City of Riverside
Public Works Department

Final Mitigated Negative Declaration

AGENDA ITEM NO.:
WARD: 5

1. **Case Number:** EPW 18-001

2. **Project Title:** Monroe Master Drainage Plan Line E Stages 2 and 3, Line E-2, and Line E-5 Storm Drain Improvements

3. **Hearing Date:** January 15, 2019

4. **Lead Agency:** City of Riverside
Public Works Department
3900 Main Street, 4th Floor
Riverside, CA 92522

5. **Contact Person:** Sweta Patel, P.E. Senior Engineer
Phone Number: (951) 826-5714

6. **Project Location:** Within 11,200 feet of existing road right-of-way for Gratton Street, Dufferin Avenue, and Hermosa Drive, in the Arlington Heights neighborhood of the City of Riverside, Riverside County, Section 16, Township 3S, Range 5W (**Figure 1–Regional Location**, **Figure 2–Project Location**).

7. **Project Applicant/ Project Sponsor's Name and Address:** City of Riverside
Public Works Department
3900 Main Street, 4th Floor
Riverside, CA 92501

8. **General Plan Designation:** Arlington Heights Greenbelt

9. **Zoning:** RA-5 (Residential-Agricultural)

10. **Description of Project:** (Describe the whole action involved, including but not limited to later phases of the project, and any secondary, support, or off-site features necessary for its implementation. Attach additional sheets if neessary.)

The proposed project includes the construction of approximately 11,200 linear feet of underground storm drain pipe within the Gratton Street, Dufferin Avenue, and Hermosa Drive rights-of-way; removing and rebuilding the existing curb, gutter, and street lights along the east side of Gratton Street between Lincoln Avenue and Victoria Avenue; and a jack-and-bore operation for trenchless pipe installation underneath Gage Canal at the intersection of Gratton Street and Hermosa Drive. The project is proposed to provide protection from a ten-year storm event by installing a system of underground storm drains, which include main Line E and laterals Line E-2 and Line E-5.

Construction of main Line E includes Stages 2 and 3, which are located within the Gratton Street right-of-way and will extend approximately 7,600 feet (1.4 miles) from Lincoln Avenue at the north to the Gage Canal at the south (**Figure 3a**, **Figure 3b**). Line E-2 is located within the Hermosa Street right-of-way and will extend approximately 2,200 feet from Gage Canal at the west to St. Lawrence Street at the east (**Figure 3c**). Line E-5 is located within the Dufferin Avenue right-of-way and will extend approximately 1,400 feet from Gratton

Street at the west to Adams Street at the east (**Figure 3d**). To facilitate construction of Line E-5, a 10-foot-wide temporary construction easement has been granted to the City within a private citrus orchard adjacent to the right-of-way on the north side of Dufferin Avenue.

Construction of the proposed project is expected to begin late 2019 or early 2020, and is expected to last approximately 15 months. Project construction would progress at an estimated average rate of 40 feet per day, with a maximum of 300 feet of work area disturbed at any given time. The depth of the trench for pipeline installation would range from a minimum of 9 feet at the eastern end of the alignment to a maximum of 20 feet at the western end of the alignment. The width of the trench to be excavated would be determined by the width of the pipeline segment to be installed. Pipeline segments would range in diameter from 18 inches (1.5 feet) at the eastern end of the alignment to 84 inches (7 feet) at the western end of the alignment. The trench would accommodate the pipeline width plus an additional two feet, and would therefore not exceed a maximum width of 9 feet. The total volume of soil that would be excavated by trenching and require exporting off-site would be approximately 29,000 cubic yards.

The majority of the construction of the project alignment from Lincoln Avenue to Hermosa Drive in Gratton Street would use conventional open trench methods. However, the portion of Line E crossing underneath Gage Canal would use a trenchless jack-and-bore construction method for placement of the new pipeline. The City of Riverside Public Works Department will obtain a maintenance easement for the Riverside County Flood Control and Water Conservation District to allow jack-and-bore construction underneath the Gage Canal. The tentative location of temporary staging areas for the storage of construction equipment and materials would be near the intersection of Gratton Street and Hermosa Drive, and/or within a nearby nursery to be determined.

10. **Surrounding land uses and setting: Briefly describe the project's surroundings:**
The project site is located within existing street right-of-way that is surrounded by citrus groves, plant nurseries, non-native grassland, and low-density residential development. The Gage Canal, a concrete irrigation canal, flows through the southeastern portion of the project site and crosses under a bridge at Gratton Street near its intersection with Hermosa Drive. Currently, there are no storm drain systems within the project area other than culvert crossings at the street intersections and an engineered retention basin on the east side of Gratton Street between Victoria Avenue and Lincoln Avenue. As a result, several of the street intersections flood during moderate storm events, especially the Gratton Street and Lincoln Avenue intersection, and the Adams Street and Dufferin Avenue intersection.

Adjacent Existing Land Use:
North: Residential
East: Residential, Agricultural
South: Residential, Agricultural
West: Residential, Agricultural

Adjacent zoning:
North: RA-5 (Residential-Agricultural)
East: RA-5 (Residential-Agricultural)
South: RA-5 (Residential-Agricultural)
West: RA-5 (Residential-Agricultural)

11. **Other public agencies whose approval is required (e.g., permits, financial approval, or participation agreement.):**
Riverside County Flood Control and Water Conservation District (RCFC&WCD)

Project Location

RECON

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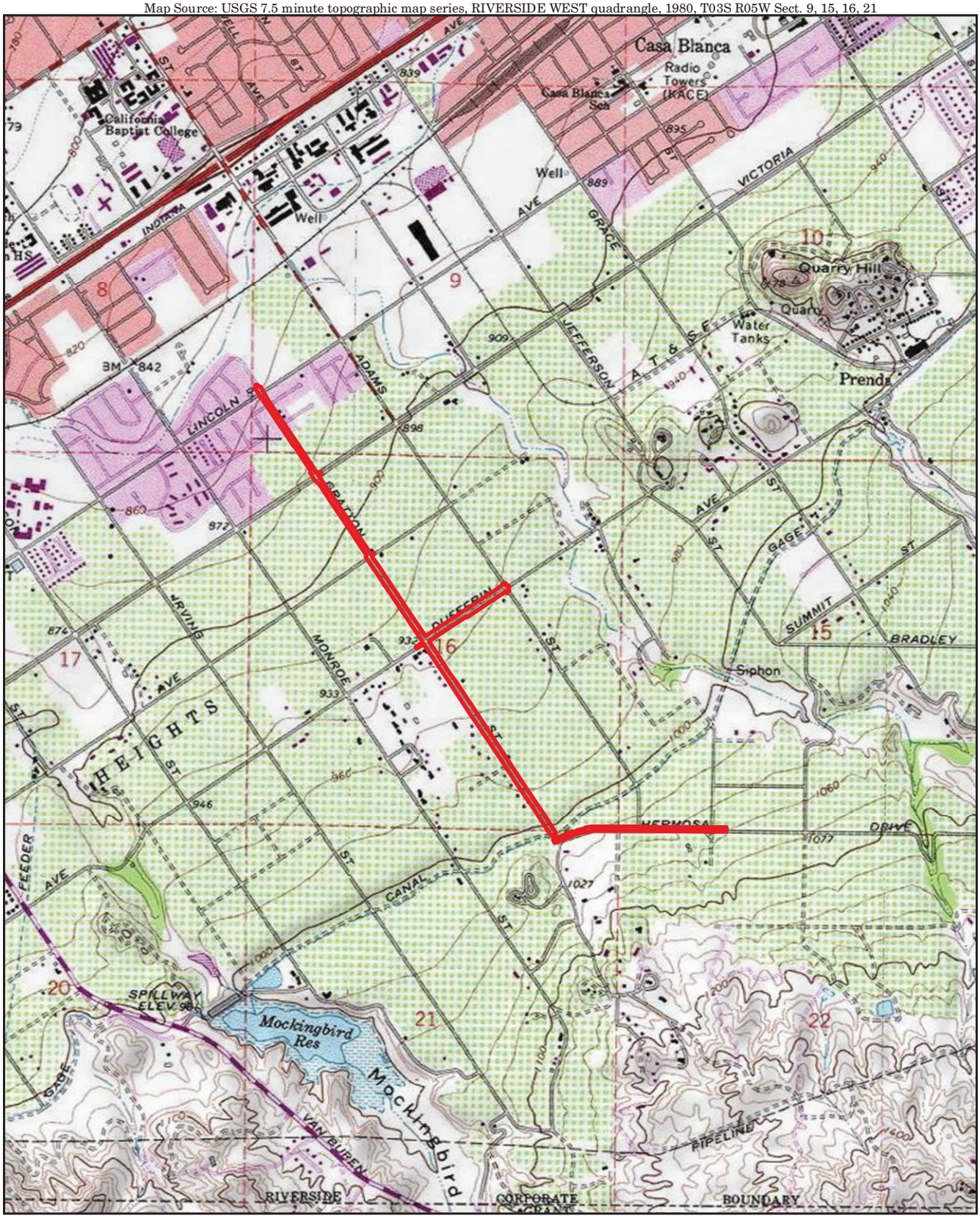
FIGURE 1

Regional Location

Map Source: USGS 7.5 minute topographic map series, RIVERSIDE WEST quadrangle, 1980, T03S R05W Sect. 9, 15, 16, 21



0 Feet 2,000

Project Boundary

RECON

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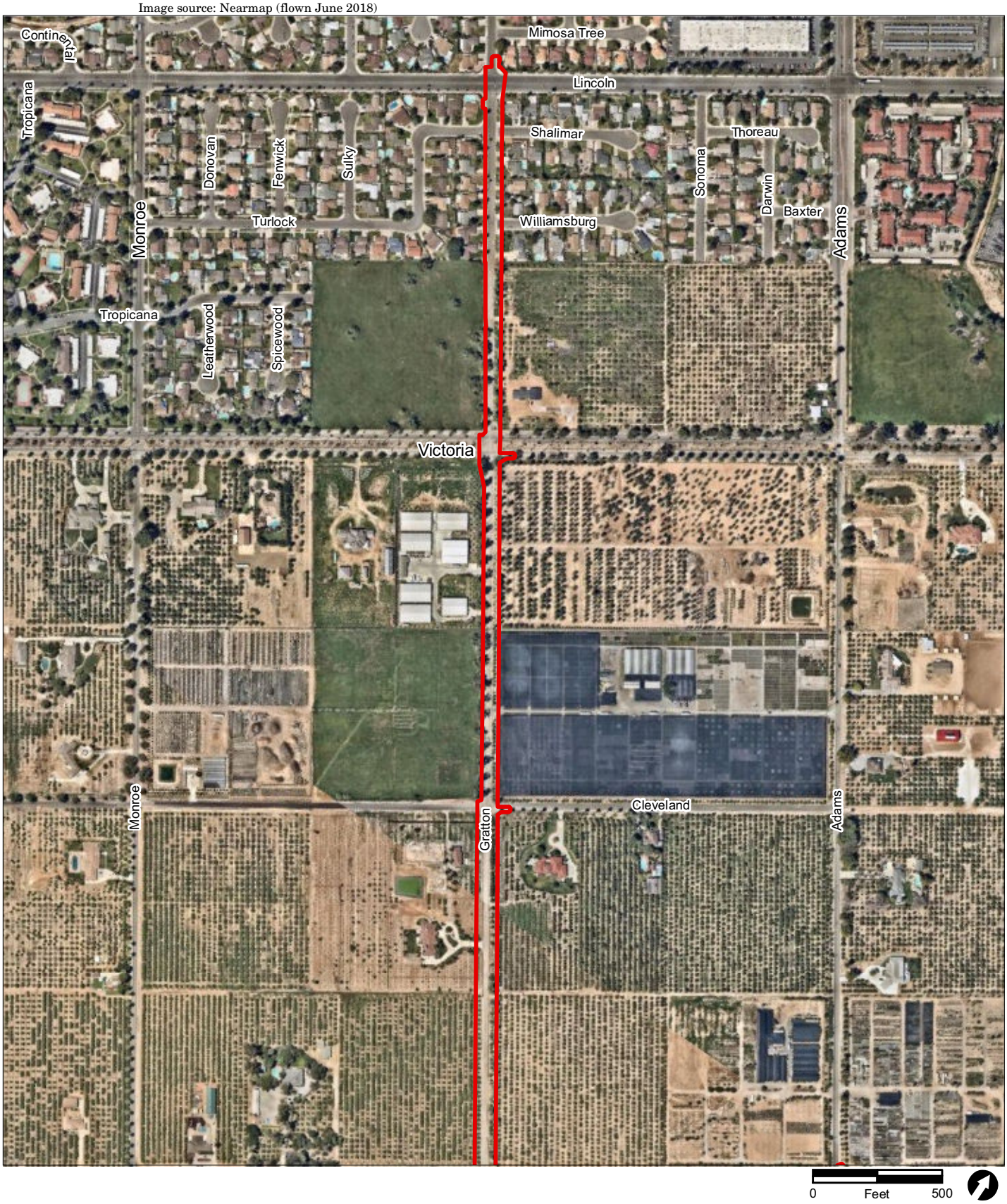
FIGURE 2

Project Location on USGS Map

Image source: Nearmap (flown June 2018)



Project Boundary

RECON

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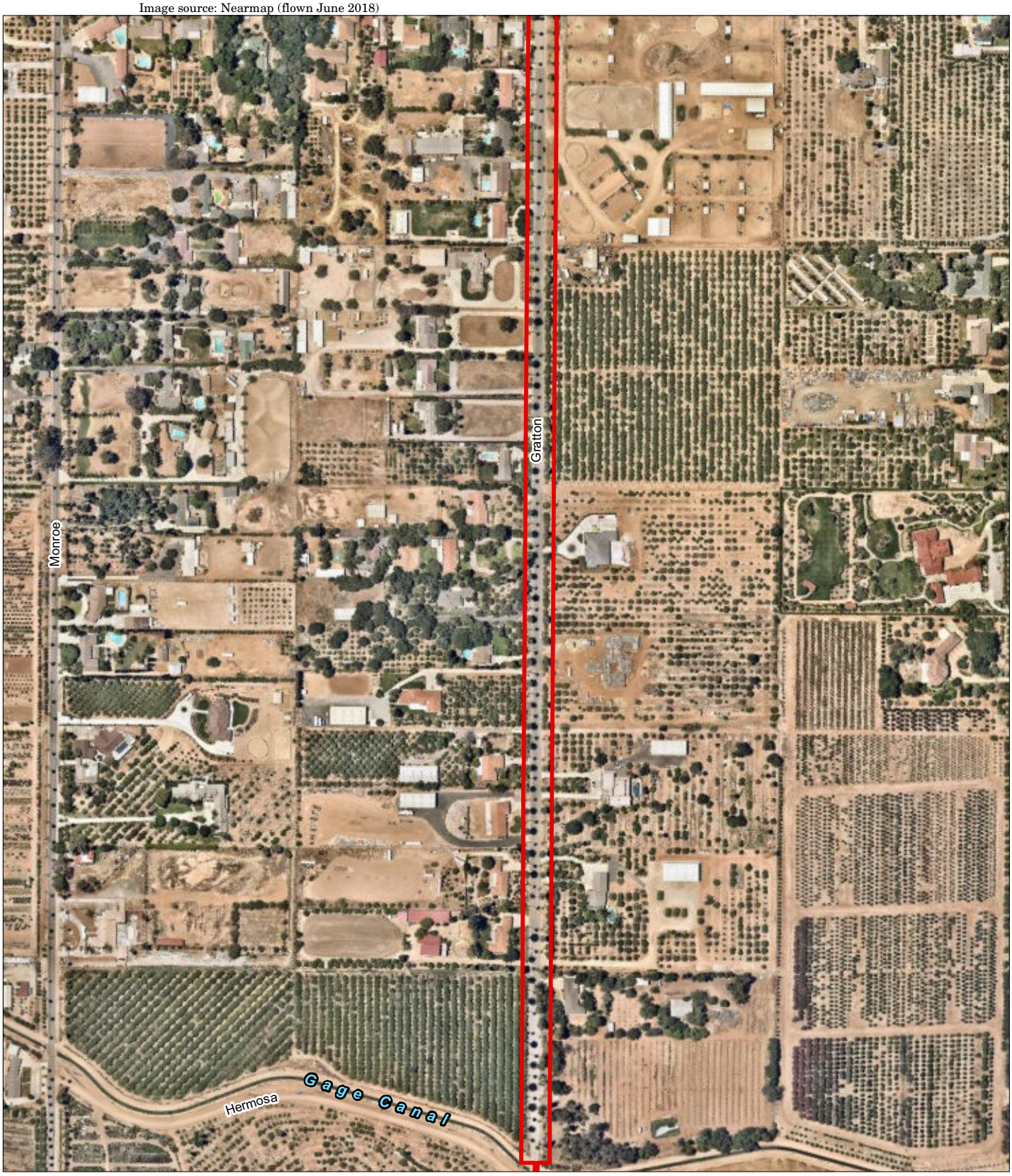
FIGURE 3a

Impact Area: Line E, Stage 2

Image source: Nearmap (flown June 2018)



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Project Boundary

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FIGURE 3b

Impact Area: Line E, Stage 3

Image source: Nearmap (flown June 2018)

0 Feet 350

Project Boundary

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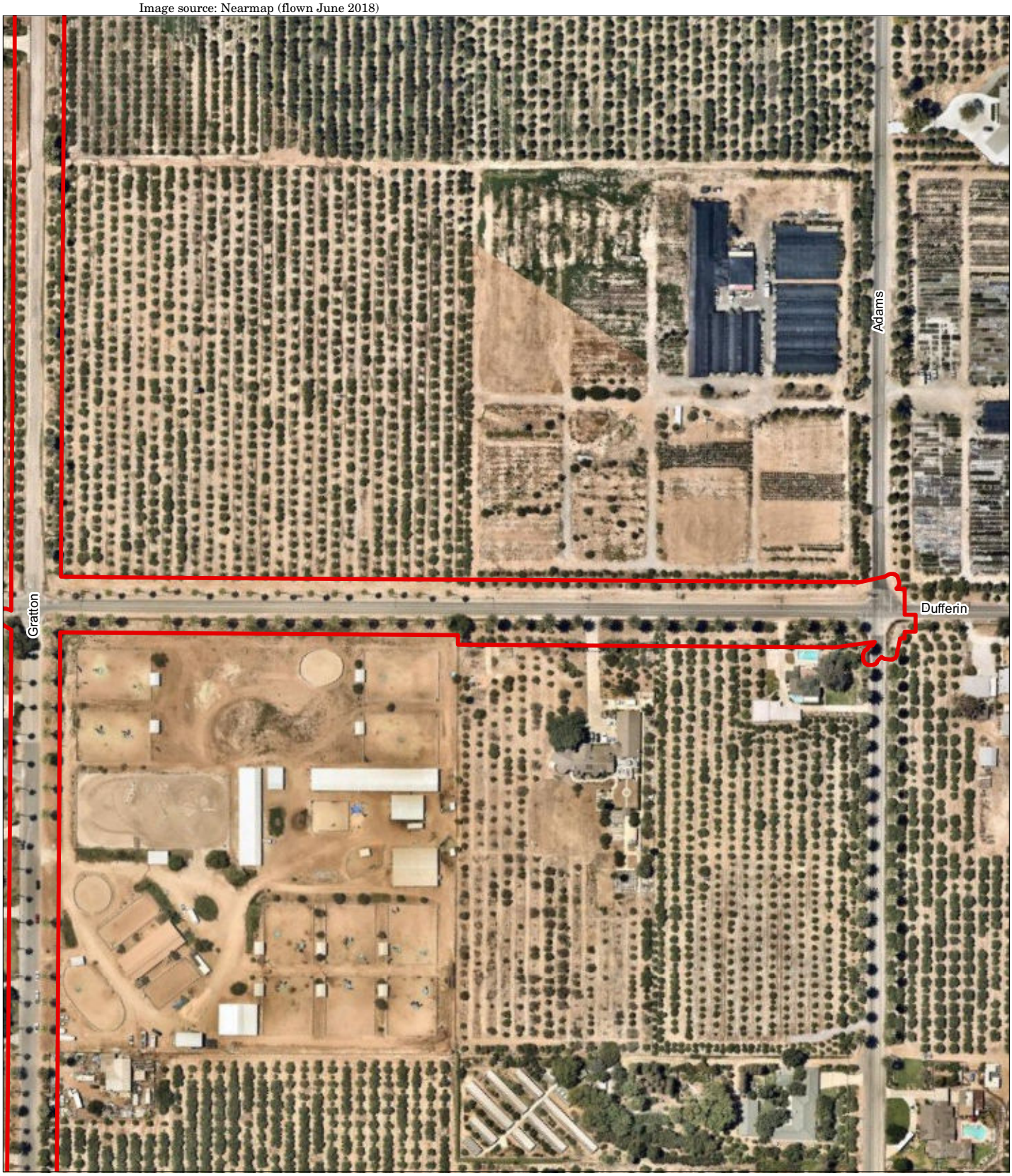
FIGURE 3c

Impact Area: Line E-2

Image source: Nearmap (flown June 2018)



Project Boundary

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FIGURE 3d

Impact Area: Line E-5

12. **List of Appendices:**
    A. Air Quality Data Sheets (RECON Environmental, Inc. [RECON] 2018)
    B. Biological Resources Report (RECON 2018)
    C. Cultural Resources Report (RECON 2018)
    D. Geotechnical Report (GeoMat 2017)

13. **Acronyms**

ACOE	-	U.S. Army Corps of Engineers
AICUZ	-	Air Installation Compatible Use Zone Study
AQMP	-	Air Quality Management Plan
AUSD	-	Alvord Unified School District
BMPs	-	Best Management Practices
CAAQS	-	California Ambient Air Quality Standards
Caltrans	-	California Department of Transportation
CEQA	-	California Environmental Quality Act
CFGC	-	California Fish and Game Code
CO	-	carbon monoxide
dB(A)	-	A-weighted decibels
DTSC	-	State of California Department of Toxic Substances Control
EOP	-	Emergency Operations Plan
FEMA	-	Federal Emergency Management Agency
FPEIR	-	GP 2025 Final Programmatic Environmental Impact Report
GIS	-	Geographic Information System
GP 2025	-	General Plan 2025
H&SC	-	State of California Health and Safety Code
L_{eq}	-	equivalent hourly noise level
LHMP	-	Local Hazard Mitigation Plan
MBTA	-	Migratory Bird Treaty Act
MSHCP	-	Multiple-Species Habitat Conservation Plan
NAAQS	-	National Ambient Air Quality Standards
NO_2	-	nitrogen dioxide
OEM	-	Office of Emergency Services
PM	-	particulate matter
$PM_{2.5}$	-	particulate matter less than 2.5 microns
PM_{10}	-	particulate matter less than 10 microns
RCALUCP	-	Riverside County Airport Land Use Compatibility Plan
RCP	-	Regional Comprehensive Plan
RTP	-	Regional Transportation Plan
RUSD	-	Riverside Unified School District
RWQCB	-	Regional Water Quality Control Board
SCAG	-	Southern California Association of Governments
SCAQMD	-	South Coast Air Quality Management District
SWPPP	-	Storm Water Pollution Prevention Plan

ENVIRONMENTAL FACTORS POTENTIALLY AFFECTED:

The environmental factors checked below would be potentially affected by this project, involving at least one impact that is a "Potentially Significant Impact" as indicated by the checklist on the following pages.

☐ Aesthetics	☐ Agriculture & Forest Resources	☐ Air Quality
☒ Biological Resources	☒ Cultural Resources	☐ Geology/Soils
☐ Greenhouse Gas Emissions	☐ Hazards & Hazardous Materials	☐ Hydrology/Water Quality
☐ Land Use/Planning	☐ Mineral Resources	☐ Noise
☐ Population/Housing	☐ Public Service	☐ Recreation
☐ Transportation/Traffic	☒ Tribal Cultural Resources	☒ Utilities and Service Systems
☒ Mandatory Findings of Significance		

DETERMINATION: (To be completed by the Lead Agency)

On the basis of this initial evaluation which reflects the independent judgment of the City of Riverside, it is recommended that:

The City of Riverside finds that the proposed project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared. ☐

The City of Riverside finds that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because revisions in the project have been made by or agreed to by the project proponent. A MITIGATED NEGATIVE DECLARATION will be prepared. ☒

The City of Riverside finds that the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required. ☐

The City of Riverside finds that the proposed project MAY have a "potentially significant impact" or "potentially significant unless mitigated" impact on the environment, but at least one effect 1) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and 2) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An ENVIRONMENTAL IMPACT REPORT is required, but it must analyze only the effects that remain to be addressed. ☐

The City of Riverside finds that although the proposed project could have a significant effect on the environment, because all potentially significant effects (a) have been analyzed adequately in an earlier EIR or NEGATIVE DECLARATION pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier EIR or NEGATIVE DECLARATION, including revisions or mitigation measures that are imposed upon the proposed project, nothing further is required. ☐

Signature _____ Date 10/24/2018

Printed Name & Title Sweta Patel, Senior Engineer For City of Riverside

EVALUATION OF ENVIRONMENTAL IMPACTS:

1) A brief explanation is required for all answers except "No Impact" answers that are adequately supported by the information sources a lead agency cites in the parentheses following each question. A "No Impact" answer is adequately supported if the referenced information sources show that the impact simply does not apply to projects like the one involved (e.g., the project falls outside a fault rupture zone). A "No Impact" answer should be explained where it is based on project-specific factors as well as general standards (e.g., the project will not expose sensitive receptors to pollutants, based on a project-specific screening analysis).

2) All answers must take account of the whole action involved, including off-site as well as on-site, cumulative as well as project-level, indirect as well as direct, and construction as well as operational impacts.

3) Once the lead agency has determined that a particular physical impact may occur, then the checklist answers must indicate whether the impact is potentially significant, less than significant with mitigation, or less than significant."Potentially Significant Impact" is appropriate if there is substantial evidence that an effect may be significant. If there are one or more "Potentially Significant Impact" entries when the determination is made, an EIR is required.

4) "Negative Declaration: Less Than Significant With Mitigation Incorporated" applies where the incorporation of mitigation measures has reduced an effect from "Potentially Significant Impact" to a "Less Than Significant Impact." The lead agency must describe the mitigation measures, and briefly explain how they reduce the effect to a less than significant level (mitigation measures from "Earlier Analyses," as described in (5) below, may be cross-referenced).

5) Earlier analyses may be used where, pursuant to the tiering, program EIR, or other California Environmental Quality Act (CEQA) process, an effect has been adequately analyzed in an earlier EIR or negative declaration. Section 15063(c)(3)(D). In this case, a brief discussion should identify the following:

   a. **Earlier Analysis Used.** Identify and state where they are available for review.
   b. **Impacts Adequately Addressed.** Identify which effects from the above checklist were within the scope of and adequately analyzed in an earlier document pursuant to applicable legal standards, and state whether such effects were addressed by mitigation measures based on the earlier analysis.
   c. **Mitigation Measures.** For effects that are "Less than Significant with Mitigation Measures Incorporated," describe the mitigation measure which were incorporated or refined from the earlier document and the extent to which they address site-specific conditions for the project.

6) Lead agencies are encouraged to incorporate into the checklist references to information sources for potential impacts (e.g., general plans, zoning ordinances). Reference to a previously prepared or outside document should, where appropriate, include a reference to the page or pages where the statement is substantiated.

7) Supporting Information Sources: A source list should be attached, and other sources used or individuals contacted should be cited in the discussion.

8) The explanation of each issue should identify:

   a. the significance criteria or threshold, if any, used to evaluate each question; and
   b. the mitigation measure identified, if any, to reduce the impact to less than significance.

ISSUES (AND SUPPORTING INFORMATION SOURCES):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
1. AESTHETICS. Would the project:				
a. Have a substantial adverse effect on a scenic vista?	☐	☐	☒	☐

1a. Response: ***(Source: City of Riverside General Plan [General Plan] 2025 Figure CCM-4–Master Plan of Roadways, General Plan 2025 Final Programmatic Environmental Impact Report [FPEIR] Figure 5.1-1–Scenic and Special Boulevards and Parkways, Table 5.1-A–Scenic and Special Boulevards, and Table 5.1-B–Scenic Parkways)***

Less Than Significant Impact. The Riverside General Plan 2025 (GP 2025) officially designates scenic resources within the City of Riverside (City). The project site is located in the Arlington Heights Greenbelt neighborhood. Within this neighborhood, the nearest scenic resources to the project site include California Citrus State Historic Park, and Victoria Avenue. California Citrus State Historic Park is located approximately one mile to the west of Gratton Street, is not visible to or from any portions of the project site, and would therefore not be affected by the proposed project. Victoria Avenue is a historic parkway that has been recognized as an important local and regional scenic resource due to its landscaped median lined with many species of trees and exotic plants.

The Line E Stage 2 segment of the project site intersects with Victoria Avenue at Gratton Street. Storm drain improvements such as inlets to the storm drain pipe constructed along this segment of the project would be located underground. Aboveground construction activities at the intersection, such as the asphalt concrete berm replacement at the outside corners of the intersection, would avoid any impacts to the visual characteristics of Victoria Avenue that qualify it as a designated scenic resource. Therefore, the proposed project would have a less than significant impact on a scenic vista.

b. Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?	☐	☐	☒	☐

1b. Response: ***(Source: California Department of Transportation [Caltrans] list of eligible and officially designated State Scenic Highways 2017)***

Less Than Significant Impact. There are no State scenic highways or Riverside County (County) scenic highways identified within the vicinity of the project site. Other than Victoria Avenue (which would not be adversely affected, as discussed above in 1a) there are no other designated scenic resources such as trees, rock outcroppings, or historic buildings that could be potentially damaged within the vicinity of the project site. Therefore, there would be a less than significant impact.

c. Substantially degrade the existing visual character or quality of the site and its surroundings?	☐	☐	☒	☐

1c. Response:

Less Than Significant Impact. The project involves temporary construction activities in order to construct approximately 11,200 linear feet of underground storm drainpipe within existing road right-of-way. During construction, the presence of heavy equipment and stockpiles may temporarily affect the visual character of the project area. However, the appearance would be temporary and would not substantially degrade the visual character or quality of the project site and its surroundings. Therefore, a less than significant impact to the existing visual character or quality of the project site and its surroundings would result.

d. Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?	☐	☐	☒	☐

1d. Response:

Less Than Significant Impact. The project's storm drain improvements would be located underground and would not result in new sources of light or glare. Streetlights would be replaced along portions of Gratton Street, but the replacement lights would not contribute a substantially greater amount of light than do the existing streetlights. If it is determined that

ISSUES (AND SUPPORTING INFORMATION SOURCES):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
nighttime work is necessary for construction, nighttime lighting for construction safety would be required. The lighting would be temporary and would be focused to illuminate the area of the construction activities and staging, and would be shielded so as not to direct light toward any nearby residences. Therefore, impacts would be less than significant.				
2. AGRICULTURE AND FOREST RESOURCES:				
In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Dept. of Conservation as an optional model to use in assessing impacts on agriculture and farmland. In determining whether impacts to forest resources, including timberland, are significant environmental effect, lead agencies may refer to information complied by the California Department of Forestry and Fire Protection regarding the state's inventory of forest land, including the Forest and Range Assessment Project and the Forest Legacy Assessment project; and the forest carbon measurement methodology provided in the Forest Protocols adopted by the California Air Resources Board. Would the project:				
a. Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?	☐	☐	☐	☒
2a. Response: ***(Source: California Department of Conservation 2012)*** **No Impact.** Although some portions of the project site are located adjacent to agricultural land, the project site is located entirely within existing road right-of-way, and is not located within Prime Farmland, Unique Farmland, or Farmland of Statewide Importance pursuant to the Farmland Mapping and Monitoring Program. No agricultural land would be converted to non-agricultural uses as a result of the proposed project. Therefore, no impact would occur.				
b. Conflict with existing zoning for agricultural use, or a Williamson Act contract?	☐	☐	☐	☒
2b. Response: ***(Source: California Department of Conservation 2012; General Plan 2025)*** **No Impact.** The project site is not designated as Prime Farmland, Unique Farmland, or Farmland of Statewide Importance under the Farmland Mapping and Monitoring Program. Although the project site is located within the RA-5 Residential-Agricultural zone ("areas where general agricultural uses can occur independently or in conjunction with a single-family residence, that preserves the agricultural character of the area," (City of Riverside 2007) and is located adjacent to existing agricultural uses (citrus groves), the project site is located entirely within existing road right-of-way, and would not adversely affect any existing agricultural uses. Therefore, no impact would occur.				
c. Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)) timberland (as defined in Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g))?	☐	☐	☐	☒
2c. Response: ***(Source: Geographic Information Systems [GIS] Map–Forest Data)*** **No Impact.** The project is not located within forest land, timberland, or land that could be utilized for timber production. Therefore, no impact would occur.				

ISSUES (AND SUPPORTING INFORMATION SOURCES):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
d. Result in the loss of forest land or conversion of forest land to non-forest use?	☐	☐	☐	☒
2d. Response: ***(Source: GIS Map–Forest Data)*** **No Impact.** The project is not located within forest land and would not convert forest land to non-forest use. Therefore, no impact would occur.				
e. Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use or conversion of forest land to non-forest use?	☐	☐	☐	☒
2e. Response: ***(Source: General Plan 2025 and GIS Map – Forest Data)*** **No Impact.** As noted above in the response to 2a, the project would not result in the conversion of farmland to non-agricultural uses. Therefore, no impact would occur.				
3. AIR QUALITY.				
Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make the following determinations. Would the project:				
a. Conflict with or obstruct implementation of the applicable air quality plan?	☐	☐	☐	☒
3a. Response: ***(Source: South Coast Air Quality Management District's 2007 Air Quality Management Plan [AQMP])*** **No Impact.** The project is located in the South Coast Air Basin (Basin). The Basin includes Orange County and the non-desert portions of Los Angeles, Riverside, and San Bernardino counties. The Basin is designated as a National Ambient Air quality Standards (NAAQS) attainment or unclassifiable attainment area for 1-hour nitrogen dioxide (NO_2) and 1- and 24-hour sulfur dioxide. The Basin is a federal maintenance area for annual NO_2, 1- and 8-hour carbon monoxide (CO), and 24-hour particulate matter (PM) less than 10 microns (PM_{10}), and is a nonattainment area for 1- and 8-hour ozone standard, 24-hour and annual PM less than 2.5 microns ($PM_{2.5}$), and 3-month lead standards. The Basin is designated as a California Ambient Air Quality Standards (CAAQS) attainment or unclassifiable attainment area for 1-hour and annual NO_2, 1- and 8-hour CO, 1-hour hydrogen sulfide, 24-hour sulfates, and 24-hour vinyl chloride. The Basin is a State nonattainment area for 1- and 8-hour ozone, 24-hour and annual PM_{10}, and 24-hour and annual $PM_{2.5}$ standards. The regional air quality plan, the South Coast Air Quality Management District's (SCAQMD) 2016 Air Quality Management Plan (AQMP), outlines measures to reduce of ozone and $PM_{2.5}$. Whereas reducing PM concentrations is achieved by reducing emissions of $PM_{2.5}$ to the atmosphere, reducing ozone concentrations is achieved by reducing the precursors of photochemical formation of ozone, volatile organic chemicals and oxides of nitrogen (NO_X). A conflict with the AQMP typically occurs when development would result in greater operational emissions than what is accounted for in the AQMP. The project would result in air pollutant emissions associated with short-term construction activities. Once construction complete, project operation would not result in air pollutant emissions. The project would not affect the land use assumptions used in the development of the AQMP. The project would not conflict with or obstruct implementation of the applicable air quality plan, and no impact would occur.				

ISSUES (AND SUPPORTING INFORMATION SOURCES):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
b. Violate any air quality standard or contribute substantially to an existing or projected air quality violation?	☐	☐	☒	☐

3b. Response: ***(Source: SCAQMD CEQA Regional Significance Thresholds)***

Less Than Significant Impact. Project operation (i.e., completed storm drains) would not result in air pollutant emissions; therefore, no impact from project operation would occur.

Project construction activities would result in temporary increases in air pollutant and greenhouse gas (GHG) emissions, generated primarily from ground disturbance, construction equipment, and construction vehicle trips. Project air pollutant emissions were calculated using the Sacramento Metropolitan Air Quality Management District's (SMAQMD) Road Construction Emissions Model (2013).

The construction area would be approximately 15 feet wide, would involve trenching up to 20 feet in depth, and would progress linearly along the 11,200-foot project area. At any given time, construction activities may include up to 12 construction workers per day and 300 feet in length of active work area. Hauling would include export of 29,000 cubic yards of soil export (the volume the installed pipelines). Project construction is anticipated to last approximately 15 months. Construction activities are anticipated to involve use of common construction equipment such as signal boards, trenchers, excavators, skid steer loaders, water trucks, off-highway trucks, forklifts, cranes, welders, concrete saws, pavers, paving equipment, and rollers.

Table 1 summarizes the anticipated maximum daily air pollutant emissions associated with project construction. For detailed modeling data see Appendix A. The assessment evaluates project air quality emissions based significance thresholds from the SCAQMD CEQA Air Quality Handbook (SCAQMD 1993).

Table 1
Project Construction Emissions
(pounds/day)

Pollutant	Project Emissions	Significance Threshold	Exceeds Threshold?
Oxides of Nitrogen (NO_X)	85.1	100	***No***
Volatile Organic Compounds (VOC)	28.2	75	***No***
Particulate Matter less than 10 microns (PM_{10})	13.5	150	***No***
Particulate Matter less than 2.5 microns ($PM_{2.5}$)	8.8	55	***No***
Oxides of Sulfur (SO_X)	0.1	150	***No***
Carbon Monoxide (CO)	68.1	550	***No***
Lead (Pb)*	0	3	***No***

SOURCE: SCAQMD's CEQA Air Quality Handbook (SCAQMD 1993).
* Emission factors are not available for lead, and consequently, lead emissions are not calculated. The SCAQMD is currently in attainment of the national and state lead standards. Furthermore, fuel used in construction equipment and most other vehicles is not leaded.

As demonstrated, air quality emissions would be less than applicable thresholds. Therefore, the project would not violate any air quality standard or contribute substantially to an existing or projected air quality violation.

c. Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)?	☐	☐	☒	☐

3c. Response:

Less Than Significant Impact. As discussed under Issue 3(a), the Basin is designated as a NAAQS attainment or unclassifiable attainment area for 1-hour NO_2 and 1- and 24-hour sulfur dioxide. The Basin is a federal maintenance area for annual NO_2, 1- and 8-hour CO, and 24-hour PM_{10}, and is a nonattainment area for 1- and 8-hour ozone standard, 24-hour and annual $PM_{2.5}$, and 3-month lead standards.

ISSUES (AND SUPPORTING INFORMATION SOURCES):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact

The Basin is designated as a CAAQS attainment or unclassifiable attainment area for 1-hour and annual NO_2, 1- and 8-hour CO, 1-hour hydrogen sulfide, 24-hour sulfates, and 24-hour vinyl chloride. The Basin is a State nonattainment area for 1- and 8-hour ozone, 24-hour and annual PM_{10}, and 24-hour and annual $PM_{2.5}$ standards.

Project operation (i.e., completed storm drains) would not result in air pollutant emissions; therefore, no impact from project operation would occur. As shown in Table 1, emissions of ozone precursors (ROG and NO_X), PM_{10}, and $PM_{2.5}$ from construction would be below the applicable SCAQMD significance thresholds. These thresholds were developed based on the Clean Air Act *de minimis level*, which are designed to provide limits below which project emissions from an individual project would not significantly affect regional air quality or the timely attainment of the NAAQS and CAAQS. Therefore, the project would not result in a cumulatively considerable net increase in emissions of ozone, PM_{10}, or $PM_{2.5}$. Impacts would be reduced to a level that is less than significant.

d. Expose sensitive receptors to substantial pollutant concentrations?	☐	☐	☒	☐

3d. Response:

Less Than Significant Impact. The term "sensitive receptor" refers to a person in the population who is more susceptible to health effects due to exposure to an air contaminant than the population at large or to a land use that may reasonably be associated with such a person. Examples include residences, schools, childcare centers, retirement homes, long-term health care facilities, and outdoor recreation areas, such as athletic fields. The nearest sensitive receptors include the residences along Monroe Street and Dufferin Street. These residences are generally setback from the project site by at least 40 feet.

Construction of the project would result in the generation of diesel-exhaust PM emissions from the use of off-road diesel equipment required for site grading and excavation, paving, and other construction activities and on-road diesel equipment used to bring materials to and from the project site. Due to the short-term nature of construction and the distance between the project site and the nearest sensitive receptor, diesel-exhaust PM generated by project construction is not anticipated to result in conditions where the probability is greater than 10 in 1 million of contracting cancer for the Maximally Exposed Individual or to generate ground-level concentrations of noncarcinogenic air toxics exceeds a Hazard Index greater than 1 for the Maximally Exposed Individual. Therefore, impacts to sensitive receptors from project construction would be less than significant. Once construction is complete, project operation would not result in air pollutant emissions. No impacts from project operation would occur.

e. Create objectionable odors affecting a substantial number of people?	☐	☐	☒	☐

3e. Response:

Less Than Significant Impact. Operation of the project would not create the addition of any facilities known to produce objectionable odors, such as landfills, wastewater treatment plants, manufacturing plants, or agricultural activities. During construction, use of diesel-powered vehicles and equipment could create temporary, localized odors that are less than significant. Therefore, odor impacts would be less than significant.

4. BIOLOGICAL RESOURCES. Would the project:				
a. Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?	☐	☒	☐	☐

4a. Response: ***(Source: Appendix B)***

Less Than Significant with Mitigation Incorporated. As detailed in the biological resources report (Appendix B), a total of 48 plant species were observed within the survey area, although the majority are non-native, and no sensitive plant species were observed, and none are anticipated to be impacted by the project. Of the 22 wildlife species detected within the survey area, two were determined to be sensitive species: turkey vulture (*Cathartes aura*), and northern harrier (*Circus*

ISSUES (AND SUPPORTING INFORMATION SOURCES):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact

hudsonius). Both of these species were observed flying overhead during the survey and did not land or clearly forage within the survey area, and so neither is anticipated to be impacted by the project.

A total of 15 additional sensitive wildlife species have been reported within two miles of the survey area, and therefore have the potential to occur. Among these, Western burrowing owl (*Athene cunicularia hypugaea*), Swainson's hawk (*Buteo swainsoni*), San Diego black-tailed jackrabbit (*Lepus californicus bennettii*), Stephen's kangaroo rat (*Dipodomys stephensi*), and San Bernardino kangaroo rat (*Dipodomys merriami parvus*) all are known to use non-native grasslands or could occur in small patches of urban woodlands. However, because the project would not impact any non-native grassland or urban woodlands, no impact is anticipated to these sensitive wildlife species with the potential to occur.
Numerous trees that provide suitable nesting opportunities for raptors and migratory birds are present within and adjacent to the project footprint. The project includes removal of approximately 28 orange trees from within a temporary construction easement that has been granted to the City within a private citrus orchard on the north side of Dufferin Avenue. If the removal or trimming of trees occurs during the migratory bird breeding season (March 1 to June 30), nesting raptors or migratory birds could be impacted. While the Migratory Bird Treaty Act (MBTA) is no longer interpreted to address incidental take of migratory birds, destruction of active nests would still be prohibited under California Fish and Game Code (CFGC) Section 3503. Direct impacts to nesting and migratory birds would be considered significant, and would require mitigation. With implementation of mitigation measure **MM-Bio-1** described below, potential impacts to raptors and migratory birds would be reduced to a level less than significant.

MM-Bio-1: To remain in compliance with CFGC Section 3503 and the construction guidelines outlined in the Western Riverside Multiple Species Habitat Conservation Plan (MSHCP) Section 7.5.3, no direct impacts shall occur to any nesting birds, their eggs, chicks, or nests during the bird breeding season (March 1 to June 30). Vegetation trimming and clearing should avoid the bird breeding season to the greatest extent feasible. If vegetation trimming or clearing must occur during the breeding season, a preconstruction clearance survey by a qualified biologist would be required. If nesting birds are detected, measures would be required to verify compliance with CFGC Section 3503 such that take of birds or eggs or disturbance of breeding activities is avoided. Potential measures may include establishing an appropriate buffer area around the nesting site (500 feet for raptors, 300 feet for other bird species) until young have fledged or the nest is inactive. If no nesting birds are detected during the pre-construction survey, no additional measures would be required.

b. Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?	☐	☐	☐	☒

4b. Response: ***(Source: Appendix B)***

No Impact. As detailed in the biological resources report (see Appendix B), the only sensitive natural communities located within the project survey area are oak woodland, non-native grassland, and open water/reservoir/pond vegetation communities. The proposed project would impact a total of 19.50 acres, but was designed to avoid any impacts to these sensitive vegetation communities, partially through the use of a jack-and-bore operation for pipe installation underneath the Gage Canal. The only land cover types that would be impacted would be orchard/grove, and urban/developed land. Therefore, there would be no impacts to any riparian habitat, or other sensitive natural community, including oak woodland, non-native grassland, or open water/reservoir/pond vegetation communities. No impact would occur.

c. Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?	☐	☐	☐	☒

4c. Response: ***(Source: Appendix B)***

No Impact. As detailed in the biological resources report (see Appendix B), two waterways were observed within the project survey area with the potential to qualify as a federally protected wetland: the Gage Canal, and an irrigation ditch along Dufferin Avenue.

ISSUES (AND SUPPORTING INFORMATION SOURCES):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact

The Gage Canal, a concrete irrigation canal, occurs in the southeastern portion of the survey area and crosses under a bridge at Gratton Street. Culvert structures adjacent to the bridge convey irrigation water and runoff across and above the canal, but do not drain into the canal itself. Flow within the Gage Canal is regulated by a series of locks to fulfill the irrigation demands of the surrounding agricultural land-uses. The canal terminates near California Citrus State Historic Park, where water is pumped into the municipal water system. While it has connectivity with the Santa Ana River, it does not serve as a tributary to any traditional navigable waterway, and is therefore not considered to be a federally protected wetland, or non-wetland water of the U.S.

At the time of the survey, water was also flowing from east to west in an irrigation ditch along the southern side of Dufferin Avenue from Adams Street to Gratton Street. At this intersection, the flowing water then crossed through a culvert under Dufferin Avenue and continued north along the eastern side of Gratton Street until the water emptied into an engineered retention basin and culvert between Victoria Avenue and Lincoln Avenue. There were several locations along Gratton Street where the ditch ended and water was diverted onto the road. Other ditches and portions of Gratton Street appear to convey irrigation water occasionally, including within a concrete channel above the Gage Canal as described above, but were dry at the time of the survey. As defined under the Army Corps of Engineers (ACOE) Regulatory Guidance Letter 07-02, an irrigation ditch is man-made, conveys water to an ultimate irrigation use or place of use, and does not fall under the jurisdiction of ACOE. As the irrigation ditch and associated culvert and retention basin facilities within the survey area meet this definition, they are not anticipated to be under the jurisdiction of ACOE, and are therefore not considered to be a federally protected wetland, or non-wetland water of the U.S.

No areas within the project survey area satisfied the criteria for ACOE wetlands or non-wetland waters of the U.S. Furthermore, no California Department of Fish and Wildlife wetlands or non-wetland Waters of the State, Regional Water Quality Control Board (RWQCB) Waters of the State, or MSHCP riparian/riverine areas were delineated within the survey area. Therefore, the project would not result in impacts to any jurisdictional wetlands or waters, or riparian/riverine areas. No impact would occur.

d. Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?	☐	☒	☐	☐

4d. Response: ***(Source: Appendix B)***

Less Than Significant with Mitigation Incorporated. See response to question 4a above. If removal or trimming of trees occurs during the migratory bird breeding season (March 1 to June 30), nesting raptors or migratory birds could be impacted. Direct impacts to nesting and migratory birds would be considered significant, and would require mitigation. With implementation of mitigation measure **MM-Bio-1** described above, potential impacts to raptors and migratory birds would be reduced to a level less than significant.

e. Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	☐	☐	☐	☒

4e. Response: ***(Source: Appendix B)***

No Impact. As discussed in the biological resources report (see Appendix B), the project was evaluated for consistency with the MSHCP and found to be compliant with respect to its policies for the protection of biological resources. More specifically, the project was evaluated in respect to Section 6.1.2 (Protection of Species Associated with Riparian/Riverine Areas and Vernal Pools), Section 6.1.3 (Protection of Narrow Endemic Plant Species), Section 6.1.4 (Guidelines Pertaining to the Urban/Wildlands Interface), Section 6.3.2 (Additional Survey Needs and Procedures), and Section 6.7 (Reserve Assembly) of the MSHCP. Additionally, a burrowing owl habitat assessment was conducted pursuant to the *Burrowing Owl Survey Instructions for the Western Riverside Multiple Species Habitat Conservation Plan Area,* and no western burrowing owls, suitable burrows, or owl sign were detected during the habitat assessment. Therefore, the project has been found to not conflict with any local policies or ordinances protecting biological resources, and there would be no impact.

ISSUES (AND SUPPORTING INFORMATION SOURCES):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
f. Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?	☐	☐	☐	☒

4f. Response: ***(Source: Appendix B)***

No Impact. See response to 4e. The project was evaluated for consistency with the MSHCP and found to be compliant with respect to its policies for the protection of biological resources. Therefore, there would be no impact.

5. CULTURAL RESOURCES. Would the project:				
a. Cause a substantial adverse change in the significance of a historical resource as defined in § 15064.5?	☐	☐	☒	☐

5a. Response: ***(Source: Appendix C)***

Less Than Significant Impact. As described in the Cultural Resources Report (Appendix C), CEQA Guidelines state that the term "historical resources" applies to any such resources listed in or determined to be eligible for listing in the California Register of Historical Resources, included in a local register of historical resources, or determined to be historically significant by the Lead Agency. Two significant historical resources, Victoria Avenue and the Gage Canal, are located within the project's impact area. Impacts to the existing gutter and curb at the intersection of Victoria Avenue and Gratton Street are not considered significant because the impacts will not materially alter in an adverse manner the physical characteristics of Victoria Avenue that qualify it as a historical resource. The project also proposes to jack and bore under the Gage Canal, which will result in no adverse effects to that resource. Because the project will not result in a substantial adverse change to the significance of these historical resources, the impact would be considered less than significant, and no mitigation is required.

b. Cause a substantial adverse change in the significance of an archeological resource pursuant to § 15064.5?	☐	☒	☐	☐

5b. Response: ***(Source: Appendix C)***

Less Than Significant with Mitigation Incorporated. As described in the Cultural Resources Report (see Appendix C)**,** no significant prehistoric cultural resources were found during the survey of the project site. Additionally, the records search revealed no known prehistoric cultural resources mapped on or immediately adjacent to the project site. However, the project site is located in an area of alluvial deposition, and therefore the possibility exists for buried prehistoric archaeological deposits to be located beneath the ground surface at the project site. Therefore, Native American representatives have recommended that tribal monitors be present during all ground-disturbing activities as potential cultural resources could possibly be unearthed during construction. To ensure that potential impacts to archaeological resources are avoided or reduced to a less than significant level, implementation of mitigation measures **MM-Cul-1** through **MM-Cul-3** will reduce potential impacts to archaeological resources to a less than significant level:

MM-Cul-1: Archaeological Monitoring: At least 30 days prior to application for a grading permit and before any grading, excavation and/or ground disturbing activities on the site take place, the City shall retain a Secretary of Interior Standards qualified archaeological monitor to monitor all ground-disturbing activities in an effort to identify any unknown archaeological resources.

1. The Project Archaeologist, in consultation with interested tribes and the City, shall develop an Archaeological Monitoring Plan to address the details, timing, and responsibility of all archaeological and cultural activities that will occur on the project site. Details in the Plan shall include project grading and development scheduling.

2. At the completion of grading, excavation and ground disturbing activities on the site a Phase IV Monitoring Report shall be created documenting monitoring activities conducted by the project Archaeologist and Native Tribal Monitors within 60 days of completion of grading. This report shall document the impacts to the known resources on the project; describe how each mitigation measure was fulfilled; document the type of cultural resources recovered

ISSUES (AND SUPPORTING INFORMATION SOURCES):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact

and the disposition of such resources; provide evidence of the required cultural sensitivity training for the construction staff held during the required pre-grade meeting; and, in a confidential appendix, include the daily/weekly monitoring notes from the archaeologist. All reports produced will be submitted to the City, Eastern Information Center and interested tribes.

MM-Cul-2: Treatment and Disposition of Cultural Resources: In the event that Native American cultural resources are inadvertently discovered during the course of grading for this Project. The following procedures will be carried out for treatment and disposition of the discoveries:

1. Temporary Curation and Storage: During the course of construction, all discovered resources shall be temporarily curated in a secure location onsite or at the offices of the project archaeologist. The removal of any artifacts from the project site will need to be thoroughly inventoried with tribal monitor oversite of the process; and

2. Treatment and Final Disposition: The City shall relinquish ownership of all cultural resources, including sacred items, burial goods, and all archaeological artifacts and non-human remains as part of the required mitigation for impacts to cultural resources. The City shall relinquish the artifacts and curate them at the Western Science Center or Riverside Metropolitan Museum

3. Discovery of Human Remains: In the event that human remains (or remains that may be human) are discovered at the project site during grading or earthmoving, the construction contractors, and/or project archaeologist shall immediately stop all activities within 100 feet of the find and comply with California Health and Safety Code Section 7050.5(b).

MM-Cul-3: Cultural Sensitivity Training: The Riverside County-certified Archaeologist and Native American Monitors shall attend the pre-grading meeting with the developer/permit holder's contractors to provide Cultural Sensitivity Training for all construction personnel. This shall include the procedures to be followed during ground disturbance in sensitive areas and protocols that apply in the event that unanticipated resources are discovered. Only construction personnel who have received this training can conduct construction and disturbance activities in sensitive areas. A sign-in sheet for attendees of this training shall be included in the Phase IV Monitoring Report.

c. Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?	☐	☒	☐	☐

5c. Response: ***(Source: General Plan 2025 Policy HP-1.3)***

Less Than Significant with Mitigation Incorporated. The only locations within the city of Riverside that are considered paleontologically sensitive are the areas south of Mockingbird Canyon Reservoir and Campbell's Sand Pit, just east of Riverside County's Anza Narrows Regional Park. Due to the highly disturbed nature of the project site from previous construction activities, impacts to paleontological resources are not anticipated. However, to ensure that potential impacts to paleontological resources are avoided or reduced to a less than significant level**,** implementation of mitigation measure **MM-Cul-4** would reduce any potential impacts to paleontological resources to a less than significant level:

MM-Cul-4: Should any paleontological resources be uncovered during construction, construction activities in the vicinity of the discovery shall be moved and a qualified paleontological resources specialist will be retained to evaluate the resources. If the find is determined to be significant, avoidance or other appropriate measures as identified by the paleontologist shall be implemented. Appropriate measures would include that a qualified paleontologist be permitted to recover, evaluate; and curate the find(s) in accordance with current standards and guidelines.

d. Disturb any human remains, including those interred outside of formal cemeteries?	☐	☐	☒	☐

5d. Response: ***(Source: General Plan 2025 FPEIR Figure 5.5-1–Archaeological Sensitivity and Figure 5.5-2–Prehistoric Cultural Resources Sensitivity)***

Less Than Significant Impact. According to GP FPEIR Figure 5.5-1, the Line E-2 segment of the project along Hermosa Drive is located in an area of high archaeological sensitivity, and the remainder of the project site is located in an area of

ISSUES (AND SUPPORTING INFORMATION SOURCES):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
unknown archaeological sensitivity. According to GP FPEIR Figure 5.5-2, the project site is located within areas of low-to-high pre-historic cultural resources sensitivity, and is not located within the vicinity of any cemeteries. The proposed Project is not expected to disturb any human remains, including those interred outside of formal cemeteries. The proposed Project is in an already disturbed area. In the unlikely event that construction activities uncover human remains (or remains that may be human), the construction contractors shall immediately stop all activities in the immediate area of the find, in accordance with H&SC Section 7050.5. With adherence to these procedures, potential impacts with regard to the disturbance of human remains would be less than significant.				
6. GEOLOGY AND SOILS. Would the project:				
a. Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:				
i. Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.	☐	☐	☒	☐
6a.i. Response: ***(Source: General Plan 2025)***				
Less Than Significant Impact. The project would not expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault. No known faults traverse the city of Riverside. In addition, no Alquist-Priolo Earthquake Fault Zones are located within the city of Riverside or within its sphere of influence. The nearest faults include the San Andreas fault located approximately eleven miles from downtown Riverside, the San Jacinto fault located approximately seven miles from downtown Riverside, and the Elsinore fault located approximately 13 miles from downtown Riverside. The project consists of improvements to an existing storm drain system located underground and therefore would not create a potential hazard to people or structures during the rupture of an earthquake fault. Impacts would be less than significant.				
ii. Strong seismic ground shaking?	☐	☐	☒	☐
6a.ii. Response: ***(Source: General Plan 2025)***				
Less Than Significant Impact. As discussed above, although they are not located within several miles of the project site, the San Andreas, San Jacinto, and Elsinore faults are major fault locations in the region. These fault zone systems are capable of producing large earthquakes with a maximum credible earthquake ranging from a 7.0 magnitude at the San Jacinto fault to an 8.3 magnitude at the San Andreas fault. Because Southern California is a seismically active region, it is likely that regional earthquakes would occur that could affect the project site. However, the potential for construction personnel to experience strong seismic ground shaking is low due to the project's short construction timeframe. In addition, impacts due to strong seismic ground shaking after construction is minimal. Therefore, the risk of strong seismic ground shaking to people or structures would be less than significant.				
iii. Seismic-related ground failure, including liquefaction?	☐	☐	☒	☐
6a.iii. Response: ***(Source: General Plan 2025 Figure PS-2–Liquefaction Zones, and GeoMat Geotechnical Report, September 2017)***				
Less Than Significant Impact. Liquefaction is the loss of soil strength in saturated soils induced by a seismic event. The General Plan Figure PS-2 (Liquefaction Zones) identifies the project area as an area designated as having low to moderate liquefaction potential north of the Gage Canal, and high liquefaction potential south of the Gage Canal. The factors that influence the potential for liquefaction involve soil type and density, elevation of the groundwater table, and intensity and duration of ground shaking. The project consists of improvements to an existing storm drain system located underground and not does include any permanent structures or other components that would create a potential for seismic-related ground failure. The Geotechnical Report (Appendix D) suggests flexible joints should be considered in the pipe design in				

ISSUES (AND SUPPORTING INFORMATION SOURCES):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
areas subject to liquefaction. Therefore, with incorporation of this project design feature, impacts would be less than significant.				
iv. Landslides?	☐	☐	☐	☒
6a.iv. Response: ***(Source: General Plan 2025 FPEIR Figure 5.6-1 – Areas Underlain by Steep Slope, and GeoMat Geotechnical Report, September 2017)*** **No Impact.** The project site and surrounding area are flat and not prone to slope instability hazards, such as landslides. The proposed project involves no modifications or grading that would result in landslide or slope instability. In addition, there are no slopes in the immediate vicinity where landslides or mudflows could occur. The project will not be impacted by a landslide or impact adjacent properties due to a project generated landslide. Therefore, there would be no impact.				
b. Result in substantial soil erosion or the loss of topsoil?	☐	☐	☒	☐
6b. Response: ***(Source: General Plan 2025 FPEIR Figure 5.6-1–Areas Underlain by Steep Slope, Figure 5.6-4–Soils, Table 5.6-B–Soil Types, Title 18–Subdivision Code, Title 17–Grading Code, and Appendix D)*** **Less Than Significant Impact.** The project site is located within existing road right-of-way on relatively flat terrain. Short-term impacts could occur during trenching and other construction work, when topsoil may be excavated to allow for installation of the new storm drain pipe. However, with preparation and implementation of a Storm Water Pollution Prevention Plan (SWPPP) prior to site preparation, excavation, and construction, the contractor would implement best management practices (BMPs) to control erosion and maintain downstream surface water quality during and after construction. Therefore, the project would result in a less than significant impact associated with soil erosion or topsoil loss.				
c. Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?	☐	☐	☒	☐
6c. Response: ***(Source: General Plan 2025 Figure PS-1 – Regional Fault Zones, Figure PS-2 – Liquefaction Zones, General Plan 2025 FPEIR Figure PS-3 – Soils with High Shrink-Swell Potential, Figure 5.6-1 - Areas Underlain by Steep Slope, Figure 5.6-4 – Soils, Table 5.6-B – Soil Types, and Appendix D)*** **Less Than Significant Impact.** See discussions above under Sections 6a.iii and 6a.iv regarding liquefaction and landslide hazards. As previously discussed, the existing terrain would not be subject to landslide, lateral spreading, subsidence, liquefaction, or collapse. Therefore, impacts related to unstable soil or geologic units would be less than significant.				
d. Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?	☐	☐	☒	☐
6d. Response: ***(Source: General Plan 2025 Figure PS-3 – Soils with High Shrink-Swell Potential, and Appendix D)*** **Less Than Significant Impact.** The project involves the construction of an underground storm drain system and is therefore not susceptible to adverse impacts due to expansive soil. Furthermore, no expansive soils have been identified within the project area, as shown in Figure PS-3 (Soils with High Shrink-Swell Potential) of GP 2025. Therefore, impacts would be less than significant.				
e. Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?	☐	☐	☐	☒
6e. Response: ***(Source: Project Description)*** **No Impact.** The project would not entail the use of septic tanks or alternative disposal systems, as no septic tanks or alternative wastewater disposal systems are proposed as part of the project. Therefore, no impact would occur.				

ISSUES (AND SUPPORTING INFORMATION SOURCES):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
7. GREENHOUSE GAS EMISSIONS. Would the project:				
a. Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?	☐	☐	☒	☐

7a. Response: ***(Source: City of Riverside Economic Property and Climate Action Plan; SCAQMD Interim CEQA GHG Significance Thresholds)***

Less Than Significant Impact. The City has not adopted its own thresholds of significance for CEQA analysis of GHG emissions. As such, this analysis follows guidance the SCAQMD's *Interim CEQA GHG Significance Thresholds* (SCAQMD 2008b). As identified in the SCAQMD Working Group meeting (Meeting Number 15), the appropriate project-level GHG emissions thresholds are:

- Tier 3 – Project GHG emissions represent an incremental increase below, or mitigated to less than Significance Screening Levels, where
  - 3,000 metric tons (MT) of carbon dioxide equivalent (CO_2E) per year is the Residential/Commercial Screening Level
  - 10,000 MT CO_2E per year is the Permitted Industrial Screening Level

Project operation (i.e., completed storm drains) would not result in GHG emissions; therefore, no impact from project operation would occur. As discussed under Issue 3(c), project air pollutant and GHG emissions were calculated using the Sacramento Metropolitan Air Quality Management District's Road Construction Emissions Model. Project construction would be anticipated to result in 963 MT CO_2E. Consistent with SCAQMD guidance, construction-related GHG emissions are amortized over 30 years (SCAQMD 2009) to estimate that annual equivalent emissions over the lifecycle of the project. The project would result in the annual equivalent of 32 MT CO_2E. As project emissions would be well below the applicable Tier 3 interim annual emissions threshold of 3,000 MT CO_2E, the project's GHG emissions, the project would result in a less than significant impact on the environment.

b. Conflict with any applicable plan, policy or regulation of an agency adopted for the purpose of reducing the emissions of greenhouse gases?	☐	☐	☒	☐

7b. Response:

Less Than Significant Impact. As previously discussed in Issue 7(a), the project's construction-related GHG emissions are below the SCAQMD recommended screening threshold and will not result in substantial amount of GHG emissions. Furthermore, project operation (i.e., completed storm drains) would not result in GHG emissions. As project emissions would be well below the applicable annual emissions threshold of 3,000 MT CO_2E, the project would have a less than significant impact on applicable plans, policies and regulations for reducing GHG emissions.

8. HAZARDS & HAZARDOUS MATERIALS. Would the project:				
a. Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	☐	☐	☐	☒

8a. Response: ***(Source: General Plan 2025 Public Safety Element, GP 2025 FPEIR, H&SC, Title 49 of the Code of Federal Regulations [CFR], California Building Code as adopted by the City of Riverside and set out in Title 16 of the Riverside Municipal Code, Riverside Fire Department Emergency Operations Plan [EOP], 2002 and Riverside Operational Area–Multi-Jurisdictional Local Hazard Mitigation Plan [LHMP], 2004 Part 1, Office of Emergency Management Strategic [OEM] Plan)***

No Impact. The proposed project consists of the construction and operation of storm drain improvements, which does not include the permanent use of hazardous materials. The proposed project would not involve the routine or continued transportation, use, or disposal of hazardous materials. Therefore, the proposed project would have no impact related to the routine transportation, use, or disposal of hazardous materials.

ISSUES (AND SUPPORTING INFORMATION SOURCES):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
b. Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?	☐	☐	☒	☐

8b. Response: ***(Source: General Plan 2025 Public Safety Element, GP 2025 FPEIR Tables 5.7 A – D, H&SC, Title 49 of the CFR, California Building Code as adopted by the City of Riverside and set out in Title 16 of the Riverside Municipal Code, City of Riverside EOP, 2002 and Riverside Operational Area–Multi-Jurisdictional LHMP, 2004 Part 1, OEM Strategic Plan)***

Less Than Significant Impact. During construction, small amounts of solvent and petroleum products such as waste oil and oil-saturated material may be on-site. Hazardous materials and waste would be managed and used in accordance with all applicable federal, state, and local laws and regulations, and would not be a significant hazard to the public or environment. Therefore, impacts associated with the potential short-term use of hazardous materials during construction are considered less than significant.

c. Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?	☐	☐	☐	☒

8c. Response: ***(Source: General Plan 2025 Public Safety and Education Elements, GP 2025 FPEIR Table 5.7-D–California Accidental Release Prevention Risk Management Facilities in the Project Area, Figure 5.13-2–Riverside Unified School District [RUSD] Boundaries, Table 5.13-D RUSD Schools, Figure 5.13-3 Alvord Unified School District [AUSD] Boundaries, Table 5.13-E AUSD Schools, Figure 5.13-4–Other School District Boundaries, H&SC, Title 49 of the CFR, California Building Code as adopted by the City of Riverside and set out in Title 16 of the Riverside Municipal Code)***

No Impact. The project area is not located within one-quarter mile of an existing or proposed school, and as stated in responses to 8a and 8b above, the proposed project would not involve the handling or use of hazardous materials, with the exception of small amounts of solvent and petroleum products from construction equipment. Therefore, no impact would occur.

d. Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?	☐	☐	☒	☐

8d. Response: ***(Source: General Plan 2025 Figure PS-5–Hazardous Waste Sites, GP 2025 FPEIR Tables 5.7-A–Comprehensive Environmental Compensation and Liability Information System Facility Information, Figure 5.7-B–Regulated Facilities in Toxic Release Inventory Information and 5.7-C–Department of Toxic Substances Control [DTSC] EnviroStor Database Listed Sites and Supplemental Guidelines Assembly Bill [AB] 2588 Air Toxics "Hot Spots")***

Less Than Significant Impact. The Hazardous Waste and Substances Sites (Cortese) List is a planning document that provides information about the location of hazardous materials release sites in the state. Government Code section 65962.5 requires the California Environmental Protection Agency to develop at least annually an updated Cortese List. The DTSC is responsible for a portion of the information contained in the Cortese List. Other state and local government agencies are required to provide additional information for the Cortese List. There are several databases that provide information regarding the facilities or sites identified as meeting the Cortese List requirements. A search of these databases was conducted for the project site and the surrounding area, including the following:

- DTSC EnviroStor database (DTSC 2018a)
- List of hazardous waste facilities subject to corrective action pursuant to Section 25187.5 of the H&SC, identified by DTSC (DTSC 2018b)
- State Water Resources Control Board (SWRCB) GeoTracker database (SWRCB 2018a)
- List of solid waste disposal sites identified by Water Board with waste constituents above hazardous waste levels

ISSUES (AND SUPPORTING INFORMATION SOURCES):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
outside the waste management unit (SWRCB 2018b) • List of "active" Desist Orders and Cleanup and Abatement Orders (SWRCB 2018c) Of the databases searched, no reports of hazardous materials contamination were recorded within one-quarter mile of the project area. The GeoTracker database search revealed one Leaking Underground Storage Tank cleanup site located approximately one-quarter mile west of the project site at 2201 Monroe Avenue (Horn Ranch), but the cleanup status was listed as "completed/case closed." No solid waste disposal sites or facilities subject to "active" corrective orders were found within one-quarter mile of the project site. Following construction, the entire project would be located underground and would not result in the exposure of people or the environment to a significant hazard. Therefore, this impact would be less than significant.				
e. For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area?	☐	☐	☐	☒
8e. Response: ***(Source: General Plan 2025 Figure PS-6–Airport Safety Zones and Influence Areas, Riverside County Airport Land Use Compatibility Plan [RCALUCP] and March Air Reserve Base/March Inland Port Comprehensive Land Use Plan (1999), Air Installation Compatible Use Zone Study for March Air Reserve Base (August 2005)*** **No Impact.** The project site is not within an airport land use plan area, or within two miles or a public or private use airport or private airstrip. No impact would occur.				
f. For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area?	☐	☐	☐	☒
8f. Response: ***(Source: General Plan 2025 Figure PS-6 – Airport Safety Zones and Influence Areas, RCALUCP, March Air Reserve Base/March Inland Port Comprehensive Land Use Plan (1999 and Air Installation Compatible Use Zone Study for March Air Reserve Base (August 2005)*** **No Impact.** The project is not located in the vicinity of a private airstrip; therefore, no impact would occur.				
g. Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?	☐	☐	☒	☐
8g. Response: ***(Source: GP 2025 FPEIR Chapter 7.5.7–Hazards and Hazardous Materials, City of Riverside's EOP, 2002 and Riverside Operational Are –Multi-Jurisdictional LHMP, 2004 Part 1, and OEM's Strategic Plan)*** **Less Than Significant Impact.** The GP 2025 Public Safety Element identifies roadways designated as evacuation routes that may be used in an emergency (City of Riverside 2007). Although Gratton Street, Hermosa Drive, and Dufferin Avenue are not identified as evacuation routes, project construction work would occur within street right-of-way and could potentially affect emergency response times in the event of an emergency during construction. However, prior to any roadway lane closures, the Department of Public Works (or its contractor) would notify emergency response agencies of the construction so that alternate routes can be used if needed. Because it is standard practice for the Department of Public Works to notify public safety agencies prior to construction and provide short-term traffic control where needed during construction, and because no arterial roadways or designated evacuation routes would be affected by the proposed project, interference with emergency response plans and emergency evacuation plans would be less than significant.				

ISSUES (AND SUPPORTING INFORMATION SOURCES):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
h. Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?	☐	☐	☐	☒

8h. Response: ***(Source: General Plan 2025 Figure PS-7 – Fire Hazard Areas)***

No Impact. The GP 2025 Public Safety Element does not designate the project site as a fire safety hazard. No impacts to wildlands or wildland fires are expected, and no impact would occur.

9. HYDROLOGY AND WATER QUALITY. Would the project:				
a. Violate any water quality standards or waste discharge requirements?	☐	☐	☒	☐

9a. Response: ***(Source: GP 2025 FPEIR)***

Less Than Significant Impact. The proposed project has the potential to result in short-term impacts to water quality during the construction activities, which include the construction of an underground storm drain pipe. Construction work is planned during dry conditions in the channel. If diversion is necessary, construction BMPs for water diversion and/or dewatering operations will be implemented. During the construction phase, it is possible that some discharge of sediments and pollutants into surface waters might occur from the use of construction equipment and as a result of excavation and construction activities. Pollutants of concern during construction include sediments, trash, oil and grease, and fuels from equipment. Construction would occur under the National Pollutant Discharge Elimination System Construction General Permit for storm water discharges from construction sites, issued by the SWRCB. The General Permit would require the implementation of a SWPPP including BMPs for water quality protection during construction. The City and its contractor would be responsible for complying with the General Permit until construction is completed, surfaces are stabilized, and a Notice of Termination is filed and accepted by the RWQCB. Compliance with the SWPPP required by the General Permit would ensure that water quality standards are not violated by the proposed project. Therefore, the project would not violate any water quality standards or waste discharge requirements, and impacts would be less than significant.

b. Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?	☐	☐	☒	☐

9b. Response: ***(Source: Project Description)***

Less Than Significant Impact. The proposed project would not require the use of groundwater during project construction or operation. Excavation of trenches for the installation of pipeline may have the potential to encounter shallow groundwater within the project area, particularly near the Gage Canal. Dewatering to remove groundwater from the trench may be necessary, and discharge may be required to allow installation of the pipeline. Under state law, direct discharges to surface waters are not allowed without a General Dewatering Permit. Should the contractor desire to directly discharge to nearby surface waters, including Gage Canal, then this permit would be required. Due to the temporary nature of the proposed project, potential dewatering associated with the proposed project would not deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level. Impacts would be less than significant.

ISSUES (AND SUPPORTING INFORMATION SOURCES):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
c. Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?	☐	☐	☒	☐

9c. Response: ***(Source: Project Description)***

Less Than Significant Impact. The proposed project will not increase the area of impermeable surfaces or surface runoff. The project will remove an existing concrete-lined storm drain channel and replace it with an underground concrete pipe and drainage features. The project would comply with the State General Permit for storm water discharges from construction sites, including implementation of a SWPPP and BMPs for water quality protection. The contractor would be responsible for compliance with the General Permit until construction disturbances are stabilized and a Notice of Termination accepted by the RWQCB. Considering these factors, the proposed changes to drainage patterns would be less than significant.

d. Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?	☐	☐	☒	☐

9d. Response: ***(Source: Project Description)***

Less Than Significant Impact. The potential for flooding of the drainages themselves and the amount of surface runoff would be lessened upon completion of the proposed project since the capacity of the facility will be increased after construction is completed. Therefore, impacts related to flooding on- or off-site would be less than significant as a result of the proposed project.

e. Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?	☐	☐	☒	☐

9e. Response: ***(Source: Project Description)***

Less Than Significant Impact. The implementation of the proposed project would not change the amount of runoff water that reaches the project site. The proposed activities are intended to improve and maintain the existing stormwater drainage systems. No significant adverse impacts related to additional sources or substantial amounts of runoff would occur as a result of the proposed project.

f. Otherwise substantially degrade water quality?	☐	☐	☒	☐

9f. Response: ***(Source: GP 2025 FPEIR)***

Less Than Significant Impact. As stated in response to 9a above, compliance with the SWPPP required by the General Permit would ensure that water quality standards are not violated by the proposed project. Water quality would not be otherwise substantially degraded by the proposed project, and impacts would be less than significant.

g. Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?	☐	☐	☐	☒

9g. Response: ***(Source: General Plan 2025 Figure PS-4–Flood Hazard Areas, and Federal Emergency Management Agency [FEMA] Flood Hazard Map, Zone X Panel 0720G)***

No Impact. As shown on FEMA's Flood Insurance Rate Map, the project site is not located in a 100-year flood zone. The proposed project involves improvements to a storm drain system and does not include construction of housing. Therefore, no impacts related to placing housing within a 100-year flood hazard area would occur as a result of the proposed project.

ISSUES (AND SUPPORTING INFORMATION SOURCES):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
h. Place within a 100-year flood hazard area structures which would impede or redirect flood flows?	☐	☐	☐	☒
9h. Response: ***(Source: General Plan 2025 Figure PS-4–Flood Hazard Areas, and FEMA Flood Hazard Map, Zone X Panel 0720G)*** **No Impact.** As shown on FEMA's Flood Insurance Rate Map, the project site is not located in a 100-year flood zone. The proposed project involves improvements to an existing storm drain system and would not result in the placement of structures that would impede or redirect flood flows. No impacts would occur.				
i. Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam?	☐	☐	☒	☐
9i. Response: ***(Source: General Plan 2025 Figure PS-4–Flood Hazard Areas, and FEMA Flood Hazard Map, Zone X Panel 0720G)*** **Less Than Significant Impact**. The proposed project site is not located within a potential dam inundation area. The project involves improvements to an existing storm drain facility, and would not expose people or structures to a significant risk of loss, injury, or death as a result of flooding, including as a result of the failure of a dam. No impact would occur.				
j. Inundation by seiche, tsunami, or mudflow?	☐	☐	☐	☒
9j. Response: ***(Source: GP 2025 FPEIR Chapter 7.5.8 – Hydrology and Water Quality)*** **No Impact.** The project site is located in an inland area, beyond the limits of a foreseeable tsunami. The proposed project is not located adjacent to an enclosed body of water such as a bay or a lake, and therefore, is not at risk by seiche. In addition, there are no slopes in the immediate vicinity where mudflows could occur. Therefore, there would be no impact.				
10. LAND USE AND PLANNING: Would the project:				
a. Physically divide an established community?	☐	☐	☐	☒
10a. Response: ***(Source: Project Description)*** **No Impact.** The proposed project involves improvements to an existing storm drain system and would not physically divide an established community. No impact would occur.				
b. Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?	☐	☐	☒	☐
10b. Response: ***(Source: General Plan 2025, General Plan 2025 Figure LU-10–Land Use Policy Map)*** **Less than Significant Impact.** The GP 2025 land use designation for the lands adjacent to the road right-of-way in which the project site is located is predominantly Agricultural/Rural Residential (A/RR), with the exception of the northern half of the segment of Gratton Street between Lincoln Avenue and Victoria Avenue, which is designated as Low Density Residential (LDR). The proposed project would not conflict with any goals, objectives, or policies detailed in the GP 2025. As discussed in detail in the Biological Resources section of this Initial Study (Section 4), the project would comply with the Western Riverside County MSHCP, and therefore would not conflict with that planning document. Because the proposed project would not conflict with any applicable land use plan, policy or regulation of an agency with jurisdiction over the project, there would be no impact.				

ISSUES (AND SUPPORTING INFORMATION SOURCES):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
c. Conflict with any applicable habitat conservation plan or natural community conservation plan?	☐	☐	☐	☒

10c. Response: ***(Source: MSHCP, General Plan 2025–Figure OS-6 – Stephen's Kangaroo Rat Core Reserve and Other Habitat Conservation Plans, Stephens' Kangaroo Rat Habitat Conservation Plan, Lake Mathews Multiple Species Habitat Conservation Plan and Natural Community Conservation Plan, and El Sobrante Landfill Habitat Conservation Plan)***

No Impact. See response to question **4e** above. The project was evaluated for consistency with the MSHCP and found to be compliant with respect to its policies for the protection of biological resources. Therefore, there would be no impact.

11. MINERAL RESOURCES. Would the project:				
a. Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?	☐	☐	☐	☒

11a. Response: ***(Source: General Plan 2025 Figure–OS-1–Mineral Resources)***

No Impact. As depicted in Figure OS-1 (Mineral Resources) of the GP 2025, the proposed project site has not been identified by the State of California or the City as containing a potential valuable mineral resource. Therefore, no mineral resources would be lost as a result of the project and no impact would occur.

b. Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?	☐	☐	☐	☒

11b. Response: ***(Source: General Plan 2025 Figure–OS-1–Mineral Resources)***

No Impact. As described above, no mineral resources have been identified within the project site. Therefore, implementation of the proposed project would not result in any impact on locally important mineral resources recovery sites.

12. NOISE. Would the project result in:				
a. Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?	☐	☐	☐	☒

12a. Response: ***(Source: Riverside Municipal Code, Title 7)***

No Impact.

<u>Short-term (Construction)</u>
City Municipal Code Title 7 Noise Control (Noise Ordinance) establishes the City's noise regulations. Pursuant to Section 7.35.010(B)(5) generally prohibited between the hours of 7:00 p.m. and 7:00 a.m. on weekdays, between the hours of 5:00 p.m. and 8:00 a.m. on Saturdays, and at any time on Sundays or federal holidays. Section 7.35.020(e) exempts construction within the public right-of-way is exempt from noise standards if such work will create traffic congestion or hazardous conditions. As the project would occur within the public right-of-way of a roadway, it would be exempt from noise standards. No impacts related to the exceedance of an applicable standard would occur.

<u>Long-term Operation</u>
Project operation (i.e., completed storm drains) would not result in generation of noise. No impacts related to the exceedance of an applicable standard would occur.

ISSUES (AND SUPPORTING INFORMATION SOURCES):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
b. Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?	☐	☐	☒	☐

12b. Response: ***(Source: Caltrans Technical Advisory: Transportation Related Earthborne Vibrations 2002)***

Less Than Significant Impact. Project operation (i.e., completed storm drains) would not result in generation of groundborne vibration. Project construction would result in temporary expose people to groundborne vibrations. Construction noise and vibration would be and associated only with common heavy-duty construction equipment such as trenchers, excavators, loaders, cranes, etc. Construction vibration potential for building damage is assessed in terms of peak particle velocity (PPV) typically in units of inches per second. Typically, the vibration threshold level for human annoyance and structural damage is 0.1 inch per second PPV and 0.2 PPV (Caltrans 2002). Groundborne vibration from typical construction activities is not typically noticeable in buildings that are farther than 25 feet from the source. No existing building would be located closer than 25 feet from construction activity, as adjacent structures are set back from property lines at least this distance, providing adequate separation. Furthermore, the project would not include nighttime construction. Thus, impacts related to groundborne vibration or noise would be less than significant.

c. A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?	☐	☐	☐	☒

12c. Response: ***(Source: Project Description)***

No Impact. Project operation (i.e., completed storm drains) would not result in generation of noise. Therefore, the project would not result in a substantial permanent increase in ambient noise levels in the project vicinity.

d. A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?	☐	☐	☒	☐

12d. Response: ***(Source: Federal Highway Administration Roadway Construction Noise Model User's Guide 2006.)***

Less Than Significant Impact. Project construction would result in temporary noise level increases. Construction noise and vibration would be and associated only with common heavy-duty construction equipment such as trenchers, excavators, loaders, cranes, etc. Construction equipment with a diesel engine typically generates maximum noise levels from 80 to 90 A-weighted decibels dB(A) at a distance of 50 feet (Federal Highway Administration 2006). Equipment goes through varying load cycles, and there are breaks for the operators and for non-equipment tasks, such as measurement. Thus, average hourly noise levels would be less than maximum noise levels. Typical equivalent hourly noise levels (L_{eq}) from earthworks activities reach 82 dB(A) at 50 feet from the center of construction activity when assessing the loudest pieces of equipment working simultaneously.
Maximum noise levels would occur when the loudest construction equipment is nearest to a noise sensitive receiver. The nearest noise sensitive receivers include the residences along Monroe Street and Dufferin Street; these residences are generally setback from the project site by at least 40 feet. Due to the linear nature of roadway construction, noise levels would be intermittent and the intensity of construction activities in a given area varies substantially.

Construction activities would progress at a rate of approximately 40 feet per day and would include an active work area of ranging from approximately 100 to 300 feet. Due to the length of the active work area, when the active work area is directly adjacent to a given receiver, construction activities throughout the day would be an average distance of 100 feet along an active portion of the alignment from the receiver. For example, conservatively assuming work is focused in 100 feet adjacent directly adjacent to a given receiver and the receiver is setback 40 feet from the work area, the average distance of from construction activities to the nearest residence would be 108 feet.

Construction along the proposed Imperial Avenue alignment would be characterized by hard site attenuation rate of 6 dB(A) per doubling of distance. This analysis conservatively assumes no attenuation from barriers and topography. Thus, when assessing the loudest pieces of equipment working simultaneously noise levels would attenuate to roughly 75 dB(A) L_{eq} at the nearest residences. As construction activities would progress at a rate of approximately 40 feet per day, this noise level on subsequent second, third, and fourth days would drop to 73 dB(A) L_{eq}, 71 dB(A) L_{eq}, 69 dB(A) L_{eq}, etc.

ISSUES (AND SUPPORTING INFORMATION SOURCES):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
Although construction noise would increase in ambient noise levels at residences in the vicinity to the project site, these increase would be temporary. Furthermore, the project would not include nighttime construction. Therefore, short-term noise level increases would be less than significant.				
e. For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	☒
12e. Response: ***(Source: RCALUCP Policy Document 2005)*** **No Impact.** The nearest airport is this Riverside Municipal Airport. The nearest portion of the Riverside Municipal Airport is approximately 2.2 miles north-northwest of the project terminus at the intersection of Gratton Street and Lincoln Avenue. The Riverside County ALUCP for Riverside Municipal Airport identifies the 55, 60, and 65 community noise equivalent level noise contours associated with aircraft overflights. The project is not within the noise contours for Riverside Municipal Airport. No impacts would occur.				
f. For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	☒
12f. Response: ***(Source: Project Description)*** **No Impact.** The project is not within the vicinity of a private airstrip. No impacts would occur.				
13. POPULATION AND HOUSING. Would the project:				
a. Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?	☐	☐	☐	☒
13a. Response: ***(Source: General Plan 2025 Table LU-3–Land Use Designations, FPEIR Table 5.12-A–Southern California Association of Governments [SCAG] Population and Households Forecast, Table 5.12-B–General Plan Population and Employment Projections–2025, Table 5.12-C–2025 General Plan and SCAG Comparisons, Table 5.12-D–General Plan Housing Projections 2025, Capital Improvement Program and SCAG's Regional Comprehensive Plan and Regional Transportation Plan)*** **No Impact.** The proposed project consists of storm drain improvements within an existing agricultural and very low-density residential area. The project does not propose any new development of homes or businesses, so it would not directly induce population growth. The improvements would not result in any zoning or land use changes that would allow for future development at a density greater than what is currently allowed, so it would not indirectly induce population growth. Therefore, there would be no impact.				
b. Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒
13b. Response: ***(Source: Project Description)*** **No Impact.** The project would not displace existing housing, as it is located within existing street right-of-way. No impact would occur.				

ISSUES (AND SUPPORTING INFORMATION SOURCES):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
c. Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒

13c. Response: ***(Source: Project Description)***

No Impact. The project would not displace any number of people or require the construction of replacement housing, as it is located within existing street right-of-way. No impact would occur.

14. PUBLIC SERVICES.				
Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:				
a. Fire protection?	☐	☐	☒	☐

14a. Response: ***(Source: FPEIR Table 5.13-B–Fire Station Locations, Table 5.13-C–Riverside Fire Department Statistics and Ordinance 5948 § 1)***

Less Than Significant Impact. The closest fire station to the proposed project site is the City Arlington Heights Fire Station 10 located at 2590 Jefferson Street, located less than one mile northeast of the project site at its nearest location. This station would be capable of offering support to the proposed project in the event of an emergency during construction. Because the project would involve construction within city streets (Gratton Street, Dufferin Avenue, Hermosa Drive) fire response time in the immediate vicinity of the proposed project could be temporarily affected during project construction. Prior to any roadway lane closures, the Department of Public Works (or its contractor) would notify emergency response agencies of the construction so that alternate routes can be used if needed. Considering that construction would be short term and emergency response agencies would be notified prior to lane closures, the impact on fire protection response time would be less than significant.

b. Police protection?	☐	☐	☒	☐

14b. Response: ***(Source: General Plan 2025 Figure PS-8 – Neighborhood Policing Centers)***

Less Than Significant Impact. Police protection is provided by the City Police Department and the closest station to the proposed project site is located at 10540 Magnolia Avenue, Riverside. The proposed project involves short-term construction activities and would not result in an increase in population or require additional police services. Therefore, the Riverside Police Department would not need to hire additional officers to maintain service ratios, nor would the Riverside Police Department need to build additional structures to house officers hired to accommodate the proposed project. Construction vehicles would temporarily add to street congestion. The project would include a traffic control plan during construction to manage traffic on Gratton Street. In addition, due to the temporary nature of the project and the limited number of vehicles that would be required during construction, impacts to police protection services would be considered less than significant.

c. Schools?	☐	☐	☐	☒

14c. Response: ***(Source: FPEIR Figure 5.13-2–RUSD Boundaries, Table 5.13-D– RUSD, Figure 5.13-3 –AUSD Boundaries, Table 5.13-E–AUSD, Table 5.13-G–Student Generation for RUSD and AUSD By Education Level, and Figure 5.13-4–Other School District Boundaries)***

No Impact. No new school facilities would be required to accommodate the proposed project, because the proposed project would not increase the population in the vicinity of the project, and would therefore not increase school populations. Although the proposed project is in the vicinity of Hawthorne Elementary School (2700 Irving Street), located two blocks west of Gratton Street at Victoria Avenue, the project would not limit access to the school during construction. Therefore, no impact would occur to schools in the vicinity as a result of the proposed project.

ISSUES (AND SUPPORTING INFORMATION SOURCES):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
d. Parks?	☐	☐	☐	☒

14d. Response: ***(Source: General Plan 2025 Figure PR-1–Parks, Open Spaces and Trails, Table PR-4–Park and Recreation Facilities, Parks Master Plan 2003, GP 2025 FPEIR Table 5.14-A–Park and Recreation Facility Types, and Table 5.14-C–Park and Recreation Facilities Funded in the Riverside Renaissance Initiative)***

No Impact. The proposed project is not located adjacent to any parks. The proposed project involves improvements to an existing drainage facility, and implementation of the proposed project would not result in population growth that could generate the need to construct or expand parks. In an effort to preserve its park-like landscaped median, Riverside City Council directed planning staff in 2007 to analyze a proposal to designate the parkway Victoria Avenue as a "linear" park, but to date it has not been officially designated as such. Construction of the proposed project on Gratton Street would avoid any impacts to the features of Victoria Avenue that may qualify it as potential parkland. Therefore, no impact would occur as a result of the proposed project.

e. Other public facilities?	☐	☐	☐	☒

14e. Response: ***(Source: General Plan 2025 Figure LU-8–Community Facilities, FPEIR Figure 5.13-5–Library Facilities, Figure 5.13-6–Community Centers, Table 5.3-F–Riverside Community Centers, Table 5.13-H–Riverside Public Library Service Standards)***

No Impact. The proposed project would not result in physical impacts or increased demand on government facilities and would not generate the need to construct or expand government facilities, including fire stations, police stations, schools, parks, or other public facilities. In addition, emergency access to the project site is available and would not be adversely affected by the proposed project. Therefore, no impact would occur to other public facilities as a result of the proposed project.

15. RECREATION.				
a. Would the project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?	☐	☐	☐	☒

15a. Response: ***(Source: General Plan 2025 Figure PR-1–Parks, Open Spaces and Trails, Table PR-4–Park and Recreation Facilities, Figure CCM-6–Master plan of Trails and Bikeways, Parks Master Plan 2003, FPEIR Table 5.14-A–Park and Recreation Facility Types, and Table 5.14-C–Park and Recreation Facilities Funded in the Riverside Renaissance Initiative, Table 5.14-D–Inventory of Existing Community Centers, Riverside Municipal Code Chapter 16.60–Local Park Development Fees, Bicycle Master Plan 2007)***

No Impact. The proposed project involves storm drain improvements that would have no impact on the use of existing neighborhood or regional parks or other recreational facilities. No impact would occur.

b. Does the project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?	☐	☐	☐	☒

15b. Response:

No Impact. The proposed project involves storm drain improvements. There are no recreational facilities included as part of the project, and the project would not increase demand for new recreational facilities or the use of existing recreational facilities. No impact would occur.

ISSUES (AND SUPPORTING INFORMATION SOURCES):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
16. TRANSPORTATION/TRAFFIC. Would the project result in:				
a. Conflict with an applicable plan, ordinance or policy establishing measures of effectiveness for the performance of the circulation system, taking into account all modes of transportation including mass transit and non-motorized travel and relevant components of the circulation system, including but not limited to intersections, streets, highways and freeways, pedestrian and bicycle paths, and mass transit?	☐	☐	☒	☐

16a. Response: ***(Source: General Plan 2025 Figure CCM-4–Master Plan of Roadways, FPEIR Figure 5.15-4–Volume to Capacity Ratio and Level of Service (Typical 2025), Table 5.15-D–Existing and Future Trip Generation Estimates, Table 5.15-H–Existing and Typical Density Scenario Intersection Levels of Service, Table 5.15-I–Conceptual General Plan Intersection Improvement Recommendations, Table 5.15-J–Current Status of Roadways Projected to Operate at Level of Service E or F in 2025, Table 5.15.-K–Freeway Analysis Proposed General Plan, Appendix H–Circulation Element Traffic Study and Traffic Study Appendix, SCAG's Regional Transportation Plan)***

Less Than Significant Impact. The GP 2025 Circulation and Community Mobility Element provides goals, policies, programs, and standards for establishing measures of effectiveness for the performance of the circulation system. The project site is located within existing street right-of-way, in an agricultural and low-density residential area. Streets affected by construction of the proposed underground storm drain improvements would be returned to existing grade and resurfaced as part of project construction, with the exception of Hermosa Drive south of Gage Canal, which would remain an unpaved dirt road. The proposed project would not affect any freeway or highway. There are no designated trails on or near the streets within the project site that would be affected by construction. Victoria Avenue features a Class 1 bikeway, but it would not be affected by project construction. Therefore, impacts would be less than significant.

b. Conflict with an applicable congestion management program, including but not limited to level of service standards and travel demand measures, or other standards established by the county congestion management agency for designated roads or highways?	☐	☐	☒	☐

16b. Response: ***(Source: Riverside County Congestion Management Program [CMP])***

Less Than Significant Impact. The project is within the area of the Riverside CMP. The CMP establishes a minimum level of service for principal arterials, highways, and interstates in the program area. State Route 60, State Route 91, and Interstate 215 are the only transportation routes proximal to the project site that are managed under the CMP (Riverside County 2011). The project would not directly affect any of these transportation routes.

The proposed project would generate traffic from construction and delivery vehicles travelling to and from the project site which would be temporary and localized in nature. These temporary, localized increases in traffic would be too small to measurably affect level of service. Maintenance of the project would occur primarily from vehicular trips that already exist for maintenance of other storm water control facilities in the area. Therefore, new vehicle trips generated by maintenance of the proposed project would be negligible.

Considering the low levels of trips generated, the short-term construction traffic, and the negligible traffic related to maintenance, the proposed project would not have a measurable impact on circulation efficiency and would not conflict with the CMP. Therefore, impacts would be less than significant.

ISSUES (AND SUPPORTING INFORMATION SOURCES):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
c. Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?	☐	☐	☐	☒

16c. Response: ***(Source: General Plan 2025 Figure PS-6 – Airport Safety Zones and Influence Areas, RCALUCP, March Air Reserve Base/March Inland Port Comprehensive Land Use Plan (1999) and Air Installation Compatible Use Zone Study for March Air Reserve Base (2005)***

No Impact. There are not anticipated to be any conflicts with air traffic patterns as the proposed project would be located underground and outside of the airport influence area of any nearby airports.

d. Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?	☐	☐	☐	☒

16d. Response:

No Impact. The project does not include any physical changes to roadways nor would it change the land use of the site; therefore, it would not introduce or increase hazards.

e. Result in inadequate emergency access?	☐	☐	☒	☐

16e. Response:

Less Than Significant Impact. The project involves improvements to an existing storm drain facility. The County Department of Public Works (or its contractor) would notify emergency response agencies of the construction so that alternate routes can be used if needed, and provide short-term traffic control where needed during construction. Following the completion of construction, the project would not affect traffic flows. No arterial roadways or designated evacuation routes would be affected by the proposed project. Therefore, there would be a less than significant impact on emergency access.

f. Conflict with adopted policies, plans or programs regarding public transit, bicycle, or pedestrian facilities, or otherwise decrease the performance or safety of such facilities)?	☐	☐	☒	☐

16f. Response: ***(Source: General Plan 2025 Circulation and Community Mobility and Education Elements, Bicycle Master Plan May 2007, School Safety Program–Walk Safe!–Drive Safe!)***

Less Than Significant Impact. The GP 2025 Circulation and Community Mobility Element provide goals, policies, and standards related to alternate transportation including public transit, bicycle, and pedestrian facilities. The proposed project includes underground storm drain improvements, and would not conflict with policies, plans, or programs involving alternative transportation. Streets affected by construction of the proposed underground storm drain improvements would be returned to existing grade and resurfaced as part of project construction, with the exception of Hermosa Drive south of Gage Canal, which would remain an unpaved dirt road. Therefore, impacts would be less than significant.

ISSUES (AND SUPPORTING INFORMATION SOURCES):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
17. TRIBAL CULTURAL RESOURCES. Would the project cause a substantial adverse change in the significance of a tribal cultural resource, defined in Public Resources Code Section 21074 as either a site, feature, place, or cultural landscape that is geographically defined in terms of the size and scope of the landscape, sacred place, or object with cultural value to a California Native American tribe, and that is::				
a. Listed or eligible for listing in the California Register of Historical Resources, or in a local register of historical resources as defined in Public Resources Code section 5020.1(k)?	☐	☒	☐	☐

17a. Response: ***(Source: Appendix C)***

Less Than Significant with Mitigation Incorporated. Chapter 532, Statutes of 2014 (i.e., AB 52), requires that lead agencies evaluate a project's potential to impact "tribal cultural resources." Such resources include "[s]ites, features, places, cultural landscapes, sacred places, and objects with cultural value to a California Native American tribe that are eligible for inclusion in the California Register of Historical resources or included in a local register of historical resources." AB 52 also gives lead agencies the discretion to determine, supported by substantial evidence, whether a resource qualifies as a "tribal cultural resource." Also per AB 52 (specifically Public Resources Code 21080.3.1), Native American consultation is required upon request by a California Native American tribe that has previously requested that the City provide it with notice of such projects.

As discussed in the Cultural Resources Report (see Appendix C), a search of the Sacred Lands File was requested for the project from the NAHC on May 11, 2018. The NAHC responded on May 14, 2018, stating that a records search was completed and no Native American cultural resources were listed within the project area.

Tribal contact letters were also sent out on April 10, 2018 to all tribal contacts on a list maintained by the City. Replies requesting formal consultation were received from the Pechanga Tribe on April 11, 2018, and the Soboba Band of Luiseño Indians on May 9, 2018. Formal consultations between the City and Soboba were conducted via telephone on July 17, 2018, at which time Soboba provided the City with proposed mitigation measures that included Native American Monitor(s) from the Soboba Band of Luiseño Indians Cultural Resource Department to be present during any ground disturbing proceedings. The proposed mitigation measures were reviewed, edited for relevancy and reformatted by the City and RECON and have been incorporated into this Mitigated Negative Declaration as **MM-Cul-1**, **MM-Cul-2**, and **MM-Cul-3**, described in Section 2.3, above. Subsequent consultation with Pechanga after receipt of Soboba's proposed mitigation resulted in a letter from Pechanga dated July 20, 2018 in which they agreed with the recommendation of archaeological and Tribal monitors during project construction.

Therefore, because interested tribes were consulted per AB 52, and mitigation measures to reduce potential impacts to less than significant were provided, with implementation of **MM-Cul-1, MM-Cul-2, and MM-Cul-3**, described in Section 2.3 above, potential impacts to tribal cultural resources would be reduced to a level less than significant.

b. A resource determined by the lead agency, in its discretion and supported by substantial evidence, to be significant pursuant to criteria set forth in subdivision (c) of Public Resources Code Section 5024.1. In applying the criteria set forth in subdivision (c) of Public Resource Code Section 5024.1, the lead agency shall consider the significance of the resource to a California Native American tribe?	☐	☒	☐	☐

17b. Response: (*Source: Appendix C*)

Less Than Significant with Mitigation Incorporated. See response to Section 17a above. With implementation of **MM-Cul-1, MM-Cul-2,** and **MM-Cul-3**, potential impacts to tribal cultural resources would be reduced to a level less than significant.

ISSUES (AND SUPPORTING INFORMATION SOURCES):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
18. UTILITIES AND SYSTEM SERVICES. Would the project:				
a. Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?	☐	☐	☐	☒
18a. Response: ***(Source: Project Description)*** **No Impact.** The proposed project will not require any wastewater treatment by the applicable RWQCB. Therefore, no impact would occur.				
b. Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	☐	☐	☐	☒
18b. Response: ***(Source: Project Description)*** **No Impact.** The proposed project does not require or result in the expansion of new water or wastewater treatment facilities. Therefore, no impact would occur.				
c. Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	☐	☒	☐	☐
18c. Response: ***(Source: Project Description)*** **Less Than Significant with Mitigation Incorporated.** The proposed project involves the installation of 11,200 feet of underground storm drainpipe and drainage facilities. The objective of the project is to reduce the extent and severity of flooding in the project area by collecting and conveying storm water runoff. Any potentially significant impacts that may result from construction of the proposed project would be mitigated to a level less than significant. Therefore, with mitigation measures **MM-Bio-1**, and **MM-Cul-1 through MM-Cul-4** for the potentially significant impacts to biological resources and cultural resources, the project would not require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects.				
d. Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed?	☐	☐	☐	☒
18d. Response: ***(Source: Project Description)*** **No Impact.** The proposed project would not require new or expanded water supplies. Therefore, no impact would occur.				
e. Result in a determination by the wastewater treatment provider which serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?	☐	☐	☐	☒
18e. Response: ***(Source: Project Description)*** **No Impact.** The proposed project would not generate wastewater. No new wastewater facilities would be required as a result of the proposed project. Therefore, no impact would occur.				
f. Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs?	☐	☐	☐	☒
18f. Response: ***(Source: Project Description)*** **No Impact.** Construction of the proposed project would not include the potential for generation of significant volumes of solid waste. Any waste disposal required during project construction will occur at permitted landfills. Maintenance of the new storm drain facility will not generate significant volumes of solid waste. Therefore, no impacts will occur.				

ISSUES (AND SUPPORTING INFORMATION SOURCES):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
g. Comply with federal, state, and local statutes and regulations related to solid waste?	☐	☐	☐	☒

18g. Response: ***(Source: Project Description)***

No Impact. See response to 18f above. If any waste is generated during project construction, disposal of construction materials would occur in accordance with federal, state, and local regulations. Therefore, no impact would occur.

19. MANDATORY FINDINGS OF SIGNIFICANCE.				
a. Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or an endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?	☐	☒	☐	☐

19a. Response: ***(Source: Above Checklist)***

Less Than Significant with Mitigation Incorporated. Construction and operation of the proposed project will not substantially degrade the quality of the environment due to the temporary nature of construction, the small footprint associated with the storm drain improvements, and the majority of facilities being underground within paved road rights-of-way. With incorporation of mitigation measure **MM-Bio-1**, implementation of the project will not substantially reduce the habitat of any wildlife or fish species or cause them to drop below self-sustaining levels. No plant or animal communities will be eliminated by implementation of the proposed project. Due to the temporary nature of construction and the underground location of the project, potential impacts to biological resources would be less than significant with mitigation incorporated.

The proposed project will be located in an area of medium archaeological sensitivity and prehistoric cultural resources sensitivity. The proposed improvements are located primarily within previously disturbed rights-of way. In the unlikely event that any materials of cultural significance (historical, archaeological, or paleontological) are found during construction of any part of the project, mitigation measures **MM-Cul-1 through MM-Cul-4** have been included to reduce potential impacts to less than significant. Therefore, implementation of the proposed project is not expected to eliminate important examples of the major periods of California history or prehistory.

b. Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects)?	☐	☐	☒	☐

19b. Response: ***(Source: Above Checklist)***

Less Than Significant Impact. Based on the analysis identified in this Initial Study, the project will not have cumulatively considerable impacts. The project involves the construction of storm drain improvements to help reduce flooding in the project area. Therefore, project impacts are only temporary and are not cumulatively considerable.

ISSUES (AND SUPPORTING INFORMATION SOURCES):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
c. Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?	☐	☒	☐	☐

19c. Response: ***(Source: Above Checklist)***

Less Than Significant with Mitigation Incorporated. The incorporation of design measures, adherence to existing codes, ordinance, regulations, standards and guidelines, combined with mitigation measures **MM-Cul-1, MM-Cul-2, and MM-Cul-3,** construction and operation of the project does not present the potential for substantial direct or indirect adverse effects to human beings. Potential impacts in this regard are considered less than significant with mitigation measures incorporated.

Note: Authority cited: Sections 21083 and 21087, Public Resources Code. Reference: Sections 21080(c), 21080.1, 21080.3, 21082.1, 21083, 21083.3, 21093, 21094, 21151, Public Resources Code; Sundstrom v. County of Mendocino, 202 Cal.App.3d 296 (1988); Leonoff v. Monterey Board of Supervisors, 222 Cal.App.3d 1337 (1990).

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APPENDIX A
AIR QUALITY MODELING DATA

Road Construction Emissions Model
Data Entry Worksheet

Version 8.1.0

Note: Required data input sections have a yellow background.
Optional data input sections have a blue background. Only areas with a yellow or blue background can be modified. Program defaults have a white background.
The user is required to enter information in cells D10 through D24, E28 through G35, and D38 through D41 for all project types.
Please use "Clear Data Input & User Overrides" button first before changing the Project Type or begin a new project.

To begin a new project, click this button to clear data previously entered. This button will only work if you opted not to disable macros when loading this spreadsheet.

SACRAMENTO METROPOLITAN AIR QUALITY MANAGEMENT DISTRICT

Input Type

Project Name	Monroe Drainage	
Construction Start Year	2019	Enter a Year between 2014 and 2025 (inclusive)
Project Type For 4: Other Linear Project Type, please provide project specific off-road equipment population and vehicle trip data	4	1) New Road Construction : Project to build a roadway from bare ground, which generally requires more site preparation than widening an existing roadway 2) Road Widening : Project to add a new lane to an existing roadway 3) Bridge/Overpass Construction : Project to build an elevated roadway, which generally requires some different equipment than a new roadway, such as a crane 4) Other Linear Project Type: Non-roadway project such as a pipeline, transmission line, or levee construction
Project Construction Time	15.00	months
Working Days per Month	22.00	days (assume 22 if unknown)
Predominant Soil/Site Type: Enter 1, 2, or 3 (for project within "Sacramento County", follow soil type selection instructions in cells E18 to E20 otherwise see instructions provided in cells J18 to J22)	1	1) Sand Gravel : Use for quaternary deposits (Delta/West County) 2) Weathered Rock-Earth : Use for Laguna formation (Jackson Highway area) or the lone formation (Scott Road, Rancho Murieta) 3) Blasted Rock : Use for Salt Springs Slate or Copper Hill Volcanics (Folsom South of Highway 50, Rancho Murieta)
Project Length	2.12	miles
Total Project Area	3.86	acres
Maximum Area Disturbed/Day	0.10	acres
Water Trucks Used?	1	1. Yes 2. No

Please note that the soil type instructions provided in cells E18 to E20 are specific to Sacramento County. Maps available from the California Geologic Survey (see weblink below) can be used to determine soil type outside Sacramento County.

http://www.conservation.ca.gov/cgs/information/geologic_mapping/Pages/googlemaps.aspx#regionalseries

Material Hauling Quantity Input

Material Type	Phase	Haul Truck Capacity (yd^3) (assume 20 if unknown)	Import Volume (yd^3/day)	Export Volume (yd^3/day)
Soil	Grubbing/Land Clearing			
	Grading/Excavation			
	Drainage/Utilities/Sub-Grade	20.00	0.00	63.56
	Paving			
Asphalt	Grubbing/Land Clearing			
	Grading/Excavation			
	Drainage/Utilities/Sub-Grade			
	Paving			

Mitigation Options

On-road Fleet Emissions Mitigation	No Mitigation	Select "2010 and Newer On-road Vehicles Fleet" option when the on-road heavy-duty truck fleet for the project will be limited to vehicles of model year 2010 or newer
Off-road Equipment Emissions Mitigation	No Mitigation	Select "20% NOx and 45% Exhaust PM reduction" option if the project will be required to use a lower emitting off-road construction fleet. The SMAQMD Construction Mitigation Calculator can be used to confirm compliance with this mitigation measure (http://www.airquality.org/ceqa/mitigation.shtml). Select "Tier 4 Equipment" option if some or all off-road equipment used for the project meets CARB Tier 4 Standard

The remaining sections of this sheet contain areas that require modification when 'Other Project Type' is selected.

Note: The program's estimates of construction period phase length can be overridden in cells D50 through D53, and F50 through F53.

Construction Periods	User Override of Construction Months	Program Calculated Months	User Override of Phase Starting Date	Program Default Phase Starting Date
Grubbing/Land Clearing	0.00	1.50		1/1/2019
Grading/Excavation	0.00	6.00		1/1/2019
Drainage/Utilities/Sub-Grade	15.00	5.25		1/1/2019
Paving	0.00	2.25		4/2/2020
Totals (Months)	15			

Note: Soil Hauling emission default values can be overridden in cells D61 through D64, and F61 through F64.

Soil Hauling Emissions	User Override of Miles/Round Trip	Program Estimate of Miles/Round Trip	User Override of Truck Round Trips/Day	Default Values Round Trips/Day	Calculated Daily VMT
User Input					
Miles/round trip: Grubbing/Land Clearing				0	0.00
Miles/round trip: Grading/Excavation				0	0.00
Miles/round trip: Drainage/Utilities/Sub-Grade	30.00			4	120.00
Miles/round trip: Paving				0	0.00

Emission Rates	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Grubbing/Land Clearing (grams/mile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grading/Excavation (grams/mile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Draining/Utilities/Sub-Grade (grams/mile)	0.13	0.51	4.80	0.13	0.06	0.02	1,644.14	0.01	0.06	1,660.85
Paving (grams/mile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hauling Emissions	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Pounds per day - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Drainage/Utilities/Sub-Grade	0.03	0.13	1.27	0.03	0.02	0.00	434.96	0.00	0.01	439.39
Tons per const. Period - Drainage/Utilities/Sub-Grade	0.01	0.02	0.21	0.01	0.00	0.00	71.77	0.00	0.00	72.50
Pounds per day - Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total tons per construction project	0.01	0.02	0.21	0.01	0.00	0.00	71.77	0.00	0.00	72.50

Note: Asphalt Hauling emission default values can be overridden in cells D87 through D90, and F87 through F90.

Asphalt Hauling Emissions	User Override of Miles/Round Trip	Program Estimate of Miles/Round Trip	User Override of Truck Round Trips/Day	Default Values Round Trips/Day	Calculated Daily VMT
User Input					
Miles/round trip: Grubbing/Land Clearing				0	0.00
Miles/round trip: Grading/Excavation				0	0.00
Miles/round trip: Drainage/Utilities/Sub-Grade				0	0.00
Miles/round trip: Paving				0	0.00

Emission Rates	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Grubbing/Land Clearing (grams/mile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grading/Excavation (grams/mile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Draining/Utilities/Sub-Grade (grams/mile)	0.13	0.51	4.80	0.13	0.06	0.02	1,644.14	0.01	0.06	1,660.85
Paving (grams/mile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Emissions	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Pounds per day - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Drainage/Utilities/Sub-Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Drainage/Utilities/Sub-Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total tons per construction project	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: Worker commute default values can be overridden in cells D113 through D118.

Worker Commute Emissions	User Override of Worker Commute Default Values	Default Values	Calculated Daily Trips	Calculated Daily VMT
User Input				
Miles/ one-way trip	20			
One-way trips/day	2			
No. of employees: Grubbing/Land Clearing			0	0.00
No. of employees: Grading/Excavation			0	0.00
No. of employees: Drainage/Utilities/Sub-Grade	12		24	480.00
No. of employees: Paving			0	0.00

Emission Rates	ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
Grubbing/Land Clearing (grams/mile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grading/Excavation (grams/mile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Draining/Utilities/Sub-Grade (grams/mile)	0.02	1.17	0.13	0.05	0.02	0.00	379.64	0.01	0.01	381.42
Paving (grams/mile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grubbing/Land Clearing (grams/trip)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grading/Excavation (grams/trip)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Draining/Utilities/Sub-Grade (grams/trip)	1.06	2.80	0.22	0.00	0.00	0.00	85.58	0.01	0.01	88.70
Paving (grams/trip)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Emissions	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Pounds per day - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Drainage/Utilities/Sub-Grade	0.08	1.38	0.14	0.05	0.02	0.00	406.27	0.01	0.01	408.32
Tons per const. Period - Drainage/Utilities/Sub-Grade	0.01	0.23	0.02	0.01	0.00	0.00	67.03	0.00	0.00	67.37
Pounds per day - Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total tons per construction project	0.01	0.23	0.02	0.01	0.00	0.00	67.03	0.00	0.00	67.37

Note: Water Truck default values can be overridden in cells D145 through D148, and F145 through F148.

Water Truck Emissions	User Override of Default # Water Trucks	Program Estimate of Number of Water Trucks	User Override of Truck Miles Traveled/Vehicle/Day	Default Values Miles Traveled/Vehicle/Day	Calculated Daily VMT
User Input					
Grubbing/Land Clearing - Exhaust					0.00
Grading/Excavation - Exhaust					0.00
Drainage/Utilities/Subgrade	1		40.00		40.00
Paving					0.00

Emission Rates	ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
Grubbing/Land Clearing (grams/mile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grading/Excavation (grams/mile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Draining/Utilities/Sub-Grade (grams/mile)	0.13	0.51	4.80	0.13	0.06	0.02	1,644.14	0.01	0.06	1,660.85
Paving (grams/mile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Emissions	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Pounds per day - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Drainage/Utilities/Sub-Grade	0.01	0.04	0.42	0.01	0.01	0.00	144.99	0.00	0.00	146.46
Tons per const. Period - Drainage/Utilities/Sub-Grade	0.00	0.01	0.07	0.00	0.00	0.00	23.92	0.00	0.00	24.17
Pounds per day - Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total tons per construction project	0.00	0.01	0.07	0.00	0.00	0.00	23.92	0.00	0.00	24.17

Note: Fugitive dust default values can be overridden in cells D171 through D173.

Fugitive Dust	User Override of Max Acreage Disturbed/Day	Default Maximum Acreage/Day	PM10 pounds/day	PM10 tons/per period	PM2.5 pounds/day	PM2.5 tons/per period
Fugitive Dust - Grubbing/Land Clearing			0.00	0.00	0.00	0.00
Fugitive Dust - Grading/Excavation			0.00	0.00	0.00	0.00
Fugitive Dust - Drainage/Utilities/Subgrade			1.03	0.17	0.21	0.04

Values in cells D183 through D216, D234 through D267, D285 through D318, and D336 through D369 are required when 'Other Project Type' is selected.

Off-Road Equipment Emissions

Grubbing/Land Clearing	Default Number of Vehicles	Override of Default Equipment Tier (applicable only when "Tier 4 Mitigation" Option Selected)	Mitigation Option Default Equipment Tier	Type	ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
Override of Default Number of Vehicles	*Program-estimate*				pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
			Model Default Tier	Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Cranes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Crawler Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Excavators	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Graders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Pavers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Pumps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Rollers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Scrapers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Trenchers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Welders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

User-Defined Off-road Equipment	If non-default vehicles are used, please provide information in 'Non-default Off-road Equipment' tab			ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
Number of Vehicles		Equipment Tier	Type	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
0.00		N/A	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00		N/A	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00		N/A	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00		N/A	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00		N/A	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00		N/A	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00		N/A	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Grubbing/Land Clearing		pounds per day	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Grubbing/Land Clearing		tons per phase	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Grading/Excavation	Default Number of Vehicles	Mitigation Option: Override of Default Equipment Tier (applicable only when "Tier 4 Mitigation" Option Selected)	Default Equipment Tier	Type	ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
Override of Default Number of Vehicles	*Program-estimate*				pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
			Model Default Tier	Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Cranes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Crawler Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Excavators	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Graders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Pavers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Pumps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Rollers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Scrapers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Trenchers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Welders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

User-Defined Off-road Equipment	If non-default vehicles are used, please provide information in 'Non-default Off-road Equipment' tab			ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
Number of Vehicles		Equipment Tier	Type	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
0.00		N/A	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00		N/A	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00		N/A	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00		N/A	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00		N/A	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00		N/A	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00		N/A	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Grading/Excavation		pounds per day	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Grading/Excavation		tons per phase	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Drainage/Utilities/Subgrade	Default Number of Vehicles	Mitigation Option: Override of Default Equipment Tier (applicable only when "Tier 4 Mitigation" Option Selected)	Default		ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
Override of Default Number of Vehicles	*Program-estimate*		Equipment Tier		pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
			Model Default Tier	Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.00			Model Default Tier	Concrete/Industrial Saws	0.45	3.70	3.53	0.22	0.22	0.01	592.67	0.04	0.00	595.02
1.00			Model Default Tier	Cranes	0.48	2.21	5.76	0.24	0.22	0.01	556.39	0.18	0.00	562.28
			Model Default Tier	Crawler Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.00			Model Default Tier	Excavators	0.27	3.37	2.71	0.13	0.12	0.01	525.00	0.17	0.00	530.57
1.00			Model Default Tier	Forklifts	0.16	1.19	1.40	0.11	0.10	0.00	150.66	0.05	0.00	152.25
			Model Default Tier	Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Graders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.00			Model Default Tier	Off-Highway Trucks	0.70	3.94	6.98	0.25	0.23	0.01	1,295.37	0.41	0.01	1,309.08
			Model Default Tier	Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.00			Model Default Tier	Pavers	0.27	2.81	2.97	0.15	0.13	0.00	449.17	0.14	0.00	453.93
1.00			Model Default Tier	Paving Equipment	0.21	2.51	2.22	0.11	0.10	0.00	398.50	0.13	0.00	402.73
			Model Default Tier	Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Pumps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.00			Model Default Tier	Rollers	0.23	1.93	2.24	0.15	0.13	0.00	261.78	0.08	0.00	264.55
			Model Default Tier	Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Scrapers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.00			Model Default Tier	Signal Boards	0.23	1.20	1.44	0.06	0.06	0.00	197.25	0.02	0.00	198.26
1.00			Model Default Tier	Skid Steer Loaders	0.08	1.39	1.11	0.05	0.05	0.00	203.71	0.06	0.00	205.87
			Model Default Tier	Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.00			Model Default Tier	Trenchers	0.45	2.74	4.04	0.31	0.28	0.00	345.22	0.11	0.00	348.87
2.00			Model Default Tier	Welders	0.75	3.60	3.23	0.19	0.19	0.01	414.96	0.07	0.00	417.68

User-Defined Off-road Equipment	If non-default vehicles are used, please provide information in 'Non-default Off-road Equipment' tab			ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
Number of Vehicles		Equipment Tier	Type	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
0.00		N/A	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00		N/A	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00		N/A	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00		N/A	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00		N/A	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00		N/A	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00		N/A	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Drainage/Utilities/Sub-Grade		pounds per day	4.28	30.58	37.62	1.97	1.85	0.06	5,390.68	1.46	0.05	5,441.08
	Drainage/Utilities/Sub-Grade		tons per phase	0.71	5.05	6.21	0.32	0.30	0.01	889.46	0.24	0.01	897.78

Paving	Default Number of Vehicles	Mitigation Option: Override of Default Equipment Tier (applicable only when "Tier 4 Mitigation" Option Selected)	Default Equipment Tier	Type	ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
Override of Default Number of Vehicles	*Program-estimate*				pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
			Model Default Tier	Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Cranes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Crawler Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Excavators	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Graders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Pavers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Pumps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Rollers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Scrapers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Trenchers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Model Default Tier	Welders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

User-Defined Off-road Equipment	If non-default vehicles are used, please provide information in 'Non-default Off-road Equipment' tab			ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
Number of Vehicles		Equipment Tier	Type	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
0.00		N/A	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00		N/A	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00		N/A	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00		N/A	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00		N/A	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00		N/A	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00		N/A	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Paving		pounds per day	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Paving		tons per phase	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Emissions all Phases (tons per construction period) =>				0.71	5.05	6.21	0.32	0.30	0.01	889.46	0.24	0.01	897.78

Equipment default values for horsepower and hours/day can be overridden in cells D391 through D424 and F391 through F424.

Equipment	User Override of Horsepower	Default Values Horsepower	User Override of Hours/day	Default Values Hours/day
Aerial Lifts		63		8
Air Compressors		78		8
Bore/Drill Rigs		206		8
Cement and Mortar Mixers		9		8
Concrete/Industrial Saws		81		8
Cranes		226		8
Crawler Tractors		208		8
Crushing/Proc. Equipment		85		8
Excavators		163		8
Forklifts		89		8
Generator Sets		84		8
Graders		175		8
Off-Highway Tractors		123		8
Off-Highway Trucks		400		8
Other Construction Equipment		172		8
Other General Industrial Equipment		88		8
Other Material Handling Equipment		167		8
Pavers		126		8
Paving Equipment		131		8
Plate Compactors		8		8
Pressure Washers		13		8
Pumps		84		8
Rollers		81		8
Rough Terrain Forklifts		100		8
Rubber Tired Dozers		255		8
Rubber Tired Loaders		200		8
Scrapers		362		8
Signal Boards		6		8
Skid Steer Loaders		65		8
Surfacing Equipment		254		8
Sweepers/Scrubbers		64		8
Tractors/Loaders/Backhoes		98		8
Trenchers		81		8
Welders		46		8

END OF DATA ENTRY SHEET

Road Construction Emissions Model, Version 8.1.0

Daily Emission Estimates for -> Monroe Drainage

Project Phases (Pounds)	ROG (lbs/day)	CO (lbs/day)	NOx (lbs/day)	Total PM10 (lbs/day)	Exhaust PM10 (lbs/day)	Fugitive Dust PM10 (lbs/day)	Total PM2.5 (lbs/day)	Exhaust PM2.5 (lbs/day)	Fugitive Dust PM2.5 (lbs/day)	SOx (lbs/day)	CO2 (lbs/day)	CH4 (lbs/day)	N2O (lbs/day)	CO2e (lbs/day)
Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Drainage/Utilities/Sub-Grade	4.41	32.15	39.45	3.09	2.06	1.03	2.10	1.89	0.21	0.07	6,376.90	1.47	0.07	6,435.25
Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maximum (pounds/day)	4.41	32.15	39.45	3.09	2.06	1.03	2.10	1.89	0.21	0.07	6,376.90	1.47	0.07	6,435.25
Total (tons/construction project)	0.73	5.30	6.51	0.51	0.34	0.17	0.35	0.31	0.04	0.01	1,052.19	0.24	0.01	1,061.82

Notes:

Project Start Year ->	2019
Project Length (months) ->	15
Total Project Area (acres) ->	4
Maximum Area Disturbed/Day (acres) ->	0
Water Truck Used? ->	Yes

	Total Material Imported/Exported Volume (yd^3/day)		Daily VMT (miles/day)			
Phase	Soil	Asphalt	Soil Hauling	Asphalt Hauling	Worker Commute	Water Truck
Grubbing/Land Clearing	0	0	0	0	0	0
Grading/Excavation	0	0	0	0	0	0
Drainage/Utilities/Sub-Grade	64	0	120	0	480	40
Paving	0	0	0	0	0	0

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.

Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns G and H. Total PM2.5 emissions shown in Column I are the sum of exhaust and fugitive dust emissions shown in columns J and K.

CO2e emissions are estimated by multiplying mass emissions for each GHG by its global warming potential (GWP), 1 , 25 and 298 for CO2, CH4 and N2O, respectively. Total CO2e is then estimated by summing CO2e estimates over all GHGs.

Total Emission Estimates by Phase for -> Monroe Drainage

Project Phases (Tons for all except CO2e. Metric tonnes for CO2e)	ROG (tons/phase)	CO (tons/phase)	NOx (tons/phase)	Total PM10 (tons/phase)	Exhaust PM10 (tons/phase)	Fugitive Dust PM10 (tons/phase)	Total PM2.5 (tons/phase)	Exhaust PM2.5 (tons/phase)	Fugitive Dust PM2.5 (tons/phase)	SOx (tons/phase)	CO2 (tons/phase)	CH4 (tons/phase)	N2O (tons/phase)	CO2e (MT/phase)
Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Drainage/Utilities/Sub-Grade	0.73	5.30	6.51	0.51	0.34	0.17	0.35	0.31	0.04	0.01	1,052.19	0.24	0.01	963.27
Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maximum (tons/phase)	0.73	5.30	6.51	0.51	0.34	0.17	0.35	0.31	0.04	0.01	1052.19	0.24	0.01	963.27
Total (tons/construction project)	0.73	5.30	6.51	0.51	0.34	0.17	0.35	0.31	0.04	0.01	1052.19	0.24	0.01	963.27

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.

Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns G and H. Total PM2.5 emissions shown in Column I are the sum of exhaust and fugitive dust emissions shown in columns J and K.

CO2e emissions are estimated by multiplying mass emissions for each GHG by its global warming potential (GWP), 1 , 25 and 298 for CO2, CH4 and N2O, respectively. Total CO2e is then estimated by summing CO2e estimates over all GHGs.

The CO2e emissions are reported as metric tons per phase.

APPENDIX B
BIOLOGICAL RESOURCES REPORT

RECON

An Employee-Owned Company

July 24, 2018

Ms. Swetaben Patel, P.E.
Senior Engineer
City of Riverside Public Works Department
3900 Main Street, 4th Floor
Riverside, CA 92501

Reference: Biological Resources Letter Report and Multiple Species Habitat Conservation Plan Consistency Analysis for the Monroe Master Drainage Plan Storm Drain Line E, Stages 2 & 3, Storm Drain Line E-2, and Storm Drain Line E-5 Project, Riverside, California (RECON Number 8995)

Dear Ms. Patel:

This report summarizes the methods and results of a general biological resources survey conducted for the Monroe Master Drainage Plan Storm Drain Line E, Stages 2 & 3, Storm Drain Line E-2, and Storm Drain Line E-5 Project (project), assesses potential impacts to biological resources from the project, and identifies mitigation to offset those impacts.

Summary

The project is located within in the city of Riverside, California and proposes to install approximately 11,200 linear feet of underground storm drain pipe within the Gratton Street, Dufferin Avenue, and Hermosa Drive rights-of-way, including trenchless pipe installation underneath the Gage Canal. The project site is located within the western burrowing owl (*Athene cunicularia hypugaea*) survey area identified in the Western Riverside Multiple Species Habitat Conservation Plan (MSHCP) and within the Habitat Conservation Plan (HCP) for Stephens' Kangaroo Rat (*Dipodomys stephensi*; SKR) Fee Area (SKR Fee Area; Riverside County Habitat Conservation Agency [RCHCA] 1996). The project site is not located inside any Criteria Area, Criteria Cell, or Conservation Area identified for conservation potential by the MSHCP (Western Riverside County Regional Conservation Authority [WRCRCA] 2003).

A biological survey, western burrowing owl habitat assessment, and a delineation of jurisdictional wetlands/waters and riparian/riverine habitats were conducted for the project. A total of five vegetation communities were mapped within the survey area: oak woodland, open water/reservoir/pond, non-native grassland, grove/orchard, and residential/urban/exotic.

Within the survey area, the Gage Canal and a network of concrete, asphalt, and earthen agricultural irrigation ditches were assessed for potential federal and state jurisdictional areas and MSHCP riparian/riverine habitat. Based on the jurisdictional wetlands/waters delineation, there are no areas that satisfy the criteria for wetlands or non-wetland waters under U. S. Army Corps of Engineers (ACOE), Regional Water Quality Control Board (RWQCB), or California Department of Fish and Wildlife (CDFW) jurisdiction. The non-vegetated Gage Canal and irrigation ditches are not expected to be considered jurisdictional because they are artificial irrigation channels and were not constructed within a naturally occurring drainage and are not tributary to a traditional navigable waterway. They also would not be considered riparian/riverine areas. While these features contain fresh water flow for a portion of the year, they are excluded from the riparian/riverine definition per Section 6.1.2 of the MSHCP because they are artificially created features.

No sensitive plant species were detected during the biological survey, but two sensitive wildlife species were detected: turkey vulture (*Cathartes aura*; MSHCP Covered Species) and northern harrier (*Circus hudsonius*; CDFW Species of Special Concern, MSHCP covered species). Both were observed flying overhead and did not land within the survey area.

No western burrowing owls, suitable burrows, or owl sign were detected during the habitat assessment; however, three patches of non-native grassland that have some habitat characteristics suitable habitat for western burrowing owl. The three patches total 17.76 acres and range in size from 3.10 to 7.35 acres. Each patch alone is too small to provide adequate western burrowing owl habitat and is isolated from the others or any off-site grasslands by active nurseries, citrus and avocado orchards, and residential developments. While agricultural areas are known to be used by western burrowing owl, the sparsity of vegetation and highly disturbed nature of these active facilities within the survey area make them unsuitable for western burrowing owls. As a result, this species is not expected to occur and in the survey area. Additionally, the proposed project has been designed to avoid all areas of non-native grassland. Therefore, focused surveys are not recommended.

The project would impact a total of 19.49 acres and was designed to avoid sensitive vegetation communities. No jurisdictional wetlands/waters or riparian/riverine areas are present within the survey area and none would be impacted. Additionally, the project would employ a jack-and-bore operation for pipe installation beneath the Gage Canal. No sensitive plant species are expected to occur within the survey area, so none would be impacted by the project. Two sensitive wildlife species (turkey vulture and northern harrier) were detected during the biological survey; however, neither is expected be impacted by the project.

The project would be required to comply with California Fish and Game Code (CFGC) Section 3503 and the construction guidelines in MSHCP Section 7.5.3, which require that no direct impacts shall occur to any nesting birds, their eggs, chicks, or nests during the breeding season. Vegetation trimming and clearing should avoid the bird breeding season (March 1 to June 30), if feasible. If vegetation trimming or clearing must occur during the breeding season, a pre-construction clearance survey by a qualified biologist would be required. If nesting birds are detected, measures would be required to verify compliance with CFGC Section 3503 such that take of birds or eggs or disturbance of breeding activities is avoided. Potential measures may include establishing an appropriate buffer area around the nesting site (500 feet for raptors, 300 feet for other bird species) until young have fledged or the nest is inactive. If no nesting birds are detected during the pre-construction survey, no additional measures would be required.

1.0 Introduction

1.1 Project Location and Description

The project is located within the Gratton Street, Dufferin Avenue, and Hermosa Drive rights-of-way, in the City of Riverside, California (Figure 1). It is within Township 03 South, Range 05 West, Sections 9, 15, 16, and 21 of the U.S. Geological Survey (USGS) 7.5-minute topographic map, Riverside West quadrangle (Figure 2; USGS 1980).

The project includes the construction of approximately 11,200 linear feet of underground storm drain pipe within the Gratton Street, Dufferin Avenue, and Hermosa Drive rights-of-way; removal and rebuilding of the existing curb, gutter, and street lights along the east side of Gratton Street between Lincoln Avenue and Victoria Avenue; and a jack-and-bore operation for trenchless pipe installation underneath the Gage Canal at the intersection of Gratton Street and Hermosa Drive. An aerial photograph showing the project alignment is included as Figure 3. The project will extend within Gratton Street approximately 7,600 feet (1.4 miles) from Lincoln Avenue at the north end to the Gage Canal at the south end. Within the Hermosa Street right-of-way, it will extend approximately 2,200 feet from Gage Canal at the west end to St. Lawrence Street at the east end. Within the Dufferin Avenue right-of-way, it will extend approximately 1,400 feet from Gratton Street at the west end to Adams Street at the east end.

Project Location

RECON

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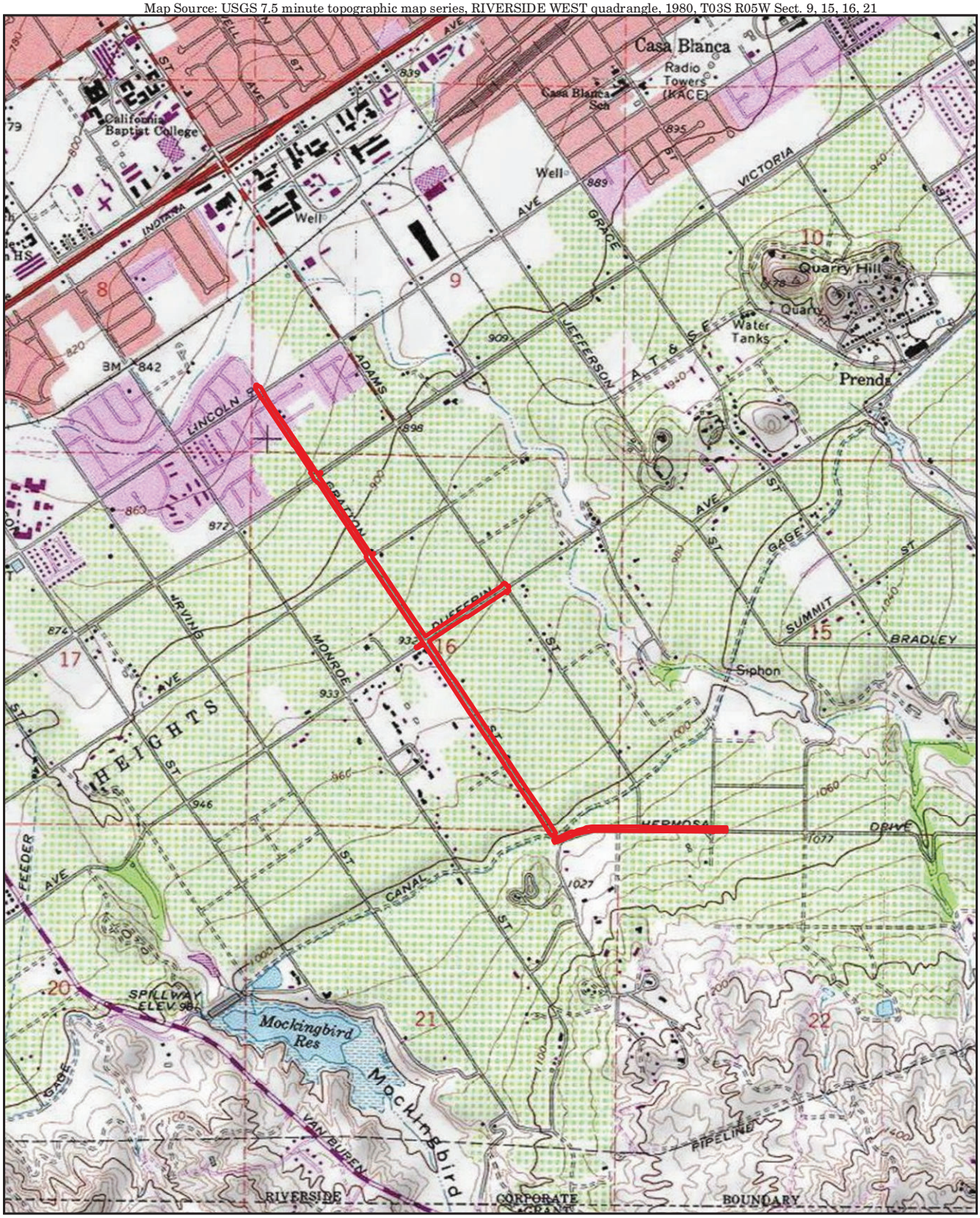
FIGURE 1

Regional Location

Map Source: USGS 7.5 minute topographic map series, RIVERSIDE WEST quadrangle, 1980, T03S R05W Sect. 9, 15, 16, 21



0 Feet 2,000

Project Boundary

RECON

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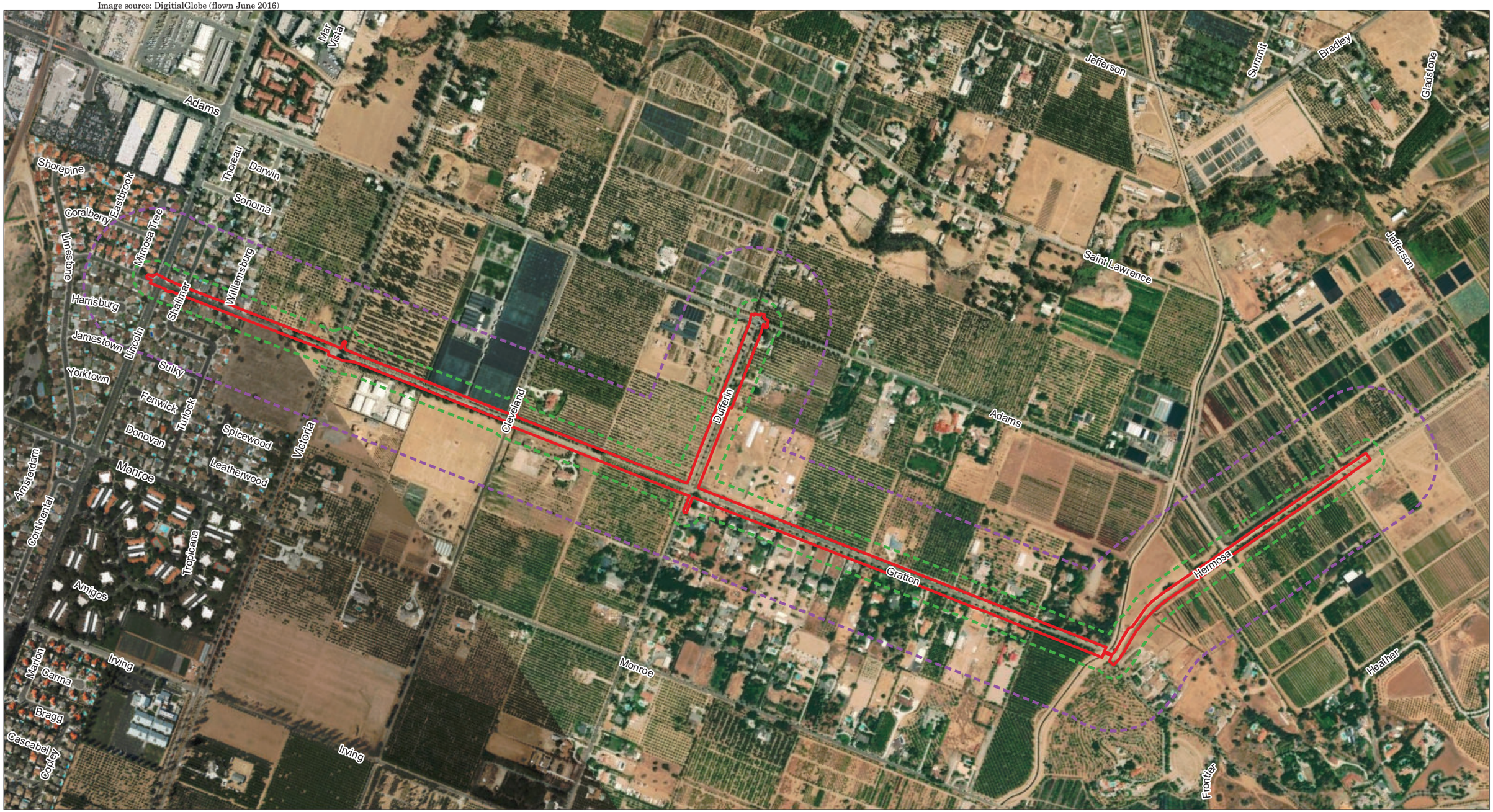
FIGURE 2

Project Location on USGS Map

Image source: DigitialGlobe (flown June 2016)



0 Feet 700

Project Boundary

Survey Area

Western Burrowing Owl Habitat Assessment Area

RECON

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FIGURE 3

Project Location on Aerial Photograph

1.2 Setting

The project site is located within a mixed residential and agricultural community. The northern portion of the project site, north of Cleveland Avenue, currently consists of single-family residences. The southern portion of the project area, south and east of the Gratton Street-Hermosa Drive intersection, consists of several large nurseries. The remainder of the project area contains a mix of single-family residences, citrus orchards, nurseries, and a small horse ranch. Based on a review of historical aerial imagery (Nationwide Environmental Title Research LLC 2018), virtually all of the survey area has consisted of citrus orchards, nurseries, ranches, and/or single-family homes since at least 1948.

The Gage Canal crosses the southern portion of the project area, just north of Hermosa Drive, and a series of earthen and asphalt irrigation ditches run throughout the project area and surrounding community transporting flows off-site water sources through the site. The Gage Canal is an approximately 20-mile-long canal system built in 1886 that transports irrigation water from the Santa Ana River in San Bernardino via a series of locks to fulfill the irrigation needs in the surrounding agricultural areas of Riverside. It terminates near California Citrus State Historic Park, where water is pumped into the municipal water system. The irrigation ditches transport flows from several sources off site to the east. One flows west along Hermosa Drive to Gratton Street, where it turns north through a pipe and concrete channels over the Gage Canal, into a series of asphalt and concrete ditches on the east side of Gratton Street. A second flows from east to west through an earthen ditch on the south side of Dufferin Avenue, drains into a wide gutter on the east side of Gratton Street, where it merges with flows from the first ditch. The combined flows continue north into a pipe beneath Victoria Avenue, back onto the street, and finally empty into an underground system beneath Gratton Street, just south of Williamsburg Place.

2.0 Surveys and Methods

2.1 Literature Review and Database Search

Prior to conducting field surveys, RECON conducted a literature review and database search for information on biological resources reported in the vicinity of the project site. This included a review of sensitive species records in the U.S. Fish and Wildlife Service (USFWS) all-species database (USFWS 2018), California Natural Diversity Database (CNDDB; CDFW 2018a), and the California Native Plant Society (CNPS) online database (CNPS 2018).

2.2 General Biological Survey

RECON biologists Brian Parker and Andrew Smisek conducted a general biological survey, which included vegetation mapping, inventories of plant and animal species detected, a delineation of jurisdictional wetland/waters and riparian/riverine areas, and a western burrowing owl (*Athene cunicularia hypugaea*) habitat assessment on April 27, 2018 between 9:45 a.m. and 3:00 p.m. Weather conditions were warm, with clear skies, temperatures increasing from 60 to 77 degrees Fahrenheit, and wind increasing from zero to 2 miles per hour at the start to 8 to 10 miles per hour at the end. The survey area for a general biological survey included the project site plus all land within 100 feet. As part of the western burrowing owl habitat assessment discussed in Section 2.3, vegetation mapping was extended out to all land within 500 feet of the project site.

The survey was conducted by walking all publicly accessible portions of the survey area. All plant and animal species apparent at the time of the survey were recorded, and vegetation within the survey area was mapped on a 1-inch-equals-200-feet aerial photograph of the survey area. Many portions of the survey area were located on private property and were not directly accessible at the time of the survey. These areas were surveyed and mapped from the nearest accessible location with the aid of binoculars and aerial imagery.

Nomenclature in this report follows Hickman (1993) as updated by Jepson Flora Project (2018) for common plants, Brenzel (2001) for ornamental plants, CDFW (2018b and c) for sensitive plants, American Ornithologists' Union (2017) and Unitt (2004) for birds, Baker et al. (2003) for mammals, Crother et al.

(2012) for amphibians and reptiles, and Opler and Wright (1999) and San Diego Natural History Museum (2002) for invertebrates.

2.3 Western Burrowing Owl Habitat Assessment

The western burrowing owl habitat assessment was performed following the guidance provided in the *Burrowing Owl Survey Instructions for the Western Riverside Multiple Species Habitat Conservation Plan Area* (Riverside County Transportation & Land Management Agency 2006). As mentioned above, the area assessed consisted of the project site plus a 500-foot (approximately 150-meter) buffer zone. The surveyors walked all publicly accessible portions of the survey area. As most of the survey area was located on private property, these areas were not directly accessible and were surveyed from the nearest accessible location with the use of binoculars. Some inaccessible areas were not visible from public rights-of-way, because they consisted of or were surrounded by dense vegetation or structures. However, review of recent aerial photography showed these areas consisted of developed areas or active nurseries or orchards.

2.4 Jurisdictional Delineation

The jurisdictional delineation was conducted by RECON biologist Andrew Smisek concurrently with the general biological survey. Within the survey area, potential federal and state jurisdictional areas were examined to determine the presence and extent of any jurisdictional waters. The delineation was performed according to the guidelines set forth by ACOE (1987, 2008). Jurisdictional waters and MSHCP riparian/riverine habitats were delineated on-site according to ACOE, CDFW, RWQCB, and MSHCP regulations, which are summarized in Sections 2.4.1 through 2.4.4 below. The entire survey area (project site plus 100 feet) was examined to determine the presence of the three wetland parameters: hydrophytic vegetation, hydric soils, and wetland hydrology.

Hydrophytic Vegetation. Hydrophytic vegetation is defined as "the sum total of macrophytic plant life growing in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content" (ACOE 1987). The wetland indicator status of each species recorded on-site was determined by using the list of wetland plants for California provided by the USFWS (Lichvar et al. 2014).

Hydric Soils. A hydric soil is a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the accumulation of visible indicators of extended saturation (ACOE 1987). Information on the soil types sampled in the project site is summarized from the Soil Survey for San Diego County (U.S. Department of Agriculture [USDA] 1971) and the March 2014 Hydric Soils list obtained from the Natural Resources Conservation Service (NRCS; 2015).

Hydrology. Wetland hydrology indicators are used to determine if inundation or saturation has occurred on a site. These indicators are features that suggest current or recent flows through an area but do not provide information about the timing, duration, or frequency of the event(s). Hydrology features are generally the most ephemeral of the three wetland parameters (ACOE 2008).

2.4.1 ACOE Jurisdictional Waters

Under Section 404 of the Clean Water Act (CWA), the ACOE regulates the dredging or discharge of fill material into waters of the U.S. including wetlands (as defined above) and non-wetland waters of the U.S.

ACOE jurisdictional non-wetland waters include vegetated or unvegetated streams, open water, and other aquatic areas with strong hydrology indicators such as the presence of seasonal flows and an ordinary high water mark (OHWM). An OHWM is defined as:

> . . . that line on the shore established by the fluctuations of water and indicated by physical characteristics such as [a] clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or

> other appropriate means that consider the characteristics of the surrounding areas (33 Code of Federal Regulations [CFR] Part 328.3).

Areas delineated as non-wetland waters may lack wetland vegetation or hydric soil characteristics. Hydric soil indicators may be missing, because topographic position precludes ponding and subsequent development of hydric soils. Absence of wetland vegetation can result from frequent scouring due to rapid water flow.

2.4.2 RWQCB Waters of the State

The jurisdiction of RWQCB includes all waters of the state and all waters of the U.S. as mandated by both Section 401 of the federal CWA and the California Porter–Cologne Water Quality Control Act. State waters generally include, but are not limited to, all waters under the jurisdiction of ACOE.

2.4.3 CDFW Waters of the State

Under CFGC Sections 1600–1607, CDFW regulates activities that would divert or obstruct the natural flow or substantially change the bed, channel, or bank of any river, stream, or lake that supports fish or wildlife. CDFW also has jurisdiction over riparian habitats associated with watercourses. Jurisdictional waters of the state are delineated by the outer edge of riparian vegetation or at the top of the bank of streams or lakes, whichever is wider.

2.4.4 MSHCP Riparian/Riverine Habitats

A riparian/riverine habitat assessment was conducted as part of the jurisdictional delineation. Riparian/riverine areas are defined in Section 6.1.2 of the MSHCP as "lands which contain habitat dominated by trees, shrubs, persistent emergent [vegetation], or emergent mosses and lichens, which occur close to or which depend upon soil moisture from a nearby fresh water source; or areas with fresh water flow during all or a portion of the year." Projects are required to "ensure that the biological functions and values of these areas throughout the MSHCP Plan Area are maintained such that Habitat values for species inside the MSHCP Conservation Area are maintained."

The riparian/riverine habitat assessment included an inspection of the Gage Canal and all of the drainage ditches within the survey area. These features were inspected for the presence of riparian habitat as defined above.

3.0 Regulatory Background and Sensitivity Criteria

3.1 Sensitive Biological Resources

For purposes of this report, sensitive vegetation communities are defined per the MSHCP (WRCRCA 2003). Plant and animal species are considered sensitive if they are (1) covered species or Narrow Endemic species under the MSHCP; (2) listed by state or federal agencies as threatened or endangered or are proposed for listing (CDFW 2018b, 2018c, 2018d); or (3) listed as California Rare Plant Rank (CRPR) 1B (considered endangered throughout its range), CRPR 2 (considered endangered in California but more common elsewhere), CRPR 3 (more information about the plant's distribution and rarity needed), or CRPR 4 (plants of limited distribution) by the CNPS Inventory of Rare and Endangered Vascular Plants of California (2018).

3.2 State Regulations

Under CFGC Section 3503, it is unlawful to take, possess, or needlessly destroy the nest or eggs of any bird, except as otherwise provided by this code or any regulation made pursuant thereto. CFGC Section 3503.3 prohibits take, possession, or destruction of any birds of prey or of their nests or eggs (CDFW 1991).

3.3 Federal Regulations

The Migratory Bird Treaty Act (MBTA) was established to provide protection to the breeding activities of migratory birds throughout the United States. The MBTA protects migratory birds and their breeding

activities from take and harassment. Pursuant to U.S. Department of the Interior Memorandum M-37050, the federal MBTA is not currently interpreted to cover incidental take of migratory birds (U.S. Department of the Interior 2017).

3.4 Western Riverside County MSHCP

The MSHCP is a comprehensive multi-jurisdictional habitat conservation plan focusing on the conservation of species and their associated habitats. It is one of several large multi-jurisdictional habitat-planning efforts in southern California with the overall goal of maintaining biological and ecological diversity within a rapidly urbanizing region. The MSHCP allows the County of Riverside and its cities to better control local land use decisions and maintain a strong economic climate in the region while addressing the requirements of the federal Endangered Species Act (WRCRCA 2003). The MSHCP plan area encompasses 1.26 million acres (1,966 square miles), including all unincorporated Riverside County land west of the crest of the San Jacinto Mountains to the Orange County line, as well as the cities of Temecula, Murrieta, Lake Elsinore, Canyon Lake, Norco, Corona, Riverside, Moreno Valley, Banning, Beaumont, Calimesa, Perris, Hemet, Menifee, and San Jacinto.

The MSHCP serves as a habitat conservation plan pursuant to Section 10(a)(1)(B) of the federal Endangered Species Act of 1973, as amended, as well as a Natural Community Conservation Plan under the Natural Community Conservation Planning Act of 2001. The MSHCP is used to allow the participating jurisdictions to authorize "take" of plant and wildlife species identified within the plan area. USFWS and CDFW have authority to regulate the take of threatened, endangered, and rare species. Under the MSHCP, USFWS and CDFW will grant "Take Authorization" for otherwise lawful actions, such as public and private development, that may incidentally take or harm individual species or their habitat outside the MSHCP Criteria Area in exchange for the assembly and management of a coordinated MSHCP Criteria Area (WRCRCA 2003).

The MSHCP was published for public review in November 2002. On June 17, 2003, the County of Riverside Board of Supervisors adopted the MSHCP, certified the Environmental Impact Report/Environmental Impact Statement, and authorized the Chairman to sign the Implementing Agreement. The plan has been approved and implemented by the permitting agencies. The City of Riverside is a permitting agency.

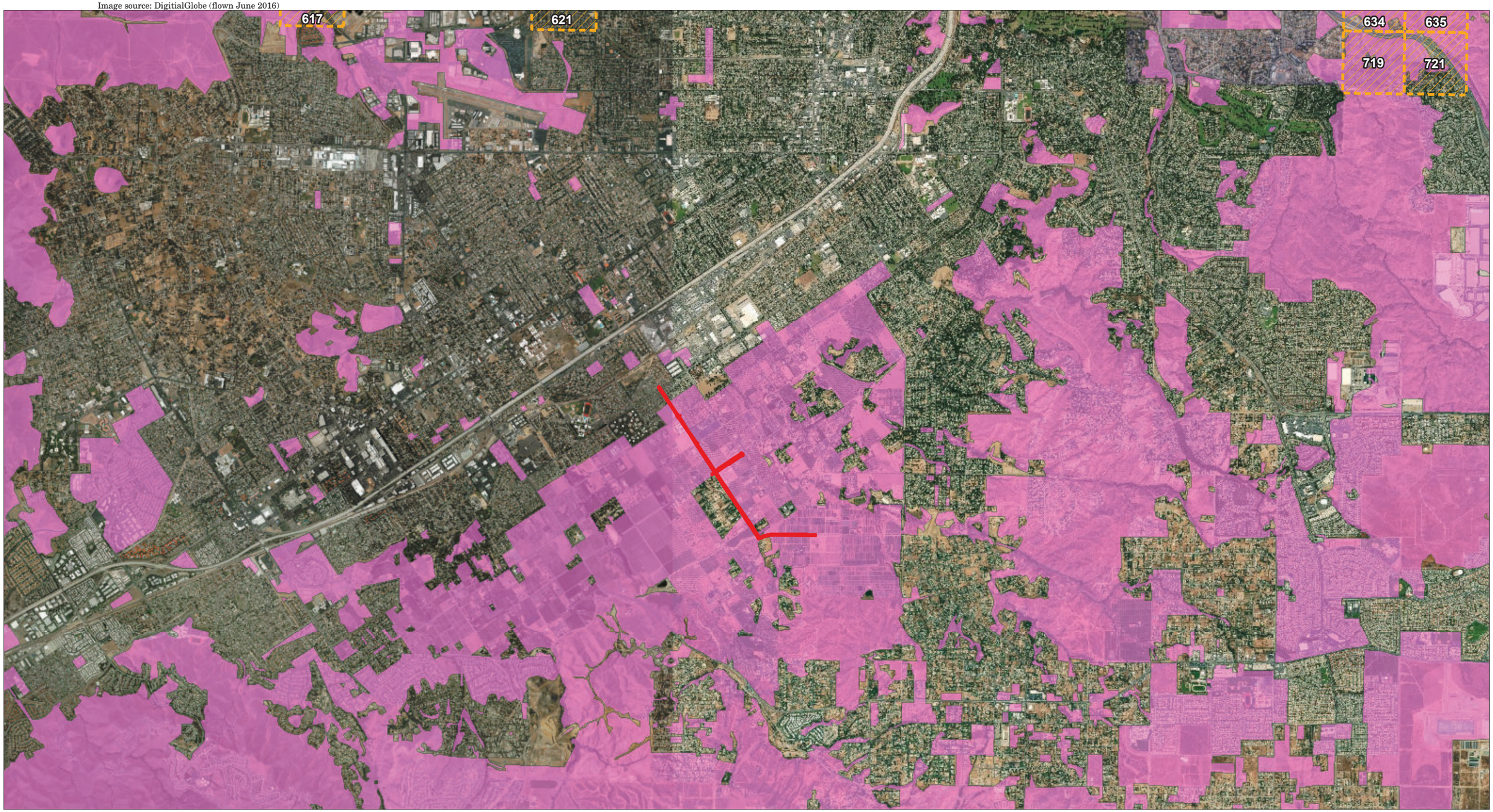
The survey area is located outside any Core Area, Criteria Cell, or Conservation Area identified for conservation potential by the MSHCP (Figure 4; WRCRCA 2003). However, the survey area is located within the Burrowing Owl Survey Area designated by the MSHCP and, as such, is required to comply with the burrowing owl habitat assessment survey requirements identified in the MSHCP (Figure 4; WRCRCA 2003).

3.5 Habitat Conservation Plan for Stephens' Kangaroo Rat

In 1996, USFWS approved the long-term Habitat Conservation Plan (HCP) for SKR in Western Riverside County, California (hereafter referred to as the SKR HCP) and granted an incidental take permit for Riverside County covering an estimated 30,000 acres of occupied habitat within eight member cities: Perris, Temecula, Murrieta, Lake Elsinore, Corona, Riverside, Moreno Valley, and Hemet (RCHCA 1996). The plan authorizes the incidental take of half of the occupied habitat remaining in the HCP plan area while using development fees to implement the plan, purchase private property, and create a reserve system. The SKR HCP and corresponding permits are in effect for areas covered by the MSHCP; however, the SKR HCP and the MSHCP remain separate. The SKR Fee Area is subject to mandatory conservation measures as outlined in the SKR HCP (RCHCA 1996) and as subsequently modified.

The survey area occurs within the SKR Fee Area (see Figure 4; RCHCA 1996); however, as the project is not a new development, it would not be subject to the SKR Preservation Fee. Additionally, the habitat on-site does not provide suitable habitat for SKR, as detailed in Section 4.5, and is not part of an SKR Core Reserve, and the project would not be subject to SKR surveys per the SKR HCP.

Image source: DigitialGlobe (flown June 2016)



0 Feet 4,000

Project Boundary

Burrowing Owl Survey Area

Criteria Cells

RECON

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Note: Entire figure is within the Stephens' Kangaroo Rat Fee Area.

FIGURE 4

Project in Relation to MSHCP Areas

4.0 Existing Conditions

4.1 Topography and Soils

The project site and the surrounding neighborhood were graded historically for citrus orchards. As a result, topography within the survey area is nearly flat, with elevations gradually increasing from north to south. The low elevation is approximately 860 feet above mean sea level near the intersection of Gratton Street and Lincoln Avenue at the northwestern portion of the survey area, and the high elevation is 1,060 feet above mean sea level on Hermosa Drive at the southeastern end of the survey area.

Three soil series, Arlington fine sandy loam, Arlington loam, and Buren fine sandy loam, are mapped within the site (USDA 1971). Arlington fine sandy loam is present in the southern portion of the site, south of the Gage Canal. Arlington loam and Buren fine sandy loam are present in alternating swaths throughout the remainder of the site.

4.2 Vegetation Communities

A total of five vegetation communities were mapped within the survey area: oak woodland, non-native grassland, open water/reservoir/pond, orchard/grove, and residential/urban/exotic (Table 1; Figures 5a–c). A description of each community is provided in Sections 4.2.1 through 4.2.5 below.

Table 1
Vegetation Communities within the Survey Area

Vegetation Community	Acres
Oak woodland	0.35
Non-native grassland	17.76
Open water/reservoir/pond	0.46
Orchard/grove	148.40
Residential/urban/exotic	129.37
TOTAL	**296.34**

4.2.1 Oak Woodland

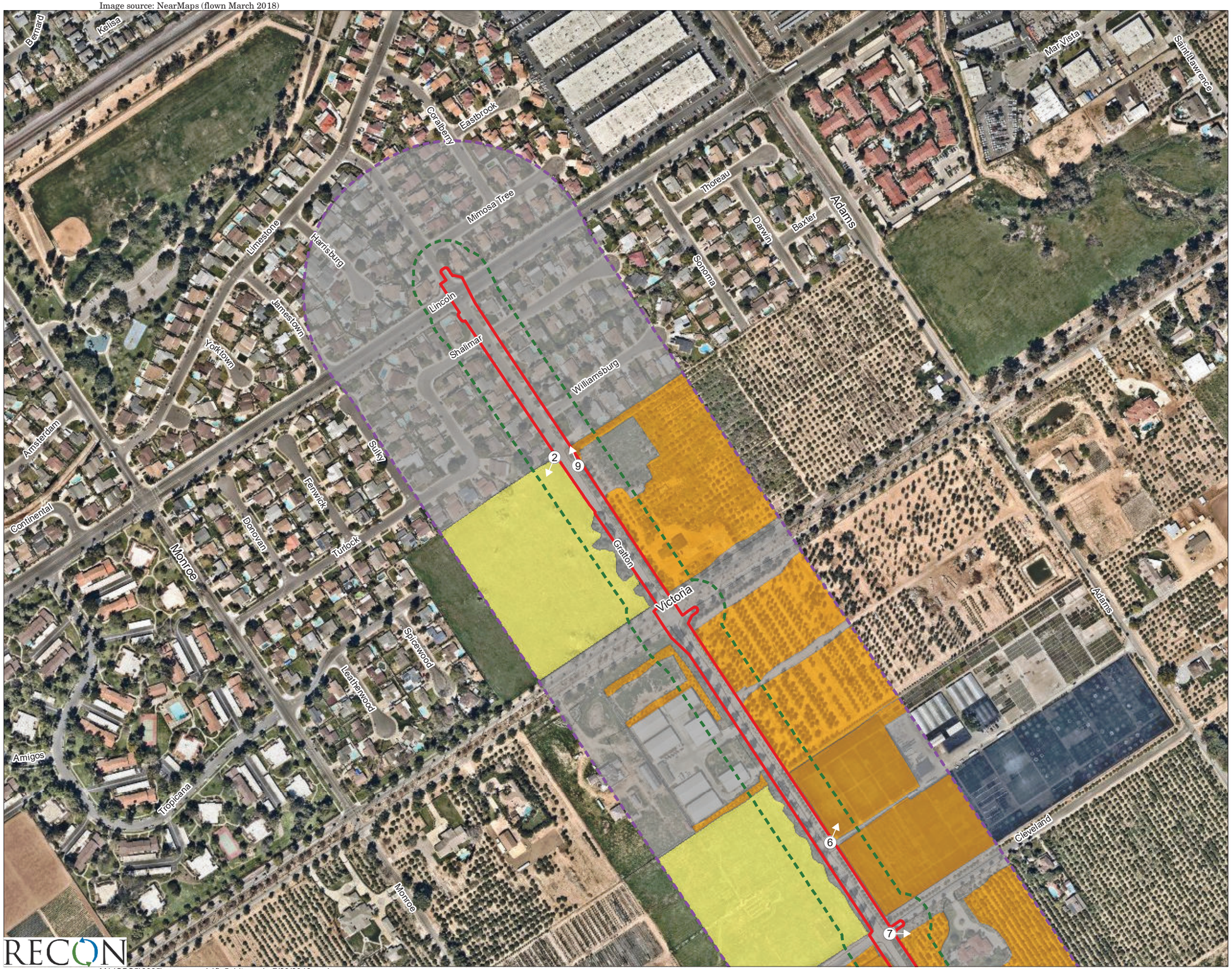
Oak woodland is a vegetation community dominated by coast live oak (*Quercus agrifolia*) trees. It occurs in the coastal slope of southern California and is typically found on north-facing slopes and shaded ravines. This plant community occurs in the outer South Coast Ranges and on coastal slopes of Transverse and Peninsular ranges, usually below 4,000 feet (Holland 1986). Oak woodland is dominated by native trees and has potential to support nesting birds, including raptors, and it is targeted for conservation by the MSHCP. Therefore, it would be considered a sensitive vegetation community.

Within the survey area, there is one small patch of oak woodland located at the southeastern corner of a fenced yard on the east side of Gratton Street, just north of the Gage Canal and Hermosa Drive (Photograph 1). This area consists of approximately five coast live oak trees mixed with two Peruvian pepper (*Schinus molle*) trees. It is bounded by residential/urban/exotic areas (including a patch of eucalyptus trees and graded, disturbed areas associated with the adjacent single-family residence) to the west and north. Dirt roads border the patch to the south and east, and the Gage Canal is located approximately 25 feet to the southeast. Although oak woodlands have potential to support nesting raptors and other birds, the habitat value of this patch is reduced due to its small size and location within a fenced yard.

4.2.2 Non-native Grassland

Non-native grassland is characterized by a cover of exotic annual grasses reaching up to three feet in height. Typically, non-native grasses comprise at least 50 percent of the herbaceous layer, often intermixed with annual forbs. Although it is dominated by non-native species, this vegetation community has potential to provide habitat for western burrowing owl as well as native rodents and the raptors that feed upon them. It is a conserved habitat under the MSHCP and is therefore considered sensitive.

Image source: NearMaps (flown March 2018)



Detail Area

a

b

c

Project Features

- Project Impacts
- Western Burrowing Owl Habitat Assessment Area
- Survey Area
- Photo Point

Vegetation Community/Land Cover Types

- Non-native Grassland
- Grove/Orchard
- Residential/Urban/Exotic

0 Feet 350

RECON

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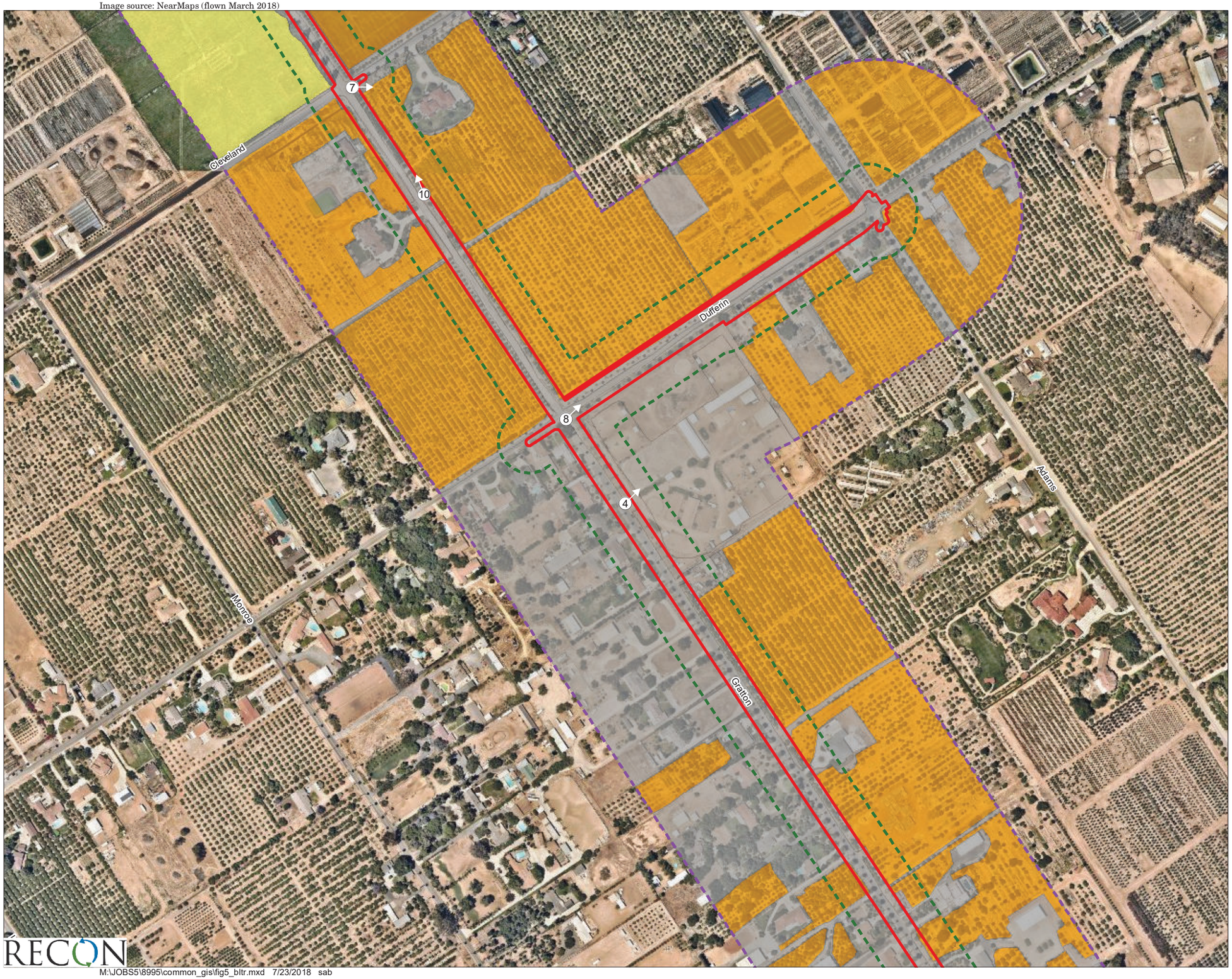
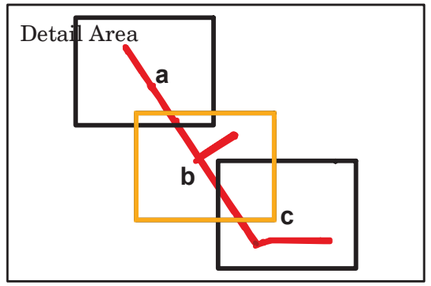
FIGURE 5a
Existing Biological Resources and Project Impacts

Image source: NearMaps (flown March 2018)





Project Features

- Project Impacts
- Western Burrowing Owl Habitat Assessment Area
- Survey Area
- Photo Point

Vegetation Community/Land Cover Types

- Non-native Grassland
- Grove/Orchard
- Residential/Urban/Exotic

0 Feet 350

RECON

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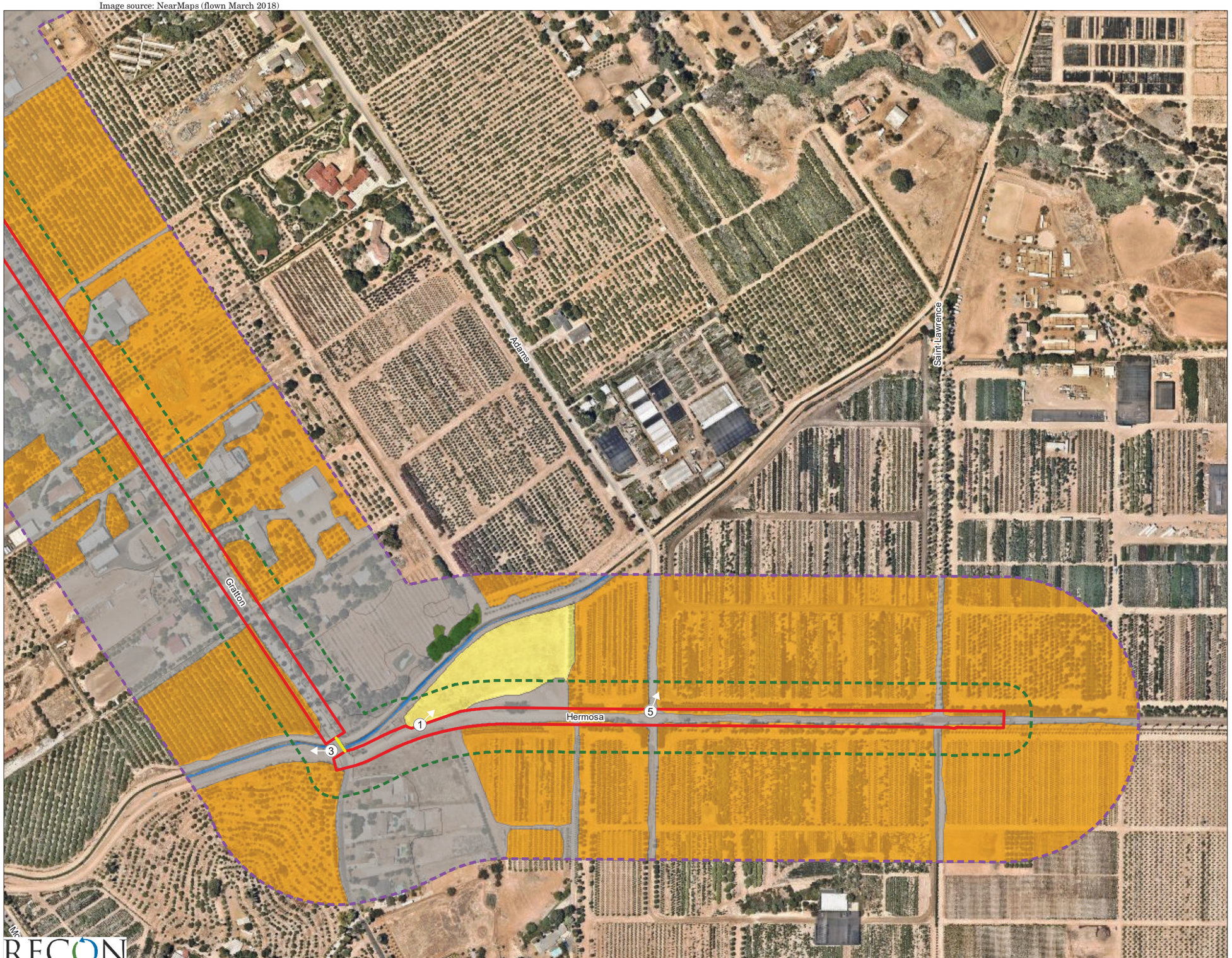
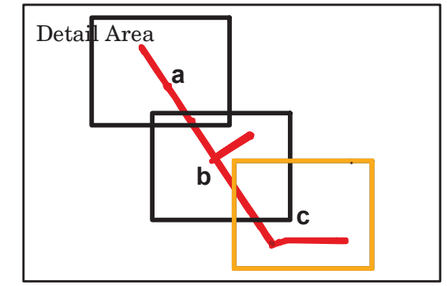
FIGURE 5b
Existing Biological Resources and Project Impacts

Image source: NearMaps (flown March 2018)





Project Features

- Project Impacts
- Underground Pipeline
- Western Burrowing Owl Habitat Assessment Area
- Survey Area
- Photo Point

Vegetation Community/Land Cover Types

- Oak Woodland
- Non-native Grassland
- Open Water/Reservoir/Pond
- Grove/Orchard
- Residential/Urban/Exotic

0 Feet 350

RECON

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FIGURE 5c
Existing Biological Resources and Project Impacts

Non-native grassland occurs in three patches within the survey area, all of which are on undeveloped parcels. Two patches are on the west side of Gratton Street, and one is on the north side of Hermosa Street. Photographs 1 and 2 show examples of the non-native grassland within the survey area. Although dominated by non-native species, non-native grasslands can support abundant rodent populations, which provide foraging habitat for raptors. Non-native grasslands have potential to support western burrowing owls, although no sign of the species was observed during the general survey or habitat assessment.

4.2.3 Open Water/Reservoir/Pond

Open water/reservoir/pond consists of inland depressions, ponds, lakes, reservoirs, and stream channels containing standing water and often occur in conjunction with riparian and upland vegetation communities. Generally, such areas have less than 10 percent vegetation cover; however, they may contain green algae, phytoplankton, and floating plants. Open water/reservoir/pond is targeted for conservation within the MSHCP and is considered sensitive.

Within the survey area, this vegetation community was mapped within the Gage Canal. Although no plants were present within the canal, there was a moderate accumulation of long filamentous green algae (Photograph 3). The Gage Canal is a manufactured, concrete lined irrigation canal and does not meet the definition of a riparian/riverine habitat.

4.2.4 Orchard/Grove

Areas mapped as orchard/grove consist of the numerous areas planted with fruit or nut trees within the survey area, as well as several nurseries. These areas are typically irrigated areas that are maintained and treated for weeds. As a result, they have little or no understory vegetation, and the areas are subject to periodic human disturbance and herbicide application.

Orchards are one of the most common land uses within the survey area. Citrus trees (*Citrus* sp.) are the most common species within the orchards in the survey area, with one grove of avocado (*Persea americana*) just southwest of the intersection of Gratton Street and Hermosa Drive. The orchards within the survey area are largely unvegetated, with the exception of large trees and very scattered non-native grasses and forbs. Photograph 4 provides a view of a typical citrus orchard.

The nurseries support a wide variety of ornamental trees and shrubs in large container boxes (Photograph 5), as well as smaller flowering plants maintained under shade structures (Photograph 6). The space surrounding the container boxes is largely bare, with only scattered weeds. Overall, orchard/grove areas are subject to periodic maintenance and disturbance, and have very low vegetation cover with the exception of the large box trees. As a result, they provide little habitat value to native wildlife.

4.2.5 Residential/Urban/Exotic

Residential/urban/exotic land is mapped within the survey area where there are graded or paved roads, buildings, disturbed areas, and exotic vegetation (e.g., street trees, a patch of eucalyptus trees, ornamental landscaping). This vegetation community includes a horse ranch located at the corner of Gratton Street and Dufferin Avenue. The ranch consists primarily of bare ground, with areas of landscaping, paddocks, and a ranch house (Photograph 7).

A variety of ornamental trees occur throughout the residential/urban/exotic areas, including numerous Peruvian pepper, magnolia (*Magnolia* sp.), gum trees (*Eucalyptus* sp.), Canary Island pine (*Pinus canariensis*), Canary Island palm (*Phoenix canariensis*), queen palm (*Syagrus romanzoffiana*), Mexican fan palm (*Washingtonia robusta*), and shamel ash (*Fraxinus uhdei*).

PHOTOGRAPH 1
View of Oak Woodland, Facing Northeast from Across Non-native Grassland
Immediately North of the Gage Canal

PHOTOGRAPH 2
View of Non-native Grassland, Facing South-Southwest from Gratton Street
200 Feet South of Williamsburg Place

PHOTOGRAPH 3
View of the Gage Canal, a Concrete-Lined Canal with Flowing Water,
Facing West from Gratton Street

PHOTOGRAPH 4
View of a Typical Citrus Orchard, Facing East from the
Intersection of Gratton Street and Cleveland Avenue

PHOTOGRAPH 5
View of a Nursery Featuring Box Trees, Facing North at the Intersection of Hermosa Drive and Adams Street

PHOTOGRAPH 6
View of a Nursery Located on the Northeast Side of Gratton Street, Between Victoria Avenue and Cleveland Avenue

PHOTOGRAPH 7

View of the Horse Ranch Located Southeast of the Intersection of Gratton Street and Dufferin Avenue

Additionally, there are numerous disturbed areas that no longer function as native or naturalized vegetation communities. Such areas include bare ground or areas vegetated with opportunistic exotic or ruderal species. Common weedy plant species found in these disturbed areas include sow-thistles (*Sonchus* spp.), London rocket (*Sisymbrium irio*), Russian thistle (*Salsola tragus*), white sweetclover (*Melilotus albus*), long-beak filaree (*Erodium botrys*), cheeseweed (*Malva parviflora*), and numerous non-native grasses.

Residential/urban/exotic is not considered a sensitive habitat, although larger exotic trees may provide perching or nesting opportunities for native birds.

4.3 Jurisdictional Wetlands and Waters and MSHCP Riparian/Riverine Areas

4.3.1 ACOE Jurisdictional Waters

No areas within the survey area satisfied the criteria for ACOE wetlands or non-wetland waters of the U.S. (Figures 6a–b). The Gage Canal occurs in the southeastern portion of the survey area, crossing under a bridge at Gratton Street (see Figure 6b; see Photograph 3). Culvert structures adjacent to the bridge convey irrigation water and/or runoff northwest across and above the canal but do not drain into the canal itself. Flow within the Gage Canal is regulated by a series of locks to fulfill the irrigation demands of the surrounding agricultural land-uses. The canal terminates near California Citrus State Historic Park, where water is pumped into the municipal water system. The Gage Canal is a concrete irrigation canal constructed within uplands and, while it has upstream connectivity with the Santa Ana River, it does not serve as a tributary to any traditional navigable waterway. Therefore, the Gage Canal is not anticipated to be considered a non-wetland water of the U.S.

At the time of the survey, water was also flowing from east to west in an irrigation ditch along the southern side of Dufferin Avenue from Adams Street to Gratton Street (Photograph 8). At this intersection, the flowing water then crossed through a culvert under Dufferin Avenue and continued north along the eastern side of Gratton Street until the water emptied into an engineered retention basin and culvert between Victoria Avenue and Lincoln Avenue (Photograph 9). There were several locations along Gratton Street where the ditch ended and water was diverted onto the road (see Photographs 9 and 10). Other ditches and portions of Gratton Street appear to convey irrigation water occasionally, including within a concrete channel above the Gage Canal as described above, but were dry at the time of the survey. As defined under the ACOE Regulatory Guidance Letter (RGL) 07-02 (ACOE 2007), an irrigation ditch is man-made and "conveys water to an ultimate irrigation use or place of use" do not fall under the jurisdiction of ACOE. As the irrigation ditch and associated culvert and retention basin facilities within the survey area meet this definition, they are not anticipated to be under the jurisdiction of ACOE.

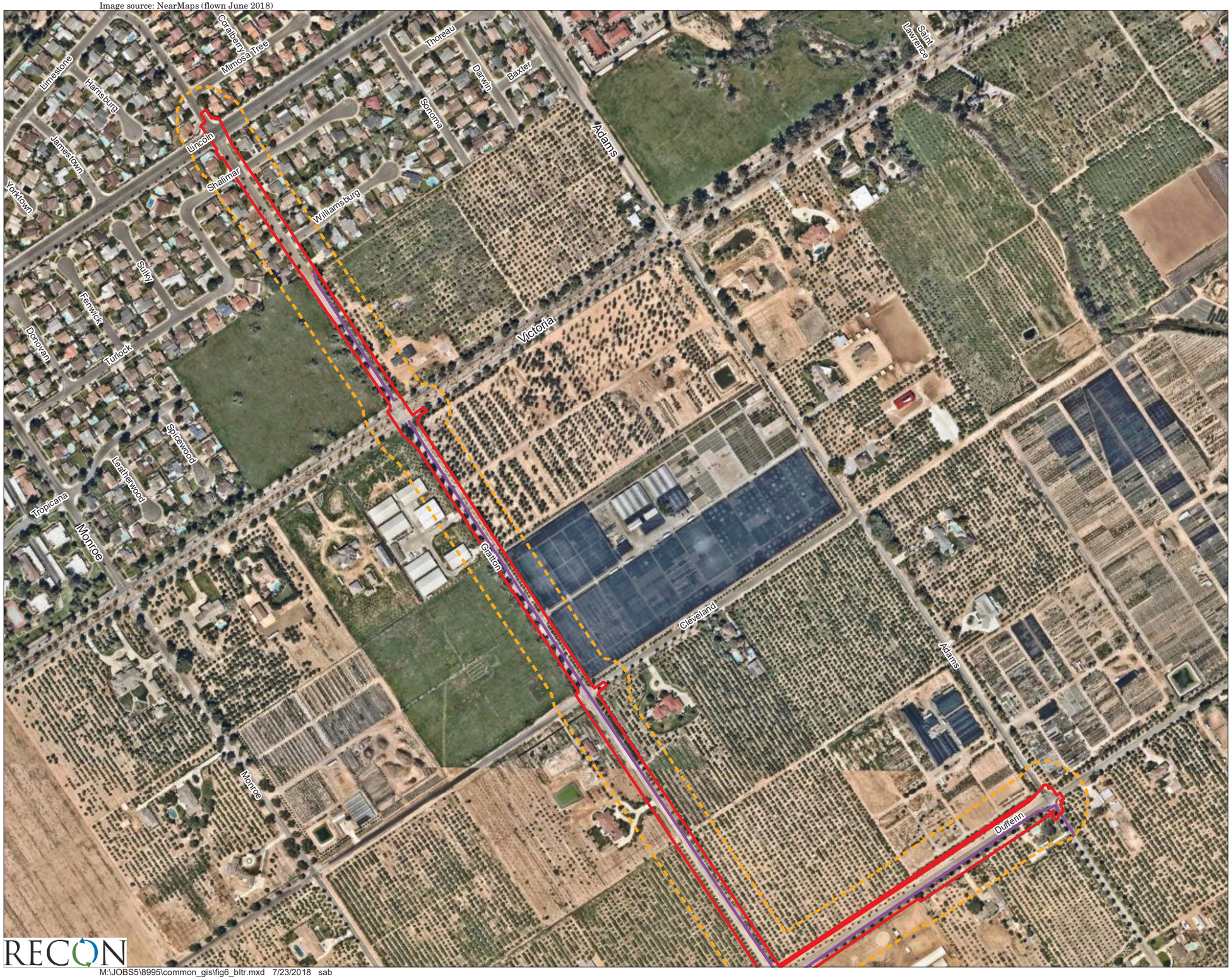
4.3.2 CDFW Waters of the State

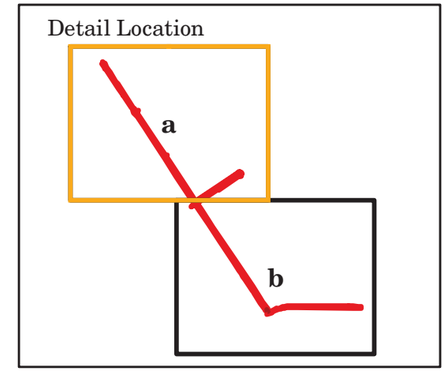
No areas that are expected to be under the jurisdiction of the CDFW were delineated within the survey area, because no natural water channels or riparian areas occur within the wetland survey area. The Gage Canal is an artificial waterway that does not provide substantial habitat to fish or wildlife.

4.3.3 RWQCB Waters of the State

Neither the Gage Canal nor the irrigation ditches are expected to meet the definition of waters of the state or waters of the U.S. Therefore, no areas under the jurisdiction of the RWQCB are anticipated to occur within the survey area.

Image source: NearMaps (flown June 2018)





Project Features

- Project Boundary
- Survey Area
- Irrigation Ditch

Note: No ACOE, RWQCB, or CDFW jurisdictional wetlands or waters, or MSHCP riparian/riverine areas were delineated within the survey area.

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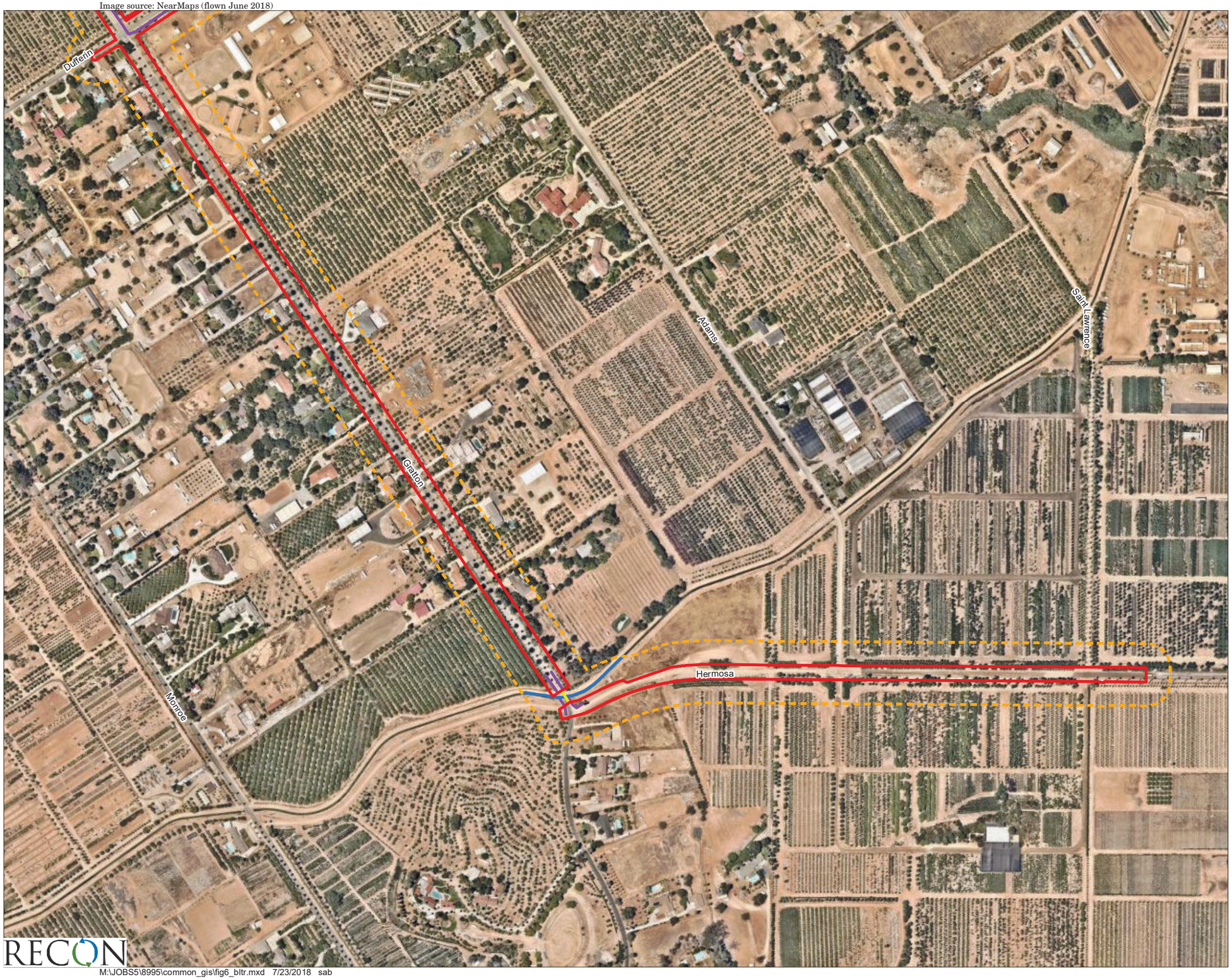
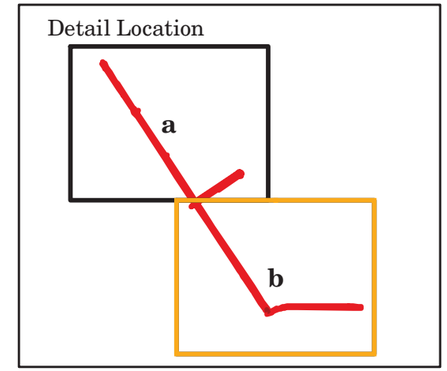
FIGURE 6a

Jurisdictional Delineation

Image source: NearMaps (flown June 2018)





Project Features

- Project Boundary
- Underground Pipeline
- Survey Area
- Gage Canal
- Irrigation Ditch

Note: No ACOE, RWQCB, or CDFW jurisdictional wetlands or waters, or MSHCP riparian/riverine areas were delineated within the survey area.

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FIGURE 6b

Jurisdictional Delineation

PHOTOGRAPH 8
View of Irrigation Ditch on East Side of Gratton Street,
Facing North from Intersection with Dufferin Avenue

PHOTOGRAPH 9
View of Irrigation Ditch on Northeast Side of Gratton Street,
Water Flowing into an Underground Basin and Culvert

PHOTOGRAPH 10
View of Irrigation Flows Where Water has been Diverted
Out of a Ditch and onto Gratton Street

4.3.4 MSHCP Riparian/Riverine Areas and Vernal Pools

The Gage Canal is situated in a concrete channel and supports little vegetation and no riparian habitat. Similarly, the numerous drainage ditches are manufactured concrete, asphalt, and earthen structures designed to transmit water for agricultural purposes. Although these features contain fresh water flow for a portion of the year, artificially created features are excluded from the riparian/riverine definition per Section 6.1.2 of the MSHCP. Moreover, this section of the MSHCP is intended to provide protection for conserved species that occur in riparian habitats and vernal pools. The Gage Canal and irrigation ditches within the survey area do not support natural habitat and do not provide any habitat value for listed or sensitive species.

No vernal pools or vernal pool species were detected within the survey area. The biological survey was conducted in late April 2018, and there had been no precipitation recorded at the nearest reported weather station (Arlington Heights, Station KCARIVER18) since March 17, 2018 (Weather Underground 2018). Given the below average precipitation for the 2017-18 rainy season, no ponding would likely have been evident at the time of the survey. Nonetheless, the three patches of non-native grassland and all open, disturbed land within the residential/urban/exotic areas were visually inspected and no vernal pools, depressions or features with potential to support vernal pools or fairy shrimp were detected. The non-native grassland occurs on graded, undeveloped pads that historically supported citrus orchards. As such they are not expected to support vernal pools or fairy shrimp.

4.4 Plant Species

A total of 48 plant species was observed within the survey (Attachment 1). As expected given the developed and disturbed nature of the project area, the majority (41) of these species are non-native.

No sensitive plant species were observed within the survey area. Only one sensitive plant species, Coulter's goldfields (*Lasthenia glabrata* ssp. *coulteri*) has been recorded within two miles of the survey area (CDFW 2018a). Coulter's goldfields is an annual herb that generally occurs in salt marsh, riparian and vernal pool habitats. The nearest record of this species was reported in 1989 within a willow riparian setting approximately one mile south of the survey area. No suitable habitat is present within the survey area, and given the urban agricultural setting and ongoing human activities, this species is not expected to occur.

4.5 Wildlife Species

A total of 22 wildlife species was detected within the survey area, including 2 arthropod, 2 reptile, 13 bird, and 5 mammal species (Attachment 2). The majority of the wildlife detected during the survey consists of urban-adapted species that can persist in developed or agricultural areas.

4.5.1 Sensitive Wildlife Species Observed

Two sensitive wildlife species were detected within the survey area: turkey vulture (*Cathartes aura*) and northern harrier (*Circus hudsonius*). Both of these species were observed flying overhead during the survey and did not land or clearly forage within the survey area.

Turkey Vulture. Turkey vulture is an MSHCP covered species, but it is not state or federally listed. It occurs in a wide variety of habitats, as it soars on wind currents in search of carrion. It nests primarily in caves or boulder crevices on steep, rocky slopes (Unitt 2004). This species was observed briefly flying at high elevation over the survey area. It has moderate potential to occasionally forage within the non-native grassland on the site, but the prevalence of developed areas, nurseries, and orchards within the survey area reduce the overall habitat value for this species. This species may occasionally forage within the survey area, but is not expected to nest there due to the lack of steep, rocky slopes with suitable nest sites.

Northern Harrier. The northern harrier is a CDFW species of special concern (nesting) and an MSHCP covered species. This species commonly nests on the ground in tall grasslands and in dense vegetation in

fields, often in the vicinity of marshes (Dechant et al. 2003; Unitt 2004). Northern harriers forage in grasslands, agricultural fields, and coastal marshes (MacWhirter and Bildstein 1996). One northern harrier was observed flying overhead near the intersection of Gratton Street and Hermosa Drive, near a patch of non-native grassland. There are three isolated patches of non-native grassland within the survey area that may provide marginal quality foraging habitat but the patches are largely too small and habitat too low and open to provide suitable nesting habitat. Thus, northern harrier has moderate potential to forage but is not expected to nest within the survey area.

4.5.2 Sensitive Wildlife Species with Potential to Occur

A total of 15 additional sensitive wildlife species have been reported within two miles of the survey area (Table 2). Western burrowing owl, Swainson's hawk (*Buteo swainsoni*), San Diego black-tailed jackrabbit (*Lepus californicus bennettii*), SKR, and San Bernardino kangaroo rat (*Dipodomys merriami parvus*) all are known to use non-native grasslands or could occur in small patches of urban woodlands, and are discussed below. The remaining species do not have potential to occur within the survey area due to the lack of natural habitats.

Table 2
Sensitive Wildlife Species Reported within Two Miles of the Project Survey Area

Species	Sensitivity Status*
Coastal whiptail (*Aspidoscelis tigris stejnegeri*)	WL, MSHCP Covered
Belding's orange-throated whiptail (*Aspidoscelis hyperythra beldingi*)	SSC, MSHCP Covered
Red-diamond rattlesnake (*Crotalus ruber*)	SSC, MSHCP Covered
Coast horned lizard (*Phrynosoma blainvillii*)	SSC, MSHCP Covered
Southern California rufous-crowned sparrow (*Aimophila ruficeps canescens*)	WL, MSHCP Covered
Bell's sage sparrow (*Artemisiospiza belli belli*)	WL, MSHCP Covered
Western burrowing owl (*Athene cunicularia hypugaea*)	SSC, MSHCP Covered
Swainson's hawk (*Buteo swainsoni*)	ST, MSHCP Covered
Coastal California gnatcatcher (*Polioptila californica californica*)	FT, SSC, MSHCP Covered
Least Bell's vireo (*Vireo bellii pusillus*)	FE, SE, MSHCP Covered
Western yellow bat (*Lasiurus xanthinus*)	SSC
Pocketed free-tailed bat (*Nyctinomops fermorosaccus*)	SSC
San Diego black-tailed jackrabbit (*Lepus californicus bennettii*)	SSC, MSHCP Covered
Stephens' kangaroo rat (*Dipodomys stephensi*)	FE, SE, MSHCP Covered
San Bernardino kangaroo rat (*Dipodomys merriami parvus*)	FE, SSC, MSHCP Covered
*Note: FE = Federally listed as Endangered, FT = federally listed as threatened, SE = state-listed as endangered, ST = state listed as threatened, SSC = state species of special concern.	

Western burrowing owl. Western burrowing owl is a state species of special concern and is an MSHCP covered species. It occurs in grassland and open scrub habitats, especially where there are abundant ground squirrels or other moderate-sized rodents, whose burrows the owl uses for shelter and nesting. The nearest records of this species appear to be in the large areas of undeveloped land one mile south and two miles east of the survey area (CDFW 2018a).

The majority of the land within the habitat assessment area consists of orchards, nurseries, horse ranches, developed land, and disturbed or landscaped areas. The orchards and nurseries are largely unvegetated, with the exception of large trees and very scattered non-native grasses and forbs. While agricultural areas are known to be used by western burrowing owl, the sparsity of vegetation and highly disturbed nature of these active facilities within the survey area make them unsuitable for western burrowing owls.

The horse ranch is characterized by bare ground with graded dirt paddocks, several horse training rings, ornamental landscaping, and a single-family home. A small patch of land in the northern portion of the property, along Dufferin Avenue has a sparse cover by non-native grasses and forbs, but this area is too limited to provide suitable habitat for western burrowing owls.

The rest of the residential/urban/exotic areas within the survey area consist of residential development, landscaped yards and a combination of paved and dirt roads. These areas do not provide suitable habitat for western burrowing owls. Some of the disturbed areas along the road edge look superficially suitable for burrows, but these areas occur only in narrow strips along and are generally bounded by more intensive land uses. Overall, the developed nature of these areas makes them unsuitable for western burrowing owls.

Small patches of oak woodland and eucalyptus trees occur on the property just north of the intersection of Gratton Street and Hermosa Drive, but these areas are not sufficiently open to provide suitable habitat for western burrowing owls.

There are three patches of non-native grassland within the habitat assessment area that contain marginally suitable habitat for western burrowing owl. These three areas (one northwest of the intersection of Gratton Street and Victoria Avenue, one northwest of the intersection of Gratton Street and Cleveland Avenue, and one north of Hermosa Drive near the intersection with Gratton Street) total 17.76 acres and range in size from 3.10 to 7.35 acres. These patches are isolated from one another and from any off-site grasslands by a series of residential development, nurseries, citrus orchards, and horse ranches. Although each of these patches could not be surveyed directly on foot, good visual coverage was possible due to the lack of tree or shrub cover. These three patches of non-native grassland are flat, with little topographic variation, and no hillocks or berms. One rodent burrow was observed on the eastern edge of the northernmost patch of non-native grassland, and California ground squirrel (*Spermophilus beecheyi*) was observed in a nearby nursery. However, the external opening of the burrow was too small for burrowing owls. A patch of the residential/urban/exotic land characterized by a mix of exotic annual forbs and grasses occurs along Hermosa Drive and on the private property south of the southern patch of non-native grassland. The portion on the private property is dominated by non-native forbs and grasses but is frequently mowed by the landowner, making it largely unsuitable. The disturbed strip of land along the road, outside the private property, contains evidence of Botta's pocket gopher (*Thomomys bottae*) burrows, but none that were suitable be usable by western burrowing owls. This strip is also very limited in area and occurs along a frequently-traveled road.

Although non-native grassland was identified within the survey area, no western burrowing owls, suitable burrows, or owl sign were detected during the habitat assessment, which was conducted during the owl breeding season. Each of the isolated patches of non-native grassland was too small to support western burrowing owls alone, and the developed nature of the surrounding land between the patches makes it unlikely for owls to use multiple patches in combination. In addition, the project has been specifically designed occur within existing roadways and to avoid non-native grassland. As a result, burrowing owl focused surveys are not recommended.

Swainson's hawk. Swainson's hawk is state listed as threatened and is an MSHCP covered species. It is strongly tied to riparian systems, where it nests in tall trees, especially cottonwoods and sycamores (Unitt 2004). No suitable riparian woodlands are present in the survey area. A patch of oak woodland and adjacent eucalyptus trees occur on a private property adjacent to a patch of non-native grassland. These areas are small and subject to frequent human activity. The woodland habitats are expected to provide only low quality habitat for nesting, so breeding is not expected. The non-native grassland provides potential foraging opportunities for Swainson's hawk, so this species may occasionally forage in the survey area.

San Diego black-tailed jackrabbit. San Diego black-tailed jackrabbit is a state species of special concern and an MSHCP covered species. It occurs in open scrub habitats, grasslands, and agricultural fields. The nearest record of this species is approximately two miles to the southwest, within a large undeveloped swath of rolling hills dominated by Riversidean sage scrub, saltbush scrub, and non-native grassland. Within the survey area, there are three patches of non-native grassland; however, these areas have few or no shrubs to provide cover for jackrabbits, and they are isolated from other areas of grassland or other native habitats, making them of only marginal value for the species. Therefore, this species has low potential to occur in the survey area.

Stephens' kangaroo rat. SKR is federally listed as endangered, state listed as threatened, and an MSHCP covered species. It occurs in grasslands and open sage scrub habitats with abundant open ground. It is generally found on friable soils in which this species can create suitable burrows. The nearest records of this species are in three large patches of hilly, undeveloped land dominated by open sage scrub and non-native grassland: one located approximately 1 mile to the south, the second 2 miles to the southwest, and the third 3 miles to the east of the survey area. Although the species is present in the general vicinity of the project, the habitat in the survey area is too disturbed to provide suitable habitat. Additionally no sign of kangaroo rats was detected during the survey. Therefore, this species is not expected to occur in the survey area.

San Bernardino kangaroo rat. San Bernardino kangaroo rat is federally listed as endangered and is an MSHCP covered species. It occurs primarily in alluvial fans and flood plains with sandy loam soils suitable for digging burrows. The nearest record of this species is a museum specimen collected in 1952 at a general locality described as "Casa Blanca,"which located approximately 0.75 mile northeast of the survey area; however, based on a review of recent aerial photography, the area appears to have been developed. No suitable habitat for San Bernardino kangaroo rat occurs in the survey area, and no sign of kangaroo rats was detected, so this species is not expected to occur.

4.6 Wildlife Movement

Section 3 of the MSHCP identifies the MSHCP Conservation Area, including Core Areas, Linkages, and Non-contiguous Habitat Blocks. The survey area is not located within the boundaries of any of these features. No Linkages or Non-contiguous Habitat Blocks are present near the survey area. Moreover, the overall developed nature and lack of natural habitats within the survey area provide little opportunity for wildlife movement.

5.0 Impacts

5.1 Vegetation Communities

Project implementation would impact a total of 19.50 acres (see Figures 5a–c; Table 3) but was designed to avoid sensitive vegetation communities, partially through the use of a jack-and-bore operation for pipe installation beneath the Gage Canal. Thus, there would be no impacts to oak woodland, non-native grassland, or open water/reservoir/pond vegetation communities.

Table 3 Impacts to Vegetation Communities		
Vegetation Community	Survey Area (acres)	Project Impacts (acres)
Oak woodland	0.35	--
Non-native grassland	17.76	--
Open water/reservoir/pond	0.46	--
Orchard/grove	148.40	2.37
Residential/urban/exotic	129.37	17.12
TOTAL	**296.34**	**19.49**

5.2 Jurisdictional Wetlands and Waters and MSHCP Riparian/Riverine Areas

As no ACOE, RWQCB, or CDFW wetlands or waters, or MSHCP riparian/riverine areas were delineated within the survey area, the project would not result in impacts to any jurisdictional wetlands or waters or riparian/riverine areas.

5.3 Sensitive Plant Species

No sensitive plant species were detected or are expected to occur within the survey area; therefore, none are anticipated to be impacted by the project.

5.4 Sensitive Wildlife Species

5.4.1 Sensitive Wildlife Species Observed

Two sensitive animal species (turkey vulture and northern harrier) were detected during the biological survey; however, neither of these species is expected be impacted by the project. A discussion of these species is presented below.

Turkey Vulture. The turkey vulture that was observed during the biological survey was detected only briefly flying high overhead. This species has moderate potential to occasionally forage over the site but has no potential to nest there. The project consists of improvement of existing storm drain facilities and would not result in loss of potential turkey vulture foraging habitat.

Northern Harrier. As discussed in Section 4.5, northern harrier has moderate potential to forage in the non-native grassland but is not expected to nest within the survey area. Because the project would not impact non-native grassland, it is not expected to result in any removal or destruction of foraging habitat for the species. Because northern harrier is not expected to nest in the survey area, construction activities would not be expected to cause any direct impacts to nesting birds or indirect impacts to the species from lighting, dust, or other construction-related factors.

5.4.2 Stephens' Kangaroo Rat Fee Area

The project would result in a total of 19.49 acres of impacts within the SKR Fee Area. However, the project is not considered new development so it would not be subject to the SKR Preservation Fee.

5.4.3 Raptors and Migratory Birds

Numerous trees that provide suitable nesting opportunities for raptors and migratory birds are present within and adjacent to the project footprint. The project includes removal of approximately 28 orange trees on the north side of Dufferin Avenue. If removal or trimming of trees occurs during the migratory bird breeding season (March 1 to June 30), nesting raptors or migratory birds could be impacted. While the MBTA is no longer interpreted to address incidental take of migratory birds, destruction of active nests

would still be prohibited under CFGC Section 3503. Direct impacts to nesting and migratory birds would be considered significant and require mitigation.

6.0 MSHCP Consistency Analysis

This section demonstrates the compliance of the project with respect to biological aspects of the MSHCP. More specifically, the project was evaluated in respect to Section 6.1.2 (Protection of Species Associated with Riparian/Riverine Areas and Vernal Pools), Section 6.1.3 (Protection of Narrow Endemic Plant Species), Section 6.1.4 (Guidelines Pertaining to the Urban/Wildlands Interface), Section 6.3.2 (Additional Survey Needs and Procedures), and Section 6.7 (Reserve Assembly) of the MSHCP.

6.1 Protection of Species Associated with Riparian/Riverine Areas and Vernal Pools

Section 6.1.2 of the MSHCP provides protections to maintain the biological functions and values of riparian/riverine areas and vernal pools, including those species that occur in them. Riparian/riverine areas are defined as "lands which contain Habitat dominated by trees, shrubs, persistent emergent [vegetation], or emergent mosses and lichens, which occur close to or which depend upon soil moisture from a nearby fresh water source; or areas with fresh water flow during all or a portion of the year."

The Gage Canal and several roadside drainage ditches are present within the survey area; however, these are artificially created features and would therefore not meet the definition of a riparian/riverine area. Nonetheless, the project proposes to bore underneath the Gage Canal, so this feature would not be affected by the project. As discussed in Section 4.3.4 above, no habitat within the survey area is suitable to support vernal pools or fairy shrimp.

The survey area does not support riparian/riverine areas, vernal pools, or vernal pool associated species. Therefore, the riparian/riverine policies under Section 6.1.2 of the MSHCP would not apply.

6.2 Protection of Narrow Endemic Plant Species (Section 6.1.3)

The survey area is not located within a MSHCP Narrow Endemic Plant Survey Area. Therefore, the measures for Protection of Narrow Endemic Plant Species in Section 6.1.3 of the MSHCP would not apply.

6.3 Guidelines Pertaining to the Urban/Wildlands Interface

Section 6.1.4 of the MSHCP addresses guidelines pertaining to the Urban/Wildlands Interface. Specifically, it requires an assessment of potential indirect impacts, including drainage, toxics, lighting, noise, invasives, barriers, and grading/development within the MHPA Conservation Area. As discussed in Section 3.4 of this report, the project is not adjacent to a MSHCP Criteria Area, Criteria Cell, or Conservation Area and would not result in impacts to any natural vegetation community. Therefore, mitigation measures for indirect effects, as addressed in the Urban/Wildland Interface Guidelines, are not required and the project would comply with Section 6.1.4 of the MSHCP.

6.4 Additional Survey Needs and Procedures

In addition to the requirements listed under Section 6.1.3 of the MSHCP for narrow endemic plant species, additional surveys may be needed for certain plant and wildlife species in order to achieve coverage for these species (WRCRCA 2003). The survey area is not located within the MSHCP Additional Survey Areas for amphibians, mammals, or within any Special Linkage Areas but is within the Survey Area for the burrowing owl. Therefore, a burrowing owl habitat assessment was conducted pursuant to the *Burrowing Owl Survey Instructions for the Western Riverside Multiple Species Habitat Conservation Plan Area* (WRCRCA 2006).

Section 4.4 details the results of the western burrowing owl habitat assessment. No western burrowing owls, suitable burrows, or owl sign were detected during the habitat assessment, which was conducted during the owl breeding season. Non-native grassland was identified within the survey area but outside the project footprint. The non-native grassland occurs in three isolated patches, totaling 17.76 acres, ranging in size

from 3.10 to 7.35 acres. All three patches were historically planted as citrus orchards (Nationwide Environmental Title Research LLC 2018).

The orchards, nurseries, horse ranches, developed, disturbed, and landscaped areas that dominate the survey area were determined not to be suitable for western burrowing owls, Each of the patches of non-native grassland was too small to support burrowing owls alone, and the developed nature of the surrounding land between the patches makes it unlikely for owls to use the patches in combination. In addition, the project has been specifically designed occur within existing roadways and avoid non-native grassland. Therefore, western burrowing owl would not be impacted by the project and focused surveys are not considered necessary.

In conducting the habitat assessment for this species, the project would be in compliance with Section 6.3.2 of the MSHCP.

6.5 Reserve Assembly

The survey area is located outside any Criteria Cell or other Core Area, Linkage, Non-contiguous Habitat Block, or Conservation Area (Figure 4; WRCRCA 2003). As such, the project would not affect reserve assembly within the MSHCP and would comply with Section 6.7 of the MSHCP.

7.0 Mitigation and Recommendations

As the project has potential to impact nesting raptors and/or migratory birds, avoidance and minimization measures are recommended below Project implementation would not result in impacts to sensitive vegetation communities, species, or jurisdictional wetlands/waters or riparian/riverine areas; therefore, no habitat-based mitigation is required. As the project is not considered new development, it would not be subject to payment of the SKR Preservation Fee.

7.1 Raptors and Nesting Birds.

To remain in compliance with CFGC 3503 and the construction guidelines outlined in MSHCP Section 7.5.3, no direct impacts shall occur to any nesting birds, their eggs, chicks, or nests during the breeding season as mentioned above. Vegetation trimming and clearing should avoid the bird breeding season (March 1 to June 30), to the degree feasible. If vegetation trimming or clearing must occur during the breeding season, a pre-construction clearance survey by a qualified biologist would be required. If nesting birds are detected, measures would be required to verify compliance with CFGC Section 3503 such that take of birds or eggs or disturbance of breeding activities is avoided. Potential measures may include establishing an appropriate buffer area around the nesting site (500 feet for raptors, 300 feet for other bird species) until young have fledged or the nest is inactive. If no nesting birds are detected during the pre-construction survey, no additional measures would be required.

With implementation of the mitigation measures and recommendations described above, all project impacts would be avoided or reduced to below a level of significance. If you have any questions, please do not hesitate to contact me via phone at 619-308-9333 x109 or by email at bparker@reconenvironmental.com.

Sincerely,

Brian Parker
Biologist/Associate Project Manager

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9.0 Preparers and Persons/Organizations Contacted

This Biological Resources Letter Report was prepared by RECON biologists Brian Parker, Andrew Smisek, and Brenna Ogg; production specialist, Jennifer Gutierrez; production specialist, Stacey Higgins; and geographic information system (GIS) specialist, Sean Bohac. The project team has been in contact with Ms. Swetaben Patel, City of Riverside engineer and project manager.

ATTACHMENTS

ATTACHMENT 1

Attachment 1 Plant Species Observed			
Scientific Name	Common Name	Habitat	Origin
GYMNOSPERMS			
CUPRESSACEAE	**CYPRESS FAMILY**		
Cupressus sempervirens	Italian cypress	RES	I
PINACEAE	**PINE FAMILY**		
Pinus canariensis	Canary Island pine	RES	I
ANGIOSPERMS: MAGNOLIIDS-LAURALES			
LAURACEAE	**LAUREL FAMILY**		
Magnolia sp.	magnolia	RES,	I
Persea americana	avocado	ORC	I
ANGIOSPERMS: MONOCOTS			
AGAVACEAE	**AGAVE FAMILY**		
Yucca elephantipes	giant yucca	RES	I
ARECACEAE	**PALM FAMILY**		
Phoenix canariensis	Canary Island palm	ORC, RES	I
Syagrus romanzoffiana	queen palm	RES	I
Washingtonia robusta	Mexican fan palm	ORC, RES	I
CYPERACEAE	**SEDGE FAMILY**		
Carex sp.	sedge	RES	N
POACEAE (GRAMINEAE)	**GRASS FAMILY**		
Avena sp.	oats	NNG	I
Brachypodium distachyon	purple falsebrome	NNG , RES	I
Bromus diandrus	ripgut grass	ORC	I
Bromus madritensis ssp. *rubens*	red brome	ORC, NNG	I
Paspalum dilatatum	dallis grass	RES	I
Poa annua	annual blue grass	RES	I
Polypogon monspeliensis	annual beard grass, rabbitfoot grass	RES	I
STRELITZIACEAE	**BRODIAEA FAMILY**		
Strelitzia sp.	bird of paradise flower	RES	I
ANGIOSPERMS: DICOTS			
ANACARDIACEAE	**SUMAC OR CASHEW FAMILY**		
Schinus molle	Peruvian pepper tree	OW, RES	I
Schinus terebinthifolius Raddi	Brazilian pepper tree	OW	I
ASTERACEAE	**SUNFLOWER FAMILY**		
Lactuca serriola	prickly lettuce	RES	I
Sonchus asper ssp. *asper*	prickly sow thistle	RES	I
Sonchus oleraceus	common sow thistle	ORC, RES	I
BORAGINACEAE	**BORAGE FAMILY**		
Amsinckia menziesii	common fiddleneck, rancher's fireweed	NNG	N
BRASSICACEAE (CRUCIFERAE)	**MUSTARD FAMILY**		
Brassica tournefortii	Sahara mustard	RES	I
Sisymbrium irio	London rocket	NNG, RES	I
CACTACEAE	**CACTUS FAMILY**		
Opuntia ficus-indica	mission prickly-pear, Indian fig	ORC	I
CHENOPODIACEAE	**GOOSEFOOT FAMILY**		
Chenopodium sp.	goosefoot	RES	I
Salsola tragus	Russian thistle, tumbleweed	RES	I

Attachment 1 Plant Species Observed			
Scientific Name	Common Name	Habitat	Origin
EUPHORBIACEAE	**SPURGE FAMILY**		
Euphorbia sp.	spurge	RES	I
FABACEAE (LEGUMINOSAE)	**LEGUME FAMILY**		
Melilotus albus	white sweetclover	NNG, RES	I
Melilotus officinalis	yellow sweetclover	ORC	I
FAGACEAE	**OAK FAMILY**		
Quercus agrifolia	coast live oak, encina	OW	N
GERANIACEAE	**GERANIUM FAMILY**		
Erodium botrys	long-beak filaree	DH	I
Malva parviflora	cheeseweed, little mallow	NNG, DH, ORC	I
MYRTACEAE	**MYRTLE FAMILY**		
Eucalyptus sp.	gum tree	RES	I
MYRSINACEAE	**MYRSINE FAMILY**		
Lysimachia [=*Anagallis*] *arvensis*	scarlet pimpernel	RES	I
OLEACEAE	**OLIVE FAMILY**		
Fraxinus uhdei	shamel ash	RES	I
ONAGRACEAE	**EVENING-PRIMROSE FAMILY**		
Epilobium sp.	willow herb, fireweed	DH	N
PORTULACACEAE	**PURSLANE FAMILY**		
Portulaca oleracea	purslane	ORC	I
PROTACEAE	**PROTEA FAMILY**		
Grevillea robusta	silk oak	RES	I
RUTACEAE	**RUE FAMILY**		
Citrus sp.	orange species	ORC, RES	I
SALICACEAE	**WILLOW FAMILY**		
Salix sp.	ornamental willow	RES	I
SAPINDACEAE	**SOAPBERRY FAMILY**		
Koelreuteria paniculata	goldenrain tree	RES	I
SOLANACEAE	**NIGHTSHADE FAMILY**		
Datura wrightii	western Jimson weed	RES	N
Solanum sp.	nightshade	RES	N
URTICACEAE	**NETTLE FAMILY**		
Urtica sp.	nettle	RES	I
VERBENACEAE	**VERVAIN FAMILY**		
Lantana camara	lantana	RES	I
ZYGOPHYLLACEAE	**CALTROP FAMILY**		
Tribulus terrestris L	puncture vine	RES	I

Notes: Scientific and common names were primarily derived from the Jepson Online Interchange (University of California 2018). In instances where common names were not provided in this resource, common names were obtained from Rebman and Simpson (2014). Additional common names were obtained from the Sunset Western Garden Book (Brenzel 2001) for ornamental/horticultural plants.

HABITATS
OW = Oak woodland
NNG = Non-native grassland
ORC = Orchard/Grove
RES = Residential/Urban/Exotic

ORIGIN
N = Native to locality
I = Introduced species from outside locality

ATTACHMENT 2

Attachment 2 Animal Species Observed			
Scientific Name	Common Name	Occupied Habitat	Evidence
INVERTEBRATES			
TENEBRIONIDAE	**DARKLING BEETLES**		
Not identified to species	darkling beetle	DH, DEV	O
HESPERIIDAE	**SKIPPERS**		
Pyrgus communis	common checkered skipper	DH	O
REPTILES			
COLUBRIDAE	**COLUBRID SNAKES**		
Pituophis catenifer annectens	San Diego gopher snake	DH	O
PHRYNOSOMATIDAE	**SPINY LIZARDS**		
Sceloporus occidentalis	western fence lizard	DH, ORC	O
BIRDS			
CATHARTIDAE	**NEW WORLD VULTURES**		
*Cathartes aura**	turkey vulture	OH	O
ACCIPITRIDAE	**HAWKS, KITES, & EAGLES**		
Buteo jamaicensis	red-tailed hawk	OH	O
*Circus hudsonius**	northern harrier	OH	O
CHARADRIIDAE	**LAPWINGS & PLOVERS**		
Charadrius vociferus vociferus	killdeer	DH, DEV	O, N, V
COLUMBIDAE	**PIGEONS & DOVES**		
Columba livia	rock dove (I)	DEV, DH	O, V
PICIDAE	**WOODPECKERS & SAPSUCKERS**		
Melanerpes formicivorus bairdi	acorn woodpecker	DEV	V
TYRANNIDAE	**TYRANT FLYCATCHERS**		
Tyrannus vociferans vociferans	Cassin's kingbird	EW, DEV	V
CORVIDAE	**CROWS, JAYS, & MAGPIES**		
Corvus corax clarionensis	common raven	ORC, DEV, OH	O, V
MIMIDAE	**MOCKINGBIRDS & THRASHERS**		
Mimus polyglottos polyglottos	northern mockingbird	ORC, DEV	V
STURNIDAE	**STARLINGS & MYNAS**		
Sturnus vulgaris	European starling (I)	ORC, DEV	O, V
EMBERIZIDAE	**EMBERIZIDS**		
Melospiza melodia	song sparrow	ORC	V
FRINGILLIDAE	**FINCHES**		
Spinus [=*Carduelis*] *psaltria hesperophilus*	lesser goldfinch	ORC, DEV, EW	V
Haemorhous [=*Carpodacus*] *mexicanus frontalis*	house finch	ORC, DH, DEV	O, V

Attachment 2 Animal Species Observed			
Scientific Name	Common Name	Occupied Habitat	Evidence
MAMMALS			
SCIURIDAE	**SQUIRRELS & CHIPMUNKS**		
Spermophilus beecheyi	California ground squirrel	AG	O
GEOMYIDAE	**POCKET GOPHERS**		
Thomomys bottae	Botta's pocket gopher	DH	B
MURIDAE	**MICE & RATS**		
Mus musculus	house mouse (I)	NNG	C
CANIDAE	**CANIDS**		
Canis familiaris	domestic dog (I)	AG, DEV	O, V
EQUIDAE	**HORSES & ASSES**		
Equus ferus caballus	domestic horse (I)	AG	O

* = Sensitive species
(I) = Introduced species

HABITATSOW
NNG = Non-native grassland
ORC = Orchard/Grove
RES = Residential/Urban/Exotic

EVIDENCE OF OCCURRENCE
B = Burrow
C = Carcass/remains
N = Nest
O = Observed
V = Vocalization

APPENDIX C
CULTURAL RESOURCES REPORT

RECON

An Employee-Owned Company

August 6, 2018

Ms. Swetaben Patel, P.E.
Senior Engineer
City of Riverside Public Works Department
3900 Main Street, 4th Floor
Riverside, CA 92501

Reference: Cultural Resources Survey for the Monroe Master Drainage Plan Storm Drain Line E, Stages 2 and 3, Storm Drain Line E-2, and Storm Drain Line E-5 (RECON Number 8995)

Dear Ms. Patel:

This letter discusses the results of the cultural resources survey for the Monroe Master Drainage Plan Storm Drain Line E, Stages 2 and 3, Storm Drain Line E-2, and Storm Drain Line E-5. The proposed project includes the construction of approximately 11,200 linear feet of underground storm drain pipe within the Gratton Street, Dufferin Avenue, and Hermosa Drive rights-of-way; removing and rebuilding the existing curb, gutter, and street lights along the east side of Gratton Street between Lincoln Avenue and Victoria Avenue; and a jack-and-bore operation for trenchless pipe installation underneath Gage Canal at the intersection of Gratton Street and Hermosa Drive (Figures 1 through 3). Line E Stages 2 and 3 are located within the Gratton Street right-of-way and will extend approximately 7,600 feet (1.4 miles) from Lincoln Avenue at the north to the Gage Canal at the south. Line E-2 is located within the Hermosa Street right-of-way and will extend approximately 2,200 feet from Gage Canal at the west to St. Lawrence Street at the east. Line E-5 is located within the Dufferin Avenue right-of-way and will extend approximately 1,400 feet from Gratton Street to the west to Adams Street to the east.

Two significant historical resources, Victoria Avenue and the Gage Canal, are within the project area of potential effect (APE). Project design will result in impacts to the existing gutter and curb at the intersection of Gratton Street and Victoria Avenue. These impacts are not considered significant and will not materially alter in an adverse manner the physical characteristics of Victoria Avenue that conveys its historical significance and that justify its inclusion in, or eligibility for, inclusion in the California Register of Historic Resources (CRHR) and City of Riverside registers. No mitigation for impacts to Victoria Avenue are recommended.

Project design proposes to jack and bore under the Gage Canal, which will result in no adverse effects to that resource and will not materially alter in an adverse manner the physical characteristics of the Gage Canal that conveys its historical significance and that justify its inclusion in, or eligibility for, inclusion in the CRHR City of Riverside registers. No mitigation for impacts to Gage Canal are recommended.

Project Location

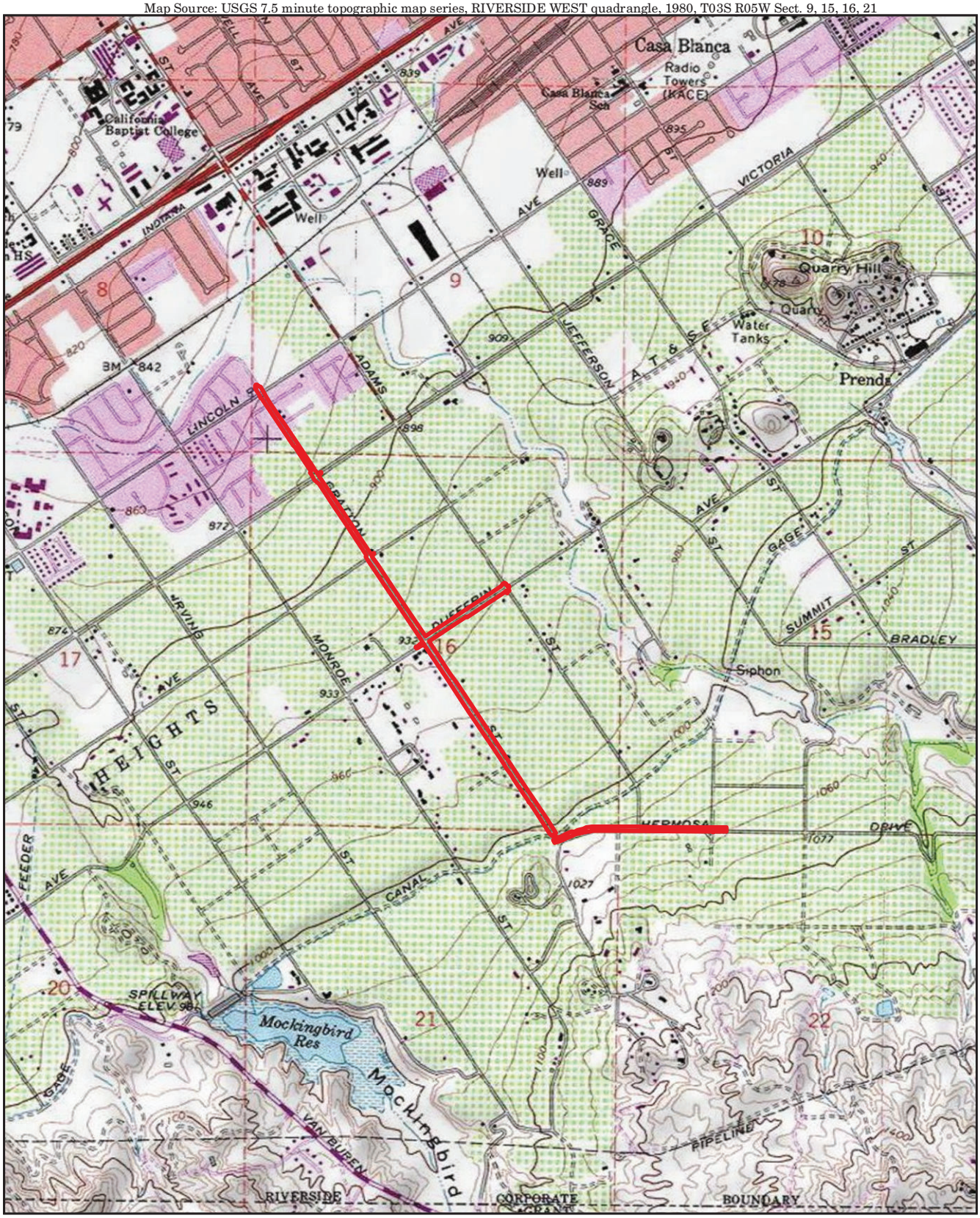
RECON

M:\JOBS5\8995\common_gis\fig1.mxd 5/15/2018 sab

FIGURE 1

Regional Location

Map Source: USGS 7.5 minute topographic map series, RIVERSIDE WEST quadrangle, 1980, T03S R05W Sect. 9, 15, 16, 21



0 Feet 2,000

Project Boundary

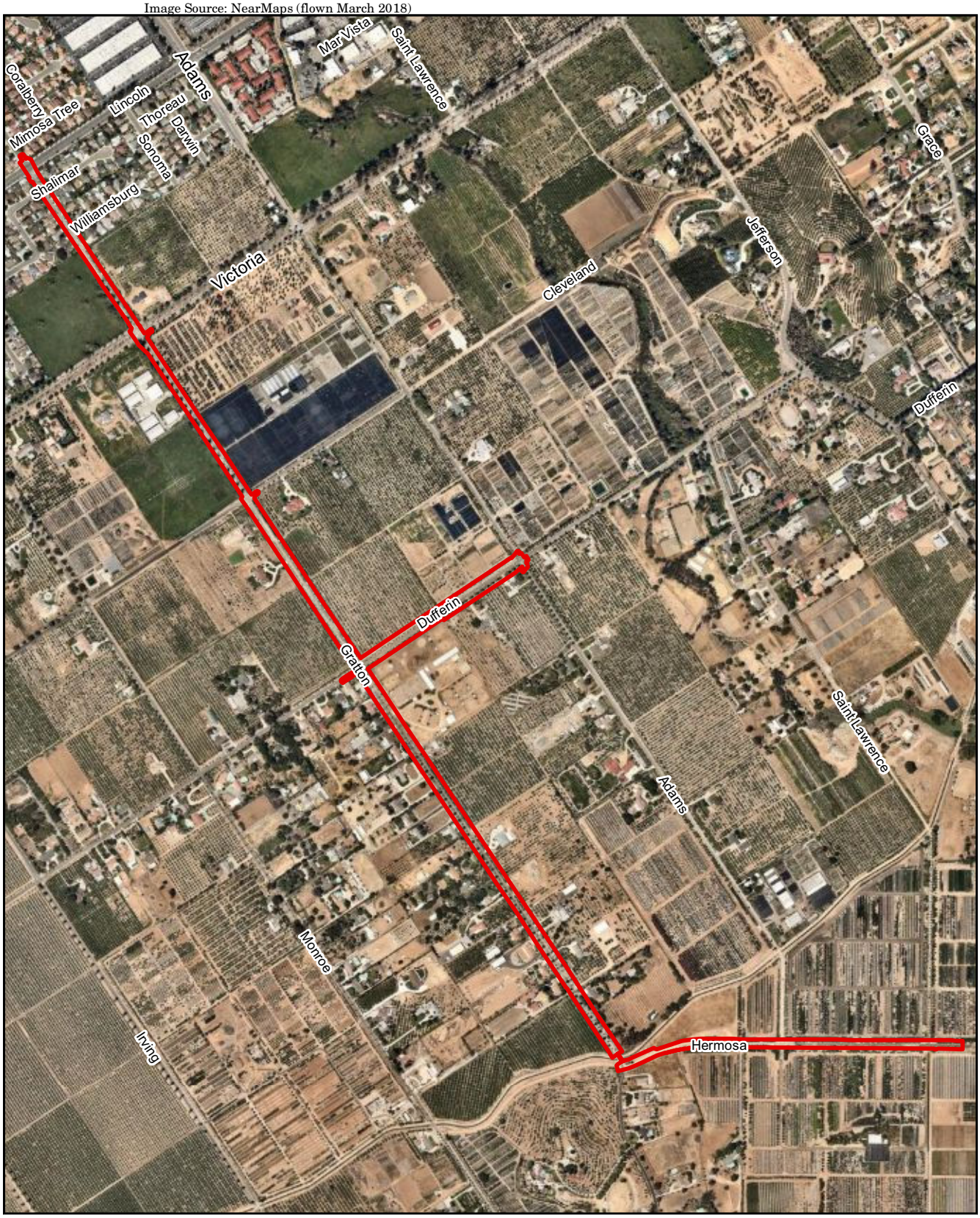
RECON

M:\JOBS5\8995\common_gis\fig2.mxd 6/26/2018 sab

FIGURE 2

Project Location on USGS Map

Image Source: NearMaps (flown March 2018)



0 Feet 1,000

Project Boundary

FIGURE 3

Project Location on Aerial Photograph

RECON

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1.0 Cultural Setting

The following culture chronology for Riverside County is based on a synthesis of the existing literature. This chronology is intended as a general model, which is dynamic and subject to modification as new information is uncovered. The prehistory of western Riverside County has been included as part of the coastal San Diego subregion (Moratto 1984). Consequently, much is made of work completed in San Diego County, to the south.

1.1 Early Holocene (10,000–7,000 B.P.)

The early occupants of the Riverside area are archaeologically represented by a culture pattern known as the Western Pluvial Lakes Tradition (WPLT) (Bedwell 1970). The WPLT includes the Playa, San Dieguito, Lake Mojave, and Death Valley I complexes. It is defined by:

- Site locations being on or near former pluvial lakeshores or along old streams;
- A focus on hunting mammals and collecting and gathering plant materials;
- A toolkit including chipped-stone crescents, large flake and core scrapers, choppers, scraper-planes, hammerstones, several types cores, drills and gravers, and a variety of flakes;
- a developed flaked-stone technology with percussion-flaked foliate knives and points, Silver Lake and Lake Mojave points; and
- A lack of ground stone artifacts.

The WPLT people were adapted to a wetter environment before the warmer climate led to the evaporation of the lakes (Moratto 1984).

1.2 Middle Holocene (7,000 to 1,500 B.P.)

The Millingstone Horizon includes the La Jolla, Pauma, and Sayles complexes (Moratto 1984). Archaeological investigations in the Cajon Pass were used to define the type site (SBR-421) for the Sayles Complex (Kowta 1969). Kowta (1969) defined the Sayles Complex as a variant of the Millingstone Horizon from the vicinity of the Cajon Pass. The Millingstone Horizon assemblages suggest a generalized subsistence focus with an emphasis on hard seeds. This emphasis is indicated by the increased frequency of slab and basin metates and the adoption of a mixed cobble/core-based tool assemblage composed primarily of crudely made choppers, scrapers, and cobble hammerstones. The assemblage is typically dominated by crude, cobble-based choppers, scrapers, and flake knives. Scraper-planes are also abundant, which Kowta (1969) suggests were used to process agave and yucca. Projectile points are relatively rare, but late in the period, Elko type points are occasionally seen. Portable basin and slab metates are relatively plentiful, suggesting an economic focus on gathering plant resources. Mortars and pestles appear in the Millingstone Horizon, suggesting the use of acorns.

1.3 Late Holocene (1,500 B.P. to 1769)

Takic-speaking people from the Colorado River region moved westward into Riverside County (Moratto 1984, Sutton 2009) during the Late Holocene. Cultures representative of this time are the San Luis Rey Complex in northern San Diego County and western Riverside County (Meighan 1954; Moratto 1984; True et al. 1974). First described by Meighan (1954) and based on excavations at Pala, the San Luis Rey Complex is divided into an early phase, San Luis Rey I, and a later phase, San Luis II. San Luis Rey I sites are associated with bedrock outcrops and often have recognizable midden soils. Features may include cremations and bedrock mortars. The artifact assemblage includes metates, Cottonwood Triangular type projectile points, drills, bifacially flaked knives, bone awls, occasional steatite arrow shaft straighteners, and bone and shell ornaments (True and Waugh 1981). San Luis Rey II sites consist of the same assemblage with the addition of Tizon Brown ware ceramics, red and black pictographs, cremation remains in urns, and historic materials such as glass beads and metal objects. The projectile points commonly found in San Luis

Rey assemblages, Cottonwood Triangular and less frequently Desert Side-notched forms, are both smaller than earlier types, suggesting the introduction of bow-and-arrow technology into the region.

1.4 Ethnography

The project vicinity includes an area where the traditional territories of the Cahuilla, Luiseño, and the Gabrieliño intersect, according to Kroeber (1970) and Bean and Smith (1978).

The Cahuilla are one of the most southwesterly of the Uto-Aztecan speakers. They are members of the Takic branch of this large language family. Traditional Cahuilla territory originally included western and part of central Riverside County and extended into northeastern San Diego and northwestern Imperial counties. The western boundary generally followed the Santa Ana, Elsinore, and Palomar mountains. The northern boundary extended north of Riverside to the San Gabriel and San Bernardino mountains. Cahuilla territory extended east to include the Coachella Valley and down the valley as far south as the approximate middle of the Salton Sea. The approximate southern territorial limits included Borrego Springs and the south end of the Santa Rosa Mountains. The Cahuilla territory consisted of the Mountain, the Pass or Western, and the Desert divisions (Bean 1978; Hooper 1920:316; Strong 1929).

According to Kroeber (1925), Cahuilla society consisted of two ceremonial divisions or moieties: wildcat and coyote. People were further divided into somewhat localized, patrilineal clans. Each clan had a chief (net in Cahuilla) (Kroeber 1925:691). Some villages contained people of only one clan, but other villages had more than one clan. Also, people of one clan might live in more than one village. Chiefs were usually chosen by heredity. They were primarily concerned with economic issues such as determining where and when people should gather particular foods or hunt game, and for the correct maintenance of the ritual aspect of the clan. Choice hunting and gathering areas were owned by the clan. The clan chief also settled intraclan disputes and met with other chiefs to solve interclan problems and organize ceremonies among clans.

The Luiseño are Takic-speaking populations that were found in northern San Diego, southern Orange, and western Riverside counties from the onset of ethnohistoric times through the present day according to ethnographic accounts (Bean and Shipek 1978). Takic languages are part of the Uto-Aztecan language family. According to the Pechanga Band of Luiseño Indians, the Luiseño ancestral territory reached as far northeast as the Santa Ana River and the Box Springs Mountain Range, as far east as Mount San Jacinto, as far southeast of Lake Henshaw, and to the west including the Southern Channel Islands. Present-day Luiseño view is that the world was created in an area known as Temecula, and that Luiseño people have been in this area since the beginning of time (Earp-Escobar 2018). The Luiseño are linguistically and culturally related to the Gabrieliño and Cahuilla and appear to be the direct descendants of Late Prehistoric populations. The basic unit of Luiseño social structure was the clan triblet. The triblet was composed of patrilineally related people who were politically and economically autonomous from neighboring triblets. Unlike other Takic-speaking tribes that surround them, the Luiseño do not appear to have been organized into exogamous moieties (descent groups that married outside one's birth group), but may have been loosely divided into mountain-oriented groups and ocean-oriented groups (Bean and Shipek 1978). One or more clans would reside together in a village (Oxendine 1983). A heredity village chief held a position that controlled economic, religious, and warfare powers (Bean and Shipek 1978).

The Gabrieliño are Cupan speakers. The Cupan languages are part of the Takic family, which is part of the Uto-Aztecan linguistic stock. Their tribal territory included the watersheds of the Los Angeles, San Gabriel, and Santa Ana rivers, all of the Los Angeles Basin, the coast from Aliso Creek in the south to Topanga Creek in the north, and the islands of San Clemente, San Nicholas, and Santa Catalina. Villages or triblets were politically autonomous and made up of different lineages. Each lineage had its own leader and would seasonally leave the village to collect resource items. The Gabrieliño traded with the Serrano to the east. They traded their coastal shell through middlemen to the interior of southern California and the Southwest. Steatite from Santa Catalina was their main trade item.

1.5 Historic Period

The Spanish Period in California (1769 to 1821) represents a time of European exploration and settlement. Military and religious contingents established the San Diego Presidio and the San Diego Mission in 1769, San Carlos Borromeo (Carmel) in 1770, and San Gabriel Arcangel in 1771. The vicinity of Riverside was part of the San Gabriel Mission (Lech 2004).The opening of the mission system created the need to link Alta California with Sonora. After some explorations along the lower Colorado River by Padre Francisco Garcés, Juan Bautista de Anza of Tubac was commissioned to open up a road across the Colorado Desert to San Gabriel and on to Monterey. The first de Anza Expedition took place between 1774 and 1775. Anza stopped in the vicinity of present-day Riverside at an Indian Village along the Santa Ana River southwest of Mount Rubidoux (Hoover et al. 2002). The de Anza Trail, as it became known, passed through present-day Borrego Springs, then part of Cahuilla territory (Lawton 1976:48).

Most scholars suggest that the Spanish mission system usually, but not always, used forced Native American labor to produce goods and provide services needed for European settlement (Forbes 1982; Hurtado 1988; McWilliams 1973; Castillo 1978; Rawls and Bean 1998). The mission system also introduced horses, cattle, sheep, and agricultural goods and implements, and provided new construction methods and architectural styles. Many Native American lands were taken over by the Spanish for cattle grazing. Also with the arrival of the Spanish came devastating epidemics and very high death rates (Cook 1976).

The Mexican Period (1821 to 1848) retained many of the Spanish institutions and laws. In 1824, Santiago Arguello, an officer of the San Diego Presidio, discovered San Felipe Valley, which opened a route through what is today known as Warner Springs. This route, which became known as the Sonora Road, soon became the official Mexican mail route (Lawton 1976). There were two branches of this route in Riverside County: one (San Bernardino Sonora Road) split at Aguanga and continued north along the western base of the San Jacinto Mountains and the other (Colorado Road) went west and then northwest through the Santa Ana Mountains valley (Hoover et al. 2002). Cattle ranching still dominated the economy, and the development of the hide and tallow trade with New England merchant ships increased during the early part of the Mexican Period. The Spanish mission system was secularized by the Mexican government, and these lands allowed for the dramatic expansion of the rancho system. Two ranchos are within approximately three miles of the western end of the project. The closest rancho to the study area was Rancho El Sobrante de San Jacinto, a rancho of approximately 49,000 acres granted to Maria del Rosario Estudillo de Aguirre in 1846. After the Mexican-American War, Maria filed a claim for the rancho with the Public Land Commission, and the grant was finally patented to her in 1967. Later the grant was purchased by a group mostly connected with the U.S. Land Office. Rancho El Sobrante is approximately 1 mile to the southwest of the study area. Rancho La Sierra (Sepulveda), approximately 3 miles west of the project, was originally granted to Vicenta Sepulveda in 1846. The original grant was for 17,774 acres, and included what is now Norco and the western end of the City of Riverside. In the early 1900s, after several owners, Willits J. Hole bought the majority of Rancho La Sierra (Sepulveda) and established the Hole Ranch. The Hole Ranch was divided into four specialized farms: A, B, C, and D, with ranch headquarters on Ranch B.

In the 1830s and 1840s, an increasing number of Americans were settling in California and the Southwest, and in 1836 Texas declared its independence. In February 1846, Texas was annexed by the United States, triggering the Mexican–American War (Texas State Historical Association 2001). Americans in northern California revolted and declared an independent California Republic, which ceased to exist three weeks later, when U.S. naval forces took Monterey on July 7, 1846. The California part of the war ended in Los Angeles on January 13, 1848, and the Treaty of Guadalupe Hidalgo, ending the greater conflict, was signed on February 2, 1848. California became a state in 1850.

American influence in the Riverside area began slowly, but the construction of the transcontinental railroad in 1869 spurred a great influx of homesteaders, developers, and speculators. The discovery of tin southeast of the project vicinity (Cajalco/Temescal) in 1852 also encouraged immigration into the area. The Southern California Colony Association, headed by John W. North, founded the City of Riverside in the early 1870s. The first orange trees were planted in 1871, and by 1882 a quarter of a million orange trees had been

planted in the area. To supply water to the citrus groves, several canal systems, such as the Gage and Riverside canals, were built. The Gage Canal was a development of Matthew Gage, an émigré originally from Ireland, who moved to Riverside in 1877 with his wife. Gage acquired land in the area and realized the possibility of increasing the value of his holdings by introducing a water source for irrigation. Gage, along with William Irving, and Gage's brother Robert, began work on a canal in 1885 (National Park Service [NPS] Form). The first canal section, completed in 1886, was 12 miles long, and a second 8-mile-long section was completed in 1888 (NPS Form). The citrus industry, fed by canals, grew rapidly and established some of the landscapes still existing in Riverside today. The first railroad in the project vicinity was the Santa Fe connecting Los Angeles with San Bernardino in 1885.

In 1883, the City of Riverside was incorporated. The County of Riverside was created in 1893 from a small (590 square miles) but wealthy part of San Bernardino County and a large (6,044 square miles) part of San Diego County. The Gage Canal contributed to the major expansion of the City of Riverside's original boundaries, development of new subdivisions, and the further expansion of the citrus industry in the 1880s. Matthew Gage continued to expand his land holdings in the Riverside area, and in 1889 began work on a subdivision in the foothills west of the Gage Canal that he named Arlington Heights (California Department of Parks and Recreation 1992). The official subdivision map for the 6,000-acre Arlington Heights was recorded on July 27, 1890 (NPS form). A bridge was constructed across Tequesquite Arroyo to provide access from the new subdivision to downtown Riverside. The bridge connected to Victoria Avenue. Victoria Avenue was designed as a centerpiece of Gage's new subdivision and grading was completed in 1892 (NPS 2000). Victoria Avenue was planned as a two-lane, divided, 120-foot-wide palm-lined thoroughfare. Each traffic lane, originally unpaved, was approximately 19 feet wide, with a 36-foot-wide central median set aside for a streetcar line (NPS 2000). The Riverside Trust Company hired prominent landscape gardener Franz Philip Hosp to landscape Victoria Avenue. The landscape design Hosp developed for Victoria Avenue was characterized by the planting of vista-defining tall evergreen species within the right-of-way. In 1924, Lilla Mylne began a campaign to add ragged robin roses to the landscaping of Victoria Avenue. Planting began in 1924 and continued into the 1930s.

Beginning in 1928 Victoria Avenue began to be referred to as a parkway. A parkway was defined by Charles H. Chaney, a planning consultant for the City of Riverside, as a "route limited to passenger vehicles and made exceptionally agreeable as a route of pleasure travel by every possible means, but especially by the feeling of openness that comes only with plenty of width and by an ample enframement of trees, shrubs, and other plantations in the parallel wide sidewalk areas." Chaney specifically singled out Victoria Avenue as a typical parkway (NPS 2000).

Western Riverside County agriculture continued to prosper and expand. In 1895, the City of Riverside was the wealthiest city per capita in the United States due to the citrus industry, which expanded rapidly due to the development of refrigerated railroad cars and innovative irrigation systems. Because the City of Riverside attracted wealthy tourists, the development of first-class luxury hotels was advocated. Early examples were the Arlington, Reynolds, and Glenwood hotels (Lech 2007). By 1903, the Glenwood hotel had been replaced by the Mission Inn, a National Historic Landmark (No. 71), a California Historic Landmark (No. 761), and listed on the National Register of Historic Places (NRHP). The Mission Inn remains an outstanding example of Mission Revival architecture in downtown Riverside.

During the 1920s and 1930s, agriculture continued to be the main economic engine in Riverside County. Businesses, hotels, and theaters increased in the City of Riverside. La Sierra College was founded by the Seventh-day Adventists in 1927. After World War II, residential tracts and commercial developments boomed. The completion of State Route 91 in the late 1950s increased opportunities for growth of business and residential development (Tibbet et al. 2008). Riverside experienced a population boom in the 1950s and 1960s that took the City from a small agrarian society to full-fledged cityhood.

2.0 Methods

RECON performed a record search at the California Historical Resources Information System, Eastern Information Center at the University of California, Riverside (EIC) (Confidential Attachment 1). Compiled archival information from EIC included known sites and isolates from any prior investigations within a one-mile radius of the survey areas. The Native American Heritage Commission (NAHC) was also contacted via a sacred lands search letter requesting the identification of spiritually significant and/or sacred sites or traditional use areas.

The survey area was inspected for evidence of archaeological materials such as debris, flaked and ground stone tools, ceramics, milling features, and human remains. Areas around previously recorded sites were inspected to determine if any notable changes had taken place. The survey area was photographed to document environmental setting, identifying surrounding landmarks and general conditions.

3.0 Archival Research Results

The record search shows a total of 54 cultural resources recorded within 1 mile of the survey areas. Of these, three cultural resources are recorded within the project survey areas. These are CA-RIV-11361, a 6.1-mile-long section of Victoria Avenue, CA-RIV-4768, the Gage Canal, and P-33-17367, the Dufferin Avenue Water Line. These three resources are discussed below. All 54 cultural resources are shown on Table 1, at the end of this letter. The results of the record search are included as Confidential Attachment 1. Copies of the site forms are available upon request.

CA-RIV-11361 (P-33-11361) is a 6.1-mile-long section of Victoria Avenue. Victoria Avenue, completed in 1892, is a divided residential boulevard with extensive landscaping associated with the development of Arlington Heights. Prominent landscape gardener Franz Philip Hosp was hired to design the landscaping for Victoria Avenue. Victoria Avenue is on the NRHP (#00001267) and California Register of Historical Places, and is City of Riverside Cultural Heritage Landmark Number 8. Victoria Avenue was listed on the National Register under Criteria A and C, as a defining element of Riverside's historic citrus landscape. Its Area of Significance is community Planning and Development and its Period of Significance is from 1892 to the 1930s. The project intersects Victoria Avenue at the Gratton Street/Victoria Avenue intersection.

CA-RIV-4768 (CA-RIV-4768/3605/3508/3509/3491/4813H) is the Gage Canal, a 20.13-mile canal beginning at the Santa Ana River and terminating at the Mockingbird Reservoir. The Gage Canal is City of Riverside Cultural Heritage Landmark #24. The Gage Canal was a development of Matthew Gage, an émigré originally from Ireland, who moved to Riverside in 1877 with his wife. Gage acquired land in the area and realized the possibility of increasing the value of his holdings by introducing a water source for irrigation. Gage, along with William Irving and Gage's brother Robert, began work on a canal in 1885 (California Department of Parks and Recreation 1992). The first canal section, completed in 1886, was 12 miles long and a second, 8-mile-long section was completed in 1888. The project crosses the canal approximately 60 feet north of the intersection of Gratton Street and Hermosa Drive.

P-33-17367, the Dufferin Avenue Water Line is an approximately 2.7-mile-long segment of underground water lines. The lines, a 10-inch steel pipe and a section of 6-inch steel pipe installed by the Riverside City Municipal Water System in the 1920s. The pipes provided water to the Arlington Heights area of the city. The Dufferin Avenue Water Line was evaluated and determined not eligible for inclusion on the California Register of Historical Resources.

4.0 Native American Consultation

A contact letter initiating Assembly Bill 52 (AB-52) was sent out by the City of Riverside Public Works on April 6, 2018 requesting tribal consultation on the proposed project. Written or email responses were received from the Temecula Band of Luiseño Mission Indians (Pechanga), the Morongo Band of Mission Indians, the Soboba Band of Luiseño Indians, Rincon Band of Luiseno Indians, and the Agua Caliente Band of Cahuilla Indians. Temecula, Morongo, and Soboba requested consultation under AB-52. Rincon

recommended a record search be conducted, but declined to request an AB-52 consultation at that time. The Morongo Band of Mission Indians requested adding a discovery plan in the event that human remains are discovered during construction. The Pechanga Band of Luiseño Mission Indians requested edits to this cultural resource report, which have been completed in this draft of the report. The Pechanga Band also agreed that archaeological and Native American monitors be present during construction. The Agua Caliente Band deferred to Soboba and concluded their consultation efforts. The Soboba Band sent the City a list of mitigation measures that include archaeological and Native American monitors during construction, disposition of artifacts found during construction, protocols for the discovery of human remains, and cultural sensitivity training. A copy of the contact letter from the City of Riverside and the four responses are included as Attachment 1.

RECON contacted the Native American Heritage Commission on May 11, 2018, requesting a search of their Sacred Lands File for information on Native American cultural resources in or adjacent to the project APE. A reply was received on May 14, 2018, stating that a records search was completed and no Native American cultural resources are listed for the area of the APE. The NAHC reply is included as Attachment 2.

Tribal contact letters were also sent out on May 15, 2018 to all groups and individuals listed in the NAHC Sacred Lands Search reply letter. An email reply was received on May 24, 2018 from BobbyRay Esparza, Cultural Coordinator for the Cahuilla Band of Indians. Mr. Esparza requested to be notified of all updates and/or changes with the project moving forward and also request tribal monitors to be present during all ground-disturbing activities as potential cultural resources could possibly be unearthed during construction. The Rincon Band of Luiseño Indians indicated that they did not wish to consult. On June 4, 2018 the Agua Caliente Band of Cahuilla Indians indicated that they defer to Soboba. The Soboba Band of Luiseño Indians requested to be consulted and that a Native American monitor from their cultural resource department be present during ground disturbing proceedings. The Soboba Band also requested that any cultural items (artifacts) be returned to them. An example of the tribal contact letters and the responses are included as Attachment 3.

5.0 Field Survey Results

The cultural resources survey was conducted on May 9, 2018, by RECON archaeologists Richard Shultz and Nathanial Yerka. The survey was done in conditions of clear skies and bright sunlight, with excellent visibility. Since the APE, which corresponds to the right-of-way for the portions of the project along Gratton Road and Hermosa Drive, extends 20 feet or less from the edge of the road it was easily covered in a single transect by the archaeologist. Residential development lines both sides of the northernmost 700 feet of the project on Gratton Street, with sidewalks and formal landscaping (Photograph 1). Ground visibility in this area was very low, averaging less than 10 percent.

The remainder of the project on Gratton Street runs through semi-rural development (Photographs 2 and 3). There are scattered single-family residences and a nursery on the northeast corner of Gratton and Cleveland Avenue. Otherwise, the project runs along the edge of citrus groves. The road shoulder in these areas is mostly dirt with numerous palm and other exotic trees planted along it. South of Dufferin Avenue tall palm trees line both sides of the street. In addition, south of Cleveland Avenue there are numbers of citrus trees planted in the right-of-way alongside the palm trees (Photograph 4). Ground visibility was generally good, averaging 75 percent. The shoulder appears heavily disturbed by previous road construction, tree planting, and access roads.

Only five houses along Gratton Street are over 50 years old. All of these houses are outside the APE and will not be affected directly or indirectly by the proposed project.

PHOTOGRAPH 1
Looking North on Gratton Street Showing Transition to Sidewalks and Landscaped Front Yards

PHOTOGRAPH 2
View of Gratton Street at the Intersection with Cleveland Avenue

PHOTOGRAPH 3
Looking North on Gratton Street Towards Victoria Avenue

PHOTOGRAPH 4
Looking North on Gratton Street Approximately 500 Feet North of the Gage Canal

The right-of-way at the intersection of Gratton Street and Victoria Avenue is predominantly dirt, with asphalt curbs defining the edges of the landscaped median (Photographs 5 and 6). There are no curbs at the outer corners of the intersection. Two 24-inch concrete pipe culverts, one on either side of Gratton Drive, extend under Victoria Avenue at the intersection. There is little landscaping in the median of Victoria Avenue within the APE, but there are large trees on the northwest, southwest, and southeast corners of Gratton Street at the intersection. Ground visibility at the intersection was generally good, averaging 75 to 90 percent. The intersection has been heavily disturbed over the years for maintenance, planting of landscaping, and installation of the culverts.

The approximately 1,400 feet of Dufferin Avenue within the APE has dirt shoulders with open dirt drainage ditches (Photograph 7). The APE on Dufferin Avenue extends 30 feet on either side of the road, and on the north side there is an additional 10 feet of temporary right of entry easement that extends into an orchard. A dirt road runs parallel to the main road in the right-of-way on the north side of the road. The entire south side of the road is lined with palm trees of substantial height planted in the right-of-way, while only the western half of the north side of the road is lined with palm trees. There are two metal culverts crossing under Dufferin Avenue, visible at the southeast corner of its' intersection with Gratton Street. Vegetation cover in the APE is sparse, with few weeds. Ground visibility was very good, averaging 90 percent.

The approximately 2,200 feet of Hermosa Drive within the APE is a dirt road approximately 18 feet wide. Shoulders are dirt with sparse weeds (Photograph 8). Especially on the south side of the road the shoulder is mounded up to a height of approximately 3 feet above the road surface. Between Adams Street and

St. Lawrence Street a large number of boxed palm trees set within the right-of-way, obscuring the ground (Photograph 9). As with Gratton Street, the right-of-way appears heavily disturbed by road maintenance, tree planting, and access roads. Ground visibility averaged 90 percent except in the areas where tree boxes obscured the ground surface.

The Gage Canal is approximately 14 feet wide where Gratton Street crosses. It is approximately 3 feet 7 inches deep, and the sides of the canal slope inward to the canal bottom at an angle of about 45 degrees. The crossing is an at-grade concrete bridge with a welded galvanized pipe guardrail (Photograph 10). There are form board impressions on the exterior of the bridge. There are dirt roads on both the north and south sides of the canal, with a 5 to 6-foot shoulder separating the roads from the canal. On the west side of the bridge is a cast iron water pipe that surfaces to cross the canal and then goes back underground. Approximately 2 feet east of the bridge is a 30-inch-wide concrete aqueduct that carries water from a culvert across the canal. The ends are 6 inches thick and the side walls are 4 inches thick. The culverts feeding into the aqueduct are 24 inches wide and oval in cross section. A second similar aqueduct is set approximately 20 feet west of the bridge (Photograph 11). The entire APE at the Gage Canal crossing is bare dirt and ground visibility was 100 percent.

No previously unrecorded cultural resources were observed within the APE during the survey.

6.0 Interpretation of Resource Significance

The City of Riverside Planning Department's California Environmental Quality Act (CEQA) process requires that cultural resources be evaluated for eligibility for listing in the NRHP, CRHR, and at the local level per Title 20 (Cultural Resource Ordinance) of the City of Riverside Municipal Code.

6.1 Federal

An archaeological or historical property is determined significant if it meets a criterion for listing on the NRHP. The NPS has established a set of criteria, listed below, that historic properties must meet in order to be eligible for or listed in the National Register.

PHOTOGRAPH 5
Looking East on Victoria Avenue at Gratton Street,
Showing Median on Victoria Avenue

PHOTOGRAPH 6
Looking West on Victoria Avenue at Gratton Street

PHOTOGRAPH 7
Looking North on Dufferin Avenue at the Intersection
with Gratton Street

PHOTOGRAPH 8
Looking North on Hermosa Drive from Near the Gage Canal

PHOTOGRAPH 9
Looking South on Hermosa Drive Near St. Lawrence Street

PHOTOGRAPH 10
Gage Canal at the Gratton Street Overcrossing

PHOTOGRAPH 11

Concrete Aqueduct Crossing Gage Canal Adjacent to Gratton Street

The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:

A. that are associated with events that have made a significant contribution to the broad patterns of our history; or

B. that are associated with the lives of persons significant in our past; or

C. that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

D. that have yielded, or may be likely to yield, information important in prehistory or history (36 Code of Federal Regulations 60.4).

To be eligible on the National Register, properties must also have integrity. There are seven aspects of integrity: location, design, setting, materials, workmanship, feeling, and association. For criteria A, B, and C, integrity means that the property must evoke the resource's period of significance to a non-historian or non-archaeologist. Most archaeological sites typically qualify for listing under criterion D. In this case, integrity means that the deposits are intact and undisturbed enough to make a meaningful data contribution to regional research issues.

Victoria Avenue (CA-RIV-11361, P-33-11361) has been determined a significant historical resource. It is on the NRHP (#00001267), is a California Historical Landmark, and is a City of Riverside Cultural Heritage Landmark No. 8. Victoria Avenue was listed on the National Register under Criteria A (associated with events that have made a significant contribution to the broad patterns of our history) and C (embodies the distinctive characteristics of a type, period, or method of construction, or represents the work of a master, or possesses high artistic values,) as a defining element of Riverside's historic citrus landscape. Its Area of Significance is community planning and development and its Period of Significance is 1892 to the 1930s.

CA-RIV-4768/3605/3508/3509/3491/4813H, the Gage Canal, also in the western survey area is a City of Riverside Cultural Heritage Landmark No. 24. The Gage Canal lacks sufficient integrity to be listed on the NRHP. The Gage Canal does retain integrity of location, setting, association, and, in the areas it is still an open canal, integrity of feeling and design. However, it lacks integrity of materials and workmanship, having been cement lined and covered along a substantial portion of its route. The covered areas have also lost integrity of feeling and design.

P-33-17367, the Dufferin Avenue Water Line, was evaluated and determined not eligible for inclusion on the National Register of Historical Places.

6.2 CEQA

Cultural resources that have been evaluated and determined to be eligible for listing in the CRHR are considered historical resources under the provisions of Public Resources Code, Sections 5020.1 and 5024.1. For planning purposes, all of the cultural resources in the survey area that have not yet been evaluated for their eligibility to the CRHR are considered to be historical resources until evaluated, with the exception of cultural isolates.

Section 5024.1(c) of the Public Resources Code addresses CEQA significance criteria. It indicates that a resource is determined significant and may be listed as an historical resource in the California Register if it meets any of the following CRHR criteria:

1. Is associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage.

2 Is associated with the lives of persons important to our past.

3. Embodies the distinctive characteristics of a type, period, construction, or represents the work of an important creative individual, possesses high artistic values.

4. Has yielded, or may be likely to yield, information important in prehistory or history.

In addition to meeting one of the above criteria, a resource must have integrity; that is, it must evoke the resource's period of significance or, in the case of criterion 4, it must retain reliable research data (California Code of Regulations [CCR] Title 14, Chapter 11.5 Section 4852 (c)). Most archaeological sites that qualify for listing do so under criterion 4.

If a project will cause a substantial adverse change in the significance of a historical resource, mitigation is required under CEQA. A substantial adverse change is defined as the physical demolition, destruction, relocation, or alteration of the resource of its immediate surroundings such that the significance of a historical resource would be materially impaired. Avoidance of the historical resource through project redesign is the preferred mitigation measure. If redesign is not feasible, minimizing impacts by limiting the degree of impacts or reducing the impact through construction monitoring are mitigation options.

Victoria Avenue has been previously determined to be a historical resource under CEQA, is listed on the CRHR, and is on the City of Riverside Cultural Heritage Landmark list.

The Gage Canal is a historical resource under CEQA, because of its inclusion on a local register, in this case the City of Riverside Cultural Heritage Landmark list. In addition, the Gage Canal meets criteria 1 and 2 for listing on the CRHR. The Gage Canal meets criterion 1, because it contributed to the major expansion of the citrus industry in the City of Riverside. The Gage Canal meets criterion 2, because of its association with Matthew Gage, a prominent person associated with the development of Riverside.

P-33-17367, the Dufferin Avenue Water Line, was evaluated and determined not eligible for inclusion on the California Register of Historical Resources

6.3 City of Riverside

The City of Riverside Municipal Code Title 20 outlines the criteria for Landmarks, Structures or Resources of Merit, and Historic Districts. A cultural resource may be eligible as a Landmark or Structure of Merit or as a contributor to a Historic District.

6.3.1 Designated Landmark

A cultural resource is eligible for Landmark designation if one of the following criteria is met:

A. Exemplifies or reflects special elements of the City's cultural, social, economic, political, aesthetic, engineering, architectural, or natural history;

B. Is identified with persons or events significant to local, state, or national history;

C. Embodies distinctive characteristics of a style, type, period, or method of construction, or is a valuable example of the sue of indigenous material or craftsmanship;

D. Represents the work of a notable builder, designer, architect, or important creative individual;

E. Embodies elements that possess high artistic values or represent significant structural or architectural achievement or innovation;

F. Reflects significant geographical patterns, including those associated with different eras of settlement and growth, particular transportation modes, or distinctive examples of park or community planning, or cultural landscape;

G. Is one of the few remaining examples in the City, region, state, or nation possessing distinguishing characteristics of an architectural or historical type or specimen; or

H. Has yielded, or may be likely to yield, information important in history or prehistory.

Victoria Avenue is on the City of Riverside Cultural Heritage Landmark list. The Gage Canal is listed on the City of Riverside Cultural Heritage Landmark list. The Dufferin Avenue Water Line was evaluated and determined not eligible for inclusion on the City of Riverside list.

6.3.2 Structure or Resource of Merit

A Structure of Merit may be buildings or structures of a lesser significance than a Landmark. The criteria to be eligible as a Structure of Merit are as follows:

A. Has a unique location or singular characteristics or is a view or vista representing an established and familiar visual feature of a neighborhood, community, or the City;

B. Is an example of a type of building which was once common, but is now rare in its neighborhood, community, or area; or

C. Is connected with a business or use which was once common but is now rare; or

D. Contributes to an understanding of contextual significance of a neighborhood, community, or area; or

E. A cultural resource that could be eligible under Landmark Criteria no longer exhibiting a high level of integrity; however, retaining sufficient integrity to convey significance under one or more of the Landmark Criteria; or

F. Has yielded, or may likely yield, information important in history or prehistory; or

G. An improvement or resource that no longer exhibits the high degree of integrity sufficient for Landmark criteria designation, yet still retains sufficient integrity under one or more of the Landmark Criteria to convey cultural resource significance as a Structure of Resource of Merit.

Victoria Avenue qualifies as a Structure of Merit under Criterion A. It is a very established and familiar visual feature of the City of Riverside, even though the neighborhood around it has changed due to conversion of agricultural lands to residential housing. When looking down the avenue itself, it retains the same basic view of horticultural landscaping as the original design, using many of the same species. None of the other sites within the survey area are recommended as a Structure of Merit.

6.3.3 Historic District

A historic district contains either (a) a concentration, linkage, or continuity of cultural resources, where at least 50 percent of the structures or elements retain significant historic integrity, or (b) a thematically related grouping of cultural resources which contribute to each other and are unified aesthetically by plan or physical development, and which have been designated or determined eligible for designation as a historic district by the Historic Preservation Officer, Board, or City Council or is listed in the NRHP or the CRHR, or is a California Historical Landmark or a California Point of Historical Interest. In addition to one of the two, the area must also:

A. Exemplifies or reflects special elements of the city's cultural, social, economic, political, aesthetic, engineering, architectural, or natural history;

B. Is identified with persons or events significant in local, State, or national history;

C. Embodies distinctive characteristics of a style, type, period, or method of construction, or is a valuable example of the use of indigenous materials or craftsmanship;

D. Represents the work of notable builders, designers, or architects;

E. Embodies a collection of elements of architectural design, detail, materials or craftsmanship that represent a significant structural or architectural achievement or innovation;

F. Reflects significant geographical patterns, including those associated with different eras of settlement and growth, particular transportation modes, or distinctive examples of park or community planning; or

G. Conveys a sense of historic and architectural cohesiveness through its design, setting, materials, workmanship, or association; or

H. Has yielded, or may likely yield, information important in history or prehistory.

None of the sites within the survey area are recommended as part of a Historic District.

7.0 Impacts to Cultural Resources

If a project will cause a substantial adverse change in the significance of a historical resource, mitigation is required under CEQA. A substantial adverse change is defined as the physical demolition, destruction, relocation, or alteration of the resource of its immediate surroundings such that the significance of a historical resource would be materially impaired. Avoidance of the historical resource through project redesign is the preferred mitigation measure. If redesign is not feasible, minimizing impacts by limiting the degree of impacts or reducing the impact through construction monitoring are mitigation options.

The project proposes to install approximately 11,200 linear feet of underground storm drain pipe within the existing Gratton Street, Dufferin Avenue, and Hermosa Drive rights-of-way. This will be done within the existing streets, and will not impact any known cultural resources. The trenching and installation will not be a significant impact to Victoria Avenue, as the trenching will run down the center of the street and will not alter the existing median curbs or landscaping either structurally or visually. The installation of the storm drain pipe will not materially alter in an adverse manner the physical characteristics of Victoria Avenue that conveys its historical significance and that justify its inclusion in, or eligibility for, inclusion in the NRHP and CRHR.

The project also proposes removing and rebuilding the existing curb, gutter, and street lights along the east side of Gratton Street between Lincoln Avenue and Victoria Avenue. This will result in the demolition of the

existing curbs and drains on the northeast and southeast corners of the Gratton Street/Victoria Avenue intersection. The existing curb on the northeast corner is a low asphalt curb that stops at the bicycle path and does not extend to Victoria Avenue itself. The existing gutter is a concrete drain emptying into a concrete pipe that crosses under Victoria Avenue. The southeast corner also has an existing low concrete gutter that the pipe empties in to. The curb begins approximately 15 feet south of the corner.

The replacement of these existing features with new concrete gutter and curb will not be a significant impact to Victoria Avenue. The new curbs and gutters will be low and unobtrusive and not extend out into Victoria Avenue. The more visible existing low asphalt curbs in the median will not be replaced. Existing landscaping in the median and along the shoulders of Victoria Avenue, a major contributing factor of the Criterion C eligibility, will not be impacted. The integrity of the existing design concept and display of a range of plant species will not be altered in an adverse manner. The replacement will also not alter the basic rural feeling and setting of the intersection. As noted above, the proposed alterations are low and do not interrupt an observer's view of Victoria Avenue landscaping. Also, they replace existing structures, and are not new structures that would clutter the intersection or remove/obscure the existing landscaping. The installation of replacement of gutters and curbs at the Victoria Avenue/Gratton Street intersection will not materially alter in an adverse manner the physical characteristics of Victoria Avenue that conveys its historical significance and that justify its inclusion in, or eligibility for, inclusion in the NRHP and CRHR.

For reasons similar to those described above, the proposed project will not have an adverse effect on the criteria that have made Victoria Avenue a City of Riverside Designated Landmark and a Structure or Resource of Merit.

The proposed jack-and-bore operation for trenchless pipe installation underneath Gage Canal at the intersection of Gratton Street and Hermosa Drive will not be a significant impact to the Gage Canal. The jack-and-bore operation begin at least 35 feet from the center of the canal leaving approximately 20 feet between the jack-and-bore operations and the edge of the canal. There are no alterations proposed to the structure of the Gage Canal itself. The trenchless pipe installation will not materially alter in an adverse manner the physical characteristics of the Gage Canal that conveys its historical significance and that justify its inclusion in, or eligibility for, inclusion in the NRHP and CRHR.

For reasons similar to those described above, the proposed project will not have an adverse effect on the criteria that have made the Gage Canal a City of Riverside Designated Landmark.

P-33-17367, the Dufferin Avenue Water Line, was determined not to be a significant historical resource and not eligible for inclusion on the NRHP, CRHR, or City of Riverside lists. Therefore, the proposed project will not have an adverse effect on the Dufferin Avenue Water line.

8.0 Recommendations

Two significant historical resources, Victoria Avenue and the Gage Canal, are within the project APE. Impacts to the existing gutter and curb at the intersection of Victoria Avenue and Gratton Street are not considered significant as the impacts will not materially alter in an adverse manner the physical characteristics of Victoria Avenue. No mitigation is recommended. Project design proposes to jack and bore under the Gage Canal, which will result in no adverse effects to that resource and no mitigation is recommended.

No significant prehistoric cultural resources were found during the survey of the project property. No prehistoric cultural resources were mapped on or immediately adjacent to the property in the record search files. Therefore, the proposed project will have no impact on known prehistoric cultural resources. However, the project is in an area of alluvial deposition and the possibility exists for buried prehistoric archaeological deposits on-site. In addition, Native American representatives have recommended that tribal monitors be present during all ground-disturbing activities as potential cultural resources could possibly be unearthed during construction Because of these factors, RECON recommends that all ground-disturbing activities for

the project be monitored by a qualified archaeological monitor and Native American monitors representing the Native American community. If archaeological materials are identified during construction activities, work in the immediate area shall cease and an archaeologist meeting the City of Riverside Qualifications Standards for Archaeology must evaluate the find. If the discovery proves to be significant under CEQA, a data recovery program shall be implemented.

According to State Health and Safety Code Section 7050.5, in the event that human remains (or remains that may be human) are discovered at the implementing development project site during grading or earthmoving, the construction contractors shall immediately stop all activities in the immediate area of the find. The project proponent shall then inform the Riverside County Coroner and the City of Riverside Planning Division, and the coroner would be permitted to examine the remains. If the coroner determines that the remains are of Native American origin, the coroner would notify the Native American Heritage Commission and the Commission would identify the "Most Likely Descendent."

If you have any questions please contact me by phone at 619 308-9333 x103 or by email at hprice@reconenvironmental.com.

Sincerely,

Harry J. Price
Project Archaeologist

HJP:sh:jg

Attachments

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Table 1 Cultural Resource Sites Recorded within 1 mile of the survey areas								
Primary #	Trinomial #	Site Type	Age	In APE	Recording Events	County	Maps	Notes
P-33-001738	CA-RIV-1738	Bedrock milling feature	Prehistoric	No	1979 (Wilmoth, S.)	Riverside	Riverside west	
P-33-002564	CA-RIV-2564	Bedrock milling feature	Prehistoric	No	1982 (Lerch, M.K., San Bernardino County Museum Association)	Riverside	Riverside West	
P-33-003084	CA-RIV-3084	Bedrock milling feature	Prehistoric	No	1986 (Lerch, M.K.); 1989 (Parr, R.E., Archaeological Research Unit, UC Riverside)	Riverside	Riverside West	
P-33-003085	CA-RIV-3085	Bedrock milling feature; ground stone	Prehistoric	No	1986 (Lerch, M.K.); 1989 (Parr, R.E., Archaeological Research Unit, UC Riverside)	Riverside	Riverside West	
P-33-003086	CA-RIV-3086	Bedrock milling feature	Prehistoric	No	1986 (Lerch, M.K.); 1989 (Parr, R.E., Archaeological Research Unit, UC Riverside)	Riverside	Riverside West	
P-33-003087	CA-RIV-3087	Bedrock milling feature	Prehistoric	No	1986 (Lerch, M.K.); 1989 (Parr, R.E., Archaeological Research Unit, UC Riverside)	Riverside	Riverside West	
P-33-003142	CA-RIV-3142H	Well; fence	Historic	No	1986 (Lerch, M.K., Michael K. Lerch & Associates))	Riverside	Riverside West	
P-33-003509	CA-RIV-3509	Bedrock milling feature	Prehistoric	No	1989 (Parr, R.E., D. Pinto, J. Torres, Archaeological Research Unit, UC Riverside)	Riverside	Riverside West	
P-33-003510	CA-RIV-3510	Bedrock milling feature	Prehistoric	No	1989 (Parr, R.E., D. Pinto, J. Torres, Archaeological Research Unit, UC Riverside)	Riverside	Riverside West	
P-33-003511	CA-RIV-3511	Bedrock milling feature	Prehistoric	No	1989 (Parr, R.E., D. Pinto, J. Torres, Archaeological Research Unit, UC Riverside)	Riverside	Riverside West	
P-33-003512	CA-RIV-3512	Bedrock milling feature	Prehistoric	No	1989 (Parr, R.E., D. Pinto, J. Torres, Archaeological Research Unit, UC Riverside)	Riverside	Riverside West	
P-33-003513	CA-RIV-3513	Bedrock milling feature	Prehistoric	No	1989 (Parr, R.E., D. Pinto, Archaeological Research Unit, UC Riverside)	Riverside	Riverside West	
P-33-003514	CA-RIV-3514	Bedrock milling feature	Prehistoric	No	1989 (Parr, R.E., D. Pinto, Archaeological Research Unit, UC Riverside)	Riverside	Riverside West	
P-33-003515	CA-RIV-3515	Bedrock milling feature	Prehistoric	No	1989 (Parr, R.E., D. Pinto, Archaeological Research Unit, UC Riverside)	Riverside	Riverside West	
P-33-003516	CA-RIV-3516	Bedrock milling feature	Prehistoric	No	1989 (Parr, R.E., D. Pinto, Archaeological Research Unit, UC Riverside)	Riverside	Riverside West	
P-33-003517	CA-RIV-3517	Bedrock milling feature	Prehistoric	No	1989 (Parr, R.E., D. Pinto, Archaeological Research Unit, UC Riverside)	Riverside	Riverside West	
P-33-003518	CA-RIV-3518	Bedrock milling feature	Prehistoric	No	1989 (Parr, R.E., D. Pinto, Archaeological Research Unit, UC Riverside)	Riverside	Riverside West	
P-33-003519	CA-RIV-3519	Bedrock milling feature	Prehistoric	No	1989 (Parr, R.E., D. Pinto, Archaeological Research Unit, UC Riverside)	Riverside	Riverside West	
P-33-003520	CA-RIV-3520	Bedrock milling feature	Prehistoric	No	1989 (Parr, R.E., D. Pinto, Archaeological Research Unit, UC Riverside)	Riverside	Riverside West	
P-33-003523	CA-RIV-3523	Bedrock milling feature	Prehistoric	No	1989 (Parr, R.E., Archaeological Research Unit, UC Riverside)	Riverside	Riverside West	
P-33-003524	CA-RIV-3524	Bedrock milling feature	Prehistoric	No	1989 (Parr, R.E., Archaeological Research Unit, UC Riverside)	Riverside	Riverside West	

Table 1 Cultural Resource Sites Recorded within 1 mile of the survey areas								
Primary #	Trinomial #	Site Type	Age	In APE	Recording Events	County	Maps	Notes
P-33-003525	CA-RIV-3525	Bedrock milling feature	Prehistoric	No	1989 (Parr, R.E., Archaeological Research Unit, UC Riverside)	Riverside	Riverside West	
P-33-3526	CA-RIV-3526	Bedrock milling feature	Prehistoric	No	1989 (Parr, R.E., Archaeological Research Unit, UC Riverside)	Riverside	Riverside West	
P-33-003527	CA-RIV-3527	Bedrock milling feature	Prehistoric	No	1989 (Parr, R.E., Archaeological Research Unit, UC Riverside)	Riverside	Riverside West	
P-33-3528	CA-RIV-3528	Bedrock milling feature	Prehistoric	No	1989 (Parr, R.E., Archaeological Research Unit, UC Riverside)	Riverside	Riverside West	
P-33-003529	CA-RIV-3529	Bedrock milling feature; ground stone	Prehistoric	No	1989 (Parr, R.E., Archaeological Research Unit, UC Riverside)	Riverside	Riverside West	
P-33-003530	CA-RIV-3530	Bedrock milling feature	Prehistoric	No	1989 (Parr, R.E., Archaeological Research Unit, UC Riverside)	Riverside	Riverside West	
P-33-004495	CA-RIV-4495H	Water conveyance system: Upper Riverside Canal	Historic	No	2016 (Austerman, G.); 2009 (Ballester, D., CRM Tech, Colton); 2001 (Gustafson, A., M. McGrath, EDAW Inc.); 1996 (Starzak, R., M. Fitzgerald, Myra L. Frank & Assoc.); 1992 (Wlodarski, R. & D. Larson); 1991 (Jertberg, P., LSA Associates, Inc.)	Riverside	Riverside West; Riverside East; San Bernardino, South	The "Upper Riverside Canal:; Also see P-33-004791, CA-RIV-4791; P-33-004787, CA-RIV-4787; due to updates deemed not eligible
P-33-004768	CA-RIV-4768H	Water conveyance system: Gage Canal	Historic	Yes	1992 (Wlodarski, R. J.); 1999 (Ashkar, S., Jones & Stokes)	Riverside, San Bernardino	Riverside West; Riverside East; San Bernardino, South	"Gage Canal"; Also see P-33-17218, 17219, 13530, and CA-RIV-7481
P-33-004791	CA-RIV-4791H	Water conveyance system: Lower Riverside Canal	Historic	No	2011 (Brunzell, D.); 2005 (McKenna, J.A., McKenna et al.); 2002 Chandler, E.N., V.M. Van Hemelryck, Chambers Group, Inc.; 1992 (Wlodarski, R. J.)	Riverside, San Bernardino	Riverside West; Riverside East; San Bernardino, South; Corona, North; Corona, South	"Lower Riverside Canal"; Also see P-33-4495, CA-RIV-4495
P-33-008167	CA-RIV-8167	Multi-family property	Historic	No	2011 (Mermilliod, J., JM Research & Consulting (JMRC); 2011 (Tang, B., CRM TECH, Colton); 1998 (Tang, B., CRM TECH, Riverside)	Riverside	Riverside West	Elements within this study were found elibile individually and as historic district for listing in National, CA, and Local Registers
P-33-011361		Road: Victoria Avenue	Historic	Yes	2000 (Wilkman, B., Planner, City of Riverside	Riverside		"Victoria Avenue"; NRHP
P-33-012172		Single-family property	Historic	No	1999 (Tibbet, C., City of Riverside)	Riverside	Riverside West	
P-33-013530	CA-RIV-7481	Landscape architecture, farm/ranch, landscaping, water conveyance system	Historic	No	2004 (Swope, K.K.)	Riverside	Riverside West	"Lansing Lemon Grove, Arlington Heights"; Also see P-33-004768, CA-RIV-4768H

Table 1 Cultural Resource Sites Recorded within 1 mile of the survey areas								
Primary #	Trinomial #	Site Type	Age	In APE	Recording Events	County	Maps	Notes
P-33-017218		Water conveyance system: Gage Canal	Historic	Yes	2001 (McCarthy, D.)	Riverside	Riverside West	"Gage Canal"; See also P-33-4768, CA-RIV-4768H, SBR-7168H
P-33-017367		Water conveyance system: Dufferin Avenue waterlines	Historic	Yes	2008 (George, J., Applied EarthWorks)	Riverside	Riverside West	
P-33-017541	CA-RIV-9106	Landscape architecture, farm/ranch, landscaping, water conveyance system	Historic	No	2008 (Cannon, A. and E. Chapman, Statistical Research, Inc.)	Riverside	Riverside West	
P-33-018076		Single-family property	Historic	No	2010 (White, L.S., Archaeological Associates)	Riverside	Riverside West	
P-33-023922		Single-family property	Historic	No	2011 (Tang, B., CRM TECH, Colton); 2011 (Tang, B., CRM TECH, Colton)	Riverside	Riverside West	
P-33-023923		Single-family property	Historic	No	2011 (Tang, B., CRM TECH, Colton	Riverside	Riverside West	
P-33-023924		Landscaping, single-family property	Historic	No	2011 (Mermilliod, J., JM Research & Consulting (JMRC));	Riverside	Riverside West	"Hawthorne House"
P-33-024618		Other - yoni	Prehistoric	No	2014 (Jewett, M., Atkins)	Riverside	Murrieta	"Yoni"
P-33-024721		Single-family property	Historic	No	2011 (Mermilliod, J., JMRC); 2010 (Mermilliod, J., JMRC)	Riverside	Riverside West	"William A. Cooper House"
P-33-026410		Other - University Campus	Historic	No	2011 (Mermilliod, J., JMRC)	Riverside	Riverside West	"California Baptist University"; Historic District
P-33-026412		Multi-family property	Historic	No	2011 (Mermilliod, J., JMRC)	Riverside	Riverside West	"Smith & Simmons Halls"; Historic District
P-33-026413		Educational building, Stadium/sports arena	Historic	No	2011 (Mermilliod, J., JMRC)	Riverside	Riverside West	"Van Dyne Field House"; Historic District
P-33-026415		1- to 3-story commercial building	Historic	No	2011 (Mermilliod, J., JMRC)	Riverside	Riverside West	"Adams Plaza", "Lancer Plaza"
P-33-026422		Community center/ social hall	Historic	No	2011 (Mermilliod, J., JMRC)	Riverside	Riverside West	"Knights of Pythias Hall", "Bourns Laboratories"
P-33-026424		Multi-family property	Historic	No	2011 (Mermilliod, J., JMRC)	Riverside	Riverside West	"Lancer Arms"
P-33-026426		Religious building, community center/ social hall	Historic	No	2011 (Mermilliod, J., JMRC)	Riverside	Riverside West	"Riverside Free Methodist Church"
P-33-026427		Multi-family property	Historic	No	2011 (Mermilliod, J., JMRC)	Riverside	Riverside West	"San Carlos Apartments"
P-33-026428		Multi-family property, Religious building, Engineering structure	Historic	No	2011 (Mermilliod, J., JMRC)	Riverside	Riverside West	"Rose Garden Village & Royal Rose"; chapel; clock tower

Table 1 Cultural Resource Sites Recorded within 1 mile of the survey areas								
Primary #	Trinomial #	Site Type	Age	In APE	Recording Events	County	Maps	Notes
P-33-026429		Multi-family property	Historic	No	2011 (Mermilliod, J., JMRC)	Riverside	Riverside West	"University Place"
P-33-028079		Educational building	Historic	No	2016 (Bechtel, E., M. Litt, LSA Associates)	Riverside	Riverside West	former "Hawthorne Elementary School"

ATTACHMENT 1

Assembly Bill 52 Consultation

Public Works Department **Engineering Division**
3900 Main Street, Riverside, CA 92501 | Phone: (951) 826-5341 | **RiversideCA.gov**

Notice of Project (AB 52)

In accordance with Assembly Bill 52, the City of Riverside is sending this notice to inform California Native American tribes that have requested such notice of a project application within a geographic area with which the tribe is traditionally and culturally affiliated. California Public Resources Code § 21080.3.1 requires this notice within 14 days of the City determining this application is complete and/or after the City has decided to undertake a project. California Native American tribes have 30 days from the date of this notice to request consultation with the City regarding this project.

DATE OF NOTICE: 04/10/2018

PROJECT TITLE: **MONROE MASTER DRAINAGE PLAN LINE E STORM DRAIN IMPROVEMENTS**

PROJECT DESCRIPTION: The proposed project includes the construction of approximately 11,200 linear feet of underground storm drain pipe within the Gratton Street, Dufferin Avenue, and Hermosa Drive rights-of-way; removing and rebuilding the curb, gutter, and street lights along portions of Gratton Street; and a jack-and-bore operation for trenchless pipe installation underneath Gage Canal at the intersection of Gratton Street and Hermosa Drive. Line E Stages 2 and 3 are located within the Gratton Street right-of-way and will extend approximately 7,600 feet (1.4 miles) from Lincoln Avenue at the north to the Gage Canal at the south. Line E-2 is located within the Hermosa Street right-of-way and will extend approximately 2,200 feet from Gage Canal at the west to St. Lawrence Street at the east. Line E-5 is located within the Dufferin Avenue right-of-way and will extend approximately 1,400 feet from Gratton Street to Adams Street. The project site is located within existing street right-of-way that is surrounded by citrus groves, plant nurseries, and low-density residential development within the Arlington Heights neighborhood (See Figure 1).

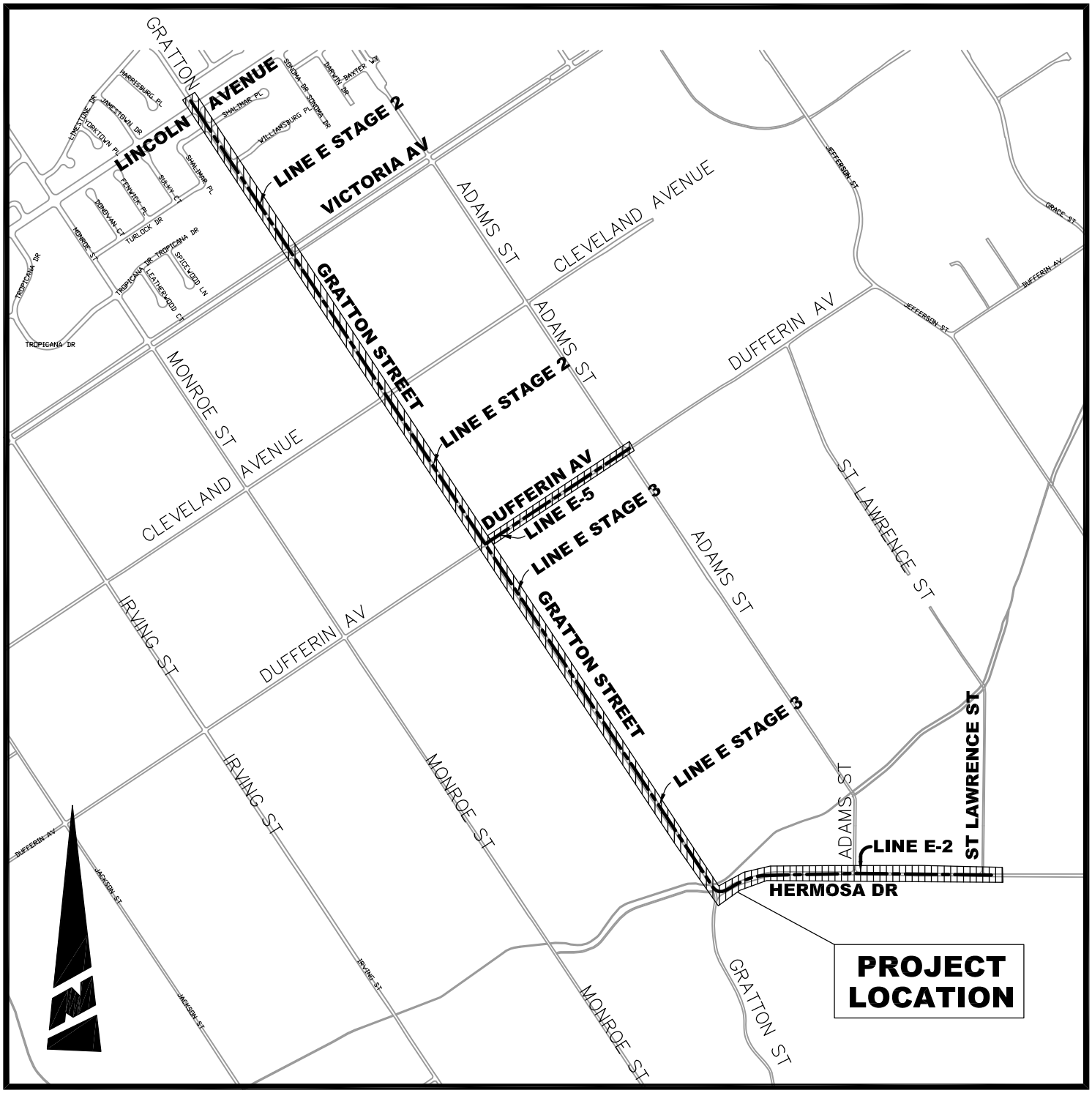
PROJECT LOCATION: Situated in Gratton Street between Lincoln Avenue and Hermosa Drive.

APN's: Existing right-of-way.

PROJECT INVOLVES GROUND DISTURBANCE: Yes

LOCAL GOVERNMENT/LEAD AGENCY: City of Riverside
CONTACT PERSON: Sweta Patel
PHONE: (951) 826-5714
E-MAIL: scpatel@riversideca.gov
ADDRESS: Public Works, Engineering Division
3900 Main Street, 4th Floor, Riverside, CA 92501

Should you have any questions regarding this case, please do not hesitate to contact the Project Engineer listed above. After 30 days from the date of this notice, the City will respond to a request for consultation or proceed with the entitlement process.



LOCATION MAP

NTS

Andrew Salas, Chairman
Gabrieleno Band of Mission Indians –
Kizh Nation
ATTN: AB52 Project Notice
P.O. Box 393
Covina, CA 91723

Joseph Ontiveros, Cultural Resources
Soboba Band of Luiseño Indian
ATTN: AB52 Project Notice
P.O. Box 487
San Jacinto, CA 92581

Andreas Heredia
Cultural Director
Cahuilla Band of Indians
ATTN: AB52 Project Notice
52701 Highway 371
Anza, CA 92539

Ebru T. Ozdil, Planning Specialist
Pechanga Cultural Resources Dept
ATTN: AB52 Project Notice
P.O. Box 2183
Temecula, CA 92593

Jim McPherson, Cultural Resources
Rincon Band of Luiseño Indians
ATTN: AB52 Project Notice
1West Tribal Road
Valley Center, CA 92082

Lee Clauss–CRM Department
San Manuel Band of Mission Indians
ATTN: AB52 Project Notice
26569 Community Center Dr.
Highland, CA 92346

Raymond Huaute
Cultural Resources Specialist
Morongo Band of Mission Indians
12700 Pumarra Road
Banning, CA 92220

Robert Martin
Tribal Chairman
Morongo Band of Mission Indians
12700 Pumarra Road
Banning, CA 92220

Patricia Garcia
Director of Tribal Hist. Presrv. Ofce
Agua Caliente Band of Cahuilla Indians
ATTN: AB52 Project Notice
5401 Dinah Shore Dr.
Palm Springs, CA 92264

San Gabriel Band of Mission Indians
Anthony Morales Chief
P.O. Box 693
San Gabriel, CA 91778

AGUA CALIENTE BAND OF CAHUILLA INDIANS

TRIBAL HISTORIC PRESERVATION

03-013-2018-004

April 16, 2018

[VIA EMAIL TO:scpatel@riversideca.gov]
City of Riverside
Sweta Patel

Riverside, CA 92501

Re: Notice of Project (AB 52) Monroe Master Drainage Plan Line E Storm Drain Improvements

Dear Sweta Patel,

The Agua Caliente Band of Cahuilla Indians (ACBCI) appreciates your efforts to include the Tribal Historic Preservation Office (THPO) in the Monroe Master Drainage Plan Line E Storm Drain Improvements project. The project area is not located within the boundaries of the ACBCI Reservation. However, it is within the Tribe's Traditional Use Area. For this reason, the ACBCI THPO requests the following:

*At this time ACBCI defers to Soboba. This letter shall conclude our consultation efforts.

Again, the Agua Caliente appreciates your interest in our cultural heritage. If you have questions or require additional information, please call me at (760)699-6829. You may also email me at ACBCI-THPO@aguacaliente.net.

Cordially,

Katie Croft

Katie Croft
Cultural Resources Manager
Tribal Historic Preservation Office
AGUA CALIENTE BAND
OF CAHUILLA INDIANS

5401 DINAH SHORE DRIVE, PALM SPRINGS, CA 92264
T 760/699/6800 F 760/699/6924 WWW.AGUACALIENTE-NSN.GOV

May 9, 2018

Attn: Sweta Patel, Senior Engineer
City of Riverside
Public Works, Engineering Division
3900 Main Street, 4th Floor
Riverside, CA 92501

RE: AB 52 Consultation; Monroe Master Drainage Plan Line E Storm Drain Improvements – Gratton Street between Lincoln Avenue and Hermosa Drive – City of Riverside, Riverside County, CA

The Soboba Band of Luiseño Indians has received your notification pursuant under Assembly Bill 52.

Soboba Band of Luiseño Indians is requesting to initiate formal consultation with the City of Riverside. A meeting can be scheduled by contacting me via email or phone. All contact information has been included in this letter.

I look forward to hearing from and meeting with you soon.

Sincerely,

Joseph Ontiveros, Tribal Historic Preservation Officer
Soboba Band of Luiseño Indians
P.O. Box 487
San Jacinto, CA 92581
Phone (951) 654-5544 ext. 4137
Cell (951) 663-5279
jontiveros@soboba-nsn.gov

Confidentiality: The entirety of the contents of this letter shall remain confidential between Soboba and the City of Riverside. No part of the contents of this letter may be shared, copied, or utilized in any way with any other individual, entity, municipality, or tribe, whatsoever, without the expressed written permission of the Soboba Band of Luiseño Indians.

Monroe Master drainage Plan Line E Storm Drain Improvement
Mitigation measures

MM 1 **Prior to grading permit issuance:** If there are any changes to project site design and/or proposed grades, the Applicant shall contact interested tribes to provide an electronic copy of the revised plans for review. Additional consultation shall occur between the City and consulting tribes to discuss the proposed changes and to review any new impacts and/or potential avoidance/preservation of the cultural resources on the Project. The City will make all attempts to avoid and/or preserve in place as many as possible of the cultural resources located on the project site if the site design and/or proposed grades should be revised in consult with the City. In specific circumstances where existing and/or new resources are determined to be unavoidable and/or unable to be preserved in place despite all feasible alternatives, the City shall make every effort to relocate the resource to a nearby open space or designated location on the project right of way that is not subject any future development, erosion or flooding.

MM 2 **Archaeological Monitoring:** At least 30-days prior to application for a grading permit and before any grading, excavation and/or ground disturbing activities on the site take place, the City shall retain a Secretary of Interior Standards qualified archaeological monitor to monitor all ground-disturbing activities in an effort to identify any unknown archaeological resources.

1. The Project Archaeologist, in consultation with interested tribes and the City, shall develop an Archaeological Monitoring Plan to address the details, timing and responsibility of all archaeological and cultural activities that will occur on the project site. Details in the Plan shall include:

    a. Project grading and development scheduling;

    b. The development of a rotating or simultaneous schedule in coordination with the applicant and the Project Archeologist for designated Native American Tribal Monitors from the consulting tribes during grading, excavation and ground disturbing activities on the site: including the scheduling, safety requirements, duties, scope of work, and Native American Tribal Monitors' authority to stop and redirect grading activities in coordination with all Project archaeologists;

MM 3 **Treatment and Disposition of Cultural Resources:** In the event that Native American cultural resources are inadvertently discovered during the course of grading for this Project. The following procedures will be carried out for treatment and disposition of the discoveries:

1. **Temporary Curation and Storage:** During the course of construction, all discovered resources shall be temporarily curated in a secure location onsite or at the offices of the project archaeologist. The removal of any artifacts from the project site will need to be thoroughly inventoried with tribal monitor oversite of the process; and

2. **Treatment and Final Disposition:** The City shall relinquish ownership of all cultural resources, including sacred items, burial goods, and all archaeological artifacts and non-human remains as part of the required mitigation for impacts to cultural resources. The City shall relinquish the artifacts through one or more of the following methods:

    a. Accommodate the process for onsite reburial of the discovered items with the consulting Native American tribes or bands. This shall include measures and provisions to protect the future reburial area from any future impacts. Reburial shall not occur until all cataloguing and basic recordation have been completed;

    b. A curation agreement with an appropriate qualified repository within Riverside County that meets federal standards per 36 CFR Part 79 and therefore would be professionally curated and made available to other archaeologists/researchers for further study. The collections and associated records shall be transferred, including title, to an appropriate curation facility within Riverside County, to be accompanied by payment of the fees necessary for permanent curation:

    c. For purposes of conflict resolution, if more than one Native American tribe or band is involved with the project and cannot come to an agreement as to the disposition of cultural materials, they shall be curated at the Western Science Center or Riverside Metropolitan Museum by default; and.

    d. At the completion of grading, excavation and ground disturbing activities on the site a Phase IV Monitoring Report shall be created documenting monitoring activities conducted by the project Archaeologist and Native Tribal Monitors within 60 days of completion of grading. This report shall document the impacts to the known resources on the project; describe how each mitigation measure was fulfilled; document the type of cultural resources recovered and the disposition of such resources; provide evidence of the required cultural sensitivity training for the construction staff held during the required pre-grade meeting; and, in a confidential appendix, include the daily/weekly monitoring notes from the archaeologist. All reports produced will be submitted to the City of Riverside, Eastern Information Center and interested tribes:

MM 4 **Cultural Sensitivity Training:** The County certified Archaeologist and Native American Monitors shall attend the pre-grading meeting with the developer/permit holder's contractors to provide Cultural Sensitivity Training for all construction personnel. This shall include the procedures to be followed during ground disturbance in sensitive areas and protocols that apply in the event that unanticipated resources are discovered. Only construction personnel who have

received this training can conduct construction and disturbance activities in sensitive areas. A sign in sheet for attendees of this training shall be included in the Phase IV Monitoring Report.

A STANDARD CONDITION OF APPROVAL WILL INCLUDE THE FOLLOWING – CONSISTENT WITH STATE LAW:

Discovery of Human Remains: In the event that human remains (or remains that may be human) are discovered at the project site during grading or earthmoving, the construction contractors, project archaeologist, and/or designated Native American Monitor shall immediately stop all activities within 100 feet of the find. The project proponent shall then inform the Riverside County Coroner and the City of Riverside Community and Economic Development Department immediately, and the coroner shall be permitted to examine the remains as required by California Health and Safety Code Section 7050.5(b). Section 7050.5 requires that excavation be stopped in the vicinity of discovered human remains until the coroner can determine whether the remains are those of a Native American. If human remains are determined as those of Native American origin, the applicant shall comply with the state relating to the disposition of Native American burials that fall within the jurisdiction of the NAHC (PRC Section 5097). The coroner shall contact the NAHC to determine the most likely descendant(s). The MLD shall complete his or her inspection and make recommendations or preferences for treatment within 48 hours of being granted access to the site. The Disposition of the remains shall be overseen by the most likely descendant(s) to determine the most appropriate means of treating the human remains and any associated grave artifacts.

The specific locations of Native American burials and reburials will be proprietary and not disclosed to the general public. The County Coroner will notify the Native American Heritage Commission in accordance with California Public Resources Code 5097.98.

According to California Health and Safety Code, six or more human burials at one location constitute a cemetery (Section 8100), and disturbance of Native American cemeteries is a felony (Section 7052) determined in consultation between the project proponent and the MLD. In the event that the project proponent and the MLD are in disagreement regarding the disposition of the remains, State law will apply and the median and decision process will occur with the NAHC (see Public Resources Code Section 5097.98(e) and 5097.94(k)).

MORONGO BAND OF MISSION INDIANS
TRIBAL HISTORIC PRESERVATION OFFICE
12700 PUMARRA RD BANNING, CA 92220
OFFICE 951-755-5025 FAX 951-572-6004

Date: 5/2/2018

Re:
AB 52 (ASSEMBLY BILL 52) – Monroe Master Drainage Plan Line E Storm Drain Improvements

Dear,
Sweta Patel
Public Works
City of Riverside

Thank you for contacting the Morongo Band of Mission Indians (MBMI) Cultural Heritage Department regarding the above referenced project(s). After conducting a preliminary review of the project, the tribe would like to respectfully issue the following comments and/or requests:

☐ The project is located outside of the Tribe's aboriginal territory and is not within an area considered to be a traditional use area or one in which the Tribe has cultural ties. We recommend contacting the appropriate tribe(s) who may have cultural affiliations to the project area. We have no further comments at this time.

☒ The project is located within the Tribe's aboriginal territory or in an area considered to be a traditional use area or one in which the Tribe has cultural ties. In order to further evaluate the project for potential impacts to tribal cultural resources, we would like to formally request the following:

- ☒ A thorough records search be conducted by contacting one of the California Historical Resources Information System (CHRIS) Archaeological Information Centers and a copy of the search results be provided to the tribe.
- ☒ Tribal monitor participation during the initial pedestrian field survey of the Phase I Study of the project and a copy of the results of that study. In the event the pedestrian survey has already been conducted, MBMI requests a copy of the Phase I study be provided to the tribe as soon as it can be made available.
- ☐ MBMI Tribal Cultural Resource Monitor(s) be present during all required ground disturbing activities pertaining to the project.

☐ The project is located with the current boundaries of the Morongo Indian Reservation. Please contact the Morongo Cultural Heritage Department for further details.

Please be aware that this letter is merely intended to notify your office that the tribe has received your letter requesting tribal consultation for the above mentioned project and is requesting to engage in consultation. Specific details regarding the tribe's involvement in the project must be discussed on a project by project basis during the tribal consultation process. This letter does not constitute "meaningful" tribal consultation nor does it conclude the consultation process. Under federal and state law, "meaningful" consultation is understood to be an ongoing government-to-government process and may involve requests for additional information, phone conferences and/or face-to-face meetings. If you have any further questions or concerns regarding this letter, please contact the Morongo Cultural Heritage office at (951) 755-5139.

Sincerely,

Raymond Huaute
Tribal Historic Preservation Officer
Morongo Band of Mission Indians
Email: rhuaute@morongo-nsn.gov
Phone: (951) 755-5025

MORONGO BAND OF MISSION INDIANS
TRIBAL HISTORIC PRESERVATION OFFICE
12700 PUMARRA RD BANNING, CA 92220
OFFICE 951-755-5059 FAX 951-572-6004

Date: 6/26/2018

Re:
AB 52 – Monroe Master Drainage Plan

Dear,
Swetaben Patel, P.E.
Senior Engineer
City of Riverside Public Works Department

Thank you for contacting the Morongo Band of Mission Indians (MBMI) Cultural Heritage Department regarding the above referenced project.

At this time the tribe does not have any additional information or immediate concerns pertaining to this particular project. However, in the unlikely event that cultural artifacts or human remains are discovered, we would like to request that you contact the Morongo Band of Mission Indians immediately to engage in consultation and follow the Standard Development Conditions outlined in the attached document. If you have any further questions regarding this matter please feel free to contact our office.

Sincerely,

Tribal Historic Preservation Office
Morongo Band of Mission Indians
Email: thpo@morongo-nsn.gov
Phone: (951) 755-5259

MORONGO BAND OF MISSION INDIANS

A SOVEREIGN NATION

Standard Development Conditions

The Morongo Band of Mission Indians asks that you impose specific conditions regarding cultural and/or archaeological resources and buried cultural materials on any development plans or entitlement applications as follows:

1. If human remains are encountered during grading and other construction excavation, work in the immediate vicinity shall cease and the County Coroner shall be contacted pursuant to State Health and Safety Code §7050.5.

2. In the event that Native American cultural resources are discovered during project development/construction, all work in the immediate vicinity of the find shall cease and a qualified archaeologist meeting Secretary of Interior standards shall be hired to assess the find. Work on the overall project may continue during this assessment period.

    a. If significant Native American cultural resources are discovered, for which a Treatment Plan must be prepared, the developer or his archaeologist shall contact the Morongo Band of Mission Indians.

    b. If requested by the Tribe[1], the developer or the project archaeologist shall, in good faith, consult on the discovery and its disposition (e.g. avoidance, preservation, return of artifacts to tribe, etc.).

[1] The Morongo Band of Mission Indians realizes that there may be additional tribes claiming cultural affiliation to the area; however, Morongo can only speak for itself. The Tribe has no objection if the archaeologist wishes to consult with other tribes and if the city wishes to revise the condition to recognize other tribes.

PECHANGA CULTURAL RESOURCES

Temecula Band of Luiseño Mission Indians

Post Office. Box 2183 • Temecula, CA 92593
Telephone (951) 770-6300 • Fax (951) 506-9491

Chairperson:
Neal Ibanez

Vice Chairperson:
Bridgett Barcello

Committee Members:
Andrew Masiel, Sr.
Darlene Miranda
Evie Gerber
Richard B. Scearce, III
Robert Villalobos

Director:
Gary DuBois

Coordinator:
Paul Macarro

Planning Specialist:
Tuba Ebru Ozdil

April 11, 2018

VIA E-MAIL and USPS

Sweta Patel
Public Works, Engineering Division
City of Riverside
3900 Main Street
Riverside, CA 92501

PECHANGA TRIBE REQUEST FOR CONSULTATION PURSUANT TO AB 52 FOR MONROE MASTER DRAINAGE PLAN LINE E STORM DRAIN IMPROVEMENTS PROJECT

Dear Ms. Patel;

This letter is written on behalf of the Pechanga Band of Luiseño Indians (hereinafter, "the Tribe") a federally recognized Indian tribe and sovereign government in response to the AB 52 notice provided by the City of Riverside Public Works Department.

This letter serves as the Tribe's formal request to begin consultation under AB 52 for this Project. Per AB 52, we intend to assist the City in determining the type of environmental document that should be prepared for this Project (i.e. EIR, MND, ND); with identifying potential tribal cultural resources (TCRs); determining whether potential substantial adverse effects will occur to them; and to develop appropriate preservation, avoidance and/or mitigation measures, as appropriate. Preferred TCR mitigation is always avoidance and the Tribe requests that all efforts to preserve sensitive TCRs be made as early in the development process as possible.

Please add the Tribe to your distribution list(s) for public notices and circulation of all documents, including environmental review documents, archaeological reports, development plans, conceptual grading plans (if available), and all other applicable documents pertaining to this Project. The Tribe further requests to be directly notified of all public hearings and scheduled approvals concerning this Project, and that these comments be incorporated into the record of approval for this Project.

The Pechanga Tribe asserts that the Project area is part of '*Atáaxum* (Luiseño), and therefore the Tribe's, aboriginal territory as evidenced by the existence of cultural resources, named places, *tóota yixélval* (rock art, pictographs, petroglyphs), and an extensive 'Atáaxum

artifact record in the vicinity of the Project. This culturally sensitive area is affiliated with the Pechanga Band of Luiseño Indians because of the Tribe's cultural ties to this area as well as our extensive history with the City and other projects within the area. During our consultation we will provide more specific, confidential information on potential TCRs that may be impacted by the proposed Project.

As you know, the AB 52 consultation process is ongoing and continues until appropriate mitigation has been agreed upon for the TCRs that may be impacted by the Project. As such, under both AB 52 and CEQA, we look forward to working closely with the City on ensuring that a full, comprehensive environmental review of the Project's impacts is completed, including addressing the culturally appropriate and respectful treatment of human remains and inadvertent discoveries. At this time, we are requesting archaeological, geotechnical, and conceptual grading plans.

In addition to those rights granted to the Tribe under AB 52, the Tribe reserves the right to fully participate in the environmental review process, as well as to provide further comment on the Project's impacts to cultural resources and potential mitigation for such impacts.

The Pechanga Tribe looks forward to working together with the City of Riverside in protecting the invaluable Pechanga cultural resources found in the Project area. The formal contact person for this Project will be Ebru Ozdil. Please contact her at 951-770-6313 or at eozdil@pechanga-nsn.gov within 30 days of receiving these comments so that we can begin the consultation process. Thank you.

Sincerely,

Ebru Ozdil
Planning Specialist

Cc Pechanga Office of the General Counsel

PECHANGA CULTURAL RESOURCES

Temecula Band of Luiseño Mission Indians

Post Office. Box 2183 • Temecula, CA 92593
Telephone (951) 770-6300 • Fax (951) 506-9491

Chairperson:
Neal Ibanez

Vice Chairperson:
Bridgett Barcello

Committee Members:
Andrew Masiel, Sr.
Darlene Miranda
Evie Gerber
Richard B. Scearce, III
Robert Villalobos

Director:
Gary DuBois

Coordinator:
Paul Macarro

Planning Specialist:
Tuba Ebru Ozdil

July 20, 2018

VIA E-MAIL and USPS

Swetaben Patel, P.E.
Senior Engineer
City of Riverside Public Works Department
3900 Main Street, 4th Floor
Riverside, CA 92501

Re: Pechanga Tribe Comments on the Cultural Resources Survey for the Monroe Master Drainage Plan Storm Drain Line E Project in the City of Riverside.

Dear Ms. Patel,

This comment letter is written on behalf of the Pechanga Band of Luiseño Indians (hereinafter, "the Tribe"), a federally recognized Indian tribe and sovereign government. The Tribe submits these comments for the official record concerning the Cultural Resources Assessment Report for the Arco Station Project prepared by RECON and dated June 2018.

The Tribe extends its thanks to the City for providing the Cultural Resource Assessment so the Tribe can review and provide comments on the content based upon tribal knowledge so we may continue to preserve and protect Luiseño cultural resources.

The Tribe is highly concerned that in the "1.3 Late Holocene (1,500 B.P. to 1769)" section, found on page 5, the report states, "*Shononean-speaking people from the Colorado River region moved westward into Riverside County (Moratto 1984) during the Lake Holocene.*" The report goes on the say "*The Luiseño were Shoshonean or Uto-Aztecan-speaking populations*" in the "1.4 Ethnography" section on page 6. The Luiseño are actually a Takic speaking population; though often misclassified, the Takic and Shononean languages are a part of separate branches of the Uto-Aztecan Language Family. The Luiseño languages are within the Californian Uto-Aztecan branch while the Shoshonean languages are of the Northern Uto-Aztecan branch[i]. Further, it is the Luiseño view that the world was created in the area now known as Temecula[1], and that the Luiseño People have been in this area since the beginning of time. The Tribe requests our comments and tribal perspective to be included in the report.

[1] Masiel-Zamora, Myra, 2016. *'Éxva Teméeku: Where We Began.* Great Oak Press, Pechanga, California.

The Pechanga Tribe asserts that the Project area is part of 'Atáaxum (Luiseño), and therefore the Tribe's, aboriginal territory. The report claims that the Luiseño "were found in norther San Diego, southern Orange, and southeaster Riverside counties from the onset of ethnohistoric times through the present day." This description leaves out approximately 60% of the true Luiseño ancestral territory. The territory reached as far northeast as the Santa Ana River and the Box Springs Mountain Range, as far east as Mount San Jacinto, as far southeast as Lake Henshaw, and to the west including the Southern Channel Islands. The Pechanga Tribe's knowledge of our ancestral boundaries is based on information passed down from our elders through songs and stories; published academic works in the areas of anthropology, history and ethno-history; and through unpublished ethnographic and linguistic field notes. Many anthropologists and historians who have proposed boundaries of the Luiseño traditional territory have included the project area in their descriptions (Kroeber 1925[2]; Drucker 1939[3]; Heizer and Whipple 1951[4]; Smith and Freers 1994[5]).

Lastly, the Tribe agrees with the recommendation of archaeological and Tribal monitors for monitoring of the Project. We understand that ground visibility was excellent during the May 9th survey, and that no prehistoric cultural resources were found, however, given the recorded resources surrounding the Project, the Tribe is concerned that cultural resources may be found sub-surface during the construction of this project.

The Tribe would like our comments to be forwarded to RECON so they may review and make the necessary updates/changes to their report and for the City to include this letter in the confidential appendix of the final report. The Tribe welcomes the opportunity to meet with the City of Riverside to further explain our comments. The Tribe reserves the right to fully participate in the environmental review process, as well as to provide further comment on the Project's impacts to cultural resources and potential mitigation for such impacts.

The Pechanga Tribe looks forward to working together with the City of Riverside in protecting the invaluable and non-renewable Luiseño cultural resources found in the Project area. Please contact me at 951-770-6314 or at crs@pechanga-nsn.gov if there are any questions or concerns regarding our cultural report comments. Otherwise, please contact our Cultural Analyst, Ebru Ozdil at 951-770-6313 or at eozdil@pechanga-nsn.gov regarding all other project related questions or concerns. Thank you.

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[2] Alfred. L. Kroeber 1925. *Handbook of the Indians of California*. Bulletin 78, Bureau of American Ethnology, Government Printing Office, Washington D.C.
[3] Phillip Drucker 1939. Culture Element Distribution, V, Southern California. *University of California Publications in American Archaeology and Ethnology,* Vol. 1.
[4] Robert F. Heizer and M.A. Whipple 1951. *The California Indians*. University of California Press, Berkeley.
[5] Gerald A. Smith and Steven M. Freers 1994. *Fading Images: Indian Pictographs of Western Riverside County*. Riverside Museum Press, Riverside, Ca.

Sincerely,

Molly Earp-Escobar

Cultural Resource Specialist

Cc Pechanga Office of the General Counsel

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[i] For further language clarification, the Glottolog organization has language classification charts. http://glottolog.org/resource/languoid/id/luis1253

RINCON BAND OF LUISEÑO INDIANS

Cultural Resources Department

1 W. Tribal Road · Valley Center, California 92082 ·
(760) 297-2635 Fax:(760) 692-1498

May 9, 2018

Sweta Patel
City of Riverside
Public Works Department
3900 Main Street
Riverside, CA 92501

Re: Monroe Master Drainage Plan Line E Section Drain Improvements

Dear Ms. Patel:

This letter is written on behalf of the Rincon Band of Luiseño Indians. We have received your notification regarding the Monroe Master Drainage Plan Line E Section Drain Improvements Project and we thank you for the opportunity to consult on this project. The identified location is within the Territory of the Luiseño people, and is also within Rincon's specific area of Historic interest.

Embedded in the Luiseño territory are Rincon's history, culture and identity. Rincon has no knowledge of any known cultural resources within or near the proposed project area. However, that does not mean that none exist. Therefore, we recommend that an archaeological record search be conducted for the proposed project. We do not request AB52 consultation at this time.

If you have additional questions or concerns please do not hesitate to contact our office at your convenience at (760) 297-2635.

Thank you for the opportunity to protect and preserve our cultural assets.

Sincerely,

Destiny Colocho
Director
Rincon Cultural Resources

Bo Mazzetti	Tishmall Turner	Steve Stallings	Laurie E. Gonzalez	Alfonso Kolb
Tribal Chairman	Vice Chairwoman	Council Member	Council Member	Council Member

ATTACHMENT 2

Native American Heritage Commission Reply Letter

NATIVE AMERICAN HERITAGE COMMISSION
Cultural and Environmental Department
1550 Harbor Blvd., Suite 100
West Sacramento, CA 95691
(916) 373-3710

May 14, 2018

Carmen Zepeda-Herman
RECON Environmental

Sent by E-mail: czepeda@reconenvironmental.com

RE: Proposed Monroe Master Drainage Plan (RECON #8995) Project, Community of Arlington Heights; Riverside West USGS Quadrangle, Riverside County, California

Dear Ms. Zepeda-Herman:

A record search of the Native American Heritage Commission (NAHC) *Sacred Lands File* was completed for the area of potential project effect (APE) referenced above with negative results. Please note that the absence of specific site information in the *Sacred Lands File* does not indicate the absence of Native American cultural resources in any APE.

Attached is a list of tribes culturally affiliated to the project area. I suggest you contact all of the listed Tribes. If they cannot supply information, they might recommend others with specific knowledge. The list should provide a starting place to locate areas of potential adverse impact within the APE. By contacting all those on the list, your organization will be better able to respond to claims of failure to consult. If a response has not been received within two weeks of notification, the NAHC requests that you follow-up with a telephone call to ensure that the project information has been received.

If you receive notification of change of addresses and phone numbers from any of these individuals or groups, please notify me. With your assistance we are able to assure that our lists contain current information. If you have any questions or need additional information, please contact via email: gayle.totton@nahc.ca.gov.

Sincerely,

Gayle Totton

Gayle Totton, M.A., PhD.
Associate Governmental Program Analyst
(916) 373-3714

CONFIDENTIALITY NOTICE: This communication with its contents may contain confidential and/or legally privileged information. It is solely for the use of the intended recipient(s). Unauthorized interception, review, use or disclosure is prohibited and may violate applicable laws including the Electronic Communications Privacy Act. If you are not the intended recipient, please contact the sender and destroy all copies of the communication.

Native American Heritage Commission
Native American Contact List
Riverside County
5/14/2018

Fernandeno Tataviam Band of Mission Indians
Jairo Avila, Tribal Historic and Cultural Preservation Officer
1019 Second Street, Suite 1 — Tataviam
San Fernando, CA, 91340
Phone: (818) 837 - 0794
Fax: (818) 837-0796
jairo.avila@tataviam-nsn.us

Fernandeno Tataviam Band of Mission Indians
Beverly Salazar Folkes, Elders Council
1931 Shady Brooks Drive — Tataviam
Thousand Oaks, CA, 91362
Phone: (805) 558 - 1154
folkes9@msn.com

Fernandeno Tataviam Band of Mission Indians
Alan Salazar, Chairman Elders Council
1019 Second St., Suite 1 — Tataviam
San Fernando, CA, 91340
Phone: (805) 423 - 0091

Gabrieleno Band of Mission Indians - Kizh Nation
Andrew Salas, Chairperson
P.O. Box 393 — Gabrieleno
Covina, CA, 91723
Phone: (626) 926 - 4131
admin@gabrielenoindians.org

Gabrieleno/Tongva San Gabriel Band of Mission Indians
Anthony Morales, Chairperson
P.O. Box 693 — Gabrieleno
San Gabriel, CA, 91778
Phone: (626) 483 - 3564
Fax: (626) 286-1262
GTTribalcouncil@aol.com

Gabrielino /Tongva Nation
Sandonne Goad, Chairperson
106 1/2 Judge John Aiso St., #231 — Gabrielino
Los Angeles, CA, 90012
Phone: (951) 807 - 0479
sgoad@gabrielino-tongva.com

Gabrielino Tongva Indians of California Tribal Council
Robert Dorame, Chairperson
P.O. Box 490 — Gabrielino
Bellflower, CA, 90707
Phone: (562) 761 - 6417
Fax: (562) 761-6417
gtongva@gmail.com

Gabrielino-Tongva Tribe
Charles Alvarez,
23454 Vanowen Street — Gabrielino
West Hills, CA, 91307
Phone: (310) 403 - 6048
roadkingcharles@aol.com

San Fernando Band of Mission Indians
Donna Yocum, Chairperson
P.O. Box 221838 — Kitanemuk
Newhall, CA, 91322 — Serrano
Phone: (503) 539 - 0933 — Tataviam
Fax: (503) 574-3308
ddyocum@comcast.net

This list is current only as of the date of this document. Distribution of this list does not relieve any person of statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resource Section 5097.98 of the Public Resources Code.

This list is only applicable for contacting local Native Americans with regard to cultural resources assessment for the proposed Monroe Master Drainage Plan Project, Riverside County.

ATTACHMENT 3

Tribal Contact Letters and Responses

Carmen Zepeda-Herman

From: Cultural Department <culturaldirector@cahuilla.net>
Sent: Thursday, May 24, 2018 11:33 AM
To: Carmen Zepeda-Herman
Cc: anthonymad2002@gmail.com
Subject: [External] Re: Monroe Master Drainage Plan Line E Storm Drain Improvements Project (RECON Number 8995)

Dear Mr. Zepeda-Herman,

The Cahuilla Band of Indians received your letter on May 15, 2018 regarding the Monroe Master Drainage Plan Line E Strom Drain Improvements Project in the City of Riverside, Riverside County, CA. The Cahuilla band does not have knowledge of any cultural resources/sites within the project area. Although the project is outside the Cahuilla reservation boundary, it is within the Cahuilla traditional land use area. We respectfully request to be notified of all updates and/or changes with the project moving forward and also request tribal monitors to be present during all ground disturbing activities as potential cultural resources could possibly be unearthed during construction. The Cahuilla band appreciates your help in preserving Tribal Cultural Resources in your project.

Respectfully,

BobbyRay Esparza
Cultural Coordinator
Cahuilla Band of Indians
Cell: (760)423-2773
Office: (951)763-5549
Fax:(951)763-2808

RINCON BAND OF LUISEÑO INDIANS

Cultural Resources Department

1 W. Tribal Road · Valley Center, California 92082 ·
(760) 297-2635 Fax:(760) 692-1498

June 18, 2018

Carmen Zepeda-Herman
RECON
1927 Fifth Avenue
San Diego, CA 92101

Re: Monroe Master Drainage Plan Line E Storm Drain Improvements Project

Dear Zepeda-Herman:

This letter is written on behalf of the Rincon Band of Luiseño Indians. We have received your notification regarding the Monroe Master Drainage Plan Line E Storm Drain Improvements Project and we thank you for the opportunity to consult on this project. The identified location is within the Territory of the Luiseño people, and is also within Rincon's specific area of Historic interest.

Embedded in the Luiseño territory are Rincon's history, culture and identity. Rincon does not have knowledge of any known cultural resources in the proposed project area. We do not request consultation at this time.

If you have additional questions or concerns please do not hesitate to contact our office at your convenience at (760) 297-2635.

Thank you for the opportunity to protect and preserve our cultural assets.

Sincerely,

Destiny Colocho
Director
Rincon Cultural Resources

Bo Mazzetti, Tribal Chairman | Tishmall Turner, Vice Chairwoman | Steve Stallings, Council Member | Laurie E. Gonzalez, Council Member | Alfonso Kolb, Council Member

AGUA CALIENTE BAND OF CAHUILLA INDIANS

TRIBAL HISTORIC PRESERVATION

03-013-2018-004

June 04, 2018

[VIA EMAIL TO:czepeda@reconenvironmental.com]

Carmen Zepeda-Herman

San Diego, CA 92101

Re: Monroe Master Drainage Plan Line E Storm Drain Improvements Project (RECON Number 8995)

Dear Carmen Zepeda-Herman,

The Agua Caliente Band of Cahuilla Indians (ACBCI) appreciates your efforts to include the Tribal Historic Preservation Office (THPO) in the Monroe Master Drainage Plan Line E Storm Drain Improvements project. The project area is not located within the boundaries of the ACBCI Reservation. However, it is within the Tribe's Traditional Use Area. For this reason, the ACBCI THPO requests the following:

*At this time ACBCI defers to Soboba. This letter shall conclude our consultation efforts.

Again, the Agua Caliente appreciates your interest in our cultural heritage. If you have questions or require additional information, please call me at (760)699-6829. You may also email me at ACBCI-THPO@aguacaliente.net.

Cordially,

Katie Croft

Katie Croft
Cultural Resources Manager
Tribal Historic Preservation Office
AGUA CALIENTE BAND
OF CAHUILLA INDIANS

5401 DINAH SHORE DRIVE, PALM SPRINGS, CA 92264
T 760/699/6800 F 760/699/6924 WWW.AGUACALIENTE-NSN.GOV

June 28, 2018

Attn: Carmen Zepeda-Herman, Senior Archaeologist
RECON Environmental, Inc.
1927 Fifth Avenue
San Diego, CA 92101

RE: Monroe Master Drainage Plan Line E Storm Drain Improvements Project (RECON Number 8995) – City of Riverside, Riverside County, CA

The Soboba Band of Luiseño Indians appreciates your observance of Tribal Cultural Resources and their preservation in your project. The information provided to us on said project has been assessed through our Cultural Resource Department, where it was concluded that although it is outside the existing reservation, the project area does fall within the bounds of our Tribal Traditional Use Areas. This project location is in proximity to known sites, is a shared use area that was used in ongoing trade between the tribes, and is considered to be culturally sensitive by the people of Soboba.

Soboba Band of Luiseño Indians is requesting the following:

1. To initiate a consultation with the project proponents and lead agency.

2. The transfer of information to the Soboba Band of Luiseno Indians regarding the progress of this project should be done as soon as new developments occur.

3. Soboba Band of Luiseño Indians continues to act as a consulting tribal entity for this project.

4. Working in and around traditional use areas intensifies the possibility of encountering cultural resources during the construction/excavation phase. For this reason the Soboba Band of Luiseño Indians requests that Native American Monitor(s) from the Soboba Band of Luiseño Indians Cultural Resource Department to be present during any ground disturbing proceedings. Including surveys and archaeological testing.

5. Request that proper procedures be taken and requests of the tribe be honored (Please see the attachment)

Multiple areas of potential impact were identified during an in-house database search. Specifics to be discussed in consultation with the lead agency.

Sincerely,

Joseph Ontiveros, Tribal Historic Preservation Officer
Soboba Band of Luiseño Indians
P.O. Box 487
San Jacinto, CA 92581
Phone (951) 654-5544 ext. 4137
Cell (951) 663-5279
jontiveros@soboba-nsn.gov

Cultural Items (Artifacts). Ceremonial items and items of cultural patrimony reflect traditional religious beliefs and practices of the Soboba Band. The Developer should agree to return all Native American ceremonial items and items of cultural patrimony that may be found on the project site to the Soboba Band for appropriate treatment. In addition, the Soboba Band requests the return of all other cultural items (artifacts) that are recovered during the course of archaeological investigations. Where appropriate and agreed upon in advance, Developer's archeologist may conduct analyses of certain artifact classes if required by CEQA, Section 106 of NHPA, the mitigation measures or conditions of approval for the Project. This may include but is not limited or restricted to include shell, bone, ceramic, stone or other artifacts.

The Developer should waive any and all claims to ownership of Native American ceremonial and cultural artifacts that may be found on the Project site. Upon completion of authorized and mandatory archeological analysis, the Developer should return said artifacts to the Soboba Band within a reasonable time period agreed to by the Parties and not to exceed (30) days from the initial recovery of the items.

Treatment and Disposition of Remains.

A. The Soboba Band shall be allowed, under California Public Resources Code § 5097.98 (a), to (1) inspect the site of the discovery and (2) make determinations as to how the human remains and grave goods shall be treated and disposed of with appropriate dignity.

B. The Soboba Band, as MLD, shall complete its inspection within twenty-four (24) hours of receiving notification from either the Developer or the NAHC, as required by California Public Resources Code § 5097.98 (a). The Parties agree to discuss in good faith what constitutes "appropriate dignity" as that term is used in the applicable statutes.

C. Reburial of human remains shall be accomplished in compliance with the California Public Resources Code § 5097.98 (a) and (b). The Soboba Band, as the MLD in consultation with the Developer, shall make the final discretionary determination regarding the appropriate disposition and treatment of human remains.

D. All parties are aware that the Soboba Band may wish to rebury the human remains and associated ceremonial and cultural items (artifacts) on or near, the site of their discovery, in an area that shall not be subject to future subsurface disturbances. The Developer should accommodate on-site reburial in a location mutually agreed upon by the Parties.

E. The term "human remains" encompasses more than human bones because the Soboba Band's traditions periodically necessitated the ceremonial burning of human remains. Grave goods are those artifacts associated with any human remains. These items, and other funerary remnants and their ashes are to be treated in the same manner as human bone fragments or bones that remain intact

Coordination with County Coroner's Office. The Lead Agencies and the Developer should immediately contact both the Coroner and the Soboba Band in the event that any human remains are discovered during implementation of the Project. If the Coroner recognizes the human remains to be those of a Native American, or has reason to believe that they are those of a Native American, the Coroner shall ensure that notification is provided to the NAHC within twenty-four (24) hours of the determination, as required by California Health and Safety Code § 7050.5 (c).

Non-Disclosure of Location Reburials. It is understood by all parties that unless otherwise required by law, the site of any reburial of Native American human remains or cultural artifacts shall not be disclosed and shall not be governed by public disclosure requirements of the California Public Records Act. The Coroner, parties, and Lead Agencies, will be asked to withhold public disclosure information related to such reburial, pursuant to the specific exemption set forth in California Government Code § 6254 (r). Ceremonial items and items of cultural patrimony reflect traditional religious beliefs and practices of the Soboba Band. The Developer agrees to return all Native American ceremonial items and items of cultural patrimony that may be found on the project site to the Soboba Band for appropriate treatment. In addition, the Soboba Band requests the return of all other cultural items (artifacts) that are recovered during the course of archaeological investigations. Where appropriate and agreed upon in advance, Developer's archeologist may conduct analyses of certain artifact classes if required by CEQA, Section 106 of NHPA, the mitigation measures or conditions of approval for the Project. This may include but is not limited or restricted to include shell, bone, ceramic, stone or other artifacts.

Confidentiality: The entirety of the contents of this letter shall remain confidential between Soboba, the City of Riverside, and hired consultant (RECON Environmental, Inc.). No part of the contents of this letter may be shared, copied, or utilized in any way with any other individual, entity, municipality, or tribe, whatsoever, without the expressed written permission of the Soboba Band of Luiseño Indians.

RECON

An Employee-Owned Company

May 15, 2018

Mr. Andreas Heredia, Cultural Director
Cahuilla Band of Indians
52701 Highway 371
Anza, CA 92539

Reference: Monroe Master Drainage Plan Line E Storm Drain Improvements Project
(RECON Number 8995)

Dear Mr. Heredia:

RECON Environmental, Inc. has been retained by the City of Riverside to conduct an archaeological survey for Monroe Master Drainage Plan Line E Storm Drain Improvements Project (proposed project). The proposed project includes the construction of approximately 11,200 linear feet of underground storm drain pipe within the Gratton Street, Dufferin Avenue, and Hermosa Drive rights-of-way; removing and rebuilding the curb, gutter, and street lights along portions of Gratton Street; and a jack-and-bore operation for trenchless pipe installation underneath Gage Canal at the intersection of Gratton Street and Hermosa Drive. Line E Stages 2 and 3 are located within the Gratton Street right-of-way and will extend approximately 7,600 feet (1.4 miles) from Lincoln Avenue at the north to the Gage Canal at the south. Line E-2 is located within the Hermosa Street right-of-way and will extend approximately 2,200 feet from Gage Canal at the west to St. Lawrence Street at the east. Line E-5 is located within the Dufferin Avenue right-of-way and will extend approximately 1,400 feet from Gratton Street to Adams Street. The project site is located within existing street right-of-way that is surrounded by citrus groves, plant nurseries, and low-density residential development within the Arlington Heights neighborhood (Figure 1).

A letter requesting identification of spiritually significant and sacred sites or traditional use areas in the proposed project vicinity was sent to the Native American Heritage Commission (NAHC). No Native American cultural resources were identified by the NAHC within the project area.

A records search was requested from the Eastern Information Center at University of California Riverside in order to determine if previously recorded prehistoric or historic cultural resources occur within the proposed project area. Three cultural resources, CA-RIV-11361, CA-RIV-4768/3605/3508/3509/3491/4813, and P-33-017367, cross the proposed project area. CA-RIV-11361 is a 6.1-mile-long section of Victoria Avenue, listed on the National Register of Historic Places and the California Register of Historical Resources. CA-RIV-4768 is the Gage Canal, a 20.13-mile canal beginning at the Santa Ana River and terminating at the Mockingbird Reservoir. The Gage Canal is City of Riverside Cultural Heritage Landmark number 24. Resource P-33-017367 is an approximately 2.7-mile-long segment of underground water lines along Dufferin Avenue. Resources within the one-mile record search radius include 26 bedrock milling features and 25 additional historic resources outside the project area.

RECON archaeologists surveyed the project area on May 9, 2018. Existing conditions for Victoria Avenue and the Gage Canal were noted. No additional cultural resources were identified.

Pursuant to the letter received from the NAHC, we are contacting you as a potentially interested party. We would like to know if you have any concerns regarding the proposed project as it relates to Native American issues or interests. Would you have any information on sacred sites in the vicinity of the proposed project area that may help us advise the client to avoid impacts to these sites? We would like to obtain Native

American input early enough in the environmental process to ensure adequate time to address any concerns you may have.

We would also appreciate any referrals to another tribe or person knowledgeable about the cultural resources within or adjacent to the proposed project area that may be of help in the planning process with regard to Native American concerns.

Please feel free to contact me if you have questions, comments, or concerns at 619-308-9333 ext. 133 or czepeda@reconenvironmental.com. If we have not heard from you by June 15, 2018, we will assume that you have no comments. Thank you for your assistance.

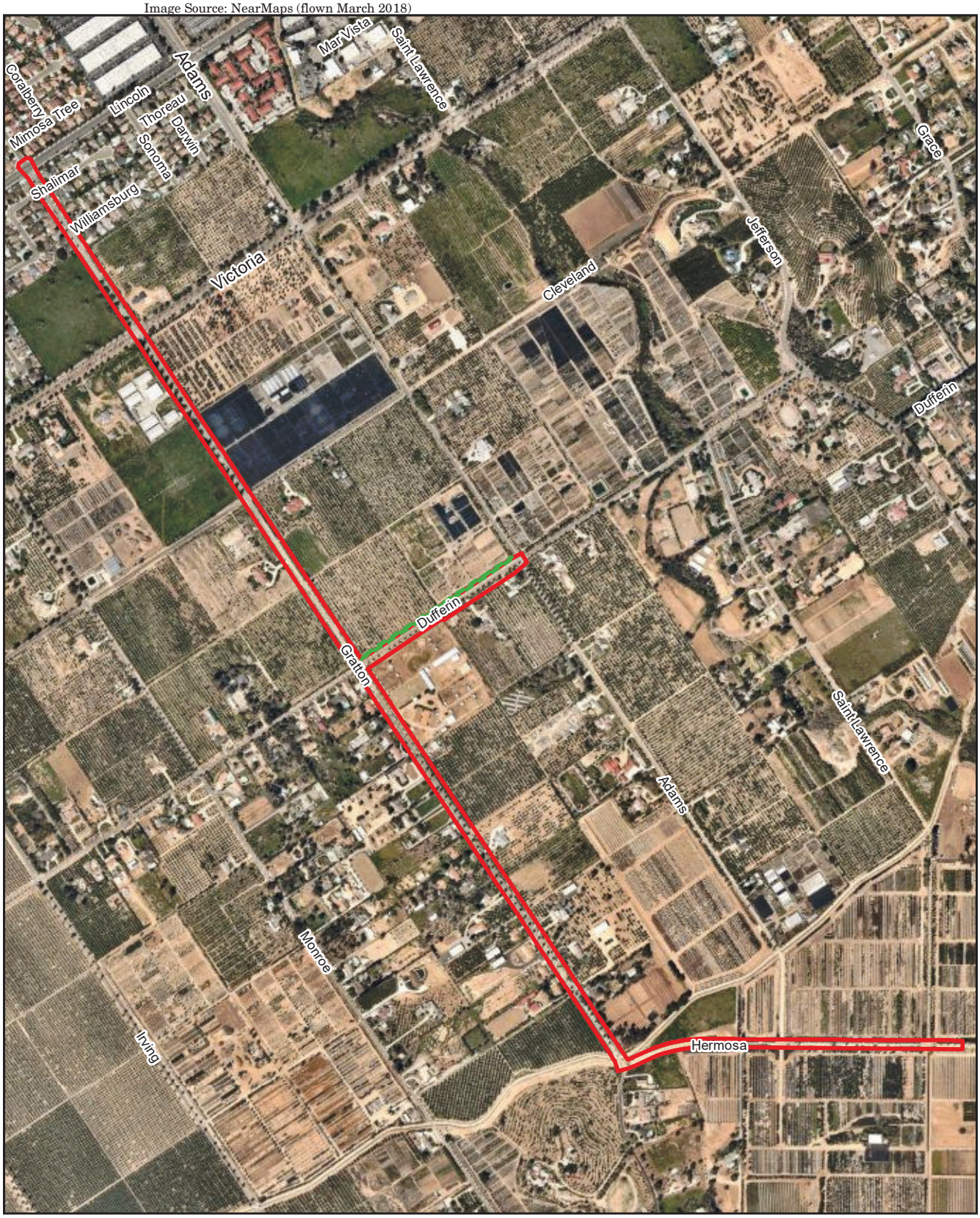
Sincerely,

Carmen Zepeda-Herman

Carmen Zepeda-Herman
Senior Archaeologist

cc: Sweta Patel, City of Riverside

Image Source: NearMaps (flown March 2018)



0 Feet 1,000

Project Boundary

Temporary Construction Impacts

RECON

M:\JOBS5\8995\common_gis\fig3.mxd 5/15/2018 sab

FIGURE 1

Project Location on Aerial Photograph

CONFIDENTIAL ATTACHMENTS

Are not for public review

APPENDIX D
GEOTECHNICAL REPORT

GeoMat Testing Laboratories, Inc.

Soil Engineering, Environmental Engineering, Materials Testing, Geology

September 14, 2017

Project No. 17066-01

TO: City of Riverside
Public Works Department
3900 Main Street
Riverside, California 92522

ATTENTION: Mr. Alex Ramirez

SUBJECT: Preliminary Geotechnical Investigation Report, Monroe Master Drainage Plan, Line "E" (Stage 2 and 3), Line "E-2" and Line "E-5", City of Riverside, California

In accordance with your authorization, GeoMat Testing Laboratories, Inc. has conducted a preliminary geotechnical investigation for the subject project alignment. The purpose of these services was to address geotechnical issues for the preliminary design of the proposed storm drain line. This report summarizes the findings of the subsurface exploration and the preliminary geotechnical study.

Sandy soil was encountered in upper ten feet from ground surface in almost all of the exploratory borehole. This material will cave in during excavation. Precautionary excavation measures should be exercised to protect personnel, utilities, street pavement, etc. Shoring recommendations are included herein.

Granitic bedrock was encountered in exploratory borehole B-17 at six feet below ground surface. Difficult excavation should be anticipated. Contractor may choose to pot hole the location with large excavator to estimate excavation difficulty prior to bidding the project.

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

Submitted for GeoMat Testing Laboratories, Inc.

Haytham Nabilsi, GE 2375
Project Engineer

Art Martinez
Staff Engineer

REGISTERED PROFESSIONAL ENGINEER
HAYTHAM NABILSI
No. 2375
Exp. 12/31/18
GEOTECHNICAL
STATE OF CALIFORNIA

Distribution: (3) Addressee

9980 Indiana Avenue ● Suite 14 ● Riverside ● California ● 92503 ● Phone (951) 688-5400 ● Fax (951) 688-5200
www.geomatlabs.com, contact: e-mail: info@geomatlabs.com

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Figure 1 Site Location Map
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APPENDIX

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1 INTRODUCTION

1.1 Scope of Work

- Review soils, groundwater data and maps in our files,
- Subsurface exploration utilizing hollow stem augers,
- Logging borehole, sampling of select soils, and observe drilling characteristics,
- Laboratory testing of select soil samples,
- Perform engineering analyses to develop design guidelines and recommendations,
- Seismic design criteria for the project areas,
- Recommended foundation types for structures and/or subgrade considerations for the pipe,
- Recommended shoring type(s) and temporary excavation slopes,

1.2 Existing Site Conditions

The project site is located on Gratton Street, Dufferin Avenue, and Hermosa Drive, in the City of Riverside, California. Gratton and Dufferin are paved roads with AC pavement and Hermosa is a dirt road. The borehole locations are shown on the provided borehole location map, Plate 1. For site vicinity refer to Figure 1.

Present underground utilities include, but not limited to sewer, storm drain, water, gas, and dry utilities. Overhead telephone and electric drops were also noted along the proposed alignment.

1.3 Proposed Development

The proposed storm drains Line E Stage 2 & Stage 3, Line E-2 and Line E-5 consisting of approximately two miles of reinforced concrete pipes and ancillary structures.

Monroe MDP Line E, Stage 2 proposes approximately 4,300 linear feet of underground storm drain system to be constructed within Gratton Street from Dufferin Avenue to the previously constructed Stage 1 facility at Lincoln Avenue, proposed pipe sizes from 84” to 66” in diameter.

Monroe MDP Line E, Stage 3 proposes 3,300 lineal feet of underground storm system to be constructed within Gratton Street from Dufferin Avenue to Hermosa Drive, with proposed pipe sizes from 66” to 54” in diameter. Monroe MDP Line E-2 will be approximately 2,200 lineal feet of underground storm drain system to be constructed from the upstream terminus of Line E, Stage 3 and extending easterly within Hermosa Drive, pipe sizes from 54” to 36” in diameter. Monroe MDP Line E-5 will be approximately 1,400 lineal feet of underground storm drain system to be constructed within Dufferin Avenue from the intersection of Dufferin Avenue and Gratton Street and extend east to end at the intersection of Adams Street.

2 SUMMARY OF GEOTECHNICAL CONDITIONS

2.1 Field Work

As requested, twenty-five exploratory boreholes were drilled on July 31st, August 1st, 2nd, and 3rd, 2017, to a maximum depth of 20 feet below existing ground surface utilizing a CME 45 drill rig equipped with 8-inch hollows stem augers. The borehole locations were provided to us and are depicted on Plate 1.

2.2 Sampling Method

Relatively undisturbed samples were obtained with the California Ring Sampler (ASTM D 1587). This sampler has three inches external diameter, 2.5 inches inside diameter, and is lined with one inch high brass rings, with an inside diameter of 2.41-inches. The sample barrel is driven into the ground at the bottom of the boring with 140-pound hammer with a free fall of approximately 30-inches. Sampler driving resistance, expressed as blows per six inches of penetration, is presented on the boring logs at the respective sampling depths. Blow counts required to drive the samplers 18-inches are recorded on the boring logs. The sum of the number of blows for the last 12 inches on an 18-inch penetration represents the SPT count. Ring samples were retained in close-fitting, moisture tight canisters for transport to our laboratory for testing.

Additional representative samples have been recovered with the SPT (Standard Penetration Test, ASTM D 1586) sampler. This sampler consists of steel driving shoe and tube that split longitudinally in half, and a coupling at the top. The coupling connects the sampler to the drill rod. The standard split tube has an inside diameter of 1 3/8-inch (1 ½ -inch inside diameter without liners) and an outside diameter of 2-inches. Unless noted otherwise, liners are usually not used. The standard driving weight and free fall for this test is similar to California Ring Sampler. Blow counts required to drive the samplers 18-inches are recorded on the boring logs. The sum of the number of blows for the last 12 inches on an 18-inch penetration represents the SPT count. This data is shown on the boring logs when obtained in the field.

Bulk samples were also collected from the auger cuttings during drilling. These samples are collected in plastic bags tied and tagged for the location and depth.

The geotechnical boring logs are presented in Appendix B and may include a description and classification of each stratum, sample locations, blow counts, groundwater conditions, results from selected types of laboratory tests, and drilling information.

2.3 Subsurface Findings

The subsurface materials encountered at the boring locations are briefly described below. Detailed descriptions are provided in the boring logs, which are presented in Appendix B.

According to the Geologic Map of the Riverside West/South ½ of Fontana Quadrangles (Figure 2), the soil units at the site is composed of old alluvial fan deposits (Qoa).

This material is generally weakly indurated, dissected alluvial fan deposits of sand and minor gravel, derived from local terrains of plutonic rocks. The ASTM classification of the material encountered in our exploratory borings is sandy lean clay (USCS “CL”), silty clay with sand (USCS “CL-ML”), clayey sand (USCS “SC”), silty sand (USCS “SM”), poorly-graded sand (USCS “SP”), poorly-graded sand with silt (USCS “SP-SM”), and well-graded sand with silt (USCS “SW-SM”).

Granitic bedrock was encountered in borehole B17 at approximately 6 feet below ground surface. The bedrock encountered was quartz diorite of peninsular ranges (qdi).

Non-cohesive clean sand was encountered in most of the borings, see Appendix B. This material is not stable in vertical excavations.

2.4 Groundwater

Groundwater study is not within the scope of this work. No groundwater was encountered during our subsurface work. The location and amount of perched water is dependent upon several factors, including hydrologic conditions, irrigation demands on or adjacent to the site, fluctuations in water features, seasonal and weather conditions.

In addition, changes in local or regional water management patterns, or both, can significantly raise the water table or create zones of perched water. The depth to the groundwater may fluctuate with seasonal changes and from one year to the next. Since groundwater may fluctuate throughout the year, we recommend the contractor verify groundwater conditions and evaluate dewatering requirements prior and during to construction.

A contour map showing minimum depths to ground water in the Santa Ana River Valley Region was constructed by the United States Geological Survey (USGS) and subsequently, a report (USGS Map MF-1802) was published in 1985. The map was constructed by contouring the shallowest water level measurements reported to the California Department of Water Resources (CDWR) for the period from 1973-1979. Based on our review of the map, the minimum depth to ground water in the project site area, during this period, was indicated to be around 10 feet at the east end of Hermosa Drive and grading down to approximately 75 feet below ground surface near the Gratton and Lincoln intersection.

2.5 Laboratory Testing

Laboratory testing was performed on soil samples collected during our subsurface exploration. The geotechnical testing program was provided by the City of Riverside. Included are the following tests:

Test	ASTM Designation
Classification	Soils were classified in accordance with the Unified Soil Classification System (USCS) in general accordance with ASTM 2488. Soil classifications are indicated on the borehole logs in Appendix B and graphically represented in Appendix C.
In Place Moisture Content and Dry Density	The results of these tests can be used to compute the overburden pressure, to correlate strength data and to aid in evaluating soil properties. The moisture content and dry density of relatively undisturbed samples obtained from the exploratory borings were evaluated in general accordance with ASTM D2216 and D2937. The test results are presented on the borehole logs in Appendix B.
Direct Shear Strength	Consolidated drained (saturated) direct shear tests were performed to evaluate the shear strength parameters of the site soils. The direct shear test was performed in accordance with ASTM 3080. The samples were inundated during shearing to represent adverse field condition. The sample was re-sheared to determine the residual shear strength of the material. Peak and residual shear strength are provided in this report.
Sulfate	A sample of dry soil is mixed with distilled water and allowed to stand overnight. The top aliquot is mixed with distilled water and a conditioning agent. The solution is then placed in a graduated cylinder and the value recorded based on the clarity of the solution. The results are presented in Appendix C.
Chloride	A sample of dry soil is mixed with distilled water and allowed to stand overnight. The top aliquot of the sample is mixed with chloride indicator and titrated over silver nitrate solution. The chloride content is determined by the difference of the volumes required to complete titration. The results are presented in Appendix C.
Ph	A sample of dry soil and distilled water are placed in a flask and allowed to stand for approximately an24 hour to stabilize. The pH is measured using a pH meter that has been compensated for temperature. The results are presented in Appendix C.

Test	ASTM Designation
Resistivity	The electrical resistivity of each soil specimen is conducted in a two-stage process using the soil box method. The first stage measures the resistivity of the soil in its as-received condition and the second stage records the value after saturation with distilled water. The results are presented in Appendix C.
R-Value	California Test 301 This test measures the lateral response of a compacted sample of soil or aggregate to a vertically applied pressure under specific conditions. This test is used by Caltrans for pavement design, replacing the California bearing ratio test.
Maximum Density & Optimum Moisture	Maximum density and optimum moisture content was conducted on select soil samples in accordance with ASTM D1557 "Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort".
Sand Equivalent	A soil sample is soaked, shaken, and irrigated in the working calcium chloride solution. After a 20 minutes sedimentation period, the clay suspension reading is taken along with the sand reading, and the sand-clay ratio is calculated. The results of the sand equivalent tests are presented in this report.

The moisture content and dry density test results are presented at the corresponding sample depths on the boring logs in Appendix B. The results of the other laboratory tests and graphical representation of the test results is presented in Appendix C.

A list of samples obtained during the subsurface work and corresponding tests performed for this study can be found in Table 1 in Appendix C:

2.6 Shear Strength

Based on direct shear test results, the cohesion intercept (c) and friction angle (φ) representing the effective shear strength of the onsite soils range from 4 to 808 psf and 26 to 43 degrees, respectively. Graphical representations of the test results can be found in Appendix C. The strength test results are summarized in the following table.

Sample	Average Dry Density	Average Moisture	Saturated Moisture	Cohesion	Friction Angle	Total Unit Weight	Allowable Soil Bearing (psf)	RANKINE RATIO		At Rest EFP*	Soil Friction
				Ultimate	Ultimate			Active EFP*	Passive EFP*,**		
B-1 @ 10'	122 pcf	13%	17%	344 psf	34°	138 pcf	3071	51	75	247	0.34
B-2 @ 20'	101 pcf	10%	24%	19 psf	36°	111 pcf	3494	48	263	72	0.37
B-3 @ 15'	98 pcf	15%	20%	49 psf	39°	113 pcf	1825	44	290	67	0.40
B-4 @ 10'	89 pcf	25%	24%	104 psf	39°	111 pcf	2312	44	290	67	0.40
B-7 @ 15'	110 pcf	11%	18%	104 psf	43°	121 pcf	3341	38	331	60	0.46
B-8 @ 5'	106 pcf	19%	24%	204 psf	30°	126 pcf	1625	58	218	82	0.30
B-9 @ 10'	97 pcf	27%	30%	264 psf	26°	123 pcf	1496	66	193	89	0.25
B-10 @ 20'	106 pcf	16%	23%	698 psf	33°	123 pcf	5028	53	239	77	0.33
B-11 @ 5'	108 pcf	13%	17%	4 psf	42°	122 pcf	1953	40	320	62	0.44
B-12 @ 15'	116 pcf	15%	17%	214 psf	34°	133 pcf	2229	51	247	75	0.34
B-13 @ 10'	112 pcf	14%	17%	19 psf	43°	128 pcf	2350	38	331	60	0.46
B-14 @ 5'	93 pcf	31%	21%	29 psf	40°	122 pcf	1819	42	299	65	0.42
B-15 @ 15'	113 pcf	11%	17%	54 psf	34°	124 pcf	1192	51	247	75	0.34
B-16 @ 10'	122 pcf	13%	16%	434 psf	31°	137 pcf	2995	56	225	80	0.31
B-17 @ 5'	114 pcf	16%	21%	808 psf	28°	133 pcf	4212	62	205	85	0.27
B-18 @ 10'	102 pcf	22%	26%	199 psf	36°	125 pcf	2481	48	263	72	0.37
B-19 @ 5'	109 pcf	14%	21%	289 psf	39°	125 pcf	3951	44	290	67	0.40
B-20 @ 10'	118 pcf	11%	20%	324 psf	37°	131 pcf	3657	47	272	70	0.38
B-21 @ 5'	105 pcf	16%	25%	264 psf	39°	121 pcf	3729	44	290	67	0.40
B-22 @ 15'	97 pcf	14%	26%	349 psf	35°	110 pcf	3330	50	255	73	0.35
B-23 @ 10'	114 pcf	10%	17%	64 psf	39°	125 pcf	1958	44	290	67	0.40
B-24 @ 5'	114 pcf	11%	15%	19 psf	36°	127 pcf	1165	48	263	72	0.37
B-25 @ 10'	106 pcf	18%	25%	469 psf	33°	124 pcf	3629	53	239	77	0.33

*Based on In-place Unit Weight.
**Maximum Passive EFP is limited to 8 times the tabulated value.

The values shown in the above table represent our interpretation of the soil properties based on the available laboratory and field test data. Use of the soil properties shown above may or may not be appropriate for a particular analysis, since choice of design parameters often depends on whether total or effective stress analysis is used, rate of loading, duration of loading, geometry of loaded area, and other factors. The total unit weight values shown above represent our interpretation of soil unit weight at natural moisture content. The allowable bearing pressures include a factor of safety of three.

3 GEOLOGIC FINDINGS

3.1 Regional Geology

The subject property is located in the Peninsular Ranges Province of California (Perris Block portion).

The Peninsular Ranges Province, generally, is noted for its pronounced, active, northwest-southeast oriented fault systems. However, the Perris Block portion, itself, is un-faulted, an outward exception to this rule.

The closest of the major faults are the Elsinore Fault Zone, to the southwest, and the San Jacinto Fault Zone, to the northeast. The item site is located approximately 9 miles northeast of the Elsinore Fault Zone and 13 miles southwest of the San Jacinto Fault Zone.

The earth units of the area are chiefly Pleistocene and Holocene alluvial deposits and cretaceous granitic bodies, refer to Figure 2.

3.2 Site Geology

The project site is located on Gratton Street, Dufferin Avenue and Hermosa Drive, in the City of Riverside, California. General surface sheet drainage flows to the northwest at a rate of approximately 2%. The maximum relief on site is approximately 197 feet, with the highest elevation located at the Hermosa and St. Lawrence intersection (1051 feet) and the lowest elevation located at the Gratton and Lincoln intersection (854 feet).

The native ground is underlain by old alluvial fan deposits. The alluvial soil encountered on site was soft to very firm sandy lean clay (USCS “CL”), loose to very dense clayey sand (USCS “SC”), medium dense to very dense silty sand (USCS “SM”), firm to very firm sandy silty clay/silty clay with sand (USCS “CL-ML”), very firm sandy silt (USCS “ML”), medium dense to dense sand (USCS “SP”), and loose to medium dense sand with silt (USCS “SP-SM” and “SW-SM”).

Very dense granitic bedrock (quartz diorite) was encountered in borehole B-17 at a depth of 6 feet below ground surface.

3.3 Geologic Hazards

3.3.1 Active Faults

Based on the Regional Fault Zone map presented in City of Riverside General Plan, there are no faults known to transverse the site.

3.3.2 Surface Rupture Zones

The site is not within a currently established Earthquake Fault Zone for surface fault rupture hazards. Therefore, the potential for surface rupture is very low. It is probable that not all-active or potentially active faults in the region have been identified. Furthermore, seismic potential of the smaller and less notable faults is not sufficiently developed for assignment of maximum magnitudes and associated levels of ground shaking that might occur at the site due to these faults.

3.3.3 Ground Shaking

Although there are no known active surface faults within or adjacent to the site that will significantly impact the project, the project is located in a region with active earthquakes and strong seismic motion of those earthquakes could affect the project. The structures that are proposed to be constructed on the site will be required to meet and comply with all applicable city and State building codes to reduce seismic ground shaking at the site to less-than-significant.

3.3.4 Tsunamis, Seiches

The setting is inland and no large bodies of water are located within the sites vicinity, therefore, the potential of Tsunamis or seiches affecting the site is considered low.

3.3.5 Slope Stability

There are no slopes on site and no slopes are proposed.

3.3.6 Landslides

The site and the surrounding properties are flat and not prone to slope instability hazards, such as landslides. The project will not be impacted by a landslide or impact adjacent properties due to a project generated landslide.

3.3.7 Liquefaction Potential

Liquefaction occurs when loose, saturated, cohesionless soils are subject to ground shaking during an earthquake of large magnitude when the water table is less than 30 feet below ground surface. According to the City of Riverside General Plan, the site is in an area of low to high liquefaction potential, see Figure 3. We suggest flexible joints should be considered in the pipe design in areas subject to liquefaction.

3.3.8 Site Class

The proposed improvement is a pipeline and accordingly, site specific evaluation to determine spectral acceleration for liquefiable soils is not required and therefore the structure need not be designed as if it is Seismic Site Class “F:” It is our opinion that structures should be designed in accordance with the current seismic building code for Site Class “D”

3.3.9 Ground Motion and Seismic Design Parameters:

The peak ground acceleration (PGA) and 2016 CBC seismic design parameters are presented in Appendix D.

4 CONCLUSIONS

- Active or potentially active faults are not known to exist on or in the immediate vicinity of the site.
- The site is located in a region of generally high seismicity, as is all of southern California. During its design life, the site is expected to experience strong ground motions from earthquakes on regional and/or local causative faults. Therefore typical structural design mitigations should be considered by the structural engineer.
- Liquefaction potential onsite is low to high, refer to Figure 3.
- The potential for seismically induced dynamic settlement of the onsite soils is very low to moderate.
- Vegetation, buried irrigation lines, old foundations, roots, and utility lines may be encountered throughout the project area.
- The onsite soils exclusive of deleterious may be used as compacted fill materials. Wet soil should be dried back to near optimum moisture before using as backfill.
- Adequate measures should be taken to protect any structural foundations and utilities adjacent to any excavations.
- **Granitic bedrock was encountered in B-17 at 6 feet below ground surface. Therefore, very hard to excavate granitic material, localized boulders, or non-rippable material may be encountered during excavation. Deeper excavations may require jack-hammering, heavy ripping to achieve grades and local blasting should not be precluded.**
- **Based on our subsurface exploration, very sandy material was encountered in most of the boreholes. This material should be expected to cave or unravel during excavation. Protection of personnel, utilities, pavement, etc. should be an important consideration. Refer to Geotechnical Logs in Appendix B for location and depth to sandy soil.**
- The use of trenchless and open-cut trench methods is considered feasible for the proposed pipeline.
- **No groundwater and/or seepage were encountered during our subsurface investigation. Wet soil was encountered in B-16 at 16 feet below ground surface. Highest historical groundwater recorded for Hermosa Drive area is 10 feet below ground surface. Water seepage may be encountered during excavation in wet season.**
- Potential for rain or irrigation water moving through from adjacent and elevated areas cannot be precluded. Our experience indicates that surface or near-surface groundwater conditions can develop in areas where groundwater conditions did not exist prior to site excavation, especially in areas where a substantial increase in surface water infiltration results from landscape irrigation. Since groundwater may fluctuate throughout the year, we recommend the contractor verify groundwater conditions and evaluate dewatering requirements prior and during to construction.
- Based on the results of our geotechnical investigation of the site, it is our opinion that the proposed improvements are feasible from a geotechnical standpoint, provided the following recommendations are incorporated into the project plans and specifications.

5 RECOMMENDATIONS

5.1 Earthwork

This section is intended to address issues that might arise during construction. Our recommendations are intended for use as guidelines in dealing with particular soil conditions. The recommendations contained herein are not intended to dictate construction methods or sequences. Instead they are provided solely to assist designers in identifying potential construction problems related to excavation, based upon findings derived from sampling. Depending upon the final design chosen for the project, the recommendations may also be useful to personnel who observe construction activity.

Prospective contractors for the project must evaluate potential construction problems on the basis of their review of the contract documents, their own knowledge of and experience in the local area, and on the basis of similar projects in other localities, taking into account their own proposed methods and procedures.

All earthwork should be performed in accordance with the recommendations presented in the attached General Earthwork and Grading Specifications in Appendix E, unless specifically revised or amended below.

5.1.1 Site Preparation

Efforts should be made to locate any existing utility lines and underground obstructions within the proposed alignment. Those lines or obstructions should be removed or rerouted if they interfere with the proposed construction, and the resulting cavities should be properly backfilled and compacted. Utility lines that cannot be relocated should be properly protected in-place to preserve their function which may require shoring or bracing of the excavation to prevent lateral displacement or undermining of the existing utility conduits.

5.1.2 General Fill Placement and Compaction

The soils encountered at the boring locations are generally suitable for use as compacted fill, provided that they are free of organic material, debris, and oversized material. Soils to be placed as fill, whether onsite or import material, should be approved by the geotechnical engineer.

All fill soils should be placed in thin, loose lifts, with each lift properly moisture conditioned to slightly above the optimum moisture contents and compacted to a minimum of 90 percent relative compaction (ASTM D 1557). The aggregate base should be compacted to a minimum of 95 percent relative compaction (ASTM D 1557).

Pipeline trenches should be backfilled with compacted fill in accordance with the *Standard Specifications for Public Works Construction* (Greenbook). Prior to backfilling, the trench bottom should be provided with at least four inches of filter material. After pipe placement on filter material, the pipe zone should be filled with CLSM (controlled low strength material) to the top of the pipe. Refer to Riverside County Flood Control Revised Standard Drawing M815.

Above the pipe zone, trenches can be backfilled with the onsite material, provided it is free of debris, organic and oversized material greater than 3 inches in largest dimension. Oversized rock (cobbles and/or boulders) should either be removed from the alignment or pulverized for use in backfill. Gravel larger than 3/4 inches in diameter should be mixed with at least 80 percent soil by weight passing the No. 4 sieve.

Backfill should be placed in thin lifts, loose lift thickness being compatible with the earthwork equipment, moisture conditioned, as necessary, and mechanically compacted to a minimum 90 percent relative compaction (ASTM D 1557). The aggregate base in pavement areas should be compacted to a minimum 95 percent relative compaction. In paved roads, the top 3 feet, measured from subgrade plane, should be compacted to at least 95% relative compaction.

5.1.3 Filter Material Below Pipe

Filter material to be used below pipe should conform to Section 90-1.02C and 90-1.02C(4)(a) of Caltrans Specifications. Grading of filter material should meet the requirement for 1"XNo.4 coarse aggregate per Section 90-1.02C(4)(b) of Caltrans Specifications. The filter material should be consolidated with appropriate means.

5.1.4 CLSM Material

CLSM is a mixture of cement, pozzolan, coarse and fine aggregate, and water that has been mixed in accordance with ASTM C94 (Standard Specification for Ready Mixed Concrete) and is in a flowable state during placement. CLSM should conform to the Standard Specification for Public Works Construction (Green Book) Section 201-6. When fully cured, the CLSM should be hand excavatable and have a minimum 28 day compressive strength of no less than 50 psi and a maximum 28 day compressive strength of no more than 150 psi. Based on our experience, this material has been delivered to local projects at an average of 127 psi.

5.1.5 Subgrade Preparation

We recommend that the exposed surfaces at the bottom of the excavations for the pipeline trenches, at-grade and below grade structures be competent and uniform in composition and free of loose soil or debris. Any loose and/or unsuitable materials encountered at the pipe invert should be removed and replaced with adequate bedding material. Refer to the following section "Pipe Bedding" for additional recommendations.

If wet or pumping soils are encountered, the excavation bottoms may need to be stabilized by working crushed and broken rock in 12 to 18-inch layers into the soil until a firm base is established on which fill can be placed. The minimum recommended thickness of crushed and broken rock layer is 12 inches to stabilize the wet and pumping soils. The wet soils will need to be air dried and/or mixed with dry material prior to placement as compacted fill. Field evaluation of the stability and support characteristics of the subgrade is recommended to be performed by the geotechnical consultant prior to pipe installation and concrete placement and the proposed at-grade and below-grade structures.

5.1.6 Allowable Soil Bearing Capacity

For below-grade structures, where the foundation level is deeper than 5 feet below the finished grade, a net allowable bearing capacity of 2000 psf may be used for competent soil. The foundation should be supported on undisturbed soils with a minimum embedment depth of 12 inches below the lowest adjacent grade. The bearing capacity may be increased by one-third for wind or seismic loading.

5.1.7 Modulus of Native Subgrade Reaction

The modulus of subgrade reaction is dependent on the native soil classification and density. There are several different soils on site at various depths. Refer to Plate 7 and Geotechnical Borehole Logs in Appendix B to obtain the Modulus of Subgrade Reaction.

5.2 Temporary Excavations

The stability of temporary cut slopes made during site work is a function of many factors, including, but not limited to, the following considerations: 1) the presence and abundance of groundwater; 2) type and density of the various soil strata; 3) the depth of the cut; 4) surcharge loadings adjacent to the excavations; and 5) the length of time the excavation remains open. Consequently, it is exceedingly difficult to establish a safe and maintenance-free cut slope angle in advance of construction.

Cut slope stability should, therefore, be the responsibility of the contractor, since he is continuously at the job site, able to observe the nature and condition of the subsurface materials encountered, monitor the cut performance, and control the scheduling of site activities.

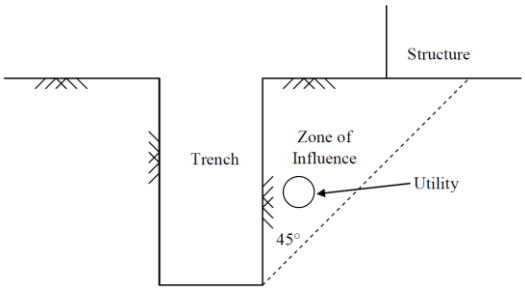
The native onsite soils encountered in the exploratory borings may be classified into two OSHA soil categories; Soil Type "B" for the onsite alluvial soil with binding material (SM, SC, CL, ML, and CL-ML), and Soil Type "C" for the onsite sandy material (SP-SM, SW-SM, SP). In our opinion, soil with Caliche may be classified as Soil Type "C". Refer to Geotechnical Boring Logs in Appendix B.

For Type "B" soils, the maximum unsurcharged vertical cut in homogenous onsite soils with no adverse geologic condition or seepage was calculated to be approximately 6 feet, see Plate 2. We recommend that excavations in vertical height greater than 6 feet be adequately sloped or braced to prevent injury to workmen from localized sloughing and spalling. Recommended maximum slope inclination is 1H:1V, per OSHA.

For Soil Type "C", the presence of these soils limits the use of vertical cuts for any excavation in this material. Excavations should be inclined to the soil's angle of repose. Tentatively this inclination is estimated to be 2.5H:1V or flatter, depending on exposed soil conditions. In Soil Type "C", caving mitigation such as trench shields or shoring should be utilized during construction. All excavations should be accomplished in accordance with applicable local, State or Federal safety provisions.

Construction site safety generally is the sole responsibility of the Contractor, who should also be solely responsible for the means, methods, and sequencing of construction operations.

No surcharge loads should be permitted within a horizontal distance equal to the height of cut or 10 feet, whichever is greater from the top of the cut, unless the cut is shored appropriately. Excavations that extend below an imaginary plane inclined at 45 degrees below the edge of any adjacent existing site foundation should be properly shored to maintain support of the adjacent structure.



Where settlement sensitive facilities are within the zone of influence, additional analysis should be done to determine both the amount of movement that is expected at the location of the facility, as well as the amount of movement that is acceptable. In the event that the movement anticipated at the location of the facility is unacceptable, the project plans and specifications should require support systems that restrict the movement of the sides of the trenches. Support systems should be designed for the specific situation by a registered professional engineer.

During construction, the soil conditions should be regularly evaluated to verify that conditions are as anticipated. The contractor shall be responsible for providing the "competent person" required by OSHA standards to evaluate soil conditions. Close coordination between the competent person and the geotechnical engineer should be maintained to facilitate construction while providing safe excavations.

Please refer to Geotechnical logs in Appendix B for a more in-depth description of soil conditions. Under adverse weather conditions, temporary slopes should be draped with plastic sheeting or other means to protect them from the elements and minimize sloughing and erosion.

5.2.1 Precaution for Trench Excavations

The planned construction will be performed along alignments near existing utility installations (either crossing or paralleling the new alignments). The contractors should be aware of potential excavation stability problems while working in the vicinity of old trenches and the excavation system should be designed to accommodate this weak material (trench backfill).

The Contractor should be aware that unsupported excavation depths beyond the recommended safe cut and inclination should in no case exceed those specified in local, state, and/or federal safety regulations (e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations).

Such regulations are strictly enforced and, if they are not followed, the Owner, Contractor, and/or earthwork and utility subcontractors could be liable for substantial penalties.

5.2.2 Excavation Characteristics

Some of the older alluvium is indurated and may be considered cemented. This material may exhibit hard excavation resistance for small equipment such as rubber tire backhoes. A sheepsfoot wheel may be used for compaction.

Dry, sandy soil was encountered on site at varying depths; refer to Geotechnical Borehole Logs in Appendix B for material descriptions. This material has little to no binder and has the potential to cave-in or unravel, if encountered. This may undermine upper soil layers and existing utilities. The contractor should have appropriate equipment (shields, shoring, etc.) to support/brace excavation and protect existing utilities, and structures, etc. Other areas not explored may contain such material.

5.2.3 Excavation Considerations

Excavations should satisfy two requirements. First, the soils above final grade must be removed without disturbing the soil below excavation grade, which will support constructed facilities. Second, the sides of the excavation must be stable to prevent damage to adjacent streets and facilities as a result of either vertical or lateral movements of the soil.

Groundwater seepage is not expected in summer time. **Wet soil was encountered in exploratory borehole B-16 at 16 feet below ground surface.** In wet season, when perched water may be encountered, a satisfactory excavation procedure must include, if necessary, an adequate construction dewatering system to lower and maintain the water level at least a few feet below the lowest excavation grade.

5.2.4 Caving Condition

Depending on the depth of excavation, soil conditions encountered along the excavation face, and slope inclination, caving or sloughing of excavation slopes is likely if seepage is encountered. Onsite sandy soil along the entire alignment is subject to sloughing and caving of excavation slopes. This caving condition could endanger personnel working within or adjacent to the excavation as well as nearby equipment, structures, or other existing improvements. The contractor should be aware of the potential for caving of sandy material on this project and take appropriate precautions to protect the safety of site personnel as well as the integrity of the excavation slopes and any existing nearby structures or other improvements.

5.3 Temporary Shoring

5.3.1 General

Trench excavations, especially when they are above groundwater table, may be supported by methods such as trench shields, speed shoring, soldier piles, Slide Rail™, cross-braced hydraulic shoring or conventional shields or other forms of shoring may be used where appropriate throughout the project provided Cal OSHA regulations are met.

The choice should be left to the contractor's judgment since economic considerations and/or the individual contractor's construction experience may determine which method is more economical and/or appropriate. The contractor and shoring designer may perform additional geotechnical studies as necessary to refine the means-and-methods of shoring construction. Shoring may be desired or even necessary to reduce excavation quantities and/or to protect existing adjacent utilities or other improvements.

Support of all adjacent existing structures without distress is the contractor's responsibility. Shoring systems should be designed by a California licensed civil or structural engineer.

5.3.2 Design Consideration

The design of the shoring system may be governed by or additional load may result from local soils and geologic conditions. In addition to the lateral forces due to retained earth, surcharge due to improvements, such as the loads from the adjacent footings and traffic, should be considered in the design of the earth retaining system. Loads applied within a 1H:1V projection from the surcharging structure on the stem of the wall shall be considered as lateral surcharge.

For additional lateral surcharge conditions, we recommend utilizing a horizontal pressure equal to 30 percent and 50 percent of the vertical load for active and at-rest conditions, respectively. This horizontal pressure should be applied at the 1H:1V projection plane as a thrust force. As an alternative, the surcharge pressure may be calculated using Boussinesq stress distribution using the 2 multiplier on the numerator in Plate 3.

5.3.3 Earth Pressure for Cantilever and Braced Excavations

The subsurface soils encountered in the exploratory boreholes, throughout the project alignment, contain soils of both Cal/OSHA Type B and Type C soils. The varying soils types and corresponding earth pressures presented on Plate 4A and 4B. Earth pressure values for Plate 4B may be obtained from table of laboratory test results on Page 8. Final earth pressures and pressure diagrams for the contractor's design and implementation of individual shoring systems will be dependent on (1) the actual soil and groundwater conditions encountered during construction, (2) the contractor's shoring type, design, and installation methods, and (3) surcharge pressures, including from stockpiling, construction equipment, and vehicular traffic.

The native soils in the project area have varying composition and consistency in vertical and lateral profiles. Therefore, shoring design should take into account the variability of native soils including the need to retain noncohesive soils that have little to no stand-up time. Special shoring designs should be required to account for surcharge pressures and to maintain positive lateral support for existing adjacent structures when excavations fall within an imaginary plane projected downward at a 45 degree and from the nearest edge of the adjacent structure's foundation.

5.3.4 Dynamic Earth Pressures

The seismic load due to lateral earth pressure may be defined in accordance with NAVAC.

Dynamic, Yielding Condition $P_{AE} = 3/8(k_h)YH^2 = 8\ H^2$
Dynamic, Non-Yielding Condition $P_{AE} = 3/8(k_h)YH^2 = 17\ H^2$

Where: P_{AE} is in lb/linear foot of wall
$PGA_m = 0.50$ g
K_h is equal to 35% PGA_m for cantilever and 75% PGA_m for restrained condition
H is height of wall in feet
Y is equal to the maximum unit weight of the backfill in pcf
The resultant dynamic force acts at a distance of 0.6H

Dynamic forces are short term loading. A one-third increase in bearing pressure and passive resistance may be allowed for dynamic analysis.

5.3.5 Jet Grout

Jet grout typically consists of cement and water mixed in situ with native soil to create soilcrete. The purpose of jet grouting for the project would include one or a combination of the following purposes.

- To completely bind granular utility trench backfill and pipe embedment material that would otherwise be unstable when exposed in vertical excavations;
- To fill any gaps in shoring with a sufficient thickness of soilcrete (grouted prism) to resist soil and hydrostatic pressures and prevent flowing ground conditions when launching and receiving pit excavations are made.
- To fill behind areas of planned tunnel portals with a sufficient thickness of soilcrete (grouted prism) to resist soil and hydrostatic pressure and prevent raveling, running, or flowing ground conditions when portals are opened for tunnel machine launching or receiving.
- For pit shoring (including perimeter groundwater cutoff purposes) or for pit bottom stabilization.

Jet grouting at shoring gaps is to be done after shoring installation but prior to pit excavation and any external dewatering. Jet grouting at tunnel portals is to be done after the pit is fully shored and excavated and prior to installation of any external dewatering wells. Jet grouting mixes insitu soil with cement slurry. The cement slurry is injected laterally into the ground at high pressure through nozzles in small diameter rotating drill rods which are advanced to predetermined elevations at predetermined rotation and advancement rates. The jet grouting process produces of coherent soilcrete which, when overlapped, create a soilcrete mass (grouted prism). Diameter of individual jet grout columns typically vary from 3 to 5 feet based on soil type, jet rod drill rotation, and advancement rates, and the jetting pressures.

5.4 Estimated Settlement Adjacent to Open Cuts

Because lateral yield of braced excavation in cohesionless soil is usually small, the loss of ground is also usually small. However, loss of ground due to densification of loose cohesionless deposits may be estimated to be on the order of 1.5 percent of the depth of cut.

Settlement due to flow or migration of sands into a cut can also cause loss of ground. This settlement is difficult to estimate because it is dependent on construction techniques and local soil conditions, and whether groundwater is present.

Lateral yield occurs in cuts in soft clays, the surface settlement associated with such cuts may be substantial. The magnitude and extent of these surface settlements may be estimated using the relationships shown in Plate 5.

To reduce the potential for distress to adjacent structures, we recommend that the shoring system be designed to limit the ground settlement behind the shoring to 1/2 inch or less.

The site is located in a zone with high potential for liquefaction. Seismically-induced settlement from liquefaction during a strong earthquake is not anticipated, however cannot be precluded if liquefaction occurs. This settlement should be considered in the design of structures if the owner wishes a higher degree of confidence by considering higher probable events. Additionally, this settlement will impact underground structures that extend to the ground surface such as manholes and metering stations. As the soils settle around these structures as a result of liquefaction, the soils tend to drag these structures down and exert downdrag friction at the contact surface of the soils and the structures. The downdrag friction is estimated as 350 psf and should be incorporated in the seismic design of these structures.

5.5 Dewatering

If encountered, we recommend removing groundwater from excavations. Sumps and pumps can be considered for excavations in low permeability silt and clayey soils, or where groundwater needs to be drawn down 2 feet or less in more permeable sandy soil. A dewatering media, such as clean crushed rock, would be required if sumps are used. This could potentially be feasible in shallow water line excavations. Where groundwater must be drawn down more than 2 feet, a well contractor should review our logs and gradation test results to determine if wells are required, how many will be required, and to what depth they will need to be installed. Well points or suction wells are generally effective in dewatering to depths of about 15 to 20 feet.

In sands, we do not recommend attempting to dewater from within an excavation. Upward seepage will loosen and disturb the excavation bottom. Rather, groundwater should be drawn down at least 2 feet below the anticipated excavation bottom in advance of excavation.

Dewatering can potentially affect near-by wells. Another issue with dewatering is settlement of the soils after the groundwater has been drawn down. This could cause problems where the soils that have settled are supporting a structure such as pavement, etc.

There are many variables that influence the amount of settlement including soil type and condition, amount of water drawdown, and duration of water drawdown. In general, the amount of settlement in a clean sand material that is dewatered with suction wells will likely be minimal and go largely unnoticed if the dewatering lasts less than a week. Noticeable settlement could occur if the dewatering is left on for an extended period of time.

Since temporary dewatering will be temporary, we recommend the contractor be solely responsible for the design, installation, maintenance, and performance of the dewatering system. Where shoring is employed, the dewatering system should be compatible with the type of shoring to be used.

Since groundwater may fluctuate throughout the year, we recommend the contractor verify groundwater conditions and evaluate dewatering requirements prior and during to construction.

The most significant impact of dewatering on the surrounding environments will be the potential for ground subsidence. Ground subsidence may cause damage to roadways, existing underground utilities, and other improvements within the zone of influence of construction.

Trench backfill should progress to a minimum depth of two feet above groundwater or seepage level before removing dewatering system. Contractor should be responsible for adequately dewatering the trench for safe and convenient installation of pipe or conduit and sufficiently to meet the compaction requirements. Crushed rock in addition to the bedding may be required to stabilize bottom of trench and/or stabilize the backfill. If crushed rock is used it should be wrapped in filter fabric.

5.6 Pipe Bedding

The storm drain line should be installed according to the Riverside County Flood Control Revised Standard Drawing Number M815. The detail shows at least four inches of filter material to be placed below the pipe.

Some of the onsite soils are characterized by high fine content. Sand equivalent tests were performed on soils in each of the boreholes; the results are in the following table.

Borehole	SE	Borehole	SE	Borehole	SE	Borehole	SE	Borehole	SE
B1@5'	8	B6@5'	10	B11@5'	61	B16@5'	11	B21@5'	67
B2@5'	18	B7@5'	14	B12@5'	NR	B17@5'	9	B22@5'	19
B3@5'	21	B8@5'	24	B13@5'	39	B18@5'	23	B23@5'	18
B4@5'	13	B9@5'	19	B14@5'	65	B19@5'	58	B24@5'	34
B5@5'	19	B10@5'	8	B15@5'	7	B20@5'	14	B25@5'	29

NR: No Sample Recovery

The excavations should be performed using methods and equipment capable of providing a relatively clean bearing area. Stable soils are essential to provide a strong base during construction. In addition, stable soils enhance trench bottom stability, support for bedding compaction, and minimize possible pipe settlement.

Whenever soft foundation soils are encountered during trench excavation, we recommend overexcavating at least 1 foot, or more to stabilize subgrade, below the base of the foundation or to firm ground and replacing the additional excavation with crushed rock compacted to at least 90% of maximum dry density.

5.7 Pipe Zone

Pipe zone should be backfilled as indicated in the Riverside County Flood Control Revised Standard M815 with Controlled Low Strength Material (CLSM) consisting of at least one sack of Portland cement per cubic-yard of sand, conforming to the 2015 Greenbook specification 201-6. CLSM should not be jetted and need not be observed by GeoMat Testing Laboratories, Inc.

5.8 Over Pipe Zone

Above the pipe zone, trenches should be backfilled with excavated on-site soils free of debris, organic and oversized material greater-than (>) 3-inches in largest dimension. Gravel larger than $^{3}/_{4}$-inch in diameter should be mixed with at least 80-percent soil by weight passing the No. 4 sieve. Excavated soil or imported sand backfill over the pipe zone should be placed in thin lifts, moisture conditioned (near optimum), as necessary, and mechanically compacted using a minimum standard of 90 percent relative compaction, relative to the maximum dry-density determined by ASTM D 1557 test method. Backfill above the pipe zone should not be jetted. In any case, backfill above the pipe zone should be observed and tested by GeoMat Testing Laboratories, Inc.

5.9 Trenchless Pipeline Construction

The proposed storm drain, near the intersection of Gratton Street and Hermosa Drive, where it crosses the Gage Canal will be installed by trenchless pipeline construction methods. This pipe is estimated to be approximately 54-inch diameter and cross approximately 70 linear feet.

Three construction methods may be considered by the contractor for the pipeline undercrossing. These options are microtunneling, pipe jacking (with shield), and bore-and-jack.

It is our opinion that trenchless construction at the project site can be accomplished by an experienced contactor using jacking/micro tunneling equipment. Provisions for controlling running soil, seepage, and hard rock should be provided during the trenchless operation to minimize ground loss and ground subsidence.

It is the contractor's responsibility to design and select the appropriate tunnel construction method, support system and to follow the requirements of the health and safety rules of the State of California pertaining to tunnel construction and permit requirements of the City/County of Riverside and other local agencies, if applicable.

5.9.1 Geotechnical Parameters for Trenchless Installation

Based on the soil conditions revealed by borings B-16 and B-17, and laboratory test data, geotechnical design parameters were developed for cohesive soils and cohesionless soils. The cohesive soils encountered was sandy lean clay. The cohesionless soils encountered are clayey sand and granitic bedrock that drills like silty sand. The bedrock was encountered at 6 feet below ground surface in borehole B-17. It should be anticipated that the bedrock will be highly weathered within the first few feet of soil-bedrock contact and will be subject to caving/raveling.

Soil Parameters	Cohesive Soil	Cohesionless Soil
Moist Unit Weight of Soil	125 pcf	120 pcf
Submerged Unit Weight of Soil	65 pcf	60 pcf
Coefficient of At-Rest Earth Pressure, K_0	0.70	0.50
Rankine Active Earth Pressure Coefficient, K_a	0.53	0.33
Rankine Passive Earth Pressure Coefficient, K_p	1.89	3.00
Angle of internal friction of soils, φ	--	28° to 32°
Undrained Shear Strength of soil	300 to 800 psf	--
Poisson's Ratio	0.25 to 0.40	0.20 to 0.30
Young's Modulus	400 to 1000 ksf	300 to 1000 ksf
Coefficient of friction between concrete and soils	0.25	0.35
Friction angle between steel and soil	14°	20°

Groundwater seepage and possible seepage from the canal may be encountered during the trenchless operation. It is the contractor responsibility to have available, onsite, sufficient and appropriate equipment for treatment of seepage, caving and hard excavation.

5.9.2 Pressures on Primary Pipe and Permanent Liners

Pipe liner design is largely dependent upon the depth of the liner beneath the ground surface and additional surface loads. Surface loads may include traffic loads, foundations in proximity of the storm drain line, and other such loading conditions. We recommend the vertical and horizontal pressures be taken as the following (using pressures on buried rigid pipes from "Structural Mechanics on Buried Pipes" by Reynold K. Watkins and Loren R. Anderson):

Total Liner Pressure = W + W”

$W = \gamma H K_a$

where,

W” = Traffic allowance;
γ = design unit weight of soil;
H = depth of pipe from the ground surface to the top of the tunnel liner; and
K_a = active lateral earth pressure coefficient

Tunnel loading equations for the pipe alignments are shown on Plate 6 of this report.

5.9.3 Bore Pit Shoring

Where trenchless pipeline installation methods are used, relatively deep excavations will be required to construct the launching and receiving shafts, typically 3 to 4 feet below the pipe invert. We expect that shoring and possibly dewatering systems will be required to construct the shafts. Shoring design for bore pits typically is the responsibility of the contractor. We expect that suitable alternatives for conventional shoring systems include soldier piles with lagging and tied-back or braced sheet piles.

Where cantilevered shoring for the jack-and-bore location is used, the design may be tentatively based upon the following lateral earth pressures (equivalent fluid pressures with a triangular pressure distribution), up to an excavation depth of 20 feet bgs.

Active: 49H psf/ft,
At-rest: 71H psf/ft,
Passive: 231D psf/ft,

Where H is the length of the sheet pile below the ground surface and D is the embedment depth of the shoring measured from the bottom of the excavation (unless pavement or hardscape are present, exclude the upper foot when calculating passive resistance to account for erosion). These equivalent fluid pressures should be applied as a triangular pressure distribution behind the shoring and assume level backfill behind and in front of shoring.

For braced shoring, a uniform rectangular pressure distribution should be used from top to bottom of the shoring equivalent to the following,

Bracing: 29H psf/ft

Where H is the depth of the excavation. The earth pressures are based on drained conditions (no hydrostatic or buoyant conditions) and the assumption that the shoring is vertical (no batter), and the ground surface in front and behind the shoring is level. For different geometries or conditions, the above lateral earth pressures should be reevaluated.

5.9.4 Thrust Block

The passive earth pressure provided on page 7 for B-16 @ 10’ or B-17 @ 5’, depending on the soil encountered, can be used for the design of a thrust block, which can be doubled for isolated thrust vectors. However, some deformation will occur and thrusting could result in heave and damage to overlying structures in the direction of the thrust vector.

This should be carefully considered by the contractor when choosing jacking and/or receiving pit locations. A factor of safety of 2.5 is recommended to be included in the design of thrust blocks.

5.9.5 Bore Pit Backfill

The pits should be backfilled following construction of the pipe crossing. Excavated native soils, free of deleterious material and oversized particles, may be used to backfill the pits. Backfill operations may be carried out utilizing the same methods as described earlier in the "General Fill Placement and Compaction" section of this report. The contractor should select the equipment and processes to be used to achieve the specified density without damage to adjacent ground, existing facilities, utilities, or completed work.

5.9.6 Influence of Tunneling on Adjacent Structures

Surface and near-surface structures near the tunnel alignment consist primarily of private properties, city streets and public utilities. Ground movement, in terms of loss of ground or ground lost, is commonly associated with soft ground tunneling. If such ground movement is excessive, it may cause damage to the structures, roads, and services located above the tunnel. While ground movement cannot be eliminated, it can be controlled within certain limits by the use of proper construction techniques and good quality workmanship. These include, but are not limited to, prevention of excessive ground loss during tunneling with the use of grouting and filling the annular space between the pipe or casing and the surrounding soil.

The selection and execution of tunneling methods that are best suited to anticipated ground conditions along the proposed tunnel are, in fact, the contractor's primary contribution to successful completion of the proposed tunnel. On review of the boring logs, the ground conditions for bore and jacking will likely cross through cohesive and cohesionless soils. In these instances, the ground may be expected to behave as firm to running near the invert. Close monitoring of ground movement should be carried out during the trenchless operation.

The proposed alignment may parallel and/or cross under existing or abandoned utility lines or structures. In general, it is the contractor's responsibility to investigate these and other possible third party interactions along the proposed rehabilitation and to accommodate all of these interactions with the use of good construction methods.

5.9.7 Estimated Surface Settlement over Pipe

Settlement is the primary source of damage to adjacent streets, utilities, and residences during trenchless construction. Settlement is caused by loss of ground at the tunnel heading and by closure of the overcut void around the pipe. Selection of appropriate tunneling equipment and methods will limit ground loss, although some minor ground losses and surface settlements are unavoidable.

Estimates of the amount of surface settlement that could occur due to bore-and-jack operations were made to evaluate the potential impact on the Gage Canal. Empirical methods have been developed for estimating surface settlement due to soft ground tunneling by the study of observed settlements on past projects (Peck, 1969; Cording and Hansmire, 1975). The settlement pattern that typically develops above a soft ground tunnel is a trough-shaped depression resembling an inverted bell shaped curve with maximum settlement occurring above the tunnel centerline (Peck, 1969).

Calculations were made for a 60-inch ID pipe (even though a 54-inch ID pipe is expected). This provides a conservative estimate of the anticipated settlement. Assuming that the pipe springline is positioned at an average depth of 126 inches below ground surface, we estimate a maximum surface settlement of approximately 1/4 to 1/2-inch. The width of the settlement trough is predicted to be about 16 feet. The assumptions for this analysis were as follows:

- Appropriate tunneling methods are implemented and good construction practices are followed to limit ground loss;
- The internal friction angle of the soil being tunneled through is 30 degrees;
- Volume loss at the casing head is between 0.5 and 1% of the excavated volume; and
- Volume loss at the surface is 100% of the total volume loss at the tunnel.

The contractor should be responsible for repairing any damage resulting from tunneling or other construction operations. Although it is unlikely that damage will result from this small amount of settlement, pre-construction and post-construction inspection surveys should be completed along the pipeline alignment. Surface settlement points should be established along the alignment and within the theoretical settlement trough limits to monitor settlement during tunneling operations.

5.10 Soil Corrosivity

To evaluate the corrosion potential of the surficial soils at the site we tested samples collected during our subsurface investigation for soluble sulfate, chloride, pH, and resistivity. The results are shown in Appendix C.

Many factors can affect the corrosion potential of soil including soil moisture content, resistivity, permeability, and pH, as well as chloride and sulfate concentration. In general, soil resistivity, which is a measure of how easily electrical current flows through soils, is the most influential factor. Based on test results and the correlation table in Appendix C, the soils may be classified as moderately corrosive to very severely corrosive.

Sulfate ion concentrations, and pH appear to play a roles in affecting corrosion potential. Sulfate ions in the soil can lower the soil resistivity and can be highly aggressive to Portland cement concrete by combining chemically with certain constituents of the concrete, principally tricalcium aluminate. This reaction is accompanied by expansion and eventual disruption of the concrete matrix. Potentially high sulfate content could also cause corrosion of the reinforcing steel in concrete.

California Building Code (CBC) provides requirements for concrete exposed to sulfate-containing solutions as shown on the sulfate test form in Appendix C.

Acidity is an important factor of soil corrosivity. The lower the pH (the more acidic the environment), the higher the soil corrosivity with respect to buried metallic structures. As soil pH increases above 7 (the neutral value), the soil is increasingly more alkaline and less corrosive to buried steel structures due to protective surface films which form on steel in high pH environments. A pH between 5 and 8.5 is generally considered relatively passive from a corrosion standpoint. From the CBC guidelines, sulfate exposure to Portland Cement Concrete (PCC) may be considered negligible for the sampled materials. Accordingly, we recommend Type II cement for all concrete in contact with earth material.

5.11 Pavement Recommendations

Asphalt pavement should conform to City of Riverside Public Works Standard Drawing 453. Minimum replaced asphalt thickness is 5 inches or one inch greater than existing pavement. On the basis of classifications of onsite soils, an assumed Traffic Indices, the minimum recommended pavement thickness is as follows:

Location	Assumed Traffic Index	Assumed R-value	Minimum Recommended Pavement Section	Full Depth AC Pavement Section
Gratton Street (Lincoln to Victoria)	5.0	15	3.0" AC over 8.5" Class 2 Base	7.5"
Gratton Street (Victoria to Dufferin)	5.0	5	3.0" AC over 10.0" Class 2 Base	8.0"
Gratton Street (Dufferin to Hermosa)	5.0	10	3.0" AC over 9.0" Class 2 Base	7.5"
Dufferin Avenue (Gratton to Adams)	5.0	10	3.0" AC over 9.0" Class 2 Base	7.5"

Final pavement design recommendations should be based on laboratory test results of representative pavement subgrade soils upon the completion of rough grading.

For R&R areas, the subgrade soils below aggregate base should be scarified, watered as necessary, and compacted to at least 90 percent relative compaction. Class 2 base should conform to section 200-2 of the Standard Specifications for Public Works Construction and should be compacted to at least 95 percent of the maximum dry density. Maximum dry densities should be determined by the Standard Test Method designated ASTM D1557. All subgrade and base must be firm and unyielding prior to placement of asphalt concrete. Final pavement design may be based on sand equivalent test results of representative subgrade soils upon completion of grading.

5.11.1 Existing Pavement Sections

Borehole	Section
B-1	6"AC/2"DG/3"AC
B-2	6.5"AC/10"DG
B-3	4"AC/2"DG
B-4	7.5"AC (NB)
B-5	4"AC/2.5"SC/1.5"MC/2"DG
B-6	2.25"AC/4"DG
B-7	3"AC (NB)
B-8	4"AC/2"DG
B-9	2"AC (NB)

Borehole	Section
B-10	8.5"AC (NB)
B-11	6"AC (NB)
B-12	6"AC (NB)
B-13	4.5"AC (NB)
B-14	8"AC (NB)
B-15	6"AC (NB)
B-16	9"AC (NB)
B-17	Dirt Road
B-18	Dirt Road

Borehole	Section
B-19	Dirt Road
B-20	Dirt Road
B-21	Dirt Road
B-22	Off Pavement
B-23	6"AC/4"Rock
B-24	Off Pavement
B-25	4"AC/4"Rock

AC: Asphalt Concrete, DG: Decomposed Granite, AB: Aggregate Base, NB: No Base, MC: Macadam, SC: Clayey Sand

5.12 Construction Monitoring Programs

Construction monitoring programs should be implemented to monitor ground settlement and lateral movement of shoring support systems during jack and bore construction. These monitoring programs should be in-place and conducted prior to the start of construction. The resulting data should be reviewed and evaluated during construction.

5.13 Additional Services

Variations in soil types and conditions are possible and may be encountered during construction. To permit correlation between the soil data obtained during this investigation and the actual soil conditions encountered during construction, we recommend that GeoMat be retained to provide observation and testing services during site earthwork and foundation construction. This will allow us the opportunity to compare actual conditions exposed during construction with those encountered in our investigation and to provide supplemental recommendations if warranted by the exposed conditions.

Earthwork should be performed in accordance with the recommendations presented in this report, or as recommended by GeoMat during construction.

GeoMat should review geotechnical portions of the final plans and specifications to evaluate how the recommendations presented in this report were implemented into the designs. If GeoMat is not retained for these services, the client will assume our responsibility for any potential claims that may arise.

We should also provide consultation during construction to assist in the observation of how key parts of the design are implemented, answering questions from the designers or contractors, and looking for subsurface conditions that might differ from the design assumptions or that might require modification of the design. This review provides an opportunity to detect misinterpretation or misunderstandings prior to the start of construction.

5.14 Final Report of Compaction

A final report of compaction control should be prepared subsequent to the completion of grading. The report should include a summary of work performed, laboratory test results, and the results and locations of field density tests performed during grading.

6 GEOTECHNICAL RISK

The concept of risk is an important aspect of the geotechnical evaluation. The primary reason for this is that the analytical methods used to develop geotechnical recommendations do not comprise an exact science. The analytical tools which geotechnical engineers use are generally empirical and must be used in conjunction with engineering judgment and experience. Therefore, the solutions and recommendations presented in the geotechnical evaluation should not be considered risk-free and, more importantly, are not a guarantee that the interaction between the soils and the proposed structure will perform as planned.

The engineering recommendations presented in the preceding sections constitute GeoMat Testing Laboratories professional estimate of those measures that are necessary for the proposed water line to perform according to the proposed design based on the information generated and referenced during this evaluation, and GeoMat Testing Laboratories experience in working with these conditions.

7 LIMITATION OF INVESTIGATION

This report was prepared for the exclusive use on the new construction. The use by others, or for the purposes other than intended, is at the user's sole risk. This work is meant for the new water line construction.

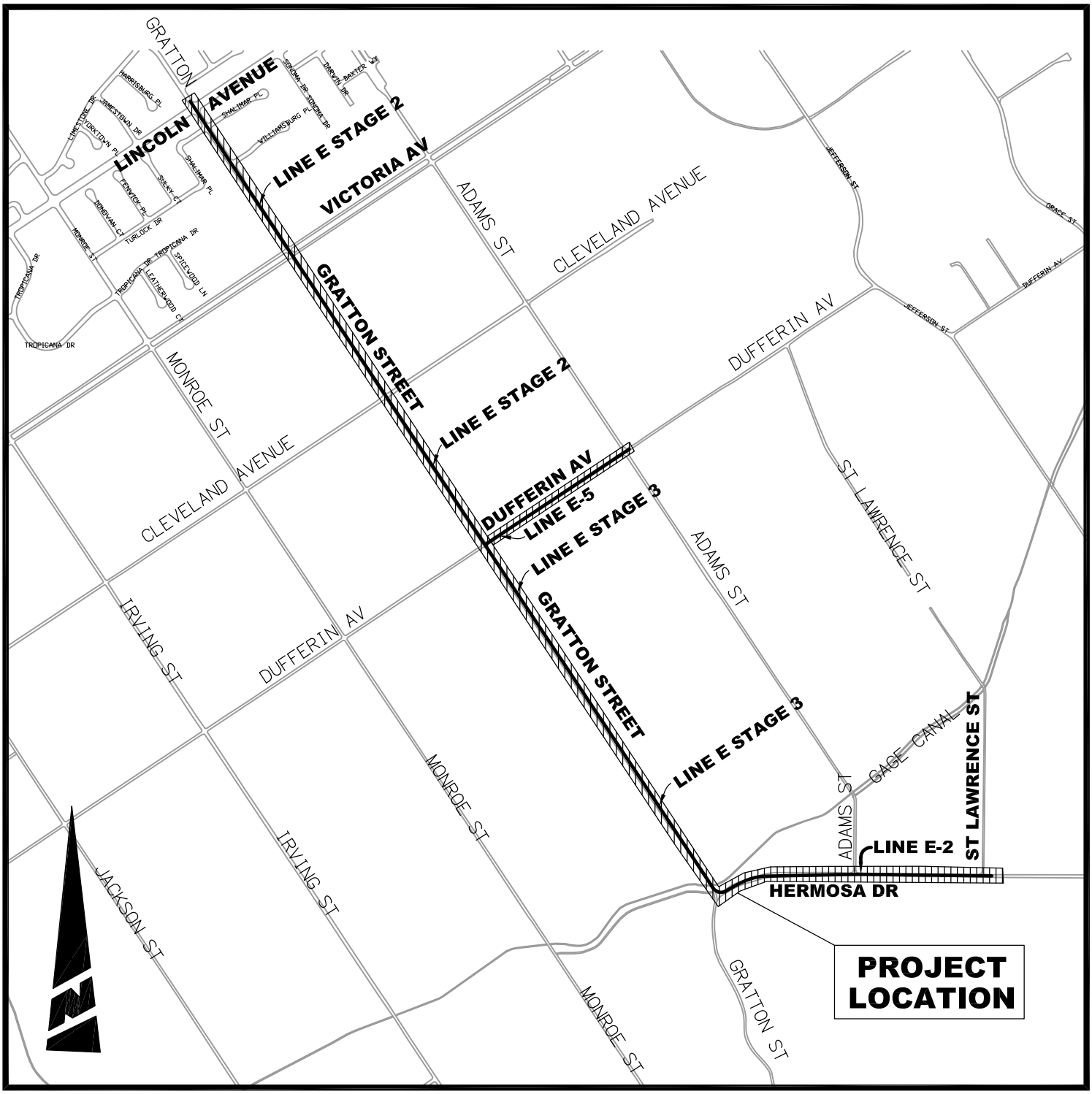
Our investigation was performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable Geotechnical Engineers practicing in this or similar locations within the limitations of scope, schedule, and budget. No other warranty, expressed or implied, is made as to the conclusions and professional advice included in this report.

The field and laboratory test data are believed representative of the site; however, soil conditions can vary significantly. As in most projects, conditions revealed during construction may be at variance with preliminary findings. If this condition occurs, the possible variations must be evaluated by the Project Geotechnical Engineer and adjusted as required or alternate design recommended.

This report is issued with the understanding that it is the responsibility of the owner, or his representative, to ensure that the information and recommendations contained herein are brought to the attention of the engineer for the addition and incorporated into the plans, and the necessary steps are taken to see that the contractor and subcontractor carry out such recommendations in the field.

This firm does not practice or consult in the field of safety engineering. We do not direct the contractor's operations, and we cannot be responsible for other than our own personnel on the site; therefore, the safety of others is the responsibility of the contractor. The contractor should notify the owner if he considers any of the recommended actions presented herein to be unsafe.

The findings, conclusions, and recommendations presented herein are based on our understanding of the addition and on subsurface conditions observed during our site work, and are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge.

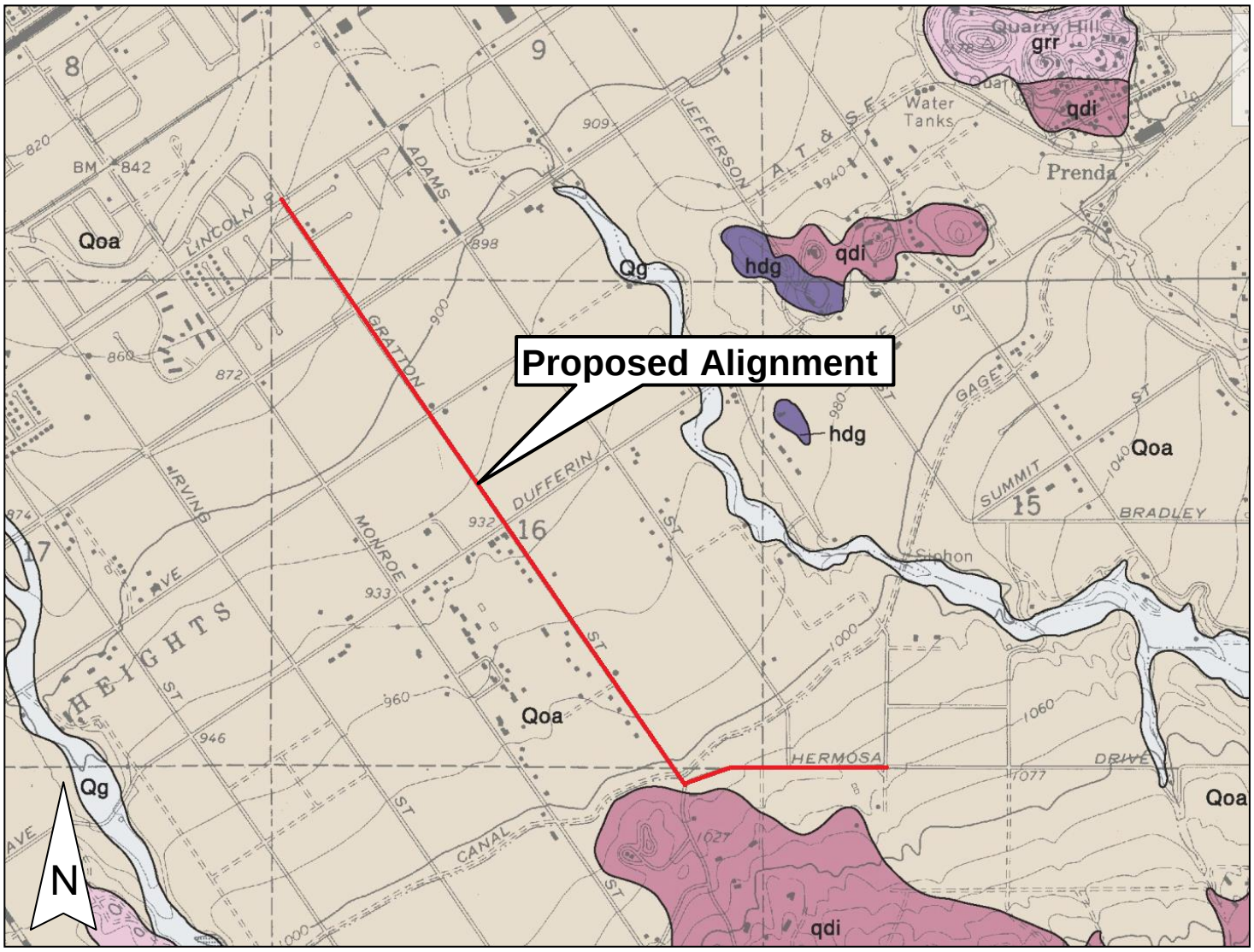


LOCATION MAP

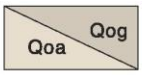
NTS

Figure 1

REGIONAL GEOLOGY MAP



LEGEND:

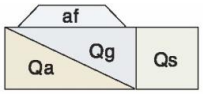


OLDER SURFICIAL SEDIMENTS

Weakly indurated dissected alluvial fan deposits derived from local terrains of plutonic rocks

Qoa *Alluvial fan deposits of sand, minor gravel, tan to light reddish brown, top surfaces slope slightly from sounce areas and dissected by stream channels from source areas*

Qog *High remnants of elevated older alluvial gravel, including coarse boulder gravel*



SURFICIAL DEPOSITS

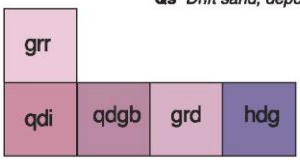
Unindurated, undissected

af *Artificial cut and fill grading by human activity for homes and streets during last several decades*

Qg *Alluvial gravel and sand of stream channels*

Qa *Alluvial sand, gravel and clay of level areas covered with soil*

Qs *Drift sand, deposited by north winds*



PLUTONIC ROCKS OF PENINSULAR RANGES

From: "Dibblee, T.W., and Minch, J.A., 2004, Geologic map of the Riverside West/south 1/2 of Fontana quadrangles, San Bernardino and Riverside County, California: Dibblee Geological Foundation, Dibblee Foundation Map DF-128, scale 1:24,000"

PROJECT: Monroe Master Drainage Plan, City of Riverside, California

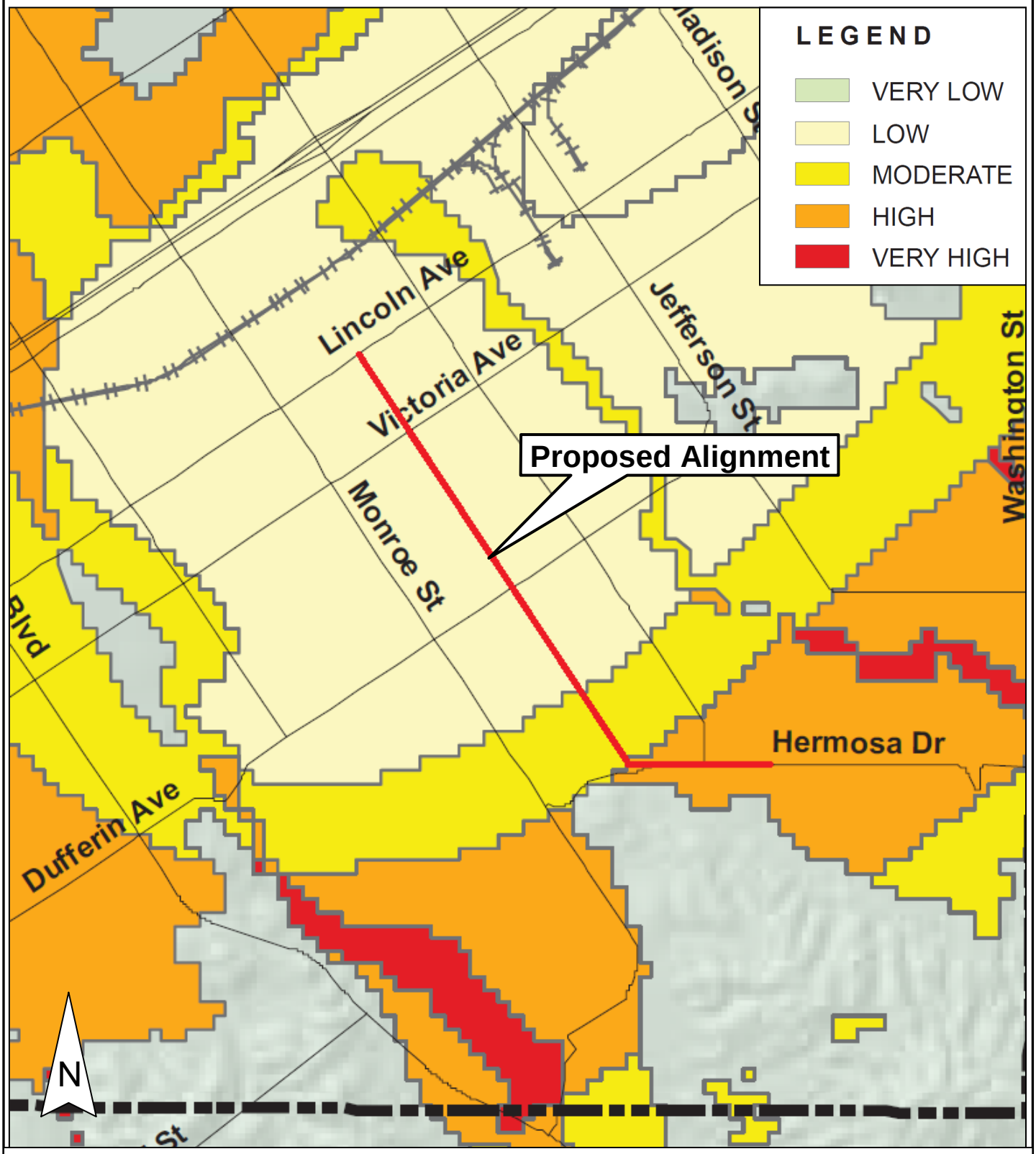
geomat

PROJECT NO: 17066-01

DATE: August 4, 2017

Figure 2

LIQUEFACTION POTENTIAL MAP



From: "City of Riverside, General Plan 2025, Figure PS-2, Liquefaction Zones

PROJECT: Monroe Master Drainage Plan, City of Riverside, California

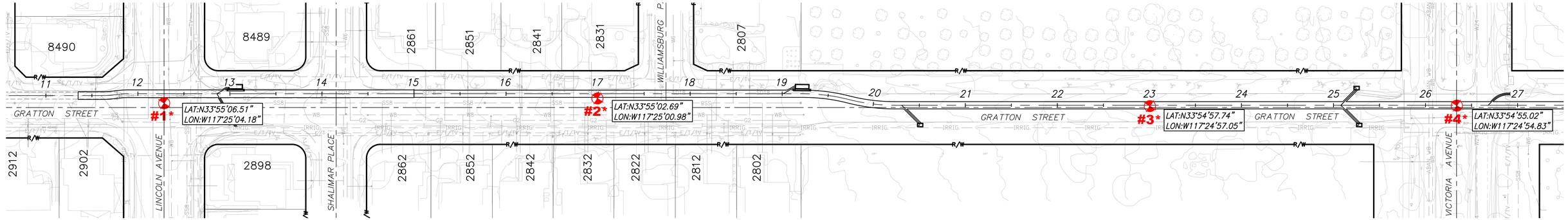
geomat

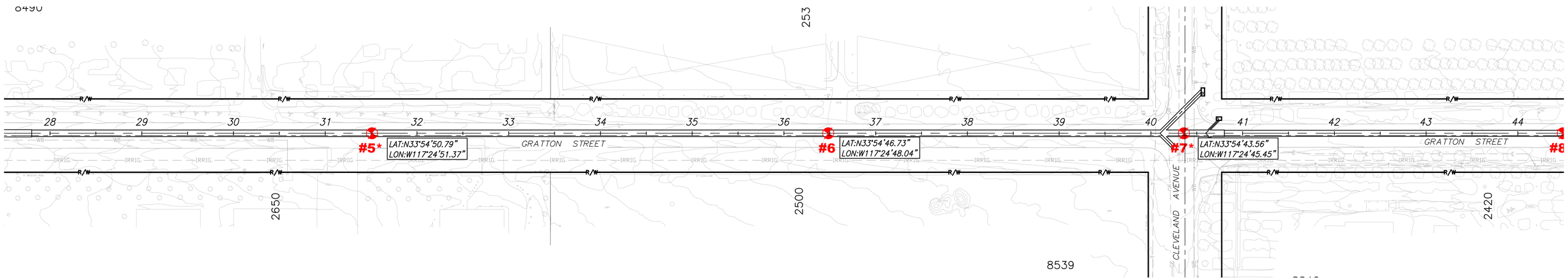
PROJECT NO: 17066-01

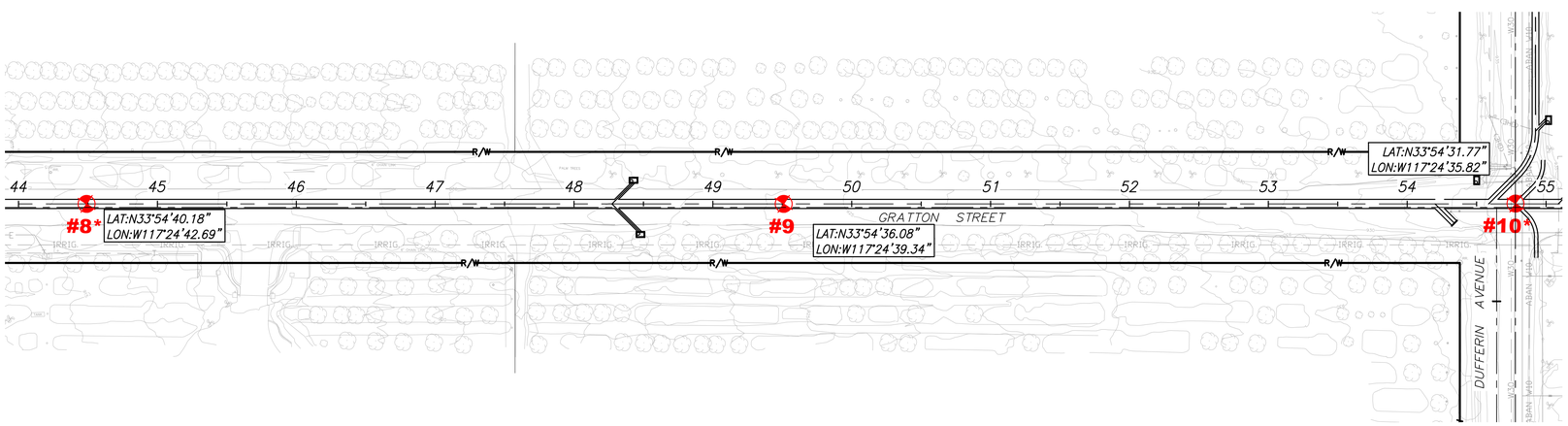
DATE: August 4, 2017

Figure 3

MONROE MDP LINE E, STAGE 2, BORING LOCATION EXHIBIT







#	LOCATION	DEPTH
1	GRATTON STREET on Storm Drain	20' DEEP BORING
2	GRATTON STREET on Storm Drain	20' DEEP BORING
3	GRATTON STREET on Storm Drain	15' DEEP BORING
4	GRATTON STREET on Storm Drain	15' DEEP BORING
5	GRATTON STREET on Storm Drain	15' DEEP BORING
6	GRATTON STREET on Storm Drain	15' DEEP BORING
7	GRATTON STREET on Storm Drain	15' DEEP BORING
8	GRATTON STREET on Storm Drain	15' DEEP BORING
9	GRATTON STREET on Storm Drain	15' DEEP BORING
10	GRATTON STREET on Storm Drain	20' DEEP BORING

N
W E S

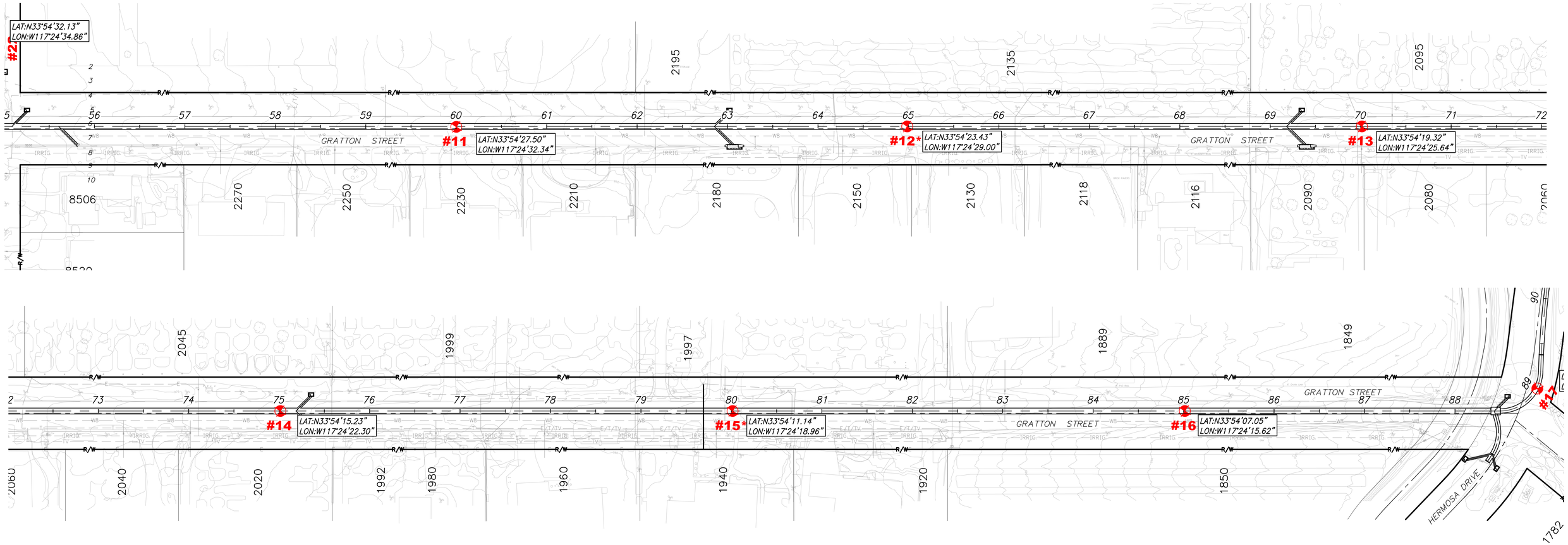
50 0 50 100 150
GRAPHIC SCALE

Plate 1A

* R-VALUE TESTING TO BE DONE AT THIS BORING LOCATION

EXHIBIT "B"
BORING LOCATION EXHIBIT
SCALE: 1"=50' | DATE: 5/01/2017
SHEET NO. B-1

MONROE MDP LINE E, STAGE 3, BORING LOCATION EXHIBIT



#	LOCATION	DEPTH
11	GRATTON STREET on Storm Drain	15' DEEP BORING
12	GRATTON STREET on Storm Drain	15' DEEP BORING
13	GRATTON STREET on Storm Drain	15' DEEP BORING
14	GRATTON STREET on Storm Drain	15' DEEP BORING
15	GRATTON STREET on Storm Drain	15' DEEP BORING
16	GRATTON STREET on Storm Drain	15' DEEP BORING

N
E
S
W

50 0 50 100 150

GRAPHIC SCALE

* R-VALUE TESTING TO BE DONE AT THIS BORING LOCATION

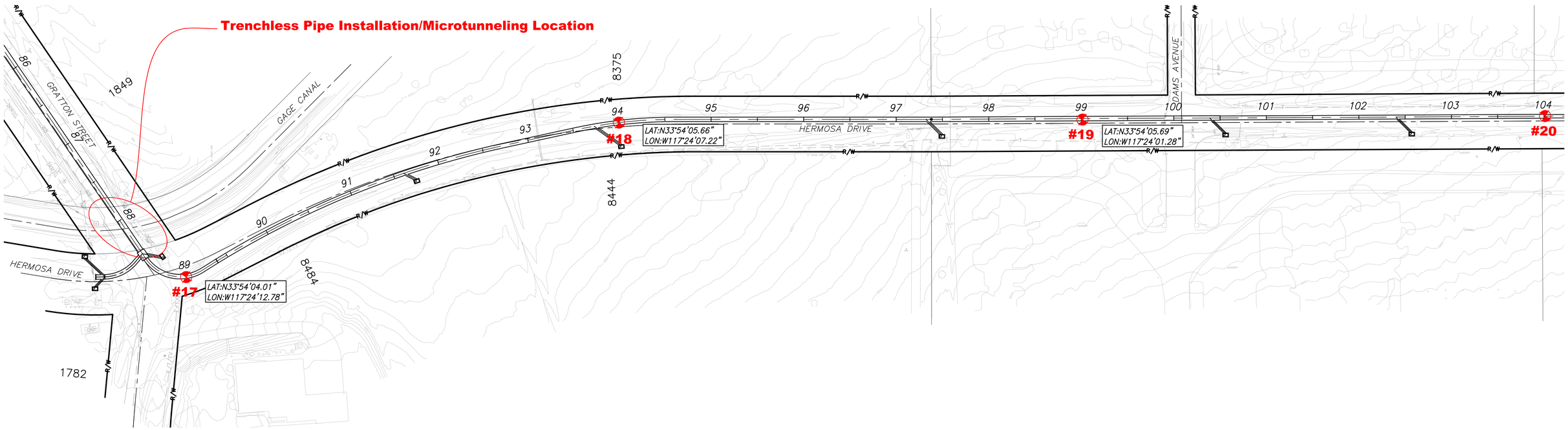
Plate 1B

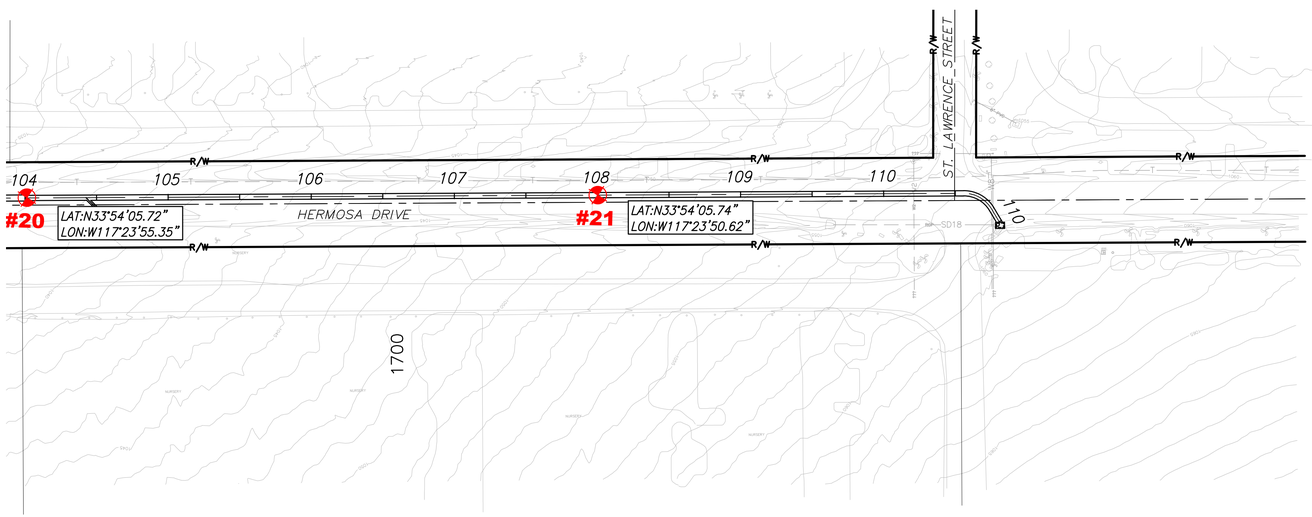
EXHIBIT "B"
BORING LOCATION EXHIBIT

SCALE: 1"=50' | DATE: 05/01/2017

SHEET NO. B-2

MONROE MDP LINE E-2 BORING LOCATION EXHIBIT





#	LOCATION	DEPTH
17	HERMOSA DRIVE on Storm Drain	10' DEEP BORING
18	HERMOSA DRIVE on Storm Drain	10' DEEP BORING
19	HERMOSA DRIVE on Storm Drain	10' DEEP BORING
20	HERMOSA DRIVE on Storm Drain	10' DEEP BORING
21	HERMOSA DRIVE on Storm Drain	10' DEEP BORING

N
W E
S

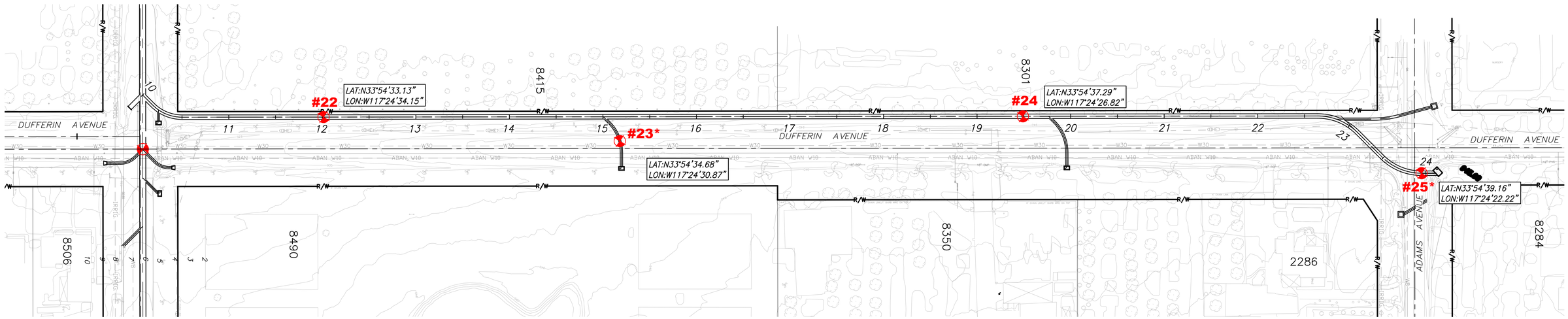
50 0 50 100 150
GRAPHIC SCALE

Plate 1C

EXHIBIT "B"
BORING LOCATION EXHIBIT
SCALE: 1"=50' DATE: 5/01/2017
SHEET NO. B-3

* R-VALUE TESTING TO BE DONE AT THIS BORING LOCATION

MONROE MDP LINE E-5 BORING LOCATION EXHIBIT



#	LOCATION	DEPTH
22	DUFFERIN AVENUE on Storm Drain	15' DEEP BORING
23	DUFFERIN AVENUE on Storm Drain	15' DEEP BORING
24	DUFFERIN AVENUE on Storm Drain	15' DEEP BORING
25	DUFFERIN AVENUE on Storm Drain	15' DEEP BORING

N
W
E
S

50 0 50 100 150

GRAPHIC SCALE

Plate 1D

* R-VALUE TESTING TO BE DONE AT THIS BORING LOCATION

EXHIBIT "B"
BORING LOCATION EXHIBIT

SCALE: 1"=50'	DATE: 5/22/2017
SHEET NO. PH-4	

STABILITY OF CUT IN NATIVE MATERIAL

Utilized Friction Angle (Φ)	25°
Cohesion (C), psf	200
Unit Weight of Soil (γ)	120 pcf
Slope Angle (β)	90 degree
Back Slope Angle (α)	0 degree
Factor of Safety	1.25
Design Cohesion C_d	160
Design Friction Angle Φ_d	20°
Stability Factor N_s =	From Chart: 5.2

Use $H_c = \frac{N_s C_d}{\gamma}$

Recommended Maximum Height of Temporary Un-Surcharged Vertical Cut: 6 feet

$H_c = 6.9$

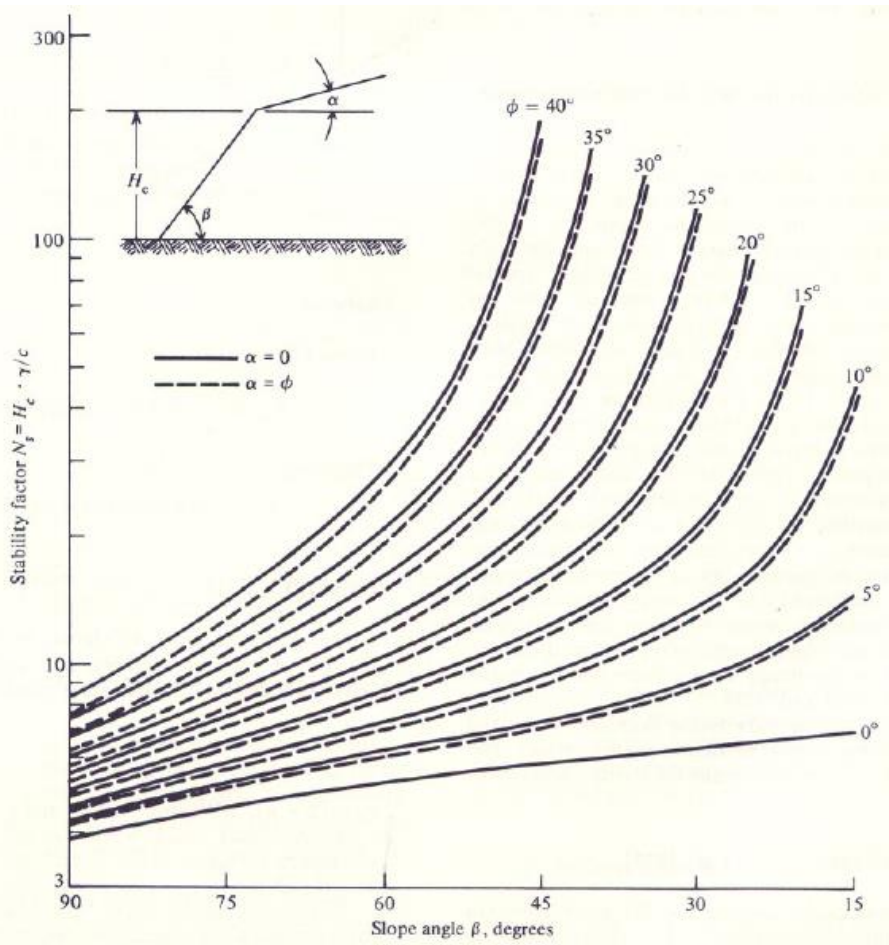
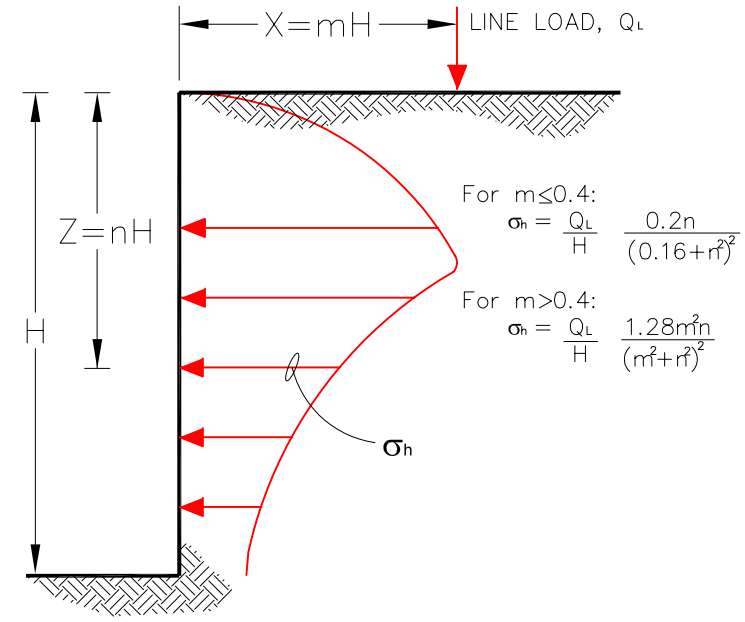


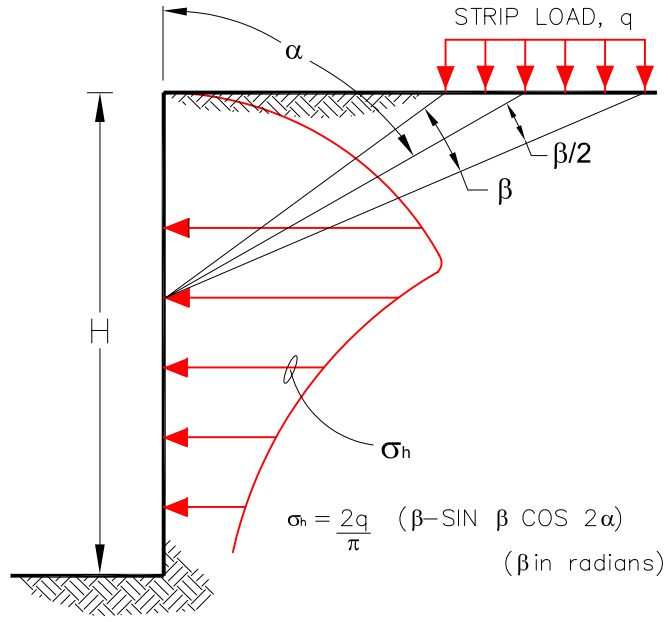
Fig. 10.22 Effect of slope angle and friction angle on stability factor.

Foundation Engineering Handbook, Second Edition, Hsai-Yang Fang.

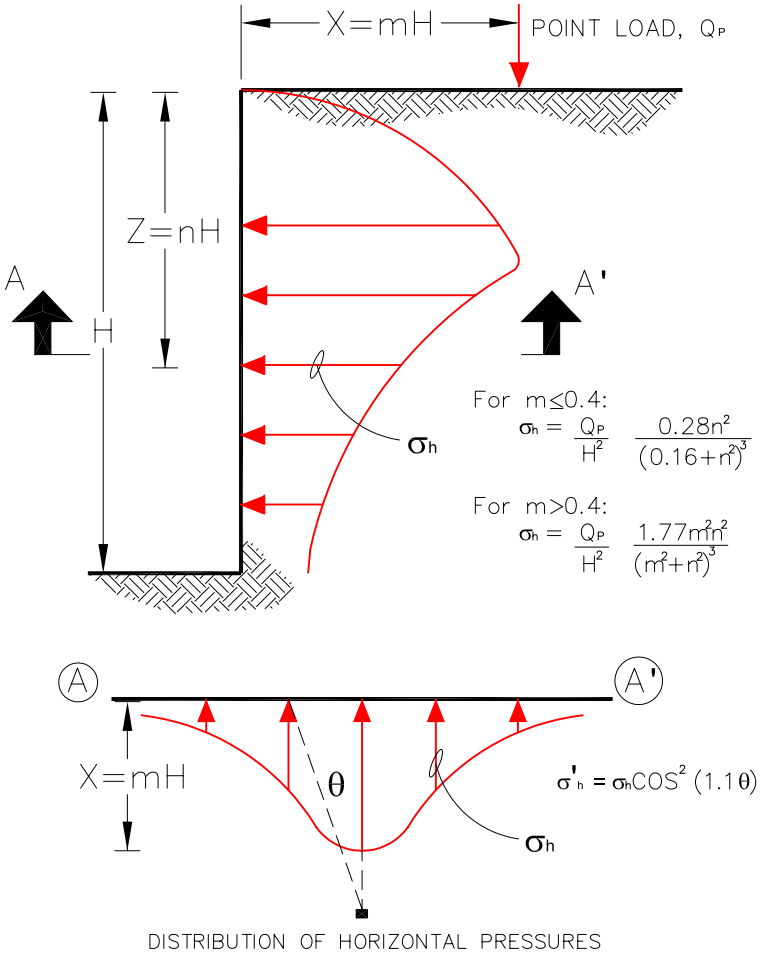
Monroe Master Drainage Plan **City of Riverside**	**Project No.** 17066-01 **Date:** August 30, 2017	Plate 2



LINE LOAD PARALLEL TO WALL



STRIP LOAD PARALLEL TO WALL



DISTRIBUTION OF HORIZONTAL PRESSURES

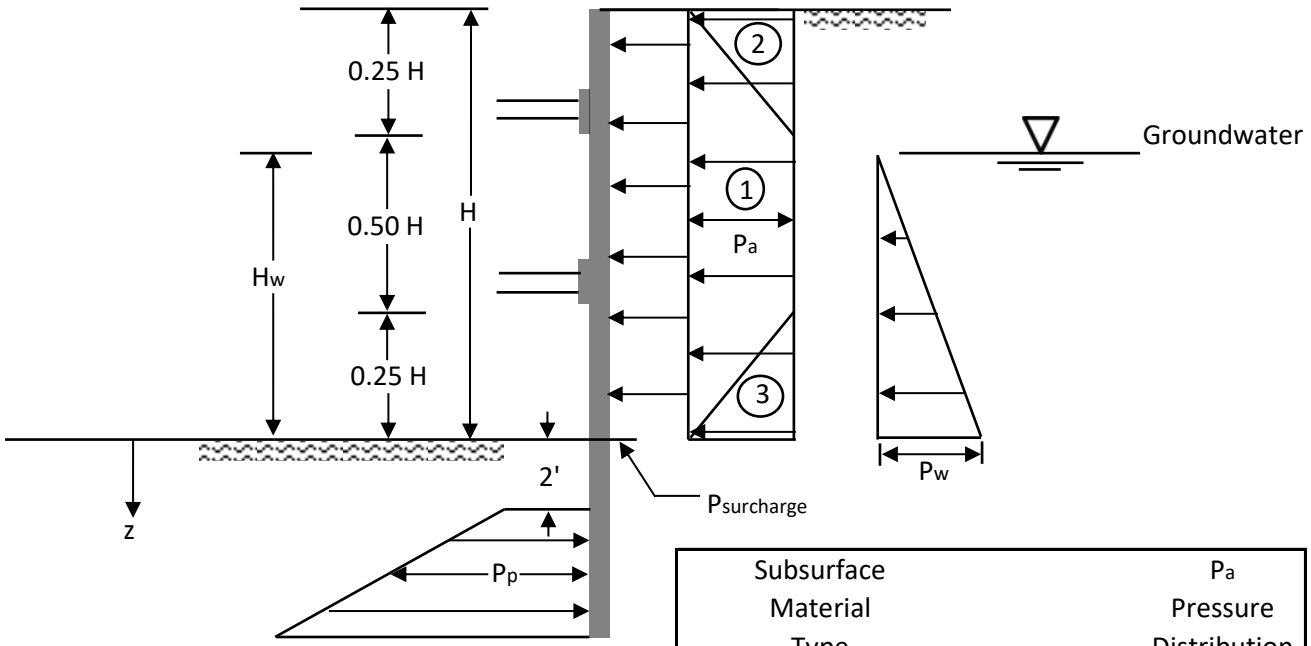
VERTICAL POINT LOAD

NOTES:

1. These guidelines apply to rigid walls with Poisson's ratio assumed to be 0.5 for backfill materials.
2. Lateral pressures from any combination of above loads may be determined by the principle of superposition.

SCALE: NTS	SURCHARGE INDUCED STATIC LATERAL EARTH PRESSURES Monroe Master Drainage Plan City of Riverside, California	Plate 3

Preliminary Shoring Pressure Diagram



Subsurface Material Type	P_a Pressure Distribution
Soft to Medium Stiff Silt & Clay	1 + 3
Stiff to Very Stiff Silt & Clay	1
Sand, Gravel, and Fill	1 + 2 + 3

LEGEND:

H = Excavation Height (feet)
z = Depth Below Base of Excavation (feet)
P_p = Passive Earth Pressure (pcf)
P_a = Active Earth Pressure (pcf)
P_w = Hydrostatic Pressure = 62.4 pcf x Hw
P_s = Lateral Surcharge Pressure (pcf)

Subsurface Material Type:	Soft to Medium Stiff Silt and Clay		Medium Stiff to Stiff Silt and Clay		Medium Dense to Dense Sand and Gravel	
Condition:	AGW	BGW	AGW	BGW	AGW	BGW
P_a (Short-Term)	50 H	25 H	40 H	20 H	30 H	15 H
P_a (Long-Term)	60 H	30 H	50 H	25 H	40 H	20 H
P_p (Ultimate)	220 z	110 z	280 z	140 z	360 z	180 z

AGW - Above Groundwater Level

BGW - Below Groundwater Level (does not include hydrostatic pressure)

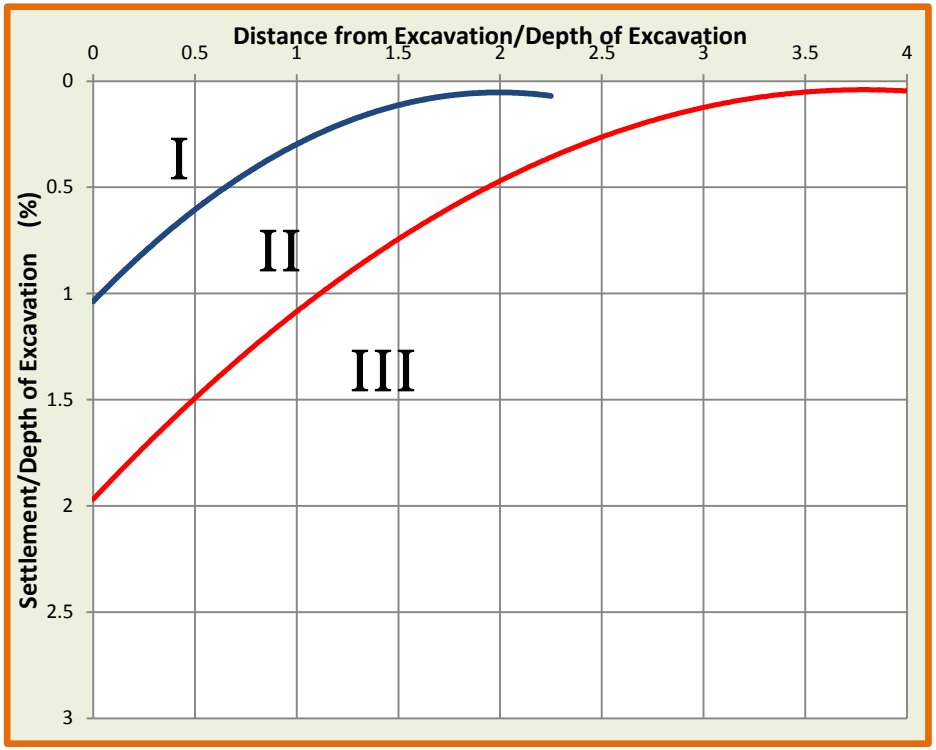
Notes:

1) These preliminary pressures and diagrams do not take into account the effects of existing structures, stockpiling, equipments, etc. The effects of these, and other surcharge loads, are to be added to the preliminary pressures and diagrams provided on this plate.

2) A minimum factor of safety of 2 should be used in passive pressure calculations. Final design shoring pressures and diagrams are to be developed by the contractor based on their selection of shoring and the subsurface soil and groundwater conditions encountered during construction.

3) Excavation base stability should be analyzed after the base width has been selected.

Guide to Settlement Adjacent Open Cuts (Peck, 1969)



Reference: Geotechnical Engineering, 1997, Braced and Strutted Excavations by G.P. Raymond

ZONE I

Sand and Soft Clay to Hard Clay, [Cu > 25 kPa (500 psf)]

ZONE II

Very Soft Clay to Soft Clay, [Cu < 25 kPa (500 psf)]

1. Limited Depth of clay belwo base of excavation
2. Significant Depth of clay below base of excavation wher Fb > 1.3

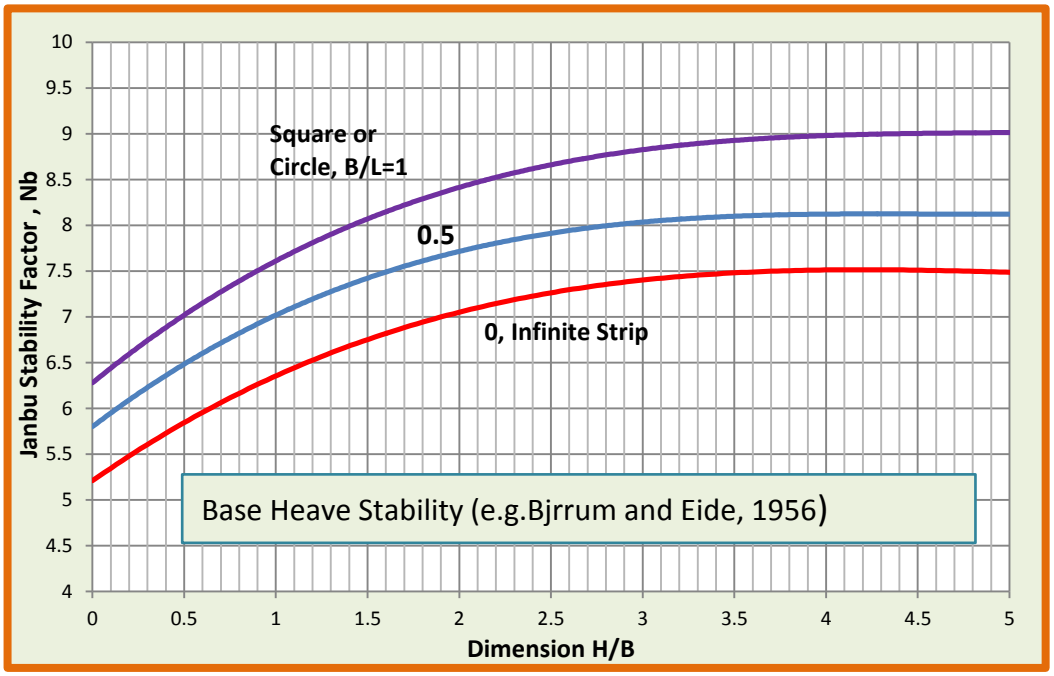
ZONE III

Very Soft to Soft Clay, [Cu < 25 kPa (500 psf)]

1. Significant Depth of clay belwo base of excavation and where Fb < 1.3

Where F_b = Factor of safety against base failure

Method is emperical and not a theoretical expression (Heave)



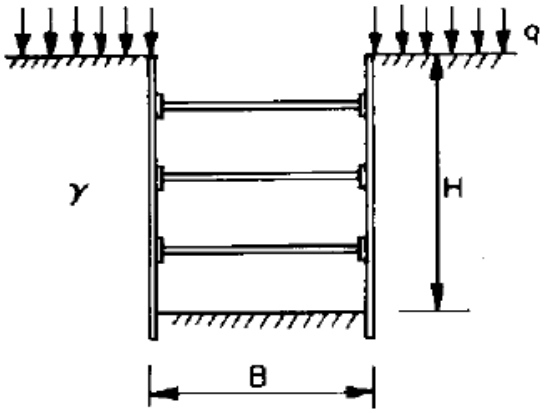
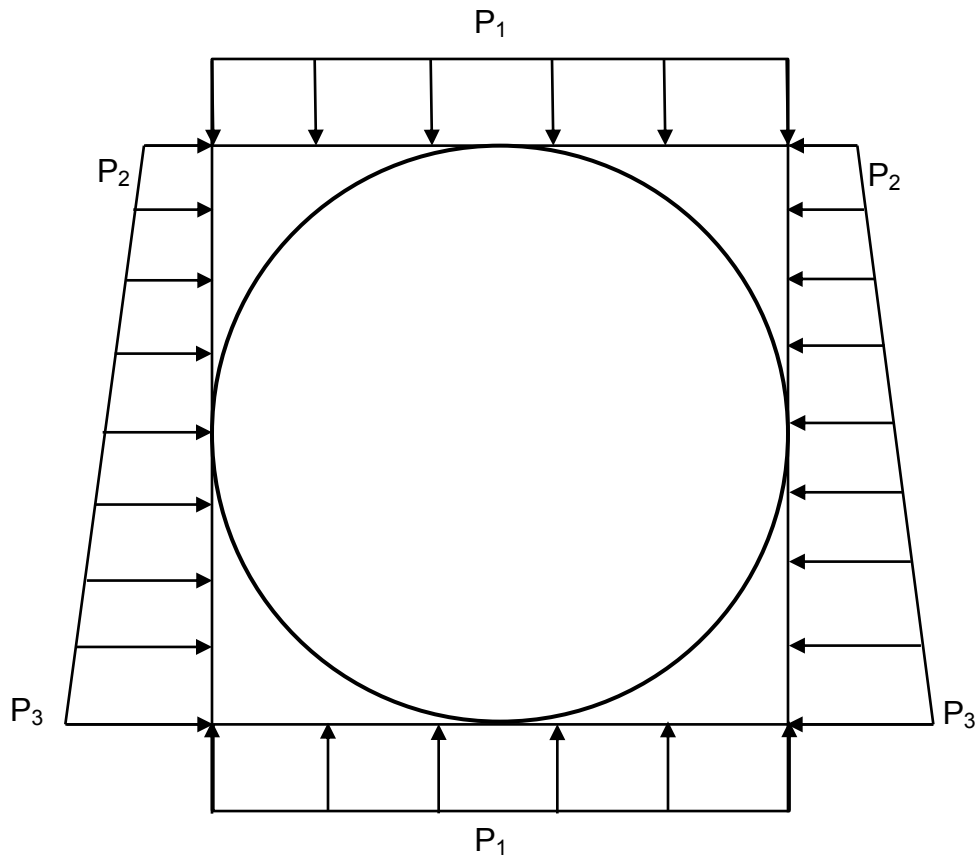


Plate 5

$$F_b = \frac{N_b C_u}{\gamma H + q}$$

Tunnel Liner Loads



$$P_1 = \left[\left(H + \frac{D}{2}\right) * (\gamma - \gamma_w) + D_w * \gamma_w\right] + q_s, \quad \text{for} \quad D_w < H + \frac{D}{2}$$

$$P_1 = \left[\left(H + \frac{D}{2}\right) * \gamma\right] + q_s \qquad \text{for} \quad D_w \geq H + \frac{D}{2}$$

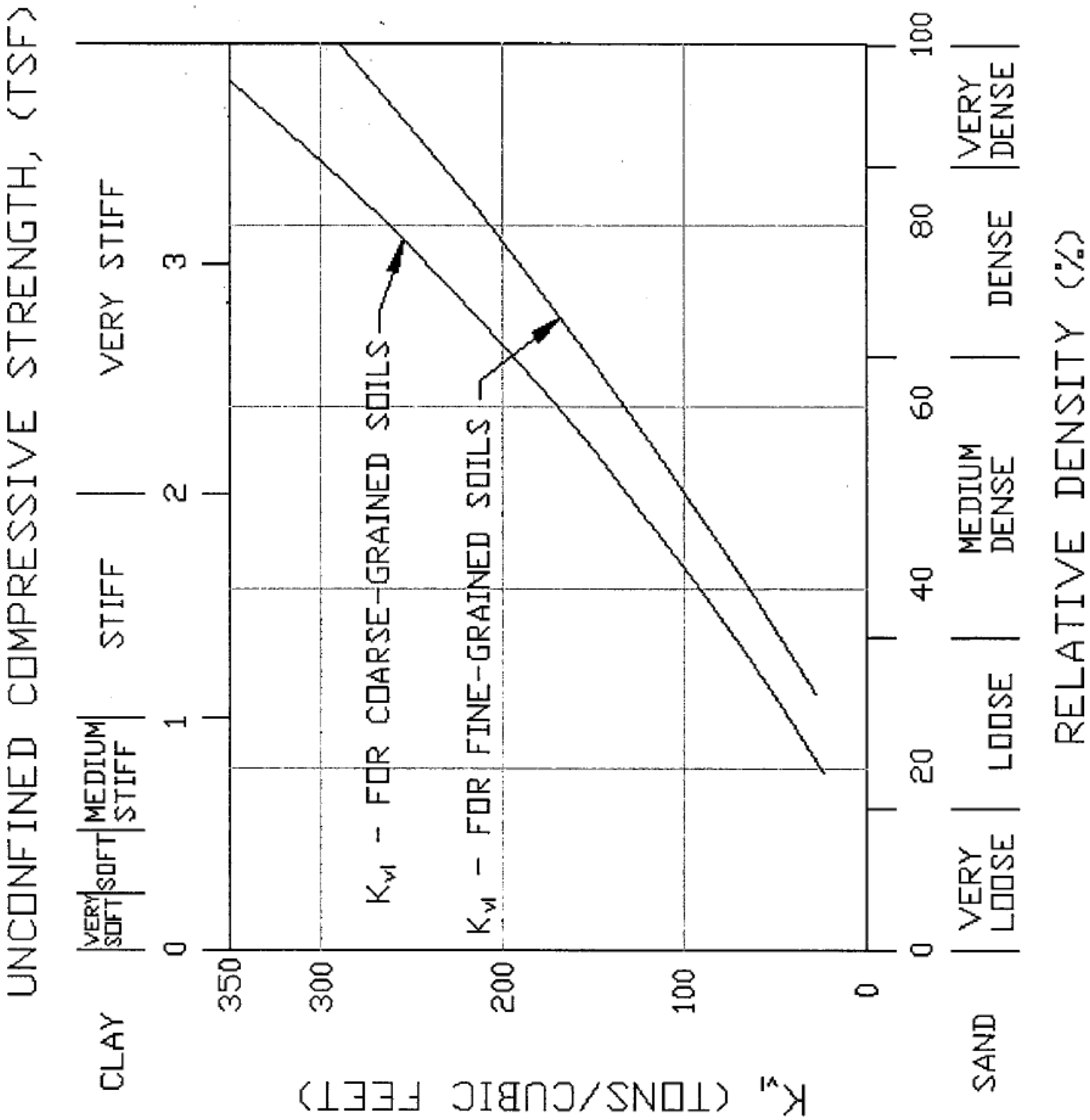
$$P_2 = (H * \gamma) + q_s$$

$$P_3 = [(H + D) * \gamma] + q_s$$

Where: P_1, P_2, and P_3 = Tunnel Liner Loads, (psf)
D = Tunnel outside diameter, (ft)
H = Depth to top of tunnel, (ft)
D_w = Depth to groundwater level, (ft)
γ = Wet unit weight of soil, (pcf)
γ_w = Unit Weight of Water, (62.4 pcf)
q_s = Surcharge Load, (psf)
K_o = Coefficient of lateral earth pressure at rest, (see report)

Monroe Master Drainage Plan **City of Riverside**	**Project No.** 17066-01 **Date:** August 30, 2017	Plate 6

Modulus of Subgrade Reation



Reference: NAVFAC 7.01

Monroe Master Drainage Plan **City of Riverside**	**Project No.** 17066-01 **Date:** August 30, 2017	Plate 7

Appendix A

REFERENCES

Dibblee, T.W., and Minch, J.A., 2004, Geologic map of the Riverside West/south 1/2 of Fontana quadrangles, San Bernardino and Riverside County, California: Dibblee Geological Foundation, Dibblee Foundation Map DF-128, scale 1:24,000

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Geologic Map of the San Bernardino and Santa Ana 30'x60' Quadrangles, Version 1.0, Morton & Miller, 2006

City of Riverside General Plan 2025

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Caltrans, Trenching and Shoring Manual

Appendix B

GENERAL NOTES

DRILLING NOTES

WATER LEVEL MEASUREMENTS

Water levels indicated on the boring logs are levels measured in the borings at the times indicated. In permeable materials, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels is not possible with only short-term observations.

WATER LEVEL OBSERVATION DESIGNATION

W.D.	While Drilling
A.B.	After Boring
B.C.R.	Before Casing Removal
A.C.R.	After Casing Removal
24 hr.	Water level taken approximately 24 hrs. after boring completion

DRILLING AND SAMPLING SYMBOLS

AS	Auger Sample
CS	Continuous Sampler
DB	Diamond Bit -NX unless otherwise noted
HA	Hand Auger
HS	Hollow Stem Auger
PA	Power Auger
RB	Rock Bit
SS*	Split-Barrel
ST	Shelby Tube - 2" (51mm) unless otherwise noted
WB	Wash Bore
CR	Calfornia Ring Sampler 3" O.D., Lined with 2.5"X1" Rings

*The Standard Penetration Test is conducted in conjunction with the split-barrel sampling procedure. The "N" value corresponds to the number of blows required to drive the last 1 foot (0.3m) of an 18 in. (0.46m) long, 2 in. (51mm) O.D. split-barrel sampler with a 140 lb. (63.5 kg) hammer falling a distance of 30 in. (0.76m). The Standard Penetration Test is carried out according to ASTM D-1586. (See "N" Value below.)

SOIL PROPERTIES & DESCRIPTIONS

TEXTURE

PARTICLE	SIZE	
Clay	< 0.002 mm	(< 0.002 mm)
Silt	< #200 Sieve	(0.075 mm)
Sand	#4 to #200 Sieve	(4.75 to 0.075 mm)
Gravel	3 in. to #4 Sieve	(75 mm to 4.75 mm)
Cobbles	12 in. to 3 in.	(300 mm to 75 mm)
Boulders	> 12 in.	(300 mm)

COMPOSITION

SAND & GRAVEL

Description	% by Dry Weight
trace	< 15
with	15 - 29
modifer	> 30

FINES

Description	% by Dry Weight
trace	< 5
with	5 - 12
modifier	> 12

Soil descriptions are based on the Unified Soil Classification System (USCS) as outlined in ASTM Designations D-2487 and D-2488. The USCS group symbol shown on the boring logs correspond to the group names listed below. The description includes soil constituents, consistency, relative density, color and other appropriate descriptive terms. Geologic description of bedrock, when encountered, also is shown in the description column.

GROUP SYMBOL	GROUP NAME	GROUP SYMBOL	GROUP NAME
GW	Well Graded Gravel	CL	Lean Clay
GP	Poorly Graded Gravel	ML	Silt
GM	Silty Gravel	OL	Organic Clay or Silt
GC	Clayey Gravel	CH	Fat Clay
SW	Well Graded Sand	MH	Elastic Silt
SP	Poorly Graded Sand	OH	Organic Clay or Silt
SM	Silty Sand	PT	Peat
SC	Clayey Sand	CL-CH	Lean to Fat Clay

COHESIVE SOILS

CONSISTENCY	UNCONFINED COMPRESSIVE STRENGTH (Qu) (psf)	(kPa)
Very Soft	< 500	(< 24)
Soft	500 - 1000	(24 - 48)
Medium	1001 - 2000	(48 - 96)
Stiff	2001 - 4000	(96 - 192)
Very Stiff	4001 - 8000	(192 - 383)
Hard	> 8001	(> 383)

PLASTICITY Description	Liquid Limit (%)
Lean	< 45%
Lean to Fat	45 to 49%
Fat	≥ 50%

Cohessive Soils Consistenacy	"N" value
Very Soft	<2
Soft	2-4
Medium	4-8
Stiff (Firm)	8-15
Very Stiff (Very Firm)	15-30
Hard	>30

COHESIONLESS SOILS

RELATIVE DENSITY	"N" VALUE*
Very Loose	0 - 3
Loose	4 - 9
Medium Dense	10 - 29
Dense	30 - 49
Very Dense	≥ 50

BEDROCK PROPERTIES & DESCRIPTIONS

ROCK QUALITY DESIGNATION (RQD**)

DESCRIPTION OF ROCK QUALITY	RQD (%)
Very Poor	0 - 25
Poor	25 - 50
Fair	50 - 75
Good	75 - 90
Excellent	90 - 100

**RQD is defined as the total length of sound core pieces, 4 inches (102mm) or greater in length, expressed as a percentage of the total length cored. RQD provides an indication of the integrity of the rock mass and relative extent of seams and bedding planes.

DEGREE OF WEATHERING

Slightly Weathered	Slight decomposition of parent material in joints and seams.
Weathered	Well-developed and decomposed joints and seams.
Highly Weathered	Rock highly decomposed, may be extremely broken.

SOLUTION AND VOID CONDITIONS

Solid	Contains no voids.
Vuggy	Containing small pits or cavities < 1/2" (13mm).
Porous	Containing numerous voids which may be interconnected.
Cavernous	Containing cavities, sometimes quite large.

When classification of rock materials has been estimated from disturbed samples, core samples and petrographic analysis may reveal other rock types.

HARDNESS & DEGREE OF CEMENTATION

LIMESTONE

Hard	Difficult to scratch with knife.
Moderately Hard	Can scratch with knife but not with fingernail.
Soft	Can be scratched with fingernail.

SHALE

Hard	Can scratch with knife but not with fingernail.
Moderately Hard	Can be scratched with fingernail.
Soft	Can be molded easily with fingers.

SANDSTONE

Well Cemented	Capable of scratching a knife blade.
Cemented	Can be scratched with knife.
Poorly Cemented	Can be broken apart easily with fingers.

BEDDING CHARACTERISTICS

TERM	THICKNESS (inches)	THICKNESS (mm)
Very Thick Bedded	> 36	> 915
Thick Bedded	12 - 36	305 - 915
Medium Bedded	4 - 12	102 - 305
Thin Bedded	1 - 4	25 - 102
Very Thin Bedded	0.4 - 1	10 - 25
Laminated	0.1 - 0.4	2.5 - 10
Thinly Laminated	< 0.1	< 2.5

Bedding Planes	Planes dividing the individual layers, beds or strata of rocks.
Joint	Fracture in rock, generally more or less vertical or transverse to the bedding.
Seam	Applies to bedding plane with an unspecified degree of weathering.

geomat	Project Name: Monroe Master Drainage Plan Project No.: 17066-01	Boring No.: **B-1**	Page 1 of 1

Boring Location:	See Plate 1	Drilling Co.	GeoMat	Logged By:	AM
Drilling Date(s):	8/3/2017	Drill Rig:	CME 45	Groundwater Depth:	-- ft
Drilling Method:	Hollow Stem Auger			Depth to Bedrock:	-- ft
Hammer Weight/Drop:	140 lbs./30-inches	Hammer Type:	Automatic	Total Depth:	20 ft

Sampler Type: Auger Cuttings (C) | California Ring (R) | Split Spoon (S)

DEPTH (feet)	SAMPLES Sample Type	SAMPLES Sample	BLOWCOUNTS 0 - 6"	BLOWCOUNTS 6" - 12"	BLOWCOUNTS 12" - 18"	SPT "N" Value	USGS	MATERIAL DESCRIPTION	LABORATORY TEST DATA Moisture Content (%)	Dry Density (pcf)	Fines (%)	Liquid Limit	Plastic Limit	Plast. Index
								6"AC / 2"DG / 3"AC						
1														
2							CL	**SANDY LEAN CLAY**						
3	C							medium brown sandy lean clay						
4								fine to coarse grained sand						
5														
6	S		3	4	5	9		firm	13		62			
7														
8														
9														
10														
11	R		7	24	32	36	SC	**CLAYEY SAND**	13	122				
12								medium brown clayey sand						
13								dense						
14														
15	S		2	3	3	6		loose, may unravel						
16														
17														
18														
19														
20														
21	S		4	6	6	12	SM	**SILTY SAND**						
22								medium brown silty sand						
23								medium dense						
24														
25														
26														
27														
28														
29														
30														
31														
32														
33														
34														

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ, the transition may be gradual.

geomat	Project Name: Monroe Master Drainage Plan Project No.: 17066-01	Boring No.: **B-2**	Page 1 of 1

Boring Location:	See Plate 1	Drilling Co.	GeoMat	Logged By:	AM
Drilling Date(s):	8/3/2017	Drill Rig:	CME 45	Groundwater Depth:	-- ft
Drilling Method:	Hollow Stem Auger			Depth to Bedrock:	-- ft
Hammer Weight/Drop:	140 lbs./30-inches	Hammer Type:	Automatic	Total Depth:	20 ft

Sampler Type: Auger Cuttings (C) ☒ California Ring (R) Split Spoon (S)

DEPTH (feet)	SAMPLES Sample Type	SAMPLES Sample	BLOWCOUNTS 0 - 6"	BLOWCOUNTS 6" - 12"	BLOWCOUNTS 12" - 18"	SPT "N" Value	USGS	MATERIAL DESCRIPTION	LABORATORY TEST DATA Moisture Content (%)	Dry Density (pcf)	Fines (%)	Liquid Limit	Plastic Limit	Plast. Index
								6.5"AC / 10"DG						
1														
2							CLML	**SILTY CLAY WITH SAND**						
3	C							light tan brown silty clay with sand						
4								fine to coarse grained sand						
5														
6	S		5	5	6	11		firm						
7														
8														
9														
10														
11	S		4	5	5	10		firm	6		72			
12														
13														
14														
15														
16	S		5	6	8	14	SM	**SILTY SAND**						
17								medium brown silty sand						
18								medium dense						
19														
20														
21	R	☒	9	13	19	21			10	101				
22								medium dense						
23														
24														
25														
26														
27														
28														
29														
30														
31														
32														
33														
34														

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ, the transition may be gradual.

geomat	Project Name: Monroe Master Drainage Plan Project No.: 17066-01	Boring No.: **B-3**	Page 1 of 1

Boring Location:	See Plate 1	Drilling Co.	GeoMat	Logged By:	AM
Drilling Date(s):	8/3/2017	Drill Rig:	CME 45	Groundwater Depth:	-- ft
Drilling Method:	Hollow Stem Auger			Depth to Bedrock:	-- ft
Hammer Weight/Drop:	140 lbs./30-inches	Hammer Type:	Automatic	Total Depth:	15 ft

Sampler Type: Auger Cuttings (C) ☒ California Ring (R) Split Spoon (S)

DEPTH (feet)	SAMPLES Sample Type	SAMPLES Sample	BLOWCOUNTS 0 - 6"	BLOWCOUNTS 6" - 12"	BLOWCOUNTS 12" - 18"	SPT "N" Value	USGS	MATERIAL DESCRIPTION	LABORATORY TEST DATA Moisture Content (%)	Dry Density (pcf)	Fines (%)	Liquid Limit	Plastic Limit	Plast. Index
								4"AC / 2"DG						
1														
2							CLML	**SILTY CLAY WITH SAND**						
3	C							orange brown silty clay with sand						
4														
5														
6	S		7	10	18	28		firm						
7														
8														
9														
10														
11	S		9	13	26	39	SP	**POORLY-GRADED SAND**	1		3			
12								gray and brown sand						
13								dense						
14								**BE WARE OF CAVING**						
15														
16	R	☒	7	8	10	12		medium dense		98				
17														
18														
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														
31														
32														
33														
34														

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ, the transition may be gradual.

geomat	Project Name: Monroe Master Drainage Plan Project No.: 17066-01	Boring No.: **B-4**	Page 1 of 1

Boring Location:	See Plate 1	Drilling Co.	GeoMat	Logged By:	AM
Drilling Date(s):	8/3/2017	Drill Rig:	CME 45	Groundwater Depth:	-- ft
Drilling Method:	Hollow Stem Auger			Depth to Bedrock:	-- ft
Hammer Weight/Drop:	140 lbs./30-inches	Hammer Type:	Automatic	Total Depth:	15 ft

Sampler Type: Auger Cuttings (C) California Ring (R) Split Spoon (S)

DEPTH (feet)	SAMPLES Sample Type	SAMPLES Sample	BLOWCOUNTS 0 - 6"	BLOWCOUNTS 6" - 12"	BLOWCOUNTS 12" - 18"	SPT "N" Value	USGS	MATERIAL DESCRIPTION	LABORATORY TEST DATA Moisture Content (%)	Dry Density (pcf)	Fines (%)	Liquid Limit	Plastic Limit	Plast. Index
								7.5"AC / No Base						
1														
2							CLML	**SANDY SILTY CLAY**						
3	C							medium to light brown sandy silty clay						
4														
5														
6	S		6	8	8	16		very firm	12		62			
7														
8														
9														
10														
11	R		10	13	15	18	SP	**POORLY-GRADED SAND**		89				
12								gray and brown sand						
13								medium dense						
14								**BE WARE OF CAVING IN THIS SOIL**						
15														
16	S		4	6	8	14	SC	**CLAYEY SAND**						
17								medium brown clayey sand						
18								medium dense						
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														
31														
32														
33														
34														

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ, the transition may be gradual.

geomat	Project Name: Monroe Master Drainage Plan Project No.: 17066-01	Boring No.: **B-5**	Page 1 of 1

Boring Location:	See Plate 1	Drilling Co.	GeoMat	Logged By:	AM
Drilling Date(s):	8/3/2017	Drill Rig:	CME 45	Groundwater Depth:	-- ft
Drilling Method:	Hollow Stem Auger			Depth to Bedrock:	-- ft
Hammer Weight/Drop:	140 lbs./30-inches	Hammer Type:	Automatic	Total Depth:	15 ft

Sampler Type: Auger Cuttings (C) | California Ring (R) | Split Spoon (S)

DEPTH (feet)	SAMPLES Sample Type	Sample	BLOWCOUNTS 0 - 6"	6" - 12"	12" - 18"	SPT "N" Value	USGS	MATERIAL DESCRIPTION	LABORATORY TEST DATA Moisture Content (%)	Dry Density (pcf)	Fines (%)	Liquid Limit	Plastic Limit	Plast. Index
								4.0"AC/2.5" Soil/1.5" Macadams/2.0" DG						
1														
2							ML	**SANDY SILT**						
3	C							medium to light brown sandy silt						
4														
5														
6	S		12	13	19	32		very firm						
7														
8														
9							SWSM	**WELL-GRADED SAND WITH SILT**						
10								gray and brown sand with silt						
11	R		9	13	18	20		medium dense						
12								No Sample Recovery						
13								**BE WARE OF CAVING IN THIS SOIL**						
14														
15														
16	S		6	10	11	21		medium dense	4		8			
17														
18														
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														
31														
32														
33														
34														

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ, the transition may be gradual.

geomat	Project Name: Monroe Master Drainage Plan Project No.: 17066-01	Boring No.: **B-6**	Page 1 of 1

Boring Location:	See Plate 1	Drilling Co.	GeoMat	Logged By:	AM
Drilling Date(s):	8/3/2017	Drill Rig:	CME 45	Groundwater Depth:	-- ft
Drilling Method:	Hollow Stem Auger			Depth to Bedrock:	-- ft
Hammer Weight/Drop:	140 lbs./30-inches	Hammer Type:	Automatic	Total Depth:	15 ft

Sampler Type: Auger Cuttings (C) | California Ring (R) | Split Spoon (S)

DEPTH (feet)	SAMPLES: Sample Type	SAMPLES: Sample	BLOWCOUNTS: 0 - 6"	BLOWCOUNTS: 6" - 12"	BLOWCOUNTS: 12" - 18"	SPT "N" Value	USGS	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Moisture Content (%)	Dry Density (pcf)	Fines (%)	Liquid Limit	Plastic Limit	Plast. Index
								2.25"AC / 4.0" DG						
1														
2							CL	**SANDY LEAN CLAY**						
3	C							red-brown sandy lean clay						
4														
5														
6	R		17	50/		50		hard						
7				5"				sample disturbed						
8														
9														
10														
11	S		6	6	7	13	SP	**POORLY-GRADED SAND**	2		3			
12								gray and brown sand						
13								medium dense						
14								**BE WARE OF CAVING IN THIS SOIL LAYER**						
15														
16	S		12	13	10	23	SC	**CLAYEY SAND**						
17								red-brown clayey sand						
18								medium dense						
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														
31														
32														
33														
34														

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ, the transition may be gradual.

geomat	Project Name: Monroe Master Drainage Plan Project No.: 17066-01	Boring No.: **B-7**	Page 1 of 1

Boring Location:	See Plate 1	Drilling Co.	GeoMat	Logged By:	AM
Drilling Date(s):	8/3/2017	Drill Rig:	CME 45	Groundwater Depth:	-- ft
Drilling Method:	Hollow Stem Auger			Depth to Bedrock:	-- ft
Hammer Weight/Drop:	140 lbs./30-inches	Hammer Type:	Automatic	Total Depth:	15 ft

Sampler Type: Auger Cuttings (C) | California Ring (R) | Split Spoon (S)

DEPTH (feet)	SAMPLES: Sample Type	SAMPLES: Sample	BLOWCOUNTS: 0 - 6"	BLOWCOUNTS: 6" - 12"	BLOWCOUNTS: 12" - 18"	SPT "N" Value	USGS	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Moisture Content (%)	Dry Density (pcf)	Fines (%)	Liquid Limit	Plastic Limit	Plast. Index
								3.0"AC / No Base						
1														
2	C						CL	**SANDY LEAN CLAY** red-brown sandy lean clay						
3														
4														
5	S		6	6	8	14		firm	17		60			
6														
7														
8														
9														
10	S		5	5	6	11	SC	**CLAYEY SAND** medium brown clayey sand medium dense						
11														
12														
13							SPSM	**POORLY-GRADED SAND WITH SILT** gray and brown sand with silt						
14														
15	R		9	14	26	26		medium dense		110				
16								**BE WARE OF CAVING IN THIS SOIL LAYER**						
17														
18														
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														
31														
32														
33														
34														

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ, the transition may be gradual.

geomat	Project Name: Monroe Master Drainage Plan Project No.: 17066-01	Boring No.: **B-8**	Page 1 of 1

Boring Location:	See Plate 1	Drilling Co.	GeoMat	Logged By:	AM
Drilling Date(s):	8/3/2017	Drill Rig:	CME 45	Groundwater Depth:	-- ft
Drilling Method:	Hollow Stem Auger			Depth to Bedrock:	-- ft
Hammer Weight/Drop:	140 lbs./30-inches	Hammer Type:	Automatic	Total Depth:	15 ft

Sampler Type: Auger Cuttings (C) | California Ring (R) | Split Spoon (S)

DEPTH (feet)	SAMPLES: Sample Type	SAMPLES: Sample	BLOWCOUNTS: 0 - 6"	BLOWCOUNTS: 6" - 12"	BLOWCOUNTS: 12" - 18"	SPT "N" Value	USGS	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Moisture Content (%)	Dry Density (pcf)	Fines (%)	Liquid Limit	Plastic Limit	Plast. Index
								4.0"AC / 2.0" DG						
1														
2	C						CL	**SANDY LEAN CLAY** medium brown sandy lean clay						
3														
4														
5														
6	R		8	9	12	14	SC	**CLAYEY SAND** medium brown clayey sand medium dense	19	106				
7														
8														
9														
10	S		2	4	6	10		medium dense	13		33			
11														
12														
13														
14														
15														
16	S		4	5	7	12	SPSM	**POORLY-GRADED SAND WITH SILT** gray and brown sand with silt medium dense **BE WARE OF CAVING IN THIS SOIL LAYER**						
17														
18														
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														
31														
32														
33														
34														

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ, the transition may be gradual.

geomat	Project Name: Monroe Master Drainage Plan Project No.: 17066-01	Boring No.: **B-9**	Page 1 of 1

Boring Location:	See Plate 1	Drilling Co.	GeoMat	Logged By:	AM
Drilling Date(s):	8/3/2017	Drill Rig:	CME 45	Groundwater Depth:	-- ft
Drilling Method:	Hollow Stem Auger			Depth to Bedrock:	-- ft
Hammer Weight/Drop:	140 lbs./30-inches	Hammer Type:	Automatic	Total Depth:	15 ft

Sampler Type: Auger Cuttings (C) | California Ring (R) | Split Spoon (S)

DEPTH (feet)	SAMPLES Sample Type	Sample	BLOWCOUNTS 0 - 6"	6" - 12"	12" - 18"	SPT "N" Value	USGS	MATERIAL DESCRIPTION	LABORATORY TEST DATA Moisture Content (%)	Dry Density (pcf)	Fines (%)	Liquid Limit	Plastic Limit	Plast. Index
								2.0"AC / No Base						
1														
2	C						CL	**SANDY LEAN CLAY** orange brown sandy lean clay						
3														
4														
5	S		3	3	5	8		medium firm						
6														
7														
8														
9														
10	R		9	15	19	22		very firm saturated at 11 feet	27	97				
11														
12														
13														
14							SC	**CLAYEY SAND** gray and brown sand with silt						
15	S		15	16	18	34		dense	7		18			
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														
31														
32														
33														
34														

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ, the transition may be gradual.

geomat	Project Name: Monroe Master Drainage Plan Project No.: 17066-01	Boring No.: **B-10**	Page 1 of 1

Boring Location:	See Plate 1	Drilling Co.	GeoMat	Logged By:	AM
Drilling Date(s):	8/1/2017	Drill Rig:	CME 45	Groundwater Depth:	-- ft
Drilling Method:	Hollow Stem Auger			Depth to Bedrock:	-- ft
Hammer Weight/Drop:	140 lbs./30-inches	Hammer Type:	Automatic	Total Depth:	20 ft

Sampler Type: Auger Cuttings (C) ☒ California Ring (R) Split Spoon (S)

DEPTH (feet)	SAMPLES Sample Type	Sample	BLOWCOUNTS 0 - 6"	6" - 12"	12" - 18"	SPT "N" Value	USGS	MATERIAL DESCRIPTION	LABORATORY TEST DATA Moisture Content (%)	Dry Density (pcf)	Fines (%)	Liquid Limit	Plastic Limit	Plast. Index
								8.5"AC / No Base						
1														
2	C						SC	**CLAYEY SAND** orange brown clayey sand						
3														
4														
5	S		2	2	3	5		loose	12		45			
6														
7														
8														
9														
10	S		3	5	9	14	CL	**SANDY LEAN CLAY** medium brown sandy lean clay firm						
11														
12														
13														
14														
15	S		7	9	9	18	SC	**CLAYEY SAND** red-brown clayey sand medium dense						
16														
17														
18														
19														
20	R	☒	50/	5"		78		very dense	16	106				
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														
31														
32														
33														
34														

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ, the transition may be gradual.

geomat	Project Name: Monroe Master Drainage Plan Project No.: 17066-01	Boring No.: **B-11**	Page 1 of 1

Boring Location:	See Plate 1	Drilling Co.	GeoMat	Logged By:	AM
Drilling Date(s):	8/1/2017	Drill Rig:	CME 45	Groundwater Depth:	-- ft
Drilling Method:	Hollow Stem Auger			Depth to Bedrock:	-- ft
Hammer Weight/Drop:	140 lbs./30-inches	Hammer Type:	Automatic	Total Depth:	15 ft

Sampler Type: Auger Cuttings (C) | California Ring (R) | Split Spoon (S)

DEPTH (feet)	SAMPLES Sample Type	SAMPLES Sample	BLOWCOUNTS 0 - 6"	BLOWCOUNTS 6" - 12"	BLOWCOUNTS 12" - 18"	SPT "N" Value	USGS	MATERIAL DESCRIPTION	LABORATORY TEST DATA Moisture Content (%)	Dry Density (pcf)	Fines (%)	Liquid Limit	Plastic Limit	Plast. Index
								6.0"AC / No Base						
1														
2							SC	**CLAYEY SAND**						
3	C							orange brown clayey sand						
4								coarse grained sand						
5														
6	R		4	4	6	7	SWSM	**WELL-GRADED SAND WITH SILT**		108				
7								medium brown sand with silt						
8								loose						
9								**BE WARE OF CAVING IN THIS SOIL LAYER**						
10	S		4	8	13	21		medium dense	3		6			
11														
12														
13														
14														
15														
16	S		5	18	43	61	SC	**CLAYEY SAND**						
17								red-brown clayey sand						
18								very dense						
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														
31														
32														
33														
34														

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ, the transition may be gradual.

geomat

Project Name: Monroe Master Drainage Plan
Project No.: 17066-01

Boring No.: **B-12** Page 1 of 1

Boring Location:	See Plate 1	Drilling Co.	GeoMat	Logged By:	AM
Drilling Date(s):	8/1/2017	Drill Rig:	CME 45	Groundwater Depth:	-- ft
Drilling Method:	Hollow Stem Auger			Depth to Bedrock:	-- ft
Hammer Weight/Drop:	140 lbs./30-inches	Hammer Type:	Automatic	Total Depth:	15 ft

Sampler Type: Auger Cuttings (C) California Ring (R) Split Spoon (S)

DEPTH (feet)	SAMPLES Sample Type	Sample	BLOWCOUNTS 0 - 6"	6" - 12"	12" - 18"	SPT "N" Value	USGS	MATERIAL DESCRIPTION	LABORATORY TEST DATA Moisture Content (%)	Dry Density (pcf)	Fines (%)	Liquid Limit	Plastic Limit	Plast. Index
								6.0"AC / No Base						
1														
2	C						CL	**SANDY LEAN CLAY**						
3								medium brown sandy lean clay						
4														
5														
6	S		3	3	3	6	SC	**CLAYEY SAND**						
7								No Recovery						
8								loose						
9														
10	S		4	5	6	11		medium dense						
11								medium brown clayey sand						
12														
13														
14														
15	R		13	18	21	25	SM	**SILTY SAND**	4	116	15			
16								medium brown silty sand						
17								medium dense						
18														
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														
31														
32														
33														
34														

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ, the transition may be gradual.

geomat	Project Name: Monroe Master Drainage Plan Project No.: 17066-01	Boring No.: **B-13**	Page 1 of 1

Boring Location:	See Plate 1	Drilling Co.	GeoMat	Logged By:	AM
Drilling Date(s):	8/1/2017	Drill Rig:	CME 45	Groundwater Depth:	-- ft
Drilling Method:	Hollow Stem Auger			Depth to Bedrock:	-- ft
Hammer Weight/Drop:	140 lbs./30-inches	Hammer Type:	Automatic	Total Depth:	15 ft

Sampler Type: Auger Cuttings (C) | California Ring (R) | Split Spoon (S)

DEPTH (feet)	SAMPLES: Sample Type	SAMPLES: Sample	BLOWCOUNTS: 0 - 6"	BLOWCOUNTS: 6" - 12"	BLOWCOUNTS: 12" - 18"	SPT "N" Value	USGS	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Moisture Content (%)	Dry Density (pcf)	Fines (%)	Liquid Limit	Plastic Limit	Plast. Index
								4.5"AC / No Base						
1														
2							SM	**SILTY SAND**						
3	C							orange brown silty sand						
4														
5														
6	S		12	18	26	44		dense	8		24			
7														
8														
9														
10														
11	R		10	12	16	18	SPSM	**POORLY-GRADED SAND WITH SILT**		112				
12								medium brown sand with silt						
13								medium dense						
14								**BE WARE OF CAVING IN THIS SOIL LAYER**						
15														
16	S		8	10	13	23		medium dense						
17														
18														
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														
31														
32														
33														
34														

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ, the transition may be gradual.

geomat	Project Name: Monroe Master Drainage Plan Project No.: 17066-01	Boring No.: **B-14**	Page 1 of 1

Boring Location:	See Plate 1	Drilling Co.	GeoMat	Logged By:	AM
Drilling Date(s):	8/1/2017	Drill Rig:	CME 45	Groundwater Depth:	-- ft
Drilling Method:	Hollow Stem Auger			Depth to Bedrock:	-- ft
Hammer Weight/Drop:	140 lbs./30-inches	Hammer Type:	Automatic	Total Depth:	15 ft

Sampler Type: Auger Cuttings (C) | California Ring (R) | Split Spoon (S)

DEPTH (feet)	SAMPLES: Sample Type	SAMPLES: Sample	BLOWCOUNTS: 0 - 6"	BLOWCOUNTS: 6" - 12"	BLOWCOUNTS: 12" - 18"	SPT "N" Value	USGS	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Moisture Content (%)	Dry Density (pcf)	Fines (%)	Liquid Limit	Plastic Limit	Plast. Index
								8.0"AC / No Base						
1														
2	C						SM	**SILTY SAND** orange brown silty sand						
3														
4														
5	R		6	7	9	16	SWSM	**WELL-GRADED SAND WITH SILT** medium brown sand with silt medium dense **BE WARE OF CAVING IN THIS SOIL LAYER**		93				
6														
7														
8														
9														
10	S		6	7	7	14		medium dense	3		9			
11														
12														
13														
14														
15	S		7	10	13	23		medium dense						
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														
31														
32														
33														
34														

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ, the transition may be gradual.

geomat

Project Name: Monroe Master Drainage Plan
Project No.: 17066-01

Boring No.: **B-15** Page 1 of 1

Boring Location:	See Plate 1	Drilling Co.	GeoMat	Logged By:	AM
Drilling Date(s):	8/1/2017	Drill Rig:	CME 45	Groundwater Depth:	-- ft
Drilling Method:	Hollow Stem Auger			Depth to Bedrock:	-- ft
Hammer Weight/Drop:	140 lbs./30-inches	Hammer Type:	Automatic	Total Depth:	15 ft

Sampler Type: Auger Cuttings (C) California Ring (R) Split Spoon (S)

DEPTH (feet)	SAMPLES Sample Type	Sample	BLOWCOUNTS 0 - 6"	6" - 12"	12" - 18"	SPT "N" Value	USGS	MATERIAL DESCRIPTION	LABORATORY TEST DATA Moisture Content (%)	Dry Density (pcf)	Fines (%)	Liquid Limit	Plastic Limit	Plast. Index
								6.0"AC / No Base						
1														
2	C						SC	**CLAYEY SAND**						
3								red brown clayey sand						
4														
5														
6	S		2	3	6	9		loose						
7														
8														
9														
10														
11	S		4	5	5	10	SM	**SILTY SAND**	8		44			
12								medium brown silty sand						
13								medium dense						
14														
15	R		9	13	31	29		medium dense	11	113				
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														
31														
32														
33														
34														

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ, the transition may be gradual.

geomat	Project Name: Monroe Master Drainage Plan Project No.: 17066-01	Boring No.: **B-16**	Page 1 of 1

Boring Location:	See Plate 1	Drilling Co.	GeoMat	Logged By:	AM
Drilling Date(s):	8/1/2017	Drill Rig:	CME 45	Groundwater Depth:	-- ft
Drilling Method:	Hollow Stem Auger			Depth to Bedrock:	-- ft
Hammer Weight/Drop:	140 lbs./30-inches	Hammer Type:	Automatic	Total Depth:	15 ft

Sampler Type: Auger Cuttings (C) | California Ring (R) | Split Spoon (S)

DEPTH (feet)	SAMPLES Sample Type	SAMPLES Sample	BLOWCOUNTS 0 - 6"	BLOWCOUNTS 6" - 12"	BLOWCOUNTS 12" - 18"	SPT "N" Value	USGS	MATERIAL DESCRIPTION	LABORATORY TEST DATA Moisture Content (%)	Dry Density (pcf)	Fines (%)	Liquid Limit	Plastic Limit	Plast. Index
								9.0"AC / No Base						
1														
2							SC	**CLAYEY SAND**						
3	C							red brown clayey sand						
4														
5														
6	S		8	10	12	22		medium dense						
7														
8														
9														
10														
11	R		15	27	50/4"	66		very dense	13	122				
12														
13														
14														
15														
16	S		2	4	4	8		loose	17		29			
17								**WET SOIL AT 16 FEET**						
18														
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														
31														
32														
33														
34														

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ, the transition may be gradual.

geomat	Project Name: Monroe Master Drainage Plan Project No.: 17066-01	Boring No.: **B-17**	Page 1 of 1

Boring Location:	See Plate 1	Drilling Co.	GeoMat	Logged By:	AM
Drilling Date(s):	8/1/2017	Drill Rig:	CME 45	Groundwater Depth:	-- ft
Drilling Method:	Hollow Stem Auger			Depth to Bedrock:	6 ft
Hammer Weight/Drop:	140 lbs./30-inches	Hammer Type:	Automatic	Total Depth:	10 ft

Sampler Type: Auger Cuttings (C) | California Ring (R) | Split Spoon (S)

DEPTH (feet)	SAMPLES Sample Type	SAMPLES Sample	BLOWCOUNTS 0 - 6"	BLOWCOUNTS 6" - 12"	BLOWCOUNTS 12" - 18"	SPT "N" Value	USGS	MATERIAL DESCRIPTION	LABORATORY TEST DATA Moisture Content (%)	Dry Density (pcf)	Fines (%)	Liquid Limit	Plastic Limit	Plast. Index
1	C						CL	**SANDY LEAN CLAY**						
2								red brown sandy lean clay						
3														
4														
5	R		5	9	19	18		very firm	16	114				
6							SM	**GRANITIC BEDROCK**						
7								drills like silty sand						
VARI								**BE WARE OF EXCAVATION DIFICULTIES**						
9														
10	S		50/	6"		65		very dense	4		12			
11														
12														
13														
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														
31														
32														
33														
34														

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ, the transition may be gradual.

geomat	Project Name: Monroe Master Drainage Plan Project No.: 17066-01	Boring No.: **B-18**	Page 1 of 1

Boring Location:	See Plate 1	Drilling Co.	GeoMat	Logged By:	AM
Drilling Date(s):	8/1/2017	Drill Rig:	CME 45	Groundwater Depth:	-- ft
Drilling Method:	Hollow Stem Auger			Depth to Bedrock:	-- ft
Hammer Weight/Drop:	140 lbs./30-inches	Hammer Type:	Automatic	Total Depth:	10 ft

Sampler Type: Auger Cuttings (C) California Ring (R) Split Spoon (S)

DEPTH (feet)	SAMPLES Sample Type	Sample	BLOWCOUNTS 0 - 6"	6" - 12"	12" - 18"	SPT "N" Value	USGS	MATERIAL DESCRIPTION	LABORATORY TEST DATA Moisture Content (%)	Dry Density (pcf)	Fines (%)	Liquid Limit	Plastic Limit	Plast. Index
1	C						CL	**SANDY LEAN CLAY** red brown sandy lean clay						
2														
3														
4														
5	S		6	10	11	21		very firm	13		65			
6														
7														
8														
9														
10	R		12	17	23	26	SC	**CLAYEY SAND** medium brown clayey sand medium dense	22	102				
11														
12														
13														
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														
31														
32														
33														
34														

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ, the transition may be gradual.

geomat

Project Name: Monroe Master Drainage Plan
Project No.: 17066-01

Boring No.: **B-19** Page 1 of 1

Boring Location:	See Plate 1	Drilling Co.	GeoMat	Logged By:	AM
Drilling Date(s):	8/1/2017	Drill Rig:	CME 45	Groundwater Depth:	-- ft
Drilling Method:	Hollow Stem Auger			Depth to Bedrock:	-- ft
Hammer Weight/Drop:	140 lbs./30-inches	Hammer Type:	Automatic	Total Depth:	10 ft

Sampler Type: Auger Cuttings (C) California Ring (R) Split Spoon (S)

DEPTH (feet)	SAMPLES Sample Type	Sample	BLOWCOUNTS 0 - 6"	6" - 12"	12" - 18"	SPT "N" Value	USGS	MATERIAL DESCRIPTION	LABORATORY TEST DATA Moisture Content (%)	Dry Density (pcf)	Fines (%)	Liquid Limit	Plastic Limit	Plast. Index
1							SC	**CLAYEY SAND**						
2	C							orange brown clayey sand						
3														
4														
5														
6	R		19	32	50/4"	70		very dense	14	109				
7														
8														
9														
10														
11	S		9	14	29	43		dense	7		17			
12														
13														
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														
31														
32														
33														
34														

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ, the transition may be gradual.

geomat	Project Name: Monroe Master Drainage Plan Project No.: 17066-01	Boring No.: **B-20**	Page 1 of 1

Boring Location:	See Plate 1	Drilling Co.	GeoMat	Logged By:	AM
Drilling Date(s):	8/1/2017	Drill Rig:	CME 45	Groundwater Depth:	-- ft
Drilling Method:	Hollow Stem Auger			Depth to Bedrock:	-- ft
Hammer Weight/Drop:	140 lbs./30-inches	Hammer Type:	Automatic	Total Depth:	10 ft

Sampler Type: Auger Cuttings (C) ☒ California Ring (R) Split Spoon (S)

DEPTH (feet)	SAMPLES Sample Type	SAMPLES Sample	BLOWCOUNTS 0 - 6"	BLOWCOUNTS 6" - 12"	BLOWCOUNTS 12" - 18"	SPT "N" Value	USGS	MATERIAL DESCRIPTION	LABORATORY TEST DATA Moisture Content (%)	Dry Density (pcf)	Fines (%)	Liquid Limit	Plastic Limit	Plast. Index
1	C						CL	**SANDY LEAN CLAY** red brown sandy lean clay						
2														
3														
4														
5	S		1	1	1	2		soft, MAY UNRAVEL	11		58			
6														
7														
8														
9														
10	R	☒	13	50/	5"	47	SC	**CLAYEY SAND** medium brown clayey sand dense	11	118				
11														
12														
13														
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														
31														
32														
33														
34														

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ, the transition may be gradual.

geomat	Project Name: Monroe Master Drainage Plan Project No.: 17066-01	Boring No.: **B-21**	Page 1 of 1

Boring Location:	See Plate 1	Drilling Co.	GeoMat	Logged By:	AM
Drilling Date(s):	8/1/2017	Drill Rig:	CME 45	Groundwater Depth:	-- ft
Drilling Method:	Hollow Stem Auger			Depth to Bedrock:	-- ft
Hammer Weight/Drop:	140 lbs./30-inches	Hammer Type:	Automatic	Total Depth:	10 ft

Sampler Type: Auger Cuttings (C) California Ring (R) Split Spoon (S)

DEPTH (feet)	SAMPLES Sample Type	Sample	BLOWCOUNTS 0 - 6"	6" - 12"	12" - 18"	SPT "N" Value	USGS	MATERIAL DESCRIPTION	LABORATORY TEST DATA Moisture Content (%)	Dry Density (pcf)	Fines (%)	Liquid Limit	Plastic Limit	Plast. Index
1	C						SC	**CLAYEY SAND**						
2								red brown clayey sand						
3														
4														
5	R		27	50/	4"	67		very dense	16	105				
6														
7														
8														
9														
10	S		7	14	30	44		dense	14		41			
11														
12														
13														
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														
31														
32														
33														
34														

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ, the transition may be gradual.

geomat	Project Name: Monroe Master Drainage Plan Project No.: 17066-01	Boring No.: **B-22**	Page 1 of 1

Boring Location:	See Plate 1	Drilling Co.	GeoMat	Logged By:	AM
Drilling Date(s):	8/2/2017	Drill Rig:	CME 45	Groundwater Depth:	-- ft
Drilling Method:	Hollow Stem Auger			Depth to Bedrock:	-- ft
Hammer Weight/Drop:	140 lbs./30-inches	Hammer Type:	Automatic	Total Depth:	15 ft

Sampler Type: Auger Cuttings (C) ☒ California Ring (R) Split Spoon (S)

DEPTH (feet)	SAMPLES Sample Type	SAMPLES Sample	BLOWCOUNTS 0 - 6"	BLOWCOUNTS 6" - 12"	BLOWCOUNTS 12" - 18"	SPT "N" Value	USGS	MATERIAL DESCRIPTION	LABORATORY TEST DATA Moisture Content (%)	Dry Density (pcf)	Fines (%)	Liquid Limit	Plastic Limit	Plast. Index
1	C						SC	**CLAYEY SAND** red brown clayey sand						
2														
3														
4														
5	S		2	3	6	9		loose, MAY UNRAVEL						
6														
7														
8														
9														
10	S		8	9	11	20		medium dense	8		20			
11														
12								hard drilling resistance at 12'						
13							SM	**SILTY SAND** medium brown silty sand						
14														
15	R	☒	50/	6"		65		very dense	14	97				
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														
31														
32														
33														
34														

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ, the transition may be gradual.

geomat	Project Name: Monroe Master Drainage Plan Project No.: 17066-01	Boring No.: **B-23**	Page 1 of 1

Boring Location:	See Plate 1	Drilling Co.	GeoMat	Logged By:	AM
Drilling Date(s):	8/2/2017	Drill Rig:	CME 45	Groundwater Depth:	-- ft
Drilling Method:	Hollow Stem Auger			Depth to Bedrock:	-- ft
Hammer Weight/Drop:	140 lbs./30-inches	Hammer Type:	Automatic	Total Depth:	15 ft

Sampler Type: Auger Cuttings (C) | California Ring (R) | Split Spoon (S)

DEPTH (feet)	SAMPLES Sample Type	SAMPLES Sample	BLOWCOUNTS 0 - 6"	BLOWCOUNTS 6" - 12"	BLOWCOUNTS 12" - 18"	SPT "N" Value	USGS	MATERIAL DESCRIPTION	LABORATORY TEST DATA Moisture Content (%)	Dry Density (pcf)	Fines (%)	Liquid Limit	Plastic Limit	Plast. Index
								6.0" AC / 4.0" Rock						
1														
2							CL	**SANDY LEAN CLAY**						
3	C							red brown sandy lean clay						
4														
5														
6	S		6	8	9	17		very firm						
7														
8														
9							SP	**POORLY-GRADED SAND**						
10								brown and gray sand						
11	R		7	11	14	16		medium dense		114				
12								**BE WARE OF CAVING IN THIS SOIL LAYER**						
13														
14														
15														
16	S		9	8	9	17		medium dense	4		5			
17														
18														
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														
31														
32														
33														
34														

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ, the transition may be gradual.

geomat	Project Name: Monroe Master Drainage Plan Project No.: 17066-01	Boring No.: **B-24**	Page 1 of 1

Boring Location:	See Plate 1	Drilling Co.	GeoMat	Logged By:	AM
Drilling Date(s):	8/2/2017	Drill Rig:	CME 45	Groundwater Depth:	-- ft
Drilling Method:	Hollow Stem Auger			Depth to Bedrock:	-- ft
Hammer Weight/Drop:	140 lbs./30-inches	Hammer Type:	Automatic	Total Depth:	15 ft

Sampler Type: Auger Cuttings (C) ☒ California Ring (R) Split Spoon (S)

DEPTH (feet)	SAMPLES Sample Type	SAMPLES Sample	BLOWCOUNTS 0 - 6"	BLOWCOUNTS 6" - 12"	BLOWCOUNTS 12" - 18"	SPT "N" Value	USGS	MATERIAL DESCRIPTION	LABORATORY TEST DATA Moisture Content (%)	Dry Density (pcf)	Fines (%)	Liquid Limit	Plastic Limit	Plast. Index
1	C						SM	**FILL (SILTY SAND WITH GRAVEL)** medium brown silty sand with gravel						
2														
3														
4	R	☒	4	6	8	9	SC	**CLAYEY SAND** red brown clayey sand loose	11	114				
5														
6														
7														
8														
9	S		3	3	4	7	SPSM	**POORLY-GRADED SAND WITH SILT** brown and gray sand with silt loose **BE WARE OF CAVING IN THIS SOIL LAYER**	3		5			
10														
11														
12														
13														
14														
15	S		9	9	10	19		medium dense						
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														
31														
32														
33														
34														

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ, the transition may be gradual.

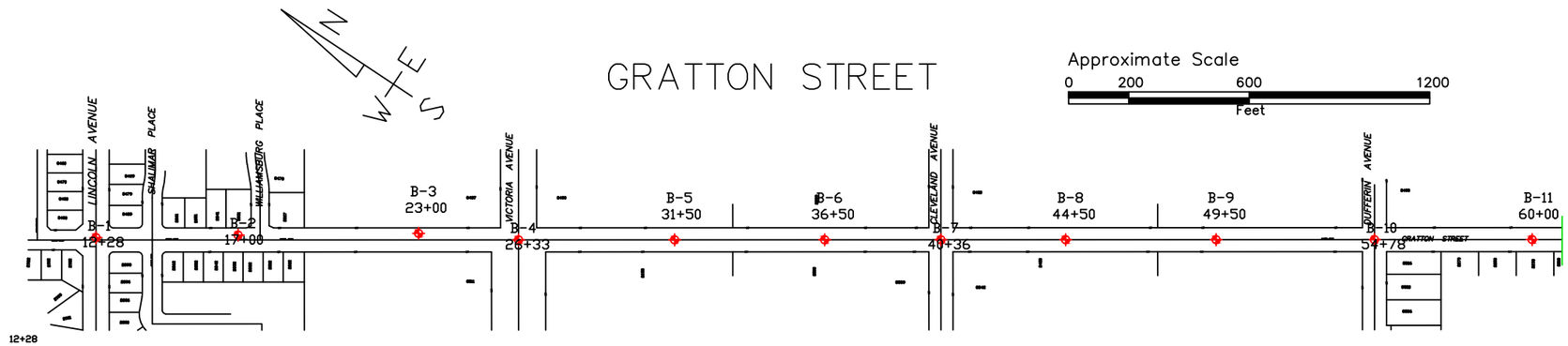
geomat	Project Name: Monroe Master Drainage Plan Project No.: 17066-01	Boring No.: **B-25**	Page 1 of 1

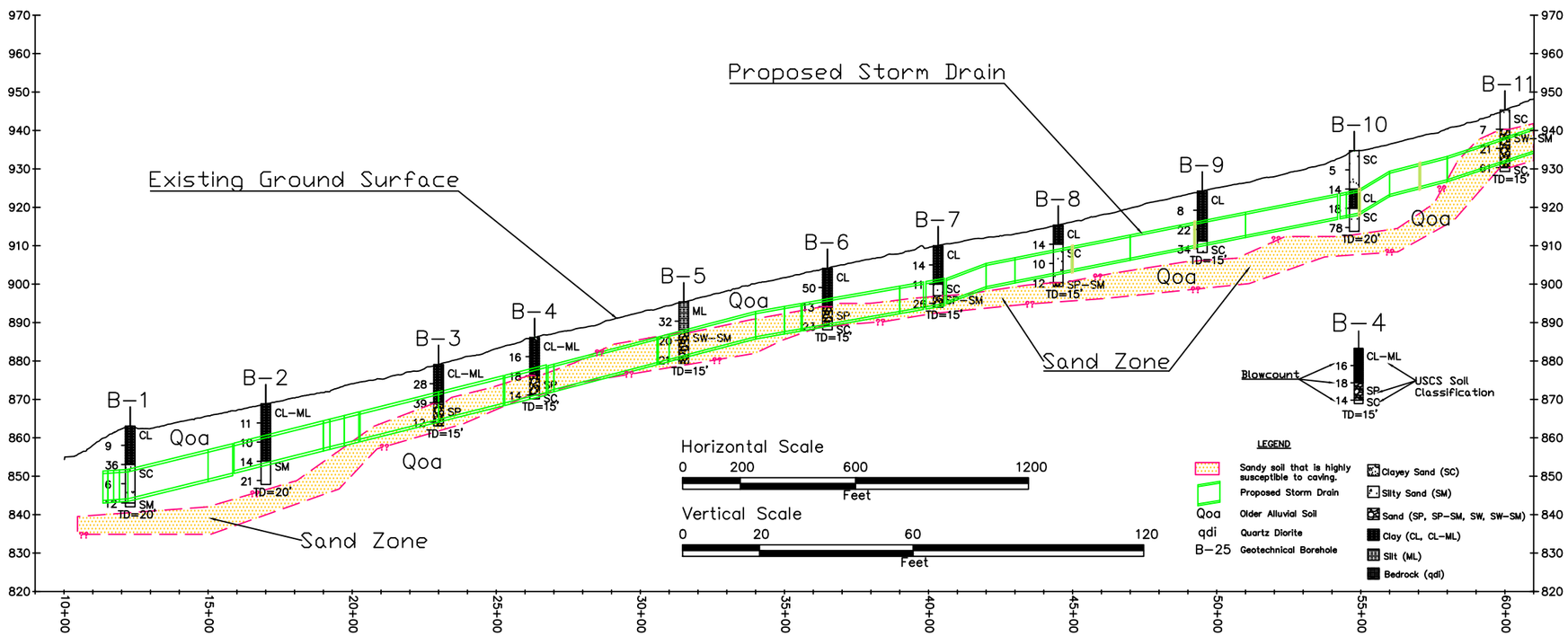
Boring Location:	See Plate 1	Drilling Co.	GeoMat	Logged By:	AM
Drilling Date(s):	8/2/2017	Drill Rig:	CME 45	Groundwater Depth:	-- ft
Drilling Method:	Hollow Stem Auger			Depth to Bedrock:	-- ft
Hammer Weight/Drop:	140 lbs./30-inches	Hammer Type:	Automatic	Total Depth:	15 ft

Sampler Type: Auger Cuttings (C) | California Ring (R) | Split Spoon (S)

DEPTH (feet)	SAMPLES Sample Type	SAMPLES Sample	BLOWCOUNTS 0 - 6"	BLOWCOUNTS 6" - 12"	BLOWCOUNTS 12" - 18"	SPT "N" Value	USGS	MATERIAL DESCRIPTION	LABORATORY TEST DATA Moisture Content (%)	Dry Density (pcf)	Fines (%)	Liquid Limit	Plastic Limit	Plast. Index
								4.0" AC / 4.0" Concrete						
1														
2							SC	**CLAYEY SAND**						
3	C							red brown clayey sand						
4														
5														
6	S		2	3	3	6		loose	8		28			
7														
8														
9														
10														
11	R		16	18	24	27		medium dense	18	106				
12														
13														
14														
15														
16	S		5	8	8	16	SPSM	**POORLY-GRADED SAND WITH SILT**						
17								brown and gray sand with silt						
18								medium dense						
19								**BE WARE OF CAVING IN THIS SOIL LAYER**						
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														
31														
32														
33														
34														

The stratification lines represent the approximate boundary lines between soil and rock types. In-situ, the transition may be gradual.





The subsurface description is of a generalized nature to highlight the major subsurface stratification features and material characteristics. The boring logs included in this appendix should be reviewed for specific information at individual boring locations. These records include soil descriptions, stratifications, penetration resistances, locations of the samples and laboratory test data. The stratifications shown on the boring logs represent the conditions only at the actual boring locations at the time of our exploration. Variations may occur and should be expected between boring locations. The stratifications indicated here and on the boring logs represent the approximate boundaries between subsurface materials. The actual transitions may be gradual.

Blowcounts are in blows per 12-inches and were sampled by the Standard Penetration Test (SPT) and the Modified California Ring Sampler. Modified California Ring Sample blowcounts have already been converted to SPT values.

The boring figure shows total depth of boring plus 1 foot to differentiate any changes in material found in the tip of the sampler.

Project: 17066-01	Geotechnical Cross Section Monroe Master Drainage Plan, Line E
Date: November 2017	
DRAWN BY: AM	
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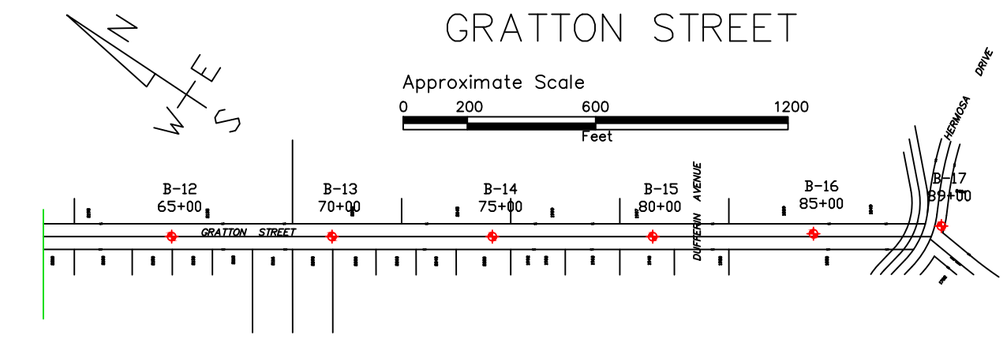

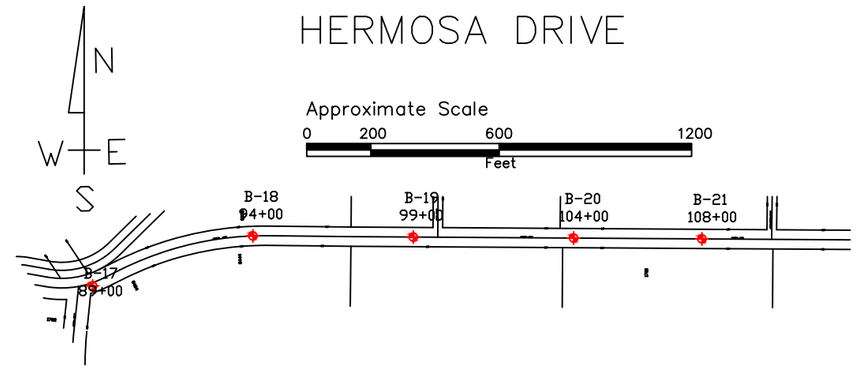

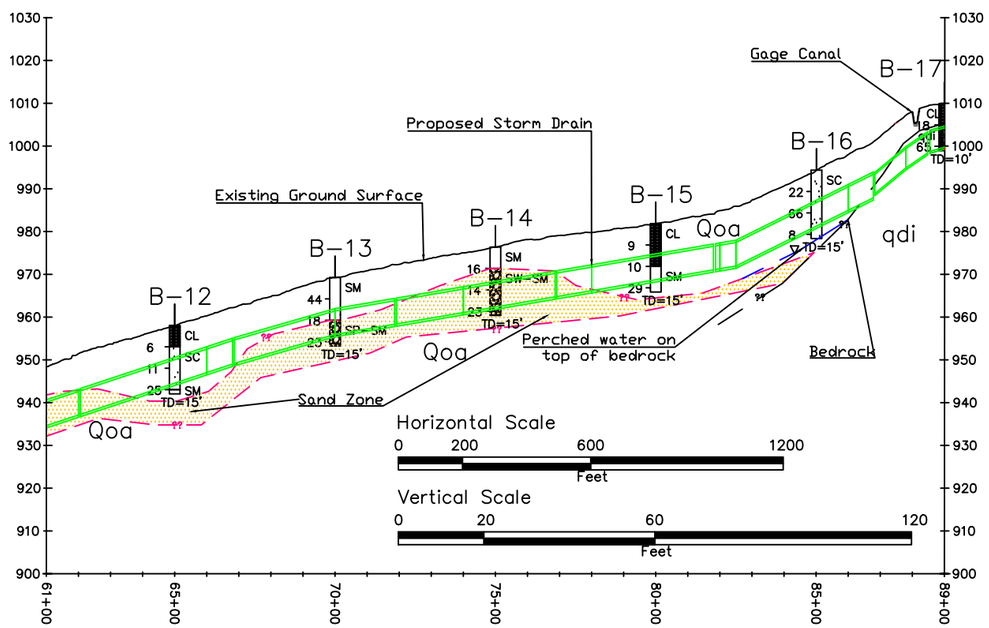

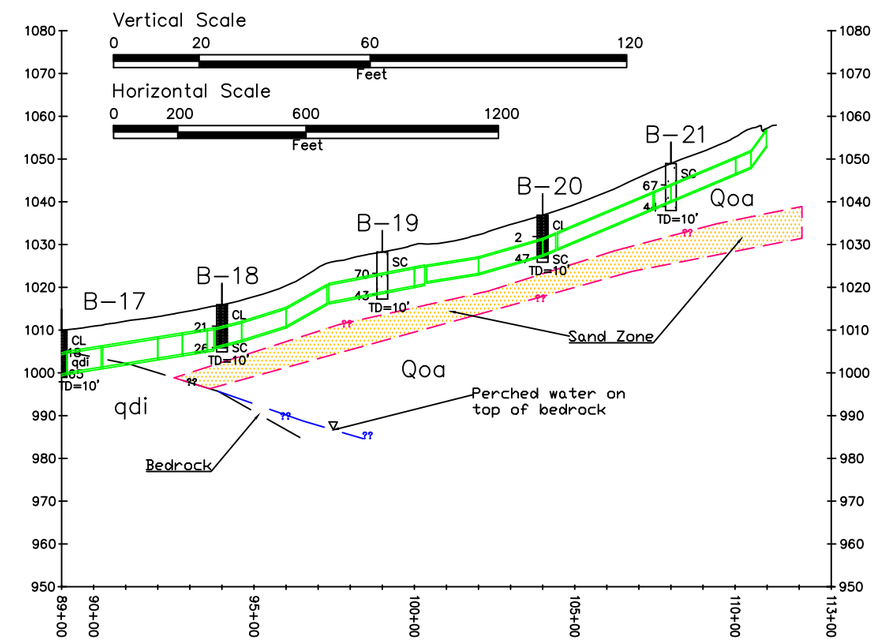

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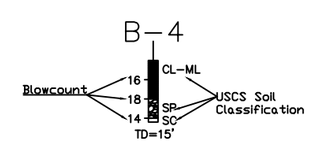

LEGEND

- Sandy soil that is highly susceptible to caving.
- Proposed Storm Drain
- Qoa — Older Alluvial Soil
- qdi — Quartz Diorite
- B-25 — Geotechnical Borehole
- Clayey Sand (SC)
- Silty Sand (SM)
- Sand (SP, SP-SM, SW, SW-SM)
- Clay (CL, CL-ML)
- Silt (ML)
- Bedrock (qdi)

Project: 17066-01	Geotechnical Cross Section Monroe Master Drainage Plan, Line E
Date: November 2017	
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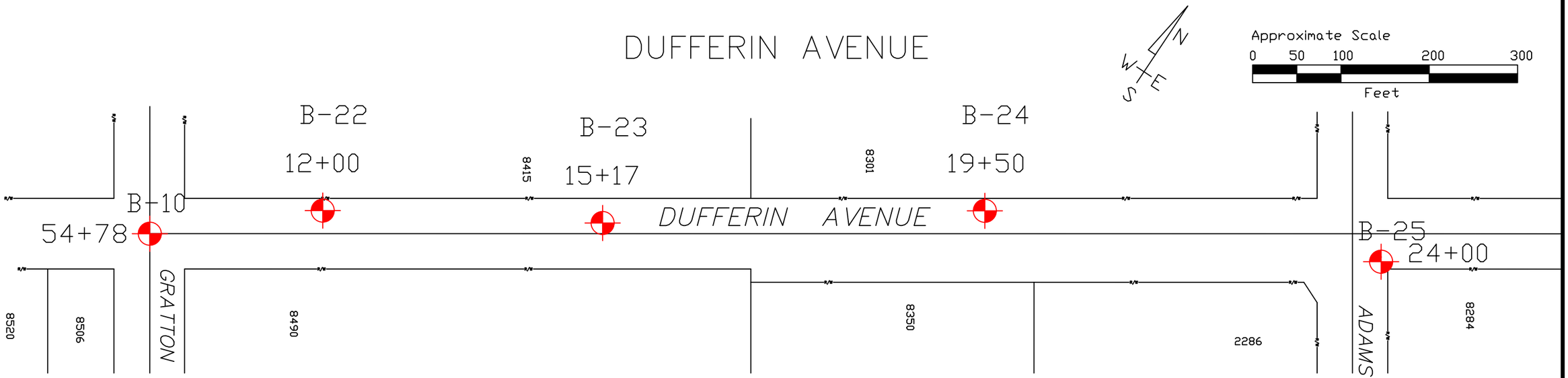
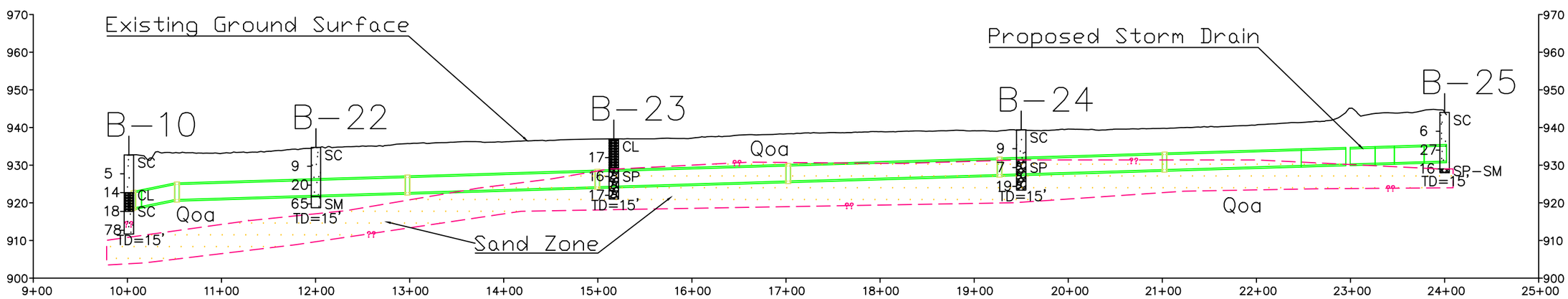




Horizontal Scale

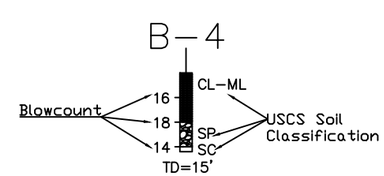
0 50 100 200 300

Feet

Vertical Scale

0 10 30 70

Feet



LEGEND

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The boring figure shows total depth of boring plus 1 foot to differentiate any changes in material found in the tip of the sampler.

Project: 17066-01	Geotechnical Cross Section Monroe Master Drainage Plan, Line E
Date: November 2017	
DRAWN BY: AM	
CHECKED BY: HMN	

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Appendix C

TABLE 1: SUMMARY OF LABORATORY TEST RESULTS

Project No.: 17066-01 Project Name: Monroe Master Drainage Plan Line

Boring No.	Sample Depth (ft)	Soil Classification ASTM D2487/D2488	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Grain Size Distribution GR:SA:FI (%)	Soil Internal Friction Angle ϕ ASTM D3080 (deg.)	Soil Cohesion ASTM D3080 (psf)	Sand Equivalent (CT 217)	Maximum Density & Optimum Moisture Content ASTM D1557 (pcf/%)	Resistance "R" Value (CT-301)	Soil Minimum Resistivity (CT-532) (ohm-cm)	Soil Soluble Sulfate Content (CT-417) (ppm)	Soil Moisture Free Chloride Content (CT-422) (ppm)	Soil pH (CT-532)
B1	0-3								135.0/8.5	14	1500	240	15	7.04
	5	CL	13.2		00:38:62			8						
	10			138.0		34	344							
	15													
	20													
B2	0-3								133.0/8.5	20	1400	270	30	6.79
	5							18						
	10	ML	6.2		00:28:72									
	15													
	20			111.0		36	19							
B3	0-3								131.5 / 8.5	19	800	300	75	6.75
	5							21						
	10	SP	1.4		00:97:03									
	15			113.0		39	49							
B4	0-3								130.0/9.0	15	1200	270	60	6.76
	5	CL	12.4		00:38:62			13						
	10			111.0		39	104							
	15													
B5	0-3								136.5 / 7.0	46	3000	270	15	6.76
	5							19						
	10													
	15	SW-SM	3.9		01:91:08									
B6	0-3								130.0/10.0		1150	300	15	7.02
	5							10						
	10	SP	1.7		04:93:03									
	15													
B7	0-3								130.0/11.0	2	1100	300	30	7.17
	5	CL	16.8		02:38:60			14						
	10													
	15			121		43	104							
B8	0-3								132.0 / 9.5	6	1200	240	30	6.85
	5			126		30	204	24						
	10	SC	13.3		01:66:33									
	15													
B9	0-3								132.0/9.0		1150	300	75	6.86
	5							19						
	10			123		26	264							
	15	SC	6.9		00:82:18									

TABLE 1: SUMMARY OF LABORATORY TEST RESULTS

Project No.: 17066-01 Project Name: Monroe Master Drainage Plan Line

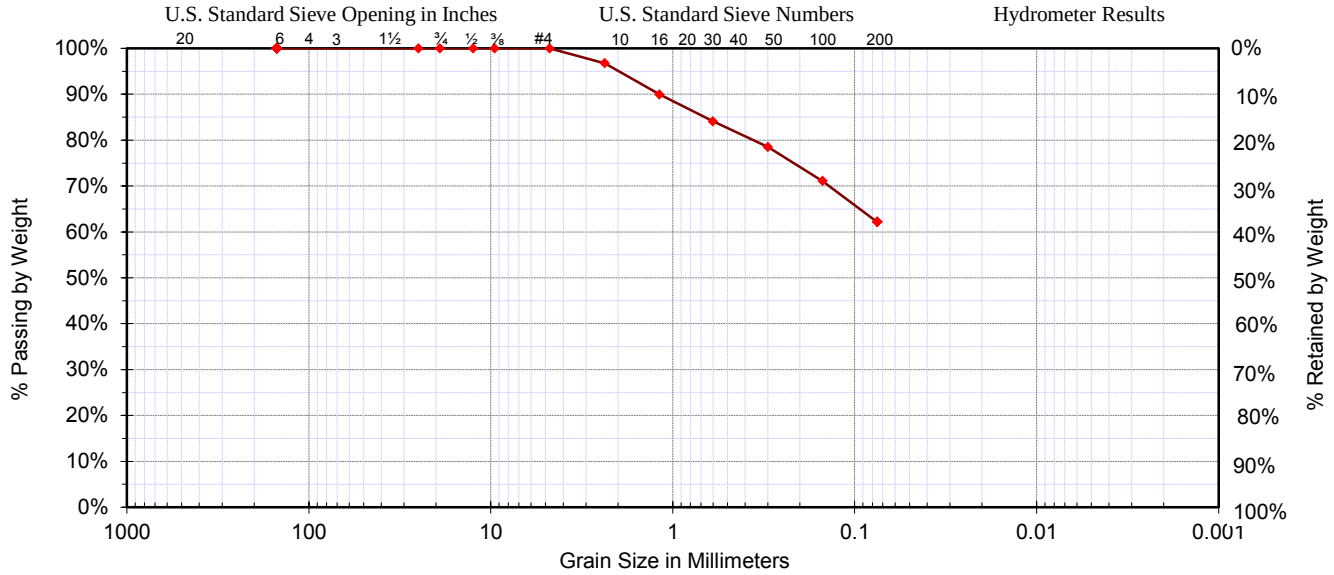
Boring No.	Sample Depth (ft)	Soil Classification ASTM D2487/D2488	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Grain Size Distribution GR:SA:FI (%)	Soil Internal Friction Angle ϕ ASTM D3080 (deg.)	Soil Cohesion ASTM D3080 (psf)	Sand Equivalent (CT 217)	Maximum Density & Optimum Moisture Content ASTM D1557 (pcf/%)	Resistance "R" Value (CT-301)	Soil Minimum Resistivity (CT-532) (ohm-cm)	Soil Soluble Sulfate Content (CT-417) (ppm)	Soil Moisture Free Chloride Content (CT-422) (ppm)	Soil pH (CT-532)
B10	0-3								131.0 / 9.5	20	1400	270	15	6.78
	5	SC	11.9		02:53:45			8						
	10													
	15													
	20			123		33	698							
B11	0-3								133.0/8.5		1100	375	15	7.19
	5			122		42	4	61						
	10	SW-SM	2.8		02:93:05									
	15													
B12	0-3								133.5 / 9.5	10	1200	450	45	7.14
	5													
	10	SM	3.7		07:78:15									
	15			133		34	214							
B13	0-3								122.0/11.5		950	450	15	6.91
	5	SM	8.2		01:75:24			39						
	10			128		43	19							
	15													
B14	0-3								130.0/9.5		1400	270	30	6.84
	5			122		40	29	65						
	10	SW-SM	3.1		00:90:10									
	15													
B15	0-3								131.5 / 8.5	13	1200	375	30	7.14
	5							7						
	10	SM	7.8		02:54:44									
	15			124		34	54							
B16	0-3								135.0/8.5		1650	270	60	6.95
	5							11						
	10			137		31	434							
	15	SC	17.4		01:70:29									
B17	0-3								127.5 / 9.5		1200	375	60	7.13
	5			133		28	808	9						
	10	SM	3.6		02:86:12									
B18	0-3								131.0/9.0		1700	375	60	6.79
	5	CL	13		00:35:65			23						
	10			125		36	199							
B19	0-3								123.0 / 11.5		1150	240	45	7.1
	5			125		39	289	58						
	10	SC	7.2		04:79:17									

TABLE 1: SUMMARY OF LABORATORY TEST RESULTS

Project No.: 17066-01 Project Name: Monroe Master Drainage Plan Line

Boring No.	Sample Depth (ft)	Soil Classification ASTM D2487/D2488	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Grain Size Distribution GR:SA:FI (%)	Soil Internal Friction Angle ϕ ASTM D3080 (deg.)	Soil Cohesion ASTM D3080 (psf)	Sand Equivalent (CT 217)	Maximum Density & Optimum Moisture Content ASTM D1557 (pcf/%)	Resistance "R" Value (CT-301)	Soil Minimum Resistivity (CT-532) (ohm-cm)	Soil Soluble Sulfate Content (CT-417) (ppm)	Soil Moisture Free Chloride Content (CT-422) (ppm)	Soil pH (CT-532)
B20	0-3								133.0/7.5		2000	375	30	7.06
	5	CL	10.6		00:42:58			14						
	10			131		37	324							
B21	0-3								132.0 / 8.5		2300	300	30	6.78
	5			121		39	264	67						
	10	SC	13.7		01:58:41									
B22	0-3								133.0/7.0		2200	240	15	6.98
	5							19						
	10	SC	7.5		02:78:20									
	15			110		35	349							
B23	0-3								129.0 / 10.0	10	1200	270	30	6.74
	5							18						
	10			125		39	64							
	15	SP	4.3		01:95:04									
B24	0-3								133.0/8.0		2000	270	15	6.68
	5			127		36	19	34						
	10	SP-SM	3.2		00:95:05									
	15													
B25	0-3								134.0 / 9.0	25	1550	270	15	6.9
	5	SC	7.6		01:71:28			29						
	10			124		33	469							
	15													

LABORATORY TEST RESULTS



Date :	08/07/17	D_{10} =	0.01	**Classification**	% Gravel
Sample #:		D_{30} =	0.04	CL, Sandy Lean Clay	0.00%
Sample ID:	B1 @ 5'	D_{60} =	0.07		% Sand
Source:	Standard	C_C =	1.50	**Specifications**	37.84%
Project:	Monroe Master Drainage Plan	C_U =	6.00	custom specs 1	% Silt & Clay
Location:	City of Riverside	Liquid Limit=	n/a		62.16%
Boring #:	B1	Plastic Limit=	n/a	Fineness Modulus	Sample Moisture
Depth:	5'	Plasticity Index=	n/a	0.80	**13.2%**

Coarse Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min	**Fines Section** Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100.0%			#4	4.750	100.0%	100.0%		
4.00"	100.00		100.0%			#8	2.360	96.8%	96.8%		
3.00"	75.00		100.0%			#10	2.000		94.7%		
2.50"	63.00		100.0%			#16	1.180	89.9%	89.9%		
2.00"	50.00		100.0%			#20	0.850		86.6%		
1.75"	45.00		100.0%			#30	0.600	84.1%	84.1%		
1.50"	37.50		100.0%			#40	0.425		80.8%		
1.25"	31.50		100.0%			#50	0.300	78.5%	78.5%		
1.00"	25.00	100.0%	100.0%			#60	0.250		76.0%		
7/8"	22.40		100.0%			#80	0.180		72.6%		
3/4"	19.00	100.0%	100.0%			#100	0.150	71.1%	71.1%		
5/8"	16.00		100.0%			#140	0.106		65.8%		
1/2"	12.50	100.0%	100.0%			#170	0.090		63.9%		
3/8"	9.50	100.0%	100.0%			#200	0.075	62.2%	62.2%		
1/4"	6.30		100.0%			#270	0.053				
#4	4.75	100.0%	100.0%								

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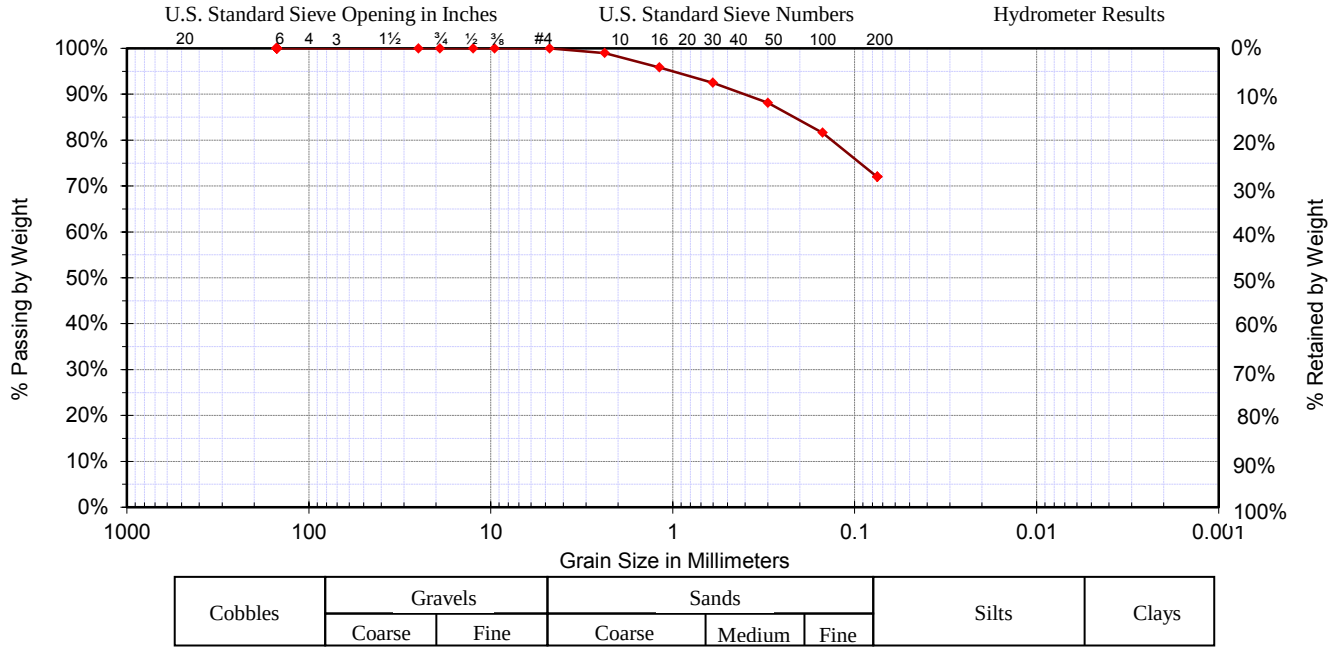
LABORATORY TEST RESULTS



Date :	08/07/17	D_{10} =	0.01	**Classification**	% Gravel
Sample #:		D_{30} =	0.03	CL-ML, Silty Clay with Sand	0.00%
Sample ID:	B2 @ 10'	D_{60} =	0.06		% Sand
Source:	Standard	C_C =	1.50	**Specifications**	28.02%
Project:	Monroe Master Drainage Plan	C_U =	6.00	custom specs 1	% Silt & Clay
Location:	City of Riverside	Liquid Limit=	n/a		71.98%
Boring #:	B2	Plastic Limit=	n/a	Fineness Modulus	Sample Moisture
Depth:	10'	Plasticity Index=	n/a	0.43	**6.2%**

Coarse Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min	**Fines Section** Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100.0%			#4	4.750	100.0%	100.0%		
4.00"	100.00		100.0%			#8	2.360	99.0%	99.0%		
3.00"	75.00		100.0%			#10	2.000		98.0%		
2.50"	63.00		100.0%			#16	1.180	95.8%	95.8%		
2.00"	50.00		100.0%			#20	0.850		93.9%		
1.75"	45.00		100.0%			#30	0.600	92.5%	92.5%		
1.50"	37.50		100.0%			#40	0.425		89.9%		
1.25"	31.50		100.0%			#50	0.300	88.1%	88.1%		
1.00"	25.00	100.0%	100.0%			#60	0.250		86.0%		
7/8"	22.40		100.0%			#80	0.180		82.9%		
3/4"	19.00	100.0%	100.0%			#100	0.150	81.6%	81.6%		
5/8"	16.00		100.0%			#140	0.106		76.0%		
1/2"	12.50	100.0%	100.0%			#170	0.090		73.9%		
3/8"	9.50	100.0%	100.0%			#200	0.075	72.0%	72.0%		
1/4"	6.30		100.0%			#270	0.053				
#4	4.75	100.0%	100.0%								

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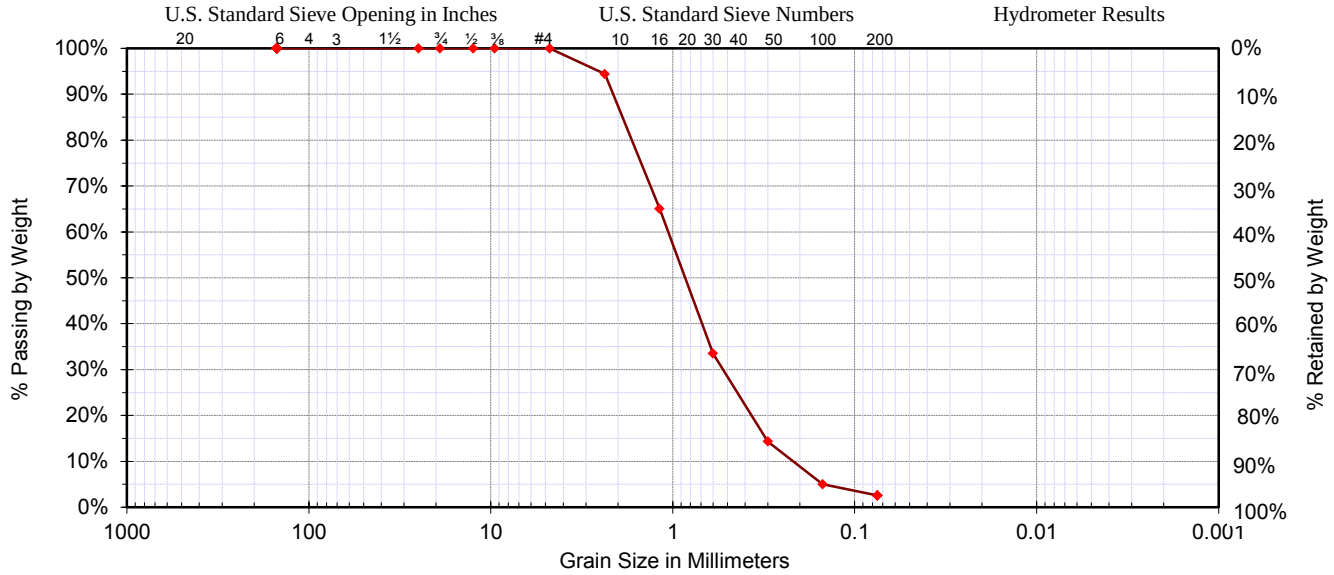
LABORATORY TEST RESULTS



Date :	08/07/17	D_{10} = 0.23	**Classification**		% Gravel
Sample #:		D_{30} = 0.55	SP, Poorly graded Sand		0.00%
Sample ID:	B3 @ 10'	D_{60} = 1.09			% Sand
Source:	Standard	C_C = 1.19	**Specifications**		97.45%
Project:	Monroe Master Drainage Plan	C_U = 4.71	custom specs 1		% Silt & Clay
Location:	City of Riverside	Liquid Limit= n/a			2.55%
Boring #:	B3	Plastic Limit= n/a	Fineness Modulus		Sample Moisture
Depth:	10'	Plasticity Index= n/a	2.88		**1.4%**

Coarse Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min	**Fines Section** Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100.0%			#4	4.750	100.0%	100.0%		
4.00"	100.00		100.0%			#8	2.360	94.4%	94.4%		
3.00"	75.00		100.0%			#10	2.000		85.5%		
2.50"	63.00		100.0%			#16	1.180	65.0%	65.0%		
2.00"	50.00		100.0%			#20	0.850		47.1%		
1.75"	45.00		100.0%			#30	0.600	33.5%	33.5%		
1.50"	37.50		100.0%			#40	0.425		22.3%		
1.25"	31.50		100.0%			#50	0.300	14.3%	14.3%		
1.00"	25.00	100.0%	100.0%			#60	0.250		11.2%		
7/8"	22.40		100.0%			#80	0.180		6.9%		
3/4"	19.00	100.0%	100.0%			#100	0.150	5.0%	5.0%		
5/8"	16.00		100.0%			#140	0.106		3.6%		
1/2"	12.50	100.0%	100.0%			#170	0.090		3.0%		
3/8"	9.50	100.0%	100.0%			#200	0.075	2.5%	2.5%		
1/4"	6.30		100.0%			#270	0.053				
#4	4.75	100.0%	100.0%								

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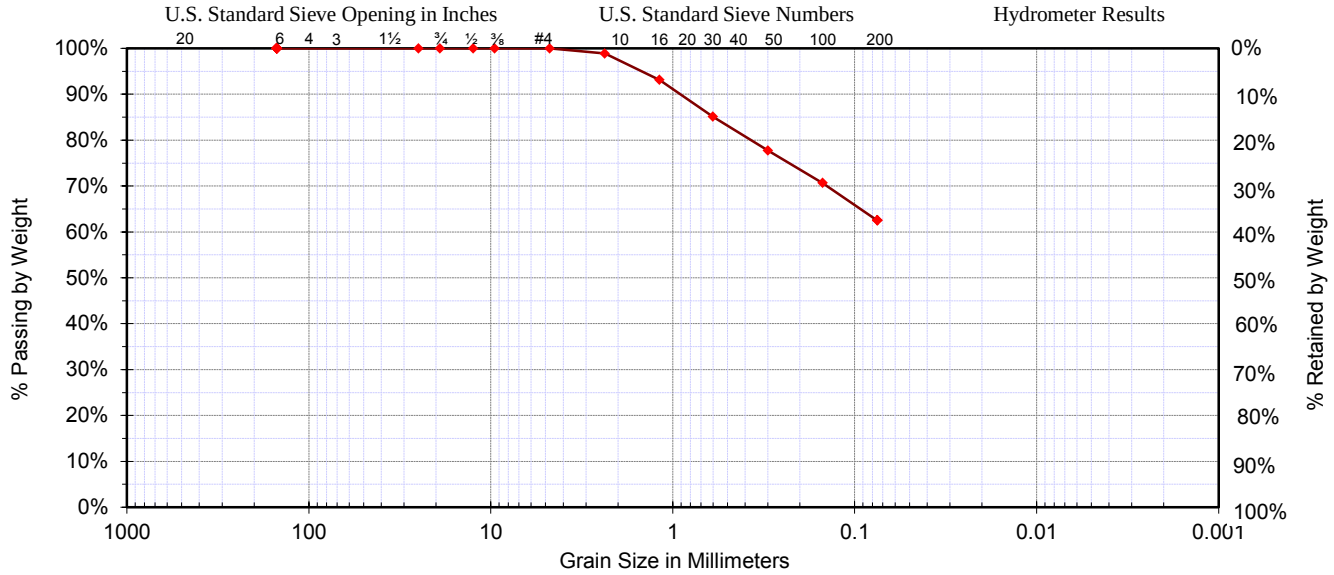
LABORATORY TEST RESULTS



Cobbles	Gravels		Sands			Silts	Clays
	Coarse	Fine	Coarse	Medium	Fine		

Date :	08/07/17	D_{10} =	0.01	**Classification**	% Gravel
Sample #:		D_{30} =	0.04	CL-ML, Sandy Silty Clay	0.00%
Sample ID:	B4 @ 5'	D_{60} =	0.07		% Sand
Source:	Standard	C_C =	1.50	**Specifications**	37.50%
Project:	Monroe Master Drainage Plan	C_U =	6.00	custom specs 1	% Silt & Clay
Location:	City of Riverside	Liquid Limit=	n/a		62.50%
Boring #:	B4	Plastic Limit=	n/a	Fineness Modulus	Sample Moisture
Depth:	5'	Plasticity Index=	n/a	0.75	**12.4%**

Coarse Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min	**Fines Section** Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100.0%			#4	4.750	100.0%	100.0%		
4.00"	100.00		100.0%			#8	2.360	98.9%	98.9%		
3.00"	75.00		100.0%			#10	2.000		97.1%		
2.50"	63.00		100.0%			#16	1.180	93.1%	93.1%		
2.00"	50.00		100.0%			#20	0.850		88.6%		
1.75"	45.00		100.0%			#30	0.600	85.1%	85.1%		
1.50"	37.50		100.0%			#40	0.425		80.8%		
1.25"	31.50		100.0%			#50	0.300	77.8%	77.8%		
1.00"	25.00	100.0%	100.0%			#60	0.250		75.4%		
7/8"	22.40		100.0%			#80	0.180		72.1%		
3/4"	19.00	100.0%	100.0%			#100	0.150	70.6%	70.6%		
5/8"	16.00		100.0%			#140	0.106		65.9%		
1/2"	12.50	100.0%	100.0%			#170	0.090		64.1%		
3/8"	9.50	100.0%	100.0%			#200	0.075	62.5%	62.5%		
1/4"	6.30		100.0%			#270	0.053				
#4	4.75	100.0%	100.0%								

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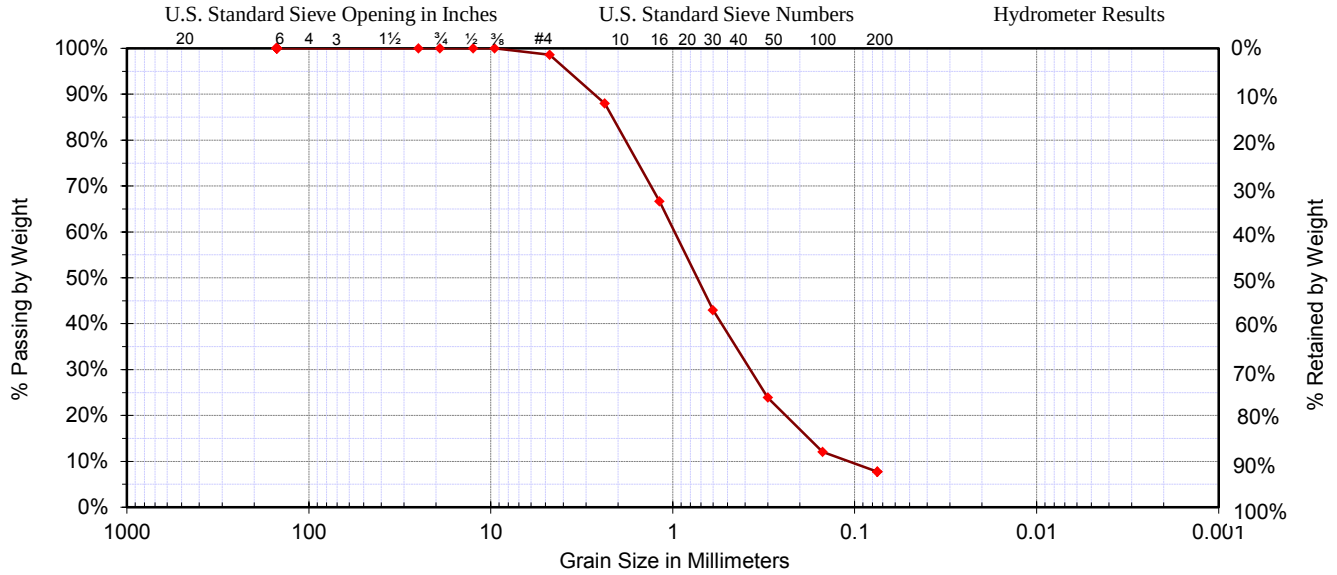
LABORATORY TEST RESULTS



Date :	08/07/17	D_{10} =	0.11	**Classification**	% Gravel
Sample #:		D_{30} =	0.40	SW-SM, Well-graded Sand with Silt	1.40%
Sample ID:	B5 @ 15'	D_{60} =	1.02		% Sand
Source:	Standard	C_C =	1.35	**Specifications**	90.87%
Project:	Monroe Master Drainage Plan	C_U =	8.89	custom specs 1	% Silt & Clay
Location:	City of Riverside	Liquid Limit=	n/a		7.72%
Boring #:	B5	Plastic Limit=	n/a	Fineness Modulus	Sample Moisture
Depth:	15'	Plasticity Index=	n/a	2.68	**3.9%**

Coarse Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min	**Fines Section** Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100.0%			#4	4.750	98.6%	98.6%		
4.00"	100.00		100.0%			#8	2.360	88.0%	88.0%		
3.00"	75.00		100.0%			#10	2.000		81.4%		
2.50"	63.00		100.0%			#16	1.180	66.6%	66.6%		
2.00"	50.00		100.0%			#20	0.850		53.1%		
1.75"	45.00		100.0%			#30	0.600	42.9%	42.9%		
1.50"	37.50		100.0%			#40	0.425		31.8%		
1.25"	31.50		100.0%			#50	0.300	23.9%	23.9%		
1.00"	25.00	100.0%	100.0%			#60	0.250		19.9%		
7/8"	22.40		100.0%			#80	0.180		14.4%		
3/4"	19.00	100.0%	100.0%			#100	0.150	12.0%	12.0%		
5/8"	16.00		100.0%			#140	0.106		9.5%		
1/2"	12.50	100.0%	100.0%			#170	0.090		8.6%		
3/8"	9.50	100.0%	100.0%			#200	0.075	7.7%	7.7%		
1/4"	6.30		99.1%			#270	0.053				
#4	4.75	98.6%	98.6%								

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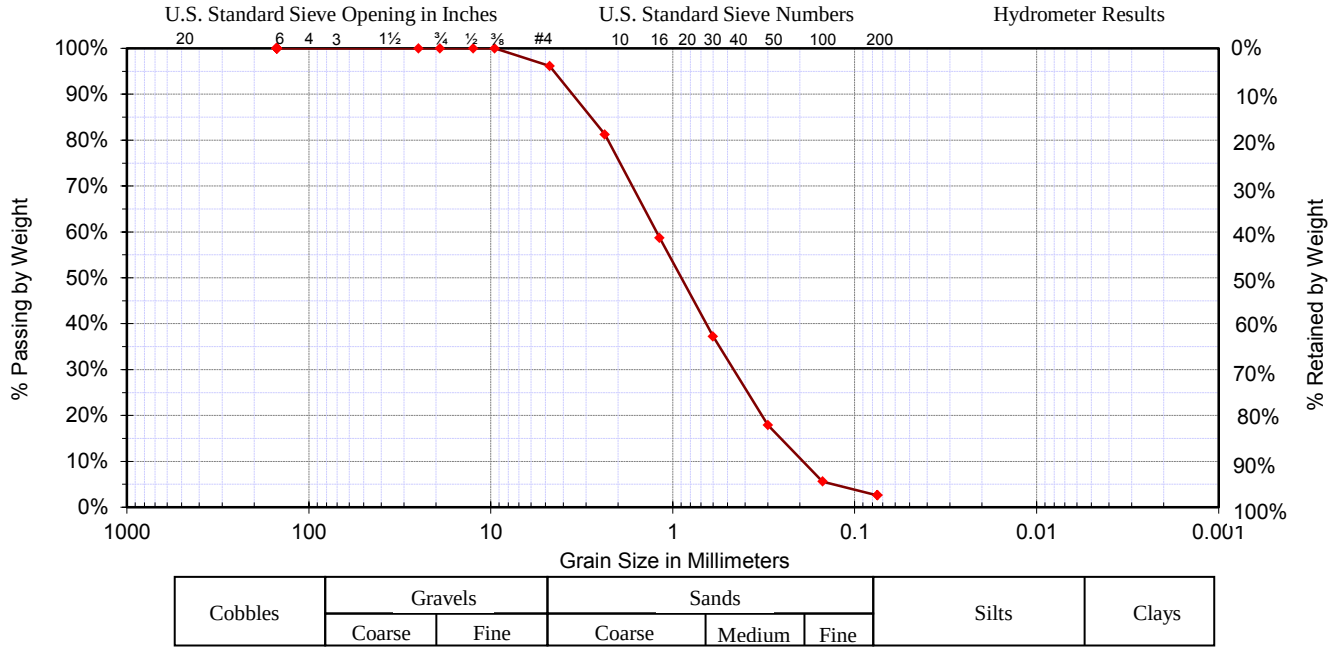
LABORATORY TEST RESULTS



Date :	08/07/17	D_{10} =	0.20	**Classification**	% Gravel
Sample #:		D_{30} =	0.49	SP, Poorly graded Sand	3.87%
Sample ID:	B6 @ 10'	D_{60} =	1.25		% Sand
Source:	Standard	C_C =	0.94	**Specifications**	93.52%
Project:	Monroe Master Drainage Plan	C_U =	6.13	custom specs 1	% Silt & Clay
Location:	City of Riverside	Liquid Limit=	n/a		2.61%
Boring #:	B6	Plastic Limit=	n/a	Fineness Modulus	Sample Moisture
Depth:	10'	Plasticity Index=	n/a	3.03	**1.7%**

Coarse Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100.0%		
4.00"	100.00		100.0%		
3.00"	75.00		100.0%		
2.50"	63.00		100.0%		
2.00"	50.00		100.0%		
1.75"	45.00		100.0%		
1.50"	37.50		100.0%		
1.25"	31.50		100.0%		
1.00"	25.00	100.0%	100.0%		
7/8"	22.40		100.0%		
3/4"	19.00	100.0%	100.0%		
5/8"	16.00		100.0%		
1/2"	12.50	100.0%	100.0%		
3/8"	9.50	100.0%	100.0%		
1/4"	6.30		97.4%		
#4	4.75	96.1%	96.1%		

Fines Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
#4	4.750	96.1%	96.1%		
#8	2.360	81.2%	81.2%		
#10	2.000		74.4%		
#16	1.180	58.7%	58.7%		
#20	0.850		46.5%		
#30	0.600	37.2%	37.2%		
#40	0.425		26.0%		
#50	0.300	17.9%	17.9%		
#60	0.250		13.8%		
#80	0.180		8.1%		
#100	0.150	5.6%	5.6%		
#140	0.106		3.9%		
#170	0.090		3.2%		
#200	0.075	2.6%	2.6%		
#270	0.053				

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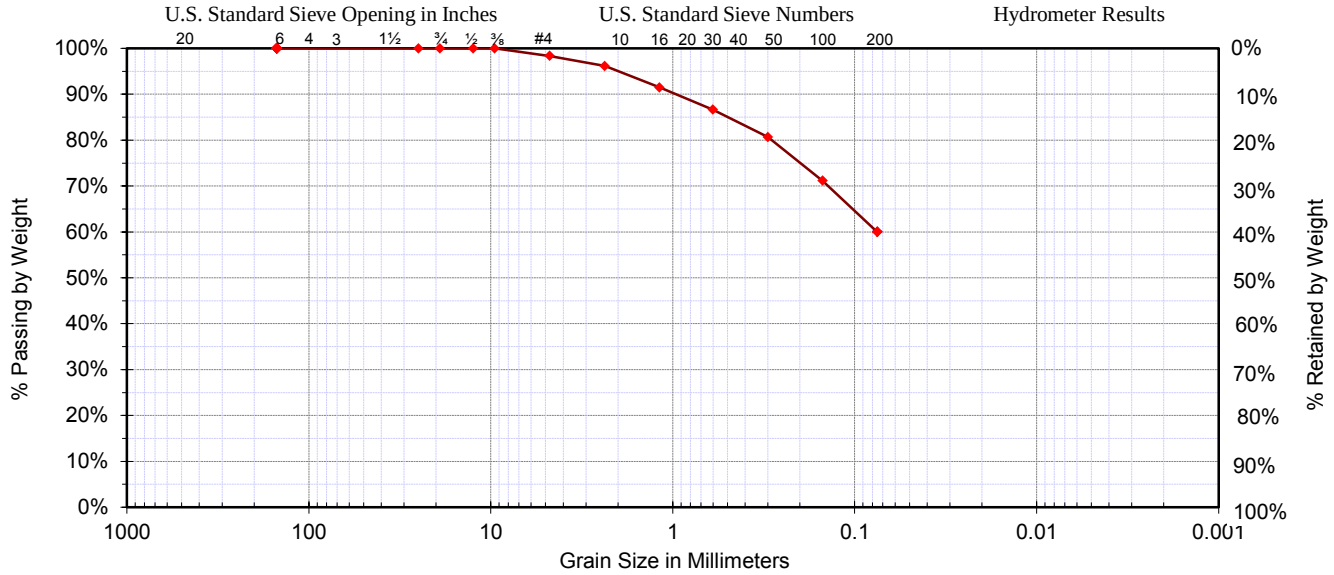
LABORATORY TEST RESULTS



Date :	08/07/17	D_{10} = 0.01	**Classification**		% Gravel
Sample #:		D_{30} = 0.04	CL, Sandy Lean Clay		1.66%
Sample ID:	B7 @ 5'	D_{60} = 0.08			% Sand
Source:	Standard	C_C = 1.50	**Specifications**		38.34%
Project:	Monroe Master Drainage Plan	C_U = 6.00	custom specs 1		% Silt & Clay
Location:	City of Riverside	Liquid Limit= n/a			60.00%
Boring #:	B7	Plastic Limit= n/a	Fineness Modulus		Sample Moisture
Depth:	5'	Plasticity Index= n/a	0.76		**16.8%**

Coarse Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min	**Fines Section** Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100.0%			#4	4.750	98.3%	98.3%		
4.00"	100.00		100.0%			#8	2.360	96.1%	96.1%		
3.00"	75.00		100.0%			#10	2.000		94.7%		
2.50"	63.00		100.0%			#16	1.180	91.5%	91.5%		
2.00"	50.00		100.0%			#20	0.850		88.7%		
1.75"	45.00		100.0%			#30	0.600	86.6%	86.6%		
1.50"	37.50		100.0%			#40	0.425		83.1%		
1.25"	31.50		100.0%			#50	0.300	80.7%	80.7%		
1.00"	25.00	100.0%	100.0%			#60	0.250		77.5%		
7/8"	22.40		100.0%			#80	0.180		73.1%		
3/4"	19.00	100.0%	100.0%			#100	0.150	71.2%	71.2%		
5/8"	16.00		100.0%			#140	0.106		64.6%		
1/2"	12.50	100.0%	100.0%			#170	0.090		62.2%		
3/8"	9.50	100.0%	100.0%			#200	0.075	60.0%	60.0%		
1/4"	6.30		98.9%			#270	0.053				
#4	4.75	98.3%	98.3%								

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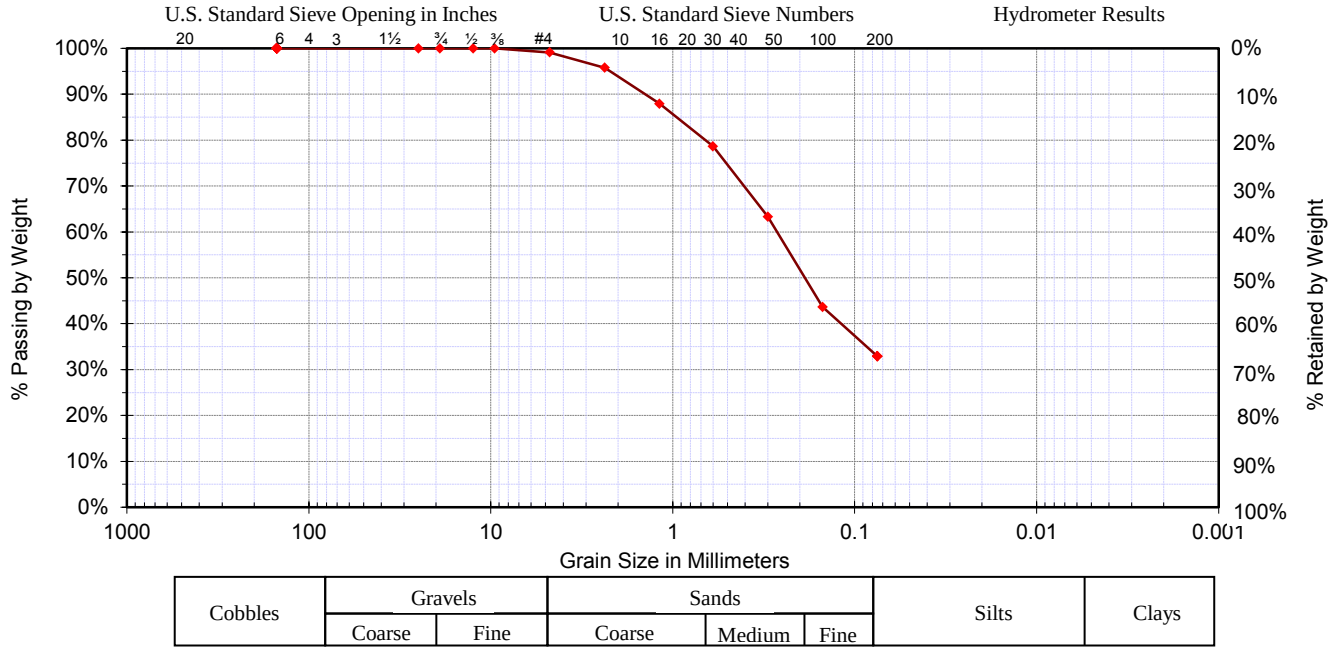
LABORATORY TEST RESULTS



Date :	08/07/17	D_{10} =	0.02	**Classification**	% Gravel
Sample #:		D_{30} =	0.07	SC, Clayey Sand	0.89%
Sample ID:	B8 @ 10'	D_{60} =	0.27		% Sand
Source:	Standard	C_C =	0.75	**Specifications**	66.22%
Project:	Monroe Master Drainage Plan	C_U =	12.05	custom specs 1	% Silt & Clay
Location:	City of Riverside	Liquid Limit=	n/a		32.89%
Boring #:	B8	Plastic Limit=	n/a	Fineness Modulus	Sample Moisture
Depth:	10'	Plasticity Index=	n/a	1.32	**13.3%**

Coarse Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100.0%		
4.00"	100.00		100.0%		
3.00"	75.00		100.0%		
2.50"	63.00		100.0%		
2.00"	50.00		100.0%		
1.75"	45.00		100.0%		
1.50"	37.50		100.0%		
1.25"	31.50		100.0%		
1.00"	25.00	100.0%	100.0%		
7/8"	22.40		100.0%		
3/4"	19.00	100.0%	100.0%		
5/8"	16.00		100.0%		
1/2"	12.50	100.0%	100.0%		
3/8"	9.50	100.0%	100.0%		
1/4"	6.30		99.4%		
#4	4.75	99.1%	99.1%		

Fines Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
#4	4.750	99.1%	99.1%		
#8	2.360	95.7%	95.7%		
#10	2.000		93.4%		
#16	1.180	87.9%	87.9%		
#20	0.850		82.6%		
#30	0.600	78.6%	78.6%		
#40	0.425		69.7%		
#50	0.300	63.3%	63.3%		
#60	0.250		56.7%		
#80	0.180		47.6%		
#100	0.150	43.6%	43.6%		
#140	0.106		37.3%		
#170	0.090		35.0%		
#200	0.075	32.9%	32.9%		
#270	0.053				

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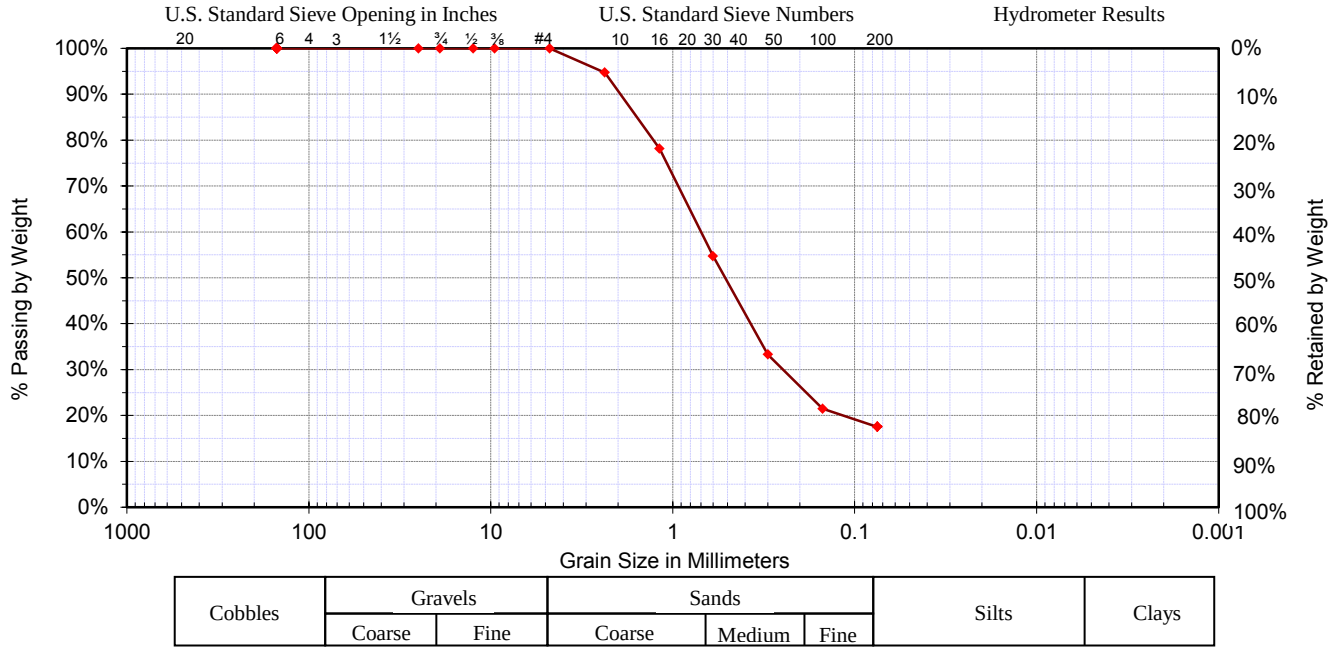
LABORATORY TEST RESULTS



Date :	08/07/17	D_{10} =	0.04	**Classification**	% Gravel
Sample #:		D_{30} =	0.26	SC, Clayey Sand	0.00%
Sample ID:	B9 @ 15'	D_{60} =	0.73		% Sand
Source:	Standard	C_C =	2.14	**Specifications**	82.49%
Project:	Monroe Master Drainage Plan	C_U =	17.07	custom specs 1	% Silt & Clay
Location:	City of Riverside	Liquid Limit=	n/a		17.51%
Boring #:	B9	Plastic Limit=	n/a	Fineness Modulus	Sample Moisture
Depth:	15'	Plasticity Index=	n/a	2.18	**6.9%**

Coarse Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min	**Fines Section** Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100.0%			#4	4.750	100.0%	100.0%		
4.00"	100.00		100.0%			#8	2.360	94.7%	94.7%		
3.00"	75.00		100.0%			#10	2.000		89.7%		
2.50"	63.00		100.0%			#16	1.180	78.1%	78.1%		
2.00"	50.00		100.0%			#20	0.850		64.8%		
1.75"	45.00		100.0%			#30	0.600	54.7%	54.7%		
1.50"	37.50		100.0%			#40	0.425		42.2%		
1.25"	31.50		100.0%			#50	0.300	33.3%	33.3%		
1.00"	25.00	100.0%	100.0%			#60	0.250		29.3%		
7/8"	22.40		100.0%			#80	0.180		23.8%		
3/4"	19.00	100.0%	100.0%			#100	0.150	21.5%	21.5%		
5/8"	16.00		100.0%			#140	0.106		19.1%		
1/2"	12.50	100.0%	100.0%			#170	0.090		18.3%		
3/8"	9.50	100.0%	100.0%			#200	0.075	17.5%	17.5%		
1/4"	6.30		100.0%			#270	0.053				
#4	4.75	100.0%	100.0%								

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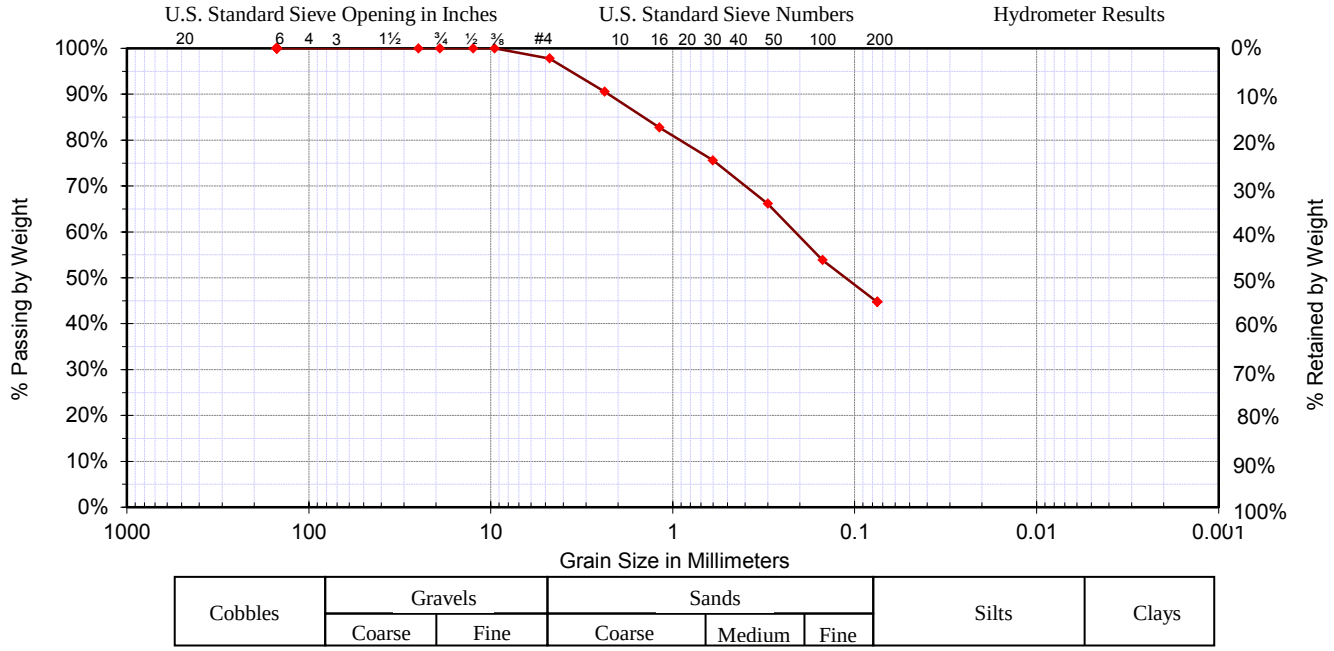
LABORATORY TEST RESULTS



Date :	08/07/17	D_{10} =	0.02	**Classification**	% Gravel
Sample #:		D_{30} =	0.05	SC, Clayey Sand	2.23%
Sample ID:	B10 @ 5'	D_{60} =	0.23		% Sand
Source:	Standard	C_C =	0.67	**Specifications**	53.07%
Project:	Monroe Master Drainage Plan	C_U =	13.43	custom specs 1	% Silt & Clay
Location:	City of Riverside	Liquid Limit=	n/a		44.70%
Boring #:	B10	Plastic Limit=	n/a	Fineness Modulus	Sample Moisture
Depth:	5'	Plasticity Index=	n/a	1.33	**11.9%**

Coarse Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min	**Fines Section** Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100.0%			#4	4.750	97.8%	97.8%		
4.00"	100.00		100.0%			#8	2.360	90.5%	90.5%		
3.00"	75.00		100.0%			#10	2.000		88.1%		
2.50"	63.00		100.0%			#16	1.180	82.7%	82.7%		
2.00"	50.00		100.0%			#20	0.850		78.7%		
1.75"	45.00		100.0%			#30	0.600	75.6%	75.6%		
1.50"	37.50		100.0%			#40	0.425		70.1%		
1.25"	31.50		100.0%			#50	0.300	66.1%	66.1%		
1.00"	25.00	100.0%	100.0%			#60	0.250		62.0%		
7/8"	22.40		100.0%			#80	0.180		56.3%		
3/4"	19.00	100.0%	100.0%			#100	0.150	53.8%	53.8%		
5/8"	16.00		100.0%			#140	0.106		48.5%		
1/2"	12.50	100.0%	100.0%			#170	0.090		46.5%		
3/8"	9.50	100.0%	100.0%			#200	0.075	44.7%	44.7%		
1/4"	6.30		98.5%			#270	0.053				
#4	4.75	97.8%	97.8%								

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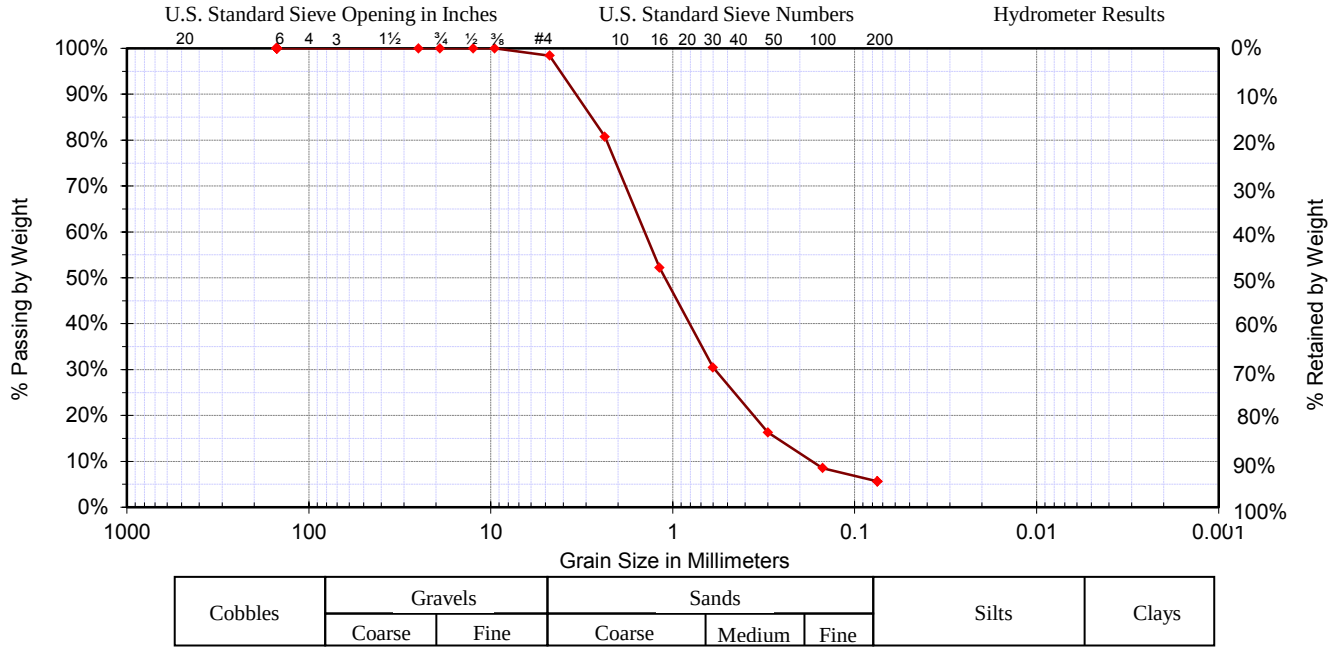
LABORATORY TEST RESULTS



Date :	08/07/17	D_{10} =	0.18	**Classification**	% Gravel
Sample #:		D_{30} =	0.59	SW-SM, Well-graded Sand with Silt	1.60%
Sample ID:	B11 @ 10'	D_{60} =	1.50		% Sand
Source:	Standard	C_C =	1.30	**Specifications**	92.76%
Project:	Monroe Master Drainage Plan	C_U =	8.42	custom specs 1	% Silt & Clay
Location:	City of Riverside	Liquid Limit=	n/a		5.64%
Boring #:	B11	Plastic Limit=	n/a	Fineness Modulus	Sample Moisture
Depth:	10'	Plasticity Index=	n/a	3.13	**2.8%**

Coarse Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min	**Fines Section** Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100.0%			#4	4.750	98.4%	98.4%		
4.00"	100.00		100.0%			#8	2.360	80.7%	80.7%		
3.00"	75.00		100.0%			#10	2.000		72.0%		
2.50"	63.00		100.0%			#16	1.180	52.2%	52.2%		
2.00"	50.00		100.0%			#20	0.850		39.8%		
1.75"	45.00		100.0%			#30	0.600	30.5%	30.5%		
1.50"	37.50		100.0%			#40	0.425		22.2%		
1.25"	31.50		100.0%			#50	0.300	16.3%	16.3%		
1.00"	25.00	100.0%	100.0%			#60	0.250		13.7%		
7/8"	22.40		100.0%			#80	0.180		10.1%		
3/4"	19.00	100.0%	100.0%			#100	0.150	8.5%	8.5%		
5/8"	16.00		100.0%			#140	0.106		6.8%		
1/2"	12.50	100.0%	100.0%			#170	0.090		6.2%		
3/8"	9.50	100.0%	100.0%			#200	0.075	5.6%	5.6%		
1/4"	6.30		98.9%			#270	0.053				
#4	4.75	98.4%	98.4%								

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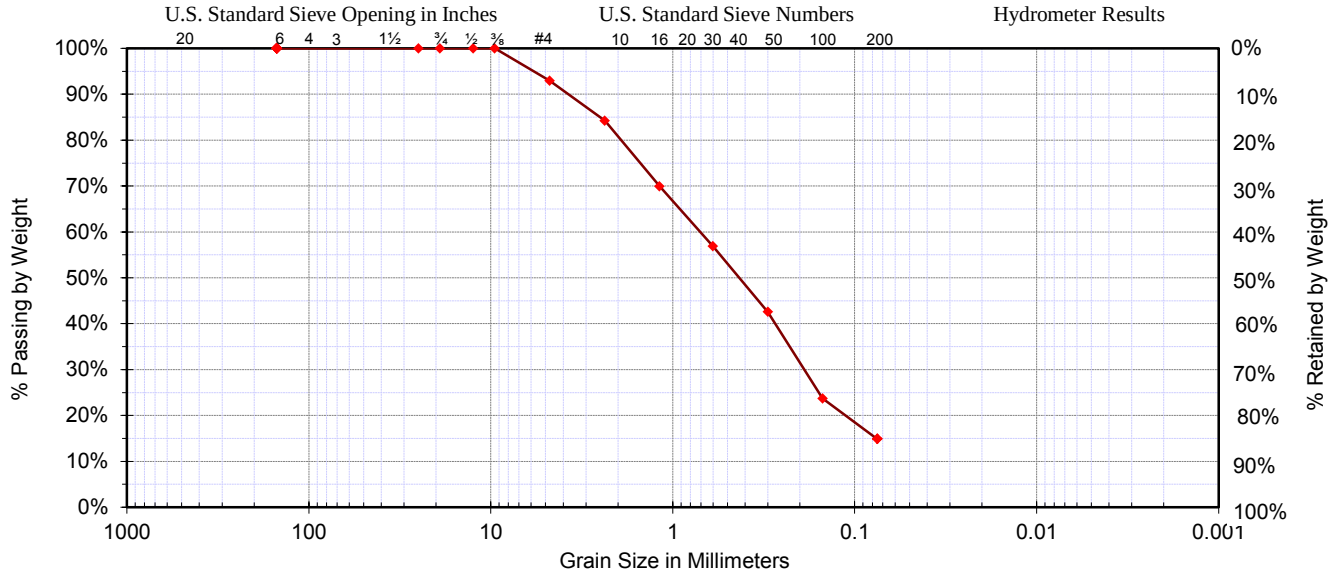
LABORATORY TEST RESULTS



Date :	08/07/17	D_{10} =	0.05	**Classification**	% Gravel
Sample #:		D_{30} =	0.20	SM, Silty Sand	7.05%
Sample ID:	B12 @ 15'	D_{60} =	0.74		% Sand
Source:	Ring	C_C =	1.07	**Specifications**	78.09%
Project:	Monroe Master Drainage Plan	C_U =	14.66	custom specs 1	% Silt & Clay
Location:	City of Riverside	Liquid Limit=	n/a		14.86%
Boring #:	B12	Plastic Limit=	n/a	Fineness Modulus	Sample Moisture
Depth:	15'	Plasticity Index=	n/a	2.30	**3.7%**

Coarse Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min	**Fines Section** Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100.0%			#4	4.750	92.9%	92.9%		
4.00"	100.00		100.0%			#8	2.360	84.2%	84.2%		
3.00"	75.00		100.0%			#10	2.000		79.9%		
2.50"	63.00		100.0%			#16	1.180	69.9%	69.9%		
2.00"	50.00		100.0%			#20	0.850		62.5%		
1.75"	45.00		100.0%			#30	0.600	56.8%	56.8%		
1.50"	37.50		100.0%			#40	0.425		48.5%		
1.25"	31.50		100.0%			#50	0.300	42.6%	42.6%		
1.00"	25.00	100.0%	100.0%			#60	0.250		36.3%		
7/8"	22.40		100.0%			#80	0.180		27.5%		
3/4"	19.00	100.0%	100.0%			#100	0.150	23.7%	23.7%		
5/8"	16.00		100.0%			#140	0.106		18.5%		
1/2"	12.50	100.0%	100.0%			#170	0.090		16.6%		
3/8"	9.50	100.0%	100.0%			#200	0.075	14.9%	14.9%		
1/4"	6.30		95.2%			#270	0.053				
#4	4.75	92.9%	92.9%								

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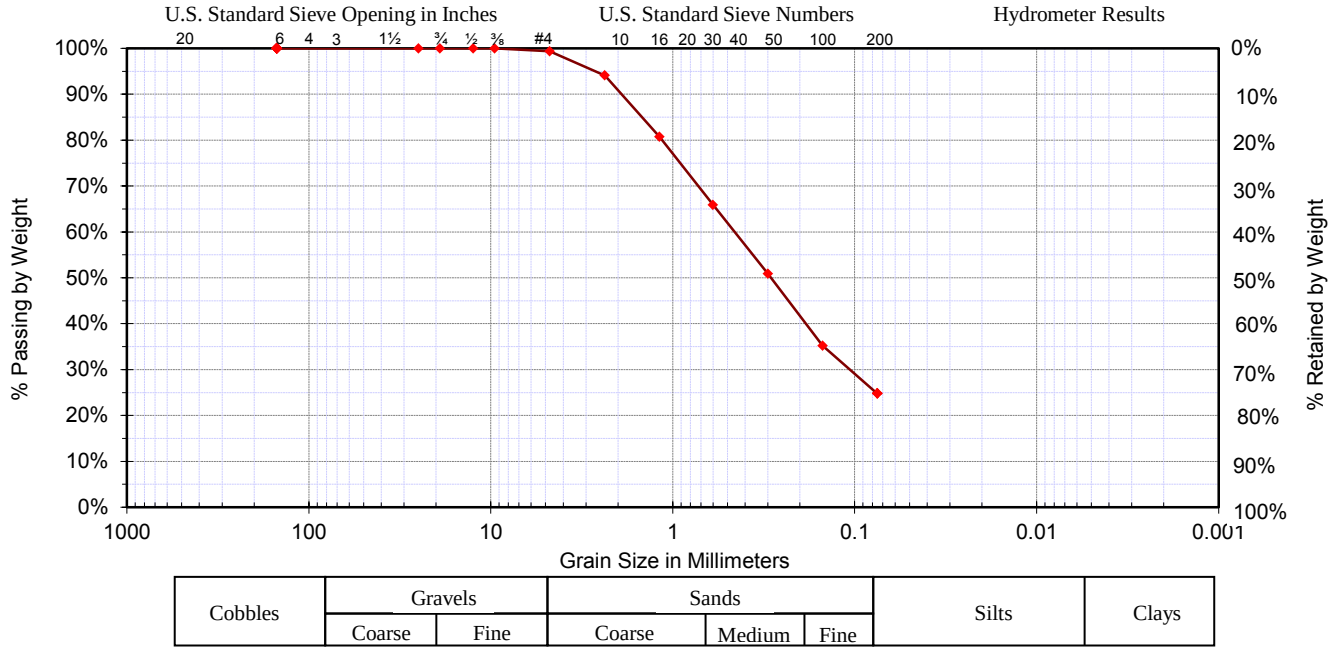
LABORATORY TEST RESULTS



Date :	08/07/17	D_{10} =	0.03	**Classification**	% Gravel
Sample #:		D_{30} =	0.11	SM, Silty Sand	0.66%
Sample ID:	B13 @ 5'	D_{60} =	0.48		% Sand
Source:	Standard	C_C =	0.87	**Specifications**	74.56%
Project:	Monroe Master Drainage Plan	C_U =	15.93	custom specs 1	% Silt & Clay
Location:	City of Riverside	Liquid Limit=	n/a		24.78%
Boring #:	B13	Plastic Limit=	n/a	Fineness Modulus	Sample Moisture
Depth:	5'	Plasticity Index=	n/a	1.74	**8.2%**

Coarse Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min	**Fines Section** Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100.0%			#4	4.750	99.3%	99.3%		
4.00"	100.00		100.0%			#8	2.360	94.1%	94.1%		
3.00"	75.00		100.0%			#10	2.000		90.0%		
2.50"	63.00		100.0%			#16	1.180	80.7%	80.7%		
2.00"	50.00		100.0%			#20	0.850		72.3%		
1.75"	45.00		100.0%			#30	0.600	65.9%	65.9%		
1.50"	37.50		100.0%			#40	0.425		57.1%		
1.25"	31.50		100.0%			#50	0.300	50.9%	50.9%		
1.00"	25.00	100.0%	100.0%			#60	0.250		45.7%		
7/8"	22.40		100.0%			#80	0.180		38.3%		
3/4"	19.00	100.0%	100.0%			#100	0.150	35.2%	35.2%		
5/8"	16.00		100.0%			#140	0.106		29.1%		
1/2"	12.50	100.0%	100.0%			#170	0.090		26.9%		
3/8"	9.50	100.0%	100.0%			#200	0.075	24.8%	24.8%		
1/4"	6.30		99.6%			#270	0.053				
#4	4.75	99.3%	99.3%								

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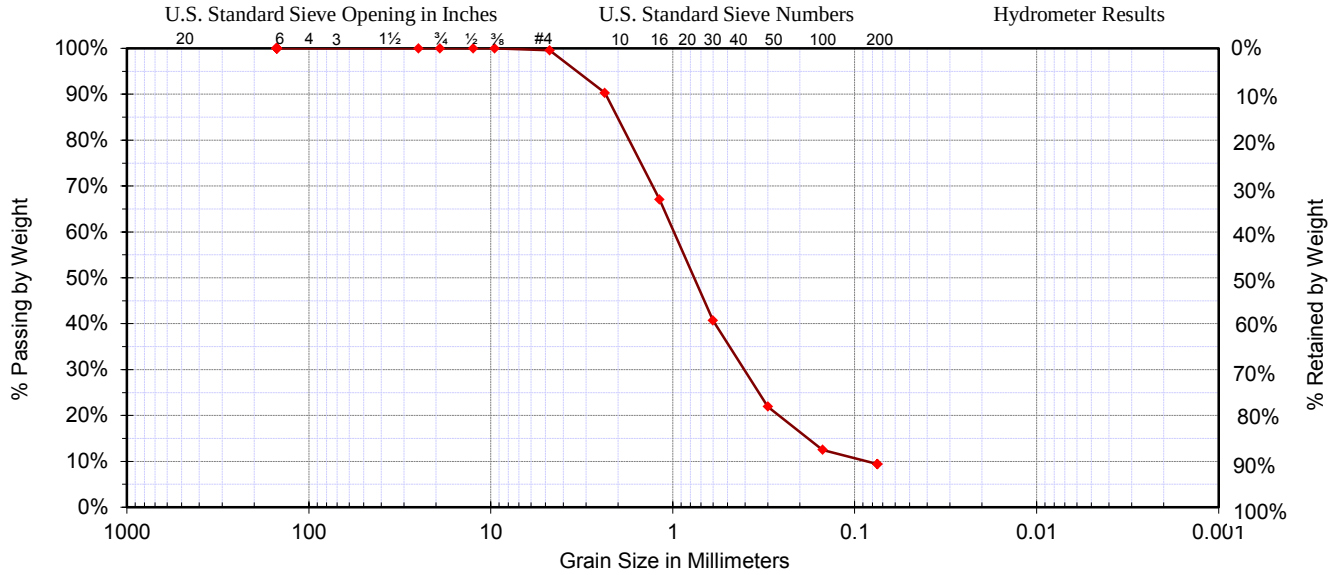
LABORATORY TEST RESULTS



Date :	08/07/17	D_{10} =	0.09	**Classification**	% Gravel
Sample #:		D_{30} =	0.43	SW-SM, Well-graded Sand with Silt	0.45%
Sample ID:	B14 @ 10'	D_{60} =	1.03		% Sand
Source:	Standard	C_C =	2.00	**Specifications**	90.17%
Project:	Monroe Master Drainage Plan	C_U =	11.42	custom specs 1	% Silt & Clay
Location:	City of Riverside	Liquid Limit=	n/a		9.39%
Boring #:	B14	Plastic Limit=	n/a	Fineness Modulus	Sample Moisture
Depth:	10'	Plasticity Index=	n/a	2.68	**3.1%**

Coarse Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min	**Fines Section** Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100.0%			#4	4.750	99.6%	99.6%		
4.00"	100.00		100.0%			#8	2.360	90.3%	90.3%		
3.00"	75.00		100.0%			#10	2.000		83.2%		
2.50"	63.00		100.0%			#16	1.180	67.0%	67.0%		
2.00"	50.00		100.0%			#20	0.850		52.0%		
1.75"	45.00		100.0%			#30	0.600	40.7%	40.7%		
1.50"	37.50		100.0%			#40	0.425		29.7%		
1.25"	31.50		100.0%			#50	0.300	21.9%	21.9%		
1.00"	25.00	100.0%	100.0%			#60	0.250		18.8%		
7/8"	22.40		100.0%			#80	0.180		14.4%		
3/4"	19.00	100.0%	100.0%			#100	0.150	12.5%	12.5%		
5/8"	16.00		100.0%			#140	0.106		10.7%		
1/2"	12.50	100.0%	100.0%			#170	0.090		10.0%		
3/8"	9.50	100.0%	100.0%			#200	0.075	9.4%	9.4%		
1/4"	6.30		99.7%			#270	0.053				
#4	4.75	99.6%	99.6%								

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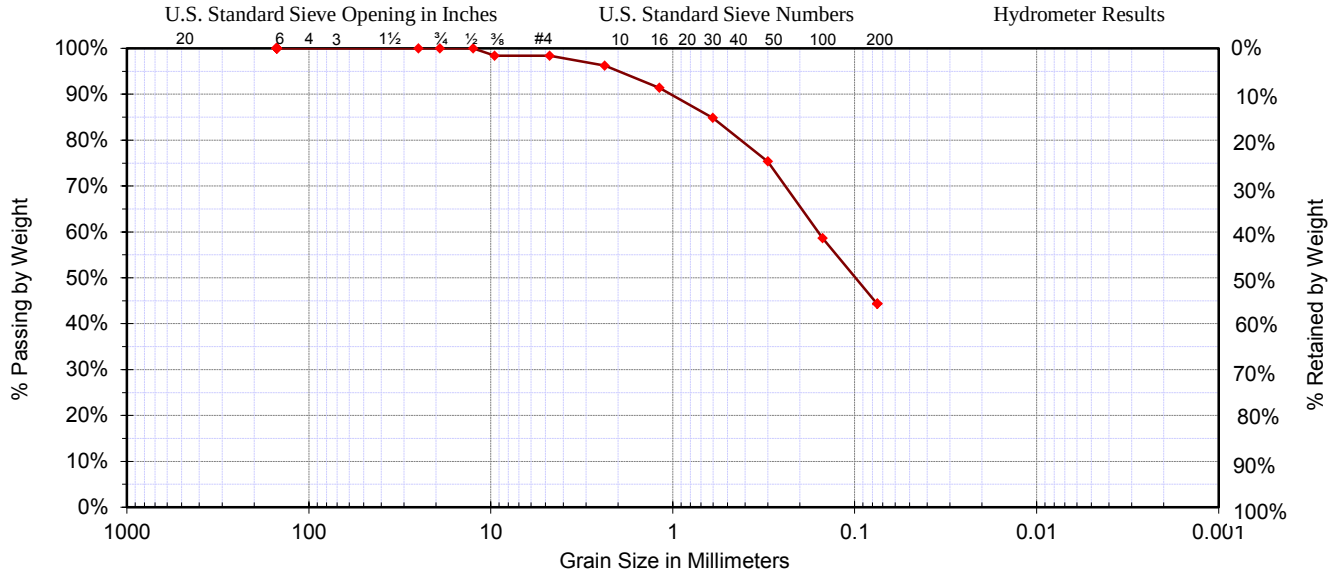
LABORATORY TEST RESULTS



Date :	08/07/17	D_{10} =	0.02	**Classification**	% Gravel
Sample #:		D_{30} =	0.05	SM, Silty Sand	1.62%
Sample ID:	B15 @ 10'	D_{60} =	0.16		% Sand
Source:	Standard	C_C =	0.94	**Specifications**	54.09%
Project:	Monroe Master Drainage Plan	C_U =	9.59	custom specs 1	% Silt & Clay
Location:	City of Riverside	Liquid Limit=	n/a		44.29%
Boring #:	B15	Plastic Limit=	n/a	Fineness Modulus	Sample Moisture
Depth:	10'	Plasticity Index=	n/a	0.97	**7.8%**

Coarse Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min	**Fines Section** Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100.0%			#4	4.750	98.4%	98.4%		
4.00"	100.00		100.0%			#8	2.360	96.2%	96.2%		
3.00"	75.00		100.0%			#10	2.000		94.7%		
2.50"	63.00		100.0%			#16	1.180	91.4%	91.4%		
2.00"	50.00		100.0%			#20	0.850		87.6%		
1.75"	45.00		100.0%			#30	0.600	84.8%	84.8%		
1.50"	37.50		100.0%			#40	0.425		79.3%		
1.25"	31.50		100.0%			#50	0.300	75.3%	75.3%		
1.00"	25.00	100.0%	100.0%			#60	0.250		69.8%		
7/8"	22.40		100.0%			#80	0.180		62.0%		
3/4"	19.00	100.0%	100.0%			#100	0.150	58.6%	58.6%		
5/8"	16.00		100.0%			#140	0.106		50.2%		
1/2"	12.50	100.0%	100.0%			#170	0.090		47.2%		
3/8"	9.50	98.4%	98.4%			#200	0.075	44.3%	44.3%		
1/4"	6.30		98.4%			#270	0.053				
#4	4.75	98.4%	98.4%								

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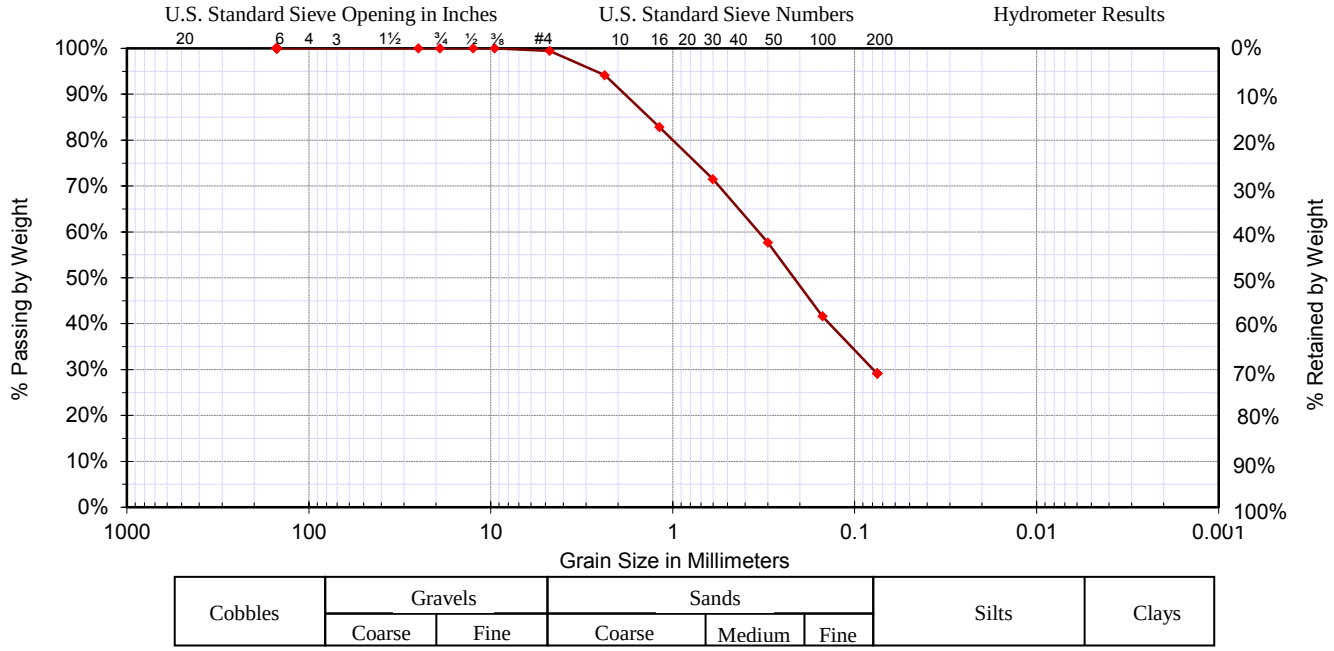
LABORATORY TEST RESULTS



Date :	08/07/17	D_{10} =	0.03	**Classification**	% Gravel
Sample #:		D_{30} =	0.08	SC, Clayey Sand	0.57%
Sample ID:	B16 @ 15'	D_{60} =	0.35		% Sand
Source:	Standard	C_C =	0.71	**Specifications**	70.33%
Project:	Monroe Master Drainage Plan	C_U =	13.63	custom specs 1	% Silt & Clay
Location:	City of Riverside	Liquid Limit=	n/a		29.11%
Boring #:	B16	Plastic Limit=	n/a	Fineness Modulus	Sample Moisture
Depth:	15'	Plasticity Index=	n/a	1.53	**17.4%**

Coarse Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min	**Fines Section** Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100.0%			#4	4.750	99.4%	99.4%		
4.00"	100.00		100.0%			#8	2.360	94.1%	94.1%		
3.00"	75.00		100.0%			#10	2.000		90.7%		
2.50"	63.00		100.0%			#16	1.180	82.8%	82.8%		
2.00"	50.00		100.0%			#20	0.850		76.3%		
1.75"	45.00		100.0%			#30	0.600	71.5%	71.5%		
1.50"	37.50		100.0%			#40	0.425		63.4%		
1.25"	31.50		100.0%			#50	0.300	57.6%	57.6%		
1.00"	25.00	100.0%	100.0%			#60	0.250		52.3%		
7/8"	22.40		100.0%			#80	0.180		44.8%		
3/4"	19.00	100.0%	100.0%			#100	0.150	41.6%	41.6%		
5/8"	16.00		100.0%			#140	0.106		34.3%		
1/2"	12.50	100.0%	100.0%			#170	0.090		31.6%		
3/8"	9.50	100.0%	100.0%			#200	0.075	29.1%	29.1%		
1/4"	6.30		99.6%			#270	0.053				
#4	4.75	99.4%	99.4%								

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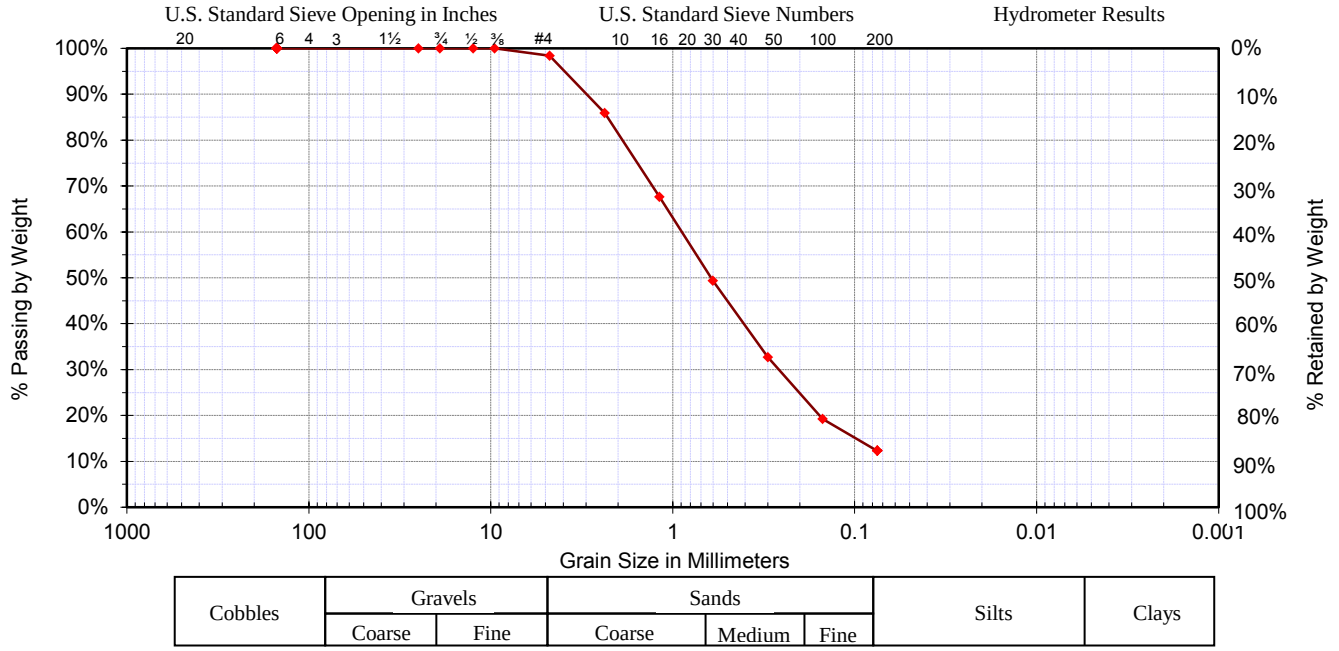
LABORATORY TEST RESULTS



Date :	08/07/17	D_{10} =	0.06	**Classification**	% Gravel
Sample #:		D_{30} =	0.27	SM, Silty Sand	1.63%
Sample ID:	B17 @ 10'	D_{60} =	0.94		% Sand
Source:	Standard	C_C =	1.27	**Specifications**	86.06%
Project:	Monroe Master Drainage Plan	C_U =	15.41	custom specs 1	% Silt & Clay
Location:	City of Riverside	Liquid Limit=	n/a		12.31%
Boring #:	B17	Plastic Limit=	n/a	Fineness Modulus	Sample Moisture
Depth:	10'	Plasticity Index=	n/a	2.47	**3.6%**

Coarse Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min	**Fines Section** Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100.0%			#4	4.750	98.4%	98.4%		
4.00"	100.00		100.0%			#8	2.360	85.9%	85.9%		
3.00"	75.00		100.0%			#10	2.000		80.3%		
2.50"	63.00		100.0%			#16	1.180	67.6%	67.6%		
2.00"	50.00		100.0%			#20	0.850		57.2%		
1.75"	45.00		100.0%			#30	0.600	49.3%	49.3%		
1.50"	37.50		100.0%			#40	0.425		39.6%		
1.25"	31.50		100.0%			#50	0.300	32.7%	32.7%		
1.00"	25.00	100.0%	100.0%			#60	0.250		28.2%		
7/8"	22.40		100.0%			#80	0.180		21.9%		
3/4"	19.00	100.0%	100.0%			#100	0.150	19.2%	19.2%		
5/8"	16.00		100.0%			#140	0.106		15.2%		
1/2"	12.50	100.0%	100.0%			#170	0.090		13.7%		
3/8"	9.50	100.0%	100.0%			#200	0.075	12.3%	12.3%		
1/4"	6.30		98.9%			#270	0.053				
#4	4.75	98.4%	98.4%								

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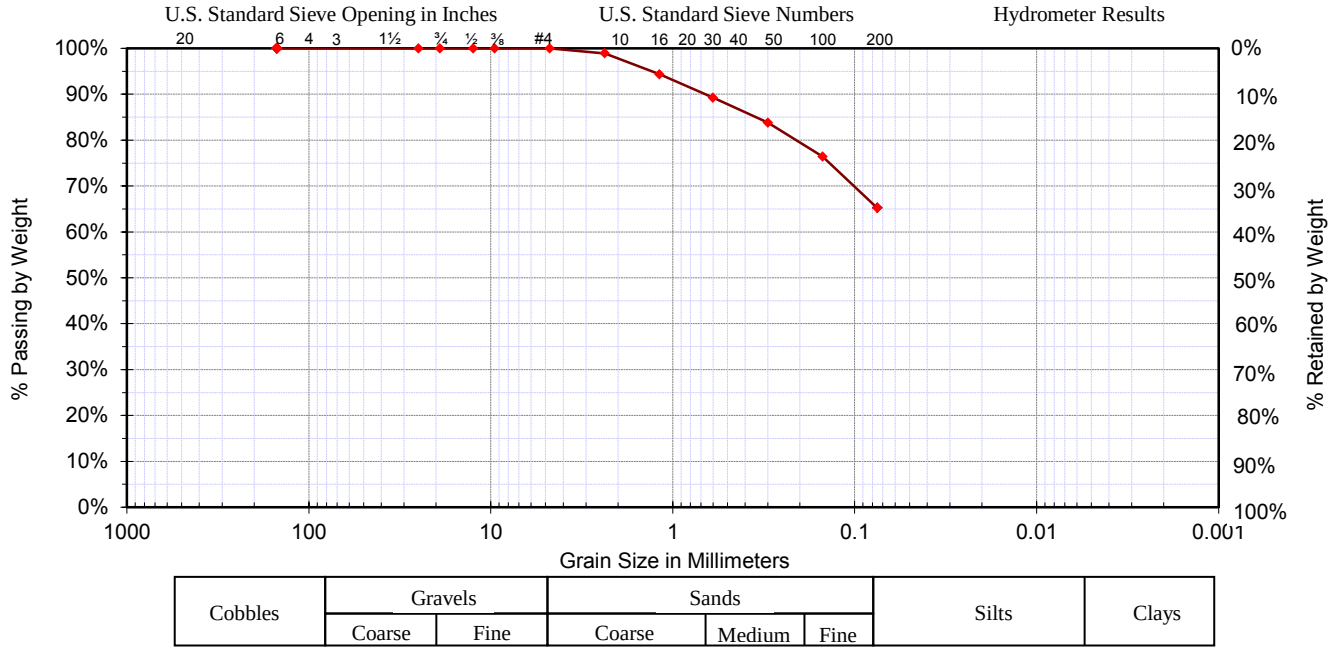
LABORATORY TEST RESULTS



Date :	08/07/17	D_{10} =	0.01	**Classification**	% Gravel
Sample #:		D_{30} =	0.03	CL, Sandy Lean Clay	0.00%
Sample ID:	B18 @ 5'	D_{60} =	0.07		% Sand
Source:	Standard	C_C =	1.50	**Specifications**	34.78%
Project:	Monroe Master Drainage Plan	C_U =	6.00	custom specs 1	% Silt & Clay
Location:	City of Riverside	Liquid Limit=	n/a		65.22%
Boring #:	B18	Plastic Limit=	n/a	Fineness Modulus	Sample Moisture
Depth:	5'	Plasticity Index=	n/a	0.57	**13.0%**

Coarse Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min	**Fines Section** Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100.0%			#4	4.750	100.0%	100.0%		
4.00"	100.00		100.0%			#8	2.360	98.9%	98.9%		
3.00"	75.00		100.0%			#10	2.000		97.5%		
2.50"	63.00		100.0%			#16	1.180	94.3%	94.3%		
2.00"	50.00		100.0%			#20	0.850		91.4%		
1.75"	45.00		100.0%			#30	0.600	89.2%	89.2%		
1.50"	37.50		100.0%			#40	0.425		86.1%		
1.25"	31.50		100.0%			#50	0.300	83.8%	83.8%		
1.00"	25.00	100.0%	100.0%			#60	0.250		81.3%		
7/8"	22.40		100.0%			#80	0.180		77.9%		
3/4"	19.00	100.0%	100.0%			#100	0.150	76.4%	76.4%		
5/8"	16.00		100.0%			#140	0.106		69.8%		
1/2"	12.50	100.0%	100.0%			#170	0.090		67.5%		
3/8"	9.50	100.0%	100.0%			#200	0.075	65.2%	65.2%		
1/4"	6.30		100.0%			#270	0.053				
#4	4.75	100.0%	100.0%								

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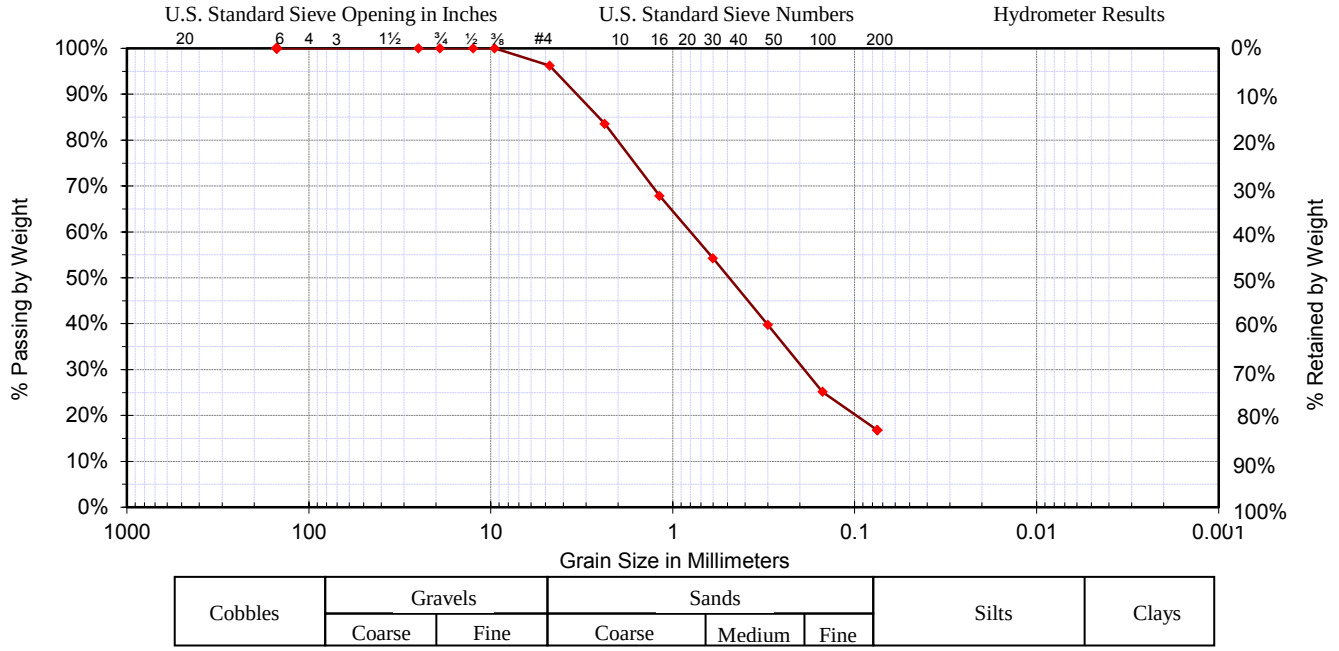
LABORATORY TEST RESULTS



Date :	08/07/17	D_{10} =	0.04	**Classification**	% Gravel
Sample #:		D_{30} =	0.20	SC, Clayey Sand	3.77%
Sample ID:	B19 @ 10'	D_{60} =	0.85		% Sand
Source:	Standard	C_C =	1.06	**Specifications**	79.44%
Project:	Monroe Master Drainage Plan	C_U =	18.94	custom specs 1	% Silt & Clay
Location:	City of Riverside	Liquid Limit=	n/a		16.78%
Boring #:	B19	Plastic Limit=	n/a	Fineness Modulus	Sample Moisture
Depth:	10'	Plasticity Index=	n/a	2.33	**7.2%**

Coarse Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min	**Fines Section** Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100.0%			#4	4.750	96.2%	96.2%		
4.00"	100.00		100.0%			#8	2.360	83.5%	83.5%		
3.00"	75.00		100.0%			#10	2.000		78.7%		
2.50"	63.00		100.0%			#16	1.180	67.8%	67.8%		
2.00"	50.00		100.0%			#20	0.850		60.1%		
1.75"	45.00		100.0%			#30	0.600	54.2%	54.2%		
1.50"	37.50		100.0%			#40	0.425		45.8%		
1.25"	31.50		100.0%			#50	0.300	39.7%	39.7%		
1.00"	25.00	100.0%	100.0%			#60	0.250		34.9%		
7/8"	22.40		100.0%			#80	0.180		28.0%		
3/4"	19.00	100.0%	100.0%			#100	0.150	25.1%	25.1%		
5/8"	16.00		100.0%			#140	0.106		20.2%		
1/2"	12.50	100.0%	100.0%			#170	0.090		18.5%		
3/8"	9.50	100.0%	100.0%			#200	0.075	16.8%	16.8%		
1/4"	6.30		97.5%			#270	0.053				
#4	4.75	96.2%	96.2%								

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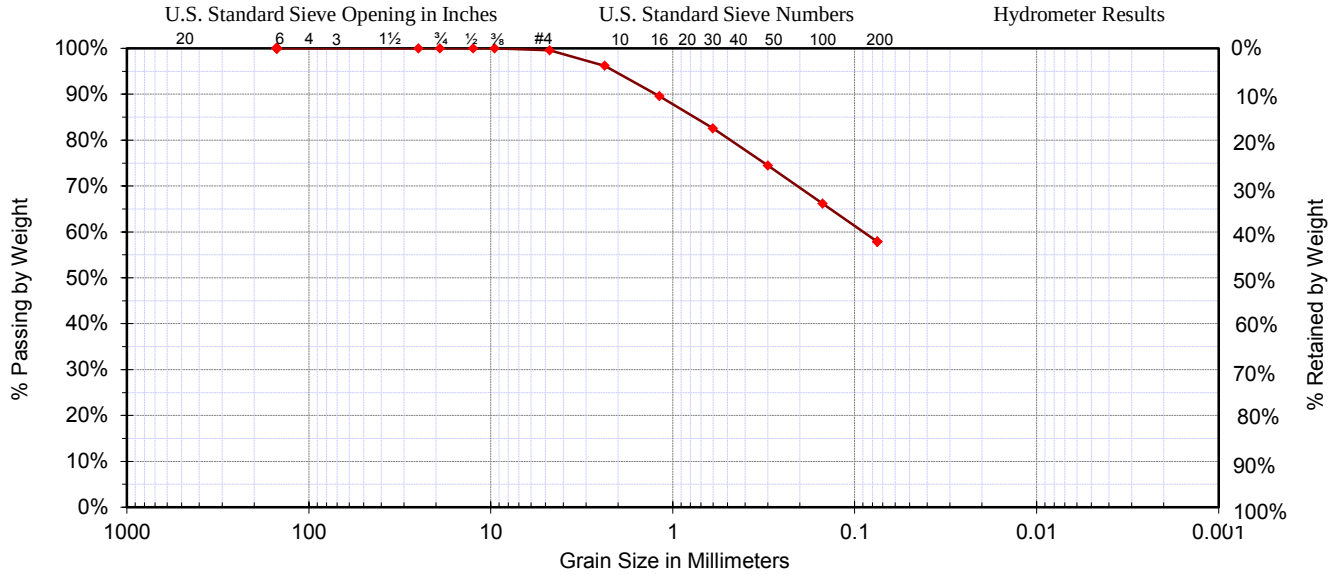
LABORATORY TEST RESULTS



Date :	08/07/17	D_{10} =	0.01	**Classification**	% Gravel
Sample #:		D_{30} =	0.04	CL, Sandy Lean Clay	0.43%
Sample ID:	B20 @ 5'	D_{60} =	0.09		% Sand
Source:	Standard	C_C =	1.24	**Specifications**	41.70%
Project:	Monroe Master Drainage Plan	C_U =	7.27	custom specs 1	% Silt & Clay
Location:	City of Riverside	Liquid Limit=	n/a		57.87%
Boring #:	B20	Plastic Limit=	n/a	Fineness Modulus	Sample Moisture
Depth:	5'	Plasticity Index=	n/a	0.91	**10.6%**

Coarse Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min	**Fines Section** Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100.0%			#4	4.750	99.6%	99.6%		
4.00"	100.00		100.0%			#8	2.360	96.2%	96.2%		
3.00"	75.00		100.0%			#10	2.000		94.2%		
2.50"	63.00		100.0%			#16	1.180	89.6%	89.6%		
2.00"	50.00		100.0%			#20	0.850		85.6%		
1.75"	45.00		100.0%			#30	0.600	82.6%	82.6%		
1.50"	37.50		100.0%			#40	0.425		77.8%		
1.25"	31.50		100.0%			#50	0.300	74.5%	74.5%		
1.00"	25.00	100.0%	100.0%			#60	0.250		71.7%		
7/8"	22.40		100.0%			#80	0.180		67.8%		
3/4"	19.00	100.0%	100.0%			#100	0.150	66.2%	66.2%		
5/8"	16.00		100.0%			#140	0.106		61.3%		
1/2"	12.50	100.0%	100.0%			#170	0.090		59.5%		
3/8"	9.50	100.0%	100.0%			#200	0.075	57.9%	57.9%		
1/4"	6.30		99.7%			#270	0.053				
#4	4.75	99.6%	99.6%								

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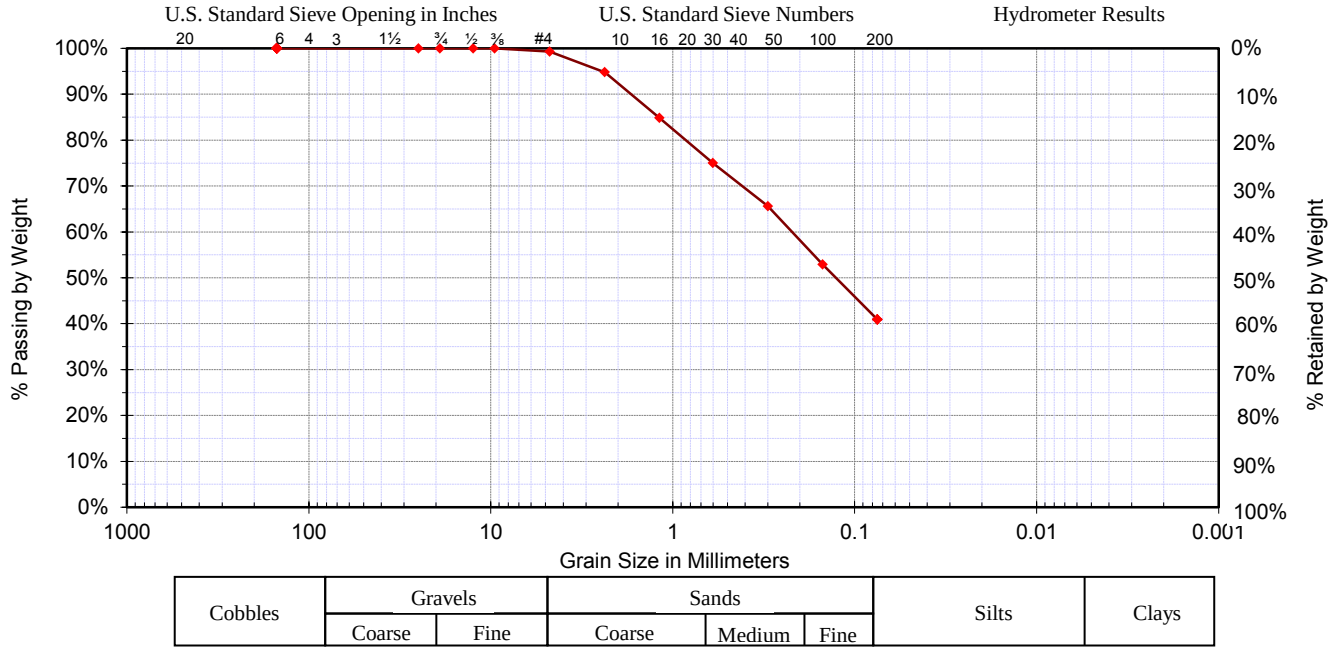
LABORATORY TEST RESULTS



Date :	08/07/17	D_{10} =	0.02	**Classification**	% Gravel
Sample #:		D_{30} =	0.06	SC, Clayey Sand	0.70%
Sample ID:	B21 @ 10'	D_{60} =	0.23		% Sand
Source:	Standard	C_C =	0.71	**Specifications**	58.40%
Project:	Monroe Master Drainage Plan	C_U =	12.75	custom specs 1	% Silt & Clay
Location:	City of Riverside	Liquid Limit=	n/a		40.90%
Boring #:	B21	Plastic Limit=	n/a	Fineness Modulus	Sample Moisture
Depth:	10'	Plasticity Index=	n/a	1.28	**13.7%**

Coarse Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min	**Fines Section** Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100.0%			#4	4.750	99.3%	99.3%		
4.00"	100.00		100.0%			#8	2.360	94.8%	94.8%		
3.00"	75.00		100.0%			#10	2.000		91.7%		
2.50"	63.00		100.0%			#16	1.180	84.8%	84.8%		
2.00"	50.00		100.0%			#20	0.850		79.2%		
1.75"	45.00		100.0%			#30	0.600	75.0%	75.0%		
1.50"	37.50		100.0%			#40	0.425		69.5%		
1.25"	31.50		100.0%			#50	0.300	65.6%	65.6%		
1.00"	25.00	100.0%	100.0%			#60	0.250		61.4%		
7/8"	22.40		100.0%			#80	0.180		55.4%		
3/4"	19.00	100.0%	100.0%			#100	0.150	52.9%	52.9%		
5/8"	16.00		100.0%			#140	0.106		45.9%		
1/2"	12.50	100.0%	100.0%			#170	0.090		43.3%		
3/8"	9.50	100.0%	100.0%			#200	0.075	40.9%	40.9%		
1/4"	6.30		99.5%			#270	0.053				
#4	4.75	99.3%	99.3%								

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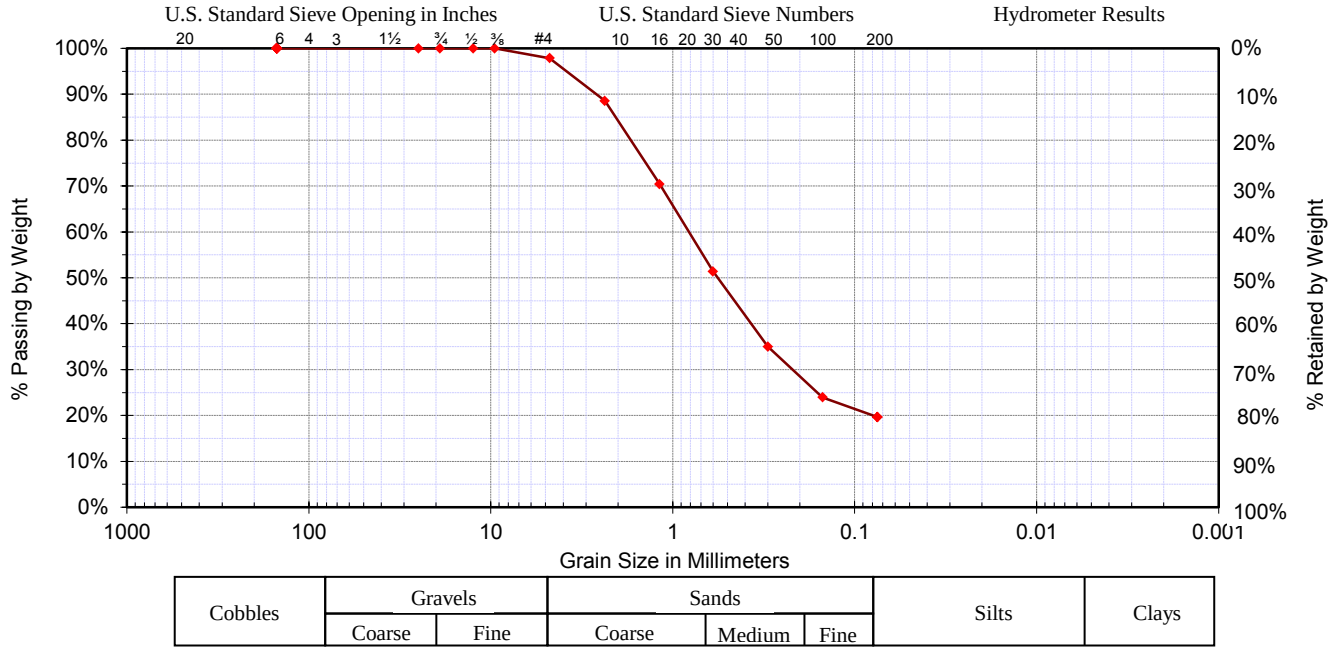
LABORATORY TEST RESULTS



Date :	08/07/17	D_{10} =	0.04	**Classification**	% Gravel
Sample #:		D_{30} =	0.23	SC, Clayey Sand	2.15%
Sample ID:	B22 @ 10'	D_{60} =	0.86		% Sand
Source:	Standard	C_C =	1.64	**Specifications**	78.20%
Project:	Monroe Master Drainage Plan	C_U =	22.60	custom specs 1	% Silt & Clay
Location:	City of Riverside	Liquid Limit=	n/a		19.65%
Boring #:	B22	Plastic Limit=	n/a	Fineness Modulus	Sample Moisture
Depth:	10'	Plasticity Index=	n/a	2.33	**7.5%**

Coarse Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min	**Fines Section** Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100.0%			#4	4.750	97.9%	97.9%		
4.00"	100.00		100.0%			#8	2.360	88.5%	88.5%		
3.00"	75.00		100.0%			#10	2.000		83.0%		
2.50"	63.00		100.0%			#16	1.180	70.4%	70.4%		
2.00"	50.00		100.0%			#20	0.850		59.6%		
1.75"	45.00		100.0%			#30	0.600	51.4%	51.4%		
1.50"	37.50		100.0%			#40	0.425		41.8%		
1.25"	31.50		100.0%			#50	0.300	35.0%	35.0%		
1.00"	25.00	100.0%	100.0%			#60	0.250		31.3%		
7/8"	22.40		100.0%			#80	0.180		26.2%		
3/4"	19.00	100.0%	100.0%			#100	0.150	24.0%	24.0%		
5/8"	16.00		100.0%			#140	0.106		21.4%		
1/2"	12.50	100.0%	100.0%			#170	0.090		20.5%		
3/8"	9.50	100.0%	100.0%			#200	0.075	19.7%	19.7%		
1/4"	6.30		98.6%			#270	0.053				
#4	4.75	97.9%	97.9%								

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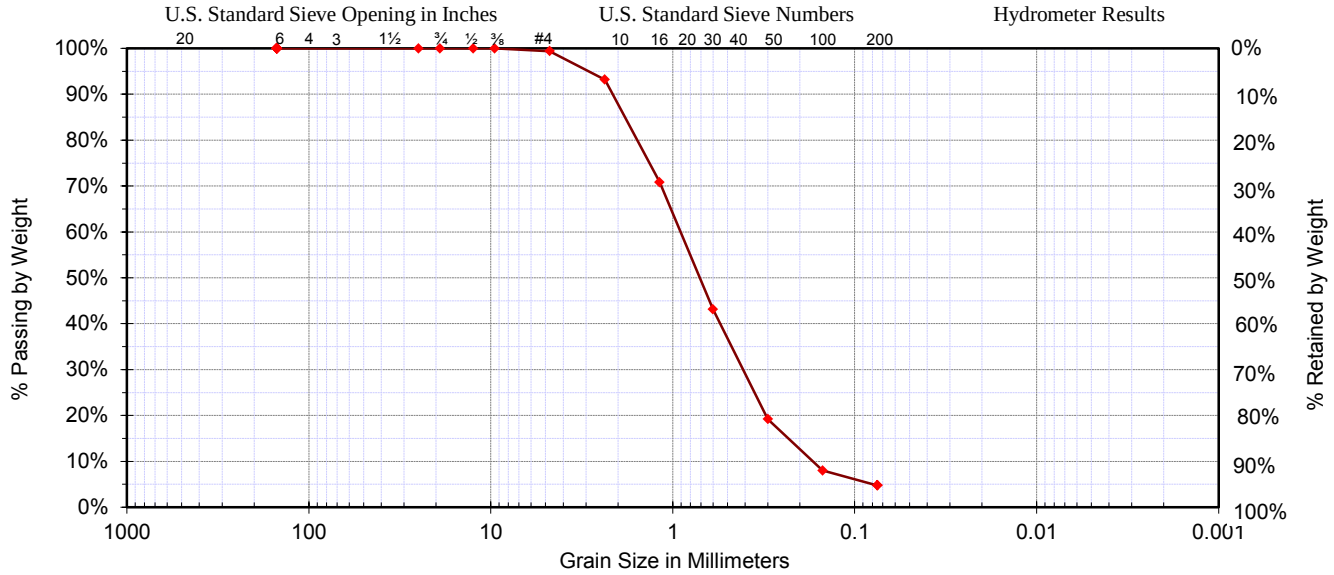
LABORATORY TEST RESULTS



Cobbles	Gravels		Sands			Silts	Clays
	Coarse	Fine	Coarse	Medium	Fine		

Date :	08/07/17	D_{10} =	0.18	**Classification**	% Gravel
Sample #:		D_{30} =	0.44	SP, Poorly graded Sand	0.59%
Sample ID:	B23 @ 15'	D_{60} =	0.95		% Sand
Source:	Standard	C_C =	1.13	**Specifications**	94.66%
Project:	Monroe Master Drainage Plan	C_U =	5.40	custom specs 1	% Silt & Clay
Location:	City of Riverside	Liquid Limit=	n/a		4.75%
Boring #:	B23	Plastic Limit=	n/a	Fineness Modulus	Sample Moisture
Depth:	15'	Plasticity Index=	n/a	2.66	**4.3%**

Coarse Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min	**Fines Section** Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100.0%			#4	4.750	99.4%	99.4%		
4.00"	100.00		100.0%			#8	2.360	93.2%	93.2%		
3.00"	75.00		100.0%			#10	2.000		86.4%		
2.50"	63.00		100.0%			#16	1.180	70.8%	70.8%		
2.00"	50.00		100.0%			#20	0.850		55.1%		
1.75"	45.00		100.0%			#30	0.600	43.1%	43.1%		
1.50"	37.50		100.0%			#40	0.425		29.2%		
1.25"	31.50		100.0%			#50	0.300	19.2%	19.2%		
1.00"	25.00	100.0%	100.0%			#60	0.250		15.5%		
7/8"	22.40		100.0%			#80	0.180		10.2%		
3/4"	19.00	100.0%	100.0%			#100	0.150	8.0%	8.0%		
5/8"	16.00		100.0%			#140	0.106		6.1%		
1/2"	12.50	100.0%	100.0%			#170	0.090		5.4%		
3/8"	9.50	100.0%	100.0%			#200	0.075	4.7%	4.7%		
1/4"	6.30		99.6%			#270	0.053				
#4	4.75	99.4%	99.4%								

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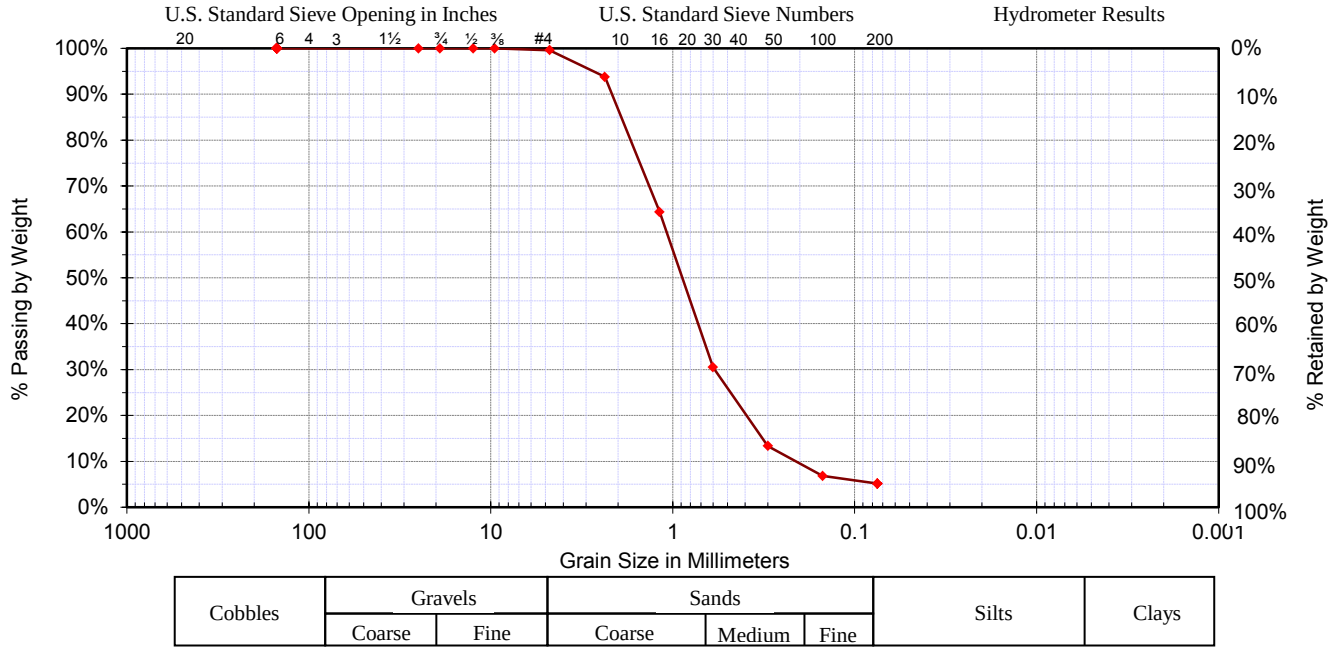
LABORATORY TEST RESULTS



Date :	08/07/17	D_{10} = 0.22	**Classification**		% Gravel
Sample #:		D_{30} = 0.59	SP-SM, Poorly graded Sand with Silt		0.39%
Sample ID:	B24 @ 10'	D_{60} = 1.11			% Sand
Source:	Standard	C_C = 1.42	**Specifications**		94.45%
Project:	Monroe Master Drainage Plan	C_U = 4.95	custom specs 1		% Silt & Clay
Location:	City of Riverside	Liquid Limit= n/a			5.16%
Boring #:	B24	Plastic Limit= n/a	Fineness Modulus		Sample Moisture
Depth:	10'	Plasticity Index= n/a	2.92		**3.2%**

Coarse Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min	**Fines Section** Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100.0%			#4	4.750	99.6%	99.6%		
4.00"	100.00		100.0%			#8	2.360	93.8%	93.8%		
3.00"	75.00		100.0%			#10	2.000		84.8%		
2.50"	63.00		100.0%			#16	1.180	64.4%	64.4%		
2.00"	50.00		100.0%			#20	0.850		45.1%		
1.75"	45.00		100.0%			#30	0.600	30.5%	30.5%		
1.50"	37.50		100.0%			#40	0.425		20.5%		
1.25"	31.50		100.0%			#50	0.300	13.3%	13.3%		
1.00"	25.00	100.0%	100.0%			#60	0.250		11.2%		
7/8"	22.40		100.0%			#80	0.180		8.1%		
3/4"	19.00	100.0%	100.0%			#100	0.150	6.8%	6.8%		
5/8"	16.00		100.0%			#140	0.106		5.8%		
1/2"	12.50	100.0%	100.0%			#170	0.090		5.5%		
3/8"	9.50	100.0%	100.0%			#200	0.075	5.2%	5.2%		
1/4"	6.30		99.7%			#270	0.053				
#4	4.75	99.6%	99.6%								

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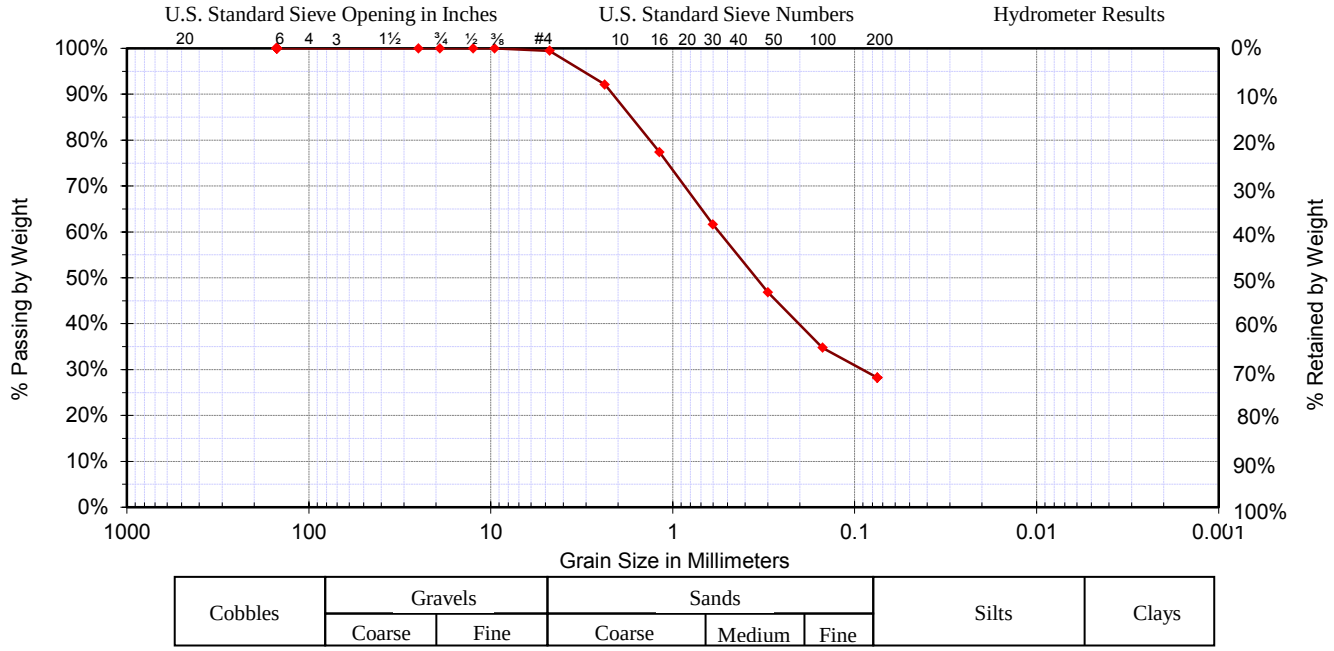
LABORATORY TEST RESULTS



Date :	08/07/17	D_{10} =	0.03	**Classification**	% Gravel
Sample #:		D_{30} =	0.10	SC, Clayey Sand	0.53%
Sample ID:	B25 @ 5'	D_{60} =	0.57		% Sand
Source:	Standard	C_C =	0.60	**Specifications**	71.26%
Project:	Monroe Master Drainage Plan	C_U =	21.36	custom specs 1	% Silt & Clay
Location:	City of Riverside	Liquid Limit=	n/a		28.21%
Boring #:	B25	Plastic Limit=	n/a	Fineness Modulus	Sample Moisture
Depth:	5'	Plasticity Index=	n/a	1.88	**7.6%**

Coarse Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min	**Fines Section** Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100.0%			#4	4.750	99.5%	99.5%		
4.00"	100.00		100.0%			#8	2.360	92.1%	92.1%		
3.00"	75.00		100.0%			#10	2.000		87.6%		
2.50"	63.00		100.0%			#16	1.180	77.4%	77.4%		
2.00"	50.00		100.0%			#20	0.850		68.4%		
1.75"	45.00		100.0%			#30	0.600	61.6%	61.6%		
1.50"	37.50		100.0%			#40	0.425		53.0%		
1.25"	31.50		100.0%			#50	0.300	46.8%	46.8%		
1.00"	25.00	100.0%	100.0%			#60	0.250		42.8%		
7/8"	22.40		100.0%			#80	0.180		37.2%		
3/4"	19.00	100.0%	100.0%			#100	0.150	34.7%	34.7%		
5/8"	16.00		100.0%			#140	0.106		30.9%		
1/2"	12.50	100.0%	100.0%			#170	0.090		29.5%		
3/8"	9.50	100.0%	100.0%			#200	0.075	28.2%	28.2%		
1/4"	6.30		99.6%			#270	0.053				
#4	4.75	99.5%	99.5%								

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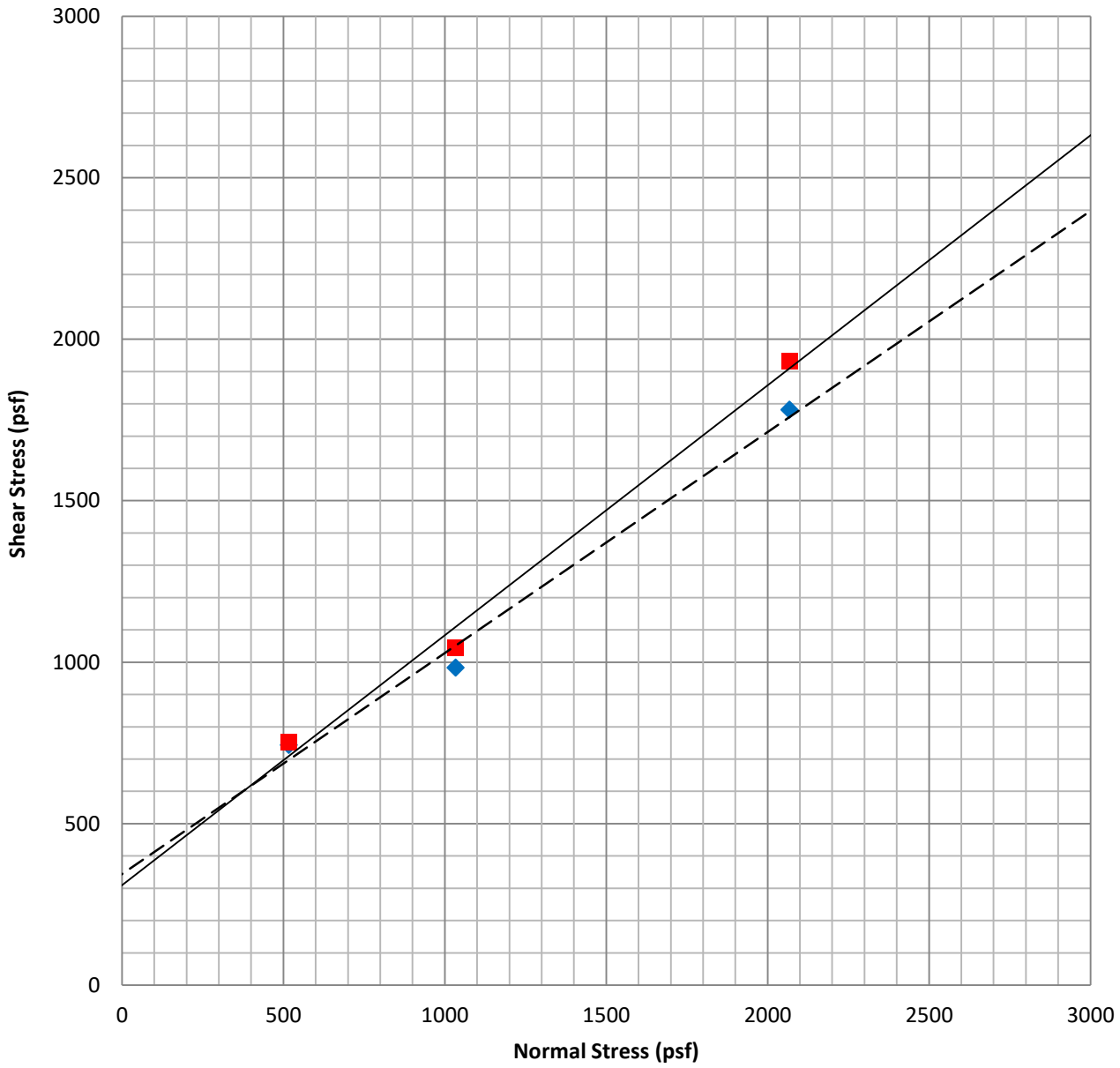
DIRECT SHEAR TEST RESULTS

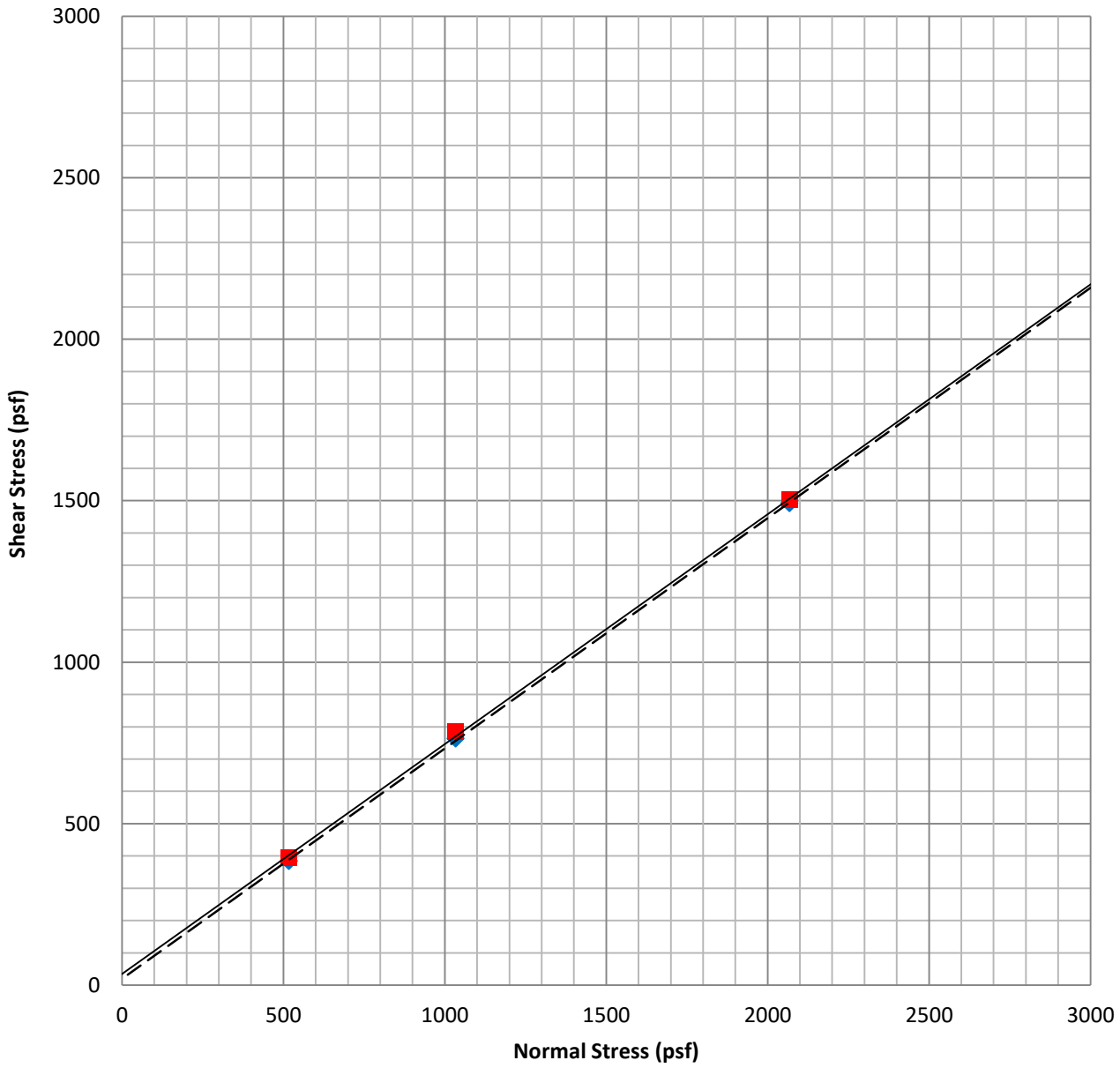


Sample	Symbol	Description	Soil Type [USCS]	Shear Strength	Friction Angle, ϕ [degrees]	Cohesion, c [psf]
B1 @ 10'	—■—	Clayey Sand	SC	Peak	37.7	309
B1 @ 10'	– –◆– –	Clayey Sand	SC	Ultimate	34.4	344

Sample Moisture [%]	Saturated Moisture [%]	Dry Unit Weight [pcf]
13.0	17.2	121.9
ASTM D-3080		

geomat

DIRECT SHEAR TEST RESULTS

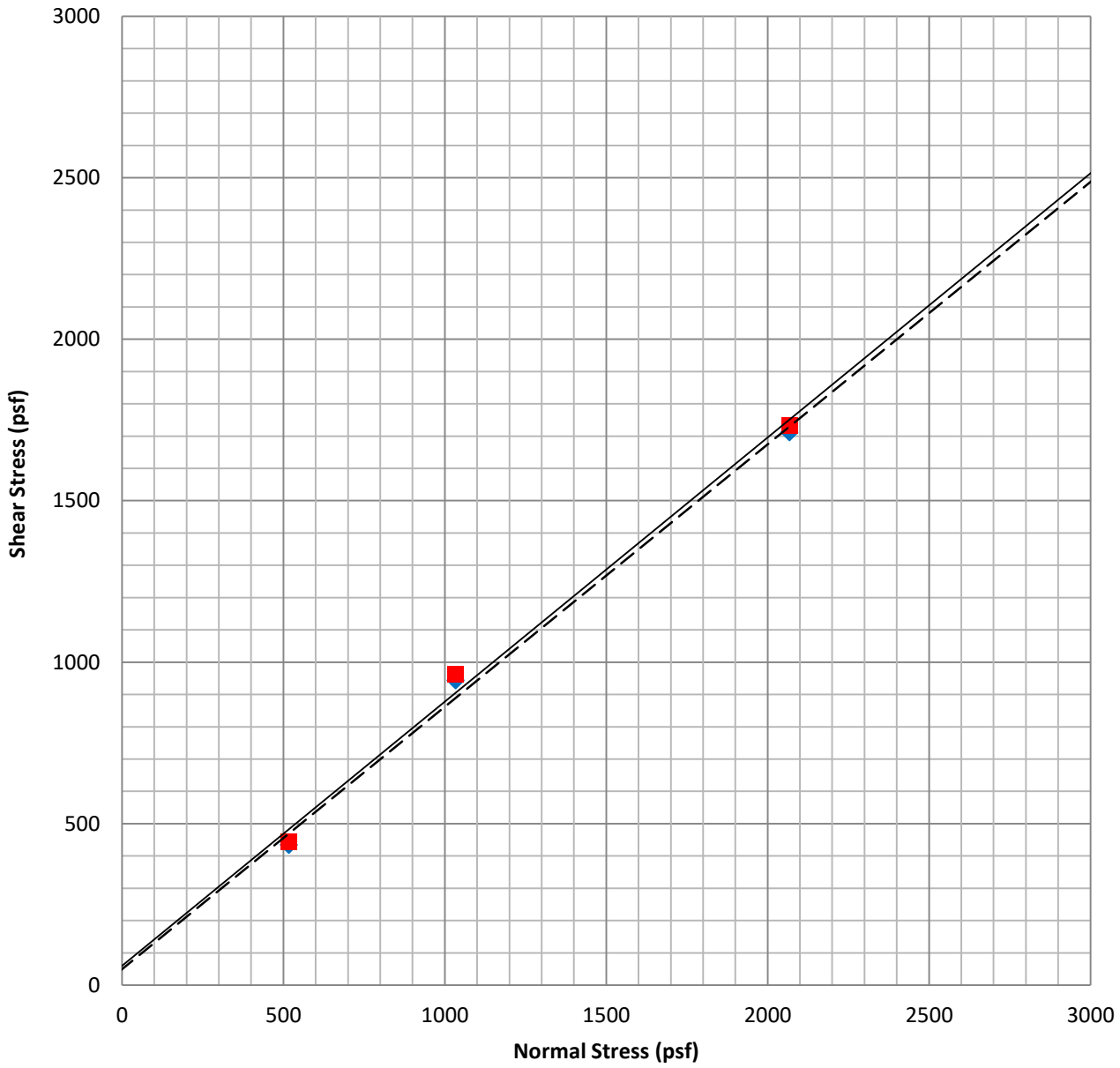


Sample	Symbol	Description	Soil Type [USCS]	Shear Strength	Friction Angle, ϕ [degrees]	Cohesion, c [psf]
B2 @ 20'	—■—	Silty Sand	SM	Peak	35.4	34
B2 @ 20'	– –◆– –	Silty Sand	SM	Ultimate	35.5	19

Sample Moisture [%]	Saturated Moisture [%]	Dry Unit Weight [pcf]
9.9	24.0	100.9
ASTM D-3080		

geomat

DIRECT SHEAR TEST RESULTS



Sample	Symbol	Description	Soil Type [USCS]	Shear Strength	Friction Angle, ϕ [degrees]	Cohesion, c [psf]
B3 @ 15'	—■—	Poorly-Graded Sand	SP	Peak	39.3	59
B3 @ 15'	– –◆– –	Poorly-Graded Sand	SP	Ultimate	39.1	49

Sample Moisture [%]	Saturated Moisture [%]	Dry Unit Weight [pcf]
14.8	19.7	98.2
ASTM D-3080		

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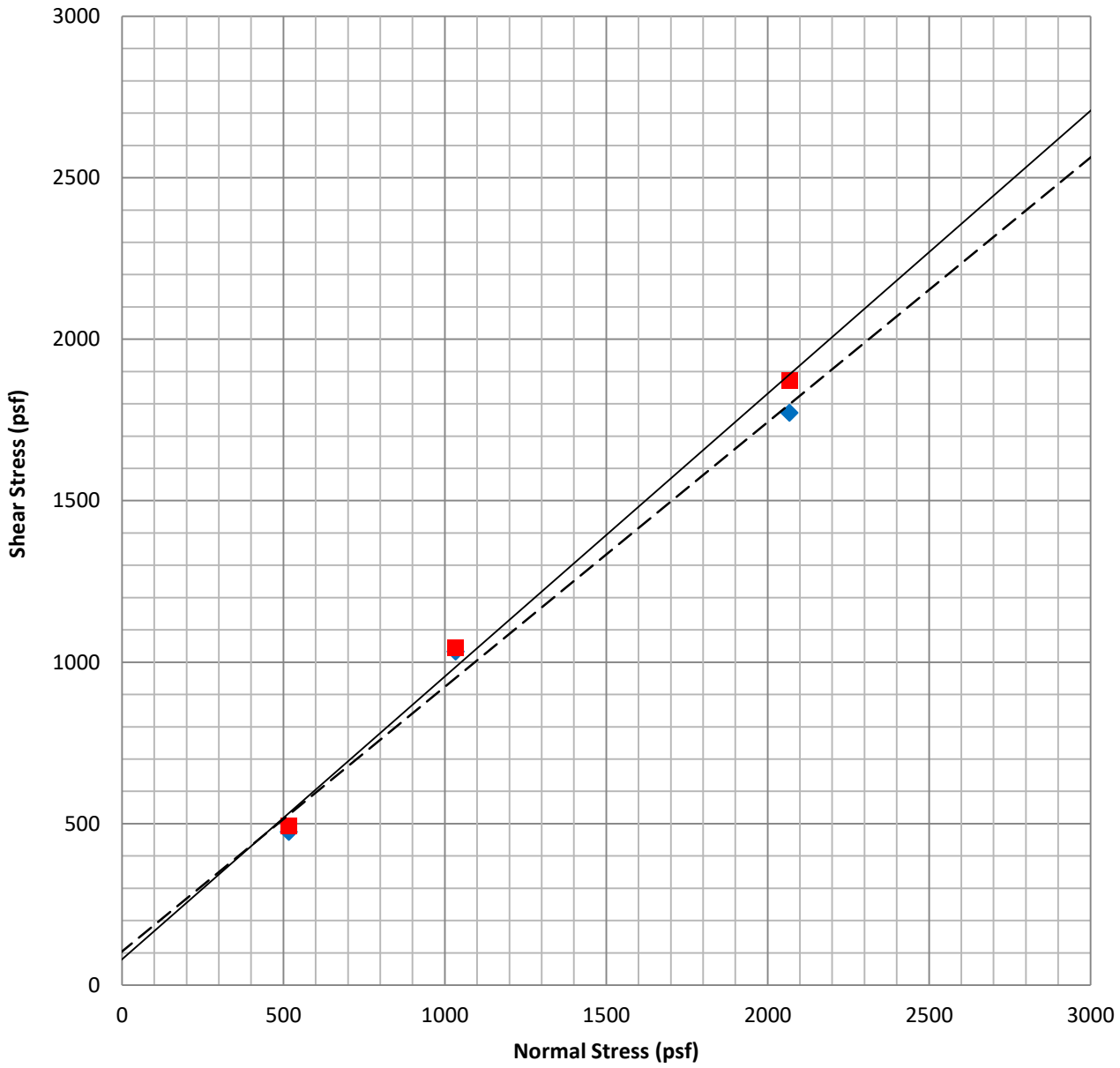
DIRECT SHEAR TEST RESULTS



Sample	Symbol	Description	Soil Type [USCS]	Shear Strength	Friction Angle, ϕ [degrees]	Cohesion, c [psf]
B4 @ 10'	—■—	Poorly-Graded Sand	SP	Peak	41.2	79
B4 @ 10'	– –◆– –	Poorly-Graded Sand	SP	Ultimate	39.3	104

Sample Moisture [%]	Saturated Moisture [%]	Dry Unit Weight [pcf]
25.1	24.3	89.1
ASTM D-3080		

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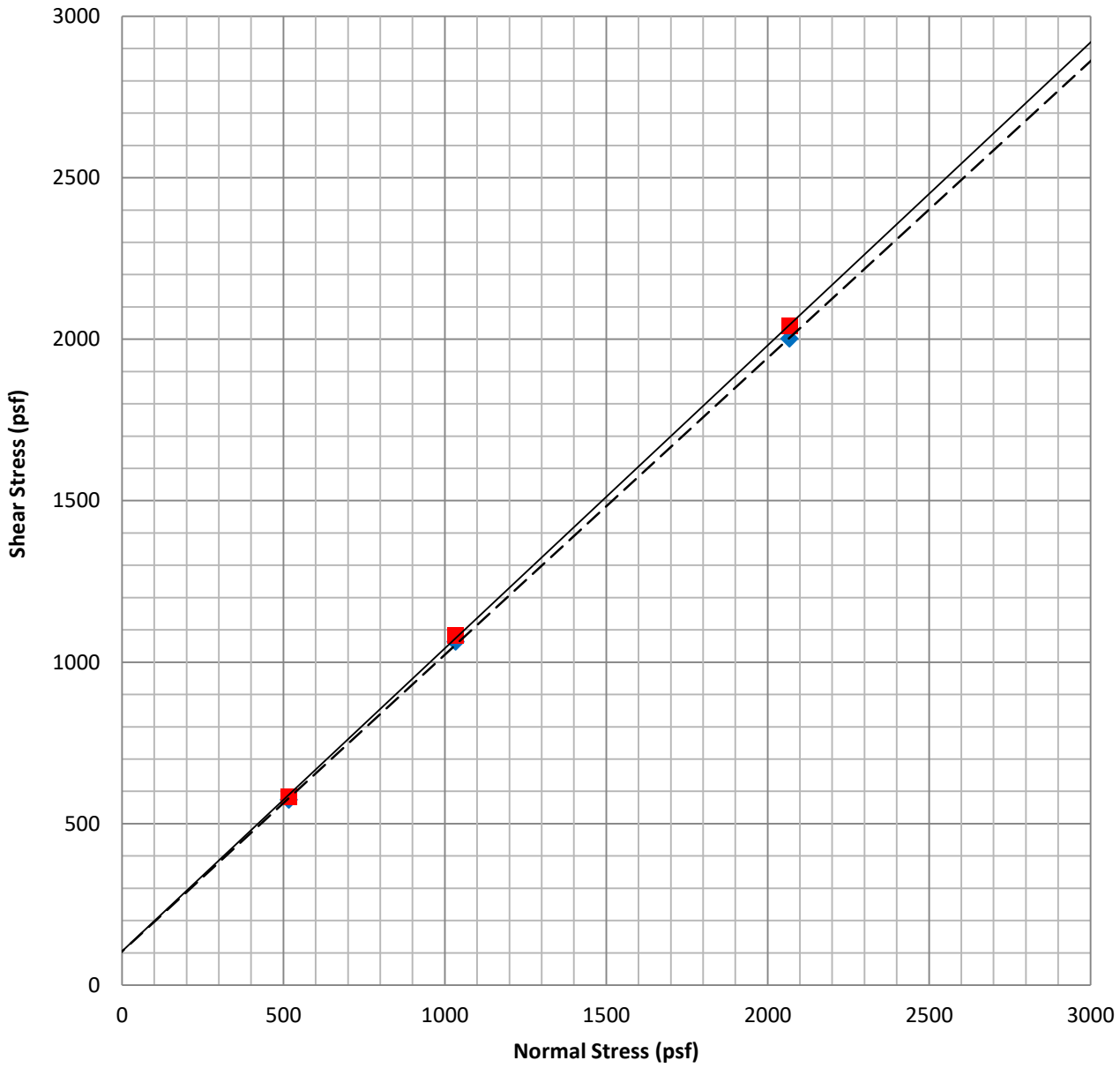
DIRECT SHEAR TEST RESULTS



Sample	Symbol	Description	Soil Type [USCS]	Shear Strength	Friction Angle, ϕ [degrees]	Cohesion, c [psf]
B7 @ 15'	—■—	Sand with Silt	SP-SM	Peak	43.2	104
B7 @ 15'	– –◆– –	Sand with Silt	SP-SM	Ultimate	42.6	104

Sample Moisture [%]	Saturated Moisture [%]	Dry Unit Weight [pcf]
10.5	17.5	109.9
ASTM D-3080		

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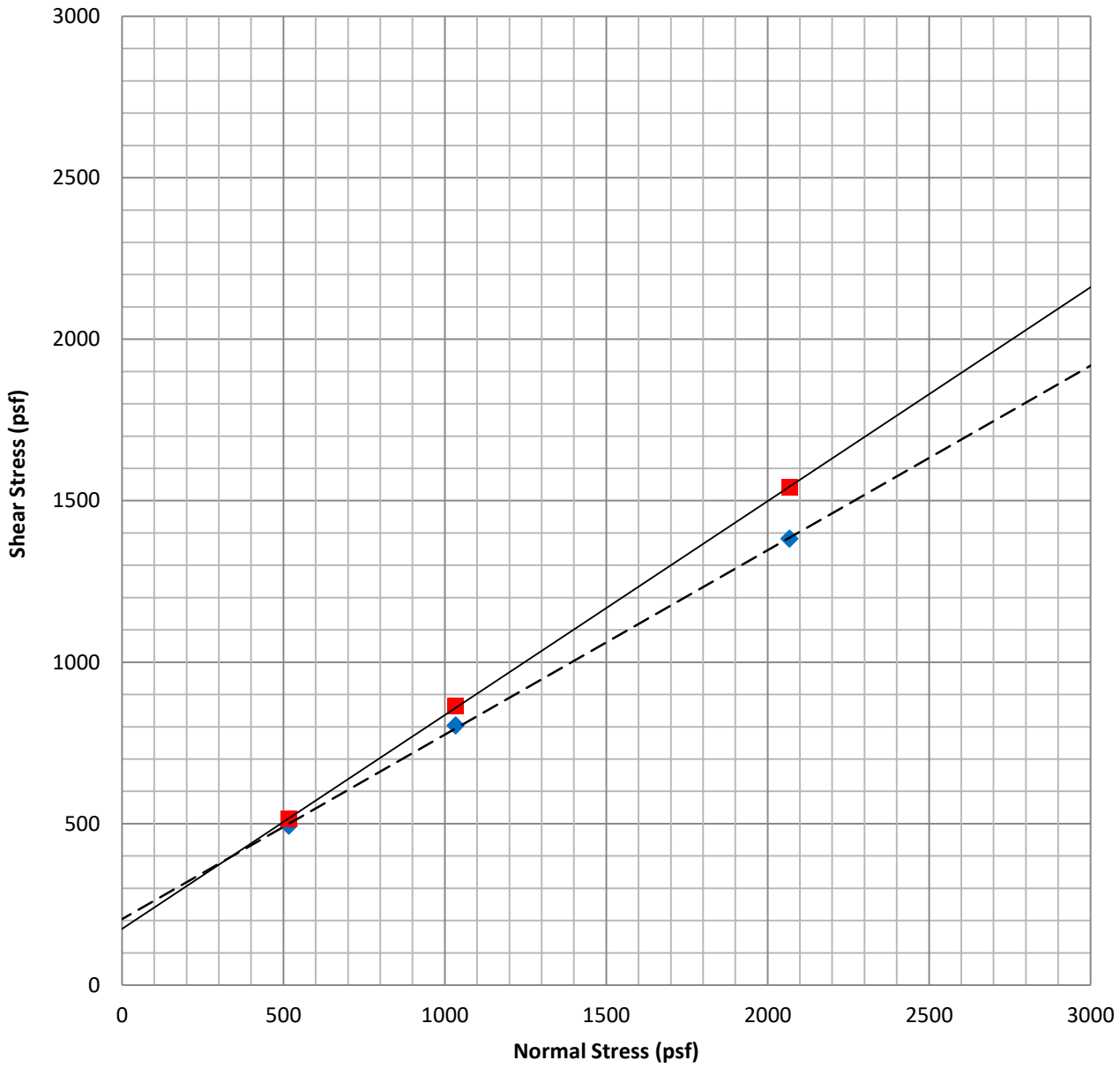
DIRECT SHEAR TEST RESULTS



Sample	Symbol	Description	Soil Type [USCS]	Shear Strength	Friction Angle, ϕ [degrees]	Cohesion, c [psf]
B8 @ 5'	—■—	Clayey Sand	SC	Peak	33.5	174
B8 @ 5'	—◆—	Clayey Sand	SC	Ultimate	29.7	204

Sample Moisture [%]	Saturated Moisture [%]	Dry Unit Weight [pcf]
19.3	24.4	105.8
ASTM D-3080		

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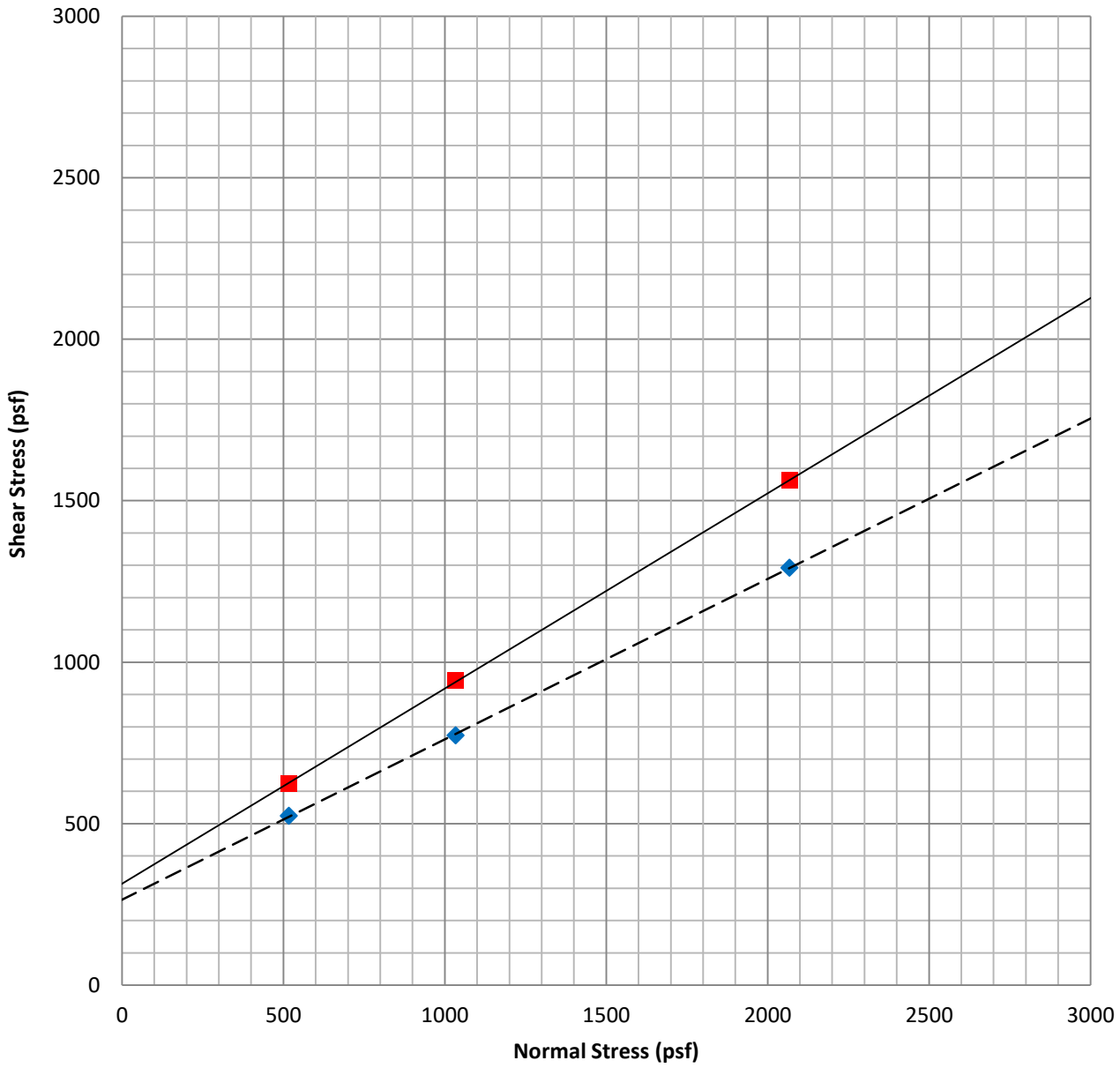
DIRECT SHEAR TEST RESULTS



Sample	Symbol	Description	Soil Type [USCS]	Shear Strength	Friction Angle, ϕ [degrees]	Cohesion, c [psf]
B9 @ 10'	—■—	Sandy Lean Clay	CL	Peak	31.1	314
B9 @ 10'	– –◆– –	Sandy Lean Clay	CL	Ultimate	26.4	264

Sample Moisture [%]	Saturated Moisture [%]	Dry Unit Weight [pcf]
27.1	30.4	96.6
ASTM D-3080		

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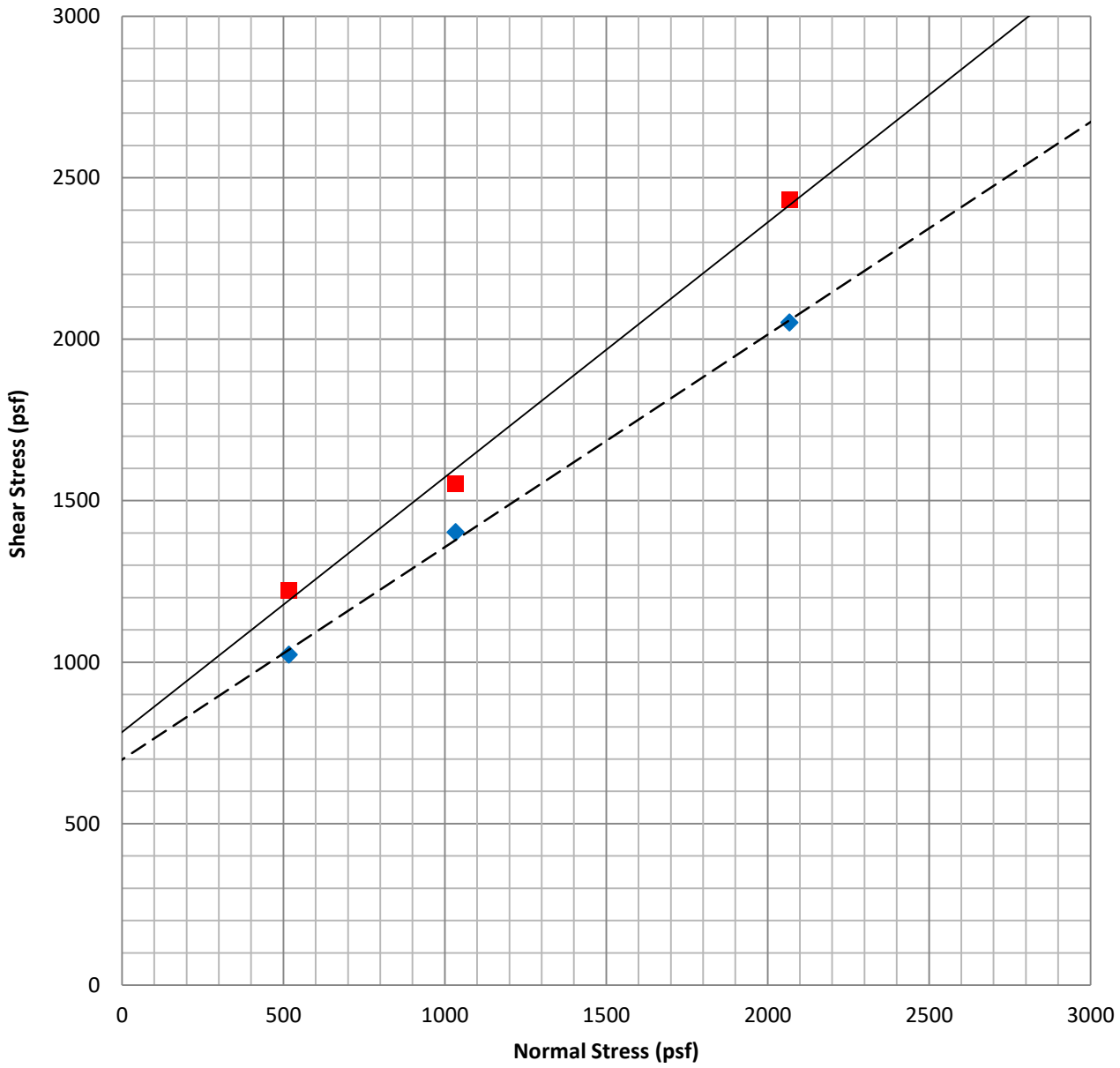
DIRECT SHEAR TEST RESULTS



Sample	Symbol	Description	Soil Type [USCS]	Shear Strength	Friction Angle, ϕ [degrees]	Cohesion, c [psf]
B10 @ 20'	—■—	Clayey Sand	SC	Peak	38.3	783
B10 @ 20'	– –◆– –	Clayey Sand	SC	Ultimate	33.3	698

Sample Moisture [%]	Saturated Moisture [%]	Dry Unit Weight [pcf]
15.8	23.3	106.2
ASTM D-3080		

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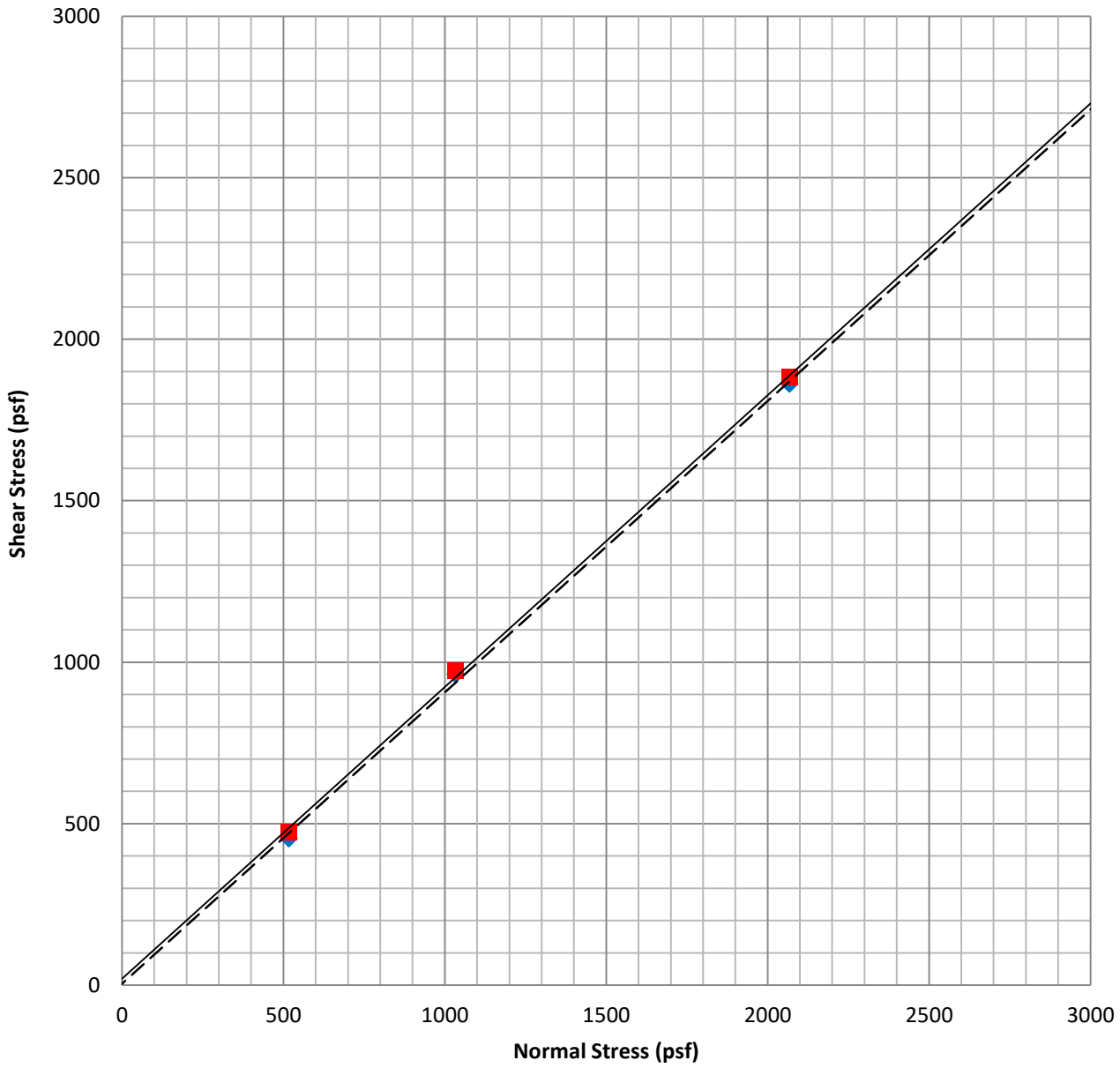
DIRECT SHEAR TEST RESULTS



Sample	Symbol	Description	Soil Type [USCS]	Shear Strength	Friction Angle, ϕ [degrees]	Cohesion, c [psf]
B11 @ 5'	—■—	Sand with Silt	SW-SM	Peak	42.1	19
B11 @ 5'	– –◆– –	Sand with Silt	SW-SM	Ultimate	42.1	4

Sample Moisture [%]	Saturated Moisture [%]	Dry Unit Weight [pcf]
12.6	17.2	108.4
ASTM D-3080		

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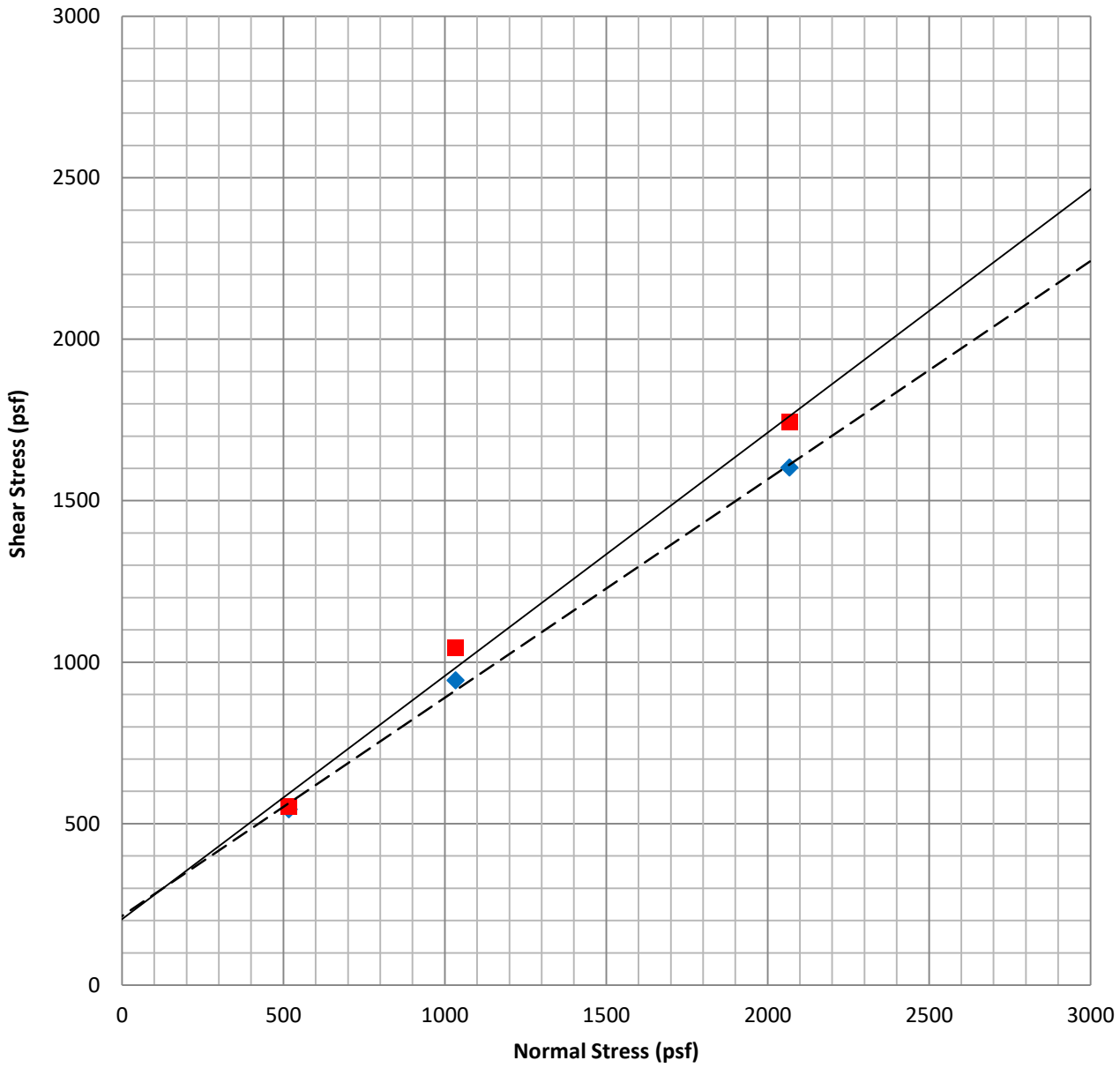
DIRECT SHEAR TEST RESULTS



Sample	Symbol	Description	Soil Type [USCS]	Shear Strength	Friction Angle, ϕ [degrees]	Cohesion, c [psf]
B12 @ 15'	—■—	Silty Sand	SM	Peak	37.0	204
B12 @ 15'	– –◆– –	Silty Sand	SM	Ultimate	34.1	214

Sample Moisture [%]	Saturated Moisture [%]	Dry Unit Weight [pcf]
14.7	17.3	115.9
ASTM D-3080		

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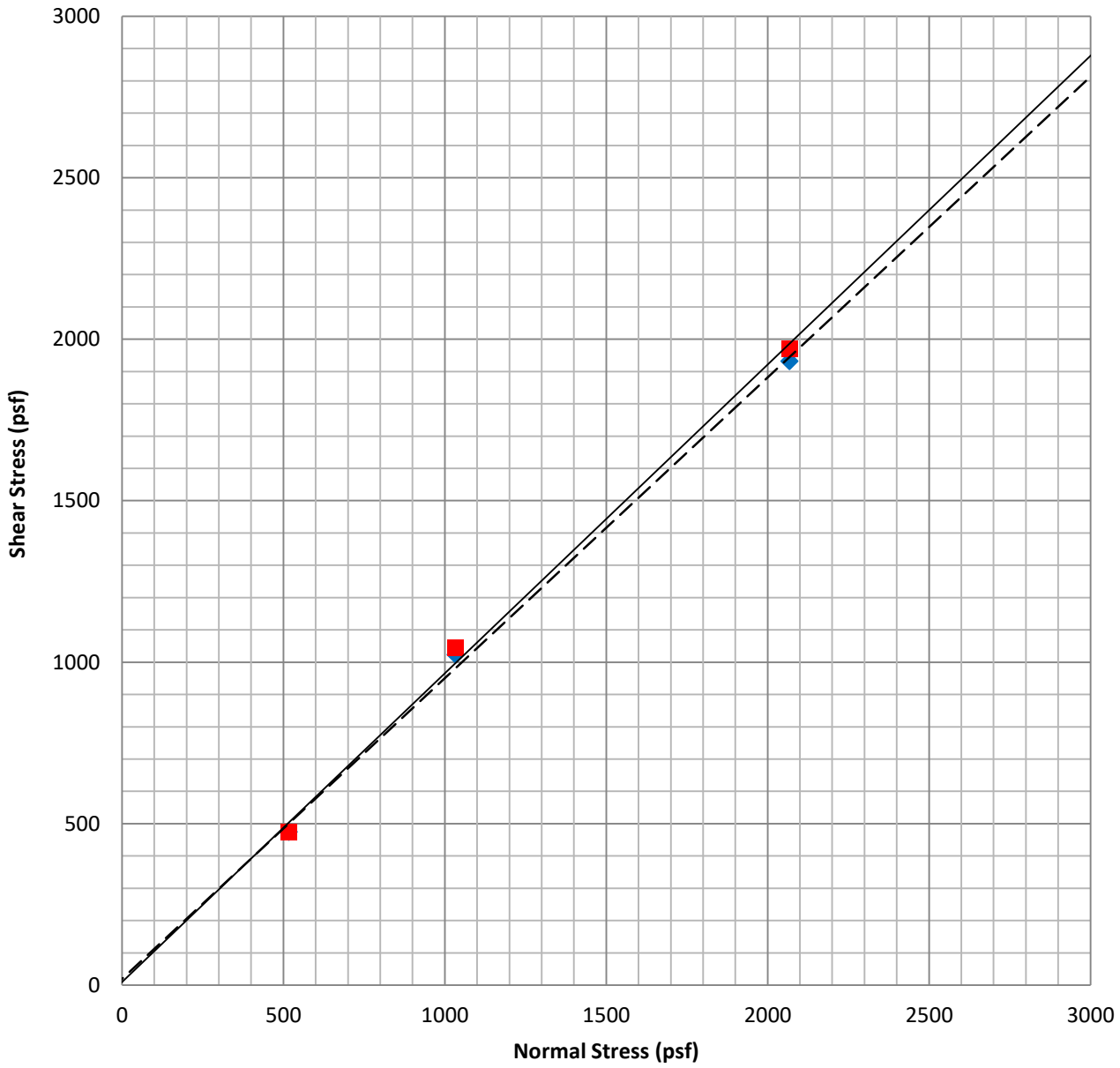
DIRECT SHEAR TEST RESULTS



Sample	Symbol	Description	Soil Type [USCS]	Shear Strength	Friction Angle, ϕ [degrees]	Cohesion, c [psf]
B13 @ 10'	—■—	Sand with Silt	SP-SM	Peak	43.7	9
B13 @ 10'	– –◆– –	Sand with Silt	SP-SM	Ultimate	43.0	19

Sample Moisture [%]	Saturated Moisture [%]	Dry Unit Weight [pcf]
14.2	17.2	111.8
ASTM D-3080		

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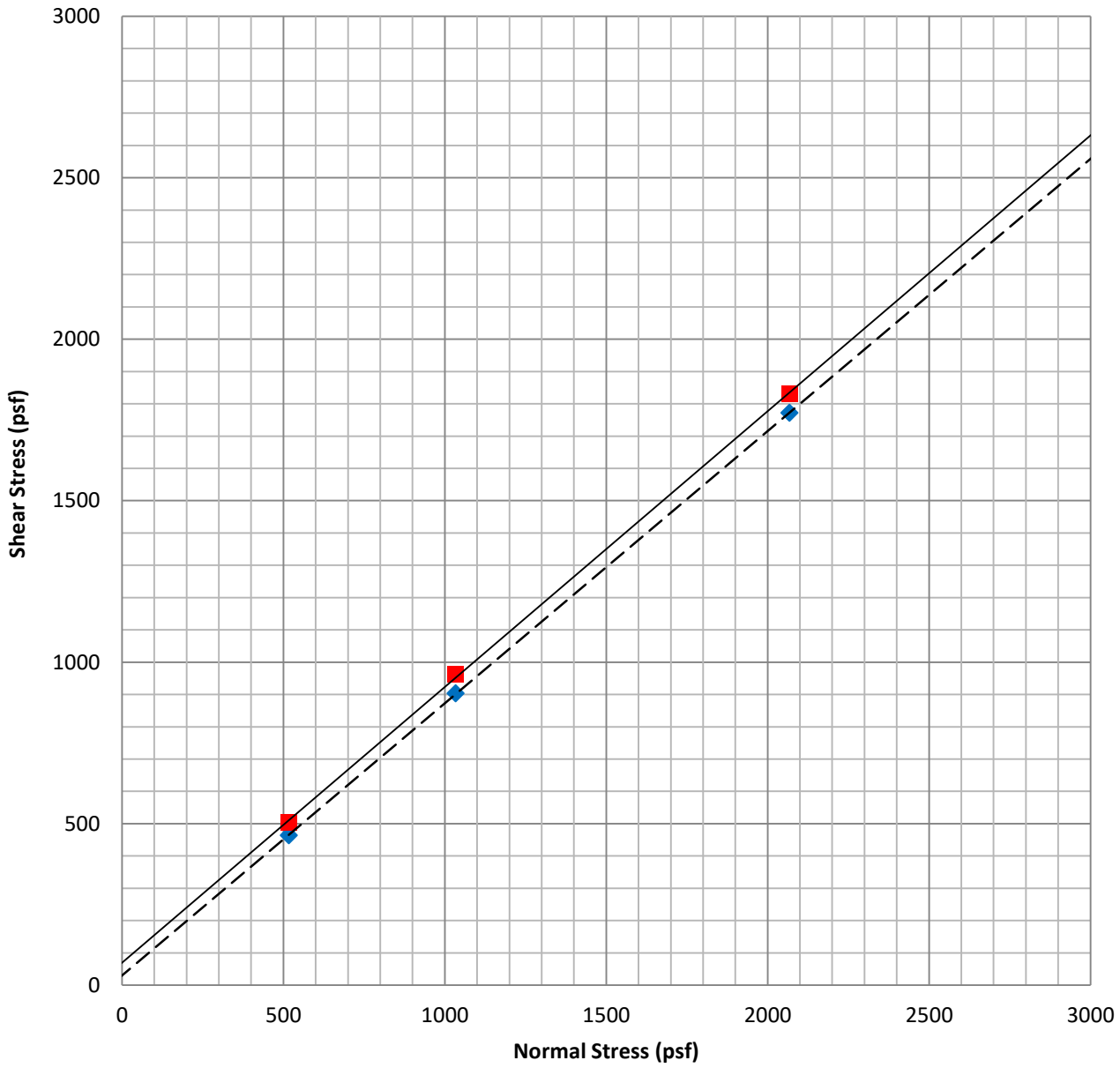
DIRECT SHEAR TEST RESULTS



Sample	Symbol	Description	Soil Type [USCS]	Shear Strength	Friction Angle, ϕ [degrees]	Cohesion, c [psf]
B14 @ 5'	—■—	Sand with Silt	SW-SM	Peak	40.5	69
B14 @ 5'	– –◆– –	Sand with Silt	SW-SM	Ultimate	40.1	29

Sample Moisture [%]	Saturated Moisture [%]	Dry Unit Weight [pcf]
31.4	21.1	92.7
ASTM D-3080		

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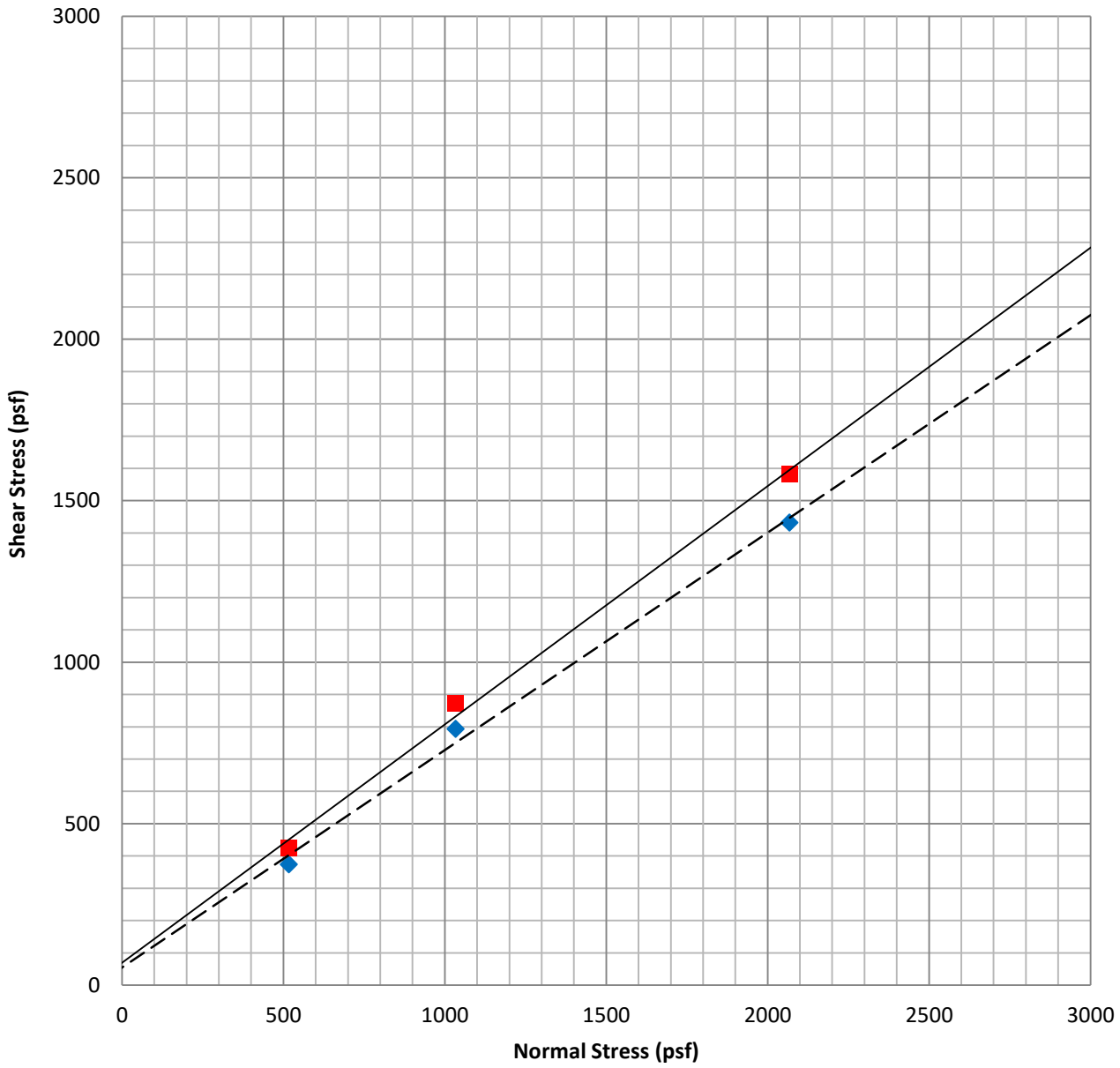
DIRECT SHEAR TEST RESULTS



Sample	Symbol	Description	Soil Type [USCS]	Shear Strength	Friction Angle, ϕ [degrees]	Cohesion, c [psf]
B15 @ 15'	—■—	Silty Sand	SM	Peak	36.4	69
B15 @ 15'	– –◆– –	Silty Sand	SM	Ultimate	33.9	54

Sample Moisture [%]	Saturated Moisture [%]	Dry Unit Weight [pcf]
10.5	16.9	112.5
ASTM D-3080		

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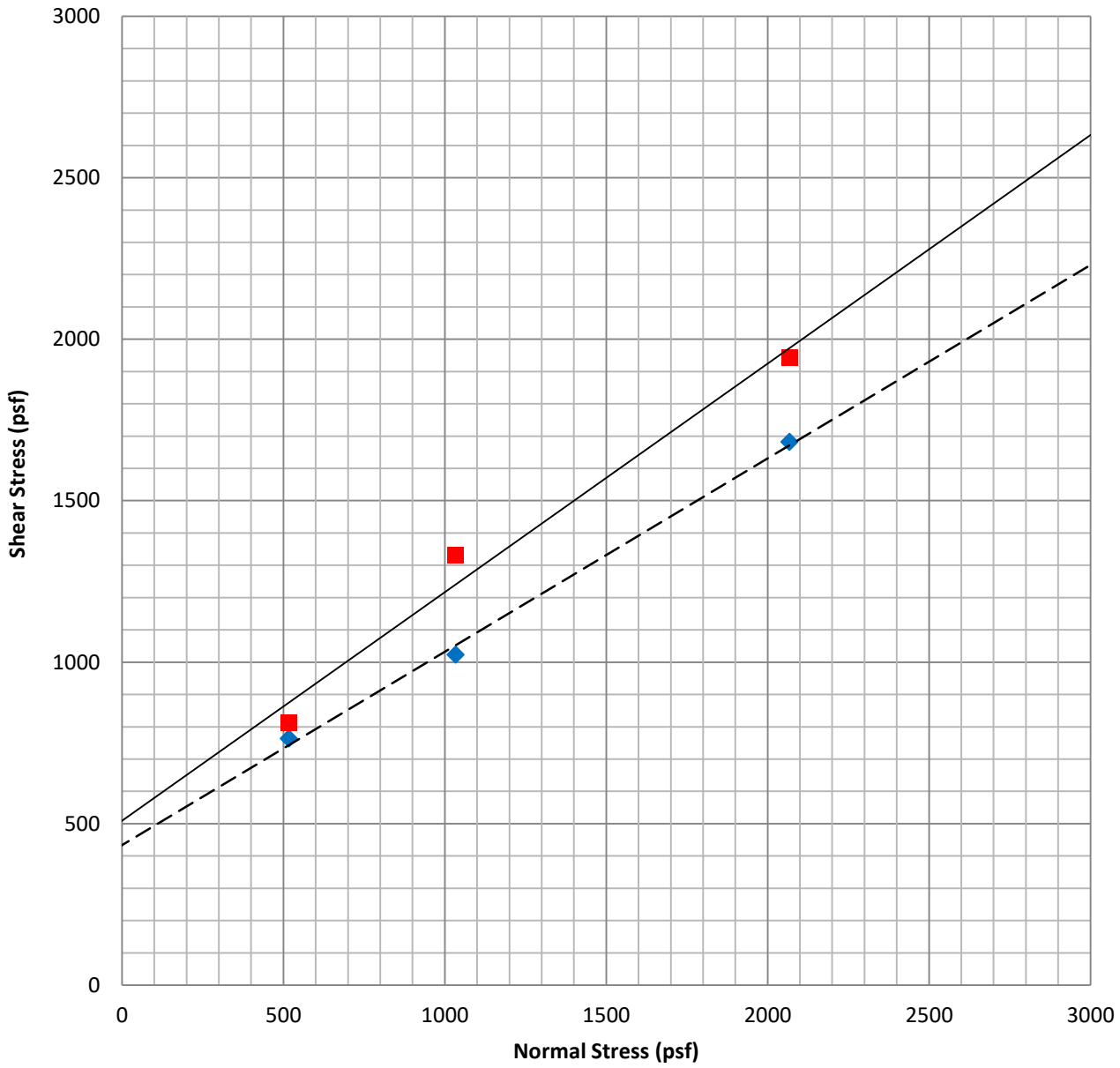
DIRECT SHEAR TEST RESULTS



Sample	Symbol	Description	Soil Type [USCS]	Shear Strength	Friction Angle, ϕ [degrees]	Cohesion, c [psf]
B16 @ 10'	—■—	Clayey Sand	SC	Peak	35.3	509
B16 @ 10'	– –◆– –	Clayey Sand	SC	Ultimate	30.9	434

Sample Moisture [%]	Saturated Moisture [%]	Dry Unit Weight [pcf]
12.6	15.9	121.6
ASTM D-3080		

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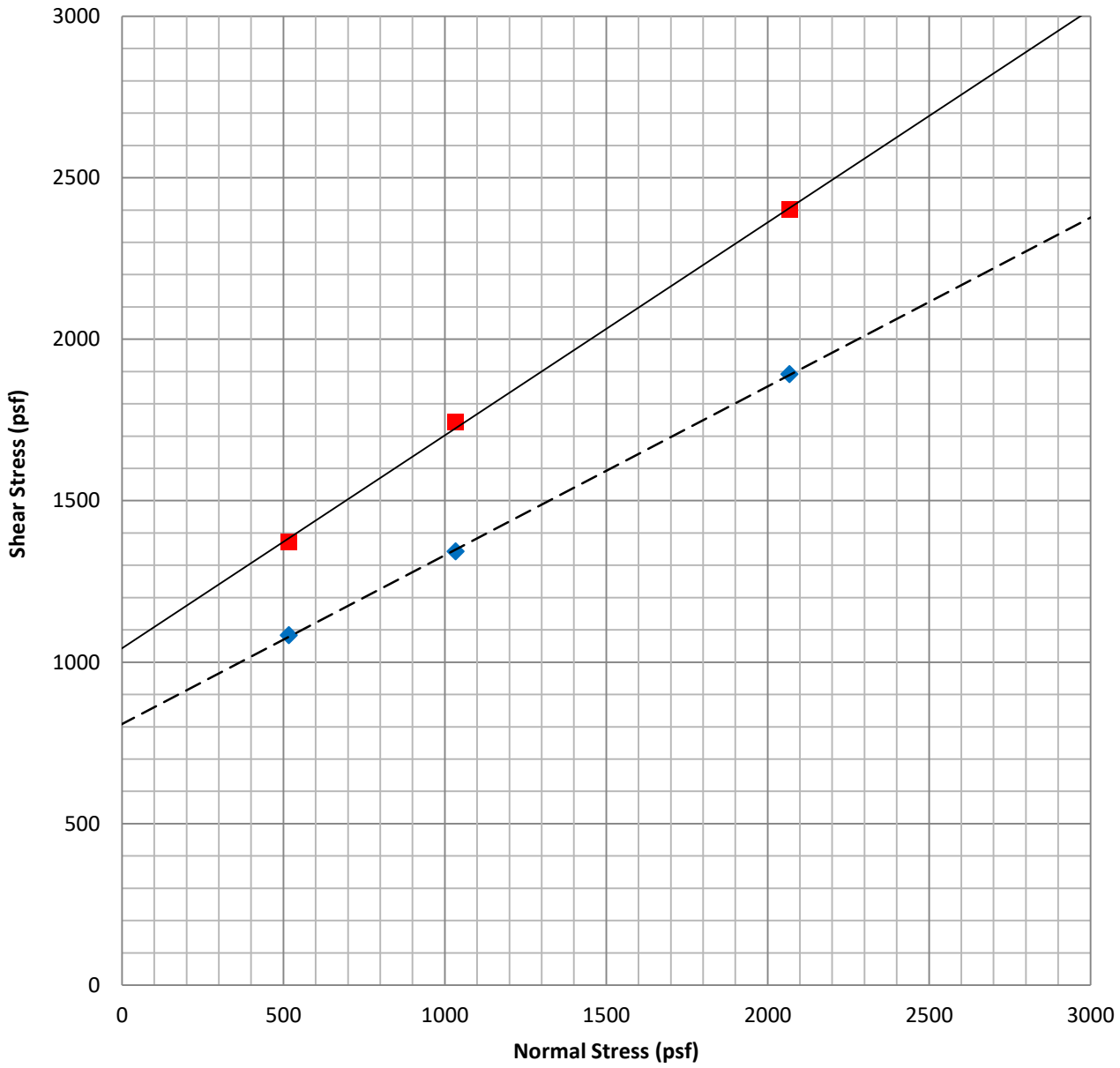
DIRECT SHEAR TEST RESULTS



Sample	Symbol	Description	Soil Type [USCS]	Shear Strength	Friction Angle, ϕ [degrees]	Cohesion, c [psf]
B17 @ 5'	—■—	Sandy Clay	CL	Peak	33.4	1043
B17 @ 5'	– –◆– –	Sandy Clay	CL	Ultimate	27.6	808

Sample Moisture [%]	Saturated Moisture [%]	Dry Unit Weight [pcf]
16.0	20.8	114.4
ASTM D-3080		

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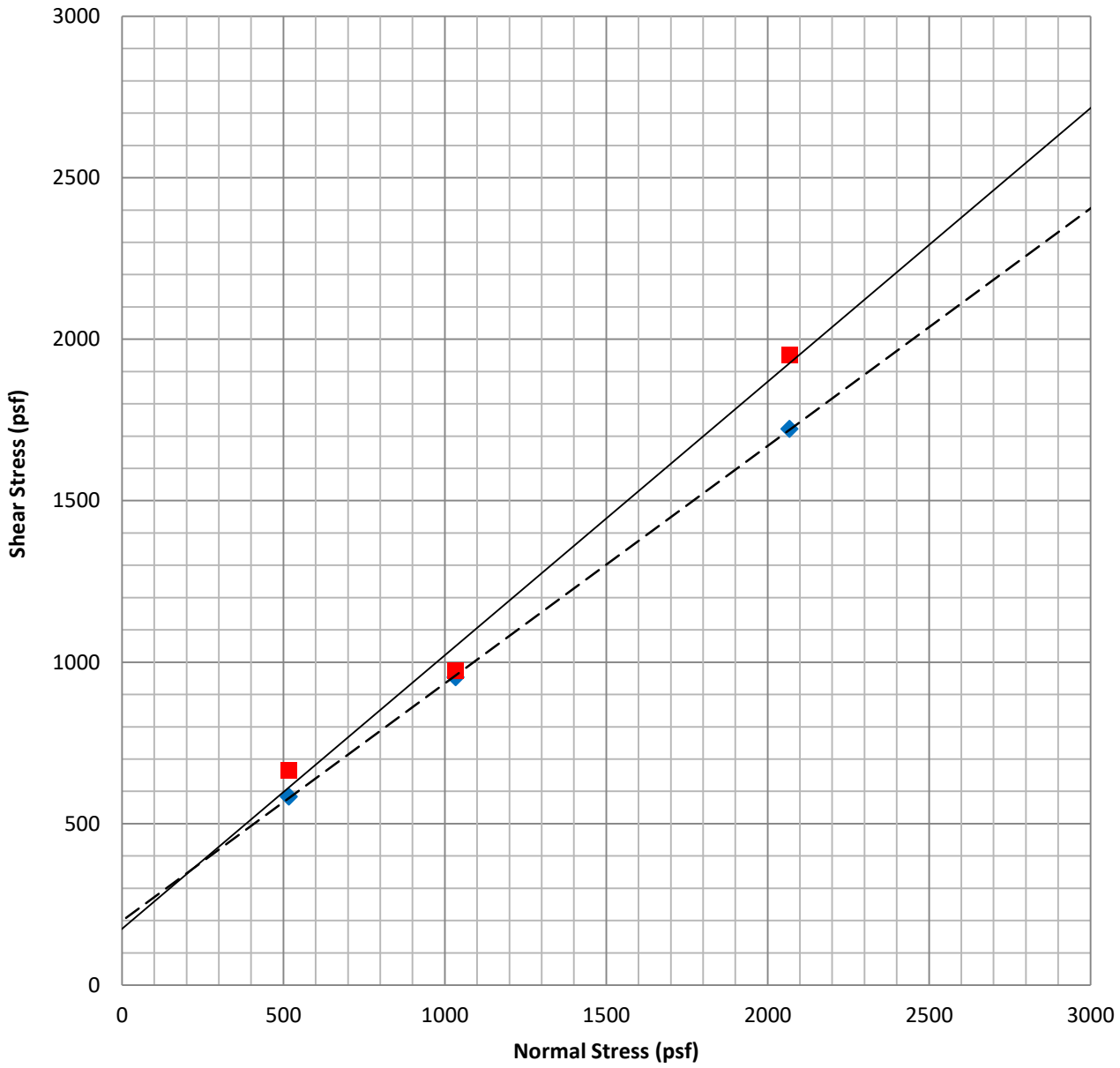
DIRECT SHEAR TEST RESULTS



Sample	Symbol	Description	Soil Type [USCS]	Shear Strength	Friction Angle, ϕ [degrees]	Cohesion, c [psf]
B18 @ 10'	—■—	Clayey Sand	SC	Peak	40.3	174
B18 @ 10'	– –◆– –	Clayey Sand	SC	Ultimate	36.3	199

Sample Moisture [%]	Saturated Moisture [%]	Dry Unit Weight [pcf]
21.9	25.8	102.3
ASTM D-3080		

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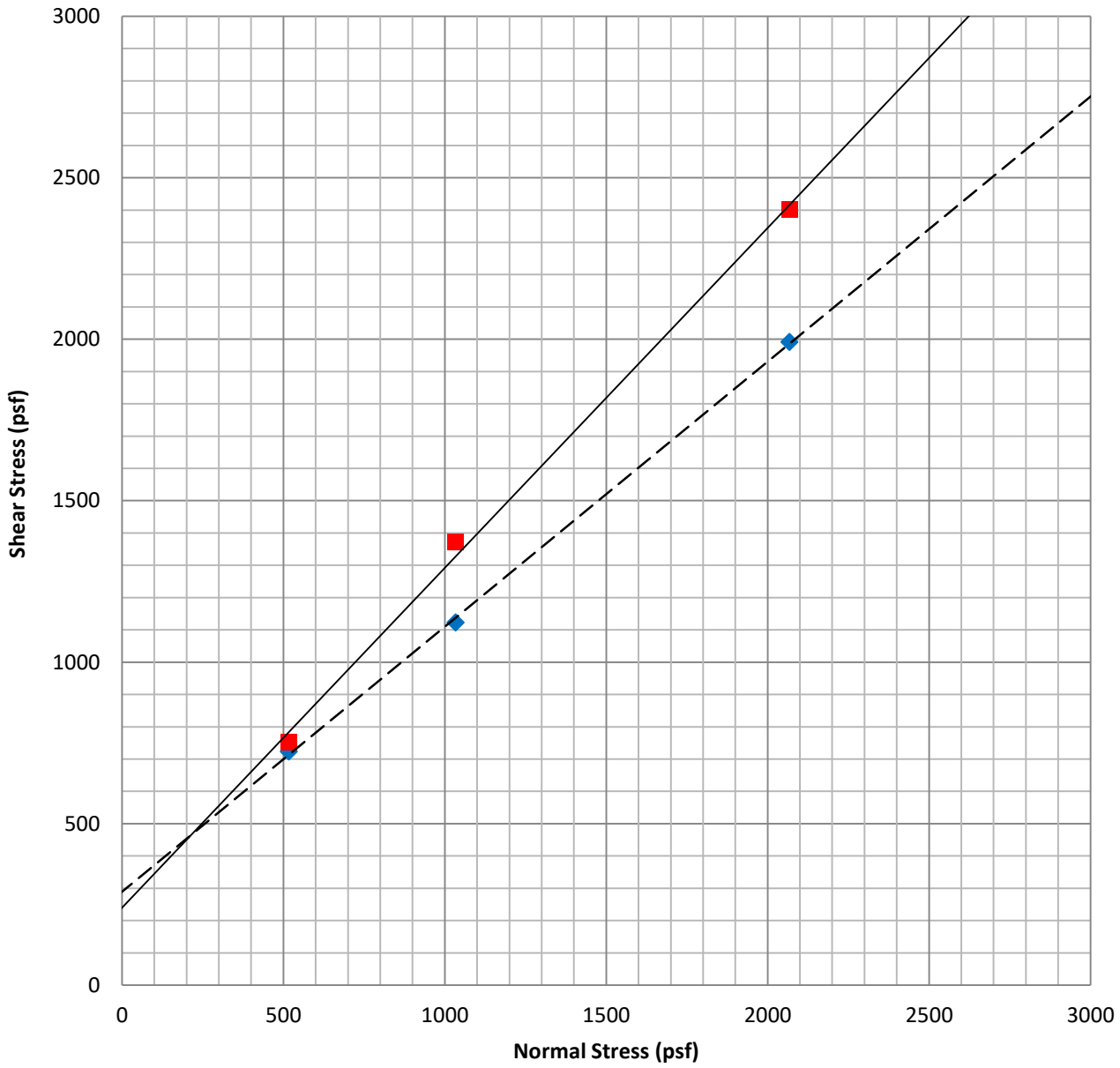
DIRECT SHEAR TEST RESULTS



Sample	Symbol	Description	Soil Type [USCS]	Shear Strength	Friction Angle, ϕ [degrees]	Cohesion, c [psf]
B19 @ 5'	—■—	Clayey Sand	SC	Peak	46.5	239
B19 @ 5'	– –◆– –	Clayey Sand	SC	Ultimate	39.4	289

Sample Moisture [%]	Saturated Moisture [%]	Dry Unit Weight [pcf]
14.0	21.2	109.3
ASTM D-3080		

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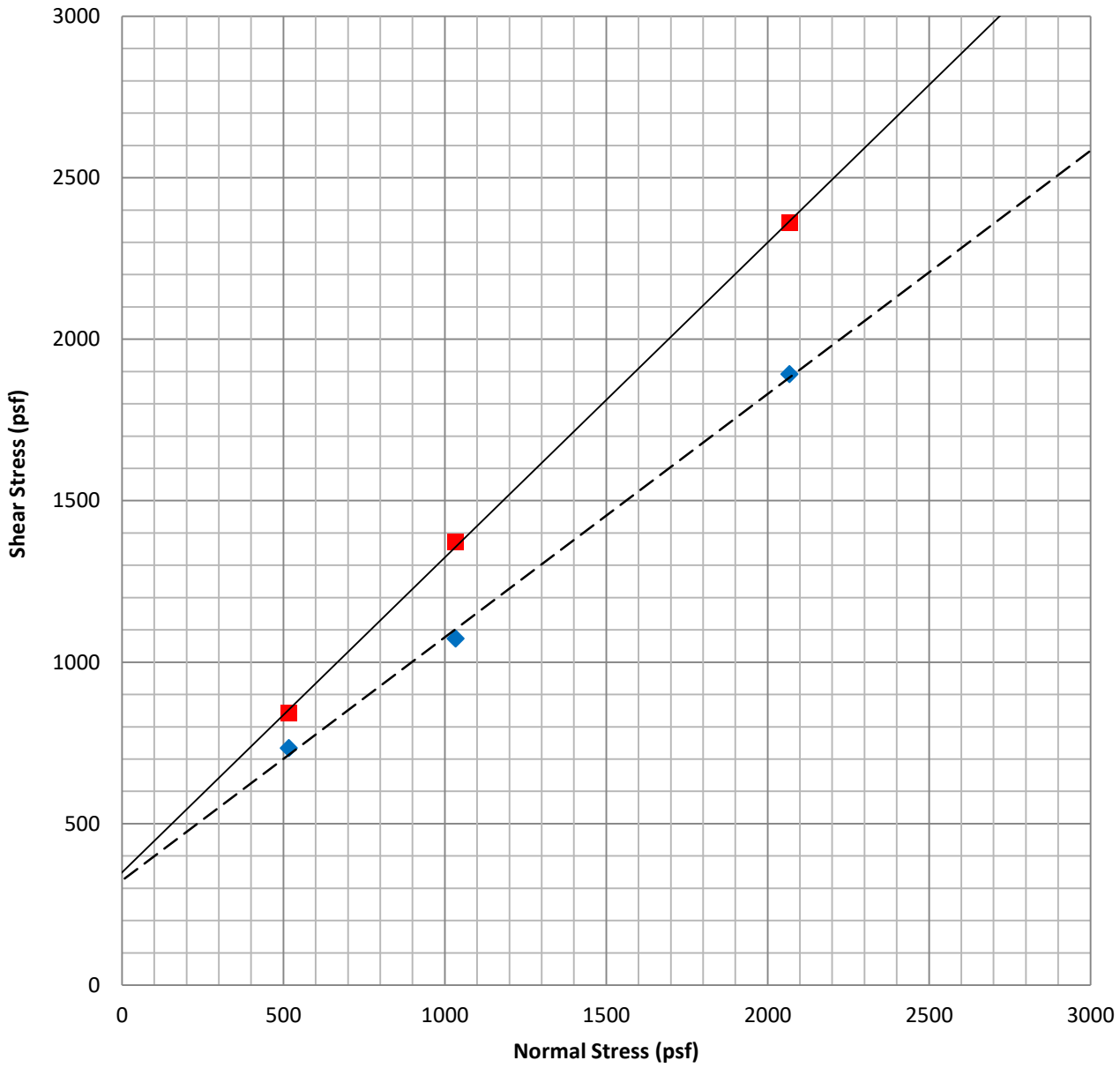
DIRECT SHEAR TEST RESULTS



Sample	Symbol	Description	Soil Type [USCS]	Shear Strength	Friction Angle, ϕ [degrees]	Cohesion, c [psf]
B20 @ 10'	—■—	Clayey Sand	SC	Peak	44.3	349
B20 @ 10'	– –◆– –	Clayey Sand	SC	Ultimate	37.0	324

Sample Moisture [%]	Saturated Moisture [%]	Dry Unit Weight [pcf]
10.6	19.5	118.0
ASTM D-3080		

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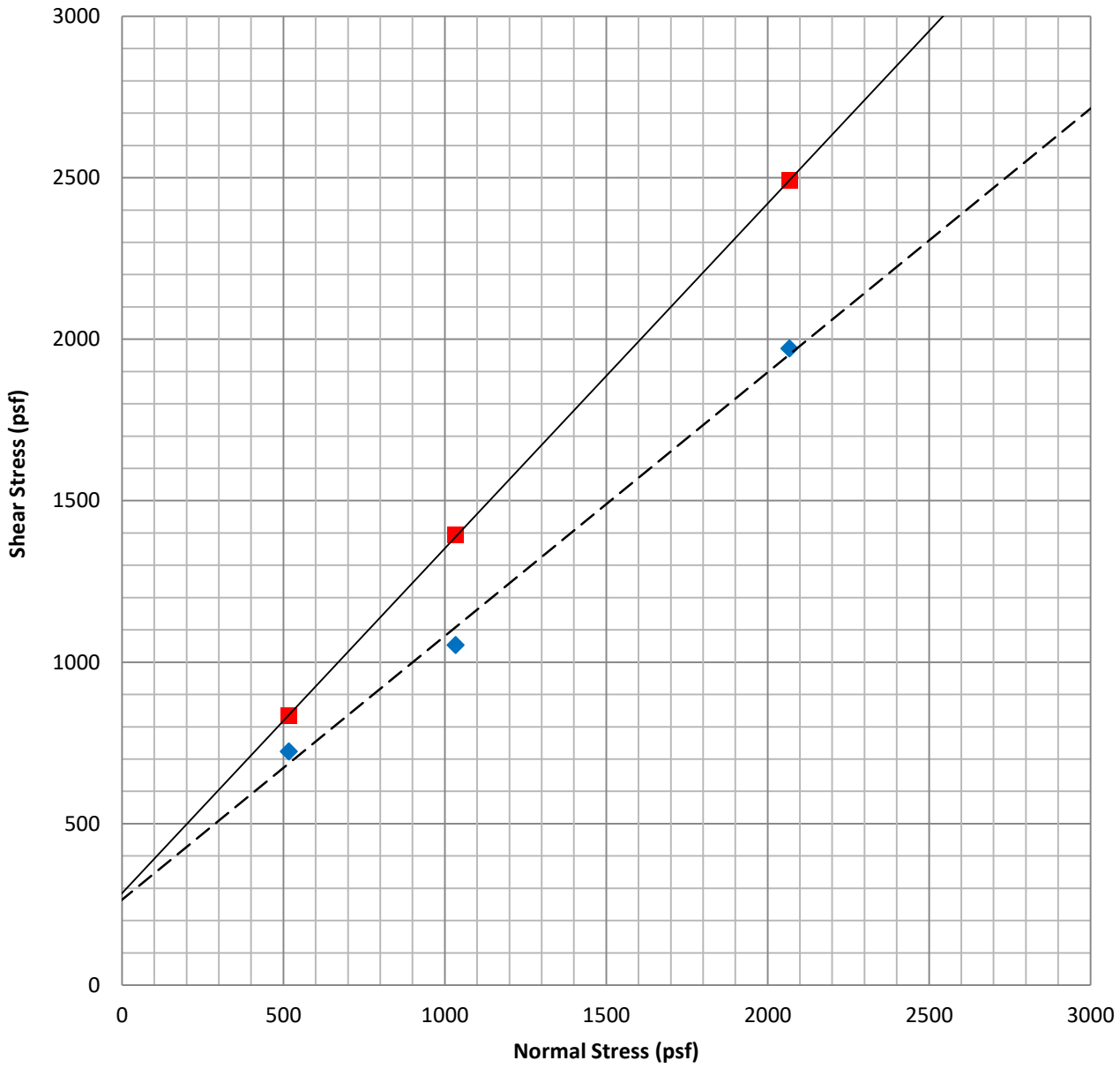
DIRECT SHEAR TEST RESULTS



Sample	Symbol	Description	Soil Type [USCS]	Shear Strength	Friction Angle, ϕ [degrees]	Cohesion, c [psf]
B21 @ 5'	—■—	Clayey Sand	SC	Peak	46.9	284
B21 @ 5'	– –◆– –	Clayey Sand	SC	Ultimate	39.2	264

Sample Moisture [%]	Saturated Moisture [%]	Dry Unit Weight [pcf]
15.7	25.1	104.6
ASTM D-3080		

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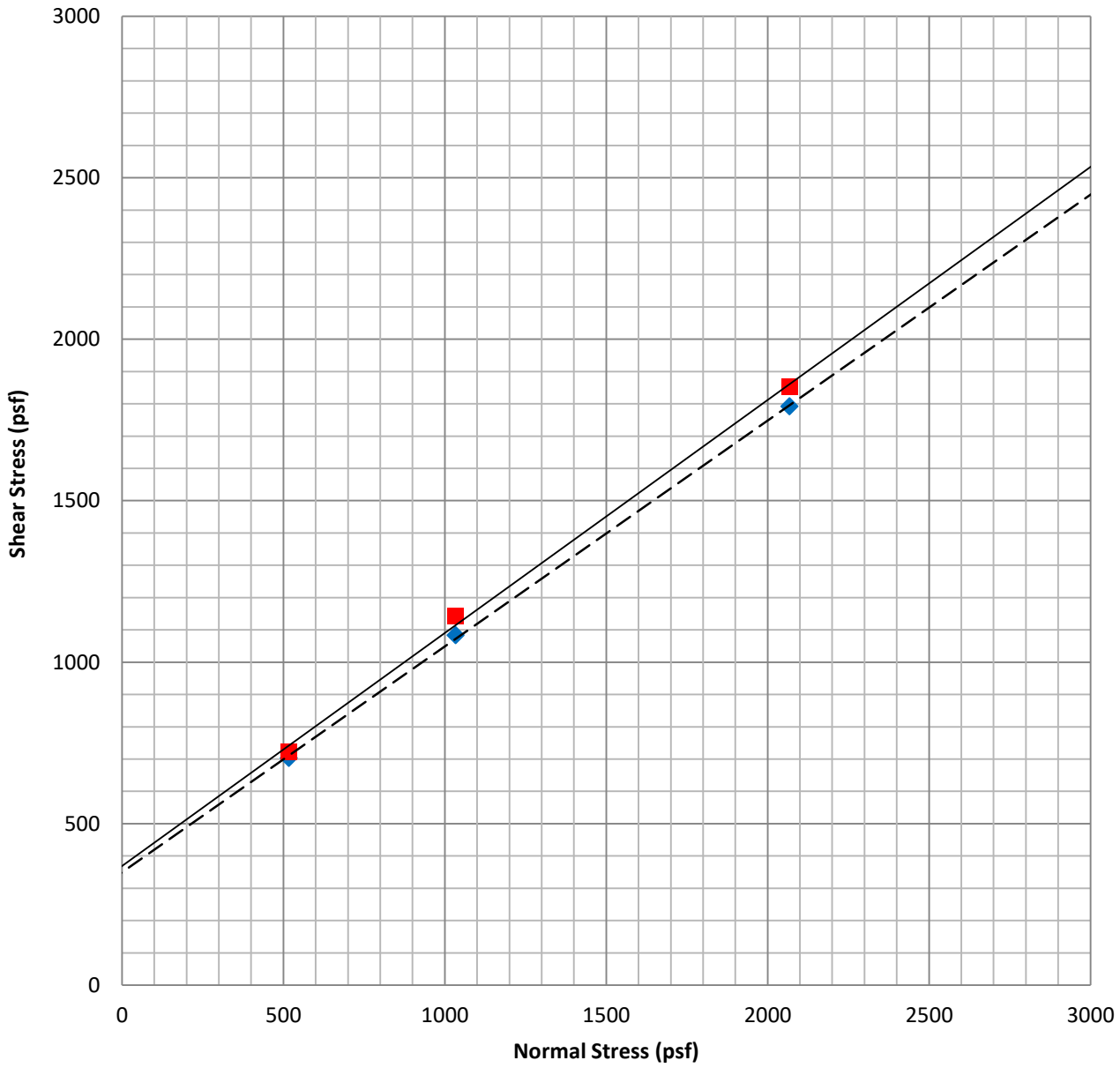
DIRECT SHEAR TEST RESULTS



Sample	Symbol	Description	Soil Type [USCS]	Shear Strength	Friction Angle, ϕ [degrees]	Cohesion, c [psf]
B22 @ 15'	—■—	Silty Sand	SM	Peak	35.8	369
B22 @ 15'	– –◆– –	Silty Sand	SM	Ultimate	35.0	349

Sample Moisture [%]	Saturated Moisture [%]	Dry Unit Weight [pcf]
13.9	26.2	96.8
ASTM D-3080		

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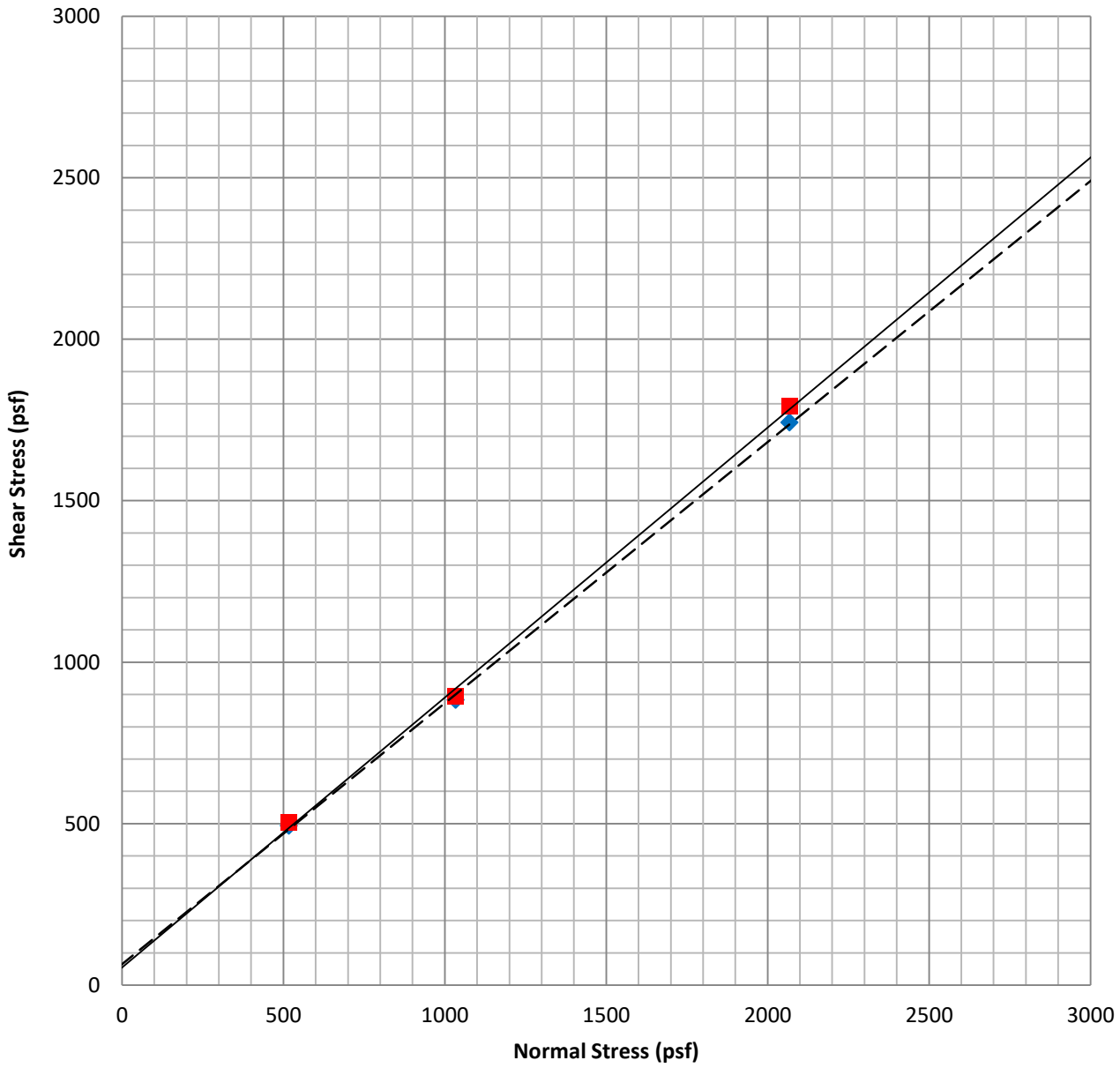
DIRECT SHEAR TEST RESULTS



Sample	Symbol	Description	Soil Type [USCS]	Shear Strength	Friction Angle, ϕ [degrees]	Cohesion, c [psf]
B23 @ 10'	—■—	Poorly-Graded Sand	SP	Peak	39.9	54
B23 @ 10'	– –◆– –	Poorly-Graded Sand	SP	Ultimate	39.0	64

Sample Moisture [%]	Saturated Moisture [%]	Dry Unit Weight [pcf]
9.5	16.6	114.2
ASTM D-3080		

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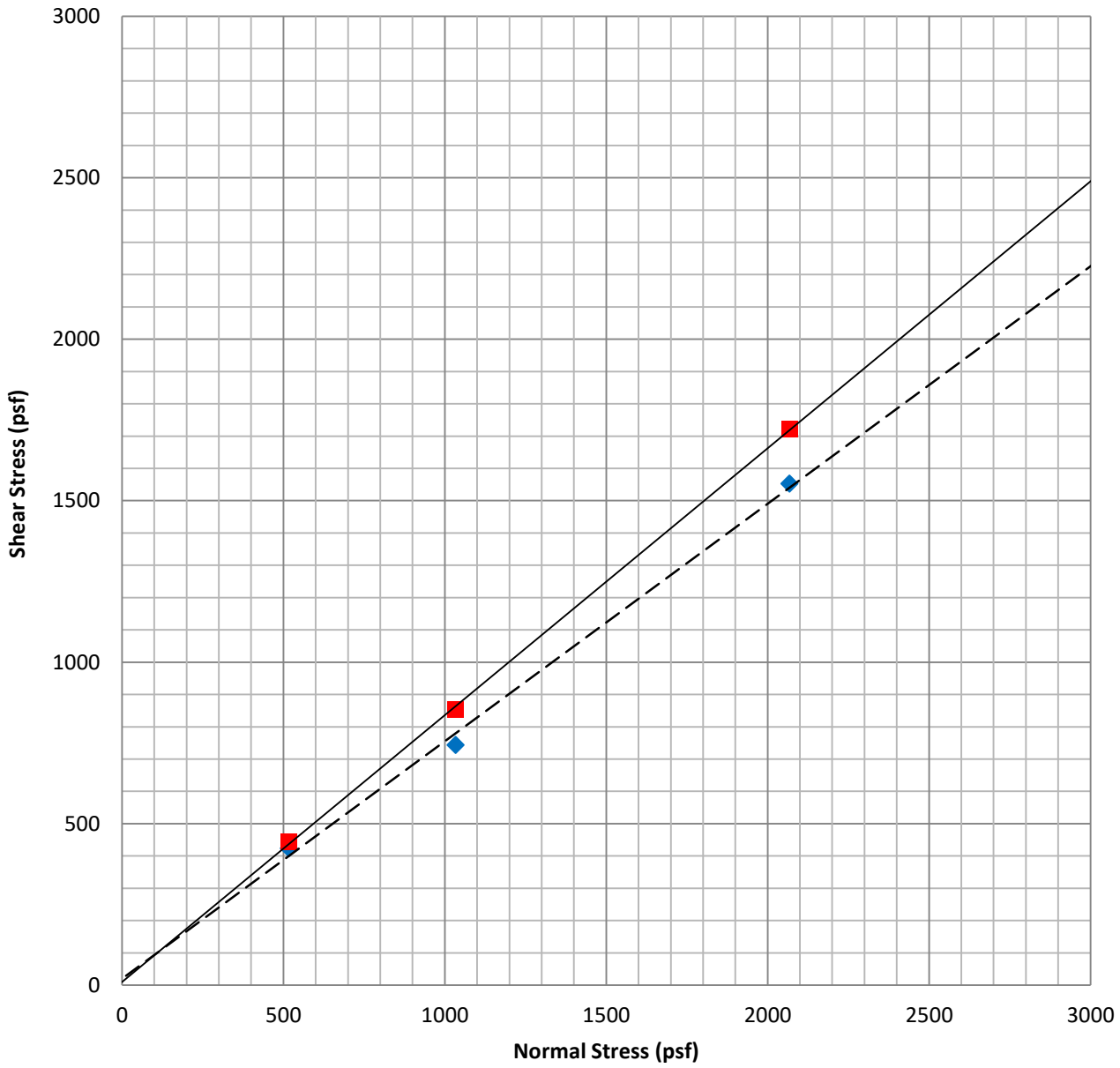
DIRECT SHEAR TEST RESULTS



Sample	Symbol	Description	Soil Type [USCS]	Shear Strength	Friction Angle, ϕ [degrees]	Cohesion, c [psf]
B24 @ 5'	—■—	Clayey Sand	SC	Peak	39.6	9
B24 @ 5'	– –◆– –	Clayey Sand	SC	Ultimate	36.3	19

Sample Moisture [%]	Saturated Moisture [%]	Dry Unit Weight [pcf]
11.0	15.2	114.3
ASTM D-3080		

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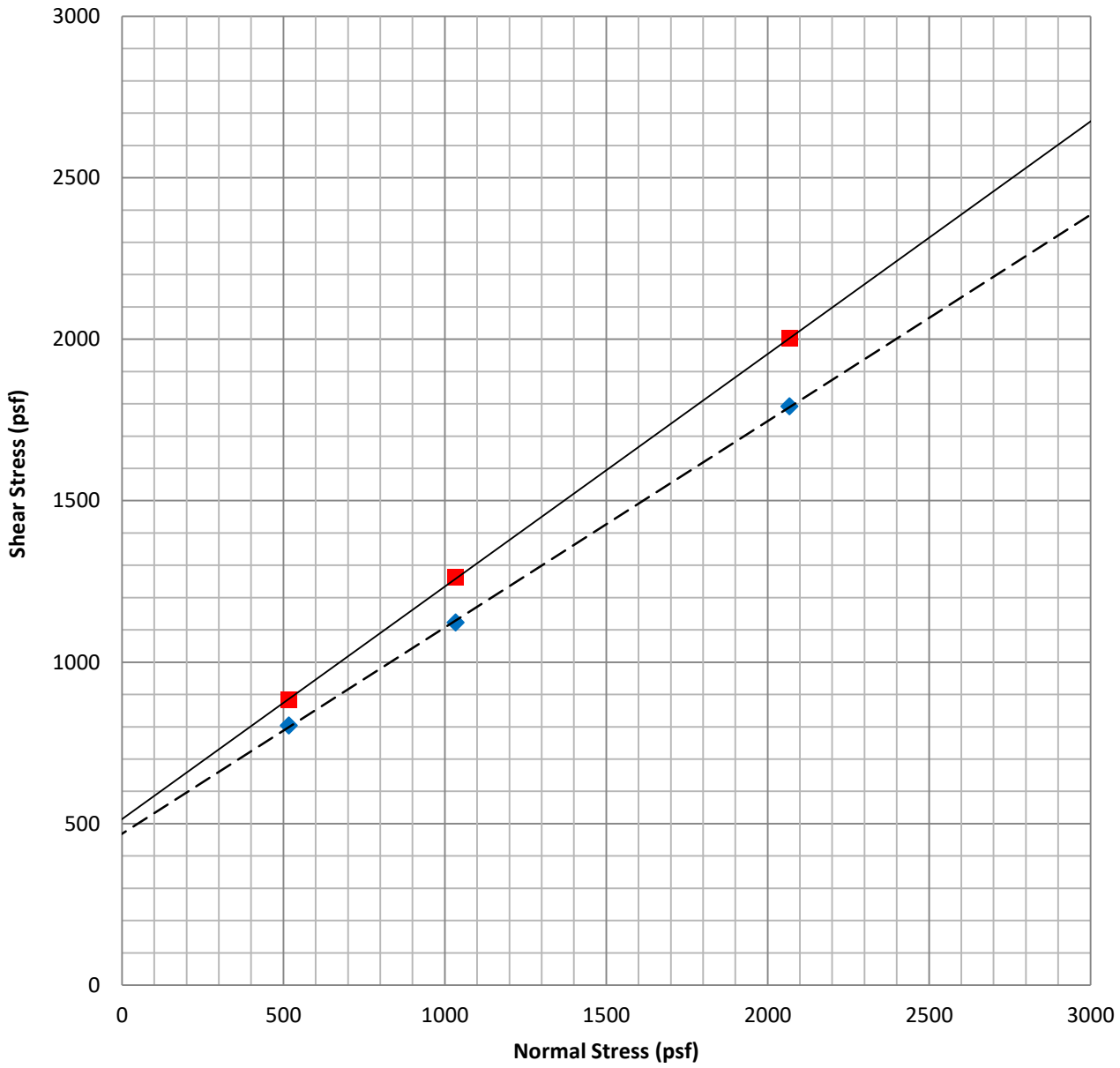
DIRECT SHEAR TEST RESULTS



Sample	Symbol	Description	Soil Type [USCS]	Shear Strength	Friction Angle, ϕ [degrees]	Cohesion, c [psf]
B25 @ 10'	—■—	Clayey Sand	SC	Peak	35.8	514
B25 @ 10'	– –◆– –	Clayey Sand	SC	Ultimate	32.6	469

Sample Moisture [%]	Saturated Moisture [%]	Dry Unit Weight [pcf]
17.5	24.9	105.9
ASTM D-3080		

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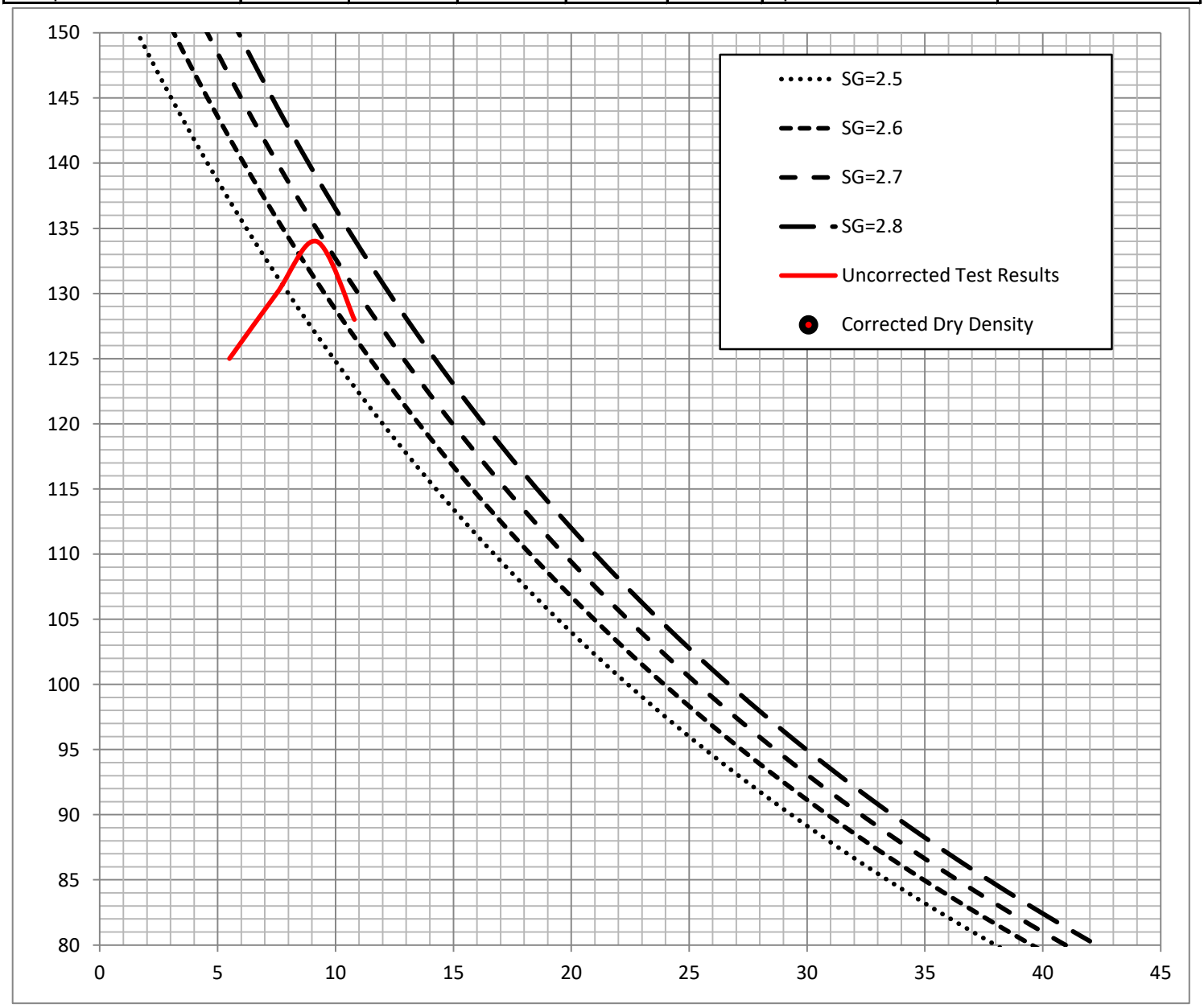
MAXIMUM DRY DENSITY - OPTIMUM MOISTURE

Project Name	RPW - Monroe Master Drainage Plan	**Test Date**	8/8/2017
Project No.	17066-01	**Date Sampled**	8/3/2017
Project Location	Gratton, Dufferin, and Hermosa	**Sampled By**	AM
Location In Structure	N/A	**Sample Type**	Bulk
Sample Location	Pavement Subgrade	**Tested By**	MN

Sample No.	B1	**Mold Size**	4-inch
Sample Depth	0-3'	**No. of Layers**	5
Soil Type	SC	**Blows per Layer**	25
Test Fraction	No.4	**Hammer Wt./Drop**	10-lb/18-inch

Total Sample Weight	g	**Bulk Spec. Grav. of Oversized**	2.600
Weight of Oversized	g	**Percentage of Dry Fines**	%
Weight of Fines	0 g	**Percentage of Dry Oversized**	<5% %
Moisture Content of Oversized	%	**Corrected Dry Density of Soil**	pcf
Moisture Content of Fines	%	**Corrected Optimum Moisture**	%

Test Data	Point 1	Point 2	Point 3	Point 4	Point 5	**Test Results (No Oversized Correction)**	
Compacted Dry Density	125.0	130.0	134.0	128.0		Maximum Dry Density	135.0 pcf
Compacted Moisture	5.5	7.5	9.2	10.8		Optimum Moisture	8.5 %



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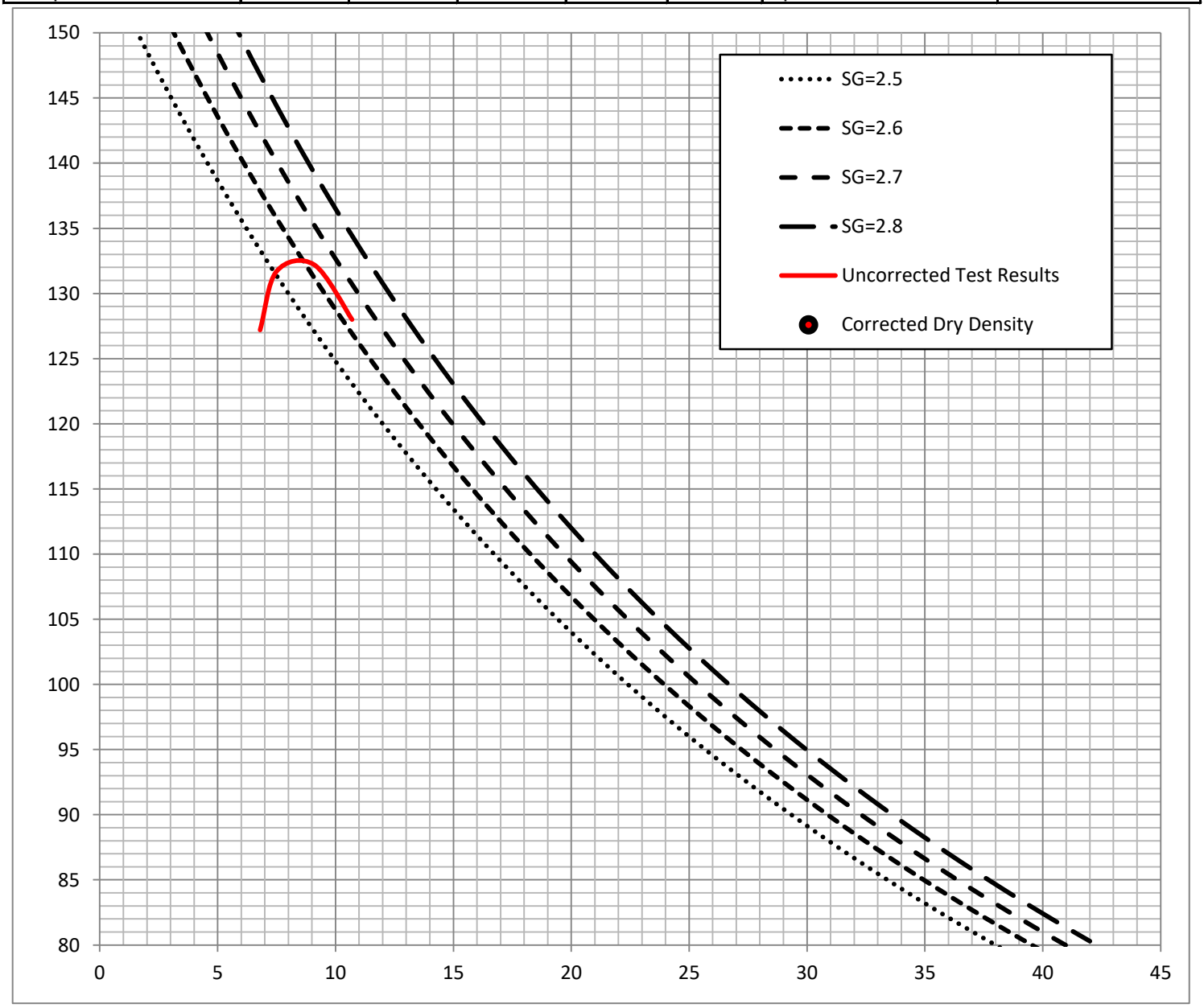
MAXIMUM DRY DENSITY - OPTIMUM MOISTURE

Project Name	RPW - Monroe Master Drainage Plan	**Test Date**	8/8/2017
Project No.	17066-01	**Date Sampled**	8/3/2017
Project Location	Gratton, Dufferin, and Hermosa	**Sampled By**	AM
Location In Structure	N/A	**Sample Type**	Bulk
Sample Location	Pavement Subgrade	**Tested By**	MN

Sample No.	B2	**Mold Size**	4-inch
Sample Depth	0-3'	**No. of Layers**	5
Soil Type	SC	**Blows per Layer**	25
Test Fraction	No.4	**Hammer Wt./Drop**	10-lb/18-inch

Total Sample Weight	g	**Bulk Spec. Grav. of Oversized**	2.600
Weight of Oversized	g	**Percentage of Dry Fines**	%
Weight of Fines	0 g	**Percentage of Dry Oversized**	<5% %
Moisture Content of Oversized	%	**Corrected Dry Density of Soil**	pcf
Moisture Content of Fines	%	**Corrected Optimum Moisture**	%

Test Data	Point 1	Point 2	Point 3	Point 4	Point 5	**Test Results (No Oversized Correction)**	
Compacted Dry Density	127.2	131.7	132.2	128.0		Maximum Dry Density	133.0 pcf
Compacted Moisture	6.8	7.5	9.1	10.7		Optimum Moisture	8.5 %



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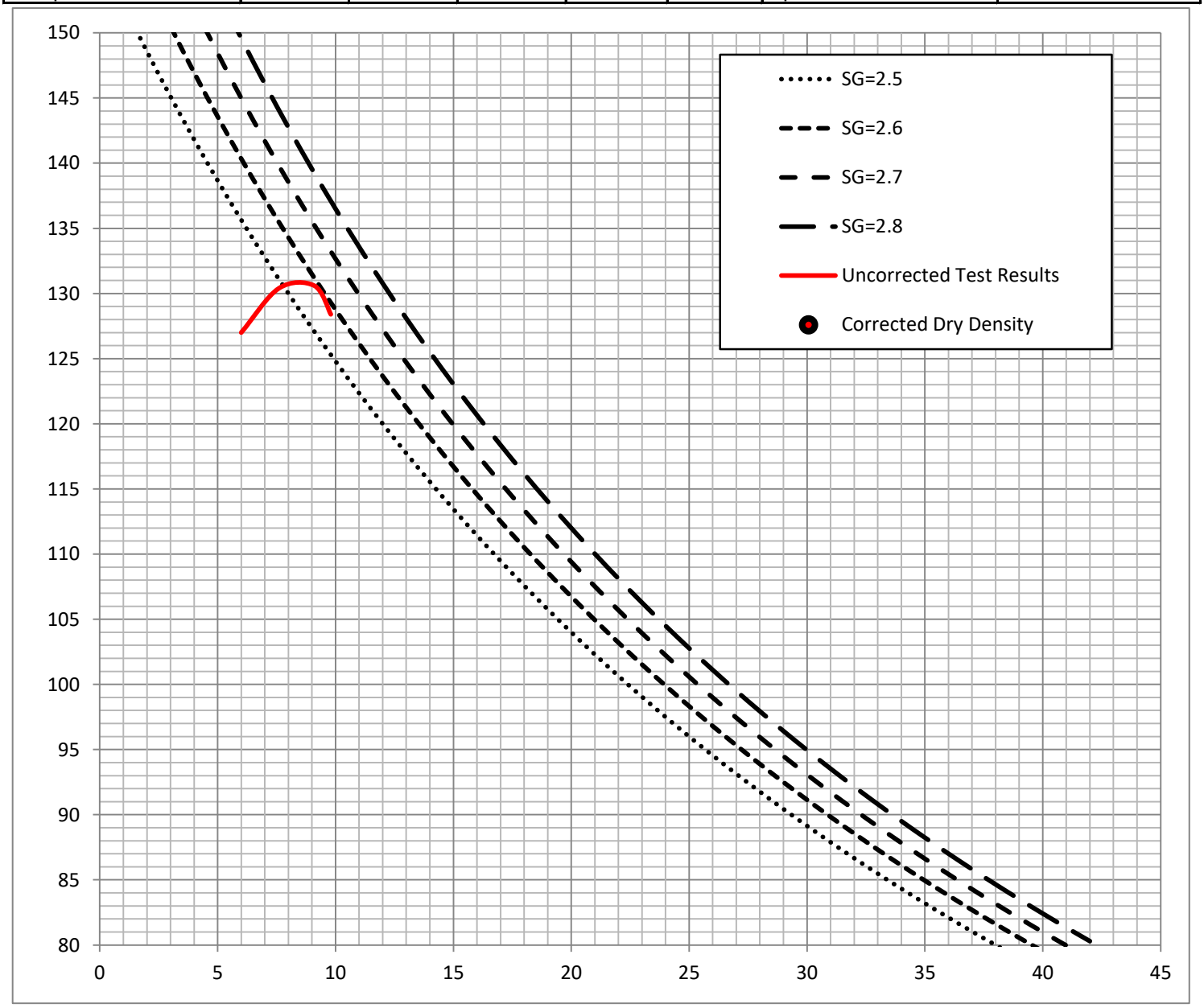
MAXIMUM DRY DENSITY - OPTIMUM MOISTURE

Project Name	RPW - Monroe Master Drainage Plan	**Test Date**	8/8/2017
Project No.	17066-01	**Date Sampled**	8/3/2017
Project Location	Gratton, Dufferin, and Hermosa	**Sampled By**	AM
Location In Structure	N/A	**Sample Type**	Bulk
Sample Location	Pavement Subgrade	**Tested By**	MN

Sample No.	B3	**Mold Size**	4-inch
Sample Depth	0-3'	**No. of Layers**	5
Soil Type	SC	**Blows per Layer**	25
Test Fraction	No.4	**Hammer Wt./Drop**	10-lb/18-inch

Total Sample Weight	g	**Bulk Spec. Grav. of Oversized**	2.600
Weight of Oversized	g	**Percentage of Dry Fines**	%
Weight of Fines	0 g	**Percentage of Dry Oversized**	<5% %
Moisture Content of Oversized	%	**Corrected Dry Density of Soil**	pcf
Moisture Content of Fines	%	**Corrected Optimum Moisture**	%

Test Data	Point 1	Point 2	Point 3	Point 4	Point 5	**Test Results (No Oversized Correction)**	
Compacted Dry Density	127.0	130.4	130.6	128.4		Maximum Dry Density	131.5 pcf
Compacted Moisture	6.0	7.6	9.1	9.8		Optimum Moisture	8.5 %



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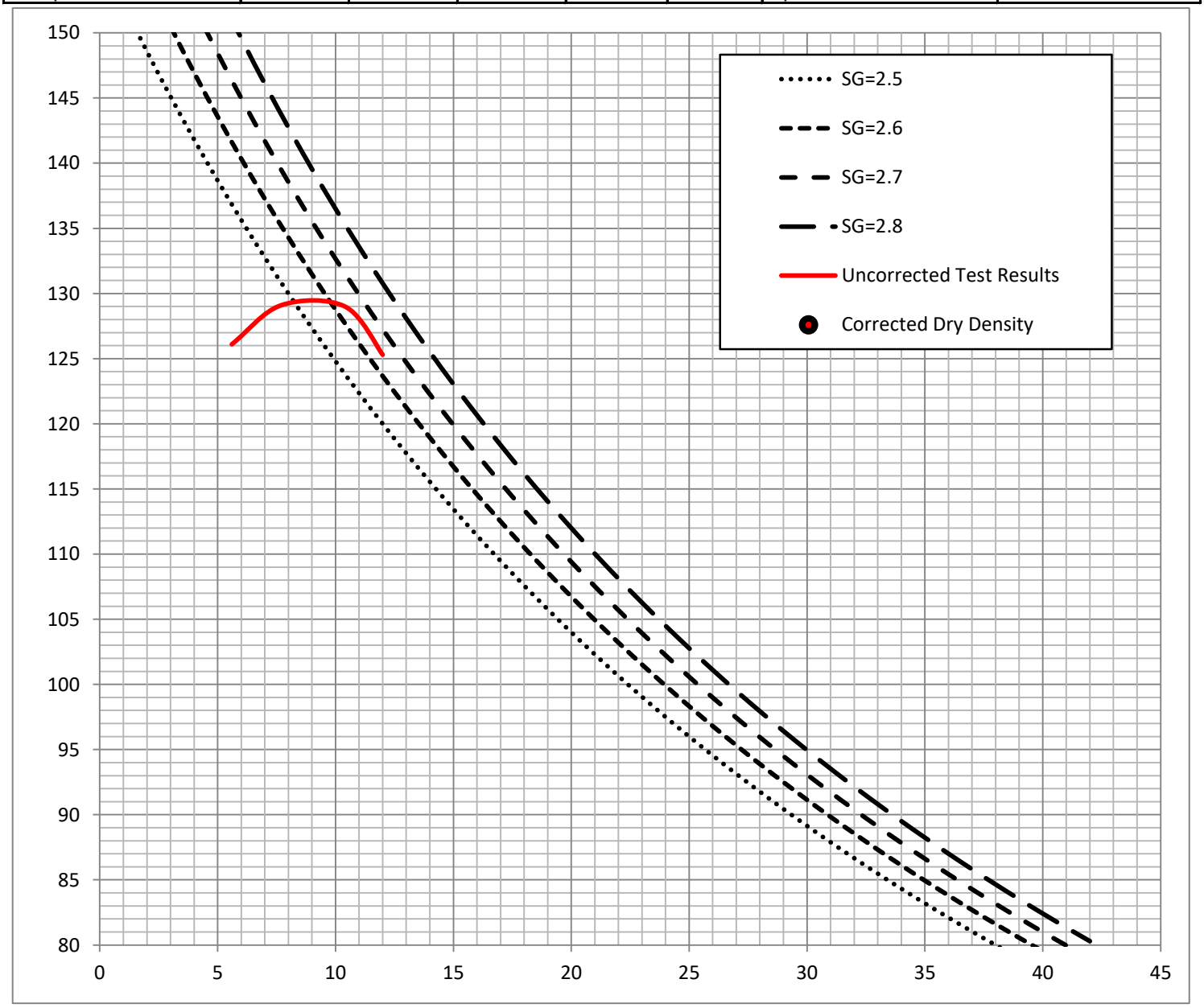
MAXIMUM DRY DENSITY - OPTIMUM MOISTURE

Project Name	RPW - Monroe Master Drainage Plan	**Test Date**	8/8/2017
Project No.	17066-01	**Date Sampled**	8/3/2017
Project Location	Gratton, Dufferin, and Hermosa	**Sampled By**	AM
Location In Structure	N/A	**Sample Type**	Bulk
Sample Location	Pavement Subgrade	**Tested By**	MN

Sample No.	B4	**Mold Size**	4-inch
Sample Depth	0-3'	**No. of Layers**	5
Soil Type	SC	**Blows per Layer**	25
Test Fraction	No.4	**Hammer Wt./Drop**	10-lb/18-inch

Total Sample Weight	g	**Bulk Spec. Grav. of Oversized**	2.600
Weight of Oversized	g	**Percentage of Dry Fines**	%
Weight of Fines	0 g	**Percentage of Dry Oversized**	<5% %
Moisture Content of Oversized	%	**Corrected Dry Density of Soil**	pcf
Moisture Content of Fines	%	**Corrected Optimum Moisture**	%

Test Data	Point 1	Point 2	Point 3	Point 4	Point 5	**Test Results (No Oversized Correction)**	
Compacted Dry Density	126.1	129.1	129.0	125.3		Maximum Dry Density	130.0 pcf
Compacted Moisture	5.6	7.7	10.4	12.0		Optimum Moisture	9.0 %



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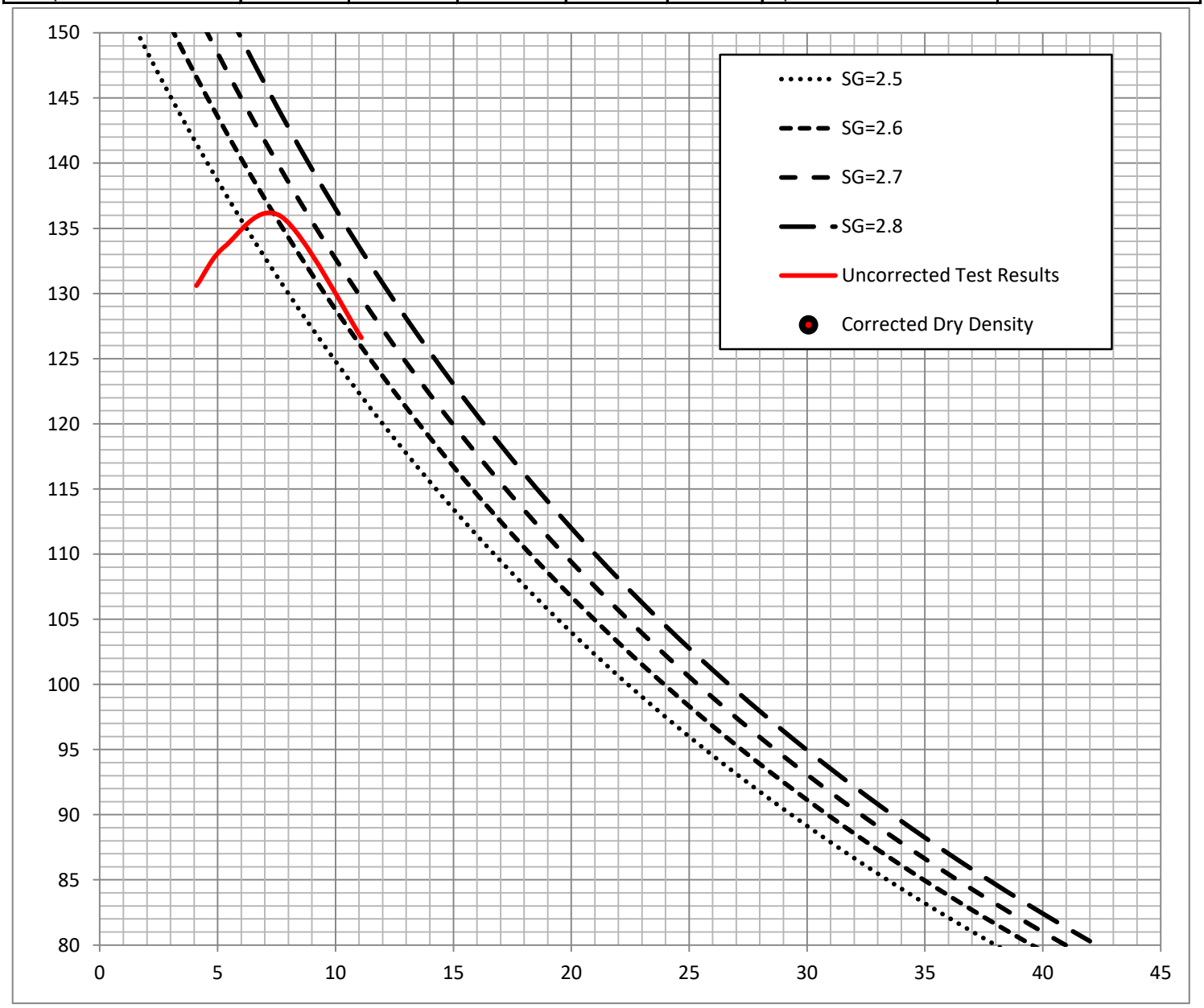
MAXIMUM DRY DENSITY - OPTIMUM MOISTURE

Project Name	RPW - Monroe Master Drainage Plan	**Test Date**	8/8/2017
Project No.	17066-01	**Date Sampled**	8/3/2017
Project Location	Gratton, Dufferin, and Hermosa	**Sampled By**	AM
Location In Structure	N/A	**Sample Type**	Bulk
Sample Location	Pavement Subgrade	**Tested By**	MN

Sample No.	B5	**Mold Size**	4-inch
Sample Depth	0-3'	**No. of Layers**	5
Soil Type	SM	**Blows per Layer**	25
Test Fraction	No.4	**Hammer Wt./Drop**	10-lb/18-inch

Total Sample Weight	g	**Bulk Spec. Grav. of Oversized**	2.600
Weight of Oversized	g	**Percentage of Dry Fines**	%
Weight of Fines	0 g	**Percentage of Dry Oversized**	<5% %
Moisture Content of Oversized	%	**Corrected Dry Density of Soil**	pcf
Moisture Content of Fines	%	**Corrected Optimum Moisture**	%

Test Data	Point 1	Point 2	Point 3	Point 4	Point 5	**Test Results (No Oversized Correction)**	
Compacted Dry Density	130.6	133.6	135.9	126.6		Maximum Dry Density	136.5 pcf
Compacted Moisture	4.1	5.3	7.7	11.1		Optimum Moisture	7.0 %



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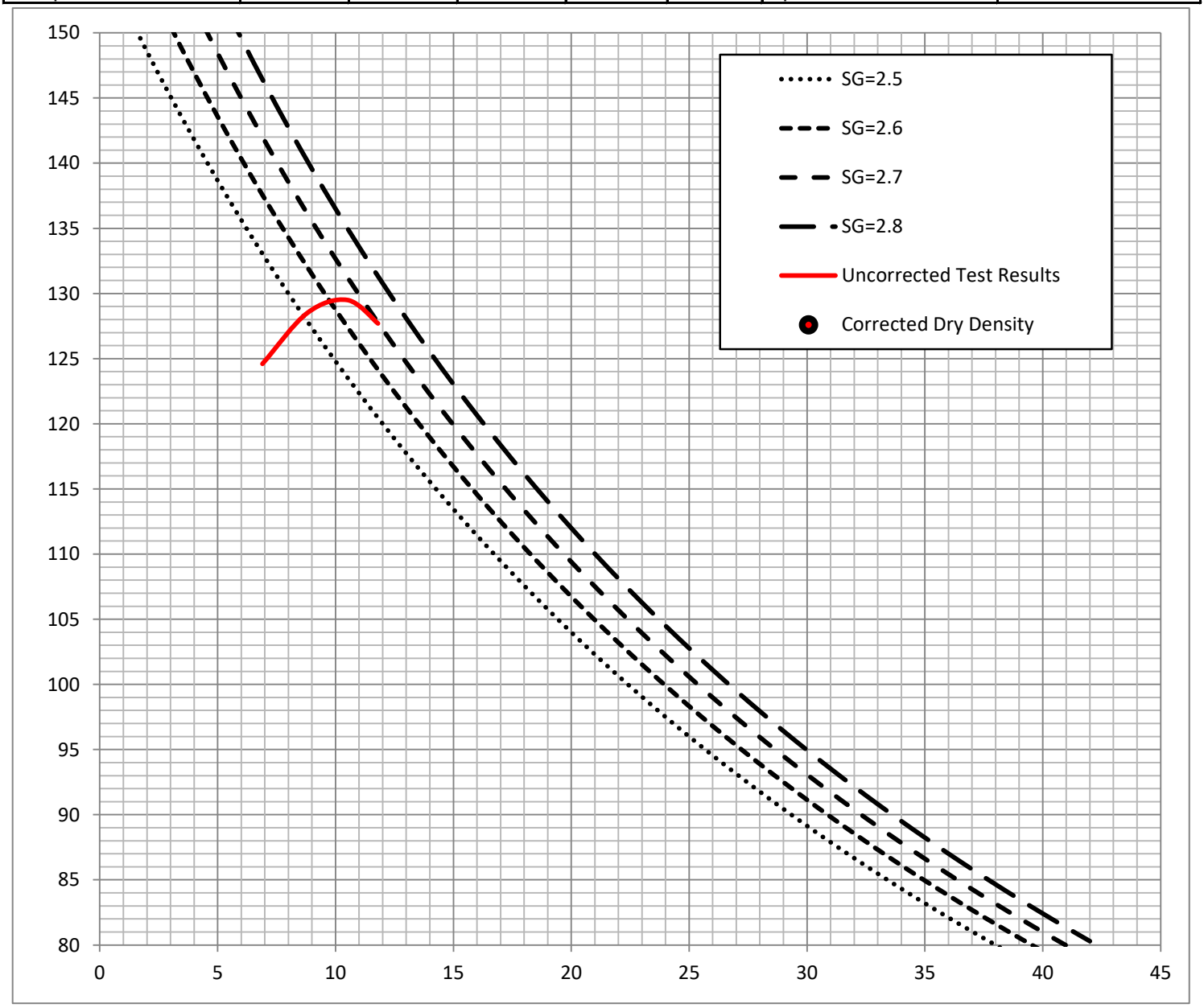
MAXIMUM DRY DENSITY - OPTIMUM MOISTURE

Project Name	RPW - Monroe Master Drainage Plan	**Test Date**	8/8/2017
Project No.	17066-01	**Date Sampled**	8/3/2017
Project Location	Gratton, Dufferin, and Hermosa	**Sampled By**	AM
Location In Structure	N/A	**Sample Type**	Bulk
Sample Location	Pavement Subgrade	**Tested By**	MN

Sample No.	B6	**Mold Size**	4-inch
Sample Depth	0-3'	**No. of Layers**	5
Soil Type	SC	**Blows per Layer**	25
Test Fraction	No.4	**Hammer Wt./Drop**	10-lb/18-inch

Total Sample Weight	g	**Bulk Spec. Grav. of Oversized**	2.600
Weight of Oversized	g	**Percentage of Dry Fines**	%
Weight of Fines	0 g	**Percentage of Dry Oversized**	<5% %
Moisture Content of Oversized	%	**Corrected Dry Density of Soil**	pcf
Moisture Content of Fines	%	**Corrected Optimum Moisture**	%

Test Data	Point 1	Point 2	Point 3	Point 4	Point 5	**Test Results (No Oversized Correction)**	
Compacted Dry Density	124.6	128.5	129.5	127.7		Maximum Dry Density	130.0 pcf
Compacted Moisture	6.9	8.8	10.5	11.8		Optimum Moisture	10.0 %



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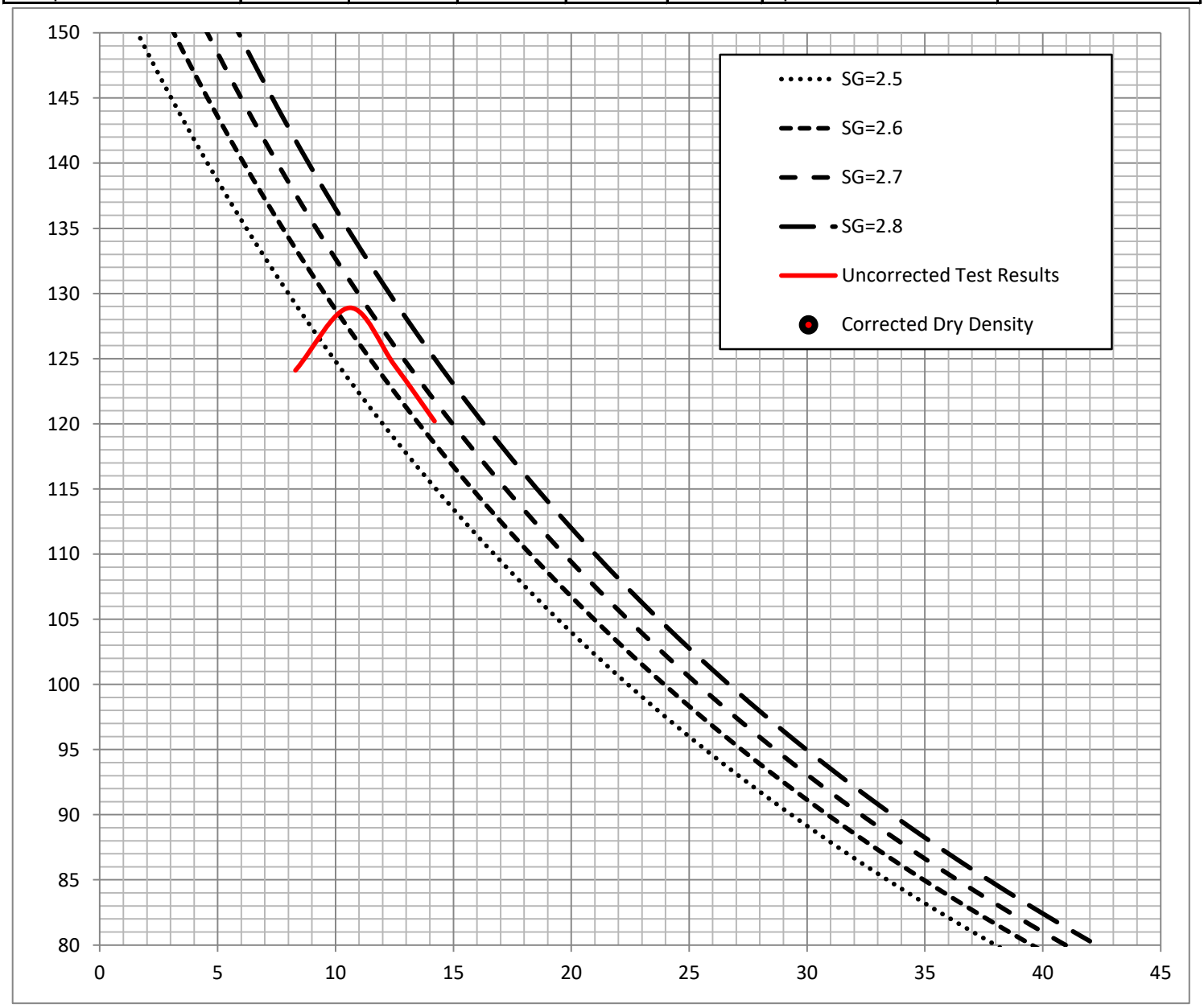
MAXIMUM DRY DENSITY - OPTIMUM MOISTURE

Project Name	RPW - Monroe Master Drainage Plan	**Test Date**	8/8/2017
Project No.	17066-01	**Date Sampled**	8/3/2017
Project Location	Gratton, Dufferin, and Hermosa	**Sampled By**	AM
Location In Structure	N/A	**Sample Type**	Bulk
Sample Location	Pavement Subgrade	**Tested By**	MN

Sample No.	B7	**Mold Size**	4-inch
Sample Depth	0-3'	**No. of Layers**	5
Soil Type	SC/CL	**Blows per Layer**	25
Test Fraction	No.4	**Hammer Wt./Drop**	10-lb/18-inch

Total Sample Weight	g	**Bulk Spec. Grav. of Oversized**	2.600
Weight of Oversized	g	**Percentage of Dry Fines**	%
Weight of Fines	0 g	**Percentage of Dry Oversized**	<5% %
Moisture Content of Oversized	%	**Corrected Dry Density of Soil**	pcf
Moisture Content of Fines	%	**Corrected Optimum Moisture**	%

Test Data	Point 1	Point 2	Point 3	Point 4	Point 5	**Test Results (No Oversized Correction)**	
Compacted Dry Density	124.1	128.9	124.5	120.2		Maximum Dry Density	130.0 pcf
Compacted Moisture	8.3	10.6	12.5	14.2		Optimum Moisture	11.0 %



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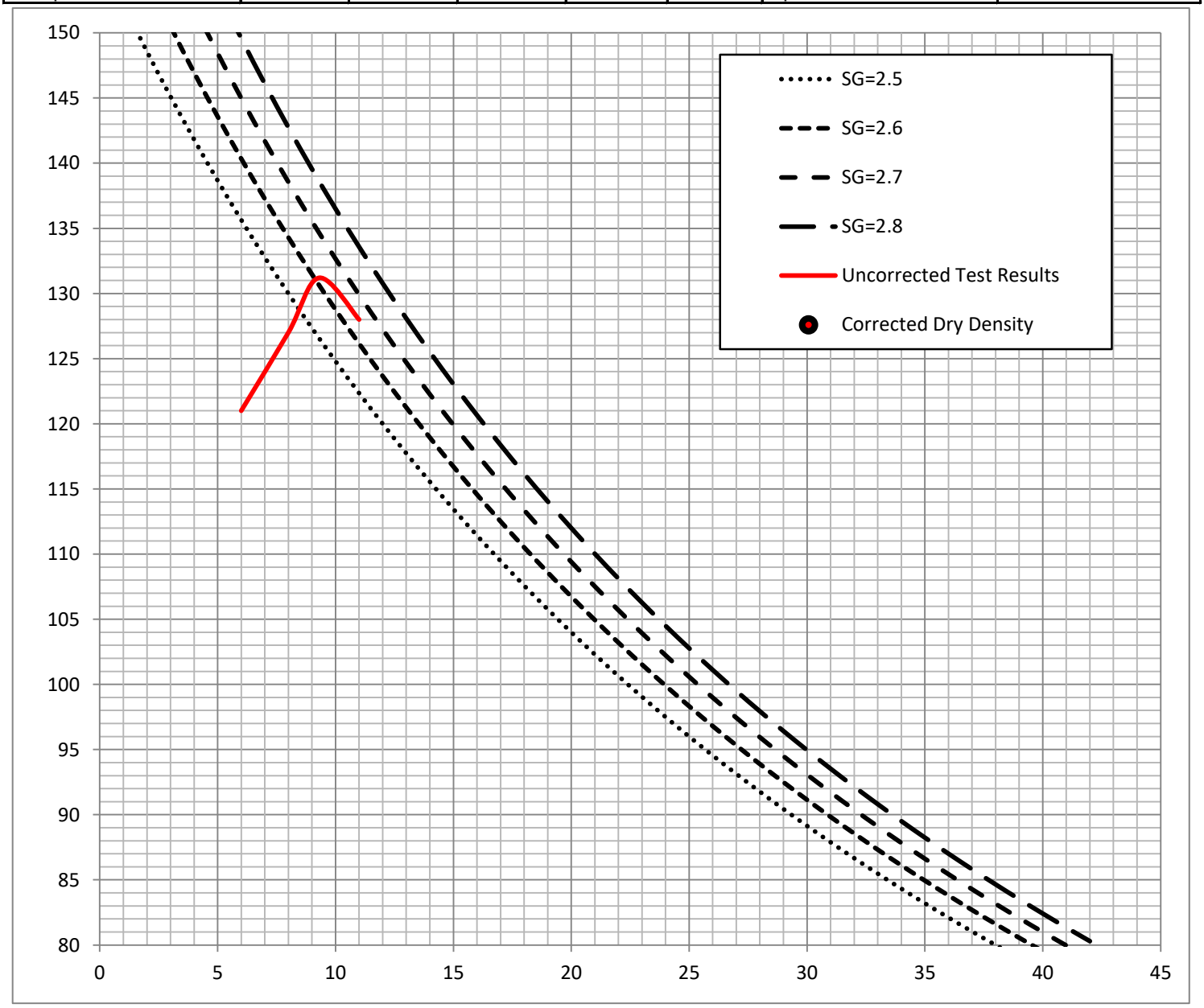
MAXIMUM DRY DENSITY - OPTIMUM MOISTURE

Project Name	RPW - Monroe Master Drainage Plan	**Test Date**	8/8/2017
Project No.	17066-01	**Date Sampled**	8/3/2017
Project Location	Gratton, Dufferin, and Hermosa	**Sampled By**	AM
Location In Structure	N/A	**Sample Type**	Bulk
Sample Location	Pavement Subgrade	**Tested By**	MN

Sample No.	B8	**Mold Size**	4-inch
Sample Depth	0-3'	**No. of Layers**	5
Soil Type	SC/CL	**Blows per Layer**	25
Test Fraction	No.4	**Hammer Wt./Drop**	10-lb/18-inch

Total Sample Weight	g	**Bulk Spec. Grav. of Oversized**	2.600
Weight of Oversized	g	**Percentage of Dry Fines**	%
Weight of Fines	0 g	**Percentage of Dry Oversized**	<5% %
Moisture Content of Oversized	%	**Corrected Dry Density of Soil**	pcf
Moisture Content of Fines	%	**Corrected Optimum Moisture**	%

Test Data	Point 1	Point 2	Point 3	Point 4	Point 5	**Test Results (No Oversized Correction)**	
Compacted Dry Density	121.0	127.0	131.2	128.0		Maximum Dry Density	132.0 pcf
Compacted Moisture	6.0	8.0	9.3	11.0		Optimum Moisture	9.5 %



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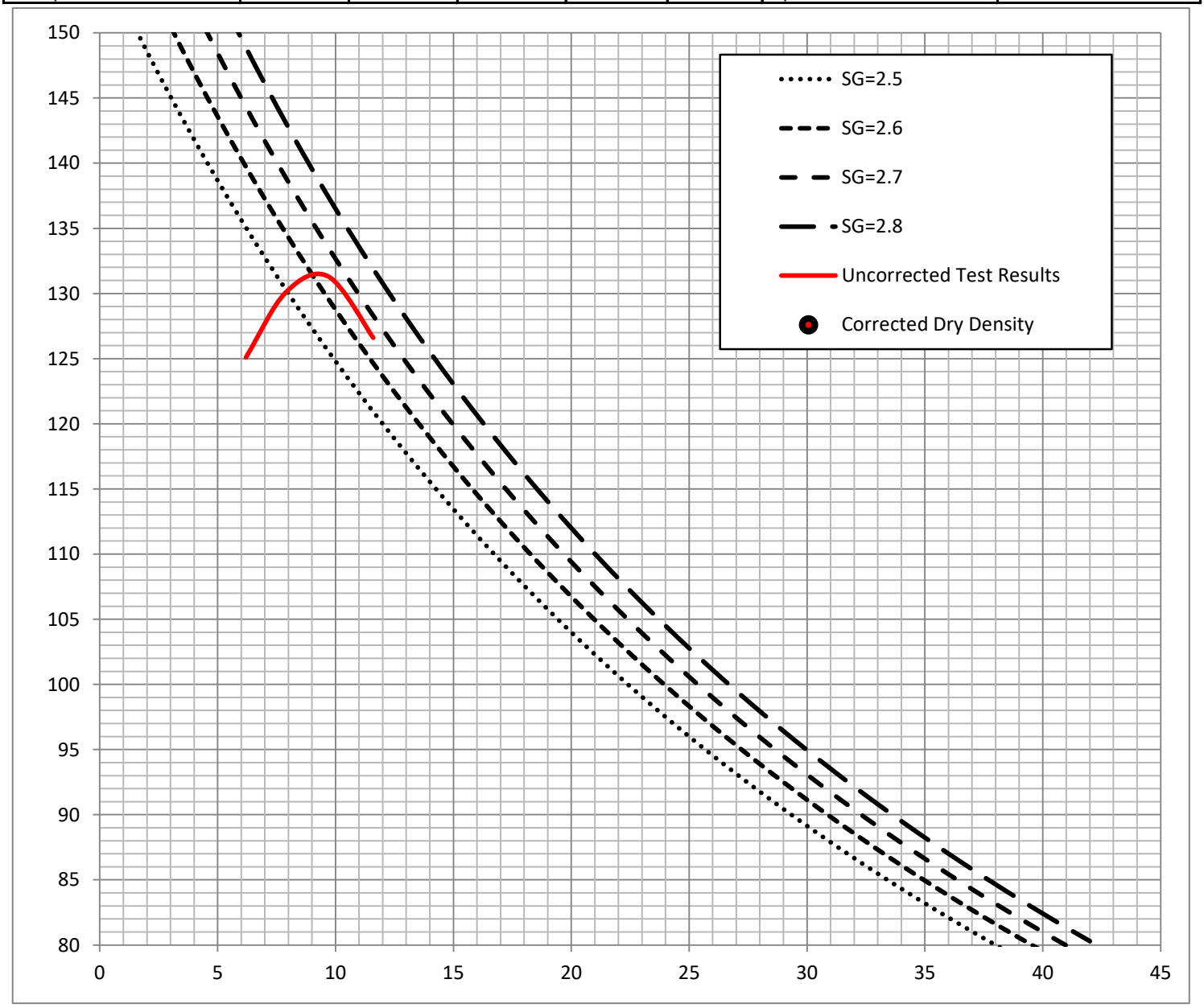
MAXIMUM DRY DENSITY - OPTIMUM MOISTURE

Project Name	RPW - Monroe Master Drainage Plan	**Test Date**	8/8/2017
Project No.	17066-01	**Date Sampled**	8/3/2017
Project Location	Gratton, Dufferin, and Hermosa	**Sampled By**	AM
Location In Structure	N/A	**Sample Type**	Bulk
Sample Location	Pavement Subgrade	**Tested By**	MN

Sample No.	B9	**Mold Size**	4-inch
Sample Depth	0-3'	**No. of Layers**	5
Soil Type	SC	**Blows per Layer**	25
Test Fraction	No.4	**Hammer Wt./Drop**	10-lb/18-inch

Total Sample Weight	g	**Bulk Spec. Grav. of Oversized**	2.600
Weight of Oversized	g	**Percentage of Dry Fines**	%
Weight of Fines	0 g	**Percentage of Dry Oversized**	<5% %
Moisture Content of Oversized	%	**Corrected Dry Density of Soil**	pcf
Moisture Content of Fines	%	**Corrected Optimum Moisture**	%

Test Data	Point 1	Point 2	Point 3	Point 4	Point 5	**Test Results (No Oversized Correction)**	
Compacted Dry Density	125.1	130.1	131.3	126.6		Maximum Dry Density	132.0 pcf
Compacted Moisture	6.2	7.9	9.7	11.6		Optimum Moisture	9.0 %



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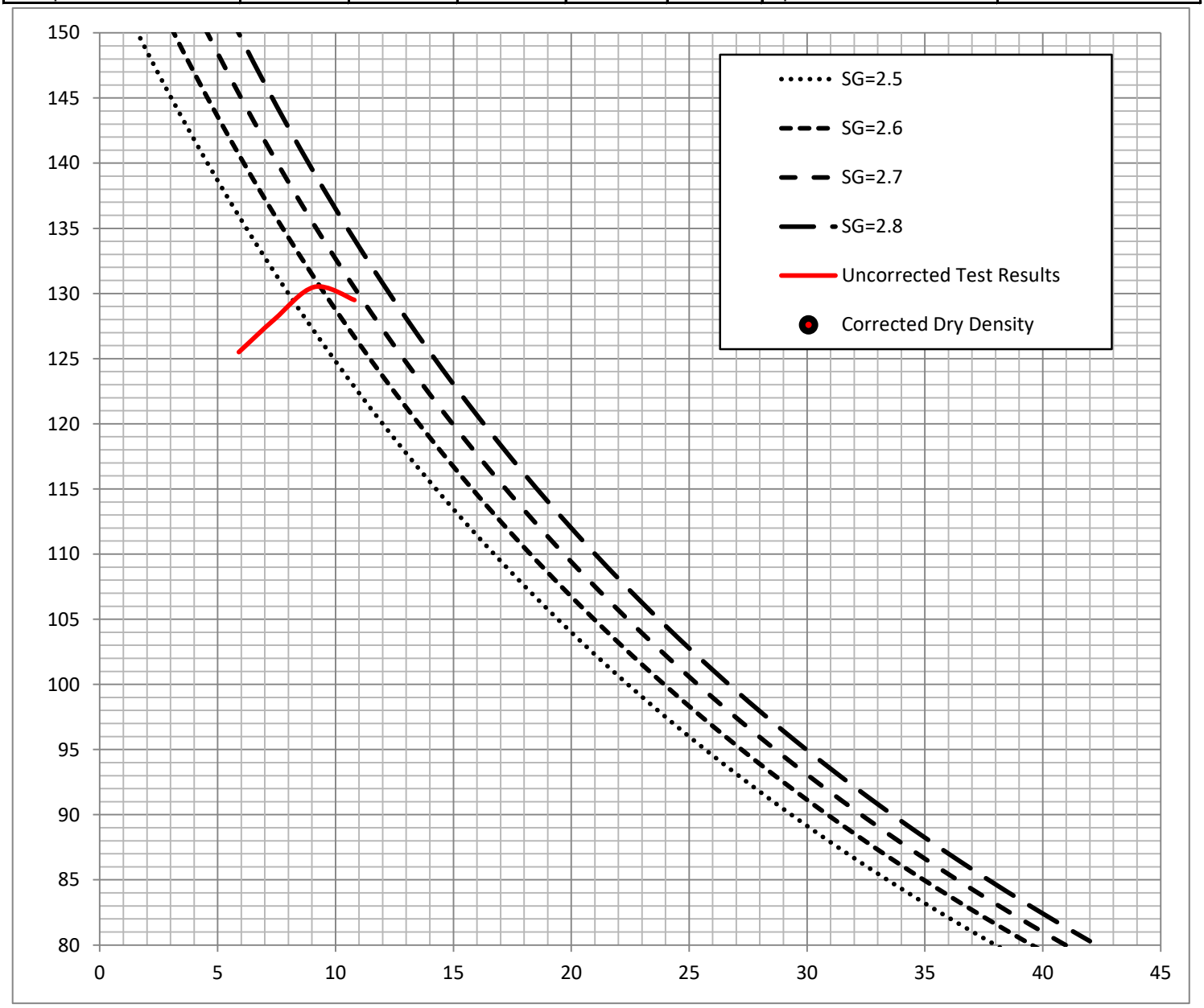
MAXIMUM DRY DENSITY - OPTIMUM MOISTURE

Project Name	RPW - Monroe Master Drainage Plan	**Test Date**	8/8/2017
Project No.	17066-01	**Date Sampled**	8/3/2017
Project Location	Gratton, Dufferin, and Hermosa	**Sampled By**	AM
Location In Structure	N/A	**Sample Type**	Bulk
Sample Location	Pavement Subgrade	**Tested By**	MN

Sample No.	B10	**Mold Size**	4-inch
Sample Depth	0-3'	**No. of Layers**	5
Soil Type	SC	**Blows per Layer**	25
Test Fraction	No.4	**Hammer Wt./Drop**	10-lb/18-inch

Total Sample Weight	g	**Bulk Spec. Grav. of Oversized**	2.600
Weight of Oversized	g	**Percentage of Dry Fines**	%
Weight of Fines	0 g	**Percentage of Dry Oversized**	<5% %
Moisture Content of Oversized	%	**Corrected Dry Density of Soil**	pcf
Moisture Content of Fines	%	**Corrected Optimum Moisture**	%

Test Data	Point 1	Point 2	Point 3	Point 4	Point 5	**Test Results (No Oversized Correction)**	
Compacted Dry Density	125.5	128.0	130.5	129.5		Maximum Dry Density	131.0 pcf
Compacted Moisture	5.9	7.4	9.1	10.8		Optimum Moisture	9.5 %



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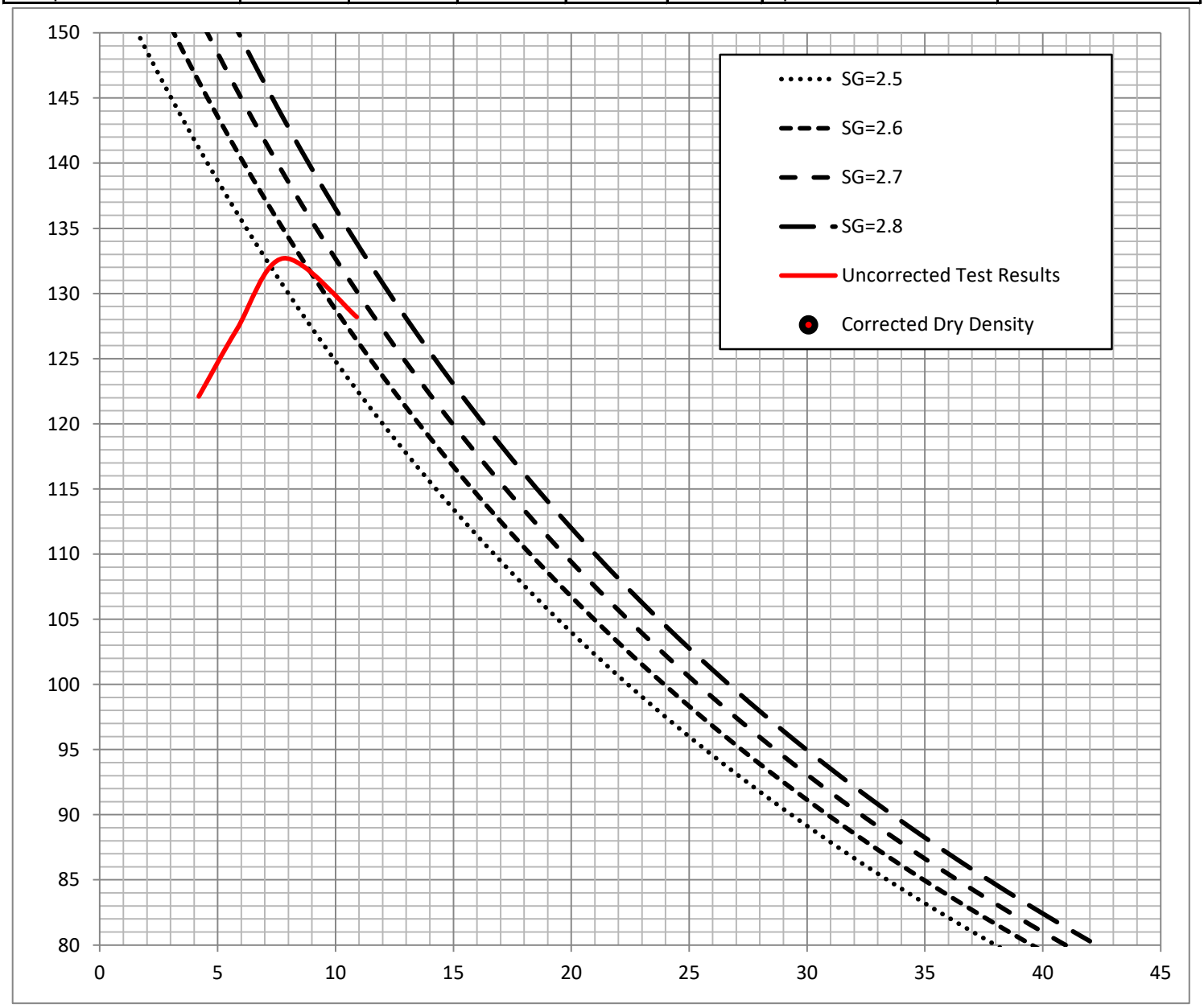
MAXIMUM DRY DENSITY - OPTIMUM MOISTURE

Project Name	RPW - Monroe Master Drainage Plan	**Test Date**	8/8/2017
Project No.	17066-01	**Date Sampled**	8/3/2017
Project Location	Gratton, Dufferin, and Hermosa	**Sampled By**	AM
Location In Structure	N/A	**Sample Type**	Bulk
Sample Location	Pavement Subgrade	**Tested By**	MN

Sample No.	B11	**Mold Size**	4-inch
Sample Depth	0-3'	**No. of Layers**	5
Soil Type	SC	**Blows per Layer**	25
Test Fraction	No.4	**Hammer Wt./Drop**	10-lb/18-inch

Total Sample Weight	g	**Bulk Spec. Grav. of Oversized**	2.600
Weight of Oversized	g	**Percentage of Dry Fines**	%
Weight of Fines	0 g	**Percentage of Dry Oversized**	<5% %
Moisture Content of Oversized	%	**Corrected Dry Density of Soil**	pcf
Moisture Content of Fines	%	**Corrected Optimum Moisture**	%

Test Data	Point 1	Point 2	Point 3	Point 4	Point 5	**Test Results (No Oversized Correction)**	
Compacted Dry Density	122.1	127.2	132.7	128.2		Maximum Dry Density	133.0 pcf
Compacted Moisture	4.2	5.8	7.8	10.9		Optimum Moisture	8.5 %



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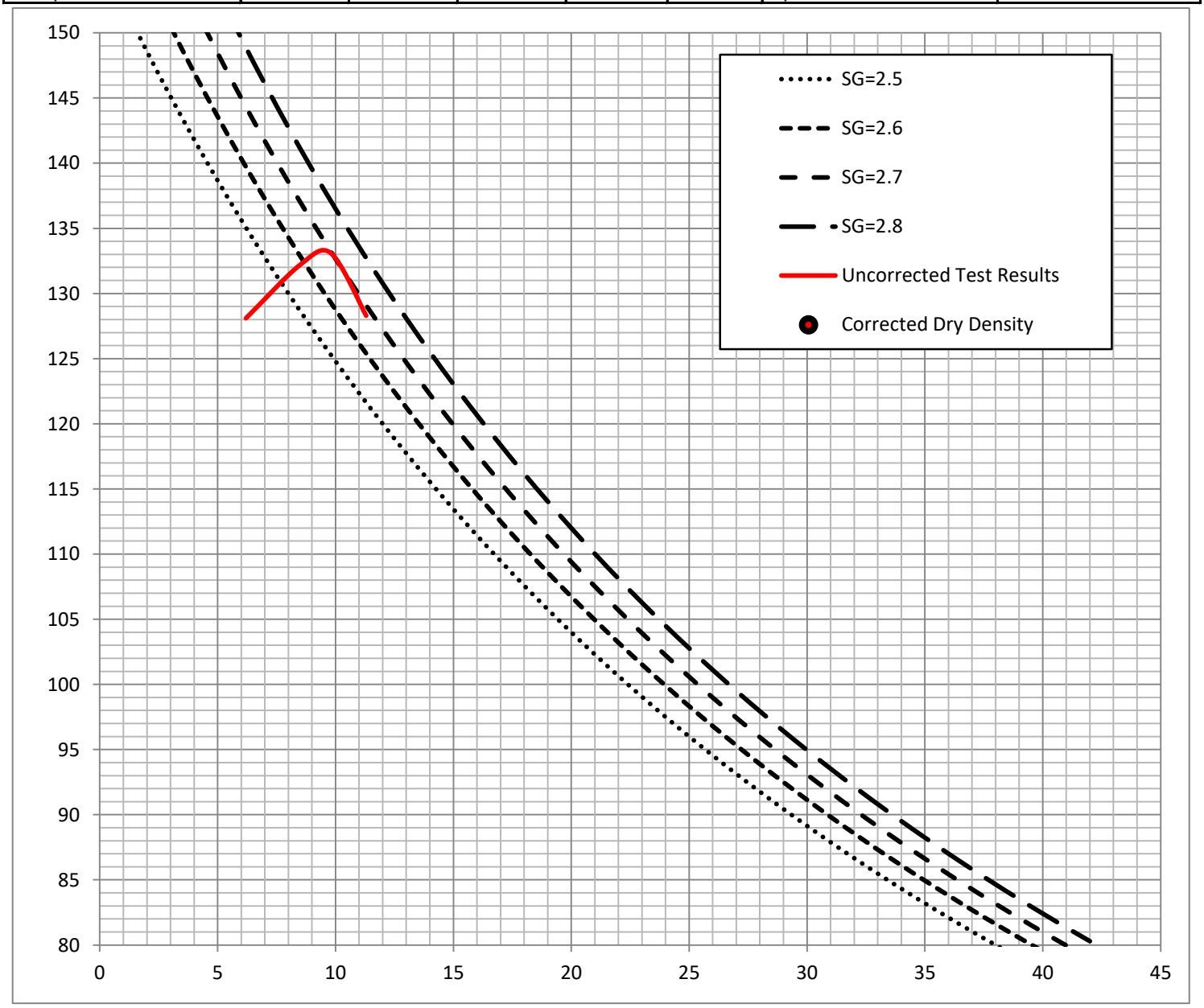
MAXIMUM DRY DENSITY - OPTIMUM MOISTURE

Project Name	RPW - Monroe Master Drainage Plan	**Test Date**	8/8/2017
Project No.	17066-01	**Date Sampled**	8/3/2017
Project Location	Gratton, Dufferin, and Hermosa	**Sampled By**	AM
Location In Structure	N/A	**Sample Type**	Bulk
Sample Location	Pavement Subgrade	**Tested By**	MN

Sample No.	B12	**Mold Size**	4-inch
Sample Depth	0-3'	**No. of Layers**	5
Soil Type	SC/CL	**Blows per Layer**	25
Test Fraction	No.4	**Hammer Wt./Drop**	10-lb/18-inch

Total Sample Weight	g	**Bulk Spec. Grav. of Oversized**	2.600
Weight of Oversized	g	**Percentage of Dry Fines**	%
Weight of Fines	0 g	**Percentage of Dry Oversized**	<5% %
Moisture Content of Oversized	%	**Corrected Dry Density of Soil**	pcf
Moisture Content of Fines	%	**Corrected Optimum Moisture**	%

Test Data	Point 1	Point 2	Point 3	Point 4	Point 5	**Test Results (No Oversized Correction)**	
Compacted Dry Density	128.1	132.2	133.1	128.3		Maximum Dry Density	133.5 pcf
Compacted Moisture	6.2	8.5	9.8	11.3		Optimum Moisture	9.5 %



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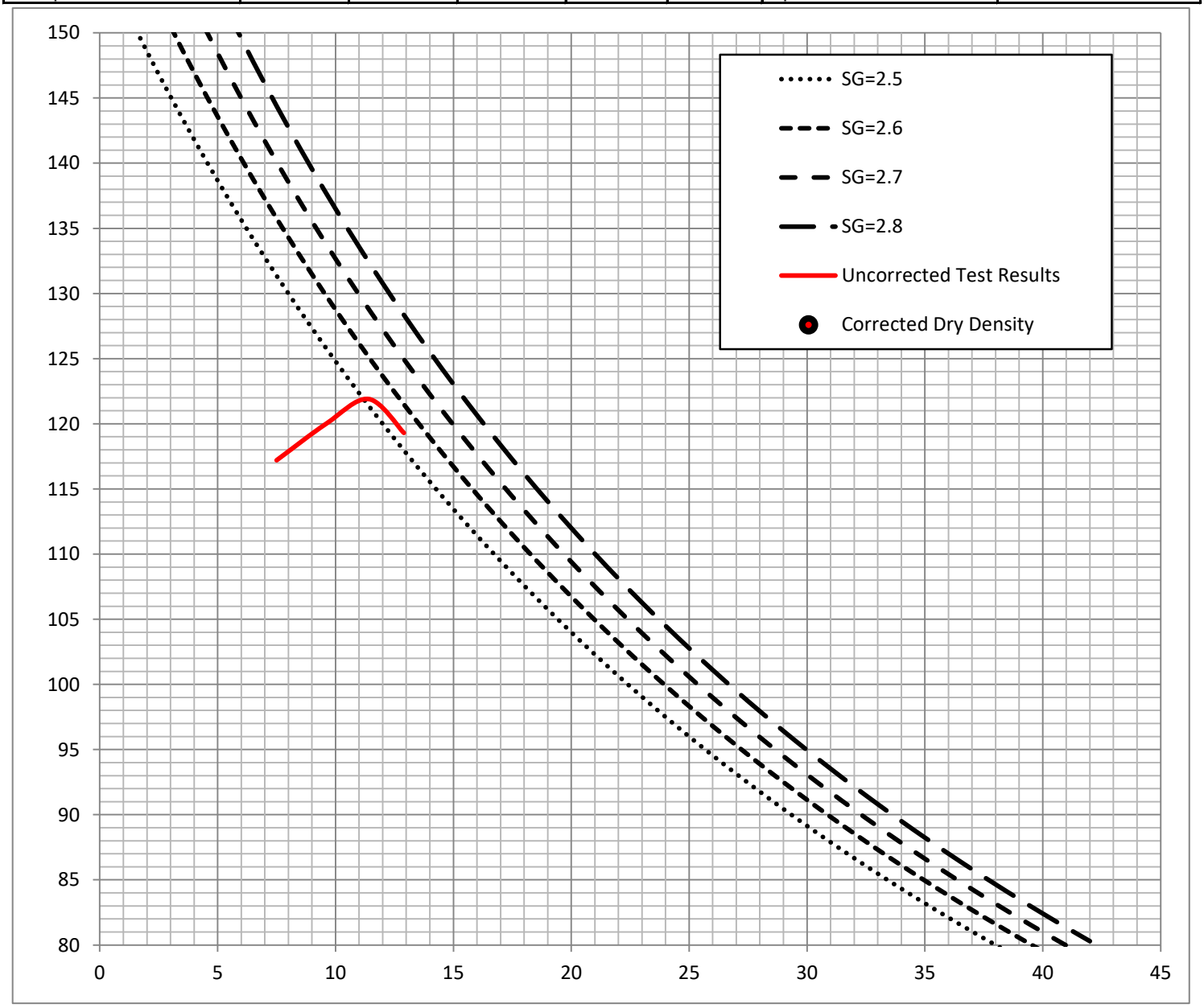
MAXIMUM DRY DENSITY - OPTIMUM MOISTURE

Project Name	RPW - Monroe Master Drainage Plan	**Test Date**	8/8/2017
Project No.	17066-01	**Date Sampled**	8/3/2017
Project Location	Gratton, Dufferin, and Hermosa	**Sampled By**	AM
Location In Structure	N/A	**Sample Type**	Bulk
Sample Location	Pavement Subgrade	**Tested By**	MN

Sample No.	B13	**Mold Size**	4-inch
Sample Depth	0-3'	**No. of Layers**	5
Soil Type	SC	**Blows per Layer**	25
Test Fraction	No.4	**Hammer Wt./Drop**	10-lb/18-inch

Total Sample Weight	g	**Bulk Spec. Grav. of Oversized**	2.600
Weight of Oversized	g	**Percentage of Dry Fines**	%
Weight of Fines	0 g	**Percentage of Dry Oversized**	<5% %
Moisture Content of Oversized	%	**Corrected Dry Density of Soil**	pcf
Moisture Content of Fines	%	**Corrected Optimum Moisture**	%

Test Data	Point 1	Point 2	Point 3	Point 4	Point 5	**Test Results (No Oversized Correction)**	
Compacted Dry Density	117.2	120.0	121.9	119.3		Maximum Dry Density	122.0 pcf
Compacted Moisture	7.5	9.6	11.4	12.9		Optimum Moisture	11.5 %



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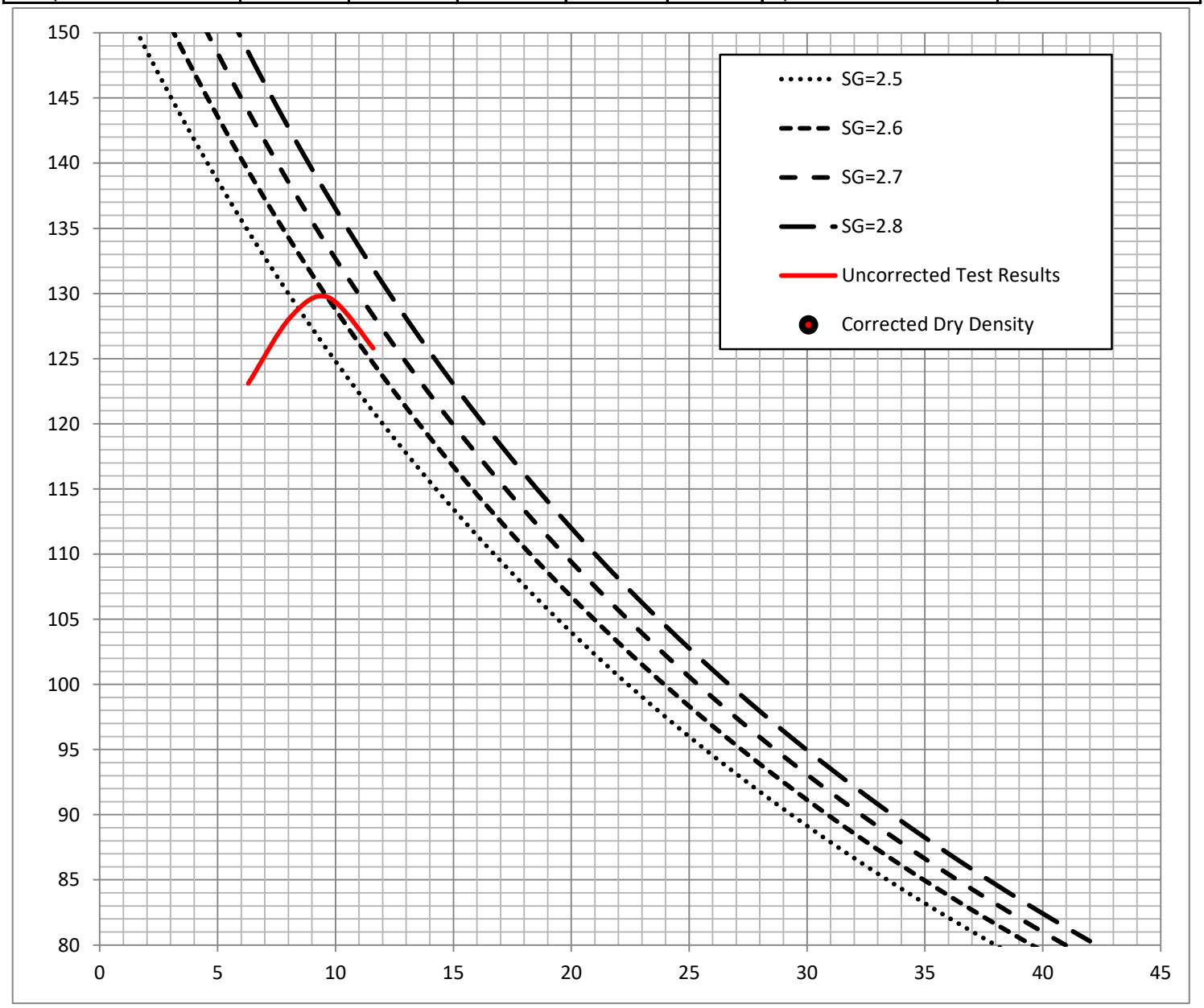
MAXIMUM DRY DENSITY - OPTIMUM MOISTURE

Project Name	RPW - Monroe Master Drainage Plan	**Test Date**	8/8/2017
Project No.	17066-01	**Date Sampled**	8/3/2017
Project Location	Gratton, Dufferin, and Hermosa	**Sampled By**	AM
Location In Structure	N/A	**Sample Type**	Bulk
Sample Location	Pavement Subgrade	**Tested By**	MN

Sample No.	B14	**Mold Size**	4-inch
Sample Depth	0-3'	**No. of Layers**	5
Soil Type	SC	**Blows per Layer**	25
Test Fraction	No.4	**Hammer Wt./Drop**	10-lb/18-inch

Total Sample Weight	g	**Bulk Spec. Grav. of Oversized**	2.600
Weight of Oversized	g	**Percentage of Dry Fines**	%
Weight of Fines	0 g	**Percentage of Dry Oversized**	<5% %
Moisture Content of Oversized	%	**Corrected Dry Density of Soil**	pcf
Moisture Content of Fines	%	**Corrected Optimum Moisture**	%

Test Data	Point 1	Point 2	Point 3	Point 4	Point 5	**Test Results (No Oversized Correction)**	
Compacted Dry Density	123.1	128.2	129.7	125.8		Maximum Dry Density	130.0 pcf
Compacted Moisture	6.3	8.1	9.7	11.6		Optimum Moisture	9.5 %



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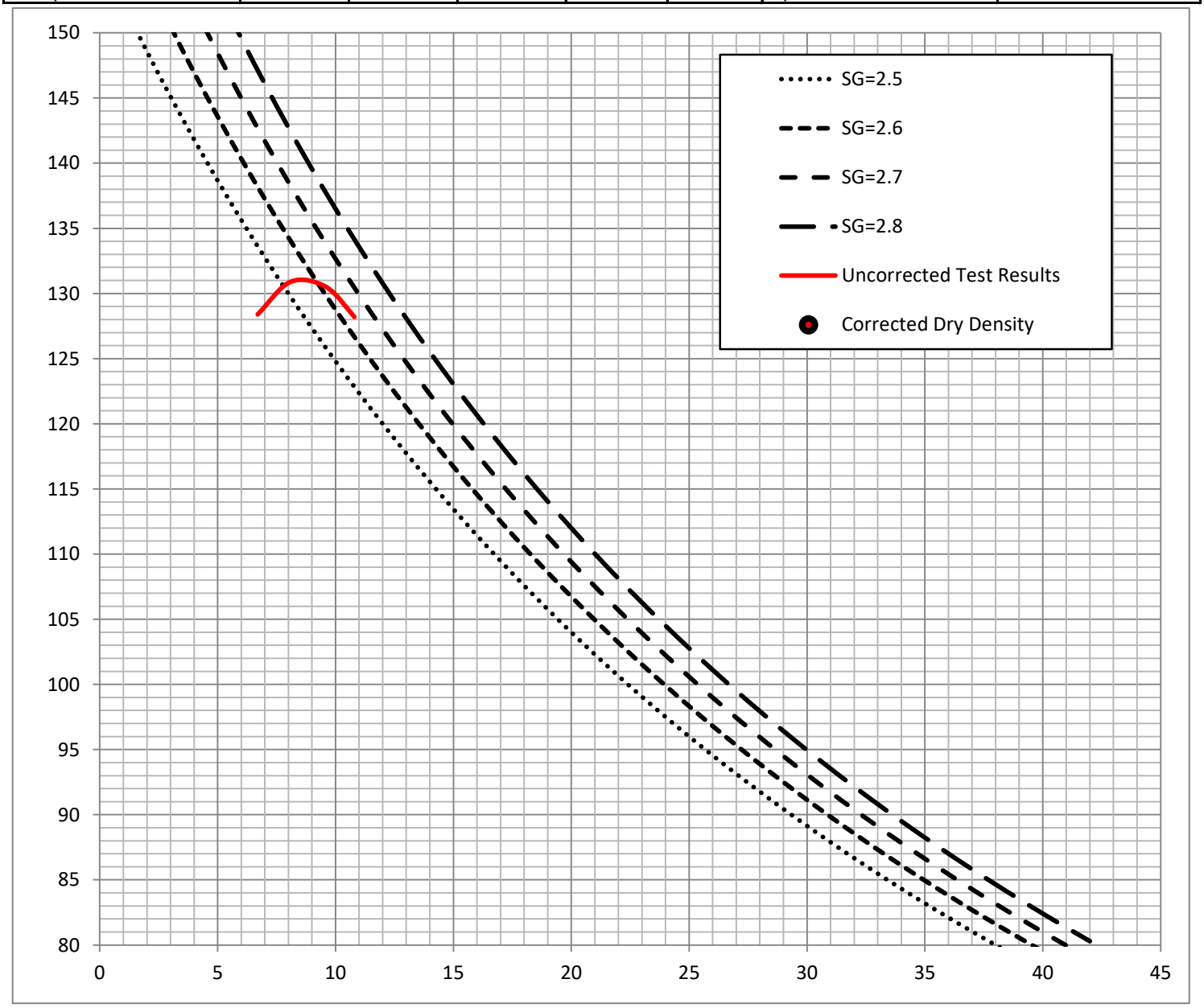
MAXIMUM DRY DENSITY - OPTIMUM MOISTURE

Project Name	RPW - Monroe Master Drainage Plan	**Test Date**	8/8/2017
Project No.	17066-01	**Date Sampled**	8/3/2017
Project Location	Gratton, Dufferin, and Hermosa	**Sampled By**	AM
Location In Structure	N/A	**Sample Type**	Bulk
Sample Location	Pavement Subgrade	**Tested By**	MN

Sample No.	B15	**Mold Size**	4-inch
Sample Depth	0-3'	**No. of Layers**	5
Soil Type	SC	**Blows per Layer**	25
Test Fraction	No.4	**Hammer Wt./Drop**	10-lb/18-inch

Total Sample Weight	g	**Bulk Spec. Grav. of Oversized**	2.600
Weight of Oversized	g	**Percentage of Dry Fines**	%
Weight of Fines	0 g	**Percentage of Dry Oversized**	<5% %
Moisture Content of Oversized	%	**Corrected Dry Density of Soil**	pcf
Moisture Content of Fines	%	**Corrected Optimum Moisture**	%

Test Data	Point 1	Point 2	Point 3	Point 4	Point 5	**Test Results (No Oversized Correction)**	
Compacted Dry Density	128.4	130.9	130.5	128.2		Maximum Dry Density	131.5 pcf
Compacted Moisture	6.7	8.1	9.6	10.8		Optimum Moisture	8.5 %



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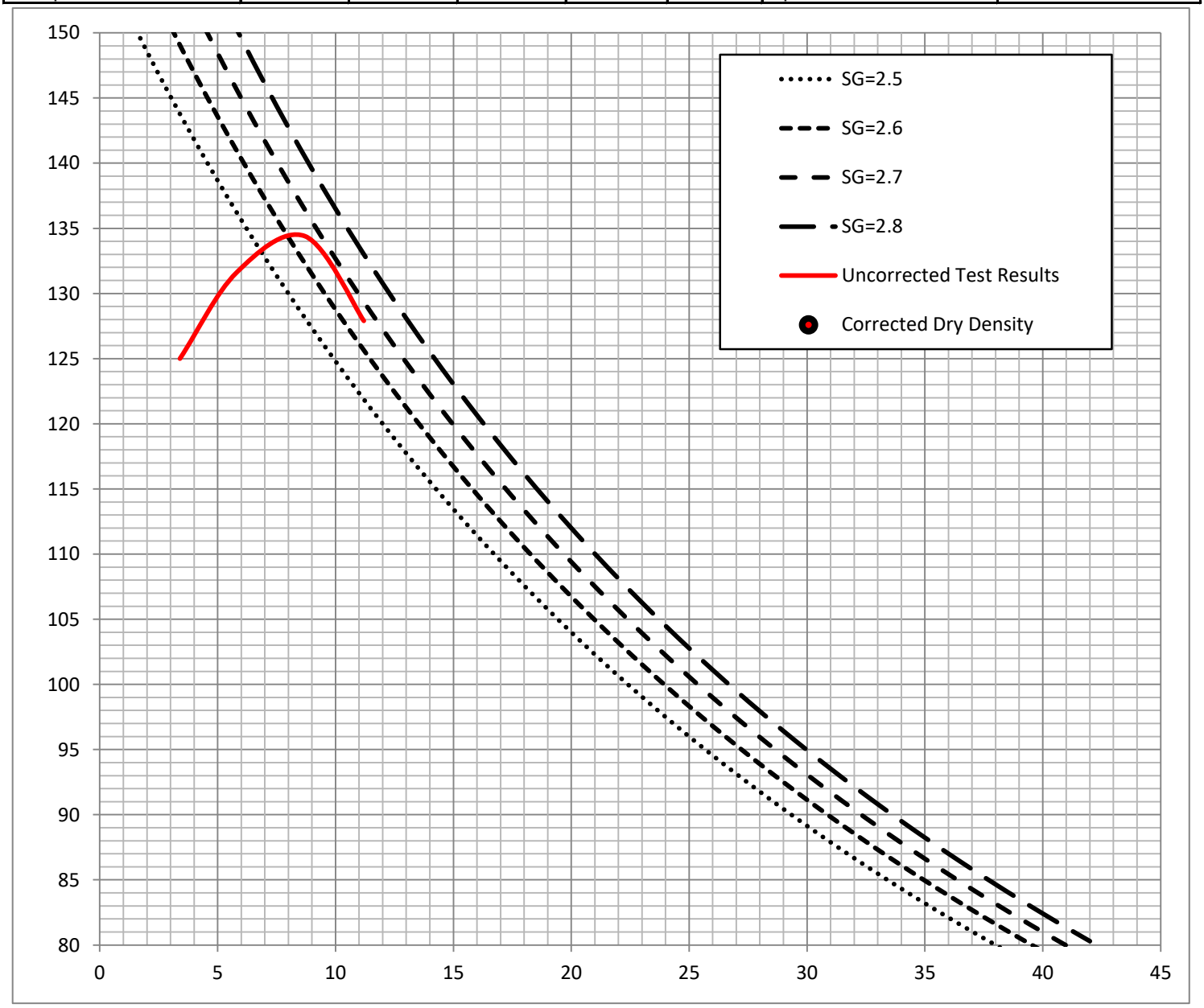
MAXIMUM DRY DENSITY - OPTIMUM MOISTURE

Project Name	RPW - Monroe Master Drainage Plan	**Test Date**	8/8/2017
Project No.	17066-01	**Date Sampled**	8/3/2017
Project Location	Gratton, Dufferin, and Hermosa	**Sampled By**	AM
Location In Structure	N/A	**Sample Type**	Bulk
Sample Location	Pavement Subgrade	**Tested By**	MN

Sample No.	B16	**Mold Size**	4-inch
Sample Depth	0-3'	**No. of Layers**	5
Soil Type	SC	**Blows per Layer**	25
Test Fraction	No.4	**Hammer Wt./Drop**	10-lb/18-inch

Total Sample Weight	g	**Bulk Spec. Grav. of Oversized**	2.600
Weight of Oversized	g	**Percentage of Dry Fines**	%
Weight of Fines	0 g	**Percentage of Dry Oversized**	<5% %
Moisture Content of Oversized	%	**Corrected Dry Density of Soil**	pcf
Moisture Content of Fines	%	**Corrected Optimum Moisture**	%

Test Data	Point 1	Point 2	Point 3	Point 4	Point 5	**Test Results (No Oversized Correction)**	
Compacted Dry Density	125.0	131.6	134.4	127.9		Maximum Dry Density	135.0 pcf
Compacted Moisture	3.4	5.8	8.7	11.2		Optimum Moisture	8.0 %



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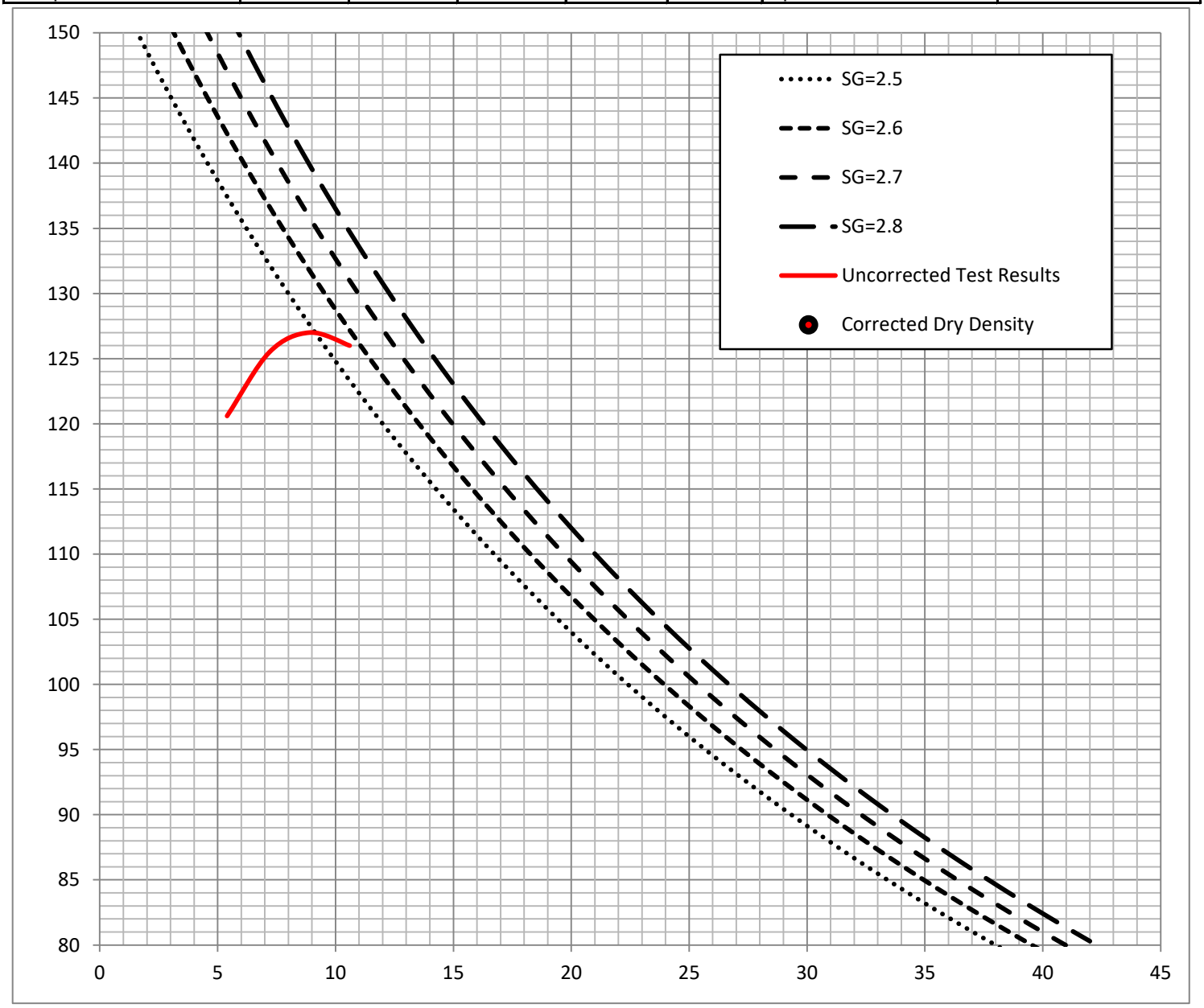
MAXIMUM DRY DENSITY - OPTIMUM MOISTURE

Project Name	RPW - Monroe Master Drainage Plan	**Test Date**	8/8/2017
Project No.	17066-01	**Date Sampled**	8/3/2017
Project Location	Gratton, Dufferin, and Hermosa	**Sampled By**	AM
Location In Structure	N/A	**Sample Type**	Bulk
Sample Location	Pavement Subgrade	**Tested By**	MN

Sample No.	B17	**Mold Size**	4-inch
Sample Depth	0-3'	**No. of Layers**	5
Soil Type	SC	**Blows per Layer**	25
Test Fraction	No.4	**Hammer Wt./Drop**	10-lb/18-inch

Total Sample Weight	g	**Bulk Spec. Grav. of Oversized**	2.600
Weight of Oversized	g	**Percentage of Dry Fines**	%
Weight of Fines	0 g	**Percentage of Dry Oversized**	<5% %
Moisture Content of Oversized	%	**Corrected Dry Density of Soil**	pcf
Moisture Content of Fines	%	**Corrected Optimum Moisture**	%

Test Data	Point 1	Point 2	Point 3	Point 4	Point 5	**Test Results (No Oversized Correction)**	
Compacted Dry Density	120.6	125.5	127.0	126.0		Maximum Dry Density	127.5 pcf
Compacted Moisture	5.4	7.2	8.9	10.6		Optimum Moisture	9.5 %



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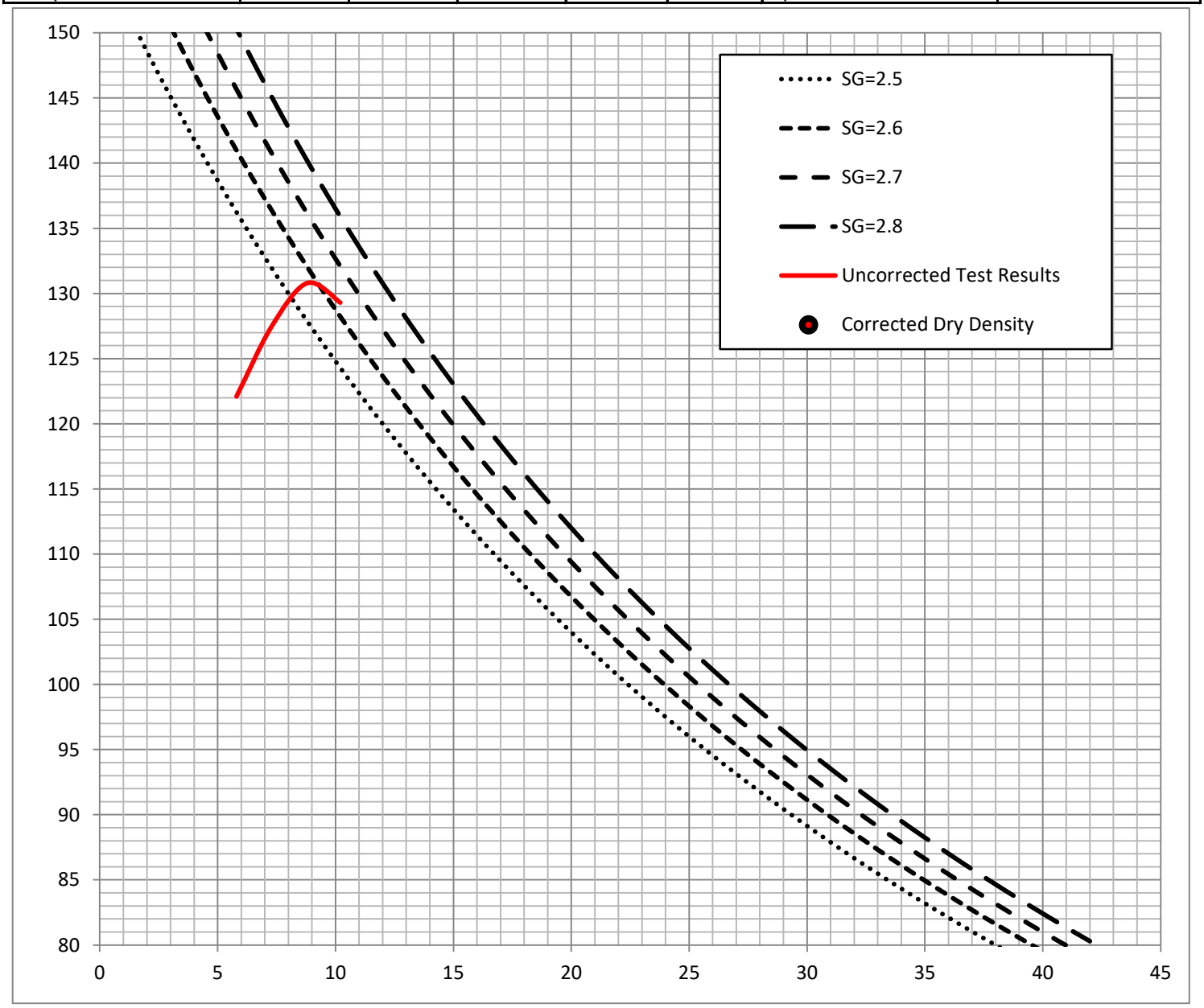
MAXIMUM DRY DENSITY - OPTIMUM MOISTURE

Project Name	RPW - Monroe Master Drainage Plan	**Test Date**	8/8/2017
Project No.	17066-01	**Date Sampled**	8/3/2017
Project Location	Gratton, Dufferin, and Hermosa	**Sampled By**	AM
Location In Structure	N/A	**Sample Type**	Bulk
Sample Location	Pavement Subgrade	**Tested By**	MN

Sample No.	B18	**Mold Size**	4-inch
Sample Depth	0-3'	**No. of Layers**	5
Soil Type	SC	**Blows per Layer**	25
Test Fraction	No.4	**Hammer Wt./Drop**	10-lb/18-inch

Total Sample Weight	g	**Bulk Spec. Grav. of Oversized**	2.600
Weight of Oversized	g	**Percentage of Dry Fines**	%
Weight of Fines	0 g	**Percentage of Dry Oversized**	<5% %
Moisture Content of Oversized	%	**Corrected Dry Density of Soil**	pcf
Moisture Content of Fines	%	**Corrected Optimum Moisture**	%

Test Data	Point 1	Point 2	Point 3	Point 4	Point 5	**Test Results (No Oversized Correction)**	
Compacted Dry Density	122.1	127.5	130.8	129.3		Maximum Dry Density	131.0 pcf
Compacted Moisture	5.8	7.3	8.8	10.2		Optimum Moisture	9.0 %



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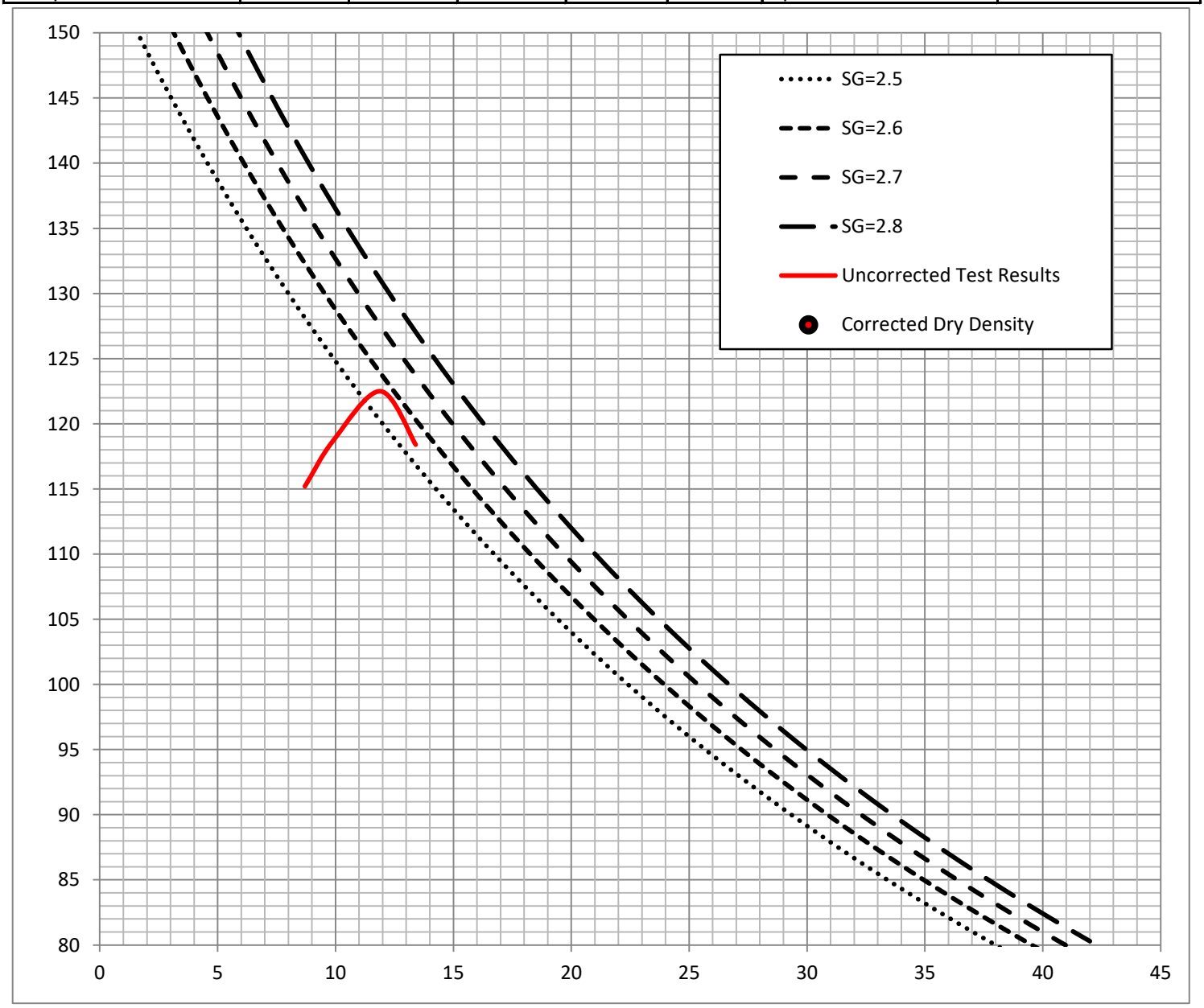
MAXIMUM DRY DENSITY - OPTIMUM MOISTURE

Project Name	RPW - Monroe Master Drainage Plan	**Test Date**	8/8/2017
Project No.	17066-01	**Date Sampled**	8/3/2017
Project Location	Gratton, Dufferin, and Hermosa	**Sampled By**	AM
Location In Structure	N/A	**Sample Type**	Bulk
Sample Location	Pavement Subgrade	**Tested By**	MN

Sample No.	B19	**Mold Size**	4-inch
Sample Depth	0-3'	**No. of Layers**	5
Soil Type	SC	**Blows per Layer**	25
Test Fraction	No.4	**Hammer Wt./Drop**	10-lb/18-inch

Total Sample Weight	g	**Bulk Spec. Grav. of Oversized**	2.600
Weight of Oversized	g	**Percentage of Dry Fines**	%
Weight of Fines	0 g	**Percentage of Dry Oversized**	<5% %
Moisture Content of Oversized	%	**Corrected Dry Density of Soil**	pcf
Moisture Content of Fines	%	**Corrected Optimum Moisture**	%

Test Data	Point 1	Point 2	Point 3	Point 4	Point 5	**Test Results (No Oversized Correction)**	
Compacted Dry Density	115.2	118.7	122.5	118.4		Maximum Dry Density	123.0 pcf
Compacted Moisture	8.7	9.9	11.9	13.4		Optimum Moisture	11.5 %



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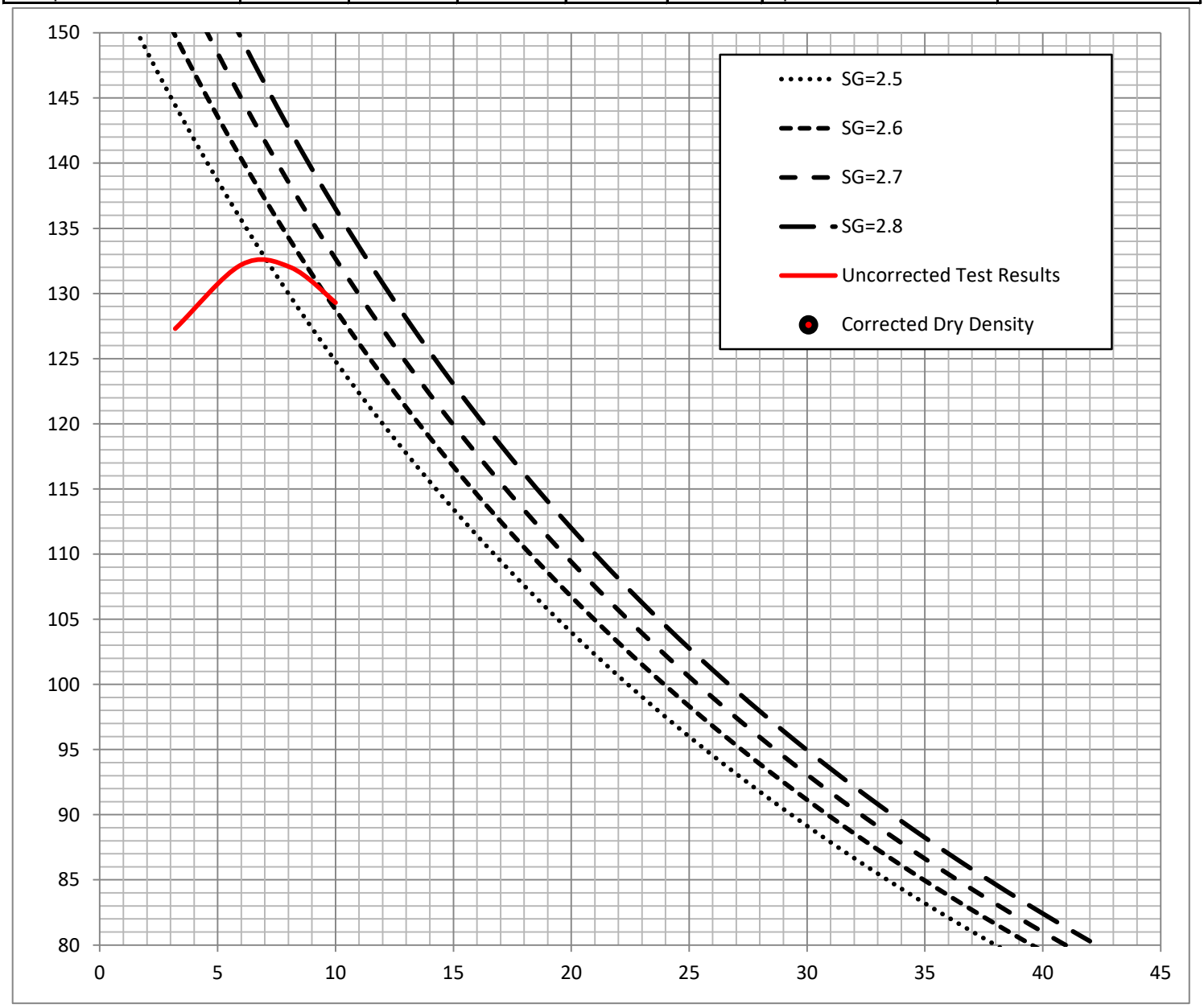
MAXIMUM DRY DENSITY - OPTIMUM MOISTURE

Project Name	RPW - Monroe Master Drainage Plan	**Test Date**	8/8/2017
Project No.	17066-01	**Date Sampled**	8/3/2017
Project Location	Gratton, Dufferin, and Hermosa	**Sampled By**	AM
Location In Structure	N/A	**Sample Type**	Bulk
Sample Location	Pavement Subgrade	**Tested By**	MN

Sample No.	B20	**Mold Size**	4-inch
Sample Depth	0-3'	**No. of Layers**	5
Soil Type	SC	**Blows per Layer**	25
Test Fraction	No.4	**Hammer Wt./Drop**	10-lb/18-inch

Total Sample Weight	g	**Bulk Spec. Grav. of Oversized**	2.600
Weight of Oversized	g	**Percentage of Dry Fines**	%
Weight of Fines	0 g	**Percentage of Dry Oversized**	<5% %
Moisture Content of Oversized	%	**Corrected Dry Density of Soil**	pcf
Moisture Content of Fines	%	**Corrected Optimum Moisture**	%

Test Data	Point 1	Point 2	Point 3	Point 4	Point 5	**Test Results (No Oversized Correction)**	
Compacted Dry Density	127.3	132.2	132.0	129.3		Maximum Dry Density	133.0 pcf
Compacted Moisture	3.2	6.0	8.1	10.0		Optimum Moisture	7.5 %



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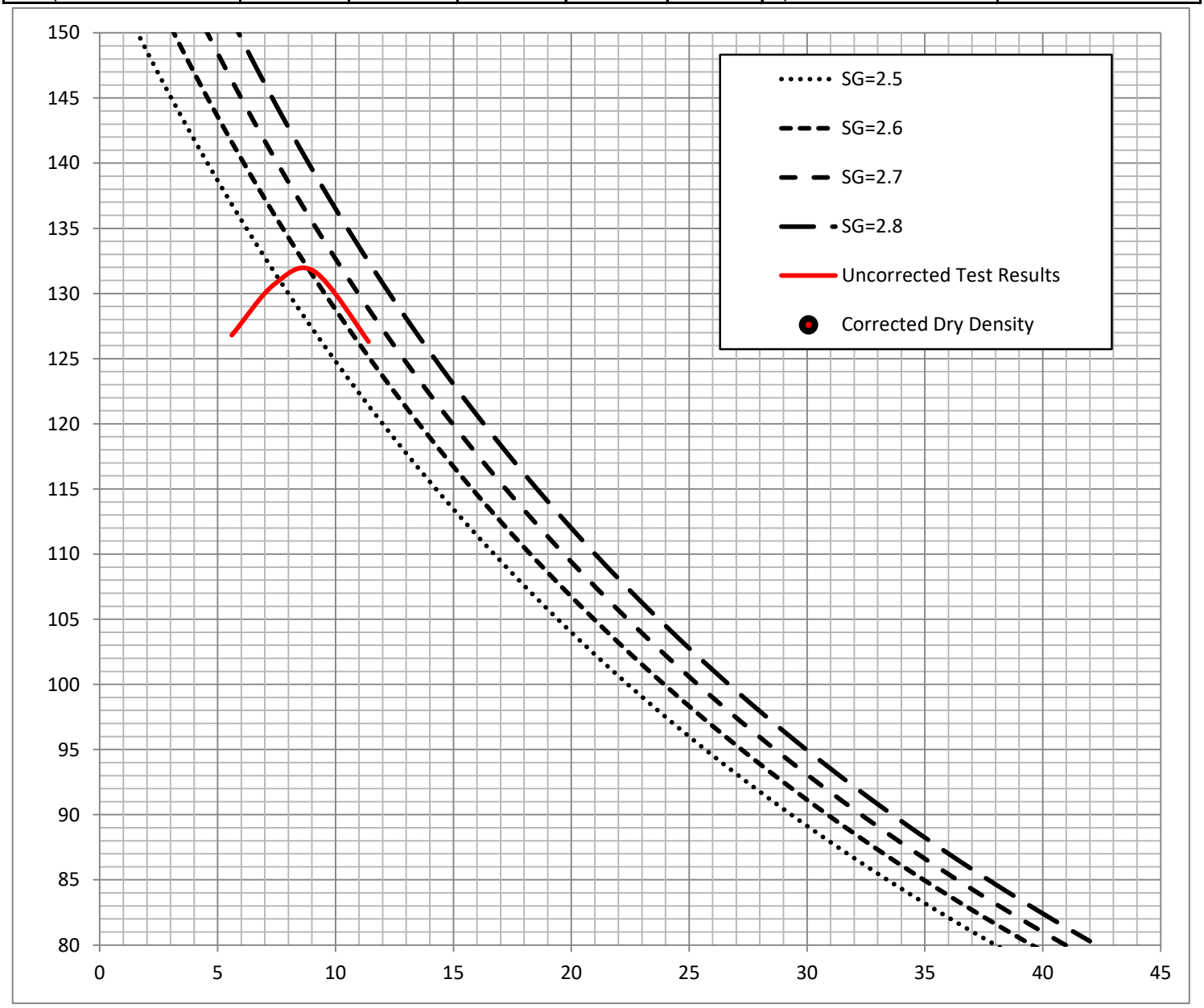
MAXIMUM DRY DENSITY - OPTIMUM MOISTURE

Project Name	RPW - Monroe Master Drainage Plan	**Test Date**	8/8/2017
Project No.	17066-01	**Date Sampled**	8/3/2017
Project Location	Gratton, Dufferin, and Hermosa	**Sampled By**	AM
Location In Structure	N/A	**Sample Type**	Bulk
Sample Location	Pavement Subgrade	**Tested By**	MN

Sample No.	B21	**Mold Size**	4-inch
Sample Depth	0-3'	**No. of Layers**	5
Soil Type	SC	**Blows per Layer**	25
Test Fraction	No.4	**Hammer Wt./Drop**	10-lb/18-inch

Total Sample Weight	g	**Bulk Spec. Grav. of Oversized**	2.600
Weight of Oversized	g	**Percentage of Dry Fines**	%
Weight of Fines	0 g	**Percentage of Dry Oversized**	<5% %
Moisture Content of Oversized	%	**Corrected Dry Density of Soil**	pcf
Moisture Content of Fines	%	**Corrected Optimum Moisture**	%

Test Data	Point 1	Point 2	Point 3	Point 4	Point 5	**Test Results (No Oversized Correction)**	
Compacted Dry Density	126.8	130.7	131.7	126.3		Maximum Dry Density	132.0 pcf
Compacted Moisture	5.6	7.4	9.1	11.4		Optimum Moisture	8.5 %



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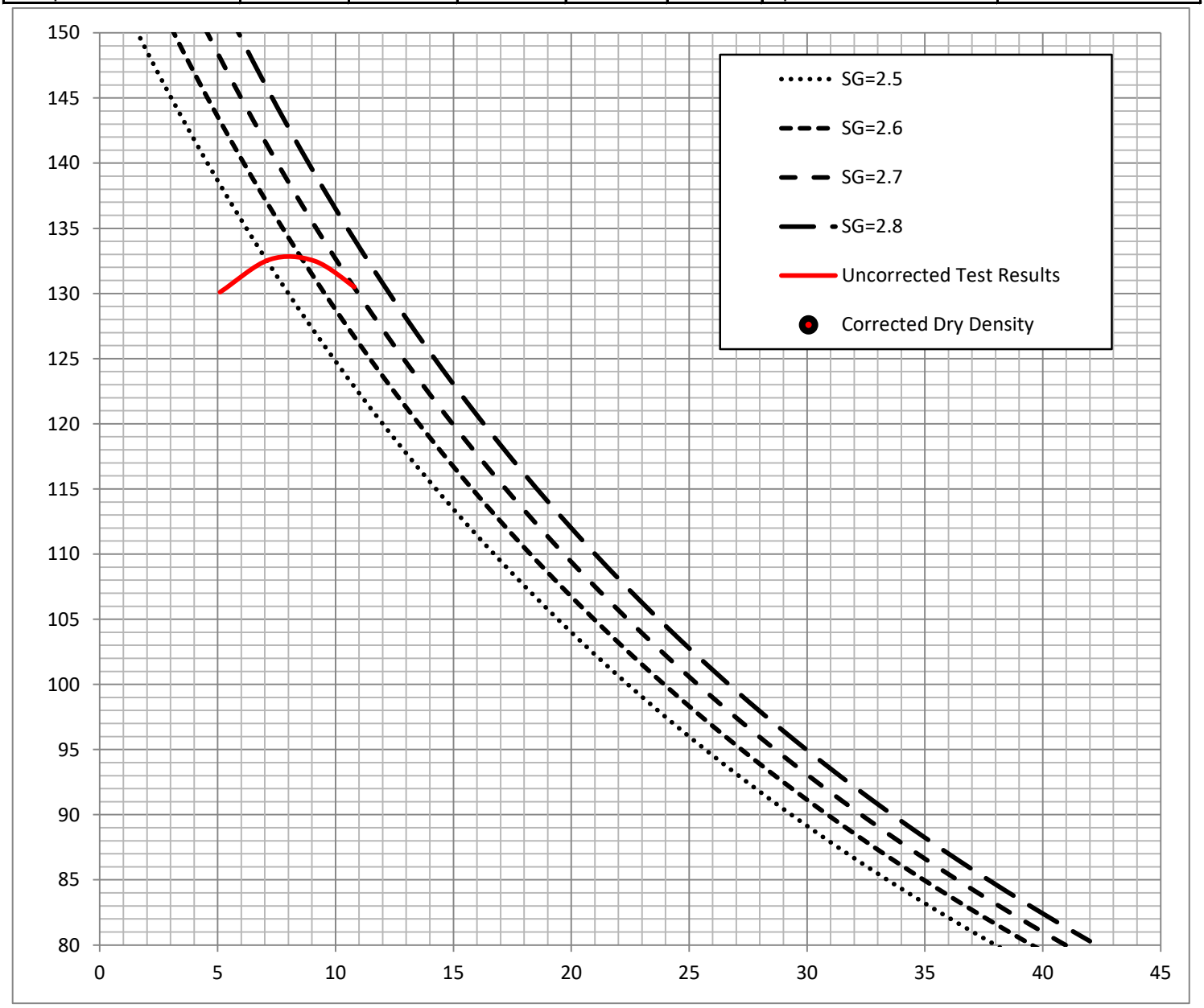
MAXIMUM DRY DENSITY - OPTIMUM MOISTURE

Project Name	RPW - Monroe Master Drainage Plan	**Test Date**	8/8/2017
Project No.	17066-01	**Date Sampled**	8/3/2017
Project Location	Gratton, Dufferin, and Hermosa	**Sampled By**	AM
Location In Structure	N/A	**Sample Type**	Bulk
Sample Location	Pavement Subgrade	**Tested By**	MN

Sample No.	B22	**Mold Size**	4-inch
Sample Depth	0-3'	**No. of Layers**	5
Soil Type	SC	**Blows per Layer**	25
Test Fraction	No.4	**Hammer Wt./Drop**	10-lb/18-inch

Total Sample Weight	g	**Bulk Spec. Grav. of Oversized**	2.600
Weight of Oversized	g	**Percentage of Dry Fines**	%
Weight of Fines	0 g	**Percentage of Dry Oversized**	<5% %
Moisture Content of Oversized	%	**Corrected Dry Density of Soil**	pcf
Moisture Content of Fines	%	**Corrected Optimum Moisture**	%

Test Data	Point 1	Point 2	Point 3	Point 4	Point 5	**Test Results (No Oversized Correction)**	
Compacted Dry Density	130.1	132.6	132.5	130.5		Maximum Dry Density	133.0 pcf
Compacted Moisture	5.1	7.2	9.1	10.8		Optimum Moisture	7.0 %



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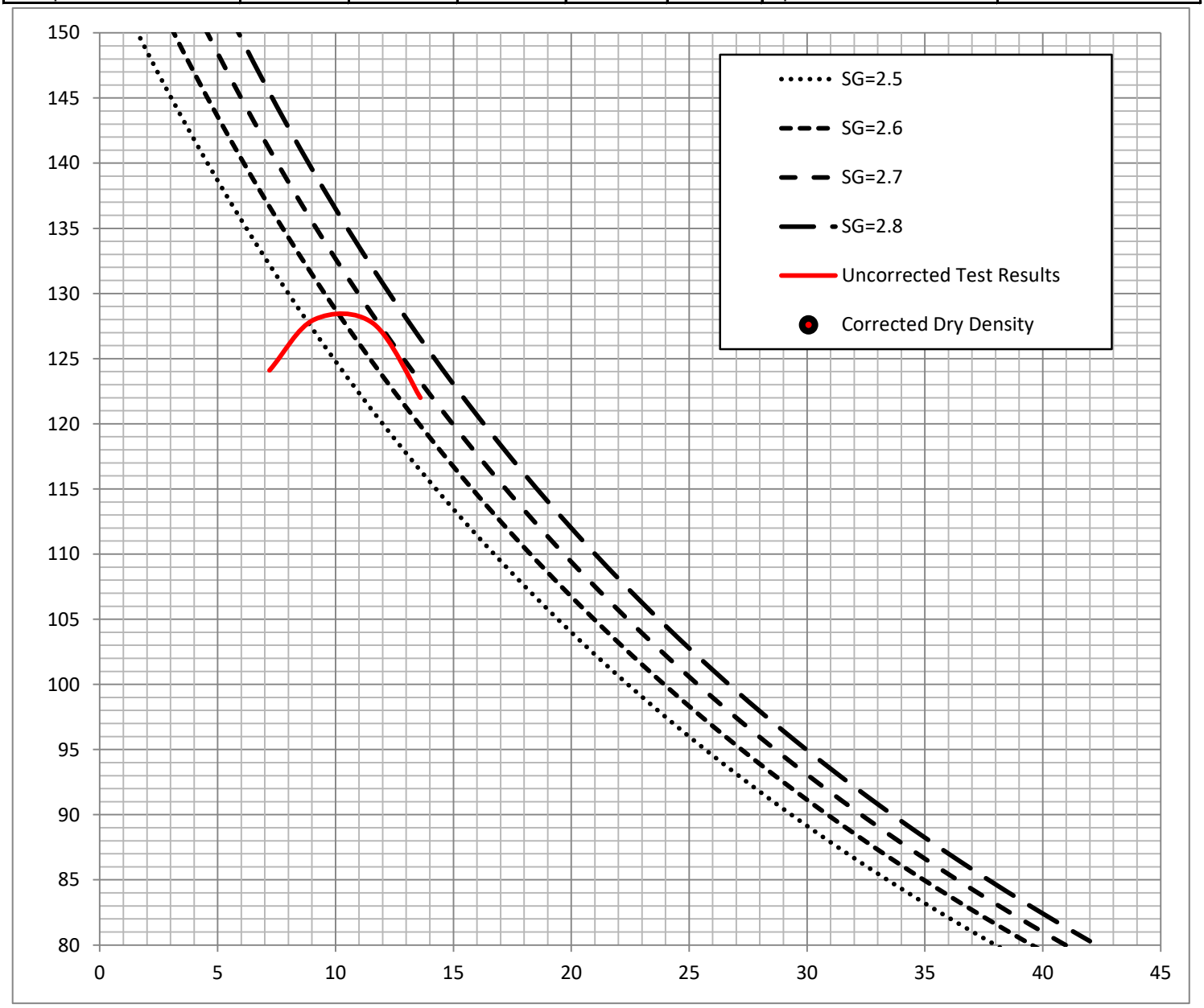
MAXIMUM DRY DENSITY - OPTIMUM MOISTURE

Project Name	RPW - Monroe Master Drainage Plan	**Test Date**	8/8/2017
Project No.	17066-01	**Date Sampled**	8/3/2017
Project Location	Gratton, Dufferin, and Hermosa	**Sampled By**	AM
Location In Structure	N/A	**Sample Type**	Bulk
Sample Location	Pavement Subgrade	**Tested By**	MN

Sample No.	B23	**Mold Size**	4-inch
Sample Depth	0-3'	**No. of Layers**	5
Soil Type	SC	**Blows per Layer**	25
Test Fraction	No.4	**Hammer Wt./Drop**	10-lb/18-inch

Total Sample Weight	g	**Bulk Spec. Grav. of Oversized**	2.600
Weight of Oversized	g	**Percentage of Dry Fines**	%
Weight of Fines	0 g	**Percentage of Dry Oversized**	<5% %
Moisture Content of Oversized	%	**Corrected Dry Density of Soil**	pcf
Moisture Content of Fines	%	**Corrected Optimum Moisture**	%

Test Data	Point 1	Point 2	Point 3	Point 4	Point 5	**Test Results (No Oversized Correction)**	
Compacted Dry Density	124.1	128.0	127.7	122.0		Maximum Dry Density	129.0 pcf
Compacted Moisture	7.2	9.1	11.6	13.6		Optimum Moisture	10.0 %



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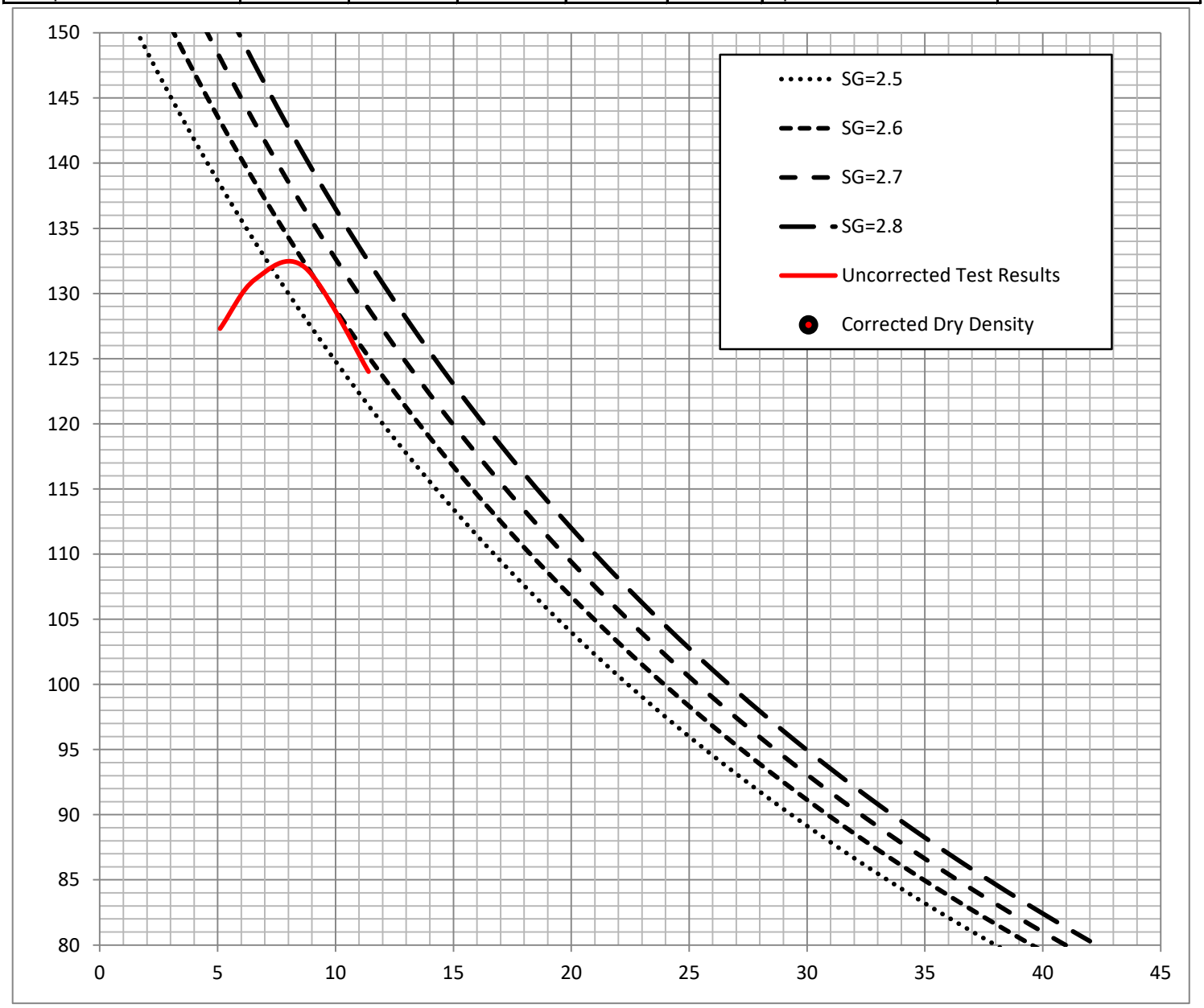
MAXIMUM DRY DENSITY - OPTIMUM MOISTURE

Project Name	RPW - Monroe Master Drainage Plan	**Test Date**	8/8/2017
Project No.	17066-01	**Date Sampled**	8/3/2017
Project Location	Gratton, Dufferin, and Hermosa	**Sampled By**	AM
Location In Structure	N/A	**Sample Type**	Bulk
Sample Location	Pavement Subgrade	**Tested By**	MN

Sample No.	B24	**Mold Size**	4-inch
Sample Depth	0-3'	**No. of Layers**	5
Soil Type	SC	**Blows per Layer**	25
Test Fraction	No.4	**Hammer Wt./Drop**	10-lb/18-inch

Total Sample Weight	g	**Bulk Spec. Grav. of Oversized**	2.600
Weight of Oversized	g	**Percentage of Dry Fines**	%
Weight of Fines	0 g	**Percentage of Dry Oversized**	<5% %
Moisture Content of Oversized	%	**Corrected Dry Density of Soil**	pcf
Moisture Content of Fines	%	**Corrected Optimum Moisture**	%

Test Data	Point 1	Point 2	Point 3	Point 4	Point 5	**Test Results (No Oversized Correction)**	
Compacted Dry Density	127.3	131.1	132.0	124.0		Maximum Dry Density	133.0 pcf
Compacted Moisture	5.1	6.6	8.7	11.4		Optimum Moisture	8.0 %



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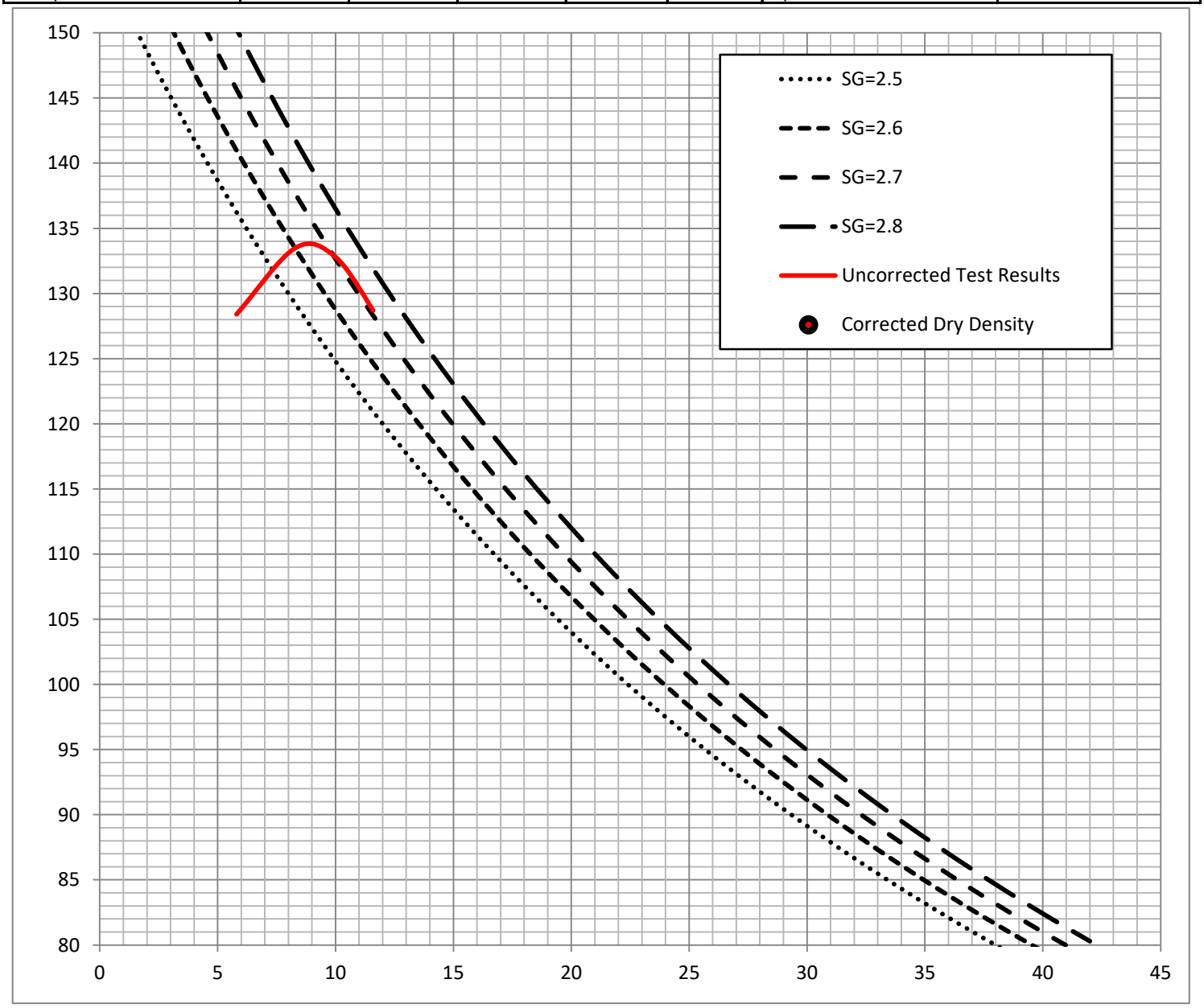
MAXIMUM DRY DENSITY - OPTIMUM MOISTURE

Project Name	RPW - Monroe Master Drainage Plan	**Test Date**	8/8/2017
Project No.	17066-01	**Date Sampled**	8/3/2017
Project Location	Gratton, Dufferin, and Hermosa	**Sampled By**	AM
Location In Structure	N/A	**Sample Type**	Bulk
Sample Location	Pavement Subgrade	**Tested By**	MN

Sample No.	B25	**Mold Size**	4-inch
Sample Depth	0-3'	**No. of Layers**	5
Soil Type	SC	**Blows per Layer**	25
Test Fraction	No.4	**Hammer Wt./Drop**	10-lb/18-inch

Total Sample Weight	g	**Bulk Spec. Grav. of Oversized**	2.600
Weight of Oversized	g	**Percentage of Dry Fines**	%
Weight of Fines	0 g	**Percentage of Dry Oversized**	<5% %
Moisture Content of Oversized	%	**Corrected Dry Density of Soil**	pcf
Moisture Content of Fines	%	**Corrected Optimum Moisture**	%

Test Data	Point 1	Point 2	Point 3	Point 4	Point 5	**Test Results (No Oversized Correction)**	
Compacted Dry Density	128.4	133.5	132.8	128.7		Maximum Dry Density	134.0 pcf
Compacted Moisture	5.8	8.3	10.0	11.6		Optimum Moisture	9.0 %



Soil Resistivity, Soluble Sulfate, Soluble Chloride, pH

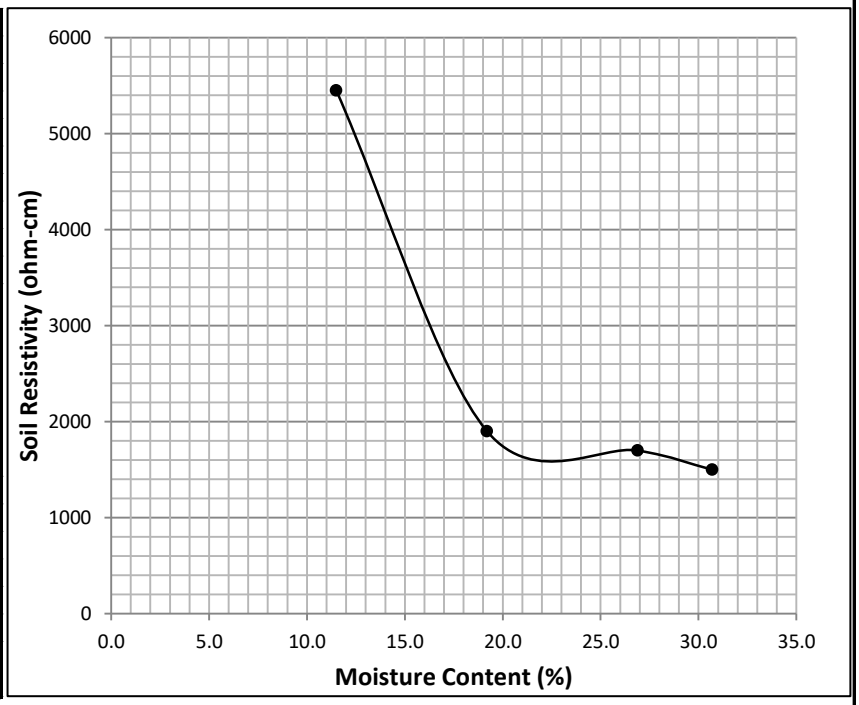
Project Name:	RPW - Monroe Master Drainage Plan	Sample Collected:	8/3/2017
Project No.:	17066-01	Collected By:	AM
Sample ID:	B1 @ 0-3'	Sample Tested:	8/10/2017
Soil Classification:	CL	Tested by:	AN

Specimen No.	1	2	3	4
Soil Box Constant (cm)	1.00	1.00	1.00	1.00
Water Added (ml)	28.8	48.0	67.2	76.8
Moisture (%)	11.5	19.2	26.9	30.7
Meter Dial Reading	5.45	1.90	1.70	1.50
Multilier Setting (ohm)	1000	1000	1000	1000
Resistance (ohm)	5450	1900	1700	1500
Minimum Resistivity (ohm-cm)	**1500**			
Temperature (˚C)	18.2			
$R_{min\ 15.5} = [R_{min\text{-}T}*(24.5+T)]/40$	1601.25			

Water increment: 100-150 ml for large box and 5-15 ml for small box
Resistivity = Resistance X Soil Box Constant
Large Soil Box Constant = 6.67 cm
Small Soil Box Constant = 1.00 cm
Rmin 15.5 Corrected Minimum Resistivity to Standard Ground Temperature of 15.5˚C

Soil Corrosivness	Resistivity (ohm-cm)
Very Severely Corrosive	0 - 900
Severely Corrosive	900 - 2,300
Moderately Corrosive	2,300 - 5,000
Mildly Corrosive	5,000 - 10,000
Very Mildly Corrosive	10,000 - 100,000

Reference: ASTM STP 1013 Titled "Effects of Soil Characteristics on Corrosion" (February, 1989).



Mixing Ratio	Dilution Factor	Sulfate Reading (ppm)	Sulfate Content ppm	Sulfate Content %	Chloride Reading (ppm)	Chloride Content ppm	Chloride Content %	pH
3	1	80	**240**	0.024	5	**15**	0.0015	**7.04**
		Average			Average			

ACI 318-05 Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions					
Sulfate Exposure	Water-Soluble Sulfate (SO4) in Soil, % by Mass	Sulfate (SO4) in Water, ppm	Cement Type	Maximum w/cm by Mass	Minimum Design Compressive Strength fc, Mpa (psi)
Negligible	< 0.10	< 150	No Special Type	--	--
Moderate (See Water)	0.10 to 0.20	150 to 1500	II IP(MS), IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.5	28 (4000)
Severe	0.20 to 2.00	1,500 to 10,000	V	0.45	31 (4500)
Very Severe	> 2.00	> 10,000	V + pozz	0.45	31 (4500)

Caltrans classifies a site as corrosive to structural concrete as an area where soil and/or water contains > 500 ppm chloride, > 2000 ppm sulfate, or has a pH < 5.5. A minimum resistivity of less than 1000 ohm-cm indicates the potential for corrosive environment requiring testing for the above criteria.

The 2007 CBC Section 1904A references ACI 318 for material selection and mix design for reinforced concrete dependant on the onsite corrosion potential, soluble sulfate content, and soluble chloride content in soil.

Comments: Sec. 4.3 of ACI 318 (2005) Soil environment is detrimental to concrete if it has soluble sulfate > 1000 ppm and/or pH < 5.5. Soil environment is corrosive to reinforcement and steel pipes if chloride ion > 500 ppm or pH < 4.0.

The information in this form is not intended for corrosion engineering design. If corrosion is critical, a corrosion specialist should be contacted to provide further recommendations.

Soil Resistivity, Soluble Sulfate, Soluble Chloride, pH

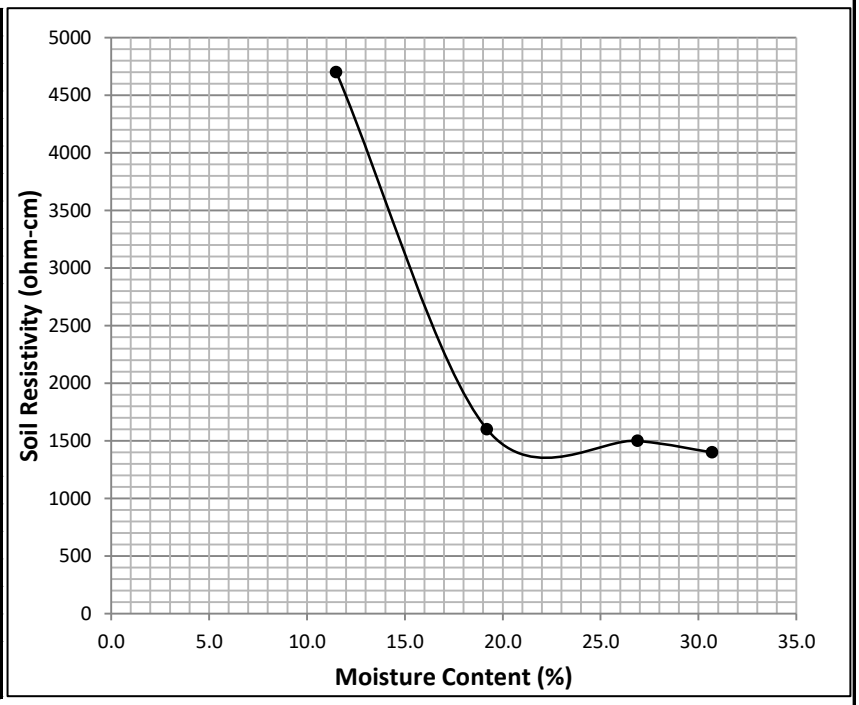
Project Name:	RPW - Monroe Master Drainage Plan	Sample Collected:	8/3/2017
Project No.:	17066-01	Collected By:	AM
Sample ID:	B2 @ 0-3'	Sample Tested:	8/10/2017
Soil Classification:	CL-ML	Tested by:	AN

Specimen No.	1	2	3	4
Soil Box Constant (cm)	1.00	1.00	1.00	1.00
Water Added (ml)	28.8	48.0	67.2	76.8
Moisture (%)	11.5	19.2	26.9	30.7
Meter Dial Reading	4.70	1.60	1.50	1.40
Multilier Setting (ohm)	1000	1000	1000	1000
Resistance (ohm)	4700	1600	1500	1400
Minimum Resistivity (ohm-cm)	**1400**			
Temperature (˚C)	17.9			
$R_{min\ 15.5} = [R_{min\text{-}T}*(24.5+T)]/40$	1484			

Water increment: 100-150 ml for large box and 5-15 ml for small box
Resistivity = Resistance X Soil Box Constant
Large Soil Box Constant = 6.67 cm
Small Soil Box Constant = 1.00 cm
Rmin 15.5 Corrected Minimum Resistivity to Standard Ground Temperature of 15.5˚C

Soil Corrosivness	Resistivity (ohm-cm)
Very Severely Corrosive	0 - 900
Severely Corrosive	900 - 2,300
Moderately Corrosive	2,300 - 5,000
Mildly Corrosive	5,000 - 10,000
Very Mildly Corrosive	10,000 - 100,000

Reference: ASTM STP 1013 Titled "Effects of Soil Characteristics on Corrosion" (February, 1989).



Mixing Ratio	Dilution Factor	Sulfate Reading (ppm)	Sulfate Content ppm	Sulfate Content %	Chloride Reading (ppm)	Chloride Content ppm	Chloride Content %	pH
3	1	90	**270**	0.027	10	**30**	0.003	**6.79**
		Average			Average			

ACI 318-05 Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions					
Sulfate Exposure	Water-Soluble Sulfate (SO4) in Soil, % by Mass	Sulfate (SO4) in Water, ppm	Cement Type	Maximum w/cm by Mass	Minimum Design Compressive Strength fc, Mpa (psi)
Negligible	< 0.10	< 150	No Special Type	--	--
Moderate (See Water)	0.10 to 0.20	150 to 1500	II IP(MS), IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.5	28 (4000)
Severe	0.20 to 2.00	1,500 to 10,000	V	0.45	31 (4500)
Very Severe	> 2.00	> 10,000	V + pozz	0.45	31 (4500)

Caltrans classifies a site as corrosive to structural concrete as an area where soil and/or water contains > 500 ppm chloride, > 2000 ppm sulfate, or has a pH < 5.5. A minimum resistivity of less than 1000 ohm-cm indicates the potential for corrosive environment requiring testing for the above criteria.

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Comments: Sec. 4.3 of ACI 318 (2005) Soil environment is detrimental to concrete if it has soluble sulfate > 1000 ppm and/or pH < 5.5. Soil environment is corrosive to reinforcement and steel pipes if chloride ion > 500 ppm or pH < 4.0.

The information in this form is not intended for corrosion engineering design. If corrosion is critical, a corrosion specialist should be contacted to provide further recommendations.

Soil Resistivity, Soluble Sulfate, Soluble Chloride, pH

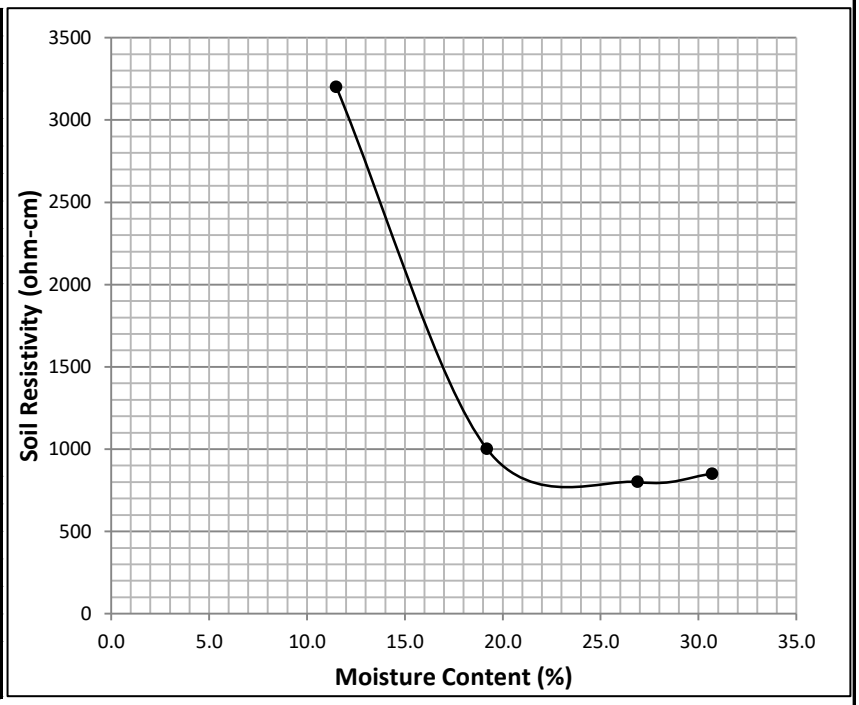
Project Name:	RPW - Monroe Master Drainage Plan	Sample Collected:	8/3/2017
Project No.:	17066-01	Collected By:	AM
Sample ID:	B3 @ 0-3'	Sample Tested:	8/10/2017
Soil Classification:	CL-ML	Tested by:	AN

Specimen No.	1	2	3	4
Soil Box Constant (cm)	1.00	1.00	1.00	1.00
Water Added (ml)	28.8	48.0	67.2	76.8
Moisture (%)	11.5	19.2	26.9	30.7
Meter Dial Reading	3.20	1.00	0.80	0.85
Multilier Setting (ohm)	1000	1000	1000	1000
Resistance (ohm)	3200	1000	800	850
Minimum Resistivity (ohm-cm)	**800**			
Temperature (˚C)	17.8			
$R_{min\ 15.5} = [R_{min\text{-}T}*(24.5+T)]/40$	846			

Water increment: 100-150 ml for large box and 5-15 ml for small box
Resistivity = Resistance X Soil Box Constant
Large Soil Box Constant = 6.67 cm
Small Soil Box Constant = 1.00 cm
Rmin 15.5 Corrected Minimum Resistivity to Standard Ground Temperature of 15.5˚C

Soil Corrosivness	Resistivity (ohm-cm)
Very Severely Corrosive	0 - 900
Severely Corrosive	900 - 2,300
Moderately Corrosive	2,300 - 5,000
Mildly Corrosive	5,000 - 10,000
Very Mildly Corrosive	10,000 - 100,000

Reference: ASTM STP 1013 Titled "Effects of Soil Characteristics on Corrosion" (February, 1989).



Mixing Ratio	Dilution Factor	Sulfate Reading (ppm)	Sulfate Content ppm	Sulfate Content %	Chloride Reading (ppm)	Chloride Content ppm	Chloride Content %	pH
3	1	100	**300**	0.03	25	**75**	0.0075	**6.75**
		Average			Average			

ACI 318-05 Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions					
Sulfate Exposure	Water-Soluble Sulfate (SO4) in Soil, % by Mass	Sulfate (SO4) in Water, ppm	Cement Type	Maximum w/cm by Mass	Minimum Design Compressive Strength fc, Mpa (psi)
Negligible	< 0.10	< 150	No Special Type	--	--
Moderate (See Water)	0.10 to 0.20	150 to 1500	II IP(MS), IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.5	28 (4000)
Severe	0.20 to 2.00	1,500 to 10,000	V	0.45	31 (4500)
Very Severe	> 2.00	> 10,000	V + pozz	0.45	31 (4500)

Caltrans classifies a site as corrosive to structural concrete as an area where soil and/or water contains > 500 ppm chloride, > 2000 ppm sulfate, or has a pH < 5.5. A minimum resistivity of less than 1000 ohm-cm indicates the potential for corrosive environment requiring testing for the above criteria.

The 2007 CBC Section 1904A references ACI 318 for material selection and mix design for reinforced concrete dependant on the onsite corrosion potential, soluble sulfate content, and soluble chloride content in soil.

Comments: Sec. 4.3 of ACI 318 (2005) Soil environment is detrimental to concrete if it has soluble sulfate > 1000 ppm and/or pH < 5.5. Soil environment is corrosive to reinforcement and steel pipes if chloride ion > 500 ppm or pH < 4.0.

The information in this form is not intended for corrosion engineering design. If corrosion is critical, a corrosion specialist should be contacted to provide further recommendations.

Soil Resistivity, Soluble Sulfate, Soluble Chloride, pH

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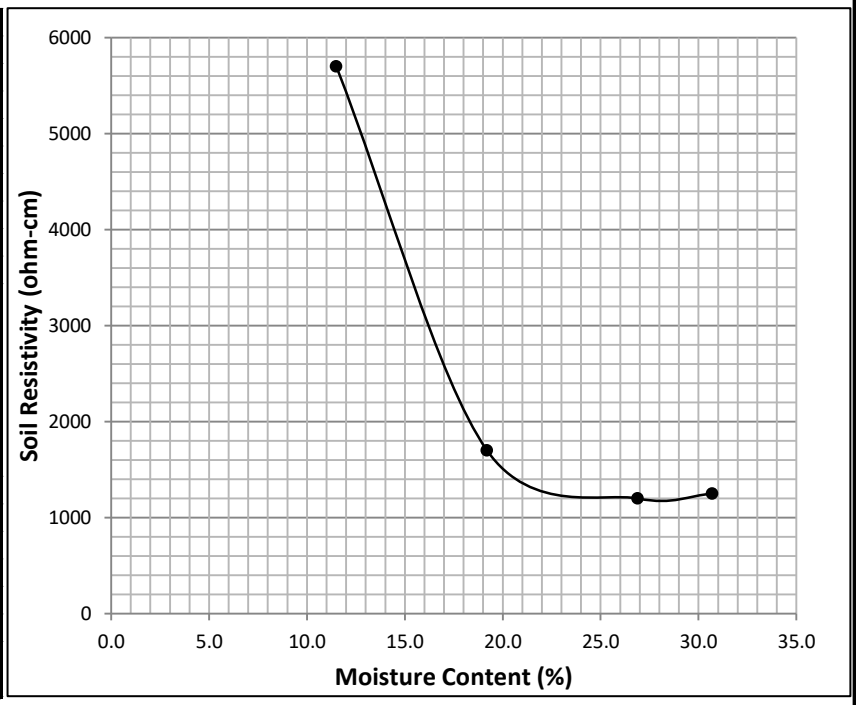
Project Name:	RPW - Monroe Master Drainage Plan	Sample Collected:	8/3/2017
Project No.:	17066-01	Collected By:	AM
Sample ID:	B4 @ 0-3'	Sample Tested:	8/10/2017
Soil Classification:	CL-ML	Tested by:	AN

Specimen No.	1	2	3	4
Soil Box Constant (cm)	1.00	1.00	1.00	1.00
Water Added (ml)	28.8	48.0	67.2	76.8
Moisture (%)	11.5	19.2	26.9	30.7
Meter Dial Reading	5.70	1.70	1.20	1.25
Multilier Setting (ohm)	1000	1000	1000	1000
Resistance (ohm)	5700	1700	1200	1250
Minimum Resistivity (ohm-cm)	**1200**			
Temperature (˚C)	18.1			
$R_{min\ 15.5} = [R_{min\text{-}T}*(24.5+T)]/40$	1278			

Water increment: 100-150 ml for large box and 5-15 ml for small box
Resistivity = Resistance X Soil Box Constant
Large Soil Box Constant = 6.67 cm
Small Soil Box Constant = 1.00 cm
Rmin 15.5 Corrected Minimum Resistivity to Standard Ground Temperature of 15.5˚C

Soil Corrosivness	Resistivity (ohm-cm)
Very Severely Corrosive	0 - 900
Severely Corrosive	900 - 2,300
Moderately Corrosive	2,300 - 5,000
Mildly Corrosive	5,000 - 10,000
Very Mildly Corrosive	10,000 - 100,000

Reference: ASTM STP 1013 Titled "Effects of Soil Characteristics on Corrosion" (February, 1989).



Mixing Ratio	Dilution Factor	Sulfate Reading (ppm)	Sulfate Content ppm	Sulfate Content %	Chloride Reading (ppm)	Chloride Content ppm	Chloride Content %	pH
3	1	90	**270**	0.027	20	**60**	0.006	**6.76**
		Average			Average			

ACI 318-05 Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions					
Sulfate Exposure	Water-Soluble Sulfate (SO4) in Soil, % by Mass	Sulfate (SO4) in Water, ppm	Cement Type	Maximum w/cm by Mass	Minimum Design Compressive Strength fc, Mpa (psi)
Negligible	< 0.10	< 150	No Special Type	--	--
Moderate (See Water)	0.10 to 0.20	150 to 1500	II IP(MS), IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.5	28 (4000)
Severe	0.20 to 2.00	1,500 to 10,000	V	0.45	31 (4500)
Very Severe	> 2.00	> 10,000	V + pozz	0.45	31 (4500)

Caltrans classifies a site as corrosive to structural concrete as an area where soil and/or water contains > 500 ppm chloride, > 2000 ppm sulfate, or has a pH < 5.5. A minimum resistivity of less than 1000 ohm-cm indicates the potential for corrosive environment requiring testing for the above criteria.

The 2007 CBC Section 1904A references ACI 318 for material selection and mix design for reinforced concrete dependant on the onsite corrosion potential, soluble sulfate content, and soluble chloride content in soil.

Comments: Sec. 4.3 of ACI 318 (2005) Soil environment is detrimental to concrete if it has soluble sulfate > 1000 ppm and/or pH < 5.5. Soil environment is corrosive to reinforcement and steel pipes if chloride ion > 500 ppm or pH < 4.0.

The information in this form is not intended for corrosion engineering design. If corrosion is critical, a corrosion specialist should be contacted to provide further recommendations.

Soil Resistivity, Soluble Sulfate, Soluble Chloride, pH

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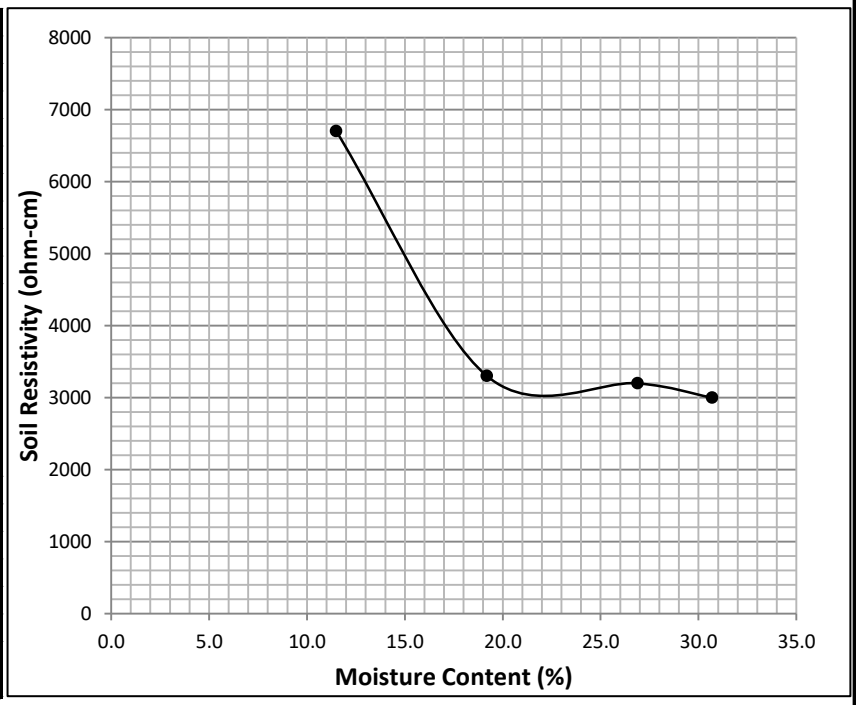
Project Name:	RPW - Monroe Master Drainage Plan	Sample Collected:	8/3/2017
Project No.:	17066-01	Collected By:	AM
Sample ID:	B5 @ 0-3'	Sample Tested:	8/10/2017
Soil Classification:	ML	Tested by:	AN

Specimen No.	1	2	3	4
Soil Box Constant (cm)	1.00	1.00	1.00	1.00
Water Added (ml)	28.8	48.0	67.2	76.8
Moisture (%)	11.5	19.2	26.9	30.7
Meter Dial Reading	6.70	3.30	3.20	3.00
Multilier Setting (ohm)	1000	1000	1000	1000
Resistance (ohm)	6700	3300	3200	3000
Minimum Resistivity (ohm-cm)	**3000**			
Temperature (˚C)	17.9			
$R_{min\ 15.5} = [R_{min\text{-}T}*(24.5+T)]/40$	3180			

Water increment: 100-150 ml for large box and 5-15 ml for small box
Resistivity = Resistance X Soil Box Constant
Large Soil Box Constant = 6.67 cm
Small Soil Box Constant = 1.00 cm
Rmin 15.5 Corrected Minimum Resistivity to Standard Ground Temperature of 15.5˚C

Soil Corrosivness	Resistivity (ohm-cm)
Very Severely Corrosive	0 - 900
Severely Corrosive	900 - 2,300
Moderately Corrosive	2,300 - 5,000
Mildly Corrosive	5,000 - 10,000
Very Mildly Corrosive	10,000 - 100,000

Reference: ASTM STP 1013 Titled "Effects of Soil Characteristics on Corrosion" (February, 1989).



Mixing Ratio	Dilution Factor	Sulfate Reading (ppm)	Sulfate Content ppm	Sulfate Content %	Chloride Reading (ppm)	Chloride Content ppm	Chloride Content %	pH
3	1	90	**270**	0.027	5	**15**	0.0015	**6.76**
		Average			Average			

ACI 318-05 Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions					
Sulfate Exposure	Water-Soluble Sulfate (SO4) in Soil, % by Mass	Sulfate (SO4) in Water, ppm	Cement Type	Maximum w/cm by Mass	Minimum Design Compressive Strength fc, Mpa (psi)
Negligible	< 0.10	< 150	No Special Type	--	--
Moderate (See Water)	0.10 to 0.20	150 to 1500	II IP(MS), IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.5	28 (4000)
Severe	0.20 to 2.00	1,500 to 10,000	V	0.45	31 (4500)
Very Severe	> 2.00	> 10,000	V + pozz	0.45	31 (4500)

Caltrans classifies a site as corrosive to structural concrete as an area where soil and/or water contains > 500 ppm chloride, > 2000 ppm sulfate, or has a pH < 5.5. A minimum resistivity of less than 1000 ohm-cm indicates the potential for corrosive environment requiring testing for the above criteria.

The 2007 CBC Section 1904A references ACI 318 for material selection and mix design for reinforced concrete dependant on the onsite corrosion potential, soluble sulfate content, and soluble chloride content in soil.

Comments: Sec. 4.3 of ACI 318 (2005) Soil environment is detrimental to concrete if it has soluble sulfate > 1000 ppm and/or pH < 5.5. Soil environment is corrosive to reinforcement and steel pipes if chloride ion > 500 ppm or pH < 4.0.

The information in this form is not intended for corrosion engineering design. If corrosion is critical, a corrosion specialist should be contacted to provide further recommendations.

Soil Resistivity, Soluble Sulfate, Soluble Chloride, pH

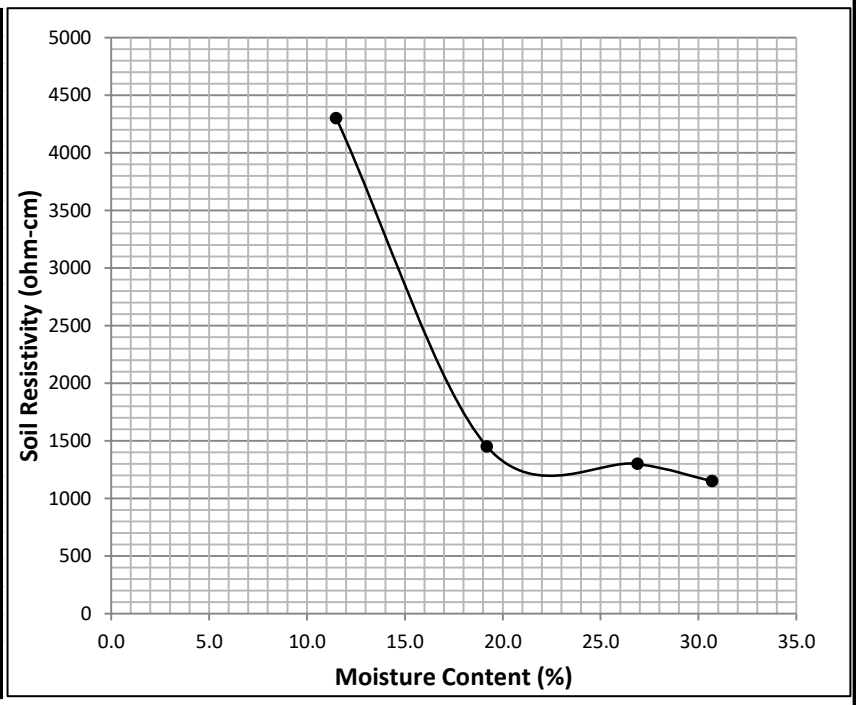
Project Name:	RPW - Monroe Master Drainage Plan	Sample Collected:	8/3/2017
Project No.:	17066-01	Collected By:	AM
Sample ID:	B6 @ 0-3'	Sample Tested:	8/10/2017
Soil Classification:	SC	Tested by:	AN

Specimen No.	1	2	3	4
Soil Box Constant (cm)	1.00	1.00	1.00	1.00
Water Added (ml)	28.8	48.0	67.2	76.8
Moisture (%)	11.5	19.2	26.9	30.7
Meter Dial Reading	4.30	1.45	1.30	1.15
Multilier Setting (ohm)	1000	1000	1000	1000
Resistance (ohm)	4300	1450	1300	1150
Minimum Resistivity (ohm-cm)	**1150**			
Temperature (˚C)	18			
$R_{min\ 15.5} = [R_{min\text{-}T}*(24.5+T)]/40$	1221.875			

Water increment: 100-150 ml for large box and 5-15 ml for small box
Resistivity = Resistance X Soil Box Constant
Large Soil Box Constant = 6.67 cm
Small Soil Box Constant = 1.00 cm
Rmin 15.5 Corrected Minimum Resistivity to Standard Ground Temperature of 15.5˚C

Soil Corrosivness	Resistivity (ohm-cm)
Very Severely Corrosive	0 - 900
Severely Corrosive	900 - 2,300
Moderately Corrosive	2,300 - 5,000
Mildly Corrosive	5,000 - 10,000
Very Mildly Corrosive	10,000 - 100,000

Reference: ASTM STP 1013 Titled "Effects of Soil Characteristics on Corrosion" (February, 1989).



Mixing Ratio	Dilution Factor	Sulfate Reading (ppm)	Sulfate Content ppm	Sulfate Content %	Chloride Reading (ppm)	Chloride Content ppm	Chloride Content %	pH
3	1	100	**300**	0.03	5	**15**	0.0015	**7.02**
		Average			Average			

ACI 318-05 Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions					
Sulfate Exposure	Water-Soluble Sulfate (SO4) in Soil, % by Mass	Sulfate (SO4) in Water, ppm	Cement Type	Maximum w/cm by Mass	Minimum Design Compressive Strength fc, Mpa (psi)
Negligible	< 0.10	< 150	No Special Type	--	--
Moderate (See Water)	0.10 to 0.20	150 to 1500	II IP(MS), IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.5	28 (4000)
Severe	0.20 to 2.00	1,500 to 10,000	V	0.45	31 (4500)
Very Severe	> 2.00	> 10,000	V + pozz	0.45	31 (4500)

Caltrans classifies a site as corrosive to structural concrete as an area where soil and/or water contains > 500 ppm chloride, > 2000 ppm sulfate, or has a pH < 5.5. A minimum resistivity of less than 1000 ohm-cm indicates the potential for corrosive environment requiring testing for the above criteria.

The 2007 CBC Section 1904A references ACI 318 for material selection and mix design for reinforced concrete dependant on the onsite corrosion potential, soluble sulfate content, and soluble chloride content in soil.

Comments: Sec. 4.3 of ACI 318 (2005) Soil environment is detrimental to concrete if it has soluble sulfate > 1000 ppm and/or pH < 5.5. Soil environment is corrosive to reinforcement and steel pipes if chloride ion > 500 ppm or pH < 4.0.

The information in this form is not intended for corrosion engineering design. If corrosion is critical, a corrosion specialist should be contacted to provide further recommendations.

Soil Resistivity, Soluble Sulfate, Soluble Chloride, pH

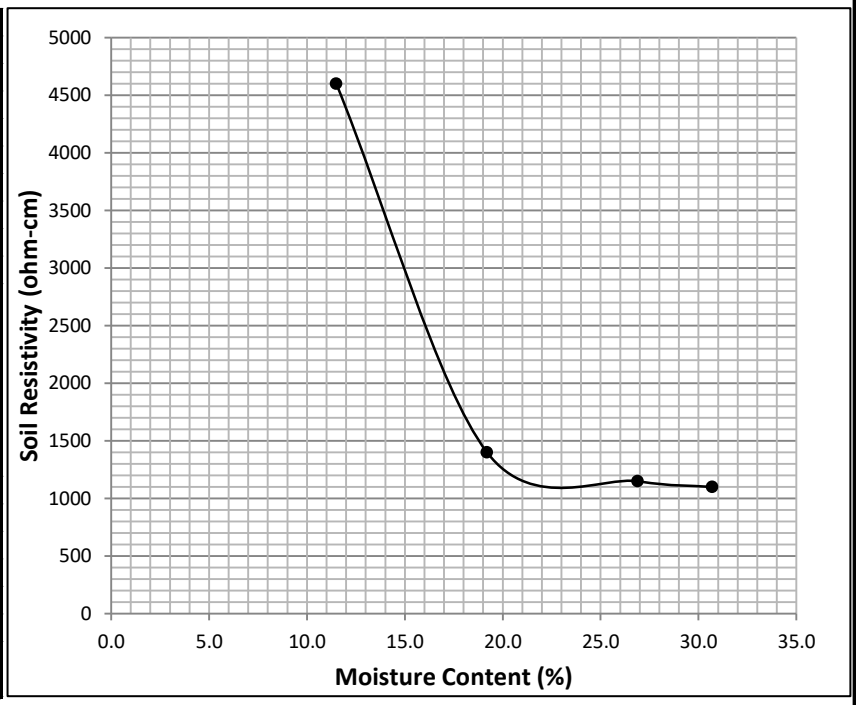
Project Name:	RPW - Monroe Master Drainage Plan	Sample Collected:	8/3/2017
Project No.:	17066-01	Collected By:	AM
Sample ID:	B7 @ 0-3'	Sample Tested:	8/10/2017
Soil Classification:	SC	Tested by:	AN

Specimen No.	1	2	3	4
Soil Box Constant (cm)	1.00	1.00	1.00	1.00
Water Added (ml)	28.8	48.0	67.2	76.8
Moisture (%)	11.5	19.2	26.9	30.7
Meter Dial Reading	4.60	1.40	1.15	1.10
Multilier Setting (ohm)	1000	1000	1000	1000
Resistance (ohm)	4600	1400	1150	1100
Minimum Resistivity (ohm-cm)	**1100**			
Temperature (˚C)	17.8			
$R_{min\ 15.5} = [R_{min\text{-}T}*(24.5+T)]/40$	1163.25			

Water increment: 100-150 ml for large box and 5-15 ml for small box
Resistivity = Resistance X Soil Box Constant
Large Soil Box Constant = 6.67 cm
Small Soil Box Constant = 1.00 cm
Rmin 15.5 Corrected Minimum Resistivity to Standard Ground Temperature of 15.5˚C

Soil Corrosivness	Resistivity (ohm-cm)
Very Severely Corrosive	0 - 900
Severely Corrosive	900 - 2,300
Moderately Corrosive	2,300 - 5,000
Mildly Corrosive	5,000 - 10,000
Very Mildly Corrosive	10,000 - 100,000

Reference: ASTM STP 1013 Titled "Effects of Soil Characteristics on Corrosion" (February, 1989).



Mixing Ratio	Dilution Factor	Sulfate Reading (ppm)	Sulfate Content ppm	Sulfate Content %	Chloride Reading (ppm)	Chloride Content ppm	Chloride Content %	pH
3	1	100	**300**	0.03	10	**30**	0.003	**7.17**
		Average			Average			

ACI 318-05 Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions					
Sulfate Exposure	Water-Soluble Sulfate (SO4) in Soil, % by Mass	Sulfate (SO4) in Water, ppm	Cement Type	Maximum w/cm by Mass	Minimum Design Compressive Strength fc, Mpa (psi)
Negligible	< 0.10	< 150	No Special Type	--	--
Moderate (See Water)	0.10 to 0.20	150 to 1500	II IP(MS), IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.5	28 (4000)
Severe	0.20 to 2.00	1,500 to 10,000	V	0.45	31 (4500)
Very Severe	> 2.00	> 10,000	V + pozz	0.45	31 (4500)

Caltrans classifies a site as corrosive to structural concrete as an area where soil and/or water contains > 500 ppm chloride, > 2000 ppm sulfate, or has a pH < 5.5. A minimum resistivity of less than 1000 ohm-cm indicates the potential for corrosive environment requiring testing for the above criteria.

The 2007 CBC Section 1904A references ACI 318 for material selection and mix design for reinforced concrete dependant on the onsite corrosion potential, soluble sulfate content, and soluble chloride content in soil.

Comments: Sec. 4.3 of ACI 318 (2005) Soil environment is detrimental to concrete if it has soluble sulfate > 1000 ppm and/or pH < 5.5. Soil environment is corrosive to reinforcement and steel pipes if chloride ion > 500 ppm or pH < 4.0.

The information in this form is not intended for corrosion engineering design. If corrosion is critical, a corrosion specialist should be contacted to provide further recommendations.

Soil Resistivity, Soluble Sulfate, Soluble Chloride, pH

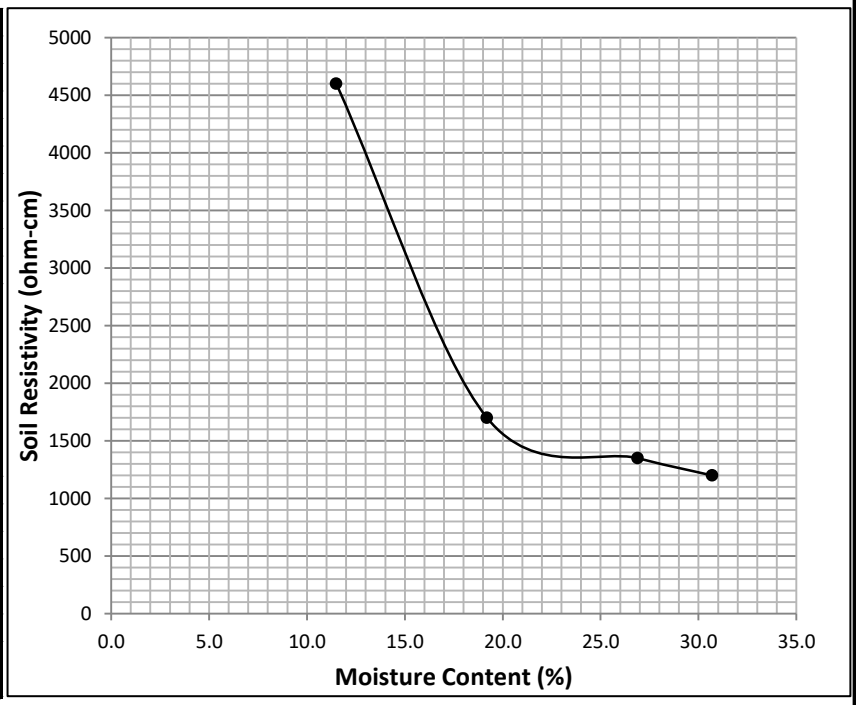
Project Name:	RPW - Monroe Master Drainage Plan	Sample Collected:	8/3/2017
Project No.:	17066-01	Collected By:	AM
Sample ID:	B8 @ 0-3'	Sample Tested:	8/10/2017
Soil Classification:	SC	Tested by:	AN

Specimen No.	1	2	3	4
Soil Box Constant (cm)	1.00	1.00	1.00	1.00
Water Added (ml)	28.8	48.0	67.2	76.8
Moisture (%)	11.5	19.2	26.9	30.7
Meter Dial Reading	4.60	1.70	1.35	1.20
Multilier Setting (ohm)	1000	1000	1000	1000
Resistance (ohm)	4600	1700	1350	1200
Minimum Resistivity (ohm-cm)	**1200**			
Temperature (˚C)	17.8			
$R_{min\ 15.5} = [R_{min\text{-}T}*(24.5+T)]/40$	1269			

Water increment: 100-150 ml for large box and 5-15 ml for small box
Resistivity = Resistance X Soil Box Constant
Large Soil Box Constant = 6.67 cm
Small Soil Box Constant = 1.00 cm
Rmin 15.5 Corrected Minimum Resistivity to Standard Ground Temperature of 15.5˚C

Soil Corrosivness	Resistivity (ohm-cm)
Very Severely Corrosive	0 - 900
Severely Corrosive	900 - 2,300
Moderately Corrosive	2,300 - 5,000
Mildly Corrosive	5,000 - 10,000
Very Mildly Corrosive	10,000 - 100,000

Reference: ASTM STP 1013 Titled "Effects of Soil Characteristics on Corrosion" (February, 1989).



Mixing Ratio	Dilution Factor	Sulfate Reading (ppm)	Sulfate Content ppm	Sulfate Content %	Chloride Reading (ppm)	Chloride Content ppm	Chloride Content %	pH
3	1	80	**240**	0.024	10	**30**	0.003	**6.85**
		Average			Average			

ACI 318-05 Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions					
Sulfate Exposure	Water-Soluble Sulfate (SO4) in Soil, % by Mass	Sulfate (SO4) in Water, ppm	Cement Type	Maximum w/cm by Mass	Minimum Design Compressive Strength fc, Mpa (psi)
Negligible	< 0.10	< 150	No Special Type	--	--
Moderate (See Water)	0.10 to 0.20	150 to 1500	II IP(MS), IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.5	28 (4000)
Severe	0.20 to 2.00	1,500 to 10,000	V	0.45	31 (4500)
Very Severe	> 2.00	> 10,000	V + pozz	0.45	31 (4500)

Caltrans classifies a site as corrosive to structural concrete as an area where soil and/or water contains > 500 ppm chloride, > 2000 ppm sulfate, or has a pH < 5.5. A minimum resistivity of less than 1000 ohm-cm indicates the potential for corrosive environment requiring testing for the above criteria.

The 2007 CBC Section 1904A references ACI 318 for material selection and mix design for reinforced concrete dependant on the onsite corrosion potential, soluble sulfate content, and soluble chloride content in soil.

Comments: Sec. 4.3 of ACI 318 (2005) Soil environment is detrimental to concrete if it has soluble sulfate > 1000 ppm and/or pH < 5.5. Soil environment is corrosive to reinforcement and steel pipes if chloride ion > 500 ppm or pH < 4.0.

The information in this form is not intended for corrosion engineering design. If corrosion is critical, a corrosion specialist should be contacted to provide further recommendations.

Soil Resistivity, Soluble Sulfate, Soluble Chloride, pH

geomat

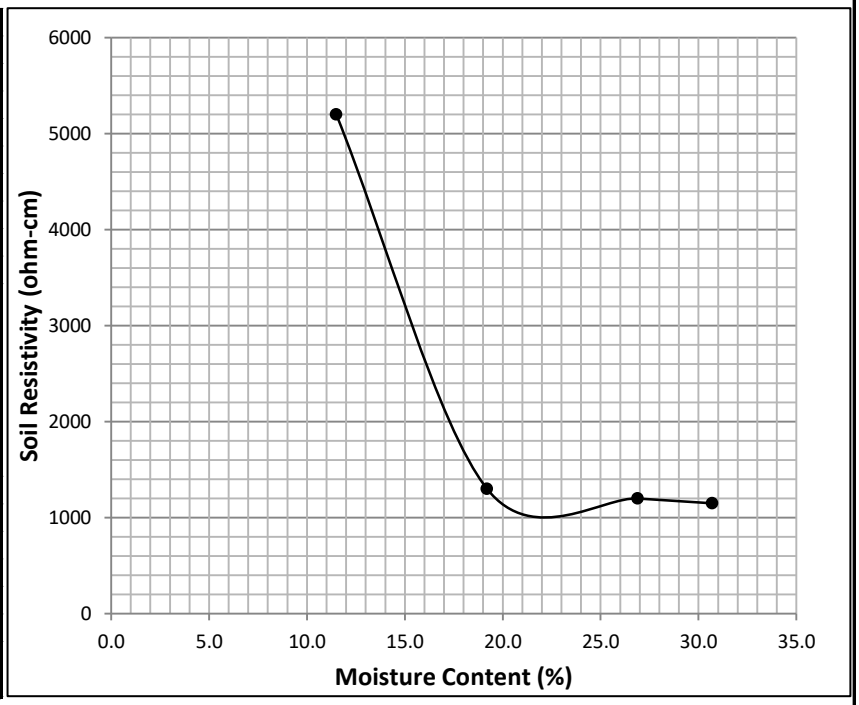
Project Name:	RPW - Monroe Master Drainage Plan	Sample Collected:	8/3/2017
Project No.:	17066-01	Collected By:	AM
Sample ID:	B9 @ 0-3'	Sample Tested:	8/10/2017
Soil Classification:	SC	Tested by:	AN

Specimen No.	1	2	3	4
Soil Box Constant (cm)	1.00	1.00	1.00	1.00
Water Added (ml)	28.8	48.0	67.2	76.8
Moisture (%)	11.5	19.2	26.9	30.7
Meter Dial Reading	5.20	1.30	1.20	1.15
Multilier Setting (ohm)	1000	1000	1000	1000
Resistance (ohm)	5200	1300	1200	1150
Minimum Resistivity (ohm-cm)	**1150**			
Temperature (˚C)	17.8			
$R_{min\ 15.5} = [R_{min\text{-}T}*(24.5+T)]/40$	1216.125			

Water increment: 100-150 ml for large box and 5-15 ml for small box
Resistivity = Resistance X Soil Box Constant
Large Soil Box Constant = 6.67 cm
Small Soil Box Constant = 1.00 cm
Rmin 15.5 Corrected Minimum Resistivity to Standard Ground Temperature of 15.5˚C

Soil Corrosivness	Resistivity (ohm-cm)
Very Severely Corrosive	0 - 900
Severely Corrosive	900 - 2,300
Moderately Corrosive	2,300 - 5,000
Mildly Corrosive	5,000 - 10,000
Very Mildly Corrosive	10,000 - 100,000

Reference: ASTM STP 1013 Titled "Effects of Soil Characteristics on Corrosion" (February, 1989).



Mixing Ratio	Dilution Factor	Sulfate Reading (ppm)	Sulfate Content ppm	Sulfate Content %	Chloride Reading (ppm)	Chloride Content ppm	Chloride Content %	pH
3	1	100	**300**	0.03	25	**75**	0.0075	**6.86**
		Average			Average			

ACI 318-05 Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions					
Sulfate Exposure	Water-Soluble Sulfate (SO4) in Soil, % by Mass	Sulfate (SO4) in Water, ppm	Cement Type	Maximum w/cm by Mass	Minimum Design Compressive Strength fc, Mpa (psi)
Negligible	< 0.10	< 150	No Special Type	--	--
Moderate (See Water)	0.10 to 0.20	150 to 1500	II IP(MS), IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.5	28 (4000)
Severe	0.20 to 2.00	1,500 to 10,000	V	0.45	31 (4500)
Very Severe	> 2.00	> 10,000	V + pozz	0.45	31 (4500)

Caltrans classifies a site as corrosive to structural concrete as an area where soil and/or water contains > 500 ppm chloride, > 2000 ppm sulfate, or has a pH < 5.5. A minimum resistivity of less than 1000 ohm-cm indicates the potential for corrosive environment requiring testing for the above criteria.

The 2007 CBC Section 1904A references ACI 318 for material selection and mix design for reinforced concrete dependant on the onsite corrosion potential, soluble sulfate content, and soluble chloride content in soil.

Comments: Sec. 4.3 of ACI 318 (2005) Soil environment is detrimental to concrete if it has soluble sulfate > 1000 ppm and/or pH < 5.5. Soil environment is corrosive to reinforcement and steel pipes if chloride ion > 500 ppm or pH < 4.0.

The information in this form is not intended for corrosion engineering design. If corrosion is critical, a corrosion specialist should be contacted to provide further recommendations.

Soil Resistivity, Soluble Sulfate, Soluble Chloride, pH

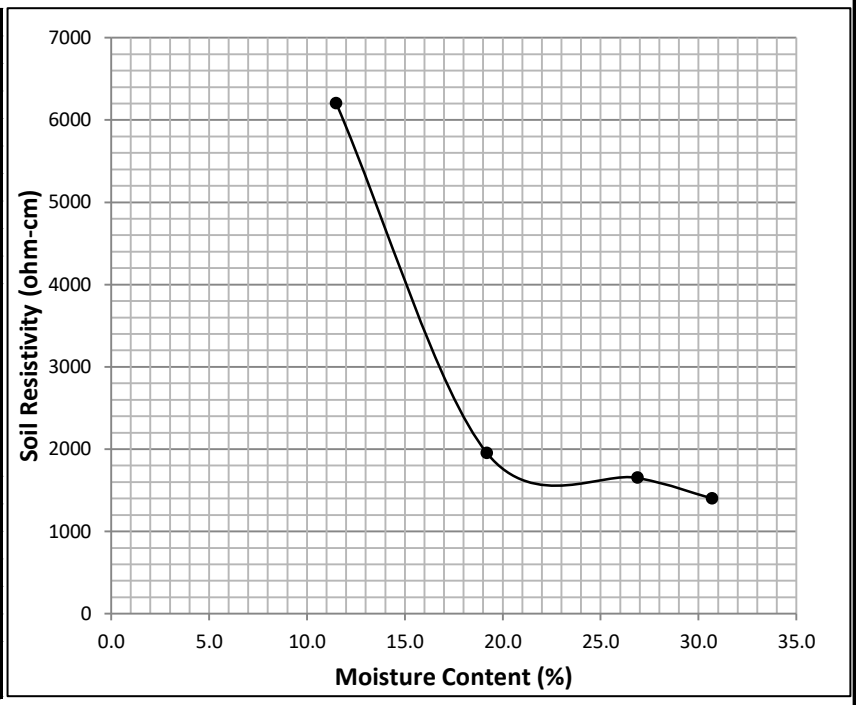
Project Name:	RPW - Monroe Master Drainage Plan	Sample Collected:	8/3/2017
Project No.:	17066-01	Collected By:	AM
Sample ID:	B10 @ 0-3'	Sample Tested:	8/10/2017
Soil Classification:	SC	Tested by:	AN

Specimen No.	1	2	3	4
Soil Box Constant (cm)	1.00	1.00	1.00	1.00
Water Added (ml)	28.8	48.0	67.2	76.8
Moisture (%)	11.5	19.2	26.9	30.7
Meter Dial Reading	6.20	1.95	1.65	1.40
Multilier Setting (ohm)	1000	1000	1000	1000
Resistance (ohm)	6200	1950	1650	1400
Minimum Resistivity (ohm-cm)	**1400**			
Temperature (˚C)	17.8			
$R_{min\ 15.5} = [R_{min\text{-}T}*(24.5+T)]/40$	1480.5			

Water increment: 100-150 ml for large box and 5-15 ml for small box
Resistivity = Resistance X Soil Box Constant
Large Soil Box Constant = 6.67 cm
Small Soil Box Constant = 1.00 cm
Rmin 15.5 Corrected Minimum Resistivity to Standard Ground Temperature of 15.5˚C

Soil Corrosivness	Resistivity (ohm-cm)
Very Severely Corrosive	0 - 900
Severely Corrosive	900 - 2,300
Moderately Corrosive	2,300 - 5,000
Mildly Corrosive	5,000 - 10,000
Very Mildly Corrosive	10,000 - 100,000

Reference: ASTM STP 1013 Titled "Effects of Soil Characteristics on Corrosion" (February, 1989).



Mixing Ratio	Dilution Factor	Sulfate Reading (ppm)	Sulfate Content ppm	Sulfate Content %	Chloride Reading (ppm)	Chloride Content ppm	Chloride Content %	pH
3	1	90	**270**	0.027	5	**15**	0.0015	**6.78**
		Average			Average			

ACI 318-05 Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions					
Sulfate Exposure	Water-Soluble Sulfate (SO4) in Soil, % by Mass	Sulfate (SO4) in Water, ppm	Cement Type	Maximum w/cm by Mass	Minimum Design Compressive Strength fc, Mpa (psi)
Negligible	< 0.10	< 150	No Special Type	--	--
Moderate (See Water)	0.10 to 0.20	150 to 1500	II IP(MS), IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.5	28 (4000)
Severe	0.20 to 2.00	1,500 to 10,000	V	0.45	31 (4500)
Very Severe	> 2.00	> 10,000	V + pozz	0.45	31 (4500)

Caltrans classifies a site as corrosive to structural concrete as an area where soil and/or water contains > 500 ppm chloride, > 2000 ppm sulfate, or has a pH < 5.5. A minimum resistivity of less than 1000 ohm-cm indicates the potential for corrosive environment requiring testing for the above criteria.

The 2007 CBC Section 1904A references ACI 318 for material selection and mix design for reinforced concrete dependant on the onsite corrosion potential, soluble sulfate content, and soluble chloride content in soil.

Comments: Sec. 4.3 of ACI 318 (2005) Soil environment is detrimental to concrete if it has soluble sulfate > 1000 ppm and/or pH < 5.5. Soil environment is corrosive to reinforcement and steel pipes if chloride ion > 500 ppm or pH < 4.0.

The information in this form is not intended for corrosion engineering design. If corrosion is critical, a corrosion specialist should be contacted to provide further recommendations.

Soil Resistivity, Soluble Sulfate, Soluble Chloride, pH

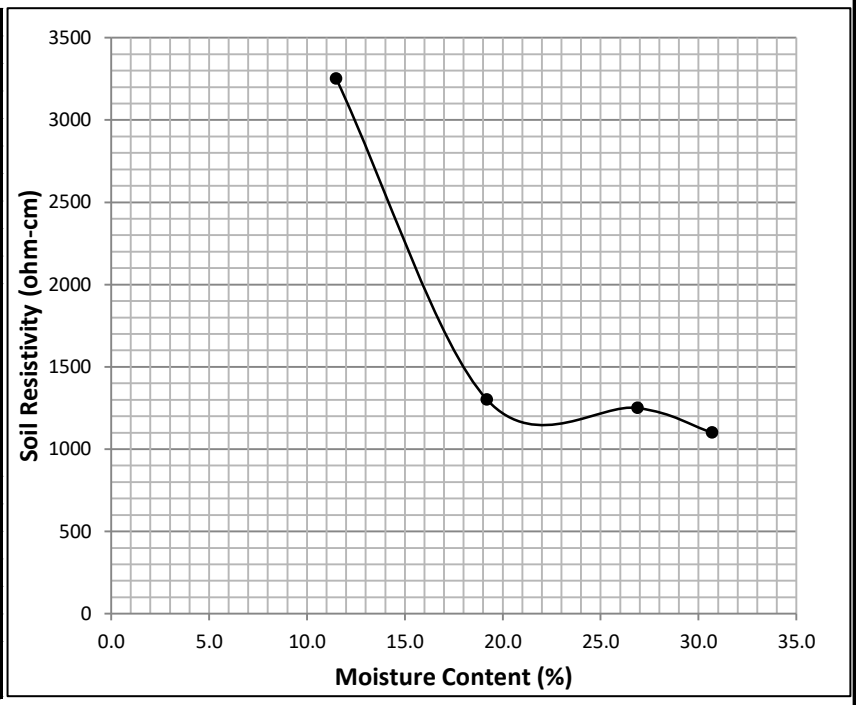
Project Name:	RPW - Monroe Master Drainage Plan	Sample Collected:	8/3/2017
Project No.:	17066-01	Collected By:	AM
Sample ID:	B11 @ 0-3'	Sample Tested:	8/10/2017
Soil Classification:	SC	Tested by:	AN

Specimen No.	1	2	3	4
Soil Box Constant (cm)	1.00	1.00	1.00	1.00
Water Added (ml)	28.8	48.0	67.2	76.8
Moisture (%)	11.5	19.2	26.9	30.7
Meter Dial Reading	3.25	1.30	1.25	1.10
Multilier Setting (ohm)	1000	1000	1000	1000
Resistance (ohm)	3250	1300	1250	1100
Minimum Resistivity (ohm-cm)	**1100**			
Temperature (˚C)	18.2			
$R_{min\ 15.5} = [R_{min\text{-}T}*(24.5+T)]/40$	1174.25			

Water increment: 100-150 ml for large box and 5-15 ml for small box
Resistivity = Resistance X Soil Box Constant
Large Soil Box Constant = 6.67 cm
Small Soil Box Constant = 1.00 cm
Rmin 15.5 Corrected Minimum Resistivity to Standard Ground Temperature of 15.5˚C

Soil Corrosivness	Resistivity (ohm-cm)
Very Severely Corrosive	0 - 900
Severely Corrosive	900 - 2,300
Moderately Corrosive	2,300 - 5,000
Mildly Corrosive	5,000 - 10,000
Very Mildly Corrosive	10,000 - 100,000

Reference: ASTM STP 1013 Titled "Effects of Soil Characteristics on Corrosion" (February, 1989).



Mixing Ratio	Dilution Factor	Sulfate Reading (ppm)	Sulfate Content ppm	Sulfate Content %	Chloride Reading (ppm)	Chloride Content ppm	Chloride Content %	pH
3	1	125	**375**	0.0375	5	**15**	0.0015	**7.19**
		Average			Average			

ACI 318-05 Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions					
Sulfate Exposure	Water-Soluble Sulfate (SO4) in Soil, % by Mass	Sulfate (SO4) in Water, ppm	Cement Type	Maximum w/cm by Mass	Minimum Design Compressive Strength fc, Mpa (psi)
Negligible	< 0.10	< 150	No Special Type	--	--
Moderate (See Water)	0.10 to 0.20	150 to 1500	II IP(MS), IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.5	28 (4000)
Severe	0.20 to 2.00	1,500 to 10,000	V	0.45	31 (4500)
Very Severe	> 2.00	> 10,000	V + pozz	0.45	31 (4500)

Caltrans classifies a site as corrosive to structural concrete as an area where soil and/or water contains > 500 ppm chloride, > 2000 ppm sulfate, or has a pH < 5.5. A minimum resistivity of less than 1000 ohm-cm indicates the potential for corrosive environment requiring testing for the above criteria.

The 2007 CBC Section 1904A references ACI 318 for material selection and mix design for reinforced concrete dependant on the onsite corrosion potential, soluble sulfate content, and soluble chloride content in soil.

Comments: Sec. 4.3 of ACI 318 (2005) Soil environment is detrimental to concrete if it has soluble sulfate > 1000 ppm and/or pH < 5.5. Soil environment is corrosive to reinforcement and steel pipes if chloride ion > 500 ppm or pH < 4.0.

The information in this form is not intended for corrosion engineering design. If corrosion is critical, a corrosion specialist should be contacted to provide further recommendations.

Soil Resistivity, Soluble Sulfate, Soluble Chloride, pH

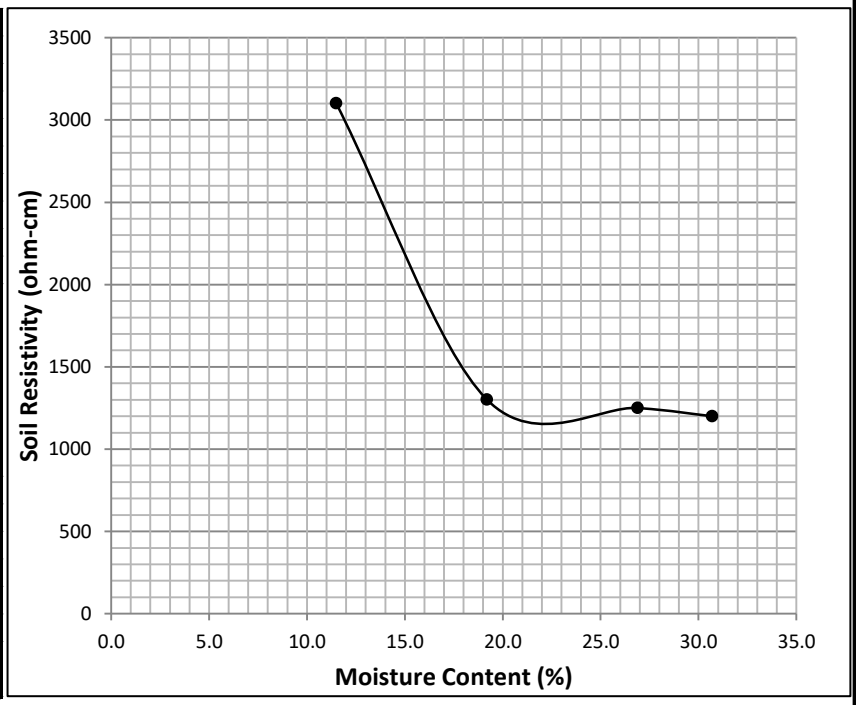
Project Name:	RPW - Monroe Master Drainage Plan	Sample Collected:	8/3/2017
Project No.:	17066-01	Collected By:	AM
Sample ID:	B12 @ 0-3'	Sample Tested:	8/10/2017
Soil Classification:	SC	Tested by:	AN

Specimen No.	1	2	3	4
Soil Box Constant (cm)	1.00	1.00	1.00	1.00
Water Added (ml)	28.8	48.0	67.2	76.8
Moisture (%)	11.5	19.2	26.9	30.7
Meter Dial Reading	3.10	1.30	1.25	1.20
Multilier Setting (ohm)	1000	1000	1000	1000
Resistance (ohm)	3100	1300	1250	1200
Minimum Resistivity (ohm-cm)	**1200**			
Temperature (˚C)	18.4			
$R_{min\ 15.5} = [R_{min\text{-}T}*(24.5+T)]/40$	1287			

Water increment: 100-150 ml for large box and 5-15 ml for small box
Resistivity = Resistance X Soil Box Constant
Large Soil Box Constant = 6.67 cm
Small Soil Box Constant = 1.00 cm
Rmin 15.5 Corrected Minimum Resistivity to Standard Ground Temperature of 15.5˚C

Soil Corrosivness	Resistivity (ohm-cm)
Very Severely Corrosive	0 - 900
Severely Corrosive	900 - 2,300
Moderately Corrosive	2,300 - 5,000
Mildly Corrosive	5,000 - 10,000
Very Mildly Corrosive	10,000 - 100,000

Reference: ASTM STP 1013 Titled "Effects of Soil Characteristics on Corrosion" (February, 1989).



Mixing Ratio	Dilution Factor	Sulfate Reading (ppm)	Sulfate Content ppm	Sulfate Content %	Chloride Reading (ppm)	Chloride Content ppm	Chloride Content %	pH
3	1	150	**450**	0.045	15	**45**	0.0045	**7.14**
		Average			Average			

ACI 318-05 Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions

Sulfate Exposure	Water-Soluble Sulfate (SO4) in Soil, % by Mass	Sulfate (SO4) in Water, ppm	Cement Type	Maximum w/cm by Mass	Minimum Design Compressive Strength fc, Mpa (psi)
Negligible	< 0.10	< 150	No Special Type	--	--
Moderate (See Water)	0.10 to 0.20	150 to 1500	II IP(MS), IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.5	28 (4000)
Severe	0.20 to 2.00	1,500 to 10,000	V	0.45	31 (4500)
Very Severe	> 2.00	> 10,000	V + pozz	0.45	31 (4500)

Caltrans classifies a site as corrosive to structural concrete as an area where soil and/or water contains > 500 ppm chloride, > 2000 ppm sulfate, or has a pH < 5.5. A minimum resistivity of less than 1000 ohm-cm indicates the potential for corrosive environment requiring testing for the above criteria.

The 2007 CBC Section 1904A references ACI 318 for material selection and mix design for reinforced concrete dependant on the onsite corrosion potential, soluble sulfate content, and soluble chloride content in soil.

Comments: Sec. 4.3 of ACI 318 (2005) Soil environment is detrimental to concrete if it has soluble sulfate > 1000 ppm and/or pH < 5.5. Soil environment is corrosive to reinforcement and steel pipes if chloride ion > 500 ppm or pH < 4.0.

The information in this form is not intended for corrosion engineering design. If corrosion is critical, a corrosion specialist should be contacted to provide further recommendations.

Soil Resistivity, Soluble Sulfate, Soluble Chloride, pH

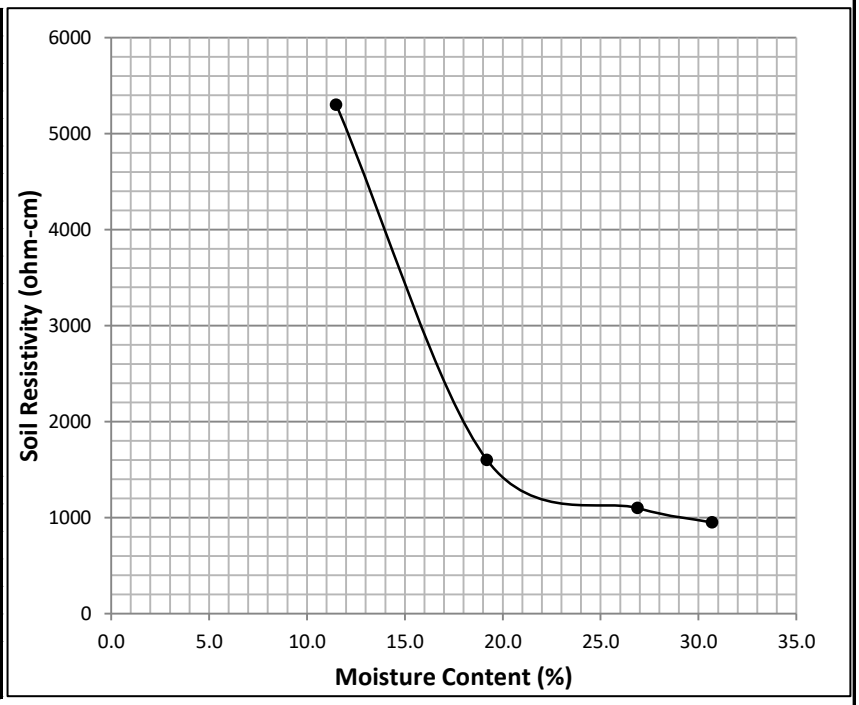
Project Name:	RPW - Monroe Master Drainage Plan	Sample Collected:	8/3/2017
Project No.:	17066-01	Collected By:	AM
Sample ID:	B13 @ 0-3'	Sample Tested:	8/10/2017
Soil Classification:	SC	Tested by:	AN

Specimen No.	1	2	3	4
Soil Box Constant (cm)	1.00	1.00	1.00	1.00
Water Added (ml)	28.8	48.0	67.2	76.8
Moisture (%)	11.5	19.2	26.9	30.7
Meter Dial Reading	5.30	1.60	1.10	0.95
Multilier Setting (ohm)	1000	1000	1000	1000
Resistance (ohm)	5300	1600	1100	950
Minimum Resistivity (ohm-cm)	**950**			
Temperature (˚C)	18.1			
$R_{min\ 15.5} = [R_{min\text{-}T}*(24.5+T)]/40$	1011.75			

Water increment: 100-150 ml for large box and 5-15 ml for small box
Resistivity = Resistance X Soil Box Constant
Large Soil Box Constant = 6.67 cm
Small Soil Box Constant = 1.00 cm
Rmin 15.5 Corrected Minimum Resistivity to Standard Ground Temperature of 15.5˚C

Soil Corrosivness	Resistivity (ohm-cm)
Very Severely Corrosive	0 - 900
Severely Corrosive	900 - 2,300
Moderately Corrosive	2,300 - 5,000
Mildly Corrosive	5,000 - 10,000
Very Mildly Corrosive	10,000 - 100,000

Reference: ASTM STP 1013 Titled "Effects of Soil Characteristics on Corrosion" (February, 1989).



Mixing Ratio	Dilution Factor	Sulfate Reading (ppm)	Sulfate Content ppm	Sulfate Content %	Chloride Reading (ppm)	Chloride Content ppm	Chloride Content %	pH
3	1	150	**450**	0.045	5	**15**	0.0015	**6.91**
		Average			Average			

ACI 318-05 Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions					
Sulfate Exposure	Water-Soluble Sulfate (SO4) in Soil, % by Mass	Sulfate (SO4) in Water, ppm	Cement Type	Maximum w/cm by Mass	Minimum Design Compressive Strength fc, Mpa (psi)
Negligible	< 0.10	< 150	No Special Type	--	--
Moderate (See Water)	0.10 to 0.20	150 to 1500	II IP(MS), IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.5	28 (4000)
Severe	0.20 to 2.00	1,500 to 10,000	V	0.45	31 (4500)
Very Severe	> 2.00	> 10,000	V + pozz	0.45	31 (4500)

Caltrans classifies a site as corrosive to structural concrete as an area where soil and/or water contains > 500 ppm chloride, > 2000 ppm sulfate, or has a pH < 5.5. A minimum resistivity of less than 1000 ohm-cm indicates the potential for corrosive environment requiring testing for the above criteria.

The 2007 CBC Section 1904A references ACI 318 for material selection and mix design for reinforced concrete dependant on the onsite corrosion potential, soluble sulfate content, and soluble chloride content in soil.

Comments: Sec. 4.3 of ACI 318 (2005) Soil environment is detrimental to concrete if it has soluble sulfate > 1000 ppm and/or pH < 5.5. Soil environment is corrosive to reinforcement and steel pipes if chloride ion > 500 ppm or pH < 4.0.

The information in this form is not intended for corrosion engineering design. If corrosion is critical, a corrosion specialist should be contacted to provide further recommendations.

Soil Resistivity, Soluble Sulfate, Soluble Chloride, pH

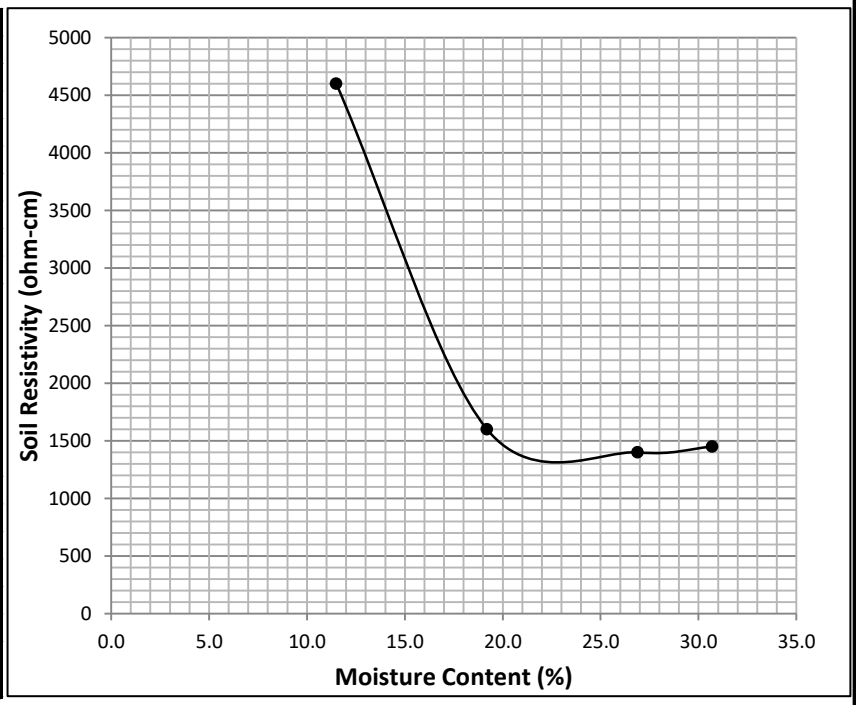
Project Name:	RPW - Monroe Master Drainage Plan	Sample Collected:	8/3/2017
Project No.:	17066-01	Collected By:	AM
Sample ID:	B14 @ 0-3'	Sample Tested:	8/10/2017
Soil Classification:	SC	Tested by:	AN

Specimen No.	1	2	3	4
Soil Box Constant (cm)	1.00	1.00	1.00	1.00
Water Added (ml)	28.8	48.0	67.2	76.8
Moisture (%)	11.5	19.2	26.9	30.7
Meter Dial Reading	4.60	1.60	1.40	1.45
Multilier Setting (ohm)	1000	1000	1000	1000
Resistance (ohm)	4600	1600	1400	1450
Minimum Resistivity (ohm-cm)	**1400**			
Temperature (˚C)	18.5			
$R_{min\ 15.5} = [R_{min\text{-}T}*(24.5+T)]/40$	1505			

Water increment: 100-150 ml for large box and 5-15 ml for small box
Resistivity = Resistance X Soil Box Constant
Large Soil Box Constant = 6.67 cm
Small Soil Box Constant = 1.00 cm
Rmin 15.5 Corrected Minimum Resistivity to Standard Ground Temperature of 15.5˚C

Soil Corrosivness	Resistivity (ohm-cm)
Very Severely Corrosive	0 - 900
Severely Corrosive	900 - 2,300
Moderately Corrosive	2,300 - 5,000
Mildly Corrosive	5,000 - 10,000
Very Mildly Corrosive	10,000 - 100,000

Reference: ASTM STP 1013 Titled "Effects of Soil Characteristics on Corrosion" (February, 1989).



Mixing Ratio	Dilution Factor	Sulfate Reading (ppm)	Sulfate Content ppm	Sulfate Content %	Chloride Reading (ppm)	Chloride Content ppm	Chloride Content %	pH
3	1	90	**270**	0.027	10	**30**	0.003	**6.84**
		Average			Average			

ACI 318-05 Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions					
Sulfate Exposure	Water-Soluble Sulfate (SO4) in Soil, % by Mass	Sulfate (SO4) in Water, ppm	Cement Type	Maximum w/cm by Mass	Minimum Design Compressive Strength fc, Mpa (psi)
Negligible	< 0.10	< 150	No Special Type	--	--
Moderate (See Water)	0.10 to 0.20	150 to 1500	II IP(MS), IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.5	28 (4000)
Severe	0.20 to 2.00	1,500 to 10,000	V	0.45	31 (4500)
Very Severe	> 2.00	> 10,000	V + pozz	0.45	31 (4500)

Caltrans classifies a site as corrosive to structural concrete as an area where soil and/or water contains > 500 ppm chloride, > 2000 ppm sulfate, or has a pH < 5.5. A minimum resistivity of less than 1000 ohm-cm indicates the potential for corrosive environment requiring testing for the above criteria.

The 2007 CBC Section 1904A references ACI 318 for material selection and mix design for reinforced concrete dependant on the onsite corrosion potential, soluble sulfate content, and soluble chloride content in soil.

Comments: Sec. 4.3 of ACI 318 (2005) Soil environment is detrimental to concrete if it has soluble sulfate > 1000 ppm and/or pH < 5.5. Soil environment is corrosive to reinforcement and steel pipes if chloride ion > 500 ppm or pH < 4.0.

The information in this form is not intended for corrosion engineering design. If corrosion is critical, a corrosion specialist should be contacted to provide further recommendations.

Soil Resistivity, Soluble Sulfate, Soluble Chloride, pH

geomat

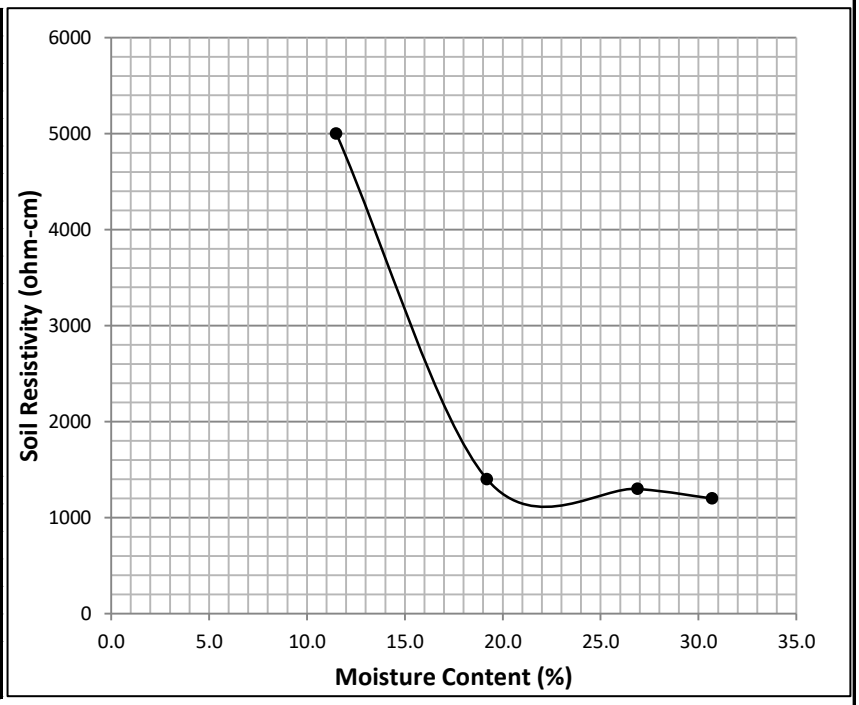
Project Name:	RPW - Monroe Master Drainage Plan	Sample Collected:	8/3/2017
Project No.:	17066-01	Collected By:	AM
Sample ID:	B15 @ 0-3'	Sample Tested:	8/10/2017
Soil Classification:	SC	Tested by:	AN

Specimen No.	1	2	3	4
Soil Box Constant (cm)	1.00	1.00	1.00	1.00
Water Added (ml)	28.8	48.0	67.2	76.8
Moisture (%)	11.5	19.2	26.9	30.7
Meter Dial Reading	5.00	1.40	1.30	1.20
Multilier Setting (ohm)	1000	1000	1000	1000
Resistance (ohm)	5000	1400	1300	1200
Minimum Resistivity (ohm-cm)	**1200**			
Temperature (˚C)	18.5			
$R_{min\ 15.5} = [R_{min\text{-}T}*(24.5+T)]/40$	1290			

Water increment: 100-150 ml for large box and 5-15 ml for small box
Resistivity = Resistance X Soil Box Constant
Large Soil Box Constant = 6.67 cm
Small Soil Box Constant = 1.00 cm
Rmin 15.5 Corrected Minimum Resistivity to Standard Ground Temperature of 15.5˚C

Soil Corrosivness	Resistivity (ohm-cm)
Very Severely Corrosive	0 - 900
Severely Corrosive	900 - 2,300
Moderately Corrosive	2,300 - 5,000
Mildly Corrosive	5,000 - 10,000
Very Mildly Corrosive	10,000 - 100,000

Reference: ASTM STP 1013 Titled "Effects of Soil Characteristics on Corrosion" (February, 1989).



Mixing Ratio	Dilution Factor	Sulfate Reading (ppm)	Sulfate Content ppm	Sulfate Content %	Chloride Reading (ppm)	Chloride Content ppm	Chloride Content %	pH
3	1	125	**375**	0.0375	10	**30**	0.003	**7.14**
		Average			Average			

ACI 318-05 Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions

Sulfate Exposure	Water-Soluble Sulfate (SO4) in Soil, % by Mass	Sulfate (SO4) in Water, ppm	Cement Type	Maximum w/cm by Mass	Minimum Design Compressive Strength fc, Mpa (psi)
Negligible	< 0.10	< 150	No Special Type	--	--
Moderate (See Water)	0.10 to 0.20	150 to 1500	II IP(MS), IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.5	28 (4000)
Severe	0.20 to 2.00	1,500 to 10,000	V	0.45	31 (4500)
Very Severe	> 2.00	> 10,000	V + pozz	0.45	31 (4500)

Caltrans classifies a site as corrosive to structural concrete as an area where soil and/or water contains > 500 ppm chloride, > 2000 ppm sulfate, or has a pH < 5.5. A minimum resistivity of less than 1000 ohm-cm indicates the potential for corrosive environment requiring testing for the above criteria.

The 2007 CBC Section 1904A references ACI 318 for material selection and mix design for reinforced concrete dependant on the onsite corrosion potential, soluble sulfate content, and soluble chloride content in soil.

Comments: Sec. 4.3 of ACI 318 (2005) Soil environment is detrimental to concrete if it has soluble sulfate > 1000 ppm and/or pH < 5.5. Soil environment is corrosive to reinforcement and steel pipes if chloride ion > 500 ppm or pH < 4.0.

The information in this form is not intended for corrosion engineering design. If corrosion is critical, a corrosion specialist should be contacted to provide further recommendations.

Soil Resistivity, Soluble Sulfate, Soluble Chloride, pH

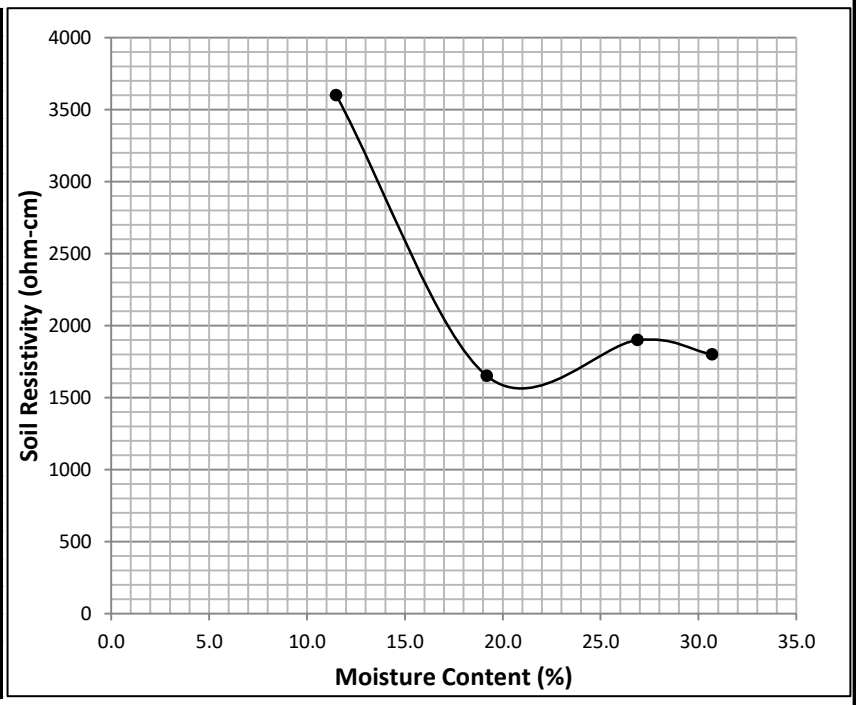
Project Name:	RPW - Monroe Master Drainage Plan	Sample Collected:	8/3/2017
Project No.:	17066-01	Collected By:	AM
Sample ID:	B16 @ 0-3'	Sample Tested:	8/10/2017
Soil Classification:	SC	Tested by:	AN

Specimen No.	1	2	3	4
Soil Box Constant (cm)	1.00	1.00	1.00	1.00
Water Added (ml)	28.8	48.0	67.2	76.8
Moisture (%)	11.5	19.2	26.9	30.7
Meter Dial Reading	3.60	1.65	1.90	1.80
Multilier Setting (ohm)	1000	1000	1000	1000
Resistance (ohm)	3600	1650	1900	1800
Minimum Resistivity (ohm-cm)	**1650**			
Temperature (˚C)	18.3			
$R_{min\ 15.5} = [R_{min\text{-}T}*(24.5+T)]/40$	1765.5			

Water increment: 100-150 ml for large box and 5-15 ml for small box
Resistivity = Resistance X Soil Box Constant
Large Soil Box Constant = 6.67 cm
Small Soil Box Constant = 1.00 cm
Rmin 15.5 Corrected Minimum Resistivity to Standard Ground Temperature of 15.5˚C

Soil Corrosivness	Resistivity (ohm-cm)
Very Severely Corrosive	0 - 900
Severely Corrosive	900 - 2,300
Moderately Corrosive	2,300 - 5,000
Mildly Corrosive	5,000 - 10,000
Very Mildly Corrosive	10,000 - 100,000

Reference: ASTM STP 1013 Titled "Effects of Soil Characteristics on Corrosion" (February, 1989).



Mixing Ratio	Dilution Factor	Sulfate Reading (ppm)	Sulfate Content ppm	Sulfate Content %	Chloride Reading (ppm)	Chloride Content ppm	Chloride Content %	pH
3	1	90	**270**	0.027	20	**60**	0.006	**6.95**
		Average			Average			

ACI 318-05 Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions					
Sulfate Exposure	Water-Soluble Sulfate (SO4) in Soil, % by Mass	Sulfate (SO4) in Water, ppm	Cement Type	Maximum w/cm by Mass	Minimum Design Compressive Strength fc, Mpa (psi)
Negligible	< 0.10	< 150	No Special Type	--	--
Moderate (See Water)	0.10 to 0.20	150 to 1500	II IP(MS), IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.5	28 (4000)
Severe	0.20 to 2.00	1,500 to 10,000	V	0.45	31 (4500)
Very Severe	> 2.00	> 10,000	V + pozz	0.45	31 (4500)

Caltrans classifies a site as corrosive to structural concrete as an area where soil and/or water contains > 500 ppm chloride, > 2000 ppm sulfate, or has a pH < 5.5. A minimum resistivity of less than 1000 ohm-cm indicates the potential for corrosive environment requiring testing for the above criteria.

The 2007 CBC Section 1904A references ACI 318 for material selection and mix design for reinforced concrete dependant on the onsite corrosion potential, soluble sulfate content, and soluble chloride content in soil.

Comments: Sec. 4.3 of ACI 318 (2005) Soil environment is detrimental to concrete if it has soluble sulfate > 1000 ppm and/or pH < 5.5. Soil environment is corrosive to reinforcement and steel pipes if chloride ion > 500 ppm or pH < 4.0.

The information in this form is not intended for corrosion engineering design. If corrosion is critical, a corrosion specialist should be contacted to provide further recommendations.

Soil Resistivity, Soluble Sulfate, Soluble Chloride, pH

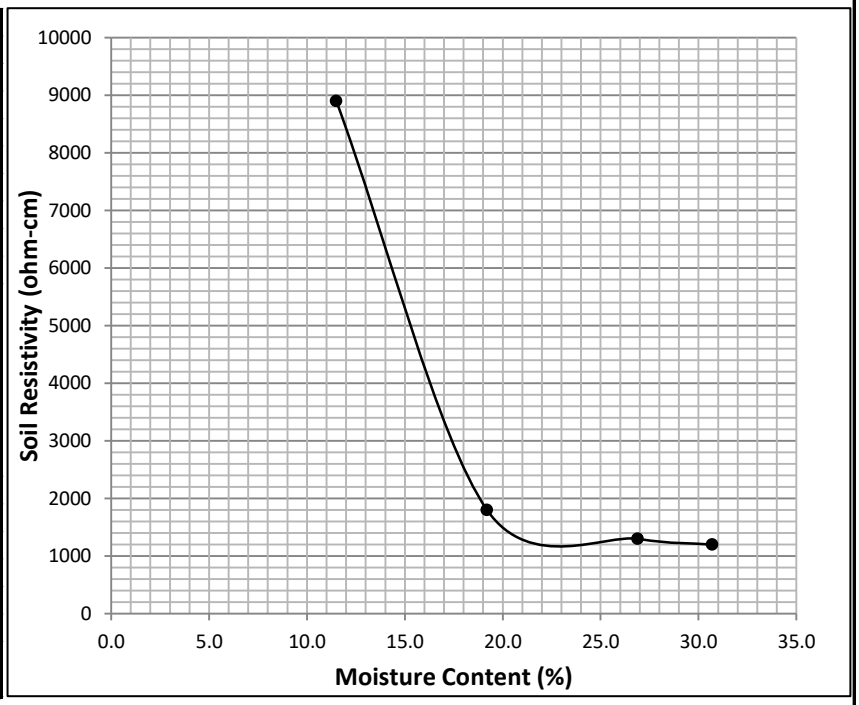
Project Name:	RPW - Monroe Master Drainage Plan	Sample Collected:	8/3/2017
Project No.:	17066-01	Collected By:	AM
Sample ID:	B17 @ 0-3'	Sample Tested:	8/10/2017
Soil Classification:	SC	Tested by:	AN

Specimen No.	1	2	3	4
Soil Box Constant (cm)	1.00	1.00	1.00	1.00
Water Added (ml)	28.8	48.0	67.2	76.8
Moisture (%)	11.5	19.2	26.9	30.7
Meter Dial Reading	8.90	1.80	1.30	1.20
Multilier Setting (ohm)	1000	1000	1000	1000
Resistance (ohm)	8900	1800	1300	1200
Minimum Resistivity (ohm-cm)	**1200**			
Temperature (˚C)	18.5			
$R_{min\ 15.5} = [R_{min\text{-}T}*(24.5+T)]/40$	1290			

Water increment: 100-150 ml for large box and 5-15 ml for small box
Resistivity = Resistance X Soil Box Constant
Large Soil Box Constant = 6.67 cm
Small Soil Box Constant = 1.00 cm
Rmin 15.5 Corrected Minimum Resistivity to Standard Ground Temperature of 15.5˚C

Soil Corrosivness	Resistivity (ohm-cm)
Very Severely Corrosive	0 - 900
Severely Corrosive	900 - 2,300
Moderately Corrosive	2,300 - 5,000
Mildly Corrosive	5,000 - 10,000
Very Mildly Corrosive	10,000 - 100,000

Reference: ASTM STP 1013 Titled "Effects of Soil Characteristics on Corrosion" (February, 1989).



Mixing Ratio	Dilution Factor	Sulfate Reading (ppm)	Sulfate Content ppm	Sulfate Content %	Chloride Reading (ppm)	Chloride Content ppm	Chloride Content %	pH
3	1	125	**375**	0.0375	20	**60**	0.006	**7.13**
		Average			Average			

ACI 318-05 Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions					
Sulfate Exposure	Water-Soluble Sulfate (SO4) in Soil, % by Mass	Sulfate (SO4) in Water, ppm	Cement Type	Maximum w/cm by Mass	Minimum Design Compressive Strength fc, Mpa (psi)
Negligible	< 0.10	< 150	No Special Type	--	--
Moderate (See Water)	0.10 to 0.20	150 to 1500	II IP(MS), IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.5	28 (4000)
Severe	0.20 to 2.00	1,500 to 10,000	V	0.45	31 (4500)
Very Severe	> 2.00	> 10,000	V + pozz	0.45	31 (4500)

Caltrans classifies a site as corrosive to structural concrete as an area where soil and/or water contains > 500 ppm chloride, > 2000 ppm sulfate, or has a pH < 5.5. A minimum resistivity of less than 1000 ohm-cm indicates the potential for corrosive environment requiring testing for the above criteria.

The 2007 CBC Section 1904A references ACI 318 for material selection and mix design for reinforced concrete dependant on the onsite corrosion potential, soluble sulfate content, and soluble chloride content in soil.

Comments: Sec. 4.3 of ACI 318 (2005) Soil environment is detrimental to concrete if it has soluble sulfate > 1000 ppm and/or pH < 5.5. Soil environment is corrosive to reinforcement and steel pipes if chloride ion > 500 ppm or pH < 4.0.

The information in this form is not intended for corrosion engineering design. If corrosion is critical, a corrosion specialist should be contacted to provide further recommendations.

Soil Resistivity, Soluble Sulfate, Soluble Chloride, pH

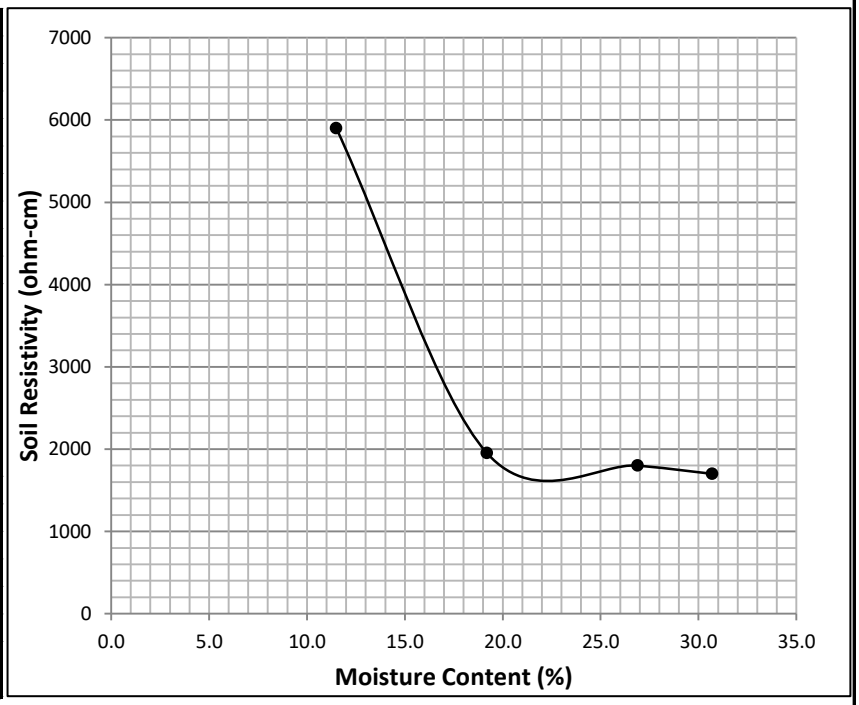
Project Name:	RPW - Monroe Master Drainage Plan	Sample Collected:	8/3/2017
Project No.:	17066-01	Collected By:	AM
Sample ID:	B18 @ 0-3'	Sample Tested:	8/10/2017
Soil Classification:	SC	Tested by:	AN

Specimen No.	1	2	3	4
Soil Box Constant (cm)	1.00	1.00	1.00	1.00
Water Added (ml)	28.8	48.0	67.2	76.8
Moisture (%)	11.5	19.2	26.9	30.7
Meter Dial Reading	5.90	1.95	1.80	1.70
Multilier Setting (ohm)	1000	1000	1000	1000
Resistance (ohm)	5900	1950	1800	1700
Minimum Resistivity (ohm-cm)	**1700**			
Temperature (˚C)	19.1			
$R_{min\ 15.5} = [R_{min\text{-}T}*(24.5+T)]/40$	1853			

Water increment: 100-150 ml for large box and 5-15 ml for small box
Resistivity = Resistance X Soil Box Constant
Large Soil Box Constant = 6.67 cm
Small Soil Box Constant = 1.00 cm
Rmin 15.5 Corrected Minimum Resistivity to Standard Ground Temperature of 15.5˚C

Soil Corrosivness	Resistivity (ohm-cm)
Very Severely Corrosive	0 - 900
Severely Corrosive	900 - 2,300
Moderately Corrosive	2,300 - 5,000
Mildly Corrosive	5,000 - 10,000
Very Mildly Corrosive	10,000 - 100,000

Reference: ASTM STP 1013 Titled "Effects of Soil Characteristics on Corrosion" (February, 1989).



Mixing Ratio	Dilution Factor	Sulfate Reading (ppm)	Sulfate Content ppm	Sulfate Content %	Chloride Reading (ppm)	Chloride Content ppm	Chloride Content %	pH
3	1	125	**375**	0.0375	20	**60**	0.006	**6.79**
		Average			Average			

ACI 318-05 Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions					
Sulfate Exposure	Water-Soluble Sulfate (SO4) in Soil, % by Mass	Sulfate (SO4) in Water, ppm	Cement Type	Maximum w/cm by Mass	Minimum Design Compressive Strength fc, Mpa (psi)
Negligible	< 0.10	< 150	No Special Type	--	--
Moderate (See Water)	0.10 to 0.20	150 to 1500	II IP(MS), IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.5	28 (4000)
Severe	0.20 to 2.00	1,500 to 10,000	V	0.45	31 (4500)
Very Severe	> 2.00	> 10,000	V + pozz	0.45	31 (4500)

Caltrans classifies a site as corrosive to structural concrete as an area where soil and/or water contains > 500 ppm chloride, > 2000 ppm sulfate, or has a pH < 5.5. A minimum resistivity of less than 1000 ohm-cm indicates the potential for corrosive environment requiring testing for the above criteria.

The 2007 CBC Section 1904A references ACI 318 for material selection and mix design for reinforced concrete dependant on the onsite corrosion potential, soluble sulfate content, and soluble chloride content in soil.

Comments: Sec. 4.3 of ACI 318 (2005) Soil environment is detrimental to concrete if it has soluble sulfate > 1000 ppm and/or pH < 5.5. Soil environment is corrosive to reinforcement and steel pipes if chloride ion > 500 ppm or pH < 4.0.

The information in this form is not intended for corrosion engineering design. If corrosion is critical, a corrosion specialist should be contacted to provide further recommendations.

Soil Resistivity, Soluble Sulfate, Soluble Chloride, pH

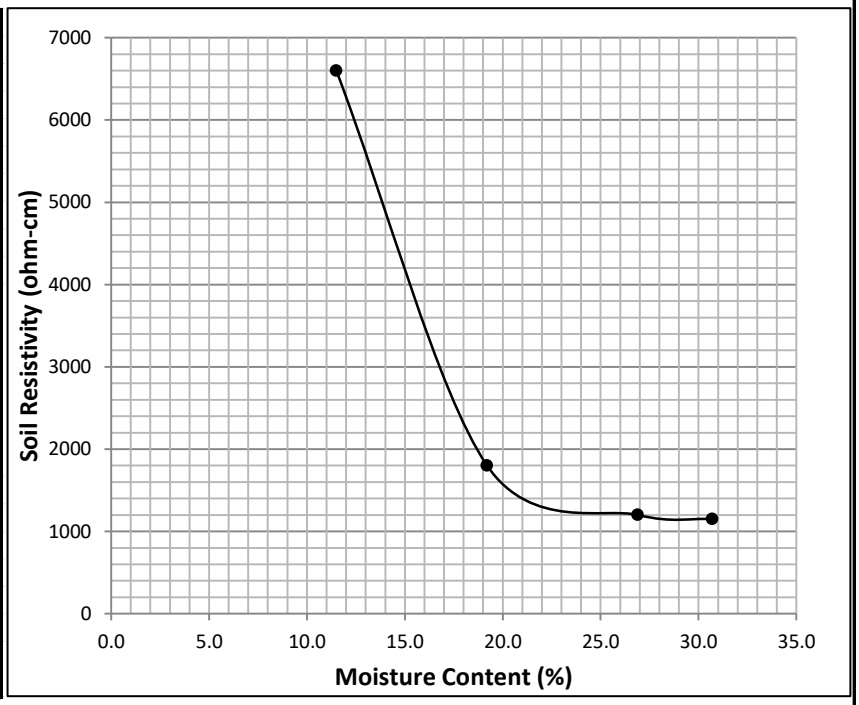
Project Name:	RPW - Monroe Master Drainage Plan	Sample Collected:	8/3/2017
Project No.:	17066-01	Collected By:	AM
Sample ID:	B19 @ 0-3'	Sample Tested:	8/10/2017
Soil Classification:	SC	Tested by:	AN

Specimen No.	1	2	3	4
Soil Box Constant (cm)	1.00	1.00	1.00	1.00
Water Added (ml)	28.8	48.0	67.2	76.8
Moisture (%)	11.5	19.2	26.9	30.7
Meter Dial Reading	6.60	1.80	1.20	1.15
Multilier Setting (ohm)	1000	1000	1000	1000
Resistance (ohm)	6600	1800	1200	1150
Minimum Resistivity (ohm-cm)	**1150**			
Temperature (˚C)	18.4			
$R_{min\ 15.5} = [R_{min\text{-}T}*(24.5+T)]/40$	1233.375			

Water increment: 100-150 ml for large box and 5-15 ml for small box
Resistivity = Resistance X Soil Box Constant
Large Soil Box Constant = 6.67 cm
Small Soil Box Constant = 1.00 cm
Rmin 15.5 Corrected Minimum Resistivity to Standard Ground Temperature of 15.5˚C

Soil Corrosivness	Resistivity (ohm-cm)
Very Severely Corrosive	0 - 900
Severely Corrosive	900 - 2,300
Moderately Corrosive	2,300 - 5,000
Mildly Corrosive	5,000 - 10,000
Very Mildly Corrosive	10,000 - 100,000

Reference: ASTM STP 1013 Titled "Effects of Soil Characteristics on Corrosion" (February, 1989).



Mixing Ratio	Dilution Factor	Sulfate Reading (ppm)	Sulfate Content ppm	Sulfate Content %	Chloride Reading (ppm)	Chloride Content ppm	Chloride Content %	pH
3	1	80	**240**	0.024	15	**45**	0.0045	**7.1**
		Average			Average			

ACI 318-05 Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions					
Sulfate Exposure	Water-Soluble Sulfate (SO4) in Soil, % by Mass	Sulfate (SO4) in Water, ppm	Cement Type	Maximum w/cm by Mass	Minimum Design Compressive Strength fc, Mpa (psi)
Negligible	< 0.10	< 150	No Special Type	--	--
Moderate (See Water)	0.10 to 0.20	150 to 1500	II IP(MS), IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.5	28 (4000)
Severe	0.20 to 2.00	1,500 to 10,000	V	0.45	31 (4500)
Very Severe	> 2.00	> 10,000	V + pozz	0.45	31 (4500)

Caltrans classifies a site as corrosive to structural concrete as an area where soil and/or water contains > 500 ppm chloride, > 2000 ppm sulfate, or has a pH < 5.5. A minimum resistivity of less than 1000 ohm-cm indicates the potential for corrosive environment requiring testing for the above criteria.

The 2007 CBC Section 1904A references ACI 318 for material selection and mix design for reinforced concrete dependant on the onsite corrosion potential, soluble sulfate content, and soluble chloride content in soil.

Comments: Sec. 4.3 of ACI 318 (2005) Soil environment is detrimental to concrete if it has soluble sulfate > 1000 ppm and/or pH < 5.5. Soil environment is corrosive to reinforcement and steel pipes if chloride ion > 500 ppm or pH < 4.0.

The information in this form is not intended for corrosion engineering design. If corrosion is critical, a corrosion specialist should be contacted to provide further recommendations.

Soil Resistivity, Soluble Sulfate, Soluble Chloride, pH

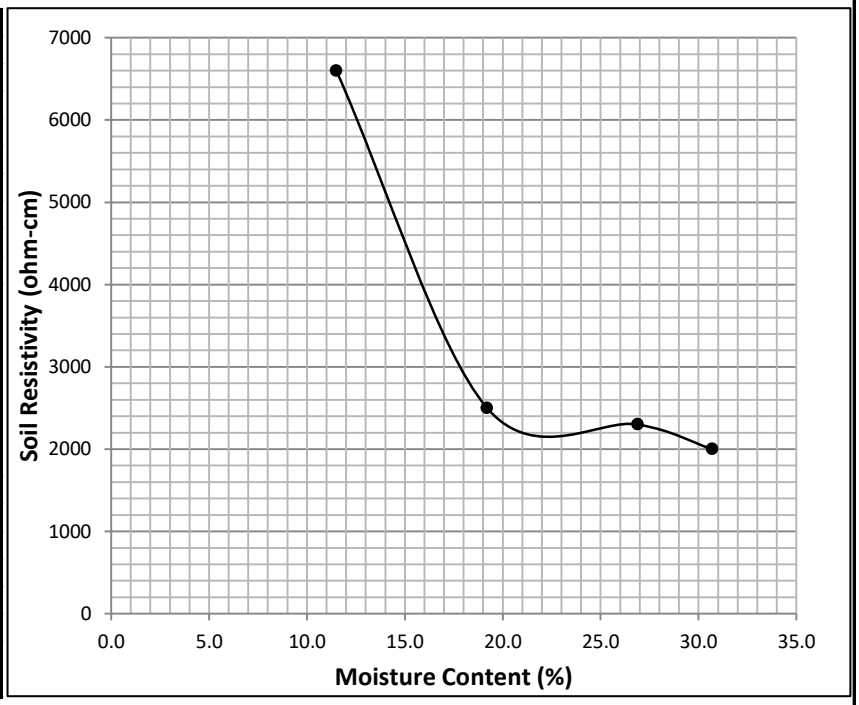
Project Name:	RPW - Monroe Master Drainage Plan	Sample Collected:	8/3/2017
Project No.:	17066-01	Collected By:	AM
Sample ID:	B20 @ 0-3'	Sample Tested:	8/10/2017
Soil Classification:	SC	Tested by:	AN

Specimen No.	1	2	3	4
Soil Box Constant (cm)	1.00	1.00	1.00	1.00
Water Added (ml)	28.8	48.0	67.2	76.8
Moisture (%)	11.5	19.2	26.9	30.7
Meter Dial Reading	6.60	2.50	2.30	2.00
Multilier Setting (ohm)	1000	1000	1000	1000
Resistance (ohm)	6600	2500	2300	2000
Minimum Resistivity (ohm-cm)	**2000**			
Temperature (˚C)	18.6			
$R_{min\ 15.5} = [R_{min\text{-}T}*(24.5+T)]/40$	2155			

Water increment: 100-150 ml for large box and 5-15 ml for small box
Resistivity = Resistance X Soil Box Constant
Large Soil Box Constant = 6.67 cm
Small Soil Box Constant = 1.00 cm
Rmin 15.5 Corrected Minimum Resistivity to Standard Ground Temperature of 15.5˚C

Soil Corrosivness	Resistivity (ohm-cm)
Very Severely Corrosive	0 - 900
Severely Corrosive	900 - 2,300
Moderately Corrosive	2,300 - 5,000
Mildly Corrosive	5,000 - 10,000
Very Mildly Corrosive	10,000 - 100,000

Reference: ASTM STP 1013 Titled "Effects of Soil Characteristics on Corrosion" (February, 1989).



Mixing Ratio	Dilution Factor	Sulfate Reading (ppm)	Sulfate Content ppm	Sulfate Content %	Chloride Reading (ppm)	Chloride Content ppm	Chloride Content %	pH
3	1	125	**375**	0.0375	10	**30**	0.003	**7.06**
		Average			Average			

ACI 318-05 Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions					
Sulfate Exposure	Water-Soluble Sulfate (SO4) in Soil, % by Mass	Sulfate (SO4) in Water, ppm	Cement Type	Maximum w/cm by Mass	Minimum Design Compressive Strength fc, Mpa (psi)
Negligible	< 0.10	< 150	No Special Type	--	--
Moderate (See Water)	0.10 to 0.20	150 to 1500	II IP(MS), IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.5	28 (4000)
Severe	0.20 to 2.00	1,500 to 10,000	V	0.45	31 (4500)
Very Severe	> 2.00	> 10,000	V + pozz	0.45	31 (4500)

Caltrans classifies a site as corrosive to structural concrete as an area where soil and/or water contains > 500 ppm chloride, > 2000 ppm sulfate, or has a pH < 5.5. A minimum resistivity of less than 1000 ohm-cm indicates the potential for corrosive environment requiring testing for the above criteria.

The 2007 CBC Section 1904A references ACI 318 for material selection and mix design for reinforced concrete dependant on the onsite corrosion potential, soluble sulfate content, and soluble chloride content in soil.

Comments: Sec. 4.3 of ACI 318 (2005) Soil environment is detrimental to concrete if it has soluble sulfate > 1000 ppm and/or pH < 5.5. Soil environment is corrosive to reinforcement and steel pipes if chloride ion > 500 ppm or pH < 4.0.

The information in this form is not intended for corrosion engineering design. If corrosion is critical, a corrosion specialist should be contacted to provide further recommendations.

Soil Resistivity, Soluble Sulfate, Soluble Chloride, pH

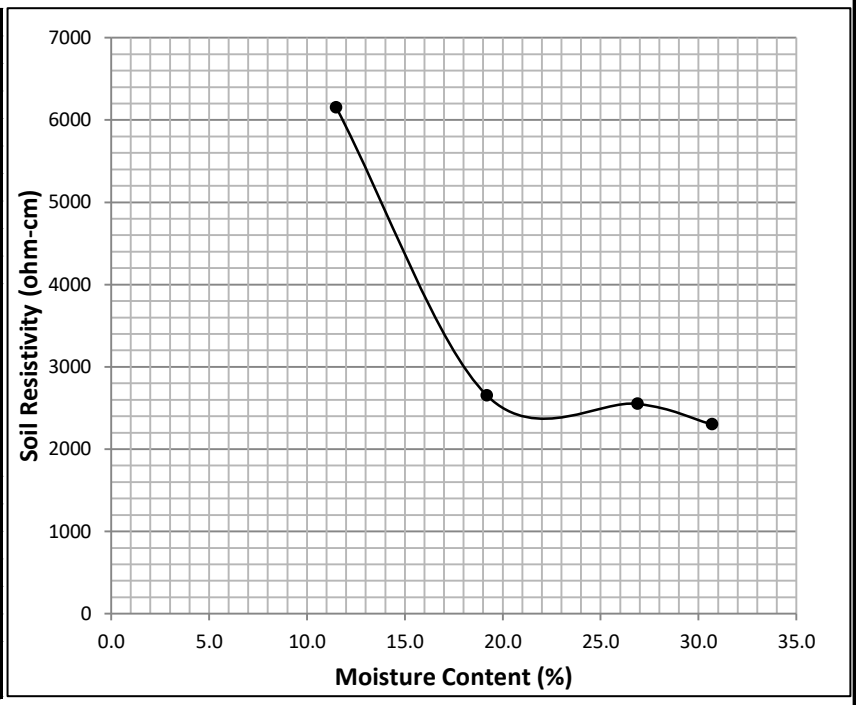
Project Name:	RPW - Monroe Master Drainage Plan	Sample Collected:	8/3/2017
Project No.:	17066-01	Collected By:	AM
Sample ID:	B21 @ 0-3'	Sample Tested:	8/10/2017
Soil Classification:	SC	Tested by:	AN

Specimen No.	1	2	3	4
Soil Box Constant (cm)	1.00	1.00	1.00	1.00
Water Added (ml)	28.8	48.0	67.2	76.8
Moisture (%)	11.5	19.2	26.9	30.7
Meter Dial Reading	6.15	2.65	2.55	2.30
Multilier Setting (ohm)	1000	1000	1000	1000
Resistance (ohm)	6150	2650	2550	2300
Minimum Resistivity (ohm-cm)	**2300**			
Temperature (˚C)	18.2			
$R_{min\ 15.5} = [R_{min\text{-}T}*(24.5+T)]/40$	2455.25			

Water increment: 100-150 ml for large box and 5-15 ml for small box
Resistivity = Resistance X Soil Box Constant
Large Soil Box Constant = 6.67 cm
Small Soil Box Constant = 1.00 cm
Rmin 15.5 Corrected Minimum Resistivity to Standard Ground Temperature of 15.5˚C

Soil Corrosivness	Resistivity (ohm-cm)
Very Severely Corrosive	0 - 900
Severely Corrosive	900 - 2,300
Moderately Corrosive	2,300 - 5,000
Mildly Corrosive	5,000 - 10,000
Very Mildly Corrosive	10,000 - 100,000

Reference: ASTM STP 1013 Titled "Effects of Soil Characteristics on Corrosion" (February, 1989).



Mixing Ratio	Dilution Factor	Sulfate Reading (ppm)	Sulfate Content ppm	Sulfate Content %	Chloride Reading (ppm)	Chloride Content ppm	Chloride Content %	pH
3	1	100	**300**	0.03	10	**30**	0.003	**6.78**
		Average			Average			

ACI 318-05 Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions					
Sulfate Exposure	Water-Soluble Sulfate (SO4) in Soil, % by Mass	Sulfate (SO4) in Water, ppm	Cement Type	Maximum w/cm by Mass	Minimum Design Compressive Strength fc, Mpa (psi)
Negligible	< 0.10	< 150	No Special Type	--	--
Moderate (See Water)	0.10 to 0.20	150 to 1500	II IP(MS), IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.5	28 (4000)
Severe	0.20 to 2.00	1,500 to 10,000	V	0.45	31 (4500)
Very Severe	> 2.00	> 10,000	V + pozz	0.45	31 (4500)

Caltrans classifies a site as corrosive to structural concrete as an area where soil and/or water contains > 500 ppm chloride, > 2000 ppm sulfate, or has a pH < 5.5. A minimum resistivity of less than 1000 ohm-cm indicates the potential for corrosive environment requiring testing for the above criteria.

The 2007 CBC Section 1904A references ACI 318 for material selection and mix design for reinforced concrete dependant on the onsite corrosion potential, soluble sulfate content, and soluble chloride content in soil.

Comments: Sec. 4.3 of ACI 318 (2005) Soil environment is detrimental to concrete if it has soluble sulfate > 1000 ppm and/or pH < 5.5. Soil environment is corrosive to reinforcement and steel pipes if chloride ion > 500 ppm or pH < 4.0.

The information in this form is not intended for corrosion engineering design. If corrosion is critical, a corrosion specialist should be contacted to provide further recommendations.

Soil Resistivity, Soluble Sulfate, Soluble Chloride, pH

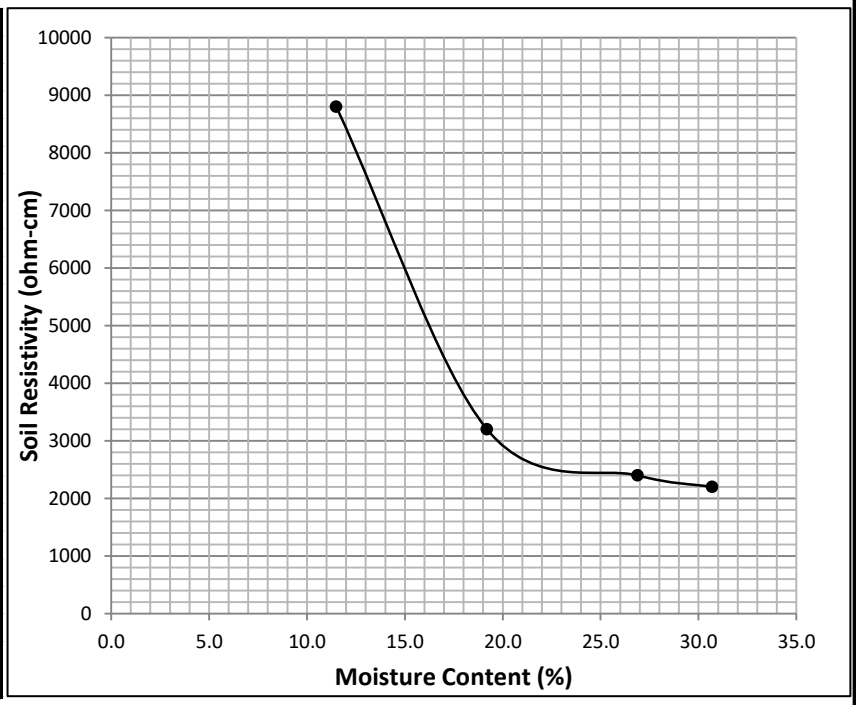
Project Name:	RPW - Monroe Master Drainage Plan	Sample Collected:	8/3/2017
Project No.:	17066-01	Collected By:	AM
Sample ID:	B22 @ 0-3'	Sample Tested:	8/10/2017
Soil Classification:	SC	Tested by:	AN

Specimen No.	1	2	3	4
Soil Box Constant (cm)	1.00	1.00	1.00	1.00
Water Added (ml)	28.8	48.0	67.2	76.8
Moisture (%)	11.5	19.2	26.9	30.7
Meter Dial Reading	8.80	3.20	2.40	2.20
Multilier Setting (ohm)	1000	1000	1000	1000
Resistance (ohm)	8800	3200	2400	2200
Minimum Resistivity (ohm-cm)	**2200**			
Temperature (˚C)	19			
$R_{min\ 15.5} = [R_{min\text{-}T}*(24.5+T)]/40$	2392.5			

Water increment: 100-150 ml for large box and 5-15 ml for small box
Resistivity = Resistance X Soil Box Constant
Large Soil Box Constant = 6.67 cm
Small Soil Box Constant = 1.00 cm
Rmin 15.5 Corrected Minimum Resistivity to Standard Ground Temperature of 15.5˚C

Soil Corrosivness	Resistivity (ohm-cm)
Very Severely Corrosive	0 - 900
Severely Corrosive	900 - 2,300
Moderately Corrosive	2,300 - 5,000
Mildly Corrosive	5,000 - 10,000
Very Mildly Corrosive	10,000 - 100,000

Reference: ASTM STP 1013 Titled "Effects of Soil Characteristics on Corrosion" (February, 1989).



Mixing Ratio	Dilution Factor	Sulfate Reading (ppm)	Sulfate Content ppm	Sulfate Content %	Chloride Reading (ppm)	Chloride Content ppm	Chloride Content %	pH
3	1	80	**240**	0.024	5	**15**	0.0015	**6.98**
		Average			Average			

ACI 318-05 Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions					
Sulfate Exposure	Water-Soluble Sulfate (SO4) in Soil, % by Mass	Sulfate (SO4) in Water, ppm	Cement Type	Maximum w/cm by Mass	Minimum Design Compressive Strength fc, Mpa (psi)
Negligible	< 0.10	< 150	No Special Type	--	--
Moderate (See Water)	0.10 to 0.20	150 to 1500	II IP(MS), IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.5	28 (4000)
Severe	0.20 to 2.00	1,500 to 10,000	V	0.45	31 (4500)
Very Severe	> 2.00	> 10,000	V + pozz	0.45	31 (4500)

Caltrans classifies a site as corrosive to structural concrete as an area where soil and/or water contains > 500 ppm chloride, > 2000 ppm sulfate, or has a pH < 5.5. A minimum resistivity of less than 1000 ohm-cm indicates the potential for corrosive environment requiring testing for the above criteria.

The 2007 CBC Section 1904A references ACI 318 for material selection and mix design for reinforced concrete dependant on the onsite corrosion potential, soluble sulfate content, and soluble chloride content in soil.

Comments: Sec. 4.3 of ACI 318 (2005) Soil environment is detrimental to concrete if it has soluble sulfate > 1000 ppm and/or pH < 5.5. Soil environment is corrosive to reinforcement and steel pipes if chloride ion > 500 ppm or pH < 4.0.

The information in this form is not intended for corrosion engineering design. If corrosion is critical, a corrosion specialist should be contacted to provide further recommendations.

Soil Resistivity, Soluble Sulfate, Soluble Chloride, pH

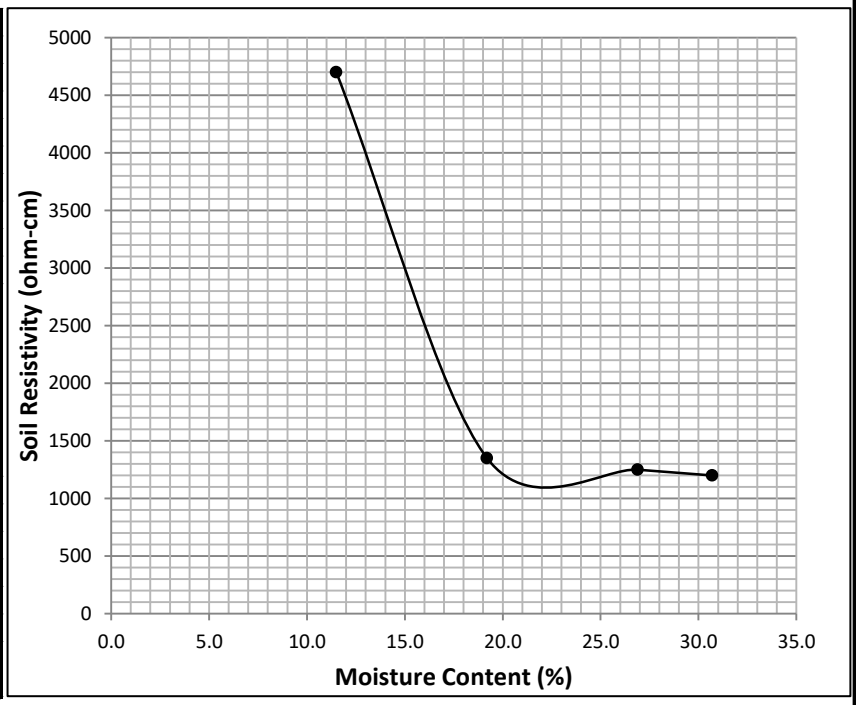
Project Name:	RPW - Monroe Master Drainage Plan	Sample Collected:	8/3/2017
Project No.:	17066-01	Collected By:	AM
Sample ID:	B23 @ 0-3'	Sample Tested:	8/10/2017
Soil Classification:	SC	Tested by:	AN

Specimen No.	1	2	3	4
Soil Box Constant (cm)	1.00	1.00	1.00	1.00
Water Added (ml)	28.8	48.0	67.2	76.8
Moisture (%)	11.5	19.2	26.9	30.7
Meter Dial Reading	4.70	1.35	1.25	1.20
Multilier Setting (ohm)	1000	1000	1000	1000
Resistance (ohm)	4700	1350	1250	1200
Minimum Resistivity (ohm-cm)	**1200**			
Temperature (˚C)	18.5			
$R_{min\ 15.5} = [R_{min\text{-}T}*(24.5+T)]/40$	1290			

Water increment: 100-150 ml for large box and 5-15 ml for small box
Resistivity = Resistance X Soil Box Constant
Large Soil Box Constant = 6.67 cm
Small Soil Box Constant = 1.00 cm
Rmin 15.5 Corrected Minimum Resistivity to Standard Ground Temperature of 15.5˚C

Soil Corrosivness	Resistivity (ohm-cm)
Very Severely Corrosive	0 - 900
Severely Corrosive	900 - 2,300
Moderately Corrosive	2,300 - 5,000
Mildly Corrosive	5,000 - 10,000
Very Mildly Corrosive	10,000 - 100,000

Reference: ASTM STP 1013 Titled "Effects of Soil Characteristics on Corrosion" (February, 1989).



Mixing Ratio	Dilution Factor	Sulfate Reading (ppm)	Sulfate Content ppm	Sulfate Content %	Chloride Reading (ppm)	Chloride Content ppm	Chloride Content %	pH
3	1	90	**270**	0.027	10	**30**	0.003	**6.74**
		Average			Average			

ACI 318-05 Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions					
Sulfate Exposure	Water-Soluble Sulfate (SO4) in Soil, % by Mass	Sulfate (SO4) in Water, ppm	Cement Type	Maximum w/cm by Mass	Minimum Design Compressive Strength fc, Mpa (psi)
Negligible	< 0.10	< 150	No Special Type	--	--
Moderate (See Water)	0.10 to 0.20	150 to 1500	II IP(MS), IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.5	28 (4000)
Severe	0.20 to 2.00	1,500 to 10,000	V	0.45	31 (4500)
Very Severe	> 2.00	> 10,000	V + pozz	0.45	31 (4500)

Caltrans classifies a site as corrosive to structural concrete as an area where soil and/or water contains > 500 ppm chloride, > 2000 ppm sulfate, or has a pH < 5.5. A minimum resistivity of less than 1000 ohm-cm indicates the potential for corrosive environment requiring testing for the above criteria.

The 2007 CBC Section 1904A references ACI 318 for material selection and mix design for reinforced concrete dependant on the onsite corrosion potential, soluble sulfate content, and soluble chloride content in soil.

Comments: Sec. 4.3 of ACI 318 (2005) Soil environment is detrimental to concrete if it has soluble sulfate > 1000 ppm and/or pH < 5.5. Soil environment is corrosive to reinforcement and steel pipes if chloride ion > 500 ppm or pH < 4.0.

The information in this form is not intended for corrosion engineering design. If corrosion is critical, a corrosion specialist should be contacted to provide further recommendations.

Soil Resistivity, Soluble Sulfate, Soluble Chloride, pH

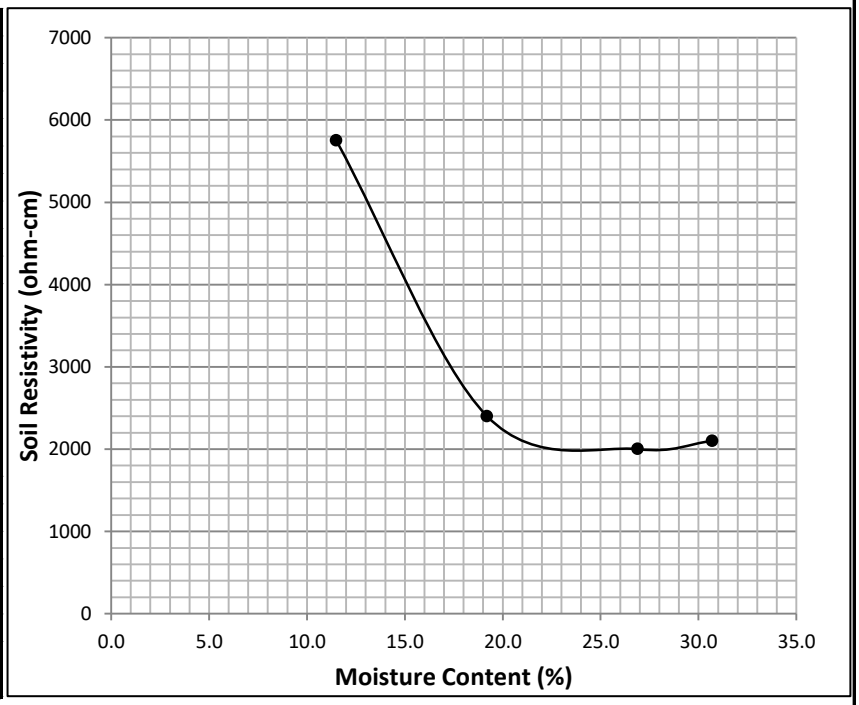
Project Name:	RPW - Monroe Master Drainage Plan	Sample Collected:	8/3/2017
Project No.:	17066-01	Collected By:	AM
Sample ID:	B24 @ 0-3'	Sample Tested:	8/10/2017
Soil Classification:	SC	Tested by:	AN

Specimen No.	1	2	3	4
Soil Box Constant (cm)	1.00	1.00	1.00	1.00
Water Added (ml)	28.8	48.0	67.2	76.8
Moisture (%)	11.5	19.2	26.9	30.7
Meter Dial Reading	5.75	2.40	2.00	2.10
Multilier Setting (ohm)	1000	1000	1000	1000
Resistance (ohm)	5750	2400	2000	2100
Minimum Resistivity (ohm-cm)	**2000**			
Temperature (˚C)	18.7			
$R_{min\ 15.5} = [R_{min\text{-}T}*(24.5+T)]/40$	2160			

Water increment: 100-150 ml for large box and 5-15 ml for small box
Resistivity = Resistance X Soil Box Constant
Large Soil Box Constant = 6.67 cm
Small Soil Box Constant = 1.00 cm
Rmin 15.5 Corrected Minimum Resistivity to Standard Ground Temperature of 15.5˚C

Soil Corrosivness	Resistivity (ohm-cm)
Very Severely Corrosive	0 - 900
Severely Corrosive	900 - 2,300
Moderately Corrosive	2,300 - 5,000
Mildly Corrosive	5,000 - 10,000
Very Mildly Corrosive	10,000 - 100,000

Reference: ASTM STP 1013 Titled "Effects of Soil Characteristics on Corrosion" (February, 1989).



Mixing Ratio	Dilution Factor	Sulfate Reading (ppm)	Sulfate Content ppm	Sulfate Content %	Chloride Reading (ppm)	Chloride Content ppm	Chloride Content %	pH
3	1	90	**270**	0.027	5	**15**	0.0015	**6.68**
		Average			Average			

ACI 318-05 Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions					
Sulfate Exposure	Water-Soluble Sulfate (SO4) in Soil, % by Mass	Sulfate (SO4) in Water, ppm	Cement Type	Maximum w/cm by Mass	Minimum Design Compressive Strength fc, Mpa (psi)
Negligible	< 0.10	< 150	No Special Type	--	--
Moderate (See Water)	0.10 to 0.20	150 to 1500	II IP(MS), IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.5	28 (4000)
Severe	0.20 to 2.00	1,500 to 10,000	V	0.45	31 (4500)
Very Severe	> 2.00	> 10,000	V + pozz	0.45	31 (4500)

Caltrans classifies a site as corrosive to structural concrete as an area where soil and/or water contains > 500 ppm chloride, > 2000 ppm sulfate, or has a pH < 5.5. A minimum resistivity of less than 1000 ohm-cm indicates the potential for corrosive environment requiring testing for the above criteria.

The 2007 CBC Section 1904A references ACI 318 for material selection and mix design for reinforced concrete dependant on the onsite corrosion potential, soluble sulfate content, and soluble chloride content in soil.

Comments: Sec. 4.3 of ACI 318 (2005) Soil environment is detrimental to concrete if it has soluble sulfate > 1000 ppm and/or pH < 5.5. Soil environment is corrosive to reinforcement and steel pipes if chloride ion > 500 ppm or pH < 4.0.

The information in this form is not intended for corrosion engineering design. If corrosion is critical, a corrosion specialist should be contacted to provide further recommendations.

Soil Resistivity, Soluble Sulfate, Soluble Chloride, pH

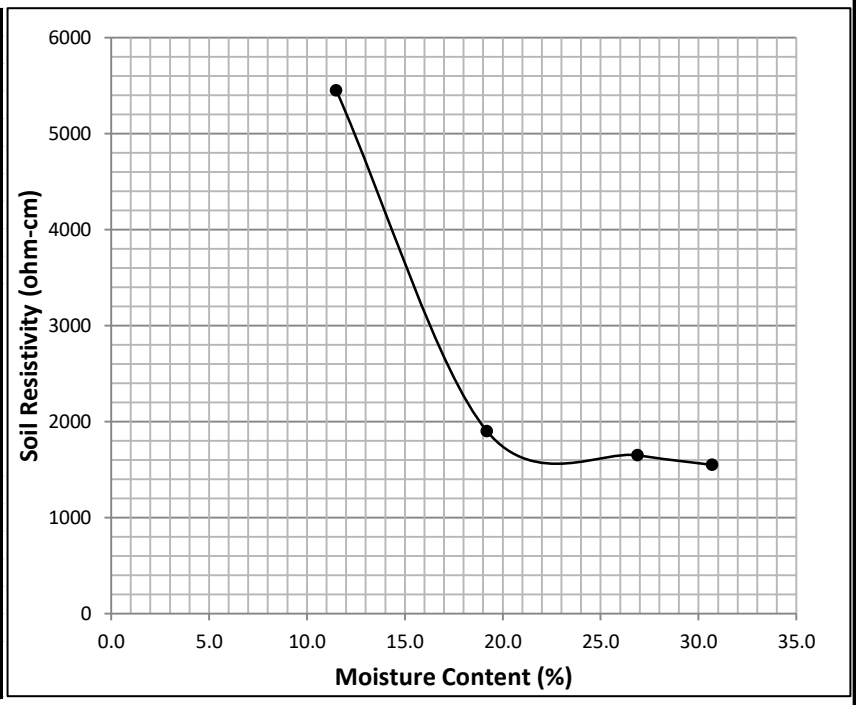
Project Name:	RPW - Monroe Master Drainage Plan	Sample Collected:	8/3/2017
Project No.:	17066-01	Collected By:	AM
Sample ID:	B25 @ 0-3'	Sample Tested:	8/10/2017
Soil Classification:	SC	Tested by:	AN

Specimen No.	1	2	3	4
Soil Box Constant (cm)	1.00	1.00	1.00	1.00
Water Added (ml)	28.8	48.0	67.2	76.8
Moisture (%)	11.5	19.2	26.9	30.7
Meter Dial Reading	5.45	1.90	1.65	1.55
Multilier Setting (ohm)	1000	1000	1000	1000
Resistance (ohm)	5450	1900	1650	1550
Minimum Resistivity (ohm-cm)	**1550**			
Temperature (˚C)	19			
$R_{min\ 15.5} = [R_{min\text{-}T}*(24.5+T)]/40$	1685.625			

Water increment: 100-150 ml for large box and 5-15 ml for small box
Resistivity = Resistance X Soil Box Constant
Large Soil Box Constant = 6.67 cm
Small Soil Box Constant = 1.00 cm
Rmin 15.5 Corrected Minimum Resistivity to Standard Ground Temperature of 15.5˚C

Soil Corrosivness	Resistivity (ohm-cm)
Very Severely Corrosive	0 - 900
Severely Corrosive	900 - 2,300
Moderately Corrosive	2,300 - 5,000
Mildly Corrosive	5,000 - 10,000
Very Mildly Corrosive	10,000 - 100,000

Reference: ASTM STP 1013 Titled "Effects of Soil Characteristics on Corrosion" (February, 1989).



Mixing Ratio	Dilution Factor	Sulfate Reading (ppm)	Sulfate Content ppm	Sulfate Content %	Chloride Reading (ppm)	Chloride Content ppm	Chloride Content %	pH
3	1	90	**270**	0.027	5	**15**	0.0015	**6.9**
		Average			Average			

ACI 318-05 Table 4.3.1 Requirements for Concrete Exposed to Sulfate-Containing Solutions					
Sulfate Exposure	Water-Soluble Sulfate (SO4) in Soil, % by Mass	Sulfate (SO4) in Water, ppm	Cement Type	Maximum w/cm by Mass	Minimum Design Compressive Strength fc, Mpa (psi)
Negligible	< 0.10	< 150	No Special Type	--	--
Moderate (See Water)	0.10 to 0.20	150 to 1500	II IP(MS), IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.5	28 (4000)
Severe	0.20 to 2.00	1,500 to 10,000	V	0.45	31 (4500)
Very Severe	> 2.00	> 10,000	V + pozz	0.45	31 (4500)

Caltrans classifies a site as corrosive to structural concrete as an area where soil and/or water contains > 500 ppm chloride, > 2000 ppm sulfate, or has a pH < 5.5. A minimum resistivity of less than 1000 ohm-cm indicates the potential for corrosive environment requiring testing for the above criteria.

The 2007 CBC Section 1904A references ACI 318 for material selection and mix design for reinforced concrete dependant on the onsite corrosion potential, soluble sulfate content, and soluble chloride content in soil.

Comments: Sec. 4.3 of ACI 318 (2005) Soil environment is detrimental to concrete if it has soluble sulfate > 1000 ppm and/or pH < 5.5. Soil environment is corrosive to reinforcement and steel pipes if chloride ion > 500 ppm or pH < 4.0.

The information in this form is not intended for corrosion engineering design. If corrosion is critical, a corrosion specialist should be contacted to provide further recommendations.

Appendix D

USGS Design Maps Detailed Report

ASCE 7-10 Standard (33.90883°N, 117.40999°W)

Site Class D – "Stiff Soil", Risk Category I/II/III

Section 11.4.1 — Mapped Acceleration Parameters

Note: Ground motion values provided below are for the direction of maximum horizontal spectral response acceleration. They have been converted from corresponding geometric mean ground motions computed by the USGS by applying factors of 1.1 (to obtain S_S) and 1.3 (to obtain S_1). Maps in the 2010 ASCE-7 Standard are provided for Site Class B. Adjustments for other Site Classes are made, as needed, in Section 11.4.3.

From Figure 22-1 [1] S_S = 1.500 g

From Figure 22-2 [2] S_1 = 0.600 g

Section 11.4.2 — Site Class

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site as Site Class D, based on the site soil properties in accordance with Chapter 20.

Table 20.3–1 Site Classification

Site Class	$\bar{v}_s$	$\bar{N}$ or $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard Rock	>5,000 ft/s	N/A	N/A
B. Rock	2,500 to 5,000 ft/s	N/A	N/A
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff Soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the characteristics: • Plasticity index PI > 20, • Moisture content w ≥ 40%, and • Undrained shear strength $\bar{s}_u$ < 500 psf		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		

For SI: 1ft/s = 0.3048 m/s 1lb/ft² = 0.0479 kN/m²

Section 11.4.3 — Site Coefficients and Risk–Targeted Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration Parameters

Table 11.4–1: Site Coefficient F_a

Site Class	Mapped MCE_R Spectral Response Acceleration Parameter at Short Period				
	$S_S \leq 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S \geq 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_S

For Site Class = D and S_S = 1.500 g, F_a = 1.000

Table 11.4–2: Site Coefficient F_v

Site Class	Mapped MCE_R Spectral Response Acceleration Parameter at 1–s Period				
	$S_1 \leq 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 \geq 0.50$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_1

For Site Class = D and S_1 = 0.600 g, F_v = 1.500

Equation (11.4–1): $S_{MS} = F_a S_S = 1.000 \times 1.500 = 1.500$ g

Equation (11.4–2): $S_{M1} = F_v S_1 = 1.500 \times 0.600 = 0.900$ g

Section 11.4.4 — Design Spectral Acceleration Parameters

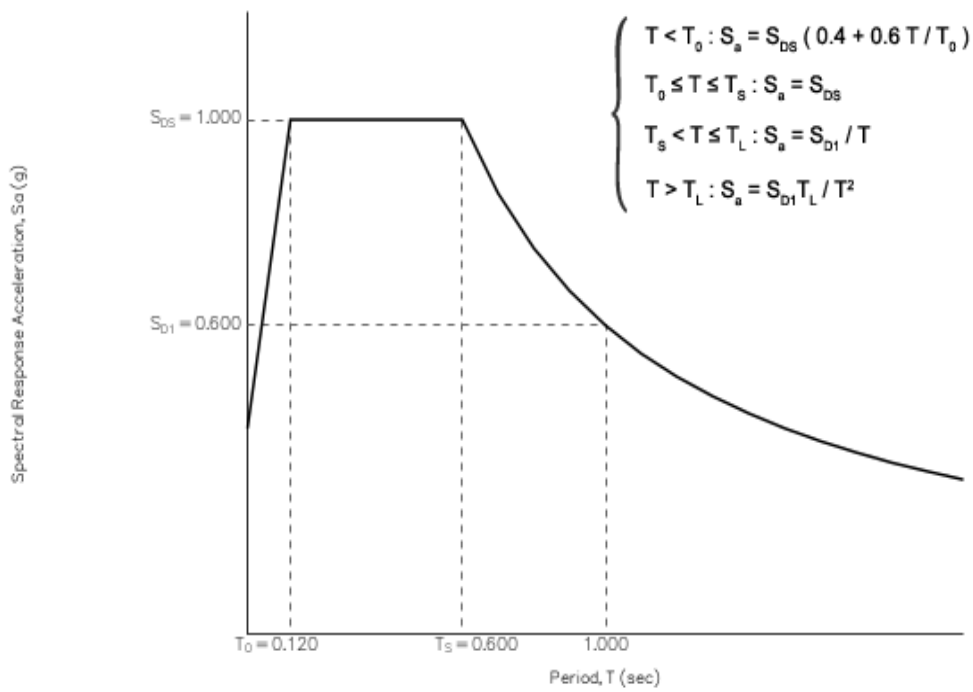
Equation (11.4–3): $S_{DS} = ⅔\ S_{MS} = ⅔ \times 1.500 = 1.000$ g

Equation (11.4–4): $S_{D1} = ⅔\ S_{M1} = ⅔ \times 0.900 = 0.600$ g

Section 11.4.5 — Design Response Spectrum

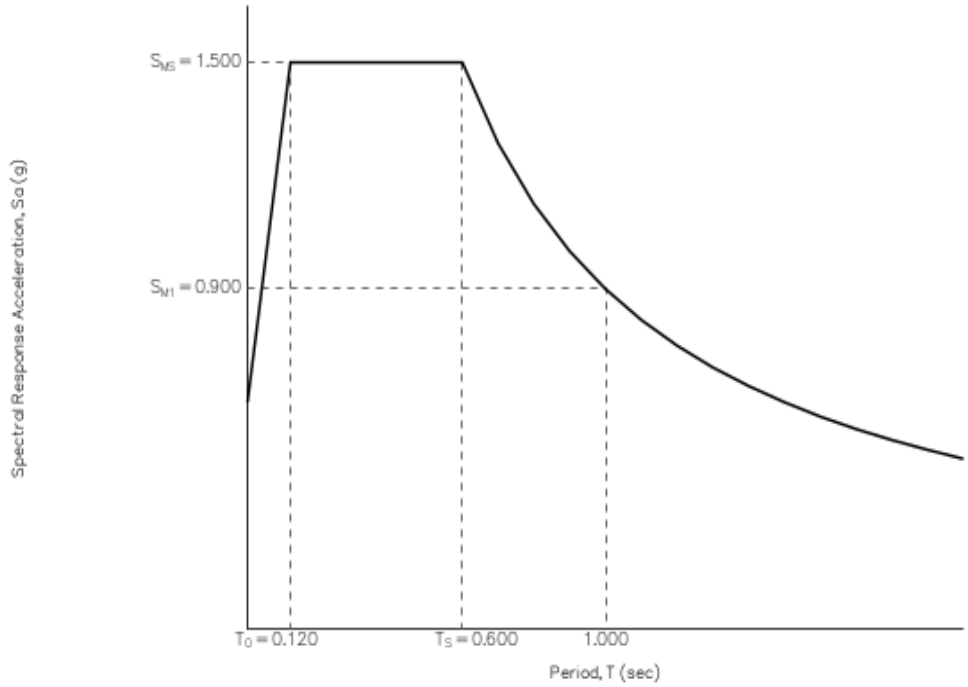
From Figure 22-12 [3] $T_L = 8$ seconds

Figure 11.4–1: Design Response Spectrum



Section 11.4.6 — Risk-Targeted Maximum Considered Earthquake (MCE_R) Response Spectrum

The MCE_R Response Spectrum is determined by multiplying the design response spectrum above by 1.5.



Section 11.8.3 — Additional Geotechnical Investigation Report Requirements for Seismic Design Categories D through F

From Figure 22-7 [4] PGA = 0.500

Equation (11.8–1): $PGA_M = F_{PGA}PGA = 1.000 \times 0.500 = 0.5$ g

Table 11.8–1: Site Coefficient F_{PGA}

Site Class	Mapped MCE Geometric Mean Peak Ground Acceleration, PGA				
	PGA ≤ 0.10	PGA = 0.20	PGA = 0.30	PGA = 0.40	PGA ≥ 0.50
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of PGA

For Site Class = D and PGA = 0.500 g, F_{PGA} = 1.000

Section 21.2.1.1 — Method 1 (from Chapter 21 – Site-Specific Ground Motion Procedures for Seismic Design)

From Figure 22-17 [5] C_{RS} = 1.101

From Figure 22-18 [6] C_{R1} = 1.071

Section 11.6 — Seismic Design Category

Table 11.6-1 Seismic Design Category Based on Short Period Response Acceleration Parameter

VALUE OF S_{DS}	RISK CATEGORY		
	I or II	III	IV
$S_{DS} < 0.167g$	A	A	A
$0.167g \le S_{DS} < 0.33g$	B	B	C
$0.33g \le S_{DS} < 0.50g$	C	C	D
$0.50g \le S_{DS}$	D	D	D

For Risk Category = I and S_{DS} = 1.000 g, Seismic Design Category = D

Table 11.6-2 Seismic Design Category Based on 1-S Period Response Acceleration Parameter

VALUE OF S_{D1}	RISK CATEGORY		
	I or II	III	IV
$S_{D1} < 0.067g$	A	A	A
$0.067g \le S_{D1} < 0.133g$	B	B	C
$0.133g \le S_{D1} < 0.20g$	C	C	D
$0.20g \le S_{D1}$	D	D	D

For Risk Category = I and S_{D1} = 0.600 g, Seismic Design Category = D

Note: When S_1 is greater than or equal to 0.75g, the Seismic Design Category is **E** for buildings in Risk Categories I, II, and III, and **F** for those in Risk Category IV, irrespective of the above.

Seismic Design Category ≡ "the more severe design category in accordance with Table 11.6-1 or 11.6-2" = D

Note: See Section 11.6 for alternative approaches to calculating Seismic Design Category.

References

1. *Figure 22-1*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-1.pdf
2. *Figure 22-2*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-2.pdf
3. *Figure 22-12*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-12.pdf
4. *Figure 22-7*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-7.pdf
5. *Figure 22-17*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-17.pdf
6. *Figure 22-18*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-18.pdf

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GENERAL

The guidelines contained herein and the standard details attached hereto represent this firm's standard recommendation for grading and other associated operations on construction projects. These guidelines should be considered a portion of the project specifications.
All plates attached hereto shall be considered as part of these guidelines.
The Contractor should not vary from these guidelines without prior recommendation by the Geotechnical Consultant and the approval of the Client or his authorized representative. Recommendation by the Geotechnical Consultant and/or Client should not be considered to preclude requirements for the approval by the controlling agency prior to the execution of any changes.
These Standard Grading Guidelines and Standard Details may be modified and/or superseded by recommendations contained in the text of the preliminary Geotechnical Report and/or subsequent reports.
If disputes arise out of the interpretation of these grading guidelines or standard details, the Geotechnical Consultant shall provide the governing interpretation.

DEFINITION OF TERMS

ALLUVIUM
Unconsolidated soil deposits resulting from flow of water, including sediments deposited in river beds, canyons, flood plains, lakes, fans and estuaries.
AS-GRADED (AS-BUILT): The surface and subsurface conditions at completion of grading.
BACKCUT: A temporary construction slope at the rear of earth retaining structures such as buttresses, shear keys, stabilization fills or retaining walls.
BACKDRAIN: Generally a pipe and gravel or similar drainage system placed behind earth retaining structures such buttresses, stabilization fills, and retaining walls.
BEDROCK: Relatively undisturbed formational rock, more or less solid, either at the surface or beneath superficial deposits of soil.
BENCH: A relatively level step and near vertical rise excavated into sloping ground on which fill is to be placed.
BORROW (Import): Any fill material hauled to the project site from off-site areas.
BUTTRESS FILL::A fill mass, the configuration of which is designed by engineering calculations to retain slope conditions containing adverse geologic features. A buttress is generally specified by minimum key width and depth and by maximum backcut angle. A buttress normally contains a back-drainage system.
CIVIL ENGINEER: The Registered Civil Engineer or consulting firm responsible for preparation of the grading plans, surveying and verifying as-graded topographic conditions.
CLIENT: The Developer or his authorized representative who is chiefly in charge of the project. He shall have the responsibility of reviewing the findings and recommendations made by the Geotechnical Consultant and shall authorize the Contractor and/or other consultants to perform work and/or provide services.
COLLUVIUM: Generally loose deposits usually found near the base of slopes and brought there chiefly by gravity through slow continuous downhill creep (also see Slope Wash).
COMPACTION : Densification of man-placed fill by mechanical means.
CONTRACTOR – A person or company under contract or otherwise retained by the Client to perform demolition, grading and other site improvements.
DEBRIS: All products of clearing, grubbing, demolition, and contaminated soil materials unsuitable for reuse as compacted fill, and/or any other material so designated by the Geotechnical Consultant.
ENGINEERING GEOLOGIST: A Geologist holding a valid certificate of registration in the specialty of Engineering Geology.
ENGINEERED FILL: A fill of which the Geotechnical Consultant or his representative, during grading, has made sufficient tests to enable him to conclude that the fill has been placed in substantial compliance with the recommendations of the Geotechnical Consultant and the governing agency requirements.
EROSION: The wearing away of ground surface as a result of the movement of wind, water, and/or ice.
EXCAVATION: The mechanical removal of earth materials.
EXISTING GRADE: The ground surface configuration prior to grading.
FILL: Any deposits of soil, rock, soil-rock blends or other similar materials placed by man.
FINISH GRADE: The ground surface configuration at which time the surface elevations conform to the approved plan.

GEOFABRIC: Any engineering textile utilized in geotechnical applications including subgrade stabilization and filtering.
GEOLOGIST: A representative of the Geotechnical Consultant educated and trained in the field of geology.
GEOTECHNICAL CONSULTANT: The Geotechnical Engineering and Engineering Geology consulting firm retained to provide technical services for the project. For the purpose of these specifications, observations by the Geotechnical Consultant include observations by the Soil Engineer, Geotechnical Engineer, Engineering Geologist and those performed by persons employed by and responsible to the Geotechnical Consultants.
GEOTECHNICAL ENGINEER: A licensed Geotechnical Engineer or Civil Engineer who applies scientific methods, engineering principles and professional experience to the acquisition, interpretation and use of knowledge of materials of the earth's crust for the evaluation of engineering problems. Geotechnical Engineering encompasses many of the engineering aspects of soil mechanics, rock mechanics, geology, geophysics, hydrology and related sciences.
GRADING: Any operation consisting of excavation, filling or combinations thereof and associated operations.
LANDSIDE DEBRIS: Material, generally porous and of low density, produced from instability of natural or man-made slopes.
MAXIMUM DENSITY: Standard laboratory test for maximum dry unit weight. Unless otherwise specified, the maximum dry unity weight shall be determined in accordance with ASTM Method of Test D 1557-91.
OPTIMUM MOISTURE – Soil moisture content at the test maximum density.
RELATIVE COMPACTION: The degree of compaction (expressed as a percentage) of dry unit weight of a material as compared to the maximum dry unit weight of the material.
ROUGH GRADE: The ground surface configuration at which time the surface elevations approximately conform to the approved plan.
SITE: The particular parcel of land where grading is being performed.
SHEAR KEY: Similar to buttress, however, it is generally constructed by excavating a slot within a natural slope, in order to stabilize the upper portion of the slope without grading encroaching into the lower portion of the slope.
SLOPE: An inclined ground surface, the steepness of which is generally specified as a ration of horizontal:vertical (e.g., 2:1)
SLOPE WASH: Soil and/or rock material that has been transported down a slope by action of gravity assisted by runoff water not confined by channels (also see Colluvium).
SOIL: Naturally occurring deposits of sand, silt, clay, etc., or combinations thereof.
SOIL ENGINEER: Licensed Geotechnical Engineer or Civil Engineer experienced in soil mechanics (also see Geotechnical Engineer).
STABILIZATION FILL: A fill mass, the configuration of which is typically related to slope height and specified by the standards of practice for enhancing the stability of locally adverse conditions. A stabilization fill is normally specified by minimum key width and depth and by maximum backcut angle. A stabilization fill may or may not have a backdrainage system specified.
SUBDRAIN: Generally a pipe and gravel or similar drainage system placed beneath a fill in the alignment of canyons or formed drainage channels.
SLOUGH: Loose, non-compacted fill material generated during grading operations.
TAILINGS: Non-engineered fill which accumulates on or adjacent to equipment haul-roads.
TERRACE: Relatively level step constructed in the face of a graded slope surface for drainage control and maintenance purposes.
TOPSOIL: The presumable fertile upper zone of soil, which is usually darker in color and loose.
WINDROW: A string of large rocks buried within engineered fill in accordance with guidelines set forth by the Geotechnical Consultant.

OBLIGATIONS OF PARTIES

The Geotechnical Consultant should provide observation and testing services and should make evaluations in order to advise the Client on Geotechnical matters. The Geotechnical Consultant should report his findings and recommendations to the Client or his authorized representative.
The client should be chiefly responsible for all aspects of the project. He or his authorized representative has the responsibility of reviewing the findings and recommendations of the Geotechnical Consultant. He shall authorize or cause to have authorized the Contractor and/or other consultants to perform work and/or provide services.

During grading the Client or his authorized representative should remain on-site or should remain reasonably accessible to all concerned parties in order to make decisions necessary to maintain the flow of the project.
The Contractor should be responsible for the safety of the project and satisfactory completion of all grading and other associated operations on construction projects, including but not limited to, earthwork in accordance with the project plans, specifications and controlling agency requirements. During grading, the Contractor or his authorized representative should remain on-site. Overnight and on days off, the Contractor should remain accessible.

SITE PREPARATION

The Client, prior to any site preparation or grading, should arrange and attend a meeting among the Grading Contractor, the Design Engineer, the Geotechnical Consultant, representatives of the appropriate governing authorities as well as any other concerned parties. All parties should be given at least 48 hours notice.
Clearing and grubbing should consist of the removal of vegetation such as brush, grass, woods, stumps, trees, roots of trees and otherwise deleterious natural materials from the areas to be graded. Clearing and grubbing should extend to the outside of all proposed excavation and fill areas.
Demolition should include removal of buildings, structures, foundations, reservoirs, utilities (including underground pipelines, septic tanks, leach fields, seepage pits, cisterns, mining shafts, tunnels, etc.) and man-made surface and subsurface improvements from the areas to be graded. Demolition of utilities should include proper capping and/or re-routing pipelines at the project perimeter and cutoff and capping of wells in accordance with the requirements of the governing authorities and the recommendations of the Geotechnical Consultant at the time of the demolition.
Trees, plants or man-made improvements not planned to be removed or demolished should be protected by the Contractor from damage or injury.
Debris generated during clearing, grubbing and/or demolition operations should be wasted from areas to be graded and disposed off-site. Clearing, grubbing and demolition operations should be performed under the observation of the Geotechnical Consultant.
The Client or Contractor should obtain the required approvals for the controlling authorities for the project prior, during and/or after demolition, site preparation and removals, etc. The appropriate approvals should be obtained prior to proceeding with grading operations.

SITE PROTECTION

Protection of the site during the period of grading should be the responsibility of the Contractor. Unless other provisions are made in writing and agreed upon among the concerned parties, completion of a portion of the project should not be considered to preclude that portion or adjacent areas from the requirements for site protection until such time as the entire project is complete as identified by the Geotechnical Consultant, the Client and the regulating agencies.
The Contractor should be responsible for the stability of all temporary excavations. Recommendations by the Geotechnical Consultant pertaining to temporary excavations (e.g., backcuts) are made in consideration of stability of the completed project and therefore, should not be considered to preclude the responsibilities of the Contractor. Recommendations by the Geotechnical Consultant should not be considered to preclude more restrictive requirements by the regulating agencies.
Precautions should be taken during the performance of site clearing, excavations and grading to protect the work site from flooding, ponding, or inundation by poor or improper surface drainage. Temporary provisions should be made during the rainy season to adequately direct surface drainage away from and off the work site. Where low areas can not be avoided, pumps should be kept on hand to continually remove water during periods of rainfall.
During periods of rainfall, plastic sheeting should be kept reasonably accessible to prevent unprotected slopes from becoming saturated. Where necessary during periods of rainfall, the Contractor should install check-dams de-silting basins, rip-rap, sandbags or other devices or methods necessary to control erosion and provide safe conditions.
During periods of rainfall, the Geotechnical Consultant should be kept informed by the Contractor as to the nature of remedial or preventative work being performed (e.g., pumping, placement of sandbags or plastic sheeting, other labor, dozing, etc.).

Following periods of rainfall, the Contractor should contact the Geotechnical Consultant and arrange a walk-over of the site in order to visually assess rain related damage. The Geotechnical Consultant may also recommend excavations and testing in order to aid in his assessments. At the request of the Geotechnical Consultant, the Contractor shall make excavations in order to evaluate the extent of rain related damage.
Rain-related damage should be considered to include, but may not be limited to, erosion, silting, saturation, swelling, structural distress and other adverse conditions identified by the Geotechnical Consultant. Soil adversely affected should be classified as Unsuitable Materials and should be subject to overexcavation and replaced with compacted fill or other remedial grading as recommended by the Geotechnical Consultant.
Relatively level areas, where saturated soils and/or erosion gullies exist to depths greater then 1 foot, should be overexcavated to unaffected, competent material. Where less than 1 foot in depth, unsuitable materials may be processed in-place to achieve near optimum moisture conditions, then thoroughly recompacted in accordance with the applicable specifications. If the desired results are not achieved, the affected materials should be overexcavated then replaced in accordance with the applicable specifications.
In slope areas, where saturated soil and/or erosion gullies exist to depths of greater than 1 foot, should be over-excavated to unaffected, competent material. Where affected materials exist to depths of 1 foot or less below proposed finished grade, remedial grading by moisture conditioning in-place, followed by thorough recompaction in accordance with the applicable grading guidelines herein may be attempted. If the desired results are not achieved, all affected materials should be overexcavated and replaced as compacted fill in accordance with the slope repair recommendations herein. As field conditions dictate, other slope repair procedures may be recommended by the Geotechnical Consultant.

EXCAVATIONS

UNSUITABLE MATERIALS:
Materials which are unsuitable should be excavated under observation and recommendations of the Geotechnical Consultant. Unsuitable materials include, but may not be limited to dry, loose, soft, wet, organic compressible natural soils and fractured, weathered, soft, bedrock and nonengineered or otherwise deleterious fill materials.
Materials identified by the Geotechnical Consultant as unsatisfactory due to its moisture conditions should be overexcavated, watered or dried, as needed, and thoroughly blended to uniform near optimum moisture condition (per Moisture guidelines presented herein) prior to placement as compacted fill.

CUT SLOPES:
Unless otherwise recommended by the Geotechnical Consultant and approved by the regulating agencies, permanent cut slopes should not be steeper than 2:1 (horizontal:vertical).
If excavations for cut slopes expose loose, cohesionless, significantly fractured or otherwise suitable material, overexcavation and replacement of the unsuitable materials with a compacted stabilization fill should be accomplished as recommended by the Geotechnical Consultant. Unless otherwise specified by the Geotechnical Consultant, stabilization fill construction should conform to the requirements of the Standard Details.
The Geotechnical Consultant should review cut slopes during excavation. The Geotechnical Consultant should be notified by the contractor prior to beginning slope excavations.
If during the course of grading, adverse or potentially adverse geotechnical conditions are encountered which were not anticipated in the preliminary report, the Geotechnical Consultant should explore, analyze and make recommendations to treat these problems.
When cuts slopes are made in the direction of the prevailing drainage, a non-erodible diversion swale (brow ditch) should be provided at the top-of-cut.

PAD AREAS:
All lot pad areas, including side yard terraces, above stabilization fills or buttresses should be over-excavated to provide for a minimum of 3-feet (refer to Standard Details) of compacted fill over the entire pad area. Pad areas with both fill and cut materials exposed and pad areas containing both very shallow (less than 3-feet) and deeper fill should be over- thickness (refer to Standard Details).
Cut areas exposing significantly varying material types should also be overexcavated to provide for at least a 3-foot thick compacted fill blanket. Geotechnical conditions may require greater depth of overexcavation. The actual depth should be delineated by the Geotechnical Consultant during grading.

For pad areas created above cut or natural slopes, positive drainage should be established away from the top-of-slope. This may be accomplished utilizing a berm and/or an appropriate pad gradient. A gradient in soil areas away from the top-of-slope of 2 percent or greater is recommended.

COMPACTED FILL

All fill materials should be compacted as specified below or by other methods specifically recommended by the Geotechnical Consultant. Unless otherwise specified, the minimum degree of compaction (relative compaction) should be 90 percent of the laboratory maximum density.

PLACEMENT

Prior to placement of compacted fill, the Contractor should request a review by the Geotechnical Consultant of the exposed ground surface. Unless otherwise recommended, the exposed ground surface should then be scarified (6-inches minimum), watered or dried as needed, thoroughly blended to achieve near optimum moisture conditions, then thoroughly compacted to a minimum of 90 percent of the maximum density. The review by the Geotechnical Consultants should not be considered to preclude requirements of inspection and approval by the governing agency.

Compacted fill should be placed in thin horizontal lifts not exceeding 8-inches in loose thickness prior to compaction. Each lift should be watered or dried as needed, thoroughly blended to achieve near optimum moisture conditions then thoroughly compacted by mechanical methods to a minimum of 90 percent of laboratory maximum dry density. Each lift should be treated in a like manner until the desired finished grades are achieved.

The Contractor should have suitable and sufficient mechanical compaction equipment and watering apparatus on the job site to handle the amount of fill being placed in consideration of moisture retention properties of the materials. If necessary, excavation equipment should be “shut down” temporarily in order to permit proper compaction of fills. Earth moving equipment should only be considered a supplement and not substituted for conventional compaction equipment.

When placing fill in horizontal lifts adjacent to areas sloping steeper than 5:1 (horizontal:vertical), horizontal keys and vertical benches should be excavated into the adjacent slope area. Keying and benching should be sufficient to provide at least 6-foot wide benches and minimum of 4-feet of vertical bench height within the firm natural ground, firm bedrock or engineered compacted fill. No compacted fill should be placed in an area subsequent to keying and benching until the area has been reviewed by the Geotechnical Consultant. Material generated by the benching operation should be moved sufficiently away from the bench area to allow for the recommended review of the horizontal bench prior to placement of fill. Typical keying and benching details have been included within the accompanying Standard Details.

Within a single fill area where grading procedures dictate two or more separate fills, temporary slopes (false slopes) may be created. When placing fill adjacent to a false slope, benching should be conducted in the same manner as above described. At least a 3-foot vertical bench should be established within the firm core of adjacent approved compacted fill prior to placement of additional fill. Benching should proceed in at least 3-foot vertical increments until the desired finished grades are achieved.

Fill should be tested for compliance with the recommended relative compaction and moisture conditions. Field density testing should conform to ASTM Method of Testing D 1556-64, D 2922-78 and/or D2937-71. Tests should be provided for about every 2 vertical feet or 1,000 cubic yards of fill placed. Actual test intervals may vary as field conditions dictate. Fill found not to be in conformance with the grading recommendations should be removed or otherwise handled as recommended by the Geotechnical Consultant.

The Contractor should assist the Geotechnical Consultant and/or his representative by digging test pits for removal determinations and/or for testing compacted fill.

As recommended by the Geotechnical Consultant, the Contractor should “shutdown” or remove any grading equipment from an area being tested.

The Geotechnical Consultant should maintain a plan with estimated locations of field tests. Unless the client provides for actual surveying of test locations, by the Geotechnical Consultant should only be considered rough estimates and should not be utilized for the purpose of preparing cross sections showing test locations or in any case for the purpose of after-the-fact evaluating of the sequence of fill placement.

MOISTURE

For field testing purposes, “near optimum” moisture will vary with material type and other factors including compaction procedures. “Near optimum” may be specifically recommended in Preliminary Investigation Reports and/or may be evaluated during grading.

Prior to placement of additional compacted fill following an overnight or other grading delay, the exposed surface of previously compacted fill should be processed by scarification, watered or dried as needed, thoroughly blended to near-optimum moisture conditions, then recompacted to a minimum of 90 percent of laboratory maximum dry density. Where wet or other dry or other unsuitable materials exist to depths of greater than one foot, the unsuitable materials should be overexcavated.

Following a period of flooding, rainfall or overwatering by other means, no additional fill should be placed until damage assessments have been made and remedial grading performed as described herein.

FILL MATERIAL

Excavated on-site materials which are acceptable to the Geotechnical Consultant may be utilized as compacted fill, provided trash, vegetation and other deleterious materials are removed prior to placement.

Where import materials are required for use on-site, the Geotechnical Consultant should be notified at least 72 hours in advance of importing, in order to sample and test materials from proposed borrow sites. No import materials should be delivered for use on-site without prior sampling and testing by Geotechnical Consultant.

Where oversized rock or similar irreducible material is generated during grading, it is recommended, where practical, to waste such material off-site or on-site in areas designated as “nonstructural rock disposal areas”. Rock placed in disposal areas should be placed with sufficient fines to fill voids. The rock should be compacted in lifts to an unyielding condition. The disposal area should be covered with at least 3-feet of compacted fill, which is free of oversized material. The upper 3-feet should be placed in accordance with the guidelines for compacted fill herein.

Rocks 3 inches in maximum dimension and smaller may be utilized within the compacted fill, provided they are placed in such a manner that nesting of the rock in avoided. Fill should be placed and thoroughly compacted over and around all rock. The amount of rock should not exceed 40 percent by dry weight passing the $^{3}/_{4}$-inch sieve size. The 3-inch and 40 percent recommendations herein may vary as field conditions dictate.

During the course of grading operations, rocks or similar irreducible materials greater than 3-inch maximum dimension (oversized material) may be generated. These rocks should not be placed within the compacted fill unless placed as recommended by the Geotechnical Consultant.

Where rocks or similar irreducible materials of greater that 3-inches but less than 4-feet of maximum dimension are generated during grading, or otherwise desired to be placed within an engineered fill, special handling in accordance with the accompanying Standard Details is recommended. Rocks greater than 4 feet should be broken down or disposed off-site. Rocks up to 4-feet maximum dimension should be placed below the upper 10-feet of any fill and should not be closer than 20-feet to any slope face. These recommendations could vary as locations of improvements dictate. Where practical, oversized material should not be placed below areas where structures of deep utilities are proposes.

Oversized material should be placed in windrows on a clean, overexcavated or unyielding compacted fill or firm natural ground surface. Select native or imported granular soil (S.E. 30 or higher) should be placed and thoroughly flooded over and around all windrowed rock, such that voids are filled. Windrows of oversized material should be staggered so that successive strata of oversized material are not in the same vertical plane.

It may be possible to dispose of individual larger rock as field conditions dictate and as recommended by the Geotechnical Consultant at time of placement.

Material that is considered unsuitable by the Geotechnical Consultant should not be utilized in the compacted fill.

During grading operations, placing and mixing the materials from the cut and/or borrow areas may result in soil mixtures which possess unique physical properties. Testing may be required of samples obtained directly from the fill areas in order to verify conformance with the specifications. Processing of these additional samples may take two or more working days. The Contractor may elect to move the operation to other areas within the project, or may continue placing compacted fill pending laboratory and field test results. Should he elect the second alternative, fill placed is done so at the Contractor’s risk.

Any fill placed in areas not previously reviewed and evaluated by the Geotechnical Consultant, and/or in other areas, without prior notification to the Geotechnical Consultant may require removal and recompaction at the Contractor's expense. Determination of overexcavations should be made upon review of field conditions by the Geotechnical Consultant.

FILL SLOPES

Unless otherwise recommended by the Geotechnical Consultant and approved by the regulating agencies, permanent fill slopes should not be steeper than 2:1 (horizontal to vertical).

Except as specifically recommended otherwise or as otherwise provided for in these grading guidelines (Reference Fill Materials), compacted fill slopes should be overbuilt and cut back to grade, exposing the firm, compacted fill inner core. The actual amount of overbuilding may vary as field conditions dictate. If the desired results are not achieved, the existing slopes should be overexcavated and reconstructed under the guidelines of the Geotechnical Consultant. The degree of overbuilding shall be increased until the desired compacted slope surface condition is achieved. Care should be taken by the Contractor to provide thorough mechanical compaction to the outer edge of the overbuilt slope surface.

Although no construction procedure produces a slope free from risk of future movement, overfilling and cutting back of slope to a compacted inner core is, given no other constraints, the most desirable procedure. Other constraints, however, must often be considered. These constraints may include property line situations, access, the critical nature of the development, and cost. Where such constraints are identified, slope face compaction may be attempted by conventional construction procedures including backrolling techniques upon specific recommendations by the Geotechnical Consultant.

As a second best alternative for slopes of 2:1 (horizontal to vertical) or flatter, slope construction may be attempted as outlined herein. Fill placement should proceed in thin lifts, (i.e., 6 to 8 inch loose thickness). Each lift should be moisture conditioned and thoroughly compacted. The desired moisture condition should be maintained and/or reestablished, where necessary, during the period between successive lifts. Selected lifts should be tested to ascertain that desired compaction is being achieved. Care should be taken to extend compactive effort to the outer edge of the slope. Each lift should extend horizontally to the desired finished slope surface or more as needed to ultimately establish desired grades. Grade during construction should not be allowed to roll off at the edge of the slope. It may be helpful to elevate slightly the outer edge of the slope. Slough resulting from the placement of individual lifts should not be allowed to drift down over previous lifts. At intervals not exceeding 4-feet in vertical slope height or the capability of available equipment, whichever is less, fill slopes should be thoroughly backrolled utilizing a conventional sheepsfoot-type roller. Care should be taken to maintain the desired moisture conditions and/or reestablishing same as needed prior to backrolling. Upon achieving final grade, the slopes should again be moisture conditioned and thoroughly backrolled. The use of a side-boom roller will probably be necessary and vibratory methods are strongly recommended. Without delay, so as to avoid (if possible) further moisture conditioning, the slopes should then be grid-rolled to achieve a relatively smooth surface and uniformly compact condition.

In order to monitor slope construction procedures, moisture and density tests will be taken at regular intervals. Failure to achieve the desired results will likely result in a recommendation by the Geotechnical Consultant to overexcavate the slope surfaces followed by reconstruction of the slopes utilizing overfilling and cutting back procedures and/or further attempt at the conventional backrolling approach. Other recommendations may also be provided which would be commensurate with field conditions.

Where placement of fill above a natural slope or above a cut slope is proposed, the fill slope configuration as presented in the accompanying standard Details should be adopted.

For pad areas above fill slopes, positive drainage should be established away from the top-of-slope. This may be accomplished utilizing a berm and pad gradients of at least 2-percent in soil area.

OFF-SITE FILL

Off-site fill should be treated in the same manner as recommended in these specifications for site preparation, excavation, drains, compaction, etc.

Off-site canyon fill should be placed in preparation for future additional fill, as shown in the accompanying Standard Details.

Off-site fill subdrains temporarily terminated (up canyon) should be surveyed for future relocation and connection.

DRAINAGE

Canyon sub-drain systems specified by the Geotechnical Consultant should be installed in accordance with the Standard Details.
Typical sub-drains for compacted fill buttresses, slope stabilization or sidehill masses, should be installed in accordance with the specifications of the accompanying Standard Details.
Roof, pad and slope drainage should be directed away from slopes and areas of structures to suitable disposal areas via non-erodible devices (i.e., gutters, downspouts, concrete swales).
For drainage over soil areas immediately away from structures (i.e., within 4-feet), a minimum of 4 percent gradient should be maintained. Pad drainage of at least 2 percent should be maintained over soil areas. Pad drainage may be reduced to at least 1 percent for projects where no slopes exist, either natural or man-made, or greater than 10-feet in height and where no slopes are planned, either natural or man-made, steeper than 2:1 (horizontal to vertical slope ratio).
Drainage patterns established at the time of fine grading should be maintained throughout the life of the project. Property owners should be made aware that altering drainage patterns can be detrimental to slope stability and foundation performance.

STAKING

In all fill areas, the fill should be compacted prior to the placement of the stakes. This particularly is important on fill slopes. Slope stakes should not be placed until the slope is thoroughly compacted (backrolled). If stakes must be placed prior to the completion of compaction procedures, it must be recognized that they will be removed and/or demolished at such time as compaction procedures resume.
In order to allow for remedial grading operations, which could include overexcavations or slope stabilization, appropriate staking offsets should be provided. For finished slope and stabilization backcut areas, we recommend at least 10-feet setback from proposed toes and tops-of-cut.

SLOPE MAINTENANCE LANDSCAPE PLANTS

In order to enhance superficial slope stability, slope planting should be accomplished at the completion of grading. Slope planting should consist of deep-rooting vegetation requiring little watering. Plants native to the Southern California area and plants relative to native plants are generally desirable. Plants native to other semiarid and arid areas may also be appropriate. A Landscape Architect would be the best party to consult regarding actual types of plants and planting configuration.

IRRIGATION

Irrigation pipes should be anchored to slope faces, not placed in trenches excavated into slope faces.
Slope irrigation should be minimized. If automatic timing devices are utilized on irrigation systems, provisions should be made for interrupting normal irrigation during periods of rainfall.
Though not a requirement, consideration should be give to the installation of near-surface moisture monitoring control devices. Such devices can aid in the maintenance of relatively uniform and reasonably constant moisture conditions.
Property owners should be made aware that overwatering of slopes is detrimental to slope stability.

MAINTENANCE

Periodic inspections of landscaped slope areas should be planned and appropriate measures should be taken to control weeds and enhance growth of the landscape plants. Some areas may require occasional replanting and/or reseeding.
Terrace drains and downdrains should be periodically inspected and maintained free of debris. Damage to drainage improvements should be repaired immediately.
Property owners should be made aware that burrowing animals can be detrimental to slope stability. A preventative program should be established to control burrowing animals.
As a precautionary measure, plastic sheeting should be readily available, or kept on hand, to protect all slope areas from saturation by periods of heavy or prolonged rainfall. This measure is strongly recommended, beginning with the period of time prior to landscape planting.

REPAIRS

If slope failures occur, the Geotechnical Consultant should be contacted for a field review of site conditions and development of recommendations for evaluation and repair.

If slope failure occurs as a result of exposure to periods of heavy rainfall, the failure areas and currently unaffected areas should be covered with plastic sheeting to protect against additional saturation.

In the accompanying Standard Details, appropriate repair procedures are illustrated for superficial slope failures (i.e., occurring typically within the outer 1 foot to 3 feet of a slope face).

TRENCH BACKFILL

Utility trench backfill should, unless otherwise recommended, be compacted by mechanical means. Unless otherwise recommended, the degree of compaction should be a minimum of 95 percent of the laboratory maximum density.

Approved granular material (sand equivalent greater than 30) should be used to bed and backfill utilities to a depth of at least 1 foot over the pipe. This backfill should be uniformly watered, compacted and/or wheel-rolled from the surface to a firm condition for pipe support.

The remainder of the backfill shall be typical on-site soil or imported soil which should be placed in lifts not exceeding 8 inches in thickness, watered or aerated to at least 3 percent above the optimum moisture content, and mechanically compacted to at least 95 percent of maximum dry density (based on ASTM D1557).

Backfill of exterior and interior trenches extending below a 1:1 projection from the outer edge of foundations should be mechanically compacted to a minimum of 95 percent of the laboratory maximum density.

Within slab areas, but outside the influence of foundations, trenches up to 1 foot wide and 2 feet deep may be backfilled with sand and consolidated by uniformly watering or by mechanical means. If on-site materials are utilized, they should be wheel-rolled, tamped or otherwise compacted to a firm condition. For minor interior trenches, density testing may be deleted or spot testing may be elected if deemed necessary, based on review of back-fill operations during construction.

If utility contractors indicate that it is undesirable to use compaction equipment in close proximity to a buried conduit, the Contractor may elect the utilization of light weight compaction equipment and/or shading of the conduit with clean, granular material, which should be thoroughly jetted in-place above the conduit, prior to initiating mechanical compaction procedures. Other methods of utility trench compaction may also be appropriate, upon review by the Geotechnical Consultant at the time of construction.

In cases where clean granular materials are proposed for use in lieu of native materials or where flooding or jetting is proposed, the procedures should be considered subject to review by the Geotechnical Consultant.

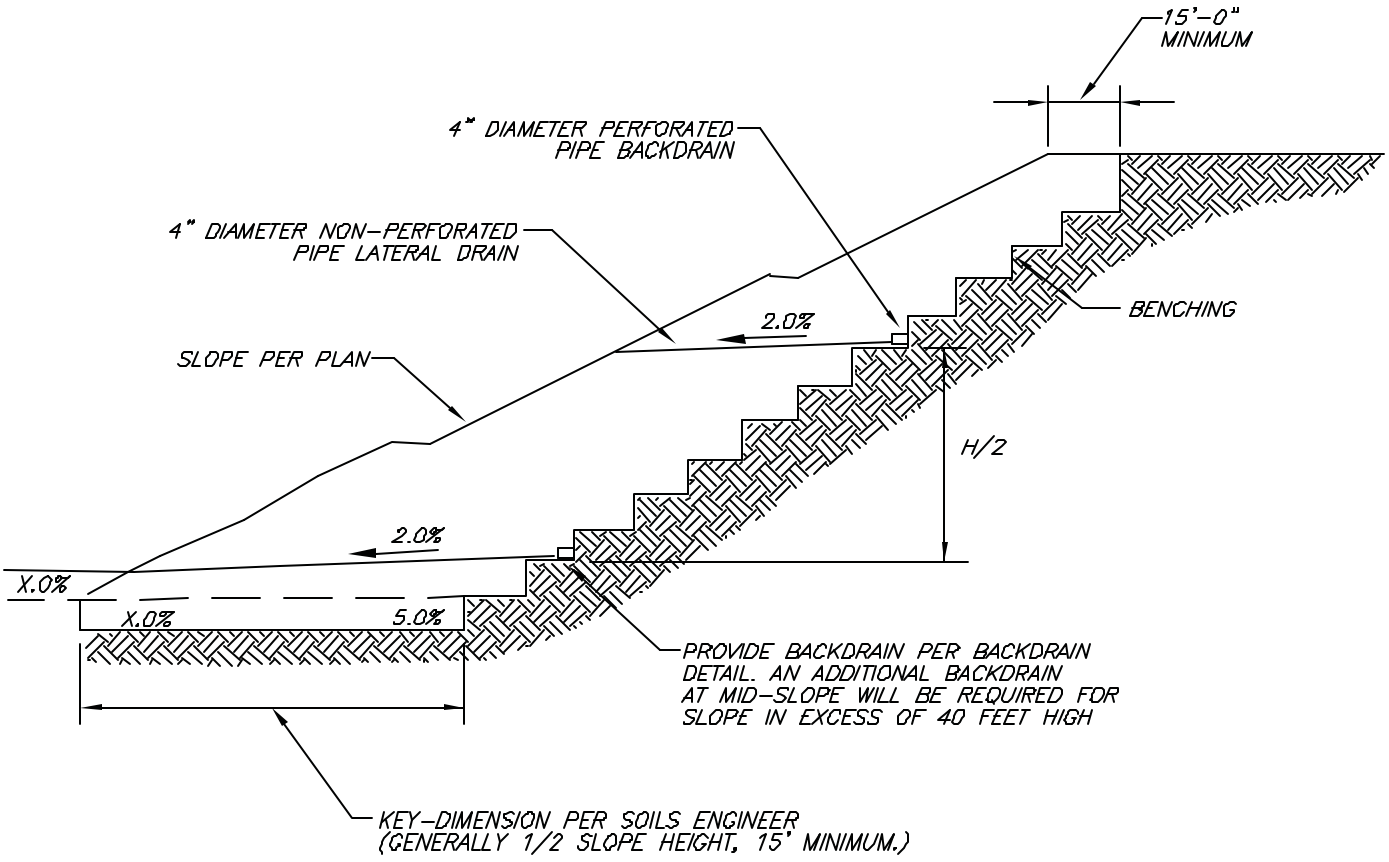
Clean Granular backfill and/or bedding are not recommended in slope areas unless provisions are made for a drainage system to mitigate the potential build-up of seepage forces.

STATUS OF GRADING

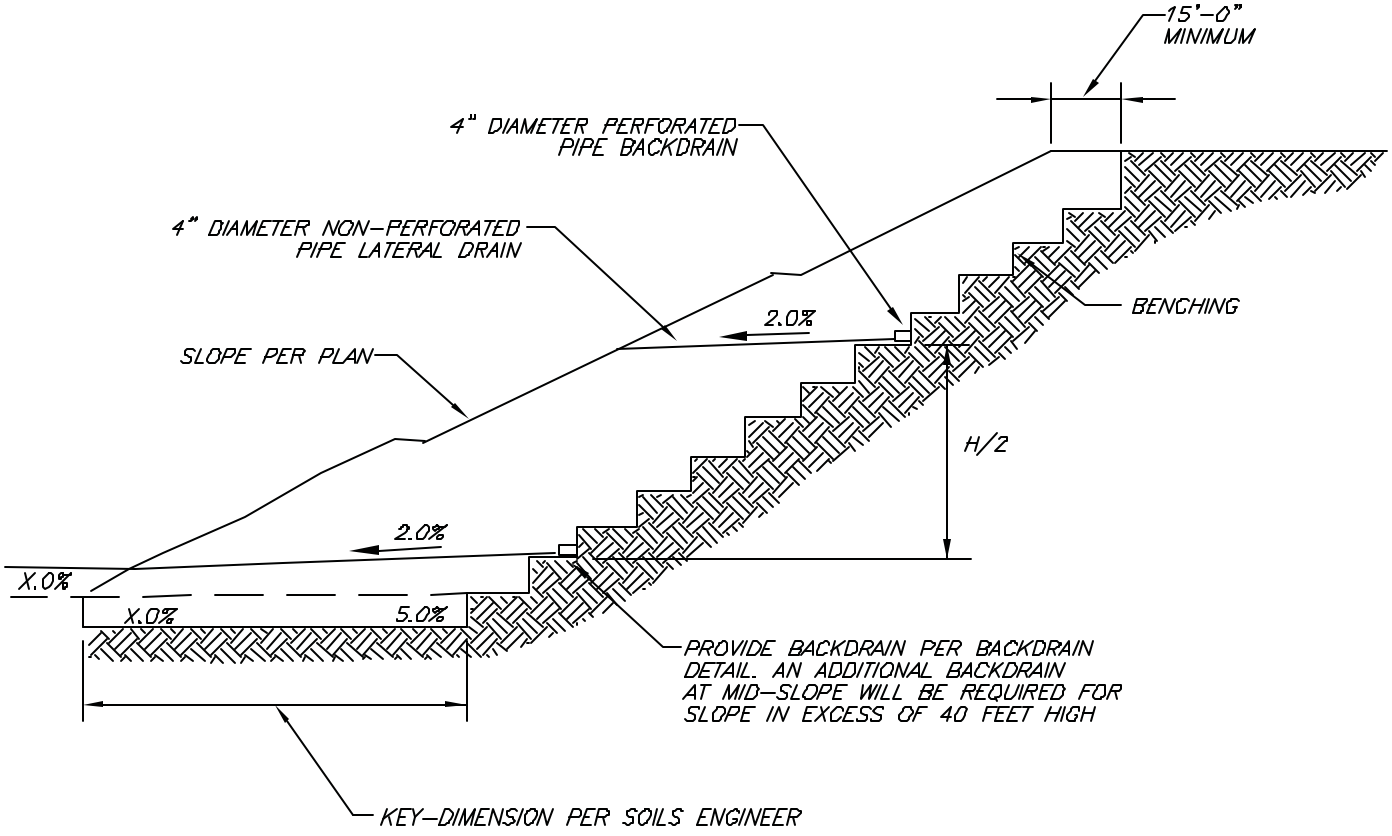
Prior to proceeding with any grading operation, the Geotechnical Consultant should be notified at least two working days in advance in order to schedule the necessary observation and testing services.

Prior to any significant expansion of cut back in the grading operation, the Geotechnical Consultant should be provided with adequate notice (i.e., two days) in order to make appropriate adjustments in observation and testing services.

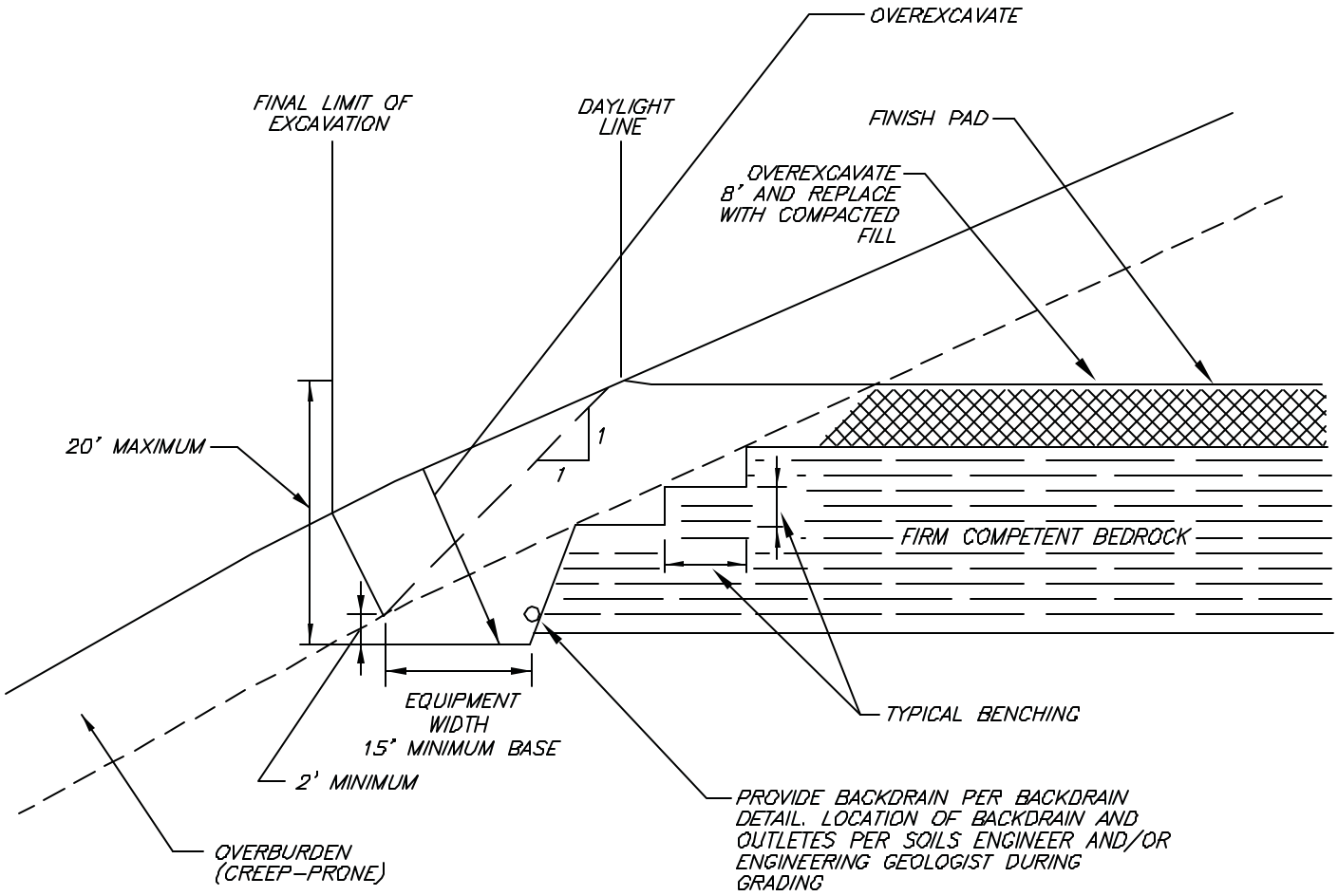
Following completion of grading operations and/or between phases of a grading operation, the Geotechnical Consultant should be provided with at least two working days notice in advance of commencement of additional grading operations.



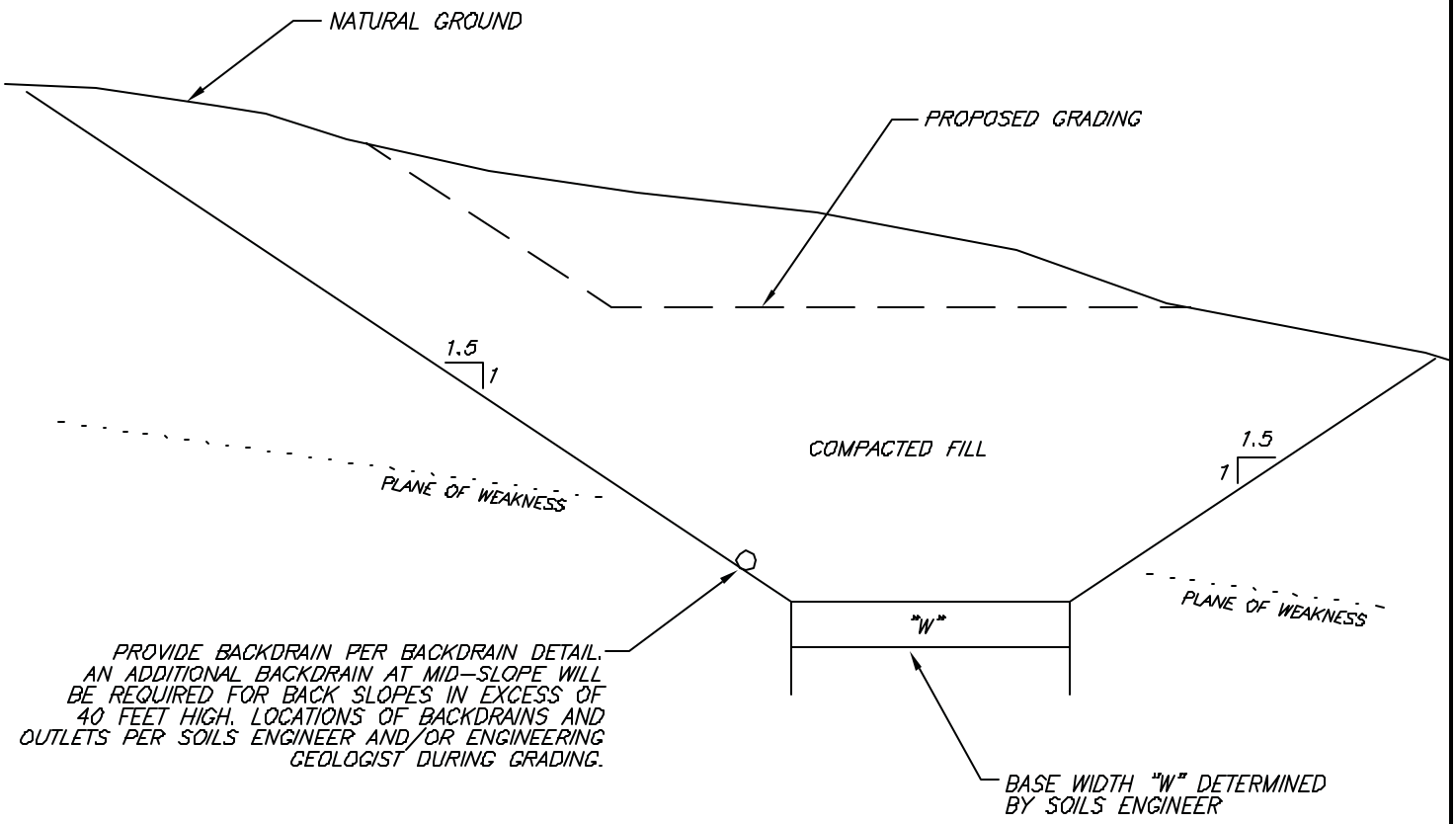
TYPICAL STABILIZATION FILL DETAIL



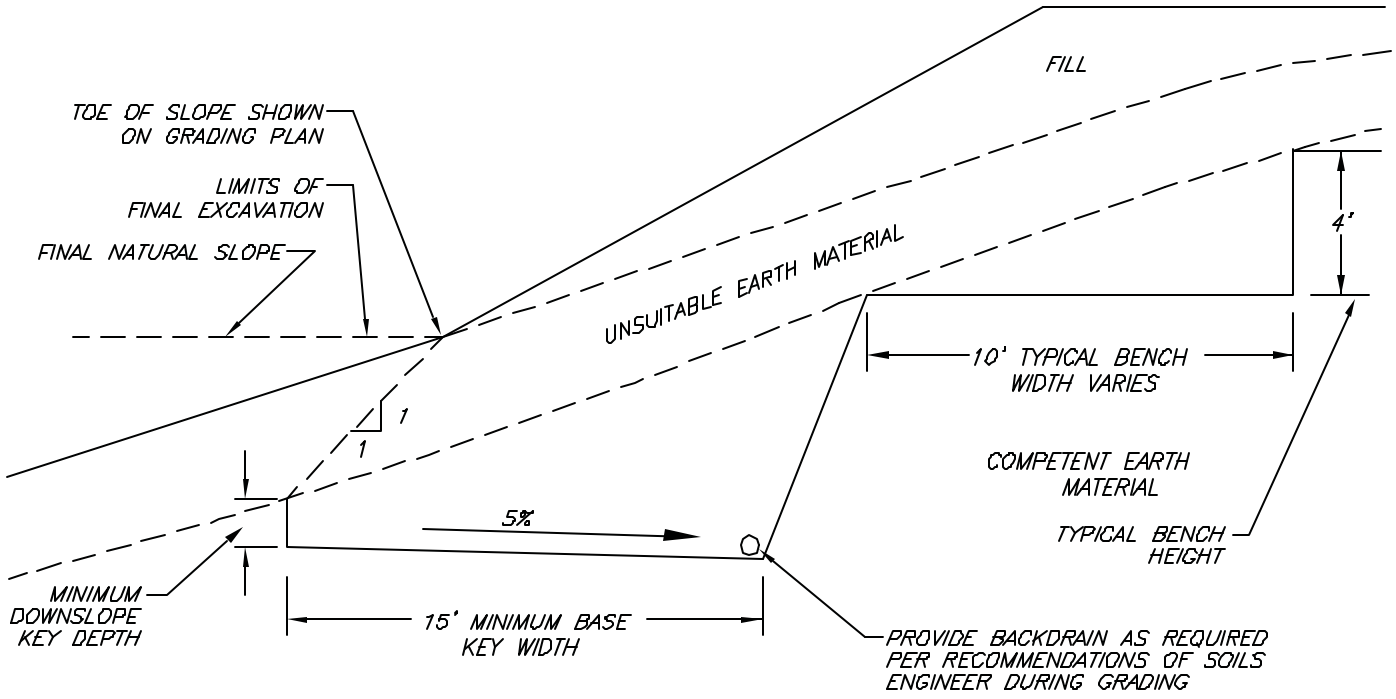
TYPICAL BUTTRESS FILL DETAIL



DAYLIGHT SHEAR KEY DETAIL

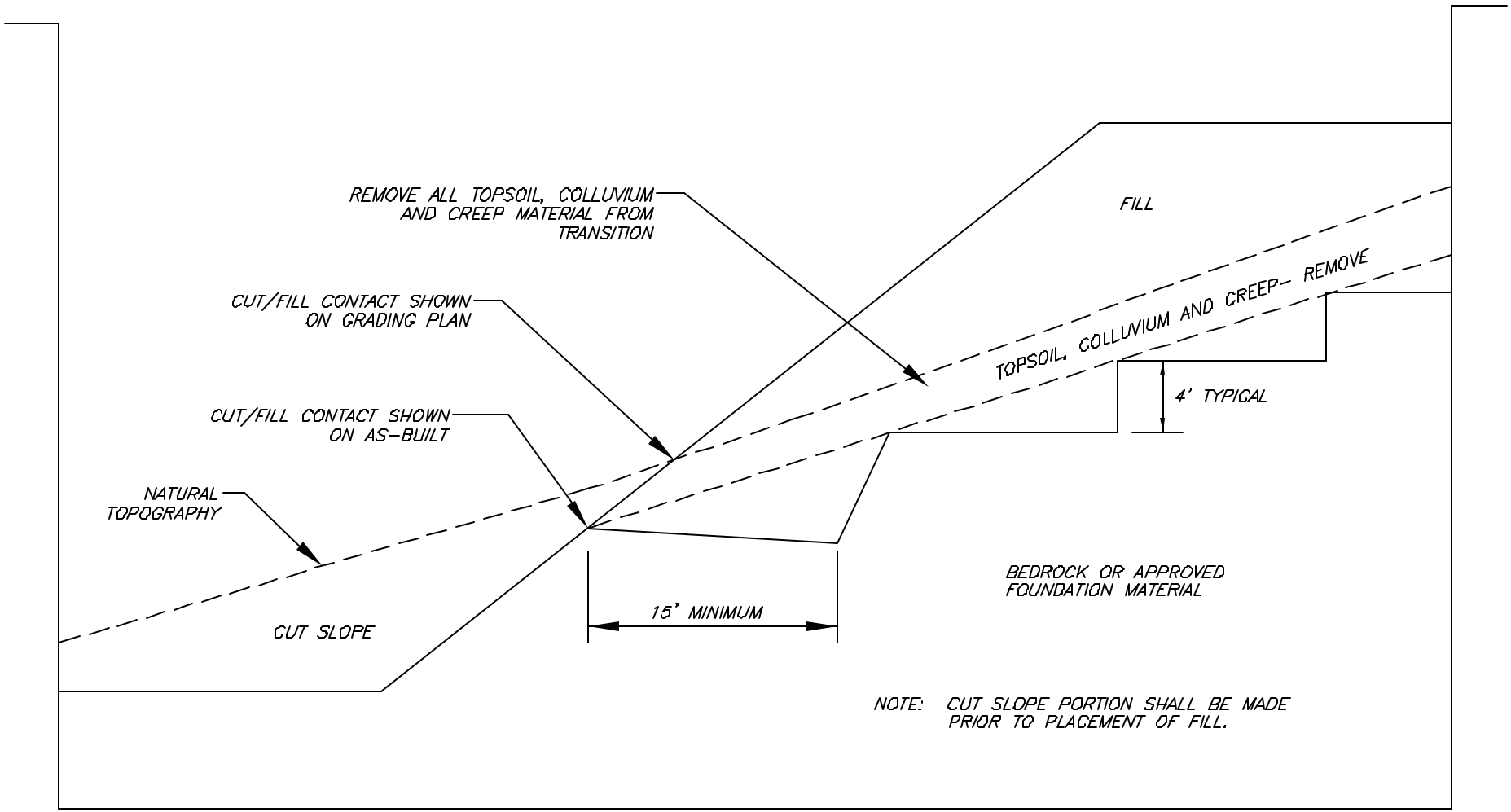


TYPICAL SHEAR KEY DETAIL

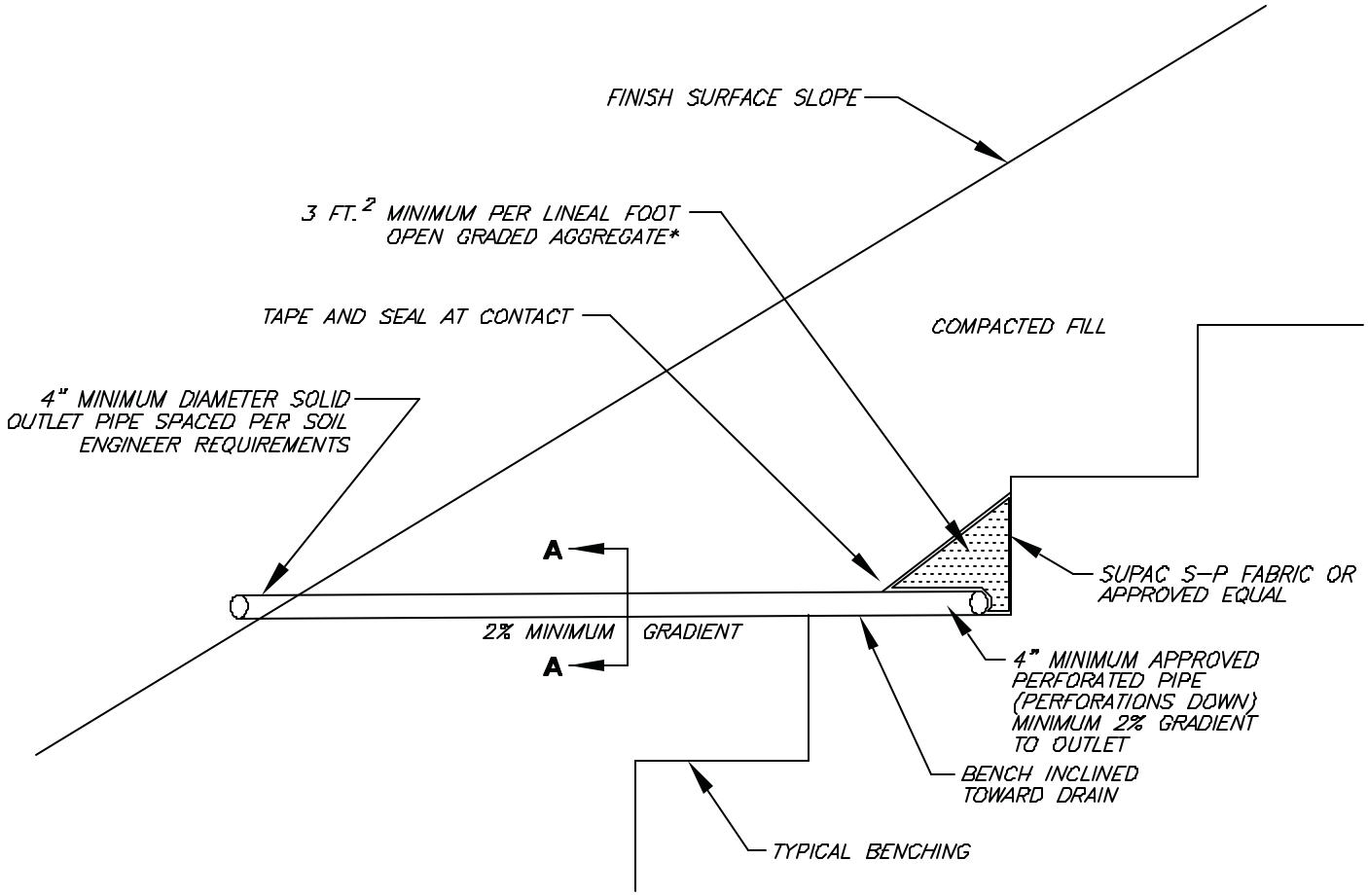


WHERE NATURAL SLOPE IS 5:1 OR LESS, BENCHING IS NOT NECESSARY, HOWEVER, FILL IS NOT TO BE PLACED ON COMPRESSIBLE OR UNSUITABLE MATERIAL.

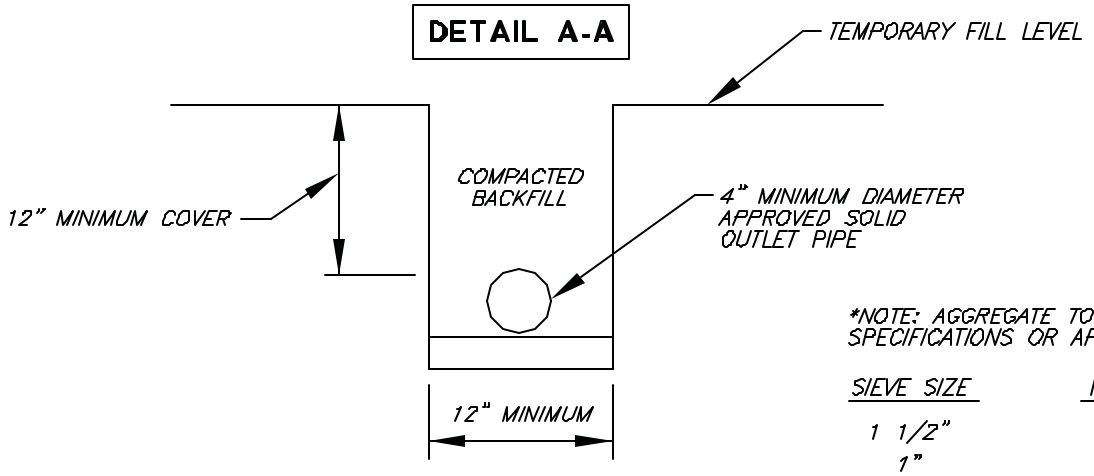
FILL SLOPE ABOVE NATURAL GROUND DETAIL



FILL SLOPE ABOVE CUT SLOPE DETAIL



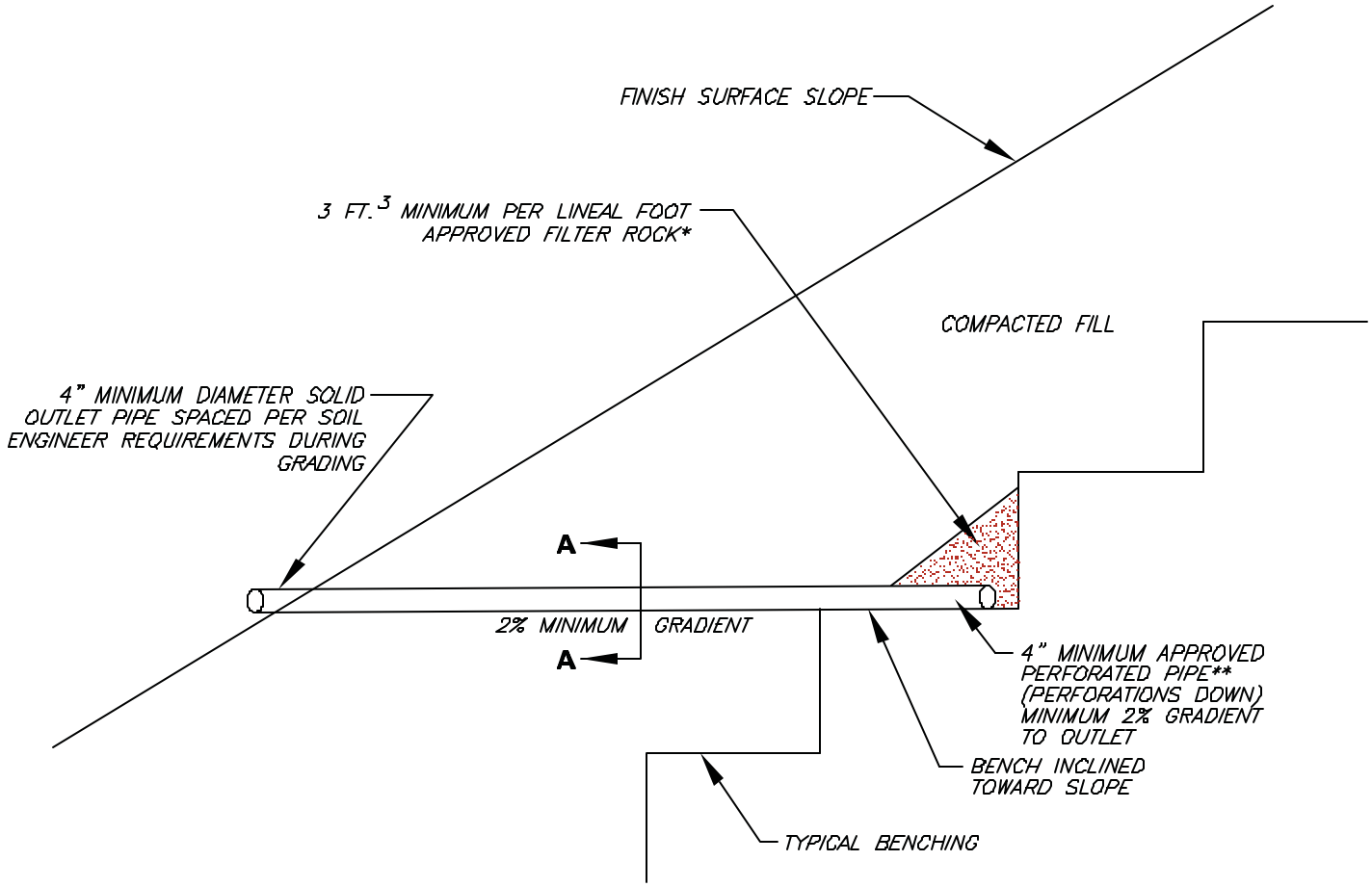
DETAIL A-A



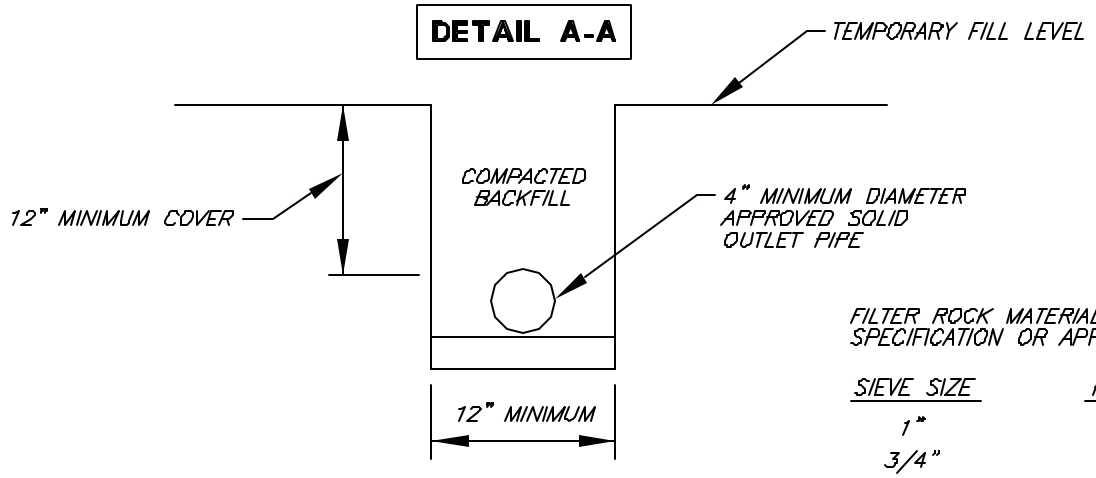
*NOTE: AGGREGATE TO MEET FOLLOWING SPECIFICATIONS OR APPROVED EQUAL:

SIEVE SIZE	PERCENTAGE PASSING
1 1/2"	100
1"	5-40
3/4"	0-17
3/8"	0-7
NO. 200	0-3

BACKDRAIN DETAIL (GEOFABRIC)



DETAIL A-A



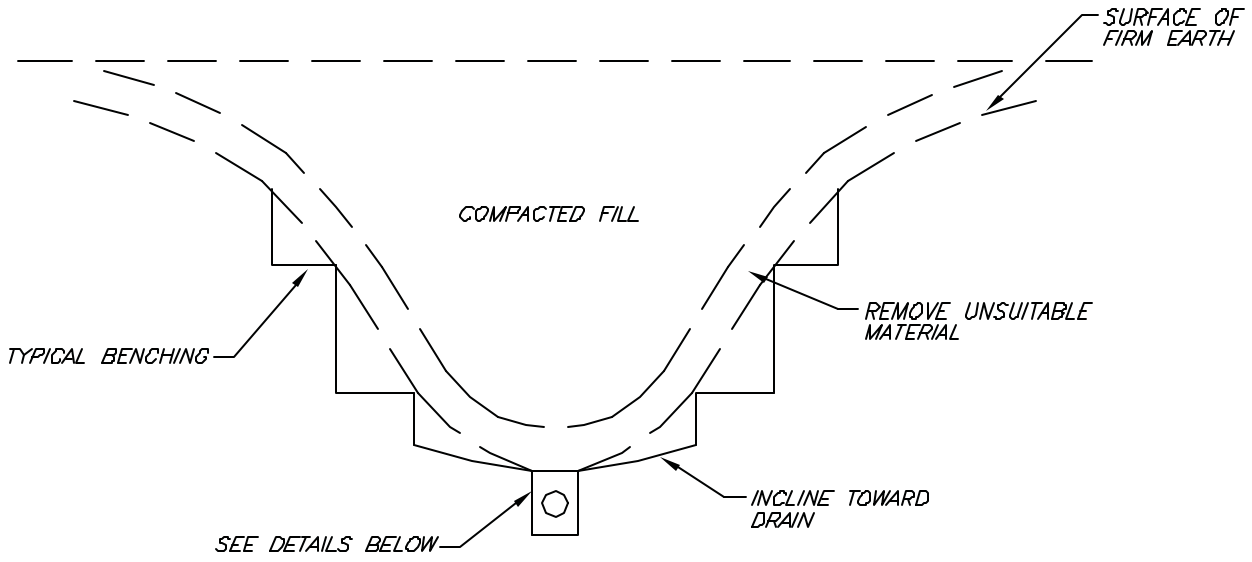
FILTER ROCK MATERIAL TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUAL:

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

**APPROVED PIPE TYPE:

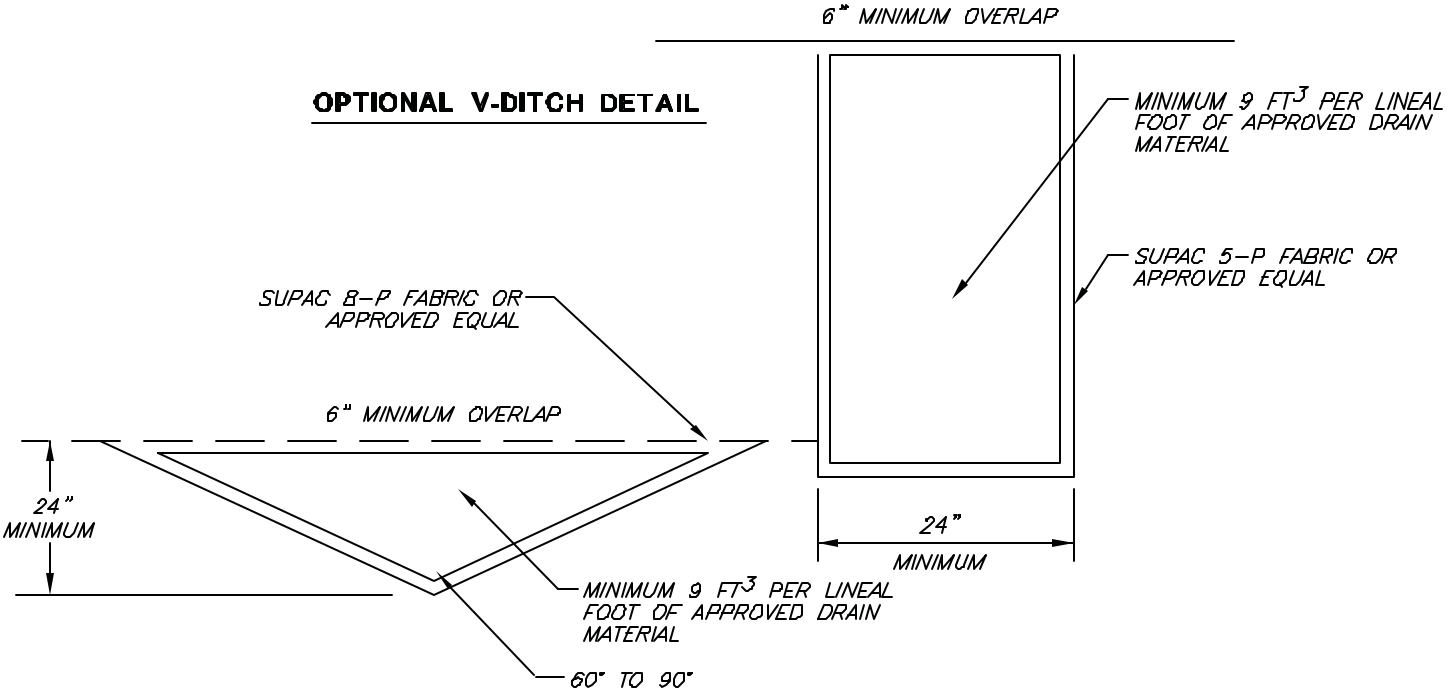
SCHEDULE 40 POLYVINYL CHLORIDE (P.V.C.) OR APPROVED EQUAL. MINIMUM CRUSH STRENGTH 1000 PSI.

TYPICAL BACKDRAIN DETAIL



TRENCH DETAIL

OPTIONAL V-DITCH DETAIL



DRAIN MATERIAL TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUAL:

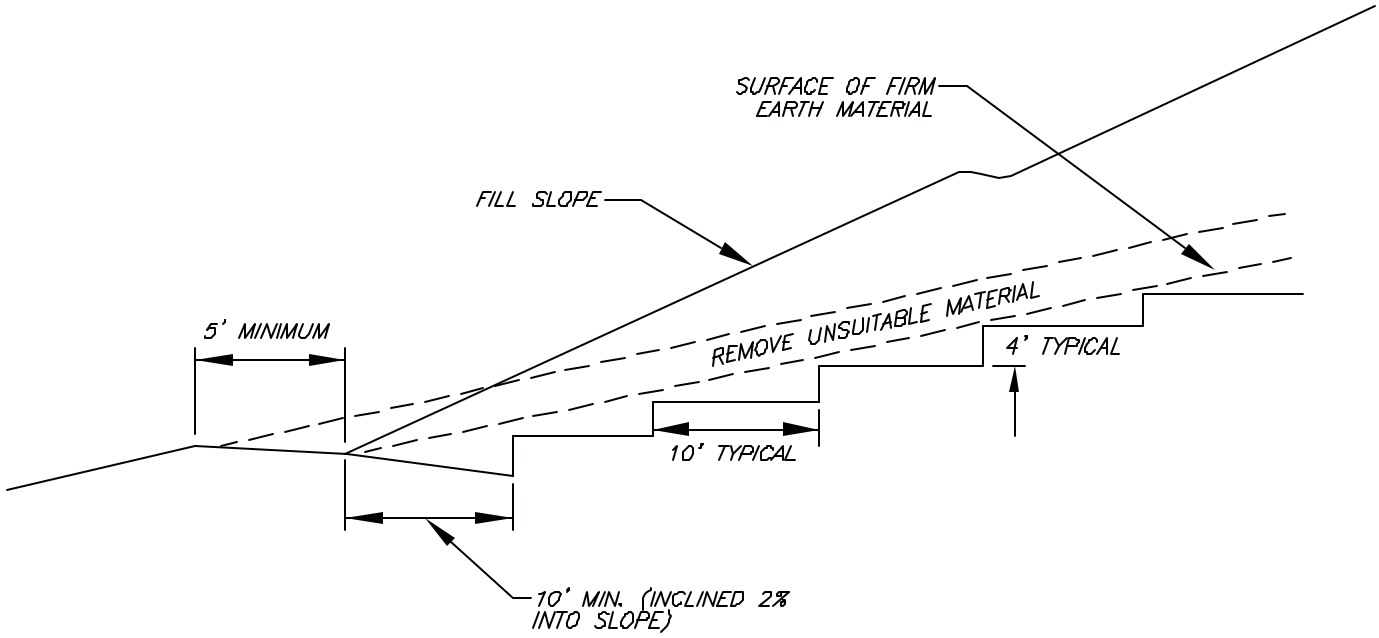
SIEVE SIZE	PERCENTAGE PASSING
1-1/2"	88-100
1"	5-40
3/4"	0-17
3/8"	0-7
NO.:200	0-3

ADD MINIMUM 4" DIAMETER APPROVED PERFORATED PIPE WHEN GRADIENT IS LESS THAN 2%

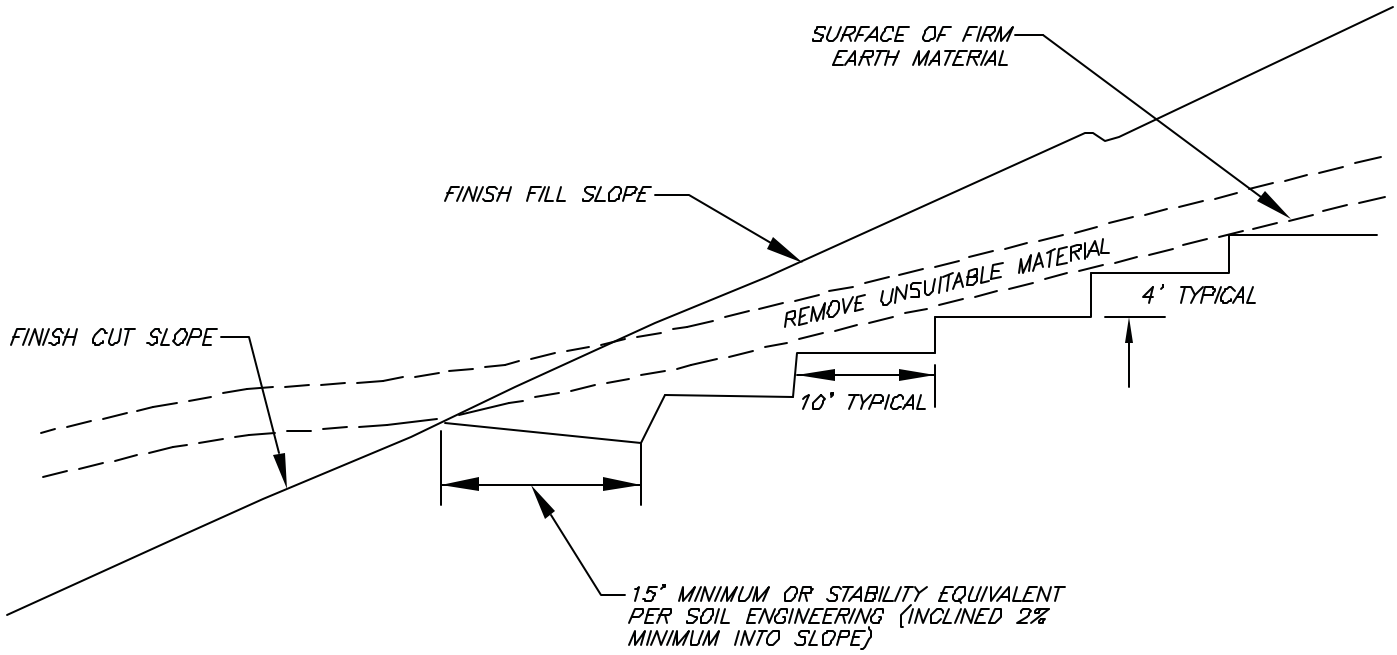
APPROVED PIPE TO BE SCHEDULE 40 POLY-VINYL-CHLORIDE (P.V.C.) OR APPROVED EQUAL. MINIMUM CRUSH STRENGTH 1000 psi.

GEOFABRIC SUBDRAIN DETAIL

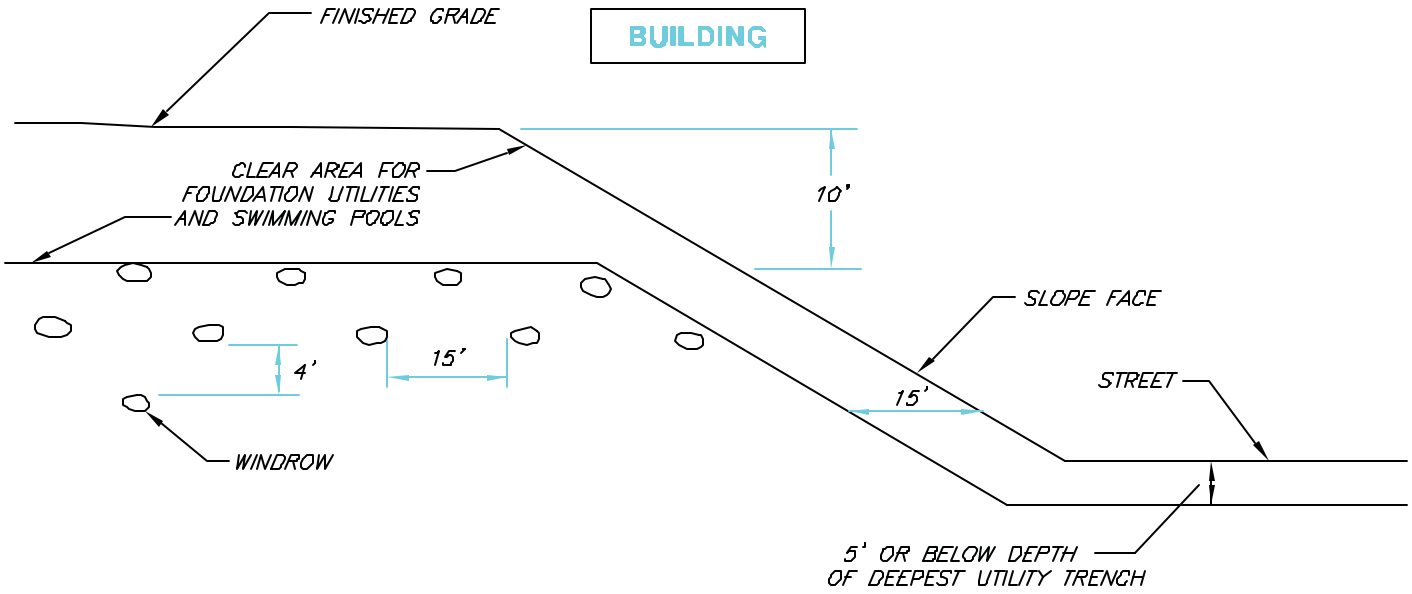
BENCHING FILL OVER NATURAL



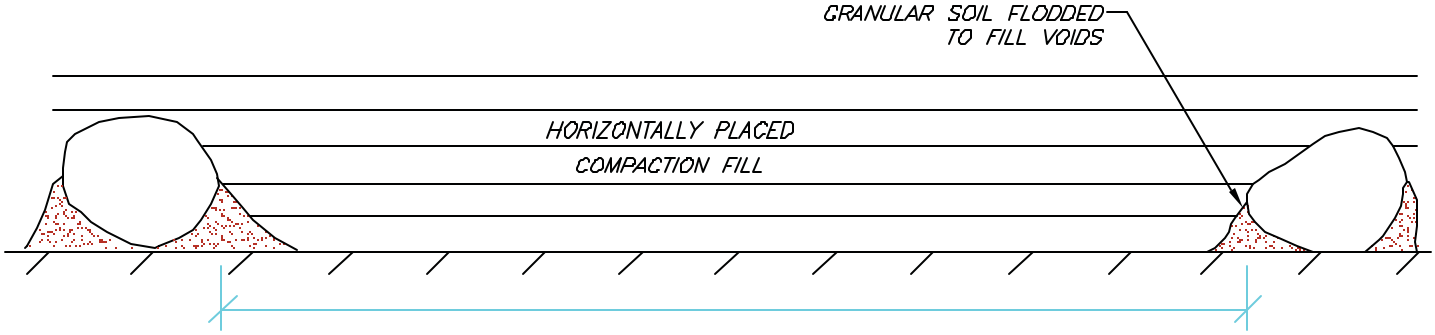
BENCHING FILL OVER CUT



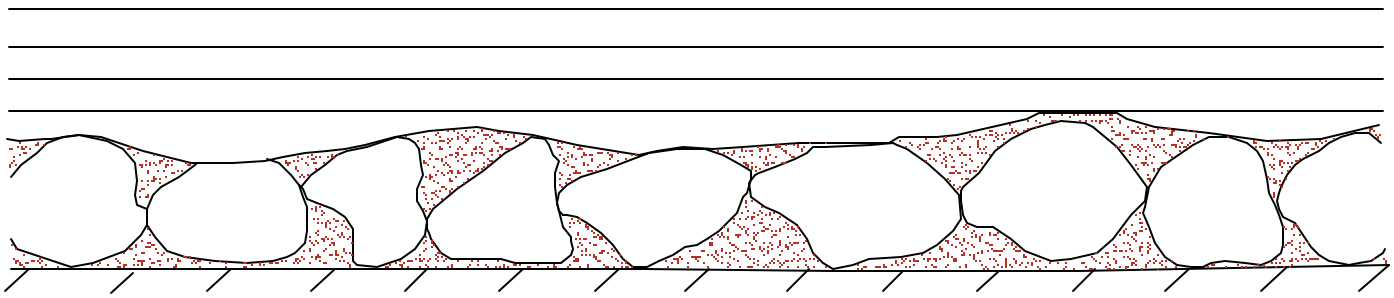
BENCHING FOR COMPACTED FILL DETAIL



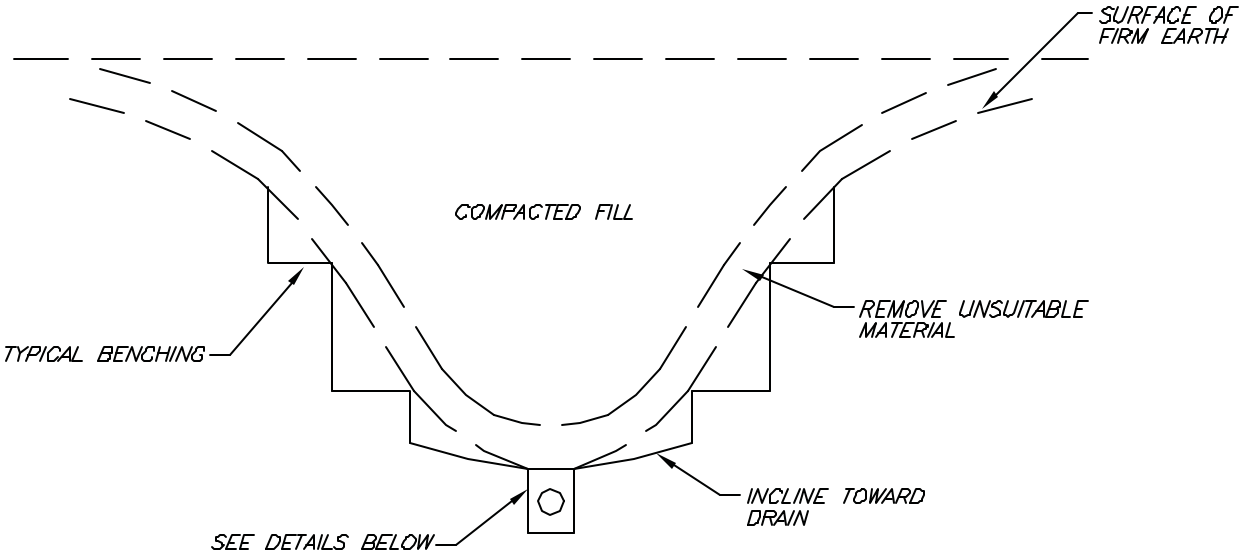
TYPICAL WINDROW DETAIL (EDGE VIEW)



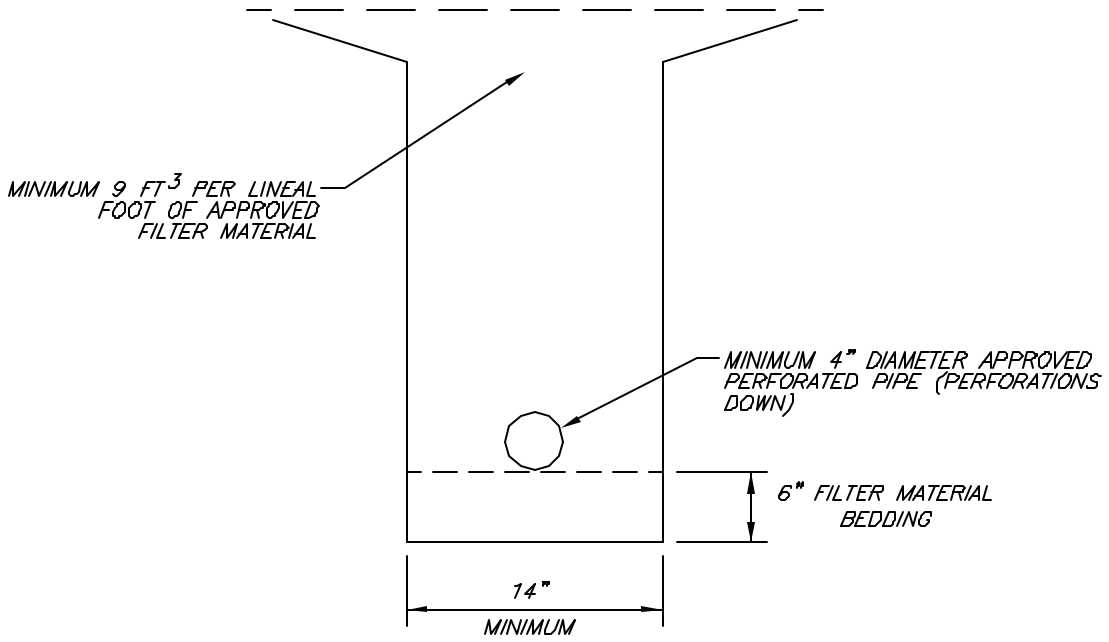
PROFILE VIEW



ROCK DISPOSAL DETAIL



TRENCH DETAIL



FILTER MATERIAL TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUAL:

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

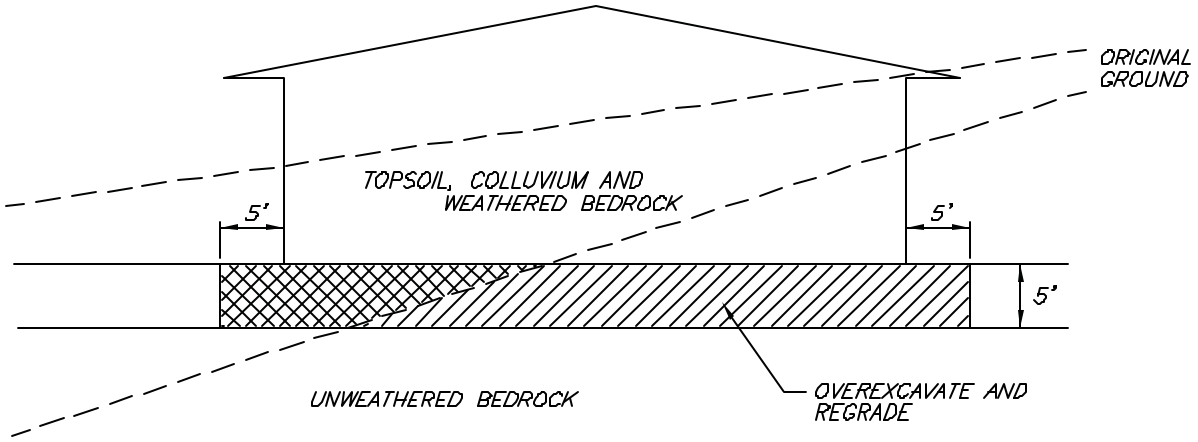
APPROVED PIPE TO BE SCHEDULE 40 POLY-VINYL-CHLORIDE (P.V.C.) OR APPROVED EQUAL. MINIMUM CRUSH STRENGTH 1000 psi.

PIPE DIAMETER TO MEET THE FOLLOWING CRITERIA. SUBJECT TO FIELD REVIEW BASED ON ACTUAL GEOTECHNICAL CONDITIONS ENCOUNTERED DURING GRADING.

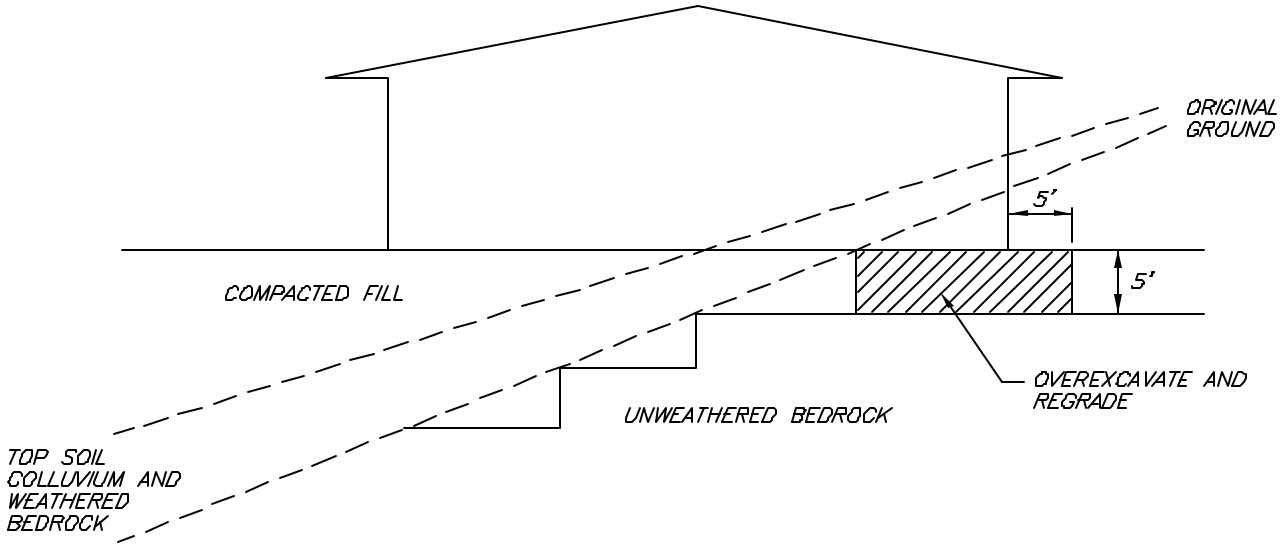
LENGTH OF RUN	PIPE DIAMETER
UPPER 500'	4"
NEXT 1000'	6"
> 1500'	8"

TYPICAL CANYON SUBDRAIN DETAIL

CUT LOT



CUT/FILL LOT (TRANSITION)



TRANSITION LOT DETAIL

ATTACHMENT 3

COMMENT LETTERS

Monroe Master Drainage Plan Line E Stages 2 and 3, Line E-2, and Line E-5 Storm Drain Improvements Final IS/MND

Letters of Comment and Responses

The Draft Initial Study (IS) and Mitigated Negative Declaration (MND) for the Monroe Master Drainage Plan Line E Stages 2 and 3, Line E-2, and Line E-5 Storm Drain Improvements (Project) was circulated for public and agency review from November 6, 2018 to December 6, 2018 (State Clearinghouse [SCH] No. 2018111014). During the 30-day public and agency review period, comment letters were received from the agencies listed in the table below. The comments did not address the adequacy of the environmental document or raise any new environmental issues. Therefore, no changes to the IS/MND were required. However, staff has provided responses to all comments as a courtesy to the commenters.

Letter	Author	Page Number
A	Governor's Office of Planning and Research	RTC-2
B	Regional Water Quality Control Board	RTC-4
C	Western Municipal Water District	RTC-7
D	Northwest Mosquito and Vector Control District	RTC-8

Letter A

STATE OF CALIFORNIA
GOVERNOR'S OFFICE *of* PLANNING AND RESEARCH

EDMUND G. BROWN JR.
GOVERNOR

KEN ALEX
DIRECTOR

RECEIVED
DEC 10 2018
PUBLIC WORKS

December 6, 2018

Sweta Patel
City of Riverside
3900 Main Street, 3rd Floor
Riverside, CA 92522

Subject: Monroe Master Drainage Plan Line E Stages 2 and 3, Line E-2, and Line E-5 Storm Drain Improvements
SCH#: 2018111014

Dear Sweta Patel:

A-1 The State Clearinghouse submitted the above named Mitigated Negative Declaration to selected state agencies for review. The review period closed on December 5, 2018, and no state agencies submitted comments by that date. This letter acknowledges that you have complied with the State Clearinghouse review requirements for draft environmental documents, pursuant to the California Environmental Quality Act.

Please call the State Clearinghouse at (916) 445-0613 if you have any questions regarding the environmental review process. If you have a question about the above-named project, please refer to the ten-digit State Clearinghouse number when contacting this office.

Sincerely,

Scott Morgan
Director, State Clearinghouse

1400 10th Street P.O. Box 3044 Sacramento, California 95812-3044
1-916-322-2318 FAX 1-916-558-3184 www.opr.ca.gov

A-1 This letter acknowledges that the City has complied with the State Clearinghouse review requirements for draft environmental documents pursuant to the California Environmental Quality Act, and that no state agencies provided comments on the Initial Study/Mitigated Negative Declaration.

Document Details Report
State Clearinghouse Data Base

SCH# 2018111014
Project Title Monroe Master Drainage Plan Line E Stages 2 and 3, Line E-2, and Line E-5 Storm Drain Improvements
Lead Agency Riverside, City of

Type MND Mitigated Negative Declaration

Description The proposed project includes the construction of approx 11,200 lf of underground storm drain pipe within the Gratton St, Dufferin Ave, and Hermosa Dr rights-of-way; removing and rebuilding the existing curb, gutter, and street lights along the east side of Gratton St between Lincoln Ave and Victoria Ave; and a jack-and-bore operation for trenchless pipe installation underneath Gage Canal at the intersection of Gratton St and Hermosa Dr.

Lead Agency Contact

Name Sweta Patel
Agency City of Riverside
Phone (951) 826-5714 **Fax**
email
Address 3900 Main Street, 3rd Floor
City Riverside **State** CA **Zip** 92522

Project Location

County Riverside
City Riverside
Region
Lat / Long 33° 54' 55" N / 117° 24' 55" W
Cross Streets Gratton St and Victoria Ave
Parcel No.
Township 3S **Range** 5W **Section** 16 **Base** SB

Proximity to:

Highways 91
Airports
Railways
Waterways Gage Canal
Schools Hawthorne ES
Land Use RA-5

Project Issues Aesthetic/Visual; Agricultural Land; Air Quality; Archaeologic-Historic; Biological Resources; Flood Plain/Flooding; Forest Land/Fire Hazard; Geologic/Seismic; Growth Inducing; Landuse; Minerals; Noise; Population/Housing Balance; Public Services; Recreation/Parks; Schools/Universities; Soil Erosion/Compaction/Grading; Toxic/Hazardous; Traffic/Circulation; Vegetation; Water Quality; Water Supply; Wetland/Riparian

Reviewing Agencies Resources Agency; Department of Conservation; Department of Fish and Wildlife, Region 6; Cal Fire; Department of Parks and Recreation; Department of Water Resources; California Highway Patrol; Caltrans, District 8; Native American Heritage Commission; Department of Toxic Substances Control; Regional Water Quality Control Board, Region 8; State Water Resources Control Board, Divison of Financial Assistance; State Water Resources Control Board, Division of Drinking Water; Air Resources Board, Transportation Projects

Date Received 11/06/2018 **Start of Review** 11/06/2018 **End of Review** 12/05/2018

Note: Blanks in data fields result from insufficient information provided by lead agency.

Letter B

From: Robertson, Glenn@Waterboards [mailto:Glenn.Robertson@waterboards.ca.gov]
Sent: Wednesday, December 05, 2018 5:25 PM
To: Patel, Swetaben
Cc: Reeder, Terri@Waterboards ; Bill, Jason@Waterboards
Subject: [External] City of Riverside, Monroe Master Drainage Plan Line E, Stages 2 and 3, Line E-2, Line E-5

To Sweta Patel, Senior Engineer, City of Riverside:

B-1 Regional Board staff has reviewed your Mitigated Negative Declaration for the construction of 11,200 linear feet of underground storm drain pipe in southern Riverside along Gratton St, east of Victoria Avenue, among several drainage and lighting improvements.

Specifically, the City intends to conduct trenchless pipe installation, by means of a jack-and-bore operation, beneath the historic Gage Canal at the intersection of Gratton St. and Hermosa Drive. It has been our staff experience that discharges from jack-and-bore operations beneath any channel/canals may result in the drilling slurry residue entering waters of the United States ("inadvertent returns" or "frac-outs"), to be suspended by subsequent flows. Therefore, we request that you please notify the U.S. Army Corps of Engineers of your plans (If you need contacts, please reply and I will send them to you). If the USACE requires a Clean Water Act Section 404 Permit for a potential "fill to waters of the U.S.," please apply to the Regional Board for a CWA Section 401 Water Quality Standards Certification.

We thank you for your attention.

Glenn S. Robertson
Engineering Geologist, PG, M.S.
Regional Water Quality Control Board
3737 Main Street, Suite 500
Riverside, CA 92501

Phone (951) 782-3259
Fax (951) 781-6288
Email Glenn.Robertson@waterboards.ca.gov

1

B-1 Thank you for your comment on the Initial Study/Mitigated Negative Declaration (IS/MND) for the City of Riverside's Monroe Master Drainage Plan Line E, Stages 2 and 3, Line E-2, and Line E-5. Your area of concern is that the proposed jack-and-bore operations beneath the Gage Canal, at the intersection of Gratton Street and Hermosa Drive, could result in an inadvertent discharge to waters of the United States in the form of "inadvertent returns" or "frac-outs." We appreciate your concern and have provided the U.S. Army Corps of Engineers (USACE) with a copy of the Final IS/MND. We also submitted a follow up letter to USACE stating your concern regarding the Gage Canal, which then explains why the project would not impact Gage Canal and would not require a 404 permit.

We have concluded that the proposed project would not have a potential to result in "fill to waters of the U.S." for two reasons. First, while the Gage Canal has connectivity with the Santa Ana River, it is a concrete-lined agricultural canal that does not serve as a tributary to any traditional navigable waterway, and is therefore not considered to be a federally-protected wetland, or non-wetland water of the U.S. And even if it were, all impacts to the Gage Canal are to be avoided. Second, the proposed jack-and bore tunnel would be at a minimum depth of 3 feet below the canal and protection of the canal during construction would be a contract requirement. In the unlikely event that the canal were to be damaged during construction, the anticipated result would be the infiltration of the tunnel by water from the canal above, but not the opposite effect of "inadvertent returns" or "frac-outs" migrating 3 or more feet upward into the canal.

The USACE was provided with the opportunity to review the Draft IS/MND and they did not comment. A hard copy was sent directly to LaShawn Richardson, USACE, Regulatory Division, 915 Wilshire Boulevard, Los Angeles, CA 90017. Additionally, USACE reviewed the follow up letter we submitted and concurred that the project would not impact the Gage Canal and would not require a 404 Permit. A copy of the letter submitted to USACE is presented below.

RECON

An Employee-Owned Company

December 6, 2018

Ms. Haley Lovan
Planning Division
U.S. Army Corps of Engineers
Los Angeles District
915 Wilshire Boulevard
Los Angeles, CA 90017

Reference: **U.S. Army Corps of Engineers Jurisdictional Determination for the City of Riverside's Monroe Master Drainage Plan Storm Drain Line E, Stages 2 and 3, Storm Drain Line E-2, and Storm Drain Line E-5** (RECON Number P8995)

Dear Ms. Lovan:

I am writing to you regarding the City of Riverside's Monroe Master Drainage Plan Storm Drain Line E, States 2 and 3, Storm Drain Line E-2, and Storm Drain Line E-5 to request your opinion on whether the U.S. Army Corps of Engineers (USACE) has jurisdiction over the Gage Canal and whether a jack-and-bore pipeline installation beneath the canal would be an activity that your office would regulate.

We provided your office with an Initial Study/Mitigated Negative Declaration and Notice of Intent with a public review period that extended from November 6, 2018 through today, December 6, 2018. The IS/MND addresses the potential environmental effects of the construction of 11,200 linear feet of underground storm drain pipe in southern Riverside, along Gratton Street, east of Victoria Avenue, among several drainage and lighting improvements. Of specific potential interest to the USACE, the City intends to conduct trenchless pipe installation, by means of a jack-and-bore operation, beneath the historic Gage Canal at the intersection of Gratton Street. and Hermosa Drive.

We received a comment letter (email) from the Regional Water Quality Control Board (RWQCB) stating that it has been their experience that discharges from jack-and-bore operations beneath any channel/canals may result in the drilling slurry residue entering waters of the United States ("inadvertent returns" or "frac-outs"), to be suspended by subsequent flows. The RWQCB has therefore requested that we notify you of our plans and has stated that if you require a Clean Water Act Section 404 Permit for a potential "fill to waters of the U.S.," the City of Riverside will need to apply to the Regional Board for a CWA Section 401 Water Quality Standards Certification.

Our environmental consultant has concluded that the proposed project would not have a potential to result in "fill to waters of the U.S." This is for two reasons. First, while the Gage Canal has connectivity with the Santa Ana River, it is a concrete-lined agricultural canal that does not serve as a tributary to any traditional navigable waterway, and is therefore not considered to be a federally-protected wetland, or non-wetland water of the U.S. And even if it were, all impacts to the Gage Canal are to be avoided. Second, the proposed jack-and bore tunnel would be at a minimum depth of 3 feet below the canal and protection of the canal during construction would be a contract requirement. In the unlikely event that the canal were to be damaged during construction, the anticipated result would be the infiltration of the tunnel by water from the canal above, but not the opposite effect of "inadvertent returns" or "frac-outs" migrating 3 or more feet upward into the canal.

1927 Fifth Avenue, San Diego, CA 92101 | 619.308.9333 | reconenvironmental.com
SAN DIEGO | CENTRAL COAST | BERKELEY | TUCSON

Ms. LaShawn Richardson
Page 2
December 6, 2018

Additionally, the RWQCB has agreed that the former Gage Canal continuity is probably disconnected from the Santa Ana River, around the vicinity of University Avenue. But, because the southern segment feeds Mockingbird Reservoir the RWQCB has asked that we contact you regarding your jurisdiction for the Gage Canal as waters of the U.S. and if our jack-and-bore construction beneath the canal would require a 404 Permit.

Please do not hesitate to call me at (951) 826-5714 if you would like to discuss or require additional information regarding this project and request. We appreciate your time and consideration.

Sincerely,

Sweta Patel
City of Riverside
Public Works Department, Engineering
Direct: 951.826.5714
Main:951-826-5341
scpatel@riversideca.gov

LETTER	RESPONSE
Letter C **From:** Hossein Juybari [mailto:HJuybari@wmwd.com] **Sent:** Wednesday, November 14, 2018 10:51 AM **To:** Patel, Swetaben **Cc:** Sonia Huff ; Hossein Juybari **Subject:** [External] Monroe Master Drainage Plan Line E - Public Notice Sweta, C-1 We have reviewed the notice of intent to adopt the Mitigated Negative Declaration (MND) for the proposed project. The proposed underground drainage line crosses Western MWD non-potable water conveyance system. Please make sure that MND has a section for the utilities conflict. During the preliminary investigation for the utilities conflict/design process, the applicant/lead agency needs to make sure that there is no conflict between the proposed line and the existing utilities. Thank you for providing us opportunity to review and comments. Hossein Juybari Serving Western MWD 1	C-1 During the preliminary investigation for the utilities conflict/design process, the City will ensure that there are no conflicts between the proposed transmission line and the existing utilities.

Letter D

NORTHWEST
MOSQUITO AND VECTOR CONTROL DISTRICT

PUBLIC HEALTH GOVERNMENT AGENCY

President
Berwin Hanna
City of Norco

Vice President
Brian Tisdale
City of Lake Elsinore

Secretary
Karen Alexander
City of Corona

Trustee
Joe Tessari
City of Eastvale

Trustee
Micheal Goodland
City of Jurupa Valley

Trustee
George Read
County of Riverside

Trustee
Jordan Ehrenkranz
City of Canyon Lake

Trustee
Gary Bradley, Ph.D.
City of Riverside

Major S. Dhillon, Ph.D.
District Manager

November 6st, 2018

City of Riverside Public Works Department
3900 Main St, 4th Floor
Riverside, CA 92522
Attn: Sweta Patel, P.E., Senior Engineer

Re: Mitigated Negative Declaration – Monroe Master Drainage Plan Line E Stages 2 and 3, and Line E-5 Storm Drain Improvements

D-1 On behalf of Northwest Mosquito and Vector Control District, I'd like to express our appreciation for being included on these communications. Please accept these general comments with regards to our district needs. As a government agency tasked with protecting the public from vectors and vector-borne diseases, our concern would be any standing or stagnant bodies of water which may breed mosquitoes and midges. Occasionally, standing water can accumulate during the implementation of development projects, particularly with added use of heavy machinery and/or increased density of staffing operating in a condensed space. Any impoundment of water which stands 3 days or longer can produce mosquitoes, and becomes a public nuisance or a health threat, or both.

As project planning and implementation progresses, please consider any additional means in mitigating the risk of the accumulation of standing water sources. If standing water is noted for a period greater than 3 days, and these potential breeding sources cannot be drained, please reach out to our office at (951) 340-9792 to allow for inspection and possible treatment. We would like all such areas to be made accessible to our technicians and vehicle traffic for the purposes of inspection and/or treatments targeting mosquito breeding. This would include maintaining access to Gage Canal during and subsequent to the scope of this project. Again, our sincere thanks for including us for comment, and we look forward to assisting with any additional questions or concerns.

RECEIVED
NOV 08 2018
PUBLIC WORKS

Sincerely,

Angela Caranci, PhD
Vector Ecologist

Cc: Major S. Dhillon, Ph.D., District Manager

1966 Compton Ave. • Corona, CA 92881-3318 • (951) 340-9792 • FAX (951) 340-2515
e.mail: office@northwestmvcd.org

D-1 Special provisions will be incorporated in the Contract to ensure the contractor is aware of any vector issues and the Northwest Mosquito and Vector Control District's vector control program. The provisions will require the contractor to construct the project in a manner that minimizes vector impacts and ensures that construction-related depressions do not hold standing water and drainage areas and Best Management Practices do not create potential mosquito breeding sources.

ATTACHMENT 4

MITIGATION MONITORING AND REPORTING PROGRAM

Monroe Master Drainage Plan Line E Stages 2 and 3, Line E-2, and Line E-5 Storm Drain Improvements

Impact Category	Mitigation Measures	Implementation Timing	Responsible Monitoring Party[1]	Monitoring/Reporting Method
Biological Resources	**MM-Bio-1:** To remain in compliance with California Fish and Game Code (CFGC) Section 3503 and the construction guidelines outlined in the Western Riverside Multiple Species Habitat Conservation Plan (MSHCP) Section 7.5.3, no direct impacts shall occur to any nesting birds, their eggs, chicks, or nests during the bird breeding season (March 1 to June 30). Vegetation trimming and clearing should avoid the bird breeding season to the greatest extent feasible. If vegetation trimming or clearing must occur during the breeding season, a preconstruction clearance survey by a qualified biologist would be required. If nesting birds are detected, measures would be required to verify compliance with CFGC Section 3503 such that take of birds or eggs or disturbance of breeding activities is avoided. Potential measures may include establishing an appropriate buffer area around the nesting site (500 feet for raptors, 300 feet for other bird species) until young have fledged or the nest is inactive. If no nesting birds are detected during the pre-construction survey, no additional measures would be required.	Prior to any vegetation trimming or clearing required for construction.	Construction Contractor, Public Works	Pre-construction Survey Report

[1] All agencies are City of Riverside Departments/Divisions unless otherwise noted.

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Impact Category	Mitigation Measures	Implementation Timing	Responsible Monitoring Party[1]	Monitoring/Reporting Method
	MM-Cul-1: Archaeological Monitoring: At least 30 days prior to application for a grading permit and before any grading, excavation and/or ground disturbing activities on the site take place, the City of Riverside shall retain a Secretary of Interior Standards qualified archaeological monitor to monitor all ground-disturbing activities in an effort to identify any unknown archaeological resources. 1. The Project Archaeologist, in consultation with interested tribes and the City, shall develop an Archaeological Monitoring Plan to address the details, timing, and responsibility of all archaeological and cultural activities that will occur on the project site. Details in the Plan shall include project grading and development scheduling. 2. At the completion of grading, excavation and ground disturbing activities on the site a Phase IV Monitoring Report shall be created documenting monitoring activities conducted by the project Archaeologist and Native Tribal Monitors within 60 days of completion of grading. This report shall document the impacts to the known resources on the project; describe how each mitigation measure was fulfilled; document the type of cultural resources recovered and the disposition of such resources; provide evidence of the required cultural sensitivity training for the construction staff held during the required pre-grade meeting; and, in a confidential appendix, include the daily/weekly monitoring notes from the archaeologist. All reports produced will be submitted to the City of Riverside, Eastern Information Center and interested tribes.	30 days prior to application for grading permit; and within 60 days of completion of grading, excavation, or ground-disturbing activities.	Construction contractor, Native American monitor, qualified professional archaeologist	Archaeological Monitoring Plan Contractor notice to representative of Native American Party. Final report to Public Works Division from archaeologist; if resources are found.

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	MM-Cul-2: Treatment and Disposition of Cultural Resources: In the event that Native American cultural resources are inadvertently discovered during the course of grading for this Project. The following procedures will be carried out for treatment and disposition of the discoveries: 1. Temporary Curation and Storage: During the course of construction, all discovered resources shall be temporarily curated in a secure location onsite or at the offices of the project archaeologist. The removal of any artifacts from the project site will need to be thoroughly inventoried with tribal monitor oversite of the process; and 2. Treatment and Final Disposition: The City shall relinquish ownership of all cultural resources, including sacred items, burial goods, and all archaeological artifacts and non-human remains as part of the required mitigation for impacts to cultural resources. The City shall relinquish the artifacts and curate them at the Western Science Center or Riverside Metropolitan Museum 3. Discovery of Human Remains: In the event that human remains (or remains that may be human) are discovered at the project site during grading or earthmoving, the construction contractors, and/or project archaeologist, shall immediately stop all activities within 100 feet of the find and comply with California Health and Safety Code Section 7050.5(b).	During construction	Construction contractor, Native American monitor, qualified professional archaeologist	Letter from the curation facility if artifacts are found and letter or note from the Most Likely Descendant indicating that the California Health and Safety Code Section 7050.5(b) was followed, if human remains are found.

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	MM-Cul-3: Cultural Sensitivity Training: The County certified Archaeologist and Native American Monitors shall attend the pre-grading meeting with the developer/permit holder's contractors to provide Cultural Sensitivity Training for all construction personnel. This shall include the procedures to be followed during ground disturbance in sensitive areas and protocols that apply in the event that unanticipated resources are discovered. Only construction personnel who have received this training can conduct construction and disturbance activities in sensitive areas. A sign in sheet for attendees of this training shall be included in the Monitoring Report.	Prior to construction	Construction contractor, Native American monitor, qualified professional archaeologist	Copy of the sign-in sheet of attendees of the Cultural Sensitivity Training.
	MM Cul-4: Should any paleontological resources be uncovered during construction, construction activities in the vicinity of the discovery shall be moved and a qualified paleontological resources specialist will be retained to evaluate the resources. If the find is determined to be significant, avoidance or other appropriate measures as identified by the paleontologist shall be implemented. Appropriate measures would include that a qualified paleontologist be permitted to recover, evaluate; and curate the find(s) in accordance with current standards and guidelines.	During construction	Construction contractor, Registered professional paleontologist	Paleontological monitoring report, if needed.