Appendix E:
Geotechnical Investigation Report

THIS PAGE INTENTIONALLY LEFT BLANK

GEOPlus

GEOTECHNICAL INVESTIGATION REPORT
WAL-MART #2044-03 EXPANSION
2044 FOREST AVENUE
CHICO, CALIFORNIA

RECEIVED
JUL 02 2015
CITY OF CHICO
PLANNING SERVICES

February 15, 2008

GEOPlus File No. 1235 / 08R013
PACLAND File No. 30001012/030

© 2008 GEOPlus, Inc. All rights reserved.
This document was prepared for the exclusive use of Wal-Mart Stores, Inc. and PACLAND and their respective successors and assigns, only for the purposes stated within a reasonable time from issuance. Non-commercial, educational, and scientific use of this report by regulatory agencies is regarded as a "fair use" and not a violation of copyright. Regulatory agencies may make additional copies of this document for internal use. Copies may also be made available to the public as required by law. The reprint must acknowledge the copyright and indicate that permission to reprint has been received.

19690 Hirsch Court #2 Anderson, CA 96007-4941
(530) 365-8088 (530) 365-8788 fax www.geoplusinc.com

A Report Prepared For:

Wal-Mart Stores, Inc.
c/o PACLAND
606 Columbia Street NW, Ste. 211
Olympia, WA 98501

Attn: Mr. Mike Neer, Principal

GEOTECHNICAL INVESTIGATION REPORT
WAL-MART #2044-03 EXPANSION
2044 FOREST AVENUE
CHICO, CALIFORNIA

GEOPlus, Inc. File No. 1235 / 08R013
PACLAND Project No. 30001012/030

Prepared by:

REGISTERED GEOLOGIST
JOHN LYMAN FINNIGSMIER
No. 2028
EXP. 7/08
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

John L. Finnigsmier, PG, CEG
Principal Engineering Geologist

REGISTERED PROFESSIONAL ENGINEER
TRAVER E. METCALF, JR.
No. GE2363
Exp. 06/10
GEOTECHNICAL
STATE OF CALIFORNIA

Traver E. Metcalf, Jr., PE, GE
Principal Geotechnical Engineer

February 15, 2008

© 2008 GEOPlus, Inc.

GEOTECHNICAL INVESTIGATION REPORT
WAL-MART #2044-03 EXPANSION
2044 FOREST AVENUE
CHICO, CALIFORNIA

February 15, 2008

GEOPlus File No. 1235 / 08R013
PACLAND File No. 30001012/030

© 2008 GEOPlus, Inc. All rights reserved.
This document was prepared for the exclusive use of Wal-Mart Stores, Inc. and PACLAND and their respective successors and assigns, only for the purposes stated within a reasonable time from issuance. Non-commercial, educational, and scientific use of this report by regulatory agencies is regarded as a "fair use" and not a violation of copyright. Regulatory agencies may make additional copies of this document for internal use. Copies may also be made available to the public as required by law. The reprint must acknowledge the copyright and indicate that permission to reprint has been received.

A Report Prepared For:

Wal-Mart Stores, Inc.
c/o PACLAND
606 Columbia Street NW, Ste. 211
Olympia, WA 98501

Attn: Mr. Mike Neer, Principal

GEOTECHNICAL INVESTIGATION REPORT
WAL-MART #2044-03 EXPANSION
2044 FOREST AVENUE
CHICO, CALIFORNIA

GEOPlus, Inc. File No. 1235 / 08R013
PACLAND Project No. 30001012/030

Prepared by:

John L. Finnigsmier, PG, CEG
Principal Engineering Geologist

Traver E. Metcalf, Jr., PE, GE
Principal Geotechnical Engineer

February 15, 2008

© 2008 GEOPlus, Inc.

EXECUTIVE SUMMARY

GEOPlus, Inc. has completed a geotechnical engineering evaluation related to the design and construction of an approximate 82,595 square foot addition to the existing Wal-Mart store at 2044 Forest Avenue in Chico, California. We understand the proposed addition will involve expanding the building primarily to the south from the existing building. The expansion will involve construction on areas currently consisting of truck loading, automobile parking, and truck and automobile driveways, landscape buffer, and undeveloped land for building and parking areas south of the existing building. The expansion will also include a minor vestibule addition on the east side of the store. New landscape areas will be constructed on the southern and western margins of the site, and will connect with the existing landscape buffer on the west side of the site. Existing utilities on the south side of the existing building, including above ground electrical transmission lines, which will be relocated. This report has been prepared based on data presented in geotechnical investigation reports for the original store site prepared by Twining Laboratories Inc. (TLI) dated December 12, 1992 and for the expansion prepared by Kleinfelder, Inc. (KI), dated March 20, 2003. New subsurface investigation and laboratory testing was performed for this report as well. An evaluation of existing pavement conditions and recommendations for extending the life of existing pavements was performed by Pavement Engineering, Inc. dated January 17, 2008.

Based on the results of our evaluation, it is our opinion that this property is generally suitable for the proposed expansion from a geotechnical perspective using relatively conventional design and construction techniques. Key design items are summarized below, and discussed in greater detail in the body of this report. Recommendations presented in this report are for the site layout as depicted on *"Schematic Site Plan, Duncan Shopping Center Expansion (Wal-Mart Store #2044), 2044 Forest Avenue, Chico, California,"* Sheet SC 3, dated November 9, 2007, prepared by PACLAND. Additionally, this report has been prepared in accordance with the Geotechnical Investigation Specifications and Report Requirements (including gas station) version dated September 27, 2007).

Soils: The major soil units encountered in the undeveloped and developed portion of the site consist of sandy lean clay, sandy lean to fat clay, clayey sand with gravel, poorly graded gravel with sand and clay, and gravelly clay; these soils extended to depths of about 2-1/2 to 9 feet beneath existing grade. Cobble to 6 inches is present within the surficial soil units. Beneath these soils variably cemented Tuscan formation materials consisting of poorly graded gravel with sand and clay was encountered to the full depth of exploration at 15-1/2 feet beneath existing grade. Fill encountered in developed areas of the site included asphalt concrete, baserock, reworked native soils and utility backfill. Additionally, visual observations indicate that about 1 to possibly 2 feet of fill is present in the existing landscaped area located south of the existing building and parking area.

Groundwater: Slow seeps were encountered in boring Nos. B-18, -19, and -20 at depths of 11 to 13 feet beneath existing grade 18-hours after drilling. Seepage and wet soil conditions defined by wet soil and wetness on the sampler were noted in several borings in the KI geotechnical report. No seepage was reported in the TLI geotechnical report. Seasonal perched groundwater development at shallow depths should be expected within the near surface soil due to the presence of fine-grained clay soils and/or dense Tuscan formation materials.

© 2008 GEOPlus, Inc.

Seismic: The site is located within Seismic Zone 3 as defined in the California Building Code (CBC, 2007). Zone 3 includes all of Butte County and represents an area of moderate seismic risk. The estimated peak bedrock acceleration with 10 percent probability of exceedance in 50 years is 0.14g for a "soft rock" site (CGS, 2007). Based on the local geology and the soil conditions encountered beneath the site, CBC Soil Profile Type C represents the closest approximation to the site conditions and is recommended for use in design. Therefore, from Figures 1613.5(3) and 1613.5(4) S_s and S_1 are 0.64 and 0.22, respectively.

Site Earthwork Recommendations: We estimate that over the portion of the site not presently covered with pavement about 2 to 3 inches of topsoil, surface vegetation, near-surface roots, and other organic materials will require stripping prior to subgrade preparation. Deeper stripping will likely be required to remove deeper root systems associated with the trees and brush growing along the south side of the landscape area on the developed parcel. Stripped material will not generally be suitable for re-use as structural fill; however, it can be screened and re-used in landscape areas, if desired. Topsoil that is unsuitable for use as landscape soil, or unwanted topsoil and other stripped material should be exported from the site. Previous disking activity on the undeveloped portion of the site, and rutting from past vehicle travel, may require deeper soil removal to address organic soils locally.

All existing fill beneath the building expansion area should be removed and reconstructed as engineered fill, except where beneath existing parking lot paving – note this includes all exiting utility trench and culvert backfill. It should be feasible to use the native clay and clayey sand for engineered fill provided they are properly moisture conditioned and compacted as discussed in Section 4.1. However, the medium to high plasticity clays soils will require additional effort to uniformly moisture condition prior to placement and compaction, if the soil is dry or wet of the recommended soil moisture range. A minimum 12-inch thick layer of non-expansive imported granular material should be used for structural fill beneath the slab-on-grade in the building areas. Subgrade stabilization with geosynthetic fabric and coarse crushed rock should be anticipated if construction occurs when the native clay soils are significantly wet of optimum moisture content; alternatively lime-treatment to dry and stabilize soils may be performed provided appropriate design and construction protocols for lime treating soils are followed. Subgrade preparation and proof rolling recommendations are presented in Section 4.1.

Shallow Foundations: Based upon the soils encountered during the previous site investigation as well as the current study, shallow foundations should be suitable for the project provided footing excavations are prepared in accordance with the recommendations provided in Section 4.2. Spread footings should bear on dense or hard native, re-compacted native soils, engineered fill, or properly compacted structural fill placed after existing fill has been removed. Individual column footings and continuous strip footings should have minimum widths of 24 and 18 inches, respectively. Spread foundations that are constructed as described above may be designed for bearing pressures up to 2,000 pounds per square foot (psf). This applies to dead plus frequently applied live loads and may be increased by up to one-third for the inclusion of wind or seismic forces. Exterior and interior footings should be founded a minimum of 30 inches below the lowest adjacent grade, to bear below the depth of

© 2008 GEOPlus, Inc.

seasonal moisture change and reduce potential intrusion of moisture from exterior areas to beneath the building. Shallow foundation recommendations are provided in Section 4.2.

Drainage Considerations: Building, pavement, and sidewalk areas are expected to generate considerable volumes of surface water during precipitation events. We recommend all building downspouts be connected directly to the storm drain system. Positive drainage should be provided away from the building foundation (see Section 4.6).

Since the site soils include moderately to highly plastic soil, and the potential exists for perched groundwater to develop over fine-grained clay soil and/or dense Tuscan formation materials, subsurface drainage from the pavement areas east and south of the store should be collected in storm drain trench backfill in trenches east and south of the expansion, and transferred to the storm drain system. Footing drains are not required for the building foundation provided drainage relief in the storm drain trenches is provided.

Interior Floor Slabs: The subgrade under all floor slab areas should be prepared in accordance with Section 4.1. We recommend that all floor slabs be underlain by a minimum 4-inch thick layer of compacted crushed rock (coarse aggregate base). This gravel layer will act as a capillary moisture break, reducing the transfer of moisture through the slab. The capillary moisture break should be supported on 12 inches of non-expansive, granular, import fill. Fine aggregate "choker" up to ¾ inches thick may be used to achieve fine grading tolerances and should be used where base material does not have sufficient fine particle to produce a surface free of exposed aggregate. Since the potential for perched water to develop in the surficial soils over the dense Tuscan formation materials and clays exists and the existing building includes one, we recommend that a vapor retarder be included in the floor slab design. The vapor retarder should be placed directly on top of the fine aggregate base material. For slabs supported on subgrades that are prepared in accordance with the preceding recommendations, the floor slab may be designed for a modulus of subgrade reaction (k) of 200 pounds per cubic inch.

Where floor slabs are constructed adjacent to existing floor slabs, we recommend the slabs be structurally connected to reduce the potential for cracking associated with differential settlement. As a minimum we recommend the slabs be doweled together; to further reduce settlement at the joint a deepened section should be considered.

Excavations/Subsurface Structures: For use with OSHA regulations, the near surface clay, sandy clay and gravelly clay encountered across on the site would be classified as soil Type A. For these soil types, OSHA recommends maximum slope inclinations of 3/4:1 (horizontal:vertical). Deeper excavations which penetrate the underlying granular soils will be Type C, where free of clay or in the presence of seepage; for these soils OSHA recommends maximum slope inclinations of 1.5:1 for excavations 20 feet or less in depth. Around the perimeter of the existing Wal-Mart building, subsurface excavations deeper than about two feet beneath surface grade (bsg) may experience seepage associated with perched water (see Section 4.6).

Excavations adjacent to the existing structure should be planned to limit the length of excavation that is open at any one time. Excavation in "windows" should be planned in order to reduce the potential for movement of the existing structure.

© 2008 GEOPlus, Inc.

Pavements: We recommend that new light-duty pavements be designed for 3.0 inches of asphalt concrete (AC) over 16.5 inches of Class 2 Aggregate Base (AB) or 6.5 inches of Class 2 AB over 11.0 inches of Class 2 Aggregate Subbase (ASB). Heavy duty pavements should be constructed with 4.0 inches of AC over 16.5 inches of AB or 6.0 inches of AB over 11.5 inches of ASB (see Section 4.7).

Existing pavements around the facility will require a combination of removal and reconstruction, paving fabric, and asphalt concrete overlays ranging from 2.0 inches in parking areas to 2.5 inches in heavy duty pavement areas. Remedial recommendations for addressing existing pavements are presented in Section 4.8.

This summary is intended for introductory and reference use only. A thorough reading of the entire report is essential for understanding total design concepts and limitations.

© 2008 GEOPlus, Inc.

TABLE OF CONTENTS

1. INTRODUCTION 3

1.1 GENERAL 3
1.2 PROJECT DESCRIPTION 3
1.3 AUTHORIZATION AND SCOPE OF WORK 4

2. PREVIOUS INVESTIGATIONS 4

2.1 TWINING LABORATORIES, INC. 4
2.2 KLEINFELDER, INC. 5

3. SITE INVESTIGATION 5

3.1 SITE RECONNAISSANCE 5
3.2 GEOPLUS, INC. – SUBSURFACE EXPLORATION 6
3.3 LABORATORY TESTING 6
3.4 EXISTING PAVEMENT EVALUATION 7

4. SITE CONDITIONS 7

4.1 SITE CLIMATE 7
4.2 REGIONAL AND SITE GEOLOGY 7
4.3 FAULTING AND SEISMICITY 9
4.3.1 Site Soil Profile Type and Seismic Parameters 9
4.3.2 Other Geologic Hazards 10
4.4 SURFACE CONDITIONS 10
4.5 SUBSURFACE CONDITIONS 10
4.5.1 Soils 11
4.5.2 Top Soil Analysis 12
4.5.3 Resistivity, pH, Chloride and Sulfate Content 12
4.5.4 Groundwater 13

5. CONCLUSIONS AND RECOMMENDATIONS 14

5.1 SITE EARTHWORK RECOMMENDATIONS 17
5.1.1 Site Preparation 17
5.1.2 Unstable Ground 18
5.1.3 Excavation Dewatering 19
5.1.4 Scarification 20
5.1.5 Structural and Non-Expansive Fill Materials 20
5.1.6 Wet Weather Construction 22
5.1.7 Structural Fill Settlements 22
5.2 FOUNDATION RECOMMENDATIONS 23
5.2.1 Shallow Spread Footings 23
5.2.2 Lateral Resistance 24
5.3 CONCRETE FLOOR SLABS 24
5.4 RETAINING WALLS 25
5.4.1 Retaining Wall Backfill 26
5.4.2 Backfill Drainage 26
5.5 SUBSURFACE FACILITIES 27
5.5.1 Temporary Excavations 27
5.5.2 Trench Backfill 27
5.5.3 Subdrainage Provisions for Utility Trenches 28
5.5.4 Excavation Dewatering 28
5.6 DRAINAGE CONSIDERATIONS 29
5.7 ASPHALT CONCRETE PAVEMENT RECOMMENDATIONS – NEW PAVEMENTS 29
5.7.1 Subgrade Preparation 30
5.7.2 Pavement Sections 30
5.7.3 Variations in Subgrade Materials 33
5.8 ASPHALT CONCRETE PAVEMENT RECOMMENDATIONS – EXISTING PAVEMENTS 33

© 2008 GEOPlus, Inc.

5.8.1 Existing Pavement Condition *33*
5.8.2 Existing Pavement – Remedial Recommendations *34*
5.9 PORTLAND CEMENT CONCRETE PAVEMENT RECOMMENDATIONS 36

6. REFERENCES **38**

7. ADDITIONAL SERVICES **39**

7.1 PLANS AND SPECIFICATIONS REVIEW 39
7.2 CONSTRUCTION OBSERVATION AND TESTING 39

8. UNCERTAINTY AND LIMITATIONS **40**

PLATES

Plate 1 Location Map
Plate 2 Site Boring / Sample Plan
Plate 3 Storm Drain Trench Backfill Drainage
Plate 4 Backfill Drainage

APPENDIX A:

Soil Boring Logs and Explanation, sheets A-1 through A-16 (Kleinfelder, 2003)
Laboratory Test Results sheets A-17 through A-21, and Sunland Analytical Test Results dated 9-20-02 (Kleinfelder, 2003)

APPENDIX B

GEOPlus Soil Boring Logs and Explanation (7 sheets)

APPENDIX C

GEOPlus Laboratory Test Results, sheets C-1 through C-3, and Sierra Testing Laboratories, Sunland Analytical Laboratory, and Fruit Growers Laboratories Topsoil Analysis Test Results (6 sheets)

APPENDIX D

Twining Laboratories, Inc. 1992 Geotechnical Report

APPENDIX E

Pavement Engineering Inc. 2007 Pavement Evaluation Report

APPENDIX F

Geotechnical Investigation Fact Sheet
Foundation Design Criteria
Foundation Subsurface Preparation

APPENDIX G

Pavement Section Calculations

© 2008 GEOPlus, Inc.

1. INTRODUCTION

1.1 General

GEOPlus was retained by PACLAND on behalf of Wal-Mart to prepare a geotechnical investigation report for an approximate 82,595-square foot addition to the existing Wal-Mart Store No. 2044 located at 2044 Forest Avenue in Chico, California (see Plate 1). The purpose of our work was to review existing subsurface exploration and laboratory data prepared by others for the site, perform additional site exploration and laboratory testing, and present recommendations pertaining to geotechnical aspects of the proposed expansion project. This report is based primarily on the subsurface and laboratory data originally presented in the *"Geotechnical Engineering Investigation, Proposed Wal-Mart Store, Chico, California, TL492-0200-01,"* prepared December 15, 1992 by Twining Laboratories, Inc. (TLI), and *"Geotechnical Investigation Report, Wal-Mart #2044 Expansion, 2044 Forest Avenue, Chico, California,"* prepared by Kleinfelder, Inc. (KI) dated March 30, 2003 (KI file no. 20935).

The approximately 16.46-acre, existing Wal-Mart site was originally developed in 1992-93 on historically undeveloped land. The site expansion area consists of 8.20 acres of currently undeveloped land immediately to the south of the existing store site. The entire site is bounded on the north by Baney Lane, on the east by Forest Avenue, on the south by Wittmeier Drive and Wittmeier Ford, and State Route 99 and commercial development on the west. The site is located in the S 1/2 of Section 31, T22N, R2E, Mount Diablo Meridian. The site is located at 39.7293 north latitude and 121.8040 west longitude.

1.2 Project Description

We understand the proposed addition to the Wal-Mart Store will involve expanding the building primarily to the south. The southern expansion will include most of the 82,595-square feet building expansion and a truck dock / loading area. The eastern building expansion will involve adding about 25 feet for an entry vestibule for the building. The proposed building expansion footprint will overly existing concrete sidewalk, asphalt concrete pavement, landscape area and planters, infrastructure including underground and above ground utilities, and undeveloped property. Based on information provided by PACLAND and Wal-Mart's *Geotechnical Investigation Specifications and Report Requirements (including gas station), revised September 27, 2007*, we understand the maximum point load will be approximately 150 kips. Maximum bearing wall and interior column loads will be approximately 4.0 to 6.0 kips per lineal foot and 85 kips, respectively. The estimated maximum uniform floor slab live load is 125 psf. The estimated maximum floor slab concentrated load is 5.0 kips. Grading to prepare the building pad along the south side of the building will require up to about 4 to 5 feet of fill. Existing utilities, including two 42-inch diameter storm drain pipes, will be removed from beneath the building foot print.

A rigid concrete pavement truck lane area and a truck dock are proposed at the south side of the main building expansion. The remaining development planned as part of this project consists of vehicle access aisleways, parking, and landscape areas.

© 2008 GEOPlus, Inc.

Asphalt concrete pavement design for this project was based on criteria presented for Neighborhood Market that are based on Equivalent Single Axle Loads (ESALs) of 109,500 for Standard Duty and 211,700 for Heavy Duty pavement sections. Cuts for the new pavement areas are not expected to exceed about 1 to 2 feet.

The above project details are based on the *Schematic Site Plan, Duncan Shopping Center Expansion, (Wal-Mart Store #2044), 2044 Forest Avenue, Chico, California,* Sheet SC-3, dated November 09, 2007, prepared by PACLAND. If any of the above assumptions are incorrect we should be contacted to review our recommendations and update them, as appropriate.

1.3 Authorization and Scope of Work

In accordance with a request from PACLAND, GEOPlus submitted a proposal for preparing an update report incorporating KI's boring log and laboratory test data (January 30, 2003 Geotechnical Investigation Report) for the project. Written authorization was provided by Mike Neer of PACLAND, dated November 30, 2007. The scope of work for update of the geotechnical report included the following tasks:

- Review the exploration data, laboratory data and geotechnical recommendations presented within the 2003 KI report, prepared for the store expansion, and the 1992 TLI report, prepared for the original store construction;

- Prepare a geotechnical report for the currently planned expansion based on the subsurface and laboratory data collected primarily by KI and to a lesser extent the TLI report, additional subsurface exploration and laboratory testing, and in general accordance with Wal-Mart's *Geotechnical Investigation Specifications and Report Requirements (including gas station) revised September 25, 2007* and the 2001 California Building Code.

2. PREVIOUS INVESTIGATIONS

2.1 Twining Laboratories, Inc.

TLI investigated this site in 1989 and 1992. TLI's 1989 report addressed the initial site planning with both a geotechnical investigation and environmental site audit. The January 5, 1989 geotechnical investigation report for the project was not reviewed. The December 15, 1992 TLI geotechnical report, which addresses a revised building location from their 1989 report, was reviewed, and is included as Appendix D.

Subsurface conditions were explored from November 2 through 4, 1992 and consisted of drilling 24 borings with a truck-mounted CME-75 drill rig equipped with 6-5/8-inch diameter hollow-stem augers. Refusal to drilling was reported at depths ranging from 2-1/2 to 11-1/2 feet beneath existing grade in very dense clayey gravels and cobbles. Groundwater was not encountered during drilling, and borings were backfilled with cuttings.

Laboratory tests including moisture content, dry density, Atterberg limits, grain-size distribution, direct shear, unconfined compressive strength, consolidation, moisture-density relationship (compaction), Expansion Index, R-value, sulfate content, chloride content, resistivity, and pH were performed on select samples obtained from the investigation.

© 2008 GEOPlus, Inc.

2.2 Kleinfelder, Inc.

Subsurface conditions were investigated on August 27 and 28, 2002 by drilling 16 soil borings (boring Nos. B-1 through B-16), at representative locations within the proposed building expansion footprint and parking lot areas to depths ranging from 5-1/2 to 10-1/2 feet below then existing surface grade (bsg). Borings drilled to depths less than Wal-Mart requirements met refusal to auger drilling equipment on variably dense clayey gravel with sand, clayey sand with gravel, and cobbles. The subsurface soil borings were drilled using a Mobile Drill B-59 hollow-stem auger drilling rig. Exploration locations presented on the boring log location map were approximated by pacing from on-site features; the exploration locations presented in the KI boring location map are illustrated on Plate 2. Soil boring logs and legend sheets as presented by KI are included with this report in Appendix A.

The laboratory testing program conducted by KI in preparation of their 2003 report included the following:

- Unit weight and moisture testing (ASTM Test Method D-2216);
- Grain-size distribution (ASTM Test Method C-422);
- Resistance (R-) Value (ASTM D2844);
- Atterberg Limits testing (ASTM Test Method D-4318);
- Expansion Index testing (ASTM Test Method D-4829);
- Unconfined compressive strength testing (ASTM Test Method D-2166); and,
- Soil pH and minimum resistivity, chloride and sulfate content (Caltrans test methods 532, 422, and 417);

Laboratory results as presented by KI are included in Appendix A following the boring logs.

3. SITE INVESTIGATION

3.1 Site Reconnaissance

The current Wal-Mart Store manager, Ms. Kimi Turner, was contacted to coordinate the geotechnical aspects of the proposed expansion. Ms. Turner was queried regard the performance of the store to date with respect to building related issues, specifically floor coverings. Ms. Turner indicated that she was not aware of any unusual problems with floor coverings in the building.

Our geotechnical engineer, Mr. Metcalf, walked both the interior and exterior of the building and performed a cursory visual examination for structure distress. The only items within the structure that were observed were minor floor tile distress (linear tile cracking and bubbling) at what appeared to be concrete floor joints and very slight floor elevation differential at the what appeared to be column cutouts in the concrete floor slab.

With respect to the exterior of the structure, some movement was observed at several building wall expansion joints on the east and west side of the structure. Minor cracking was noted in the façade above the exposed masonry block wall on the south side of the structure. These features also appeared to have been addressed in a remedial fashion.

© 2008 GEOPlus, Inc.

PACLAND subcontracted with Pavement Engineering, Inc. (PEI) of Redding, California, to perform an evaluation of the existing pavement areas. PEI's final report is included with this report as Appendix E.

3.2 GEOPlus, Inc. – Subsurface Exploration

Subsurface conditions were investigated during the period of December 6 and 7, 2007. A total of 5 borings were drilled (B-17 through B-21) at selected locations within the proposed building footprint and parking lot areas to depths ranging from 7 to 15-1/4 feet below the existing ground surface (bgs). The subsurface soil borings were drilled using an AH400 truck-mounted drill rig equipped with 7-inch diameter hollow stem augers. The approximate locations are illustrated on Plate 2; boring coordinates are presented in Table B-1 in Appendix B.

The Wal-Mart *Geotechnical Investigations Specifications and Report Requirements (including gas station), revised September 28, 2007* provided by PACLAND indicate that one boring should be drilled to 100 feet to provide information for site seismic classification where the International Building Code (IBC) is enforced. The IBC is not used in California; therefore, the maximum depth explored (15-¼ feet) was selected based on geotechnical conditions encountered.

A GEOPlus engineer geologist directed exploration activities, prepared logs of soil borings, visually classified soils according to the Unified Soil Classification System, and collected representative, undisturbed and bulk soil samples. Soil samples were packaged and sealed in the field to reduce moisture loss and returned to our soil laboratory for further testing. The boring logs were prepared in accordance with the nomenclature and symbols presented on Plates B-1 through B-3 with the boring logs Appendix B. The stratigraphic contacts shown represent the approximate boundaries between soil types; actual transitions may be more gradual. The soil and groundwater conditions depicted are only for the specific dates and locations reported.

After completing the soil borings they were backfilled with cement-bentonite grout to near existing ground surface. Several borings were left open overnight to monitor groundwater. Where encountered groundwater levels were recorded at the time of drilling and about 20 hours later.

Five surficial samples of soil were collected from the undeveloped portion of the site and composited to perform top soil analysis tests to evaluate the potential of using existing top soil on the project. The approximate sample locations are presented on Plate 2.

3.3 Laboratory Testing

Selected soil samples were returned to GEOPlus' soils laboratory for further examination and testing to refine field visual soil classifications and to evaluate physical soil properties that may affect the geotechnical aspects of project design and construction.

The laboratory testing program consisted of the following:

- Unit weight and moisture testing in general accordance with ASTM Test Method D-2216;

© 2008 GEOPlus, Inc.

- Grain-size distribution in accordance with ASTM Test Method D-422;
- Atterberg Limits testing in accordance with ASTM Test Method D-4318;
- Moisture/Density relationship (compaction) in accordance with ASTM D-1557;
- Unconfined compressive strength testing in accordance with ASTM Test Method D-2166 (performed by Sierra Testing Laboratory);
- Expansion Index in accordance with ASTM D-4829;
- One-Dimensional Consolidation Properties of Soils in accordance with ASTM 2439; and
- Soil pH and resistivity, chloride and sulfate content in accordance with Cal 532, 422, and 417 test methods (performed by Sunland Analytical of Rancho Cordova, CA).

Laboratory results are summarized on the Logs of Borings in Appendix B and in tabular format on Plate C-1 in Appendix C. Plots of the Plasticity Index and Compaction tests are presented on Plates C-2 and C-3. Tests including unconfined compression and corrosion potential follow these plates.

Topsoil analysis tests were performed by FGL Laboratories in Chico, California; results are presented at the end of Appendix C.

3.4 Existing Pavement Evaluation

PACLAND subcontracted with Pavement Engineering, Inc. (PEI) of Redding, California, to perform an evaluation of the existing pavement areas. GEOPlus reviewed the study prepared by PEI; the final pavement evaluation report is excerpted in Section 5.8 of this report and the PEI report is included with this report as Appendix E.

4. SITE CONDITIONS

4.1 Site Climate

Chico is located within the northern portion of the Sacramento Valley in California, and the climate is characterized by a dry, hot summer and a mild winter with moderate rainfall. The average annual precipitation in the Chico area is approximately 26 inches, most of which falls as rain between November and April. The average daily minimum temperature is 36 degrees Fahrenheit (January) and the average daily maximum temperature 97 degrees Fahrenheit (July).

4.2 Regional and Site Geology

Chico is located within the northern portion of the Great Valley Geologic Province of California, which includes the Sacramento and San Joaquin Valleys. The Province is characterized by thousands of feet of marine and non-marine (continental) sedimentary rocks and some volcanic rocks that have accumulated within a large down-warped basin, known as the Great Valley, over the last about 100 million years. Much of Chico is located on a broad alluvial apron deposited by the numerous river and stream systems exiting the Sierra Nevada Mountains to the east. The alluvial apron thins to the east, where bedrock of the Tuscan formation is commonly at or very

© 2008 GEOPlus, Inc.

near the surface. Within the Chico area, the geologic formations exposed are generally Pliocene age (about 2 to 5 million years old) and younger volcanic rocks and unconsolidated to semi-consolidated continental sediments. Much older marine sedimentary rocks are exposed within some of the deep canyons east of Chico.

A review of published geologic maps and publications covering the northern Sacramento Valley area (Helley and Harwood, 1985; Harwood and Helley, 1987; and Saucedo and Wagner, 1992; and DWR, 2001) indicates that beneath the Chico area, a thick sequence of Pliocene age (about 5 to 1.6 million years old) continental volcanic rocks and conglomerate known as the Tuscan formation is present. The Tuscan formation consists of up to about 1000 feet of pyroclastic rocks (volcanic ash-flows and mud-flows) with a few interbedded layers/lenses of conglomerate and sandstone (stream system deposits). Within the hills east of Chico the Tuscan formation rocks have been uplifted and folded into a broad west dipping monocline. Uplift has occurred as a result of reverse faulting at depth along the Chico Monocline fault, the northernmost extension of the Foothills fault system. Deep incision of the upwarped Tuscan formation by Quaternary streams has created the topography for which Butte County is named.

Overlying the Tuscan formation in many areas of eastern Chico and vicinity is the mid-Pleistocene age Red Bluff formation (about ½ million years old), which consists of a thin layer of coarse alluvial sediments that were deposited over a broad erosional surface atop the Tuscan formation. The Red Bluff formation consist predominantly of sand, gravel and cobble deposits that have been weathered to exhibit a strong red-orange color and presence of significant clay content. The formation is generally very dense and locally exhibits weak cementation. The Red bluff formation is typically less than about 50 feet thick and has been eroded away in many areas.

Late Pleistocene river terrace deposits associated with the Sacramento River and its tributaries are common within the lowland areas and adjacent to rivers and streams. These terrace deposits are typically unconsolidated alluvium and range in age from about 40,000 to 12,000 years. The older terrace deposits (older than about 50,000 years are known as the Riverbank formation, while the younger terrace deposits are known as the Modesto formation. Within the Chico area much of the valley floor exposes the Modesto formation at the ground surface. The formation typically consists of fine-grained sand, silt and clay floodplain deposits, but also contains coarser grained sand and gravel units. Due to its young age these sediments are typically slightly weathered, unconsolidated and uncemented.

Holocene age (less than about 11,000 years) alluvial fan, flood plain (basin), stream channel and natural levee sediments overlie the older sediments in many areas as well. Like the Modesto formation the Holocene age sediments are unconsolidated and uncemented, but also generally unweathered. The Holocene deposits, particularly flood plain and basin deposits, are commonly very thin (less than 10 feet thick) and relatively soft.

Geologic units underlying the site and immediately adjacent areas have been mapped by Helley and Harwood (1985) as the Red Bluff formation (map symbol **Qrb**) with Holocene basin deposits (**Qb**). Much of the surrounding area is mapped as underlain by the Modesto formation. Borings drilled at the site encountered predominantly dark brown sandy clay basin deposits (Qb) underlain at shallow depths by very dense and cemented granular materials (Tuscan formation).

© 2008 GEOPlus, Inc.

4.3 Faulting and Seismicity

The northern Sacramento Valley in general is not characterized by an abundance of active faulting. The site is not located within an Earthquake Fault Zone (Hart and Bryant (1997). Jennings (1994), Saucedo (1992), and Harwood and Helley (1987) indicate that there are no active faults that have surface expressions within the Chico area. The closest active fault considered to have ruptured the ground surface is the Cleveland Hills fault (part of Foothills fault system) located about 24 miles to the south. Although the Chico Monocline fault, located about 2 miles east of the site, does not reach the ground surface, it is considered to be the northernmost extension of the Foothills fault system, therefore a potential significant seismic source.

Butte County is located within an area of low seismic activity relative to other areas of California. The California Geological Survey's *Probabilistic Seismic Hazards Mapping Ground Motion Page* (CGS, 2003), indicates that the expected peak horizontal ground acceleration, resulting from the California Building Code, 2007 edition, Design Basis Earthquake (DBE - 10% probability of exceedance in a 50 year period) for this "soft rock" site is 0.14g.

Review of CDMG Map Sheet 49 (Toppozada et al, 2000) indicates that nine earthquakes of greater than M5 magnitude, including one of M6 or greater, have been reported to have occurred within about 65 miles of the site during the period of 1800-1999. The M6+ event is reported to have occurred in 1888 in the Mohawk Valley area about 40 miles to the east. Perhaps, the most significant nearby earthquake was a 5.7 (Richter magnitude) earthquake that occurred about 25 miles from the site on the Cleveland Hills fault south of Oroville Reservoir in 1975. The Oroville earthquake is considered to have been caused in part by rapid drawdown and refilling of Oroville reservoir (Toppozada and Cramer, 1984). Other significant local earthquakes include one estimated to be M5.7 that occurred about 20 miles northeast of the site in 1940 and one of estimated M5.0 that occurred about 30 miles northwest of the site, in the Los Molinos area, in 1881.

4.3.1 Site Soil Profile Type and Seismic Parameters

In developing site-specific seismic design criteria, the characteristics of the soils underlying the site are critical in evaluating the site response at a given site. Based on the results of our field investigation at this site and review of boring log data presented in previous reports for the site, the site is underlain by a shallow layer of soil overlying very dense and variably cemented granular deposits of the Pliocene age Tuscan formation. Based on the boring blow count data and our knowledge of the Tuscan formation, we conclude that a Site Profile Type C per Table 1613.5.2 of the 2007 CBC is appropriate for this site. This Soil Profile Type is defined as very dense soil or soft rock with shear wave velocity between 360 m/s (1,200 feet/sec) and 760 m/s (2,500 feet/sec) or SPT N > 50, or Su > 2000 psf.

Structures should be designed for lateral force requirements as set forth in Section 1613 of the CBC (2007). Parameters for input to seismic modeling are provided in Table 1, below, on the basis of information contained in this report and the CBC Design Basis Earthquake (DBE) as follows:

© 2008 GEOPlus, Inc.

TABLE 1 2007 CBC SEISMIC DESIGN PARAMETERS			
Seismic Design Parameter	***Reference***	***Symbol***	***Recommended Value***
Site Class	CBC Table1613.5.2	A-F	C
Spectral Response Acceleration (short period)	CBC Figure 1613.5(3)	S_s	0.64
Spectral Response Acceleration (1 sec. period)	CBC Figure 1613.5(4)	S_1	0.22
Site Coefficient (short period)	CBC Table1613.5.3(1)	F_a	1.14
Site Coefficient (long period)	CBC Table1613.5.3(2)	F_v	1.58
Peak Horizontal Ground Motion	CGS (2003)*	g_h	0.14g
* California Geological Survey Probabilistic Seismic Hazards Mapping Ground Motion Page (http://www.consrv.ca.gov/cgs/rghm/pshamap).			

4.3.2 Other Geologic Hazards

Liquefaction: The City of Chico General Plan Safety Element (1999) indicates that the risk of liquefaction at the site is low. Based on the shallow bedrock conditions, generally high fines content, and lack of shallow groundwater it is our opinion that the subsurface materials present at this site are not susceptible to liquefaction.

Landslide: The site and adjacent areas exhibit very little topographic relief; hence the potential for landslide or rockfall hazards at the site is nil.

Tsunami, Seiche, or Flooding: There is no risk of tsunami inundation based on the inland location of the site. The City of Chico General Plan Safety Element (1999) indicates that the site is located outside of the potential inundation zones from catastrophic failure of Shasta and Clair A. Hill (Whiskeytown Reservoir), and Black Butte Dams. The General Plan also indicates that the site is also outside of the 100-year flood event inundation zones.

4.4 Surface Conditions

The project site is located northwest of the intersection of Forest Avenue and Talbert/Wittmeier Drive in Chico, California (Figure 1). The 16.46-acre existing Wal-Mart site and proposed 8.20-acre undeveloped property to the south is located on a relatively broad, poorly drained, historic flood plain that is characterized by very gently sloping to flat surfaces. The surficial native basin deposits consist of sandy lean/fat clay that exhibit seasonal shrinkage cracking. Vegetation consists of moderate grasses with the exception of small bushes and trees located on the north side of the undeveloped portion of the site adjacent to the existing landscape improvements.

4.5 Subsurface Conditions

The site soils include a surficial layer of sandy lean to fat clay, sandy silt and clayey silt (basin deposits) with generally moderate to high plasticity, as indicated by varying size and depth desiccation cracks during dry periods. The basin deposits were moist to wet on the surface due to recent rainfall, and remained moist with depth. The upper 3 to 6 inches of these surficial

© 2008 GEOPlus, Inc.

deposits includes organics (stems and roots) from past disking activities. Beneath the basin deposits lies the weathered surface of the Tuscan formation, which consists of variably cemented clayey sand with gravel and clayey gravel with sand with cobble. These weathered materials were typically moist and varied in thickness from about 2 to 8 feet. Beneath the weathered materials the Tuscan formation typically consisted of weakly cemented and very dense sandy gravel with cobble.

Groundwater was not encountered in our test borings; however slow seepage was noted in three of the borings left open for 18 hours. While Wal-Mart criteria requires borings being monitored for groundwater 24 hours after drilling, in our opinion the measurement time differential is not significant and should not adversely impact the observations made. It should be noted that groundwater and soil moisture conditions within the area will vary depending on rainfall, irrigation practices, and/or runoff conditions not apparent at the time of our field investigation. Boring logs describing subsurface conditions are presented in Appendix A (Kleinfelder borings) and B (GEOPlus borings), and are summarized below. Boring explanation sheets are included at the beginning of both appendices as Plates A-1, A-2, B-1 and B-2.

4.5.1 Soils

The major soil units encountered at the site are described below in the stratigraphic sequence in which they were encountered.

Top Soil: Dark brown, organic top soil was encountered at the ground surface in explorations in undeveloped areas of the site. The soil moisture condition varied from dry and dry to moist in November 2003 to wet in December 2007. The soil structure was noted as fractured and blocky, with desiccation cracks ranging from ¼- to ¾-inch wide in November 2003; no evidence of structure was apparent in December 2007 as site conditions were wet. The topsoil was observed to be about 2 to 4 inches thick (depending on depth of disking) and contained significant amounts of organic material. Cobbles to 6 inches in maximum dimension were observed scattered in the topsoil at various locations on the site. Areas of the site were disturbed due to ground squirrel burrows.

Moderately to Highly Plastic Clay, Gravelly Clay, and Clayey Sand: Surficial soils consist of dark brown, dry and fractured (November 2003) to wet (December 2007), very stiff to hard, moderately to highly plastic, moderately expansive clay, sandy clay, clayey sand and gravelly clay which extended to depths ranging from about 0 to 6 feet beneath existing grade. Surface desiccation cracks ranging from ¼ to ¾ inches wide were reported in this soil by KI when moisture contents were lower (November 2003). Based on the laboratory test results on the material, the expansion potential is considered to be low to moderate (expansion indexes ranging from 20 to 55). Moisture contents range from approximately 14 to 27 percent, in part due to seasonal moisture fluctuations. The inplace density of this material ranged from 91 to 108 pounds per cubic foot (pcf). Grain-size distribution tests indicate the sandy layers contain 10 to 47 percent silt/clay-sized particles, with gravel contents ranging from about 16 to 22 percent. This percentage of fine-grained particles places these soils in the moderate range for frost-heave potential. The unconfined compressive strength of clay samples collected from depths ranging from 1-1/2 feet to 5 feet bgs ranged from 3.2 to 19.5 kips per square foot (ksf). Resistance values of 12 and 15 were obtained from samples from 0 to 2 feet bgs by KI.

© 2008 GEOPlus, Inc.

Clayey Silt: A red-grey, moist, hard fine-grained clayey silt from 2-1/2 to 4-1/2 feet bgs in boring No. 3 had a plasticity index of 9 and a liquid limit of 39. Test results indicate this material has an expansion index of 45.

Silty Sand: A brown, moist to wet, hard fine-grained silty sand with gravel underlies the clay, clayey sand, and clayey gravel at depths ranging from 2-1/2 to 4-1/2 feet bgs in boring No. B-1. Moisture content for the sand horizons in B-1 was measured at 26.6 percent and grain-size distribution testing indicates 48 percent silt/clay-sized particles.

Silt: Brown, moist to wet, stiff to hard sandy silt and silt were encountered in boring nos. B-1 and B-4 from depths of about 2-1/2 to nearly 4-1/2 feet bgs. The inplace moisture content and density of a sample from 3-1/2 feet bgs in boring no. B-4 was 15 percent and 111 pcf, respectively; this sample had 52 percent silt/clay size particles.

Clayey Sand with Gravel, Clayey Gravel with Sand, and Cobble: Red-brown and brown-gray, variably cemented clayey sand with gravel and clayey gravel with sand containing gravel to 3 inches, and including some cobble, was encountered in all of the test borings. These granular soils were typically dry to wet and very dense. The matrix material is weakly to moderately cemented. The grain size analysis on a sample from boring no. B-14 to 4 feet bgs indicated 55 percent gravel, 19 percent sand, and 26 percent silt/clay sized particles. Penetration resistance values from driving the Standard Penetration Test sampler ranged from 50 blows for 6 inches to as little as 50 blows for 1 inch. These materials are representative of the Tuscan formation, which is massive and extends to depths greater than 100 feet in the vicinity of the site.

4.5.2 Top Soil Analysis

The surficial soil horizon at the site consists of a clay-rich basin deposit soil that supports only native grasses and weeds. Laboratory tests to evaluate the potential to use the top soil for landscape soil purposes at the site were performed by Fruit Growers Laboratory (FGL) of Chico, California. Soil samples from five locations in the undeveloped area were obtained from a depth of 0 to ½ foot, and composited for testing. The following tests were performed as requested: percentage of organic matter; percentages of sand, silt and clay content; percentage of deleterious material; pH; mineral content; micro and macro nutrient content; and presence of herbicides. Results of these tests are presented in Appendix C.

4.5.3 Resistivity, pH, Chloride and Sulfate Content

Results of corrosion testing performed on samples collected from both the Kleinfelder and GEOPlus borings at the site performed by Sunland Analytical are summarized below; copies of the test results are presented at the end of appendices A and B. The potential corrosion with regards to ferrous metals and concrete was evaluated using procedures by Caltrans as follows: pH and resistivity (Caltrans test method 532), chloride content (Caltrans test method 422) and sulfate content (Caltrans test method 417).

© 2008 GEOPlus, Inc.

TABLE 2 CORROSIVITY TEST RESULTS				
Sample No.	***pH***	***Resistivity (ohm-cm)***	***Sulfate Content (ppm SO_4/dry wt.)***	***Chloride Content (ppm CL/dry wt.)***
B-1 @ 6 ft.	7.6	4,560	5	4
B-17 @ 5 ft.	7.3	1,770	10	3
B-19 @ 1-4 ft.	7.4	1,340	16	8
B-20 @ 3 ft.	7.8	1,470	66	2

Caltrans' Division of Engineering Services, Materials Engineering & Testing Services, Corrosion Technical Branch, Corrosion Guidelines, Version 1.0, September 2003, defines site conditions as corrosive or non-corrosive based on the following definition:

> "For structural elements, the Department considers the site to be corrosive if one or more of the following conditions exist for representative soil and/or water samples taken at the site: chloride concentration is 500 ppm or greater, sulfate concentration is 2000 ppm or greater, or pH is 5.5 or less."

Based on these criteria the soil sampled at the site is considered to be non-corrosive by Caltrans design standards. However, per *Corrosion Basics an Introduction*, prepared by the National Association of Corrosion Engineers (1984), the minimum resistivity test result suggests that the soils have a severe corrosion potential to buried metal objects.

Based on the sulfate content test results and the ACI Manual of Concrete Practice Part I - 2000, Section 201.2R-10, the site soils can be considered to have a mild exposure to sulfate attack and that Type I or II cement should be suitable. Likewise, the chloride concentrations measured indicate that the soils have a low potential for corrosion of concrete embedded metal objects.

It should be noted that GEOPlus does not provide corrosion engineering services. If it is determined that a greater level of study is required, we recommend that a corrosion engineer be retained to further evaluate soil corrosivity issues and design corrosion protection systems appropriate for the project.

4.5.4 Groundwater

Groundwater was not encountered in any of the test borings during drilling. However, minor seepage and wet soil conditions were noted as water on the sampler (boring No. B-1 at 7-3/4 feet), and slow seepage eventually filled the bottom of boring Nos. B-17 through B-19 (depths ranging from 11 to 13 feet) when observed 18 hours after drilling. While Wal-Mart criteria requires borings being monitored for groundwater 24 hours after drilling, in our opinion the measurement time differential is not significant and should not adversely impact the observations made. It should be noted that groundwater and soil moisture conditions within the area will vary depending on rainfall, irrigation practices, and/or runoff conditions not apparent at the time of our field investigation.

The potential for perched groundwater to develop on top of compacted native clay-rich soils and on the Tuscan formation and saturate near-surface soils is significant, and such conditions can

© 2008 GEOPlus, Inc.

adversely impact earthwork and construction activities. Dewatering and/or measures to improve the workability of wet soils should be anticipated for excavations extending below 1 to 2 feet bsg if construction is performed during winter, spring, and/or early summer.

5. CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the field exploration, laboratory testing, and engineering analyses, it is our opinion that the proposed expansion project is feasible from a geotechnical perspective, provided the recommendations of this report are incorporated in project design and construction. Near surface soil conditions are characterized by the following properties that will influence site development from a geotechnical perspective:

- *Organic material in the top 2 to 4 inches of soil in undeveloped areas.* The organic material present in the surficial soil will be subject to future degradation; therefore we recommend all surficial materials containing appreciable organic content be removed and not used for engineered fill to support proposed improvements.

- *Tree and Shrub Removal.* Removal of trees and shrubs will require grubbing to remove roots. Excavations from grubbing should be cleaned and dished-out to facilitate replacement with engineered fill.

- *Landscape Planter Removal.* Expansion of the store south and east of the current limits requires that exterior concrete slab-on-grade, asphalt concrete, and landscape planters be removed. Additional excavation should be expected to remove loose, wet and unstable soils within and around all landscape planters.

- *Asphalt Concrete and Baserock Removal.* Expansion of the store south of the current limits requires removal of asphalt concrete, pavements, asphalt concrete walkways, and concrete curb and gutter. Asphalt concrete and baserock may be suitable to be reused as either Class 2 Aggregate Subbase or Class 2 Aggregate Base, depending on the contractor's effectiveness in removing these materials.

- *Existing Utilities.* Existing below ground and above ground utilities are present in the area of the proposed expansion. Water, storm drain, and electrical lines will either be removed or abandoned in place. Pipes to be abandoned in place should be backfilled with a controlled material such as lean concrete. Excavations required to remove utility pipes or lines should be dish shaped to facilitate scarification and compaction of existing soils, and placement and compaction of engineered fill. Electrical transmission line tower foundations should be removed to at least 2 feet beneath finished soil subgrade or existing soil grade, which ever is lower. Excavation efforts to remove the foundations should be monitored, and disturbed soils removed and replaced with engineered fill.

- *Concrete Walls and Foundations.* Concrete foundations and masonry block walls associated with the truck dock on the south side of the existing building should be removed as part of the building expansion. Concrete and/or masonry and reinforcing steel should be removed and disposed to a facility suitable for handling such construction debris. Excavations for removal should be dished to facilitate scarification and reconstruction with engineered fill.

© 2008 GEOPlus, Inc.

- *Soft, Wet Subgrade soils.* Soft and wet soils were encountered in the borings drilled at the site for the expansion during August 2002 and December 2007. Such soils, even when dry, have relatively poor support characteristics that can result in construction difficulty, as well as exhibit inadequate bearing capacity and/or excessive settlement under expected foundation loads. During site development removal and reconstruction of the upper 2 feet of native soils in undeveloped areas should be expected to support fill for the building pad. Existing pavements, concrete flatwork, underground utilities and culverts that will be removed for structure expansion may also be underlain by soft and/or wet soil. After removing these features and excavating the exposed soil grade to required elevation, the exposed soil grade should be evaluated by proof-rolling or other method acceptable to the Geotechnical Engineer to assess whether additional excavation and/or stabilization measures may be necessary. Other areas to support new pavements should require less effort to construct stable subgrades, and depending on the moisture condition at the time of construction, require about 1 to 2 feet of surficial soil preparation. Construction efforts in winter and spring, during and shortly after the rainy season should expect soft and unstable surficial soils, requiring additional construction effort.

- *Expansion potential of the moderately to highly plastic clay soils extending from 0 to 6 feet bsg.* The clay soils will be subject to volume changes due to future variation in soil moisture content. To reduce the potential for distress to planned improvements due to shrinking and swelling with seasonal moisture changes, several options have been considered feasible for this site. Options include: 1) removal and replacement with non-expansive fill, 2) admixture stabilization (lime treatment), and 3) partial removal and replacement with non-expansive fill in the top 12 inches of the building pad in conjunction with special moisture conditioning and compaction requirements, deepened perimeter and interior foundations, and inclusion of structural steel in foundations and concrete slabs-on-grade.

- Recommendations for the third option are presented since they are consistent with the existing structure design and construction recommendations, and to our knowledge, there are no reported structure performance issues with this store. In the event Wal-Mart has concerns regarding the existing retail store performance at the site, GEOPlus should be contacted immediately to review this information, and revise these recommendations, if appropriate.

- The surficial clay soils will likely require additional effort to uniformly moisture condition when the soil is either dry of or wet of the recommended moisture content range. Repeated processing/blending should be anticipated to establish a uniform moisture content.

- *Potential for developing perched groundwater conditions.* The presence of low permeability fine-grained clay soil and variably cemented Tuscan formation at shallow depths beneath the surficial clay soils can contribute to development of "perched" groundwater. Moisture from rainfall, runoff and landscape irrigation on-site will also tend to wet and saturate near surface soils. The fine-grained and/or variably cemented underlying materials tend to act as a barrier to downward infiltration of water due to low permeability characteristics. Furthermore, where the building expansion overlies

© 2008 GEOPlus, Inc.

currently paved areas with underground utilities, the existing aggregate base and/or utility backfill materials may serve as a conduit for water to encroach beneath the building. To reduce the potential for development of perched groundwater beneath the building expansion, we recommend that the existing aggregate base and utility trench backfill materials be completely removed from beneath the building expansion area. Additionally, recommendations are presented for collecting and diverting all rainfall and runoff to storm drain systems and including subdrainage provisions within storm drain trench that will parallel the west and south side of the building expansion.

- *Concrete Slab-on-Grade Moisture Vapor Transmission.* Exterior site grades south of the existing building and parking areas slope downward toward the west, and towards the building. Seepage with pavement baserock will tend to migrate toward the structure, and contribute to development of perched groundwater. As such we recommend that a moisture vapor transmission retarder be incorporated into the new building construction. The 1992 TLI geotechnical report for the existing building recommended a vapor retarder consisting of 10-mil plastic sheeting. Current criteria for vapor retarders vary significantly with respect to the level of protection provided. We recommend that the vapor retarder be a minimum of 15-mil thick, and conform to requirements of ASTM E1745, "Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs." Vapor retarder installation should conform to the manufacturer's requirements.

- *Corrosion characteristics of native clay and silt soils.* The native clay and silt soils are considered to be highly corrosive with respect to buried ferrous metals. Normal Portland cements (Type I or Type II) should be suitable for the project.

- *Potential for differential settlement in utility trench backfill.* The sanitary sewer, storm drain, and electrical utility corridor on the south side of the existing improvements will be removed and re–routed. Where the expansion overlies this backfill there may be potential for differential settlement. Therefore, recommendations are presented for increasing the relative compaction of backfill placed in existing trenches that will be beneath the new structure.

- *Pavement performance and considerations.* Site pavements constructed as part of the original store development appear to be performing reasonably well over the majority of the site. However, increasing the existing pavement life to 15 to 20 years will require some partial pavement removal and reconstruction, in conjunction with pavement fabric and new overlay (2.5 inches) after removing and reconstructing areas with significant distress (alligator cracking). Remaining parking and aisleway areas will require pavement fabric and overlay as well (1.5 inches). Specific recommendations for addressing the pavement conditions are presented in this report.

Detailed recommendations regarding the geotechnical aspects of project design and construction are provided in the following sections of this report. The Geotechnical Investigation Fact Sheet, Foundation Design Criteria, and Foundation Subsurface Preparation sheets, required by Wal-Mart, are presented with this report in Appendix F.

© 2008 GEOPlus, Inc.

5.1 Site Earthwork Recommendations

5.1.1 Site Preparation

General site preparation will primarily involve the removal of surface vegetation and near-surface roots and existing fill. All areas that will receive structural fill, pavements, foundations, floor slabs or other structures should be stripped to a depth that is sufficient to remove topsoil, and any other deleterious materials including roots greater than one-half inch in diameter. Stripping should extend at least ten feet laterally beyond the proposed building addition footprint and all impervious surfaces. We estimate that in areas not presently paved or covered with concrete flatwork, it will be necessary to strip approximately 1 to 3 inches of topsoil and organic matter.

Stripped material and organic fill will not be suitable for re-use as structural fill. Stripped material can be passed through a one-inch screen to remove the larger organic fraction and stockpiled for possible later use in landscaped areas, if desired. Unwanted topsoil and other stripped material should be exported from the construction site.

All existing fill, utility trench backfill, and culvert backfill within the planned building expansion area should be removed for its full depth and replaced with structural fill. This includes all fill in the landscape area south of the existing building and pavement areas. Fill on the order of 1 to 4 feet should be anticipated in these areas. Removal of existing storm drain culvert backfill may be on the order of 10 plus feet. The approximate limit of the landscape fill is shown on Plate 2 and the depth of fill is estimated to be 1 to 4 feet in maximum depth.

The existing aggregate base material underlying currently paved areas is relatively permeable in relation to other materials typically used to construct building pads and the native soils; hence, the baserock can serve to collect and transfer subsurface moisture beneath the structure. As such, this material should be removed from beneath the building expansion areas and the building pad constructed with a low permeability fill (soil with a minimum of 15 percent minus No. 200 sieve material and a hydraulic conductivity of less than 10^{-6} cm/sec) when compacted to the required relative compaction. The excavated baserock and asphalt materials may be used for structural fill outside the building pad and/or Class II Aggregate Base and/or Class II Aggregate Subbase materials, provided they meet the material specifications for such materials. Such materials may be used for structural fill in the upper 1 foot of the building pad provided they contain a minimum of 15 percent fines and meet the other requirements for non-expansive structural fill.

The southern expansion area includes a few small landscape planter areas, underground utilities, and a landscaped buffer with an asphalt concrete pathway. After removal of existing landscape materials, pavement materials, and any organic soils, utilities should be located, abandoned and removed. The landscape planter area subsurface soils will likely be wet due to rainfall, runoff and/or irrigation. Excavations associated with removal of utilities may encounter perched groundwater. If construction is performed in the winter, or spring prior to natural drying, or in wet areas associated with the landscape planters, existing fill and native clay soils could be unstable due to moisture contents greater than optimum moisture content. Depending on the extent of wet soils, removal may be accomplished with an excavator or light bulldozer.

© 2008 GEOPlus, Inc.

5.1.2 Unstable Ground

If soft soil conditions (i.e. unstable or "pumping" ground) are observed where near-saturated of saturated soils are encountered, it will be necessary to either remove or stabilize existing soils to provide a stable, unyielding surface on which to construct fill. Depending on the time of year construction is performed, excavations may encounter perched ground water as well. Subsurface conditions should be monitored by the project Geotechnical Engineer to assess whether subgrade stabilization is warranted, if it is not feasible to air dry soils wet of optimum such that they can be used to construct stable engineered fill. Alternate subgrade stabilization methods are presented below in the event unstable subgrade is encountered.

Geosynthetic fabric may be used for ground stabilization. For this site the stabilization fabric should consist of Mirafi 600X, or equivalent, placed over the unstable ground surface. A 12-inch lift of coarse, crushed gravel should be carefully spread over the fabric with light-duty bulldozers or front-end loaders, such that the fabric does not become damaged. Compaction of the initial lift of granular fill should be sufficient to create a stable working surface; however, over-compaction should be avoided. Subsequent lifts of granular fill can be compacted to greater density, in accordance with the recommendations in Section 5.1.5. ***Use of this stabilization method must be coordinated with planned construction to avoid conflict with structure foundations and utilities that could cut and/or damage geosynthetic fabric.***

Alternately, it should also be feasible to reduce the soil moisture content to within the range suitable for constructing stable engineered fill by adding lime to the soil. The following recommendations should be implemented if lime is used to dry the native soils:

- Lime-treatment construction should be performed by a contractor with demonstrated experience and equipment suitable for this type of construction.

- We recommend that the soil-lime mixture be prepared using a roto-mixer; use of plows and or harrows to blend the soil-lime mixture may result in inadequate mixing and is therefore not recommended. Inadequate mixing can result in future expansion of aggregated lime that can distress improvements. ***It should also be noted that the presence of some gravel and cobble in the upper soil profiles could damage the roto-mixer equipment.***

- Soil-lime treatment should extend to a depth of at least 16 inches; the depth of soil-lime compaction should be at least 12 inches.

- The percentage by dry weight of lime product added should be sufficient to reduce the soil-lime mixture moisture content in order to produce a stable, compactable material. The amount of lime product required to produce the soil-lime material may vary depending on: the type of lime product used; and the soil moisture content and weather conditions at the time of treatment. The actual amount of lime product added should be measured prior to mixing. Lime contents ranging from 1½ to 5 percent or more by dry weight may be required.

- Lime should be added to the site after stripping and immediately prior to mixing. The contractor should avoid placing lime during windy weather to reduce the potential for

© 2008 GEOPlus, Inc.

lime dust blowing to surrounding areas. Use of a granular lime instead of a powdered lime will also reduce the potential for lime migration due to wind.

- The soil-lime-water mixture should be allowed to hydrate a ***minimum*** of 24 hours prior to compaction.

- Laboratory compaction tests to determine the maximum dry density for evaluating relative compaction should be performed on soil-lime-water samples after the 24-hour hydration time, prior to the contractor compacting the mixture.

- After compaction the treated material surfaces should be trimmed to a smooth surface. The surface should be trimmed to facilitate drainage of rainfall and runoff.

- Provided the treated soil-lime mixture is stable to construction traffic, the surface of the soil-lime material should be covered with baserock or other granular material as soon as possible. The cover material tends to reduce surface drying of the soil-lime treated material. If the soil-lime mixture is not stable immediately after compaction, the soil-lime material should be allowed to cure for several days to a week to allow the soil-lime mixture to cure.

- Any areas of the site that will be landscaped should be excavated to remove all soil-lime material, since the lime in the mixture is detrimental to plant growth.

- A controlled density fill, such as sand-cement slurry, should be used to backfill the top of all utility trenches excavated through compacted soil-lime treated material.

The project Geotechnical Engineer should be present to observe the mixing process, sample the soil-lime mixture, and provide criteria for testing the in-place compaction of the lime treated areas. The project Geotechnical Engineer's representative should verify that the compacted mixture meets the compaction recommendations for the project.

5.1.3 Excavation Dewatering

Removal and reconstruction of existing underground and above ground utilities may require the excavation of soils below seasonal, perched groundwater. The seeping soils encountered would be considered a Type C soil when applying the OSHA regulations. For this soil type, OSHA recommends a maximum slope inclination of 1.5:1 or flatter for excavations 20 feet or less in depth. Placement of crushed rock on trench bottoms may be necessary to stabilize soft ground.

Slow seepage was encountered during the 2003 Kleinfelder and 2007 GEOPlus investigations. Native subsurface soils may experience sloughing due to perched groundwater and removal of lateral support. If sloughing occurs, the cut slope can be redressed or covered with at least 12 inches of crushed rock or gravel. It should be possible to dewater the excavation area using a system of ditches directing water inflow away from the construction area to a sump where it can be removed by a pump. During wet weather, earthen berms or other methods should be used to prevent runoff water from entering excavations. All runoff water and groundwater encountered within the excavations should be collected and disposed of outside the construction limits.

© 2008 GEOPlus, Inc.

5.1.4 Scarification

Following initial site stripping, over-excavation of existing native soil or fill, and prior to placement of any structural fill, pavements, foundations, floor slabs or other structures, we recommend scarifying all subgrades to a minimum depth of 12 inches. The near-surface clay soils should then be uniformly moisture conditioned to between 1 and 4 percent above optimum moisture content and compacted to between 88 to 92 percent relative compaction (RC) as determined by the ASTM D1557 test method, with a *minimum* of 4 passes of a heavy, vibratory sheepsfoot roller, or equivalent equipment approved by the Geotechnical Engineer. We recommend that the top twelve inches of subgrade that will support pavements be uniformly moisture conditioned to the recommended moisture content and compacted to at least 93 percent relative compaction. Relative compaction should be based on the modified Proctor test method (ASTM D1557).

Native clay soil moisture content less than 1 percent above optimum moisture content and soil moisture in excess of 4 percent above optimum moisture content, or non-uniform soil moisture content, will require processing to either increase or reduce soil moisture, respectively, and produce *uniform* moisture content in the soil prior to compaction. Increasing soil moisture content will require wetting and processing to uniformly moisture condition the soil to within the recommended moisture content range. Depending on the dryness and uniformity of the soil moisture content, multiple iterations of moistening, blending, mixing and/or curing may be required to increase the soil moisture content prior to compaction. Conversely, aeration to reduce the soil moisture content to the recommended moisture content range may also require multiple iterations of spreading, aerating, mixing, blending, and/or curing to reduce the soil moisture content to within the recommended soil moisture content range and produce a uniformly distributed moisture content.

Alternate approaches to addressing unstable and/or soil wet of the recommended soil moisture content may include lime-treatment, or use of geosynthetic fabric and crushed rock, in order to construct stable, unyielding fill (refer to section 5.1.2). Surface stripping, preparation, moisture conditioning and compaction testing of subgrade soils, as appropriate, should be observed and documented by the project Geotechnical Engineer.

5.1.5 Structural and Non-Expansive Fill Materials

We understand that the proposed expansions will be constructed as close as practical to the existing floor elevation. This section contains our general recommendations for soil type and placement of structural fills. We have assumed that final building details will be selected to avoid the need for structural fills that are more than about four feet deep. GEOPlus should be retained to review final grading plans to confirm the applicability of our recommendations and to make modifications, if appropriate.

Structural fill should only be installed on subgrades that have been prepared and stabilized in accordance with the preceding recommendations.

Fill material should consist of relatively well-graded soil that is free of organic material and debris. The suitability of soil for use as compacted structural fill will depend on the gradation and moisture content of the soil when it is placed. As the amount of fines (that portion finer than the US Standard No. 200 sieve) increases, soil becomes increasingly sensitive to small changes

© 2008 GEOPlus, Inc.

in moisture content and compaction becomes more difficult to achieve. Soils containing more than about 10 percent fines cannot consistently be compacted to a dense, non-yielding condition when the water content is significantly greater than optimum moisture content. Poorly graded granular soils can be successfully compacted to a dense condition in wet conditions provided they can freely drain; however, theses soils do not "bind" together, are sensitive to disturbance such as construction traffic, and can serve as a conduit for seepage migration.

The native clay and clayey sand surficial soils encountered at this site are low to moderately expansive, and in our opinion are suitable for use as structural fill provided the moisture content at the time of compaction is uniform and within the recommended range of 1 to 4 percent above optimum moisture content, and soil is compacted to with the ranges recommended below. Non-expansive soils should uniformly moisture conditioned to between 0 and 3 percent above optimum moisture content prior to compaction.

1. Where fill will be greater than 5 feet thick, the native clay and clayey sand soils should be compacted to at least 93 percent relative compaction to with 5 feet of finished soil grade. Where fill will be less than 5 feet, the native clayey sand soils should be compacted to between 88 and 92 percent relative compaction.

2. Non expansive soil, where greater than 5 feet thick, should be compacted to at least 95 percent relative compaction to within 5 feet of finished soil grade. Where fill will be less than 5 feet thick, soil should be compacted to at least 90 percent relative compaction.

Significant processing (drying, wetting, mixing, blending and/or curing) of the native clay soils may be required to produce the recommended *uniform* moisture content for compaction when the soil is either wet or dry of the recommended moisture range. Native clay soils that are below the recommended moisture content at the time of compaction will require scarification, wetting, and processing (mixing, blending and/or curing) to achieve uniform soil moisture content to within the recommended range of moisture contents. Native clay soils wet of the recommended moisture content range will require scarification, aeration, and processing to produce uniform soil moisture contents within the recommended range to construct stable fill. It may also be feasible to use lime-treatment to reduce soil moisture content to within the recommended range (refer to Section 5.1.2).

The upper 12 inches of soil beneath the building expansion areas **must** be non-expansive (UBC 18-2 Expansion Index or ASTM Test Method D-4829 less than 20); this will require importing fill material. Any imported structural fill material should be non-expansive, have 100 percent passing the 3-inch sieve, contain at least 60 percent passing the No. 4 sieve, and at least 15 percent passing a No. 200 sieve. Imported fill material should be approved by the project Geotechnical Engineer prior to hauling to the site. Non-expansive fill should be uniformly moisture conditioned to between 0 and 3 percent and compacted to a minimum of 95 percent relative compaction.

All fills intended to support structures or pavements be placed in horizontal lifts not exceeding 8 inches in thickness prior to compaction. For fill consisting of native clay soil intended to support pavements, we recommend that the top 12 inches be compacted to at least 93 percent relative compaction, based on the modified Proctor test method (ASTM D1557). If non-expansive fill is placed in pavement subgrades, it should be compacted to a minimum of 95 percent relative

© 2008 GEOPlus, Inc.

compaction. Fills should not be placed during freezing weather; extended periods of freezing weather in Chico are rare.

The specified compaction level may be reduced to 85 percent in landscaped areas if the potential for minor settlement is acceptable. Fill placement should be observed and tested for compaction on a daily basis by the project Geotechnical Engineer.

5.1.6 Wet Weather Construction

The near surface soils contain significant clay content and will be sensitive during wet weather. The mean annual precipitation for Chico is approximately 26 inches, almost all of which falls between November and April. The clay and clayey sand will be difficult to compact if wet, and grading may have to be delayed during periods of wet weather.

If wet weather construction is contemplated, imported fill material may be required. In general such fill should be clean, well-graded sand and gravel and have less than 10 percent passing a No. 200 sieve. Such soil materials are relatively pervious and could collect water beneath structures. As such, for imported materials to be used for fill beneath structures, see the criteria for imported structural fill in the preceding section (5.1.5).

Alternately, the native clay soils could be dried using lime-treatment. Preliminary lime treatment recommendations are presented in Section 5.1.2 Unstable Ground; however, if lime-treatment is considered desirable, further evaluation and testing should be performed to assess possible negative impacts of the lime with the native clay soils as well as the most appropriate lime percentage and application/mixing methods.

Local ordinances require contractors to mitigate the tracking of soil from the site to improved streets, and the use of silt fences and other means to control erosion and sediment transport during construction.

5.1.7 Structural Fill Settlements

Fills up to about three feet in depth will be required to achieve building pad grade under the proposed addition. Reconstruction of storm drain culvert removal excavations will require fills up to about 10 feet thick. Where fills are deeper than 5 feet, we recommend that non-expansive predominantly granular structural fill be placed to reduce potential post-construction differential settlement. Where native clay soils are used for fill, we anticipate that some minor settlement will occur over time. We expect very minor to negligible consolidation of underlying clay and silt soils will occur due to the weight of structural fill. Some settlement (less than ½-inch) should be expected to occur within a well-constructed engineered fill. Most settlement will occur shortly after the fill is completed, however, the clay will experience some minor time-dependent consolidation. Settlement of the underlying Tuscan formation materials should be negligible.

© 2008 GEOPlus, Inc.

5.2 Foundation Recommendations

5.2.1 Shallow Spread Footings

After preparation and compaction of original ground to engineered fill standards, in conjunction with construction of engineered structural fill up to 3 feet in thickness, shallow spread footings should be suitable for, and are recommended for support of the building expansion on the north and west sides of the existing structure.

Spread footing should be designed in accordance with the following sections of this report. Information provided by Wal-Mart indicates maximum column loads of approximately 150 kips with typical loads of approximately 50 to 85 kips for exterior and interior columns, respectively. Bearing wall loads range from 4 to 6 kips per lineal foot. The structures should be able to accommodate total settlements of as much as ¾-inch and differential settlements of on the order of ½-inch over a distance of 40 feet.

Spread footings should bear on dense or hard native, re-compacted soils, or properly compacted structural fill after existing non-engineered fill has been removed. The footings should be designed for a maximum allowable bearing pressure of 2,000 pounds per square foot (psf). The following recommendations should also be implemented:

- Exterior footings should bear below the seasonal depth of moisture variation. Therefore, a foundation embedment depth of 30 inches is recommended for exterior and interior footings.
- Continuous strip footings should be at least 18 inches wide. Isolated pad footings should be at least 30 inches square. A structural engineer should size footings and design reinforcement.
- Four No. 4 reinforcing bars (2 top, 2 bottom) should be placed in continuous footings to reduce the potential for distress associated with expansive soil pressures.
- The total settlement under the recommended bearing pressure should not exceed ¾-inch. Differential settlement across a 40-foot span should not exceed ½-inch. Structural and architectural design should accommodate this degree of differential settlement.
- Continuous strip footings should be reinforced to span a localized settlement six feet in length.
- The allowable bearing can be increased by 1/3 for temporary loads such as wind and seismic.
- Footings should bear on undisturbed native soils or on structural fill prepared in accordance with the recommendations presented in Section 5.1. All footing excavations should be trimmed neat and any loose or softened material should be removed from the footing excavation prior to placing rebar and pouring concrete.
- It is recommended that footing excavations be observed by the project Geotechnical Engineer prior to placing steel and concrete to verify that the recommendations of this report have been incorporated into construction.

© 2008 GEOPlus, Inc.

5.2.2 Lateral Resistance

The soil resistance available to withstand lateral foundation loads is a function of the frictional resistance which can develop on the base and the passive resistance which can develop on the face of below-grade elements of the structure as these elements tend to move into the soil. We recommend that allowable frictional resistance be computed using a coefficient of friction of 0.35 applied to vertical dead-load forces. The allowable passive resistance on the face of footings or other embedded foundation elements may be computed using an equivalent fluid density of 300 pounds per cubic foot (pcf) (triangular distribution) for the near surface on-site soils. The top six inches of the adjacent soils should be neglected when calculating the lateral resistance capacity of the soil. The above coefficient of friction and passive, equivalent fluid density values include a factor of safety of approximately 1.5.

5.3 Concrete Floor Slabs

In order to reduce impact associated with the expansion potential the native clay soils and eliminate the need for steel reinforcing in the slab-on-grade to resist expansive soil pressures, we have recommend a minimum 12-inch thick layer of non-expansive import material be placed beneath the building and extend to at least 5 feet beyond the building footprint and compacted to at least 95 percent relative compaction based on the modified Proctor test method (ASTM D1557). This material should be placed over the recompacted native clay soils and/or structural fill immediately after compaction to lock the soil moisture content into the soil. See material specifications for non-expansive fill in Section 5.1.5.

The subgrade under all floor slab areas should be prepared in accordance with Section 5.1. We recommend that all floor slabs be underlain by a minimum 4-inch thick layer of compacted crushed rock (coarse aggregate base) graded to meet either: 100 percent passing the 1-1/2-inch screen, 15 to 55 percent passing the No. 4 sieve, and 5 to 12 percent passing the No. 200 sieve; or ASTM D1241 General and Gradation "A", "C", or "D" requirements, with the modified allowance of 5 to 15 percent passing the No. 200 sieve. This clean gravel layer will act as a capillary moisture break, reducing the transfer of moisture through the slab. The capillary moisture break should be supported on 12 inches of non-expansive, granular, import fill.

As per *Wal-Mart Specifications for Geotechnical Investigations* (version dated September 27, 2007), Wal-Mart prefers to place up to ¾ inches of fine aggregate "choker" to achieve fine grading tolerances and cover base material that does not have sufficient fine particle to produce a surface free of exposed aggregate or surface voids greater than 3/8 inch at the time of slab installation. Aggregate choker shall consist of fine aggregate meeting the gradation requirements of ASTM D-488 Table 1 Size No. 10 modified to include 6 to 12 percent passing the No. 200 sieve. Alternatively, a fine aggregate meeting the following gradation criteria may be used: 85 to 100 percent passing the No. 4 sieve, 75 to 95 percent passing the No. 8 sieve, 55 to 75 percent passing the No. 16 sieve, 25 to 45 percent passing the No. 50 sieve, 10 to 30 percent passing the No. 10 sieve, and 6 to 12 percent passing the No. 200 sieve. We recommend these base materials be compacted to at least 90 percent of the maximum dry density as determined by the Maximum Index Density and Unit Weight of Soil Using a Vibratory Table (ASTM D-4253).

Exterior grades of the paved areas to the east of the existing building and proposed building expansion are higher than the finished floor elevation and drain westward toward the building.

© 2008 GEOPlus, Inc.

Soil conditions are also conducive for perched water development at the site, and as such, may affect moisture transmission through the concrete slab. Given these conditions, even with a capillary break as outlined above, it is likely that moisture vapor will rise through the slab. We recommend the use of an underslab vapor retarder meeting with the requirements of ASTM E-1745 and installed in accordance with the manufacturer's recommendations. Per *Wal-Mart Specifications for Geotechnical Investigations* (version dated September 27, 2007) the sheet should be a minimum 15-mil thick and be placed directly beneath the concrete. Most floor covering manufacturers require a moisture vapor emission rating (MVER) of less than 3 lbs./ft.^{2}/24 hours; however, this should be verified by the manufacturer of the specific flooring products prior to selecting the vapor barrier material. Due to placement directly beneath the concrete, the contractor must exercise care to avoid puncturing the membrane and make repairs as necessary.

It must be understood that factors other than a vapor barrier can significantly influence flooring problems. These other factors include quality of concrete, interior ventilation, type of flooring adhesive, concrete curing time and sources of moisture from plumbing leaks, landscaping or surface drainage. It is emphasized that we are not floor moisture proofing experts. The building designers should consider all available measures for slab moisture protection.

For floor slabs supported on subgrades that are prepared in accordance with the preceding recommendations the floor slab may be designed for a modulus of subgrade reaction (k) of 150 pounds per square inch per inch.. This value of modulus should be achievable using non expansive, predominantly granular soils such as silty sand (SM), clayey sand (SC), silty gravel (GM) or clayey gravel (GC) compacted to 95 percent relative compaction based on ASTM D-1557 test methods. There are materials in the Chico area that meet these requirements, as well as materials produced at aggregate suppliers. Plant produced materials that will meet this requirement cost on the order of $9 to $12 per ton at the plant. Based on current fuel prices and a 44 mile round-trip, trucking costs will range from about $20 to $30 per ton for the Chico area.

Based on our experience with similar projects, slab reinforcement to distribute pressures associated with low to moderately expansive subgrade soils (that have been properly moisture-conditioned) would typically involve at least: (1) No. 3 bars, 18 inches on-center, each way, and centered within the slab; or (2) 6 x 6 - W2.9/W2.9 welded wire mesh centered within the slab. Since the slab-on-grade will be supported on 12 inches of non-expansive engineered fill, the spacing of the No. 3 bars could be expanded to 24 inches on center, or a lighter gauge of welded wire mesh, 6 x 6 – W1.4 x W1.4 should be suitable to address soil expansion concerns. Additionally, we recommend the slab and perimeter footing be structurally connected using No. 3 reinforcing bars, spaced no wider than 4 feet on center, extending from the footing and into the slab a minimum of 3 feet.

Reinforcing guidelines provided above address only expansive soils. Reinforcing beyond that indicated above may be necessary to accommodate structural requirements of the project.

5.4 Retaining Walls

Cast-in-place concrete walls up to 5 feet in maximum height are expected at the planned truck well and dock. The following section provides general retaining wall recommendations.

© 2008 GEOPlus, Inc.

GEOPlus should review the final grading plan to determine if additional recommendations are warranted.

Lateral pressures on retaining walls depend upon the type of wall, hydrostatic pressure behind the wall, type of backfill material, and allowable wall movement. Where allowable wall movement is less than approximately 0.5 percent of the wall height or where wall movement is constrained, lateral earth pressures may be estimated using and equivalent fluid pressure of 55 pcf for an "at rest" condition. Where allowable wall movement is greater than 0.5 percent of the wall height, lateral earth pressures may be estimated using an equivalent fluid pressure of 35 pcf for an "active" condition. However, walls backfilled with native clay material or similar import should be designed for an equivalent fluid lateral earth pressure of 55 pounds per cubic foot (pcf) for the "at rest" condition for level backfill.

We recommend an allowable coefficient of sliding resistance between the concrete and bearing soils of 0.35 be used in the analysis. If passive earth resistance is needed, such as for keyways, a value of 300 pcf equivalent fluid pressure, should be used for the native clay or compacted fill. These values include a safety factor of 1.5. For retaining walls not attached to a structure, placing a series of weep holes at the wall base should control hydrostatic pressures. Drainage is discussed in greater detail in Section 5.4.2, *Backfill Drainage*.

Surcharge loads near the top of retaining walls increase the lateral load on the retaining wall. Experience has shown that lateral loads caused by minor surcharges are often over-estimated during wall design, while lateral loads caused by heavy surcharges, i.e. truck traffic, are frequently under-estimated using simplified analysis methods. Heavy vehicular traffic within 5 feet of retaining walls can increase the lateral load to values in excess of those calculated using a surcharge load representing two feet of fill. GEOPlus should be notified to analyze the resultant lateral loads applied to the walls. We recommend lateral earth pressure diagrams prepared by the structural engineer or by the engineer for the wall contractor be reviewed by GEOPlus during the design process.

5.4.1 Retaining Wall Backfill

Backfill within a distance of 2 feet of the back of retaining walls should consist of free-draining crushed rock with 100 percent passing the 1-inch sieve and 95 percent retained on the No. 4 sieve. To reduce backfill pressures, we recommend that backfill be compacted to between 90 and 93 percent of the maximum dry density (ASTM D-4253) within five feet of the wall. In addition, we recommend that any backfill that is placed within five feet of the wall (measured horizontally) be compacted in thin lifts with lightweight or hand-operated compaction equipment. Over-compaction of this fill can significantly increase wall pressures. If any foundations or other major loads are supported on the backfill, these situations can create lateral surcharges pressures on retaining walls. In this situation GEOPlus should be contacted for additional recommendations.

5.4.2 Backfill Drainage

To prevent the development of hydrostatic pressures behind retaining walls, all retaining walls should be backfilled with a free draining granular material as discussed in the previous section. This backfill should be separated from the retained soils by a geosynthetic filter fabric meeting

© 2008 GEOPlus, Inc.

the minimum property values for underdrains as specified in the 2002 Caltrans Standard Specifications Section 88-1.03 Filter Fabric. Seepage collected in the gravel and fabric drain should be conveyed by a solid drainpipe to a storm drain inlet or other suitable disposal location; For retaining walls not attached to a structure, i.e. retaining walls of the truck wells, a series of weep holes placed at the wall base can be used to control hydrostatic pressures (see Plate 4).

5.5 Subsurface Facilities

5.5.1 Temporary Excavations

The near-surface soils encountered during our field investigation consist primarily of up to 6 feet of native clay or clayey sand soils underlain by variably cemented Tuscan formation materials. Excavations to remove existing storm drain culverts are expected to be on the order of 10 feet deep. Based upon our explorations, we anticipate that relatively shallow excavations for cuts and utilities can be accomplished using conventional excavation equipment (backhoes, excavators, and bulldozers). We do not anticipate the need for blasting or hydro-hammers.

Although these surficial clay soils will often stand at near vertical slopes, they may collapse suddenly and without warning. Any excavations that will involve personnel within the excavation should be adequately sloped or shored if they are deeper than four feet. Stability of temporary excavations is the responsibility of the contractor, who must maintain safe excavation slopes and/or shoring. The contractor should be aware that slope height, slope inclination, or excavation depths (including utility trench excavations) should in no case exceed those specified in local, state, and/or federal safety regulations (e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations). Such regulations are strictly enforced and, if they are not followed, the Owner, Contractor, and/or earthwork and utility subcontractors could be liable for substantial penalties.

For use with OSHA regulations, the near surface clay materials and variably cemented Tuscan formation materials encountered across on the site would be classified as soil Type A . For these soil types, OSHA recommends maximum slope inclinations of ¾:1 (horizontal to vertical) for excavations 20 feet or less in depth. If clean coarse grained soils or seepage is encountered within excavations, such soils would be classified as Type C soil. OSHA recommends maximum slope inclination of 1-1/2:1 for excavations 12 feet deep, or less.

The recommended maximum inclination for temporary slopes assumes the ground surface behind the cut slopes is level, the surface loads from equipment and materials are kept a sufficient distance away from the top of the slope (typically at least half the slope height), and utility trench excavations are completed and backfilled prior to the construction of structures adjacent to the excavations. If these assumptions are not valid, we should be contacted for additional recommendations.

5.5.2 Trench Backfill

If gravel or other coarse-grained soils are used for trench backfill including pipe bedding, these materials may serve to collect and transmit seepage, which could impact the building and other planned improvements. If such materials are used, the recommendations outlined in Table 3 below should be applied to the respective situations:

© 2008 GEOPlus, Inc.

TABLE 3 UTILITY TRENCH DRAINAGE RECOMMENDATIONS	
Condition	***Recommended Design/Construction Action***
Floor Construction At or Near Elevation of Adjacent Parking Grade	Slope utility trench down away from structure to reduce water migration beneath structure
First Floor Construction Below Adjacent Parking Grade	Construct barrier in trench beneath foundation (or point of penetration) to reduce water migration along trench into structure. Barrier should extend at least one foot beyond the edges of foundation, and extend from bottom of trench to above bottom of footing. Footing penetrations should be caulked with waterproof, flexible caulking.
Trenches Extending From High To Low Topographical Areas	Install drain in lowest portion of trench to remove seepage collecting in backfill and dispose of in storm drain inlet or other suitable location. (See Section 4.5.3)

Trench backfill should be compacted to the standards for structural and select fill as discussed in Section 4.3.

5.5.3 Subdrainage Provisions for Utility Trenches

Since the proposed new parking lot area east of the building expansion drains toward the building, there is potential for seepage to collect within utility trench bedding/shading and seep beneath the building. We recommend that the storm drain trench that will parallel the east side of the expansion include provisions for draining the backfill beneath the low points of the parking area. Subdrainage within the storm drain trench should consist of a 3-inch diameter hole drilled through all catch basin boxes, drain inlet boxes, and storm drain man holes. Effectiveness of this method requires the pipe bedding material to be a free draining granular material with less than 5 percent passing the No. 200 sieve. This should not be incompatible with the bedding materials recommended by pipe manufacturers. Where multiple pipes enter the storm drain structure, one hole should be provided adjacent to each pipe. The hole should be located at an elevation at the mid-level of the outgoing pipe within the storm drain structure so as to reduce the potential for backflow during periods of high flow within the storm drain system. A minimum of two cubic feet of drain rock wrapped in filter fabric (Mirafi 140NL or equivalent) should be located against the hole on the outside of the storm drain structure. A corrosion resistant rigid screen should be placed between the fabric and the storm drain structure to keep the filter fabric and drain rock outside the structure. This recommendation is illustrated on the Storm Drain Trench Detail, Plate 3.

5.5.4 Excavation Dewatering

Removal and reconstruction of utilities may require the excavation of soils below seasonal, perched groundwater. The seeping soils encountered would be considered a Type C soil when applying the OSHA regulations. For this soil type, OSHA recommends a maximum slope inclination of 1.5:1 or flatter for excavations 20 feet or less in depth. Placement of crushed rock on trench bottoms may be necessary to stabilize soft ground.

© 2008 GEOPlus, Inc.

Localized seepage was encountered during the 2003 KI and 2007 GEOPlus investigations. Native subsurface soils may experience sloughing due to perched groundwater and removal of lateral support. If sloughing occurs, the cut slope can be redressed or covered with at least 12 inches of crushed rock or gravel. It should be possible to dewater the excavation area using a sump and pump, or a system of ditches directing water inflow away from the construction area to a sump where it can be removed by a pump. During wet weather, earthen berms or other methods should be used to prevent runoff water from entering excavations. All runoff water and groundwater encountered within excavations should be collected and disposed of outside the construction limits.

Perched groundwater seepage through clay soils should be slow. Seepage between the clay and the underlying Tuscan formation materials is typically faster.

5.6 Drainage Considerations

Foundation and slab performance depends greatly on how well runoff waters drain from the site. This drainage should be maintained both during construction and over the entire life of the project. The ground surface around structures should be graded so that water readily flows rapidly away from structures without ponding. The surface gradient needed to do this depends on the landscaping type. In general, pavement and lawns within five feet of buildings should slope away at gradients of greater than two percent. Densely vegetated areas should have minimum gradients of five percent away from buildings in the first five feet. Water from downspouts and overland runoff should be independently collected and routed to storm drains. This water should not be allowed to infiltrate to the foundation level beneath the building.

Planters should be built so that water exiting from them will not seep into the foundation areas or beneath slabs and pavement. In general, the elevation of exterior grades should not be higher than the elevation of the gravel capillary break beneath the slabs to help prevent water intrusion beneath slabs. In any event, maintenance personnel should be instructed to limit irrigation to the minimum actually necessary to properly sustain landscaping plants. Should excessive irrigation, waterline breaks, or unusually high rainfall occur, saturated zones and "perched" groundwater may develop. Consequently, the site should be graded so that water drains away readily without saturating the foundation or landscaped areas. Potential sources of water, such as water pipes, drains, garden ponds, and the like, should be frequently examined for signs of leakage or damage. Any such leakage or damage should be promptly repaired.

5.7 Asphalt Concrete Pavement Recommendations – New Pavements

New pavement design is based on considerations of predicted traffic volumes, anticipated soil subgrade conditions, and acceptable maintenance levels. Wal-Mart specifications provided vehicle and traffic information for pavement design, including 18-kip ESAL's (18,000-lb. equivalent single-axle loads). For this project ESALs of 109,500 and 211,700 were used from Standard Duty and Heavy Duty pavements; these ESALs correspond to Traffic Indexes of 7.0 and 7.5, respectively. New pavement design was conducted in accordance with the Caltrans Highway Design Manual – Chapter 600, Design of the Pavement Structural Element (July 1, 1996). Analysis was performed for light and heavy-duty pavement classifications and laboratory testing included gradation, Atterberg limits and R-value to characterize the surficial soils. The anticipated subgrade soils classify as clay (CL) and sandy clay (SC) according to the Unified Soil Classification System. R-value tests conducted by KI on representative samples of

© 2008 GEOPlus, Inc.

pavement subgrade materials and yielded R-values ranging from 12 to 15 (see Appendix A). R-value test results on subgrade soils reported by TLI ranged were reported as less than 5. R-value tests from existing paved areas sampled by PEI ranged from 8 to 15. An R-value of 10 was selected for calculating pavement sections for a 20-year design life, assuming normal pavement maintenance including crack sealing is performed on a periodic basis.

Where import fill is required to construct the parking areas east and south of the building expansion, it is possible that import fill may consist of material with better pavement subgrade support characteristics. R-value testing should be performed on representative samples of proposed import fill; if the results indicate an R-value greater than 10, pavement sections requiring a minimum of 2 feet of import fill should be recalculated to assess possible reductions in aggregate base material thickness, and associated import material procurement and placement cost.

5.7.1 Subgrade Preparation

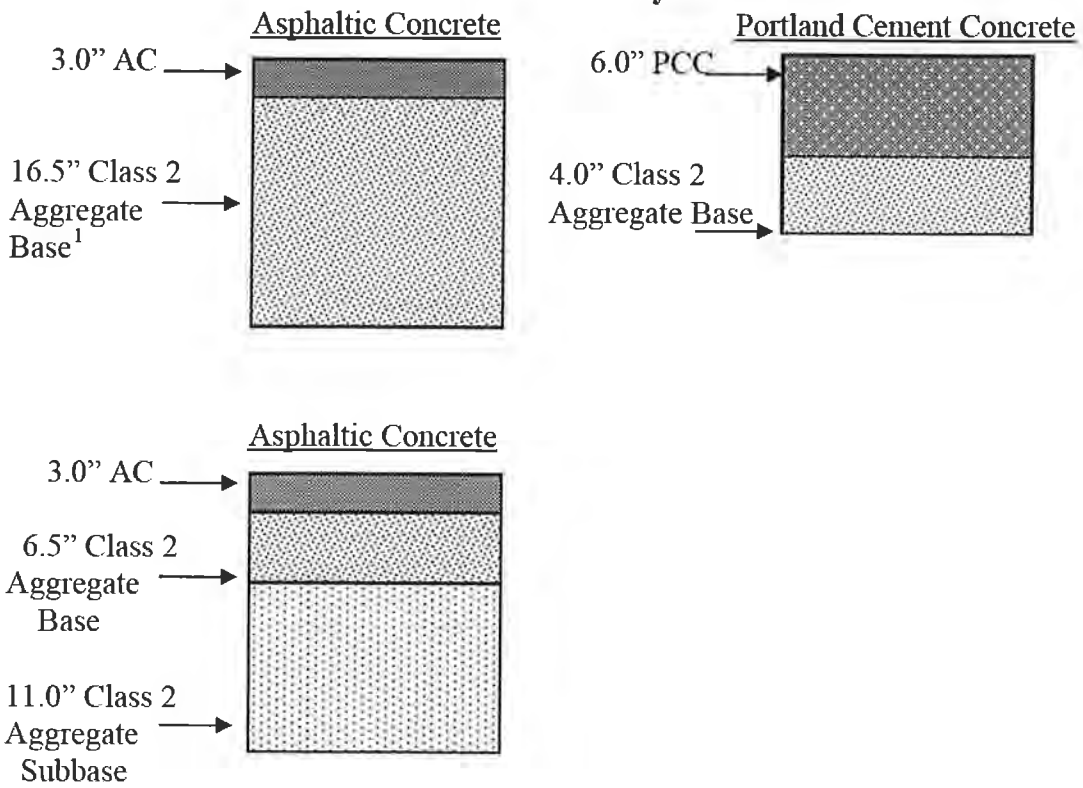
We recommend that all pavement subgrades be prepared in accordance with Section 5.1 of this report. Prior to installing base course we recommend that all pavement areas be proof rolled with a fully loaded dump truck or equivalent rubber-tired earthwork equipment. We recommend this vehicle have a minimum rear axle load (at the time of testing) of 16,000 pounds with tires inflated to at least 65 pounds per square inch pressure. If the tested surface shows a visible deflection extending more than 6 inches from the wheel track at the time of loading, or a visible crack remains after loading, corrective measures should be implemented. Any areas that pump, or appear soft or muddy should be over-excavated and compacted fill should be reinstalled. Subgrade stabilization should be completed in accordance with Section 5.1. Pavement and base course materials and installation should be in accordance with California Department of Transportation Standard Specifications with the exception that relative compaction should be evaluated using ASTM D1557 test methods.

5.7.2 Pavement Sections

Based on traffic information provided by Wal-Mart and related laboratory testing, we recommend the following minimum pavement structural sections based on the R-value of 10; note that we have included the section thickness for constructing the pavement with Class 2 Aggregate Subbase (AB) and a combination of AB and Class 2 Aggregate Subbase (ASB):

© 2008 GEOPlus, Inc.

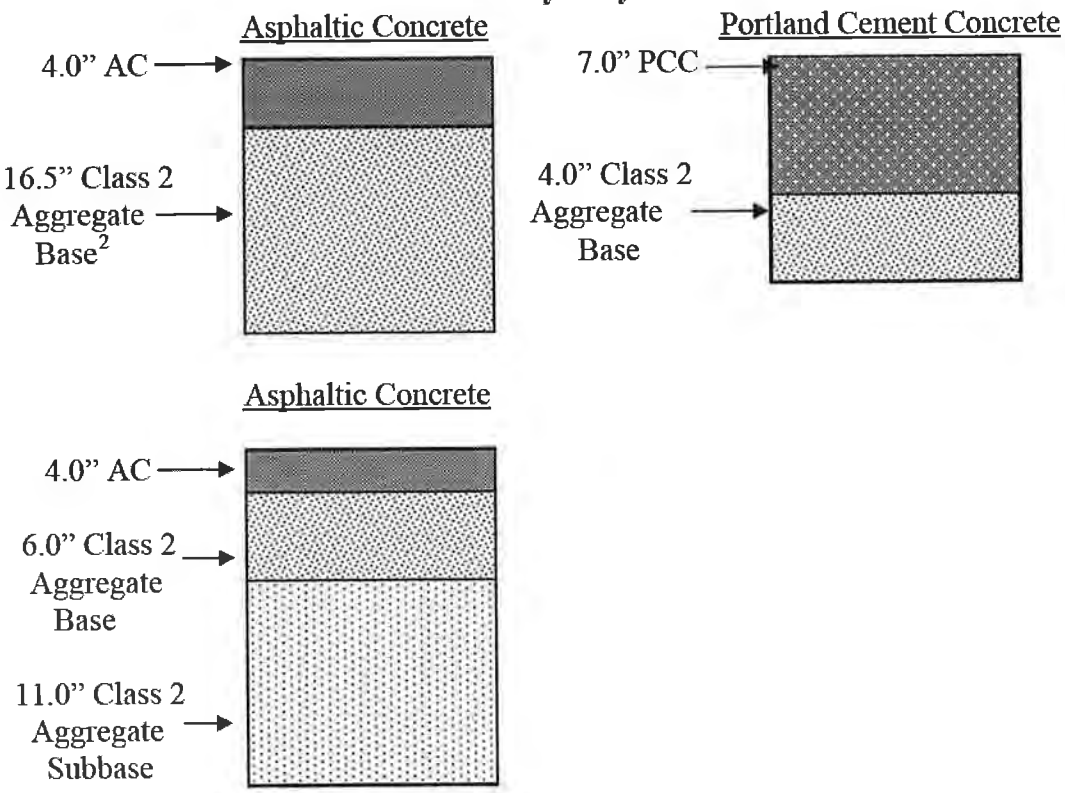
Standard Duty Pavement



[1] *Caltrans design procedures for asphalt concrete pavements provide sections in units of feet, rounded to the nearest 0.05 feet. We have also provided sections in units of inches, rounded to the nearest 1/2-inch. Sections provided above do* ***not*** *include a Gravel Equivalent Safety Factor of 0.2 (as recommended by Caltrans).*

© 2008 GEOPlus. Inc.

Heavy Duty Pavement



Asphaltic pavement should be from an approved mix design and Class 2 Aggregate Base should consist of 1-inch minus material conforming to the requirements of Section 26 of the Caltrans Standard Specifications. Class 2 Aggregate Subbase should consist of 1-1/2-inch minus material conforming to the requirements of Section 25 Caltrans Standard Specifications.

Additionally, pavement sections provided above are contingent on the following recommendations being implemented during construction.

- All pavement subgrades should be scarified to a depth of 12 inches below finished subgrade elevation, uniformly moisture conditioned prior to compaction. Native clay soil should be moisture conditioned to between 1 and 4 percent above the optimum moisture content, and compacted to at least 93 percent relative compaction. Non-expansive materials should be moisture conditioned to between 0 and 3 percent above optimum moisture content and compacted to at least 95 percent relative compaction.

- Subgrade soils should be in a stable, non-pumping condition at the time aggregate base materials are placed and compacted.

- Aggregate base and subbase materials should be compacted to at least 95 percent relative compaction.

---

[2] *Caltrans design procedures for asphalt concrete pavements provide sections in units of feet, rounded to the nearest 0.05 feet. We have also provided sections in units of inches, rounded to the nearest 1/2-inch. Sections provided above do **not** include a Gravel Equivalent Safety Factor of 0.2 (as recommended by Caltrans).*

© 2008 GEOPlus, Inc.

- Adequate drainage (both surface and subsurface) should be provided such that the subgrade soils and aggregate base materials are not allowed to become wet.

- Asphalt paving materials and placement methods should meet current Caltrans specifications for asphalt concrete (Section 39).

- All concrete curbs separating pavement and landscaped areas should extend into the subgrade and below the bottom of adjacent, aggregate base materials.

5.7.3 Variations in Subgrade Materials

Pavement sections provided above are based on the soil conditions encountered during our field investigation, our assumptions regarding final site grades, and limited laboratory testing. In the event actual pavement subgrade materials are significantly different than those tested for this study, we recommend representative subgrade samples be obtained and additional R-value tests performed. Should the results of these tests indicate a significant difference, the design pavement section(s) provided above may need to be revised.

5.8 Asphalt Concrete Pavement Recommendations – Existing Pavements

A pavement survey consisting of visual survey, structural deflection testing, coring and sampling asphalt concrete, baserock, and subgrade soil, laboratory R-value testing, and pavement analysis was performed by Pavement Engineering, Inc. (PEI) of Redding for PACLAND to provide a basis of discussion regarding the expected performance of the existing asphalt concrete pavements and to present recommendations regarding remedial measures and maintenance to extend the life of these pavement to be consistent with new pavements to be constructed. PEI's report is presented in Appendix E.

5.8.1 Existing Pavement Condition

Table 4 (below) summarizes the current condition of the existing pavements presented by PEI:

© 2008 GEOPlus, Inc.

TABLE 4 EXISTING ASPHALT CONCRETE VISUAL CONDITION	
Main Parking Area	Moderate raveling and shrinkage cracking, with some areas of raveling developed into drainage paths
Rear Parking Area	Slight to moderate raveling and shrinkage cracking.
Truck Service Route	Severe raveling, joint cracking, block shrinkage cracking and areas of alligator cracking on west side of building.
Main Storefront Drive	Slight to moderate raveling and block shrinkage cracking.

5.8.2 Existing Pavement – Remedial Recommendations

Table 5 below summarizes PEI's finding and recommendations:

© 2008 GEOPlus, Inc.

TABLE 5
EXISTING ASPHALT CONCRETE PAVEMENT SUMMARY AND RECOMMENDATIONS

Area	Main Parking Area	Rear Parking Area	Truck Service Route (West Side of Building)	Truck Service Route (Remainder)	
Asphalt Concrete (in)	3-1/4 to 4	3-1/2	3 to 3-1/4	3 to 3-1/4	
Aggregate Base (in)	12 to 13	12	3-1/4 to 5-1/4	3-1/4 to 5-1/4	
Performance Traffic Index (TI)	7.0	7.0	7.5	7.5	
5 to 10 Year Recommendations	Crack filling, seal coating	Crack filling, seal coating	Remove cracked pavement to 0.33', scarify and recompact baserock, replace and compact asphalt to original grade, install paving fabric, and place 1.5" overlay.	Crack filling, install paving fabric, and place 1.5" overlay.	

© 2008 GEOPlus, Inc.

15 to 20 Year Recommendations	Install paving fabric (optional), place 1.5" asphalt concrete overlay	Install paving fabric (optional), place 1.5" asphalt concrete overlay	Remove cracked pavement to 0.33', scarify and recompact baserock, replace and compact asphalt to original grade, install paving fabric, and place 2.5" overlay.	Install paving fabric, and place 2.5" overlay.	

Roof drains piped directly into project storm drains should improve pavement performance while continued overland discharge of runoff should be expected to contribute to premature pavement distress.

Repairs and upgrades should be performed around drop inlets, and disable access should be reviewed and upgraded.

Pavement maintenance including crack sealing and seal coating the pavement surface will help extend the pavement life by reducing surface water infiltration into the pavement section. Detailed recommendations for maintenance are presented in PEI's report in Appendix E.

It should be noted that the pavement survey indicates that the structural sections for pavement areas indicate TI's of 7 and 8, with respect to their performance, and which pavement sections are thinner than those presented for new pavement areas. The difference between the pavement section thicknesses reflects factors associated with the sections as constructed (material quality, compaction, drainage conditions, etc.) while the design sections based on the Caltrans methodology reflects design conservatism to address variations associated with both materials and construction. As example, the R-value test result reflects a saturated condition for the material compacted to less than 95 percent relative compaction (300 psi exudation pressure). Where existing pavement subgrades are compacted to 95 percent relative compaction (about 500 psi exudation pressure) and are not saturated, the R-value is significantly higher; thus, deflection testing will indicate that pavement section TI is greater than what the design procedure would indicate. The difference in the existing section thicknesses, and those presented for new pavements in this report, reflects the difference in the R-value used for design.

5.9 Portland Cement Concrete Pavement Recommendations

Portland cement concrete (PCC) pavement sections are illustrated above in section 4.7.2 and are based on current Portland Cement Association (PCA) design procedures, the traffic loading

© 2008 GEOPlus, Inc.

provided by Wal-Mart presented in Section 4.7, and the assumptions listed below. The following assumptions should be reviewed by the project Owner, Architect, and/or Civil Engineer to evaluate their suitability for this project. Changes in the assumptions will affect the corresponding pavement section.

- Modulus of subgrade reaction = 150 psi/in
- Modulus of rupture of concrete = 600 psi
- Aggregate Interlock Joints
- No concrete shoulders
- 20-year design life
- Load Safety Factor = 1.0

Based on the traffic information provided, we recommend that the Standard Duty Pavement Section consist of 6.0 inches of PCC over 4.0 inches of compacted Class 2 Aggregate Base and the Heavy Duty Pavement Section Consist of 7.0 inches of PCC over 4.0 inches of compacted Class 2 Aggregate Base.

Portland cement concrete pavement sections provided above are contingent on the following recommendations being implemented during construction.

- All pavement subgrades should be scarified to a depth of 12 inches below finished subgrade elevation, uniformly moisture conditioned prior to compaction. Native clay soil should be moisture conditioned to between 1 and 4 percent above the optimum moisture content, and compacted to at least 93 percent relative compaction. Non-expansive materials should be moisture conditioned to between 0 and 3 percent above optimum moisture content and compacted to at least 95 percent relative compaction.

- Adequate drainage (both surface and subsurface) should be provided such that the subgrade soils are not allowed to become wet.

- Concrete pavement should have a minimum 28 day compressive strength of 4,000 psi. Concrete slumps should be from 3 to 4 inches. The concrete should be properly cured in accordance with PCA recommended procedures and vehicular traffic should not be allowed for 3 days (automobile traffic) or 7 days (truck traffic).

- Aggregate base materials should be compacted to at least 95 percent relative compaction.

- To help offset plastic shrinkage, concrete pavement may be reinforced with at least No. 3 bars, 24 inches on-center, each way or 6x6-W2.0xW2.0 wire mesh (located 1/3 of the slab thickness from the top of the slab).

- Construction joint spacing should not exceed 12 feet.

© 2008 GEOPlus, Inc.

- Thickened edges should be used along outside edges of concrete pavements. Edge thickness should be at least 2 inches greater than the concrete pavement thickness and taper to the actual concrete pavement thickness 36 inches inward from the edge. Integral curbs may be used in lieu of thickened edges.

- Overfinishing of concrete pavements should be avoided. Typically, a broom or burlap drag finish should be used.

6. REFERENCES

California Building Standards Commission (2001), California Code of Regulation Title 24, Part 2, volume 2 – California Building Code.

California Department of Transportation (2002), Standard Specifications for Construction of Local streets and Roads, July 2002.

California Department of Transportation (2003), Corrosion Guidelines Version 1.0: California Department of Transportation Division of Engineering Services Materials Engineering and Testing Services Corrosion technology Branch, September 2003.

California Department of Transportation (2004), Highway Design Manual, July 2004.

California Department of Water Resources (DWR), 2001, Geology and Hydrogeology of the Freshwater Bearing Aquifer Systems of the Northern Sacramento Valley, California: DWR Bulletin 118-7 (Pre-publication Draft Geologic Sections).

California Geological Survey (CGS, 2003), Probabilistic Seismic Hazards Mapping Ground Motion Page, http://www.consrv.ca.gov/cgs/rghm/pshamap.

City of Chico (1999), City of Chico General Plan, Updated February, 1999

Department of the Army and Air Force (Army/Air Force 1987), Concrete Floor Slabs on Grade Subjected to Heavy Loads, Departments of Army and Air Force Technical Manaual, TM 5-809-12.

Hart E.W. and Bryant W.A. (1997), Fault-Rupture Hazard Zones in California: California Department of Conservation Division of Mines and Geology, Special Publication 42, 1997 revised edition, 38p.

Harwood, D.S. and Helley, E.J. (1987), Late Cenozoic Tectonism of the Sacramento Valley, California: United States Geological Survey Professional Paper 1359, scale 1:250,000.

Helley, E.J. and Harwood D.S. (1985), Geologic Map of the Late Cenozoic Deposits of the Sacramento Valley and Northern Sierran Foothills, California: United States Geological Survey Map MF-1790, scale 1:62,500.

Jennings C.W. (1994), Fault Activity Map of California and Adjacent Areas with Locations and Ages of Recent Volcanic Eruptions, California Division of Mines and Geology Geologic Data Map Series, Map No. 6.

© 2008 GEOPlus, Inc.

Kleinfelder, Inc. (2003), Geotechnical Investigation Report, Wal-Mart #2044 Expansion, 2044 Forest Avenue, Chico, California: March 20, 2003

NACE (1984), Corrosion Basics an Introduction, National Association of Corrosion Engineers.

Pavement Engineering, Inc. (2007), Walmart Shopping Center – Forest Avenue, Chico, California

Petersen M., Beeby D., Bryant W., Cao C., Cramer C., Davis J., Reichle M., Saucedo G., Tan S., Taylor G., Toppozada T., Treiman J. and Wills C. (1999), Seismic Shaking Hazard Maps of California: California Department of Conservation Division of Mines & Geology Map Sheet 48.

Saucedo, G.J. (1992), Map Showing Recency of Faulting, Chico Quadrangle, California *in* California Department of Conservation Division of Mines and Geology Regional Geologic Map Series Map No. 7A, 1:250,000 scale.

Saucedo, G.J. and Wagner, D.L. (1992), Geologic Map of the Chico Quadrangle, California *in* California Department of Conservation Division of Mines and Geology Regional Geologic Map Series Map No. 7A, 1:250,000 scale.

Toppozada T., Branum D., Petersen M., Hallstrom C., Cramer C., Reichle M. (2000), Epicenters of and Areas Damaged by M≥5 California Earthquakes, 1800-1999: California Department of Conservation Division of Mines and Geology Map Sheet 49.

Twining Laboratories, Inc. (1992), Geotechnical Engineering Investigation, Proposed Wal-Mart Store, Chico, California, TL 492-0200-01, December 15, 1992.

7. ADDITIONAL SERVICES

7.1 Plans and Specifications Review

Because the design details for the proposed project were not available at the time this report was prepared, we recommend that GEOPlus be retained to review the geotechnical aspects of the project plans and specifications as the design is being developed to confirm the applicability of our recommendations, or to make approach modifications.

In the event GEOPlus is not retained to review the final project plans and specifications to evaluate if our recommendations have been properly interpreted, we will assume no responsibility for misinterpretation of our recommendations.

7.2 Construction Observation and Testing

GEOPlus provides comprehensive construction observation, special inspection, and testing services to meet the requirements of the CBC, local building officials, and project plans and specifications. If authorized by Wal-Mart and/or PACLAND, GEOPlus could provide earthwork monitoring and testing, special inspection, and materials testing in accordance with project plans and specifications. This would also provide GEOPlus the opportunity to observe the soil conditions encountered during construction, evaluate the applicability of the recommendations presented in this report to the soil conditions encountered, and recommend appropriate changes in design or construction procedures if conditions differ from those described herein.

© 2008 GEOPlus, Inc.

8. UNCERTAINTY AND LIMITATIONS

We have prepared this report for use by Wal-Mart and PACLAND for design and construction planning purposes. The data and report should be reviewed as a part of the project evaluation process, however, our report, conclusions and interpretations should not be considered as warranty of the subsurface conditions. Experience has shown that subsurface soil and groundwater conditions can vary significantly over small distances. Inconsistent conditions can occur between explorations and not be detected by a geotechnical study. If, during future site operations, subsurface conditions are encountered which vary appreciably from those described herein, GEOPlus should be notified for review of our recommendations and revision of such, if necessary.

GEOPlus is available to provide continuing geotechnical services as the project proceeds through design. We also routinely monitor the geotechnical aspects of construction in order to evaluate compliance with our recommendations, particularly those activities outlined in Section 4.0 of this report.

This report may be used only by the Client and for the purposes stated, within a reasonable time from its issuance (2 years). Any party other than those referenced above that wish to rely on the report should contact GEOPlus for such authorization. Unauthorized use of this report by any party other than the Client will release GEOPlus from all liability resulting from unauthorized use of the report.

Land use, site conditions (both on- and off-site), or other factors may change over time and could materially affect our findings. Therefore, this report should not be relied upon after 24 months from its issue. GEOPlus should be notified if the project is delayed by more than 24 months from the date of this report so that a review of site conditions can be made, and recommendations revised if appropriate.

This firm does not practice or consult in the field of safety engineering. We do not direct the contractor's operations, and we cannot be responsible for the safety of personnel other than our own on the site; the safety of others is the responsibility of the contractor. The contractor should notify the owner if he considers any of the recommended actions presented herein unsafe.

© 2008 GEOPlus, Inc.

PLATES

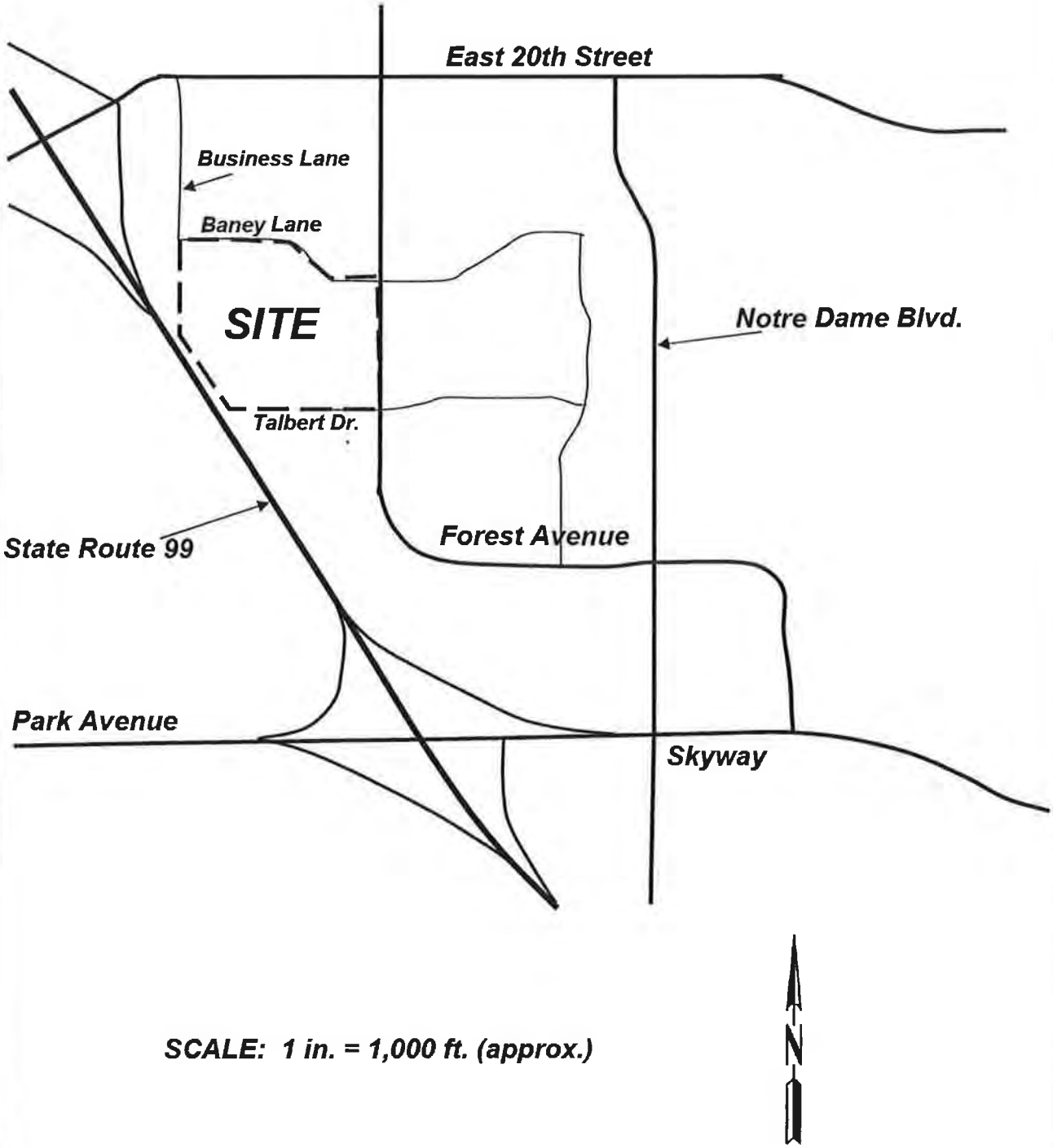
Plate 1 Location Map
Plate 2 Site Boring / Sample Plan
Plate 3 Storm Drain Trench Backfill Drainage
Plate 4 Backfill Drainage

© *GEOPlus, Inc.*

PLATES

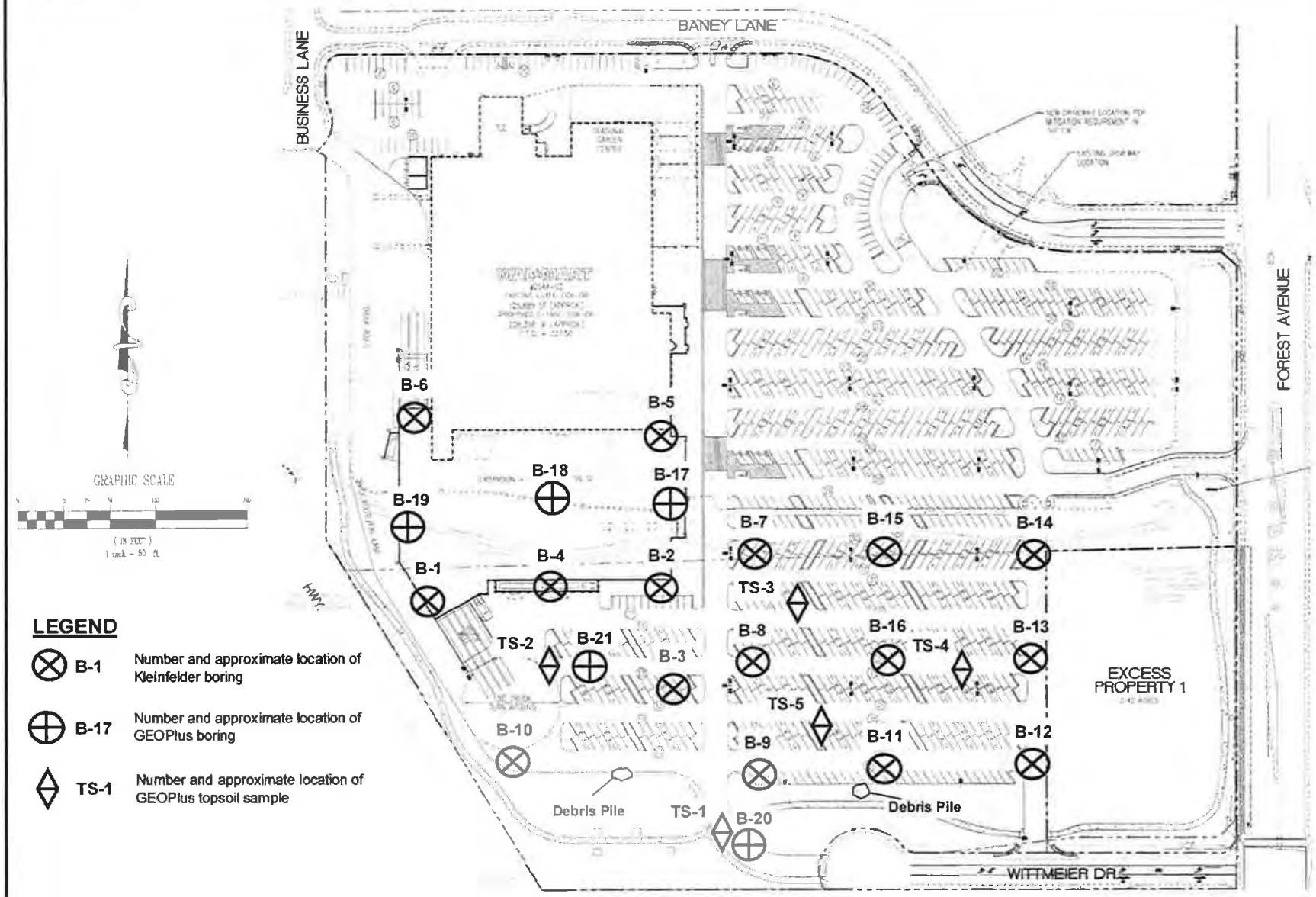
Plate 1 Location Map
Plate 2 Site Boring / Sample Plan
Plate 3 Storm Drain Trench Backfill Drainage
Plate 4 Backfill Drainage

© *GEOPlus, Inc.*



SCALE: 1 in. = 1,000 ft. (approx.)

GEO Plus			SITE LOCATION MAP Wal-Mart Store #2044-03 Expansion Chico, California	PLATE 1
Drafted by:	JLF	Project No.:	1235	
Date:	12/21/2007	Doc. No.:	07D101	



Based on drawing titled "Duncan Shopping Center Expansion, (Wal-Mart Store #2044), 2044 Forest Avenue, Chico, California," Schematic Site Plan Sheet SC-3, dated 11-9-07, prepared by PACLAND

Drafted By:	TEM	Project No.	1235
Date:	12/26/2007	Document No.	07D104

GEOPlus

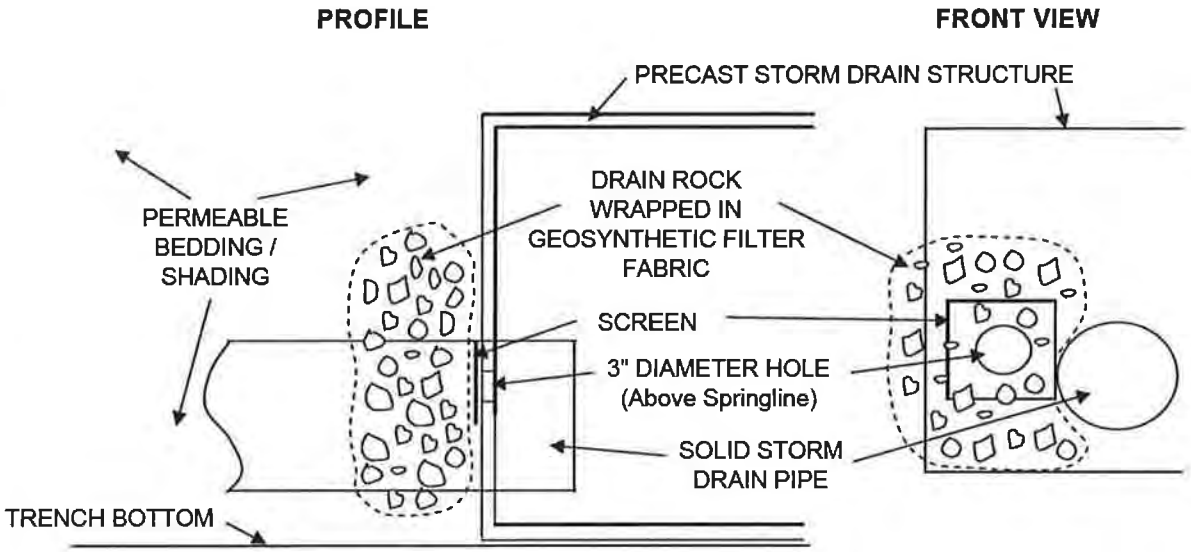
SITE BORING/SAMPLE MAP

WAL-MART STORE #2044-03 EXPANSION
2044 FOREST AVENUE
CHICO, CALIFORNIA

PLATE

2

STORM DRAIN TRENCH SUBDRAIN DETAIL



NOT TO SCALE

NOTES:

1 Permeable pipe bedding and shading should consist of durable, granular materials meeting the pipe manufacturer's specifications, and with less than 5% passing the #200 sieve.

2 Geosynthetic filter fabric should have an apparent opening size (AOS), U. S. Standard Sieve, of between 40 and 70, a permeability of at least 0.2 centimeters per second, a minimum flow rate of 50 gallons per minute per square foot of fabric, and a minimum puncture strength of 75 pounds.

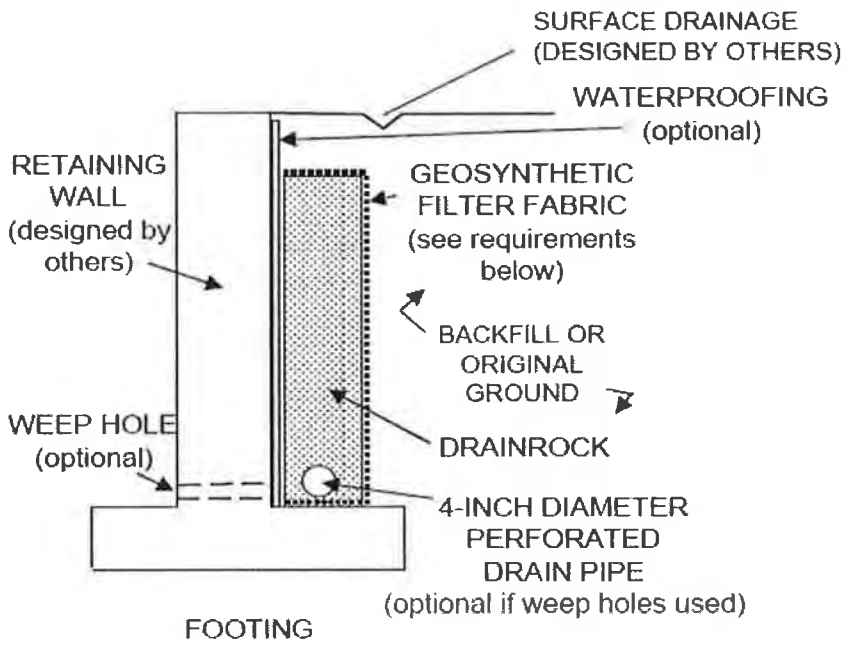
3 Woven geosynthetic fabrics are less susceptible to clogging than non-woven fabrics. Therefore, in areas subjected to sustained subsurface flows, a woven fabric may be used. In areas subject to intermittent flows, a non-woven fabric may be used.

4 Geosynthetic filter fabric should be placed in accordance with manufacturer's recommendations.

5 Surfaces to receive geosynthetic filter fabric should be free of loose or extraneous materials and sharp objects that might damage the filter fabric during installation.

6 Subdrainage should be disposed either into storm drain structures (drain inlets, catch basins, or man-holes), or conveyed into solid pipe connected to the storm drain structures. Where conveyed directly into the drain inlet, catch basin or man-hole, a 3-inch diameter inlet hole should be should be drilled through the structure at an elevation above springline of the outgoing pipe. A minimum of 2 cubic feet of drain rock (100 percent passing 1-inch screen and 95 percent retained on the No. 4 sieve) should be wrapped in geosynthetic filter fabric (properties presented above). A corrosion resistant screen should be placed between the fabric and storm drain structure to keep the filter fabric and drain rock from entering the drain inlet, catch basin or man-hole.

GEO Plus		STORM DRAIN TRENCH SUBDRAIN DETAIL WAL-MART STORE #2044-03 EXPANSION 2044 FOREST AVENUE CHICO, CALIFORNIA	PLATE 3
Drawn By: TEM Project # 1235	Date: 12-27-078/16/07 Doc No. 07D105		



No Scale

1 Drainrock should consist of durable, crushed stone having 100 percent passing the 1-inch screen and zero percent passing the No. 4 sieve.

2 Geosynthetic filter fabric should have a an equivalent opening size (EOS), U.S. Standard Sieve, of between 40 and 70, a permeability of at least 0.02 cm/sec, a minimum flow rate of 50 gallons per minute per square foot of fabric, and a minimum puncture strength of 50 pounds.

3 Woven fabrics are generally less susceptible to clogging than non-woven fabrics. Therefore, in areas subject to sustained subsurface water flows, a woven fabric should be used. In areas subject to intermittent flows, a non-woven fabric may be used.

4 Geosynthetic filter fabric should be placed in accordance with manufacturer's recommendations.

5 Perforated drain pipe should consist of schedule 40 PVC, 4 inches in diameter, with 1/4-inch diameter (maximum) perforations, 12 to 24 inches on-center, placed facing down.

6 Pipe drainage should be collected in a solid conduit and directed to a storm drain, sump, weep hole, or other suitable locations for disposal.

7 Perforated and collector pipes should be sloped a minimum of one percent (1%) to drain.

8 Waterproofing (if used) should be designed by others.

9 Weep holes spaced 4- to 8- feet on-center may be used in lieu of perforated drain pipe provided surface drainage provisions are provided downslope of wall

10 As an alternative to that presented above, perforated drain pipe may be placed at the base of the wall footing and the filter media extended accordingly.

GEO Plus		**WALL DRAIN DETAIL**	**PLATE**
Drafted by: TEM	Project No.: 1235	**WAL-MART STORE #2044-03 EXPANSI**	**4**
Date: 12/27/07	Doc No.: 07D106	**2044 FOREST AVENUE**	
		CHICO, CALIFORNIA	

APPENDIX A

Soil Boring Logs and Explanation, sheets A-1 through A-16 (Kleinfelder, 2003)
Laboratory Test Results sheets A-17 through A-21, and Sunland Analytical Test Results, dated 9-20-02 (Kleinfelder, 2003)

© GEOPlus, Inc.

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			USCS SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	GRAVELS (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS (More than half of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
			SP	POORLY-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
			SC	CLAYEY SANDS, SAND-GRAVEL-CLAY MIXTURES
FINE GRAINED SOILS (More than half of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid limit less than 50)		ML	INORGANIC SILTS & VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid limit greater than 50)		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY
LOAMS				UNDER USDA SOIL CLASSIFICATION SYSTEM, SOIL OF APPROXIMATELY EQUAL SAND/SILT/CLAY

KA-USCS 20935_1.GPJ 9/24/02

KLEINFELDER

Drafted By: D. Ross
Date: 9/24/2002
Project No.: 20935/3
File Number: 20935_1

UNIFIED SOIL CLASSIFICATION SYSTEM

WAL-MART RETAIL EXPANSION
2044 FOREST AVENUE
CHICO, CALIFORNIA

PLATE

A-1

Copyright Kleinfelder, Inc. 2002

LOG SYMBOLS

	BULK / BAG SAMPLE	-4	PERCENT FINER THAN THE NO. 4 SIEVE (ASTM Test Method C 136)
	MODIFIED CALIFORNIA SAMPLER (2-1/2 inch outside diameter)	-200	PERCENT FINER THAN THE NO. 200 SIEVE (ASTM Test Method C 117)
	CALIFORNIA SAMPLER (3 inch outside diameter)	LL	LIQUID LIMIT (ASTM Test Method D 4318)
	STANDARD PENETRATION SPLIT SPOON SAMPLER (2 inch outside diameter)	PI	PLASTICITY INDEX (ASTM Test Method D 4318)
	CONTINUOUS CORE	TXCU	CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (EM 1110-1-1906)
	SHELBY TUBE	EI	EXPANSION INDEX (UBC STANDARD 18-2)
	ROCK CORE	COL	COLLAPSE POTENTIAL
	WATER LEVEL (level where first encountered)	UC	UNCONFINED COMPRESSION (ASTM Test Method D 2166)
	WATER LEVEL (level after completion)		
	SEEPAGE	MC	MOISTURE CONTENT (ASTM Test Method D 2216)

GENERAL NOTES

1. *Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual.*
2. *No warranty is provided as to the continuity of soil conditions between individual sample locations.*
3. *Logs represent general soil conditions observed at the point of exploration on the date indicated.*
4. *In general, Unified Soil Classification System designations presented on the logs were evaluated by visual methods only. Therefore, actual designations (based on laboratory tests) may vary.*

KA-LOG KEY 20935 1.GPJ 9/24/02

KLEINFELDER

Drafted By: D. Ross
Date: 9/24/2002
Project No.: 20935/3
File Number: 20935_1

LOG KEY

WAL-MART RETAIL EXPANSION
2044 FOREST AVENUE
CHICO, CALIFORNIA

PLATE

A-2

Copyright Kleinfelder, Inc. 2002

Surface Conditions: Tall dead grass.

Groundwater: No free groundwater encountered.

Method: Hollow Stem Auger

Equipment: B-59

Date Completed: 8/27/2002

Logged By: B. Bergmann

Total Depth: 8 feet

Boring Diameter: 8 inch

Depth (feet)	Sample Type	Sample No.	Blows/ft	Pocket Penetrometer (tsf)	Dry Density (pcf)	Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION
													Fat CLAY(CH): Red-gray, dry, very stiff, blocky, 10% coarse gravel
		1b											
		1c	50/6"		108	17					UC=19.560 psf		dark brown, moist, hard
													Silty SAND with gravel(SM): Brown, moist to wet, hard (1 inch gravel in shoe)
		2				27			83	48			
5		3	50/3"										**Clayey GRAVEL with sand**(SC): Red-gray, highly weathered, friable, volcanic clasts
		4									pH=7.6; Res=4.6X(1000) ohm-cm; Chloride=5.3ppm Sulfat3e=3.5 ppm		gravel and cobble, very dense
		5	50/4"										brown to gray, wet
													Boring completed at a depth of approximately 8 feet below existing site grade.
10													

KLEINFELDER

Drafted By: D. Ross
Date: 9/24/2002
Project No.: 20935/3
File Number: 20935_1

LOG OF BORING B-1

WAL-MART RETAIL EXPANSION
2044 FOREST AVENUE
CHICO, CALIFORNIA

PLATE
1 of 1
A-3

SAC 2002 20935_1.GPJ 9/24/02

Copyright Kleinfelder, Inc. 2002

Surface Conditions: Tall dead grass.

Groundwater: No free groundwater encountered.

Method: Hollow Stem Auger

Equipment: B-59

Date Completed: 8/27/2002

Logged By: B. Bergmann

Total Depth: 10-1/4 feet

Boring Diameter: 8 inch

Depth (feet)	Sample Type	Sample No.	Blows/ft	Pocket Penetrometer (tsf)	Dry Density (pcf)	Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION
		1											**COBBLES with clay** Dark brown, cobbles to 5 inches diameter
		2	50/5-1/2"										gravel to 2 inches diameter
		3	50/6"										**Clay SAND with gravel**(SC): Brown, moist, very dense
													cobbles
5		4	50/4"										red-gray, dry to moist, very dense
													red-gray, very dense
10		5	50/2"										
													Boring completed at a depth of approximately 10-1/4 feet below existing site grade.

KLEINFELDER

Drafted By: D. Ross

Date: 9/24/2002

Project No.: 20935/3

File Number: 20935_1

LOG OF BORING B- 2

WAL-MART RETAIL EXPANSION
2044 FOREST AVENUE
CHICO, CALIFORNIA

PLATE

1 of 1

A-4

SAC 2002 20935_1.GPJ 9/24/02

Copyright Kleinfelder, Inc. 2002

Surface Conditions:	Dry dead grass.	Date Completed:	8/28/2002
Groundwater:	No free groundwater encountered.	Logged By:	B. Bergmann/T. Metcalf
		Total Depth:	6-1/2 feet
Method:	Hollow Stem Auger	Boring Diameter:	8 inch
Equipment:	B-59		

Depth (feet)	FIELD: Sample Type	Sample No.	Blows/ft	Pocket Penetrometer (tsf)	LABORATORY: Dry Density (pcf)	Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION
													Fat CLAY(CH): Red-gray, dry, hard, blocky
		1					39	9					**Clayey SILT**(ML): Red-gray, moist, hard moist
5													**Clayey SAND with grave**(SC): Red-gray, moist, hard
													Boring completed at a depth of approximately 6-1/2 feet below existing site grade.
10													

KLEINFELDER

Drafted By: D. Ross
Date: 9/24/2002
Project No.: 20935/3
File Number: 20935_1

LOG OF BORING B- 3

WAL-MART RETAIL EXPANSION
2044 FOREST AVENUE
CHICO, CALIFORNIA

PLATE
1 of 1
A-5

SAC 2002 20935_1.GPJ 9/24/02

Copyright Kleinfelder, Inc. 2002

Surface Conditions: Disced, dry dead grass.

Groundwater: No free groundwater encountered.

Method: Hollow Stem Auger

Equipment: B-59

Date Completed: 8/28/2002

Logged By: T. Metcalf

Total Depth: 10-1/4 feet

Boring Diameter: 8 inch

Depth (feet)	Sample Type	Sample No.	FIELD: Blows/ft	FIELD: Pocket Penetrometer (tsf)	LABORATORY: Dry Density (pcf)	LABORATORY: Moisture Content (%)	LABORATORY: Liquid Limit	LABORATORY: Plasticity Index	LABORATORY: Passing #4 Sieve (%)	LABORATORY: Passing #200 Sieve (%)	LABORATORY: Other Tests	Lithography	DESCRIPTION
													Lean/Fat CLAY(CL/CH): Red-gray, dry, hard, some sand, blocky
		1a											
		1b											
		1c	67		106	14							
													Sandy SILT(ML): Brown, dry, hard
		2a											
		2b											
			53		111	15			100	52			
													Clayey SAND with gravel(SC): Red-gray, moist, very dense
5			50/1"										
													cobbles
10			50/2"										
													Boring completed at a depth of approximately 10-1/4 feet below existing site grade.

KLEINFELDER

Drafted By: D. Ross

Date: 9/24/2002

Project No.: 20935/3

File Number: 20935_1

LOG OF BORING B- 4

WAL-MART RETAIL EXPANSION
2044 FOREST AVENUE
CHICO, CALIFORNIA

PLATE

1 of 1

A-6

SAC 2002 20935_1.GPJ 9/24/02

Copyright Kleinfelder, Inc. 2002

Surface Conditions: Asphalt concrete parking lot.

Groundwater: No free groundwater encountered.

Method: Hollow Stem Auger

Equipment: B-59

Date Completed: 8/28/2002

Logged By: T. Metcalf

Total Depth: 10-1/4 feet

Boring Diameter: 8 inch

Depth (feet)	Sample Type	Sample No.	Blows/ft	Pocket Penetrometer (tsf)	Dry Density (pcf)	Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION
													ASPHALT CONCRETE PAVEMENT 3-1/2 inches thick
													AGGREGATE BASE ROCK 9 inches thick
													Sandy CLAY(CH): Red-gray, dry to moist, hard
		1a									EI=33; pH=7.0; Res=1.3X(1000) ohm-cm; Chloride=15.0 ppm Sulfate=15.4 ppm UC=4,860 psf		
		1b											
		1c	50		104	20							
5		2	50/4"						77	36			**Clayey SAND with gravel**(SC): Red-gray, moist, very dense
													cobbles
													red-gray, moist, very dense
10		3	50/1-1/2"										
													Boring completed at a depth of approximately 10-1/4 feet below existing site grade.

KLEINFELDER

Drafted By: D. Ross
Date: 9/24/2002

Project No.: 20935/3
File Number: 20935_1

LOG OF BORING B- 5

WAL-MART RETAIL EXPANSION
2044 FOREST AVENUE
CHICO, CALIFORNIA

PLATE
1 of 1
A-7

SAC 2002 20935 1.GPJ 9/24/02

Copyright Kleinfelder, Inc. 2002

Surface Conditions:	Asphalt concrete pavement.	Date Completed:	8/28/2002
Groundwater:	No free groundwater encountered.	Logged By:	T. Metcalf
		Total Depth:	10-1/2 feet
Method:	Hollow Stem Auger	Boring Diameter:	8 inch
Equipment:	B-59		

Depth (feet)	Sample Type	Sample No.	Blows/ft	Pocket Penetrometer (tsf)	Dry Density (pcf)	Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION
													ASPHALT CONCRETE PAVEMENT: 3-1/2 inches thick AGGREGATE BASEROCK18 inches thick
		1	50/6"										Fat CLAY(CH): Red-brown, moist, hard
													SILT (ML): Brown, moist to wet, stiff, fine sand
5													Sandy SILT(ML): Brown, wet, stiff
		2b											
		2c	75/8"						100	28			Silty SAND(SM): Brown, wet, dense
													Clayey SAND with grave(SC): Red-gray, moist, very dense
10													
		3	50/5-1/5"			20							moist to wet
													Boring completed at a depth of approximately 10-1/2 feet below existing site grade.

KLEINFELDER

Drafted By: D. Ross
Date: 9/24/2002
Project No.: 20935/3
File Number: 20935_1

LOG OF BORING B- 6

WAL-MART RETAIL EXPANSION
2044 FOREST AVENUE
CHICO, CALIFORNIA

PLATE
1 of 1
A-8

SAC 2002 20935 1.GPJ 9/24/02

Copyright Kleinfelder, Inc. 2002

Surface Conditions: Dry grasses in disced field, desiccation cracks to 3/4 inch wide.

Groundwater: No free groundwater encountered.

Method: Hollow Stem Auger

Equipment: B-59

Date Completed: 8/28/2002

Logged By: T. Metcalf

Total Depth: 5-1/2 feet

Boring Diameter: 8 inch

Depth (feet)	FIELD: Sample Type	Sample No.	Blows/ft	Pocket Penetrometer (tsf)	LABORATORY: Dry Density (pcf) / Moisture Content (%)	Liquid Limit / Plasticity Index	Passing #4 Sieve (%) / Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION
		1								**Gravelly CLAY**(CL): Red-gray, dry, blocky, hard, some gravel
5										**Clayey GRAVEL with sand**(GC): Red-gray, moit, very dense, gravel to 2 inches diameter
										Boring completed at a depth of approximately 5-1/2 feet below existing site grade.
10										

KLEINFELDER

Drafted By: D. Ross
Date: 9/24/2002

Project No.: 20935/3
File Number: 20935_1

LOG OF BORING B- 7

WAL-MART RETAIL EXPANSION
2044 FOREST AVENUE
CHICO, CALIFORNIA

PLATE
1 of 1
A-9

SAC 2002 20935_1.GPJ 9/24/02

Copyright Kleinfelder, Inc. 2002

Surface Conditions: Dry grasses in disced field, desiccation cracks to 1 inch wide.

Groundwater: No free groundwater encountered.

Method: Hollow Stem Auger

Equipment: B-59

Date Completed: 8/28/2002

Logged By: T. Metcalf

Total Depth: 5-1/2 feet

Boring Diameter: 8 inch

Depth (feet)	FIELD: Sample Type	FIELD: Sample No.	FIELD: Blows/ft	FIELD: Pocket Penetrometer (tsf)	LABORATORY: Dry Density (pcf)	LABORATORY: Moisture Content (%)	LABORATORY: Liquid Limit	LABORATORY: Plasticity Index	LABORATORY: Passing #4 Sieve (%)	LABORATORY: Passing #200 Sieve (%)	LABORATORY: Other Tests	Lithography	DESCRIPTION
		1											**Gravelly Lean/Fat CLAY**(CL/CH): Red-gray, dry, hard, fractured, with gravel to 3 inches diameter
5													**Clayey SAND with gravel**(SC): Red-gray, moist, very dense, gravel to 2 inches
													Boring completed at a depth of approximately 5-1/2 feet below existing site grade.
10													

KLEINFELDER

Drafted By: D. Ross

Date: 9/24/2002

Project No.: 20935/3

File Number: 20935_1

LOG OF BORING B- 8

WAL-MART RETAIL EXPANSION
2044 FOREST AVENUE
CHICO, CALIFORNIA

PLATE

1 of 1

A-10

SAC 2002 20935_1.GPJ 9/24/02

Copyright Kleinfelder, Inc. 2002

Surface Conditions:	Dry grasses in disced field. obbles to 6 inches scattered on parcel.	Date Completed:	8/27/2002
Groundwater:	No free groundwater encountered.	Logged By:	T. Metcalf
		Total Depth:	5-1/2 feet
Method:	Hollow Stem Auger	Boring Diameter:	8 inch
Equipment:	B-59		

Depth (feet)	FIELD: Sample Type	Sample No.	Blows/ft	Pocket Penetrometer (tsf)	LABORATORY: Dry Density (pcf) / Moisture Content (%)	Liquid Limit / Plasticity Index	Passing #4 Sieve (%) / Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION
		1								**Gravelly CLAY**(CL): Dark brown, dry, hard, fractured
										Clayey GRAVEL with sand(GC): Red-brown, moist, very dense
5										
										Boring completed at a depth of approximately 5-1/2 feet below existing site grade.
10										

KLEINFELDER

Drafted By: D. Ross
Date: 9/24/2002
Project No.: 20935/3
File Number: 20935_1

LOG OF BORING B- 9

WAL-MART RETAIL EXPANSION
2044 FOREST AVENUE
CHICO, CALIFORNIA

PLATE
1 of 1
A-11

SAC 2002 20935_1.GPJ 9/24/02

Copyright Kleinfelder, Inc. 2002

Surface Conditions: Dry grasses in disced field.

Groundwater: No free groundwater encountered.

Method: Hollow Stem Auger

Equipment: B-59

Date Completed: 8/28/2002

Logged By: T. Metcalf

Total Depth: 5-1/2 feet

Boring Diameter: 8 inch

Depth (feet)	FIELD: Sample Type	FIELD: Sample No.	FIELD: Blows/ft	FIELD: Pocket Penetrometer (tsf)	LABORATORY: Dry Density (pcf)	LABORATORY: Moisture Content (%)	LABORATORY: Liquid Limit	LABORATORY: Plasticity Index	LABORATORY: Passing #4 Sieve (%)	LABORATORY: Passing #200 Sieve (%)	LABORATORY: Other Tests	Lithography	DESCRIPTION
		1							78	31	R-Value=15		**Clayey SAND with grave**l(SC): Dark brown, dry, medium dense
													GRAVEL AND COBBLES Brown, moist
													Clayey SAND with gravel(SC): Red-gray, moist, very dense
5													
													Boring completed at a depth of approximately 5-1/2 feet below existing site grade.
10													

KLEINFELDER

Drafted By: D. Ross

Date: 9/24/2002

Project No.: 20935/3

File Number: 20935_1

LOG OF BORING B-10

WAL-MART RETAIL EXPANSION
2044 FOREST AVENUE
CHICO, CALIFORNIA

PLATE

1 of 1

A-12

SAC 2002 20935 1.GPJ 9/24/02

Copyright Kleinfelder, Inc. 2002

Surface Conditions:	Dry grasses in disced field.	Date Completed:	8/28/2002
Groundwater:	No free groundwater encountered.	Logged By:	T. Metcalf
		Total Depth:	5 feet
Method:	Hollow Stem Auger	Boring Diameter:	8 inch
Equipment:	B-59		

Depth (feet)	FIELD: Sample Type	FIELD: Sample No.	FIELD: Blows/ft	FIELD: Pocket Penetrometer (tsf)	LABORATORY: Dry Density (pcf) / Moisture Content (%)	LABORATORY: Liquid Limit / Plasticity Index	LABORATORY: Passing #4 Sieve (%) / Passing #200 Sieve (%)	LABORATORY: Other Tests	Lithography	DESCRIPTION
										Lean/Fat CLAY(CL/CH): Dark brown, dry, hard, fractured
										Clayey GRAVEL with sand(GC): Red-gray, moist, very dense
										cobbles and gravel
5										Boring completed at a depth of approximately 5 feet below existing site grade.
10										

KLEINFELDER

Drafted By: D. Ross
Date: 9/24/2002
Project No.: 20935/3
File Number: 20935_1

LOG OF BORING B-11

WAL-MART RETAIL EXPANSION
2044 FOREST AVENUE
CHICO, CALIFORNIA

PLATE
1 of 1
A-13

SAC 2002 20935_1.GPJ 9/24/02

Copyright Kleinfelder, Inc. 2002

Surface Conditions: Dry grasses in disced field

Groundwater: No free groundwater encountered.

Method: Hollow Stem Auger

Equipment: B-59

Date Completed: 8/28/2002

Logged By: T. Metcalf

Total Depth: 5-1/2 feet

Boring Diameter: 8 inch

Depth (feet)	FIELD: Sample Type	FIELD: Sample No.	FIELD: Blows/ft	FIELD: Pocket Penetrometer (tsf)	LABORATORY: Dry Density (pcf)	LABORATORY: Moisture Content (%)	LABORATORY: Liquid Limit	LABORATORY: Plasticity Index	LABORATORY: Passing #4 Sieve (%)	LABORATORY: Passing #200 Sieve (%)	LABORATORY: Other Tests	Lithography	DESCRIPTION
									84	47	R-Value=12		**Clayey SAND with grave**l(SC): Dark brown, dry, hard, fractured
													CLAY (CL): Red-brown, dry to moist, hard, sandy
													Clayey SAND with gravel(SC): Red-gray, moist, very dense, gravel to 3 inches diameter
5													
													Boring completed at a depth of approximately 5-1/2 feet below existing site grade.
10													

KLEINFELDER

Drafted By: D. Ross

Date: 9/24/2002

Project No.: 20935/3

File Number: 20935_1

LOG OF BORING B-12

WAL-MART RETAIL EXPANSION
2044 FOREST AVENUE
CHICO, CALIFORNIA

PLATE

1 of 1

A-14

SAC 2002 20935_1.GPJ 9/24/02

Copyright Kleinfelder, Inc. 2002

Surface Conditions:	Dry grasses in disced field.	Date Completed:	8/28/2002
Groundwater:	No free groundwater encountered.	Logged By:	T. Metcalf
		Total Depth:	5-1/2 feet
Method:	Hollow Stem Auger	Boring Diameter:	8 inch
Equipment:	B-59		

Depth (feet)	FIELD: Sample Type	Sample No.	Blows/ft	Pocket Penetrometer (tsf)	LABORATORY: Dry Density (pcf) / Moisture Content (%)	Liquid Limit / Plasticity Index	Passing #4 Sieve (%) / Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION
										Gravelly CLAY(CL): Dark brown, dry, hard, fine gravel
										Clayey GRAVEL with sand(GC): Red-brown, dry to moist, very dense
										cobbles, dry to moist
5										
										Boring completed at a depth of approximately 5-1/2 feet below existing site grade.
10										

KLEINFELDER

Drafted By: D. Ross
Date: 9/24/2002
Project No.: 20935/3
File Number: 20935_1

LOG OF BORING B-13

WAL-MART RETAIL EXPANSION
2044 FOREST AVENUE
CHICO, CALIFORNIA

PLATE
1 of 1
A-15

SAC 2002 20935_1.GPJ 9/24/02

Copyright Kleinfelder, Inc. 2002

Surface Conditions:	Dry grasses in disced field. Cobbles to 8 inches present in area.	Date Completed:	8/28/2002
Groundwater:	No free groundwater encountered.	Logged By:	T. Metcalf
		Total Depth:	6 feet
Method:	Hollow Stem Auger	Boring Diameter:	8 inch
Equipment:	B-59		

Depth (feet)	FIELD: Sample Type	FIELD: Sample No.	FIELD: Blows/ft	FIELD: Pocket Penetrometer (tsf)	LABORATORY: Dry Density (pcf) / Moisture Content (%)	LABORATORY: Liquid Limit / Plasticity Index	LABORATORY: Passing #4 Sieve (%) / Passing #200 Sieve (%)	LABORATORY: Other Tests	Lithography	DESCRIPTION
										Gravelly CLAY(CL/CH): Dark brown, dry, hard, fractured, gravel to 1-1/2 inch diameter
		1					45 : 26			**Clayey SAND**(SC): Dark brown, dry to moist, dense
5										moist
										Clayey GRAVEL with sand(GC): Red-gray, moist, very dense
										Boring completed at a depth of approximately 6 feet below existing site grade.
10										

KLEINFELDER

Drafted By: D. Ross
Date: 9/24/2002
Project No.: 20935/3
File Number: 20935_1

LOG OF BORING B-14

WAL-MART RETAIL EXPANSION
2044 FOREST AVENUE
CHICO, CALIFORNIA

PLATE
1 of 1
A-16

SAC 2002 20935 1.GPJ 9/24/02

Copyright Kleinfelder, Inc. 2002

Surface Conditions:	Dry grasses in disced field.	Date Completed:	8/28/2002
Groundwater:	No free groundwater encountered.	Logged By:	T. Metcalf
		Total Depth:	5-1/2 feet
Method:	Hollow Stem Auger	Boring Diameter:	8 inch
Equipment:	B-59		

Depth (feet)	FIELD: Sample Type	FIELD: Sample No.	FIELD: Blows/ft	FIELD: Pocket Penetrometer (tsf)	LABORATORY: Dry Density (pcf) / Moisture Content (%)	LABORATORY: Liquid Limit / Plasticity Index	LABORATORY: Passing #4 Sieve (%) / Passing #200 Sieve (%)	LABORATORY: Other Tests	Lithography	DESCRIPTION
										Gravelly CLAY(CL/CH): Brown, dry, hard
										Clayey GRAVEL with sand(GC): Red-gray, moist , very dense, gravel to 2 inches diameter
5										
										Boring completed at a depth of approximately 5-1/2 feet below existing site grade.
10										

KLEINFELDER

Drafted By: D. Ross
Date: 9/24/2002
Project No.: 20935/3
File Number: 20935_1

LOG OF BORING B-15

WAL-MART RETAIL EXPANSION
2044 FOREST AVENUE
CHICO, CALIFORNIA

PLATE
1 of 1
A-17

SAC 2002 20935_1.GPJ 9/24/02

Copyright Kleinfelder, Inc. 2002

Surface Conditions:	Dry grasses in disced field.	Date Completed:	8/28/2002
Groundwater:	No free groundwater encountered.	Logged By:	T. Metcalf
		Total Depth:	5-1/2 feet
Method:	Hollow Stem Auger	Boring Diameter:	8 inch
Equipment:	B-59		

Depth (feet)	FIELD: Sample Type	Sample No.	Blows/ft	Pocket Penetrometer (tsf)	LABORATORY: Dry Density (pcf) / Moisture Content (%)	Liquid Limit / Plasticity Index	Passing #4 Sieve (%) / Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION
										Gravelly CLAY(CL/CH): Dark brown, dry, hard, gravel to 2 inches diameter
										Clayey SAND with gravel(SC): Red-gray, dry to moist, dense
5										
										Boring completed at a depth of approximately 5-1/2 feet below existing site grade.
10										

KLEINFELDER

Drafted By: D. Ross
Date: 9/24/2002
Project No.: 20935/3
File Number: 20935_1

LOG OF BORING B-16

WAL-MART RETAIL EXPANSION
2044 FOREST AVENUE
CHICO, CALIFORNIA

PLATE
1 of 1
A-18

SAC 2002 20935_1.GPJ 9/24/02

Copyright Kleinfelder, Inc. 2002

BORING NO.	SAMPLE DEPTH	DRY UNI WEIGHT	MOISTURE CONTENT	PARTICLE SIZE SIEVE SIZE (percent passing)						ATTERBERG LIMITS		OTHER TESTS
	(ft)	(pcf)	(%)	3"	3/4"	#4	#16	#50	#200	LL	PI	
B-1	1/1/02	108	17							25	10	Uc = 19,560 psf
	3	114	27			83			48			
	6											pH = 7.6; Res = 4.6 x 1000 ohm-cm; Chloride = 5.3 ppm: Sulfate = 3.5 ppm.
B-3	0									39	9	Expansion Index = 55
B-4	2	106	14									
	4	111	15			100			52			
B-10	0					78			31			R-value = 15
												R-value = 12
B-12	0					84			47			
B-14	2									45	20	

Note: * Data may not be reliable

KLEINFELDER

Drafted by: BEN
Date: 3-18-03

Project No.: 20935
Doc No.:20935 PP A17

SUMMARY OF LABORATORY TESTS
Wal-Mart #2044 Expansion
2044 Forest Avenue
Chico, California

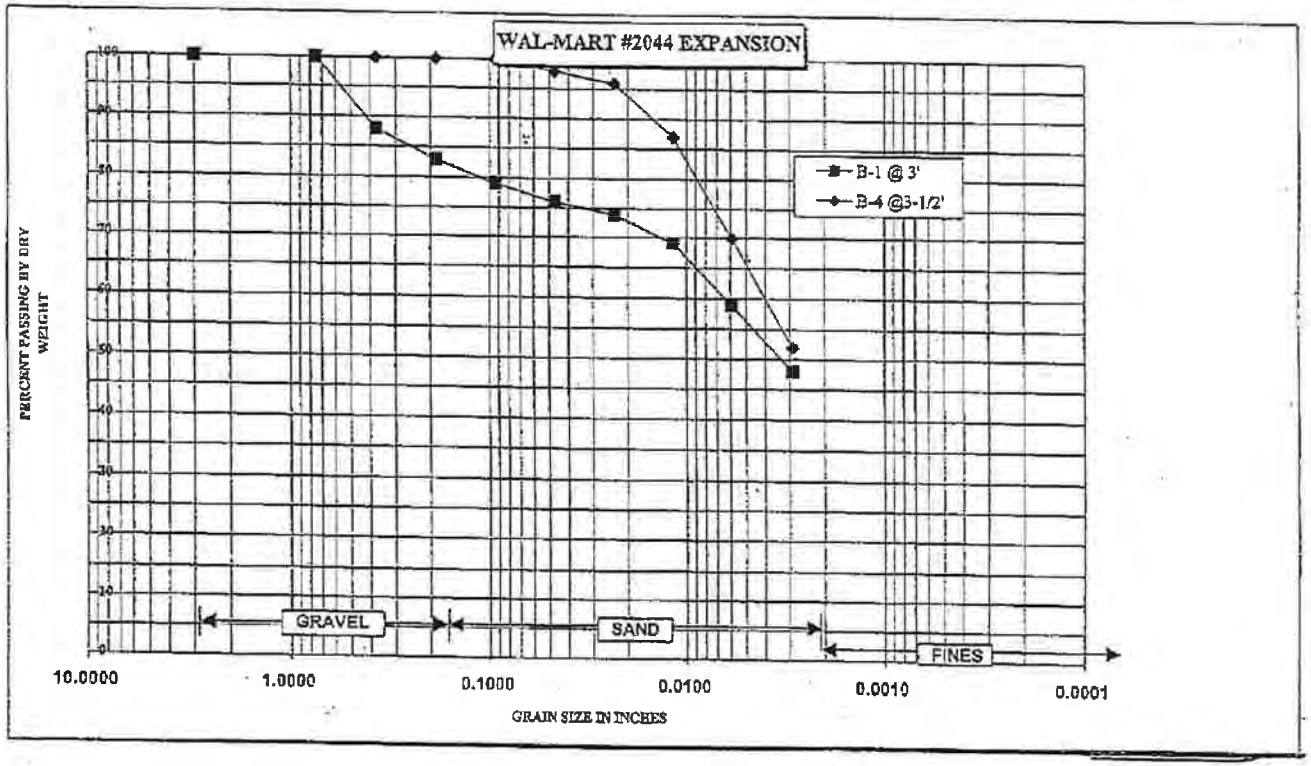
PLATE
A-17

SIEVE/HYDROMETER ANALYSIS

Percent Passing by Dry Weight

Sample Date	Sample Description	Screen Size (in)/Sieve Size											
		3	3/4	#4	#8	#16	#30	#50	#100	#200	0.002	0.0018	LL PI
8/28/02	B-1 @ 3'	100	100	83	79	76	74	69	59	48	0	0	-
8/28/02	B-4 @3-1/2'	100	100	100	100	98	96	87	70	52	0	0	-
													-
													-

Hydrometer and sieve analysis by ASTM D422; LL-PI by ASTM D4254



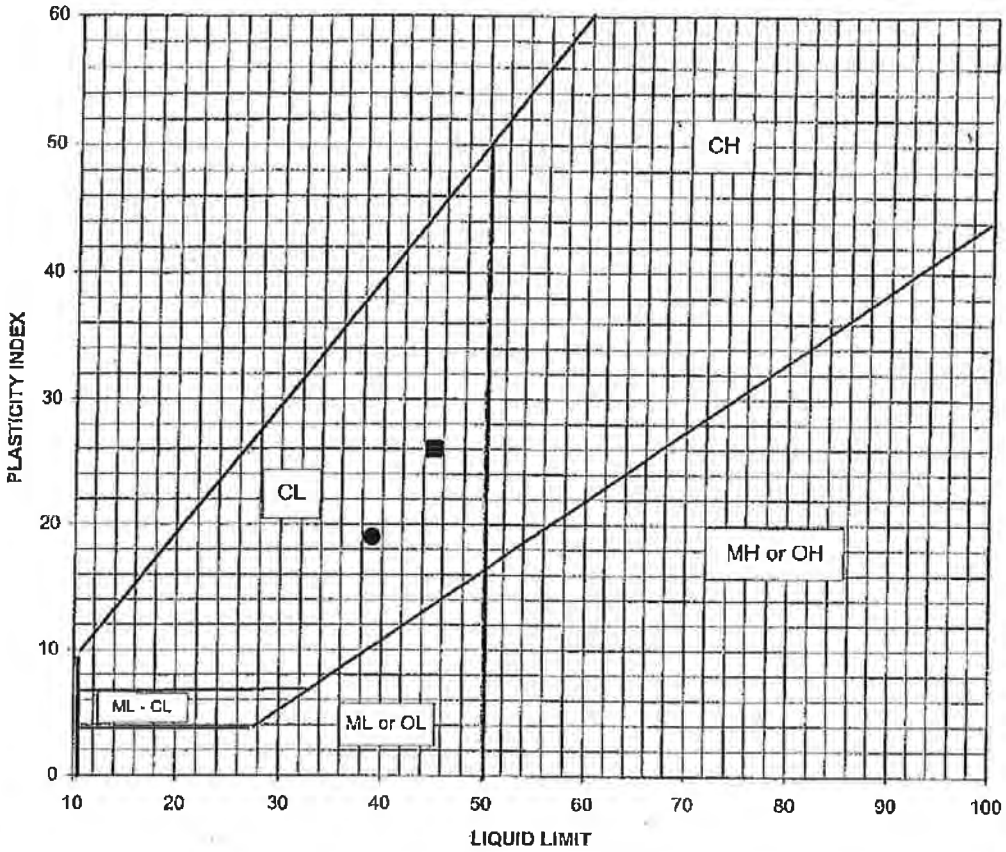
Project No.: 20935
Doc No.: 20935-pp-2
Drafted by: BEN
Date: 3-19-03

KLEINFELDER

SIEVE/HYDROMETER ANALYSIS
Wal-Mart # 2044 Expansion
2044 Forest Avenue
Chico, Califonira

PLATE
A-18

ATTERBERG LIMITS



GROUP SYMBOL	UNIFIED SOIL CLASSIFICATION FINE GRAINED SOIL
OL	Organic silts and organic silty clays of low plasticity
ML	Inorganic clayey silts to very fine sands of slight plasticity
CL	Inorganic clays of low to medium plasticity
OH	Organic silts and clays of medium to high plasticity
MH	Inorganic silts, clayey silts, and sandy silts
CH	Inorganic clays of high plasticity

Sample I Depth	B-3 2'	B-14 3'
LL	39	45
PL	20	19
PI	19	26

Note : Test performed in accordance with ASTM D 4318.

KLEINFELDER

Drafted by: BEN
Date: 3-19-03

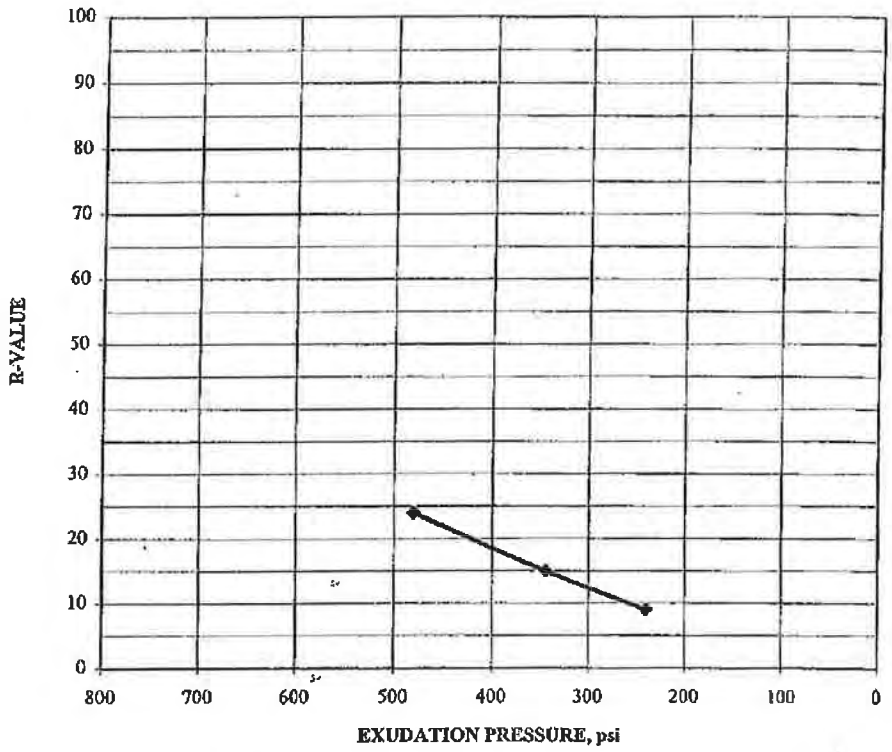
Project No.: 20935
Doc No.:20935 PP 1

ATTERBERG LIMIT TESTS
Wal-Mart #2044 Expansion
2044 Forest Avenue
Chico, California

PLATE
A-19

RESISTANCE VALUE

PROJECT NAME: Wal-Mart Chico Expansion
PROJECT NUMBER: 20935
SAMPLE IDENTIFICATION: Boring No. B-12 @ 0 to 1-1/2'
MATERIAL DESCRIPTION: CLAY with Some Silt



SPECIMEN	A	B	C
MOISTURE AT TEST, %	19.6	18.7	17.7
DRY DENSITY AT TEST, pcf	106.8	110.4	113.3
EXPANSION PRESSURE, psf	108	169	204
EXUDATION PRESSURE, psi	240	344	480
RESISTANCE VALUE	9	15	24

R - VALUE AT 300 PSI EXUDATION PRESSURE	12

KLEINFELDER

Drafted by: BEN
Date: 3-19-03

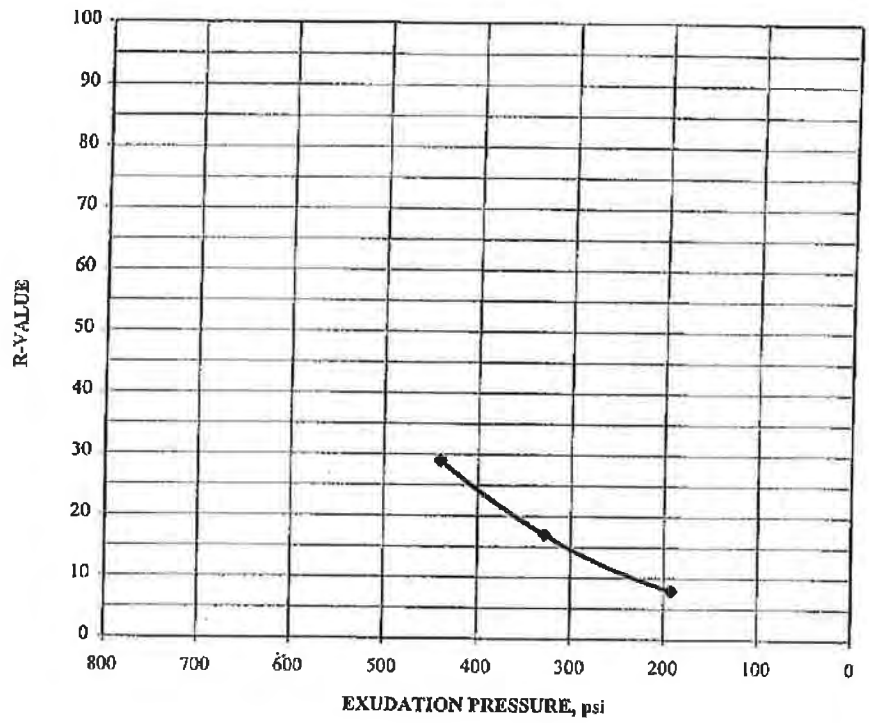
Project No.: 20935
Doc No.:20935 PP 1

RESISTANCE VALUE TEST
Wal-Mart #2044 Expansion
2044 Forest Avenue
Chico, California

PLATE
A-20

RESISTANCE VALUE

PROJECT NAME: Wal-Mart Chico Expansion
PROJECT NUMBER: 20935
SAMPLE IDENTIFICATION: Boring No. B-10 @ 0 to 1 '
MATERIAL DESCRIPTION: CLAY



SPECIMEN	A	B	C
MOISTURE AT TEST, %	28.0	27.0	28.9
DRY DENSITY AT TEST, pcf	92.3	94.1	90.4
EXPANSION PRESSURE, psf	247	113	65
EXUDATION PRESSURE, psi	328	440	192
RESISTANCE VALUE	17	29	8

R - VALUE AT 300 PSI EXUDATION PRESSURE	15

KLEINFELDER

Drafted by: BEN
Date: 3-19-03

Project No.: 20935
Doc No.:20935 PP 1

RESISTANCE VALUE TEST
Wal-Mart #2044 Expansion
2044 Forest Avenue
Chico, California

PLATE
A-21

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

RECEIVED
SEP 23 2002
KLEINFELDER, INC
REDDING, CA

Date Reported 09/20/2002
Date Submitted 09/17/2002

To: Corky Metcalf
Kleinfelder
9530 Crossroads Dr.
Redding, CA 96003

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 20935/2WALMART CHICO Site ID : B-1\4@6'.
Thank you for your business.

* For future reference to this analysis please use SUN # 38050-73201.

EVALUATION FOR SOIL CORROSION

Soil pH	7.61		
Minimum Resistivity	4.56	ohm-cm (x1000)	
Chloride	5.3 ppm	00.00053	%
Sulfate	3.5 ppm	00.00035	%

METHODS
pH and Min.Resistivity CA DOT Test #643 Mod.(Sm.Cell)
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

APPENDIX B

***GEOPLus* Soil Boring Logs and Explanation (7 sheets)**

© GEOPlus, Inc.

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

GEO Plus

Drafted by: TEM Project No.: 1235
Date: 2-14'08 Doc. No.: 07D102

UNIFIED SOIL CLASSIFICATION SYSTEM

WAL-MART STORE #2044-03
FOREST AVENUE
CHICO, CALIFORNIA

PLATE

B-1

SYMBOL	ROCK TYPE	SYMBOL	ROCK TYPE	SYMBOL	ROCK TYPE
	BRECCIA		SILTSTONE		SCHIST
	CLAYSTONE		MUDSTONE		SANDSTONE
	CONGLOMERATE		TUFF		GRAYWACKE
	GREENSTONE		LIMESTONE		GRANITE

WEATHERING

DESIGNATION	CRITERIA
DECOMPOSED	ROCK REDUCED TO SOIL WITH RELICT ROCK TEXTURE/STRUCTURE; GENERALLY MOLDED AND CRUMBLED BY HAND.
HIGHLY WEATHERED	ENTIRE MASS DISCOLORED; ALTERATION PERVADING NEARLY ALL ROCK WITH SOME SLIGHTLY WEATHRED POCKETS MOTICABLE; SOME MINERALS MAY BE LEACHED.
MODERATELY WEATHERED	DISCOLORING EVIDENT; SURFACE PITTING AND ALTERATION PENETRATING WELL BELOW SURFACE; WEATHERING "HALOS" EVIDENT; 10 TO 50 % OF ROCK ALTERED.
SLIGHTLY WEATHERED	SLIGHT DISCOLORATION ON SURFACE; SLIGHT ALTERATION ALONG DISCONTINUITIES; LESS THAN 10% OF ROCK VOLUME ALTERED.
UNWEATHERED	NO EVIDENCE OF CHEMICAL/MECHANICAL ALTERATION.

FRACTURE SPACING

DESIGNATION	CRITERIA
CRUSHED	SPACING < 1/2 INCH
INTENSELY FRACTURED	SPACING < 2 INCHES
HIGHLY FRACTURED	SPACING 2 INCHES TO 8 INCHES
MODERATELY FRACTURED	SPACING 8 INCHES TO 2 FEET
SLIGHTLY FRACTURED	SPACING 2 FEET TO 6 FEET
UNFRACTURED	SPACING GREATER THAN 6 FEET

HARDNESS/STRENGTH

DESIGNATION	CRITERIA
FRIABLE	CAN BE READILY INDENTED, GROOVED, OR GOUGED WITH FINGERNAIL OR CARVED WITH KNIFE; BREAKS WITH MODERATE TO LIGHT MANUAL PRESSURE
VERY WEAK	CAN BE GROOVED/GOUGED EASILY BY SHARP PICK WITH LIGHT PRESURE; CAN BE SCRATCHED BY FINGERNAIL; BREAKS UNDER MODERATE MANUAL PRESSURE.
WEAK	CAN BE GROOVED/GOUGED 2MM DEEP BY KNIFE OR SHARP PICK WITH MODERATE TO HEAVY PRESSURE; BREAKS WITH LIGHT HAMMER BLOW OR HEAVY MANUAL PRESSURE.
MODERATELY HARD	CAN BE SCRATCHED WITH A KNIFE OR SHARP PICK WITH LIGHT TO MODERATE PRESSURE; BREAKS WITH MODERATE HAMMER BLOW.
HARD	CANNOT BE SCRATCHED WITH A KNIFE OR SHARP PICK; BREAKS WITH REPEATED HAMMER BLOWS
VERY HARD	CANNOT BE SCRATCHED WITH A KNIFE OR SHARP PICK; BREAKS WITH REPEATED HAMMER BLOWS
EXTREMELY HARD	CANNOT BE SCRATCHED WITH A KNIFE OR SHARP PICK; CAN ONLY BE CHIPPED WITH REPEATED HAMMER BLOWS.

GEO Plus

Drafted by: TEM Project No.: 1235
Date: 2-14-08 Doc. No.: 07D102

ROCK DESCRIPTION CRITERIA

WAL-MART STORE #2044-03
FOREST AVENUE
CHICO, CALIFORNIA

PLATE

B-2

LOG SYMBOLS

	BULK BAG/SAMPLE	-4	PERCENT FINER THAT THE NO. 4 SIEVE (ASTM TEST METHOD D-422)
	MODIFIED CALIFORNIA SAMPLER (2-1/2 INCH OUTSIDE DIAMETER)	-200	PERCENT FINER THAT THE NO. 200 SIEVE (ASTM TEST METHOD D-422)
	CALIFORNIA SAMPLER (3-INCH OUTSIDE DIAMETER)	LL	LIQUID LIMIT (ASTM TEST METHOD D-4318)
	STANDARD PENETRATION SPLIT SPOON SAMPLER (2-INCH OUTSIDE DIAMETER)	PI	LIQUID LIMIT (ASTM TEST METHOD D-4318)
	CONTINUOUS CORE	TXCU	CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (ASTM TEST
	SHELBY TUBE	EI	EXPANSION INDEX (UBC STANDARD 18-2)
	ROCK CORE	COL	COLLAPSE POTENTIAL
	WATER LEVEL (LEVEL WHERE FIRST ENCOUNTERED)	UC	UNCONFINED COMPRESSION (ASTM TEST METHOD D-2166)
	WATER LEVEL (LEVEL AFTER COMPLETION)	MC	MOISTURE CONTENT (ASTM TEST METHOD D-2216)
	SEEPAGE		

GENERAL NOTES

1. LINES SEPARATING STRATA ON THE LOGS REPRESENT APPROXIMATE BOUNDARIES ONLY. ACTUAL TRANSITIONS MAY BE GRADUAL

2. NO WARRANTY IS PROVIDED AS TO THE CONTINUITY OF SOIL CONDITIONS BETWEEN INDIVIDUAL SAMPLE LOCATIONS.

3. LOGS REPRESENT GENERAL SOIL CONDITIONS OBSERVED AT THE POINT OF EXPLORATION ON THE DATE INDICATED.

4. IN GENERAL, UNIFIED SOIL CLASSIFICATION SYSTEM DESIGNATIONS PRESENTED ON THE LOGS WERE EVALUATED BY VISUAL METHODS. WHERE LABORATORY TESTS WERE PERFORMED, THE DESIGNATIONS REFLECT THE LABORATORY TEST RESULTS.

GEO Plus	**LOG KEY**	**PLATE**
Drafted by: TEM Project No.: 1235	**WAL-MART STORE #2044-03**	**B-3**
Date: 2-14-08 Doc. No.: 07D102	**FOREST AVENUE**	
	CHICO, CALIFORNIA	

TABLE B-1
WAL-MART CHICO EXPANSION BORING COORDINATES

Boring No.	Latitude	Longitude	Elevation (ft)
B-17	39° 43" 20.46'	121° 48" 15.70'	225.5
B-18	39° 43" 20.67'	121° 48" 18.32'	224.0
B-19	39° 43" 20.58'	121° 48" 19.31'	224.0
B-20	39° 43" 15.85'	121° 48" 14.37'	222.5
B-21	39° 43" 18.98'	121° 48" 16.44'	224

Copyright 2008, ***GEOPlus, Inc.***

GEOPlus, Inc.
19690 North Hirsch Court, Ste. 2
Anderson, CA 96007
Telephone: 530-365-8088
www.geoplusinc.com

BORING NUMBER B-17

CLIENT PACLAND
PROJECT NAME Wal-Mart Expansion Store #2044-03
PROJECT NUMBER 1235
PROJECT LOCATION Chico, California
DATE STARTED 12/06/07 **COMPLETED** 12/06/07
GROUND ELEVATION
HOLE SIZE 7-inch
DRILLING CONTRACTOR PC Exploration
GROUND WATER LEVELS:
DRILLING METHOD Hollow Augers
AT TIME OF DRILLING dry
LOGGED BY Traver E. Metcalf **CHECKED BY** John L. Finnigsmier
AT END OF DRILLING dry
NOTES
18hrs AFTER DRILLING 11.0 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (per ft.)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	-#4 SIEVE (%)	-#200 SIEVE (%)
0		asphalt - 3"										
		Aggregate Base										
		Sandy Lean/Fat Clay (CL/CH) - dark brown, moist, stiff to very stiff, some gravel	CAL	83	6-9-11 (20)	1.4						
		Sandy Lean Clay (CL) - brown, very stiff, moist, fine sand, rounded gravel (<1.5")	CAL	94	15-18-34 (52)	2.5						
5		increased sand content (approx. 40%)	CAL	94	10-11-11 (22)	1.1	96	23				
		Poorly Graded Gravel with Sand and Clay (GP-GC) - yellow-brown to gray, dense, wet, fine to coarse sand, subrounded gravel and small cobble										
10		becomes weakly cemented - Tuscan formation	SPT	67	50							
		Bottom of hole at 12.0 feet.										

GEOPlus, Inc.
19690 North Hirsch Court, Ste. 2
Anderson, CA 96007
Telephone: 530-365-8088
www.geoplusinc.com

BORING NUMBER B-18

CLIENT PACLAND
PROJECT NAME Wal-Mart Expansion Store #2044-03
PROJECT NUMBER 1235
PROJECT LOCATION Chico, California
DATE STARTED 12/06/07 **COMPLETED** 12/06/07
GROUND ELEVATION **HOLE SIZE** 7-inch
DRILLING CONTRACTOR PC Exploration
GROUND WATER LEVELS:
DRILLING METHOD Hollow Augers
AT TIME OF DRILLING dry
LOGGED BY Traver E. Metcalf **CHECKED BY** John L. Finnigsmier
AT END OF DRILLING dry
NOTES
18hrs AFTER DRILLING 12.0 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (per ft.)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	-#4 SIEVE (%)	-#200 SIEVE (%)
0		asphalt - 3"										
		Aggregate Base										
		Sandy Lean/Fat Clay (CL/CH) - dark brown, moist, stiff to very stiff, some gravel	CAL	67	10-13-18 (31)	3.2	91	24	54	34	100	74
		Clayey Sand (SC) - yellow-brown, dense, moist, fine to coarse sand, few gravel (<1")	CAL	100	17-18-38 (56)	3.2	92	20			98	33
5		Sandy Lean Clay (CL) - yellow-brown, hard, moist, fine sand	CAL	75	18-50	3.8						
		Clayey Sand with Gravel (SC) - yellow-brown, dense, moist, medium sand, very weak cementation, fine rounded gravel - Tuscan formation	CAL	94	37-23-23 (46)							
		Poorly Graded Gravel with Sand and Clay - gray and yellow-brown, very dense, moist, fine to coarse sand, subrounded gravel and cobble										
10			SPT	75	34-50							
		becomes weakly cemented - Tuscan formation										
15			SPT	0	50/3"							
		Bottom of hole at 15.3 feet.										

GEOTECH BH COLUMNS 1235 WAL-MART CHICO EXPANSION.GPJ GINT US.GDT 12/28/07

GEOPlus, Inc.
19690 North Hirsch Court, Ste. 2
Anderson, CA 96007
Telephone: 530-365-8088
www.geoplusinc.com

BORING NUMBER B-19

CLIENT PACLAND
PROJECT NAME Wal-Mart Expansion Store #2044-03
PROJECT NUMBER 1235
PROJECT LOCATION Chico, California
DATE STARTED 12/06/07 **COMPLETED** 12/06/07
GROUND ELEVATION
HOLE SIZE 7-inch
DRILLING CONTRACTOR PC Exploration
GROUND WATER LEVELS:
DRILLING METHOD Hollow Augers
AT TIME OF DRILLING dry
LOGGED BY Traver E. Metcalf **CHECKED BY** John L. Finnigsmier
AT END OF DRILLING dry
NOTES
18hrs AFTER DRILLING 13.0 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (per ft.)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	-#4 SIEVE (%)	-#200 SIEVE (%)
0		Sandy Lean/Fat Clay (CL/CH) - dark brown, moist, stiff to very stiff, some gravel										
			GB CAL	100 94	11-13-19 (32)	1.4 2.4	93	23	47	28		
		Poorly Graded Gravel with Sand and Clay (GP-GC) - gray-brown, medium dense, wet, fine to coarse sand, subrounded gravel										
5			CAL	72	17-12-18 (30)	2.4					39	10
		Gravelly Clay (CL) - dark brown, very stiff, moist, subrounded gravel (<2")										
			CAL	83	16-22-26 (48)							
		Clayey Sand with Gravel (SC) - yellow-brown, dense, moist, medium sand, very weak cementation, fine rounded gravel - Tuscan formation	CAL	100	50						83	16
10		Poorly Graded Gravel with Sand and Clay (GP-GC) - yellow-brown to gray, dense, wet, fine to coarse sand, subrounded gravel and small cobble, weakly cemented - Tuscan formation										
			SPT	50	27-40-48 (88)							
		Bottom of hole at 14.0 feet.										

GEOPlus, Inc.
19690 North Hirsch Court, Ste. 2
Anderson, CA 96007
Telephone: 530-365-8088
www.geoplusinc.com

BORING NUMBER B-20

CLIENT PACLAND
PROJECT NAME Wal-Mart Expansion Store #2044-03
PROJECT NUMBER 1235
PROJECT LOCATION Chico, California
DATE STARTED 12/06/07 **COMPLETED** 12/06/07
GROUND ELEVATION
HOLE SIZE 7-inch
DRILLING CONTRACTOR PC Exploration
GROUND WATER LEVELS:
DRILLING METHOD Hollow Augers
AT TIME OF DRILLING dry
LOGGED BY Traver E. Metcalf **CHECKED BY** John L. Finnigsmier
AT END OF DRILLING dry
NOTES
18hrs AFTER DRILLING dry

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (per ft.)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	-#4 SIEVE (%)	-#200 SIEVE (%)
0		Sandy Lean Clay (CL) - brown, stiff, dry, fine to medium sand, moderately plastic										
		Clayey Sand with Gravel (SC) - yellow-brown, very dense, moist, fine to medium sand, subrounded to rounded gravel (<3", moderately to highly weathered)	CAL	113	17-50-50/3"		97	15				
			CAL	100	50							
5		Poorly Graded Gravel with Sand and Clay (GP-GC) - gray-brown, very dense, moist, fine to coarse sand, subrounded gravel and cobble, weakly cemented -Tuscan formation	SPT	50	50/4"							
			SPT	33	50							
		Clayey Sand with Gravel (SC) - yellow-brown, dense, moist, medium sand, very weak cementation, fine rounded gravel - Tuscan formation	CAL	100	50							
		Bottom of hole at 9.0 feet.										

GEOPlus, Inc.
19690 North Hirsch Court, Ste. 2
Anderson, CA 96007
Telephone: 530-365-8088
www.geoplusinc.com

BORING NUMBER B-21

CLIENT PACLAND
PROJECT NAME Wal-Mart Expansion Store #2044-03
PROJECT NUMBER 1235
PROJECT LOCATION Chico, California
DATE STARTED 12/06/07 **COMPLETED** 12/06/07
GROUND ELEVATION
HOLE SIZE 7-inch
DRILLING CONTRACTOR PC Exploration
GROUND WATER LEVELS:
DRILLING METHOD Hollow Augers
AT TIME OF DRILLING dry
LOGGED BY Traver E. Metcalf **CHECKED BY** John L. Finnigsmier
AT END OF DRILLING dry
NOTES
18hrs AFTER DRILLING dry

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (per ft.)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	-#4 SIEVE (%)	-#200 SIEVE (%)
0		Sandy Lean/Fat Clay (CL/CH) - dark brown, moist, stiff to very stiff, some gravel	CAL	78	17-22-40 (62)	3.1						
		Poorly Graded Gravel with Sand and Clay (GP-GC) - gray-brown, very dense, moist, fine to coarse sand, subrounded gravel and cobble, weakly cemented - Tuscan formation	CAL	125	50/4"						49	13
5			SPT	0	50/4"							
		Bottom of hole at 7.0 feet.										