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Acknowledgments

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Washington, DC 20460

For more information regarding water efficiency, please contact:
Water Efficiency Program (4204M)
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Ariel Rios Building, 1200 Pennsylvania Avenue, NW.
Washington, DC 20460
<www.epa.gov/OWM/water-efficiency/index.htm>

EPA
United States
Environmental Protection Agency (4204M)
Washington, DC 20460

Attachment B: WQMP Exhibit & Vicinity Map

Source: ESRI

Regional Vicinity

Exhibit 1

Michael Baker INTERNATIONAL

Source: ESRI

0 100 200 Feet

Site Vicinity

Exhibit 2

WATER QUALITY MANAGEMENT PLAN EXHIBIT

BARSTOW PARKING LOT EXPANSION

1161 W MAIN STREET, BARSTOW, CA

DA NUMBER	DA AREA SQ.FT.	DA AREA ACRES	ASPHALT SQ.FT.	CONCRETE SQ.FT.	ROOF SQ.FT.	LANDSCAPE SQ.FT.	IMPERVIOUS %	PERVIOUS %
DA-1	23,971	0.55	19,139	1,251	0	3,581	85%	15%

SITE ADDRESS:
1161 W MAIN STREET
BARSTOW, CA 92311

OWNER/APPLICANT:
SAN BERNARDINO COUNTY
385 NORTH ARROWHEAD AVE
SAN BERNARDINO, CA 92415
(909)838-9128

LEGEND

- PROPERTY LINE
- DMA BOUNDARY
- FLOW DIRECTION
- ASPHALT CONCRETE PAVEMENT
- CONCRETE PAVEMENT
- LANDSCAPE/BASIN
- DA-1 0.55 AC — DMA NUMBER & AREA

SCALE 1"=10'

10 5 0 10 20 30

SCALE: 1"=10'

BARSTOW PARKING LOT
COUNTY OF SAN BERNARDINO

Michael Baker INTERNATIONAL
3536 CONCOURS ST., STE.100, ONTARIO, CA 91764
PHONE: (909) 974-4900 · MBAKERINTL.COM

NOAA Atlas 14, Volume 6, Version 2
Location name: Barstow, California, USA*
Latitude: 34.8962°, Longitude: -117.0406°
Elevation: 2151.8 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.084** (0.068-0.103)	**0.113** (0.092-0.139)	**0.153** (0.125-0.190)	**0.188** (0.152-0.235)	**0.239** (0.187-0.308)	**0.280** (0.215-0.368)	**0.324** (0.243-0.436)	**0.372** (0.272-0.513)	**0.440** (0.309-0.632)	**0.497** (0.338-0.737)
10-min	**0.120** (0.098-0.148)	**0.162** (0.132-0.200)	**0.220** (0.179-0.272)	**0.270** (0.218-0.337)	**0.342** (0.268-0.441)	**0.401** (0.308-0.527)	**0.464** (0.349-0.624)	**0.533** (0.390-0.736)	**0.631** (0.443-0.906)	**0.712** (0.484-1.06)
15-min	**0.145** (0.119-0.179)	**0.195** (0.160-0.241)	**0.266** (0.217-0.329)	**0.326** (0.264-0.407)	**0.414** (0.325-0.533)	**0.485** (0.373-0.638)	**0.561** (0.422-0.755)	**0.644** (0.471-0.890)	**0.763** (0.536-1.10)	**0.861** (0.585-1.28)
30-min	**0.203** (0.166-0.250)	**0.274** (0.224-0.338)	**0.372** (0.304-0.461)	**0.457** (0.370-0.571)	**0.580** (0.455-0.747)	**0.680** (0.522-0.893)	**0.786** (0.591-1.06)	**0.902** (0.660-1.25)	**1.07** (0.751-1.54)	**1.21** (0.820-1.79)
60-min	**0.274** (0.224-0.337)	**0.369** (0.302-0.456)	**0.502** (0.409-0.622)	**0.616** (0.499-0.769)	**0.782** (0.613-1.01)	**0.916** (0.704-1.20)	**1.06** (0.796-1.43)	**1.22** (0.890-1.68)	**1.44** (1.01-2.07)	**1.63** (1.11-2.41)
2-hr	**0.361** (0.296-0.446)	**0.481** (0.394-0.594)	**0.645** (0.526-0.799)	**0.784** (0.635-0.979)	**0.981** (0.769-1.26)	**1.14** (0.875-1.50)	**1.31** (0.980-1.76)	**1.48** (1.08-2.05)	**1.73** (1.22-2.49)	**1.93** (1.32-2.87)
3-hr	**0.419** (0.343-0.517)	**0.557** (0.456-0.688)	**0.744** (0.607-0.922)	**0.902** (0.730-1.13)	**1.12** (0.881-1.45)	**1.30** (0.998-1.71)	**1.48** (1.11-1.99)	**1.68** (1.23-2.32)	**1.95** (1.37-2.80)	**2.17** (1.47-3.22)
6-hr	**0.518** (0.424-0.639)	**0.692** (0.566-0.854)	**0.925** (0.754-1.15)	**1.12** (0.905-1.40)	**1.39** (1.09-1.79)	**1.60** (1.23-2.10)	**1.82** (1.37-2.45)	**2.05** (1.50-2.83)	**2.37** (1.67-3.40)	**2.62** (1.78-3.89)
12-hr	**0.603** (0.493-0.744)	**0.813** (0.665-1.00)	**1.10** (0.893-1.36)	**1.33** (1.08-1.66)	**1.65** (1.30-2.13)	**1.91** (1.47-2.51)	**2.17** (1.63-2.92)	**2.45** (1.79-3.39)	**2.83** (1.99-4.07)	**3.14** (2.13-4.66)
24-hr	**0.759** (0.673-0.872)	**1.04** (0.918-1.19)	**1.41** (1.24-1.62)	**1.71** (1.50-1.99)	**2.13** (1.81-2.56)	**2.46** (2.04-3.02)	**2.79** (2.26-3.52)	**3.14** (2.48-4.07)	**3.63** (2.74-4.89)	**4.00** (2.92-5.60)
2-day	**0.875** (0.777-1.01)	**1.21** (1.07-1.39)	**1.64** (1.45-1.89)	**1.99** (1.74-2.31)	**2.46** (2.09-2.96)	**2.82** (2.34-3.46)	**3.18** (2.58-4.01)	**3.56** (2.80-4.60)	**4.06** (3.07-5.48)	**4.44** (3.24-6.21)
3-day	**0.954** (0.847-1.10)	**1.32** (1.17-1.52)	**1.79** (1.58-2.06)	**2.16** (1.90-2.52)	**2.67** (2.26-3.21)	**3.05** (2.53-3.74)	**3.42** (2.77-4.31)	**3.81** (3.00-4.93)	**4.32** (3.26-5.83)	**4.71** (3.44-6.58)
4-day	**0.998** (0.885-1.15)	**1.38** (1.22-1.59)	**1.87** (1.65-2.15)	**2.25** (1.98-2.62)	**2.77** (2.35-3.33)	**3.15** (2.62-3.87)	**3.53** (2.86-4.45)	**3.92** (3.09-5.07)	**4.43** (3.35-5.98)	**4.81** (3.51-6.72)
7-day	**1.09** (0.965-1.25)	**1.49** (1.32-1.72)	**2.00** (1.77-2.31)	**2.40** (2.10-2.79)	**2.92** (2.48-3.52)	**3.31** (2.75-4.07)	**3.69** (2.99-4.65)	**4.07** (3.21-5.27)	**4.57** (3.45-6.17)	**4.94** (3.61-6.90)
10-day	**1.16** (1.02-1.33)	**1.58** (1.40-1.81)	**2.10** (1.86-2.43)	**2.52** (2.21-2.93)	**3.05** (2.59-3.68)	**3.45** (2.86-4.24)	**3.84** (3.11-4.83)	**4.22** (3.32-5.46)	**4.71** (3.56-6.36)	**5.08** (3.71-7.09)
20-day	**1.34** (1.19-1.54)	**1.84** (1.63-2.12)	**2.48** (2.19-2.86)	**2.97** (2.60-3.45)	**3.60** (3.06-4.34)	**4.07** (3.38-5.00)	**4.51** (3.66-5.69)	**4.96** (3.91-6.42)	**5.52** (4.17-7.46)	**5.94** (4.34-8.30)
30-day	**1.50** (1.33-1.72)	**2.10** (1.86-2.41)	**2.84** (2.51-3.28)	**3.43** (3.00-3.99)	**4.18** (3.54-5.03)	**4.73** (3.93-5.81)	**5.26** (4.26-6.63)	**5.79** (4.56-7.49)	**6.46** (4.88-8.72)	**6.95** (5.08-9.72)
45-day	**1.69** (1.50-1.95)	**2.41** (2.14-2.78)	**3.32** (2.93-3.83)	**4.02** (3.53-4.68)	**4.94** (4.19-5.95)	**5.62** (4.66-6.90)	**6.27** (5.08-7.90)	**6.92** (5.45-8.96)	**7.75** (5.86-10.5)	**8.37** (6.11-11.7)
60-day	**1.85** (1.64-2.13)	**2.68** (2.38-3.09)	**3.72** (3.29-4.30)	**4.54** (3.98-5.29)	**5.61** (4.76-6.75)	**6.40** (5.31-7.86)	**7.16** (5.81-9.02)	**7.92** (6.24-10.3)	**8.91** (6.73-12.0)	**9.63** (7.03-13.5)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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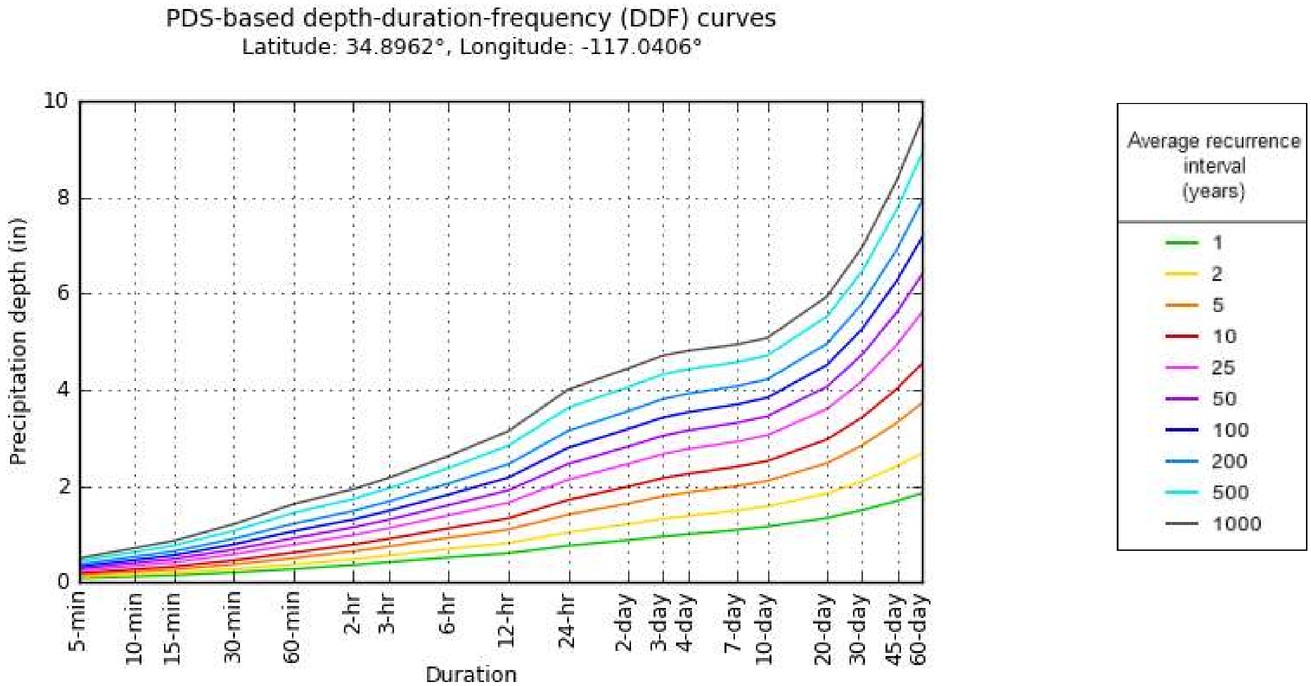
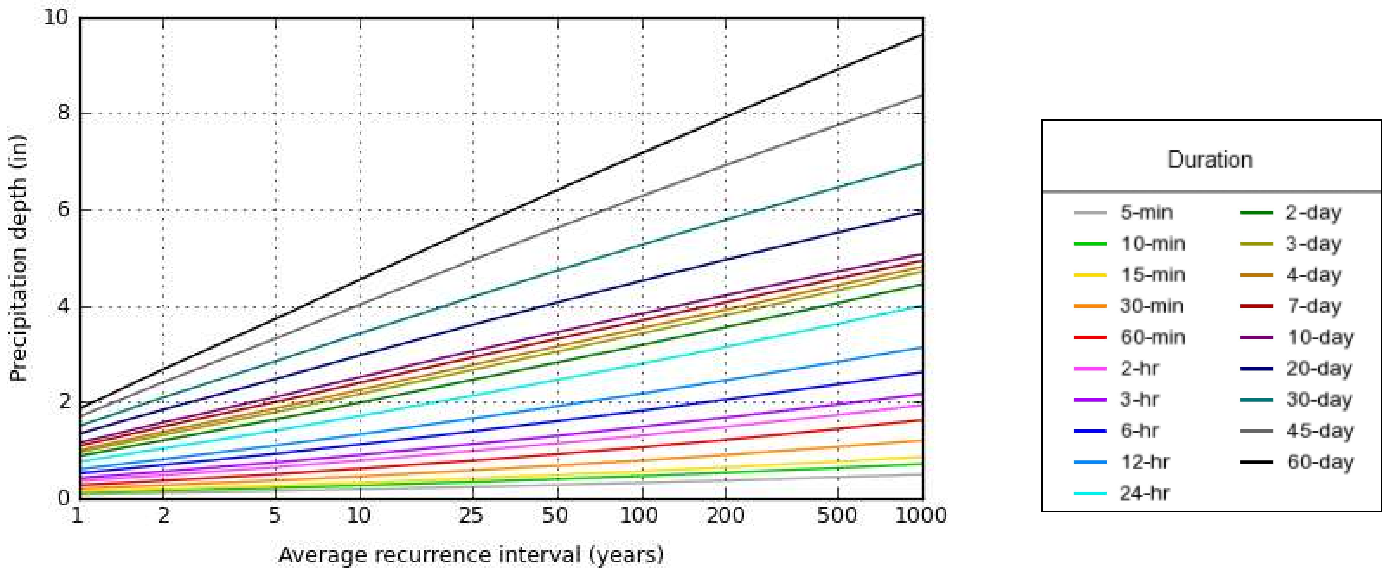
PF graphical





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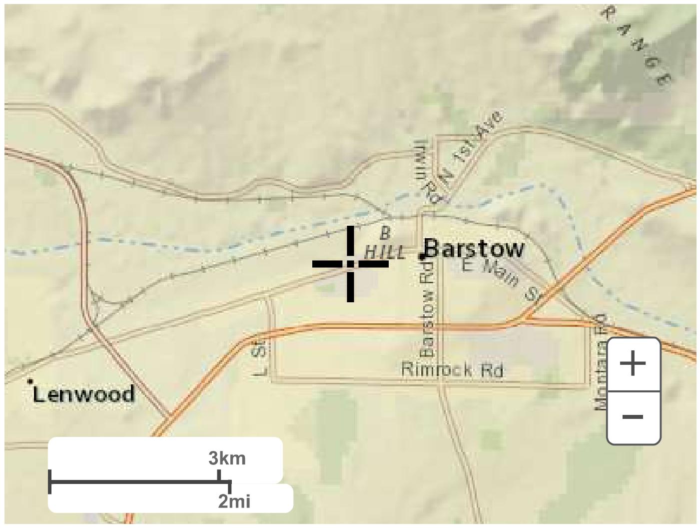
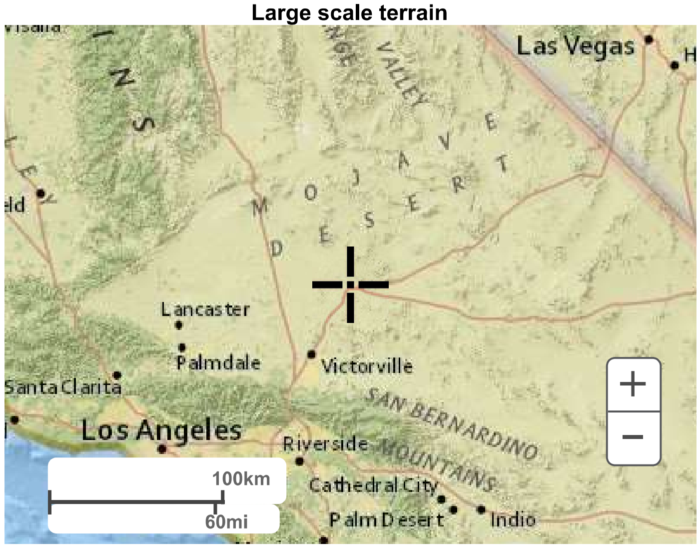
Maps & aerials

Small scale terrain

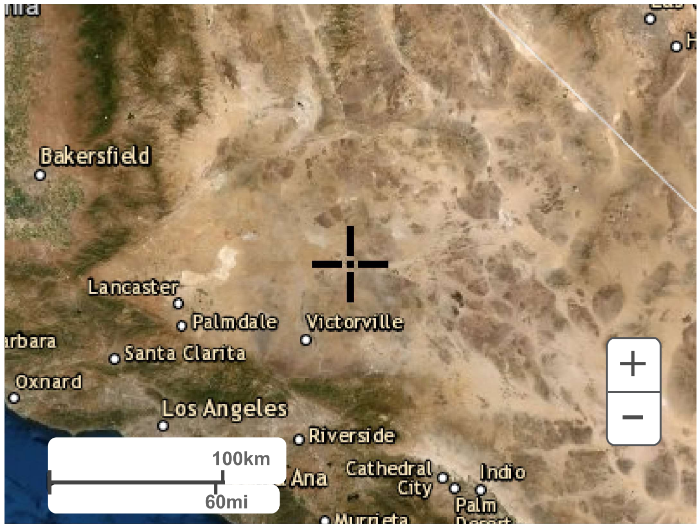


Large scale terrain



Large scale map

Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Attachment C: Geotechnical Investigation

GEOTECHNICAL AND INFILTRATION EVALUATION
PROPOSED PARKING LOT IMPROVEMENTS
1121 MAIN STREET
BARSTOW, SAN BERNARDINO COUNTY, CALIFORNIA

PREPARED FOR

MICHAEL BAKER INTERNATIONAL
3536 CONCOURS, SUITE 100
ONTARIO, CALIFORNIA 91764

ATTENTION: MR. MICHAEL TYLMAN

PREPARED BY

GEOTEK, INC.
1548 NORTH MAPLE STREET
CORONA, CALIFORNIA 92880

PROJECT NO. 2195-CR **AUGUST 20, 2019**

GEOTEK

GeoTek, Inc.
1548 North Maple Street, Corona, California 92880
(951) 710-1160 Office (951) 710-1167 Fax www.geotekusa.com

August 20, 2019
Project No. 2195-CR

Michael Baker International
3536 Concours, Suite 100
Ontario, California 91764

Attention: Mr. Michael Tylman

Subject: Geotechnical and Infiltration Evaluation
Proposed Parking Lot Improvements
1121 Main Street
Barstow, San Bernardino County, California

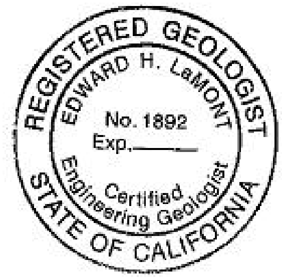
Dear Mr. Tylman:

We are pleased to provide the results of our geotechnical and infiltration evaluation for the proposed parking lot improvements located in Barstow, California. This report presents a discussion of our evaluation and provides preliminary geotechnical recommendations for site preparation, utility installation and pavement design.

Based on the results of our evaluation, the planned parking lot improvements appears feasible from a geotechnical viewpoint provided that the recommendations presented in this report and in future reports are incorporated into design and construction.

The opportunity to be of service is sincerely appreciated. If you have any questions, please do not hesitate to contact our office.

Respectfully submitted,
GeoTek, Inc.



Robert R. Russell
GE 2042, Exp. 12/31/20
Senior Project Engineer

Edward H. LaMont
CEG 1892, Exp. 07/31/20
Principal Geologist

Anna M. Scott
Project Geologist

Distribution: (1) Addressee via email (one PDF file)

G:\Projects\2151 to 2200\2195CR Michael Baker International 1121 Main Street Barstow\Geotechnical and Infiltration Evaluation\2195CR Geotechnical and Infiltration Evaluation Barstow.docx

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ENCLOSURES

1.0 PURPOSE AND SCOPE OF SERVICES

The purpose of this study was to evaluate the geotechnical conditions for the proposed parking lot improvements at 1121 Main Street, located in Barstow, California. Services provided for this study included the following:

- Research and review of available geologic and geotechnical data and general information pertinent to the site,
- A site reconnaissance,
- Excavation of 2 exploratory borings for the geotechnical evaluation,
- Excavation of 2 additional borings and perform infiltration tests in those borings,
- Collection of soil samples in the test borings,
- Laboratory testing of selected soil samples, and
- Compilation of this geotechnical report which presents our preliminary recommendations for site development.

The intent of this report is to aid in the evaluation of the site for future proposed development from a geotechnical perspective. The professional opinions and geotechnical information contained in this report may need to be updated based upon our review of the final site development plans. These plans should be provided to GeoTek, Inc. for review when available.

2.0 SITE DESCRIPTION AND PROPOSED DEVELOPMENT

2.1 SITE DESCRIPTION

The subject site is located at 1121 Main Street in Barstow, San Bernardino County and is situated along the north side of Main Street. The site is presently improved with two pre-school structures and associated parking/drive improvements. The topography of the site is generally flat with less than about 4 feet of elevation differential. The approximate location of the site is presented on Figure 1.

2.2 PROPOSED IMPROVEMENTS

We understand that it is planned to construct a pathway from the pre-school building to the northerly structure and also construct a new pavement area for parking. A new storm water disposal facility is also proposed.

Based on the site topography it appears that maximum cuts and fills of less than approximately two feet, not including utility installation, will be required and major permanent slopes and retaining walls are not proposed.

3. FIELD EXPLORATION AND LABORATORY TESTING

3.1 FIELD EXPLORATION

Our field exploration for the project was conducted on August 9, 2019 and included two geotechnical test borings which were excavated with a truck-mounted hollow-stem auger drill rig to depths of about 21-½ feet below existing grade. A geologist from GeoTek logged the exploratory borings. The boring locations are presented on Figure 2. Logs of the exploratory borings are included in Appendix A.

The exploration logs show subsurface conditions at the dates and locations indicated and may not be representative of other locations and times. The stratification lines presented on the logs represent the approximate boundaries between soil types and the transitions may be gradual.

In the geotechnical borings, relatively undisturbed soil samples were recovered at various intervals with a California sampler. The California sampler is an approximate 3-inch outside diameter, 2.5-inch inside diameter, split barrel sampler lined with brass rings. The sampler was 18 inches long. The sampler conformed to the requirements of ASTM D 3550. A 140-pound automatic trip hammer was utilized, dropping 30 inches for each blow. The relatively undisturbed samples, together with bulk samples of representative soil types, were returned to the laboratory for testing and evaluation.

Two borings (I-1 and I-2) were also excavated in the vicinity of the proposed stormwater management area to depths of about 4 and 30 feet, as requested by the civil engineer. Infiltration testing was conducted in these borings in general accordance with the requirements of the County of San Bernardino (Technical Guidance Document, 2013). The infiltration tests consisted of drilling an eight-inch diameter test hole to the desired depth and installing approximately two inches of gravel in the bottom of the hole. A three-inch diameter perforated PVC pipe, wrapped in a filter sock, was placed in the excavations and the annular space was filled with gravel to prevent caving within the boring. Water was then placed in the borings to presoak the holes for two 25 minutes periods. Following presoaking, percolation testing was performed and included six test cycles. Results of the field infiltration testing is presented below and the field infiltration data is provided in Appendix C.

Test No.	Boring Depth	Soil Type	Percolation Rate	Infiltration Rate*
I-1	4 ft	Silty Sand	67.5 in/hr	50.51 in/hr
I-2	30 ft	Silty Sand	43.5 in/hr	1.49 in/hr

*Percolation rate converted to an Infiltration rate using the Porchet Method.

3.2 LABORATORY TESTING

Laboratory testing was performed on selected soil samples obtained during our field exploration. The purpose of the laboratory testing was to confirm the field classification of the soils encountered and to evaluate the physical properties of the soils for use in engineering design and analysis.

Included in our laboratory testing included moisture-density determinations on representative undisturbed samples and an Expansion Index (EI) test on a representative sample of the near-surface soil. R-value testing was performed on a near surface soil sample for pavement design purposes. Chemical testing comprised of pH, soluble sulfate, chloride and resistivity testing was conducted on a selected sample. The moisture-density data are presented on the exploration logs. The R-value, Expansion Index test and chemical test data are presented in Appendix B.

4 GEOLOGIC AND SOILS CONDITIONS

4.1 REGIONAL SETTING

The subject property is situated in the Mojave Desert geomorphic province. The Mojave Desert province is a broad interior region of isolated mountain ranges separated by expanses of desert plains. This province includes both NW-SE (more prominent) and E-W faulting. The province is wedged in between the Garlock fault and the San Andreas fault, where it bends east from its major trend.

More specific to the subject property, the site is located in an area geologically mapped to be underlain by alluvial deposits (USGS, 1960).

4.2 GENERAL SOIL/GEOLOGIC CONDITIONS

A brief description of the soils encountered on the site is presented in the following sections. Based on our field exploration and observations, the site is generally underlain by alluvium.

4.2.1 Alluvium

Alluvial deposits consisting of loose to medium dense silty sand and sand with trace amounts of gravel and silt, and very stiff sandy silt were encountered below the ground surface in our test borings. The alluvium extended to the maximum depths explored.

4.3 SURFACE AND GROUNDWATER

4.3.1 Surface Water

Surface water was not observed during our site visit. If encountered during earthwork construction, surface water on this site is the result of precipitation or possibly some minor surface run-off from surrounding areas. Overall site drainage is generally in a southwest direction, as directed by site topography. Provisions for surface drainage will need to be accounted for by the project civil engineer.

4.3.2 Groundwater

Groundwater was not encountered in our test borings. Based on a review of groundwater data contained in the State Department of Water Resources Water Data Library and State Geotracker websites, we estimate that the depth to groundwater is greater than 50 feet below ground surface. Based on this estimated depth to groundwater, groundwater related problems are not expected.

4.4 FAULTING AND SEISMICITY

The geologic structure of the entire southern California area is dominated mainly by northwest-trending faults associated with the San Andreas system. The site is in a seismically active region. No active or potentially active fault is presently known to exist at this site nor is the site situated within an *"Alquist-Priolo"* Earthquake Fault Zone. The County of San Bernardino (Geologic

Hazards Map EH08 C) indicates the site area as "not in a fault zone" and "not within a liquefaction susceptible area". The nearest known active fault is the Mount General Fault Zone, located about 1.8 miles to the northwest.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 GENERAL

The proposed improvements appear feasible from a geotechnical viewpoint provided that the recommendations presented in this report are incorporated into the design and construction phases of development.

5.2 EARTHWORK CONSIDERATIONS

Earthwork and grading should be performed in accordance with the applicable grading ordinances of the City of Barstow, the County of San Bernardino, the 2016 California Building Code (CBC) and recommendations contained in this report. The Grading Guidelines included in Appendix D outline general procedures and do not anticipate all site-specific situations. In the event of conflict, the recommendations presented in the text of this report should supersede those contained in Appendix D.

5.2.1 Site Clearing & Demolition

In areas of planned grading and improvements, any conflicting construction should be demolished and removed including all foundations, utilities and any other below-grade construction. Conflicting utilities should either be removed or re-routed around the planned improvements. Debris generated by the clearing and demolition operations should be properly disposed of off-site. Voids resulting from site clearing and demolition should be backfilled with engineered fill compacted to at least 90 percent of the soil's maximum dry density, per ASTM D-1557.

5.2.2 Site Preparation

Following site stripping, and lowering of site grades where necessary, we recommend that the exposed subgrade beneath the future paved areas and beneath all other areas to receive surface improvements and/or new fill soils should be proof rolled with a rubber-tired piece of construction equipment approved by and in the presence of the geotechnical engineer. The proof roll equipment should possess a minimum weight of 15 tons and proof rolling should include at least four passes, two in each perpendicular direction. Any soil that ruts or excessively deflects during proof rolling should be removed as recommended by the geotechnical engineer. The lateral extent of the proof rolling should extend at least 3 feet beyond the limits of all surface improvements, where possible.

Following proof rolling and any necessary additional over-excavation, the exposed soils should be examined and approved by the geotechnical engineer. Upon approval, the exposed soils should be scarified to a depth of approximately 12 inches, moistened to slightly above the soil's the optimum moisture content and compacted to a minimum relative compaction of 90 percent (ASTM D 1557). The top 12 inches of subgrade beneath new pavements should be compacted to at least 95 percent of the soil's maximum dry density.

5.2.3 Engineered Fills

The on-site soils are generally considered suitable for reuse as engineered fill and backfill provided they are free from vegetation, debris and other deleterious material. Engineered fill should be placed in loose lifts with a thickness of eight inches or less, moisture conditioned to about two percent above the optimum moisture content and then compacted to at least 90 percent of the soil's maximum dry density, per ASTM D-1557.

5.2.4 Trench Excavations and Backfill

Temporary excavations within the on-site materials should be stable at 1:1 inclinations for short durations during construction, and where cuts do not exceed 12 feet in height. We anticipate that temporary cuts to a maximum height of four feet can be excavated vertically.

Trench excavations should conform to Cal-OSHA regulations. The contractor should have a competent person, per OSHA requirements, on site during construction to observe conditions and to make the appropriate recommendations.

Utility trench backfill should be compacted to at least 90 percent relative compaction (ASTM D 1557). Where applicable, based on jurisdictional requirements, the top 12 inches of backfill below subgrade for pavements should be compacted to at least 95 percent relative compaction. Compaction should be achieved with a mechanical compaction device. Ponding or jetting of trench backfill is not recommended. If soils to be used as backfill have dried out, they should be thoroughly moisture conditioned prior to placement in trenches.

Materials for use in any bedding zones should consist of a free draining granular soil such as sand, gravel, or crushed aggregate containing no rocks greater than one inch in maximum dimension and having a sand equivalent of not less than 30. In general, bedding material should be compacted by mechanical means and should be placed in lifts not exceeding eight inches in loose thickness.

Each lift should be moisture-conditioned to optimum moisture content or above. Bedding should be brought up uniformly on both sides of underground improvements.

In accordance with the definition of the Standard Specifications for Public Works Construction (Green Book), Section 306.1.21, bedding is the material supporting, surrounding and extending to one foot above the top of the pipe. Bedding material should have a sand equivalent of at least 30.

5.3 PAVEMENT DESIGN

The appropriate pavement section depends primarily upon the type of subgrade soil, traffic load and planned pavement life. Based on the results of laboratory R-value testing (R=73), an R-value of 70 was utilized for preliminary pavement design. For preliminary pavement design, we have also assumed Traffic Indices of 5.0 and 6.0 for car parking and drive lanes for the new parking areas. Final pavement design should be evaluated after R-value tests have been performed on the actual as-graded subgrade material.

Street	Assumed Traffic Index	Asphaltic Concrete/Aggregate Base (inches)
Car Parking Areas	5.0	3 over 4 OR 3.5 over native
Drive Lanes	6.0	3 over 4

The final pavement sections are subject to the review and approval by the local jurisdictional agency. Performance of the pavement sections will ultimately be based largely on construction methods, traffic loading and subgrade performance.

All pavement installation, including preparation and compaction of subgrade and base material and placement and rolling of asphaltic concrete, should be done in accordance with the City of Barstow and/or County of San Bernardino specifications, and under the observation and testing of GeoTek and a City or County inspector where required.

The aggregate base should consist of crushed rock with an R-Value and gradation in accordance with Crushed Aggregate Base (Section 200-2 of the "Greenbook"). Minimum compaction requirements should be 95 percent for both subgrade and aggregate base (ASTM D 1557). Jurisdictional minimum compaction requirements in excess of the aforementioned minimums may govern.

5.4 CORROSIVITY TESTING

5.4.1 Soil Corrosivity

Based on the chemical test results presented in Appendix B, the corrosivity test results indicate that the on-site soils are "corrosive" to buried ferrous metal. This corrosion classification is obtained from "Corrosion Basics: An Introduction," by Pierre Roberge (2005). Recommendations for any protection of buried ferrous metal should be provided by a corrosion engineer.

5.4.2 Soil Sulfate Content

Based on the chemical test results presented in Appendix B, the sulfate test results on a sample obtained from the project site indicate a soluble sulfate content of less than 0.1% by weight. Soluble sulfate contents of this level would be in the range of "not applicable" (i.e. negligible) in accordance with Table 4.2.1 of ACI 318. Based on the test results and Table 4.3.1 of ACI 318, no special concrete mix design will be necessary to resist sulfate attack.

5.4.3 Import Soils

Import soils should have a "very low" expansion potential. GeoTek, Inc. also recommends that the proposed import soils be tested for expansion and corrosivity potential. GeoTek, Inc. should be notified a minimum of 72 hours prior to importing so that appropriate sampling and laboratory testing can be performed.

5.5 CONCRETE FLATWORK

5.5.1 Exterior Concrete Slabs, Sidewalks and Driveways

Exterior concrete slabs, sidewalks and driveways should be designed using a four-inch minimum thickness. Some shrinkage and cracking of the concrete should be anticipated as a result of typical mix designs and curing practices typically utilized in construction.

Sidewalks and driveways may be under the jurisdiction of the governing agency. If so, jurisdictional design and construction criteria would apply, if more restrictive than the recommendations presented in this report.

Subgrade soils should be pre-moistened prior to placing concrete. The subgrade soils below exterior slabs, sidewalks, driveways, etc. should be pre-saturated to a minimum of 100 percent of the optimum moisture content to a depth of 12 inches.

All concrete installation, including preparation and compaction of subgrade, should be done in accordance with the City of Barstow/County of San Bernardino specifications, and under the observation and testing of GeoTek and a City/County inspector, if necessary.

5.5.2 Concrete Performance

Concrete cracks should be expected. These cracks can vary from sizes that are essentially unnoticeable to more than 1/8 inch in width. Most cracks in concrete, while unsightly, do not significantly impact long-term performance. While it is possible to take measures (proper concrete mix, placement, curing, control joints, etc.) to reduce the extent and size of cracks that occur, some cracking will occur despite the best efforts to minimize it. Concrete undergoes chemical processes that are dependent on a wide range of variables, which are difficult, at best, to control. Concrete, while seemingly a stable material, is subject to internal expansion and contraction due to external changes over time.

One of the simplest means to control cracking is to provide weakened control joints for cracking to occur along. These do not prevent cracks from developing; they simply provide a relief point for the stresses that develop. These joints are a widely accepted means to control cracks but are not always effective. Control joints are more effective the more closely spaced they are. GeoTek, Inc. suggests that control joints be placed in two directions and located a distance apart approximately equal to 24 to 36 times the slab thickness.

5.6 PLAN REVIEW AND CONSTRUCTION OBSERVATIONS

We recommend that site specifications and improvement plans be reviewed by this office prior to construction to check for conformance with the recommendations of this report. We also recommend that GeoTek representatives be present during any site earthwork, trenching, and backfilling to check for proper implementation of the geotechnical recommendations. These representatives should perform at least the following duties:

- Observe trenching and excavation operations, in order to evaluate temporary stability of cuts.
- Observe bottom of trenches prior to any pipe/backfill placement.
- Evaluate the suitability of on-site and import materials for fill placement and collect soil samples for laboratory testing where necessary.
- Observe the utility trench backfill for uniformity during placement. Also, test the fill for field density and relative compaction.

Our findings are based on site conditions observed and the stated sources. Thus, our comments are professional opinions that are limited to the extent of the available data.

GeoTek has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practicing under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report.

Since our recommendations are based on the site conditions observed and encountered, and laboratory testing, our conclusions and recommendations are professional opinions that are limited to the extent of the available data. Observations during construction are important to allow for any change in recommendations found to be warranted. These opinions have been derived in accordance with current standards of practice and no warranty of any kind is expressed or implied. Standards of care/practice are subject to change with time.

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