Converse Consultants
Geotechnical Engineering
Environmental & Groundwater Science
Inspection & Testing Services

MATERIALS REPORT (MR)

MAGNOLIA AVENUE BRIDGE AND ROADWAY WIDENING (BR NO. 56C-0199, PM-40.9)

CITY OF CORONA PROJECT NUMBER 2105-15
FEDERAL AID PROJECT NO. STPL-5104 (046)
CITY OF CORONA, RIVERSIDE COUNTY, CALIFORNIA

CONVERSE PROJECT NO. 18-81-147-02

Prepared For:

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December 28, 2020

Converse Consultants
Geotechnical Engineering, Environmental & Groundwater Science, Inspection & Testing Services

December 28, 2020

Mr. James Lu, PE
Principal Engineer
CNS Engineering, Inc.
11870 Pierce Street, Suite 265
Riverside, CA 92505

Subject: **MATERIALS REPORT (MR)**
Magnolia Avenue Bridge and Roadway Widening
(BR No. 56C-0199, PM-40.9)
El Camino Avenue to 1,000 Feet East of All-American Way
City of Corona Project Number 2015-15
Federal Aid Project No. STPL-5104 (046)
City of Corona, Riverside County, California
Converse Project No. 18-81-147-02

Dear Mr. Lu:

Converse Consultants (Converse) is pleased to submit this Materials Report (MR) to assist CNS Engineering, Inc in preparing the Project Specifications and Estimation (PS&E) for the proposed Magnolia Avenue Bridge and Roadway Widening project, located in the City of Corona, Riverside County, California. This report addresses pavement structural sections and materials information in accordance with the California Department of Transportation (Caltrans) Highway Design Manual, Chapter 100, Topic 114, *Materials* (Caltrans HDM, 2020) and Chapter 3, Section 6, *Materials* of the Project Development Procedures Manual (Caltrans PDPM, 2020). This report was prepared in accordance with our revised proposal dated April 5, 2018 and your Subconsultant Professional Service Agreement dated July 29, 2019.

We appreciate the opportunity to be of continued service to CNS Engineering, Inc. Should you have any questions, please contact us at 909-796-0544.

CONVERSE CONSULTANTS

Hashmi S. E. Quazi, PhD, PE, GE
Principal Engineer

Dist: 3/Addressee
HSQ/CA/RG/ZA/kvg

PROFESSIONAL CERTIFICATION

This report has been prepared by the individuals whose seals and signatures appear herein.

The findings, recommendations, specifications, or professional opinions contained in this report were prepared in accordance with generally accepted professional engineering, engineering geologic principles, and practice in this area of Southern California. There is no warranty, either expressed or implied.

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1.0 INTRODUCTION

This report presents the geologic and geotechnical information and, pavement structural sections and materials recommendations for the proposed Magnolia Avenue Bridge and Roadway Widening project, located in the City of Corona, Riverside County, California. The project location is shown on Figure No. 1, *Approximate Project Location Map*.

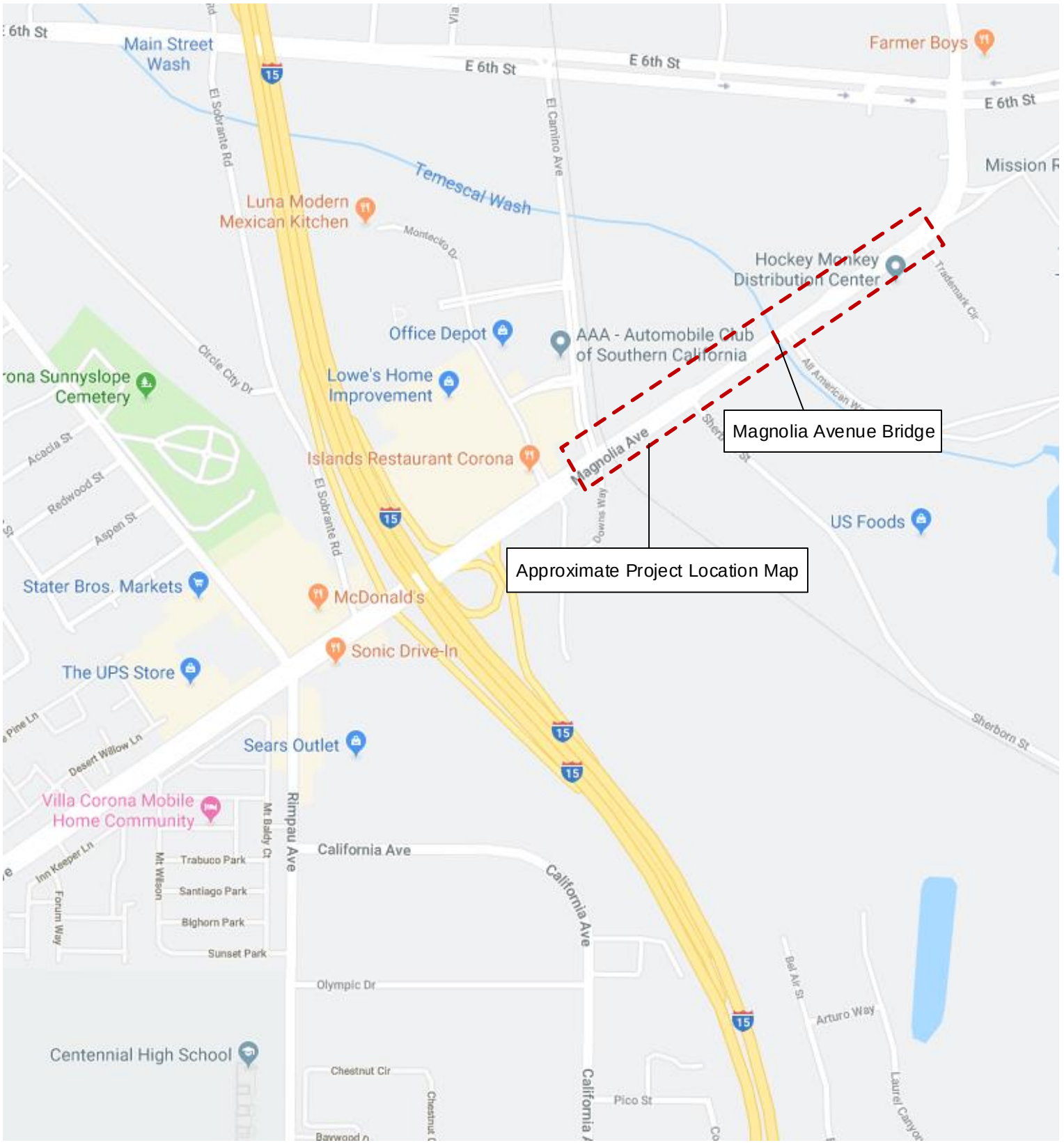
The purposes of this report were to document subsurface geotechnical conditions, provide analyses of site conditions, and to recommend design and construction criteria for the roadway portion of the project. Our scope of services consisted of review of existing data, a field investigation program, laboratory testing, and preparation of this report to provide the following:

- A description of the proposed project including a site vicinity map showing the location of the project limits and the approximate locations of the exploratory borings.
- A summary of the field exploration and laboratory testing programs, including a log of test borings.
- A general description of the surface and subsurface materials, including groundwater conditions.
- Minimum flexible pavement structural sections recommendations.
- Earthwork recommendations.
- Comments on materials to be used in construction.
- Comments on disposal of on-site materials unsuitable for construction.
- Comments on locally available material sources.
- Comments on the general corrosion potential of on-site soils to buried metal and Concrete.

This Materials Report was prepared in accordance with California Department of Transportation (Caltrans) Highway Design Manual, Chapter 100, Topic 114, *Materials* (Caltrans HDM, 2020) and Chapter 3, Section 6, Materials of the Project Development Procedures Manual (Caltrans PDPM, 2020).

2.0 PERTINENTS REPORTS AND INVESTIGATIONS

A review of readily available publications from various public and private files addressing the surface and subsurface conditions in the project area was conducted. The objective of this task was to develop an understanding of the geologic, hydrogeologic, and geotechnical considerations for the improvements. The list of all documents reviewed is presented in the Section 16.0 *References*.



Approximate Project Location Map

Project: Magnolia Avenue Bridge and Roadway Widening
Location: El Camino Avenue to 1,000 feet East of All American Way
City of Corona, Riverside County, California
For: CNS Engineering, Inc.

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Figure No.
1

3.0 PROJECT DESCRIPTION

Project improvements will occur on Magnolia Avenue between El Camino Avenue to 1,000 feet east of All-American Way, which is close to the intersection of eastbound lane of Leeson Lane. Magnolia Avenue is accessible from the I-15 Freeway. The rectangular concrete lined Temescal Creek (Channel) at this location, crosses under Magnolia Avenue in a north-south direction.

3.1 Project Purpose

The purpose of the Project is to increase existing traffic capacity and improve pedestrian and non-motorized travel on Magnolia Avenue between El Camino Avenue to 1,000 feet east of All-American Way at Leeson Lane. The proposed improvements will accomplish the following in the Project area.

- Provide sidewalks, curbs, gutters, and ADA compliance.
- Provide an additional lane of travel in each direction, per the City's General Plan.
- Widen the bridge over the Channel to accommodate the additional travel lanes, sidewalks, curbs, and gutters.
- Provide for ultimate build-out of the roadway per the City's General Plan.

3.2 Project Need

Magnolia Avenue is an east-west divided Major Arterial in the City of Corona, accessible from Interstate 15 (I-15). It is identified as six lanes in the City's General Plan, but it was only striped/constructed to accommodate four lanes. The Project improvements will begin at El Camino Avenue, approximately 600 feet east of the I-15. Land uses along the Project alignment include light industrial to heavy industrial on both sides of the road. The heavy industrial uses include a quarry located south of the Project alignment, accessible on the south side of Magnolia Avenue from Sherborn Street and All-American Way.

Given its proximity to the I-15 and the mix of light and heavy industrial uses, this approximately 2,100 linear foot Project alignment experiences a high volume of heavy truck traffic. Build-out of the roadway to the design as envisioned by the City's General Plan would improve overall circulation in this section.

3.3 Existing Conditions

The existing condition of the structures (street/bridge/channel) within the project limits is discussed below.

Western Section of Alignment (El Camino Avenue to Temescal Creek Channel Bridge)
The paved travel way in this section is approximately 82 feet wide, which includes two lanes of travel in each direction, turn lanes, and a striped median to the Temescal Creek Channel Bridge. The right-of-way in this section is approximately 100 feet wide - approximately 40 feet to the north and approximately 60 feet to the south of centerline. Sidewalk, curb and gutter exist on the south side but not on the north side. City-owned streetlights are present on both sides of the street.

The BNSF railroad crossing exists approximately 80 feet east of the intersection with El Camino Avenue.

Sherborn Street intersects on the south side, approximately halfway between El Camino Avenue and the bridge approach.

All electrical and low-voltage (phone, cable) utilities are located underground throughout this section.

Temescal Creek Channel Bridge
The Temescal Creek Channel is an improved, 84-foot-wide by 15-foot-deep rectangular concrete channel. There is a storm drain outlet into the channel, which includes a grated drop inlet at the north side of Magnolia Avenue west of the Channel; a 30-inch storm drain line that ties into the Channel at the northeast, southeast and southwest corners of the bridge. The channel is owned and maintained by the Riverside County Flood Control and Water Conservation District (RCFC &WCD).

The existing bridge over the Channel is 67.5 feet wide providing a travelled way of 64 feet from barrier to barrier. The bridge deck is striped with two lanes in each direction and a painted median. At each approach, the bridge barrier is protected by a standard metal beam guardrail. There are no sidewalks on the bridge. The existing structure was built in 1986. It consists of two spans of cast-in-place reinforced concrete box girder, a pier wall along the centerline of the Channel, and two abutments. The bridge abutments were constructed outside the rectangular concrete channel. The bridge has a high Sufficiency Rating of 95.8 indicating the feasibility of the proposed structure widening with proper rehabilitation, as required.

The City of Corona's 30-inch water line (Cross-Town Transmission Feeder) is attached to the exterior edge of the south side of the bridge, and other utilities (Southern California Edison and cable and phone) are within conduits attached to the bridge exterior along the north side. An electrical/phone overhead line spans over the Channel on the south side of the bridge.

Eastern Section of Alignment (Temescal Creek Bridge to Eastbound Leeson Lane)

The paved travel way in this section is approximately 82 feet wide, which includes two lanes of travel in each direction with turn lanes. A narrow-raised concrete median is present in this section, from approximately 1475 Magnolia Avenue to the alignment terminus at the eastbound lane of Leeson Lane. The right-of-way in this section is approximately 110 feet wide - approximately 60 feet to the north and approximately 50 feet to the south of centerline.

Sidewalk, curb, and gutter exist on both the north and south sides, but not in front of the Corona Auto Parts Store, located at 1450 Magnolia Avenue, which is on the southeast corner of All-American Way and Magnolia Avenue intersection. City-owned streetlights are present on both sides of the street.

All American Way intersects immediately east and adjacent to the bridge on the south side. Other intersecting streets include Trademark Circle and Leeson Lane on the south side toward the end of the alignment.

Low voltage utilities (i.e., phone and cable) rise approximately 112 feet west of the bridge and are located on poles on the south side of the street, for approximately 679 feet to 1480 Magnolia Avenue. The utilities then transition to underground at this location and remain underground through the end of the Project alignment at the eastbound Leeson Lane.

The photographs below show the overall site condition within the project limit.

Photograph No. 1, Magnolia Avenue, east from El Camino Avenue, railroad crossing in view.

Photograph No. 2, Magnolia Avenue Bridge, facing southwest.

Photograph No. 3, Northwest side of the bridge.

Photograph No. 4, Magnolia Avenue, southwest of the bridge.

3.4 Proposed Improvements

The City of Corona is proposing to widen the Magnolia Avenue Bridge over Temescal Creek Channel and Magnolia Avenue from El Camino Avenue to 1,000 feet east of the All-American Way generally to increase the number of travel lanes per the City's General Plan, and construct sidewalks, curbs, and gutters. Improvements will include restriping for three 12-foot-wide lanes in each direction, a 12-foot-wide median, 5-foot-wide shoulders, and 6-foot-wide sidewalks/curbs and gutters at locations that currently lack sidewalk/curb/gutter. The total roadway width would be increased to approximately 100 feet, curb to curb, throughout the alignment, and right-of-way varies throughout the alignment.

The work will include the following.

- Roadway widening including drainage improvements.
- Modification to street signs, streetlights, and landscaping.
- Pavement rehabilitation where required.
- Modifying the existing roadway striping.
- Installing new curbs and gutters, and sidewalks in the missing sections.
- Re-striping and/or replacing the existing BNSF railroad crossing. The crossing arms and railroad signals may be preserved; however, it is to be further

determined based on the results of the field Railroad Diagnostic Meeting with CPUC and BNSF Railway.
- Widening and rehabilitating the concrete bridge over the Temescal Creek Channel.
- Relocating utilities that conflict with the planned improvements. and
- Providing ADA compliant access ramps at all intersections.

As a part of the bridge construction, the abutment at each end of the bridge would be extended, along with one pier within the Temescal Creek Channel.

3.5 Potential Right-of-Way Requirements and/or Special Considerations

The Project will generally be constructed within the City's rights-of-way (ROW). However, additional ROW or permissions may be required including the following:

- Magnolia Avenue north side, west of Temescal Creek Channel Bridge: Providing the desired roadway section with a sidewalk will result in the need to acquire additional right of way from the limits of BNSF Railroad to the Channel. The right of way acquisition will be limited to the back edge of the sidewalk. The preliminary impact of this right-of-way acquisition is along the frontage of the Clow Valve facility at 1375 Magnolia Avenue. Clow Valve facility fronting Magnolia Avenue is mostly used as a lay-down yard for their product and there is a segment of landscaped parkway fronting an office building.

- Magnolia Avenue, south side, east of Temescal Creek Channel Bridge: Providing the desired roadway section with a sidewalk will result in the need to acquire 6 feet of additional right of way from All American Way to the eastbound lane of Leeson Lane. The right of way acquisition will be limited to the back edge of the sidewalk. The primary impact of this right-of-way acquisition will include:

    - Corona Auto Parts Business, located at 1450 Magnolia Ave., on the southeast corner of All American Way and Magnolia Avenue intersection, immediately east of the Temescal Creek Channel Bridge: There is no sidewalk, and the existing parking lot connects to the edge of the traveled way pavement. There are no defined driveways on this parcel. Under the existing condition, there is just enough clearance between the edge of the roadway and the face of the building for cars to maneuver into parking stalls perpendicular to the front of the building. Constructing curb and gutter, sidewalk and additional travel lane consistent with the City's General Plan will place the curb and gutter approximately 35 feet from the building. Therefore, Project improvements will likely reduce the number of customer parking spaces at the business by six spaces. Design alternatives to the parking lot have been developed to minimize impacts.

- Existing landscaped buffer areas on the south side of Magnolia Avenue between 1460 Magnolia Avenue (adjacent to the Corona Auto Parts business) and 1560 Magnolia Avenue (at Leeson Lane): In this section, a sidewalk exists in the City's portion of the right-of-way. Within the private property immediately adjacent to the sidewalk exists landscaped buffer areas that separate the sidewalk from the customer parking for the businesses along this section. The landscaped buffer areas range from approximately 11 feet wide at 1480 Magnolia Avenue to approximately 27 feet wide at 1580 Magnolia Avenue. Trees and shrubs in these landscaped areas would be removed, but customer parking would not be impacted.

- Burlington-Northern Santa Fe (BNSF) Railroad: The intersection of El Camino Avenue and Magnolia Avenue is located east and adjacent to a BNSF grade crossing. The proposed roadway improvements may require upgrades to grade crossing equipment and operation, although major improvements are not expected. Close coordination with the California Public Utilities Commission (CPUC) and BNSF railroad will be required to obtain approvals and permits within the Project schedule. Conceptual plans will be drafted indicating proposed improvements and presented to all stakeholders during a railroad diagnostic meeting.

- Temescal Creek Channel: Bridge widening will require an additional 20 feet of right-of-way on both the north and south side of the bridge (for a total of approximately 40 feet) to be acquired from the Riverside County Flood Control and Water Conservation District (RCFC &WCD).

- Utility Relocation: Some streetlights (owned by the City) will need to be temporarily relocated during Project construction to facilitate sidewalk construction. Additionally, all streetlights within the Project limits will be converted to light-emitting diode (LED). The SCE conduits and lower voltage utilities that are attached to the bridge structure on the north side will be relocated to within new cells inside the bridge. The 30-inch water main from the City of Corona, attached to the existing bridge on the south side will also be reattached to the new southern edge of the widened bridge. All pole-mounted utilities located on the south side, between All American Way and 1480 Magnolia Avenue, will be relocated during construction only but remain above ground.

4.0 EXCEPTION TO POLICY

There is no exception that deviates from Caltrans policy related to the preparation of this report.

5.0 SCOPE OF WORK

To prepare this materials report, the following tasks were conducted.

- Discussed the project with the project team.
- Reviewed published maps and literature related to site soil, rock, groundwater and geologic conditions.
- Reviewed published geotechnical data and as-built information for existing structures in the project area.
- Prepared a boring locations map and submitted to CNS for review and approval.
- Conducted a site and alignment reconnaissance and marked the borings at locations approved by CNS.
- Obtained permit from the City of Corona.
- Prepared a traffic control plans.
- Notified Underground Service Alert (USA) at least 48 hours prior to drilling to clear the boring location of any conflict with existing underground utilities.
- Engaged a California-licensed driller to drill exploratory borings.

6.0 FIELD INVESTIGATION AND TESTING PROGRAM

Six exploratory borings (A-20-001 through A-20-005 and O-20-001) were drilled to investigate the subsurface conditions for the project. The borings (A-20-001 through A-20-005) were advanced using a standard CME 75 drill rig equipped with 8-inch diameter hollow-stem augers. The hammer energy transfer ratio of the drill rig is 86.2 percent (attached in appendix A-1). Due to the presence of cobbles and boulders, borings at the bottom of the bridge foundation could not be penetrated up to the maximum required depth of 90 feet bgs. Therefore, one additional boring (O-20-001) was drilled using Becker Hammer up to 90 feet bgs. The Becker hammer energy transfer ratio is 86.2 and 83 percent (attached in appendix A-1). A summary of boring information is presented in the following table.

Table No. 1, Summary of Borings

Boring No.	Associated Improvements	Location		Approx. Station	Approx. Ground Surface Elev. (feet, NAVD 88)	Boring Depth (ft, bgs)	Date Completed
		Latitude	Longitude				
A-20-001	Percolation	33.8683N	117.5382W	25+00	645.47	16.5	10/15/2020
A-20-002	Roadway	33.8686N	117.5377W	26+50	646.79	16.5	10/15/2020
*A-20-003	Bridge	33.8697N	117.5358W	33+75	646.84	20.5	10/6/2020
*A-20-004	Bridge	33.8696N	117.5352W	35+20	647.78	32.0	10/6/2020

Table No. 1: Summary of Borings (continued)

Boring No.	Associated Improvements	Location		Approx. Station	Approx. Ground Surface Elev. (feet, NAVD 88)	Boring Depth (ft, bgs)	Date Completed
		Latitude	Longitude				
A-20-005	Roadway	33.8711N	117.5334W	42+80	647.78	11.5	10/7/2020
**O-20-001	Bridge	33.8696N	117.5351W	35+20	644.78	90.0	11/4/2020

Notes:
Stations and ground surface elevations were based on the project plans provided by CNS.
*Borings were terminated due to presence of cobbles and possible boulders.
**Becker Hammer was used to drill.

The approximate boring locations are shown in Figure No. 2, *Approximate Boring and Percolation Test Locations Map*. Detailed description of the field exploration program, a summary table of boring information, and boring records are presented in Appendix A, *Field Exploration.*

The exploration locations and depths were selected by CNS is in consultation with Converse Consultants in accordance with the boring spacing and depth requirements provided in AASHTO LRFD, 2020 and other relevant documents.

7.0 LABORATORY TESTING PROGRAM

The following laboratory soil tests will be performed when a site-specific field investigation is completed after approval of bridge type selection during PS&E phase.

- *In-situ* moisture content and dry densities (ASTM D2216/D2937)
- Expansion Index (ASTM D4829)
- Sand equivalent (ASTM D2419)
- R-value (California Test 301)
- Soil corrosivity (California Tests 643, 422, and 417)
- Grain size distribution (ASTM D6913)
- Maximum dry density and optimum-moisture content (ASTM D1557)
- Direct shear (ASTM D3080)

8.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

The regional and local geology and subsurface conditions are discussed below.

Project: Magnolia Avenue Bridge and Roadway Widening
Location: El Camino Avenue to 1,000 feet East of All American Way
City of Corona, Riverside County, CA
For: CNS Engineering, Inc.

Approximate Boring and Percolation Test Locations Map

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Figure No.
2

8.1 Regional Geology

The project site is located in the northwestern portion of the Peninsular Ranges Geomorphic Province of Southern California. The Peninsular Ranges province is characterized by northwest tending valleys and mountain ranges which have formed in response to regional tectonic forces along the boundary between the Pacific and North American tectonic plates. The geologic structure is dominated by northwest trending right-lateral faults, most notable, the San Andreas Fault, San Jacinto Fault, Elsinore Fault, Whittier Fault, and the Newport-Inglewood Fault. The province extends southward from the Transverse Ranges province at the north end of the Los Angeles Basin to the southern tip of the Baja California Peninsula.

Basement rocks in the region are predominantly granitic and metamorphic rocks associated with the Mesozoic-age Southern California Batholith. Erosional remnants of granitic rocks are exposed in isolated hilly outcrops within the northern portions of the Chino Basin. Cenozoic-age sedimentary rocks overly the basement rocks in many areas and are well exposed in the Santa Ana Mountains and the Chino Hills southwest and west of the site.

8.2 Local Geology

The project site is underlain by Holocene and late Pleistocene artificial fill and alluvial deposits. These deposits primarily consist of fine to medium-grained sand with gravel and possible cobbles. (Morton et al, 2002). Descriptions of each unit are provided below.

- **Qaf: Artificial fill (late Holocene)—**Deposits of fill, may exist on the site, resulting from human construction or mining activities; includes numerous noncontiguous areas related to sand and gravel operations and flood control in and adjacent to Temescal Wash and to road grade and ramps along Corona Freeway segment of Interstate 15.
- **Qya: Young alluvial channel deposits (Holocene and late Pleistocene)—** Gray, unconsolidated alluvium. Found chiefly in Temescal Wash and its tributaries, where it consists of medium- to fine-grained sand in lower reaches and coarsens to gravel and cobbles up stream. Also found in Wardlaw Canyon and its tributaries, and in Ladd Canyon in southwestern part of quadrangle.
- **Qyf: Young alluvial fan deposits (Holocene and late Pleistocene)—**Gray-hued gravel and boulder deposits derived largely from volcanic and sedimentary units of Santa Ana Mountains. Fans consisting mainly of gravel emanate and coalesce from Tin Mine, Hagador, Main Street, and Eagle Canyons. Fan emanating from Bedford Canyon is coarser grained, containing a large component of boulders. All fans coarsen toward mountains. Locally, young alluvial fan deposits are divided into subunits based on sequential terrace development and other factors; one such unit is found in quadrangle.

The site and surrounding local geology are shown on Figure No. 3, *Geologic Map* on the following page.

8.3 Subsurface soil Conditions

According to the Log of Test Borings (LOTB) sheet (attached in Appendix C) included with the as-built plans (Caltrans, 1984), two borings (B-1 and B-2) were drilled in December 1983 and January 1984, near the bridge crossing areas during the field investigation by the Caltrans Bridge Department.

Boring No. B-1, which was located on the northwest side of the bridge, encountered dense to very dense sandy gravel with cobbles from the surface to approximately 20 feet bgs. Dense silty sand and sand was encountered from approximately 20 to 35 feet bgs. Very dense coarse gravel and sand was encountered from 35 feet bgs to the boring termination at approximately 40 feet bgs.

Boring No. B-2, which was located on the southeast side of the bridge, encountered dense sand and gravel with scattered cobbles from the ground surface to approximately 15 feet bgs. Very dense sandy gravel with abundant large cobbles and occasional boulders was encountered from approximately 15 feet bgs to 35 feet bgs. Very dense cobbles and boulders were encountered from approximately 35 feet bgs to 39 feet bgs. Very dense sand and coarse gravel was encountered from approximately 39 feet bgs to the boring termination at approximately 42 feet bgs.

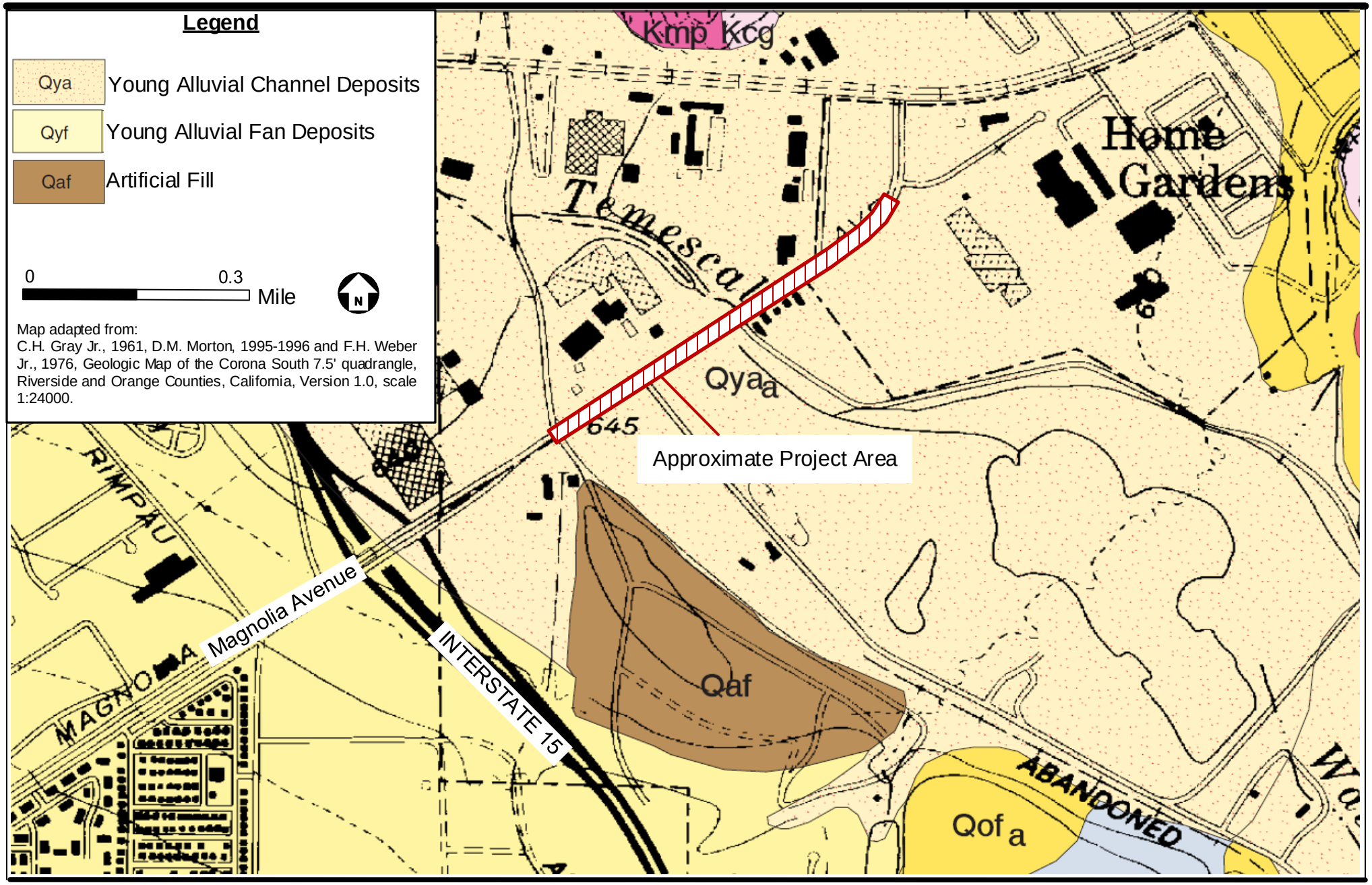
Based on the exploratory borings and laboratory test results (Converse, 2020), the alluvium soils consist primarily of sand, silt, gravel and cobbles. Scattered to some gravel up to 2.5 inches and scattered to few cobbles up to 5 inches in largest dimension were encountered to the maximum explored depth of 90 feet bgs. Possible boulders may present at depth greater than 20 to 31 feet bgs. Two sandy clay layers were encountered at depths between 36.5 and 45.0 feet, and 70.0 and 75.0 feet bgs in boring O-20-001.

For a detailed description of the subsurface materials encountered in the exploratory borings see, *Boring Records*, in Appendix A, Field Exploration.

8.4 Groundwater

At the time of field investigation (1983 and 1984), groundwater was encountered at approximately 12 feet bgs, corresponding to an elevation of 632 feet (NGVD, 29).

During this field investigation (2020), groundwater was encountered only in the boring (O-20-001) at depth of approximately 50.0 feet bgs, corresponding to elevation of 596.8 feet (NGVD, 29).



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Geologic Map

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FIGURE
3

The GeoTracker database (SWRCB, 2020) was reviewed for groundwater data from sites within close proximity of the project. Two sites were identified within a 1.0-mile radius of the project site that contained groundwater elevation data.

- SHELL MAGNOLIA CORONA (T0606500247), located approximately 3,500 feet southwest of the project site, reported groundwater at depths ranging between 100 and 118 feet bgs between 2005 and 2009.
- SMOG CHECK OF CORONA (T0606500118), located approximately 5,200 feet northeast of the project site, reported groundwater at a depth of 37 feet bgs in 2005.

Data was not found on the National Water Information System (USGS, 2020).

Based on available data, the historical high groundwater level near the site is estimated to be approximately 12 feet. Groundwater is not expected to be encountered during construction of the roadway. It should be noted that the groundwater level could vary depending upon the seasonal precipitation and possible groundwater pumping activity in the site vicinity. Shallow perched groundwater may be present locally, particularly following precipitation or irrigation events.

9.0 CORROSION EVALUATION

Typically, fine-grained soils (silts and clays) increase site corrosive conditions, whereas coarse-grained soils (sand) tend to be non-corrosive. According to the Caltrans Corrosion Guidelines (Caltrans, 2018), soils are considered corrosive if the pH is 5.5 or less, or chloride content is 500 parts per million (ppm) or greater, or sulfate content is 1,500 ppm or greater. A minimum resistivity value less than 1,100 ohm-cm indicates the presence of high quantities of soluble salts and a higher propensity for corrosion.

Corrosion test results, presented in Table B-4 in *Appendix B*, indicate the soils are non-corrosive based on Caltrans Corrosion Guidelines. Converse does not practice in the area of corrosion consulting. If needed, a qualified corrosion consultant should provide appropriate corrosion mitigation measures for any ferrous metals in contact with the site soils.

10.0 MATERIAL SOURCES

Converse has not evaluated any site for use as import borrow. The contractor must make his own arrangements for obtaining materials and is responsible for the grading and quality requirements.

Embankment fill will be required for the widening of the approaches to the bridges and interchanges. Quantities of fill are not known at this time. It is assumed that import

material sources will be listed on the current *AB 3098 List* at the time of construction and all materials will be approved prior to importing to the site. On-site soils are expected to be adequate for use as compacted fill.

Commercial suppliers for sand, gravel, aggregate base, and concrete near the project area should be identified during the PS&E phase of the project. Existing pavement (asphalt concrete and Portland cement concrete) can be pulverized and used as aggregate base (AB). Pulverized material should be processed and must meet the requirements specified in Caltrans Standard Specifications (Caltrans, 2018). Caltrans must approve the use of pulverized material for AB. On-site soils can be a source material. However, laboratory testing will be required to conform their suitability as construction materials. Other sites as potential sources of fill or other materials were not assessed in this report.

11.0 MATERIAL DISPOSAL

Debris, topsoil, vegetation, etc., will be present at the site. These materials are unsuitable for use in construction and should be properly disposed of at an approved location or stockpiled and reused for landscaping purposes as suitable within the project. Disposal of spoils from excavated soils is expected during construction. It is the responsibility of the contractor to make arrangements to dispose of such materials and follow guidelines provided in Section 7-1.13 of the Caltrans Standard Specifications.

12.0 PAVEMENT RECOMMENDATIONS

The following design recommendations have been provided based on a site-specific geotechnical investigation.

12.1 Existing Pavement Sections

Based on our review of as-built roadway plans RCE No. 56155 dated March 20, 2015, provided to us by CNS, the existing pavement sections for Magnolia Avenue are presented in the following table.

Table No. 2, Existing Pavement Sections

Magnolia Avenue	Pavement Sections
Temescal Wash (Channel) to 1,000 ft east	6” AC, 10” AB
*El Camino Ave. to Temescal Wash (Channel)	6” AC, 10” AB

Note:
AC = Asphalt Concrete; AB = Aggregate Base.
* As-built plans are not available at this time. Based on the street improvement plan for Magnolia Avenue and Sherborn Street dated September 18, 2003, pavement sections (AC/AB) should be based on soil recommendation. The City minimum pavement section for TI 11 is 6”AC/10” AB.

12.2 Pavement Design Parameters

Pavement design parameters are discussed below.

12.2.1 Traffic Indices and Design Life

The traffic index (TI) provides information necessary to design a structural section for a roadway. The TI is a measure of the number of ESALs expected in the traffic lane over the pavement design life. Pavement design life, also referred to as performance period, is the period of time that a newly constructed or rehabilitated pavement is engineered to perform before reaching the performance thresholds.

According to the City of Corona General Plan, Magnolia Avenue is a major arterial street. Based on the City of Corona Standard Plan No. 100, *Street Design Table*, the TI for Magnolia Avenue is 11. Typically, design life for this type of street is 20 years.

12.2.2 Subgrade R-Value

The Resistance Value (R-value) test is a relative measure of soil strength. The test expresses a material's resistance to deformation as a function of the ratio of transmitted lateral pressure to applied vertical pressure. Based on laboratory test results, R-value for this project is 79 to 80.

12.3 Pavement Structural Sections

For flexible pavement design, we have utilized an R-value of 50 and design Traffic Index (TI) of 11.

Hot mix asphalt (HMA) and aggregate base (AB) thicknesses were determined by using the Caltrans web-based tool CalFP-Web. Output files of CalFP-Web are attached in Appendix D, *CalFP-Web Output Files*. Important design parameters used in CalFP-Web software includes the following.

i) HMA binder grade = PG64-XX and up to 15% RAP
ii) Aggregate Base = Class II
iii) Subgrade = Type II (ML)

Flexible pavement sections are presented in the Table No. 3, *Flexible Pavement Sections*.

Table No. 3, Flexible Pavement Sections

	Design Life 20 Years		
R-value 50	Location	Traffic Index (TI)	Pavement Section
	Magnolia Ave.	11	6" AC 10" AB

Note:
AC = Asphalt Concrete (HMA Type A)
AB = Aggregate Base; CL II = Class 2
Full depth AC pavement should be at least 16".
Curb and gutter should be 8" and constructed as per City Std. Plan No. 136.
Sidewalk should be 6 feet and constructed as per City Std. Plan No. 142.

At or near the completion of grading, the subgrade should be tested to evaluate the actual subgrade R-value for final pavement design.

Prior to placement of aggregate base, at least the upper 2.5 feet below the finished grade for the width of the traveled way plus 3 feet on each side should be scarified, moisture conditioned, if necessary, and compacted to at least 95 percent of the laboratory maximum dry density.

Pavement materials should confirm to requirements described in Section 14.0, *Recommended Materials Specifications* of this report.

Positive drainage should be provided away from all pavement areas to prevent seepage of surface and/or subsurface water into the pavement base and/or subgrade. The pavement structures and sidewalks should be provided with adequate surface and subsurface drainage.

13.0 GENERAL EARTHWORK REQUIREMENTS

Earthwork should conform to requirements of the Caltrans Standard Specifications (CSS, 2018), Section 19, *Earthwork*. Soil compaction should be accomplished in accordance with Section 19-5, *Compaction* of the Standard Specification. Fill placed during widening of the embankments should be benched into the existing slopes as described in Section 19-6, *Embankment Construction* of the Standard Specifications. Actual depths and extents of toe-of-fill keyways will be determined during site specific geotechnical investigations. All earthwork should be observed by a qualified geotechnical engineer.

In areas where compacted fill will be placed, all debris, deleterious material, and surficial soils including compressible existing topsoil, loose or soft alluvium or fill soil, dry and saturated soil, and otherwise any unsuitable materials should be removed prior to

fill placement. Deleterious material, including organics, concrete, and debris generated during excavation, should not be placed as fill.

14.0 RECOMMENDED MATERIALS SPECIFICATIONS

Pavement materials specifications are presented below.

14.1 Hot Mix Asphalt

Hot mix asphalt (HMA) must conform to requirements of Section 39, *Asphalt Concrete* of the CSS, 2018. Type A HMA should be utilized. Aggregate may include up to 15 percent material processed from reclaimed asphalt concrete, Portland cement concrete, lean concrete base, cement treated base, or a combination of any of these materials. Asphalt binder to be mixed with aggregate shall be steam-refined paving asphalt in conformance with the provisions in Section 92, *Asphalt Binders* of the CSS, 2015. Performance Graded (PG) type asphalt should be used. The grade of asphalt should be determined in accordance Caltrans asphalt binder grade selection policy. The recommended asphalt binder is PG64-28M. Performance Based Asphalt (PBA) binder can also be considered where required for design consideration.

The maximum HMA lift thickness shall conform to Section 39, *Asphalt Concrete* of the CSS, 2018.

14.2 Concrete Pavement

Concrete pavement materials and construction shall conform to Section 40, *Concrete Pavement* of the CSS, 2018.

14.3 Aggregate Base

Class 2 aggregate base should be utilized for aggregate base and shall conform to Section 26, *Aggregate Bases* of the CSS 2018. Class 2 aggregate base shall be free from organic matter and other deleterious substances and shall be of such nature that it can be compacted readily under watering and rolling to form a firm stable base. Aggregate may include material processed from reclaimed asphalt concrete, Portland cement concrete, lean concrete base, cement treated base, or a combination of any of these materials. The amount of reclaimed material shall not exceed 50 percent of the total volume of the aggregate used. The design engineer can select an alternative to save costs on the project, with an undefined potential for reduced design life. Aggregate shall also conform to the grading and quality requirements per Section 26, *Aggregate Bases* of the CSS, 2018.

14.4 Local and Import Borrow

Any on-site excavated soil is considered suitable for use as local borrow. It is anticipated construction of the additional lanes and ramps will require imported borrow. Borrow material shall conform to Section 19-7, *Borrow Material* of the CSS, 2018.

14.5 Shoulder Backing

Shoulder backing must be clean and consist of one or any combination of broken stone, crushed gravel, natural rough surfaced gravel, sand, RAP, concrete, lean concrete base, cement treated base. Shoulder backing materials and construction should conform to section 19-9, *Shoulder Backing* in the CSS, 2018.

14.6 Penetration Treatment

Penetration treatment shall consist of liquid asphalt to be applied to the shoulder backing and unimproved driveways. Liquid asphalt shall conform to the provisions in Section 93, *Liquid Asphalts* of the CSS, 2018.

14.7 Asphaltic Emulsion

Asphaltic emulsion should conform to Section 94, *Asphaltic Emulsion* of the CSS, 2018. Asphaltic emulsions must be composed of a bituminous material uniformly emulsified with water and an emulsifying or a stabilizing agent. Polymer modified asphaltic emulsion must contain a polymer. Asphaltic emulsion must be homogeneous. Within 30 days after delivery and if freezing has not caused separation, the asphaltic emulsion must be homogeneous after thorough mixing. Asphaltic emulsion must be anionic, cationic, polymer modified, or quick setting.

14.8 Reinforced Concrete Pipe

Reinforced concrete pipe shall conform to the provisions in Section 65-2, *Reinforced Concrete Pipe* of the CSS, 2018. The concrete for reinforced concrete pipe must contain at least 470 pounds of cementitious material per cubic yard and have a water to cementitious material ratio that does not exceed 0.40 by weight. Reinforcement must have a minimum cover of 1 inch, except pipes with a nominal diameter of 18 inches or less must have a minimum cover of 3/4 inch.

14.9 Corrugated Metal Pipe

Corrugated metal pipe shall conform to Section 66, *Corrugated Metal Pipe*, in the CSS, 2018. Corrugated metal pipe must be corrugated aluminum pipe or corrugated steel pipe. Do not mix aluminum and steel materials in any installation, except coupling band

fastening hardware. Ship, handle, and lay corrugated metal materials in a way that prevents bruising, scaling, or breaking of the galvanized surface, aluminized surface, or protective coating. If concrete collars or tee connections are required, construct the collars or tee connections with minor concrete.

15.0 CLOSURE

This report is prepared for the project described herein and is intended for use solely by CNS Engineering, Inc. and their authorized agents, to assist in the design and construction of the proposed project. Recommendations contained in this report are based on our field observations, field investigation, documents review, laboratory and engineering analysis. It is possible that soil conditions could vary. Our findings and recommendations were obtained in accordance with generally accepted professional principles practiced in geotechnical engineering. We make no other warranty, either expressed or implied.

Converse Consultants is not responsible or liable for any claims or damages associated with interpretation of available information provided to others. Site exploration identifies actual soil conditions only at those points where samples are taken, when they are taken. Data derived through sampling and laboratory testing is extrapolated by Converse employees who render an opinion about the overall soil conditions. Actual conditions in areas not sampled may differ. In the event that changes to the project occur, or additional, relevant information about the project is brought to our attention, the recommendations contained in this report may not be valid unless these changes and additional relevant information are reviewed, and the recommendations of this report are modified or verified in writing. In addition, the recommendations can only be finalized by observing actual subsurface conditions revealed during construction. Converse cannot be held responsible for misinterpretation or changes to our recommendations made by others during construction.

As the project evolves, continued consultation and construction monitoring by a qualified geotechnical consultant should be considered an extension of geotechnical investigation services performed to date. The geotechnical consultant should review plans and specifications to verify that the recommendations presented herein have been appropriately interpreted, and that the design assumptions used in this report are valid. Where significant design changes occur, Converse may be required to augment or modify the recommendations presented herein. Subsurface conditions may differ in some locations from those encountered in the explorations, and may require additional analyses and, possibly, modified recommendations.

16.0 REFERENCES

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Appendix A

Field Exploration

APPENDIX A

FIELD EXPLORATION

Our field investigation included site reconnaissance and a subsurface exploration program consisting of drilling soil borings. During the site reconnaissance, the surface conditions were noted, and the borings were marked at locations approved by CNS. The boring locations should be considered accurate only to the degree implied by the method used to mark them in the field.

Six exploratory borings (A-20-001 through A-20-005 and O-20-001) were drilled to investigate the subsurface conditions for the project. The borings (A-20-001 through A-20-005) were advanced using a standard CME 75 drill rig equipped with 8-inch diameter hollow-stem augers. The hammer energy transfer ratio of the drill rig is 86.2 percent (attached in appendix A-1). Due to the presence of cobbles and boulders, borings at the bottom of the bridge foundation could not be penetrated up to the maximum required depth of 90 feet bgs. Therefore, one additional boring (O-20-001) was drilled using Becker Hammer up to 90 feet bgs. The Becker hammer energy transfer ratio is 86.2 and 83 percent (attached in appendix A-1). A summary of boring information is presented in the following table.

Table No. A-1, Summary of Borings

Boring No.	Associated Improvements	Location		Approx. Station	Approx. Ground Surface Elev. (feet, NAVD 88)	Boring Depth (ft, bgs)	Date Completed
		Latitude	Longitude				
A-20-001	Percolation	33.8683N	117.5382W	25+00	645.47	16.5	10/15/2020
A-20-002	Roadway	33.8686N	117.5377W	26+50	646.79	16.5	10/15/2020
*A-20-003	Bridge	33.8697N	117.5358W	33+75	646.84	20.5	10/6/2020
*A-20-004	Bridge	33.8696N	117.5352W	35+20	647.78	32.0	10/6/2020
A-20-005	Roadway	33.8711N	117.5334W	42+80	647.78	11.5	10/7/2020
**O-20-001	Bridge	33.8696N	117.5351W	35+20	644.78	90.0	11/4/2020

Notes:
Stations and ground surface elevations were based on the project plans provided by CNS.
*Borings were terminated due to presence of cobbles and possible boulders.
**Becker Hammer was used to drill.

Encountered earth materials were continuously logged and visually classified in the field using Unified Soil Classification System by a Converse staff engineer. Where appropriate, field descriptions and classifications have been modified to reflect laboratory test results.

Relatively undisturbed samples were obtained using California Modified Samplers (2.4 inches inside diameter and 3 inches outside diameter) lined with thin sample rings. The steel ring sampler was driven into the bottom of the borehole with successive drops of a 140-pound driving weight falling 30 inches. Blow counts at each sample interval are presented on the boring logs. Samples were retained in brass rings (2.4-inches inside diameter and 1 inch in height) and carefully sealed in waterproof plastic containers for shipment to the Converse laboratory. Bulk samples of representative soil types were also collected.

Standard Penetration Testing (SPT) was also performed in borings A-20-002, A-20-003 and A-20-004 in accordance with the ASTM Standard D1586 test method using a standard (1.4 inches inside diameter and 2.0 inches outside diameter) split-barrel sampler. The mechanically driven hammer for the SPT sampler was 140 pounds, falling 30 inches for each blow. The recorded blow counts for every 6 inches for a total of 1.5 feet of sampler penetration are shown on the Boring Records.

The Becker Hammer Drill is capable to penetrate through cobbles and boulders. The discharged material is accumulated in suitable containers as it emerges from the cyclone, and drive samples are taken at specified intervals for analysis of the materials drilled.

The exact depths at which material changes occur cannot always be established accurately. Unless a more precise depth can be established by other means, changes in material conditions that occur between driven samples are indicated in the log at the top of the next drive sample.

Following the completion of logging and sampling, the borings (A-20-002 through A-20-005) performed with drill rig were backfilled with soil cuttings, compacted by pushing down with augers using drill rig weight, and, where applicable, the surface was patched with cold asphalt concrete. The boring (O-20-001) performed with Becker Hammer was backfilled with mix of soil cuttings and cement and compacted by pushing down with augers using drill rig weight. After completion of percolation test in boring (A-20-001), the pipe was cut below the asphalt surface, backfilled with soil cuttings, compacted by pushing down with augers using drill rig weight and surface patched with cold asphalt concrete.

If construction is delayed, the surface may settle over time. We recommend the contractor of record monitor the boring locations and backfill any depressions that might occur or provide protection around the area of the boring locations to prevent trip and fall injuries from occurring near the area of any potential settlement.

For a key to soil symbols and terminology used in the boring records, refer to, *Key to Boring Records.* Logs of the exploratory borings are presented in, *Boring Records*.

GROUP SYMBOLS AND NAMES

Graphic / Symbol	Group Name
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND and SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic / Symbol	Group Name
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTS

C	Consolidation (ASTM D 2435-04)
CL	Collapse Potential (ASTM D 5333-03)
CP	Compaction Curve (ASTM D 1557)
CR	Corrosion, Sulfates, Chlorides (CTM 643-99; CTM 417-06; CTM 422-06)
CU	Consolidated Undrained Triaxial (ASTM D 4767-02)
DS	Direct Shear (ASTM D 3080-04)
EI	Expansion Index (ASTM D 4829-03)
M	Moisture Content (ASTM D 2216-05)
OC	Organic Content (ASTM D 2974-07)
P	Permeablility (CTM 220-05)
PA	Particle Size Analysis (ASTM D422-63 [2002])
PI	Liquid Limit, Plastic Limit, Plasticity Index (AASHTO T 89-02, AASHTO T 90-00)
PL	Point Load Index (ASTM D 5731-05)
PM	Pressure Meter
PP	Pocket Penetrometer
R	R-Value (CTM 301-00)
SE	Sand Equivalent (CTM 217-99)
SG	Specific Gravity (AASHTO T 100-06)
SL	Shrinkage Limit (ASTM D 427-04)
SW	Swell Potential (ASTM D 4546-03)
TV	Pocket Torvane
UC	Unconfined Compression - Soil (ASTM D 2166-06) Unconfined Compression - Rock (ASTM D 2938-95)
UU	Unconsolidated Undrained Triaxial (ASTM D 2850-03)
UW	Unit Weight (ASTM D 4767-04)
VS	Vane Shear (AASHTO T 223-96 [2004])

SAMPLER GRAPHIC SYMBOLS

- Standard Penetration Test (SPT)
- Standard California Sampler
- Modified California Sampler
- Shelby Tube
- Piston Sampler
- NX Rock Core
- HQ Rock Core
- Bulk Sample
- Other (see remarks)

DRILLING METHOD SYMBOLS

- Auger Drilling
- Mud Rotary Drilling
- Dynamic Cone or Hand Driven
- Diamond Core

WATER LEVEL SYMBOLS

- First Water Level Reading (during drilling)
- Static Water Level Reading (short-term)
- Static Water Level Reading (long-term)

Converse Consultants
Geotechnical Engineering & Consulting
Environmental & Groundwater Science
Material Testing & Inspection Services

REPORT TITLE **BORING RECORD**				HOLE ID **Key**
DIST **8**	COUNTY **Riverside**	ROUTE	POSTMILE **40.9**	EA
PROJECT OR BRIDGE NAME **Magnolia Avenue Bridge and Roadway Widening**				
BRIDGE NUMBER **BR NO.56C-0199**	PREPARED BY **Mahmoud Suliman**	DATE **12/14/2020**	SHEET **1 of 2**	

CONSISTENCY OF COHESIVE SOILS

Descriptor	Unconfined Compressive Strength (tsf)	Pocket Penetrometer (tsf)	Torvane (tsf)	Field Approximation
Very Soft	<0.25	<0.25	<0.12	Easily penetrated several inches by fist
Soft	0.25 - 0.50	0.25 - 0.50	0.12 - 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 - 1.0	0.50 - 1.0	0.25 - 0.50	Can be penetrated several inches by thumb with moderate effort
Stiff	1.0 - 2.0	1.0 - 2.0	0.50 - 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2.0 - 4.0	2.0 - 4.0	1.0 - 2.0	Readily indented by thumbnail
Hard	>4.0	>4.0	>2.0	Indented by thumbnail with difficulty

APPARENT DENSITY OF COHESIONLESS SOILS

Descriptor	SPT N_{60} - Value (blows / foot)
Very Loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	>50

MOISTURE

Descriptor	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OF PROPORTION OF SOILS

Descriptor	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

SOIL PARTICLE SIZE

Descriptor		Size
Boulder		> 12 inches
Cobble		3 to 12 inches
Gravel	Coarse	3/4 inch to 3 inches
	Fine	No. 4 Sieve to 3/4 inch
Sand	Coarse	No. 10 Sieve to No. 4 Sieve
	Medium	No. 40 Sieve to No. 10 Sieve
	Fine	No. 200 Sieve to No. No. 40 Sieve
Silt and Clay		Passing No. 200 Sieve

PLASTICITY OF FINE-GRAINED SOILS

Descriptor	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled, and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll, and not much time is required to reach the plastic limit; it cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

CEMENTATION

Descriptor	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

NOTE: This legend sheet provides descriptions and associated criteria for required soil description components only. Refer to Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010), Section 2, for tables of additional soil description components and discussion of soil description and identification.

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long)	HOLE ID
Mahmoud Suliman	**10/15/2020**	**10/15/2020**	**33.86832° N, 117.53815° W**	**A-20-001**
DRILLING CONTRACTOR			BOREHOLE LOCATION (Station, Offset, Line)	SURFACE ELEVATION
2 R drilling			**25+00**	**644.8 ft**
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow Stem Auger			**CME 75**	**8" in**
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modcal (2.4")			**Automatic, Weight = 140 lbs/ Drop = 30"**	**86.2 %**
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READING DURING DRILLING AFTER DRILLING	TOTAL DEPTH OF BORING
Soil Cuttings			**Not Encountered**	**16.5 ft**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Type	Sample ID	Blows per 6 in.	Blows per foot	Recovery %	RQD %	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks (Other Tests)
644	0		10" ASPHALT CONCRETE/ NO BASE 0.8 El. 644.0'												
	1		ALLUVIUM: Well-graded SAND with SILT and GRAVEL (SP-SM): , yellowish brown to brown, fine to coarse-grained, little gravel up to 2.5" and few cobbles up to 4.5" in largest dimension.												
642	3				B1 D2	11 20 27	57	100		3	124.0				PA
	4														
640	5				D3	11 22 34	56	NR							
638	7														
	8				D4	14 19 32	51	100		2	117.7				
636	9														
	10				D5	12 19 30	49	100		1	101.7				
634	11														
	12				B6										
632	13														
	14														
630	15		15.0 El. 629.8'												
	16		SILTY SAND (SM): , brown, fine to coarse-grained. 16.5 El. 628.3'		D7	4 5 8	13	100		4	116.8				
628	17		Bottom of Borehole at 16.5 feet bgs. End of boring at 16.5 feet bgs. No groundwater encountered. Borehole prepared for percolation test on 10/15/2020. After completion the test, pipe was cut below the asphalt surface, Borehole backfilled with soil cuttings, compacted by pushing down with augers using drill rig weight and surface patched with cold asphalt concrete on 10/15/2020.												
	18														
626	19														
	20														
624	21														
	22														
622	23														
	24														
620	25														
	26														
618	27														
	28														
616	29														
	30														

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Geotechnical Engineering & Consulting
Environmental & Groundwater Science
Material Testing & Inspection Services

REPORT TITLE				HOLE ID
BORING RECORD (PERCOLATION_)				**A-20-001**
DIST	COUNTY	ROUTE	POSTMILE	EA
8	**Riverside**		**40.9**	
PROJECT OR BRIDGE NAME				
Magnolia Avenue Bridge and Roadway Widening				
BRIDGE NUMBER	PREPARED BY	DATE	SHEET	
BR NO.56C-0199	**Mahmoud Suliman**	**12/14/2020**	**1 of 1**	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long)	HOLE ID
Mahmoud Suliman	**10/15/2020**	**10/15/2020**	**33.86859° N, 117.53767° W**	**A-20-002**
DRILLING CONTRACTOR			BOREHOLE LOCATION (Station, Offset, Line)	SURFACE ELEVATION
2 R drilling			**26+50**	**645.5 ft**
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow Stem Auger			**CME 75**	**8" in**
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modcal (2.4")			**Automatic, Weight = 140 lbs/ Drop = 30"**	**86.2 %**
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READING DURING DRILLING AFTER DRILLING	TOTAL DEPTH OF BORING
Soil Cuttings			**Not Encountered**	**16.5 ft**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Type	Sample ID	Blows per 6 in.	Blows per foot	Recovery %	RQD %	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks (Other Tests)
	0		0.7 7.5" ASPHALT CONCRETE/ NO BASE El. 644.8'												
644	1		ALLUVIUM: Poorly-graded SAND WITH SILT and GRAVEL (SP-SM): brown, fine to coarse-grained, some gravel up to 2" in largest dimension.												
	2														
642	3				B1										R
	4				D2	11 13 13	26	100		2	109.3				
	5														
640	6				D3	11 14 16	30	100		3	98.2				
	7														
638	8				B4 D5	10 17 21	38	100		2	109.9				
	9														
636	10														
	11				D6	11 15 15	30	100		1	106.2				
634	12														
	13														
632	14														
	15		15.0 El. 630.5'												
630	16		SILTY SAND (SM): brown, fine to coarse-grained, trace clay. 16.5 El. 629.0'		D7	4 5 8	13	100		18	104.8				
628	17		Bottom of Borehole at 16.5 feet bgs. End of boring at 16.5 feet bgs. No groundwater encountered. Borehole backfilled with soil cuttings, compacted by pushing down with augers using drill rig weight and surface patched with cold asphalt concrete on 10/15/2020.												
	18														
626	19														
	20														
624	21														
	22														
622	23														
	24														
620	25														
	26														
618	27														
	28														
616	29														
	30														

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REPORT TITLE				HOLE ID
BORING RECORD (ROADWAY)				**A-20-002**
DIST	COUNTY	ROUTE	POSTMILE	EA
8	**Riverside**		**40.9**	
PROJECT OR BRIDGE NAME				
Magnolia Avenue Bridge and Roadway Widening				
BRIDGE NUMBER	PREPARED BY	DATE	SHEET	
BR NO.56C-0199	**Mahmoud Suliman**	**12/14/2020**	**1 of 1**	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long)	HOLE ID
Mahmoud Suliman	**10/6/2020**	**10/6/2020**	**33.86973° N, 117.53582° W**	**A-20-003**
DRILLING CONTRACTOR			BOREHOLE LOCATION (Station, Offset, Line)	SURFACE ELEVATION
2 R drilling			**33+75**	**646.8 ft**
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow Stem Auger			**CME 75**	**8" in**
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
SPT (1.4"), Modcal (2.4")			**Automatic, Weight = 140 lbs/ Drop = 30"**	**86.2 %**
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READING DURING DRILLING AFTER DRILLING	TOTAL DEPTH OF BORING
Soil Cuttings			**Not Encountered**	**20.5 ft**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Type	Sample ID	Blows per 6 in.	Blows per foot	Recovery %	RQD %	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks (Other Tests)
646	0		ALLUVIUM												
	1		SILTY SAND with Gravel (SM): brown, fine to coarse-grained, little gravel up to 1" in largest dimension.												
	2				B1										
644	3				D2	40 40 42	82	100		5	121.3				PA
	4														
642	5		5.0 El. 641.8'												
	6		Poorly-graded SAND with SILT and GRAVEL (SP-SM): yellowish brown to brown, fine to coarse-grained, some gravel up to 1.5" in largest dimension.		D3	15 19 15	34	100		2	108.5				
640	7														
	8				B4 D5	8.18 22	40	100		1	112.0				CP SE
638	9														
	10														
636	11				D6	8 11 20	31	100		1	105.7				
	12														
634	13														
	14														
632	15		15.0 El. 631.8'												
	16		Poorly-graded GRAVEL with SAND and SILT (GP-GM): yellowish brown to brown, fine to coarse-grained sand, some gravel up to 2" and scattered cobbles up to 4" in the largest dimension.		D7	20 50-6"	70+	NR							
630	17														
	18														
628	19														
	20		20.5 El. 626.3'		S8	50-4"	100+	NR							
626	21		Bottom of Borehole at 20.5 feet bgs. Boring terminated at 20.5 feet bgs due to refusal on cobbles and possible boulders. No groundwater encountered. Borehole backfilled with soil cuttings, compacted by pushing down with augers using drill rig weight on 10/6/2020												
	22														
624	23														
	24														
622	25														
	26														
620	27														
	28														
618	29														
	30														

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REPORT TITLE				HOLE ID
BORING RECORD (BRIDGE)				**A-20-003**
DIST	COUNTY	ROUTE	POSTMILE	EA
8	**Riverside**		**40.9**	
PROJECT OR BRIDGE NAME				
Magnolia Avenue Bridge and Roadway Widening				
BRIDGE NUMBER	PREPARED BY	DATE	SHEET	
BR NO.56C-0199	**Mahmoud Suliman**	**12/14/2020**	**1 of 1**	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long)	HOLE ID
Mahmoud Suliman	**10/6/2020**	**10/6/2020**	**33.86957° N, 117.53516° W**	**A-20-004**
DRILLING CONTRACTOR			BOREHOLE LOCATION (Station, Offset, Line)	SURFACE ELEVATION
2 R drilling			**35+20**	**646.8 ft**
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow Stem Auger			**CME 75**	**8" in**
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
SPT (1.4"), Modcal (2.4")			**Automatic, Weight = 140 lbs/ Drop = 30"**	**86.2 %**
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READING DURING DRILLING AFTER DRILLING	TOTAL DEPTH OF BORING
Soil Cuttings			**Not Encountered**	**31.5 ft**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Type	Sample ID	Blows per 6 in.	Blows per foot	Recovery %	RQD %	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks (Other Tests)
646	0		ALLUVIUM												
	1		Silty SAND with GRAVEL (SM): brown, fine to coarse-grained, little gravel up to 1.5" in largest dimension.												
	2				B1										SE
644	3				D2	33 44 37	81	100		4	107.7				
	4														
642	5		5.0 El. 641.8'												
	6		Poorly-graded SAND with SILT and GRAVEL (SP-SM): brown, fine to coarse-grained, some gravel up to 3" and scattered cobbles up to 4.5" in largest dimension.		D3	17 24 34	58	100		3	112				
640	7														
	8				D4	50-5"	100+	NR							
638	9														
	10				D5	50-1"	100+	NR							
636	11														
	12														
634	13														
	14														
632	15				D6	13 50-4"	63+	70		2	95.5				
	16														
630	17														
	18														
628	19														
	20														
626	21				S7	17 16 30	43	100							
	22														
624	23														
	24														
622	25		25.0 El. 621.8'		D8	50-0"	100+	NR							
	26		Poorly-graded GRAVEL with SAND and SILT (GP-GM): grayish brown, fine to coarse-grained, some gravel up to 3" and scattered cobbles up to 5" in largest dimension.												
620	27														
	28														
618	29														
	30														

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REPORT TITLE				HOLE ID
BORING RECORD (BRIDGE)				**A-20-004**
DIST	COUNTY	ROUTE	POSTMILE	EA
8	**Riverside**		**40.9**	
PROJECT OR BRIDGE NAME				
Magnolia Avenue Bridge and Roadway Widening				
BRIDGE NUMBER	PREPARED BY	DATE	SHEET	
BR NO.56C-0199	**Mahmoud Suliman**	**12/14/2020**	**1 of 2**	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long)	HOLE ID
Mahmoud Suliman	**10/6/2020**	**10/6/2020**	**33.86957° N, 117.53516° W**	**A-20-004**
DRILLING CONTRACTOR			BOREHOLE LOCATION (Station, Offset, Line)	SURFACE ELEVATION
2 R drilling			**35+20**	**646.8 ft**
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow Stem Auger			**CME 75**	**8" in**
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
SPT (1.4"), Modcal (2.4")			**Automatic, Weight = 140 lbs/ Drop = 30"**	**86.2 %**
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READING DURING DRILLING AFTER DRILLING	TOTAL DEPTH OF BORING
Soil Cuttings			**Not Encountered**	**31.5 ft**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Type	Sample ID	Blows per 6 in.	Blows per foot	Recovery %	RQD %	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks (Other Tests)
616	30		ALLUVIUM												
	31		Poorly-graded GRAVEL with SAND and SILT (GP-GM): grayish brown, fine to coarse-grained, some gravel up to 3" and scattered cobbles up to 5" in largest dimension.	X	S9	7 12 21	33	100							
	31.5		El. 615.3'												
614	32		Bottom of Borehole at 31.5 feet bgs. Boring terminated at 31.5 feet bgs due to refusal on cobbles and possible boulders. No groundwater encountered. Borehole backfilled with soil cuttings, compacted by pushing down with augers using drill rig weight on 10/6/2020.												
	33														
	34														
612	35														
	36														
610	37														
	38														
608	39														
	40														
606	41														
	42														
604	43														
	44														
602	45														
	46														
600	47														
	48														
598	49														
	50														
596	51														
	52														
594	53														
	54														
592	55														
	56														
590	57														
	58														
588	59														
	60														

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REPORT TITLE				HOLE ID
BORING RECORD (BRIDGE)				**A-20-004**
DIST	COUNTY	ROUTE	POSTMILE	EA
8	**Riverside**		**40.9**	
PROJECT OR BRIDGE NAME				
Magnolia Avenue Bridge and Roadway Widening				
BRIDGE NUMBER	PREPARED BY	DATE	SHEET	
BR NO.56C-0199	**Mahmoud Suliman**	**12/14/2020**	**2 of 2**	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long)	HOLE ID
Mahmoud Suliman	**10/7/2020**	**10/7/2020**	**33.87105° N, 117.53342° W**	**A-20-005**
DRILLING CONTRACTOR			BOREHOLE LOCATION (Station, Offset, Line)	SURFACE ELEVATION
2 R drilling			**42+80**	**647.8 ft**
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow Stem Auger			**CME 75**	**8" in**
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modcal (2.4")			**Automatic, Weight = 140 lbs/ Drop = 30"**	**86.2 %**
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READING DURING DRILLING AFTER DRILLING	TOTAL DEPTH OF BORING
Soil Cuttings			**Not Encountered**	**11.0 ft**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Type	Sample ID	Blows per 6 in.	Blows per foot	Recovery %	RQD %	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks (Other Tests)
	0		6.5" ASPHALT CONCRETE/ 11" AGGREGATE BASE												
	1		1.5 El. 646.3'												
646	2		Poorly-graded SAND with GRAVEL (SP): brown, fine to coarse-grained, little gravel up to 1" in largest dimension.												
	3				B1 D2	8 9 12	21	100		1	111.5				R
644	4														
	5														
642	6				D3	9 15 20	35	100		2	112.1				
	7														
640	8				B4 D5	9 18 19	37	100		2	108.9				PA
	9														
638	10				D6	36 50-5"	86+	67		2	113.8				
	11		11.0 El. 636.8'												
636	12		Bottom of Borehole at 11.0 feet bgs. End of boring at 11.0 feet bgs. No groundwater encountered. Borehole backfilled with soil cuttings, compacted by pushing down with augers using drill rig weight and surface patched with cold asphalt concrete on 10/7/2020.												
	13														
634	14														
	15														
632	16														
	17														
630	18														
	19														
628	20														
	21														
626	22														
	23														
624	24														
	25														
622	26														
	27														
620	28														
	29														
618	30														

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REPORT TITLE				HOLE ID
BORING RECORD (ROADWAY)				**A-20-005**
DIST	COUNTY	ROUTE	POSTMILE	EA
8	**Riverside**		**40.9**	
PROJECT OR BRIDGE NAME				
Magnolia Avenue Bridge and Roadway Widening				
BRIDGE NUMBER	PREPARED BY	DATE	SHEET	
BR NO.56C-0199	**Mahmoud Suliman**	**12/14/2020**	**1 of 1**	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long)	HOLE ID
Mahmoud Suliman	**11/4/2020**	**11/4/2020**	**33.86956° N, 117.53514° W**	**O-20-001**
DRILLING CONTRACTOR			BOREHOLE LOCATION (Station, Offset, Line)	SURFACE ELEVATION
Great West Drilling			**35+20**	**646.8 ft**
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Becker Hammer				**6 5/8" in**
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
SPT (1.4"), Modcal (2.4")			**Automatic, Weight = 140 lbs/ Drop = 30"**	**83 %**
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READING DURING DRILLING / AFTER DRILLING	TOTAL DEPTH OF BORING
Soil Cuttings with Cement Mix			**50.0 ft**	**90.1 ft**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Type	Sample ID	Blows per 6 in.	Blows per foot	Recovery %	RQD %	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks (Other Tests)
646	0		ALLUVIUM: Silty SAND with GRAVEL (SM): brown, fine to coarse-grained, little gravel up to 1.5" and scattered cobbles up to 4" in largest dimension.												
644	1														
	2														
642	3														
	4														
	5		5.0 El. 641.8'												
640	6		Well-graded SAND with SILT and GRAVEL (SP-SM): brown, fine to coarse-grained, little gravel up to 2" and scattered cobbles up to 4" in largest dimension.												
	7				B1										
	8														
638	9														
	10														
636	11				D3	40 41 45	86	100		5	108.7				
	12														
634	13														
	14														
632	15				B2										CR EI PA
	16														
630	17														
	18														
628	19														
	20		20.0 El. 626.8'												
626	21		Poorly-graded SAND with GRAVEL (SP): grayish brown, fine to coarse-grained, some gravel up to 3"; scattered cobbles up to 4.5" in largest dimension.		S5	13 22 22	44	100		6.5	110.6				
	22				B4										CR CP PA DS
624	23														
	24														
622	25		25.0 El. 621.8'												
	26		Poorly-graded GRAVEL with SAND and SILT (GP-GM): Very Dense, grayish brown, moist, fine to coarse-grained, little gravel up to 3", few cobbles up to 4.5" in largest dimension, possible boulders.												
620	27														
	28														
618	29														
	30		30.0 El. 616.8'												

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REPORT TITLE				HOLE ID
BORING RECORD (BRIDGE)				**O-20-001**
DIST	COUNTY	ROUTE	POSTMILE	EA
8	**Riverside**		**40.9**	
PROJECT OR BRIDGE NAME				
Magnolia Avenue Bridge and Roadway Widening				
BRIDGE NUMBER	PREPARED BY	DATE	SHEET	
BR NO.56C-0199	**Mahmoud Suliman**	**12/14/2020**	**1 of 4**	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long)	HOLE ID
Mahmoud Suliman	**11/4/2020**	**11/4/2020**	**33.86956° N, 117.53514° W**	**O-20-001**
DRILLING CONTRACTOR			BOREHOLE LOCATION (Station, Offset, Line)	SURFACE ELEVATION
Great West Drilling			**35+20**	**646.8 ft**
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Becker Hammer				**6 5/8" in**
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
SPT (1.4"), Modcal (2.4")			**Automatic, Weight = 140 lbs/ Drop = 30"**	**83 %**
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READING DURING DRILLING / AFTER DRILLING	TOTAL DEPTH OF BORING
Soil Cuttings with Cement Mix			**50.0 ft**	**90.1 ft**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Type	Sample ID	Blows per 6 in.	Blows per foot	Recovery %	RQD %	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks (Other Tests)
	30				D6	50-3"	100+	NR							
616	31		ALLUVIUM: Well-graded SAND with SILT and GRAVEL (SP-SM): brown, fine to coarse-grained, some gravel up to 2" and scattered cobbles up to 4" in largest dimension.												
	32														
614	33				B7										CR PA
	34														
612	35														
	36														
	36.5		El. 610.3'												
610	37		SANDY CLAY (CL): olive brown, fine to medium-grained, scattered gravel up to 2.5" in largest dimension.												
	38														
608	39														
	40														
606	41				S8	4 17 30	47	100							
	42														
604	43				B9										CR PA
	44														
602	45														
	45.0		El. 601.8'												
	46		Poorly-graded SAND with GRAVEL (SP): grayish brown, fine to coarse-grained, little gravel up to 3"and scattered cobbles up to 4.5" in largest dimension.												
600	47														
	48														
598	49														
	50		▼												
596	51				D10	25 32 39	71	100		17.9	101.0				DS
	52														
594	53				B11										
	54														
592	55														
	56														
590	57														
	58														
588	59														
	60														
	60.0		El. 586.8'												

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REPORT TITLE				HOLE ID
BORING RECORD (BRIDGE)				**O-20-001**
DIST	COUNTY	ROUTE	POSTMILE	EA
8	**Riverside**		**40.9**	
PROJECT OR BRIDGE NAME				
Magnolia Avenue Bridge and Roadway Widening				
BRIDGE NUMBER	PREPARED BY	DATE	SHEET	
BR NO.56C-0199	**Mahmoud Suliman**	**12/14/2020**	**2 of 4**	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long)	HOLE ID
Mahmoud Suliman	**11/4/2020**	**11/4/2020**	**33.86956° N, 117.53514° W**	**O-20-001**
DRILLING CONTRACTOR			BOREHOLE LOCATION (Station, Offset, Line)	SURFACE ELEVATION
Great West Drilling			**35+20**	**646.8 ft**
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Becker Hammer				**6 5/8" in**
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
SPT (1.4"), Modcal (2.4")			**Automatic, Weight = 140 lbs/ Drop = 30"**	**83 %**
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READING DURING DRILLING / AFTER DRILLING	TOTAL DEPTH OF BORING
Soil Cuttings with Cement Mix			**50.0 ft**	**90.1 ft**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Type	Sample ID	Blows per 6 in.	Blows per foot	Recovery %	RQD %	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks (Other Tests)
586	60		ALLUVIUM: Poorly-graded SAND with GRAVEL (SP): grayish brown, fine to coarse-grained, little gravel up to 3"and scattered cobbles up to 4.5" in largest dimension.												
	61														
	62														
584	63				B12										
	64														
582	65														
	66														
580	67														
	68														
578	69														
	70		70.0 El. 576.8'												
576	71		SANDY CLAY (CL): olive brown, fine to medium-grained, scattered gravel up to 2.5" in largest dimension												
	72														
574	73				B13										
	74														
572	75		75.0 El. 571.8'												
	76		Poorly-graded SAND with GRAVEL (SP): grayish brown, fine to coarse-grained, little gravel up to 3"and scattered cobbles up to 4.5" in largest dimension.												
570	77														
	78														
568	79														
	80														
566	81				B14										
	82														
564	83														
	84														
562	85														
	86														
560	87				B15										
	88														
558	89														
	90		90.0 El. 556.8'												

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REPORT TITLE				HOLE ID
BORING RECORD (BRIDGE)				**O-20-001**
DIST	COUNTY	ROUTE	POSTMILE	EA
8	**Riverside**		**40.9**	
PROJECT OR BRIDGE NAME				
Magnolia Avenue Bridge and Roadway Widening				
BRIDGE NUMBER	PREPARED BY	DATE	SHEET	
BR NO.56C-0199	**Mahmoud Suliman**	**12/14/2020**	**3 of 4**	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long)	HOLE ID
Mahmoud Suliman	**11/4/2020**	**11/4/2020**	**33.86956° N, 117.53514° W**	**O-20-001**
DRILLING CONTRACTOR			BOREHOLE LOCATION (Station, Offset, Line)	SURFACE ELEVATION
Great West Drilling			**35+20**	**646.8 ft**
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Becker Hammer				**6 5/8" in**
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
SPT (1.4"), Modcal (2.4")			**Automatic, Weight = 140 lbs/ Drop = 30"**	**83 %**
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READING DURING DRILLING / AFTER DRILLING	TOTAL DEPTH OF BORING
Soil Cuttings with Cement Mix			**50.0 ft**	**90.1 ft**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Type	Sample ID	Blows per 6 in.	Blows per foot	Recovery %	RQD %	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks (Other Tests)
556	90		Bottom of Borehole at 90.1 feet bgs. End of boring at 90.0 feet bgs. Groundwater encountered at 50.0 feet bgs. Borehole backfilled with soil cuttings mixed with Cement quick-mix, compacted by pushing down with augers using drill rig weight on 11/4/2020.												
	91														
	92														
554	93														
	94														
552	95														
	96														
550	97														
	98														
548	99														
	100														
546	101														
	102														
544	103														
	104														
542	105														
	106														
540	107														
	108														
538	109														
	110														
536	111														
	112														
534	113														
	114														
532	115														
	116														
530	117														
	118														
528	119														
	120														

Converse Consultants
Geotechnical Engineering & Consulting
Environmental & Groundwater Science
Material Testing & Inspection Services

REPORT TITLE				HOLE ID
BORING RECORD (BRIDGE)				**O-20-001**
DIST	COUNTY	ROUTE	POSTMILE	EA
8	**Riverside**		**40.9**	
PROJECT OR BRIDGE NAME				
Magnolia Avenue Bridge and Roadway Widening				
BRIDGE NUMBER	PREPARED BY	DATE	SHEET	
BR NO.56C-0199	**Mahmoud Suliman**	**12/14/2020**	**4 of 4**	

Appendix A-1

Hammer Calibration Record

SPT CAL

SPT HAMMER ENERGY MEASUREMENTS

Prepared by;

SPT CAL
5512 Belem Dr
Chino Hills, CA 91709

909-730-2161
bc@sptcal.com

Prepared for;

2R Drilling, Inc
6939 Schaefer Ave Ste D-304
Chino, CA 91710-9100

909-490-0530

Date: 03/12/20

Project Title: 2R Rig 6
Project Description: Rig 6 Ontario

Energy Transfer Ratio = 86.2% at 56.9 blows per minute

Testing was performed on March 12, 2020 in Ontario, California

Hammer Energy Measurements performed in accordance to ASTM D4633 using an approved and calibrated SPT Analyzer from Pile Dynamics, Inc.

PRESENTATION OF SPT ANALYZER TEST DATA

1. Introduction

This report presents the results of SPT Hammer Energy Measurements recorded with an SPT Analyzer from Pile Dynamics carried out on March 12, 2020 in Ontario, California.

2. Field Equipment and Procedures

The drill used is a CME 75. It is referred to at at 2R Drilling as Rig 6 or 2R6. It has an attached CME SPT Automatic Hammer.

This CME SPT Automatic Hammer uses a 140 lb. weight dropped 30” on to an anvil above the bore hole. The drill rod connects the anvil to a split spoon type soil sampler inside an 8” o.d. hollow stem auger at the designated sample depth. After a seeding blow the sampler is driven 18”. The number of blows required to penetrate the last 12" is referred to as the “N value”, which is related to soil strength.

The first recording was taken at 5’ below ground surface and then every 5' to final recording at 30’.

3. Instrumentation

An SPT Analyzer from Pile Dynamics was used to record and the process the data. The raw data was stored directly in the SPT Analyzer computer with subsequent analysis in the office with PDA-W and PDIPlot software. The measurements and analysis were conducted in general accordance with ASTM D4945 and ASTM D6066 test standards.

The SPT Analyzer is fully compliant with the minimum digital sampling frequency requirements of ASTM D4633-05 (50 kHz) and EN ISO 22476-3:2005 (100 kHz), as well as with the low pass filter, (cutoff frequency of 5000 Hz instead of 3000 Hz) requirements of ASTM D4633-05. All equipment and analysis also conform to ASTM D6066.

A 2' instrumented section of AWJ rod, with two sets of accelerometers and strain transducers mounted on opposite sides of the drill rod, was placed below the anvil. It measured strain and acceleration of every hammer blow. The SPT Analyzer then calculates the amount of energy transferred to the rod by force and velocity measurements.

4. Observations

The drill rig motor is diesel fueled. The drill and sample equipment looked to be well operated and maintained.

5. Results

Results from the SPT Hammer Energy Measurements are summarized below. It shows the Energy Transfer Ratio (ETR) at each sampling depth. ETR is the ratio of the measured maximum transferred energy to rated energy of the hammer which is the product of the weight of the hammer times the height of the fall. 140 lb x 30" = 4200 lb-in = 0.350 kip-ft.

Energy Transfer Ratio = 86.2% at 56.9 blows per minute

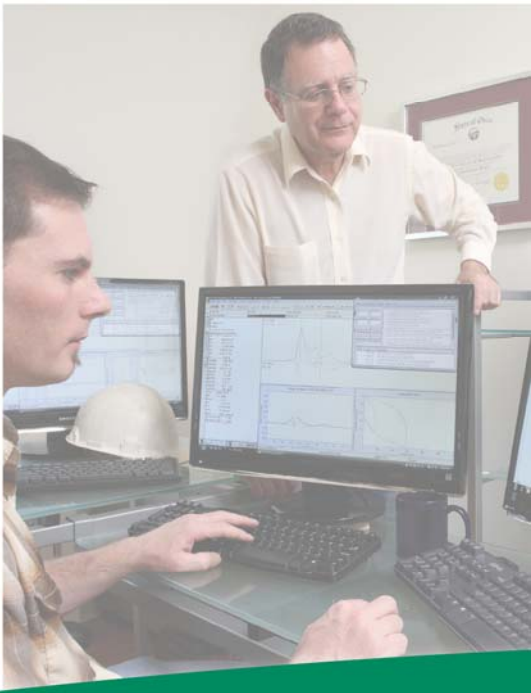
N60=(ETR/60)N

Depth	ETR%	BPM
5	85.8	58.2
*10	70.5	56.6
15	84.9	56.8
20	86.8	56.2
25	87.7	55.8
30	85.8	58.0
Average	**86.2**	**56.9**

*** The sample at 10' had blow counts too low to be included in the average above. The N value at 10' was less 5. Anything less than 10 is considered too low for an accurate measurement of hammer energy transferred.**

If you have any questions please do not hesitate to call or email.Thank you,

Brian Serl
Calibration Engineer
SPT CAL
909-730-2161
bc@sptcal.com



Job No. 148146-1

Report on: Energy Measurement for Dynamic Penetrometers
Standard Penetration Tests (SPT)
California

Prepared for Great West Drilling, Inc.

By Camilo Alvarez, MSCE, P.E. and
Anna M. Klesney, MSCE, E.I.T.

December 11, 2014

GRL Dynamic Measurements and Analyses
engineers, inc.

www.GRLengineers.com info@GRLengineers.com

December 11, 2014

Jim Benson
Great West Drilling, Inc.
9431 Resenda Avenue
Fontana, California 92335

Re: Energy Measurement for Dynamic Penetrometers
Standard Penetration Tests (SPT)
California GRL Job No. 148146-1

Dear Mr. Jim Benson:

This report transmits our findings from energy measurements and related data analysis conducted by GRL Engineers, Inc. for your drill rig and the TH14 Phase 5B project. One automatic hammer and penetrometer system was monitored during Standard Penetration Tests for two boring locations. Dynamic testing summarized in this report was conducted on November 17, 2014.

A Pile Driving Analyzer® Model PAX recorded, processed and displayed the dynamic data to meet the objectives of the hammer system calibration. Discussions on the test methods, limitations and implementation are provided in Appendix A. The energy measurement results are summarized in Tables 1A and 1B, with the average and standard deviation provided in Appendix B, and representative plots of force and normalized velocity are in Appendix C.

EQUIPMENT

Hammer and Penetrometer System

Energy measurements were recorded during standard penetration tests conducted for one automatic hammer and the following drill rig type and name.

Drill Rig Type	Drill Rig Name
DEEPROCK	GW

Measurements were recorded for two boring locations for the one drill rig. Great West Drilling, Inc. advanced the penetrometer to a minimum depth of 15.0 feet prior to energy measurements. The instrumented subassembly was connected to the top of the drill rod string and measurements recorded at 5 foot intervals for three depths of data at each boring location.

Measurements were recorded for every blow required to advance the sampler 18 inches or terminated upon encountering refusal conditions. Results are provided for the final 12 inches of the sampler advancement alone (i.e., excluding the initial 6 inches of advancement). ASTM Standard D4633 states that tests for energy evaluation should be limited to SPT N-values between 10 and 50. All energy measurements are included in the averages reported herein.

The following drill rod dimensions, of rod size AWJ or AW, were employed during testing.

Drill Rod Area sq. inch		Outside Diameter Inch		Inside Diameter inch	
A	B	A	B	A	B
1.19		1.75		1.25	
Depth of Penetrometer * feet		Drill Rod Section Lengths * feet		Transducer to Penetrometer Length * feet	
A	B	A	B	A	B
15.0	25.0	20.0	30.0	20.0	30.0
20.0	30.0	25.0	35.0	25.0	35.0
25.0	35.0	30.0	40.0	30.0	40.0

* A (Boring Location B1); B (Boring Location B17).

Instrumentation

A Pile Driving Analyzer was employed for recording, processing, and displaying the dynamic data. An instrumented subassembly, inserted at the top of the drill rod string below the hammer and anvil system and above the drill rods to record force and acceleration data. The subassembly was instrumented with two foil strain gages in a full bridge circuit and two piezoresistive accelerometers attached on diametrically opposite sides of the subassembly. Data sampling frequency was 50.0 kHz.

The PAX utilizes a digital system, and with the employed sampling frequency of 50.0 kHz, the signal conditioning conforms to ASTM D4633. Results for the maximum hammer operating rate, rod top force and velocity, and transferred energy are provided in Appendix B and summarized in the Tables 1. Discussions on the test method and its limitations can be found in Appendix A.

MEASUREMENTS AND CALCULATIONS

The primary objective of testing was the measurement of the energy transmitted from the hammer impact through the anvil into the instrumented subassembly and drill rods. Strain

transducers and accelerometers were employed for the calculation of the transferred energy using force, F(t) and velocity v(t), records as follows:

$$EMX = \int_{b}^{a} F(t)v(t)dt$$

where time "b" is to the beginning of the energy transfer and time "a" is to the time at which the energy transfer reaches a maximum. Force is calculated as the product of the measured strain, elastic modulus and cross-sectional area, and measured acceleration is integrated to velocity.

Integrated over the complete impact event and calculated from measured force and velocity, the energy transferred to the top of the drill rod was calculated as a function of time. The maximum transferred energy (i.e., EMX or also referred to as EFV) is used as an indicator of the energy content of the event. The described method is the only theoretically correct method of measuring energy transfer and automatically corrects for rod non-uniformities such as connector masses or loose joints. The EF2 method results included in Appendix B are inherently incorrect and included in Appendix B for reference alone.

TEST RESULTS

Result Discussion

Dynamic data was evaluated for the hammer operating rate, rod top force and velocity, and transferred energy. Appendix B provides the evaluated quantities for blows making up the SPT N-value, with their averages and standard deviation, plotted and printed as a function of depth for the monitored sequences of the standard penetration tests.

The plots in Appendix B include:

- FMX – the maximum measured rod top force
- VMX – the maximum measured rod top velocity
- BPM – the hammer operating rate in blows per minute
- EMX – the maximum calculated energy (EFV) transferred to the rod top
- EF2 – the maximum of the integral of the square of force, theoretically incorrect energy transfer calculation

Corresponding tables also include:

- ETR – ratio of transferred energy (EFV) to the maximum theoretical potential energy
- CSX – the maximum measured rod top compressive stress, averaged over the cross-sectional area

The maximum theoretical potential energy is the product of the standard 140 lb hammer impact mass dropped the standard 30 inches.

TABLE 1A: Summary of Field Results
Energy Measurement for Dynamic Penetrometers

Location	Depth(s)	Uncorrected N value	Corrected N value	Hammer Operating Rate (BPM)	Average Transferred Energy (EMX)	Energy Transfer Ratio (ETR)	Maximum Compressive	
							Measured Top Stress (CSX)	Impact Top Force (FMX)
		(1)	(2)		(3)	(3)	(4)	(5)
	ft	blows	N_{60}	bpm	ft-lbs	%	ksi	kips
B1								
	15.0 - 16.5	27	38	23	299	85	31	37
	20.0 - 21.4	82 for 11"	- - -	26	280	80	24	29
	25.0 - 26.5	24	33	18	291	83	28	33
	Overall System Performance			22	290	83	28	33

Notes

1. Uncorrected N-value, number of hammer blows required to advance sampler the final 12 inches, unless noted otherwise.
2. Corrected N-value, number of hammer blows required to advance sampler the final 12 inches, corrected for calculated energy transfer ratio (ETR).
3. Average transferred energy at transducer location; ratio of transferred energy to theoretical potential energy of hammer.
4. Average, measured Compressive driving Stress averaged over the drill rod cross section at transducer location.
5. Average, measured Compressive driving Force at transducer location.

Appendix B

Laboratory Testing Program

APPENDIX B

LABORATORY TESTING PROGRAM

Tests were conducted in our laboratory on representative soil samples for the purpose of classification and evaluation of their physical properties and engineering characteristics. The amount and selection of tests were based on the geotechnical parameters required for this project. Test results are presented herein and on the Boring Records, in Appendix A, *Field Exploration*. The following is a summary of the various laboratory tests conducted for this project.

In-Situ Moisture Content and Dry Density

In-situ dry density and moisture content tests were performed on relatively undisturbed ring samples, in accordance with the ASTM Standard D2216 and ASTM D2937 to aid soils classification and to provide qualitative information on strength and compressibility characteristics of the subsurface soils. For test results, see the Boring Records in Appendix A, *Field Exploration.*

Expansion Index

One representative bulk soil sample was tested in accordance with ASTM Standard D4829 test method to evaluate the expansion potential of materials encountered at the site. The test result is presented in the following table.

Table No. 1, Summary of Expansion Index Test Result

Boring No.	Depth (feet)	Soil Description	Expansion Index	Expansion Potential
O-20-001	10-20	Well-graded Silty Sand with Gravel (SM)	0	Very Low

Sand Equivalent

Two representative soil samples were tested in accordance with the ASTM Standard D2419 test method to determine the sand equivalent. The test results are presented in the following table.

Table No. 2, Sand Equivalent Test Results

Boring No.	Depth (feet)	Soil Description	Sand Equivalent
A-20-003	5-10	Poorly graded Sand with Silt and Gravel (SP-SM)	42
A-20-004	0-5	Silty Sand with Gravel (SM)	55

R-value

Two bulk soil samples were tested for resistance value (R-value) in accordance with the Caltrans Test Method 301. The test is designed to provide a relative measure of soil strength for use in pavement design. The test results are presented in the following table.

Table No. 3, Summary of R-Value Test Results

Boring No.	Depth (feet)	Soil Classification	Measured R-value
A-20-002	1-5	Poorly graded Sand with Silt and Gravel (SP-SM)	79
A-20-005	1.5-5	Poorly graded Sand with Gravel (SP)	80

Soil Corrosivity

Four representative soil samples were tested by AP Engineering and Testing, Inc. (Pomona, California) in accordance with California Test Method (CTM) 643, 422, and 417, to determine minimum electrical resistivity, pH, and chemical content, including soluble sulfate and chloride concentrations. The purpose of these tests was to determine the corrosion potential of the soils when placed in contact with common pipe materials. The test results are summarized in the table below.

Table No. 4, Summary of Corrosivity Test Results

Boring No.	Depth (feet)	pH	Soluble Sulfates (CTM 417) (ppm)	Soluble Chlorides (CTM 422) (ppm)	Min. Resistivity (CTM 643) (Ohm-cm)
O-20-001	10-20	8.4	22	39	12,671
O-20-001	20-25	8.5	39	35	13,980
O-20-001	30-35	8.7	24	38	6,032
O-20-001	40-45	8.4	28	42	3,503

Grain Size Analysis

To assist in classification of soils, mechanical grain-size analyses were performed on 7 selected samples in general accordance with the ASTM D6913 test method. Grain-size curves are shown in Figure Nos. B-2a and B-2b, *Grain Size Distribution Results* and summarized in the table below.

Table No. 5, Summary Grain Size Distribution Test Results

Boring No.	Depth (ft)	Soil Classification	% Gravel	% Sand	%Silt	%Clay
A-20-001	1-5	Well-graded Sand with Silt and Gravel (SP-SM)	20.0	71.0	9.0	
A-20-003	0-5	Silty Sand with Gravel (SM)	24.0	59.0	17.0	
A-20-005	5-10	Poorly graded Sand with Silt and Gravel (SP-SM)	19.0	77.0	4.0	
O-20-001	10-20	Well-graded Sand with Silt and Gravel (SP-SM)	18.0	75.0	7.0	
O-20-001	20-25	Poorly graded Sand with Gravel (SP)	34.0	62.0	4.0	
O-20-001	30-35	Well-graded Sand with Silt and Gravel (SP-SM)	36.0	55.0	9.0	
O-20-001	40-45	Sandy Clay (CL)	8.0	18.0	74.0	

Maximum Dry Density and Optimum Moisture Content

Laboratory maximum dry density and optimum moisture content relationship tests were performed on 2 representative bulk soil samples. The tests were conducted in accordance with ASTM D1557 test method and CT 216 method. Test results are presented on Figure No. B-3, *Moisture-Density Relationship Results* and summarized in the following table.

Table No. 6, Laboratory Maximum Density Test Results

Boring No.	Depth (feet)	Soil Description	Maximum Dry Density (pcf)	Optimum Moisture (%)
*A-20-003	5-10	Poorly graded Sand with Silt and Gravel (SP-SM), Yellowish Brown to Brown	135.0 (138.6*)	5.7 (5.0*)
*O-20-001	20-25	Poorly graded Sand with Gravel (SP), Grayish Brown	123.5 (130.9*)	6.5 (5.0*)
(*Rock correction: A-20-002= 13.06% and A-20-004= 21.00%)				

Direct Shear

One direct shear test was performed on relatively undisturbed samples and one (1) direct shear test was performed on sample remolded to 90% of the maximus dry density under soaked condition in accordance with ASTM Standard 3080. For each test, three samples contained in a brass sampler ring were placed, one at a time, directly into the test apparatus and subjected to a range of normal loads appropriate for the anticipated conditions. The samples were then sheared at a constant strain rate of 0.02. Shear deformation was recorded until a maximum of about 0.25-inch shear displacement was achieved. Ultimate strength was selected from the shear-stress deformation data and

plotted to determine the shear strength parameters. The test results, including average sample density and moisture content are shown in Figure Nos. B-4 and B-5, *Direct Shear Test Results,* and summarized in the following table.

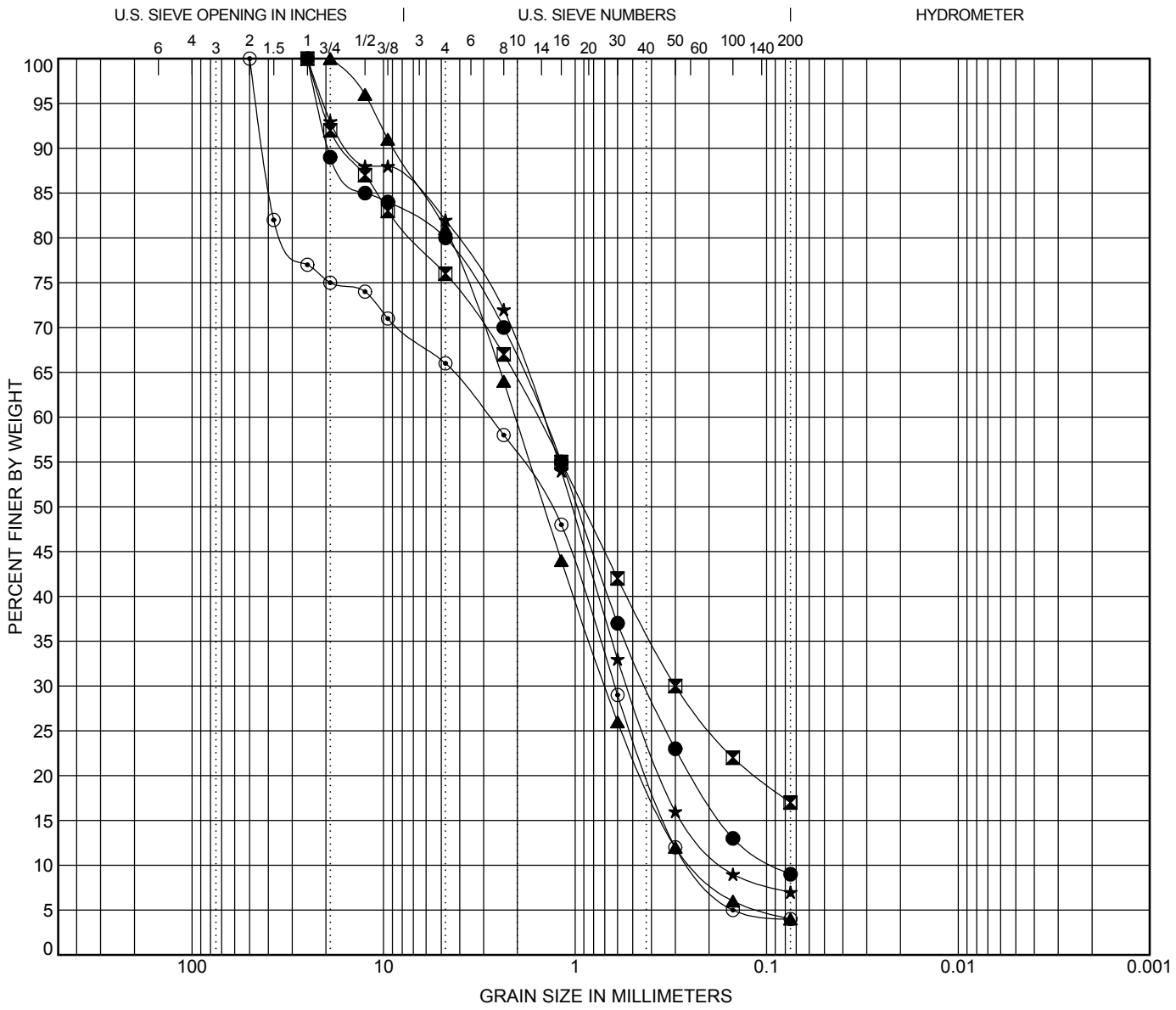
Table No. B-7, Summary of Direct Shear Test Results

Boring No.	Depth (feet)	Soil Description	Ultimate Strength Parameters	
			Friction Angle (degrees)	Cohesion (psf)
*O-20-001	20-25	Poorly graded Sand with Gravel (SP)	35	0
O-20-001	50.0-51.5	Poorly graded Sand with Gravel (SP)	32	90

(*Remolded to 90% of the maximum dry density)

Sample Storage

Soil samples currently stored in our laboratory will be discarded thirty days after the date of the final report, unless this office receives a specific request to retain the samples for a longer period.



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring No.	Depth (ft)	Description	LL	PL	PI	Cc	Cu
●	A-20-001	1-5	WELL-GRADED SAND with SILT and GRAVEL (SP-SM)				1.36	16.67
⊠	A-20-003	0-5	SILTY SAND with GRAVEL (SM)					
▲	A-20-005	5-10	POORLY-GRADED SAND with SILT and GRAVEL (SP-SM)				0.99	8.63
★	O-20-001	10-20	WELL-GRADED SAND with SILT and GRAVEL (SP-SM)				1.14	8.98
⊙	O-20-001	20-25	POORLY-GRADED SAND with GRAVEL (SP)				0.56	11.42

	Boring No.	Depth (ft)	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	A-20-001	1-5	25	1.487	0.424	0.089	20.0	71.0	9.0	
⊠	A-20-003	0-5	25	1.575	0.3		24.0	59.0	17.0	
▲	A-20-005	5-10	19	2.054	0.697	0.238	19.0	77.0	4.0	
★	O-20-001	10-20	25	1.487	0.531	0.166	18.0	75.0	7.0	
⊙	O-20-001	20-25	50	2.811	0.622	0.246	34.0	62.0	4.0	

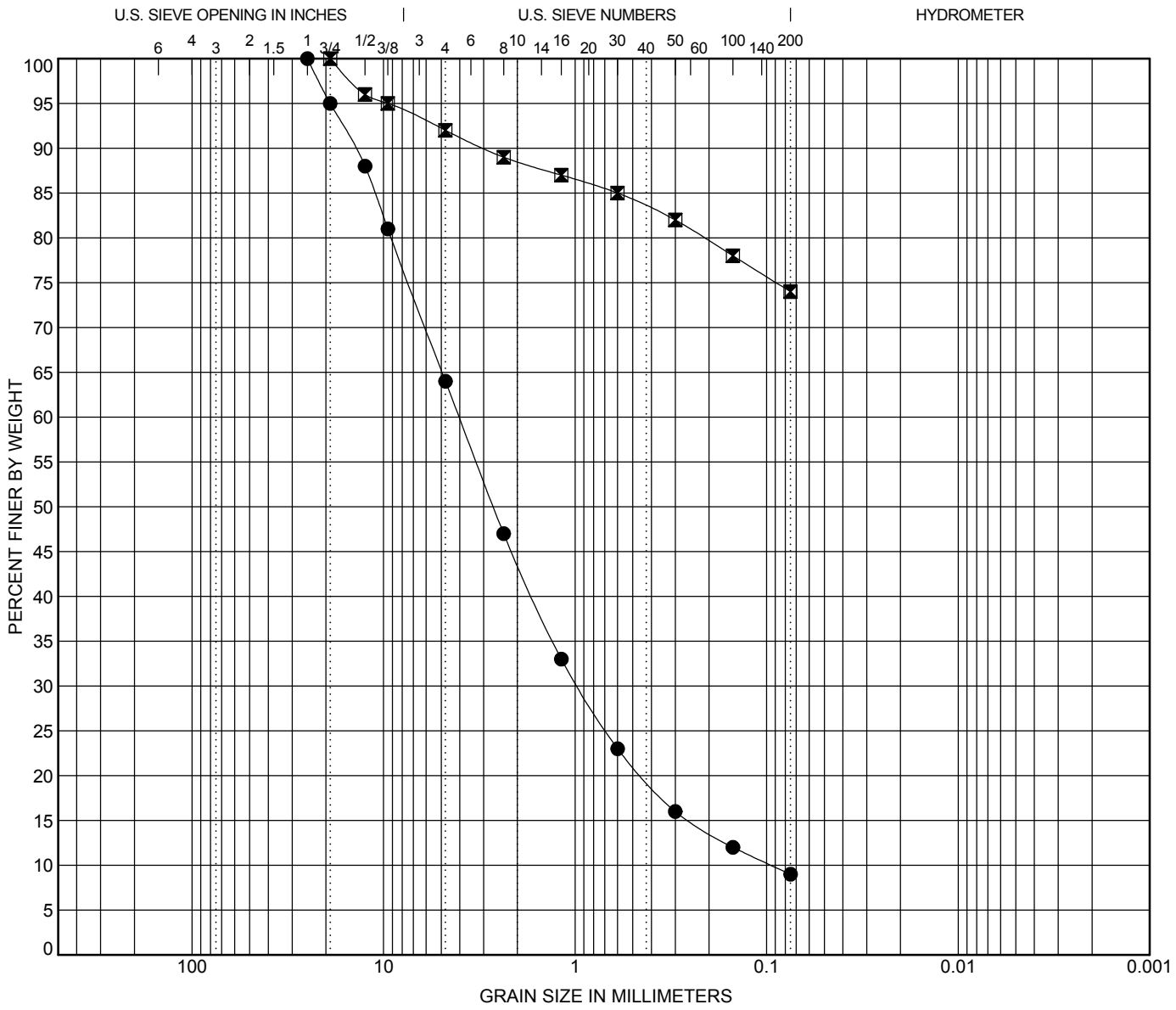
GRAIN SIZE DISTRIBUTION RESULTS

Converse Consultants

Magnolia Avenue Bridge and Roadway Widening
El Camino Avenue to 1,000 feet East of All American Way
City of Corona, Riverside County, CA
For: CNS Engineering, Inc.

Project No. **18-81-147-02**

Drawing No. **B-1a**



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring No.	Depth (ft)	Description	LL	PL	PI	Cc	Cu
●	**O-20-001**	**30-35**	**WELL-GRADED SAND with SILT and GRAVEL (SP-SM)**				**2.44**	**42.64**
⊠	**O-20-001**	**40-45**	**SANDY CLAY (CL)**					

	Boring No.	Depth (ft)	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**O-20-001**	**30-35**	**25**	**4.029**	**0.963**	**0.094**	**36.0**	**55.0**	**9.0**	
⊠	**O-20-001**	**40-45**	**19**				**8.0**	**18.0**	**74.0**	

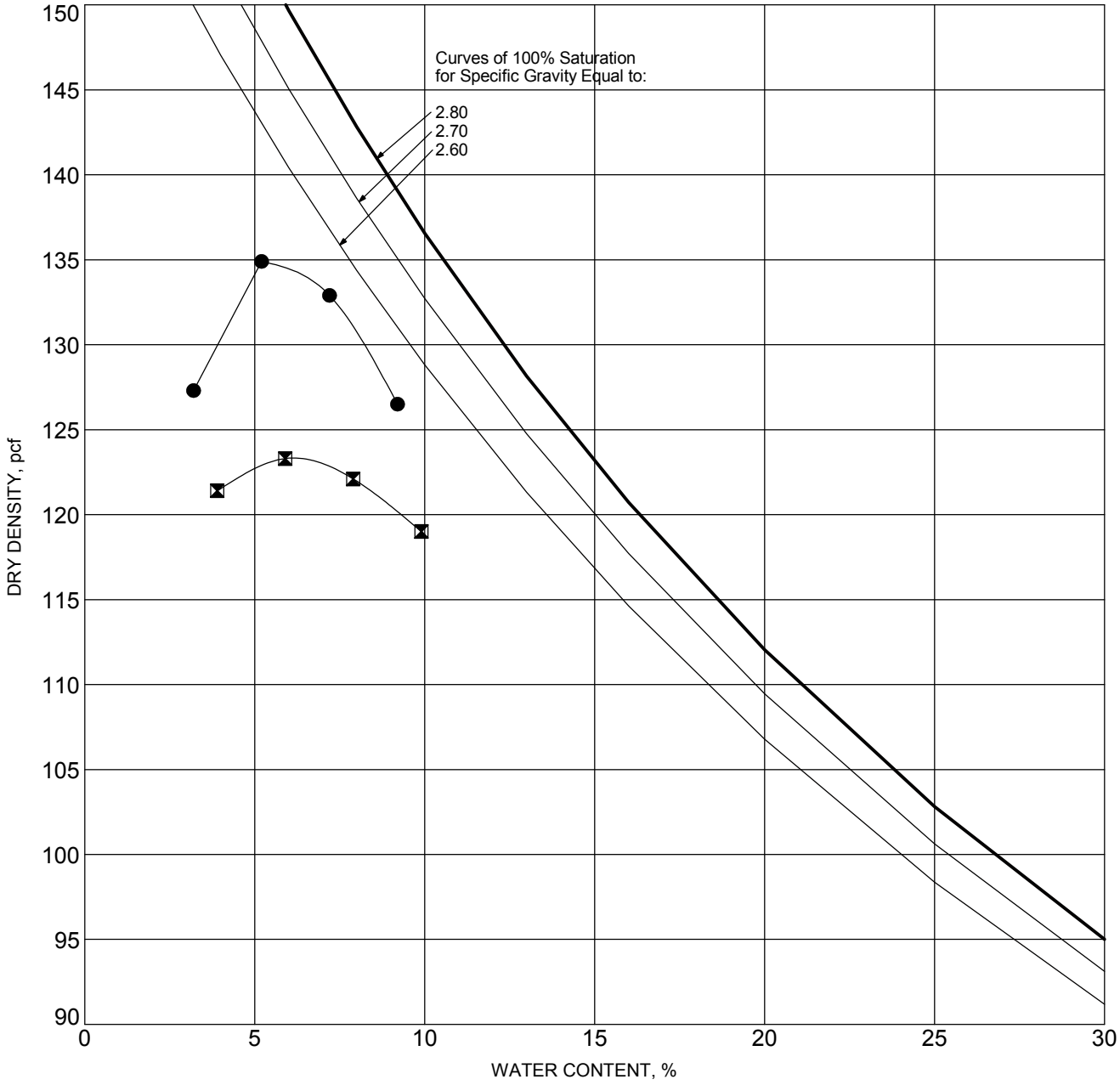
GRAIN SIZE DISTRIBUTION RESULTS

Converse Consultants

Magnolia Avenue Bridge and Roadway Widening
El Camino Avenue to 1,000 feet East of All American Way
City of Corona, Riverside County, CA
For: CNS Engineering, Inc.

Project No. **18-81-147-02**

Drawing No. **B-1b**



SYMBOL	BORING NO.	DEPTH (ft)	DESCRIPTION	ASTM TEST METHOD	OPTIMUM WATER, %	MAXIMUM DRY DENSITY, pcf
●	**A-20-003**	**5-10**	**POORLY-GRADED SAND WITH GRAVEL (SP), GRAYISH BROWN**	**D1557 - C**	**5.7 (5.0*)**	**135.0 (138.6*)**
⊠	**O-20-001**	**20-25**	**POORLY-GRADED SAND with GRAVEL (SP), YELLOWISH BROWN TO BROWN**	**D1557 - C**	**6.5 (5.2*)**	**123.5 (130.9*)**

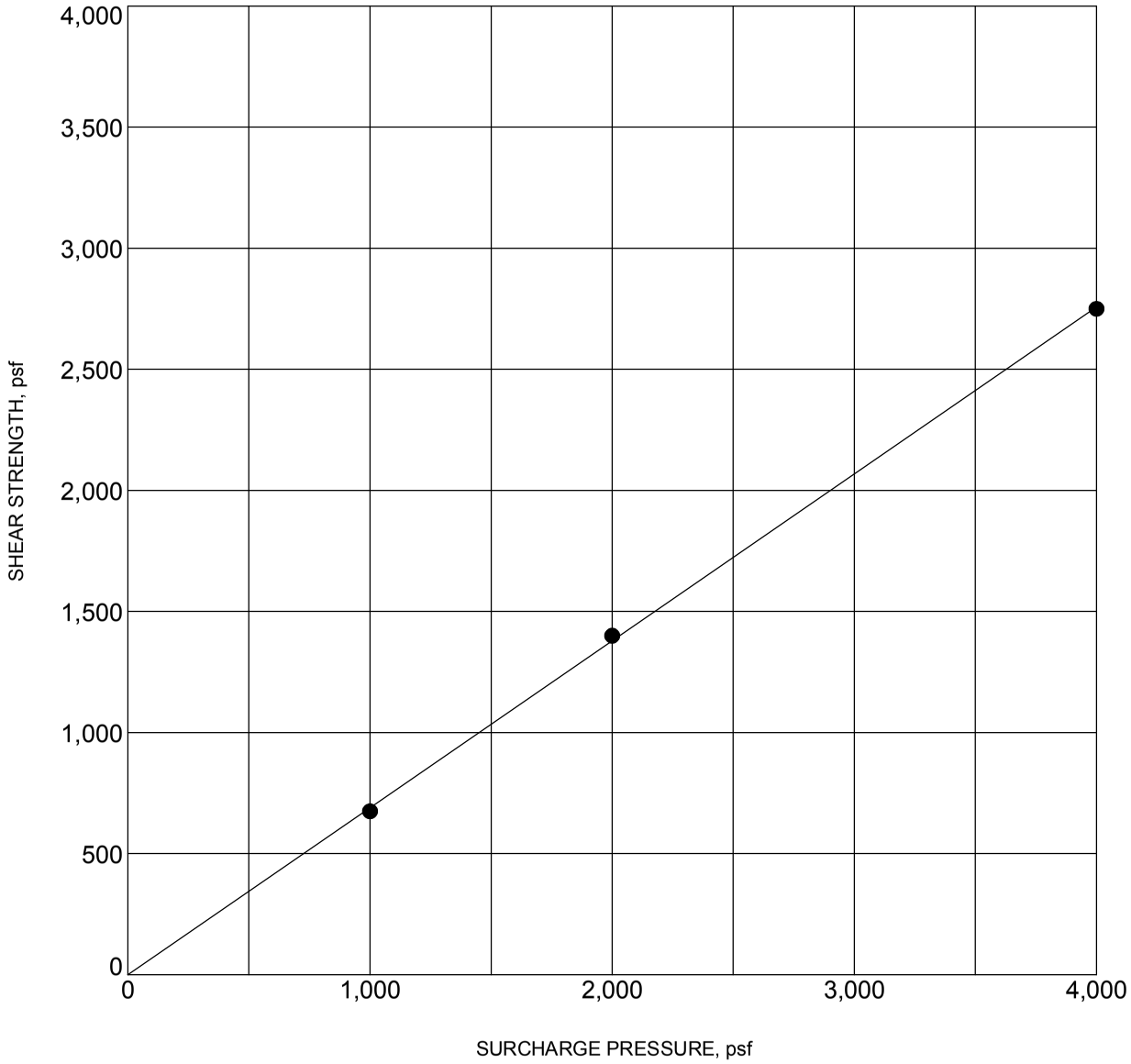
MOISTURE-DENSITY RELATIONSHIP RESULTS

Converse Consultants

Magnolia Avenue Bridge and Roadway Widening
El Camino Avenue to 1,000 feet East of All American Way
City of Corona, Riverside County, CA
For: CNS Engineering, Inc.

Project No. **18-81-147-02**

Drawing No. **B-2**



BORING NO.	:	**O-20-001**	DEPTH (ft)	:	**20-25**
DESCRIPTION	:	**POORLY-GRADED SAND with GRAVEL (SP)**			
COHESION (psf)	:	**0**	FRICTION ANGLE (degrees):		**35**
MOISTURE CONTENT (%)	:	**6.5**	DRY DENSITY (pcf)	:	**110.6**

(* Remolded to 90% of the laboratory maximum dry density)

NOTE: Ultimate Strength.

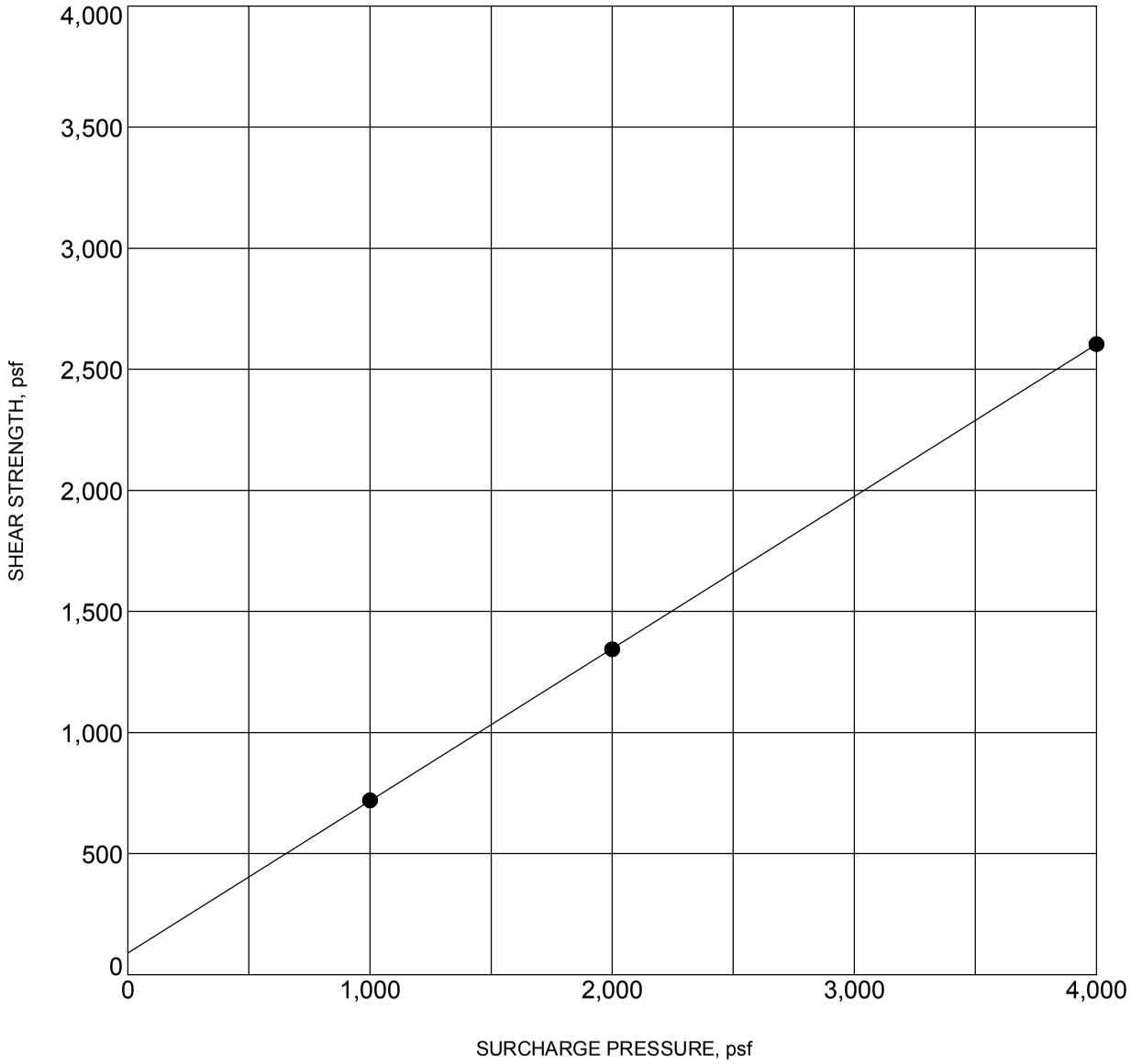
DIRECT SHEAR TEST RESULTS

Converse Consultants

Magnolia Avenue Bridge and Roadway Widening
El Camino Avenue to 1,000 feet East of All American Way
City of Corona, Riverside County, CA
For: CNS Engineering, Inc.

Project No. **18-81-147-02**

Drawing No. **B-3**



BORING NO.	:	**O-20-001**	DEPTH (ft)	:	**50.0-51.5**
DESCRIPTION	:	**POORLY-GRADED SAND with GRAVEL (SP)**			
COHESION (psf)	:	**90**	FRICTION ANGLE (degrees):		**32**
MOISTURE CONTENT (%)	:	**17.9**	DRY DENSITY (pcf)	:	**101.0**

NOTE: Ultimate Strength.

DIRECT SHEAR TEST RESULTS

Converse Consultants

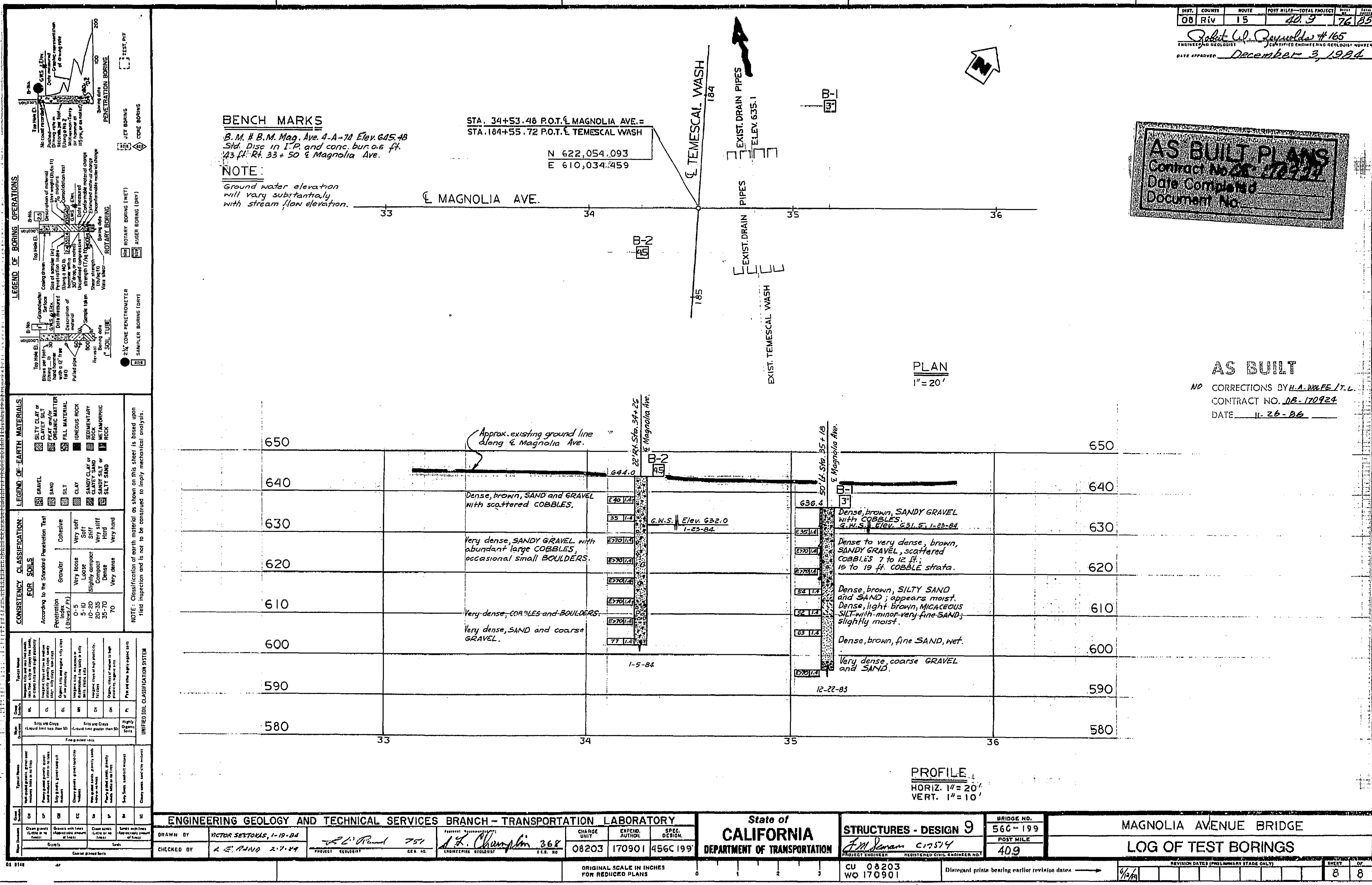
Magnolia Avenue Bridge and Roadway Widening
El Camino Avenue to 1,000 feet East of All American Way
City of Corona, Riverside County, CA
For: CNS Engineering, Inc.

Project No. **18-81-147-02**

Drawing No. **B-4**

Appendix C

Log of Test Borings (As Built)



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(170926)

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF TRANSPORTATION.

DATE 1-15-87 SIGNATURE Donald Blackford TITLE SUPERVISOR OF MICROFILM SERVICES

Appendix D

Flexible Pavement Sections Calculation

Problem Description (User Input)

Project Location

District 8, Riverside, Route 15, North, Start PM: R0.000, End PM: R1.000

Project Length: 1.000 mi Lane Miles: 4.000 Avg #lanes: 4.00 Area (12 ft Lane Width): 253,440.00 ft**2

Pavement Structure

Layer	Material	Thick (ft)	Modulus (ksi)	Poisson	R	GF	Cost ($/ft3)	Cost ($)
1	2020 Standard HMA Type A Mix with PG64-XX Binder and up	0.60	945.1	0.35	N/A	0.00	0.00	0.00
2	2020 Standard AB-Class 2	0.90	45.0	0.35	78	1.10	0.00	0.00
3	2020 Standard ML	0.00	28.7	0.35	50	0.00	0.00	0.00
						Project Cost:		0.00
						Project Cost/Lane Mile:		0.00

Traffic Segment Counts

PM Location: **R0.000-R0.750**
AADT: **67500**
Total Trucks (AADTT): **4556**
% Trucks: **6.8**

Design Lane Traffic Loads

Load Distribution (WIM Station): **Group1b**
Growth Rate (From First Year): **5.5**%
Design Life: **20** yrs
First Year Loads / Lane:
- Axles: **830,123**
- Trucks: **327,343**
- ESALs: **5,399,511**
- TI: **11.0**

Climate

Zone: **Inland Valley**

Results of the Caltrans Empirical Design Check Applied to the Current Structure

Minimum and Maximum Thickness Checks

No problems with minimum/maximum thickness checks;

Structural Adequacy Checks

Warning: Gravel Equivalent Provided above Layer 2 (AB): 1.07 is more than required: 0.97;

Warning: Gravel Equivalent Provided above Layer 3 (SG): 2.06 is more than required: 1.76;

CalFP Design Alternatives

Design	HMA	AB	SG	AC GF	Res GE	TtlThick	Cost/mi	MsgsText
1	0.55	0.75	0.00	1.73	0.02	1.30	0	
2	0.60	0.65	0.00	1.78	0.02	1.25	0	
3	0.65	0.50	0.00	1.83	-0.02	1.15	0	
4	0.70	0.40	0.00	1.87	-0.01	1.10	0	
5	0.75	0.35	0.00	1.92	0.06	1.10	0	
6	0.80	0.35	0.00	1.96	0.19	1.15	0	
7	0.85	0.35	0.00	2.00	0.32	1.20	0	
8	0.90	0.35	0.00	2.04	0.46	1.25	0	