 100.000 Sum= | 51.802 |

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The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

| Unit | Time (Hr.) | Pattern Percent | Storm Rain (In/Hr) | Loss rate(In./Hr) Max | Low | Effective (In/Hr) |
|---|---|---|---|---|---|---|
| 1 | 0.08 | 0.07 | 0.019 | ( 0.145) | 0.006 | 0.013 |
| 2 | 0.17 | 0.07 | 0.019 | ( 0.145) | 0.006 | 0.013 |
| 3 | 0.25 | 0.07 | 0.019 | ( 0.144) | 0.006 | 0.013 |
| 4 | 0.33 | 0.10 | 0.029 | ( 0.144) | 0.010 | 0.019 |
| 5 | 0.42 | 0.10 | 0.029 | ( 0.143) | 0.010 | 0.019 |
| 6 | 0.50 | 0.10 | 0.029 | ( 0.143) | 0.010 | 0.019 |
| 7 | 0.58 | 0.10 | 0.029 | ( 0.142) | 0.010 | 0.019 |
| 8 | 0.67 | 0.10 | 0.029 | ( 0.141) | 0.010 | 0.019 |
| 9 | 0.75 | 0.10 | 0.029 | ( 0.141) | 0.010 | 0.019 |
| 10 | 0.83 | 0.13 | 0.038 | ( 0.140) | 0.013 | 0.025 |
| 11 | 0.92 | 0.13 | 0.038 | ( 0.140) | 0.013 | 0.025 |
| 12 | 1.00 | 0.13 | 0.038 | ( 0.139) | 0.013 | 0.025 |
| 13 | 1.08 | 0.10 | 0.029 | ( 0.139) | 0.010 | 0.019 |
| 14 | 1.17 | 0.10 | 0.029 | ( 0.138) | 0.010 | 0.019 |
| 15 | 1.25 | 0.10 | 0.029 | ( 0.138) | 0.010 | 0.019 |
| 16 | 1.33 | 0.10 | 0.029 | ( 0.137) | 0.010 | 0.019 |
| 17 | 1.42 | 0.10 | 0.029 | ( 0.136) | 0.010 | 0.019 |
| 18 | 1.50 | 0.10 | 0.029 | ( 0.136) | 0.010 | 0.019 |
| 19 | 1.58 | 0.10 | 0.029 | ( 0.135) | 0.010 | 0.019 |
| 20 | 1.67 | 0.10 | 0.029 | ( 0.135) | 0.010 | 0.019 |
| 21 | 1.75 | 0.10 | 0.029 | ( 0.134) | 0.010 | 0.019 |
| 22 | 1.83 | 0.13 | 0.038 | ( 0.134) | 0.013 | 0.025 |
| 23 | 1.92 | 0.13 | 0.038 | ( 0.133) | 0.013 | 0.025 |
| 24 | 2.00 | 0.13 | 0.038 | ( 0.133) | 0.013 | 0.025 |
| 25 | 2.08 | 0.13 | 0.038 | ( 0.132) | 0.013 | 0.025 |
| 26 | 2.17 | 0.13 | 0.038 | ( 0.132) | 0.013 | 0.025 |
| 27 | 2.25 | 0.13 | 0.038 | ( 0.131) | 0.013 | 0.025 |
| 28 | 2.33 | 0.13 | 0.038 | ( 0.131) | 0.013 | 0.025 |
| 29 | 2.42 | 0.13 | 0.038 | ( 0.130) | 0.013 | 0.025 |
| 30 | 2.50 | 0.13 | 0.038 | ( 0.129) | 0.013 | 0.025 |
| 31 | 2.58 | 0.17 | 0.048 | ( 0.129) | 0.016 | 0.031 |
| 32 | 2.67 | 0.17 | 0.048 | ( 0.128) | 0.016 | 0.031 |
| 33 | 2.75 | 0.17 | 0.048 | ( 0.128) | 0.016 | 0.031 |
| 34 | 2.83 | 0.17 | 0.048 | ( 0.127) | 0.016 | 0.031 |
| 35 | 2.92 | 0.17 | 0.048 | ( 0.127) | 0.016 | 0.031 |
| 36 | 3.00 | 0.17 | 0.048 | ( 0.126) | 0.016 | 0.031 |
| 37 | 3.08 | 0.17 | 0.048 | ( 0.126) | 0.016 | 0.031 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 38 | 3.17 | 0.17 | 0.048 | ( 0.125) | 0.016 | 0.031 |
| 39 | 3.25 | 0.17 | 0.048 | ( 0.125) | 0.016 | 0.031 |
| 40 | 3.33 | 0.17 | 0.048 | ( 0.124) | 0.016 | 0.031 |
| 41 | 3.42 | 0.17 | 0.048 | ( 0.124) | 0.016 | 0.031 |
| 42 | 3.50 | 0.17 | 0.048 | ( 0.123) | 0.016 | 0.031 |
| 43 | 3.58 | 0.17 | 0.048 | ( 0.123) | 0.016 | 0.031 |
| 44 | 3.67 | 0.17 | 0.048 | ( 0.122) | 0.016 | 0.031 |
| 45 | 3.75 | 0.17 | 0.048 | ( 0.122) | 0.016 | 0.031 |
| 46 | 3.83 | 0.20 | 0.057 | ( 0.121) | 0.019 | 0.038 |
| 47 | 3.92 | 0.20 | 0.057 | ( 0.121) | 0.019 | 0.038 |
| 48 | 4.00 | 0.20 | 0.057 | ( 0.120) | 0.019 | 0.038 |
| 49 | 4.08 | 0.20 | 0.057 | ( 0.120) | 0.019 | 0.038 |
| 50 | 4.17 | 0.20 | 0.057 | ( 0.119) | 0.019 | 0.038 |
| 51 | 4.25 | 0.20 | 0.057 | ( 0.119) | 0.019 | 0.038 |
| 52 | 4.33 | 0.23 | 0.067 | ( 0.118) | 0.023 | 0.044 |
| 53 | 4.42 | 0.23 | 0.067 | ( 0.118) | 0.023 | 0.044 |
| 54 | 4.50 | 0.23 | 0.067 | ( 0.117) | 0.023 | 0.044 |
| 55 | 4.58 | 0.23 | 0.067 | ( 0.117) | 0.023 | 0.044 |
| 56 | 4.67 | 0.23 | 0.067 | ( 0.116) | 0.023 | 0.044 |
| 57 | 4.75 | 0.23 | 0.067 | ( 0.116) | 0.023 | 0.044 |
| 58 | 4.83 | 0.27 | 0.076 | ( 0.115) | 0.026 | 0.050 |
| 59 | 4.92 | 0.27 | 0.076 | ( 0.115) | 0.026 | 0.050 |
| 60 | 5.00 | 0.27 | 0.076 | ( 0.114) | 0.026 | 0.050 |
| 61 | 5.08 | 0.20 | 0.057 | ( 0.114) | 0.019 | 0.038 |
| 62 | 5.17 | 0.20 | 0.057 | ( 0.113) | 0.019 | 0.038 |
| 63 | 5.25 | 0.20 | 0.057 | ( 0.113) | 0.019 | 0.038 |
| 64 | 5.33 | 0.23 | 0.067 | ( 0.112) | 0.023 | 0.044 |
| 65 | 5.42 | 0.23 | 0.067 | ( 0.112) | 0.023 | 0.044 |
| 66 | 5.50 | 0.23 | 0.067 | ( 0.111) | 0.023 | 0.044 |
| 67 | 5.58 | 0.27 | 0.076 | ( 0.111) | 0.026 | 0.050 |
| 68 | 5.67 | 0.27 | 0.076 | ( 0.110) | 0.026 | 0.050 |
| 69 | 5.75 | 0.27 | 0.076 | ( 0.110) | 0.026 | 0.050 |
| 70 | 5.83 | 0.27 | 0.076 | ( 0.109) | 0.026 | 0.050 |
| 71 | 5.92 | 0.27 | 0.076 | ( 0.109) | 0.026 | 0.050 |
| 72 | 6.00 | 0.27 | 0.076 | ( 0.108) | 0.026 | 0.050 |
| 73 | 6.08 | 0.30 | 0.086 | ( 0.108) | 0.029 | 0.057 |
| 74 | 6.17 | 0.30 | 0.086 | ( 0.107) | 0.029 | 0.057 |
| 75 | 6.25 | 0.30 | 0.086 | ( 0.107) | 0.029 | 0.057 |
| 76 | 6.33 | 0.30 | 0.086 | ( 0.106) | 0.029 | 0.057 |
| 77 | 6.42 | 0.30 | 0.086 | ( 0.106) | 0.029 | 0.057 |
| 78 | 6.50 | 0.30 | 0.086 | ( 0.105) | 0.029 | 0.057 |
| 79 | 6.58 | 0.33 | 0.095 | ( 0.105) | 0.032 | 0.063 |
| 80 | 6.67 | 0.33 | 0.095 | ( 0.104) | 0.032 | 0.063 |
| 81 | 6.75 | 0.33 | 0.095 | ( 0.104) | 0.032 | 0.063 |
| 82 | 6.83 | 0.33 | 0.095 | ( 0.103) | 0.032 | 0.063 |
| 83 | 6.92 | 0.33 | 0.095 | ( 0.103) | 0.032 | 0.063 |
| 84 | 7.00 | 0.33 | 0.095 | ( 0.103) | 0.032 | 0.063 |
| 85 | 7.08 | 0.33 | 0.095 | ( 0.102) | 0.032 | 0.063 |
| 86 | 7.17 | 0.33 | 0.095 | ( 0.102) | 0.032 | 0.063 |
| 87 | 7.25 | 0.33 | 0.095 | ( 0.101) | 0.032 | 0.063 |
| 88 | 7.33 | 0.37 | 0.105 | ( 0.101) | 0.036 | 0.069 |
| 89 | 7.42 | 0.37 | 0.105 | ( 0.100) | 0.036 | 0.069 |
| 90 | 7.50 | 0.37 | 0.105 | ( 0.100) | 0.036 | 0.069 |
| 91 | 7.58 | 0.40 | 0.114 | ( 0.099) | 0.039 | 0.075 |
| 92 | 7.67 | 0.40 | 0.114 | ( 0.099) | 0.039 | 0.075 |
| 93 | 7.75 | 0.40 | 0.114 | ( 0.098) | 0.039 | 0.075 |
| 94 | 7.83 | 0.43 | 0.124 | ( 0.098) | 0.042 | 0.082 |
| 95 | 7.92 | 0.43 | 0.124 | ( 0.097) | 0.042 | 0.082 |
| 96 | 8.00 | 0.43 | 0.124 | ( 0.097) | 0.042 | 0.082 |
| 97 | 8.08 | 0.50 | 0.143 | ( 0.097) | 0.049 | 0.094 |
| 98 | 8.17 | 0.50 | 0.143 | ( 0.096) | 0.049 | 0.094 |
| 99 | 8.25 | 0.50 | 0.143 | ( 0.096) | 0.049 | 0.094 |
| 100 | 8.33 | 0.50 | 0.143 | ( 0.095) | 0.049 | 0.094 |
| 101 | 8.42 | 0.50 | 0.143 | ( 0.095) | 0.049 | 0.094 |
| 102 | 8.50 | 0.50 | 0.143 | ( 0.094) | 0.049 | 0.094 |
| 103 | 8.58 | 0.53 | 0.152 | ( 0.094) | 0.052 | 0.101 |
| 104 | 8.67 | 0.53 | 0.152 | ( 0.093) | 0.052 | 0.101 |
| 105 | 8.75 | 0.53 | 0.152 | ( 0.093) | 0.052 | 0.101 |
| 106 | 8.83 | 0.57 | 0.162 | ( 0.093) | 0.055 | 0.107 |
| 107 | 8.92 | 0.57 | 0.162 | ( 0.092) | 0.055 | 0.107 |
| 108 | 9.00 | 0.57 | 0.162 | ( 0.092) | 0.055 | 0.107 |
| 109 | 9.08 | 0.63 | 0.181 | ( 0.091) | 0.061 | 0.119 |
| 110 | 9.17 | 0.63 | 0.181 | ( 0.091) | 0.061 | 0.119 |
| 111 | 9.25 | 0.63 | 0.181 | ( 0.090) | 0.061 | 0.119 |
| 112 | 9.33 | 0.67 | 0.190 | ( 0.090) | 0.065 | 0.126 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 113 | 9.42 | 0.67 | 0.190 | ( 0.090) | 0.065 | 0.126 |
| 114 | 9.50 | 0.67 | 0.190 | ( 0.089) | 0.065 | 0.126 |
| 115 | 9.58 | 0.70 | 0.200 | ( 0.089) | 0.068 | 0.132 |
| 116 | 9.67 | 0.70 | 0.200 | ( 0.088) | 0.068 | 0.132 |
| 117 | 9.75 | 0.70 | 0.200 | ( 0.088) | 0.068 | 0.132 |
| 118 | 9.83 | 0.73 | 0.209 | ( 0.087) | 0.071 | 0.138 |
| 119 | 9.92 | 0.73 | 0.209 | ( 0.087) | 0.071 | 0.138 |
| 120 | 10.00 | 0.73 | 0.209 | ( 0.087) | 0.071 | 0.138 |
| 121 | 10.08 | 0.50 | 0.143 | ( 0.086) | 0.049 | 0.094 |
| 122 | 10.17 | 0.50 | 0.143 | ( 0.086) | 0.049 | 0.094 |
| 123 | 10.25 | 0.50 | 0.143 | ( 0.085) | 0.049 | 0.094 |
| 124 | 10.33 | 0.50 | 0.143 | ( 0.085) | 0.049 | 0.094 |
| 125 | 10.42 | 0.50 | 0.143 | ( 0.084) | 0.049 | 0.094 |
| 126 | 10.50 | 0.50 | 0.143 | ( 0.084) | 0.049 | 0.094 |
| 127 | 10.58 | 0.67 | 0.190 | ( 0.084) | 0.065 | 0.126 |
| 128 | 10.67 | 0.67 | 0.190 | ( 0.083) | 0.065 | 0.126 |
| 129 | 10.75 | 0.67 | 0.190 | ( 0.083) | 0.065 | 0.126 |
| 130 | 10.83 | 0.67 | 0.190 | ( 0.082) | 0.065 | 0.126 |
| 131 | 10.92 | 0.67 | 0.190 | ( 0.082) | 0.065 | 0.126 |
| 132 | 11.00 | 0.67 | 0.190 | ( 0.082) | 0.065 | 0.126 |
| 133 | 11.08 | 0.63 | 0.181 | ( 0.081) | 0.061 | 0.119 |
| 134 | 11.17 | 0.63 | 0.181 | ( 0.081) | 0.061 | 0.119 |
| 135 | 11.25 | 0.63 | 0.181 | ( 0.080) | 0.061 | 0.119 |
| 136 | 11.33 | 0.63 | 0.181 | ( 0.080) | 0.061 | 0.119 |
| 137 | 11.42 | 0.63 | 0.181 | ( 0.080) | 0.061 | 0.119 |
| 138 | 11.50 | 0.63 | 0.181 | ( 0.079) | 0.061 | 0.119 |
| 139 | 11.58 | 0.57 | 0.162 | ( 0.079) | 0.055 | 0.107 |
| 140 | 11.67 | 0.57 | 0.162 | ( 0.078) | 0.055 | 0.107 |
| 141 | 11.75 | 0.57 | 0.162 | ( 0.078) | 0.055 | 0.107 |
| 142 | 11.83 | 0.60 | 0.171 | ( 0.078) | 0.058 | 0.113 |
| 143 | 11.92 | 0.60 | 0.171 | ( 0.077) | 0.058 | 0.113 |
| 144 | 12.00 | 0.60 | 0.171 | ( 0.077) | 0.058 | 0.113 |
| 145 | 12.08 | 0.83 | 0.238 | 0.077 | ( 0.081) | 0.161 |
| 146 | 12.17 | 0.83 | 0.238 | 0.076 | ( 0.081) | 0.162 |
| 147 | 12.25 | 0.83 | 0.238 | 0.076 | ( 0.081) | 0.162 |
| 148 | 12.33 | 0.87 | 0.247 | 0.075 | ( 0.084) | 0.172 |
| 149 | 12.42 | 0.87 | 0.247 | 0.075 | ( 0.084) | 0.173 |
| 150 | 12.50 | 0.87 | 0.247 | 0.075 | ( 0.084) | 0.173 |
| 151 | 12.58 | 0.93 | 0.267 | 0.074 | ( 0.091) | 0.192 |
| 152 | 12.67 | 0.93 | 0.267 | 0.074 | ( 0.091) | 0.193 |
| 153 | 12.75 | 0.93 | 0.267 | 0.073 | ( 0.091) | 0.193 |
| 154 | 12.83 | 0.97 | 0.276 | 0.073 | ( 0.094) | 0.203 |
| 155 | 12.92 | 0.97 | 0.276 | 0.073 | ( 0.094) | 0.203 |
| 156 | 13.00 | 0.97 | 0.276 | 0.072 | ( 0.094) | 0.204 |
| 157 | 13.08 | 1.13 | 0.324 | 0.072 | ( 0.110) | 0.252 |
| 158 | 13.17 | 1.13 | 0.324 | 0.072 | ( 0.110) | 0.252 |
| 159 | 13.25 | 1.13 | 0.324 | 0.071 | ( 0.110) | 0.252 |
| 160 | 13.33 | 1.13 | 0.324 | 0.071 | ( 0.110) | 0.253 |
| 161 | 13.42 | 1.13 | 0.324 | 0.071 | ( 0.110) | 0.253 |
| 162 | 13.50 | 1.13 | 0.324 | 0.070 | ( 0.110) | 0.253 |
| 163 | 13.58 | 0.77 | 0.219 | 0.070 | ( 0.074) | 0.149 |
| 164 | 13.67 | 0.77 | 0.219 | 0.069 | ( 0.074) | 0.149 |
| 165 | 13.75 | 0.77 | 0.219 | 0.069 | ( 0.074) | 0.150 |
| 166 | 13.83 | 0.77 | 0.219 | 0.069 | ( 0.074) | 0.150 |
| 167 | 13.92 | 0.77 | 0.219 | 0.068 | ( 0.074) | 0.150 |
| 168 | 14.00 | 0.77 | 0.219 | 0.068 | ( 0.074) | 0.151 |
| 169 | 14.08 | 0.90 | 0.257 | 0.068 | ( 0.087) | 0.189 |
| 170 | 14.17 | 0.90 | 0.257 | 0.067 | ( 0.087) | 0.190 |
| 171 | 14.25 | 0.90 | 0.257 | 0.067 | ( 0.087) | 0.190 |
| 172 | 14.33 | 0.87 | 0.247 | 0.067 | ( 0.084) | 0.181 |
| 173 | 14.42 | 0.87 | 0.247 | 0.066 | ( 0.084) | 0.181 |
| 174 | 14.50 | 0.87 | 0.247 | 0.066 | ( 0.084) | 0.181 |
| 175 | 14.58 | 0.87 | 0.247 | 0.066 | ( 0.084) | 0.182 |
| 176 | 14.67 | 0.87 | 0.247 | 0.065 | ( 0.084) | 0.182 |
| 177 | 14.75 | 0.87 | 0.247 | 0.065 | ( 0.084) | 0.182 |
| 178 | 14.83 | 0.83 | 0.238 | 0.065 | ( 0.081) | 0.173 |
| 179 | 14.92 | 0.83 | 0.238 | 0.064 | ( 0.081) | 0.174 |
| 180 | 15.00 | 0.83 | 0.238 | 0.064 | ( 0.081) | 0.174 |
| 181 | 15.08 | 0.80 | 0.228 | 0.064 | ( 0.078) | 0.165 |
| 182 | 15.17 | 0.80 | 0.228 | 0.063 | ( 0.078) | 0.165 |
| 183 | 15.25 | 0.80 | 0.228 | 0.063 | ( 0.078) | 0.165 |
| 184 | 15.33 | 0.77 | 0.219 | 0.063 | ( 0.074) | 0.156 |
| 185 | 15.42 | 0.77 | 0.219 | 0.062 | ( 0.074) | 0.157 |
| 186 | 15.50 | 0.77 | 0.219 | 0.062 | ( 0.074) | 0.157 |
| 187 | 15.58 | 0.63 | 0.181 | ( 0.062) | 0.061 | 0.119 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 188 | 15.67 | 0.63 | 0.181 | 0.061 | ( 0.061) | 0.119 |
| 189 | 15.75 | 0.63 | 0.181 | 0.061 | ( 0.061) | 0.120 |
| 190 | 15.83 | 0.63 | 0.181 | 0.061 | ( 0.061) | 0.120 |
| 191 | 15.92 | 0.63 | 0.181 | 0.061 | ( 0.061) | 0.120 |
| 192 | 16.00 | 0.63 | 0.181 | 0.060 | ( 0.061) | 0.121 |
| 193 | 16.08 | 0.13 | 0.038 | ( 0.060) | 0.013 | 0.025 |
| 194 | 16.17 | 0.13 | 0.038 | ( 0.060) | 0.013 | 0.025 |
| 195 | 16.25 | 0.13 | 0.038 | ( 0.059) | 0.013 | 0.025 |
| 196 | 16.33 | 0.13 | 0.038 | ( 0.059) | 0.013 | 0.025 |
| 197 | 16.42 | 0.13 | 0.038 | ( 0.059) | 0.013 | 0.025 |
| 198 | 16.50 | 0.13 | 0.038 | ( 0.058) | 0.013 | 0.025 |
| 199 | 16.58 | 0.10 | 0.029 | ( 0.058) | 0.010 | 0.019 |
| 200 | 16.67 | 0.10 | 0.029 | ( 0.058) | 0.010 | 0.019 |
| 201 | 16.75 | 0.10 | 0.029 | ( 0.057) | 0.010 | 0.019 |
| 202 | 16.83 | 0.10 | 0.029 | ( 0.057) | 0.010 | 0.019 |
| 203 | 16.92 | 0.10 | 0.029 | ( 0.057) | 0.010 | 0.019 |
| 204 | 17.00 | 0.10 | 0.029 | ( 0.057) | 0.010 | 0.019 |
| 205 | 17.08 | 0.17 | 0.048 | ( 0.056) | 0.016 | 0.031 |
| 206 | 17.17 | 0.17 | 0.048 | ( 0.056) | 0.016 | 0.031 |
| 207 | 17.25 | 0.17 | 0.048 | ( 0.056) | 0.016 | 0.031 |
| 208 | 17.33 | 0.17 | 0.048 | ( 0.055) | 0.016 | 0.031 |
| 209 | 17.42 | 0.17 | 0.048 | ( 0.055) | 0.016 | 0.031 |
| 210 | 17.50 | 0.17 | 0.048 | ( 0.055) | 0.016 | 0.031 |
| 211 | 17.58 | 0.17 | 0.048 | ( 0.055) | 0.016 | 0.031 |
| 212 | 17.67 | 0.17 | 0.048 | ( 0.054) | 0.016 | 0.031 |
| 213 | 17.75 | 0.17 | 0.048 | ( 0.054) | 0.016 | 0.031 |
| 214 | 17.83 | 0.13 | 0.038 | ( 0.054) | 0.013 | 0.025 |
| 215 | 17.92 | 0.13 | 0.038 | ( 0.054) | 0.013 | 0.025 |
| 216 | 18.00 | 0.13 | 0.038 | ( 0.053) | 0.013 | 0.025 |
| 217 | 18.08 | 0.13 | 0.038 | ( 0.053) | 0.013 | 0.025 |
| 218 | 18.17 | 0.13 | 0.038 | ( 0.053) | 0.013 | 0.025 |
| 219 | 18.25 | 0.13 | 0.038 | ( 0.053) | 0.013 | 0.025 |
| 220 | 18.33 | 0.13 | 0.038 | ( 0.052) | 0.013 | 0.025 |
| 221 | 18.42 | 0.13 | 0.038 | ( 0.052) | 0.013 | 0.025 |
| 222 | 18.50 | 0.13 | 0.038 | ( 0.052) | 0.013 | 0.025 |
| 223 | 18.58 | 0.10 | 0.029 | ( 0.052) | 0.010 | 0.019 |
| 224 | 18.67 | 0.10 | 0.029 | ( 0.051) | 0.010 | 0.019 |
| 225 | 18.75 | 0.10 | 0.029 | ( 0.051) | 0.010 | 0.019 |
| 226 | 18.83 | 0.07 | 0.019 | ( 0.051) | 0.006 | 0.013 |
| 227 | 18.92 | 0.07 | 0.019 | ( 0.051) | 0.006 | 0.013 |
| 228 | 19.00 | 0.07 | 0.019 | ( 0.050) | 0.006 | 0.013 |
| 229 | 19.08 | 0.10 | 0.029 | ( 0.050) | 0.010 | 0.019 |
| 230 | 19.17 | 0.10 | 0.029 | ( 0.050) | 0.010 | 0.019 |
| 231 | 19.25 | 0.10 | 0.029 | ( 0.050) | 0.010 | 0.019 |
| 232 | 19.33 | 0.13 | 0.038 | ( 0.049) | 0.013 | 0.025 |
| 233 | 19.42 | 0.13 | 0.038 | ( 0.049) | 0.013 | 0.025 |
| 234 | 19.50 | 0.13 | 0.038 | ( 0.049) | 0.013 | 0.025 |
| 235 | 19.58 | 0.10 | 0.029 | ( 0.049) | 0.010 | 0.019 |
| 236 | 19.67 | 0.10 | 0.029 | ( 0.048) | 0.010 | 0.019 |
| 237 | 19.75 | 0.10 | 0.029 | ( 0.048) | 0.010 | 0.019 |
| 238 | 19.83 | 0.07 | 0.019 | ( 0.048) | 0.006 | 0.013 |
| 239 | 19.92 | 0.07 | 0.019 | ( 0.048) | 0.006 | 0.013 |
| 240 | 20.00 | 0.07 | 0.019 | ( 0.048) | 0.006 | 0.013 |
| 241 | 20.08 | 0.10 | 0.029 | ( 0.047) | 0.010 | 0.019 |
| 242 | 20.17 | 0.10 | 0.029 | ( 0.047) | 0.010 | 0.019 |
| 243 | 20.25 | 0.10 | 0.029 | ( 0.047) | 0.010 | 0.019 |
| 244 | 20.33 | 0.10 | 0.029 | ( 0.047) | 0.010 | 0.019 |
| 245 | 20.42 | 0.10 | 0.029 | ( 0.047) | 0.010 | 0.019 |
| 246 | 20.50 | 0.10 | 0.029 | ( 0.046) | 0.010 | 0.019 |
| 247 | 20.58 | 0.10 | 0.029 | ( 0.046) | 0.010 | 0.019 |
| 248 | 20.67 | 0.10 | 0.029 | ( 0.046) | 0.010 | 0.019 |
| 249 | 20.75 | 0.10 | 0.029 | ( 0.046) | 0.010 | 0.019 |
| 250 | 20.83 | 0.07 | 0.019 | ( 0.046) | 0.006 | 0.013 |
| 251 | 20.92 | 0.07 | 0.019 | ( 0.045) | 0.006 | 0.013 |
| 252 | 21.00 | 0.07 | 0.019 | ( 0.045) | 0.006 | 0.013 |
| 253 | 21.08 | 0.10 | 0.029 | ( 0.045) | 0.010 | 0.019 |
| 254 | 21.17 | 0.10 | 0.029 | ( 0.045) | 0.010 | 0.019 |
| 255 | 21.25 | 0.10 | 0.029 | ( 0.045) | 0.010 | 0.019 |
| 256 | 21.33 | 0.07 | 0.019 | ( 0.045) | 0.006 | 0.013 |
| 257 | 21.42 | 0.07 | 0.019 | ( 0.044) | 0.006 | 0.013 |
| 258 | 21.50 | 0.07 | 0.019 | ( 0.044) | 0.006 | 0.013 |
| 259 | 21.58 | 0.10 | 0.029 | ( 0.044) | 0.010 | 0.019 |
| 260 | 21.67 | 0.10 | 0.029 | ( 0.044) | 0.010 | 0.019 |
| 261 | 21.75 | 0.10 | 0.029 | ( 0.044) | 0.010 | 0.019 |
| 262 | 21.83 | 0.07 | 0.019 | ( 0.044) | 0.006 | 0.013 |

```
263  21.92     0.07      0.019       (  0.043)       0.006        0.013
264  22.00     0.07      0.019       (  0.043)       0.006        0.013
265  22.08     0.10      0.029       (  0.043)       0.010        0.019
266  22.17     0.10      0.029       (  0.043)       0.010        0.019
267  22.25     0.10      0.029       (  0.043)       0.010        0.019
268  22.33     0.07      0.019       (  0.043)       0.006        0.013
269  22.42     0.07      0.019       (  0.043)       0.006        0.013
270  22.50     0.07      0.019       (  0.042)       0.006        0.013
271  22.58     0.07      0.019       (  0.042)       0.006        0.013
272  22.67     0.07      0.019       (  0.042)       0.006        0.013
273  22.75     0.07      0.019       (  0.042)       0.006        0.013
274  22.83     0.07      0.019       (  0.042)       0.006        0.013
275  22.92     0.07      0.019       (  0.042)       0.006        0.013
276  23.00     0.07      0.019       (  0.042)       0.006        0.013
277  23.08     0.07      0.019       (  0.042)       0.006        0.013
278  23.17     0.07      0.019       (  0.042)       0.006        0.013
279  23.25     0.07      0.019       (  0.042)       0.006        0.013
280  23.33     0.07      0.019       (  0.041)       0.006        0.013
281  23.42     0.07      0.019       (  0.041)       0.006        0.013
282  23.50     0.07      0.019       (  0.041)       0.006        0.013
283  23.58     0.07      0.019       (  0.041)       0.006        0.013
284  23.67     0.07      0.019       (  0.041)       0.006        0.013
285  23.75     0.07      0.019       (  0.041)       0.006        0.013
286  23.83     0.07      0.019       (  0.041)       0.006        0.013
287  23.92     0.07      0.019       (  0.041)       0.006        0.013
288  24.00     0.07      0.019       (  0.041)       0.006        0.013
              (Loss Rate Not Used)
    Sum =     100.0                                  Sum =    19.6
      Flood volume = Effective rainfall      1.63(In)
       times area      51.4(Ac.)/[(In)/(Ft.)] =       7.0(Ac.Ft)
      Total soil loss =      0.75(In)
      Total soil loss =     3.207(Ac.Ft)
      Total rainfall =      2.38(In)
      Flood volume =      304303.6 Cubic Feet
      Total soil loss =      139716.9 Cubic Feet
      ---------------------------------------------------------------------
       Peak flow rate of this hydrograph =     13.116(CFS)
      ---------------------------------------------------------------------
      +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                          24 - H O U R    S T O R M
                     R u n o f f      H y d r o g r a p h
      ---------------------------------------------------------------------
                  Hydrograph in   5   Minute intervals ((CFS))

      ---------------------------------------------------------------------
 Time(h+m) Volume Ac.Ft   Q(CFS)  0        5.0      10.0      15.0      20.0
 ---------------------------------------------------------------------------
   0+ 5       0.0011      0.15  Q        |         |         |         |
   0+10       0.0046      0.52  VQ       |         |         |         |
   0+15       0.0089      0.61  VQ       |         |         |         |
   0+20       0.0138      0.72  VQ       |         |         |         |
   0+25       0.0200      0.91  VQ       |         |         |         |
   0+30       0.0266      0.96  VQ       |         |         |         |
   0+35       0.0333      0.97  VQ       |         |         |         |
   0+40       0.0400      0.98  VQ       |         |         |         |
   0+45       0.0468      0.98  VQ       |         |         |         |
   0+50       0.0540      1.05  V Q      |         |         |         |
   0+55       0.0625      1.24  V Q      |         |         |         |
   1+ 0       0.0714      1.28  V Q      |         |         |         |
   1+ 5       0.0798      1.22  V Q      |         |         |         |
   1+10       0.0870      1.04  V Q      |         |         |         |
   1+15       0.0938      1.00  VQ       |         |         |         |
   1+20       0.1006      0.98  VQ       |         |         |         |
   1+25       0.1073      0.98  VQ       |         |         |         |
   1+30       0.1140      0.98  VQ       |         |         |         |
   1+35       0.1208      0.98  VQ       |         |         |         |
   1+40       0.1275      0.98  VQ       |         |         |         |
   1+45       0.1342      0.98  VQ       |         |         |         |
   1+50       0.1415      1.05  V Q      |         |         |         |
   1+55       0.1500      1.24  V Q      |         |         |         |
   2+ 0       0.1588      1.28  V Q      |         |         |         |
   2+ 5       0.1678      1.30  V Q      |         |         |         |
   2+10       0.1767      1.30  |VQ      |         |         |         |
   2+15       0.1857      1.30  |VQ      |         |         |         |
   2+20       0.1947      1.30  |VQ      |         |         |         |
```

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2+25       0.2036      1.30  |VQ       |         |         |         |
2+30       0.2126      1.30  |VQ       |         |         |         |
2+35       0.2221      1.38  |VQ       |         |         |         |
2+40       0.2329      1.56  |V Q      |         |         |         |
2+45       0.2439      1.61  |V Q      |         |         |         |
2+50       0.2551      1.62  |V Q      |         |         |         |
2+55       0.2663      1.63  |V Q      |         |         |         |
3+ 0       0.2775      1.63  |V Q      |         |         |         |
3+ 5       0.2887      1.63  |V Q      |         |         |         |
3+10       0.3000      1.63  |V Q      |         |         |         |
3+15       0.3112      1.63  |V Q      |         |         |         |
3+20       0.3224      1.63  |V Q      |         |         |         |
3+25       0.3336      1.63  |V Q      |         |         |         |
3+30       0.3448      1.63  |V Q      |         |         |         |
3+35       0.3560      1.63  | VQ      |         |         |         |
3+40       0.3672      1.63  | VQ      |         |         |         |
3+45       0.3784      1.63  | VQ      |         |         |         |
3+50       0.3902      1.71  | VQ      |         |         |         |
3+55       0.4032      1.89  | VQ      |         |         |         |
4+ 0       0.4165      1.93  | VQ      |         |         |         |
4+ 5       0.4299      1.95  | VQ      |         |         |         |
4+10       0.4434      1.95  | VQ      |         |         |         |
4+15       0.4568      1.95  | VQ      |         |         |         |
4+20       0.4708      2.03  | V Q     |         |         |         |
4+25       0.4861      2.21  | V Q     |         |         |         |
4+30       0.5016      2.26  | V Q     |         |         |         |
4+35       0.5173      2.27  | V Q     |         |         |         |
4+40       0.5330      2.28  |  VQ     |         |         |         |
4+45       0.5487      2.28  |  VQ     |         |         |         |
4+50       0.5649      2.36  |  VQ     |         |         |         |
4+55       0.5824      2.54  |  V Q    |         |         |         |
5+ 0       0.6002      2.59  |  V Q    |         |         |         |
5+ 5       0.6170      2.45  |  VQ     |         |         |         |
5+10       0.6314      2.09  |  VQ     |         |         |         |
5+15       0.6451      1.99  |  Q      |         |         |         |
5+20       0.6592      2.04  |  VQ     |         |         |         |
5+25       0.6744      2.22  |  VQ     |         |         |         |
5+30       0.6900      2.26  |  VQ     |         |         |         |
5+35       0.7062      2.35  |   Q     |         |         |         |
5+40       0.7237      2.54  |   VQ    |         |         |         |
5+45       0.7415      2.59  |   VQ    |         |         |         |
5+50       0.7594      2.60  |   VQ    |         |         |         |
5+55       0.7773      2.60  |   VQ    |         |         |         |
6+ 0       0.7952      2.60  |   VQ    |         |         |         |
6+ 5       0.8137      2.68  |   VQ    |         |         |         |
6+10       0.8334      2.86  |   VQ    |         |         |         |
6+15       0.8535      2.91  |   VQ    |         |         |         |
6+20       0.8736      2.93  |    Q    |         |         |         |
6+25       0.8938      2.93  |    Q    |         |         |         |
6+30       0.9140      2.93  |    Q    |         |         |         |
6+35       0.9347      3.01  |    VQ   |         |         |         |
6+40       0.9567      3.19  |    VQ   |         |         |         |
6+45       0.9790      3.24  |    VQ   |         |         |         |
6+50       1.0013      3.25  |    VQ   |         |         |         |
6+55       1.0238      3.25  |    VQ   |         |         |         |
7+ 0       1.0462      3.26  |    VQ   |         |         |         |
7+ 5       1.0686      3.26  |     Q   |         |         |         |
7+10       1.0910      3.26  |     Q   |         |         |         |
7+15       1.1135      3.26  |     Q   |         |         |         |
7+20       1.1364      3.33  |     Q   |         |         |         |
7+25       1.1606      3.52  |     VQ  |         |         |         |
7+30       1.1852      3.56  |     VQ  |         |         |         |
7+35       1.2103      3.65  |     VQ  |         |         |         |
7+40       1.2368      3.84  |      Q  |         |         |         |
7+45       1.2635      3.89  |      Q  |         |         |         |
7+50       1.2909      3.98  |      Q  |         |         |         |
7+55       1.3196      4.16  |      VQ |         |         |         |
8+ 0       1.3486      4.21  |      VQ |         |         |         |
8+ 5       1.3788      4.38  |      VQ |         |         |         |
8+10       1.4115      4.75  |       VQ|         |         |         |
8+15       1.4449      4.85  |       VQ|         |         |         |
8+20       1.4785      4.87  |       VQ|         |         |         |
8+25       1.5121      4.88  |       VQ|         |         |         |
8+30       1.5457      4.88  |       VQ|         |         |         |
8+35       1.5799      4.96  |        Q|         |         |         |
```

| | | | | | | |
|---|---|---|---|---|---|---|
| 8+40 | 1.6153 | 5.14 | \| VQ \| \| \| |
| 8+45 | 1.6511 | 5.19 | \| VQ \| \| \| |
| 8+50 | 1.6874 | 5.28 | \| VQ \| \| \| |
| 8+55 | 1.7251 | 5.47 | \| VQ \| \| \| |
| 9+ 0 | 1.7631 | 5.52 | \| VQ \| \| \| |
| 9+ 5 | 1.8022 | 5.68 | \| VQ \| \| \| |
| 9+10 | 1.8439 | 6.05 | \| V Q \| \| \| |
| 9+15 | 1.8863 | 6.15 | \| V Q \| \| \| |
| 9+20 | 1.9293 | 6.25 | \| VQ \| \| \| |
| 9+25 | 1.9737 | 6.44 | \| VQ \| \| \| |
| 9+30 | 2.0184 | 6.49 | \| VQ \| \| \| |
| 9+35 | 2.0638 | 6.58 | \| V Q \| \| \| |
| 9+40 | 2.1104 | 6.77 | \| VQ \| \| \| |
| 9+45 | 2.1573 | 6.82 | \| VQ \| \| \| |
| 9+50 | 2.2049 | 6.91 | \| VQ \| \| \| |
| 9+55 | 2.2538 | 7.10 | \| V Q \| \| \| |
| 10+ 0 | 2.3030 | 7.14 | \| VQ \| \| \| |
| 10+ 5 | 2.3486 | 6.62 | \| Q \| \| \| |
| 10+10 | 2.3854 | 5.35 | \| Q V \| \| \| |
| 10+15 | 2.4200 | 5.02 | \| Q V \| \| \| |
| 10+20 | 2.4539 | 4.92 | \| Q \| V \| \| \| |
| 10+25 | 2.4876 | 4.90 | \| Q \| V \| \| \| |
| 10+30 | 2.5212 | 4.88 | \| Q \| V \| \| \| |
| 10+35 | 2.5575 | 5.27 | \| Q V \| \| \| |
| 10+40 | 2.6001 | 6.18 | \| Q V \| \| \| |
| 10+45 | 2.6443 | 6.42 | \| Q V \| \| \| |
| 10+50 | 2.6889 | 6.49 | \| Q V \| \| \| |
| 10+55 | 2.7337 | 6.50 | \| Q V \| \| \| |
| 11+ 0 | 2.7786 | 6.51 | \| Q V \| \| \| |
| 11+ 5 | 2.8229 | 6.44 | \| Q V \| \| \| |
| 11+10 | 2.8660 | 6.25 | \| Q V \| \| \| |
| 11+15 | 2.9087 | 6.21 | \| Q V \| \| \| |
| 11+20 | 2.9513 | 6.19 | \| Q V \| \| \| |
| 11+25 | 2.9940 | 6.19 | \| Q V \| \| \| |
| 11+30 | 3.0366 | 6.19 | \| Q V \| \| \| |
| 11+35 | 3.0781 | 6.03 | \| Q V \| \| \| |
| 11+40 | 3.1172 | 5.67 | \| Q V \| \| \| |
| 11+45 | 3.1555 | 5.57 | \| Q V \| \| \| |
| 11+50 | 3.1943 | 5.62 | \| Q V \| \| \| |
| 11+55 | 3.2342 | 5.80 | \| Q V \| \| \| |
| 12+ 0 | 3.2744 | 5.84 | \| Q V \| \| \| |
| 12+ 5 | 3.3189 | 6.45 | \| Q V \| \| \| |
| 12+10 | 3.3730 | 7.86 | \| Q V \| \| \| |
| 12+15 | 3.4297 | 8.24 | \| Q V \| \| \| |
| 12+20 | 3.4882 | 8.48 | \| Q V \| \| \| |
| 12+25 | 3.5488 | 8.81 | \| Q V \| \| \| |
| 12+30 | 3.6102 | 8.91 | \| Q V \| \| \| |
| 12+35 | 3.6734 | 9.18 | \| Q \| V \| \| \| |
| 12+40 | 3.7406 | 9.76 | \| Q \| V \| \| \| |
| 12+45 | 3.8090 | 9.93 | \| Q \| V \| \| \| |
| 12+50 | 3.8786 | 10.10 | \| Q V \| \| \| |
| 12+55 | 3.9503 | 10.41 | \| Q V \| \| \| |
| 13+ 0 | 4.0227 | 10.51 | \| \| Q V \| \| \| |
| 13+ 5 | 4.0993 | 11.13 | \| \| QV \| \| \| |
| 13+10 | 4.1856 | 12.53 | \| \| V Q \| \| \| |
| 13+15 | 4.2746 | 12.91 | \| \| VQ \| \| \| |
| 13+20 | 4.3644 | 13.04 | \| \| V Q \| \| \| |
| 13+25 | 4.4545 | 13.08 | \| \| VQ \| \| \| |
| 13+30 | 4.5448 | 13.12 | \| \| Q \| \| \| |
| 13+35 | 4.6264 | 11.85 | \| \| Q V \| \| \| |
| 13+40 | 4.6873 | 8.84 | \| \| Q \| V \| \| \| |
| 13+45 | 4.7428 | 8.06 | \| \| Q \| V \| \| \| |
| 13+50 | 4.7969 | 7.85 | \| \| Q \| V \| \| \| |
| 13+55 | 4.8507 | 7.81 | \| \| Q \| V \| \| \| |
| 14+ 0 | 4.9044 | 7.80 | \| \| Q \| V \| \| \| |
| 14+ 5 | 4.9614 | 8.29 | \| \| Q \| V \| \| \| |
| 14+10 | 5.0262 | 9.40 | \| \| Q \| V \| \| \| |
| 14+15 | 5.0931 | 9.71 | \| \| Q \| V \| \| \| |
| 14+20 | 5.1599 | 9.70 | \| \| Q \| V \| \| \| |
| 14+25 | 5.2250 | 9.46 | \| \| Q \| V \| \| \| |
| 14+30 | 5.2899 | 9.42 | \| \| Q \| V \| \| \| |
| 14+35 | 5.3547 | 9.41 | \| \| Q \| V \| \| \| |
| 14+40 | 5.4196 | 9.42 | \| \| Q \| V \| \| \| |
| 14+45 | 5.4846 | 9.44 | \| \| Q \| V \| \| \| |
| 14+50 | 5.5489 | 9.34 | \| \| Q \| V \| \| \| |

```
14+55       5.6115      9.08  |          |        Q |          | V        |
15+ 0       5.6736      9.03  |          |        Q |          | V        |
15+ 5       5.7350      8.91  |          |       Q  |          | V        |
15+10       5.7945      8.64  |          |       Q  |          |  V       |
15+15       5.8536      8.58  |          |       Q  |          |  V       |
15+20       5.9119      8.46  |          |      Q   |          |  V       |
15+25       5.9684      8.20  |          |      Q   |          |   V      |
15+30       6.0244      8.14  |          |      Q   |          |   V      |
15+35       6.0773      7.67  |          |     Q    |          |   V      |
15+40       6.1226      6.59  |          |   Q      |          |    V     |
15+45       6.1661      6.31  |          | Q        |          |    V     |
15+50       6.2090      6.24  |          | Q        |          |    V     |
15+55       6.2519      6.23  |          | Q        |          |    V     |
16+ 0       6.2949      6.24  |          | Q        |          |     V    |
16+ 5       6.3299      5.08  |         Q|          |          |     V    |
16+10       6.3458      2.32  |    Q     |          |          |     V    |
16+15       6.3568      1.59  |  Q       |          |          |     V    |
16+20       6.3663      1.38  | Q        |          |          |     V    |
16+25       6.3755      1.33  | Q        |          |          |     V    |
16+30       6.3844      1.30  | Q        |          |          |     V    |
16+35       6.3929      1.23  | Q        |          |          |     V    |
16+40       6.4000      1.04  | Q        |          |          |     V    |
16+45       6.4069      1.00  |Q         |          |          |     V    |
16+50       6.4137      0.98  |Q         |          |          |     V    |
16+55       6.4204      0.98  |Q         |          |          |     V    |
17+ 0       6.4271      0.98  |Q         |          |          |     V    |
17+ 5       6.4349      1.13  | Q        |          |          |     V    |
17+10       6.4452      1.49  | Q        |          |          |     V    |
17+15       6.4562      1.59  |  Q       |          |          |     V    |
17+20       6.4673      1.62  |  Q       |          |          |      V   |
17+25       6.4785      1.62  |  Q       |          |          |      V   |
17+30       6.4897      1.63  |  Q       |          |          |      V   |
17+35       6.5009      1.63  |  Q       |          |          |      V   |
17+40       6.5121      1.63  |  Q       |          |          |      V   |
17+45       6.5234      1.63  |  Q       |          |          |      V   |
17+50       6.5340      1.55  |  Q       |          |          |      V   |
17+55       6.5435      1.37  | Q        |          |          |      V   |
18+ 0       6.5526      1.32  | Q        |          |          |      V   |
18+ 5       6.5616      1.31  | Q        |          |          |      V   |
18+10       6.5706      1.30  | Q        |          |          |      V   |
18+15       6.5795      1.30  | Q        |          |          |      V   |
18+20       6.5885      1.30  | Q        |          |          |      V   |
18+25       6.5975      1.30  | Q        |          |          |      V   |
18+30       6.6064      1.30  | Q        |          |          |      V   |
18+35       6.6149      1.23  | Q        |          |          |      V   |
18+40       6.6221      1.04  | Q        |          |          |      V   |
18+45       6.6289      1.00  |Q         |          |          |      V   |
18+50       6.6351      0.90  |Q         |          |          |      V   |
18+55       6.6401      0.72  |Q         |          |          |       V  |
19+ 0       6.6447      0.67  |Q         |          |          |       V  |
19+ 5       6.6498      0.73  |Q         |          |          |       V  |
19+10       6.6561      0.91  |Q         |          |          |       V  |
19+15       6.6627      0.96  |Q         |          |          |       V  |
19+20       6.6699      1.05  | Q        |          |          |       V  |
19+25       6.6784      1.23  | Q        |          |          |       V  |
19+30       6.6872      1.28  | Q        |          |          |       V  |
19+35       6.6956      1.22  | Q        |          |          |       V  |
19+40       6.7028      1.04  | Q        |          |          |       V  |
19+45       6.7096      1.00  |Q         |          |          |       V  |
19+50       6.7159      0.90  |Q         |          |          |       V  |
19+55       6.7208      0.72  |Q         |          |          |       V  |
20+ 0       6.7255      0.67  |Q         |          |          |       V  |
20+ 5       6.7305      0.73  |Q         |          |          |       V  |
20+10       6.7368      0.91  |Q         |          |          |       V  |
20+15       6.7434      0.96  |Q         |          |          |       V  |
20+20       6.7501      0.97  |Q         |          |          |       V  |
20+25       6.7568      0.98  |Q         |          |          |       V  |
20+30       6.7635      0.98  |Q         |          |          |       V  |
20+35       6.7702      0.98  |Q         |          |          |       V  |
20+40       6.7770      0.98  |Q         |          |          |       V  |
20+45       6.7837      0.98  |Q         |          |          |       V  |
20+50       6.7899      0.90  |Q         |          |          |       V  |
20+55       6.7948      0.72  |Q         |          |          |       V  |
21+ 0       6.7995      0.67  |Q         |          |          |       V  |
21+ 5       6.8045      0.73  |Q         |          |          |       V  |
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  21+10       6.8108      0.91  |Q        |         |         |       V |
  21+15       6.8174      0.96  |Q        |         |         |        V|
  21+20       6.8235      0.89  |Q        |         |         |        V|
  21+25       6.8285      0.72  |Q        |         |         |        V|
  21+30       6.8331      0.67  |Q        |         |         |        V|
  21+35       6.8381      0.73  |Q        |         |         |        V|
  21+40       6.8444      0.91  |Q        |         |         |        V|
  21+45       6.8510      0.96  |Q        |         |         |        V|
  21+50       6.8572      0.89  |Q        |         |         |        V|
  21+55       6.8621      0.72  |Q        |         |         |        V|
  22+ 0       6.8667      0.67  |Q        |         |         |        V|
  22+ 5       6.8718      0.73  |Q        |         |         |        V|
  22+10       6.8781      0.91  |Q        |         |         |        V|
  22+15       6.8847      0.96  |Q        |         |         |        V|
  22+20       6.8908      0.89  |Q        |         |         |        V|
  22+25       6.8958      0.72  |Q        |         |         |        V|
  22+30       6.9004      0.67  |Q        |         |         |        V|
  22+35       6.9049      0.66  |Q        |         |         |        V|
  22+40       6.9094      0.65  |Q        |         |         |        V|
  22+45       6.9139      0.65  |Q        |         |         |        V|
  22+50       6.9184      0.65  |Q        |         |         |        V|
  22+55       6.9228      0.65  |Q        |         |         |        V|
  23+ 0       6.9273      0.65  |Q        |         |         |        V|
  23+ 5       6.9318      0.65  |Q        |         |         |        V|
  23+10       6.9363      0.65  |Q        |         |         |        V|
  23+15       6.9408      0.65  |Q        |         |         |        V|
  23+20       6.9453      0.65  |Q        |         |         |        V|
  23+25       6.9498      0.65  |Q        |         |         |        V|
  23+30       6.9542      0.65  |Q        |         |         |        V|
  23+35       6.9587      0.65  |Q        |         |         |        V|
  23+40       6.9632      0.65  |Q        |         |         |        V|
  23+45       6.9677      0.65  |Q        |         |         |        V|
  23+50       6.9722      0.65  |Q        |         |         |        V|
  23+55       6.9767      0.65  |Q        |         |         |        V|
  24+ 0       6.9811      0.65  |Q        |         |         |        V|
  24+ 5       6.9846      0.50  Q        |         |         |        V|
  24+10       6.9855      0.13  Q        |         |         |        V|
  24+15       6.9858      0.04  Q        |         |         |        V|
  24+20       6.9858      0.01  Q        |         |         |        V|
  24+25       6.9859      0.00  Q        |         |         |        V|
-------------------------------------------------------------------------
```

# Drainage Area B – 8.4 Acres

U n i t  H y d r o g r a p h  A n a l y s i s

Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2008, Version 8.1
Study date 01/29/18 File: nrareabex2242.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 4029

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English (in-lb) Input Units Used
English Rainfall Data (Inches) Input Values Used

English Units used in output format

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Tract 37305 - Nichols Road Development
Drainage Area B - 8.4 Ac
Existing Condition (for HCOC comparison)
2-year 24-hour storm

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Drainage Area = 8.40(Ac.) = 0.013 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 8.40(Ac.) = 0.013 Sq. Mi.
Length along longest watercourse = 1015.00(Ft.)
Length along longest watercourse measured to centroid = 444.00(Ft.)
Length along longest watercourse = 0.192 Mi.
Length along longest watercourse measured to centroid = 0.084 Mi.
Difference in elevation = 34.00(Ft.)
Slope along watercourse = 176.8670 Ft./Mi.
Average Manning's 'N' = 0.035
Lag time = 0.066 Hr.
Lag time = 3.93 Min.
25% of lag time = 0.98 Min.
40% of lag time = 1.57 Min.
Unit time = 5.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

| Area(Ac.)[1] | Rainfall(In)[2] | Weighting[1*2] |
|---|---|---|
| 8.40 | 2.38 | 19.99 |

100 YEAR Area rainfall data:

| Area(Ac.)[1] | Rainfall(In)[2] | Weighting[1*2] |
|---|---|---|
| 8.40 | 6.35 | 53.34 |

STORM EVENT (YEAR) = 2.00
Area Averaged 2-Year Rainfall = 2.380(In)
Area Averaged 100-Year Rainfall = 6.350(In)

Point rain (area averaged) = 2.380(In)
Areal adjustment factor = 100.00 %
Adjusted average point rain = 2.380(In)

Sub-Area Data:

| Area(Ac.) | Runoff Index | Impervious % |
|---|---|---|
| 8.400 | 86.00 | 0.050 |

Total Area Entered = 8.40(Ac.)

| RI | RI | Infil. Rate | Impervious | Adj. Infil. Rate | Area% | F |
|---|---|---|---|---|---|---|

| AMC2 | AMC-2 | (In/Hr) | (Dec.%) | (In/Hr) | (Dec.) | (In/Hr) |
|---|---|---|---|---|---|---|
| 86.0 | 86.0 | 0.176 | 0.050 | 0.168 | 1.000 | 0.168 |
| | | | | | Sum (F) = | 0.168 |

Area averaged mean soil loss (F) (In/Hr) = 0.168
Minimum soil loss rate ((In/Hr)) = 0.084
(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.900

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U n i t H y d r o g r a p h
FOOTHILL S-Curve

---

Unit Hydrograph Data

| Unit time period (hrs) | | Time % of lag | Distribution Graph % | | Unit Hydrograph (CFS) |
|---|---|---|---|---|---|
| 1 | 0.083 | 127.154 | 23.749 | | 2.010 |
| 2 | 0.167 | 254.309 | 55.783 | | 4.722 |
| 3 | 0.250 | 381.463 | 14.621 | | 1.238 |
| 4 | 0.333 | 508.618 | 4.238 | | 0.359 |
| 5 | 0.417 | 635.772 | 1.080 | | 0.091 |
| 6 | 0.500 | 762.927 | 0.529 | | 0.045 |
| | | | Sum = 100.000 | Sum= | 8.466 |

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The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

| Unit Time (Hr.) | Pattern Percent | Storm Rain (In/Hr) | Loss rate(In./Hr) Max | Low | Effective (In/Hr) |
|---|---|---|---|---|---|
| 1 | 0.08 | 0.07 | 0.019 | ( 0.297) | 0.017 | 0.002 |
| 2 | 0.17 | 0.07 | 0.019 | ( 0.296) | 0.017 | 0.002 |
| 3 | 0.25 | 0.07 | 0.019 | ( 0.295) | 0.017 | 0.002 |
| 4 | 0.33 | 0.10 | 0.029 | ( 0.294) | 0.026 | 0.003 |
| 5 | 0.42 | 0.10 | 0.029 | ( 0.293) | 0.026 | 0.003 |
| 6 | 0.50 | 0.10 | 0.029 | ( 0.292) | 0.026 | 0.003 |
| 7 | 0.58 | 0.10 | 0.029 | ( 0.290) | 0.026 | 0.003 |
| 8 | 0.67 | 0.10 | 0.029 | ( 0.289) | 0.026 | 0.003 |
| 9 | 0.75 | 0.10 | 0.029 | ( 0.288) | 0.026 | 0.003 |
| 10 | 0.83 | 0.13 | 0.038 | ( 0.287) | 0.034 | 0.004 |
| 11 | 0.92 | 0.13 | 0.038 | ( 0.286) | 0.034 | 0.004 |
| 12 | 1.00 | 0.13 | 0.038 | ( 0.285) | 0.034 | 0.004 |
| 13 | 1.08 | 0.10 | 0.029 | ( 0.284) | 0.026 | 0.003 |
| 14 | 1.17 | 0.10 | 0.029 | ( 0.283) | 0.026 | 0.003 |
| 15 | 1.25 | 0.10 | 0.029 | ( 0.281) | 0.026 | 0.003 |
| 16 | 1.33 | 0.10 | 0.029 | ( 0.280) | 0.026 | 0.003 |
| 17 | 1.42 | 0.10 | 0.029 | ( 0.279) | 0.026 | 0.003 |
| 18 | 1.50 | 0.10 | 0.029 | ( 0.278) | 0.026 | 0.003 |
| 19 | 1.58 | 0.10 | 0.029 | ( 0.277) | 0.026 | 0.003 |
| 20 | 1.67 | 0.10 | 0.029 | ( 0.276) | 0.026 | 0.003 |
| 21 | 1.75 | 0.10 | 0.029 | ( 0.275) | 0.026 | 0.003 |
| 22 | 1.83 | 0.13 | 0.038 | ( 0.274) | 0.034 | 0.004 |
| 23 | 1.92 | 0.13 | 0.038 | ( 0.273) | 0.034 | 0.004 |
| 24 | 2.00 | 0.13 | 0.038 | ( 0.271) | 0.034 | 0.004 |
| 25 | 2.08 | 0.13 | 0.038 | ( 0.270) | 0.034 | 0.004 |
| 26 | 2.17 | 0.13 | 0.038 | ( 0.269) | 0.034 | 0.004 |
| 27 | 2.25 | 0.13 | 0.038 | ( 0.268) | 0.034 | 0.004 |
| 28 | 2.33 | 0.13 | 0.038 | ( 0.267) | 0.034 | 0.004 |
| 29 | 2.42 | 0.13 | 0.038 | ( 0.266) | 0.034 | 0.004 |
| 30 | 2.50 | 0.13 | 0.038 | ( 0.265) | 0.034 | 0.004 |
| 31 | 2.58 | 0.17 | 0.048 | ( 0.264) | 0.043 | 0.005 |
| 32 | 2.67 | 0.17 | 0.048 | ( 0.263) | 0.043 | 0.005 |
| 33 | 2.75 | 0.17 | 0.048 | ( 0.262) | 0.043 | 0.005 |
| 34 | 2.83 | 0.17 | 0.048 | ( 0.261) | 0.043 | 0.005 |
| 35 | 2.92 | 0.17 | 0.048 | ( 0.259) | 0.043 | 0.005 |
| 36 | 3.00 | 0.17 | 0.048 | ( 0.258) | 0.043 | 0.005 |
| 37 | 3.08 | 0.17 | 0.048 | ( 0.257) | 0.043 | 0.005 |
| 38 | 3.17 | 0.17 | 0.048 | ( 0.256) | 0.043 | 0.005 |
| 39 | 3.25 | 0.17 | 0.048 | ( 0.255) | 0.043 | 0.005 |
| 40 | 3.33 | 0.17 | 0.048 | ( 0.254) | 0.043 | 0.005 |
| 41 | 3.42 | 0.17 | 0.048 | ( 0.253) | 0.043 | 0.005 |
| 42 | 3.50 | 0.17 | 0.048 | ( 0.252) | 0.043 | 0.005 |
| 43 | 3.58 | 0.17 | 0.048 | ( 0.251) | 0.043 | 0.005 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 44 | 3.67 | 0.17 | 0.048 | ( 0.250) | 0.043 | 0.005 |
| 45 | 3.75 | 0.17 | 0.048 | ( 0.249) | 0.043 | 0.005 |
| 46 | 3.83 | 0.20 | 0.057 | ( 0.248) | 0.051 | 0.006 |
| 47 | 3.92 | 0.20 | 0.057 | ( 0.247) | 0.051 | 0.006 |
| 48 | 4.00 | 0.20 | 0.057 | ( 0.246) | 0.051 | 0.006 |
| 49 | 4.08 | 0.20 | 0.057 | ( 0.245) | 0.051 | 0.006 |
| 50 | 4.17 | 0.20 | 0.057 | ( 0.244) | 0.051 | 0.006 |
| 51 | 4.25 | 0.20 | 0.057 | ( 0.243) | 0.051 | 0.006 |
| 52 | 4.33 | 0.23 | 0.067 | ( 0.242) | 0.060 | 0.007 |
| 53 | 4.42 | 0.23 | 0.067 | ( 0.241) | 0.060 | 0.007 |
| 54 | 4.50 | 0.23 | 0.067 | ( 0.239) | 0.060 | 0.007 |
| 55 | 4.58 | 0.23 | 0.067 | ( 0.238) | 0.060 | 0.007 |
| 56 | 4.67 | 0.23 | 0.067 | ( 0.237) | 0.060 | 0.007 |
| 57 | 4.75 | 0.23 | 0.067 | ( 0.236) | 0.060 | 0.007 |
| 58 | 4.83 | 0.27 | 0.076 | ( 0.235) | 0.069 | 0.008 |
| 59 | 4.92 | 0.27 | 0.076 | ( 0.234) | 0.069 | 0.008 |
| 60 | 5.00 | 0.27 | 0.076 | ( 0.233) | 0.069 | 0.008 |
| 61 | 5.08 | 0.20 | 0.057 | ( 0.232) | 0.051 | 0.006 |
| 62 | 5.17 | 0.20 | 0.057 | ( 0.231) | 0.051 | 0.006 |
| 63 | 5.25 | 0.20 | 0.057 | ( 0.230) | 0.051 | 0.006 |
| 64 | 5.33 | 0.23 | 0.067 | ( 0.229) | 0.060 | 0.007 |
| 65 | 5.42 | 0.23 | 0.067 | ( 0.228) | 0.060 | 0.007 |
| 66 | 5.50 | 0.23 | 0.067 | ( 0.227) | 0.060 | 0.007 |
| 67 | 5.58 | 0.27 | 0.076 | ( 0.226) | 0.069 | 0.008 |
| 68 | 5.67 | 0.27 | 0.076 | ( 0.225) | 0.069 | 0.008 |
| 69 | 5.75 | 0.27 | 0.076 | ( 0.224) | 0.069 | 0.008 |
| 70 | 5.83 | 0.27 | 0.076 | ( 0.223) | 0.069 | 0.008 |
| 71 | 5.92 | 0.27 | 0.076 | ( 0.222) | 0.069 | 0.008 |
| 72 | 6.00 | 0.27 | 0.076 | ( 0.221) | 0.069 | 0.008 |
| 73 | 6.08 | 0.30 | 0.086 | ( 0.220) | 0.077 | 0.009 |
| 74 | 6.17 | 0.30 | 0.086 | ( 0.219) | 0.077 | 0.009 |
| 75 | 6.25 | 0.30 | 0.086 | ( 0.218) | 0.077 | 0.009 |
| 76 | 6.33 | 0.30 | 0.086 | ( 0.217) | 0.077 | 0.009 |
| 77 | 6.42 | 0.30 | 0.086 | ( 0.216) | 0.077 | 0.009 |
| 78 | 6.50 | 0.30 | 0.086 | ( 0.215) | 0.077 | 0.009 |
| 79 | 6.58 | 0.33 | 0.095 | ( 0.215) | 0.086 | 0.010 |
| 80 | 6.67 | 0.33 | 0.095 | ( 0.214) | 0.086 | 0.010 |
| 81 | 6.75 | 0.33 | 0.095 | ( 0.213) | 0.086 | 0.010 |
| 82 | 6.83 | 0.33 | 0.095 | ( 0.212) | 0.086 | 0.010 |
| 83 | 6.92 | 0.33 | 0.095 | ( 0.211) | 0.086 | 0.010 |
| 84 | 7.00 | 0.33 | 0.095 | ( 0.210) | 0.086 | 0.010 |
| 85 | 7.08 | 0.33 | 0.095 | ( 0.209) | 0.086 | 0.010 |
| 86 | 7.17 | 0.33 | 0.095 | ( 0.208) | 0.086 | 0.010 |
| 87 | 7.25 | 0.33 | 0.095 | ( 0.207) | 0.086 | 0.010 |
| 88 | 7.33 | 0.37 | 0.105 | ( 0.206) | 0.094 | 0.010 |
| 89 | 7.42 | 0.37 | 0.105 | ( 0.205) | 0.094 | 0.010 |
| 90 | 7.50 | 0.37 | 0.105 | ( 0.204) | 0.094 | 0.010 |
| 91 | 7.58 | 0.40 | 0.114 | ( 0.203) | 0.103 | 0.011 |
| 92 | 7.67 | 0.40 | 0.114 | ( 0.202) | 0.103 | 0.011 |
| 93 | 7.75 | 0.40 | 0.114 | ( 0.201) | 0.103 | 0.011 |
| 94 | 7.83 | 0.43 | 0.124 | ( 0.200) | 0.111 | 0.012 |
| 95 | 7.92 | 0.43 | 0.124 | ( 0.199) | 0.111 | 0.012 |
| 96 | 8.00 | 0.43 | 0.124 | ( 0.198) | 0.111 | 0.012 |
| 97 | 8.08 | 0.50 | 0.143 | ( 0.198) | 0.129 | 0.014 |
| 98 | 8.17 | 0.50 | 0.143 | ( 0.197) | 0.129 | 0.014 |
| 99 | 8.25 | 0.50 | 0.143 | ( 0.196) | 0.129 | 0.014 |
| 100 | 8.33 | 0.50 | 0.143 | ( 0.195) | 0.129 | 0.014 |
| 101 | 8.42 | 0.50 | 0.143 | ( 0.194) | 0.129 | 0.014 |
| 102 | 8.50 | 0.50 | 0.143 | ( 0.193) | 0.129 | 0.014 |
| 103 | 8.58 | 0.53 | 0.152 | ( 0.192) | 0.137 | 0.015 |
| 104 | 8.67 | 0.53 | 0.152 | ( 0.191) | 0.137 | 0.015 |
| 105 | 8.75 | 0.53 | 0.152 | ( 0.190) | 0.137 | 0.015 |
| 106 | 8.83 | 0.57 | 0.162 | ( 0.189) | 0.146 | 0.016 |
| 107 | 8.92 | 0.57 | 0.162 | ( 0.188) | 0.146 | 0.016 |
| 108 | 9.00 | 0.57 | 0.162 | ( 0.188) | 0.146 | 0.016 |
| 109 | 9.08 | 0.63 | 0.181 | ( 0.187) | 0.163 | 0.018 |
| 110 | 9.17 | 0.63 | 0.181 | ( 0.186) | 0.163 | 0.018 |
| 111 | 9.25 | 0.63 | 0.181 | ( 0.185) | 0.163 | 0.018 |
| 112 | 9.33 | 0.67 | 0.190 | ( 0.184) | 0.171 | 0.019 |
| 113 | 9.42 | 0.67 | 0.190 | ( 0.183) | 0.171 | 0.019 |
| 114 | 9.50 | 0.67 | 0.190 | ( 0.182) | 0.171 | 0.019 |
| 115 | 9.58 | 0.70 | 0.200 | ( 0.181) | 0.180 | 0.020 |
| 116 | 9.67 | 0.70 | 0.200 | ( 0.181) | 0.180 | 0.020 |
| 117 | 9.75 | 0.70 | 0.200 | 0.180 | ( 0.180) | 0.020 |
| 118 | 9.83 | 0.73 | 0.209 | 0.179 | ( 0.188) | 0.031 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 119 | 9.92 | 0.73 | 0.209 | | 0.178 | ( | 0.188) | 0.031 |
| 120 | 10.00 | 0.73 | 0.209 | | 0.177 | ( | 0.188) | 0.032 |
| 121 | 10.08 | 0.50 | 0.143 | ( | 0.176) | | 0.129 | 0.014 |
| 122 | 10.17 | 0.50 | 0.143 | ( | 0.175) | | 0.129 | 0.014 |
| 123 | 10.25 | 0.50 | 0.143 | ( | 0.175) | | 0.129 | 0.014 |
| 124 | 10.33 | 0.50 | 0.143 | ( | 0.174) | | 0.129 | 0.014 |
| 125 | 10.42 | 0.50 | 0.143 | ( | 0.173) | | 0.129 | 0.014 |
| 126 | 10.50 | 0.50 | 0.143 | ( | 0.172) | | 0.129 | 0.014 |
| 127 | 10.58 | 0.67 | 0.190 | | 0.171 | ( | 0.171) | 0.019 |
| 128 | 10.67 | 0.67 | 0.190 | | 0.170 | ( | 0.171) | 0.020 |
| 129 | 10.75 | 0.67 | 0.190 | | 0.169 | ( | 0.171) | 0.021 |
| 130 | 10.83 | 0.67 | 0.190 | | 0.169 | ( | 0.171) | 0.022 |
| 131 | 10.92 | 0.67 | 0.190 | | 0.168 | ( | 0.171) | 0.023 |
| 132 | 11.00 | 0.67 | 0.190 | | 0.167 | ( | 0.171) | 0.023 |
| 133 | 11.08 | 0.63 | 0.181 | ( | 0.166) | | 0.163 | 0.018 |
| 134 | 11.17 | 0.63 | 0.181 | ( | 0.165) | | 0.163 | 0.018 |
| 135 | 11.25 | 0.63 | 0.181 | ( | 0.165) | | 0.163 | 0.018 |
| 136 | 11.33 | 0.63 | 0.181 | ( | 0.164) | | 0.163 | 0.018 |
| 137 | 11.42 | 0.63 | 0.181 | ( | 0.163) | | 0.163 | 0.018 |
| 138 | 11.50 | 0.63 | 0.181 | | 0.162 | ( | 0.163) | 0.019 |
| 139 | 11.58 | 0.57 | 0.162 | ( | 0.161) | | 0.146 | 0.016 |
| 140 | 11.67 | 0.57 | 0.162 | ( | 0.161) | | 0.146 | 0.016 |
| 141 | 11.75 | 0.57 | 0.162 | ( | 0.160) | | 0.146 | 0.016 |
| 142 | 11.83 | 0.60 | 0.171 | ( | 0.159) | | 0.154 | 0.017 |
| 143 | 11.92 | 0.60 | 0.171 | ( | 0.158) | | 0.154 | 0.017 |
| 144 | 12.00 | 0.60 | 0.171 | ( | 0.157) | | 0.154 | 0.017 |
| 145 | 12.08 | 0.83 | 0.238 | | 0.157 | ( | 0.214) | 0.081 |
| 146 | 12.17 | 0.83 | 0.238 | | 0.156 | ( | 0.214) | 0.082 |
| 147 | 12.25 | 0.83 | 0.238 | | 0.155 | ( | 0.214) | 0.083 |
| 148 | 12.33 | 0.87 | 0.248 | | 0.154 | ( | 0.223) | 0.093 |
| 149 | 12.42 | 0.87 | 0.248 | | 0.153 | ( | 0.223) | 0.094 |
| 150 | 12.50 | 0.87 | 0.248 | | 0.153 | ( | 0.223) | 0.095 |
| 151 | 12.58 | 0.93 | 0.267 | | 0.152 | ( | 0.240) | 0.115 |
| 152 | 12.67 | 0.93 | 0.267 | | 0.151 | ( | 0.240) | 0.115 |
| 153 | 12.75 | 0.93 | 0.267 | | 0.150 | ( | 0.240) | 0.116 |
| 154 | 12.83 | 0.97 | 0.276 | | 0.150 | ( | 0.248) | 0.126 |
| 155 | 12.92 | 0.97 | 0.276 | | 0.149 | ( | 0.248) | 0.127 |
| 156 | 13.00 | 0.97 | 0.276 | | 0.148 | ( | 0.248) | 0.128 |
| 157 | 13.08 | 1.13 | 0.324 | | 0.147 | ( | 0.291) | 0.176 |
| 158 | 13.17 | 1.13 | 0.324 | | 0.147 | ( | 0.291) | 0.177 |
| 159 | 13.25 | 1.13 | 0.324 | | 0.146 | ( | 0.291) | 0.178 |
| 160 | 13.33 | 1.13 | 0.324 | | 0.145 | ( | 0.291) | 0.179 |
| 161 | 13.42 | 1.13 | 0.324 | | 0.144 | ( | 0.291) | 0.179 |
| 162 | 13.50 | 1.13 | 0.324 | | 0.144 | ( | 0.291) | 0.180 |
| 163 | 13.58 | 0.77 | 0.219 | | 0.143 | ( | 0.197) | 0.076 |
| 164 | 13.67 | 0.77 | 0.219 | | 0.142 | ( | 0.197) | 0.077 |
| 165 | 13.75 | 0.77 | 0.219 | | 0.141 | ( | 0.197) | 0.078 |
| 166 | 13.83 | 0.77 | 0.219 | | 0.141 | ( | 0.197) | 0.078 |
| 167 | 13.92 | 0.77 | 0.219 | | 0.140 | ( | 0.197) | 0.079 |
| 168 | 14.00 | 0.77 | 0.219 | | 0.139 | ( | 0.197) | 0.080 |
| 169 | 14.08 | 0.90 | 0.257 | | 0.139 | ( | 0.231) | 0.118 |
| 170 | 14.17 | 0.90 | 0.257 | | 0.138 | ( | 0.231) | 0.119 |
| 171 | 14.25 | 0.90 | 0.257 | | 0.137 | ( | 0.231) | 0.120 |
| 172 | 14.33 | 0.87 | 0.248 | | 0.136 | ( | 0.223) | 0.111 |
| 173 | 14.42 | 0.87 | 0.248 | | 0.136 | ( | 0.223) | 0.112 |
| 174 | 14.50 | 0.87 | 0.248 | | 0.135 | ( | 0.223) | 0.112 |
| 175 | 14.58 | 0.87 | 0.248 | | 0.134 | ( | 0.223) | 0.113 |
| 176 | 14.67 | 0.87 | 0.248 | | 0.134 | ( | 0.223) | 0.114 |
| 177 | 14.75 | 0.87 | 0.248 | | 0.133 | ( | 0.223) | 0.115 |
| 178 | 14.83 | 0.83 | 0.238 | | 0.132 | ( | 0.214) | 0.106 |
| 179 | 14.92 | 0.83 | 0.238 | | 0.132 | ( | 0.214) | 0.106 |
| 180 | 15.00 | 0.83 | 0.238 | | 0.131 | ( | 0.214) | 0.107 |
| 181 | 15.08 | 0.80 | 0.228 | | 0.130 | ( | 0.206) | 0.098 |
| 182 | 15.17 | 0.80 | 0.228 | | 0.130 | ( | 0.206) | 0.099 |
| 183 | 15.25 | 0.80 | 0.228 | | 0.129 | ( | 0.206) | 0.100 |
| 184 | 15.33 | 0.77 | 0.219 | | 0.128 | ( | 0.197) | 0.091 |
| 185 | 15.42 | 0.77 | 0.219 | | 0.128 | ( | 0.197) | 0.091 |
| 186 | 15.50 | 0.77 | 0.219 | | 0.127 | ( | 0.197) | 0.092 |
| 187 | 15.58 | 0.63 | 0.181 | | 0.126 | ( | 0.163) | 0.055 |
| 188 | 15.67 | 0.63 | 0.181 | | 0.126 | ( | 0.163) | 0.055 |
| 189 | 15.75 | 0.63 | 0.181 | | 0.125 | ( | 0.163) | 0.056 |
| 190 | 15.83 | 0.63 | 0.181 | | 0.124 | ( | 0.163) | 0.056 |
| 191 | 15.92 | 0.63 | 0.181 | | 0.124 | ( | 0.163) | 0.057 |
| 192 | 16.00 | 0.63 | 0.181 | | 0.123 | ( | 0.163) | 0.058 |
| 193 | 16.08 | 0.13 | 0.038 | ( | 0.123) | | 0.034 | 0.004 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 194 | 16.17 | 0.13 | 0.038 | ( 0.122) | 0.034 | 0.004 |
| 195 | 16.25 | 0.13 | 0.038 | ( 0.121) | 0.034 | 0.004 |
| 196 | 16.33 | 0.13 | 0.038 | ( 0.121) | 0.034 | 0.004 |
| 197 | 16.42 | 0.13 | 0.038 | ( 0.120) | 0.034 | 0.004 |
| 198 | 16.50 | 0.13 | 0.038 | ( 0.119) | 0.034 | 0.004 |
| 199 | 16.58 | 0.10 | 0.029 | ( 0.119) | 0.026 | 0.003 |
| 200 | 16.67 | 0.10 | 0.029 | ( 0.118) | 0.026 | 0.003 |
| 201 | 16.75 | 0.10 | 0.029 | ( 0.118) | 0.026 | 0.003 |
| 202 | 16.83 | 0.10 | 0.029 | ( 0.117) | 0.026 | 0.003 |
| 203 | 16.92 | 0.10 | 0.029 | ( 0.116) | 0.026 | 0.003 |
| 204 | 17.00 | 0.10 | 0.029 | ( 0.116) | 0.026 | 0.003 |
| 205 | 17.08 | 0.17 | 0.048 | ( 0.115) | 0.043 | 0.005 |
| 206 | 17.17 | 0.17 | 0.048 | ( 0.115) | 0.043 | 0.005 |
| 207 | 17.25 | 0.17 | 0.048 | ( 0.114) | 0.043 | 0.005 |
| 208 | 17.33 | 0.17 | 0.048 | ( 0.114) | 0.043 | 0.005 |
| 209 | 17.42 | 0.17 | 0.048 | ( 0.113) | 0.043 | 0.005 |
| 210 | 17.50 | 0.17 | 0.048 | ( 0.112) | 0.043 | 0.005 |
| 211 | 17.58 | 0.17 | 0.048 | ( 0.112) | 0.043 | 0.005 |
| 212 | 17.67 | 0.17 | 0.048 | ( 0.111) | 0.043 | 0.005 |
| 213 | 17.75 | 0.17 | 0.048 | ( 0.111) | 0.043 | 0.005 |
| 214 | 17.83 | 0.13 | 0.038 | ( 0.110) | 0.034 | 0.004 |
| 215 | 17.92 | 0.13 | 0.038 | ( 0.110) | 0.034 | 0.004 |
| 216 | 18.00 | 0.13 | 0.038 | ( 0.109) | 0.034 | 0.004 |
| 217 | 18.08 | 0.13 | 0.038 | ( 0.109) | 0.034 | 0.004 |
| 218 | 18.17 | 0.13 | 0.038 | ( 0.108) | 0.034 | 0.004 |
| 219 | 18.25 | 0.13 | 0.038 | ( 0.107) | 0.034 | 0.004 |
| 220 | 18.33 | 0.13 | 0.038 | ( 0.107) | 0.034 | 0.004 |
| 221 | 18.42 | 0.13 | 0.038 | ( 0.106) | 0.034 | 0.004 |
| 222 | 18.50 | 0.13 | 0.038 | ( 0.106) | 0.034 | 0.004 |
| 223 | 18.58 | 0.10 | 0.029 | ( 0.105) | 0.026 | 0.003 |
| 224 | 18.67 | 0.10 | 0.029 | ( 0.105) | 0.026 | 0.003 |
| 225 | 18.75 | 0.10 | 0.029 | ( 0.104) | 0.026 | 0.003 |
| 226 | 18.83 | 0.07 | 0.019 | ( 0.104) | 0.017 | 0.002 |
| 227 | 18.92 | 0.07 | 0.019 | ( 0.103) | 0.017 | 0.002 |
| 228 | 19.00 | 0.07 | 0.019 | ( 0.103) | 0.017 | 0.002 |
| 229 | 19.08 | 0.10 | 0.029 | ( 0.102) | 0.026 | 0.003 |
| 230 | 19.17 | 0.10 | 0.029 | ( 0.102) | 0.026 | 0.003 |
| 231 | 19.25 | 0.10 | 0.029 | ( 0.101) | 0.026 | 0.003 |
| 232 | 19.33 | 0.13 | 0.038 | ( 0.101) | 0.034 | 0.004 |
| 233 | 19.42 | 0.13 | 0.038 | ( 0.101) | 0.034 | 0.004 |
| 234 | 19.50 | 0.13 | 0.038 | ( 0.100) | 0.034 | 0.004 |
| 235 | 19.58 | 0.10 | 0.029 | ( 0.100) | 0.026 | 0.003 |
| 236 | 19.67 | 0.10 | 0.029 | ( 0.099) | 0.026 | 0.003 |
| 237 | 19.75 | 0.10 | 0.029 | ( 0.099) | 0.026 | 0.003 |
| 238 | 19.83 | 0.07 | 0.019 | ( 0.098) | 0.017 | 0.002 |
| 239 | 19.92 | 0.07 | 0.019 | ( 0.098) | 0.017 | 0.002 |
| 240 | 20.00 | 0.07 | 0.019 | ( 0.097) | 0.017 | 0.002 |
| 241 | 20.08 | 0.10 | 0.029 | ( 0.097) | 0.026 | 0.003 |
| 242 | 20.17 | 0.10 | 0.029 | ( 0.097) | 0.026 | 0.003 |
| 243 | 20.25 | 0.10 | 0.029 | ( 0.096) | 0.026 | 0.003 |
| 244 | 20.33 | 0.10 | 0.029 | ( 0.096) | 0.026 | 0.003 |
| 245 | 20.42 | 0.10 | 0.029 | ( 0.095) | 0.026 | 0.003 |
| 246 | 20.50 | 0.10 | 0.029 | ( 0.095) | 0.026 | 0.003 |
| 247 | 20.58 | 0.10 | 0.029 | ( 0.094) | 0.026 | 0.003 |
| 248 | 20.67 | 0.10 | 0.029 | ( 0.094) | 0.026 | 0.003 |
| 249 | 20.75 | 0.10 | 0.029 | ( 0.094) | 0.026 | 0.003 |
| 250 | 20.83 | 0.07 | 0.019 | ( 0.093) | 0.017 | 0.002 |
| 251 | 20.92 | 0.07 | 0.019 | ( 0.093) | 0.017 | 0.002 |
| 252 | 21.00 | 0.07 | 0.019 | ( 0.093) | 0.017 | 0.002 |
| 253 | 21.08 | 0.10 | 0.029 | ( 0.092) | 0.026 | 0.003 |
| 254 | 21.17 | 0.10 | 0.029 | ( 0.092) | 0.026 | 0.003 |
| 255 | 21.25 | 0.10 | 0.029 | ( 0.091) | 0.026 | 0.003 |
| 256 | 21.33 | 0.07 | 0.019 | ( 0.091) | 0.017 | 0.002 |
| 257 | 21.42 | 0.07 | 0.019 | ( 0.091) | 0.017 | 0.002 |
| 258 | 21.50 | 0.07 | 0.019 | ( 0.090) | 0.017 | 0.002 |
| 259 | 21.58 | 0.10 | 0.029 | ( 0.090) | 0.026 | 0.003 |
| 260 | 21.67 | 0.10 | 0.029 | ( 0.090) | 0.026 | 0.003 |
| 261 | 21.75 | 0.10 | 0.029 | ( 0.089) | 0.026 | 0.003 |
| 262 | 21.83 | 0.07 | 0.019 | ( 0.089) | 0.017 | 0.002 |
| 263 | 21.92 | 0.07 | 0.019 | ( 0.089) | 0.017 | 0.002 |
| 264 | 22.00 | 0.07 | 0.019 | ( 0.089) | 0.017 | 0.002 |
| 265 | 22.08 | 0.10 | 0.029 | ( 0.088) | 0.026 | 0.003 |
| 266 | 22.17 | 0.10 | 0.029 | ( 0.088) | 0.026 | 0.003 |
| 267 | 22.25 | 0.10 | 0.029 | ( 0.088) | 0.026 | 0.003 |
| 268 | 22.33 | 0.07 | 0.019 | ( 0.087) | 0.017 | 0.002 |

```
269  22.42     0.07      0.019       (  0.087)       0.017        0.002
270  22.50     0.07      0.019       (  0.087)       0.017        0.002
271  22.58     0.07      0.019       (  0.087)       0.017        0.002
272  22.67     0.07      0.019       (  0.086)       0.017        0.002
273  22.75     0.07      0.019       (  0.086)       0.017        0.002
274  22.83     0.07      0.019       (  0.086)       0.017        0.002
275  22.92     0.07      0.019       (  0.086)       0.017        0.002
276  23.00     0.07      0.019       (  0.086)       0.017        0.002
277  23.08     0.07      0.019       (  0.085)       0.017        0.002
278  23.17     0.07      0.019       (  0.085)       0.017        0.002
279  23.25     0.07      0.019       (  0.085)       0.017        0.002
280  23.33     0.07      0.019       (  0.085)       0.017        0.002
281  23.42     0.07      0.019       (  0.085)       0.017        0.002
282  23.50     0.07      0.019       (  0.084)       0.017        0.002
283  23.58     0.07      0.019       (  0.084)       0.017        0.002
284  23.67     0.07      0.019       (  0.084)       0.017        0.002
285  23.75     0.07      0.019       (  0.084)       0.017        0.002
286  23.83     0.07      0.019       (  0.084)       0.017        0.002
287  23.92     0.07      0.019       (  0.084)       0.017        0.002
288  24.00     0.07      0.019       (  0.084)       0.017        0.002
               (Loss Rate Not Used)
    Sum =     100.0                                  Sum =      6.8
      Flood volume = Effective rainfall      0.57(In)
       times area       8.4(Ac.)/[(In)/(Ft.)] =       0.4(Ac.Ft)
      Total soil loss =      1.81(In)
      Total soil loss =     1.270(Ac.Ft)
      Total rainfall =      2.38(In)
      Flood volume =       17233.3 Cubic Feet
      Total soil loss =       55336.5 Cubic Feet
      ---------------------------------------------------------------------
       Peak flow rate of this hydrograph =      1.518(CFS)
      ---------------------------------------------------------------------
      +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                        24 - H O U R    S T O R M
                    R u n o f f      H y d r o g r a p h
      ---------------------------------------------------------------------
                 Hydrograph in   5   Minute intervals ((CFS))

      ---------------------------------------------------------------------
 Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
 ---------------------------------------------------------------------------
   0+ 5       0.0000      0.00  Q         |         |         |         |
   0+10       0.0001      0.01  Q         |         |         |         |
   0+15       0.0002      0.02  Q         |         |         |         |
   0+20       0.0003      0.02  Q         |         |         |         |
   0+25       0.0005      0.02  Q         |         |         |         |
   0+30       0.0007      0.02  Q         |         |         |         |
   0+35       0.0008      0.02  Q         |         |         |         |
   0+40       0.0010      0.02  Q         |         |         |         |
   0+45       0.0012      0.02  Q         |         |         |         |
   0+50       0.0013      0.03  Q         |         |         |         |
   0+55       0.0015      0.03  Q         |         |         |         |
   1+ 0       0.0018      0.03  Q         |         |         |         |
   1+ 5       0.0020      0.03  Q         |         |         |         |
   1+10       0.0022      0.03  Q         |         |         |         |
   1+15       0.0023      0.02  Q         |         |         |         |
   1+20       0.0025      0.02  Q         |         |         |         |
   1+25       0.0027      0.02  Q         |         |         |         |
   1+30       0.0028      0.02  Q         |         |         |         |
   1+35       0.0030      0.02  Q         |         |         |         |
   1+40       0.0032      0.02  Q         |         |         |         |
   1+45       0.0033      0.02  Q         |         |         |         |
   1+50       0.0035      0.03  Q         |         |         |         |
   1+55       0.0037      0.03  Q         |         |         |         |
   2+ 0       0.0039      0.03  Q         |         |         |         |
   2+ 5       0.0042      0.03  Q         |         |         |         |
   2+10       0.0044      0.03  Q         |         |         |         |
   2+15       0.0046      0.03  Q         |         |         |         |
   2+20       0.0048      0.03  Q         |         |         |         |
   2+25       0.0050      0.03  Q         |         |         |         |
   2+30       0.0053      0.03  Q         |         |         |         |
   2+35       0.0055      0.03  Q         |         |         |         |
   2+40       0.0058      0.04  Q         |         |         |         |
   2+45       0.0060      0.04  Q         |         |         |         |
   2+50       0.0063      0.04  Q         |         |         |         |
```

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2+55 | 0.0066 | 0.04 | Q | | | | |
| 3+ 0 | 0.0069 | 0.04 | Q | | | | |
| 3+ 5 | 0.0072 | 0.04 | Q | | | | |
| 3+10 | 0.0074 | 0.04 | Q | | | | |
| 3+15 | 0.0077 | 0.04 | Q | | | | |
| 3+20 | 0.0080 | 0.04 | Q | | | | |
| 3+25 | 0.0083 | 0.04 | Q | | | | |
| 3+30 | 0.0085 | 0.04 | Q | | | | |
| 3+35 | 0.0088 | 0.04 | Q | | | | |
| 3+40 | 0.0091 | 0.04 | Q | | | | |
| 3+45 | 0.0094 | 0.04 | Q | | | | |
| 3+50 | 0.0097 | 0.04 | Q | | | | |
| 3+55 | 0.0100 | 0.05 | QV | | | | |
| 4+ 0 | 0.0103 | 0.05 | QV | | | | |
| 4+ 5 | 0.0106 | 0.05 | QV | | | | |
| 4+10 | 0.0110 | 0.05 | QV | | | | |
| 4+15 | 0.0113 | 0.05 | QV | | | | |
| 4+20 | 0.0117 | 0.05 | QV | | | | |
| 4+25 | 0.0120 | 0.05 | QV | | | | |
| 4+30 | 0.0124 | 0.06 | QV | | | | |
| 4+35 | 0.0128 | 0.06 | QV | | | | |
| 4+40 | 0.0132 | 0.06 | QV | | | | |
| 4+45 | 0.0136 | 0.06 | QV | | | | |
| 4+50 | 0.0140 | 0.06 | QV | | | | |
| 4+55 | 0.0144 | 0.06 | QV | | | | |
| 5+ 0 | 0.0149 | 0.06 | QV | | | | |
| 5+ 5 | 0.0153 | 0.06 | QV | | | | |
| 5+10 | 0.0156 | 0.05 | QV | | | | |
| 5+15 | 0.0160 | 0.05 | QV | | | | |
| 5+20 | 0.0163 | 0.05 | QV | | | | |
| 5+25 | 0.0167 | 0.05 | QV | | | | |
| 5+30 | 0.0171 | 0.06 | QV | | | | |
| 5+35 | 0.0175 | 0.06 | QV | | | | |
| 5+40 | 0.0179 | 0.06 | QV | | | | |
| 5+45 | 0.0184 | 0.06 | QV | | | | |
| 5+50 | 0.0188 | 0.06 | QV | | | | |
| 5+55 | 0.0192 | 0.06 | QV | | | | |
| 6+ 0 | 0.0197 | 0.06 | QV | | | | |
| 6+ 5 | 0.0202 | 0.07 | Q V | | | | |
| 6+10 | 0.0206 | 0.07 | Q V | | | | |
| 6+15 | 0.0211 | 0.07 | Q V | | | | |
| 6+20 | 0.0216 | 0.07 | Q V | | | | |
| 6+25 | 0.0221 | 0.07 | Q V | | | | |
| 6+30 | 0.0226 | 0.07 | Q V | | | | |
| 6+35 | 0.0231 | 0.07 | Q V | | | | |
| 6+40 | 0.0237 | 0.08 | Q V | | | | |
| 6+45 | 0.0242 | 0.08 | Q V | | | | |
| 6+50 | 0.0248 | 0.08 | Q V | | | | |
| 6+55 | 0.0254 | 0.08 | Q V | | | | |
| 7+ 0 | 0.0259 | 0.08 | Q V | | | | |
| 7+ 5 | 0.0265 | 0.08 | Q V | | | | |
| 7+10 | 0.0270 | 0.08 | Q V | | | | |
| 7+15 | 0.0276 | 0.08 | Q V | | | | |
| 7+20 | 0.0281 | 0.08 | Q V | | | | |
| 7+25 | 0.0287 | 0.09 | Q V | | | | |
| 7+30 | 0.0293 | 0.09 | Q V | | | | |
| 7+35 | 0.0300 | 0.09 | Q V | | | | |
| 7+40 | 0.0306 | 0.10 | Q V | | | | |
| 7+45 | 0.0313 | 0.10 | Q V | | | | |
| 7+50 | 0.0320 | 0.10 | Q V | | | | |
| 7+55 | 0.0327 | 0.10 | Q V | | | | |
| 8+ 0 | 0.0334 | 0.10 | Q V | | | | |
| 8+ 5 | 0.0341 | 0.11 | Q V | | | | |
| 8+10 | 0.0350 | 0.12 | Q V | | | | |
| 8+15 | 0.0358 | 0.12 | Q V | | | | |
| 8+20 | 0.0366 | 0.12 | Q V | | | | |
| 8+25 | 0.0374 | 0.12 | Q V | | | | |
| 8+30 | 0.0383 | 0.12 | Q V | | | | |
| 8+35 | 0.0391 | 0.12 | Q V | | | | |
| 8+40 | 0.0400 | 0.13 | Q V | | | | |
| 8+45 | 0.0409 | 0.13 | Q V | | | | |
| 8+50 | 0.0418 | 0.13 | Q V | | | | |
| 8+55 | 0.0427 | 0.14 | Q V | | | | |
| 9+ 0 | 0.0437 | 0.14 | Q V | | | | |
| 9+ 5 | 0.0446 | 0.14 | Q V | | | | |

```
 9+10       0.0457      0.15  Q   V     |         |         |         |
 9+15       0.0467      0.15  Q   V     |         |         |         |
 9+20       0.0478      0.15  Q   V     |         |         |         |
 9+25       0.0489      0.16  Q   V     |         |         |         |
 9+30       0.0500      0.16  Q    V    |         |         |         |
 9+35       0.0511      0.16  Q    V    |         |         |         |
 9+40       0.0523      0.17  Q    V    |         |         |         |
 9+45       0.0534      0.17  Q    V    |         |         |         |
 9+50       0.0547      0.19  Q    V    |         |         |         |
 9+55       0.0564      0.24  Q    V    |         |         |         |
10+ 0       0.0582      0.26 |Q   V    |         |         |         |
10+ 5       0.0598      0.23  Q     V   |         |         |         |
10+10       0.0609      0.15  Q     V   |         |         |         |
10+15       0.0618      0.13  Q     V   |         |         |         |
10+20       0.0626      0.12  Q     V   |         |         |         |
10+25       0.0635      0.12  Q     V   |         |         |         |
10+30       0.0643      0.12  Q     V   |         |         |         |
10+35       0.0652      0.13  Q     V   |         |         |         |
10+40       0.0663      0.16  Q     V   |         |         |         |
10+45       0.0674      0.17  Q     V   |         |         |         |
10+50       0.0686      0.18  Q     V   |         |         |         |
10+55       0.0699      0.18  Q      V  |         |         |         |
11+ 0       0.0712      0.19  Q      V  |         |         |         |
11+ 5       0.0725      0.19  Q      V  |         |         |         |
11+10       0.0736      0.16  Q      V  |         |         |         |
11+15       0.0747      0.16  Q      V  |         |         |         |
11+20       0.0757      0.15  Q      V  |         |         |         |
11+25       0.0768      0.15  Q      V  |         |         |         |
11+30       0.0779      0.15  Q      V  |         |         |         |
11+35       0.0789      0.15  Q      V  |         |         |         |
11+40       0.0799      0.14  Q       V |         |         |         |
11+45       0.0808      0.14  Q       V |         |         |         |
11+50       0.0818      0.14  Q       V |         |         |         |
11+55       0.0828      0.14  Q       V |         |         |         |
12+ 0       0.0838      0.14  Q       V |         |         |         |
12+ 5       0.0857      0.27 |Q       V |         |         |         |
12+10       0.0897      0.58  | Q      V|         |         |         |
12+15       0.0942      0.66  | Q      V|         |         |         |
12+20       0.0992      0.71  | Q       V         |         |         |
12+25       0.1045      0.77  |  Q      V         |         |         |
12+30       0.1099      0.79  |  Q      |V        |         |         |
12+35       0.1157      0.84  |  Q      |V        |         |         |
12+40       0.1222      0.94  |  Q      | V       |         |         |
12+45       0.1288      0.97  |  Q      |  V      |         |         |
12+50       0.1357      1.00  |   Q     |  V      |         |         |
12+55       0.1430      1.05  |   Q     |   V     |         |         |
13+ 0       0.1504      1.07  |   Q     |    V    |         |         |
13+ 5       0.1585      1.18  |   Q     |     V   |         |         |
13+10       0.1682      1.41  |    Q    |      V  |         |         |
13+15       0.1784      1.48  |    Q    |       V |         |         |
13+20       0.1887      1.50  |    Q    |        V|         |         |
13+25       0.1991      1.51  |     Q   |         V         |         |
13+30       0.2095      1.52  |     Q   |         |V        |         |
13+35       0.2186      1.31  |    Q    |         | V       |         |
13+40       0.2243      0.83  |  Q      |         | V       |         |
13+45       0.2291      0.70  | Q       |         |  V      |         |
13+50       0.2337      0.67  | Q       |         |  V      |         |
13+55       0.2383      0.67  | Q       |         |   V     |         |
14+ 0       0.2429      0.67  | Q       |         |   V     |         |
14+ 5       0.2481      0.75  |  Q      |         |    V    |         |
14+10       0.2545      0.94  |  Q      |         |    V    |         |
14+15       0.2614      0.99  |  Q      |         |     V   |         |
14+20       0.2682      0.99  |  Q      |         |      V  |         |
14+25       0.2748      0.96  |  Q      |         |      V  |         |
14+30       0.2813      0.95  |  Q      |         |       V |         |
14+35       0.2879      0.95  |  Q      |         |        V|         |
14+40       0.2945      0.96  |  Q      |         |        V|         |
14+45       0.3011      0.96  |  Q      |         |         V         |
14+50       0.3077      0.95  |  Q      |         |         |V        |
14+55       0.3139      0.91  |  Q      |         |         |V        |
15+ 0       0.3202      0.91  |  Q      |         |         | V       |
15+ 5       0.3263      0.89  |  Q      |         |         | V       |
15+10       0.3321      0.85  |  Q      |         |         |  V      |
15+15       0.3379      0.84  |  Q      |         |         |   V     |
15+20       0.3436      0.82  |  Q      |         |         |   V     |
```

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 15+25 | 0.3490 | 0.78 | \| Q | \| | \| | \| V | \| |
| 15+30 | 0.3544 | 0.78 | \| Q | \| | \| | \| V | \| |
| 15+35 | 0.3592 | 0.70 | \| Q | \| | \| | \| V | \| |
| 15+40 | 0.3628 | 0.53 | \| Q | \| | \| | \| V | \| |
| 15+45 | 0.3662 | 0.49 | \|Q | \| | \| | \| V | \| |
| 15+50 | 0.3695 | 0.48 | \|Q | \| | \| | \| V | \| |
| 15+55 | 0.3728 | 0.48 | \|Q | \| | \| | \| V | \| |
| 16+ 0 | 0.3761 | 0.48 | \|Q | \| | \| | \| V | \| |
| 16+ 5 | 0.3787 | 0.38 | \|Q | \| | \| | \| V | \| |
| 16+10 | 0.3796 | 0.13 | Q | \| | \| | \| V | \| |
| 16+15 | 0.3800 | 0.06 | Q | \| | \| | \| V | \| |
| 16+20 | 0.3803 | 0.04 | Q | \| | \| | \| V | \| |
| 16+25 | 0.3805 | 0.03 | Q | \| | \| | \| V | \| |
| 16+30 | 0.3807 | 0.03 | Q | \| | \| | \| V | \| |
| 16+35 | 0.3809 | 0.03 | Q | \| | \| | \| V | \| |
| 16+40 | 0.3811 | 0.03 | Q | \| | \| | \| V | \| |
| 16+45 | 0.3813 | 0.02 | Q | \| | \| | \| V | \| |
| 16+50 | 0.3815 | 0.02 | Q | \| | \| | \| V | \| |
| 16+55 | 0.3816 | 0.02 | Q | \| | \| | \| V | \| |
| 17+ 0 | 0.3818 | 0.02 | Q | \| | \| | \| V | \| |
| 17+ 5 | 0.3820 | 0.03 | Q | \| | \| | \| V | \| |
| 17+10 | 0.3822 | 0.04 | Q | \| | \| | \| V | \| |
| 17+15 | 0.3825 | 0.04 | Q | \| | \| | \| V | \| |
| 17+20 | 0.3828 | 0.04 | Q | \| | \| | \| V | \| |
| 17+25 | 0.3831 | 0.04 | Q | \| | \| | \| V | \| |
| 17+30 | 0.3833 | 0.04 | Q | \| | \| | \| V | \| |
| 17+35 | 0.3836 | 0.04 | Q | \| | \| | \| V | \| |
| 17+40 | 0.3839 | 0.04 | Q | \| | \| | \| V | \| |
| 17+45 | 0.3842 | 0.04 | Q | \| | \| | \| V | \| |
| 17+50 | 0.3844 | 0.04 | Q | \| | \| | \| V | \| |
| 17+55 | 0.3847 | 0.03 | Q | \| | \| | \| V | \| |
| 18+ 0 | 0.3849 | 0.03 | Q | \| | \| | \| V | \| |
| 18+ 5 | 0.3851 | 0.03 | Q | \| | \| | \| V | \| |
| 18+10 | 0.3853 | 0.03 | Q | \| | \| | \| V | \| |
| 18+15 | 0.3856 | 0.03 | Q | \| | \| | \| V | \| |
| 18+20 | 0.3858 | 0.03 | Q | \| | \| | \| V | \| |
| 18+25 | 0.3860 | 0.03 | Q | \| | \| | \| V | \| |
| 18+30 | 0.3862 | 0.03 | Q | \| | \| | \| V | \| |
| 18+35 | 0.3864 | 0.03 | Q | \| | \| | \| V | \| |
| 18+40 | 0.3866 | 0.03 | Q | \| | \| | \| V | \| |
| 18+45 | 0.3868 | 0.02 | Q | \| | \| | \| V | \| |
| 18+50 | 0.3869 | 0.02 | Q | \| | \| | \| V | \| |
| 18+55 | 0.3871 | 0.02 | Q | \| | \| | \| V | \| |
| 19+ 0 | 0.3872 | 0.02 | Q | \| | \| | \| V | \| |
| 19+ 5 | 0.3873 | 0.02 | Q | \| | \| | \| V | \| |
| 19+10 | 0.3875 | 0.02 | Q | \| | \| | \| V | \| |
| 19+15 | 0.3876 | 0.02 | Q | \| | \| | \| V | \| |
| 19+20 | 0.3878 | 0.03 | Q | \| | \| | \| V | \| |
| 19+25 | 0.3880 | 0.03 | Q | \| | \| | \| V | \| |
| 19+30 | 0.3882 | 0.03 | Q | \| | \| | \| V | \| |
| 19+35 | 0.3884 | 0.03 | Q | \| | \| | \| V | \| |
| 19+40 | 0.3886 | 0.03 | Q | \| | \| | \| V | \| |
| 19+45 | 0.3888 | 0.02 | Q | \| | \| | \| V | \| |
| 19+50 | 0.3889 | 0.02 | Q | \| | \| | \| V | \| |
| 19+55 | 0.3891 | 0.02 | Q | \| | \| | \| V | \| |
| 20+ 0 | 0.3892 | 0.02 | Q | \| | \| | \| V | \| |
| 20+ 5 | 0.3893 | 0.02 | Q | \| | \| | \| V | \| |
| 20+10 | 0.3895 | 0.02 | Q | \| | \| | \| V | \| |
| 20+15 | 0.3896 | 0.02 | Q | \| | \| | \| V | \| |
| 20+20 | 0.3898 | 0.02 | Q | \| | \| | \| V | \| |
| 20+25 | 0.3899 | 0.02 | Q | \| | \| | \| V | \| |
| 20+30 | 0.3901 | 0.02 | Q | \| | \| | \| V | \| |
| 20+35 | 0.3903 | 0.02 | Q | \| | \| | \| V | \| |
| 20+40 | 0.3904 | 0.02 | Q | \| | \| | \| V | \| |
| 20+45 | 0.3906 | 0.02 | Q | \| | \| | \| V | \| |
| 20+50 | 0.3908 | 0.02 | Q | \| | \| | \| V | \| |
| 20+55 | 0.3909 | 0.02 | Q | \| | \| | \| V | \| |
| 21+ 0 | 0.3910 | 0.02 | Q | \| | \| | \| V | \| |
| 21+ 5 | 0.3911 | 0.02 | Q | \| | \| | \| V | \| |
| 21+10 | 0.3913 | 0.02 | Q | \| | \| | \| V | \| |
| 21+15 | 0.3915 | 0.02 | Q | \| | \| | \| V | \| |
| 21+20 | 0.3916 | 0.02 | Q | \| | \| | \| V | \| |
| 21+25 | 0.3917 | 0.02 | Q | \| | \| | \| V | \| |
| 21+30 | 0.3918 | 0.02 | Q | \| | \| | \| V | \| |
| 21+35 | 0.3920 | 0.02 | Q | \| | \| | \| V | \| |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 21+40 | 0.3921 | 0.02 | Q | \| | \| | \| | V\| |
| 21+45 | 0.3923 | 0.02 | Q | \| | \| | \| | V\| |
| 21+50 | 0.3924 | 0.02 | Q | \| | \| | \| | V\| |
| 21+55 | 0.3926 | 0.02 | Q | \| | \| | \| | V\| |
| 22+ 0 | 0.3927 | 0.02 | Q | \| | \| | \| | V\| |
| 22+ 5 | 0.3928 | 0.02 | Q | \| | \| | \| | V\| |
| 22+10 | 0.3930 | 0.02 | Q | \| | \| | \| | V\| |
| 22+15 | 0.3931 | 0.02 | Q | \| | \| | \| | V\| |
| 22+20 | 0.3933 | 0.02 | Q | \| | \| | \| | V\| |
| 22+25 | 0.3934 | 0.02 | Q | \| | \| | \| | V\| |
| 22+30 | 0.3935 | 0.02 | Q | \| | \| | \| | V\| |
| 22+35 | 0.3936 | 0.02 | Q | \| | \| | \| | V\| |
| 22+40 | 0.3937 | 0.02 | Q | \| | \| | \| | V\| |
| 22+45 | 0.3938 | 0.02 | Q | \| | \| | \| | V\| |
| 22+50 | 0.3940 | 0.02 | Q | \| | \| | \| | V\| |
| 22+55 | 0.3941 | 0.02 | Q | \| | \| | \| | V\| |
| 23+ 0 | 0.3942 | 0.02 | Q | \| | \| | \| | V\| |
| 23+ 5 | 0.3943 | 0.02 | Q | \| | \| | \| | V\| |
| 23+10 | 0.3944 | 0.02 | Q | \| | \| | \| | V\| |
| 23+15 | 0.3945 | 0.02 | Q | \| | \| | \| | V\| |
| 23+20 | 0.3946 | 0.02 | Q | \| | \| | \| | V\| |
| 23+25 | 0.3947 | 0.02 | Q | \| | \| | \| | V\| |
| 23+30 | 0.3948 | 0.02 | Q | \| | \| | \| | V\| |
| 23+35 | 0.3949 | 0.02 | Q | \| | \| | \| | V\| |
| 23+40 | 0.3951 | 0.02 | Q | \| | \| | \| | V\| |
| 23+45 | 0.3952 | 0.02 | Q | \| | \| | \| | V\| |
| 23+50 | 0.3953 | 0.02 | Q | \| | \| | \| | V\| |
| 23+55 | 0.3954 | 0.02 | Q | \| | \| | \| | V\| |
| 24+ 0 | 0.3955 | 0.02 | Q | \| | \| | \| | V\| |
| 24+ 5 | 0.3956 | 0.01 | Q | \| | \| | \| | V\| |
| 24+10 | 0.3956 | 0.00 | Q | \| | \| | \| | V\| |
| 24+15 | 0.3956 | 0.00 | Q | \| | \| | \| | V\| |
| 24+20 | 0.3956 | 0.00 | Q | \| | \| | \| | V\| |
| 24+25 | 0.3956 | 0.00 | Q | \| | \| | \| | V\| |

```
       U n i t   H y d r o g r a p h   A n a l y s i s

       Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2008, Version 8.1
              Study date  01/29/18 File: nrareabpr2242.out

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

Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 4029

----------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



----------------------------------------------------------------------
Tract 37305 - Nichols Road Development
Drainage Area B - 8.4 Ac
Proposed Condition
2-year 24-hour storm

----------------------------------------------------------------------
Drainage Area =       8.40(Ac.)  =      0.013 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       8.40(Ac.)  =      0.013 Sq. Mi.
Length along longest watercourse =    1015.00(Ft.)
Length along longest watercourse measured to centroid =     444.00(Ft.)
Length along longest watercourse =      0.192 Mi.
Length along longest watercourse measured to centroid =      0.084 Mi.
Difference in elevation =      34.00(Ft.)
Slope along watercourse =    176.8670 Ft./Mi.
Average Manning's 'N' = 0.017
Lag time =    0.032 Hr.
Lag time =     1.91 Min.
25% of lag time =     0.48 Min.
40% of lag time =     0.76 Min.
Unit time =     5.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        8.40           2.38                 19.99

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        8.40           6.35                 53.34

STORM EVENT (YEAR) =    2.00
Area Averaged 2-Year Rainfall =    2.380(In)
Area Averaged 100-Year Rainfall =    6.350(In)

Point rain (area averaged) =    2.380(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    2.380(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     0.800           69.00         0.050
     7.600           69.00         0.550
 Total Area Entered =      8.40(Ac.)
```

| RI AMC2 | RI AMC-3 | Infil. Rate (In/Hr) | Impervious (Dec.%) | Adj. Infil. Rate (In/Hr) | Area% (Dec.) | F (In/Hr) |
|---|---|---|---|---|---|---|
| 69.0 | 84.4 | 0.194 | 0.050 | 0.185 | 0.095 | 0.018 |
| 69.0 | 84.4 | 0.194 | 0.550 | 0.098 | 0.905 | 0.089 |
| | | | | | Sum (F) = | 0.106 |

Area averaged mean soil loss (F) (In/Hr) = 0.106
Minimum soil loss rate ((In/Hr)) = 0.053
(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.430

---

U n i t H y d r o g r a p h
FOOTHILL S-Curve

---

Unit Hydrograph Data

| Unit time period (hrs) | | Time % of lag | Distribution Graph % | Unit Hydrograph (CFS) |
|---|---|---|---|---|
| 1 | 0.083 | 261.789 | 52.730 | 4.464 |
| 2 | 0.167 | 523.577 | 43.889 | 3.715 |
| 3 | 0.250 | 785.366 | 3.381 | 0.286 |
| | | | Sum = 100.000 | Sum= 8.466 |

---

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

| Unit | Time (Hr.) | Pattern Percent | Storm Rain (In/Hr) | Loss rate(In./Hr) Max | Low | Effective (In/Hr) |
|---|---|---|---|---|---|---|
| 1 | 0.08 | 0.07 | 0.019 | ( 0.188) | 0.008 | 0.011 |
| 2 | 0.17 | 0.07 | 0.019 | ( 0.188) | 0.008 | 0.011 |
| 3 | 0.25 | 0.07 | 0.019 | ( 0.187) | 0.008 | 0.011 |
| 4 | 0.33 | 0.10 | 0.029 | ( 0.186) | 0.012 | 0.016 |
| 5 | 0.42 | 0.10 | 0.029 | ( 0.185) | 0.012 | 0.016 |
| 6 | 0.50 | 0.10 | 0.029 | ( 0.185) | 0.012 | 0.016 |
| 7 | 0.58 | 0.10 | 0.029 | ( 0.184) | 0.012 | 0.016 |
| 8 | 0.67 | 0.10 | 0.029 | ( 0.183) | 0.012 | 0.016 |
| 9 | 0.75 | 0.10 | 0.029 | ( 0.182) | 0.012 | 0.016 |
| 10 | 0.83 | 0.13 | 0.038 | ( 0.182) | 0.016 | 0.022 |
| 11 | 0.92 | 0.13 | 0.038 | ( 0.181) | 0.016 | 0.022 |
| 12 | 1.00 | 0.13 | 0.038 | ( 0.180) | 0.016 | 0.022 |
| 13 | 1.08 | 0.10 | 0.029 | ( 0.180) | 0.012 | 0.016 |
| 14 | 1.17 | 0.10 | 0.029 | ( 0.179) | 0.012 | 0.016 |
| 15 | 1.25 | 0.10 | 0.029 | ( 0.178) | 0.012 | 0.016 |
| 16 | 1.33 | 0.10 | 0.029 | ( 0.177) | 0.012 | 0.016 |
| 17 | 1.42 | 0.10 | 0.029 | ( 0.177) | 0.012 | 0.016 |
| 18 | 1.50 | 0.10 | 0.029 | ( 0.176) | 0.012 | 0.016 |
| 19 | 1.58 | 0.10 | 0.029 | ( 0.175) | 0.012 | 0.016 |
| 20 | 1.67 | 0.10 | 0.029 | ( 0.175) | 0.012 | 0.016 |
| 21 | 1.75 | 0.10 | 0.029 | ( 0.174) | 0.012 | 0.016 |
| 22 | 1.83 | 0.13 | 0.038 | ( 0.173) | 0.016 | 0.022 |
| 23 | 1.92 | 0.13 | 0.038 | ( 0.173) | 0.016 | 0.022 |
| 24 | 2.00 | 0.13 | 0.038 | ( 0.172) | 0.016 | 0.022 |
| 25 | 2.08 | 0.13 | 0.038 | ( 0.171) | 0.016 | 0.022 |
| 26 | 2.17 | 0.13 | 0.038 | ( 0.170) | 0.016 | 0.022 |
| 27 | 2.25 | 0.13 | 0.038 | ( 0.170) | 0.016 | 0.022 |
| 28 | 2.33 | 0.13 | 0.038 | ( 0.169) | 0.016 | 0.022 |
| 29 | 2.42 | 0.13 | 0.038 | ( 0.168) | 0.016 | 0.022 |
| 30 | 2.50 | 0.13 | 0.038 | ( 0.168) | 0.016 | 0.022 |
| 31 | 2.58 | 0.17 | 0.048 | ( 0.167) | 0.020 | 0.027 |
| 32 | 2.67 | 0.17 | 0.048 | ( 0.166) | 0.020 | 0.027 |
| 33 | 2.75 | 0.17 | 0.048 | ( 0.166) | 0.020 | 0.027 |
| 34 | 2.83 | 0.17 | 0.048 | ( 0.165) | 0.020 | 0.027 |
| 35 | 2.92 | 0.17 | 0.048 | ( 0.164) | 0.020 | 0.027 |
| 36 | 3.00 | 0.17 | 0.048 | ( 0.164) | 0.020 | 0.027 |
| 37 | 3.08 | 0.17 | 0.048 | ( 0.163) | 0.020 | 0.027 |
| 38 | 3.17 | 0.17 | 0.048 | ( 0.162) | 0.020 | 0.027 |
| 39 | 3.25 | 0.17 | 0.048 | ( 0.162) | 0.020 | 0.027 |
| 40 | 3.33 | 0.17 | 0.048 | ( 0.161) | 0.020 | 0.027 |
| 41 | 3.42 | 0.17 | 0.048 | ( 0.160) | 0.020 | 0.027 |
| 42 | 3.50 | 0.17 | 0.048 | ( 0.160) | 0.020 | 0.027 |
| 43 | 3.58 | 0.17 | 0.048 | ( 0.159) | 0.020 | 0.027 |
| 44 | 3.67 | 0.17 | 0.048 | ( 0.158) | 0.020 | 0.027 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 45 | 3.75 | 0.17 | 0.048 | ( 0.158) | 0.020 | 0.027 |
| 46 | 3.83 | 0.20 | 0.057 | ( 0.157) | 0.025 | 0.033 |
| 47 | 3.92 | 0.20 | 0.057 | ( 0.156) | 0.025 | 0.033 |
| 48 | 4.00 | 0.20 | 0.057 | ( 0.156) | 0.025 | 0.033 |
| 49 | 4.08 | 0.20 | 0.057 | ( 0.155) | 0.025 | 0.033 |
| 50 | 4.17 | 0.20 | 0.057 | ( 0.154) | 0.025 | 0.033 |
| 51 | 4.25 | 0.20 | 0.057 | ( 0.154) | 0.025 | 0.033 |
| 52 | 4.33 | 0.23 | 0.067 | ( 0.153) | 0.029 | 0.038 |
| 53 | 4.42 | 0.23 | 0.067 | ( 0.152) | 0.029 | 0.038 |
| 54 | 4.50 | 0.23 | 0.067 | ( 0.152) | 0.029 | 0.038 |
| 55 | 4.58 | 0.23 | 0.067 | ( 0.151) | 0.029 | 0.038 |
| 56 | 4.67 | 0.23 | 0.067 | ( 0.150) | 0.029 | 0.038 |
| 57 | 4.75 | 0.23 | 0.067 | ( 0.150) | 0.029 | 0.038 |
| 58 | 4.83 | 0.27 | 0.076 | ( 0.149) | 0.033 | 0.043 |
| 59 | 4.92 | 0.27 | 0.076 | ( 0.148) | 0.033 | 0.043 |
| 60 | 5.00 | 0.27 | 0.076 | ( 0.148) | 0.033 | 0.043 |
| 61 | 5.08 | 0.20 | 0.057 | ( 0.147) | 0.025 | 0.033 |
| 62 | 5.17 | 0.20 | 0.057 | ( 0.146) | 0.025 | 0.033 |
| 63 | 5.25 | 0.20 | 0.057 | ( 0.146) | 0.025 | 0.033 |
| 64 | 5.33 | 0.23 | 0.067 | ( 0.145) | 0.029 | 0.038 |
| 65 | 5.42 | 0.23 | 0.067 | ( 0.145) | 0.029 | 0.038 |
| 66 | 5.50 | 0.23 | 0.067 | ( 0.144) | 0.029 | 0.038 |
| 67 | 5.58 | 0.27 | 0.076 | ( 0.143) | 0.033 | 0.043 |
| 68 | 5.67 | 0.27 | 0.076 | ( 0.143) | 0.033 | 0.043 |
| 69 | 5.75 | 0.27 | 0.076 | ( 0.142) | 0.033 | 0.043 |
| 70 | 5.83 | 0.27 | 0.076 | ( 0.141) | 0.033 | 0.043 |
| 71 | 5.92 | 0.27 | 0.076 | ( 0.141) | 0.033 | 0.043 |
| 72 | 6.00 | 0.27 | 0.076 | ( 0.140) | 0.033 | 0.043 |
| 73 | 6.08 | 0.30 | 0.086 | ( 0.140) | 0.037 | 0.049 |
| 74 | 6.17 | 0.30 | 0.086 | ( 0.139) | 0.037 | 0.049 |
| 75 | 6.25 | 0.30 | 0.086 | ( 0.138) | 0.037 | 0.049 |
| 76 | 6.33 | 0.30 | 0.086 | ( 0.138) | 0.037 | 0.049 |
| 77 | 6.42 | 0.30 | 0.086 | ( 0.137) | 0.037 | 0.049 |
| 78 | 6.50 | 0.30 | 0.086 | ( 0.136) | 0.037 | 0.049 |
| 79 | 6.58 | 0.33 | 0.095 | ( 0.136) | 0.041 | 0.054 |
| 80 | 6.67 | 0.33 | 0.095 | ( 0.135) | 0.041 | 0.054 |
| 81 | 6.75 | 0.33 | 0.095 | ( 0.135) | 0.041 | 0.054 |
| 82 | 6.83 | 0.33 | 0.095 | ( 0.134) | 0.041 | 0.054 |
| 83 | 6.92 | 0.33 | 0.095 | ( 0.133) | 0.041 | 0.054 |
| 84 | 7.00 | 0.33 | 0.095 | ( 0.133) | 0.041 | 0.054 |
| 85 | 7.08 | 0.33 | 0.095 | ( 0.132) | 0.041 | 0.054 |
| 86 | 7.17 | 0.33 | 0.095 | ( 0.132) | 0.041 | 0.054 |
| 87 | 7.25 | 0.33 | 0.095 | ( 0.131) | 0.041 | 0.054 |
| 88 | 7.33 | 0.37 | 0.105 | ( 0.130) | 0.045 | 0.060 |
| 89 | 7.42 | 0.37 | 0.105 | ( 0.130) | 0.045 | 0.060 |
| 90 | 7.50 | 0.37 | 0.105 | ( 0.129) | 0.045 | 0.060 |
| 91 | 7.58 | 0.40 | 0.114 | ( 0.129) | 0.049 | 0.065 |
| 92 | 7.67 | 0.40 | 0.114 | ( 0.128) | 0.049 | 0.065 |
| 93 | 7.75 | 0.40 | 0.114 | ( 0.127) | 0.049 | 0.065 |
| 94 | 7.83 | 0.43 | 0.124 | ( 0.127) | 0.053 | 0.071 |
| 95 | 7.92 | 0.43 | 0.124 | ( 0.126) | 0.053 | 0.071 |
| 96 | 8.00 | 0.43 | 0.124 | ( 0.126) | 0.053 | 0.071 |
| 97 | 8.08 | 0.50 | 0.143 | ( 0.125) | 0.061 | 0.081 |
| 98 | 8.17 | 0.50 | 0.143 | ( 0.125) | 0.061 | 0.081 |
| 99 | 8.25 | 0.50 | 0.143 | ( 0.124) | 0.061 | 0.081 |
| 100 | 8.33 | 0.50 | 0.143 | ( 0.123) | 0.061 | 0.081 |
| 101 | 8.42 | 0.50 | 0.143 | ( 0.123) | 0.061 | 0.081 |
| 102 | 8.50 | 0.50 | 0.143 | ( 0.122) | 0.061 | 0.081 |
| 103 | 8.58 | 0.53 | 0.152 | ( 0.122) | 0.065 | 0.087 |
| 104 | 8.67 | 0.53 | 0.152 | ( 0.121) | 0.065 | 0.087 |
| 105 | 8.75 | 0.53 | 0.152 | ( 0.120) | 0.065 | 0.087 |
| 106 | 8.83 | 0.57 | 0.162 | ( 0.120) | 0.070 | 0.092 |
| 107 | 8.92 | 0.57 | 0.162 | ( 0.119) | 0.070 | 0.092 |
| 108 | 9.00 | 0.57 | 0.162 | ( 0.119) | 0.070 | 0.092 |
| 109 | 9.08 | 0.63 | 0.181 | ( 0.118) | 0.078 | 0.103 |
| 110 | 9.17 | 0.63 | 0.181 | ( 0.118) | 0.078 | 0.103 |
| 111 | 9.25 | 0.63 | 0.181 | ( 0.117) | 0.078 | 0.103 |
| 112 | 9.33 | 0.67 | 0.190 | ( 0.117) | 0.082 | 0.109 |
| 113 | 9.42 | 0.67 | 0.190 | ( 0.116) | 0.082 | 0.109 |
| 114 | 9.50 | 0.67 | 0.190 | ( 0.115) | 0.082 | 0.109 |
| 115 | 9.58 | 0.70 | 0.200 | ( 0.115) | 0.086 | 0.114 |
| 116 | 9.67 | 0.70 | 0.200 | ( 0.114) | 0.086 | 0.114 |
| 117 | 9.75 | 0.70 | 0.200 | ( 0.114) | 0.086 | 0.114 |
| 118 | 9.83 | 0.73 | 0.209 | ( 0.113) | 0.090 | 0.119 |
| 119 | 9.92 | 0.73 | 0.209 | ( 0.113) | 0.090 | 0.119 |

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|---|---|---|---|---|---|---|
| 120 | 10.00 | 0.73 | 0.209 | ( 0.112) | 0.090 | 0.119 |
| 121 | 10.08 | 0.50 | 0.143 | ( 0.112) | 0.061 | 0.081 |
| 122 | 10.17 | 0.50 | 0.143 | ( 0.111) | 0.061 | 0.081 |
| 123 | 10.25 | 0.50 | 0.143 | ( 0.111) | 0.061 | 0.081 |
| 124 | 10.33 | 0.50 | 0.143 | ( 0.110) | 0.061 | 0.081 |
| 125 | 10.42 | 0.50 | 0.143 | ( 0.109) | 0.061 | 0.081 |
| 126 | 10.50 | 0.50 | 0.143 | ( 0.109) | 0.061 | 0.081 |
| 127 | 10.58 | 0.67 | 0.190 | ( 0.108) | 0.082 | 0.109 |
| 128 | 10.67 | 0.67 | 0.190 | ( 0.108) | 0.082 | 0.109 |
| 129 | 10.75 | 0.67 | 0.190 | ( 0.107) | 0.082 | 0.109 |
| 130 | 10.83 | 0.67 | 0.190 | ( 0.107) | 0.082 | 0.109 |
| 131 | 10.92 | 0.67 | 0.190 | ( 0.106) | 0.082 | 0.109 |
| 132 | 11.00 | 0.67 | 0.190 | ( 0.106) | 0.082 | 0.109 |
| 133 | 11.08 | 0.63 | 0.181 | ( 0.105) | 0.078 | 0.103 |
| 134 | 11.17 | 0.63 | 0.181 | ( 0.105) | 0.078 | 0.103 |
| 135 | 11.25 | 0.63 | 0.181 | ( 0.104) | 0.078 | 0.103 |
| 136 | 11.33 | 0.63 | 0.181 | ( 0.104) | 0.078 | 0.103 |
| 137 | 11.42 | 0.63 | 0.181 | ( 0.103) | 0.078 | 0.103 |
| 138 | 11.50 | 0.63 | 0.181 | ( 0.103) | 0.078 | 0.103 |
| 139 | 11.58 | 0.57 | 0.162 | ( 0.102) | 0.070 | 0.092 |
| 140 | 11.67 | 0.57 | 0.162 | ( 0.102) | 0.070 | 0.092 |
| 141 | 11.75 | 0.57 | 0.162 | ( 0.101) | 0.070 | 0.092 |
| 142 | 11.83 | 0.60 | 0.171 | ( 0.101) | 0.074 | 0.098 |
| 143 | 11.92 | 0.60 | 0.171 | ( 0.100) | 0.074 | 0.098 |
| 144 | 12.00 | 0.60 | 0.171 | ( 0.100) | 0.074 | 0.098 |
| 145 | 12.08 | 0.83 | 0.238 | 0.099 | ( 0.102) | 0.139 |
| 146 | 12.17 | 0.83 | 0.238 | 0.099 | ( 0.102) | 0.139 |
| 147 | 12.25 | 0.83 | 0.238 | 0.098 | ( 0.102) | 0.140 |
| 148 | 12.33 | 0.87 | 0.248 | 0.098 | ( 0.106) | 0.150 |
| 149 | 12.42 | 0.87 | 0.248 | 0.097 | ( 0.106) | 0.150 |
| 150 | 12.50 | 0.87 | 0.248 | 0.097 | ( 0.106) | 0.151 |
| 151 | 12.58 | 0.93 | 0.267 | 0.096 | ( 0.115) | 0.170 |
| 152 | 12.67 | 0.93 | 0.267 | 0.096 | ( 0.115) | 0.171 |
| 153 | 12.75 | 0.93 | 0.267 | 0.095 | ( 0.115) | 0.171 |
| 154 | 12.83 | 0.97 | 0.276 | 0.095 | ( 0.119) | 0.181 |
| 155 | 12.92 | 0.97 | 0.276 | 0.094 | ( 0.119) | 0.182 |
| 156 | 13.00 | 0.97 | 0.276 | 0.094 | ( 0.119) | 0.182 |
| 157 | 13.08 | 1.13 | 0.324 | 0.093 | ( 0.139) | 0.230 |
| 158 | 13.17 | 1.13 | 0.324 | 0.093 | ( 0.139) | 0.231 |
| 159 | 13.25 | 1.13 | 0.324 | 0.092 | ( 0.139) | 0.231 |
| 160 | 13.33 | 1.13 | 0.324 | 0.092 | ( 0.139) | 0.232 |
| 161 | 13.42 | 1.13 | 0.324 | 0.091 | ( 0.139) | 0.232 |
| 162 | 13.50 | 1.13 | 0.324 | 0.091 | ( 0.139) | 0.233 |
| 163 | 13.58 | 0.77 | 0.219 | 0.090 | ( 0.094) | 0.128 |
| 164 | 13.67 | 0.77 | 0.219 | 0.090 | ( 0.094) | 0.129 |
| 165 | 13.75 | 0.77 | 0.219 | 0.090 | ( 0.094) | 0.129 |
| 166 | 13.83 | 0.77 | 0.219 | 0.089 | ( 0.094) | 0.130 |
| 167 | 13.92 | 0.77 | 0.219 | 0.089 | ( 0.094) | 0.130 |
| 168 | 14.00 | 0.77 | 0.219 | 0.088 | ( 0.094) | 0.131 |
| 169 | 14.08 | 0.90 | 0.257 | 0.088 | ( 0.111) | 0.169 |
| 170 | 14.17 | 0.90 | 0.257 | 0.087 | ( 0.111) | 0.170 |
| 171 | 14.25 | 0.90 | 0.257 | 0.087 | ( 0.111) | 0.170 |
| 172 | 14.33 | 0.87 | 0.248 | 0.086 | ( 0.106) | 0.161 |
| 173 | 14.42 | 0.87 | 0.248 | 0.086 | ( 0.106) | 0.162 |
| 174 | 14.50 | 0.87 | 0.248 | 0.086 | ( 0.106) | 0.162 |
| 175 | 14.58 | 0.87 | 0.248 | 0.085 | ( 0.106) | 0.162 |
| 176 | 14.67 | 0.87 | 0.248 | 0.085 | ( 0.106) | 0.163 |
| 177 | 14.75 | 0.87 | 0.248 | 0.084 | ( 0.106) | 0.163 |
| 178 | 14.83 | 0.83 | 0.238 | 0.084 | ( 0.102) | 0.154 |
| 179 | 14.92 | 0.83 | 0.238 | 0.083 | ( 0.102) | 0.155 |
| 180 | 15.00 | 0.83 | 0.238 | 0.083 | ( 0.102) | 0.155 |
| 181 | 15.08 | 0.80 | 0.228 | 0.083 | ( 0.098) | 0.146 |
| 182 | 15.17 | 0.80 | 0.228 | 0.082 | ( 0.098) | 0.146 |
| 183 | 15.25 | 0.80 | 0.228 | 0.082 | ( 0.098) | 0.147 |
| 184 | 15.33 | 0.77 | 0.219 | 0.081 | ( 0.094) | 0.138 |
| 185 | 15.42 | 0.77 | 0.219 | 0.081 | ( 0.094) | 0.138 |
| 186 | 15.50 | 0.77 | 0.219 | 0.080 | ( 0.094) | 0.139 |
| 187 | 15.58 | 0.63 | 0.181 | ( 0.080) | 0.078 | 0.103 |
| 188 | 15.67 | 0.63 | 0.181 | ( 0.080) | 0.078 | 0.103 |
| 189 | 15.75 | 0.63 | 0.181 | ( 0.079) | 0.078 | 0.103 |
| 190 | 15.83 | 0.63 | 0.181 | ( 0.079) | 0.078 | 0.103 |
| 191 | 15.92 | 0.63 | 0.181 | ( 0.078) | 0.078 | 0.103 |
| 192 | 16.00 | 0.63 | 0.181 | ( 0.078) | 0.078 | 0.103 |
| 193 | 16.08 | 0.13 | 0.038 | ( 0.078) | 0.016 | 0.022 |
| 194 | 16.17 | 0.13 | 0.038 | ( 0.077) | 0.016 | 0.022 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 195 | 16.25 | 0.13 | 0.038 | ( 0.077) | 0.016 | 0.022 |
| 196 | 16.33 | 0.13 | 0.038 | ( 0.076) | 0.016 | 0.022 |
| 197 | 16.42 | 0.13 | 0.038 | ( 0.076) | 0.016 | 0.022 |
| 198 | 16.50 | 0.13 | 0.038 | ( 0.076) | 0.016 | 0.022 |
| 199 | 16.58 | 0.10 | 0.029 | ( 0.075) | 0.012 | 0.016 |
| 200 | 16.67 | 0.10 | 0.029 | ( 0.075) | 0.012 | 0.016 |
| 201 | 16.75 | 0.10 | 0.029 | ( 0.074) | 0.012 | 0.016 |
| 202 | 16.83 | 0.10 | 0.029 | ( 0.074) | 0.012 | 0.016 |
| 203 | 16.92 | 0.10 | 0.029 | ( 0.074) | 0.012 | 0.016 |
| 204 | 17.00 | 0.10 | 0.029 | ( 0.073) | 0.012 | 0.016 |
| 205 | 17.08 | 0.17 | 0.048 | ( 0.073) | 0.020 | 0.027 |
| 206 | 17.17 | 0.17 | 0.048 | ( 0.073) | 0.020 | 0.027 |
| 207 | 17.25 | 0.17 | 0.048 | ( 0.072) | 0.020 | 0.027 |
| 208 | 17.33 | 0.17 | 0.048 | ( 0.072) | 0.020 | 0.027 |
| 209 | 17.42 | 0.17 | 0.048 | ( 0.072) | 0.020 | 0.027 |
| 210 | 17.50 | 0.17 | 0.048 | ( 0.071) | 0.020 | 0.027 |
| 211 | 17.58 | 0.17 | 0.048 | ( 0.071) | 0.020 | 0.027 |
| 212 | 17.67 | 0.17 | 0.048 | ( 0.070) | 0.020 | 0.027 |
| 213 | 17.75 | 0.17 | 0.048 | ( 0.070) | 0.020 | 0.027 |
| 214 | 17.83 | 0.13 | 0.038 | ( 0.070) | 0.016 | 0.022 |
| 215 | 17.92 | 0.13 | 0.038 | ( 0.069) | 0.016 | 0.022 |
| 216 | 18.00 | 0.13 | 0.038 | ( 0.069) | 0.016 | 0.022 |
| 217 | 18.08 | 0.13 | 0.038 | ( 0.069) | 0.016 | 0.022 |
| 218 | 18.17 | 0.13 | 0.038 | ( 0.068) | 0.016 | 0.022 |
| 219 | 18.25 | 0.13 | 0.038 | ( 0.068) | 0.016 | 0.022 |
| 220 | 18.33 | 0.13 | 0.038 | ( 0.068) | 0.016 | 0.022 |
| 221 | 18.42 | 0.13 | 0.038 | ( 0.067) | 0.016 | 0.022 |
| 222 | 18.50 | 0.13 | 0.038 | ( 0.067) | 0.016 | 0.022 |
| 223 | 18.58 | 0.10 | 0.029 | ( 0.067) | 0.012 | 0.016 |
| 224 | 18.67 | 0.10 | 0.029 | ( 0.066) | 0.012 | 0.016 |
| 225 | 18.75 | 0.10 | 0.029 | ( 0.066) | 0.012 | 0.016 |
| 226 | 18.83 | 0.07 | 0.019 | ( 0.066) | 0.008 | 0.011 |
| 227 | 18.92 | 0.07 | 0.019 | ( 0.065) | 0.008 | 0.011 |
| 228 | 19.00 | 0.07 | 0.019 | ( 0.065) | 0.008 | 0.011 |
| 229 | 19.08 | 0.10 | 0.029 | ( 0.065) | 0.012 | 0.016 |
| 230 | 19.17 | 0.10 | 0.029 | ( 0.065) | 0.012 | 0.016 |
| 231 | 19.25 | 0.10 | 0.029 | ( 0.064) | 0.012 | 0.016 |
| 232 | 19.33 | 0.13 | 0.038 | ( 0.064) | 0.016 | 0.022 |
| 233 | 19.42 | 0.13 | 0.038 | ( 0.064) | 0.016 | 0.022 |
| 234 | 19.50 | 0.13 | 0.038 | ( 0.063) | 0.016 | 0.022 |
| 235 | 19.58 | 0.10 | 0.029 | ( 0.063) | 0.012 | 0.016 |
| 236 | 19.67 | 0.10 | 0.029 | ( 0.063) | 0.012 | 0.016 |
| 237 | 19.75 | 0.10 | 0.029 | ( 0.063) | 0.012 | 0.016 |
| 238 | 19.83 | 0.07 | 0.019 | ( 0.062) | 0.008 | 0.011 |
| 239 | 19.92 | 0.07 | 0.019 | ( 0.062) | 0.008 | 0.011 |
| 240 | 20.00 | 0.07 | 0.019 | ( 0.062) | 0.008 | 0.011 |
| 241 | 20.08 | 0.10 | 0.029 | ( 0.061) | 0.012 | 0.016 |
| 242 | 20.17 | 0.10 | 0.029 | ( 0.061) | 0.012 | 0.016 |
| 243 | 20.25 | 0.10 | 0.029 | ( 0.061) | 0.012 | 0.016 |
| 244 | 20.33 | 0.10 | 0.029 | ( 0.061) | 0.012 | 0.016 |
| 245 | 20.42 | 0.10 | 0.029 | ( 0.060) | 0.012 | 0.016 |
| 246 | 20.50 | 0.10 | 0.029 | ( 0.060) | 0.012 | 0.016 |
| 247 | 20.58 | 0.10 | 0.029 | ( 0.060) | 0.012 | 0.016 |
| 248 | 20.67 | 0.10 | 0.029 | ( 0.060) | 0.012 | 0.016 |
| 249 | 20.75 | 0.10 | 0.029 | ( 0.059) | 0.012 | 0.016 |
| 250 | 20.83 | 0.07 | 0.019 | ( 0.059) | 0.008 | 0.011 |
| 251 | 20.92 | 0.07 | 0.019 | ( 0.059) | 0.008 | 0.011 |
| 252 | 21.00 | 0.07 | 0.019 | ( 0.059) | 0.008 | 0.011 |
| 253 | 21.08 | 0.10 | 0.029 | ( 0.058) | 0.012 | 0.016 |
| 254 | 21.17 | 0.10 | 0.029 | ( 0.058) | 0.012 | 0.016 |
| 255 | 21.25 | 0.10 | 0.029 | ( 0.058) | 0.012 | 0.016 |
| 256 | 21.33 | 0.07 | 0.019 | ( 0.058) | 0.008 | 0.011 |
| 257 | 21.42 | 0.07 | 0.019 | ( 0.057) | 0.008 | 0.011 |
| 258 | 21.50 | 0.07 | 0.019 | ( 0.057) | 0.008 | 0.011 |
| 259 | 21.58 | 0.10 | 0.029 | ( 0.057) | 0.012 | 0.016 |
| 260 | 21.67 | 0.10 | 0.029 | ( 0.057) | 0.012 | 0.016 |
| 261 | 21.75 | 0.10 | 0.029 | ( 0.057) | 0.012 | 0.016 |
| 262 | 21.83 | 0.07 | 0.019 | ( 0.056) | 0.008 | 0.011 |
| 263 | 21.92 | 0.07 | 0.019 | ( 0.056) | 0.008 | 0.011 |
| 264 | 22.00 | 0.07 | 0.019 | ( 0.056) | 0.008 | 0.011 |
| 265 | 22.08 | 0.10 | 0.029 | ( 0.056) | 0.012 | 0.016 |
| 266 | 22.17 | 0.10 | 0.029 | ( 0.056) | 0.012 | 0.016 |
| 267 | 22.25 | 0.10 | 0.029 | ( 0.056) | 0.012 | 0.016 |
| 268 | 22.33 | 0.07 | 0.019 | ( 0.055) | 0.008 | 0.011 |
| 269 | 22.42 | 0.07 | 0.019 | ( 0.055) | 0.008 | 0.011 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 270 | 22.50 | 0.07 | 0.019 | ( 0.055) | 0.008 | 0.011 |
| 271 | 22.58 | 0.07 | 0.019 | ( 0.055) | 0.008 | 0.011 |
| 272 | 22.67 | 0.07 | 0.019 | ( 0.055) | 0.008 | 0.011 |
| 273 | 22.75 | 0.07 | 0.019 | ( 0.055) | 0.008 | 0.011 |
| 274 | 22.83 | 0.07 | 0.019 | ( 0.054) | 0.008 | 0.011 |
| 275 | 22.92 | 0.07 | 0.019 | ( 0.054) | 0.008 | 0.011 |
| 276 | 23.00 | 0.07 | 0.019 | ( 0.054) | 0.008 | 0.011 |
| 277 | 23.08 | 0.07 | 0.019 | ( 0.054) | 0.008 | 0.011 |
| 278 | 23.17 | 0.07 | 0.019 | ( 0.054) | 0.008 | 0.011 |
| 279 | 23.25 | 0.07 | 0.019 | ( 0.054) | 0.008 | 0.011 |
| 280 | 23.33 | 0.07 | 0.019 | ( 0.054) | 0.008 | 0.011 |
| 281 | 23.42 | 0.07 | 0.019 | ( 0.054) | 0.008 | 0.011 |
| 282 | 23.50 | 0.07 | 0.019 | ( 0.053) | 0.008 | 0.011 |
| 283 | 23.58 | 0.07 | 0.019 | ( 0.053) | 0.008 | 0.011 |
| 284 | 23.67 | 0.07 | 0.019 | ( 0.053) | 0.008 | 0.011 |
| 285 | 23.75 | 0.07 | 0.019 | ( 0.053) | 0.008 | 0.011 |
| 286 | 23.83 | 0.07 | 0.019 | ( 0.053) | 0.008 | 0.011 |
| 287 | 23.92 | 0.07 | 0.019 | ( 0.053) | 0.008 | 0.011 |
| 288 | 24.00 | 0.07 | 0.019 | ( 0.053) | 0.008 | 0.011 |

(Loss Rate Not Used)

Sum = 100.0 Sum = 17.1

Flood volume = Effective rainfall 1.43(In)
times area 8.4(Ac.)/[(In)/(Ft.)] = 1.0(Ac.Ft)
Total soil loss = 0.95(In)
Total soil loss = 0.668(Ac.Ft)
Total rainfall = 2.38(In)
Flood volume = 43452.8 Cubic Feet
Total soil loss = 29117.0 Cubic Feet

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Peak flow rate of this hydrograph = 1.969(CFS)

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24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

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Hydrograph in 5 Minute intervals ((CFS))

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| Time(h+m) | Volume Ac.Ft | Q(CFS) | 0 | 2.5 | 5.0 | 7.5 | 10.0 |
|---|---|---|---|---|---|---|---|
| 0+ 5 | 0.0003 | 0.05 | Q | | | | |
| 0+10 | 0.0009 | 0.09 | Q | | | | |
| 0+15 | 0.0016 | 0.09 | Q | | | | |
| 0+20 | 0.0024 | 0.12 | Q | | | | |
| 0+25 | 0.0033 | 0.14 | Q | | | | |
| 0+30 | 0.0043 | 0.14 | Q | | | | |
| 0+35 | 0.0052 | 0.14 | Q | | | | |
| 0+40 | 0.0062 | 0.14 | Q | | | | |
| 0+45 | 0.0071 | 0.14 | Q | | | | |
| 0+50 | 0.0082 | 0.16 | Q | | | | |
| 0+55 | 0.0095 | 0.18 | Q | | | | |
| 1+ 0 | 0.0108 | 0.18 | Q | | | | |
| 1+ 5 | 0.0119 | 0.16 | Q | | | | |
| 1+10 | 0.0128 | 0.14 | Q | | | | |
| 1+15 | 0.0138 | 0.14 | Q | | | | |
| 1+20 | 0.0147 | 0.14 | Q | | | | |
| 1+25 | 0.0157 | 0.14 | Q | | | | |
| 1+30 | 0.0166 | 0.14 | Q | | | | |
| 1+35 | 0.0176 | 0.14 | Q | | | | |
| 1+40 | 0.0185 | 0.14 | Q | | | | |
| 1+45 | 0.0195 | 0.14 | Q | | | | |
| 1+50 | 0.0206 | 0.16 | Q | | | | |
| 1+55 | 0.0218 | 0.18 | Q | | | | |
| 2+ 0 | 0.0231 | 0.18 | Q | | | | |
| 2+ 5 | 0.0244 | 0.18 | Q | | | | |
| 2+10 | 0.0256 | 0.18 | QV | | | | |
| 2+15 | 0.0269 | 0.18 | QV | | | | |
| 2+20 | 0.0282 | 0.18 | QV | | | | |
| 2+25 | 0.0294 | 0.18 | QV | | | | |
| 2+30 | 0.0307 | 0.18 | QV | | | | |
| 2+35 | 0.0321 | 0.21 | QV | | | | |
| 2+40 | 0.0337 | 0.23 | QV | | | | |
| 2+45 | 0.0353 | 0.23 | QV | | | | |
| 2+50 | 0.0369 | 0.23 | QV | | | | |
| 2+55 | 0.0384 | 0.23 | QV | | | | |

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3+ 0       0.0400      0.23  QV        |         |         |         |
3+ 5       0.0416      0.23  QV        |         |         |         |
3+10       0.0432      0.23  QV        |         |         |         |
3+15       0.0448      0.23  QV        |         |         |         |
3+20       0.0464      0.23  QV        |         |         |         |
3+25       0.0479      0.23  QV        |         |         |         |
3+30       0.0495      0.23  QV        |         |         |         |
3+35       0.0511      0.23  Q V       |         |         |         |
3+40       0.0527      0.23  Q V       |         |         |         |
3+45       0.0543      0.23  Q V       |         |         |         |
3+50       0.0560      0.25  |QV       |         |         |         |
3+55       0.0579      0.27  |QV       |         |         |         |
4+ 0       0.0598      0.28  |QV       |         |         |         |
4+ 5       0.0617      0.28  |QV       |         |         |         |
4+10       0.0636      0.28  |QV       |         |         |         |
4+15       0.0655      0.28  |QV       |         |         |         |
4+20       0.0676      0.30  |QV       |         |         |         |
4+25       0.0698      0.32  |QV       |         |         |         |
4+30       0.0720      0.32  |QV       |         |         |         |
4+35       0.0742      0.32  |QV       |         |         |         |
4+40       0.0764      0.32  |Q V      |         |         |         |
4+45       0.0786      0.32  |Q V      |         |         |         |
4+50       0.0810      0.35  |Q V      |         |         |         |
4+55       0.0835      0.37  |Q V      |         |         |         |
5+ 0       0.0861      0.37  |Q V      |         |         |         |
5+ 5       0.0883      0.32  |Q V      |         |         |         |
5+10       0.0902      0.28  |Q V      |         |         |         |
5+15       0.0921      0.28  |Q V      |         |         |         |
5+20       0.0942      0.30  |Q V      |         |         |         |
5+25       0.0964      0.32  |Q V      |         |         |         |
5+30       0.0986      0.32  |Q V      |         |         |         |
5+35       0.1010      0.35  |Q  V     |         |         |         |
5+40       0.1035      0.37  |Q  V     |         |         |         |
5+45       0.1060      0.37  |Q  V     |         |         |         |
5+50       0.1086      0.37  |Q  V     |         |         |         |
5+55       0.1111      0.37  |Q  V     |         |         |         |
6+ 0       0.1136      0.37  |Q  V     |         |         |         |
6+ 5       0.1163      0.39  |Q  V     |         |         |         |
6+10       0.1192      0.41  |Q  V     |         |         |         |
6+15       0.1220      0.41  |Q  V     |         |         |         |
6+20       0.1249      0.41  |Q   V    |         |         |         |
6+25       0.1277      0.41  |Q   V    |         |         |         |
6+30       0.1306      0.41  |Q   V    |         |         |         |
6+35       0.1336      0.44  |Q   V    |         |         |         |
6+40       0.1367      0.46  |Q   V    |         |         |         |
6+45       0.1399      0.46  |Q   V    |         |         |         |
6+50       0.1431      0.46  |Q   V    |         |         |         |
6+55       0.1462      0.46  |Q   V    |         |         |         |
7+ 0       0.1494      0.46  |Q   V    |         |         |         |
7+ 5       0.1525      0.46  |Q    V   |         |         |         |
7+10       0.1557      0.46  |Q    V   |         |         |         |
7+15       0.1589      0.46  |Q    V   |         |         |         |
7+20       0.1622      0.48  |Q    V   |         |         |         |
7+25       0.1657      0.50  | Q   V   |         |         |         |
7+30       0.1692      0.51  | Q   V   |         |         |         |
7+35       0.1728      0.53  | Q   V   |         |         |         |
7+40       0.1766      0.55  | Q    V  |         |         |         |
7+45       0.1804      0.55  | Q    V  |         |         |         |
7+50       0.1844      0.58  | Q    V  |         |         |         |
7+55       0.1885      0.60  | Q    V  |         |         |         |
8+ 0       0.1926      0.60  | Q    V  |         |         |         |
8+ 5       0.1970      0.65  | Q    V  |         |         |         |
8+10       0.2018      0.69  | Q     V |         |         |         |
8+15       0.2065      0.69  | Q     V |         |         |         |
8+20       0.2113      0.69  | Q     V |         |         |         |
8+25       0.2160      0.69  | Q     V |         |         |         |
8+30       0.2208      0.69  | Q     V |         |         |         |
8+35       0.2257      0.71  | Q      V|         |         |         |
8+40       0.2307      0.73  | Q      V|         |         |         |
8+45       0.2358      0.74  | Q      V|         |         |         |
8+50       0.2410      0.76  |  Q     V|         |         |         |
8+55       0.2464      0.78  |  Q     V|         |         |         |
9+ 0       0.2518      0.78  |  Q      V         |         |         |
9+ 5       0.2575      0.83  |  Q      V         |         |         |
9+10       0.2635      0.87  |  Q      V         |         |         |
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| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 9+15 | 0.2695 | 0.87 | Q | V | | | |
| 9+20 | 0.2757 | 0.90 | Q | V | | | |
| 9+25 | 0.2820 | 0.92 | Q | V | | | |
| 9+30 | 0.2883 | 0.92 | Q | V | | | |
| 9+35 | 0.2948 | 0.94 | Q | V | | | |
| 9+40 | 0.3015 | 0.96 | Q | V | | | |
| 9+45 | 0.3081 | 0.97 | Q | V | | | |
| 9+50 | 0.3149 | 0.99 | Q | V | | | |
| 9+55 | 0.3219 | 1.01 | Q | V | | | |
| 10+ 0 | 0.3288 | 1.01 | Q | V | | | |
| 10+ 5 | 0.3346 | 0.84 | Q | V | | | |
| 10+10 | 0.3395 | 0.70 | Q | V | | | |
| 10+15 | 0.3442 | 0.69 | Q | V | | | |
| 10+20 | 0.3489 | 0.69 | Q | V | | | |
| 10+25 | 0.3537 | 0.69 | Q | V | | | |
| 10+30 | 0.3584 | 0.69 | Q | V | | | |
| 10+35 | 0.3640 | 0.81 | Q | V | | | |
| 10+40 | 0.3703 | 0.91 | Q | V | | | |
| 10+45 | 0.3766 | 0.92 | Q | V | | | |
| 10+50 | 0.3830 | 0.92 | Q | V | | | |
| 10+55 | 0.3893 | 0.92 | Q | V | | | |
| 11+ 0 | 0.3956 | 0.92 | Q | V | | | |
| 11+ 5 | 0.4018 | 0.89 | Q | V | | | |
| 11+10 | 0.4078 | 0.87 | Q | V | | | |
| 11+15 | 0.4138 | 0.87 | Q | V | | | |
| 11+20 | 0.4198 | 0.87 | Q | V | | | |
| 11+25 | 0.4259 | 0.87 | Q | V | | | |
| 11+30 | 0.4319 | 0.87 | Q | V | | | |
| 11+35 | 0.4376 | 0.82 | Q | V | | | |
| 11+40 | 0.4430 | 0.78 | Q | V | | | |
| 11+45 | 0.4483 | 0.78 | Q | V | | | |
| 11+50 | 0.4539 | 0.81 | Q | V | | | |
| 11+55 | 0.4596 | 0.83 | Q | V | | | |
| 12+ 0 | 0.4653 | 0.83 | Q | V | | | |
| 12+ 5 | 0.4722 | 1.01 | Q | V | | | |
| 12+10 | 0.4803 | 1.17 | Q | V | | | |
| 12+15 | 0.4884 | 1.18 | Q | V | | | |
| 12+20 | 0.4969 | 1.23 | Q | V | | | |
| 12+25 | 0.5056 | 1.27 | Q | V | | | |
| 12+30 | 0.5144 | 1.28 | Q | V | | | |
| 12+35 | 0.5238 | 1.36 | Q | V | | | |
| 12+40 | 0.5337 | 1.44 | Q | V | | | |
| 12+45 | 0.5437 | 1.45 | Q | V | | | |
| 12+50 | 0.5540 | 1.50 | Q | V | | | |
| 12+55 | 0.5646 | 1.54 | Q | V | | | |
| 13+ 0 | 0.5752 | 1.54 | Q | V | | | |
| 13+ 5 | 0.5873 | 1.76 | Q | V | | | |
| 13+10 | 0.6007 | 1.94 | Q | V | | | |
| 13+15 | 0.6141 | 1.96 | Q | V | | | |
| 13+20 | 0.6276 | 1.96 | Q | V | | | |
| 13+25 | 0.6412 | 1.97 | Q | V | | | |
| 13+30 | 0.6547 | 1.97 | Q | V | | | |
| 13+35 | 0.6651 | 1.51 | Q | V | | | |
| 13+40 | 0.6728 | 1.12 | Q | V | | | |
| 13+45 | 0.6804 | 1.09 | Q | V | | | |
| 13+50 | 0.6879 | 1.10 | Q | V | | | |
| 13+55 | 0.6955 | 1.10 | Q | V | | | |
| 14+ 0 | 0.7031 | 1.11 | Q | V | | | |
| 14+ 5 | 0.7119 | 1.28 | Q | V | | | |
| 14+10 | 0.7217 | 1.42 | Q | V | | | |
| 14+15 | 0.7317 | 1.44 | Q | V | | | |
| 14+20 | 0.7413 | 1.40 | Q | V | | | |
| 14+25 | 0.7507 | 1.37 | Q | V | | | |
| 14+30 | 0.7602 | 1.37 | Q | V | | | |
| 14+35 | 0.7696 | 1.37 | Q | V | | | |
| 14+40 | 0.7791 | 1.38 | Q | V | | | |
| 14+45 | 0.7886 | 1.38 | Q | V | | | |
| 14+50 | 0.7979 | 1.34 | Q | V | | | |
| 14+55 | 0.8069 | 1.31 | Q | V | | | |
| 15+ 0 | 0.8159 | 1.31 | Q | V | | | |
| 15+ 5 | 0.8247 | 1.27 | Q | V | | | |
| 15+10 | 0.8332 | 1.24 | Q | V | | | |
| 15+15 | 0.8418 | 1.24 | Q | V | | | |
| 15+20 | 0.8501 | 1.20 | Q | V | | | |
| 15+25 | 0.8581 | 1.17 | Q | V | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 15+30 | 0.8662 | 1.17 | \| Q | \| | \| | \| V | \| |
| 15+35 | 0.8732 | 1.01 | \| Q | \| | \| | \| V | \| |
| 15+40 | 0.8793 | 0.88 | \| Q | \| | \| | \| V | \| |
| 15+45 | 0.8853 | 0.87 | \| Q | \| | \| | \| V | \| |
| 15+50 | 0.8913 | 0.87 | \| Q | \| | \| | \| V | \| |
| 15+55 | 0.8973 | 0.87 | \| Q | \| | \| | \| V | \| |
| 16+ 0 | 0.9033 | 0.87 | \| Q | \| | \| | \| V | \| |
| 16+ 5 | 0.9068 | 0.51 | \| Q | \| | \| | \| V | \| |
| 16+10 | 0.9083 | 0.21 | Q | \| | \| | \| V | \| |
| 16+15 | 0.9095 | 0.18 | Q | \| | \| | \| V | \| |
| 16+20 | 0.9108 | 0.18 | Q | \| | \| | \| V | \| |
| 16+25 | 0.9121 | 0.18 | Q | \| | \| | \| V | \| |
| 16+30 | 0.9133 | 0.18 | Q | \| | \| | \| V | \| |
| 16+35 | 0.9144 | 0.16 | Q | \| | \| | \| V | \| |
| 16+40 | 0.9154 | 0.14 | Q | \| | \| | \| V | \| |
| 16+45 | 0.9163 | 0.14 | Q | \| | \| | \| V | \| |
| 16+50 | 0.9173 | 0.14 | Q | \| | \| | \| V | \| |
| 16+55 | 0.9182 | 0.14 | Q | \| | \| | \| V | \| |
| 17+ 0 | 0.9192 | 0.14 | Q | \| | \| | \| V | \| |
| 17+ 5 | 0.9205 | 0.19 | Q | \| | \| | \| V | \| |
| 17+10 | 0.9220 | 0.23 | Q | \| | \| | \| V | \| |
| 17+15 | 0.9236 | 0.23 | Q | \| | \| | \| V | \| |
| 17+20 | 0.9252 | 0.23 | Q | \| | \| | \| V | \| |
| 17+25 | 0.9268 | 0.23 | Q | \| | \| | \| V | \| |
| 17+30 | 0.9284 | 0.23 | Q | \| | \| | \| V | \| |
| 17+35 | 0.9299 | 0.23 | Q | \| | \| | \| V | \| |
| 17+40 | 0.9315 | 0.23 | Q | \| | \| | \| V | \| |
| 17+45 | 0.9331 | 0.23 | Q | \| | \| | \| V | \| |
| 17+50 | 0.9345 | 0.21 | Q | \| | \| | \| V | \| |
| 17+55 | 0.9358 | 0.19 | Q | \| | \| | \| V | \| |
| 18+ 0 | 0.9371 | 0.18 | Q | \| | \| | \| V | \| |
| 18+ 5 | 0.9383 | 0.18 | Q | \| | \| | \| V | \| |
| 18+10 | 0.9396 | 0.18 | Q | \| | \| | \| V | \| |
| 18+15 | 0.9409 | 0.18 | Q | \| | \| | \| V | \| |
| 18+20 | 0.9421 | 0.18 | Q | \| | \| | \| V | \| |
| 18+25 | 0.9434 | 0.18 | Q | \| | \| | \| V | \| |
| 18+30 | 0.9447 | 0.18 | Q | \| | \| | \| V | \| |
| 18+35 | 0.9458 | 0.16 | Q | \| | \| | \| V | \| |
| 18+40 | 0.9467 | 0.14 | Q | \| | \| | \| V | \| |
| 18+45 | 0.9477 | 0.14 | Q | \| | \| | \| V | \| |
| 18+50 | 0.9485 | 0.11 | Q | \| | \| | \| V | \| |
| 18+55 | 0.9491 | 0.09 | Q | \| | \| | \| V | \| |
| 19+ 0 | 0.9497 | 0.09 | Q | \| | \| | \| V | \| |
| 19+ 5 | 0.9505 | 0.12 | Q | \| | \| | \| V | \| |
| 19+10 | 0.9515 | 0.14 | Q | \| | \| | \| V | \| |
| 19+15 | 0.9524 | 0.14 | Q | \| | \| | \| V | \| |
| 19+20 | 0.9535 | 0.16 | Q | \| | \| | \| V | \| |
| 19+25 | 0.9548 | 0.18 | Q | \| | \| | \| V | \| |
| 19+30 | 0.9561 | 0.18 | Q | \| | \| | \| V | \| |
| 19+35 | 0.9572 | 0.16 | Q | \| | \| | \| V | \| |
| 19+40 | 0.9581 | 0.14 | Q | \| | \| | \| V | \| |
| 19+45 | 0.9591 | 0.14 | Q | \| | \| | \| V | \| |
| 19+50 | 0.9599 | 0.11 | Q | \| | \| | \| V | \| |
| 19+55 | 0.9605 | 0.09 | Q | \| | \| | \| V | \| |
| 20+ 0 | 0.9611 | 0.09 | Q | \| | \| | \| V | \| |
| 20+ 5 | 0.9619 | 0.12 | Q | \| | \| | \| V | \| |
| 20+10 | 0.9629 | 0.14 | Q | \| | \| | \| V | \| |
| 20+15 | 0.9638 | 0.14 | Q | \| | \| | \| V | \| |
| 20+20 | 0.9648 | 0.14 | Q | \| | \| | \| V | \| |
| 20+25 | 0.9657 | 0.14 | Q | \| | \| | \| V | \| |
| 20+30 | 0.9667 | 0.14 | Q | \| | \| | \| V | \| |
| 20+35 | 0.9676 | 0.14 | Q | \| | \| | \| V | \| |
| 20+40 | 0.9686 | 0.14 | Q | \| | \| | \| V | \| |
| 20+45 | 0.9695 | 0.14 | Q | \| | \| | \| V | \| |
| 20+50 | 0.9703 | 0.11 | Q | \| | \| | \| V | \| |
| 20+55 | 0.9709 | 0.09 | Q | \| | \| | \| V | \| |
| 21+ 0 | 0.9716 | 0.09 | Q | \| | \| | \| V | \| |
| 21+ 5 | 0.9724 | 0.12 | Q | \| | \| | \| V | \| |
| 21+10 | 0.9733 | 0.14 | Q | \| | \| | \| V | \| |
| 21+15 | 0.9743 | 0.14 | Q | \| | \| | \| V | \| |
| 21+20 | 0.9750 | 0.11 | Q | \| | \| | \| V | \| |
| 21+25 | 0.9757 | 0.09 | Q | \| | \| | \| V | \| |
| 21+30 | 0.9763 | 0.09 | Q | \| | \| | \| V | \| |
| 21+35 | 0.9771 | 0.12 | Q | \| | \| | \| V | \| |
| 21+40 | 0.9781 | 0.14 | Q | \| | \| | \| V | \| |

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  21+45       0.9790      0.14  Q          |          |          |         V|
  21+50       0.9798      0.11  Q          |          |          |         V|
  21+55       0.9804      0.09  Q          |          |          |         V|
  22+ 0       0.9811      0.09  Q          |          |          |         V|
  22+ 5       0.9819      0.12  Q          |          |          |         V|
  22+10       0.9828      0.14  Q          |          |          |         V|
  22+15       0.9838      0.14  Q          |          |          |         V|
  22+20       0.9845      0.11  Q          |          |          |         V|
  22+25       0.9852      0.09  Q          |          |          |         V|
  22+30       0.9858      0.09  Q          |          |          |         V|
  22+35       0.9865      0.09  Q          |          |          |         V|
  22+40       0.9871      0.09  Q          |          |          |         V|
  22+45       0.9877      0.09  Q          |          |          |         V|
  22+50       0.9884      0.09  Q          |          |          |         V|
  22+55       0.9890      0.09  Q          |          |          |         V|
  23+ 0       0.9896      0.09  Q          |          |          |         V|
  23+ 5       0.9903      0.09  Q          |          |          |         V|
  23+10       0.9909      0.09  Q          |          |          |         V|
  23+15       0.9915      0.09  Q          |          |          |         V|
  23+20       0.9922      0.09  Q          |          |          |         V|
  23+25       0.9928      0.09  Q          |          |          |         V|
  23+30       0.9934      0.09  Q          |          |          |         V|
  23+35       0.9941      0.09  Q          |          |          |         V|
  23+40       0.9947      0.09  Q          |          |          |         V|
  23+45       0.9953      0.09  Q          |          |          |         V|
  23+50       0.9960      0.09  Q          |          |          |         V|
  23+55       0.9966      0.09  Q          |          |          |         V|
  24+ 0       0.9972      0.09  Q          |          |          |         V|
  24+ 5       0.9975      0.04  Q          |          |          |         V|
  24+10       0.9975      0.00  Q          |          |          |          V
-------------------------------------------------------------------------------
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# Detention Basin Routing

FLOOD HYDROGRAPH ROUTING PROGRAM
Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2005
Study date: 01/31/18

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Tract 37305 – Nichols Road Development
Drainage Area A – 51.4 Ac
Detention Basin Routing
2-year 24-hour storm

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Program License Serial Number 4029

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********** HYDROGRAPH INFORMATION **********

From study/file name: nrareaapr2242.rte

**********HYDROGRAPH DATA**********

Number of intervals = 293
Time interval = 5.0 (Min.)
Maximum/Peak flow rate = 13.116 (CFS)
Total volume = 6.986 (Ac.Ft)

Status of hydrographs being held in storage

| | Stream 1 | Stream 2 | Stream 3 | Stream 4 | Stream 5 |
|---|---|---|---|---|---|
| Peak (CFS) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Vol (Ac.Ft) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

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Process from Point/Station 10.000 to Point/Station 11.000
**** RETARDING BASIN ROUTING ****

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User entry of depth-outflow-storage data

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Total number of inflow hydrograph intervals = 293
Hydrograph time unit = 5.000 (Min.)
Initial depth in storage basin = 0.00(Ft.)

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

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Depth vs. Storage and Depth vs. Discharge data:

| Basin Depth (Ft.) | Storage (Ac.Ft) | Outflow (CFS) | (S-O*dt/2) (Ac.Ft) | (S+O*dt/2) (Ac.Ft) |
|---|---|---|---|---|
| 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1.000 | 0.110 | 2.980 | 0.100 | 0.120 |
| 2.000 | 0.620 | 5.170 | 0.602 | 0.638 |
| 3.000 | 1.540 | 6.670 | 1.517 | 1.563 |
| 4.000 | 2.890 | 7.900 | 2.863 | 2.917 |
| 5.000 | 4.550 | 19.560 | 4.483 | 4.617 |
| 6.000 | 6.400 | 65.010 | 6.176 | 6.624 |
| 7.000 | 8.470 | 129.350 | 8.025 | 8.915 |

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Hydrograph Detention Basin Routing

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

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| Time (Hours) | Inflow (CFS) | Outflow (CFS) | Storage (Ac.Ft) | .0 | 3.3 | 6.56 | 9.84 | 13.12 | Depth (Ft.) |
|---|---|---|---|---|---|---|---|---|---|
| 0.083 | 0.15 | 0.01 | 0.000 | O | \| | \| | \| | \| | 0.00 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0.167 | 0.52 | 0.07 | 0.003 | OI | | | | 0.02 |
| 0.250 | 0.61 | 0.15 | 0.006 | OI | | | | 0.05 |
| 0.333 | 0.72 | 0.24 | 0.009 | OI | | | | 0.08 |
| 0.417 | 0.91 | 0.34 | 0.012 | O I | | | | 0.11 |
| 0.500 | 0.96 | 0.44 | 0.016 | \|OI | | | | 0.15 |
| 0.583 | 0.97 | 0.53 | 0.020 | \|OI | | | | 0.18 |
| 0.667 | 0.98 | 0.60 | 0.022 | \|OI | | | | 0.20 |
| 0.750 | 0.98 | 0.67 | 0.025 | \|OI | | | | 0.22 |
| 0.833 | 1.05 | 0.73 | 0.027 | \|OI | | | | 0.24 |
| 0.917 | 1.24 | 0.80 | 0.029 | \|O I | | | | 0.27 |
| 1.000 | 1.28 | 0.88 | 0.032 | \| OI | | | | 0.29 |
| 1.083 | 1.22 | 0.94 | 0.035 | \| O | | | | 0.32 |
| 1.167 | 1.04 | 0.97 | 0.036 | \| O | | | | 0.33 |
| 1.250 | 1.00 | 0.98 | 0.036 | \| O | | | | 0.33 |
| 1.333 | 0.98 | 0.98 | 0.036 | \| O | | | | 0.33 |
| 1.417 | 0.98 | 0.98 | 0.036 | \| O | | | | 0.33 |
| 1.500 | 0.98 | 0.98 | 0.036 | \| O | | | | 0.33 |
| 1.583 | 0.98 | 0.98 | 0.036 | \| O | | | | 0.33 |
| 1.667 | 0.98 | 0.98 | 0.036 | \| O | | | | 0.33 |
| 1.750 | 0.98 | 0.98 | 0.036 | \| O | | | | 0.33 |
| 1.833 | 1.05 | 0.99 | 0.036 | \| O | | | | 0.33 |
| 1.917 | 1.24 | 1.01 | 0.037 | \| OI | | | | 0.34 |
| 2.000 | 1.28 | 1.05 | 0.039 | \| OI | | | | 0.35 |
| 2.083 | 1.30 | 1.10 | 0.040 | \| OI | | | | 0.37 |
| 2.167 | 1.30 | 1.13 | 0.042 | \| OI | | | | 0.38 |
| 2.250 | 1.30 | 1.16 | 0.043 | \| OI | | | | 0.39 |
| 2.333 | 1.30 | 1.18 | 0.044 | \| OI | | | | 0.40 |
| 2.417 | 1.30 | 1.20 | 0.044 | \| OI | | | | 0.40 |
| 2.500 | 1.30 | 1.22 | 0.045 | \| OI | | | | 0.41 |
| 2.583 | 1.38 | 1.24 | 0.046 | \| O | | | | 0.42 |
| 2.667 | 1.56 | 1.28 | 0.047 | \| O | | | | 0.43 |
| 2.750 | 1.61 | 1.33 | 0.049 | \| O | | | | 0.45 |
| 2.833 | 1.62 | 1.38 | 0.051 | \| O | | | | 0.46 |
| 2.917 | 1.63 | 1.42 | 0.053 | \| O | | | | 0.48 |
| 3.000 | 1.63 | 1.46 | 0.054 | \| O | | | | 0.49 |
| 3.083 | 1.63 | 1.49 | 0.055 | \| O | | | | 0.50 |
| 3.167 | 1.63 | 1.51 | 0.056 | \| O | | | | 0.51 |
| 3.250 | 1.63 | 1.53 | 0.057 | \| O | | | | 0.51 |
| 3.333 | 1.63 | 1.55 | 0.057 | \| O | | | | 0.52 |
| 3.417 | 1.63 | 1.56 | 0.058 | \| O | | | | 0.52 |
| 3.500 | 1.63 | 1.57 | 0.058 | \| O | | | | 0.53 |
| 3.583 | 1.63 | 1.58 | 0.058 | \| O | | | | 0.53 |
| 3.667 | 1.63 | 1.59 | 0.059 | \| O | | | | 0.53 |
| 3.750 | 1.63 | 1.60 | 0.059 | \| O | | | | 0.54 |
| 3.833 | 1.71 | 1.61 | 0.059 | \| OI | | | | 0.54 |
| 3.917 | 1.89 | 1.64 | 0.061 | \| O | | | | 0.55 |
| 4.000 | 1.93 | 1.69 | 0.062 | \| O | | | | 0.57 |
| 4.083 | 1.95 | 1.73 | 0.064 | \| O | | | | 0.58 |
| 4.167 | 1.95 | 1.77 | 0.065 | \| O | | | | 0.59 |
| 4.250 | 1.95 | 1.80 | 0.066 | \| O | | | | 0.60 |
| 4.333 | 2.03 | 1.83 | 0.068 | \| O | | | | 0.61 |
| 4.417 | 2.21 | 1.88 | 0.069 | \| OI | | | | 0.63 |
| 4.500 | 2.26 | 1.94 | 0.072 | \| OI | | | | 0.65 |
| 4.583 | 2.27 | 2.00 | 0.074 | \| OI | | | | 0.67 |
| 4.667 | 2.28 | 2.05 | 0.075 | \| OI | | | | 0.69 |
| 4.750 | 2.28 | 2.08 | 0.077 | \| O | | | | 0.70 |
| 4.833 | 2.36 | 2.12 | 0.078 | \| O | | | | 0.71 |
| 4.917 | 2.54 | 2.18 | 0.080 | \| OI | | | | 0.73 |
| 5.000 | 2.59 | 2.24 | 0.083 | \| OI | | | | 0.75 |
| 5.083 | 2.45 | 2.29 | 0.085 | \| O | | | | 0.77 |
| 5.167 | 2.09 | 2.29 | 0.084 | \| O | | | | 0.77 |
| 5.250 | 1.99 | 2.24 | 0.083 | \| IO | | | | 0.75 |
| 5.333 | 2.04 | 2.21 | 0.081 | \| IO | | | | 0.74 |
| 5.417 | 2.22 | 2.19 | 0.081 | \| O | | | | 0.74 |
| 5.500 | 2.26 | 2.20 | 0.081 | \| O | | | | 0.74 |
| 5.583 | 2.35 | 2.22 | 0.082 | \| O | | | | 0.74 |
| 5.667 | 2.54 | 2.26 | 0.083 | \| OI | | | | 0.76 |
| 5.750 | 2.59 | 2.31 | 0.085 | \| OI | | | | 0.77 |
| 5.833 | 2.60 | 2.36 | 0.087 | \| OI | | | | 0.79 |
| 5.917 | 2.60 | 2.40 | 0.089 | \| OI | | | | 0.80 |
| 6.000 | 2.60 | 2.43 | 0.090 | \| OI | | | | 0.82 |
| 6.083 | 2.68 | 2.47 | 0.091 | \| O | | | | 0.83 |
| 6.167 | 2.86 | 2.52 | 0.093 | \| O | | | | 0.85 |
| 6.250 | 2.91 | 2.58 | 0.095 | \| OI\| | | | | 0.87 |
| 6.333 | 2.93 | 2.64 | 0.097 | \| OI\| | | | | 0.89 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 6.417 | 2.93 | 2.69 | 0.099 | OI | | | | | 0.90 |
| 6.500 | 2.93 | 2.73 | 0.101 | OI | | | | | 0.92 |
| 6.583 | 3.01 | 2.77 | 0.102 | OI | | | | | 0.93 |
| 6.667 | 3.19 | 2.83 | 0.104 | OI | | | | | 0.95 |
| 6.750 | 3.24 | 2.89 | 0.107 | O | | | | | 0.97 |
| 6.833 | 3.25 | 2.95 | 0.109 | O | | | | | 0.99 |
| 6.917 | 3.25 | 2.98 | 0.111 | O | | | | | 1.00 |
| 7.000 | 3.26 | 2.99 | 0.113 | O | | | | | 1.01 |
| 7.083 | 3.26 | 3.00 | 0.115 | O | | | | | 1.01 |
| 7.167 | 3.26 | 3.01 | 0.116 | O | | | | | 1.01 |
| 7.250 | 3.26 | 3.01 | 0.118 | O | | | | | 1.02 |
| 7.333 | 3.33 | 3.02 | 0.120 | OI | | | | | 1.02 |
| 7.417 | 3.52 | 3.03 | 0.123 | OI | | | | | 1.02 |
| 7.500 | 3.56 | 3.05 | 0.126 | OI | | | | | 1.03 |
| 7.583 | 3.65 | 3.07 | 0.130 | OI | | | | | 1.04 |
| 7.667 | 3.84 | 3.09 | 0.134 | O | I | | | | 1.05 |
| 7.750 | 3.89 | 3.11 | 0.140 | O | I | | | | 1.06 |
| 7.833 | 3.98 | 3.13 | 0.145 | O | I | | | | 1.07 |
| 7.917 | 4.16 | 3.16 | 0.152 | O | I | | | | 1.08 |
| 8.000 | 4.21 | 3.19 | 0.159 | O | I | | | | 1.10 |
| 8.083 | 4.38 | 3.22 | 0.166 | O | I | | | | 1.11 |
| 8.167 | 4.75 | 3.26 | 0.175 | O | I | | | | 1.13 |
| 8.250 | 4.85 | 3.31 | 0.186 | O | I | | | | 1.15 |
| 8.333 | 4.87 | 3.35 | 0.196 | O | I | | | | 1.17 |
| 8.417 | 4.88 | 3.40 | 0.207 | O | I | | | | 1.19 |
| 8.500 | 4.88 | 3.44 | 0.217 | O | I | | | | 1.21 |
| 8.583 | 4.96 | 3.48 | 0.227 | O | I | | | | 1.23 |
| 8.667 | 5.14 | 3.53 | 0.238 | O | I | | | | 1.25 |
| 8.750 | 5.19 | 3.58 | 0.249 | O | I | | | | 1.27 |
| 8.833 | 5.28 | 3.62 | 0.260 | O | I | | | | 1.29 |
| 8.917 | 5.47 | 3.67 | 0.272 | O | I | | | | 1.32 |
| 9.000 | 5.52 | 3.73 | 0.284 | O | I | | | | 1.34 |
| 9.083 | 5.68 | 3.78 | 0.297 | O | I | | | | 1.37 |
| 9.167 | 6.05 | 3.84 | 0.311 | O | I | | | | 1.39 |
| 9.250 | 6.15 | 3.91 | 0.326 | O | I | | | | 1.42 |
| 9.333 | 6.25 | 3.98 | 0.342 | O | I | | | | 1.45 |
| 9.417 | 6.44 | 4.04 | 0.358 | O | I | | | | 1.49 |
| 9.500 | 6.49 | 4.12 | 0.374 | O | I | | | | 1.52 |
| 9.583 | 6.58 | 4.19 | 0.391 | O | I | | | | 1.55 |
| 9.667 | 6.77 | 4.26 | 0.408 | O | I | | | | 1.58 |
| 9.750 | 6.82 | 4.33 | 0.425 | O | I | | | | 1.62 |
| 9.833 | 6.91 | 4.41 | 0.442 | O | I | | | | 1.65 |
| 9.917 | 7.10 | 4.48 | 0.460 | O | I | | | | 1.69 |
| 10.000 | 7.14 | 4.56 | 0.478 | O | I | | | | 1.72 |
| 10.083 | 6.62 | 4.63 | 0.493 | O | I | | | | 1.75 |
| 10.167 | 5.35 | 4.67 | 0.503 | O | I | | | | 1.77 |
| 10.250 | 5.02 | 4.68 | 0.506 | O | I | | | | 1.78 |
| 10.333 | 4.92 | 4.69 | 0.508 | O | I | | | | 1.78 |
| 10.417 | 4.90 | 4.70 | 0.510 | O | | | | | 1.78 |
| 10.500 | 4.88 | 4.70 | 0.511 | O | | | | | 1.79 |
| 10.583 | 5.27 | 4.71 | 0.513 | O | I | | | | 1.79 |
| 10.667 | 6.18 | 4.74 | 0.520 | O | I | | | | 1.80 |
| 10.750 | 6.42 | 4.79 | 0.531 | O | I | | | | 1.83 |
| 10.833 | 6.49 | 4.84 | 0.542 | O | I | | | | 1.85 |
| 10.917 | 6.50 | 4.88 | 0.553 | O | I | | | | 1.87 |
| 11.000 | 6.51 | 4.93 | 0.564 | O | I | | | | 1.89 |
| 11.083 | 6.44 | 4.98 | 0.575 | O | I | | | | 1.91 |
| 11.167 | 6.25 | 5.02 | 0.584 | O | I | | | | 1.93 |
| 11.250 | 6.21 | 5.05 | 0.592 | O | I | | | | 1.95 |
| 11.333 | 6.19 | 5.09 | 0.600 | O | I | | | | 1.96 |
| 11.417 | 6.19 | 5.12 | 0.608 | O | I | | | | 1.98 |
| 11.500 | 6.19 | 5.15 | 0.615 | O | I | | | | 1.99 |
| 11.583 | 6.03 | 5.17 | 0.622 | O | I | | | | 2.00 |
| 11.667 | 5.67 | 5.18 | 0.626 | O | I | | | | 2.01 |
| 11.750 | 5.57 | 5.19 | 0.629 | O | I | | | | 2.01 |
| 11.833 | 5.62 | 5.19 | 0.632 | O | I | | | | 2.01 |
| 11.917 | 5.80 | 5.20 | 0.636 | O | I | | | | 2.02 |
| 12.000 | 5.84 | 5.20 | 0.640 | O | I | | | | 2.02 |
| 12.083 | 6.45 | 5.21 | 0.646 | O | I | | | | 2.03 |
| 12.167 | 7.86 | 5.23 | 0.660 | O | | I | | | 2.04 |
| 12.250 | 8.24 | 5.27 | 0.679 | O | | I | | | 2.06 |
| 12.333 | 8.48 | 5.30 | 0.700 | O | | I | | | 2.09 |
| 12.417 | 8.81 | 5.34 | 0.723 | O | | I | | | 2.11 |
| 12.500 | 8.91 | 5.38 | 0.747 | O | | I | | | 2.14 |
| 12.583 | 9.18 | 5.42 | 0.772 | O | | I | | | 2.17 |

| | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 18.917 | 0.72 | 4.91 | 0.559 | I | O | | | 1.88 |
| 19.000 | 0.67 | 4.79 | 0.531 | I | O | | | 1.82 |
| 19.083 | 0.73 | 4.67 | 0.503 | I | O | | | 1.77 |
| 19.167 | 0.91 | 4.56 | 0.477 | I | O | | | 1.72 |
| 19.250 | 0.96 | 4.45 | 0.452 | I | O | | | 1.67 |
| 19.333 | 1.05 | 4.35 | 0.429 | I | O | | | 1.63 |
| 19.417 | 1.23 | 4.26 | 0.407 | I | O | | | 1.58 |
| 19.500 | 1.28 | 4.17 | 0.387 | I | O | | | 1.54 |
| 19.583 | 1.22 | 4.08 | 0.367 | I | O | | | 1.50 |
| 19.667 | 1.04 | 4.00 | 0.347 | I | O | | | 1.46 |
| 19.750 | 1.00 | 3.91 | 0.327 | I | O | | | 1.42 |
| 19.833 | 0.90 | 3.82 | 0.307 | I | O | | | 1.39 |
| 19.917 | 0.72 | 3.74 | 0.286 | I | O | | | 1.35 |
| 20.000 | 0.67 | 3.65 | 0.266 | I | O | | | 1.31 |
| 20.083 | 0.73 | 3.56 | 0.246 | I | O | | | 1.27 |
| 20.167 | 0.91 | 3.48 | 0.227 | I | O | | | 1.23 |
| 20.250 | 0.96 | 3.41 | 0.210 | I | O | | | 1.20 |
| 20.333 | 0.97 | 3.34 | 0.193 | I | O | | | 1.16 |
| 20.417 | 0.98 | 3.27 | 0.177 | I | O | | | 1.13 |
| 20.500 | 0.98 | 3.20 | 0.162 | I | O | | | 1.10 |
| 20.583 | 0.98 | 3.14 | 0.146 | I | O | | | 1.07 |
| 20.667 | 0.98 | 3.07 | 0.132 | I | O | | | 1.04 |
| 20.750 | 0.98 | 3.01 | 0.118 | I | O | | | 1.01 |
| 20.833 | 0.90 | 2.82 | 0.104 | I | O | | | 0.94 |
| 20.917 | 0.72 | 2.47 | 0.091 | I | O | | | 0.83 |
| 21.000 | 0.67 | 2.17 | 0.080 | I | O | | | 0.73 |
| 21.083 | 0.73 | 1.92 | 0.071 | I | O | | | 0.64 |
| 21.167 | 0.91 | 1.73 | 0.064 | I | O | | | 0.58 |
| 21.250 | 0.96 | 1.60 | 0.059 | I | O | | | 0.54 |
| 21.333 | 0.89 | 1.48 | 0.055 | I | O | | | 0.50 |
| 21.417 | 0.72 | 1.37 | 0.050 | I | O | | | 0.46 |
| 21.500 | 0.67 | 1.25 | 0.046 | I | O | | | 0.42 |
| 21.583 | 0.73 | 1.16 | 0.043 | I | O | | | 0.39 |
| 21.667 | 0.91 | 1.10 | 0.041 | I | O | | | 0.37 |
| 21.750 | 0.96 | 1.07 | 0.040 | I | O | | | 0.36 |
| 21.833 | 0.89 | 1.05 | 0.039 | I | O | | | 0.35 |
| 21.917 | 0.72 | 1.01 | 0.037 | I | O | | | 0.34 |
| 22.000 | 0.67 | 0.95 | 0.035 | I | O | | | 0.32 |
| 22.083 | 0.73 | 0.91 | 0.034 | I | O | | | 0.31 |
| 22.167 | 0.91 | 0.89 | 0.033 | I | O | | | 0.30 |
| 22.250 | 0.96 | 0.90 | 0.033 | I | O | | | 0.30 |
| 22.333 | 0.89 | 0.91 | 0.033 | I | O | | | 0.30 |
| 22.417 | 0.72 | 0.89 | 0.033 | I | O | | | 0.30 |
| 22.500 | 0.67 | 0.86 | 0.032 | I | O | | | 0.29 |
| 22.583 | 0.66 | 0.82 | 0.030 | I | O | | | 0.28 |
| 22.667 | 0.65 | 0.79 | 0.029 | I | O | | | 0.27 |
| 22.750 | 0.65 | 0.77 | 0.028 | I | O | | | 0.26 |
| 22.833 | 0.65 | 0.75 | 0.028 | I | O | | | 0.25 |
| 22.917 | 0.65 | 0.73 | 0.027 | I | O | | | 0.25 |
| 23.000 | 0.65 | 0.72 | 0.027 | I | O | | | 0.24 |
| 23.083 | 0.65 | 0.71 | 0.026 | I | O | | | 0.24 |
| 23.167 | 0.65 | 0.70 | 0.026 | I | O | | | 0.23 |
| 23.250 | 0.65 | 0.69 | 0.025 | I | O | | | 0.23 |
| 23.333 | 0.65 | 0.68 | 0.025 | I | O | | | 0.23 |
| 23.417 | 0.65 | 0.68 | 0.025 | I | O | | | 0.23 |
| 23.500 | 0.65 | 0.67 | 0.025 | I | O | | | 0.23 |
| 23.583 | 0.65 | 0.67 | 0.025 | I | O | | | 0.22 |
| 23.667 | 0.65 | 0.67 | 0.025 | I | O | | | 0.22 |
| 23.750 | 0.65 | 0.66 | 0.025 | I | O | | | 0.22 |
| 23.833 | 0.65 | 0.66 | 0.024 | I | O | | | 0.22 |
| 23.917 | 0.65 | 0.66 | 0.024 | I | O | | | 0.22 |
| 24.000 | 0.65 | 0.66 | 0.024 | I | O | | | 0.22 |
| 24.083 | 0.50 | 0.64 | 0.024 | I | O | | | 0.22 |
| 24.167 | 0.13 | 0.59 | 0.022 | I | O | | | 0.20 |
| 24.250 | 0.04 | 0.50 | 0.019 | I | O | | | 0.17 |
| 24.333 | 0.01 | 0.42 | 0.016 | I | O | | | 0.14 |
| 24.417 | 0.00 | 0.35 | 0.013 | O | | | | 0.12 |
| 24.500 | 0.00 | 0.29 | 0.011 | O | | | | 0.10 |
| 24.583 | 0.00 | 0.24 | 0.009 | O | | | | 0.08 |
| 24.667 | 0.00 | 0.20 | 0.007 | O | | | | 0.07 |
| 24.750 | 0.00 | 0.17 | 0.006 | O | | | | 0.06 |
| 24.833 | 0.00 | 0.14 | 0.005 | O | | | | 0.05 |
| 24.917 | 0.00 | 0.11 | 0.004 | O | | | | 0.04 |
| 25.000 | 0.00 | 0.09 | 0.003 | O | | | | 0.03 |
| 25.083 | 0.00 | 0.08 | 0.003 | O | | | | 0.03 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 25.167 | 0.00 | 0.07 | 0.002 | O | \| | \| | \| | \| | 0.02 |
| 25.250 | 0.00 | 0.05 | 0.002 | O | \| | \| | \| | \| | 0.02 |
| 25.333 | 0.00 | 0.04 | 0.002 | O | \| | \| | \| | \| | 0.02 |
| 25.417 | 0.00 | 0.04 | 0.001 | O | \| | \| | \| | \| | 0.01 |
| 25.500 | 0.00 | 0.03 | 0.001 | O | \| | \| | \| | \| | 0.01 |
| 25.583 | 0.00 | 0.03 | 0.001 | O | \| | \| | \| | \| | 0.01 |
| 25.667 | 0.00 | 0.02 | 0.001 | O | \| | \| | \| | \| | 0.01 |
| 25.750 | 0.00 | 0.02 | 0.001 | O | \| | \| | \| | \| | 0.01 |
| 25.833 | 0.00 | 0.01 | 0.001 | O | \| | \| | \| | \| | 0.00 |
| 25.917 | 0.00 | 0.01 | 0.000 | O | \| | \| | \| | \| | 0.00 |
| 26.000 | 0.00 | 0.01 | 0.000 | O | \| | \| | \| | \| | 0.00 |
| 26.083 | 0.00 | 0.01 | 0.000 | O | \| | \| | \| | \| | 0.00 |
| 26.167 | 0.00 | 0.01 | 0.000 | O | \| | \| | \| | \| | 0.00 |
| 26.250 | 0.00 | 0.01 | 0.000 | O | \| | \| | \| | \| | 0.00 |
| 26.333 | 0.00 | 0.00 | 0.000 | O | \| | \| | \| | \| | 0.00 |
| 26.417 | 0.00 | 0.00 | 0.000 | O | \| | \| | \| | \| | 0.00 |
| 26.500 | 0.00 | 0.00 | 0.000 | O | \| | \| | \| | \| | 0.00 |
| 26.583 | 0.00 | 0.00 | 0.000 | O | \| | \| | \| | \| | 0.00 |

**********HYDROGRAPH DATA**********

Number of intervals = 319
Time interval = 5.0 (Min.)
Maximum/Peak flow rate = 6.754 (CFS)
Total volume = 6.986 (Ac.Ft)

Status of hydrographs being held in storage

| | Stream 1 | Stream 2 | Stream 3 | Stream 4 | Stream 5 |
|---|---|---|---|---|---|
| Peak (CFS) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Vol (Ac.Ft) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

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FLOOD HYDROGRAPH ROUTING PROGRAM
Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2005
Study date: 01/31/18

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Tract 37305 - Nichols Road Development
Drainage Area B - 8.4 Ac
Detention Basin Routing
2-year 24-hour storm

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Program License Serial Number 4029

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********** HYDROGRAPH INFORMATION **********

From study/file name: nrareabpr2242.rte

**********HYDROGRAPH DATA**********

Number of intervals = 290
Time interval = 5.0 (Min.)
Maximum/Peak flow rate = 1.969 (CFS)
Total volume = 0.998 (Ac.Ft)

Status of hydrographs being held in storage

| | Stream 1 | Stream 2 | Stream 3 | Stream 4 | Stream 5 |
|---|---|---|---|---|---|
| Peak (CFS) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Vol (Ac.Ft) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

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Process from Point/Station 20.000 to Point/Station 21.000
**** RETARDING BASIN ROUTING ****

User entry of depth-outflow-storage data

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Total number of inflow hydrograph intervals = 290
Hydrograph time unit = 5.000 (Min.)
Initial depth in storage basin = 0.00(Ft.)

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

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Depth vs. Storage and Depth vs. Discharge data:

| Basin Depth (Ft.) | Storage (Ac.Ft) | Outflow (CFS) | (S-O*dt/2) (Ac.Ft) | (S+O*dt/2) (Ac.Ft) |
|---|---|---|---|---|
| 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 0.500 | 0.093 | 0.860 | 0.090 | 0.096 |
| 1.500 | 0.306 | 1.000 | 0.303 | 0.309 |
| 2.500 | 0.552 | 1.960 | 0.545 | 0.559 |
| 3.500 | 0.832 | 17.440 | 0.772 | 0.892 |
| 4.500 | 1.145 | 75.270 | 0.886 | 1.404 |

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Hydrograph Detention Basin Routing

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

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| Time (Hours) | Inflow (CFS) | Outflow (CFS) | Storage (Ac.Ft) | .0 0.5 0.98 1.48 1.97 | Depth (Ft.) |
|---|---|---|---|---|---|
| 0.083 | 0.05 | 0.00 | 0.000 | O \| \| \| \| | 0.00 |
| 0.167 | 0.09 | 0.01 | 0.001 | OI \| \| \| \| | 0.00 |
| 0.250 | 0.09 | 0.01 | 0.001 | OI \| \| \| \| | 0.01 |
| 0.333 | 0.12 | 0.02 | 0.002 | OI \| \| \| \| | 0.01 |
| 0.417 | 0.14 | 0.02 | 0.003 | O I \| \| \| \| | 0.01 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0.500 | 0.14 | 0.03 | 0.003 | O I | | | | 0.02 |
| 0.583 | 0.14 | 0.04 | 0.004 | O I | | | | 0.02 |
| 0.667 | 0.14 | 0.04 | 0.005 | O I | | | | 0.03 |
| 0.750 | 0.14 | 0.05 | 0.005 | O I | | | | 0.03 |
| 0.833 | 0.16 | 0.06 | 0.006 | O I | | | | 0.03 |
| 0.917 | 0.18 | 0.06 | 0.007 | OI | | | | 0.04 |
| 1.000 | 0.18 | 0.07 | 0.008 | OI | | | | 0.04 |
| 1.083 | 0.16 | 0.08 | 0.008 | OI | | | | 0.04 |
| 1.167 | 0.14 | 0.08 | 0.009 | OI | | | | 0.05 |
| 1.250 | 0.14 | 0.08 | 0.009 | OI | | | | 0.05 |
| 1.333 | 0.14 | 0.09 | 0.009 | OI | | | | 0.05 |
| 1.417 | 0.14 | 0.09 | 0.010 | OI | | | | 0.05 |
| 1.500 | 0.14 | 0.09 | 0.010 | OI | | | | 0.05 |
| 1.583 | 0.14 | 0.10 | 0.010 | OI | | | | 0.06 |
| 1.667 | 0.14 | 0.10 | 0.011 | OI | | | | 0.06 |
| 1.750 | 0.14 | 0.10 | 0.011 | OI | | | | 0.06 |
| 1.833 | 0.16 | 0.10 | 0.011 | OI | | | | 0.06 |
| 1.917 | 0.18 | 0.11 | 0.012 | OI | | | | 0.06 |
| 2.000 | 0.18 | 0.11 | 0.012 | OI | | | | 0.07 |
| 2.083 | 0.18 | 0.12 | 0.013 | OI | | | | 0.07 |
| 2.167 | 0.18 | 0.12 | 0.013 | OI | | | | 0.07 |
| 2.250 | 0.18 | 0.13 | 0.014 | O | | | | 0.07 |
| 2.333 | 0.18 | 0.13 | 0.014 | O | | | | 0.08 |
| 2.417 | 0.18 | 0.13 | 0.014 | O | | | | 0.08 |
| 2.500 | 0.18 | 0.14 | 0.015 | O | | | | 0.08 |
| 2.583 | 0.21 | 0.14 | 0.015 | OI | | | | 0.08 |
| 2.667 | 0.23 | 0.14 | 0.016 | OI | | | | 0.08 |
| 2.750 | 0.23 | 0.15 | 0.016 | OI | | | | 0.09 |
| 2.833 | 0.23 | 0.15 | 0.017 | OI | | | | 0.09 |
| 2.917 | 0.23 | 0.16 | 0.017 | OI | | | | 0.09 |
| 3.000 | 0.23 | 0.16 | 0.018 | OI | | | | 0.10 |
| 3.083 | 0.23 | 0.17 | 0.018 | OI | | | | 0.10 |
| 3.167 | 0.23 | 0.17 | 0.019 | OI | | | | 0.10 |
| 3.250 | 0.23 | 0.17 | 0.019 | OI | | | | 0.10 |
| 3.333 | 0.23 | 0.18 | 0.019 | OI | | | | 0.10 |
| 3.417 | 0.23 | 0.18 | 0.020 | OI | | | | 0.11 |
| 3.500 | 0.23 | 0.18 | 0.020 | OI | | | | 0.11 |
| 3.583 | 0.23 | 0.19 | 0.020 | O | | | | 0.11 |
| 3.667 | 0.23 | 0.19 | 0.021 | O | | | | 0.11 |
| 3.750 | 0.23 | 0.19 | 0.021 | O | | | | 0.11 |
| 3.833 | 0.25 | 0.20 | 0.021 | OI | | | | 0.11 |
| 3.917 | 0.27 | 0.20 | 0.022 | OI | | | | 0.12 |
| 4.000 | 0.28 | 0.20 | 0.022 | OI | | | | 0.12 |
| 4.083 | 0.28 | 0.21 | 0.023 | OI | | | | 0.12 |
| 4.167 | 0.28 | 0.21 | 0.023 | OI | | | | 0.12 |
| 4.250 | 0.28 | 0.22 | 0.023 | OI | | | | 0.13 |
| 4.333 | 0.30 | 0.22 | 0.024 | OI | | | | 0.13 |
| 4.417 | 0.32 | 0.23 | 0.025 | O I | | | | 0.13 |
| 4.500 | 0.32 | 0.23 | 0.025 | O I | | | | 0.14 |
| 4.583 | 0.32 | 0.24 | 0.026 | O I | | | | 0.14 |
| 4.667 | 0.32 | 0.24 | 0.026 | O I | | | | 0.14 |
| 4.750 | 0.32 | 0.25 | 0.027 | OI | | | | 0.14 |
| 4.833 | 0.35 | 0.25 | 0.027 | OI | | | | 0.15 |
| 4.917 | 0.37 | 0.26 | 0.028 | OI | | | | 0.15 |
| 5.000 | 0.37 | 0.27 | 0.029 | OI | | | | 0.15 |
| 5.083 | 0.32 | 0.27 | 0.029 | OI | | | | 0.16 |
| 5.167 | 0.28 | 0.27 | 0.029 | O | | | | 0.16 |
| 5.250 | 0.28 | 0.27 | 0.030 | O | | | | 0.16 |
| 5.333 | 0.30 | 0.27 | 0.030 | O | | | | 0.16 |
| 5.417 | 0.32 | 0.28 | 0.030 | OI | | | | 0.16 |
| 5.500 | 0.32 | 0.28 | 0.030 | OI | | | | 0.16 |
| 5.583 | 0.35 | 0.28 | 0.031 | OI | | | | 0.16 |
| 5.667 | 0.37 | 0.29 | 0.031 | OI | | | | 0.17 |
| 5.750 | 0.37 | 0.29 | 0.032 | OI | | | | 0.17 |
| 5.833 | 0.37 | 0.30 | 0.032 | OI | | | | 0.17 |
| 5.917 | 0.37 | 0.30 | 0.033 | OI | | | | 0.17 |
| 6.000 | 0.37 | 0.31 | 0.033 | OI | | | | 0.18 |
| 6.083 | 0.39 | 0.31 | 0.033 | OI | | | | 0.18 |
| 6.167 | 0.41 | 0.32 | 0.034 | OI | | | | 0.18 |
| 6.250 | 0.41 | 0.32 | 0.035 | OI | | | | 0.19 |
| 6.333 | 0.41 | 0.33 | 0.035 | OI | | | | 0.19 |
| 6.417 | 0.41 | 0.33 | 0.036 | OI | | | | 0.19 |
| 6.500 | 0.41 | 0.34 | 0.036 | OI | | | | 0.20 |
| 6.583 | 0.44 | 0.34 | 0.037 | O I | | | | 0.20 |
| 6.667 | 0.46 | 0.35 | 0.038 | O I | | | | 0.20 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 6.750 | 0.46 | 0.36 | 0.039 | O I\| | | | | 0.21 |
| 6.833 | 0.46 | 0.36 | 0.039 | O I\| | | | | 0.21 |
| 6.917 | 0.46 | 0.37 | 0.040 | O I\| | | | | 0.21 |
| 7.000 | 0.46 | 0.37 | 0.040 | OI\| | | | | 0.22 |
| 7.083 | 0.46 | 0.38 | 0.041 | OI\| | | | | 0.22 |
| 7.167 | 0.46 | 0.38 | 0.042 | OI\| | | | | 0.22 |
| 7.250 | 0.46 | 0.39 | 0.042 | OI\| | | | | 0.23 |
| 7.333 | 0.48 | 0.39 | 0.043 | OI\| | | | | 0.23 |
| 7.417 | 0.50 | 0.40 | 0.043 | O I | | | | 0.23 |
| 7.500 | 0.51 | 0.41 | 0.044 | O I | | | | 0.24 |
| 7.583 | 0.53 | 0.41 | 0.045 | O I | | | | 0.24 |
| 7.667 | 0.55 | 0.42 | 0.046 | O I | | | | 0.24 |
| 7.750 | 0.55 | 0.43 | 0.046 | O I | | | | 0.25 |
| 7.833 | 0.58 | 0.44 | 0.047 | O\|I | | | | 0.25 |
| 7.917 | 0.60 | 0.45 | 0.048 | O\|I | | | | 0.26 |
| 8.000 | 0.60 | 0.46 | 0.049 | O\|I | | | | 0.27 |
| 8.083 | 0.65 | 0.47 | 0.050 | O\| I | | | | 0.27 |
| 8.167 | 0.69 | 0.48 | 0.052 | O\| I | | | | 0.28 |
| 8.250 | 0.69 | 0.49 | 0.053 | O\| I | | | | 0.29 |
| 8.333 | 0.69 | 0.50 | 0.054 | O I | | | | 0.29 |
| 8.417 | 0.69 | 0.52 | 0.056 | O I | | | | 0.30 |
| 8.500 | 0.69 | 0.53 | 0.057 | O I | | | | 0.31 |
| 8.583 | 0.71 | 0.54 | 0.058 | O I | | | | 0.31 |
| 8.667 | 0.73 | 0.55 | 0.059 | O I | | | | 0.32 |
| 8.750 | 0.74 | 0.56 | 0.061 | \|O I | | | | 0.33 |
| 8.833 | 0.76 | 0.57 | 0.062 | \|O I | | | | 0.33 |
| 8.917 | 0.78 | 0.58 | 0.063 | \|O I | | | | 0.34 |
| 9.000 | 0.78 | 0.60 | 0.064 | \|O I | | | | 0.35 |
| 9.083 | 0.83 | 0.61 | 0.066 | \|O I | | | | 0.35 |
| 9.167 | 0.87 | 0.62 | 0.067 | \| O I | | | | 0.36 |
| 9.250 | 0.87 | 0.64 | 0.069 | \| O I | | | | 0.37 |
| 9.333 | 0.90 | 0.65 | 0.071 | \| O I | | | | 0.38 |
| 9.417 | 0.92 | 0.67 | 0.072 | \| O I | | | | 0.39 |
| 9.500 | 0.92 | 0.69 | 0.074 | \| O I | | | | 0.40 |
| 9.583 | 0.94 | 0.70 | 0.076 | \| O I\| | | | | 0.41 |
| 9.667 | 0.96 | 0.72 | 0.077 | \| O I\| | | | | 0.42 |
| 9.750 | 0.97 | 0.73 | 0.079 | \| O I\| | | | | 0.43 |
| 9.833 | 0.99 | 0.75 | 0.081 | \| O I | | | | 0.43 |
| 9.917 | 1.01 | 0.76 | 0.082 | \| O I | | | | 0.44 |
| 10.000 | 1.01 | 0.78 | 0.084 | \| O I | | | | 0.45 |
| 10.083 | 0.84 | 0.79 | 0.085 | \| OI | | | | 0.46 |
| 10.167 | 0.70 | 0.79 | 0.085 | \| IO | | | | 0.46 |
| 10.250 | 0.69 | 0.78 | 0.084 | \| IO | | | | 0.45 |
| 10.333 | 0.69 | 0.77 | 0.084 | \| IO | | | | 0.45 |
| 10.417 | 0.69 | 0.77 | 0.083 | \| IO | | | | 0.45 |
| 10.500 | 0.69 | 0.76 | 0.083 | \| IO | | | | 0.44 |
| 10.583 | 0.81 | 0.76 | 0.083 | \| OI | | | | 0.44 |
| 10.667 | 0.91 | 0.77 | 0.083 | \| O I | | | | 0.45 |
| 10.750 | 0.92 | 0.78 | 0.084 | \| O I | | | | 0.45 |
| 10.833 | 0.92 | 0.79 | 0.085 | \| O I | | | | 0.46 |
| 10.917 | 0.92 | 0.80 | 0.086 | \| O I | | | | 0.46 |
| 11.000 | 0.92 | 0.80 | 0.087 | \| OI | | | | 0.47 |
| 11.083 | 0.89 | 0.81 | 0.088 | \| OI | | | | 0.47 |
| 11.167 | 0.87 | 0.81 | 0.088 | \| OI | | | | 0.47 |
| 11.250 | 0.87 | 0.82 | 0.088 | \| OI | | | | 0.48 |
| 11.333 | 0.87 | 0.82 | 0.089 | \| OI | | | | 0.48 |
| 11.417 | 0.87 | 0.82 | 0.089 | \| OI | | | | 0.48 |
| 11.500 | 0.87 | 0.83 | 0.089 | \| OI | | | | 0.48 |
| 11.583 | 0.82 | 0.83 | 0.090 | \| O | | | | 0.48 |
| 11.667 | 0.78 | 0.83 | 0.089 | \| IO | | | | 0.48 |
| 11.750 | 0.78 | 0.82 | 0.089 | \| IO | | | | 0.48 |
| 11.833 | 0.81 | 0.82 | 0.089 | \| O | | | | 0.48 |
| 11.917 | 0.83 | 0.82 | 0.089 | \| O | | | | 0.48 |
| 12.000 | 0.83 | 0.82 | 0.089 | \| O | | | | 0.48 |
| 12.083 | 1.01 | 0.83 | 0.090 | \| O I | | | | 0.48 |
| 12.167 | 1.17 | 0.84 | 0.091 | \| O \| I | | | | 0.49 |
| 12.250 | 1.18 | 0.86 | 0.094 | \| O \| I | | | | 0.50 |
| 12.333 | 1.23 | 0.86 | 0.096 | \| O \| I | | | | 0.51 |
| 12.417 | 1.27 | 0.86 | 0.099 | \| O \| I | | | | 0.53 |
| 12.500 | 1.28 | 0.87 | 0.101 | \| O \| I | | | | 0.54 |
| 12.583 | 1.36 | 0.87 | 0.105 | \| O \| I | | | | 0.55 |
| 12.667 | 1.44 | 0.87 | 0.108 | \| O \| I\| | | | | 0.57 |
| 12.750 | 1.45 | 0.87 | 0.112 | \| O \| I\| | | | | 0.59 |
| 12.833 | 1.50 | 0.88 | 0.116 | \| O \| I | | | | 0.61 |
| 12.917 | 1.54 | 0.88 | 0.121 | \| O \| I | | | | 0.63 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 13.000 | 1.54 | 0.88 | 0.125 | \| | \| | O \| | \|I \| | \| | 0.65 |
| 13.083 | 1.76 | 0.88 | 0.130 | \| | \| | O \| | \| I \| | \| | 0.68 |
| 13.167 | 1.94 | 0.89 | 0.137 | \| | \| | O \| | \| I\| | \| | 0.71 |
| 13.250 | 1.96 | 0.89 | 0.144 | \| | \| | O \| | \| I\| | \| | 0.74 |
| 13.333 | 1.96 | 0.90 | 0.152 | \| | \| | O \| | \| I\| | \| | 0.78 |
| 13.417 | 1.97 | 0.90 | 0.159 | \| | \| | O \| | \| I\| | \| | 0.81 |
| 13.500 | 1.97 | 0.91 | 0.166 | \| | \| | O \| | \| I\| | \| | 0.84 |
| 13.583 | 1.51 | 0.91 | 0.172 | \| | \| | O \| | I \| | \| | 0.87 |
| 13.667 | 1.12 | 0.91 | 0.175 | \| | \| | O \| I \| | \| | \| | 0.88 |
| 13.750 | 1.09 | 0.91 | 0.176 | \| | \| | O \|I \| | \| | \| | 0.89 |
| 13.833 | 1.10 | 0.92 | 0.177 | \| | \| | O \|I \| | \| | \| | 0.90 |
| 13.917 | 1.10 | 0.92 | 0.179 | \| | \| | O \|I \| | \| | \| | 0.90 |
| 14.000 | 1.11 | 0.92 | 0.180 | \| | \| | O \|I \| | \| | \| | 0.91 |
| 14.083 | 1.28 | 0.92 | 0.182 | \| | \| | O \| I \| | \| | \| | 0.92 |
| 14.167 | 1.42 | 0.92 | 0.185 | \| | \| | O \| I\| | \| | \| | 0.93 |
| 14.250 | 1.44 | 0.92 | 0.188 | \| | \| | O \| I\| | \| | \| | 0.95 |
| 14.333 | 1.40 | 0.92 | 0.192 | \| | \| | O\| I \| | \| | \| | 0.96 |
| 14.417 | 1.37 | 0.93 | 0.195 | \| | \| | O\| I \| | \| | \| | 0.98 |
| 14.500 | 1.37 | 0.93 | 0.198 | \| | \| | O\| I \| | \| | \| | 0.99 |
| 14.583 | 1.37 | 0.93 | 0.201 | \| | \| | O\| I \| | \| | \| | 1.01 |
| 14.667 | 1.38 | 0.93 | 0.204 | \| | \| | O\| I \| | \| | \| | 1.02 |
| 14.750 | 1.38 | 0.93 | 0.207 | \| | \| | O\| I \| | \| | \| | 1.04 |
| 14.833 | 1.34 | 0.94 | 0.210 | \| | \| | O\| I \| | \| | \| | 1.05 |
| 14.917 | 1.31 | 0.94 | 0.213 | \| | \| | O\| I \| | \| | \| | 1.06 |
| 15.000 | 1.31 | 0.94 | 0.215 | \| | \| | O\| I \| | \| | \| | 1.07 |
| 15.083 | 1.27 | 0.94 | 0.218 | \| | \| | O\| I \| | \| | \| | 1.09 |
| 15.167 | 1.24 | 0.94 | 0.220 | \| | \| | O\| I \| | \| | \| | 1.10 |
| 15.250 | 1.24 | 0.94 | 0.222 | \| | \| | O\| I \| | \| | \| | 1.11 |
| 15.333 | 1.20 | 0.95 | 0.224 | \| | \| | O\| I \| | \| | \| | 1.11 |
| 15.417 | 1.17 | 0.95 | 0.225 | \| | \| | O\| I \| | \| | \| | 1.12 |
| 15.500 | 1.17 | 0.95 | 0.227 | \| | \| | O\| I \| | \| | \| | 1.13 |
| 15.583 | 1.01 | 0.95 | 0.228 | \| | \| | OI \| | \| | \| | 1.13 |
| 15.667 | 0.88 | 0.95 | 0.228 | \| | \| | IO\| \| | \| | \| | 1.13 |
| 15.750 | 0.87 | 0.95 | 0.227 | \| | \| | IO\| \| | \| | \| | 1.13 |
| 15.833 | 0.87 | 0.95 | 0.227 | \| | \| | IO\| \| | \| | \| | 1.13 |
| 15.917 | 0.87 | 0.95 | 0.226 | \| | \| | IO\| \| | \| | \| | 1.13 |
| 16.000 | 0.87 | 0.95 | 0.226 | \| | \| | IO\| \| | \| | \| | 1.12 |
| 16.083 | 0.51 | 0.95 | 0.224 | \| | I | O\| \| | \| | \| | 1.12 |
| 16.167 | 0.21 | 0.94 | 0.220 | \| I \| | \| | O\| \| | \| | \| | 1.10 |
| 16.250 | 0.18 | 0.94 | 0.215 | \| I \| | \| | O\| \| | \| | \| | 1.07 |
| 16.333 | 0.18 | 0.94 | 0.210 | \| I \| | \| | O\| \| | \| | \| | 1.05 |
| 16.417 | 0.18 | 0.93 | 0.205 | \| I \| | \| | O\| \| | \| | \| | 1.02 |
| 16.500 | 0.18 | 0.93 | 0.199 | \| I \| | \| | O\| \| | \| | \| | 1.00 |
| 16.583 | 0.16 | 0.93 | 0.194 | \| I \| | \| | O\| \| | \| | \| | 0.98 |
| 16.667 | 0.14 | 0.92 | 0.189 | \| I \| | \| | O\| \| | \| | \| | 0.95 |
| 16.750 | 0.14 | 0.92 | 0.184 | \| I \| | \| | O \| \| | \| | \| | 0.93 |
| 16.833 | 0.14 | 0.92 | 0.178 | \| I \| | \| | O \| \| | \| | \| | 0.90 |
| 16.917 | 0.14 | 0.91 | 0.173 | \| I \| | \| | O \| \| | \| | \| | 0.87 |
| 17.000 | 0.14 | 0.91 | 0.168 | \| I \| | \| | O \| \| | \| | \| | 0.85 |
| 17.083 | 0.19 | 0.91 | 0.162 | \| I \| | \| | O \| \| | \| | \| | 0.83 |
| 17.167 | 0.23 | 0.90 | 0.158 | \| I \| | \| | O \| \| | \| | \| | 0.80 |
| 17.250 | 0.23 | 0.90 | 0.153 | \| I \| | \| | O \| \| | \| | \| | 0.78 |
| 17.333 | 0.23 | 0.90 | 0.148 | \| I \| | \| | O \| \| | \| | \| | 0.76 |
| 17.417 | 0.23 | 0.89 | 0.144 | \| I \| | \| | O \| \| | \| | \| | 0.74 |
| 17.500 | 0.23 | 0.89 | 0.139 | \| I \| | \| | O \| \| | \| | \| | 0.72 |
| 17.583 | 0.23 | 0.89 | 0.135 | \| I \| | \| | O \| \| | \| | \| | 0.70 |
| 17.667 | 0.23 | 0.88 | 0.130 | \| I \| | \| | O \| \| | \| | \| | 0.67 |
| 17.750 | 0.23 | 0.88 | 0.126 | \| I \| | \| | O \| \| | \| | \| | 0.65 |
| 17.833 | 0.21 | 0.88 | 0.121 | \| I \| | \| | O \| \| | \| | \| | 0.63 |
| 17.917 | 0.19 | 0.88 | 0.116 | \| I \| | \| | O \| \| | \| | \| | 0.61 |
| 18.000 | 0.18 | 0.87 | 0.112 | \| I \| | \| | O \| \| | \| | \| | 0.59 |
| 18.083 | 0.18 | 0.87 | 0.107 | \| I \| | \| | O \| \| | \| | \| | 0.57 |
| 18.167 | 0.18 | 0.87 | 0.102 | \| I \| | \| | O \| \| | \| | \| | 0.54 |
| 18.250 | 0.18 | 0.86 | 0.098 | \| I \| | \| | O \| \| | \| | \| | 0.52 |
| 18.333 | 0.18 | 0.86 | 0.093 | \| I \| | \| O \| \| | \| | \| | 0.50 |
| 18.417 | 0.18 | 0.82 | 0.088 | \| I \| | \| O \| \| | \| | \| | 0.47 |
| 18.500 | 0.18 | 0.78 | 0.084 | \| I \| | \| O \| \| | \| | \| | 0.45 |
| 18.583 | 0.16 | 0.74 | 0.080 | \| I \| | \| O \| \| | \| | \| | 0.43 |
| 18.667 | 0.14 | 0.70 | 0.076 | \| I \| | \| O \| \| | \| | \| | 0.41 |
| 18.750 | 0.14 | 0.67 | 0.072 | \| I \| | \| O \| \| | \| | \| | 0.39 |
| 18.833 | 0.11 | 0.64 | 0.069 | \|I \| | \| O \| \| | \| | \| | 0.37 |
| 18.917 | 0.09 | 0.60 | 0.065 | \|I \| | \|O \| \| | \| | \| | 0.35 |
| 19.000 | 0.09 | 0.57 | 0.062 | \|I \| | \|O \| \| | \| | \| | 0.33 |
| 19.083 | 0.12 | 0.54 | 0.059 | \|I \| | O \| \| | \| | \| | 0.32 |
| 19.167 | 0.14 | 0.52 | 0.056 | \| I \| | O \| \| | \| | \| | 0.30 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 19.250 | 0.14 | 0.49 | 0.053 | \| I O \| | \| | \| | \| | 0.29 |
| 19.333 | 0.16 | 0.47 | 0.051 | \| I O\| | \| | \| | \| | 0.27 |
| 19.417 | 0.18 | 0.45 | 0.049 | \| I O\| | \| | \| | \| | 0.26 |
| 19.500 | 0.18 | 0.44 | 0.047 | \| I O\| | \| | \| | \| | 0.25 |
| 19.583 | 0.16 | 0.42 | 0.045 | \| I O \| | \| | \| | \| | 0.24 |
| 19.667 | 0.14 | 0.40 | 0.044 | \| I O \| | \| | \| | \| | 0.23 |
| 19.750 | 0.14 | 0.39 | 0.042 | \| I O \| | \| | \| | \| | 0.23 |
| 19.833 | 0.11 | 0.37 | 0.040 | \|I O \| | \| | \| | \| | 0.22 |
| 19.917 | 0.09 | 0.35 | 0.038 | \|I O \| | \| | \| | \| | 0.21 |
| 20.000 | 0.09 | 0.34 | 0.037 | \|I O \| | \| | \| | \| | 0.20 |
| 20.083 | 0.12 | 0.32 | 0.035 | \|I O \| | \| | \| | \| | 0.19 |
| 20.167 | 0.14 | 0.31 | 0.034 | \| I O \| | \| | \| | \| | 0.18 |
| 20.250 | 0.14 | 0.30 | 0.033 | \| I O \| | \| | \| | \| | 0.18 |
| 20.333 | 0.14 | 0.29 | 0.031 | \| I O \| | \| | \| | \| | 0.17 |
| 20.417 | 0.14 | 0.28 | 0.030 | \| I O \| | \| | \| | \| | 0.16 |
| 20.500 | 0.14 | 0.27 | 0.029 | \| I O \| | \| | \| | \| | 0.16 |
| 20.583 | 0.14 | 0.26 | 0.029 | \| I O \| | \| | \| | \| | 0.15 |
| 20.667 | 0.14 | 0.26 | 0.028 | \| I O \| | \| | \| | \| | 0.15 |
| 20.750 | 0.14 | 0.25 | 0.027 | \| I O \| | \| | \| | \| | 0.14 |
| 20.833 | 0.11 | 0.24 | 0.026 | \|I O \| | \| | \| | \| | 0.14 |
| 20.917 | 0.09 | 0.23 | 0.025 | \|I O \| | \| | \| | \| | 0.14 |
| 21.000 | 0.09 | 0.22 | 0.024 | \|I O \| | \| | \| | \| | 0.13 |
| 21.083 | 0.12 | 0.22 | 0.023 | \|I O \| | \| | \| | \| | 0.13 |
| 21.167 | 0.14 | 0.21 | 0.023 | \| IO \| | \| | \| | \| | 0.12 |
| 21.250 | 0.14 | 0.21 | 0.022 | \| IO \| | \| | \| | \| | 0.12 |
| 21.333 | 0.11 | 0.20 | 0.022 | \|I O \| | \| | \| | \| | 0.12 |
| 21.417 | 0.09 | 0.20 | 0.021 | \|I O \| | \| | \| | \| | 0.11 |
| 21.500 | 0.09 | 0.19 | 0.020 | \|I O \| | \| | \| | \| | 0.11 |
| 21.583 | 0.12 | 0.18 | 0.020 | \|IO \| | \| | \| | \| | 0.11 |
| 21.667 | 0.14 | 0.18 | 0.020 | \| O \| | \| | \| | \| | 0.10 |
| 21.750 | 0.14 | 0.18 | 0.019 | \| O \| | \| | \| | \| | 0.10 |
| 21.833 | 0.11 | 0.17 | 0.019 | \|IO \| | \| | \| | \| | 0.10 |
| 21.917 | 0.09 | 0.17 | 0.018 | \|IO \| | \| | \| | \| | 0.10 |
| 22.000 | 0.09 | 0.17 | 0.018 | \|IO \| | \| | \| | \| | 0.10 |
| 22.083 | 0.12 | 0.16 | 0.017 | \|IO \| | \| | \| | \| | 0.09 |
| 22.167 | 0.14 | 0.16 | 0.017 | \| O \| | \| | \| | \| | 0.09 |
| 22.250 | 0.14 | 0.16 | 0.017 | \| O \| | \| | \| | \| | 0.09 |
| 22.333 | 0.11 | 0.16 | 0.017 | \|IO \| | \| | \| | \| | 0.09 |
| 22.417 | 0.09 | 0.15 | 0.017 | \|IO \| | \| | \| | \| | 0.09 |
| 22.500 | 0.09 | 0.15 | 0.016 | \|IO \| | \| | \| | \| | 0.09 |
| 22.583 | 0.09 | 0.15 | 0.016 | \|IO \| | \| | \| | \| | 0.08 |
| 22.667 | 0.09 | 0.14 | 0.015 | \|IO \| | \| | \| | \| | 0.08 |
| 22.750 | 0.09 | 0.14 | 0.015 | \|IO \| | \| | \| | \| | 0.08 |
| 22.833 | 0.09 | 0.14 | 0.015 | \|IO \| | \| | \| | \| | 0.08 |
| 22.917 | 0.09 | 0.13 | 0.014 | \|IO \| | \| | \| | \| | 0.08 |
| 23.000 | 0.09 | 0.13 | 0.014 | \|IO \| | \| | \| | \| | 0.08 |
| 23.083 | 0.09 | 0.13 | 0.014 | \|IO \| | \| | \| | \| | 0.07 |
| 23.167 | 0.09 | 0.13 | 0.014 | \|IO \| | \| | \| | \| | 0.07 |
| 23.250 | 0.09 | 0.12 | 0.013 | \|IO \| | \| | \| | \| | 0.07 |
| 23.333 | 0.09 | 0.12 | 0.013 | \|O \| | \| | \| | \| | 0.07 |
| 23.417 | 0.09 | 0.12 | 0.013 | \|O \| | \| | \| | \| | 0.07 |
| 23.500 | 0.09 | 0.12 | 0.013 | \|O \| | \| | \| | \| | 0.07 |
| 23.583 | 0.09 | 0.12 | 0.013 | \|O \| | \| | \| | \| | 0.07 |
| 23.667 | 0.09 | 0.12 | 0.012 | \|O \| | \| | \| | \| | 0.07 |
| 23.750 | 0.09 | 0.11 | 0.012 | \|O \| | \| | \| | \| | 0.07 |
| 23.833 | 0.09 | 0.11 | 0.012 | \|O \| | \| | \| | \| | 0.07 |
| 23.917 | 0.09 | 0.11 | 0.012 | \|O \| | \| | \| | \| | 0.06 |
| 24.000 | 0.09 | 0.11 | 0.012 | \|O \| | \| | \| | \| | 0.06 |
| 24.083 | 0.04 | 0.11 | 0.012 | IO \| | \| | \| | \| | 0.06 |
| 24.167 | 0.00 | 0.10 | 0.011 | IO \| | \| | \| | \| | 0.06 |
| 24.250 | 0.00 | 0.10 | 0.010 | IO \| | \| | \| | \| | 0.06 |
| 24.333 | 0.00 | 0.09 | 0.010 | IO \| | \| | \| | \| | 0.05 |
| 24.417 | 0.00 | 0.08 | 0.009 | IO \| | \| | \| | \| | 0.05 |
| 24.500 | 0.00 | 0.08 | 0.009 | IO \| | \| | \| | \| | 0.05 |
| 24.583 | 0.00 | 0.07 | 0.008 | IO \| | \| | \| | \| | 0.04 |
| 24.667 | 0.00 | 0.07 | 0.008 | IO \| | \| | \| | \| | 0.04 |
| 24.750 | 0.00 | 0.07 | 0.007 | IO \| | \| | \| | \| | 0.04 |
| 24.833 | 0.00 | 0.06 | 0.007 | O \| | \| | \| | \| | 0.04 |
| 24.917 | 0.00 | 0.06 | 0.006 | O \| | \| | \| | \| | 0.03 |
| 25.000 | 0.00 | 0.05 | 0.006 | O \| | \| | \| | \| | 0.03 |
| 25.083 | 0.00 | 0.05 | 0.005 | O \| | \| | \| | \| | 0.03 |
| 25.167 | 0.00 | 0.05 | 0.005 | O \| | \| | \| | \| | 0.03 |
| 25.250 | 0.00 | 0.04 | 0.005 | O \| | \| | \| | \| | 0.03 |
| 25.333 | 0.00 | 0.04 | 0.005 | O \| | \| | \| | \| | 0.02 |
| 25.417 | 0.00 | 0.04 | 0.004 | O \| | \| | \| | \| | 0.02 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 25.500 | 0.00 | 0.04 | 0.004 | O | \| | \| | \| | \| | 0.02 |
| 25.583 | 0.00 | 0.03 | 0.004 | O | \| | \| | \| | \| | 0.02 |
| 25.667 | 0.00 | 0.03 | 0.004 | O | \| | \| | \| | \| | 0.02 |
| 25.750 | 0.00 | 0.03 | 0.003 | O | \| | \| | \| | \| | 0.02 |
| 25.833 | 0.00 | 0.03 | 0.003 | O | \| | \| | \| | \| | 0.02 |
| 25.917 | 0.00 | 0.03 | 0.003 | O | \| | \| | \| | \| | 0.02 |
| 26.000 | 0.00 | 0.03 | 0.003 | O | \| | \| | \| | \| | 0.01 |
| 26.083 | 0.00 | 0.02 | 0.003 | O | \| | \| | \| | \| | 0.01 |
| 26.167 | 0.00 | 0.02 | 0.002 | O | \| | \| | \| | \| | 0.01 |
| 26.250 | 0.00 | 0.02 | 0.002 | O | \| | \| | \| | \| | 0.01 |
| 26.333 | 0.00 | 0.02 | 0.002 | O | \| | \| | \| | \| | 0.01 |
| 26.417 | 0.00 | 0.02 | 0.002 | O | \| | \| | \| | \| | 0.01 |
| 26.500 | 0.00 | 0.02 | 0.002 | O | \| | \| | \| | \| | 0.01 |
| 26.583 | 0.00 | 0.02 | 0.002 | O | \| | \| | \| | \| | 0.01 |
| 26.667 | 0.00 | 0.02 | 0.002 | O | \| | \| | \| | \| | 0.01 |
| 26.750 | 0.00 | 0.01 | 0.002 | O | \| | \| | \| | \| | 0.01 |
| 26.833 | 0.00 | 0.01 | 0.001 | O | \| | \| | \| | \| | 0.01 |
| 26.917 | 0.00 | 0.01 | 0.001 | O | \| | \| | \| | \| | 0.01 |
| 27.000 | 0.00 | 0.01 | 0.001 | O | \| | \| | \| | \| | 0.01 |
| 27.083 | 0.00 | 0.01 | 0.001 | O | \| | \| | \| | \| | 0.01 |
| 27.167 | 0.00 | 0.01 | 0.001 | O | \| | \| | \| | \| | 0.01 |
| 27.250 | 0.00 | 0.01 | 0.001 | O | \| | \| | \| | \| | 0.01 |
| 27.333 | 0.00 | 0.01 | 0.001 | O | \| | \| | \| | \| | 0.01 |
| 27.417 | 0.00 | 0.01 | 0.001 | O | \| | \| | \| | \| | 0.00 |
| 27.500 | 0.00 | 0.01 | 0.001 | O | \| | \| | \| | \| | 0.00 |
| 27.583 | 0.00 | 0.01 | 0.001 | O | \| | \| | \| | \| | 0.00 |
| 27.667 | 0.00 | 0.01 | 0.001 | O | \| | \| | \| | \| | 0.00 |
| 27.750 | 0.00 | 0.01 | 0.001 | O | \| | \| | \| | \| | 0.00 |
| 27.833 | 0.00 | 0.01 | 0.001 | O | \| | \| | \| | \| | 0.00 |
| 27.917 | 0.00 | 0.01 | 0.001 | O | \| | \| | \| | \| | 0.00 |
| 28.000 | 0.00 | 0.01 | 0.001 | O | \| | \| | \| | \| | 0.00 |
| 28.083 | 0.00 | 0.01 | 0.001 | O | \| | \| | \| | \| | 0.00 |
| 28.167 | 0.00 | 0.00 | 0.001 | O | \| | \| | \| | \| | 0.00 |
| 28.250 | 0.00 | 0.00 | 0.000 | O | \| | \| | \| | \| | 0.00 |
| 28.333 | 0.00 | 0.00 | 0.000 | O | \| | \| | \| | \| | 0.00 |
| 28.417 | 0.00 | 0.00 | 0.000 | O | \| | \| | \| | \| | 0.00 |
| 28.500 | 0.00 | 0.00 | 0.000 | O | \| | \| | \| | \| | 0.00 |
| 28.583 | 0.00 | 0.00 | 0.000 | O | \| | \| | \| | \| | 0.00 |
| 28.667 | 0.00 | 0.00 | 0.000 | O | \| | \| | \| | \| | 0.00 |
| 28.750 | 0.00 | 0.00 | 0.000 | O | \| | \| | \| | \| | 0.00 |
| 28.833 | 0.00 | 0.00 | 0.000 | O | \| | \| | \| | \| | 0.00 |
| 28.917 | 0.00 | 0.00 | 0.000 | O | \| | \| | \| | \| | 0.00 |
| 29.000 | 0.00 | 0.00 | 0.000 | O | \| | \| | \| | \| | 0.00 |
| 29.083 | 0.00 | 0.00 | 0.000 | O | \| | \| | \| | \| | 0.00 |
| 29.167 | 0.00 | 0.00 | 0.000 | O | \| | \| | \| | \| | 0.00 |
| 29.250 | 0.00 | 0.00 | 0.000 | O | \| | \| | \| | \| | 0.00 |
| 29.333 | 0.00 | 0.00 | 0.000 | O | \| | \| | \| | \| | 0.00 |
| 29.417 | 0.00 | 0.00 | 0.000 | O | \| | \| | \| | \| | 0.00 |
| 29.500 | 0.00 | 0.00 | 0.000 | O | \| | \| | \| | \| | 0.00 |
| 29.583 | 0.00 | 0.00 | 0.000 | O | \| | \| | \| | \| | 0.00 |

**********HYDROGRAPH DATA**********

Number of intervals = 355
Time interval = 5.0 (Min.)
Maximum/Peak flow rate = 0.949 (CFS)
Total volume = 0.997 (Ac.Ft)

Status of hydrographs being held in storage

| | Stream 1 | Stream 2 | Stream 3 | Stream 4 | Stream 5 |
|---|---|---|---|---|---|
| Peak (CFS) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Vol (Ac.Ft) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

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# Appendix 8: Source Control

*Pollutant Sources/Source Control Checklist*

**Source Control BMPs**

| Potential Sources of Runoff Pollutants | Permanent Controls—Show on WQMP Drawings | Permanent Controls—List in WQMP Table and Narrative | Operational BMPs—Include in WQMP Table and Narrative |
|---|---|---|---|
| ☒ A. On-site storm drain inlets | ☒ Locations of inlets. | ☒ Mark all inlets with the words "Only Rain Down the Storm Drain" or similar. Catch Basin Markers may be available from the Riverside County Flood Control and Water Conservation District, call 951.955.1200 to verify. | ☒ Maintain and periodically repaint or replace inlet markings.<br>☒ Provide stormwater pollution prevention information to new site owners, lessees, or operators.<br>☒ See applicable operational BMPs in Fact Sheet SC-44, "Drainage System Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com<br>☒ Include the following in lease agreements: "Tenant shall not allow anyone to discharge anything to storm drains or to store or deposit materials so as to create a potential discharge to storm drains." |
| ☐ B. Interior floor drains and elevator shaft sump pumps | | ☐ State that interior floor drains and elevator shaft sump pumps will be plumbed to sanitary sewer. | ☐ Inspect and maintain drains to prevent blockages and overflow. |
| ☐ C. Interior parking garages | | ☐ State that parking garage floor drains will be plumbed to the sanitary sewer. | ☐ Inspect and maintain drains to prevent blockages and overflow. |
| ☐ D1. Need for future indoor & structural pest control | | ☐ Note building design features that discourage entry of pests. | ☐ Provide Integrated Pest Management information to owners, lessees, and operators. |
| ☒ D2. Landscape/ Outdoor Pesticide Use | ☒ Show locations of native trees or areas of shrubs and ground cover to be undisturbed and retained.<br>☒ Show self-retaining | State that final landscape plans will accomplish all of the following.<br>☒ Preserve existing native trees, shrubs, and ground cover to the maximum extent possible.<br>☒ Design landscaping to minimize | ☒ Maintain landscaping using minimum or no pesticides.<br>☒ See applicable operational BMPs in "What you should know for…..Landscape and Gardening" at |

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| | landscape areas, if any.<br>☒ Show stormwater treatment and hydrograph modification management BMPs. (See instructions in Chapter 3, Step 5 and guidance in Chapter 5.) | irrigation and runoff, to promote surface infiltration where appropriate, and to minimize the use of fertilizers and pesticides that can contribute to stormwater pollution.<br>☒ Where landscaped areas are used to retain or detain stormwater, specify plants that are tolerant of saturated soil conditions.<br>☒ Consider using pest-resistant plants, especially adjacent to hardscape.<br>☒ To insure successful establishment, select plants appropriate to site soils, slopes, climate, sun, wind, rain, land use, air movement, ecological consistency, and plant interactions. | http://rcflood.org/stormwater/Error! Hyperlink reference not valid.<br>☒ Provide IPM information to new owners, lessees and operators. |
| ☒ E. Pools, spas, ponds, decorative fountains, and other water features. | ☒ Show location of water feature and a sanitary sewer cleanout in an accessible area within 10 feet. (Exception: Public pools must be plumbed according to County Department of Environmental Health Guidelines.) | If the Co-Permittee requires pools to be plumbed to the sanitary sewer, place a note on the plans and state in the narrative that this connection will be made according to local requirements. | ☒ See applicable operational BMPs in "Guidelines for Maintaining Your Swimming Pool, Jacuzzi and Garden Fountain" at http://rcflood.org/stormwater/ |
| ☒ F. Food service<br><br>**Restaurant maybe proposed in the proposed Commercial Areas (to be determined in final stage)** | ☒ For restaurants, grocery stores, and other food service operations, show location (indoors or in a covered area outdoors) of a floor sink or other area for cleaning floor mats, containers, and equipment.<br>☐ On the drawing, show a note that this drain will be connected to a grease interceptor before | ☒ Describe the location and features of the designated cleaning area.<br><br>☐ Describe the items to be cleaned in this facility and how it has been sized to insure that the largest items can be accommodated.<br><br>**Restaurant maybe proposed in the proposed Commercial Areas (to be** | ☒ See the brochure, "The Food Service Industry Best Management Practices for: Restaurants, Grocery Stores, Delicatessens and Bakeries" at http://rcflood.org/stormwater/<br>Provide this brochure to new site owners, lessees, and operators.<br><br>**Restaurant maybe proposed in the proposed Commercial Areas (to be determined in final** |

| | | | |
|---|---|---|---|
| | discharging to the sanitary sewer.<br><br>**Restaurant maybe proposed in the proposed Commercial Areas (to be determined in final stage)** | **determined in final stage)** | **stage)** |
| ☒ G. Refuse areas | ☒ Show where site refuse and recycled materials will be handled and stored for pickup. See local municipal requirements for sizes and other details of refuse areas.<br><br>☒ If dumpsters or other receptacles are outdoors, show how the designated area will be covered, graded, and paved to prevent runon and show locations of berms to prevent runoff from the area.<br>☒ Any drains from dumpsters, compactors, and tallow bin areas shall be connected to a grease removal device before discharge to sanitary sewer. | ☒ State how site refuse will be handled and provide supporting detail to what is shown on plans.<br><br>☒ State that signs will be posted on or near dumpsters with the words "Do not dump hazardous materials here" or similar. | ☒ State how the following will be implemented:<br>Provide adequate number of receptacles. Inspect receptacles regularly; repair or replace leaky receptacles. Keep receptacles covered. Prohibit/prevent dumping of liquid or hazardous wastes. Post "no hazardous materials" signs. Inspect and pick up litter daily and clean up spills immediately. Keep spill control materials available on-site. See Fact Sheet SC-34, "Waste Handling and Disposal" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com |
| ☐ H.Industrial processes. | ☐ Show process area. | ☐ If industrial processes are to be located on site, state: "All process activities to be performed indoors. No processes to drain to exterior or to storm drain system." | ☐ See Fact Sheet SC-10, "Non-Stormwater Discharges" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com<br>See the brochure "Industrial & Commercial Facilities Best Management Practices for: Industrial, Commercial Facilities" at http://rcflood.org/stormwater/ |
| ☐ I. Outdoor storage of equipment or materials. (See rows J and K for | ☐ Show any outdoor storage areas, including how materials | Include a detailed description of materials to be stored, storage | ☐ See the Fact Sheets SC-31, "Outdoor Liquid Container Storage" and SC-33, |

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|---|---|---|---|
| source control measures for vehicle cleaning, repair, and maintenance.) | will be covered. Show how areas will be graded and bermed to prevent runon or run-off from area.<br>☐ Storage of non-hazardous liquids shall be covered by a roof and/or drain to the sanitary sewer system, and be contained by berms, dikes, liners, or vaults.<br>☐ Storage of hazardous materials and wastes must be in compliance with the local hazardous materials ordinance and a Hazardous Materials Management Plan for the site. | areas, and structural features to prevent pollutants from entering storm drains.<br>Where appropriate, reference documentation of compliance with the requirements of Hazardous Materials Programs for:<br>☐ Hazardous Waste Generation<br>☐ Hazardous Materials Release Response and Inventory<br>☐ California Accidental Release (CalARP)<br>☐ Aboveground Storage Tank<br>☐ Uniform Fire Code Article 80 Section 103(b) & (c) 1991<br>☐ Underground Storage Tank<br>www.cchealth.org/groups/hazmat/ | "Outdoor Storage of Raw Materials " in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com |
| ☐ J. Vehicle and Equipment Cleaning | ☐ Show on drawings as appropriate:<br>(1) Commercial/industrial facilities having vehicle/equipment cleaning needs shall either provide a covered, bermed area for washing activities or discourage vehicle/equipment washing by removing hose bibs and installing signs prohibiting such uses.<br>(2) Multi-dwelling complexes shall have a paved, bermed, and covered car wash area (unless car washing is prohibited on-site and hoses are provided with an automatic shutoff to discourage such use). | ☐ If a car wash area is not provided, describe any measures taken to discourage on-site car washing and explain how these will be enforced. | Describe operational measures to implement the following (if applicable):<br>☐ Washwater from vehicle and equipment washing operations shall not be discharged to the storm drain system. Refer to "Outdoor Cleaning Activities and Professional Mobile Service Providers" for many of the Potential Sources of Runoff Pollutants categories below. Brochure can be found at http://rcflood.org/stormwater<br>☐ Car dealerships and similar may rinse cars with water only. |

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| | (3) Washing areas for cars, vehicles, and equipment shall be paved, designed to prevent run-on to or runoff from the area, and plumbed to drain to the sanitary sewer.<br>(4) Commercial car wash facilities shall be designed such that no runoff from the facility is discharged to the storm drain system. Wastewater from the facility shall discharge to the sanitary sewer, or a wastewater reclamation system shall be installed. | | |
| ☐ K. Vehicle/Equipment Repair and Maintenance | ☐ Accommodate all vehicle equipment repair and maintenance indoors. Or designate an outdoor work area and design the area to prevent run-on and runoff of stormwater.<br><br>☐ Show secondary containment for exterior work areas where motor oil, brake fluid, gasoline, diesel fuel, radiator fluid, acid-containing batteries or other hazardous materials or hazardous wastes are used or stored. Drains shall not be installed within the secondary containment areas.<br>☐ Add a note on the plans that states either (1) there are no floor drains, or (2) floor drains are connected to wastewater | ☐ State that no vehicle repair or maintenance will be done outdoors, or else describe the required features of the outdoor work area.<br><br>☐ State that there are no floor drains or if there are floor drains, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements.<br><br>☐ State that there are no tanks, containers or sinks to be used for parts cleaning or rinsing or, if there are, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements. | In the Stormwater Control Plan, note that all of the following restrictions apply to use the site:<br><br>☐ No person shall dispose of, nor permit the disposal, directly or indirectly of vehicle fluids, hazardous materials, or rinsewater from parts cleaning into storm drains.<br>☐ No vehicle fluid removal shall be performed outside a building, nor on asphalt or ground surfaces, whether inside or outside a building, except in such a manner as to ensure that any spilled fluid will be in an area of secondary containment. Leaking vehicle fluids shall be contained or drained from the vehicle immediately.<br>☐ No person shall leave unattended drip parts or other open containers containing vehicle fluid, unless such containers are in use or in an area of secondary containment.<br>Refer to "Automotive Maintenance & Car Care Best Management Practices for Auto Body Shops, |

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| | pretreatment systems prior to discharge to the sanitary sewer and an industrial waste discharge permit will be obtained. | | Auto Repair Shops, Car Dealerships, Gas Stations and Fleet Service Operations". Brochure can be found at http://rcflood.org/stormwater/ Refer to Outdoor Cleaning Activities and Professional Mobile Service Providers for many of the Potential Sources of Runoff Pollutants categories below. Brochure can be found at http://rcflood.org/stormwater/ |
| ☒ L. Fuel Dispensing Areas<br><br>**Gas Station maybe proposed in the proposed Commercial Areas (to be determined in final stage)** | ☒ Fueling areas[6] shall have impermeable floors (i.e., Portland cement concrete or equivalent smooth impervious surface) that are: a) graded at the minimum slope necessary to prevent ponding; and b) separated from the rest of the site by a grade break that prevents run-on of stormwater to the maximum extent practicable.<br>☒ Fueling areas shall be covered by a canopy that extends a minimum of ten feet in each direction from each pump. [Alternative: The fueling area must be covered and the cover's minimum dimensions must be equal to or greater than the area within the grade break or fuel dispensing area[1].] The canopy [or cover] shall not drain onto the fueling area.<br><br>**Gas Station maybe proposed in the proposed Commercial Areas (to be determined in final stage)** | | ☒ Move loaded and unloaded items indoors as soon as possible.<br>☒ See Fact Sheet SC-30, "Outdoor Loading and Unloading," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com<br><br>**Gas Station maybe proposed in the proposed Commercial Areas (to be determined in final stage)** |

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|---|---|---|---|
| ☒ M. Loading Docks<br><br>**The Loading Docks maybe use in the proposed Commercial Areas (to be determined in final stage)** | ☒ Show a preliminary design for the loading dock area, including roofing and drainage. Loading docks shall be covered and/or graded to minimize run-on to and runoff from the loading area. Roof downspouts shall be positioned to direct stormwater away from the loading area. Water from loading dock areas shall be drained to the sanitary sewer, or diverted and collected for ultimate discharge to the sanitary sewer.<br>☒ Loading dock areas draining directly to the sanitary sewer shall be equipped with a spill control valve or equivalent device, which shall be kept closed during periods of operation.<br>☒ Provide a roof overhang over the loading area or install door skirts (cowling) at each bay that enclose the end of the trailer.<br><br>**The Loading Docks maybe use in the proposed Commercial Areas (to be determined in final stage)** | | ☒ Move loaded and unloaded items indoors as soon as possible.<br>☒ See Fact Sheet SC-30, "Outdoor Loading and Unloading," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com<br><br>**The Loading Docks maybe use in the proposed Commercial Areas (to be determined in final stage)** |
| ☒ N. Fire Sprinkler Test Water | | ☒ Provide a means to drain fire sprinkler test water to the sanitary sewer. | ☒ See the note in Fact Sheet SC-41, "Building and Grounds Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com |

| | | | |
|---|---|---|---|
| O. Miscellaneous Drain or Wash Water or Other Sources<br>☐ Boiler drain lines<br>☐ Condensate drain lines<br>☒ Rooftop equipment<br>☐ Drainage sumps<br>☒ Roofing, gutters, and trim.<br>☐ Other sources | | ☐ Boiler drain lines shall be directly or indirectly connected to the sanitary sewer system and may not discharge to the storm drain system.<br>☐ Condensate drain lines may discharge to landscaped areas if the flow is small enough that runoff will not occur. Condensate drain lines may not discharge to the storm drain system.<br>☒ Rooftop equipment with potential to produce pollutants shall be roofed and/or have secondary containment.<br>☐ Any drainage sumps on-site shall feature a sediment sump to reduce the quantity of sediment in pumped water.<br>☒ Avoid roofing, gutters, and trim made of copper or other unprotected metals that may leach into runoff.<br>☐ Include controls for other sources as specified by local reviewer. | ☒ Drain to landscaping areas. See D2 for landscape area maintenance. |
| ☒ P. Plazas, sidewalks, and parking lots. | | | ☒ Sweep plazas, sidewalks, and parking lots regularly to prevent accumulation of litter and debris. Collect debris from pressure washing to prevent entry into the storm drain system. Collect washwater containing any cleaning agent or degreaser and discharge to the sanitary sewer not to a storm drain. |
| | | | |

# Appendix 9: O&M

*Operation and Maintenance Plan and Documentation of Finance, Maintenance and Recording Mechanisms*

**Insert Operation and Maintenance Agreement:**

# Appendix 10: Educational Materials

*BMP Fact Sheets, Maintenance Guidelines and Other End-User BMP Information*

# BIORETENTION FACILITY BMP FACT SHEET

## Inspection and Maintenance Schedule

The Bioretention Facility area shall be inspected for erosion, dead vegetation, soggy soils, or standing water. The use of fertilizers and pesticides on the plants inside the Bioretention Facility should be minimized.

| Schedule | Activity |
|---|---|
| Ongoing | • Keep adjacent landscape areas maintained. Remove clippings from landscape maintenance activities.<br>• Remove trash and debris<br>• Replace damaged grass and/or plants<br>• Replace surface mulch layer as needed to maintain a 2-3 inch soil cover. |
| After storm events | • Inspect areas for ponding |
| Annually | • Inspect/clean inlets and outlets |

# The Ocean Begins at Your Front Door

*Never allow pollutants to enter the street, gutter or storm drain!*

Follow these simple steps to help reduce water pollution:

## Household Activities

- Do not rinse spills with water. Use dry cleanup methods such as applying cat litter or another absorbent material, sweep and dispose of in the trash. Take items such as used or excess batteries, oven cleaners, automotive fluids, painting products and cathode ray tubes, like TVs and computer monitors, to a Household Hazardous Waste Collection Center (HHWCC).
- For a HHWCC near you call (714) 834-6752 or visit www.oclandfills.com.
- Do not hose down your driveway, sidewalk or patio to the street, gutter or storm drain. Sweep up debris and dispose of it in the trash.

## Automotive

- Take your vehicle to a commercial car wash whenever possible. If you wash your vehicle at home, choose soaps, cleaners, or detergents labeled non-toxic, phosphate- free or biodegradable. Vegetable and citrus-based products are typically safest for the environment.
- Do not allow washwater from vehicle washing to drain into the street, gutter or storm drain. Excess washwater should be disposed of in the sanitary sewer (through a sink or toilet) or onto an absorbent surface like your lawn.
- Monitor your vehicles for leaks and place a pan under leaks. Keep your vehicles well maintained to stop and prevent leaks.
- Never pour oil or antifreeze in the street, gutter or storm drain. Recycle these substances at a service station, a waste oil collection center or used oil recycling center. For the nearest Used Oil Collection Center call 1-800-CLEANUP or visit www.1800cleanup.org.

## Pool Maintenance

- Pool and spa water must be dechlorinated and free of excess acid, alkali or color to be allowed in the street, gutter or storm drain.
- When it is not raining, drain dechlorinated pool and spa water directly into the sanitary sewer.
- Some cities may have ordinances that do not allow pool water to be disposed of in the storm drain. Check with your city.

## Landscape and Gardening

- Do not over-water. Water your lawn and garden by hand to control the amount of water you use or set irrigation systems to reflect seasonal water needs. If water flows off your yard onto your driveway or sidewalk, your system is over-watering. Periodically inspect and fix leaks and misdirected sprinklers.
- Do not rake or blow leaves, clippings or pruning waste into the street, gutter or storm drain. Instead, dispose of waste by composting, hauling it to a permitted landfill, or as green waste through your city's recycling program.
- Follow directions on pesticides and fertilizer, (measure, do not estimate amounts) and do not use if rain is predicted within 48 hours.
- Take unwanted pesticides to a HHWCC to be recycled. For locations and hours of HHWCC, call (714) 834-6752 or visit www.oclandfills.com.

## Trash

- Place trash and litter that cannot be recycled in securely covered trash cans.
- Whenever possible, buy recycled products.
- Remember: Reduce, Reuse, Recycle.

## Pet Care

- Always pick up after your pet. Flush waste down the toilet or dispose of it in the trash. Pet waste, if left outdoors, can wash into the street, gutter or storm drain.
- If possible, bathe your pets indoors. If you must bathe your pet outside, wash it on your lawn or another absorbent/permeable surface to keep the washwater from entering the street, gutter or storm drain.
- Follow directions for use of pet care products and dispose of any unused products at a HHWCC.

## Common Pollutants

### Home Maintenance

- Detergents, cleaners and solvents
- Oil and latex paint
- Swimming pool chemicals
- Outdoor trash and litter

### Lawn and Garden

- Pet and animal waste
- Pesticides
- Clippings, leaves and soil
- Fertilizer

### Automobile

- Oil and grease
- Radiator fluids and antifreeze
- Cleaning chemicals
- Brake pad dust

## Did You Know?

- Most people believe that the largest source of water pollution in urban areas comes from specific sources such as factories and sewage treatment plants. In fact, the largest source of water pollution comes from city streets, neighborhoods, construction sites and parking lots. This type of pollution is sometimes called "non-point source" pollution.
- There are two types of non-point source pollution: stormwater and urban runoff pollution.
- Stormwater runoff results from rainfall. When rainstorms cause large volumes of water to rinse the urban landscape, picking up pollutants along the way.
- Urban runoff can happen any time of the year when excessive water use from irrigation, vehicle washing and other sources carries trash, lawn clippings and other urban pollutants into storm drains.

## Where Does It Go?

- Anything we use outside homes, vehicles and businesses – like motor oil, paint, pesticides, fertilizers and cleaners – can be blown or washed into storm drains.
- A little water from a garden hose or rain can also send materials into storm drains.
- Storm drains are separate from our sanitary sewer systems; unlike water in sanitary sewers (from sinks or toilets), water in storm drains is not treated before entering our waterways.

## Sources of Non-Point Source Pollution

- Automotive leaks and spills.
- Improper disposal of used oil and other engine fluids.
- Metals found in vehicle exhaust, weathered paint, rust, metal plating and tires.
- Pesticides and fertilizers from lawns, gardens and farms.
- Improper disposal of cleaners, paint and paint removers.
- Soil erosion and dust debris from landscape and construction activities.
- Litter, lawn clippings, animal waste, and other organic matter.
- Oil stains on parking lots and paved surfaces.

## The Effect on the Ocean

Non-point source pollution can have a serious impact on water quality in Orange County. Pollutants from the storm drain system can harm marine life as well as coastal and wetland habitats. They can also degrade recreation areas such as beaches, harbors and bays.

Stormwater quality management programs have been developed throughout Orange County to educate and encourage the public to protect water quality, monitor runoff in the storm drain system, investigate illegal dumping and maintain storm drains.

Support from Orange County residents and businesses is needed to improve water quality and reduce urban runoff pollution. Proper use and disposal of materials will help stop pollution before it reaches the storm drain and the ocean.

# Stormwater and the Construction Industry

## Protect Natural Features

Bad

Good

- Minimize clearing.
- Minimize the amount of exposed soil.
- Identify and protect areas where existing vegetation, such as trees, will not be disturbed by construction activity.
- Protect streams, stream buffers, wild woodlands, wetlands, or other sensitive areas from any disturbance or construction activity by fencing or otherwise clearly marking these areas.

## Construction Phasing

- Sequence construction activities so that the soil is not exposed for long periods of time.
- Schedule or limit grading to small areas.
- Install key sediment control practices before site grading begins.
- Schedule site stabilization activities, such as landscaping, to be completed immediately after the land has been graded to its final contour.

## Vegetative Buffers

Bad

Good

- Protect and install vegetative buffers along waterbodies to slow and filter stormwater runoff.
- Maintain buffers by mowing or replanting periodically to ensure their effectiveness.

## Silt Fencing

Bad

Good

- Inspect and maintain silt fences after each rainstorm.
- Make sure the bottom of the silt fence is buried in the ground.
- Securely attach the material to the stakes.
- Don't place silt fences in the middle of a waterway or use them as a check dam.
- Make sure stormwater is not flowing around the silt fence.

# Maintain your BMPs!

**IN RIVERSIDE COUNTY....Call 1-800-506-2555**
**TO REPORT ILLEGAL STORMDRAIN DISPOSAL**

E-mail: Flood.fcnpdes@co.riverside.ca.us
Visit our website: www.floodcontrol.co.riverside.ca.us

Brought to you by the Storm Water/Clean Water Pollution Protection Program.....
**REMEMBER, ONLY RAIN IN THE STORMDRAIN!**

## Site Stabilization

Bad

Good

- Vegetate, mulch, or otherwise stabilize all exposed areas as soon as land alterations have been completed.

## Construction Entrances

Bad

Good

- Remove mud and dirt from the tires of construction vehicles before they enter a paved roadway.
- Properly size entrance BMPs for all anticipated vehicles.
- Make sure that the construction entrance does not become buried in soil.

## Slopes

Bad

Good

- Rough grade or terrace slopes.
- Break up long slopes with sediment barriers, or under drain, or divert stormwater away from slopes.

## Dirt Stockpiles

Bad

Good

- Cover or seed all dirt stockpiles.

## Storm Drain Inlet Protection

Bad

Good

- Use rock or other appropriate material to cover the storm drain inlet to filter out trash and debris.
- Make sure the rock size is appropriate (usually 1 to 2 inches in diameter).
- If you use inlet filters, maintain them regularly.

*www.epa.gov/npdes/menuofbmps*

EPA 833-B-03-002
January 2003

# A Citizen's Guide to Understanding Stormwater



# After the Storm

## What is stormwater runoff?



Stormwater runoff occurs when precipitation from rain or snowmelt flows over the ground. Impervious surfaces like driveways, sidewalks, and streets prevent stormwater from naturally soaking into the ground.

## Why is stormwater runoff a problem?



Stormwater can pick up debris, chemicals, dirt, and other pollutants and flow into a storm sewer system or directly to a lake, stream, river, wetland, or coastal water. Anything that enters a storm sewer system is discharged untreated into the waterbodies we use for swimming, fishing, and providing drinking water.

## The effects of pollution



Polluted stormwater runoff can have many adverse effects on plants, fish, animals, and people.

- Sediment can cloud the water and make it difficult or impossible for aquatic plants to grow. Sediment also can destroy aquatic habitats.
- Excess nutrients can cause algae blooms. When algae die, they sink to the bottom and decompose in a process that removes oxygen from the water. Fish and other aquatic organisms can't exist in water with low dissolved oxygen levels.



- Bacteria and other pathogens can wash into swimming areas and create health hazards, often making beach closures necessary.
- Debris—plastic bags, six-pack rings, bottles, and cigarette butts—washed into waterbodies can choke, suffocate, or disable aquatic life like ducks, fish, turtles, and birds.
- Household hazardous wastes like insecticides, pesticides, paint, solvents, used motor oil, and other auto fluids can poison aquatic life. Land animals and people can become sick or die from eating diseased fish and shellfish or ingesting polluted water.
- Polluted stormwater often affects drinking water sources. This, in turn, can affect human health and increase drinking water treatment costs.



For more information contact:

or visit
www.epa.gov/npdes/stormwater
www.epa.gov/nps

# Stormwater Pollution Solutions

*Recycle or properly dispose of household products that contain chemicals, such as insecticides, pesticides, paint, solvents, and used motor oil and other auto fluids. Don't pour them onto the ground or into storm drains.*

### Lawn care

Excess fertilizers and pesticides applied to lawns and gardens wash off and pollute streams. In addition, yard clippings and leaves can wash into storm drains and contribute nutrients and organic matter to streams.

- Don't overwater your lawn. Consider using a soaker hose instead of a sprinkler.
- Use pesticides and fertilizers sparingly. When use is necessary, use these chemicals in the recommended amounts. Use organic mulch or safer pest control methods whenever possible.
- Compost or mulch yard waste. Don't leave it in the street or sweep it into storm drains or streams.
- Cover piles of dirt or mulch being used in landscaping projects.

### Auto care

Washing your car and degreasing auto parts at home can send detergents and other contaminants through the storm sewer system. Dumping automotive fluids into storm drains has the same result as dumping the materials directly into a waterbody.

- Use a commercial car wash that treats or recycles its wastewater, or wash your car on your yard so the water infiltrates into the ground.
- Repair leaks and dispose of used auto fluids and batteries at designated drop-off or recycling locations.

### Septic systems

Leaking and poorly maintained septic systems release nutrients and pathogens (bacteria and viruses) that can be picked up by stormwater and discharged into nearby waterbodies. Pathogens can cause public health problems and environmental concerns.

- Inspect your system every 3 years and pump your tank as necessary (every 3 to 5 years).
- Don't dispose of household hazardous waste in sinks or toilets.

### Pet waste

Pet waste can be a major source of bacteria and excess nutrients in local waters.

- When walking your pet, remember to pick up the waste and dispose of it properly. Flushing pet waste is the best disposal method. Leaving pet waste on the ground increases public health risks by allowing harmful bacteria and nutrients to wash into the storm drain and eventually into local waterbodies.

*Education is essential to changing people's behavior. Signs and markers near storm drains warn residents that pollutants entering the drains will be carried untreated into a local waterbody.*

## Residential landscaping

**Permeable Pavement**—Traditional concrete and asphalt don't allow water to soak into the ground. Instead these surfaces rely on storm drains to divert unwanted water. Permeable pavement systems allow rain and snowmelt to soak through, decreasing stormwater runoff.

**Rain Barrels**—You can collect rainwater from rooftops in mosquito-proof containers. The water can be used later on lawn or garden areas.

**Rain Gardens and Grassy Swales**—Specially designed areas planted with native plants can provide natural places for rainwater to collect and soak into the ground. Rain from rooftop areas or paved areas can be diverted into these areas rather than into storm drains.

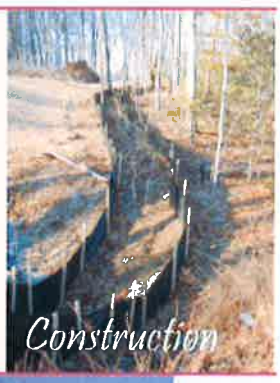
**Vegetated Filter Strips**—Filter strips are areas of native grass or plants created along roadways or streams. They trap the pollutants stormwater picks up as it flows across driveways and streets.

Dirt, oil, and debris that collect in parking lots and paved areas can be washed into the storm sewer system and eventually enter local waterbodies.

- Sweep up litter and debris from sidewalks, driveways and parking lots, especially around storm drains.
- Cover grease storage and dumpsters and keep them clean to avoid leaks.
- Report any chemical spill to the local hazardous waste cleanup team. They'll know the best way to keep spills from harming the environment.

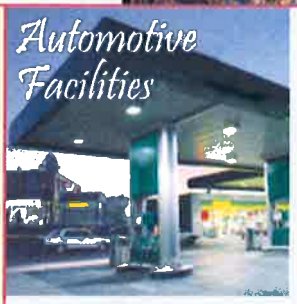
Erosion controls that aren't maintained can cause excessive amounts of sediment and debris to be carried into the stormwater system. Construction vehicles can leak fuel, oil, and other harmful fluids that can be picked up by stormwater and deposited into local waterbodies.

- Divert stormwater away from disturbed or exposed areas of the construction site.
- Install silt fences, vehicle mud removal areas, vegetative cover, and other sediment and erosion controls and properly maintain them, especially after rainstorms.
- Prevent soil erosion by minimizing disturbed areas during construction projects, and seed and mulch bare areas as soon as possible.



Lack of vegetation on streambanks can lead to erosion. Overgrazed pastures can also contribute excessive amounts of sediment to local waterbodies. Excess fertilizers and pesticides can poison aquatic animals and lead to destructive algae blooms. Livestock in streams can contaminate waterways with bacteria, making them unsafe for human contact.

- Keep livestock away from streambanks and provide them a water source away from waterbodies.
- Store and apply manure away from waterbodies and in accordance with a nutrient management plan.
- Vegetate riparian areas along waterways.
- Rotate animal grazing to prevent soil erosion in fields.
- Apply fertilizers and pesticides according to label instructions to save money and minimize pollution.




Uncovered fueling stations allow spills to be washed into storm drains. Cars waiting to be repaired can leak fuel, oil, and other harmful fluids that can be picked up by stormwater.

- Clean up spills immediately and properly dispose of cleanup materials.
- Provide cover over fueling stations and design or retrofit facilities for spill containment.
- Properly maintain fleet vehicles to prevent oil, gas, and other discharges from being washed into local waterbodies.
- Install and maintain oil/water separators.

Improperly managed logging operations can result in erosion and sedimentation.

- Conduct preharvest planning to prevent erosion and lower costs.
- Use logging methods and equipment that minimize soil disturbance.
- Plan and design skid trails, yard areas, and truck access roads to minimize stream crossings and avoid disturbing the forest floor.
- Construct stream crossings so that they minimize erosion and physical changes to streams.
- Expedite revegetation of cleared areas.

Because every industrial site is unique, every SWPPP is unique. The SWPPP needs to be reviewed and updated by the operator on a regular basis. Please visit **www.epa.gov/npdes/stormwater/msgp** for more information on how to develop your SWPPP.

### Basic SWPPP Elements

- Stormwater pollution prevention team
- Site description
- Summary of potential pollutant sources
- Description of control measures
- Schedules and procedures
- Documentation to support eligibility considerations under other federal laws
- Certification of the SWPPP

**3. Complete documentation for eligibility under other Federal laws.**
The operator must assess the potential effects of stormwater runoff on federally listed endangered and threatened species and any designated critical habitat located on or near the site, as well as impacts on historic properties on or near the facility. In making these determinations, the operator needs to consider areas beyond the immediate footprint of the facility site as well as beyond the property line—areas that could be affected directly or indirectly by stormwater discharges. The MSGP contains more information about completing these determinations in applying for permit coverage.

**4. File a Notice of Intent (NOI) application.**
The Notice of Intent (NOI) form lets EPA know that you are filing for permit coverage. It also attests that you have read, understood, and are complying with the requirements of the MSGP. The fastest and easiest way to file an NOI is through EPA's online permit application system (www.epa.gov/npdes/enoi). (Mailing a paper NOI to EPA can add 2 or more weeks to your processing time.) Your permit coverage begins after a 30-day waiting period, during which NOIs are reviewed by EPA and others.

**5. Implement all stormwater control measures outlined in your SWPPP.**
Your SWPPP must be updated as conditions at the industrial facility and as practices change.

*Storm drain adjacent to access road to plant; drain is not protected and not being serviced.*

### Questions?

To find out more about the stormwater permit program, please contact in the EPA Region 10 Seattle office:


**Julie Congdon**
Stormwater Compliance Assistance Coordinator
Office of Compliance & Enforcement, NPDES Unit
**1.800.424.4372**, x. **2752**
**congdon.julie@epa.gov**

**Michael Le**
Industrial Stormwater Permits
Office of Water & Watersheds, NPDES Permits Unit
**1.800.424.4372**, x. **1099**
**le.michael@epa.gov**



***Notice:*** The statements in this document are intended solely as guidance to aid regulated entities in complying with the Clean Water Act's stormwater requirements. The guidance is not a substitute for reading the Clean Water Act and its implementing regulations and understanding all its requirements as they apply to your facility. This guidance does not constitute rulemaking by the EPA and may not be relied on to create a substantive or procedural right or benefit enforceable, at law or in equity, by any person. EPA may decide to update this guide without public notice to reflect changes in EPA's approach to implementing the Clean Water Act. This document reflects information available in EPA's NPDES Multi-Sector General Permit for Stormwater Discharges Associated with Industrial Activity.

*Waste materials are left exposed to the elements and stormwater runoff. Lack of secondary containment for the tank.*


EPA 910-K-09-006


EPA
United States Environmental Protection Agency

# Does Your Facility Need a Stormwater Permit?

## An Industrial Facility Operator's Guide to EPA's Stormwater Permit Program

Office of Compliance and Enforcement
US EPA Region 10

# Many Industrial Facilities *(with few exceptions)* Need Stormwater Permit Coverage!

## *Why is stormwater runoff a problem?*

Runoff from rainstorms and snowmelt picks up pollutants like sediment, oil and grease, nitrogen, phosphorus, and other chemicals and carries them into storm drains or directly into waterbodies. Because most storm drain systems do not provide any treatment to the water they collect, preventing contamination of stormwater is critically important. Otherwise, polluted runoff will be discharged untreated into the waterbodies we use for swimming, fishing, and drinking water.

This brochure describes who must comply with the EPA's stormwater permit requirements for:

- Idaho
- Federal facilities in Washington
- Indian Country within Alaska, Idaho, Oregon and Washington.*

* *If your facility is not in one of the areas noted, you will need to obtain permit coverage from the appropriate state authority. A list of state permitting authorities can be found at* **www.epa.gov/npdes/stormwater**.

*Unauthorized non-stormwater discharge from an industrial facility.*

***Photo courtesy of TetraTech.***

*Two photos showing an industrial facility before and after it followed good housekeeping practices.*

***Photos courtesy of TetraTech.***

## *What is the Multi-Sector General Permit, or MSGP?*

EPA's National Pollutant Discharge Elimination System (NPDES) program regulates stormwater runoff from industrial facilities. The Multi-Sector General Permit (MSGP) covers industrial facilities in 29 different industrial sectors.

### *If your facility...*

- is located in Idaho, Indian Country or is a Federal facility in Washington,
- has "primary" or "co-located" industrial activities covered by the MSGP,
- has stormwater runoff that discharges to a surface water or to a storm sewer that flows to a surface water,

you need permit coverage under the **Multi-Sector General Permit**.

## *What industries are covered by the MSGP?*

Permit eligibility is limited to discharges from facilities in the "sectors" of industrial activity listed. The sector descriptions are based on Standard Industrial Classification (SIC) Codes and Industrial Activity Codes. For a more detailed list, please see Appendix D of the MSGP. The industrial sectors listed in the table must minimize pollutants in their stormwater discharges and obtain permit coverage under the MSGP.

### Industries Covered by the MSGP and SIC Codes

| *SIC Code* | *Industrial Activity Sector* |
|---|---|
| 24xx | A: Timber Products |
| 26xx | B: Paper Products |
| 28xx, 3952 | C: Chemical Products |
| 29xx | D: Asphalt/Roofing |
| 32xx | E: Glass, Clay, Cement |
| 33xx | F: Primary Metals |
| 10xx | G: Metal Mining |
| 12xx | H: Coal Mines |
| 13xx | I: Oil and Gas |
| 14xx | J: Mineral Mining |
| HZ | K: Hazardous Waste |
| LF | L: Landfills |
| 5015 | M: Auto Salvage Yards |
| 5093 | N: Scrap Recycling |
| SE | O: Steam Electric Facilities |
| 40xx, 41xx, 42xx, 4311, 5171 | P: Land Transportation |
| 44xx | Q: Water Transportation |
| 37xx | R: Ship/Boat Building, Repair |
| 45xx | S: Air Transportation |
| TW | T: Treatment Works (WWTPs) |
| 20xx, 21xx | U: Food Products |
| 22xx, 23xx, 31xx | V: Textile Mills |
| 2434, 25xx | W: Furniture and Fixtures |
| 27xx | X: Printing, Publishing |
| 30xx, 39xx | Y: Rubber, Misc. Plastics |
| 3111 | Z: Leather Tanning/ Finishing |
| 34xx, 39xx | AA: Fabricated Metal Products |
| 35xx, 37xx | AB: Transportation Equip. |
| 357x, 38xx, 36xx | AC: Electronic, photo goods |

## I need permit coverage. *Where do I begin?*

**1. Read EPA's Multi-Sector General Permit.**

You can download a copy of EPA's permit at **www.epa.gov/npdes/stormwater/msgp**. Read the permit carefully, and remember that operators are legally responsible for complying with all of its requirements.

### Who is responsible for coverage and who submits an NOI?

The "operator" submits a Notice of Intent (NOI) application. The operator is the entity (generally the company, corporation, etc.) that has operational control over the industrial activities, or has day-to-day operational control of activities at the facility necessary to implement the Stormwater Pollution Prevention Plan (SWPPP—see below/ next page for more information) and ensure compliance with the permit (e.g., the entity is authorized to direct workers at a facility to carry out activities required by the permit).

It is the responsibility of the operator(s) to develop and implement a SWPPP and maintain all "best management practices" or stormwater control measures at the facility. These include swales, detention ponds, spill protection equipment, schedules of activities, prohibitions of practices, and maintenance procedures that you use to prevent or reduce the discharge of pollutants.

**2. Develop a site-specific stormwater pollution prevention plan (SWPPP).**

The SWPPP explains how you will control pollutants in stormwater runoff from your facility. It is a written document that identifies the sources of pollution and industrial activities conducted at the site, including stormwater control practices which the operator will use to prevent pollutants from making their way into stormwater runoff. The SWPPP must be completed before you apply for permit coverage. EPA does not require that you submit the SWPPP with your application to obtain permit coverage, but the plan must be available to EPA by request or for review during inspection.

## Resources

State Water Resources Control Board
Division of Water Quality
1001 I Street
Sacramento CA 95814
(916) 341-5455
www.swrcb.ca.gov/stormwtr/

Colorado River Basin Regional Water
Quality Control Board - Region 7
73-720 Fred Waring Drive, Suite 100
Palm Desert, CA 92260
(760) 346-7491
www.swrcb.ca.gov/~rwqcb7/

Santa Ana Regional Water
Quality Control Board - Region 8
3737 Main Street, Suite 500
Riverside, CA 92501-3348
(909) 782-4130
www.swrcb.ca.gov/~rwqcb8/

San Diego Regional Water
Quality Control Board - Region 9
9771 Clairemont Mesa Blvd., Suite A
San Diego, CA 92124
(858) 467-2952
www.swrcb.ca.gov/~rwqcb9/

The StormWater/CleanWater Protection Program gratefully acknowledges the Santa Clara Valley Nonpoint Pollution Control Program, Alameda Countywide CleanWater Program and the City of Los Angeles Stormwater Management Division for information provided in this brochure.

StormWater CleanWater
PROTECTION PROGRAM

**To report a hazardous materials spill, call:**

Riverside County Hazardous Materials
Emergency Response Team
(909) 358-5055 8:00 a.m. – 5:00 p.m.
(909) 358-5245 after 5:00 p.m.

In an emergency call: **911**

**For recycling and hazardous waste disposal, call:**

(909) 358-5055

**To report an illegal dumping or a clogged storm drain, call:**

**1-800-506-2555**

To order additional brochures or to obtain information on other pollution prevention activities, please call (909) 955-1200 or visit the StormWater/CleanWater Protection Program website at:
www.co.riverside.ca.us/depts/flood/waterquality/bmpdes.asp

# StormWater Pollution

What you should know for...

## GENERAL CONSTRUCTION & SITE SUPERVISION



## Best Management Practices (BMPs) for:

- Developers
- General Contractors
- Home Builders
- Construction Inspectors
- Anyone in the construction business

## StormWater Pollution . . . What You Should Know

Riverside County has two drainage systems - sewers and storm drains. The storm drain system was designed to reduce flooding by carrying excess rainwater away from streets and developed areas. Since the storm drain system does not provide for water treatment, it also serves the *unintended* function of transporting pollutants directly to our local waterways.



*Unlike sanitary sewers, storm drains are not connected to a wastewater treatment plant – they flow directly to our local streams, rivers and lakes.*

Stormwater runoff is a part of the natural hydrologic process. However, land development and construction activities can significantly alter natural drainage processes and introduce pollutants into stormwater runoff. Polluted stormwater runoff from construction sites has been identified as a major source of water pollution in California. It jeopardizes the quality of our local waterways and can pose a serious threat to the health of our aquatic ecosystems.

## The Cities and County of Riverside StormWater/CleanWater Protection Program




Because preventing pollution is much easier and less costly than cleaning up "after the fact," the Cities and County of Riverside StormWater/CleanWater Protection Program informs residents and businesses on pollution prevention activities. This pamphlet describes various Best Management Practices (BMPs) that construction site operators can use to prevent stormwater pollution.

In accordance with applicable federal and state law, the Cities and County of Riverside have adopted ordinances for stormwater management and discharge control that **prohibit** the discharge of pollutants into the storm drain system or local surface water. This includes discharges from construction sites containing sediment, concrete, mortar, paint, solvents, lubricants, vehicle fluids, fuel, pesticides, and construction debris.

PLEASE NOTE: The Federal, State and local regulations strictly prohibit the discharge of sediment and pollutants into the streets, the storm drain system or waterways. As an owner, operator or supervisor of a construction site, you may be held financially responsible for any environmental damage caused by your subcontractors or employees.

## Stormwater Pollution from Construction Activities

The two most common sources of stormwater pollution problems associated with construction activities are ***erosion*** and ***sedimentation***. Failure to maintain adequate erosion and sediment controls at construction sites often results in sediment discharges into the storm drain system, creating multiple problems once it enters local waterways.

Construction vehicles and heavy equipment can also track significant amounts of mud and sediment onto adjacent streets. Additionally, wind may transport construction materials and wastes into streets storm drains, or directly into our local waterways.

## What Should You Do?
## Advance Planning to Prevent Pollution

- ❑ Remove existing vegetation only as needed.
- ❑ Schedule excavation, grading, and paving operations for dry weather periods, if possible.
- ❑ Designate a specific area of the construction site, well away from storm drain inlets or watercourses, for material storage and equipment maintenance.
- ❑ Develop and implement an effective combination of erosion and sediment controls for the construction site.
- ❑ Practice source reduction by ordering only the amount of materials that are needed to finish the project.
- ❑ Educate your employees and subcontractors about stormwater management requirements and their pollution prevention responsibilities.
- ❑ Control the amount of surface runoff at the construction site by impeding internally generated flows and using berms or drainage ditches to direct incoming offsite flows to go around the site. ***Note:*** *Consult local drainage policies for more information.*

# Best Management Practices

The following Best Management Practices (BMPs) can significantly reduce pollutant discharges from your construction site. Compliance with stormwater regulations can be as simple as minimizing stormwater contact with potential pollutants by providing covers and secondary containment for construction materials, designating areas away from storm drain systems for storing equipment and materials and implementing good housekeeping practices at the construction site.

- ❑ Protect all storm drain inlets and streams located near the construction site to prevent sediment-laden water from entering the storm drain system.
- ❑ Limit access to and from the site. Stabilize construction entrances/exits to minimize the track out of dirt and mud onto adjacent streets. Conduct frequent street sweeping.
- ❑ Protect stockpiles and construction materials from winds and rain by storing them under a roof, secured impermeable tarp or plastic sheeting.
- ❑ Avoid storing or stockpiling materials near storm drain inlets, gullies or streams.
- ❑ Phase grading operations to limit disturbed areas and duration of exposure.
- ❑ Perform major maintenance and repairs of vehicles and equipment offsite.
- ❑ Wash out concrete mixers only in designated washout areas at the construction site.
- ❑ Set-up and operate small concrete mixers on tarps or heavy plastic drop cloths.
- ❑ Keep construction sites clean by removing trash, debris, wastes, etc. on a regular basis.
- ❑ Clean-up spills immediately using dry clean-up methods (e.g., absorbent materials such as cat litter, sand or rags for liquid spills; sweeping for dry spills such as cement, mortar or fertilizer) and by removing the contaminated soil from spills on dirt areas. .
- ❑ Prevent erosion by implementing any or a combination of soil stabilization practices such as mulching, surface roughening, permanent or temporary seeding.
- ❑ Maintain all vehicles and equipment in good working condition. Inspect frequently for leaks, and repair promptly.
- ❑ Practice proper waste disposal. Many construction materials and wastes, including solvents, water-based paint, vehicle fluids, broken asphalt and concrete, wood, and cleared vegetation can be recycled. Materials that cannot be recycled must be taken to an appropriate landfill or disposed of as hazardous waste.
- ❑ Cover open dumpsters with secured tarps or plastic sheeting. Never clean out a dumpster by washing it down on the construction site.
- ❑ Arrange for an adequate debris disposal schedule to insure that dumpsters do not overflow.

# General Construction Activities Stormwater Permit

## *(Construction Activities General Permit)*

The State Water Resources Control Board (SWRCB) adopted a new Construction Activities General Permit (WQ Order No. 99-08DWQ) on August 19, 1999, superseding the now expired SWRCB statewide General Permit (WQ Order No. 92-08DWQ). This permit is administered and enforced by the SWRCB and the local Regional Water Quality Control Boards (RWQCB). The updated Construction Activities General Permit establishes a number of new stormwater management requirements for construction site operator.

*NOTE: Some construction activies stormwater permits are issued on a regional basis. Consult your local RWQCB to find out if your project requires coverage under any of these permits.*

## Frequently Asked Questions:

### *Does my construction site require coverage under the Construction Activities General Permit?*

Yes, if construction activity results in the disturbance of five or more acres of total land area or is part of a common plan of development that results in the disturbance of five or more acres.

### *How do I obtain coverage under the Construction Activities General Permit?*

Obtain the permit package and submit the completed Notice of Intent (NOI) form to the SWRCB prior to grading or disturbing soil at the construction site. For ongoing construction activity involving a change of ownership, the new owner must submit a new NOI within 30 days of the date of change of ownership. The completed NOI along with the required fee should be mailed to the SWRCB.

### *What must I do to comply with the requirements of the Construction Activities General Permit?*

- ● Implement BMPs for non-stormwater discharges year-round.
- ● Prepare and implement a Stormwater Pollution Prevention Plan (SWPPP) prior to commencing construction activities.
- ● Keep a copy of the SWPPP at the construction site for the entire duration of the project.
- ● Calculate the anticipated stormwater run-off.
- ● Implement an effective combination of erosion and sediment control on all soil disturbed areas.
- ● Conduct site inspections prior to anticipated storm events, every 24-hours during extended storm events, and after actual storm event.
- ● Perform repair and maintenance of BMPs as soon as possible after storm events depending upon worker safety.
- ● Update the SWPPP as needed, to manage pollutants or reflect changes in site conditions.
- ● Include description of post construction BMPs at the construction site, including parties responsible for long-term maintenance.

*NOTE: Please refer to the Construction Activities General Permit for detailed information. You may contact the SWRCB, your local RWQCB, or visit the SWRCB website at www.swrcb.ca.gov/stormwtr/ to obtain a State Construction Activities Stormwater General Permit packet.*

### *How long is this Construction Activities General Permit in effect?*

The Permit coverage stays in effect untilyou submit a Notice of Termination (NOT) to the SWRCB. For the purpose of submitting a NOT, all soil disturbing activities have to be completed and one of the three following criteria has to be met:

1. Change of ownership;
2. A uniform vegetative cover with 70 percent coverage has been established; or,
3. Equivalent stabilization measures such as the use of reinforced channel liners, soil cement, fiber matrices, geotextiles, etc., have been employed.

## For Information:

For information on “closed-loop” suppliers and recycling/disposal vendors, contact:
County of Riverside
Health Services Agency
Department of Environmental Health
at (909) 358-5055.

**SPILL RESPONSE AGENCY:**
HAZ-MAT: (909) 358-5055
AFTER 5:00 P.M.: (909) 358-5245 OR 911

**HAZARDOUS WASTE DISPOSAL:** (909) 358-5055

**RECYCLING INFORMATION:** 1-800-366-SAVE

**TO REPORT ILLEGAL DUMPING OR A CLOGGED STORM DRAIN:** 1-800-506-2555

To order additional brochures or to obtain information on other pollution prevention activities, call: (909) 955-1111.

The Cities and County of Riverside
StormWater/CleanWater Protection Program
**1-800-506-2555**

StormWater
CleanWater
PROTECTION PROGRAM

Riverside County gratefully acknowledges the Santa Clara Valley Nonpoint Source Pollution Control Program, Alameda Countywide Clean Water Program and the San Bernardino County Stormwater Program for information provided in this brochure.

# StormWater Pollution

What you should know for...

## THE FOOD SERVICE INDUSTRY

## Best Management Practices (BMPS) for:

- Restaurants
- Grocery Stores
- Delicatessens
- Bakeries

## StormWater Pollution . . . What You Should Know

Riverside County has two drainage systems - sanitary sewers and storm drains. The storm drain system is designed to help prevent flooding by carrying excess rainwater away from streets. Since the storm drain system does not provide for water treatment, it also serves the *unintended* function of transporting pollutants directly to our waterways.

*Unlike sanitary sewers, storm drains are not connected to a treatment plant - they flow directly to our local streams, rivers and lakes.*

Waste or washwater generated by the food service industry often contains materials such as food wastes, oil, grease, detergents, and degreasers. These materials can degrade local waters when allowed to flow into a storm drain system.

*Stormwater pollution causes as much as 60% of our water pollution problem. It jeopardizes the quality of our waterways and poses a threat to groundwater resources if pollutants percolate through soil.*

## The Cities and County of Riverside StormWater/CleanWater Protection Program

Since preventing pollution is much easier, and less costly, than cleaning up “after the fact,” the Cities and County of Riverside StormWater/CleanWater Protection Program informs residents and businesses on pollution prevention activities such as the Best Management Practices (BMPs) described in this pamphlet.

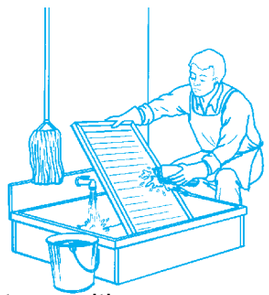
The Cities and County of Riverside have adopted ordinances for stormwater management and discharge control. In accordance with state and federal law, these local stormwater ordinances **prohibit** the discharge of wastes into the storm drain system or local surface waters. This includes discharges from the food service industry containing food wastes, oil, grease, detergents, and degreasers.

**PLEASE NOTE:** A common stormwater pollution problem associated with the food service industry is the discharge of washwater into alleys and gutters, and the hosing down of outdoor areas. Often, these activities flush pollutants into the storm drain system. The discharges of pollutants is ***strictly prohibited*** by local ordinances and state and federal regulations.

# A Menu of Activities . . . to Keep Our Water Clean

## Cleanin' It Right . . .

Pour mop and wash water into the mop sink or down floor drains . . . not into gutters, alleys, parking lots or a storm drain. Wash greasy equipment only in designated wash areas which are properly connected to the sewer system with an appropriate oil/water separator. Also, avoid washing kitchen mats, garbage containers, and other items in areas where wastewater is likely to flow into a storm drain.



## Watch Out For Spills . . .

Use dry methods for spill cleanup. Don't hose down outside spills. Use rags or absorbents such as cat litter and then dispose of in the garbage, or handle as hazardous waste as appropriate. If necessary, mop the area with a minimum amount of water.

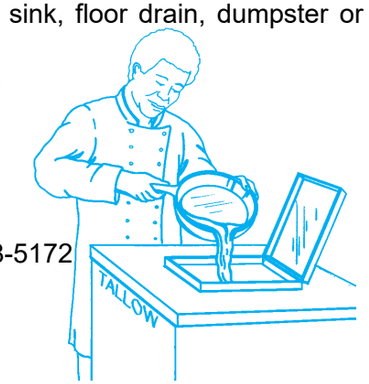
## Proper Storage and Disposal . . .

General cleaners, floor cleaners, solvents, and detergents often contain toxic substances. Read labels carefully and store and dispose of these products properly.

REMEMBER: Don't throw toxic waste into the trash or into a storm drain. To report toxic spill call 911. For information on hazardous waste pick-up call (909) 358-5055.

## Grease and Oil . . .

Handle and dispose of grease properly. Save used cooking grease and oil for recycling in tallow bins or sealed containers. Never pour grease into a sink, floor drain, dumpster or storm drain. Watch out for, and report to management, overflowing grease interceptors. Call (909) 358-5172 for disposal information.

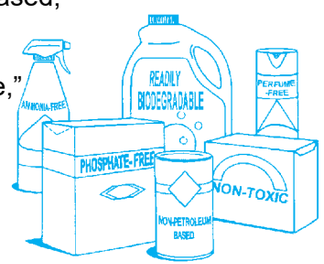



## How 'Bout That Dumpster . . .

Keep dumpster and loading dock areas clean. Control litter by sweeping - don't hose down the area. Replace leaky dumpsters and keep lids closed to keep out rainwater.

## Use Water-Friendly Products . . .

Whenever possible, purchase water-based cleaning products. Look for products labeled "non-toxic," "non-petroleum based," "ammonia-free," "phosphate-free," and "perfume-free," or "readily biodegradable."




## Outdoor/Sidewalk Areas . . .

Sweep up food particles, cigarette butts, and trash from outdoor dining areas before rinsing or steam cleaning. Don't use toxic bleaches or detergents when you pressure wash outdoor dining areas, entrances or surrounding sidewalk areas.

***You may be** already implementing many of the BMPs prescribed in this brochure. However, if you discover any potential problem areas, please consider using one or more of the recommended BMPS.*

***Also,** please note that the Riverside County Environmental Health Department will monitor potential sources of stormwater pollution activities during regularly scheduled inspections of food service facilities. If Health Department staff observe activities which may be contributing to stormwater pollution, suggestions will be provided and/or use of prescribed BMPS listed in this brochure will be offered.*

## Please remember:

**Everyone contributes a little to the problem of stormwater pollution. Now it's time for all of us to become part of the solution!**

# Site Design & Landscape Planning SD-10

**Design Objectives**

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- ☑ Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

## Description

Each project site possesses unique topographic, hydrologic, and vegetative features, some of which are more suitable for development than others. Integrating and incorporating appropriate landscape planning methodologies into the project design is the most effective action that can be done to minimize surface and groundwater contamination from stormwater.

## Approach

Landscape planning should couple consideration of land suitability for urban uses with consideration of community goals and projected growth. Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

## Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

## Design Considerations

Design requirements for site design and landscapes planning should conform to applicable standards and specifications of agencies with jurisdiction and be consistent with applicable General Plan and Local Area Plan policies.

***Designing New Installations***

Begin the development of a plan for the landscape unit with attention to the following general principles:

- Formulate the plan on the basis of clearly articulated community goals. Carefully identify conflicts and choices between retaining and protecting desired resources and community growth.
- Map and assess land suitability for urban uses. Include the following landscape features in the assessment: wooded land, open unwooded land, steep slopes, erosion-prone soils, foundation suitability, soil suitability for waste disposal, aquifers, aquifer recharge areas, wetlands, floodplains, surface waters, agricultural lands, and various categories of urban land use. When appropriate, the assessment can highlight outstanding local or regional resources that the community determines should be protected (e.g., a scenic area, recreational area, threatened species habitat, farmland, fish run). Mapping and assessment should recognize not only these resources but also additional areas needed for their sustenance.

Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

*Conserve Natural Areas during Landscape Planning*

If applicable, the following items are required and must be implemented in the site layout during the subdivision design and approval process, consistent with applicable General Plan and Local Area Plan policies:

- Cluster development on least-sensitive portions of a site while leaving the remaining land in a natural undisturbed condition.
- Limit clearing and grading of native vegetation at a site to the minimum amount needed to build lots, allow access, and provide fire protection.
- Maximize trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought tolerant plants.
- Promote natural vegetation by using parking lot islands and other landscaped areas.
- Preserve riparian areas and wetlands.

*Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit*

- Promote the conservation of forest cover. Building on land that is already deforested affects basin hydrology to a lesser extent than converting forested land. Loss of forest cover reduces interception storage, detention in the organic forest floor layer, and water losses by evapotranspiration, resulting in large peak runoff increases and either their negative effects or the expense of countering them with structural solutions.
- Maintain natural storage reservoirs and drainage corridors, including depressions, areas of permeable soils, swales, and intermittent streams. Develop and implement policies and

regulations to discourage the clearing, filling, and channelization of these features. Utilize them in drainage networks in preference to pipes, culverts, and engineered ditches.

- Evaluating infiltration opportunities by referring to the stormwater management manual for the jurisdiction and pay particular attention to the selection criteria for avoiding groundwater contamination, poor soils, and hydrogeological conditions that cause these facilities to fail. If necessary, locate developments with large amounts of impervious surfaces or a potential to produce relatively contaminated runoff away from groundwater recharge areas.

*Protection of Slopes and Channels during Landscape Design*

- Convey runoff safely from the tops of slopes.
- Avoid disturbing steep or unstable slopes.
- Avoid disturbing natural channels.
- Stabilize disturbed slopes as quickly as possible.
- Vegetate slopes with native or drought tolerant vegetation.
- Control and treat flows in landscaping and/or other controls prior to reaching existing natural drainage systems.
- Stabilize temporary and permanent channel crossings as quickly as possible, and ensure that increases in run-off velocity and frequency caused by the project do not erode the channel.
- Install energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion. Energy dissipaters shall be installed in such a way as to minimize impacts to receiving waters.
- Line on-site conveyance channels where appropriate, to reduce erosion caused by increased flow velocity due to increases in tributary impervious area. The first choice for linings should be grass or some other vegetative surface, since these materials not only reduce runoff velocities, but also provide water quality benefits from filtration and infiltration. If velocities in the channel are high enough to erode grass or other vegetative linings, riprap, concrete, soil cement, or geo-grid stabilization are other alternatives.
- Consider other design principles that are comparable and equally effective.

### *Redeveloping Existing Installations*

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Redevelopment may present significant opportunity to add features which had not previously been implemented. Examples include incorporation of depressions, areas of permeable soils, and swales in newly redeveloped areas. While some site constraints may exist due to the status of already existing infrastructure, opportunities should not be missed to maximize infiltration, slow runoff, reduce impervious areas, disconnect directly connected impervious areas.

### Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Stormwater Management Manual for Western Washington, Washington State Department of Ecology, August 2001.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

# Roof Runoff Controls SD-11

Rain Garden

**Design Objectives**

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- ☑ Contain Pollutants
- Collect and Convey

## Description

Various roof runoff controls are available to address stormwater that drains off rooftops. The objective is to reduce the total volume and rate of runoff from individual lots, and retain the pollutants on site that may be picked up from roofing materials and atmospheric deposition. Roof runoff controls consist of directing the roof runoff away from paved areas and mitigating flow to the storm drain system through one of several general approaches: cisterns or rain barrels; dry wells or infiltration trenches; pop-up emitters, and foundation planting. The first three approaches require the roof runoff to be contained in a gutter and downspout system. Foundation planting provides a vegetated strip under the drip line of the roof.

## Approach

Design of individual lots for single-family homes as well as lots for higher density residential and commercial structures should consider site design provisions for containing and infiltrating roof runoff or directing roof runoff to vegetative swales or buffer areas. Retained water can be reused for watering gardens, lawns, and trees. Benefits to the environment include reduced demand for potable water used for irrigation, improved stormwater quality, increased groundwater recharge, decreased runoff volume and peak flows, and decreased flooding potential.

## Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

## Design Considerations

### *Designing New Installations*

*Cisterns or Rain Barrels*

One method of addressing roof runoff is to direct roof downspouts to cisterns or rain barrels. A cistern is an above ground storage vessel with either a manually operated valve or a permanently open outlet. Roof runoff is temporarily stored and then released for irrigation or infiltration between storms. The number of rain

barrels needed is a function of the rooftop area. Some low impact developers recommend that every house have at least 2 rain barrels, with a minimum storage capacity of 1000 liters. Roof barrels serve several purposes including mitigating the first flush from the roof which has a high volume, amount of contaminants, and thermal load. Several types of rain barrels are commercially available. Consideration must be given to selecting rain barrels that are vector proof and childproof. In addition, some barrels are designed with a bypass valve that filters out grit and other contaminants and routes overflow to a soak-away pit or rain garden.

If the cistern has an operable valve, the valve can be closed to store stormwater for irrigation or infiltration between storms. This system requires continual monitoring by the resident or grounds crews, but provides greater flexibility in water storage and metering. If a cistern is provided with an operable valve and water is stored inside for long periods, the cistern must be covered to prevent mosquitoes from breeding.

A cistern system with a permanently open outlet can also provide for metering stormwater runoff. If the cistern outlet is significantly smaller than the size of the downspout inlet (say ¼ to ½ inch diameter), runoff will build up inside the cistern during storms, and will empty out slowly after peak intensities subside. This is a feasible way to mitigate the peak flow increases caused by rooftop impervious land coverage, especially for the frequent, small storms.

*Dry wells and Infiltration Trenches*

Roof downspouts can be directed to dry wells or infiltration trenches. A dry well is constructed by excavating a hole in the ground and filling it with an open graded aggregate, and allowing the water to fill the dry well and infiltrate after the storm event. An underground connection from the downspout conveys water into the dry well, allowing it to be stored in the voids. To minimize sedimentation from lateral soil movement, the sides and top of the stone storage matrix can be wrapped in a permeable filter fabric, though the bottom may remain open. A perforated observation pipe can be inserted vertically into the dry well to allow for inspection and maintenance.

In practice, dry wells receiving runoff from single roof downspouts have been successful over long periods because they contain very little sediment. They must be sized according to the amount of rooftop runoff received, but are typically 4 to 5 feet square, and 2 to 3 feet deep, with a minimum of 1-foot soil cover over the top (maximum depth of 10 feet).

To protect the foundation, dry wells must be set away from the building at least 10 feet. They must be installed in solids that accommodate infiltration. In poorly drained soils, dry wells have very limited feasibility.

Infiltration trenches function in a similar manner and would be particularly effective for larger roof areas. An infiltration trench is a long, narrow, rock-filled trench with no outlet that receives stormwater runoff. These are described under Treatment Controls.

*Pop-up Drainage Emitter*

Roof downspouts can be directed to an underground pipe that daylights some distance from the building foundation, releasing the roof runoff through a pop-up emitter. Similar to a pop-up irrigation head, the emitter only opens when there is flow from the roof. The emitter remains flush to the ground during dry periods, for ease of lawn or landscape maintenance.

*Foundation Planting*

Landscape planting can be provided around the base to allow increased opportunities for stormwater infiltration and protect the soil from erosion caused by concentrated sheet flow coming off the roof. Foundation plantings can reduce the physical impact of water on the soil and provide a subsurface matrix of roots that encourage infiltration. These plantings must be sturdy enough to tolerate the heavy runoff sheet flows, and periodic soil saturation.

### *Redeveloping Existing Installations*

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

## Supplemental Information

### *Examples*

- City of Ottawa's Water Links Surface –Water Quality Protection Program
- City of Toronto Downspout Disconnection Program
- City of Boston, MA, Rain Barrel Demonstration Program

## Other Resources

Hager, Marty Catherine, Stormwater, "Low-Impact Development", January/February 2003. www.stormh2o.com

Low Impact Urban Design Tools, Low Impact Development Design Center, Beltsville, MD. www.lid-stormwater.net

Start at the Source, Bay Area Stormwater Management Agencies Association, 1999 Edition

# Efficient Irrigation SD-12

**Design Objectives**

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

## Description

Irrigation water provided to landscaped areas may result in excess irrigation water being conveyed into stormwater drainage systems.

## Approach

Project plan designs for development and redevelopment should include application methods of irrigation water that minimize runoff of excess irrigation water into the stormwater conveyance system.

## Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

## Design Considerations

### *Designing New Installations*

The following methods to reduce excessive irrigation runoff should be considered, and incorporated and implemented where determined applicable and feasible by the Permittee:

- Employ rain-triggered shutoff devices to prevent irrigation after precipitation.
- Design irrigation systems to each landscape area's specific water requirements.
- Include design featuring flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.
- Implement landscape plans consistent with County or City water conservation resolutions, which may include provision of water sensors, programmable irrigation times (for short cycles), etc.

- Design timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm water drainage system.
- Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species). Consider design features such as:
  - Using mulches (such as wood chips or bar) in planter areas without ground cover to minimize sediment in runoff
  - Installing appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant materials where possible and/or as recommended by the landscape architect
  - Leaving a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible
  - Choosing plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth
- Employ other comparable, equally effective methods to reduce irrigation water runoff.

***Redeveloping Existing Installations***

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

**Other Resources**

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

# Storm Drain Signage SD-13

**Design Objectives**

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- ☑ Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

## Description

Waste materials dumped into storm drain inlets can have severe impacts on receiving and ground waters. Posting notices regarding discharge prohibitions at storm drain inlets can prevent waste dumping. Storm drain signs and stencils are highly visible source controls that are typically placed directly adjacent to storm drain inlets.

## Approach

The stencil or affixed sign contains a brief statement that prohibits dumping of improper materials into the urban runoff conveyance system. Storm drain messages have become a popular method of alerting the public about the effects of and the prohibitions against waste disposal.

## Suitable Applications

Stencils and signs alert the public to the destination of pollutants discharged to the storm drain. Signs are appropriate in residential, commercial, and industrial areas, as well as any other area where contributions or dumping to storm drains is likely.

## Design Considerations

Storm drain message markers or placards are recommended at all storm drain inlets within the boundary of a development project. The marker should be placed in clear sight facing toward anyone approaching the inlet from either side. All storm drain inlet locations should be identified on the development site map.

### *Designing New Installations*

The following methods should be considered for inclusion in the project design and show on project plans:

- Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language. Examples include "NO DUMPING

– DRAINS TO OCEAN" and/or other graphical icons to discourage illegal dumping.

- Post signs with prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and creeks within the project area.

Note - Some local agencies have approved specific signage and/or storm drain message placards for use. Consult local agency stormwater staff to determine specific requirements for placard types and methods of application.

***Redeveloping Existing Installations***

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. If the project meets the definition of "redevelopment", then the requirements stated under " designing new installations" above should be included in all project design plans.

## Additional Information

***Maintenance Considerations***

- Legibility of markers and signs should be maintained. If required by the agency with jurisdiction over the project, the owner/operator or homeowner's association should enter into a maintenance agreement with the agency or record a deed restriction upon the property title to maintain the legibility of placards or signs.

***Placement***

- Signage on top of curbs tends to weather and fade.
- Signage on face of curbs tends to be worn by contact with vehicle tires and sweeper brooms.

## Supplemental Information

***Examples***

- Most MS4 programs have storm drain signage programs. Some MS4 programs will provide stencils, or arrange for volunteers to stencil storm drains as part of their outreach program.

## Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

# Fueling Areas SD-30

Photo Credit: Geoff Brosseau

**Design Objectives**

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- ☑ Contain Pollutants
- ☑ Collect and Convey

## Description

Fueling areas have the potential to contribute oil and grease, solvents, car battery acid, coolant and gasoline to the stormwater conveyance system. Spills at vehicle and equipment fueling areas can be a significant source of pollution because fuels contain toxic materials and heavy metals that are not easily removed by stormwater treatment devices.

## Approach

Project plans must be developed for cleaning near fuel dispensers, emergency spill cleanup, containment, and leak prevention.

## Suitable Applications

Appropriate applications include commercial, industrial, and any other areas planned to have fuel dispensing equipment, including retail gasoline outlets, automotive repair shops, and major non-retail dispensing areas.

## Design Considerations

Design requirements for fueling areas are governed by Building and Fire Codes and by current local agency ordinances and zoning requirements. Design requirements described in this fact sheet are meant to enhance and be consistent with these code and ordinance requirements.

### *Designing New Installations*

*Covering*

Fuel dispensing areas should provide an overhanging roof structure or canopy. The cover's minimum dimensions must be equal to or greater than the area within the grade break. The cover must not drain onto the fuel dispensing area and the downspouts must be routed to prevent drainage across the fueling area. The fueling area should drain to the project's treatment control BMP(s) prior to discharging to the stormwater conveyance system. Note - If fueling large equipment or vehicles that would prohibit the use of covers or roofs, the fueling island should be designed to sufficiently accommodate the larger vehicles and equipment and to prevent stormwater run-on and runoff. Grade to direct stormwater to a dead-end sump.

*Surfacing*

Fuel dispensing areas should be paved with Portland cement concrete (or equivalent smooth impervious surface). The use of asphalt concrete should be prohibited. Use asphalt sealant to protect asphalt paved areas surrounding the fueling area. This provision may be made to sites that have pre-existing asphalt surfaces.

The concrete fuel dispensing area should be extended a minimum of 6.5 ft from the corner of each fuel dispenser, or the length at which the hose and nozzle assembly may be operated plus 1 ft, whichever is less.

*Grading/Contouring*

Dispensing areas should have an appropriate slope to prevent ponding, and be separated from the rest of the site by a grade break that prevents run-on of urban runoff. (Slope is required to be 2 to 4% in some jurisdictions' stormwater management and mitigation plans.)

Fueling areas should be graded to drain toward a dead-end sump. Runoff from downspouts/roofs should be directed away from fueling areas. Do not locate storm drains in the immediate vicinity of the fueling area.

### *Redeveloping Existing Installations*

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

## Additional Information

- In the case of an emergency, provide storm drain seals, such as isolation valves, drain plugs, or drain covers, to prevent spills or contaminated stormwater from entering the stormwater conveyance system.

## Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

# Maintenance Bays & Docks SD-31

**Design Objectives**

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- ☑ Prohibit Dumping of Improper Materials
- ☑ Contain Pollutants
- Collect and Convey

## Description

Several measures can be taken to prevent operations at maintenance bays and loading docks from contributing a variety of toxic compounds, oil and grease, heavy metals, nutrients, suspended solids, and other pollutants to the stormwater conveyance system.

## Approach

In designs for maintenance bays and loading docks, containment is encouraged. Preventative measures include overflow containment structures and dead-end sumps. However, in the case of loading docks from grocery stores and warehouse/distribution centers, engineered infiltration systems may be considered.

## Suitable Applications

Appropriate applications include commercial and industrial areas planned for development or redevelopment.

## Design Considerations

Design requirements for vehicle maintenance and repair are governed by Building and Fire Codes, and by current local agency ordinances, and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code requirements.

### *Designing New Installations*

Designs of maintenance bays should consider the following:

- Repair/maintenance bays and vehicle parts with fluids should be indoors; or designed to preclude urban run-on and runoff.
- Repair/maintenance floor areas should be paved with Portland cement concrete (or equivalent smooth impervious surface).

- Repair/maintenance bays should be designed to capture all wash water leaks and spills. Provide impermeable berms, drop inlets, trench catch basins, or overflow containment structures around repair bays to prevent spilled materials and wash-down waters form entering the storm drain system. Connect drains to a sump for collection and disposal. Direct connection of the repair/maintenance bays to the storm drain system is prohibited. If required by local jurisdiction, obtain an Industrial Waste Discharge Permit.
- Other features may be comparable and equally effective.

The following designs of loading/unloading dock areas should be considered:

- Loading dock areas should be covered, or drainage should be designed to preclude urban run-on and runoff.
- Direct connections into storm drains from depressed loading docks (truck wells) are prohibited.
- Below-grade loading docks from grocery stores and warehouse/distribution centers of fresh food items should drain through water quality inlets, or to an engineered infiltration system, or an equally effective alternative. Pre-treatment may also be required.
- Other features may be comparable and equally effective.

### *Redeveloping Existing Installations*

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

## Additional Information

Stormwater and non-stormwater will accumulate in containment areas and sumps with impervious surfaces. Contaminated accumulated water must be disposed of in accordance with applicable laws and cannot be discharged directly to the storm drain or sanitary sewer system without the appropriate permit.

## Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

# Trash Storage Areas SD-32

## Description

Trash storage areas are areas where a trash receptacle (s) are located for use as a repository for solid wastes. Stormwater runoff from areas where trash is stored or disposed of can be polluted. In addition, loose trash and debris can be easily transported by water or wind into nearby storm drain inlets, channels, and/or creeks. Waste handling operations that may be sources of stormwater pollution include dumpsters, litter control, and waste piles.

**Design Objectives**

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- ☑ Contain Pollutants
- Collect and Convey

## Approach

This fact sheet contains details on the specific measures required to prevent or reduce pollutants in stormwater runoff associated with trash storage and handling. Preventative measures including enclosures, containment structures, and impervious pavements to mitigate spills, should be used to reduce the likelihood of contamination.

## Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

## Design Considerations

Design requirements for waste handling areas are governed by Building and Fire Codes, and by current local agency ordinances and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code and ordinance requirements. Hazardous waste should be handled in accordance with legal requirements established in Title 22, California Code of Regulation.

Wastes from commercial and industrial sites are typically hauled by either public or commercial carriers that may have design or access requirements for waste storage areas. The design criteria in this fact sheet are recommendations and are not intended to be in conflict with requirements established by the waste hauler. The waste hauler should be contacted prior to the design of your site trash collection areas. Conflicts or issues should be discussed with the local agency.

### *Designing New Installations*

Trash storage areas should be designed to consider the following structural or treatment control BMPs:

- Design trash container areas so that drainage from adjoining roofs and pavement is diverted around the area(s) to avoid run-on. This might include berming or grading the waste handling area to prevent run-on of stormwater.
- Make sure trash container areas are screened or walled to prevent off-site transport of trash.

- Use lined bins or dumpsters to reduce leaking of liquid waste.
- Provide roofs, awnings, or attached lids on all trash containers to minimize direct precipitation and prevent rainfall from entering containers.
- Pave trash storage areas with an impervious surface to mitigate spills.
- Do not locate storm drains in immediate vicinity of the trash storage area.
- Post signs on all dumpsters informing users that hazardous materials are not to be disposed of therein.

### *Redeveloping Existing Installations*

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

## Additional Information

### *Maintenance Considerations*

The integrity of structural elements that are subject to damage (i.e., screens, covers, and signs) must be maintained by the owner/operator. Maintenance agreements between the local agency and the owner/operator may be required. Some agencies will require maintenance deed restrictions to be recorded of the property title. If required by the local agency, maintenance agreements or deed restrictions must be executed by the owner/operator before improvement plans are approved.

## Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

# Outdoor Loading/Unloading SC-30

## Description

The loading/unloading of materials usually takes place outside on docks or terminals; therefore, materials spilled, leaked, or lost during loading/unloading may collect in the soil or on other surfaces and have the potential to be carried away by wind, stormwater runoff or when the area is cleaned. Additionally, rainfall may wash pollutants from machinery used to unload or move materials. Implementation of the following protocols will prevent or reduce the discharge of pollutants to stormwater from outdoor loading/unloading of materials.

## Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

### *General Pollution Prevention Protocols*

- ☐ Park tank trucks or delivery vehicles in designated areas so that spills or leaks can be contained.
- ☐ Limit exposure of material to rainfall whenever possible.
- ☐ Prevent stormwater run-on.
- ☐ Check equipment regularly for leaks.

### *Good Housekeeping*

- ☐ Develop an operations plan that describes procedures for loading and/or unloading.
- ☐ Conduct loading and unloading in dry weather if possible.

| Objectives |
|---|
| ■ *Cover* |
| ■ *Contain* |
| ■ *Educate* |
| ■ *Reduce/Minimize* |
| ■ *Product Substitution* |

| Targeted Constituents | |
|---|---|
| *Sediment* | ✓ |
| *Nutrients* | ✓ |
| *Trash* | |
| *Metals* | ✓ |
| *Bacteria* | |
| *Oil and Grease* | ✓ |
| *Organics* | ✓ |

| Minimum BMPs Covered | |
|---|---|
| *Good Housekeeping* | ✓ |
| *Preventative Maintenance* | |
| *Spill and Leak Prevention and Response* | ✓ |
| *Material Handling & Waste Management* | ✓ |
| *Erosion and Sediment Controls* | |
| *Employee Training Program* | ✓ |
| *Quality Assurance Record Keeping* | ✓ |

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- Cover designated loading/unloading areas to reduce exposure of materials to rain.
- Consider placing a seal or door skirt between delivery vehicles and building to prevent exposure to rain.
- Design loading/unloading area to prevent stormwater run-on, which would include grading or berming the area, and position roof downspouts so they direct stormwater away from the loading/unloading areas.
- Have employees load and unload all materials and equipment in covered areas such as building overhangs at loading docks if feasible.
- Load/unload only at designated loading areas.
- Use drip pans underneath hose and pipe connections and other leak-prone spots during liquid transfer operations, and when making and breaking connections. Several drip pans should be stored in a covered location near the liquid transfer area so that they are always available, yet protected from precipitation when not in use. Drip pans can be made specifically for railroad tracks. Drip pans must be cleaned periodically, and drip collected materials must be disposed of properly.
- Pave loading areas with concrete instead of asphalt.
- Avoid placing storm drains inlets in the area.
- Grade and/or berm the loading/unloading area with drainage to sump; regularly remove materials accumulated in sump.

### *Spill Response and Prevention Procedures*

- Keep your spill prevention and control plan up-to-date or have an emergency spill cleanup plan readily available, as applicable.
- Contain leaks during transfer.
- Store and maintain appropriate spill cleanup materials in a location that is readily accessible and known to all employees.
- Ensure that employees are familiar with the site's spill control plan and proper spill cleanup procedures.
- Use drip pans or comparable devices when transferring oils, solvents, and paints.

### *Material Handling and Waste Management*

- Spot clean leaks and drips routinely to prevent runoff of spillage.
- Do not pour liquid wastes into floor drains, sinks, outdoor storm drain inlets, or other storm drains or sewer connections.

- Do not put used or leftover cleaning solutions, solvents, and automotive fluids in the storm drain or sanitary sewer.
- Collect leaking or dripping fluids in drip pans or containers. Fluids are easier to recycle if kept separate.
- Promptly transfer used fluids to the proper waste or recycling drums. Do not leave drip pans or other open containers lying around.
- Minimize the possibility of stormwater pollution from outside waste receptacles by doing at least one of the following:
  - ✓ Use only watertight waste receptacle(s) and keep the lid(s) closed.
  - ✓ Grade and pave the waste receptacle area to prevent run-on of stormwater.
  - ✓ Install a roof over the waste receptacle area.
  - ✓ Install a low containment berm around the waste receptacle area.
  - ✓ Use and maintain drip pans under waste receptacles.
- Post "no littering" signs.
- Perform work area clean-up and dry sweep after daily operations.

### *Employee Training Program*

- Train employees (e.g., fork lift operators) and contractors on proper spill containment and cleanup.
- Have employees trained in spill containment and cleanup present during loading/unloading.
- Train employees in proper handling techniques during liquid transfers to avoid spills.
- Make sure forklift operators are properly trained on loading and unloading procedures.

### *Quality Assurance and Record Keeping*

- Keep accurate maintenance logs that document activities performed, quantities of materials removed, and improvement actions.
- Keep accurate logs of spill response actions that document what was spilled, how it was cleaned up, and how the waste was disposed.
- Establish procedures to complete logs and file them in the central office.
- Keep accurate logs of daily clean-up operations.

## Potential Limitations and Work-Arounds

Some facilities may have space constraints, limited staffing and time limitations that may preclude implementation of BMPs. Provided below are typical limitations and recommended "work-arounds."

- Space and time limitations may preclude all transfers from being performed indoors or under cover.
  - ✓ Designate specific areas for outdoor loading and unloading.
  - ✓ Require employees to understand and follow spill and leak prevention BMPs.
- It may not be possible to conduct transfers only during dry weather.
  - ✓ Limit materials and equipment rainfall exposure to all extents practicable.
  - ✓ Require employees to understand and follow spill and leak prevention BMPs.

## Potential Capital Facility Costs and Operation & Maintenance Requirements

### *Facilities*

Many facilities will already have indoor or covered areas where loading/unloading takes place and will require no additional capital expenditures.

If outdoor activities are required, construction of berms or other means to retain spills and leaks may require appropriate constructed systems for containment. These containment areas may require significant new capital investment.

Capital investments will likely be required at some sites if adequate cover and containment facilities do not exist and can vary significantly depending upon site conditions.

### *Maintenance*

Most of the operations and maintenance activities associated with implementing this BMP are integrally linked to routine operations as previously described. Therefore additional O&M is not required.

- Conduct regular inspections and make repairs and improvements as necessary.
- Check loading and unloading equipment regularly for leaks.
- Conduct regular broom dry-sweeping of area. Do not wash with water.

## Supplemental Information

### *Loading and Unloading of Liquids*

- Loading or unloading of liquids should occur in the manufacturing building so that any spills that are not completely retained can be discharged to the sanitary sewer,

treatment plant, or treated in a manner consistent with local sewer authorities and permit requirements.

- For loading and unloading tank trucks to above and below ground storage tanks, the following procedures should be used:
  - ✓ The area where the transfer takes place should be paved. If the liquid is reactive with the asphalt, Portland cement should be used to pave the area.
  - ✓ The transfer area should be designed to prevent run-on of stormwater from adjacent areas. Sloping the pad and using a curb, like a speed bump, around the uphill side of the transfer area should reduce run-on.
  - ✓ The transfer area should be designed to prevent runoff of spilled liquids from the area. Sloping the area to a drain should prevent runoff. The drain should be connected to a dead-end sump or to the sanitary sewer. A positive control valve should be installed on the drain.
- For transfer from rail cars to storage tanks that must occur outside, use the following procedures:
  - ✓ Drip pans should be placed at locations where spillage may occur, such as hose connections, hose reels, and filler nozzles. Use drip pans when making and breaking connections.
  - ✓ Drip pan systems should be installed between the rails to collect spillage from tank cars.

## References and Resources

Minnesota Pollution Control Agency, *Industrial Stormwater Best Management Practices Guidebook BMP 26 Fueling and Liquid Loading/Unloading Operations.* Available online at: http://www.pca.state.mn.us/index.php/view-document.html?gid=10557.

New Jersey Department of Environmental Protection, 2013. *Basic Industrial Stormwater General Permit Guidance Document NJPDES General Permit No NJ0088315.* Available online at: http://www.nj.gov/dep/dwq/pdf/5G2_guidance_color.pdf.

Orange County Stormwater Program, Best Management Practices for Industrial/Commercial Business Activities. Available online at: http://ocwatersheds.com/documents/bmp/industrialcommercialbusinessesactivities.

Oregon Department of Environmental Quality, 2013. *Industrial Stormwater Best Management Practices Manual- BMP 26 Fueling and Liquid Loading/Unloading Operations.* Available online at: http://www.deq.state.or.us/wq/wqpermit/docs/IndBMP021413.pdf.

Sacramento Stormwater Management Program, *Best Management Practices for Industrial Storm Water Pollution Control.* Available online at: http://www.msa.saccounty.net/sactostormwater/documents/guides/industrial-BMP-manual.pdf.

Sacramento County Environmental Management Stormwater Program: *Best Management Practices.* Available online at: http://www.emd.saccounty.net/EnvHealth/Stormwater/Stormwater-BMPs.html.

Santa Clara Valley Urban Runoff Pollution Prevention Program. http://www.scvurppp-w2k.com/.

US EPA. National Pollutant Discharge Elimination System – Industrial Fact Sheet Series for Activities Covered by EPA's Multi Sector General Permit. Available online at: http://cfpub.epa.gov/npdes/stormwater/swsectors.cfm.

# Waste Handling & Disposal SC-34

## Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

## Description

Improper storage and handling of solid wastes can allow toxic compounds, oils and greases, heavy metals, nutrients, suspended solids, and other pollutants to enter stormwater runoff. The discharge of pollutants to stormwater from waste handling and disposal can be prevented and reduced by tracking waste generation, storage, and disposal; reducing waste generation and disposal through source reduction, re-use, and recycling; and preventing runon and runoff.

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | ☑ |
| Oil and Grease | ☑ |
| Organics | ☑ |
| Oxygen Demanding | ☑ |

## Approach

### *Pollution Prevention*

- Reduction in the amount of waste generated can be accomplished using the following source controls such as:
  - Production planning and sequencing
  - Process or equipment modification
  - Raw material substitution or elimination
  - Loss prevention and housekeeping
  - Waste segregation and separation
  - Close loop recycling
- Establish a material tracking system to increase awareness about material usage. This may reduce spills and minimize contamination, thus reducing the amount of waste produced.
- Recycle materials whenever possible.

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***Suggested Protocols***

*General*

- Cover storage containers with leak proof lids or some other means. If waste is not in containers, cover all waste piles (plastic tarps are acceptable coverage) and prevent stormwater runon and runoff with a berm. The waste containers or piles must be covered except when in use.
- Use drip pans or absorbent materials whenever grease containers are emptied by vacuum trucks or other means. Grease cannot be left on the ground. Collected grease must be properly disposed of as garbage.
- Check storage containers weekly for leaks and to ensure that lids are on tightly. Replace any that are leaking, corroded, or otherwise deteriorating.
- Sweep and clean the storage area regularly. If it is paved, do not hose down the area to a storm drain.
- Dispose of rinse and wash water from cleaning waste containers into a sanitary sewer if allowed by the local sewer authority. Do not discharge wash water to the street or storm drain.
- Transfer waste from damaged containers into safe containers.
- Take special care when loading or unloading wastes to minimize losses. Loading systems can be used to minimize spills and fugitive emission losses such as dust or mist. Vacuum transfer systems can minimize waste loss.

*Controlling Litter*

- Post "No Littering" signs and enforce anti-litter laws.
- Provide a sufficient number of litter receptacles for the facility.
- Clean out and cover litter receptacles frequently to prevent spillage.

*Waste Collection*

- Keep waste collection areas clean.
- Inspect solid waste containers for structural damage or leaks regularly. Repair or replace damaged containers as necessary.
- Secure solid waste containers; containers must be closed tightly when not in use.
- Place waste containers under cover if possible.
- Do not fill waste containers with washout water or any other liquid.
- Ensure that only appropriate solid wastes are added to the solid waste container. Certain wastes such as hazardous wastes, appliances, fluorescent lamps, pesticides, etc. may not be

disposed of in solid waste containers (see chemical/ hazardous waste collection section below).

- Do not mix wastes; this can cause chemical reactions, make recycling impossible, and complicate disposal.

*Good Housekeeping*

- Use all of the product before disposing of the container.
- Keep the waste management area clean at all times by sweeping and cleaning up spills immediately.
- Use dry methods when possible (e.g. sweeping, use of absorbents) when cleaning around restaurant/food handling dumpster areas. If water must be used after sweeping/using absorbents, collect water and discharge through grease interceptor to the sewer.
- Stencil storm drains on the facility's property with prohibitive message regarding waste disposal.

*Chemical/Hazardous Wastes*

- Select designated hazardous waste collection areas on-site.
- Store hazardous materials and wastes in covered containers protected from vandalism, and in compliance with fire and hazardous waste codes.
- Place hazardous waste containers in secondary containment.
- Make sure that hazardous waste is collected, removed, and disposed of only at authorized disposal areas.

*Runon/Runoff Prevention*

- Prevent stormwater runon from entering the waste management area by enclosing the area or building a berm around the area.
- Prevent the waste materials from directly contacting rain.
- Cover waste piles with temporary covering material such as reinforced tarpaulin, polyethylene, polyurethane, polypropyleneor hypalon.
- Cover the area with a permanent roof if feasible.
- Cover dumpsters to prevent rain from washing waste out of holes or cracks in the bottom of the dumpster.
- Move the activity indoor after ensuring all safety concerns such as fire hazard and ventilation are addressed.

*Inspection*

- Inspect and replace faulty pumps or hoses regularly to minimize the potential of releases and spills.
- Check waste management areas for leaking containers or spills.
- Repair leaking equipment including valves, lines, seals, or pumps promptly.

***Training***

- Train staff pollution prevention measures and proper disposal methods.
- Train employees and contractors proper spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill if one should occur.
- Train employees and subcontractors in proper hazardous waste management.

***Spill Response and Prevention***

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Keep your Spill Prevention Control and countermeasure (SPCC) plan up-to-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.
- Vehicles transporting waste should have spill prevention equipment that can prevent spills during transport. The spill prevention equipment includes:
  - Vehicles equipped with baffles for liquid waste
  - Trucks with sealed gates and spill guards for solid waste

***Other Considerations***

- Hazardous waste cannot be re-used or recycled; it must be disposed of by a licensed hazardous waste hauler.

## Requirements

***Costs***

- Capital and operation and maintenance costs will vary substantially depending on the size of the facility and the types of waste handled. Costs should be low if there is an inventory program in place.

***Maintenance***

- None except for maintaining equipment for material tracking program.

## Supplemental Information

***Further Detail of the BMP***

*Land Treatment System*

- Minimize the runoff of polluted stormwater from land application of municipal waste on-site by:
  - Choosing a site where slopes are under 6%, the soil is permeable, there is a low water table, it is located away from wetlands or marshes, there is a closed drainage system.
  - Avoiding application of waste to the site when it is raining or when the ground is saturated with water.
  - Growing vegetation on land disposal areas to stabilize soils and reduce the volume of surface water runoff from the site.
  - Maintaining adequate barriers between the land application site and the receiving waters. Planted strips are particularly good.
  - Using erosion control techniques such as mulching and matting, filter fences, straw bales, diversion terracing, and sediment basins.
  - Performing routine maintenance to ensure the erosion control or site stabilization measures are working.

## References and Resources

King County Stormwater Pollution Control Manual - http://dnr.metrokc.gov/wlr/dss/spcm.htm

Orange County Stormwater Program
http://www.ocwatersheds.com/StormWater/swp_introduction.asp

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Associations (BASMAA). On-line: http://www.basmaa.org

# Building & Grounds Maintenance SC-41

## Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | ☑ |
| Oil and Grease | ☑ |
| Organics | ☑ |
| Oxygen Demanding | ☑ |

## Description

Stormwater runoff from building and grounds maintenance activities can be contaminated with toxic hydrocarbons in solvents, fertilizers and pesticides, suspended solids, heavy metals, and abnormal pH. Utilizing the following protocols will prevent or reduce the discharge of pollutants to stormwater from building and grounds maintenance activities by washing and cleaning up with as little water as possible, following good landscape management practices, preventing and cleaning up spills immediately, keeping debris from entering the storm drains, and maintaining the stormwater collection system.

## Approach

### *Pollution Prevention*

- Switch to non-toxic chemicals for maintenance when possible.
- Choose cleaning agents that can be recycled.
- Encourage proper lawn management and landscaping, including use of native vegetation.
- Encourage use of Integrated Pest Management techniques for pest control.
- Encourage proper onsite recycling of yard trimmings.
- Recycle residual paints, solvents, lumber, and other material as much as possible.

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***Suggested Protocols***

*Pressure Washing of Buildings, Rooftops, and Other Large Objects*

- In situations where soaps or detergents are used and the surrounding area is paved, pressure washers must use a waste water collection device that enables collection of wash water and associated solids. A sump pump, wet vacuum or similarly effective device must be used to collect the runoff and loose materials. The collected runoff and solids must be disposed of properly.
- If soaps or detergents are not used, and the surrounding area is paved, wash water runoff does not have to be collected but must be screened. Pressure washers must use filter fabric or some other type of screen on the ground and/or in he catch basin to trap the particles in wash water runoff.
- If you are pressure washing on a grassed area (with or without soap), runoff must be dispersed as sheet flow as much as possible, rather than as a concentrated stream. The wash runoff must remain on the grass and not drain to pavement. Ensure that this practice does not kill grass.

*Landscaping Activities*

- Do not apply any chemicals (insecticide, herbicide, or fertilizer) directly to surface waters, unless the application is approved and permitted by the state.
- Dispose of grass clippings, leaves, sticks, or other collected vegetation as garbage, or by composting. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures on exposed soils.
- Check irrigation schedules so pesticides will not be washed away and to minimize non-stormwater discharge.

*Building Repair, Remodeling, and Construction*

- Do not dump any toxic substance or liquid waste on the pavement, the ground, or toward a storm drain.
- Use ground or drop cloths underneath outdoor painting, scraping, and sandblasting work, and properly dispose of collected material daily.
- Use a ground cloth or oversized tub for activities such as paint mixing and tool cleaning.
- Clean paint brushes and tools covered with water-based paints in sinks connected to sanitary sewers or in portable containers that can be dumped into a sanitary sewer drain. Brushes and tools covered with non-water-based paints, finishes, or other materials must be cleaned in a manner that enables collection of used solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal.

- Use a storm drain cover, filter fabric, or similarly effective runoff control mechanism if dust, grit, wash water, or other pollutants may escape the work area and enter a catch basin. The containment device(s) must be in place at the beginning of the work day, and accumulated dirty runoff and solids must be collected and disposed of before removing the containment device(s) at the end of the work day.
- If you need to de-water an excavation site, you may need to filter the water before discharging to a catch basin or off-site. In which case you should direct the water through hay bales and filter fabric or use other sediment filters or traps.
- Store toxic material under cover with secondary containment during precipitation events and when not in use. A cover would include tarps or other temporary cover material.

*Mowing, Trimming, and Planting*

- Dispose of leaves, sticks, or other collected vegetation as garbage, by composting or at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures when soils are exposed.
- Place temporarily stockpiled material away from watercourses and drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.
- Consider an alternative approach when bailing out muddy water; do not put it in the storm drain, pour over landscaped areas.
- Use hand or mechanical weeding where practical.

*Fertilizer and Pesticide Management*

- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.
- Follow manufacturers' recommendations and label directions. Pesticides must never be applied if precipitation is occuring or predicted. Do not apply insecticides within 100 feet of surface waters such as lakes, ponds, wetlands, and streams.
- Use less toxic pesticides that will do the job, whenever possible. Avoid use of copper-based pesticides if possible.
- Do not use pesticides if rain is expected.
- Do not mix or prepare pesticides for application near storm drains.
- Use the minimum amount needed for the job.
- Calibrate fertilizer distributors to avoid excessive application.
- Employ techniques to minimize off-target application (e.g. spray drift) of pesticides, including consideration of alternative application techniques.

- Apply pesticides only when wind speeds are low.
- Work fertilizers into the soil rather than dumping or broadcasting them onto the surface.
- Irrigate slowly to prevent runoff and then only as much as is needed.
- Clean pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Dispose of empty pesticide containers according to the instructions on the container label.
- Use up the pesticides. Rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Implement storage requirements for pesticide products with guidance from the local fire department and County Agricultural Commissioner. Provide secondary containment for pesticides.

*Inspection*

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering, and repair leaks in the irrigation system as soon as they are observed.

***Training***

- Educate and train employees on use of pesticides and in pesticide application techniques to prevent pollution.
- Train employees and contractors in proper techniques for spill containment and cleanup.
- Be sure the frequency of training takes into account the complexity of the operations and the nature of the staff.

***Spill Response and Prevention***

- Refer to SC-11, Spill Prevention, Control & Cleanup
- Keep your Spill Prevention Control and countermeasure (SPCC) plan up-to-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

***Other Considerations***

- Alternative pest/weed controls may not be available, suitable, or effective in many cases.

## Requirements

### *Costs*

- Overall costs should be low in comparison to other BMPs.

### *Maintenance*

- Sweep paved areas regularly to collect loose particles, and wipe up spills with rags and other absorbent material immediately, do not hose down the area to a storm drain.

## Supplemental Information

### *Further Detail of the BMP*

*Fire Sprinkler Line Flushing*

Building fire sprinkler line flushing may be a source of non-stormwater runoff pollution. The water entering the system is usually potable water though in some areas it may be non-potable reclaimed wastewater. There are subsequent factors that may drastically reduce the quality of the water in such systems. Black iron pipe is usually used since it is cheaper than potable piping but it is subject to rusting and results in lower quality water. Initially the black iron pipe has an oil coating to protect it from rusting between manufacture and installation; this will contaminate the water from the first flush but not from subsequent flushes. Nitrates, poly-phosphates and other corrosion inhibitors, as well as fire suppressants and antifreeze may be added to the sprinkler water system. Water generally remains in the sprinkler system a long time, typically a year, between flushes and may accumulate iron, manganese, lead, copper, nickel and zinc. The water generally becomes anoxic and contains living and dead bacteria and breakdown products from chlorination. This may result in a significant BOD problem and the water often smells. Consequently dispose fire sprinkler line flush water into the sanitary sewer. Do not allow discharge to storm drain or infiltration due to potential high levels of pollutants in fire sprinkler line water.

## References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

King County - ftp://dnr.metrokc.gov/wlr/dss/spcm/Chapter%203.PDF

Orange County Stormwater Program
http://www.ocwatersheds.com/StormWater/swp_introduction.asp

Mobile Cleaners Pilot Program: Final Report. 1997. Bay Area Stormwater Management Agencies Association (BASSMA) http://www.basmaa.org/

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA) http://www.basmaa.org/

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (URMP) -
http://www.projectcleanwater.org/pdf/Model%20Program%20Municipal%20Facilities.pdf

# Drainage System Maintenance SC-44

**Objectives**

- Cover
- Contain
- Educate
- Reduce/Minimize

## Description

As a consequence of its function, the stormwater conveyance system collects and transports urban runoff and stormwater that may contain certain pollutants. The protocols in this fact sheet are intended to reduce pollutants reaching receiving waters through proper conveyance system operation and maintenance.

**Targeted Constituents**

| | |
|---|---|
| Sediment | ✓ |
| Nutrients | |
| Trash | ✓ |
| Metals | |
| Bacteria | ✓ |
| Oil and Grease | |
| Organics | |

## Approach

### *Pollution Prevention*

Maintain catch basins, stormwater inlets, and other stormwater conveyance structures on a regular basis to remove pollutants, reduce high pollutant concentrations during the first flush of storms, prevent clogging of the downstream conveyance system, restore catch basins' sediment trapping capacity, and ensure the system functions properly hydraulically to avoid flooding.

### *Suggested Protocols*

*Catch Basins/Inlet Structures*

- Staff should regularly inspect facilities to ensure compliance with the following:
  - Immediate repair of any deterioration threatening structural integrity.
  - Cleaning before the sump is 40% full. Catch basins should be cleaned as frequently as needed to meet this standard.
  - Stenciling of catch basins and inlets (see SC34 Waste Handling and Disposal).

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- Clean catch basins, storm drain inlets, and other conveyance structures before the wet season to remove sediments and debris accumulated during the summer.
- Conduct inspections more frequently during the wet season for problem areas where sediment or trash accumulates more often. Clean and repair as needed.
- Keep accurate logs of the number of catch basins cleaned.
- Store wastes collected from cleaning activities of the drainage system in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain.
- Dewater the wastes if necessary with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not allowed, water should be pumped or vacuumed to a tank and properly disposed. Do not dewater near a storm drain or stream.

*Storm Drain Conveyance System*

- Locate reaches of storm drain with deposit problems and develop a flushing schedule that keeps the pipe clear of excessive buildup.
- Collect and pump flushed effluent to the sanitary sewer for treatment whenever possible.

*Pump Stations*

- Clean all storm drain pump stations prior to the wet season to remove silt and trash.
- Do not allow discharge to reach the storm drain system when cleaning a storm drain pump station or other facility.
- Conduct routine maintenance at each pump station.
- Inspect, clean, and repair as necessary all outlet structures prior to the wet season.

*Open Channel*

- Modify storm channel characteristics to improve channel hydraulics, increase pollutant removals, and enhance channel/creek aesthetic and habitat value.
- Conduct channel modification/improvement in accordance with existing laws. Any person, government agency, or public utility proposing an activity that will change the natural (emphasis added) state of any river, stream, or lake in California, must enter into a Steam or Lake Alteration Agreement with the Department of Fish and Game. The developer-applicant should also contact local governments (city, county, special districts), other state agencies (SWRCB, RWQCB, Department of Forestry, Department of Water Resources), and Federal Corps of Engineers and USFWS.

*Illicit Connections and Discharges*

- Look for evidence of illegal discharges or illicit connections during routine maintenance of conveyance system and drainage structures:
  - Is there evidence of spills such as paints, discoloring, etc?

- Are there any odors associated with the drainage system?
- Record locations of apparent illegal discharges/illicit connections?
- Track flows back to potential dischargers and conduct aboveground inspections. This can be done through visual inspection of upgradient manholes or alternate techniques including zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, or television camera inspection.
- Eliminate the discharge once the origin of flow is established.

- Stencil or demarcate storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste Drains to Stream" stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

*Illegal Dumping*

- Inspect and clean up hot spots and other storm drainage areas regularly where illegal dumping and disposal occurs.
- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots
  - Types and quantities (in some cases) of wastes
  - Patterns in time of occurrence (time of day/night, month, or year)
  - Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
  - Responsible parties
- Post "No Dumping" signs in problem areas with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

***Training***

- Train crews in proper maintenance activities, including record keeping and disposal.
- Allow only properly trained individuals to handle hazardous materials/wastes.
- Have staff involved in detection and removal of illicit connections trained in the following:
  - OSHA-required Health and Safety Training (29 CFR 1910.120) plus annual refresher training (as needed).

- OSHA Confined Space Entry training (Cal-OSHA Confined Space, Title 8 and Federal OSHA 29 CFR 1910.146).
- Procedural training (field screening, sampling, smoke/dye testing, TV inspection).

***Spill Response and Prevention***

- Investigate all reports of spills, leaks, and/or illegal dumping promptly.
- Clean up all spills and leaks using "dry" methods (with absorbent materials and/or rags) or dig up, remove, and properly dispose of contaminated soil.
- Refer to fact sheet SC-11 Spill Prevention, Control, and Cleanup.

***Other Considerations (Limitations and Regulations)***

- Clean-up activities may create a slight disturbance for local aquatic species. Access to items and material on private property may be limited. Trade-offs may exist between channel hydraulics and water quality/riparian habitat. If storm channels or basins are recognized as wetlands, many activities, including maintenance, may be subject to regulation and permitting.
- Storm drain flushing is most effective in small diameter pipes (36-inch diameter pipe or less, depending on water supply and sediment collection capacity). Other considerations associated with storm drain flushing may include the availability of a water source, finding a downstream area to collect sediments, liquid/sediment disposal, and prohibition against disposal of flushed effluent to sanitary sewer in some areas.
- Regulations may include adoption of substantial penalties for illegal dumping and disposal.
- Local municipal codes may include sections prohibiting discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.

## Requirements

***Costs***

- An aggressive catch basin cleaning program could require a significant capital and O&M budget.
- The elimination of illegal dumping is dependent on the availability, convenience, and cost of alternative means of disposal. The primary cost is for staff time. Cost depends on how aggressively a program is implemented. Other cost considerations for an illegal dumping program include:
  - Purchase and installation of signs.
  - Rental of vehicle(s) to haul illegally-disposed items and material to landfills.
  - Rental of heavy equipment to remove larger items (e.g., car bodies) from channels.
  - Purchase of landfill space to dispose of illegally-dumped items and material.

- Methods used for illicit connection detection (smoke testing, dye testing, visual inspection, and flow monitoring) can be costly and time-consuming. Site-specific factors, such as the level of impervious area, the density and ages of buildings, and type of land use will determine the level of investigation necessary.

***Maintenance***

- Two-person teams may be required to clean catch basins with vactor trucks.
- Teams of at least two people plus administrative personnel are required to identify illicit discharges, depending on the complexity of the storm sewer system.
- Arrangements must be made for proper disposal of collected wastes.
- Technical staff are required to detect and investigate illegal dumping violations.

## Supplemental Information

***Further Detail of the BMP***

*Storm Drain Flushing*

Flushing is a common maintenance activity used to improve pipe hydraulics and to remove pollutants in storm drainage systems. Flushing may be designed to hydraulically convey accumulated material to strategic locations, such as an open channel, another point where flushing will be initiated, or the sanitary sewer and the treatment facilities, thus preventing resuspension and overflow of a portion of the solids during storm events. Flushing prevents "plug flow" discharges of concentrated pollutant loadings and sediments. Deposits can hinder the designed conveyance capacity of the storm drain system and potentially cause backwater conditions in severe cases of clogging.

Storm drain flushing usually takes place along segments of pipe with grades that are too flat to maintain adequate velocity to keep particles in suspension. An upstream manhole is selected to place an inflatable device that temporarily plugs the pipe. Further upstream, water is pumped into the line to create a flushing wave. When the upstream reach of pipe is sufficiently full to cause a flushing wave, the inflated device is rapidly deflated with the assistance of a vacuum pump, thereby releasing the backed up water and resulting in the cleaning of the storm drain segment.

To further reduce impacts of stormwater pollution, a second inflatable device placed well downstream may be used to recollect the water after the force of the flushing wave has dissipated. A pump may then be used to transfer the water and accumulated material to the sanitary sewer for treatment. In some cases, an interceptor structure may be more practical or required to recollect the flushed waters.

It has been found that cleansing efficiency of periodic flush waves is dependent upon flush volume, flush discharge rate, sewer slope, sewer length, sewer flow rate, sewer diameter, and population density. As a rule of thumb, the length of line to be flushed should not exceed 700 feet. At this maximum recommended length, the percent removal efficiency ranges between 65-75% for organics and 55-65% for dry weather grit/inorganic material. The percent removal efficiency drops rapidly beyond that. Water is commonly supplied by a water truck, but fire hydrants can also supply water. To make the best use of water, it is recommended that reclaimed water be used or that fire hydrant line flushing coincide with storm sewer flushing.

## References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

Ferguson, B.K. 1991. Urban Stream Reclamation, p. 324-322, Journal of Soil and Water Conservation.

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Storm Drain System Cleaning. On line:
http://www.epa.gov/npdes/menuofbmps/poll_16.htm

# Non-Stormwater Discharges SC-10

## Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

## Description

Non-stormwater discharges are those flows that do not consist entirely of stormwater. Some non-stormwater discharges do not include pollutants and may be discharged to the storm drain. These include uncontaminated groundwater and natural springs. There are also some non-stormwater discharges that typically do not contain pollutants and may be discharged to the storm drain with conditions. These include car washing, air conditioner condensate, etc. However there are certain non-stormwater discharges that pose environmental concern. These discharges may originate from illegal dumping or from internal floor drains, appliances, industrial processes, sinks, and toilets that are connected to the nearby storm drainage system. These discharges (which may include: process waste waters, cooling waters, wash waters, and sanitary wastewater) can carry substances such as paint, oil, fuel and other automotive fluids, chemicals and other pollutants into storm drains. They can generally be detected through a combination of detection and elimination. The ultimate goal is to effectively eliminate non-stormwater discharges to the stormwater drainage system through implementation of measures to detect, correct, and enforce against illicit connections and illegal discharges of pollutants on streets and into the storm drain system and creeks.

## Targeted Constituents

| | |
|---|---|
| Sediment | |
| Nutrients | ✓ |
| Trash | |
| Metals | ✓ |
| Bacteria | ✓ |
| Oil and Grease | ✓ |
| Organics | ✓ |

## Approach

Initially the industry must make an assessment of non-stormwater discharges to determine which types must be eliminated or addressed through BMPs. The focus of the following approach is in the elimination of non-stormwater discharges.

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