California Regional Water Quality Control Board
Colorado River Basin Region

Linda S. Adams
Secretary for
Environmental Protection

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http://www.waterboards.ca.gov/coloradoriver

Arnold Schwarzenegger
Governor

April 14, 2010

Craig Wentworth
Department of Transportation
464 West 4th Street
San Bernardino, CA 92401

RE: ORDER FOR TECHNICALLY-CONDITIONED CLEAN WATER ACT SECTION 401 WATER QUALITY CERTIFICATION FOR DISCHARGE OF DREDGED AND/OR FILL MATERIALS

PROJECT: Colorado River Bridge Replacement Project

APPLICANT: Department of Transportation

ACTION:
1. ☐ Order for Standard Certification
2. ☒ Order for Technically-Conditioned Certification
3. ☐ Order for Denial of Certification

STANDARD CONDITIONS:

The following standard conditions apply to all certification actions, except as noted above under Action 3 for denials.

1. This certification action is subject to modification or revocation upon administrative or judicial review, including review and amendment pursuant to section 13330 of the California Water Code and section 3867 of Title 23 of the California Code of Regulations (23 CCR).

2. This certification action is not intended and shall not be construed to apply to any discharge from any activity involving a hydroelectric facility requiring a Federal Energy Regulatory Commission (FERC) license or an amendment to a FERC license unless the pertinent certification application was filed pursuant to 23 CCR section 3855(b) and the application specifically identified that a FERC license or amendment to a FERC license for a hydroelectric facility was being sought.

3. The validity of any non-denial certification action (Actions 1 and 2) shall be conditioned upon total payment of the full fee required under 23 CCR section 3833, unless otherwise stated in writing by the certifying agency.

4. In the event of any violation or threatened violation of the conditions of this certification, the violation or threatened violation shall be subject to any remedies, penalties, process, or sanctions as provided for under State law. For purposes of Clean Water Act (CWA) section 401(d), the applicability of any State law authorizing remedies, penalties, process, or sanctions for the violation or threatened violation constitutes a limitation necessary to assure compliance with the water quality standards and other pertinent requirements incorporated into this Water Quality Certification (WQC).

    a. In response to a suspected violation of any condition of this WQC, the Regional Water Quality Control Board (Regional Water Board) may require the holder of any permit or license subject to this certification to furnish, under penalty of perjury, any technical or monitoring reports the Regional Water Board deems appropriate, provided that the burden, including cost of the reports, shall be in reasonable relationship to the need for the reports and the benefits to be obtained from the reports.

    b. In response to any violation of the conditions of this WQC, the Regional Water Board may add to or modify the conditions of this certification as appropriate to ensure compliance.

ADDITIONAL CONDITIONS:

The following additional conditions apply to this certification:

1. This WQC applies towards the proposed project as described in the 401 application received by the Regional Water Board on April 12, 2010. The Applicant shall provide the Regional Water Board and other interested agencies with written notification of any significant modifications made to the project prior to implementation of the modifications.

2. This WQC does not convey any property rights of any sort or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state, or local laws or regulations.

3. This WQC does not authorize the Applicant or any associated party to trespass on any land or property unless the applicant has obtained written authorization or acquired a special use authorization permit from the land or property owner.

4. A copy of this WQC shall be provided to the appropriate onsite Supervisor for the Project. All personnel performing work on the proposed project shall be familiar with the content of this WQC. Copies of the WQC shall be readily available at the project site at all times during periods of active work and shall be presented to regulatory agency representatives upon request.

5. The Applicant shall grant Regional Water Board staff, or an authorized representative, upon presentation of credentials and other documents as may be required by law, to enter the project site at reasonable times, to ensure compliance with the terms and conditions

of this WQC and/or to determine the impacts the project may have on waters of the United States.

6. The proposed projects shall not be enlarged or extend beyond the proposed project impact area. The Applicant shall delineate the project boundaries and staging areas with stakes, flags and/or temporary construction fencing.

7. The area of vegetation and soil disturbance shall be restricted to the smallest extent possible.

8. Projects shall not discharge substances in concentrations toxic to human, plant, animal, or aquatic life or that produce detrimental physiological responses.

9. Projects shall not discharge waste classified as "hazardous" as defined in Title 22 CCR section 66261 and the California Water Code section 13173.

10. No oil, petroleum products, or rubbish shall be allowed to enter into or be placed where it may be washed by rainfall or runoff into waters of the United States.

11. No equipment maintenance will be done within or near any stream channel where petroleum products or other pollutants from the equipment may enter waters of the United States.

12. Equipment refueling shall not occur within waters of the United States.

13. Any oil or grease leaks shall be immediately cleaned up.

14. The Applicant shall ensure that all contaminated material and/or contaminated soil removed or excavated from the Project site is properly loaded, transported, and disposed of in accordance with Federal, State, and local regulations.

15. Staging/storage areas for equipment and materials shall be located outside of waters of the United States.

16. The Applicant shall ensure that all disturbed and filled areas are adequately stabilized and protected from erosion and siltation by implementing appropriate soil stabilization, sedimentation and silt control measures.

17. Any flow diversion used during construction shall be designed in a manner to prevent pollution, minimize siltation, and shall provide flows to downstream reaches. Flows shall be maintained to support existing aquatic life and riparian wetlands and habitat that may be located upstream and downstream from any temporary diversion.

18. The Applicant shall restore drainages, to the greatest extent possible, to the original bank configuration, stream bottom width, and channel gradient.

19. All temporary facilities and impacts shall be removed and restored to the preexisting conditions and contours to the extent practicable.

20. Construction related materials and wastes shall be removed from the project site upon completion of the project.

21. The Applicant shall submit Notice to the Regional Water Board within 60-days of completion of the Project. The Notice shall include: 1) a detailed summary of the mitigation and restoration activities implemented during the project and 2) provide photographic documentation that supports the information summarized in the Notice.

22. The Regional Water Board reserves the right to suspend, cancel, or modify and reissue this WQC, after providing notice to the Applicant and/or responsible Site-Supervisor, if the Regional Water Board determines that the project fails to comply with any of the terms or conditions of this WQC.

23. The Applicant shall orally notify the Regional Water Board of any noncompliance that may impact the beneficial uses of waters of the United States, as soon as notification is possible and notification can be provided without substantially impeding measures necessary to address the noncompliance.

REGIONAL WATER QUALITY CONTROL BOARD CONTACT PERSON:

If you have any questions, please contact Jay Mirpour, Water Resources Control Engineer, at (760) 776-8981 or jmirpour@waterboards.ca.gov.

WATER QUALITY CERTIFICATION:

I hereby issue an order certifying that any discharge from the referenced project will comply with the applicable provisions of sections 301 (Effluent Limitations), 302 (Water Quality Related Effluent Limitations), 303 (Water Quality Standards and Implementation Plans), 306 (National Standards of Performance), and 307 (Toxic and Pretreatment Effluent Standards) of the Clean Water Act, and with other applicable requirements of State law.

Except insofar as may be modified by any preceding conditions, all certification actions are contingent on (a) the discharge being limited and all proposed mitigation being completed in strict compliance with the applicants' project description and the attached Project Information Sheet, and (b) compliance with all applicable requirements of the Regional Water Quality Control Board's Water Quality Control Plan (Basin Plan).

Robert E Perdue

ROBERT PERDUE
Executive Officer

JJM/

cc: Marjorie Blaine, U.S. Army Corps of Engineers, Tucson Project Office
Bill Orme, SWRCB, Division of Water Quality, Water Quality Certification Unit
David Smith, U.S. Environmental Protection Agency, Region 9
Thomas A. Vandenberg, Office of Chief Counsel, SWRCB

File: 401 Certification for the Department of Transportation - Colorado River Bridge Replacement Project, WDID No. 7B363023001

Mailing List:

Marjorie Blaine
Senior Project Manager/Biologist
U.S. Army Corps of Engineers
Tucson Project Office, Regulatory Division
5205 E. Comanche Street
Tucson, AZ 85707

Bill Orme (*)
Water Quality Certification Unit
Division of Water Quality
State Water Resources Control Board
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David Smith
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75 Hawthorne Street
San Francisco, CA 94105

Thomas A. Vandenberg (*)
Staff Counsel
Office of Chief Counsel
State Water Resources Control Board
1001 I Street
Sacramento, CA 95814

Note: (*) will e-mail electronic copy

PROJECT INFORMATION

Application Date:
April 12, 2010

Applicant:
Department of Transportation

Contact:
Craig Wentworth, (909) 383-6936

Applicant Representative:
Department of Transportation

Project Name:
Colorado River Bridge Replacement Project

Project Start and Completion:
Start 4/16/2010 - Completion 4/30/2015

Project Description (purpose/goal):
The proposed project will replace the Colorado River Bridge (Br. No. 54-1000) on State Route 62 (SR 62) in San Bernardino County, California and on State Route 95 (SR 95) in La Paz County, Arizona. The project will include the realignment and shoulder widening of existing SR62/SR95 from Parker Dam Road in Earp, California to 1.10 km east of 2nd Street in Parker, Arizona. The construction activity will accomplish the following objectives:

1. Resolve the Colorado River Bridge's decreased structural integrity
2. Maintain a continuous safe movement of vehicular traffic
3. Improve people and goods movement in the region in both California and Arizona.

The Colorado River Bridge has been identified as scour critical as a result of continual streambed degradation. Since the original construction of the bridge, the existing river channel has dropped approximately 20 feet. This change in the channel grade has resulted in a loss of lateral support and embedment for the existing bridge foundation pilings.
The proposed projects would resolve the scour issues and replace bridge foundations and pilings. The bridge foundation depths and pier design will account for potential degradation and localized pier scour.

As part of the bridge replacement, certain elements of the existing structure and SR-62 roadway need to be updated to match the latest Highway Design Manual (HDM) Structures and the Americans with Disabilities Act (ADA) requirements. These items include shoulder widths on the bridge and roadway approaches, and accessibility requirements (bridge sidewalk widths) per the ADA. To meet current ADA requirements and improve pedestrian mobility, the bridge sidewalk widths will be widened. A sidewalk will be constructed on the south side of the bridge to become consistent with ADA accessibility requirements. The proposed project is to construct a new structure to provide a structure foundation capable of sustaining nonstandard loads.

Project Location:

City or Area: Earp and Parker

County: San Bernardino, California & La Paz, Arizona

Longitude/Latitude: -114° 18' 59.99"/ +34° 09' 99.94" & -114° 28' 91.18"/ +34° 15'00.18", Township/Range: 1N/25E & 9N/20W

Receiving Water(s):
Colorado River

Fill/Excavation Area (acres):
N/A

Dredge Volume (cy):
4352 cy

Mitigation:
The following avoidance and minimization are used throughout the project:

- The existing bridge will be removed or modified in a way that will not adversely impact the river.

- A silt fence and Environmentally Sensitive Area (ESA) Fence (for visibility) will be placed around the wetland area. Construction equipment and people will not be able to enter the wetland.

- Native seeds will be used as part of erosion control and native plants will be installed in the project area.

- Caltrans shall wash all construction equipment and vehicles to reduce invasive species spreading from the proposed construction site.

- A Storm Water Pollution Prevention Plan (SWPPP) will be prepared for the project area and implemented for all activities at the project site. It will include measures necessary to maintain water quality. Caltrans will require that the Contractor follow Best Management Practices, including but not limited to the following:

- Construction staging/storage, fueling, and batch plant areas shall be located away from undisturbed areas, with minimal risk of discharge into drainages or other sensitive habitat types. Only previously disturbed areas, such as turnouts may be used for these purposes. The Resident Engineer and district biologist shall coordinate on such sites prior to their approval/use.

- Raw cement/concrete or washings thereof, asphalt, paint or other coating material, oil or other petroleum products, or any other substances which could be hazardous to aquatic life, resulting from project related activities, shall be prevented from contaminating the soil and/or entering the waters of the state, which includes drainages.

- No debris, soil, silt, sand, bark, slash, sawdust, rubbish, cement or concrete or washings thereof, oil or petroleum products or other organic or earthen material from any construction or associated activity of whatever nature shall be allowed to enter into or placed where it may be washed by rainfall or runoff into waters of the State, which includes drainages and culverts. Sandbags, straw wattles, or silt fences will be used.

- No equipment maintenance/parking shall be done within or near any stream or drainage where petroleum products or other pollutants from the equipment may enter these areas under any flow.

-To the extent practicable, impacted sites will be returned to pre-construction contours.

- Maintenance and monitoring activities will include regular and post-storm event inspections.

Federal Permit(s):
U.S. Army Corps of Engineers section 404 Permit Nationwide Permit Numbers 15 (pending).

Status of CEQA:
A Mitigated Negative Declaration, dated May 19, 2008, was prepared for this project pursuant to the provisions of CEQA, and a Notice of Determination was filed with the State Clearinghouse on July 15, 2008, State Clearinghouse Number: 2008051081. Lead Agency: Department of Transportation.

Reference No.:
401 Certification for the Department of Transportation - Colorado River Bridge Replacement Project, WDID No. 7B363023001

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, CORPS OF ENGINEERS
ARIZONA-NEVADA AREA OFFICE
3636 NORTH CENTRAL AVENUE, SUITE 900
PHOENIX, ARIZONA 85012-1939

REPLY TO
ATTENTION OF:

June 4, 2010

Office of the Chief
Regulatory Division

Craig Wentworth, Senior Environmental Planner
California Department of Transportation – District 8
464 West 4th Street
San Bernardino, California 92401

SUBJECT: Nationwide Permit # 15 Verification (SPL-2004-01619-WHM)

Dear Mr. Wentworth:

I am responding to your application, dated 3 June 2010, concerning your proposal to replace the Colorado River Bridge (Br. No. 54-1000) on State Route 62 in San Bernardino County, California and on State Route 95 in La Paz County, Arizona. The proposed project would include temporary impacts totaling approximately 1.13 acres and 5,955 cubic yards of fill associated with using trestles and cofferdams during construction within waters of the U.S. determined to be jurisdictional under Section 404 of the Clean Water Act (33 U.S.C. 1344). Additionally, the proposed project would include permanent impacts totaling approximately 0.011 acres and 477 cubic yards of fill associated with the new bridge piles. The project is located near the City of Earp, San Bernardino, California and the City of Parker, La Paz County, Arizona (Section 24, Township 1 North, Range 25 East).

The Corps of Engineers has determined, under Section 404 of the Clean Water Act (33 U.S.C. 1344), that your proposed activity complies with the terms of Nationwide Permit No. 15, "U.S. Coast Guard Approved Bridges." You must comply with all terms and applicable conditions (regional, general, and 401 conditions) described in Enclosure 1 and complete the compliance statement (Enclosure 2).

Furthermore, you must comply with the following Special Condition(s):

a. **Water Quality Certification:** The permittee shall comply with all requirements and conditions in the state water quality certification that the California Regional Water Quality Control Board signed on April 14, 2010, the Environmental Protection Agency's Modified Pre-Construction Notice issued on November 30, 2009 and the Arizona Water Quality Conditions associated with Nationwide Permit No. 15. These certifications demonstrate that the permittee has complied with Section 401(a) of the Clean Water Act. Copies of these letters are enclosed.

b. **Cultural Resources:** Should cultural resources or archeological remains be encountered during construction/excavation, work shall immediately cease in the area of discovery. The permittee shall promptly notify the appropriate State Historic Preservation Office and the Corps at (602) 640-5385.

c. **Protection of Native Vegetation:** The permittee shall not disturb native vegetation outside of the construction footprint.

d. **Stockpiled Materials:** The permittee shall not stockpile material below the ordinary high water mark of the Colorado River.

e. **Site Clean-Up:** The permittee shall remove all excess fill and/or construction debris/equipment from the site immediately upon completion of construction.

f. **Contractor Notification:** The permittee shall provide each contractor with written instructions to be reviewed by all on-site supervisory construction personnel on the protection of cultural and ecological resources, including all agrees-to environmental stipulations for the project and all conditions required by this permit. The instructions shall also address federal and state laws regarding antiquities, plants, and wildlife; including collection, removal, and the importance of these resources and the purpose and necessity of protecting them. A copy of this permit shall be posted on site at all times during construction.

g. **Mitigation:** Prior to the onset of any construction activities within jurisdictional water of the U.S. the applicant shall submit an in-lieu mitigation fee of $8,000 to the La Paz County Endangered Species Fund, via the U.S. Army Corps of Engineers Arizona Regulatory Branch.

This verification is valid until the nationwide permit(s) referenced above is modified, reissued, or revoked. All of the nationwide permits are scheduled to be modified, reissued, or revoked prior to **March 18, 2012**. It is incumbent upon you to remain informed of changes to the nationwide permits. We will issue a public notice when the nationwide permits are reissued. Furthermore, if you commence or are under contract to commence the authorized activity before the date that the relevant nationwide permit(s) is modified, reissued or revoked you will have twelve (12) months from the date of the modification, reissuance, or revocation of the nationwide permits to complete the activity under the present terms and conditions of the nationwide permits.

If you sell/transfer the property associated with this letter of verification you should work with the new owner to complete the enclosed Transfer Statement (Enclosure 3). This transfer is necessary to ensure that the new owner of the property is aware of all terms and conditions of this letter of this verification including any special conditions that will continue to be binding on the new owner.

A nationwide permit does not grant any property rights or exclusive privileges. Also, it does not authorize any injury to the property or rights of others or authorize interference with any existing or proposed Federal project. Furthermore, it does not obviate the need to obtain other Federal, state, or local authorizations required by law.

You are encouraged to comment on your experience by accessing the Corps web-based customer survey form at: http://per2.nwp.usace.army.mil/survey.html. Thank you for participating in our regulatory program. If you have questions, please contact William Miller at (602) 640-5385 x 221.

Sincerely,

Sallie McGuire

Sallie McGuire
Chief, Arizona Branch
Regulatory Division

Enclosures
1. Nationwide Permit
2. Certification of Compliance
3. Transfer Statement
4. CRWCB 401 Certification
5. EPA MPCN

LOS ANGELES DISTRICT
U.S. ARMY CORPS OF ENGINEERS

CERTIFICATION OF COMPLIANCE WITH DEPARTMENT OF THE ARMY NATIONWIDE PERMIT

Permit Number: SPL-2004-01619-WHM

Date of Issuance: June 3, 2010

Name of Permittee:

Craig Wentworth, Senior Environmental Planner
California Department of Transportation – District 8
464 West 4th Street
San Bernardino, California 92401

Upon completion of the activity authorized by this permit, sign this certification and return it with an original signature to the following address:

U.S. Army Corps of Engineers
ATTENTION: Regulatory Division (SPL-2004-01619-WHM)
3636 North Central Avenue, Suite 900
Phoenix, Arizona 85012-1939

Please note that your permitted activity is subject to a compliance inspection by a Corps of Engineers' representative. If you fail to comply with this Nationwide Permit you may be subject to permit suspension, modification, or revocation.

I hereby certify that the work authorized by the above referenced Nationwide Permit has been completed in accordance with the terms and conditions of said permit.

______________________________ ________________________

Signature of Permittee Date

Enclosure 2

NATIONWIDE PERMIT NUMBER 15

U.S. COAST GUARD APPROVED BRIDGES

US Army Corps of Engineers
Los Angeles District
Regulatory Division/Arizona Branch

Pursuant to Section 404 of the Clean Water Act (33 U.S.C. 1344) and/or Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 401 et seq) the U.S. Army Corps of Engineers published the "Reissuance of Nationwide Permits" in the Federal Register (72 FR 11092) on March 12, 2007. This Nationwide Permit is effective from March 19, 2007 to March 18, 2012 unless modified, reissued or revoked before that time. It is incumbent upon the permittee to remain informed of changes to the nationwide permits.

15. U.S. Coast Guard Approved Bridges. Discharges of dredged or fill material incidental to the construction of bridges across navigable waters of the United States, including cofferdams, abutments, foundation seals, piers, and temporary construction and access fills, provided such discharges have been authorized by the U.S. Coast Guard as part of the bridge permit. Causeways and approach fills are not included in this NWP and will require a separate section 404 permit. (Section 404)

401 Certification

303[d]-impaired waters (see Water Quality Definitions): For projects on a waterbody with an impaired reach, if the project impacts the listed waterbody within 800 meters (or ½ mile) downstream of an impaired reach to within 1600 meters (or 1 mile) upstream of an impaired reach: Individual Certification required.

Tributaries to 303[d]-impaired waters: For projects on a tributary to a waterbody listed as impaired, if the tributary mouth is on an impaired reach and the project impacts the tributary within 1600 meters (or 1 mile) of its mouth: Individual Certification required.

Outstanding Arizona Waters (a.k.a. "unique Waters") (see Water Quality Definitions): For projects on a designated Outstanding Arizona Water, if the project impacts the designated waterbody within 800 meters (or ½ mile) downstream of a designated reach to within 1600 meters (or 1 mile) upstream of a designated reach: Individual Certification required.

Tributaries to Outstanding Arizona Waters: For projects on a tributary to a designated Outstanding Arizona Water, if the tributary mouth is on a designated reach and the project impacts the tributary within 1600 meters (or 1 mile) of its mouth: Individual Certification required.

Lake (see Water Quality Definitions): Individual Certification required.

Other waters: Conditionally certified (all applicable general 401 conditions below). *Note: Conditional certification only applies when none of the other 401 certification categories apply.*

Tribal Waters:
Hualapai Tribe – Individual Certification required
Navajo Nation – Individual Certification required
White Mountain Apache Tribe – Individual Certification required
All other reservations – Contact EPA Region IX

State of Arizona 401 Water Quality Conditions

Except as noted, the following 401 General Conditions apply to all waters of the U.S. (WUS) and all applicable NWP:

1. Any discharge (including runoff or seepage) occurring as a result of activities certified for the subject project shall not cause a violation of surface water quality standards for any WUS. Applicability of this condition is as defined in A.A.C. R18-11-102.
2. This certification does not authorize the discharge of process water, material processing residues, wastewater or other residual material to any WUS.
3. Activities herein certified shall be performed during periods of low flow (baseflow or less) in any watercourse or other WUS, or no flow in the case of ephemeral and intermittent waterbodies.
4. If activities are likely to create an erosion or sedimentation problem, operations shall cease until the problem is resolved or until reasonable control measures have been undertaken.
5. Erosion control, sediment control and/or bank protection measures shall be installed before construction and pre-operation activities, and shall be maintained as necessary during construction and post-construction periods to minimize

channel or bank erosion, soil loss and sedimentation. Control measures shall not be constructed of uncemented or unconfined soil, or other easily transportable (by flow) materials.

6. The applicant is responsible for ensuring construction material and/or fill including, but not limited to: rock, gabion fill or other uncemented channel-lining materials, placed within the Ordinary High Water Mark (OHWM) of any WUS, shall not include materials that can cause or contribute to an exceedence of Arizona Water Quality Standards for Surface Waters (18, A.A.C., 11, Article 1). Any fill material washing must occur outside of the floodplain of any WUS prior to placement and the rinseate from such washing shall be contained and settled or otherwise prevented from contributing sediment or causing erosion to any WUS. Fill placed in locations subject to scour shall contain not more than ten percent (10%) on a dry weight basis of particles finer than 0.25 mm diameter (passing a No. 60 sieve).

7. Any dredged material is to be placed and retained in areas outside the OHWM of any WUS. Runoff from materials deposited outside the OHWM is to be settled, filtered or otherwise treated to prevent escape of pollutants (including sediment) to any WUS.

8. Except as otherwise allowed herein, upon completion of construction the applicant shall ensure no adverse change due to the subject project has occurred in the stability (with respect to stream geometry, erosion and sedimentation) of any WUS, including upstream and downstream from the project. If such change has occurred, the applicant shall take steps to restore the pre-project stability of any impacted segments.

9. Except where the activities certified herein are intended to permanently alter any WUS, all disturbed areas between the OHWM shall be restored to preconstruction conditions. Denuded areas shall be revegetated as soon as possible with native and/or salvaged plants and seed. Vegetation should be maintained on unarmored banks and slopes to stabilize soil and prevent erosion.

10. Where needed to prevent erosion/sedimentation, flows unimpacted by the subject project shall be diverted around work operations, and material and equipment storage areas. Permanent and temporary access roadways, staging areas and material stockpiles shall be designed or located to allow storm flows to pass unimpeded. Except as otherwise allowed herein, when flow is present in any wash or other WUS within the project area, the applicant and any contractor will not impede, restrict, or stop the flow by any means.

11. Permanent and temporary pipes and culverted crossings and pads shall be adequately sized to handle expected flow and properly set with end section, splash pads, or headwalls that dissipate water energy to control erosion. Culverted and unculverted crossings and pads shall be constructed so as to accommodate the overtopping of the fill by streamflow and armored to prevent erosion of the fill.

12. Acceptable construction materials that will or may contact water in any WUS are: crushed stone, native fill (meeting the requirements in 401 General Condition 6) concrete, steel, plastic, or aluminum and other materials specifically approved in writing by ADEQ.

13. Silt laden or turbid water resulting from project activity shall be settled, filtered or otherwise treated prior to discharge to ensure no violation of Arizona Surface Water Quality Standards in any WUS.

14. When flow greater than described in 401 General Condition 3 above is present within the project area, all activities certified herein shall cease and construction equipment and materials easily transported by flow will be moved outside the flow area and the OHWM of any WUS. If such movement cannot be accomplished rapidly enough to prevent pollution of a WUS, measures shall be taken to prevent transport of sediment or other pollutants out of the construction area or into any WUS.

15. Work shall be conducted and monitored to ensure that pollution from the activities certified herein including, but not limited to: earthwork, concrete mixing and placement, detention ponds, and equipment maintenance and washing does not drain into any WUS.

16. If water is used for dust suppression, it shall not contain contaminants that could violate Arizona Surface Water Quality Standards of any WUS.

17. The applicant will erect any barriers, covers, shields and other protective devices as necessary to prevent any construction materials, equipment or contaminants/pollutants from falling, being thrown or otherwise entering any flowing WUS.

18. Upon completion of the activities certified herein, areas within the OHWM of all WUS at the project site shall be promptly cleared of all false work, piling, construction residues, equipment, debris or other obstructions. Any debris including, but not limited to: soil, silt, sand, rubbish, cement, bituminous material, oil or petroleum products, organic materials, tires or batteries, derived from the activities certified herein shall not be stored at any site where it may be washed into a WUS and shall be properly disposed of after completion of the work.

19. The applicant must designate area(s) for equipment staging and storage located where runoff from these activities cannot enter any WUS. Any equipment maintenance, washing or fueling that cannot be done offsite will be done here. Material specifically manufactured and sold as spill adsorbent/absorbent will be on hand to control small spills. All equipment and workboats shall be inspected for leaks daily and prior to use. All leaks shall be repaired immediately. All equipment and workboats will be steam cleaned prior to use in any WUS with flow.

20. The applicant shall have a spill containment plan onsite to ensure that pollutants are contained, removed and properly disposed of. In addition, the applicant must designate areas, located where runoff from these activities cannot enter any WUS, for chemical and petroleum storage, and solid waste containment. All materials stored onsite will be stored in appropriate containers or packaging. Any pollutant produced by activities certified herein shall be properly disposed of in accordance with applicable regulations. A spill response kit will be maintained in this (these) area(s) to mitigate a potential spill. The kit will include material specifically manufactured and sold as spill adsorbent/absorbent including booms. The applicant will ensure that whenever there is activity on the site, that there are personnel on site trained in the proper response to spills and the use of spill response equipment.

21. If fully, partially or occasionally submerged structures are constructed of cast-in-place concrete instead of pre-cast concrete planks or slabs, applicant will take steps; e.g., sheet piling or temporary dams (except for NWP 33 & 15, filled cofferdams are not allowed), to prevent contact between water (instream and runoff) and the concrete until it cures and until any curing agents have evaporated or otherwise cease to be available; i.e., are no longer a pollutant threat. Where possible, construction work will be during extreme low water conditions or at a time and season that ensures all work is done in the dry.

22. For portions of the project utilizing potable water or groundwater for irrigation, direct runoff of irrigation water and overflows from runoff detention and/or retention areas into washes shall be limited to the extent practicable and shall not cause downstream erosion or flooding.

23. For portions of the project utilizing reclaimed wastewater for irrigation, direct runoff of irrigation water and overflow from retention/detention structures or storage impoundments into WUS is prohibited without the proper permits including, but not limited to, Arizona's Reclaimed Wastewater Permit and, if within the wetted area of a 25-year flood event (or within the floodplain in some cases), a AZPDES permit.

24. Fertilizer, herbicide and insecticide chemicals used for development of vegetated areas shall be selected based on minimum environmental impacts and approved for the intended use. Application rates printed on the product labels shall be strictly followed. Excess chemicals shall not be applied on recently treated areas and must either be stored, used elsewhere or disposed of (in any case, in accordance with all applicable regulations).

Water Quality Definitions

303[d]-listed Impaired Waters: These are waterbodies that as a result of the CWA 305[b] process are listed under CWA 303[d] as impaired; i.e., consistently not meeting water quality standards, and as a result merit special attention. The complete current 303[d] list of Impaired Waters is available on ADEQ's website:
http://www.azdeq.gov/environ/water/assessment/assess.html
(401 conditions herein are meant to apply to waterbodies on the current, not draft, list)

Lake: The following are lakes which require an individual 401 certification for activities undertaken via a NWP:

Apache County

- Becker Lake — Lat.: 34° 9' 14.4" — Long.: 109° 18' 18.0"
- Carnero Lake — Lat.: 34° 6' 57.6" — Long.: 109° 31' 40.8"
- Lyman Lake — Lat.: 34° 21' 28.8" — Long.: 109° 21' 28.8"

Cochise County

- Parker Canyon Lake — Lat.: 31° 25' 33.6" — Long.: 110° 27' 14.4"

Coconino County

- Ashurst Lake — Lat.: 35° 1' 08.4" — Long.: 111° 24' 10.8"
- Bear Canyon Lake — Lat.: 34° 24' 10.8" — Long.: 111° 0' 10.8"
- Blue Ridge Reservoir — Lat.: 34° 33' 14.4" — Long.: 111° 11' 02.4"
- Boot Lake — Lat.: 34° 58' 51.6" — Long.: 111° 19' 58.8"
- Chevelon Canyon Lake — Lat.: 34° 30' 39.6" — Long.: 110° 49' 26.4"
- Kinnikinick Lake — Lat.: 34° 53' 52.8" — Long.: 111° 18' 21.6"
- Lake Mary, Lower — Lat.: 35° 6' 21.6" — Long.: 111° 34' 19.2"
- Lake Mary, Upper — Lat.: 35° 4' 44.4" — Long.: 111° 31' 55.2"
- Long Lake — Lat.: 34° 46' 44.4" — Long.: 111° 12' 0.0"
- Long Lake — Lat.: 35° 0' 0.0" — Long.: 111° 20' 60.0"
- Mormon Lake — Lat.: 34° 56' 38.4" — Long.: 111° 27' 10.8"
- Odell Lake — Lat.: 34° 56' 02.4" — Long.: 111° 37' 51.6"
- Soldier Annex Lake — Lat.: 34° 47' 13.2" — Long.: 111° 13' 48.0"

- Soldier Lake Lat.: 34° 47' 13.96" Long.: 111° 13' 48.0"
- Steel Dam Lake Lat.: 35° 13' 37.2" Long.: 112° 24' 50.4"
- Stone Dam Lake Lat.: 35° 13' 37.2" Long.: 112° 24' 14.4"
- Stoneman Lake Lat.: 34° 46' 44.4" Long.: 111° 31' 04.8"
- Whitehorse Lake Lat.: 35° 7' 01.2" Long.: 112° 0' 46.8"
- Woods Canyon Lake Lat.: 34° 20' 06.0" Long.: 110° 56' 34.8"

Gila County
- Roosevelt Lake Lat.: 33° 40' 44.4" Long.: 111° 9' 14.4"

La Paz County
- Alamo Lake Lat.: 34° 14' 45.6" Long.: 113° 34' 58.8"

Maricopa County
- Apache Lake Lat.: 33° 35' 31.2" Long.: 111° 20' 31.2"
- Bartlett Lake Lat.: 33° 49' 01.2" Long.: 111° 37' 44.4"
- Canyon Lake Lat.: 33° 32' 38.2" Long.: 111° 26' 06.1"
- Lake Pleasant Lat.: 33° 51' 14.4" Long.: 112° 16' 15.6"
- Painted Rock Borrow Pit Lat.: 33° 4' 58.8" Long.: 113° 1' 19.2"
- Painted Rock Reservoir Lat.: 33° 4' 15.6" Long.: 113° 0' 28.8"
- Roosevelt Lake Lat.: 33° 40' 44.4" Long.: 111° 9' 14.4"
- Saguaro Lake Lat.: 33° 34' 01.2" Long.: 111° 32' 06.0"

Mojave County
- Alamo Lake Lat.: 34° 14' 45.6" Long.: 113° 34' 58.8"

Navajo County
- Rainbow Lake Lat.: 34° 9' 03.6" Long.: 109° 59' 02.4"
- Show Low Lake Lat.: 34° 11' 24.0" Long.: 109° 59' 56.4"

Pima County
- Arivaca Lake Lat.: 31° 31' 51.6" Long.: 111° 15' 03.6"

Santa Cruz County
- Arivaca Lake Lat.: 31° 31' 51.6" Long.: 111° 15' 03.6"
- Patagonia Lake Lat.: 31° 29' 31.2" Long.: 110° 52' 01.2"
- Peña Blanca Lake Lat.: 31° 24' 10.8" Long.: 111° 5' 02.4"

Yavapai County
- Granite Basin Lake Lat.: 34° 37' 02.1" Long.: 112° 32' 56.5"
- Horseshoe Reservoir Lat.: 33° 58' 58.8" Long.: 111° 42' 28.8"
- Horsethief Lake Lat.: 34° 9' 43.2" Long.: 112° 17' 56.4"
- Lake Pleasant Lat.: 33° 51' 14.4" Long.: 112° 16' 15.6"
- Lynx Lake Lat.: 34° 31' 08.4" Long.: 112° 23' 06.0"
- Peck's Lake Lat.: 34° 47' 06.0" Long.: 112° 2' 31.2"
- Watson Lake Lat.: 34° 35' 16.8" Long.: 112° 25' 04.8"

Other Waters: Any waters of the United States, occurring on non-tribal land, that does not fall within one of the other definitions listed here.

Outstanding Arizona Waters: ADEQ is in the process of the triennial review of surface water quality standards (18 Arizona Administrative Code 11, Art 1) and among other things, this entails an updating of the Unique Waters of the state. A definite change is the name: instead of "Unique Waters", these bodies of water shall be referred to as "Outstanding Arizona Waters". Current Water Quality Standards For Surface Waters are available on the Arizona Secretary of State website (http://azsos.gov/public_services/Title_18/18-11.pdf).
The following are currently classified as Unique Waters (from R18-11-112(E), Arizona Administrative Code):

Apache County

- The West Fork of the Little Colorado River, from its headwaters to Government Springs at Latitude 33° 59' 33" / Longitude 109° 27' 54".
- Lee Valley Creek, from its headwaters to confluence with Lee Valley Reservoir.
- Hay Creek, from its headwaters to its confluence with the West Fork of the Black River.
- Stinky Creek, from the White Mountain Apache Indian Reservation boundary to its confluence with the West Fork of the Black River.

Cochise County

- Cave Creek from the headwaters to the Coronado National Forest boundary.
- South Fork of Cave Creek from its headwaters to its confluence with Cave Creek.

Coconino County

- Oak Creek from its headwaters to confluence with the Verde River.
- West Fork of Oak Creek from its headwaters to confluence with Oak Creek.

Gila County

- (Proposed) Fossil Creek, from its headwaters at the confluence of Sandrock and Calf Pen Canyons above Fossil Springs to its confluence with the Verde River.

Graham County

- Bonita Creek, from the boundary of the San Carlos Indian Reservation to its confluence with the Gila River.
- Aravaipa Creek, from its confluence with Stowe Gulch at Latitude 32° 52' 10" / Longitude 110° 22' 03" to the downstream boundary of Aravaipa Canyon Wilderness Area at Latitude 32° 54' 23" / Longitude 110° 33' 42".

Greenlee County

- Bear Wallow Creek, from its headwaters to the boundary of the San Carlos Indian Reservation.
- North Fork of Bear Wallow Creek, from its headwaters to confluence with Bear Wallow Creek.
- South Fork of Bear Wallow Creek, from its headwaters to confluence with Bear Wallow Creek.
- Snake Creek, from its headwaters to its confluence with the Black River.
- KP Creek, from its headwaters to its confluence with the Blue River.

Mohave County

- Francis Creek, from its headwaters to its confluence with Burro Creek.

Pima County

- Cienega Creek, from confluence with Gardner Canyon and Spring Water Canyon to USGS gaging station at Latitude 32° 02 ' 09" / Longitude 110° 40' 36".
- Buehman Canyon Creek, from its headwaters to confluence with unnamed tributary at Latitude 32° 24' 31.5"/ Longitude 110° 32' 08".
- Aravaipa Creek, from its confluence with Stowe Gulch at Latitude 32° 52' 10" / Longitude 110° 22' 03" to the downstream boundary of Aravaipa Canyon Wilderness Area at Latitude 32° 54' 23" / Longitude 110° 33' 42".

Yavapai County

- Oak Creek from its headwaters to confluence with the Verde River.
- Peoples Canyon Creek from its headwaters to confluence with the Santa Maria River.
- Burro Creek, from its headwaters to confluence with Boulder Creek.
- Francis Creek, from its headwaters to its confluence with Burro Creek.

Tribal Waters: All waters of the United States occurring on tribal lands.

Unique Waters: Now known as "Outstanding Arizona Waters"

Regional Conditions

Of the ten regional conditions effective within the Los Angeles District of the Corps of Engineers, three apply to projects within Arizona (2, 3, and 4). The remaining conditions apply to specific geographic areas, resources or species in California.

The following regional conditions must be followed in order for any authorization by an NWP to be valid in the State of Arizona:

2. For the State of Arizona and the Mojave and Sonoran (Colorado) desert regions of California in Los Angeles District (generally north and east of the San Gabriel, San Bernardino, San Jacinto, and Santa Rosa mountain ranges, and south of Little Lake, Inyo County), no nationwide permit, except Nationwide Permits 1 (Aids to Navigation), 2 (Structures in Artificial Canals), 3 (Maintenance), 4 (Fish and Wildlife Harvesting, Enhancement, and Attraction Devices and Activities), 5 (Scientific Measurement Devices), 6 (Survey Activities), 9 (Structures in Fleeting and Anchorage Areas), 10 (Mooring Buoys), 11 (Temporary Recreational Structures), 20 (Oil Spill Cleanup), 22 (Removal of Vessels), 27 (Stream and Wetland Restoration Activities), 30 (Moist Soil Management for Wildlife), 31 (Maintenance of Existing Flood Control Projects), 32 (Completed Enforcement Actions), 35 (Maintenance Dredging of Existing Basins), 37 (Emergency Watershed Protection and Rehabilitation), and 38 (Cleanup of Hazardous and Toxic Waste), or other nationwide or regional general permits that specifically authorize maintenance of previously authorized structures or fill, can be used to authorize the discharge of dredged or fill material into a jurisdictional special aquatic site as defined at 40 CFR Part 230.40-45 (sanctuaries and refuges, wetlands, mudflats, vegetated shallows, coral reefs, and riffle-and-pool complexes).

3. For all projects proposed for authorization by nationwide or regional general permits where prior notification to the District Engineer is required, applicants must provide color photographs or color photocopies of the project area taken from representative points documented on a site map. Pre-project photographs and the site map would be provided with the permit application. Photographs should represent conditions typical or indicative of the resources before impacts.

4. Notification pursuant to general condition 13 shall be required for projects in all special aquatic sites as defined at 40 CFR Part 230.40-45 (sanctuaries and refuges, wetlands, mudflats, vegetated shallows, coral reefs, and riffle-and-pool complexes), and in all perennial watercourses or waterbodies in the State of Arizona and the Mojave and Sonoran (Colorado) desert regions of California in Los Angeles District (generally north and east of the San Gabriel, San Bernardino, San Jacinto, and Santa Rosa mountain ranges, and south of Little Lake, Inyo County), excluding the Colorado River from Davis Dam downstream to the north end of Topock and downstream of Imperial Dam.

General Conditions

Note: To qualify for NWP authorization, the prospective permittee must comply with the following general conditions, as appropriate, in addition to any regional or case-specific conditions imposed by the division engineer or district engineer. Prospective permittees should contact the appropriate Corps district office to determine if regional conditions have been imposed on an NWP. Prospective permittees should also contact the appropriate Corps district office to determine the status of Clean Water Act Section 401 water quality certification and/ or Coastal Zone Management Act consistency for an NWP.

1. Navigation

(a) No activity may cause more than a minimal adverse effect on navigation.
(b) Any safety lights and signals prescribed by the U.S. Coast Guard, through regulations or otherwise, must be installed and maintained at the permittee's expense on authorized facilities in navigable waters of the United States.
(c) The permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

2. Aquatic Life Movements

No activity may substantially disrupt the necessary life cycle movements of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the area, unless the activity's primary purpose is to impound water. Culverts placed in streams must be installed to maintain low flow conditions.

3. Spawning Areas

Activities in spawning areas during spawning seasons must be avoided to the maximum extent practicable. Activities that result in the physical destruction (e.g., through excavation, fill, or downstream smothering by substantial turbidity) of an important spawning area are not authorized.

4. Migratory Bird Breeding Areas

Activities in waters of the United States that serve as breeding areas for migratory birds must be avoided to the maximum extent practicable.

5. Shellfish Beds

No activity may occur in areas of concentrated shellfish populations, unless the activity is directly related to a shellfish harvesting activity authorized by NWPs 4 and 48.

6. Suitable Material

No activity may use unsuitable material (e.g., trash, debris, car bodies, asphalt, etc.). Material used for construction or discharged must be free from toxic pollutants in toxic amounts (see Section 307 of the Clean Water Act).

7. Water Supply Intakes.

No activity may occur in the proximity of a public water supply intake, except where the activity is for the repair or improvement of public water supply intake structures or adjacent bank stabilization.

8. Adverse Effects From Impoundments.

If the activity creates an impoundment of water, adverse effects to the aquatic system due to accelerating the passage of water, and/or restricting its flow must be minimized to the maximum extent practicable.

9. Management of Water Flows

To the maximum extent practicable, the pre-construction course, condition, capacity, and location of open waters must be maintained for each activity, including stream channelization and storm water management activities, except as provided below. The activity must be constructed to withstand expected high flows. The activity must not restrict or impede the passage of normal or high flows, unless the primary purpose of the activity is to impound water or manage high flows. The activity may alter the pre-construction course, condition, capacity, and location of open waters if it benefits the aquatic environment (e.g., stream restoration or relocation activities).

10. Fills Within 100-Year Floodplains.

The activity must comply with applicable FEMA-approved state or local floodplain management requirements.

11. Equipment

Heavy equipment working in wetlands or mudflats must be placed on mats, or other measures must be taken to minimize soil disturbance.

12. Soil Erosion and Sediment Controls

Appropriate soil erosion and sediment controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high tide line, must be permanently stabilized at the earliest practicable date. Permittees are encouraged to perform work within waters of the United States during periods of low-flow or no-flow.

13. Removal of Temporary Fills

Temporary fills must be removed in their entirety and the affected areas returned to pre-construction elevations. The affected areas must be revegetated, as appropriate.

14. Proper Maintenance

Any authorized structure or fill shall be properly maintained, including maintenance to ensure public safety.

15. Wild and Scenic Rivers

No activity may occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a ''study river'' for possible inclusion in the system while the river is in an official study status, unless the appropriate Federal agency with direct management responsibility for such river, has determined in writing that the proposed activity will not adversely affect the Wild and Scenic River designation or study status. Information on Wild and Scenic Rivers may be obtained from the appropriate Federal land management agency in the area (e.g., National Park Service, U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service).

16. Tribal Rights

No activity or its operation may impair reserved tribal rights, including, but not limited to, reserved water rights and treaty fishing and hunting rights.

17. Endangered Species

(a) No activity is authorized under any NWP which is likely to jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act (ESA), or which will destroy or adversely modify the critical habitat of such species. No activity is authorized under any NWP which ''may affect'' a listed species or critical habitat, unless Section 7 consultation addressing the effects of the proposed activity has been completed.

(b) Federal agencies should follow their own procedures for complying with the requirements of the ESA. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements.

(c) Non-federal permittees shall notify the district engineer if any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, and shall not begin work on the activity until notified by the district engineer that the requirements of the ESA have been satisfied and that the activity is authorized. For activities that might affect Federally-listed endangered or threatened species or designated critical habitat, the pre-construction notification must include the name(s) of the endangered or threatened species that may be affected by the proposed work or that utilize the designated critical habitat that may be affected by the proposed work. The district engineer will determine whether the proposed activity ''may affect'' or will have ''no effect'' to listed species and designated critical habitat and will notify the non-Federal applicant of the Corps' determination within 45 days of receipt of a complete pre-construction notification. In cases where the non-Federal applicant has identified listed species or critical habitat that might be affected or is in the vicinity of the project, and has so notified the Corps, the applicant shall not begin work until the Corps has provided notification the proposed activities will have ''no effect'' on listed species or critical habitat, or until Section 7 consultation has been completed.

(d) As a result of formal or informal consultation with the FWS or NMFS the district engineer may add species-specific regional endangered species conditions to the NWPs.

(e) Authorization of an activity by a NWP does not authorize the ''take'' of a threatened or endangered species as defined under the ESA. In the absence of separate authorization (e.g., an ESA Section 10 Permit, a Biological Opinion with ''incidental take'' provisions, etc.) from the U.S. FWS or the NMFS, both lethal and non-lethal ''takes'' of protected species are in violation of the ESA. Information on the location of threatened and endangered species and their critical habitat can be obtained directly from the offices of the U.S. FWS and NMFS or their world wide Web pages at http://www.fws.gov/ and http://www.noaa.gov/fisheries.html respectively.

18. Historic Properties

(a) In cases where the district engineer determines that the activity may affect properties listed, or eligible for listing, in the National Register of Historic Places, the activity is not authorized, until the requirements of Section 106 of the National Historic Preservation Act (NHPA) have been satisfied.

(b) Federal permittees should follow their own procedures for complying with the requirements of Section 106 of the National Historic Preservation Act. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements.

(c) Non-federal permittees must submit a pre-construction notification to the district engineer if the authorized activity may have the potential to cause effects to any historic properties listed, determined to be eligible for listing on, or potentially eligible for listing on the National Register of Historic Places, including previously unidentified properties. For such activities, the pre-construction notification must state which historic properties may be affected by the proposed work or include a vicinity map indicating the location of the historic properties or the potential for the presence of historic properties. Assistance regarding information on the location of or potential for the presence of historic resources can be sought from the State Historic Preservation Officer or Tribal Historic Preservation Officer, as appropriate, and the National Register of Historic Places (see 33 CFR 330.4(g)). The district engineer shall make a reasonable and good faith effort to carry out appropriate identification efforts, which may include background research, consultation, oral history interviews, sample field investigation, and field survey. Based on the information submitted and these efforts, the district engineer shall determine whether the proposed activity has the potential to cause an effect on the historic properties. Where the non-Federal applicant has identified historic properties which the activity may have the potential to cause effects and so notified the Corps, the non-Federal applicant shall not begin the activity until notified by the district engineer either that the activity has no potential to cause effects or that consultation under Section 106 of the NHPA has been completed.

(d) The district engineer will notify the prospective permittee within 45 days of receipt of a complete pre-construction notification whether NHPA Section 106 consultation is required. Section 106 consultation is not required when the Corps determines that the activity does not have the potential to cause effects on historic properties (see 36 CFR 800.3(a)). If NHPA section 106 consultation is required and will occur, the district engineer will notify the non-Federal applicant that he or she cannot begin work until Section 106 consultation is completed.

(e) Prospective permittees should be aware that section 110k of the NHPA (16 U.S.C. 470h-2(k)) prevents the Corps from granting a permit or other assistance to an applicant who, with intent to avoid the requirements of Section 106 of the NHPA, has intentionally significantly adversely affected a historic property to which the permit would relate, or having legal power to prevent it, allowed such significant adverse effect to occur, unless the Corps, after consultation with the Advisory Council on Historic Preservation (ACHP), determines that circumstances justify granting such assistance despite the adverse effect created or permitted by the applicant. If circumstances justify granting the assistance, the Corps is required to notify the ACHP and provide documentation specifying the circumstances, explaining the degree of damage to the integrity of any historic properties affected, and proposed mitigation. This documentation must include any views obtained from the applicant, SHPO/THPO, appropriate Indian tribes if the undertaking occurs on or affects historic properties on tribal lands or affects properties of interest to those tribes, and other parties known to have a legitimate interest in the impacts to the permitted activity on historic properties.

19. Designated Critical Resource Waters

Critical resource waters include, NOAA-designated marine sanctuaries, National Estuarine Research Reserves, state natural heritage sites, and outstanding national resource waters or other waters officially designated by a state as having particular environmental or ecological significance and identified by the district engineer after notice and opportunity for public comment. The district engineer may also designate additional critical resource waters after notice and opportunity for comment.

(a) Discharges of dredged or fill material into waters of the United States are not authorized by NWPs 7, 12, 14, 16, 17, 21, 29, 31, 35, 39, 40, 42, 43, 44, 49, and 50 for any activity within, or directly affecting, critical resource waters, including wetlands adjacent to such waters.

(b) For NWPs 3, 8, 10, 13, 15, 18, 19, 22, 23, 25, 27, 28, 30, 33, 34, 36, 37, and 38, notification is required in accordance with general condition 27, for any activity proposed in the designated critical resource waters including wetlands adjacent to those waters. The district engineer may authorize activities under these NWPs only after it is determined that the impacts to the critical resource waters will be no more than minimal.

20. Mitigation

The district engineer will consider the following factors when determining appropriate and practicable mitigation necessary to ensure that adverse effects on the aquatic environment are minimal:

(a) The activity must be designed and constructed to avoid and minimize adverse effects, both temporary and permanent, to waters of the United States to the maximum extent practicable at the project site (i.e., on site).

(b) Mitigation in all its forms (avoiding, minimizing, rectifying, reducing, or compensating) will be required to the extent necessary to ensure that the adverse effects to the aquatic environment are minimal.

(c) Compensatory mitigation at a minimum one-for-one ratio will be required for all wetland losses that exceed 1/10 acre and require pre-construction notification, unless the district engineer determines in writing that some other form of mitigation would be more environmentally appropriate and provides a project-specific waiver of this requirement. For wetland losses of 1/10 acre or less that require pre-construction notification, the district engineer may determine on a case-by-case basis that compensatory mitigation is required to ensure that the activity results in minimal adverse effects on the aquatic environment. Since the likelihood of success is greater and the impacts to potentially valuable uplands are reduced, wetland restoration should be the first compensatory mitigation option considered.

(d) For losses of streams or other open waters that require pre-construction notification, the district engineer may require compensatory mitigation, such as stream restoration, to ensure that the activity results in minimal adverse effects on the aquatic environment.

(e) Compensatory mitigation will not be used to increase the acreage losses allowed by the acreage limits of the NWPs. For example, if an NWP has an acreage limit of ½ acre, it cannot be used to authorize any project resulting in the loss of greater than ½ acre of waters of the United States, even if compensatory mitigation is provided that replaces or restores some of the lost waters. However, compensatory mitigation can and should be used, as necessary, to ensure that a project already meeting the established acreage limits also satisfies the minimal impact requirement associated with the NWPs.

(f) Compensatory mitigation plans for projects in or near streams or other open waters will normally include a requirement for the establishment, maintenance, and legal protection (e.g., conservation easements) of riparian areas next to open waters. In some cases, riparian areas may be the only compensatory mitigation required. Riparian areas should consist of native species. The width of the required riparian area will address documented water quality or aquatic habitat loss concerns. Normally, the riparian area will be 25 to 50 feet wide on each side of the stream, but the district engineer may require slightly wider riparian areas to address documented water quality or habitat loss concerns. Where both wetlands and open waters exist on the project site, the district engineer will determine the appropriate compensatory mitigation (e.g., riparian areas and/or wetlands compensation) based on what is best for the aquatic environment on a watershed basis. In cases where riparian areas are determined to be the most appropriate form of compensatory mitigation, the district engineer may waive or reduce the requirement to provide wetland compensatory mitigation for wetland losses.

(g) Permittees may propose the use of mitigation banks, in-lieu fee arrangements or separate activity-specific compensatory mitigation. In all cases, the mitigation provisions will specify the party responsible for accomplishing and/or complying with the mitigation plan.

(h) Where certain functions and services of waters of the United States are permanently adversely affected, such as the conversion of a forested or scrub-shrub wetland to a herbaceous wetland in a permanently maintained utility line right-of-way, mitigation may be required to reduce the adverse effects of the project to the minimal level.

21.Water Quality

Where States and authorized Tribes, or EPA where applicable, have not previously certified compliance of an NWP with CWA Section 401, individual 401 Water Quality Certification must be obtained or waived (see 33 CFR 330.4(c)). The district engineer or State or Tribe may require additional water quality management measures to ensure that the authorized activity does not result in more than minimal degradation of water quality.

22. Coastal Zone Management
In coastal states where an NWP has not previously received a state coastal zone management consistency concurrence, an individual state coastal zone management consistency concurrence must be obtained, or a presumption of concurrence must occur (see 33 CFR 330.4(d)). The district engineer or a State may require additional measures to ensure that the authorized activity is consistent with state coastal zone management requirements.
23. Regional and Case-By-Case Conditions
The activity must comply with any regional conditions that may have been added by the Division Engineer (see 33 CFR 330.4(e)) and with any case specific conditions added by the Corps or by the state, Indian Tribe, or U.S. EPA in its section 401 Water Quality Certification, or by the state in its Coastal Zone Management Act consistency determination.
24. Use of Multiple Nationwide Permits
The use of more than one NWP for a single and complete project is prohibited, except when the acreage loss of waters of the United States authorized by the NWPs does not exceed the acreage limit of the NWP with the highest specified acreage limit. For example, if a road crossing over tidal waters is constructed under NWP 14, with associated bank stabilization authorized by NWP 13, the maximum acreage loss of waters of the United States for the total project cannot exceed 1/3-acre.
25. Transfer of Nationwide Permit Verifications
If the permittee sells the property associated with a nationwide permit verification, the permittee may transfer the nationwide permit verification to the new owner by submitting a letter to the appropriate Corps district office to validate the transfer. A copy of the nationwide permit verification must be attached to the letter, and the letter must contain the following statement and signature:
''When the structures or work authorized by this nationwide permit are still in existence at the time the property is transferred, the terms and conditions of this nationwide permit, including any special conditions, will continue to be binding on the new owner(s) of the property. To validate the transfer of this nationwide permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below.''

____
(Transferee)

____
(Date)

26. Compliance Certification
Each permittee who received an NWP verification from the Corps must submit a signed certification regarding the completed work and any required mitigation. The certification form must be forwarded by the Corps with the NWP verification letter and will include:
(a) A statement that the authorized work was done in accordance with the NWP authorization, including any general or specific conditions;
(b) A statement that any required mitigation was completed in accordance with the permit conditions; and
(c) The signature of the permittee certifying the completion of the work and mitigation.
27. Pre-Construction Notification
(a) *Timing.* Where required by the terms of the NWP, the prospective permittee must notify the district engineer by submitting a pre-construction notification (PCN) as early as possible. The district engineer must determine if the PCN is complete within 30 calendar days of the date of receipt and, as a general rule, will request additional information necessary to make the PCN complete only once. However, if the prospective permittee does not provide all of the requested information, then the district engineer will notify the prospective permittee that the PCN is still incomplete and the PCN review process will not commence until all of the requested information has been received by the district engineer. The prospective permittee shall not begin the activity until either:
(1) He or she is notified in writing by the district engineer that the activity may proceed under the NWP with any special conditions imposed by the district or division engineer; or
(2) Forty-five calendar days have passed from the district engineer's receipt of the complete PCN and the prospective permittee has not received written notice from the district or division engineer. However, if the permittee was required to notify the Corps pursuant to general condition 17 that listed species or critical habitat might be affected or in the vicinity of the project, or to notify the Corps pursuant to general condition 18 that the activity may have the potential to cause effects to historic properties, the permittee cannot begin the activity until receiving written notification from the Corps that is ''no effect'' on listed species or ''no potential to cause effects'' on historic properties, or that any consultation required under Section 7 of the Endangered Species Act (see 33 CFR 330.4(f)) and/or Section 106 of the National Historic Preservation (see 33 CFR 330.4(g)) is completed. Also, work cannot begin under NWPs 21, 49, or 50 until the permittee has received written approval from the Corps. If the proposed activity requires a written waiver to exceed specified limits of an NWP, the permittee cannot begin the activity until the district engineer issues the waiver. If the district or division engineer notifies the permittee in writing that an individual permit is required within 45 calendar days of receipt of a complete PCN, the permittee cannot begin the activity until an individual permit has been obtained. Subsequently, the permittee's right to proceed under the NWP may be modified, suspended, or revoked only in accordance with the procedure set forth in 33 CFR 330.5(d)(2).
(b) *Contents of Pre-Construction Notification:* The PCN must be in writing and include the following information:
(1) Name, address and telephone numbers of the prospective permittee;
(2) Location of the proposed project;
(3) A description of the proposed project; the project's purpose; direct and indirect adverse environmental effects the project would cause; any other NWP(s), regional general permit(s), or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity. The description should be sufficiently detailed to allow the district engineer to determine that the adverse effects of the project will be minimal and to determine the need for compensatory mitigation. Sketches should be provided when necessary to show that the activity complies with the terms of the NWP. (Sketches usually clarify the project and when provided result in a quicker decision.);
(4) The PCN must include a delineation of special aquatic sites and other waters of the United States on the project site. Wetland delineations must be prepared in accordance with the current method required by the Corps. The permittee may ask the Corps to delineate the special aquatic sites and other waters of the United States, but there may be a delay if the Corps does the delineation, especially if the project site is large or contains many waters of the United States. Furthermore, the 45 day period will not start until the delineation has been submitted to or completed by the Corps, where appropriate;

(5) If the proposed activity will result in the loss of greater than 1/10 acre of wetlands and a PCN is required, the prospective permittee must submit a statement describing how the mitigation requirement will be satisfied. As an alternative, the prospective permittee may submit a conceptual or detailed mitigation plan.
(6) If any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, for non-Federal applicants the PCN must include the name(s) of those endangered or threatened species that might be affected by the proposed work or utilize the designated critical habitat that may be affected by the proposed work. Federal applicants must provide documentation demonstrating compliance with the Endangered Species Act; and
(7) For an activity that may affect a historic property listed on, determined to be eligible for listing on, or potentially eligible for listing on, the National Register of Historic Places, for non-Federal applicants the PCN must state which historic property may be affected by the proposed work or include a vicinity map indicating the location of the historic property. Federal applicants must provide documentation demonstrating compliance with Section 106 of the National Historic Preservation Act.
(c) *Form of Pre-Construction Notification:* The standard individual permit application form (Form ENG 4345) may be used, but the completed application form must clearly indicate that it is a PCN and must include all of the information required in paragraphs (b)(1) through (7) of this general condition. A letter containing the required information may also be used.
(d) *Agency Coordination:* (1) The district engineer will consider any comments from Federal and state agencies concerning the proposed activity's compliance with the terms and conditions of the NWPs and the need for mitigation to reduce the project's adverse environmental effects to a minimal level.
(2) For all NWP 48 activities requiring pre-construction notification and for other NWP activities requiring pre-construction notification to the district engineer that result in the loss of greater than ½-acre of waters of the United States, the district engineer will immediately provide (e.g., via facsimile transmission, overnight mail, or other expeditious manner) a copy of the PCN to the appropriate Federal or state offices (U.S. FWS, state natural resource or water quality agency, EPA, State Historic Preservation Officer (SHPO) or Tribal Historic Preservation Office (THPO), and, if appropriate, the NMFS). With the exception of NWP 37, these agencies will then have 10 calendar days from the date the material is transmitted to telephone or fax the district engineer notice that they intend to provide substantive, site-specific comments. If so contacted by an agency, the district engineer will wait an additional 15 calendar days before making a decision on the pre-construction notification. The district engineer will fully consider agency comments received within the specified time frame, but will provide no response to the resource agency, except as provided below. The district engineer will indicate in the administrative record associated with each pre-construction notification that the resource agencies' concerns were considered. For NWP 37, the emergency watershed protection and rehabilitation activity may proceed immediately in cases where there is an unacceptable hazard to life or a significant loss of property or economic hardship will occur. The district engineer will consider any comments received to decide whether the NWP 37 authorization should be modified, suspended, or revoked in accordance with the procedures at 33 CFR 330.5.
(3) In cases of where the prospective permittee is not a Federal agency, the district engineer will provide a response to NMFS within 30 calendar days of receipt of any Essential Fish Habitat conservation recommendations, as required by Section 305(b)(4)(B) of the Magnuson-Stevens Fishery Conservation and Management Act.
(4) Applicants are encouraged to provide the Corps multiple copies of pre-construction notifications to expedite agency coordination.
(5) For NWP 48 activities that require reporting, the district engineer will provide a copy of each report within 10 calendar days of receipt to the appropriate regional office of the NMFS.
(e) *District Engineer's Decision:* In reviewing the PCN for the proposed activity, the district engineer will determine whether the activity authorized by the NWP will result in more than minimal individual or cumulative adverse environmental effects or may be contrary to the public interest. If the proposed activity requires a PCN and will result in a loss of greater than 1/10 acre of wetlands, the prospective permittee should submit a mitigation proposal with the PCN. Applicants may also propose compensatory mitigation for projects with smaller impacts. The district engineer will consider any proposed compensatory mitigation the applicant has included in the proposal in determining whether the net adverse environmental effects to the aquatic environment of the proposed work are minimal. The compensatory mitigation proposal may be either conceptual or detailed. If the district engineer determines that the activity complies with the terms and conditions of the NWP and that the adverse effects on the aquatic environment are minimal, after considering mitigation, the district engineer will notify the permittee and include any conditions the district engineer deems necessary. The district engineer must approve any compensatory mitigation proposal before the permittee commences work. If the prospective permittee elects to submit a compensatory mitigation plan with the PCN, the district engineer will expeditiously review the proposed compensatory mitigation plan. The district engineer must review the plan within 45 calendar days of receiving a complete PCN and determine whether the proposed mitigation would ensure no more than minimal adverse effects on the aquatic environment. If the net adverse effects of the project on the aquatic environment (after consideration of the compensatory mitigation proposal) are determined by the district engineer to be minimal, the district engineer will provide a timely written response to the applicant. The response will state that the project can proceed under the terms and conditions of the NWP.
If the district engineer determines that the adverse effects of the proposed work are more than minimal, then the district engineer will notify the applicant either:
(1) That the project does not qualify for authorization under the NWP and instruct the applicant on the procedures to seek authorization under an individual permit; (2) that the project is authorized under the NWP subject to the applicant's submission of a mitigation plan that would reduce the adverse effects on the aquatic environment to the minimal level; or (3) that the project is authorized under the NWP with specific modifications or conditions. Where the district engineer determines that mitigation is required to ensure no more than minimal adverse effects occur to the aquatic environment, the activity will be authorized within the 45-day PCN period. The authorization will include the necessary conceptual or specific mitigation or a requirement that the applicant submit a mitigation plan that would reduce the adverse effects on the aquatic environment to the minimal level. When mitigation is required, no work in waters of the United States may occur until the district engineer has approved a specific mitigation plan.

28. Single and Complete Project

The activity must be a single and complete project. The same NWP cannot be used more than once for the same single and complete project.

Further Information

1. District Engineers have authority to determine if an activity complies with the terms and conditions of an NWP.
2. NWPs do not obviate the need to obtain other federal, state, or local permits, approvals, or authorizations required by law.

3. NWPs do not grant any property rights or exclusive privileges.
4. NWPs do not authorize any injury to the property or rights of others.
5. NWPs do not authorize interference with any existing or proposed Federal project.

Definitions

Best management practices (BMPs): Policies, practices, procedures, or structures implemented to mitigate the adverse environmental effects on surface water quality resulting from development. BMPs are categorized as structural or non-structural.

Compensatory mitigation: The restoration, establishment (creation), enhancement, or preservation of aquatic resources for the purpose of compensating for unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved.

Currently serviceable: Useable as is or with some maintenance, but not so degraded as to essentially require reconstruction.

Discharge: The term "discharge" means any discharge of dredged or fill material.

Enhancement: The manipulation of the physical, chemical, or biological characteristics of an aquatic resource to heighten, intensify, or improve a specific aquatic resource function(s). Enhancement results in the gain of selected aquatic resource function(s), but may also lead to a decline in other aquatic resource function(s). Enhancement does not result in a gain in aquatic resource area.

Ephemeral stream: An ephemeral stream has flowing water only during, and for a short duration after, precipitation events in a typical year. Ephemeral stream beds are located above the water table year-round. Groundwater is not a source of water for the stream. Runoff from rainfall is the primary source of water for stream flow.

Establishment (creation): The manipulation of the physical, chemical, or biological characteristics present to develop an aquatic resource that did not previously exist at an upland site. Establishment results in a gain in aquatic resource area.

Historic Property: Any prehistoric or historic district, site (including archaeological site), building, structure, or other object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register criteria (36 CFR part 60).

Independent utility: A test to determine what constitutes a single and complete project in the Corps regulatory program. A project is considered to have independent utility if it would be constructed absent the construction of other projects in the project area. Portions of a multi-phase project that depend upon other phases of the project do not have independent utility. Phases of a project that would be constructed even if the other phases were not built can be considered as separate single and complete projects with independent utility.

Intermittent stream: An intermittent stream has flowing water during certain times of the year, when groundwater provides water for stream flow. During dry periods, intermittent streams may not have flowing water. Runoff from rainfall is a supplemental source of water for stream flow.

Loss of waters of the United States: Waters of the United States that are permanently adversely affected by filling, flooding, excavation, or drainage because of the regulated activity. Permanent adverse effects include permanent discharges of dredged or fill material that change an aquatic area to dry land, increase the bottom elevation of a waterbody, or change the use of a waterbody. The acreage of loss of waters of the United States is a threshold measurement of the impact to jurisdictional waters for determining whether a project may qualify for an NWP; it is not a net threshold that is calculated after considering compensatory mitigation that may be used to offset losses of aquatic functions and services. The loss of stream bed includes the linear feet of stream bed that is filled or excavated. Waters of the United States temporarily filled, flooded, excavated, or drained, but restored to pre-construction contours and elevations after construction, are not included in the measurement of loss of waters of the United States. Impacts resulting from activities eligible for exemptions under Section 404(f) of the Clean Water Act are not considered when calculating the loss of waters of the United States.

Non-tidal wetland: A non-tidal wetland is a wetland that is not subject to the ebb and flow of tidal waters. The definition of a wetland can be found at 33 CFR 328.3(b). Non-tidal wetlands contiguous to tidal waters are located landward of the high tide line (i.e., spring high tide line).

Open water: For purposes of the NWPs, an open water is any area that in a year with normal patterns of precipitation has water flowing or standing above ground to the extent that an ordinary high water mark can be determined. Aquatic vegetation within the area of standing or flowing water is either non-emergent, sparse, or absent. Vegetated shallows are considered to be open waters. Examples of "open waters" include rivers, streams, lakes, and ponds.

Ordinary High Water Mark: An ordinary high water mark is a line on the shore established by the fluctuations of water and indicated by physical characteristics, or by other appropriate means that consider the characteristics of the surrounding areas (see 33 CFR 328.3(e)).

Perennial stream: A perennial stream has flowing water year-round during a typical year. The water table is located above the stream bed for most of the year. Groundwater is the primary source of water for stream flow. Runoff from rainfall is a supplemental source of water for stream flow.

Practicable: Available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes.

Pre-construction notification: A request submitted by the project proponent to the Corps for confirmation that a particular activity is authorized by nationwide permit. The request may be a permit application, letter, or similar document that includes information about the proposed work and its anticipated environmental effects. Pre-construction notification may be required by the terms and conditions of a nationwide permit, or by regional conditions. A pre-construction notification may be voluntarily submitted in cases where pre-construction notification is not required and the project proponent wants confirmation that the activity is authorized by nationwide permit.

Preservation: The removal of a threat to, or preventing the decline of, aquatic resources by an action in or near those aquatic resources. This term includes activities commonly associated with the protection and maintenance of aquatic resources through the implementation of appropriate legal and physical mechanisms. Preservation does not result in a gain of aquatic resource area or functions.

Re-establishment: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former aquatic resource. Re-establishment results in rebuilding a former aquatic resource and results in a gain in aquatic resource area.

Rehabilitation: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions to a degraded aquatic resource. Rehabilitation results in a gain in aquatic resource function, but does not result in a gain in aquatic resource area.

Restoration: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former or degraded aquatic resource. For the purpose of tracking net gains in aquatic resource area, restoration is divided into two categories: Re-establishment and rehabilitation.

Riffle and pool complex: Riffle and pool complexes are special aquatic sites under the 404(b)(1) Guidelines. Riffle and pool complexes sometimes characterize steep gradient sections of streams. Such stream sections are recognizable by their hydraulic characteristics. The rapid movement of water over a course substrate in riffles results in a rough flow, a turbulent surface, and high dissolved oxygen levels in the water. Pools are deeper areas associated with riffles. A slower stream velocity, a streaming flow, a smooth surface, and a finer substrate characterize pools.

Riparian areas: Riparian areas are lands adjacent to streams, lakes, and estuarine-marine shorelines. Riparian areas are transitional between terrestrial and aquatic ecosystems, through which surface and subsurface hydrology connects waterbodies with their adjacent uplands. Riparian areas provide a variety of ecological functions and services and help improve or maintain local water quality. (See general condition 20.)

Shellfish seeding: The placement of shellfish seed and/or suitable substrate to increase shellfish production. Shellfish seed consists of immature individual shellfish or individual shellfish attached to shells or shell fragments (i.e., spat on shell). Suitable substrate may consist of shellfish shells, shell fragments, or other appropriate materials placed into waters for shellfish habitat.

Single and complete project: The term "single and complete project" is defined at 33 CFR 330.2(i) as the total project proposed or accomplished by one owner/developer or partnership or other association of owners/developers. A single and complete project must have independent utility (see definition). For linear projects, a "single and complete project" is all crossings of a single water of the United States (i.e., a single waterbody) at a specific location. For linear projects crossing a single waterbody several times at separate and distant locations, each crossing is considered a single and complete project. However, individual channels in a braided stream or river, or individual arms of a large, irregularly shaped wetland or lake, etc., are not separate waterbodies, and crossings of such features cannot be considered separately.

Stormwater management: Stormwater management is the mechanism for controlling stormwater runoff for the purposes of reducing downstream erosion, water quality degradation, and flooding and mitigating the adverse effects of changes in land use on the aquatic environment.

Stormwater management facilities: Stormwater management facilities are those facilities, including but not limited to, stormwater retention and detention ponds and best management practices, which retain water for a period of time to control runoff and/or improve the quality (i.e., by reducing the concentration of nutrients, sediments, hazardous substances and other pollutants) of stormwater runoff.

Stream bed: The substrate of the stream channel between the ordinary high water marks. The substrate may be bedrock or inorganic particles that range in size from clay to boulders. Wetlands contiguous to the stream bed, but outside of the ordinary high water marks, are not considered part of the stream bed.

Stream channelization: The manipulation of a stream's course, condition, capacity, or location that causes more than minimal interruption of normal stream processes. A channelized stream remains a water of the United States.

Structure: An object that is arranged in a definite pattern of organization. Examples of structures include, without limitation, any pier, boat dock, boat ramp, wharf, dolphin, weir, boom, breakwater, bulkhead, revetment, riprap, jetty, artificial island, artificial reef, permanent mooring structure, power transmission line, permanently moored floating vessel, piling, aid to navigation, or any other manmade obstacle or obstruction.

Tidal wetland: A tidal wetland is a wetland (i.e., water of the United States) that is inundated by tidal waters. The definitions of a wetland and tidal waters can be found at 33 CFR 328.3(b) and 33 CFR 328.3(f), respectively. Tidal waters rise and fall in a predictable and measurable rhythm or cycle due to the gravitational pulls of the moon and sun. Tidal waters end where the rise and fall of the water surface can no longer be practically measured in a predictable rhythm due to masking by other waters, wind, or other effects. Tidal wetlands are located channelward of the high tide line, which is defined at 33 CFR 328.3(d).

Vegetated shallows: Vegetated shallows are special aquatic sites under the 404(b)(1) Guidelines. They are areas that are permanently inundated and under normal circumstances have rooted aquatic vegetation, such as seagrasses in marine and estuarine systems and a variety of vascular rooted plants in freshwater systems.

Waterbody: For purposes of the NWPs, a waterbody is a jurisdictional water of the United States that, during a year with normal patterns of precipitation, has water flowing or standing above ground to the extent that an ordinary high water mark (OHWM) or other indicators of jurisdiction can be determined, as well as any wetland area (see 33 CFR 328.3(b)). If a jurisdictional wetland is adjacent—meaning bordering, contiguous, or neighboring— to a jurisdictional waterbody displaying an OHWM or other indicators of jurisdiction, that waterbody and its adjacent wetlands are considered together as a single aquatic unit (see 33 CFR 328.4(c)(2)). Examples of "waterbodies" include streams, rivers, lakes, ponds, and wetlands.

U.S. Department of Homeland Security
United States Coast Guard

BRIDGE PERMIT

(1-10-11) MAY 0 3 2010

WHEREAS by Title V of an act of Congress approved August 2, 1946, entitled "General Bridge Act of 1946," as amended (33 U.S.C. 525-533), the consent of Congress was granted for the construction, maintenance and operation of bridges and approaches thereto over the navigable waters of the United States;

AND WHEREAS the Secretary of Homeland Security has delegated the authority of Section 502(b) of that act to the Commandant, U. S. Coast Guard by Department of Homeland Security Delegation Number: 0170.1;

AND WHEREAS before construction is commenced, the Commandant must approve the location and plans of any such bridge and may impose any specific conditions relating to the construction, maintenance and operation of the structure deemed necessary in the interest of public navigation, such conditions to have the force of law;

AND WHEREAS the - **STATE OF CALIFORNIA** - has submitted for approval the location and plans of a bridge to be constructed across the Colorado River between Parker, Arizona and Earp, California;

NOW THEREFORE, This is to certify that the location and plans dated 8 August 2009 are hereby approved by the Commandant, subject to the following conditions:

1. No deviation from the approved plans may be made either before or after completion of the structure unless the modification of said plans has previously been submitted to and received the approval of the Commandant.

2. The construction of falsework, trestles, cofferdams or other obstructions, if required, shall be in accordance with plans submitted to and approved by the Commander, Eleventh Coast Guard District, prior to construction of the bridge. All work shall be so conducted that the free navigation of the waterway is not unreasonably interfered with and the present navigable depths are not impaired. Timely notice of any and all events that may affect navigation shall be given to the District Commander during construction of the bridge. The channel or channels through the structure shall be promptly cleared of all obstructions placed therein or caused by the construction of the bridge to the satisfaction of the District Commander, when in the judgment of the District Commander the construction work has reached a point where such action should be taken, but in no case later than 90 days after the bridge has been opened to traffic.

3. Issuance of this permit does not relieve the permittee of the obligation or responsibility for compliance with the provisions of any other law or regulation as may be under the jurisdiction of the U.S. Army Corps of Engineers, South Pacific Division; U.S. Department of Commerce, National Marine Fisheries Service; U.S. Environmental Protection Agency, Region IX; the Colorado River Indian Tribes, or any other federal, state or local authority having cognizance of any aspect of the location, construction or maintenance of said bridge.

4. A bridge fendering system shall be installed and maintained in good condition by and at the expense of the owner of the bridge when so required by the District Commander. Said installation and maintenance shall be for the safety of navigation and be in accordance with plans submitted to and approved by the District Commander prior to its construction.

5. Clearance gauges shall be installed and maintained in a good and legible condition by and at the expense of the owner of the bridge when so required by the District Commander. The type of gauges and the locations in which they are to be installed will be submitted to the District Commander for approval.

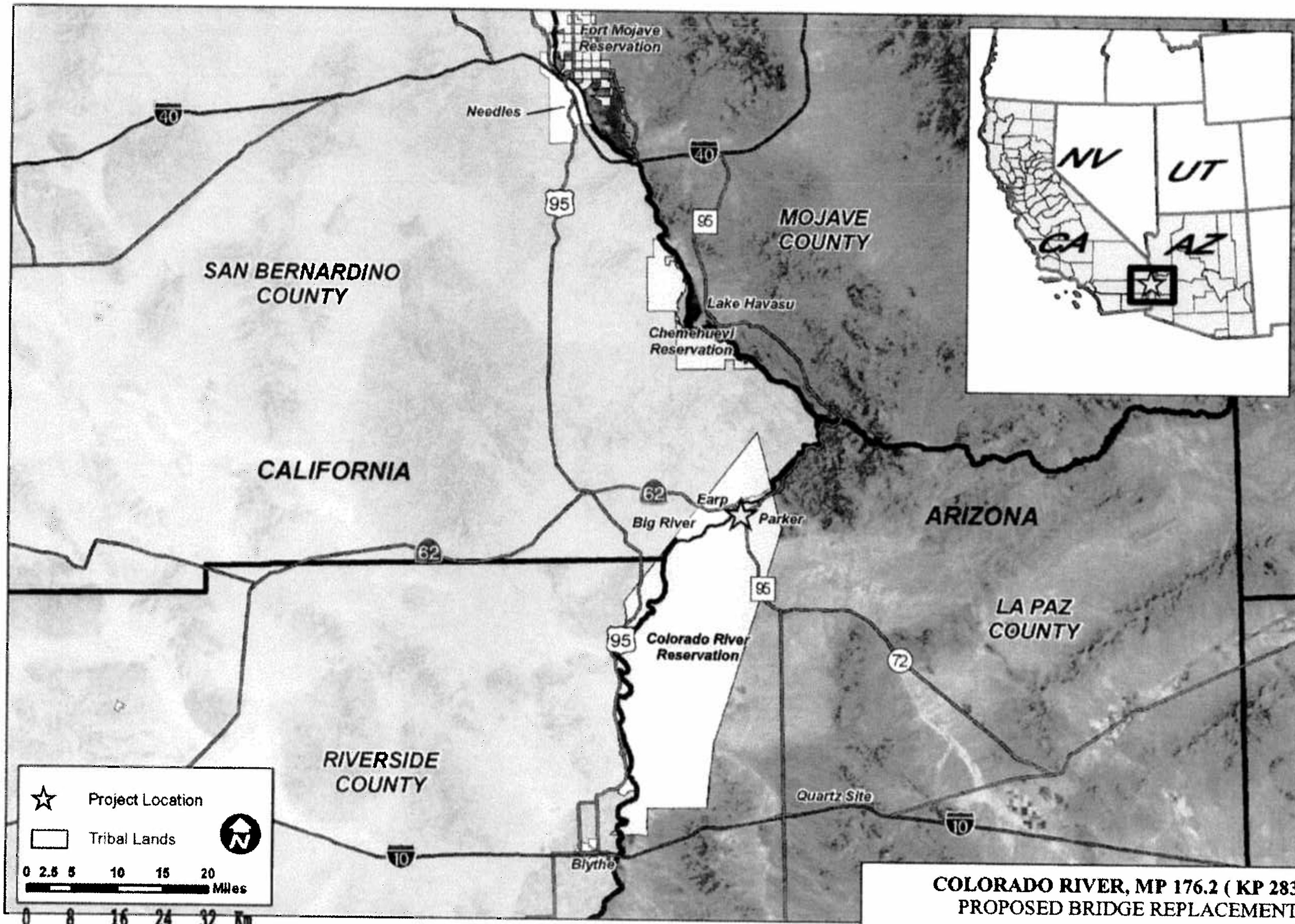
6. All parts of the existing to-be-replaced AZ Route 95S1/CA Route 62 (Colorado River) Bridge across the Colorado River, mile 176.2, not utilized in the new bridge which are located within the waterway shall be removed down to or below elevation 305.3 feet, Mean Sea Level. All other parts shall be removed down to or below the natural ground line. The waterway shall be cleared to the satisfaction of the District Commander. A period of 90 days subsequent to the opening to traffic of the new bridge, mile 176.2, will be allowed for such removal and clearance.

7. When the proposed bridge is no longer used for transportation purposes, it shall be removed in its entirety or to an elevation deemed appropriate by the District Commander and the waterway cleared to the satisfaction of the District Commander. Such removal and clearance shall be completed by and at the expense of the owner of the bridge upon due notice from the District Commander.

8. The approval hereby granted shall cease and be null and void unless construction of the bridge is commenced within three years and completed within five years after the date of this permit.

Hala Elgaaly

HALA ELGAALY, P.E.
Administrator, Bridge Program
U. S. Coast Guard
By direction of the Commandant



Aerial Source: Google Earth, 200

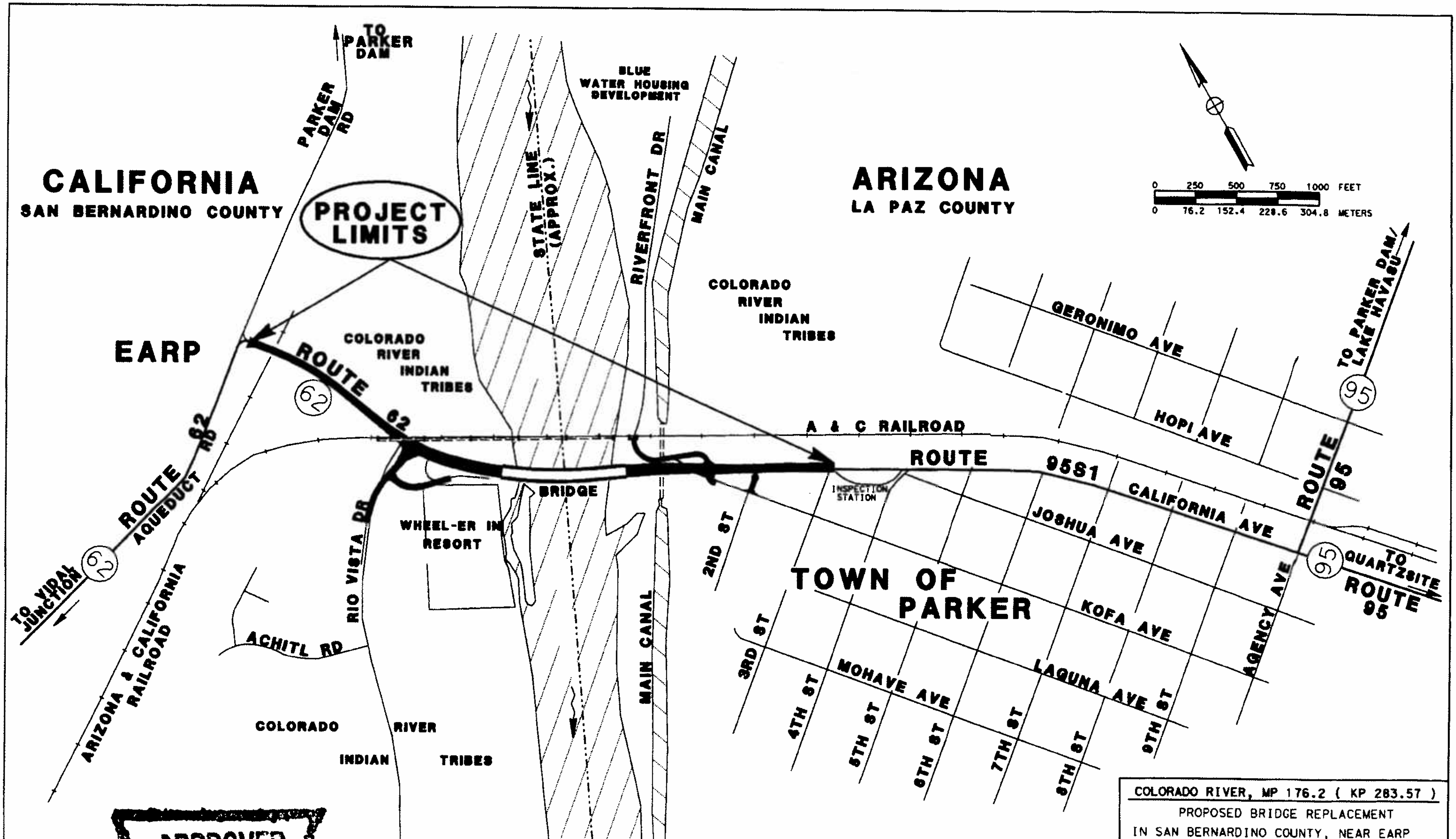
Vicinity Map

COLORADO RIVER, MP 176.2 (KP 283.57)
PROPOSED BRIDGE REPLACEMENT

IN SAN BERNARDINO COUNTY, NEAR EARP
CA. AND IN LA PAZ COUNTY, AT PARKER AZ.

APPLICATION BY: CA DEPT. OF TRANSPORTATION

SHEET 1 OF 4 DATE: AUGUST 8, 2009



COLORADO RIVER, MP 176.2 (KP 283.57)

PROPOSED BRIDGE REPLACEMENT

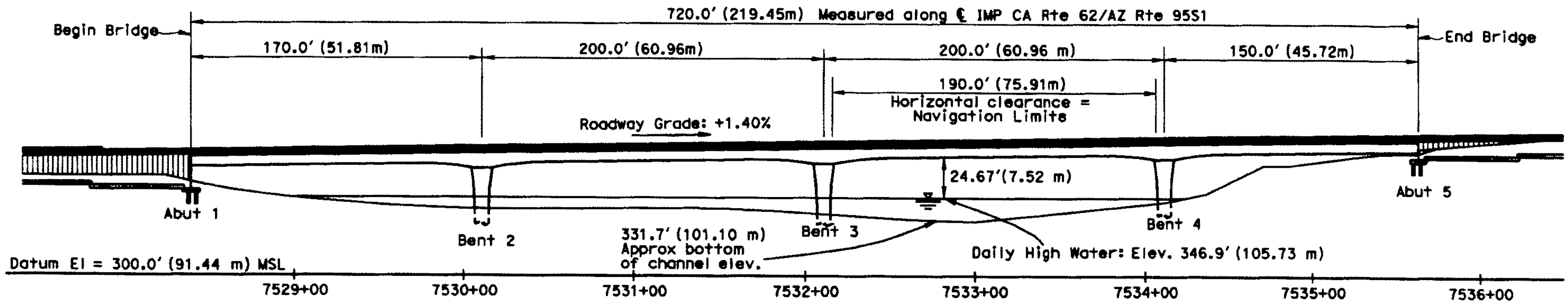
IN SAN BERNARDINO COUNTY, NEAR EARP CA. AND IN LA PAZ COUNTY AT PARKER AZ.

APPLICATION BY:
CA DEPARTMENT OF TRANSPORTATION

SHEET 2 OF 4 DATE: AUGUST 8, 2009

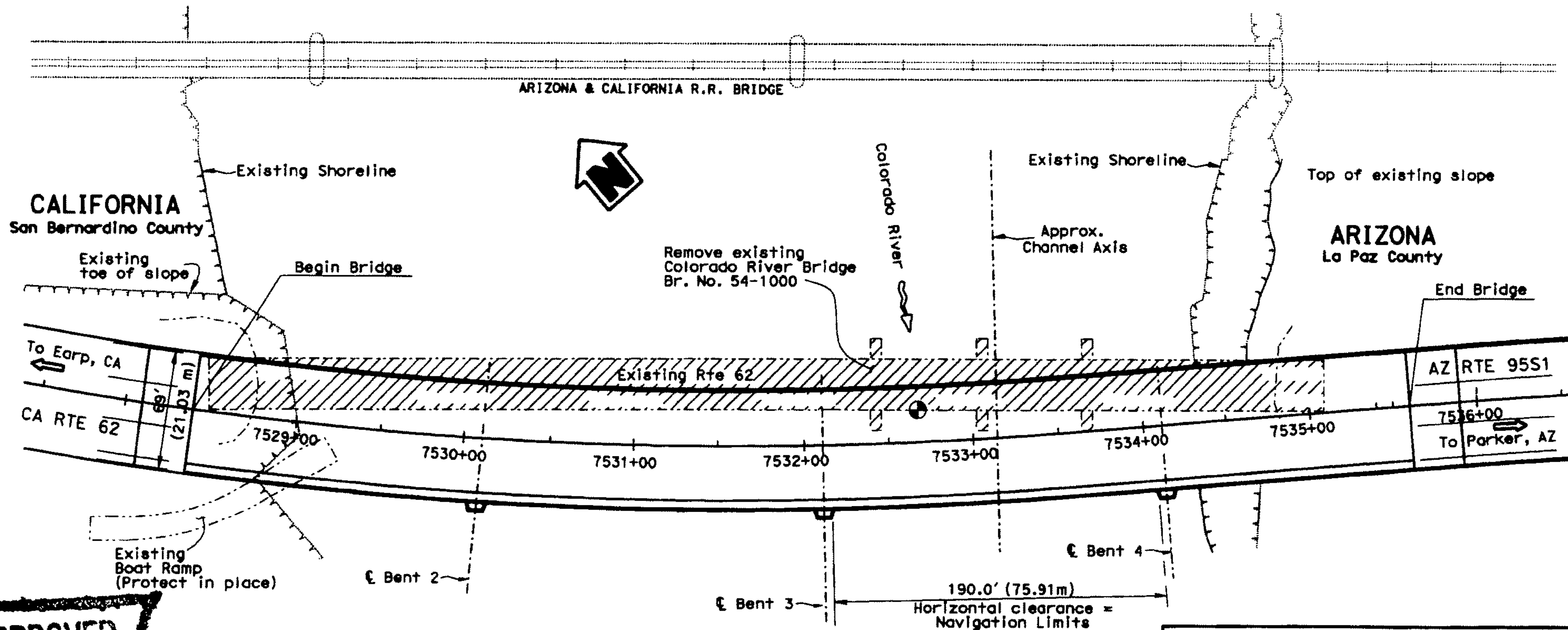
LOCATION MAP

APPROVED
MAY 03 2010
PCL-10-15
U.S.
COAST GUARD



ELEVATION

1" = 40.0' (12.19 m)



PLAN

1" = 40.0' (12.19 m)

Note 1: All elevations are based on NVGD29.

⊕ Indicates location of min vert clr

--- Indicates existing

▨ Indicates limits of bridge removal

0 1 2 3 INCHES
0 2.5 5 7.6 CENTIMETERS

COLORADO RIVER, MP 176.2 (KP 283.57)

PROPOSED BRIDGE REPLACEMENT

IN SAN BERNARDINO COUNTY, NEAR EARP CA. AND IN LA PAZ COUNTY AT PARKER AZ.

APPLICATION BY:
CA DEPARTMENT OF TRANSPORTATION

SHEET 3 OF 4 DATE: AUGUST 8, 2009

- - - Indicates existing

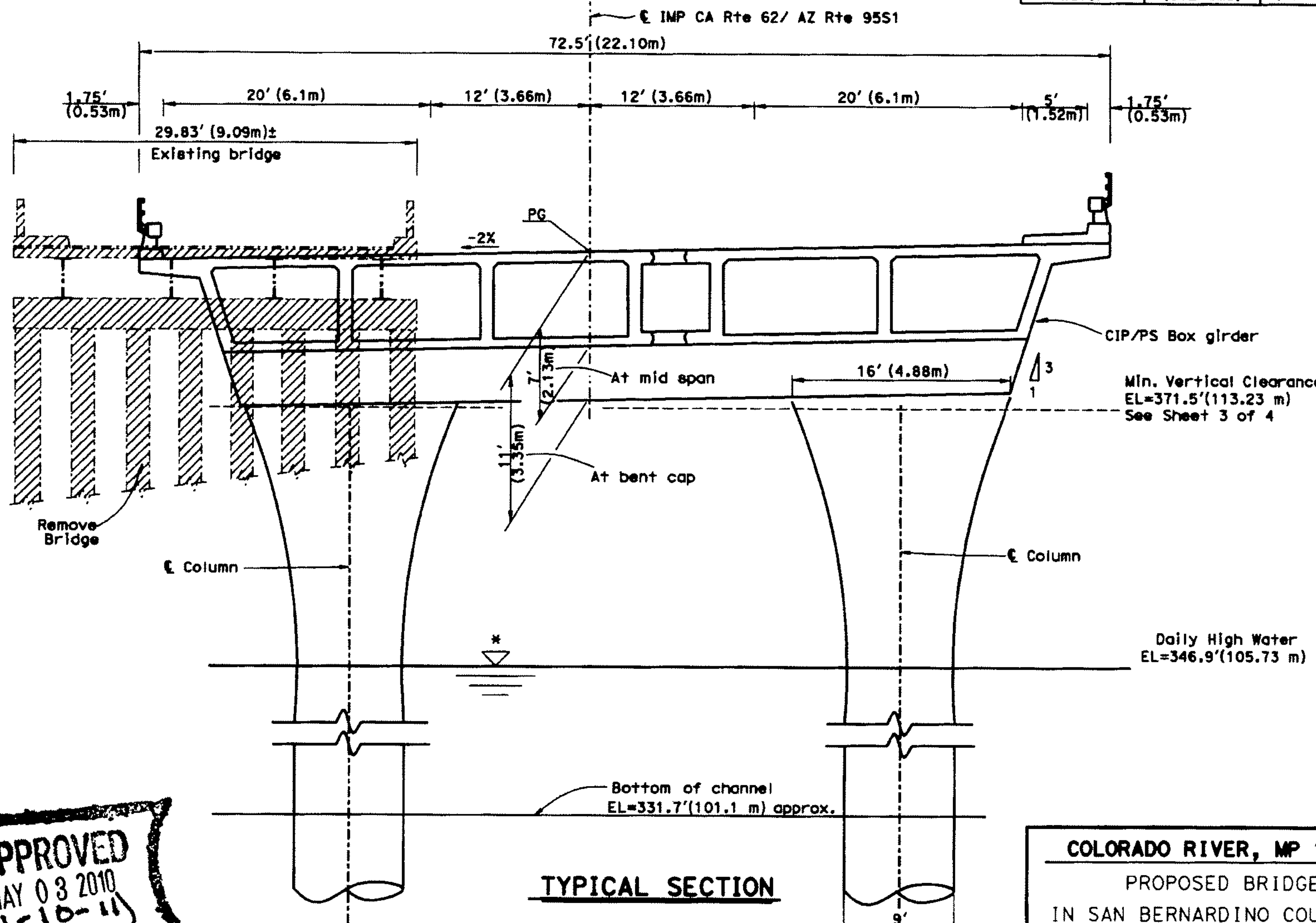
[hatched] Indicates limits of bridge removal

* Water surface elevation - Mean Sea Level- (Vertical clearances shown are applicable within navigation limits, see sheet 3 of 4)

CMS-Cubic Meters Per Second

CFS-Cubic Feet Per Second

Return Period	Discharge (CFS)	* Water Surface Elev	Proposed Vert Clr
500 Years	74,000 (2095 CMS)	358.9' (109.39m)	12.7' (3.87m)
100 Years	40,000 (1133 CMS)	352.4' (107.41m)	19.2' (5.85m)
Daily High Water	19,000 (538 CMS)	346.9' (105.73m)	24.7' (7.53m)
Ordinary High Water	11,020 (312 CMS)	344.0' (104.85m)	27.5' (8.38m)



TYPICAL SECTION

COLORADO RIVER, MP 176.2 (KP 283.57)

PROPOSED BRIDGE REPLACEMENT

IN SAN BERNARDINO COUNTY, NEAR EARP CA. AND IN LA PAZ COUNTY AT PARKER AZ.

APPLICATION BY:
CA DEPARTMENT OF TRANSPORTATION

SHEET 4 OF 4 DATE: AUGUST 8, 2009

United States Department of the Interior

U.S. Fish and Wildlife Service
Arizona Ecological Services Field Office
2321 West Royal Palm Road, Suite 103
Phoenix, Arizona 85021-4951
Telephone: (602) 242-0210 Fax: (602) 242-2513

In Reply Refer to:

AESO/SE
22410-2000-I-0062

March 13, 2008

Mr. Craig Wentworth
California Department of Transportation
District 8 Environmental Planning (MS 822)
464 W. Fourth Street, 6th Floor
San Bernardino, California 92401-1400

Dear Mr. Wentworth:

Thank you for your correspondence of February 27, received on February 29, 2008. This letter documents our review of the Colorado River Bridge Replacement in La Paz County, Arizona and San Bernardino County, California, in compliance with section 7 of the Endangered Species Act of 1973 (ESA) as amended (16 U.S.C. 1531 et seq.). Your letter concluded that the proposed project may affect, but is not likely to adversely affect the bonytail (*Gila elegans*), razorback sucker (*Xyrauchen* texanus) and its critical habitat, Yuma clapper rail (*Rallus longirostris yumanensis*), and southwestern willow flycatcher (*Empidonax traillii extimus*). We concur with your determination and provide our rationale below.

Description of the Proposed Action

A complete description of the proposed action is found in materials provided with your February 27, 2008 request for concurrence and other materials in our file for this project. The proposed action is the replacement of the existing bridge over the Colorado River at Parker, Arizona that provided connections between Arizona and California for California Highway 62 and Arizona State Route 95. Construction of the new bridge would require placement of new piers and superstructure for the bridge, and a trestle structure extending from both the Arizona and California shorelines for construction equipment to work on the bridge. The existing bridge would be removed following construction of the new bridge. The project includes avoidance and minimization measures to reduce the potential for effects to the listed species, particularly:

- Use of cofferdams or small mesh netting around new bridge or trestle pilings to keep fish out of the work areas.
- Wetlands outside of the area of effect would be fenced to prevent construction equipment or personnel from entering the area. Design of retaining walls and abutment will minimize the amount of wetland affected.
- Removal of riparian or marsh habitat would occur outside the breeding season for listed bird species (February 1-September 15).

DETERMINATION OF EFFECTS

We concur with your determination that the proposed action may affect, but is not likely to adversely affect the listed species for the following reasons:

Bonytail

- Bonytail may be present in the main river channel through the project area. The project area does not support spawning or nursery habitat for this species, and no preferred adult habitat is present in the project area. The number of bonytail that may be present is very low. Therefore, any potential direct or indirect effects on the species are discountable.

- Project effects are likely to be limited to periods when cofferdams or nets are placed into the river to keep individual bonytail out of the actual work areas so they are not injured or killed during construction. The cofferdams, trestles, and other in-water construction activities will not block the river, so individual fish will be able to move through the area unimpeded. These effects are insignificant.

Razorback sucker with critical habitat

- Razorback suckers may be present in the main river channel through the project area. The project area does not support spawning or nursery habitat for this species, and no preferred adult habitat is present in the project area. The number of razorback suckers that may be present is very low. Therefore, any potential direct or indirect effects on the species are discountable.

- Project effects are likely to be limited to periods when cofferdams or nets are placed into the river to keep individual razorback suckers out of the actual work areas so they are not injured or killed during construction. The cofferdams, trestles, and other in-water construction activities will not block the river, so individual fish will be able to move through the area unimpeded. These effects are insignificant.

- The likelihood of any direct or indirect interaction between the proposed action and primary constituent elements is extremely low; therefore, any effects to critical habitat are assumed to be discountable.

Yuma clapper rail

- Ms. Lesley Fitzpatrick of my staff reviewed the project area for Yuma clapper rail habitat on March 11, 2008 and determined that the marsh/wetland area that would be affected by the proposed action does not provide the necessary physical features to support clapper rails and is not likely occupied by clapper rails. Therefore, any potential direct or indirect effects to the species are insignificant and discountable.
- Avoidance of vegetation clearing during the clapper rail breeding season will minimize any effects to clapper rails moving along the Colorado River corridor toward breeding

areas up- and downstream of the project area. Therefore, effects to the species are insignificant.

Southwestern willow flycatcher

- The riparian habitat in and adjacent to the project area may support flycatchers during spring and fall migration but is not suitable for nesting. Avoidance of vegetation clearing during the flycatcher migration and breeding seasons would minimize effects to flycatchers moving along the Colorado River corridor to breeding sites upstream and subsequent southward migrations in the fall. There is sufficient unaffected riparian vegetation adjacent to the project area to provide for cover, resting, and foraging areas for migrating flycatchers such that migration through the area would not likely be impeded. Therefore, effects to the species are insignificant and discountable.

In keeping with our trust responsibility to American Indian Tribes, when we enter into consultation with agencies not in the Departments of Interior or Commerce on a proposed action that may affect Indian lands, Tribal trust resources, or Tribal rights, we encourage you to invite the affected Tribe and Bureau of Indian Affairs to participate in the consultation process and, by copy of this letter, are notifying the Colorado River Indian Tribes of our concurrence.

Thank you for your continued coordination. No further section 7 consultation is required for this project at this time. Should project plans change, or if information on the distribution or abundance of listed species or critical habitat becomes available, this determination may need to be reconsidered. In all future correspondence on this project, please refer to the consultation number 22410-2000-I-0062. We also encourage you to coordinate the review of this project with the Arizona Game and Fish Department and California Department of Fish and Game. Should you require further assistance or if you have any questions, please contact Lesley Fitzpatrick at (602) 242-0210 x 236.

Sincerely,

Delbert T. Bill

for Steven L. Spangle
Field Supervisor

cc: Chief, Habitat Branch, Arizona Game and Fish Department, Phoenix, AZ
Chairman, Colorado River Indian Tribes, Parker, AZ
Director, Environmental Programs, Bureau of Indian Affairs, Phoenix, AZ

W:\Lesley Fitzpatrick\00-62 Parker Bridge concurrence.doc: jkey

Memorandum

To : **Mr. Ben Amiri,**
Office Chief Design I

Date : **Dec 31, 2008**

Attention: **Mr. Alex Sanchez,**
Project Engineer

File No: **08-SBd-62**
PM 142.2/143.0
EA 378701
Replace the Colorado River Bridge including rehabilitation of SR-62 and local streets.

From: **DEPARTMENT OF TRANSPORTATION**
Bruce W. Kean, District 8 Materials Engineer

Subject : **Materials Report**

This transmittal constitutes the Materials Report for the above referenced project. Background information contained herein was based on previous reports for this projects, and the documentation that accompanied your request dated September 8, 2008, and the updated traffic data received November 25, 2008.

1.0 GENERAL

1.1 PROPOSED IMPROVEMENTS

According to information provided, this project consists of replacing the Colorado River Bridge at the California/Arizona State Line. The project will also include realignment and shoulder widening of existing CA Route 62/AZ Route 95 from Parker Dam Road in Earp, California to 3rd Street in Parker, Arizona.

1.2 EXISTING FACILITIES

The Colorado River Bridge is located at the State line between the towns of Earp in California and Parker in Arizona, and is a primary connector between these two towns. The bridge, built in 1937, consists of a ten span steel girder structure, measuring 656 feet in length, on a pile foundation. The total existing bridge width is 30 feet with an approximately road width of 24 feet, and a 4-foot sidewalk on the north side. The bridge superstructure is composed of four 3-foot deep steel girders with a reinforced concrete deck. It has ten spans, nine sets of concrete and steel piers and two abutments. The Colorado River bridge is where California Ste Route 62 (SR-62) meets Arizona State Route 95 (SR-95S1).

In California, SR-62 within the project limits is a two-lane east-west undivided conventional highway constructed of asphalt concrete pavement with basically no shoulders.

In Arizona, SR-95S1 is considered a spur of the main trunk of Arizona State Route 95 (SR-95) and within the project limits is also a two-lane east-west undivided road constructed of asphalt concrete pavement with basically no shoulders. From Kofa Ave going east, the road has two lanes on the eastbound and one lane on the west direction.

1.3 CLIMATE

The project is located within the Colorado River Indian Reservation Arizona-California zone, at elevations ranging from 385 to 415 feet above sea level.

Climate information is based in the USDA Soil Survey of Colorado River Indian Reservation Arizona-California issued in November 1986. Climate information (temperature and precipitation) comes from data recorded at Parker, Arizona, for the period1951-1980.

Summers are long and very hot. Winters are quite warm despite occasional series of days when the temperature at night drops below freezing. In winter, the average temperature is 55 °F and the average daily minimum temperature is 40 °F. The lowest temperature on record, which occurred at parker on January 3, 1970, is 17 °F. In summer, the average temperature is 92 °F and the average daily maximum temperature is 107 °F. The highest recorded temperature, which occurred on June 25, 1970, is 121 °F.

Rainfall is scant in all months and the total annual precipitation averages slightly above the four inches,. Most of the rain occur between the months of August to March. The heaviest 1-day rainfall during the period of record was 2.1 inches at parker on October 21, 1978. Thunderstorms occur on about 23 days each year, and most occur late in summer.

Snowfall is rare; in 99 percent of the winters, there is no measurable snowfall. In 1 percent, there is only a trace of snowfall, usually of short duration. Strong, dry, dusty winds with gusts of as much as 75 miles per hour occur at times in summer and winter.

1.4 SOIL

According to the USDA Soil Survey of Colorado River Indian Reservation Arizona-California issued in November 1986, the type of soil encountered within the project limits are:

<u>California side:</u>

- Carrizo extremely gravelly coarse sand, 0 to 3 percent slopes: This soil is present underneath Route 62 from begin project limits up to the railroad crossing. The surface layer is a extremely gravelly coarse sand 5 inches thick. The underlying material to a depth of 60 inches or more consists in a very gravelly coarse sand and very gravelly loamy coarse sand that has thin strata of fine sandy loam and sandy loam 0.5 inch thick or more. Permeability of this soil is very rapid, and runoff is slow.
- Lagunita loamy sand, strongly saline, 0 to 5 percent slope: This soil is present underneath Route 62 from the railroad underpass up to the Colorado River. Typically the surface layer is a loamy sand 7 inches thick. The underlying material to a depth of 60 inches or more is a strongly saline fine sand that has thin strata of sand. Permeability of this soil is rapid, and runoff is slow.

Arizona side:

- Gunsight very gravelly sandy loam, 15 to 60 percent slopes: This soil is present underneath Route 95S1 from the Colorado river up to the end of the project limits. The surface layer is a moderately alkaline very gravelly sandy loam 2 inches thick. The subsoil is moderate alkaline and strongly alkaline gravelly sandy clay loam and extremely gravelly sandy clay loam 17 inches thick. The underlying material to a depth of 60 inches or more is moderately alkaline extremely gravelly sandy loam. Permeability of this soil is moderate, and runoff is rapid.

1.5 GROUNDWATER

Groundwater at the site is considered to be at the elevation of the Colorado River itself. The river fluctuates on a daily basis due to agricultural demands, but in general, the water elevation is approximately 345 feet above sea level. Based on this information, groundwater should not be a factor in pavement design.

2.0 EXISTING STRUCTURAL SECTIONS

2.1 SR 62 (California):

Within the project limits, Route 62 has a concrete asphalt pavement surface, but no records were found on when was constructed. Since its construction, the road has been rehabilitated with different treatments. Below is a list of AS-Builts found for this Route within the project limits:

- Year 1976: 0.08' AC Type B overlay (PM 134.3/142.6)
- Year 1984: Seal Coat (PM 134.3/142.6)
- Year 1992: Seal Coat (PM 134.0/142.8)
- Year 1998: 0.08' AC overlay (PM 139.1/142.5)

2.2 SR 95S1 (Arizona):

As-Builts provided by the designer shows existing 0.20' AC over 0.25' Base material over 0.50' Subbase material.

3.0 PAVEMENT DESIGN PARAMETERS

3.1 TRAFFIC INDEX (TI)

The following Traffic Index values (TI) for SR-62 were provided in the memorandum dated November 25, 2008 from the Office of Forecasting:

Traffic Index	Mainline	Shoulder
10-Year	11.0	7.0
20-Year	12.0	7.5
40-Year	14.0	9.0

The Office of Forecasting did no include traffic data for local streets. A 20-Year TI=6 was assumed, but if an actual TI value becomes available, the pavement structural section shown below on Table V need to be recalculated.

3.2 RESISTANCE VALUES (R-VALUES) FOR BASEMENT SOILS

An R-value of 40 was selected for pavement design. This value was estimated based in Log of Test Borings (LTBs) drilled within the project limits as part of the Geotechnical Report currently being prepared by the Office of Geotechnical Design-South 2.

3.3 PAVEMENT DESIGN LIFE

Based in the projected traffic data provided by the Office of Forecasting and the Highway Design Manual design policies, the new pavement is required to be designed for a minimum 20-Year design period. A 40 Year pavement design is also offered to the designer as a requirement for the Life Cycle Cost Analysis (LCCA). The final pavement structural section should be decided by the designer for the one with the lowest life-cycle costs.

The portion of pavement that will not be reconstructed will be rehabilitated and brought up to the same life expectancy as for the new pavement of the roadway.

For local streets, we considered a 20-Year pavement design (assumed TI=6 for a 20-Year Traffic Index).

4.0 RECOMMENDED PAVEMENT DESIGN:

4.1 From Begin Project to Begin Bridge & From End Bridge to Kofa Ave: SR-62 & SR-95S1

The existing profile grade will be modified and the road approaches will be reconstructed to fit the new profile grade. We offer both flexible and rigid structural sections for the new pavement section.

4.2 From Kofa Ave to End Project: SR-95S1

The modified profile grade will match to the existing profile grade at Sta 7541+67.5 (on Route 95 at Kofa Ave). From this location the existing AC pavement will be rehabilitated up to the end of the project limits (Sta 7549+92). We provide flexible pavement rehabilitation for this segment of the road.

4.3 Local Streets:

For local streets pavement we provide a flexible pavement design.

5.0 FLEXIBLE PAVEMENT DESIGN

5.1 SR-62 and SR-95S1:

The pavement sections below was obtained employing CalFP version 1.1, a computer program based on design methodology as documented in Chapter 630 of the Caltrans Highway Design Manual (HDM). The recommended flexible material is Hot Mix Asphalt Type High Stability (HMA-HS), and the thickness selected took in consideration the layer thickness range this type of HMA has for a ¾-inch aggregate grading: 0.25' minimum to 0.33' maximum. The 20-Year and 40-Year flexible pavement design are shown in the below two tables I and II respectively.

Table I: 20-Year Design

Structural Section	Traveled Lanes (TI=12.0)	Shoulders* (TI=7.5)
Hot Mix Asphalt Type High Stability HMA-HS)	0.65'	0.35'
Class II Aggregate Base	1.05'	0.65'

* Follow Caltrans HDM Topic 613.5 2(a) for shoulder pavement structure requirements.

Table II : 40-Year Design

Structural Section	Traveled Lanes (TI=14.0)	Shoulders* (TI=9.0)
Hot Mix Asphalt Open Graded Friction Course(OFGC)	0.10'	010'
Hot Mix Asphalt Type High Stability (HMA-HS) (Full depth)	1.35'	0.85'
Class II Aggregate Base	0.50'	0.50'

* Follow Caltrans HDM Topic 613.5 2(a) for shoulder pavement structure requirements.

Note:

The LCCA Manual requires that Rubberized Hot Mix Asphalt (RHMA) must be one of the alternatives of pavement design when flexible pavement is being considered unless RHMA is not viable. RHMA is viable in this area and for this project; therefore, the designer should consider this material as another alternative in his LCCA analysis. The 20-Year and 40-Year flexible pavement design using RHMA-G are shown in the below two tables III and IV respectively.

Table III: 20-Year Design

Pavement Structure	Traveled Lanes (TI=12.0)	Shoulders* (TI=7.5)
Rubberized Hot Mix Asphalt Gap Graded (RHMA-G)	0.20'	0.20'
Hot Mix Asphalt Type High Stability (HMA-HS)	0.50'	0.25'
Class II Aggregate Base	0.95'	0.45'

* Follow Caltrans HDM Topic 613.5 2(a) for shoulder pavement structure requirements.

Table IV : 40-Year Design

Pavement Structure	Traveled Lanes (TI=14.0)	Shoulders* (TI=9.0)
Rubberized Hot Mix Asphalt Open Graded (RHMA-O)	0.10'	0.10'
Rubberized Hot Mix Asphalt Gap Graded (RHMA-G)	0.20'	0.20'
Hot Mix Asphalt Type High Stability (HMA-HS)	1.15'	0.65'
Class II Aggregate Base	0.50'	0.50'

* Follow Caltrans HDM Topic 613.5 2(a) for shoulder pavement structure requirements.

5.1 Local Streets:

Table V: 20-Year Design

Structural Section	TI=6*
Hot Mix Asphalt Type High Stability (HMA-HS)	0.25'
Class II Aggregate Base	0.50'

* Assumed

6.0 RIGID PAVEMENT DESIGN

The recommended rigid pavement is the most common type used by Caltrans: Jointed Plain Concrete Pavement (JPCP), previously known as Portland cement concrete or PCC pavement.

Pavement sections below were obtained using the procedure described in Section 623.1 of the September 1, 2006 edition of the HDM. This procedure utilized "Type I" soil, "Desert" climate region, and Table 623.1 (H) with lateral support provided by tied concrete shoulders.. Concrete shoulders is recommended to facilitate a longer-life pavement. The 20-Year and 40-Year rigid pavement design are shown in the below two tables VI and VII respectively.

Table VI - 20 Year Design:

Structural Section	Traveled Lanes (TI=12.0)	Shoulders* (TI=7.5)
Jointed Plain Concrete Pavement (JPCP)	0.85'	0.70'
AC Type A (Bond breaker)	0.10'	0.10'
Lean Concrete Base (LCB)	0.40'	0.35'
Class 2 Aggregate Subbase (AS)**	0.35'	0.35'

* Follow HDM Topic 613.5 2(a) for shoulder pavement structure requirements.
** Added to provide a working table.

Table VII - 40 Year Design:

Structural Section	Traveled Lanes (TI=14.0)	Shoulders* (TI=9.0)
Jointed Plain Concrete Pavement (JPCP)	1.00'	0.70'
AC Type A (Bond breaker)	0.10'	0.10'
Lean Concrete Base (LCB)	0.50'	0.35'
Class 2 Aggregate Subbase (AS)**	0.35'	0.35'

* Follow HDM Topic 613.5 2(a) for shoulder pavement structure requirements.
** Added to provide a working table.

7.0 ASPHALT CONCRETE PAVEMENT REHABILITATION

The modified profile grade will match to the existing profile grade at Sta 7541+67.5 (on Route 95 at Kofa Ave). From this location the existing AC pavement will be rehabilitated up to the end of the project limits (Sta 7549+92).

We provide only flexible pavement rehabilitation for this segment of the road and for only 20-Year pavement design. The following alternatives offered below are based in As-Builts provided by the designer showing an existing 0.20' AC over 0.25' Base material over 0.50' Subbase material.

Alternative 1: Mill and HMA Overlay

Mill existing AC pavement 0.20' depth and replace with a 0.60' HMA-HS overlay. The milling, according with As-Builts provided for SR 95S1, will likely remove all the existing AC. This strategy will raise the existing profile grade 0.40' foot. Additional cost will include shoulder backing work.

Alternative 2: Reconstruct with HMA

If the existing profile grade need to be maintained, then a full reconstruction of the existing pavement is recommended. The new structural section would be the same as for the 20-Year new pavement offered above in Table I or Table III.

8.0 MATERIALS SPECIFICATIONS

8.1 FLEXIBLE PAVEMENT

- Hot Mix Asphalt Concrete (HMA):
  a) Type High Stability (HMA-HS): aggregate will comply with the ¾-inch grading, and the HMA lift thickness range should be between 0.25 and 0.33 foot.
  b) Type Rubberized Gap Graded (RHMA-G): aggregate will comply with the ¾-inch grading. The lift thickness is 0.20 foot.
  c) Type Rubberized Open Graded (RHMA-O): aggregate will comply with the ½-inch grading. The lift thickness is 0.10 foot.
- Asphalt Binder:
  Caltrans is now using the performance graded (PG) system (replacing the "aged residue" or "AR" classification) for asphalt binder specification, which assigns the proper grade of binder according to the project Climate Region (this project is located in an area defined as "desert").
  a) Type High Stability (HMA-HS): PG 64-28 PM
  b) Type Rubberized Gap Graded (RHMA-G): PG 64-16
  c) Type Rubberized Open Graded (RHMA-O): PG 64-16
  Aggregate Base (AB) shall be Class 2 conforming to Section 26 of the May 2006 Standard Specifications.
- Prime Coat shall be applied to base material prior to placing hot mix asphalt concrete. If the quantity required exceeds one ton, it shall be included as a pay item in the engineer's estimate.
- Tack Coat shall be applied to the existing AC surface and between successive layers of HMA.

8.2 RIGID PAVEMENT

- Jointed Plain Concrete Pavement (JPCP), previously referred to as Portland Cement Concrete (PCC) pavement, shall conform to Section 40 of the May 2006 Standard Specifications

- HMA Type A (Bond Breaker) shall comply with the 3/8-inch maximum aggregate grading, the additional one percent oil above optimal binder content. The grade of asphalt binder shall be PG 64-10.
- Lean Concrete Base shall conform to Section 28 of the May 2006 Standard Specifications.

9.0 LIFE CYCLE COST ANALYSIS (LCCA)

The LCCA is an effective and useful tool for comparing the value of constructing this project with HMA versus JPCP. The LCCA must be conducted by the Project Engineer during the Design Phase, and be an integral part of the decision making process for selecting pavement type and design strategy.

For information and guidance, please refer to Topic 619.1 of the Caltrans HDM, and to the "Life-Cycle Cost Analysis Procedures Manual", available at the Caltrans Pavement Engineering website ***http://www.dot.ca.gov/hq/esc/Translab/ope/PavementSpecs_SSPs.html.***

10.0 CULVERTS & CORROSION POTENTIAL

Field testing for potential corrosion were performed in Feb 2008 by the Office of Geotechnical Design-South 2 as part of the Geotechnical Report that is being prepared for this project. Draft of test results provided by the Office of Geotechnical Office are shown in the below table.

Sample Location	Sample Type	Sample Depth (feet)	Minimum Resistivity (ohm-cm) **CTM 643**	pH **CTM 643**	pH **CTM 532**	Chloride Content (ppm) **CTM 422**	Sulfate Content (ppm) **CTM 417**
California side:							
Abutment 1 (Sta 7529)	Soil	5.0-35.0	937	8.50		250	270
Arizona side:							
Boring B-5B (Sta 7535)	Soil	0.0-35.0	1,300		9.23	195	Not detected
Boring WB-3 (Sta 7537)	Soil	5.0-30.0	300		6.78	525	240

Our corrosivity recommendations are based on using the computer program CULVERT4 with the soil data indicated in the above table, and Section 850 of the Highway Design Manual. These recommendations are based on corrosion only, and thicker sections may be needed for strength and overfill requirements. For the computer calculations, the water flow velocity was assumed to be less than 5 fps with no-abrasive conditions. A reevaluation would be required if conditions differ from this assumption.

a) <u>For drainage structures located on the California side</u>:
Two drainages structures on this side of the Colorado River:

1. Existing 18" Corrugate Steel pipe (CSP) culvert at approximately Sta 7512: It is proposed to extend this pipe at both sides.
2. Proposed 18" CSP downdrain at approximately Sta 7523.

Using the soil data performed at Abut. 1, the following is recommended to achieve a 50-year service life:

- **For CSP pipes:** the minimum steel thickness required without coating should be 0.109 inch (gage 12). If a bituminous coat is applied, the minimum steel thickness should be 0.064 inches (gage 16).
- **For Concrete and Reinforced Concrete pipes (RCP):** Standard RCP pipes are suitable for the defined level of chlorides, and for the level of sulfates, it is required the use of Type IP (MS) Modified cement or Type II Modified cement, minimum Caltrans requirements for protection against acid and sulfate exposure conditions.
- **Corrugated Aluminum pipe (CAP):** should not be used due to corrosive conditions.
- **Corrugated Aluminized Steel pipe (CASP):** should not be used due to corrosive conditions.
- **Plastic pipes:** are approved for 50 Years service life for corrosive conditions. Abrasion must be evaluated. Also, consider concrete headwalls and concrete or metal end treatment where high fire potential exists.

Design needs to verify actual condition of the existing 18" CSP culvert. Due to its age and the soil conditions present at the site, it may be necessary to be replaced.

b) <u>For drainage structures located on the Arizona side</u>:
Two drainages structures on this side of the Colorado River:

1. Replacement of an existing 48" CSP drainage pipe from Sta 7535 to Sta 7540
2. Existing concrete box culvert at approximately Sta 75+38: No work is proposed here.

Using the soil data performed at WB-3 the following is recommended to achieve a 50-year service life:

- **For CSP pipes:** the minimum steel thickness required is 0.168 inches (gage 8) and **should** have a bituminous coat. Thinner steel will not achieve the 50-year service life.
- **For Concrete and RCP:** use Type IP (MS) Modified cement or Type II Modified cement, use 7 sacks/cubic-yard, a water content of 15%, a maximum water-to-cementitious ratio of 0.45, and a minimum concrete cover thickness of 2 inches.
- **Corrugated Aluminum pipe (CAP):** should not be used due to corrosive conditions.
- **Corrugated Aluminized Steel pipe (CASP):** should not be used due to corrosive conditions.
- **Plastic pipes:** are approved for 50 Years service life for corrosive conditions. Abrasion must be evaluated. Also, consider concrete headwalls and concrete or metal end treatment where high fire potential exists.

11.0 REFERENCE

- Project Report approved on June, 2008.
- Preliminary Foundation Report prepared by the Office of Geotechnical Design–South 2, dated March 17, 2006.

Draft Boring Logs performed by the Office of Geotechnical Design-South 2, dated in 2008 as part of the Final Geotechnical Report currently being prepared for this project.

- Draft Field testing for Corrosion Potential performed by the Office of Geotechnical Design-South 2, dated in 2008 as part of the Final Geotechnical Report currently being prepared for this project.
- As-Built for SR 95S1 prepared by ADOT and provided by Caltrans Design.
- Soil Survey of Colorado River Indian Reservation Arizona-California prepared by The United states Department of Agriculture (USDA) and the National Cooperative Soil Survey (NCSS), issued November 1986.

If you have any questions, you may call Edgar Arevalo of my staff at 383-4040, or myself at 383-4044.

BWK:EA

State of California | Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: SHAWN WEI
Senior Transportation Engineer
Office of Geotechnical Design South-2

Attn: Mark Wilson

Date: April 30, 2009

File: 08-SBd-62-PM142.3
08-378701
Colorado River Bridge
(Replace)
Bridge No. 54-1272

From: **DEPARTMENT OF TRANSPORTATION**
Division of Engineering Services
Geotechnical Services - MS 5

Subject: Revised Driveability Study

Attached is a report summarizing the results of revised driveability analyses performed by this Office for the subject piles at Bents 2, 3 and 4 of the above-referenced project. This report was originally sent to selected addressees in draft form on February 3, 2009 at the request of the Designer.

If you have any questions or comments regarding this report, please contact Michael K. Harris, P.E. at (916) 227-1058.

BRIAN LIEBICH, P.E.
Senior Transportation Engineer
Foundation Testing Branch

Attachments

R. Stott – SC (Email)
M. Wilson - OGDS2 (Email)
D. Soon - SD (Email)

MKH/mkh

FOUNDATION TESTING BRANCH

April 30, 2009

08-SBd-62-PM142.3
08-378701

Colorado River Bridge (Replace)
Bridge No. 54-1272

Revised Driveability Study

April 30, 2009

Project Information

08-SBd-62-PM142.3
08-378701
Colorado River Bridge (Replace)
Bridge No. 54-1272

Subject

Revised Driveability Study

Introduction

This Office has performed a revised set of pile driveability analyses for the proposed installation of open-ended, 108-inch diameter steel pipe piles of varying wall thicknesses at the locations of Bents 2, 3 and 4 of the above-referenced project. This product was provided to addressees in draft form on February 3, 2009. The analyses were based on the original study requested by Mr. Shawn Wei of the Office of Geotechnical Design South-2 (OGDS-2) on January 8, 2009 to support the foundation recommendations. According to the submitted preliminary design information, the subject piles at Bents 2, 3 and 4 were required to be driven approximately 30 to 75 feet into formational rock materials in order to satisfy the design lateral requirements. Personnel from the Foundation Testing Branch (FTB) of the Office of Geotechnical Support performed the analyses utilizing GRLWEAP™ computer program, Version 2005. GRLWEAP program does not have the capability to model the driving condition into formational rock materials. As such, the results were not applicable to the proposed foundation type with the specified design requirements.

A revised driveability study was requested on January 29, 2009 for the proposed installation of the open-ended, 108-inch diameter steel pipe piling with CIDH socket. This study models the performance of various pile driving systems to determine the appropriate hammer for achieving satisfactory installation of the subject piles at Bents 2, 3 and 4. The submitted pile and soil information were used in the analyses to determine the performance of various driving systems on proposed shell thicknesses as requested by the Geotechnical Designer.

Description of Piling

The driveability study was performed for the proposed installation of the open-ended, 108-inch diameter steel pipe piling with CIDH socket to be constructed at Bents 2, 3 and 4 of the Colorado River Bridge replacement structure. Based on the submitted information, minimum steel yield strength was not specified; therefore, this study will assume the piles to be in conformance with ASTM Designation A 252, Grade 3 steel with minimum yield strength of 45 ksi. This places the maximum allowable compressive stress during driving at 0.95*45 = 42.75 ksi. Pile wall shell thickness is to be determined based on the results of this study.

The pile type, nominal resistance in compression, pile cut-off and design tip elevations for the subject piles were provided by Mark Wilson of OGDS-2. Table I presents the submitted piling information that was used in the driving analyses at the locations of Bents 2, 3 and 4.

Table I. Piling Information at Bents 2, 3 and 4

Support Location	Pile Type*	Soil Surface Elevation* (ft)	CISS Pipe Pile Tip Elevation** (ft)	Analyzed CISS Pile Penetration Length (ft)
Bent 2	108-inch dia. CISS pipe pile w/CIDH socket	339.7	205.5	134.2
Bent 3		333.4	228.4	105.0
Bent 4		345.0	288.0	57.0

* Information provided by M. Wilson based on Draft Foundation Report dated 12/17/08.
** Information obtained from design calc. sheet. Estimated scour elevation at Bents 2 to 4 = 297.7 ft

Subsurface Conditions and Soil Resistance Parameters

Based on the submitted Log of Test Borings (LOTBs), three test borings were analyzed at the locations of Bents 2, 3 and 4. According to the submitted Log of Test Borings (LOTBs), the foundation materials at the site are described as follows:

For Boring B-2 at Bent 2, the foundation material at the site consists of medium dense sand with gravel grading to very dense sand and gravel. Loose sand and silty sand layers were encountered within the soil matrix. Underlain these layers are the very dense decomposed, weathered sand and gravel conglomerate.

For Boring B-3 at Bent 3, the foundation material at the site consists of medium dense sand to silty sand. Soft to firm clay silt, clay, and very loose sand layers were encountered within the soil matrix. Underlain these layers are the very dense, friable sandy gravel/cobble conglomerate materials.

For Boring B-4 at Bent 4, the foundation material at the site consists of medium dense silty sand to sand. Loose sand and very dense gravel layers were encountered within the soil matrix as increasing in depths. Underlain these layers are the very dense to hard, very friable, pebble, cobble, and boulder conglomerate materials.

For complete description of the subsurface conditions, please refer to the Log of Test Borings (LOTBs) in the Foundation Report. Table II presents the soil resistance parameters that were utilized to model the dynamic soil behavior for the subject piles at the locations of Bents 2, 3 and 4.

Table II: Soil Resistance Parameters

PARAMETER TYPE	QUAKE	DAMPING
Skin (Shaft)	0.10-inch	0.05 sec/ft
Toe	0.10-inch.	0.15 sec/ft

Pile Driving Resistance

To install a driven pile, the pile must overcome resistance to penetration developed by the soil. The driving resistance will determine the size of the required pile driving hammer and the stress magnitude imparted to the steel pile by the driving system. As such, an estimate of driving resistance is necessary to perform a driveability study when investigating the potential for pile damage due to steel overstressing during driving. Driving resistance can be related to static axial capacity using set-up and relaxation factors applied to various layers of soil that the pile penetrates. Several methods are available to estimate pile static axial capacity and thereby driving resistance. These methods will generally determine a range of axial capacities for a given pile penetration. To be conservative, pile tip elevation may be based on lower estimates of static capacity, but higher capacity estimates are generally used for the driveability analysis.

The maximum initial driving resistance predicted by GRLWEAP, based on the submitted information provided by Mr. Mark Wilson (OGDS-2) at Bents 2, 3 and 4, is generally estimated to range between 2700 kips and 8500 kips. These estimates rely upon the following assumptions:

- All piles will be driven as open-ended steel pipe piles. Plugging will not occur.
- The anticipated driving resistance includes the resistance contributions of approximately 80% to 85% from skin friction (Qs); and 15% to 20% from end bearing (Qp). Percentage distributions are based on GRLWEAP output.
- The set-up factor at this site is expected to be minimal due to the presence of the predominately cohesionless soils within the overall embedded length of the pile.
- Piles will be driven into formational rock at some locations. Formational rock materials (gravelly/cobble/boulder-sized) were modeled as very dense granular/sandy materials (due to limitation of the GRLWEAP program).
- The anticipated driving resistance includes the additional resistance contribution of the scourable soil layer at the bent locations. The additional resistance was neglected in

determining nominal capacity used for the foundation design but was included in the driving condition (per Geotechnical Designer's submittal).

Description of Pile Driving Systems

This study involved modeling the performance of three selected driving systems to reflect the range of rated energies possibly appropriate for the installation of the 108-inch diameter CISS steel pipe piles of three different wall thicknesses to the ***design tip elevations*** at the bent locations.

The analyses were performed using GRLWEAP™ recommended default parameters. For each hammer, the analysis was performed with the hammer operating at maximum stroke for determining driving-behavior stresses imparted to the steel pile. The analysis performed for each hammer was utilized to demonstrate the predicted blow counts and corresponding maximum compressive stresses expected during pile driving. Standard configurations for the hammer driving systems and related components were based upon information published in GRLWEAP™ literature and database. The hammer characteristics are listed in Table III for the subject piles at Bents 2, 3 and 4.

Table III: Summary of Hammer Systems at Bents 2, 3 and 4

Hammer Manufacturer	Delmag	IHC	Menck
Hammer Model	D100-13	S-400	MHU 500T
Hammer Type	OED	ECH	ECH
Rated Energy (kip-ft)	265.67	292.60	405.53
Ram Weight (kips)	22.066	44.20	65.958
Maximum Stroke (ft)	13.5	6.62	6.1

Note: OED= Open End Diesel; ECH = External Combustion Hammer (Hydraulic)

Discussion of Results

Analysis printouts and charts depicting predicted relationships between driving resistances (for steel pipe pile portion only) and driving stresses versus blow counts for each of the hammers are included in Appendix A for Bents 2, 3 and 4, respectively. The analyses results of the three hammers are summarized in Tables IV to VI for Bents 2, 3 and 4, respectively.

Table IV: Summary of Results at Bent 2

Hammer Manufacturer/ Model	Estimated Maximum Driving Resistance (kips)	108" Dia. Pile Wall Thickness*(In.)	Estimated Max. Compressive Stress (ksi)	Estimated Ending Blow Count (Blows/ft)	At Stroke (ft)
Delmag/ D100-13	8492	1.375	19.5	841	10.4
		1.5	18.7	682	10.5
		1.75	17.3	533	10.6
IHC/S-400		1.375	24.0	90	6.6
		1.5	23.0	85	6.6
		1.75	21.3	80	6.6
Menck/ MHU 500T		1.375	24.9	63	6.1
		1.5	24.2	60	6.1
		1.75	23.0	56	6.1

*Steel pipe pile, Fy = 45 ksi

Table V: Summary of Results at Bent 3

Hammer Manufacturer/ Model	Estimated Maximum Driving Resistance (kips)	108" Dia. Pile Wall Thickness*(In.)	Estimated Max. Compressive Stress (ksi)	Estimated Ending Blow Count (Blows/ft)	At Stroke (ft)
Delmag/ D100-13	5464	1.375	19.4	152	10.3
		1.5	18.6	143	10.4
		1.75	17.1	131	10.6
IHC/ S-400		1.375	24.0	47	6.6
		1.5	23.0	46	6.6
		1.75	21.3	45	6.6
Menck/ MHU 500T		1.375	25.0	35	6.1
		1.5	24.4	35	6.1
		1.75	23.2	33	6.1

Note: *Steel pipe pile, Fy = 45 ksi

Table VI: Summary of Results at Bent 4

Hammer Manufacturer / Model	Estimated Maximum Driving Resistance (kips)	108" Dia. Pile Wall Thickness*(In.)	Estimated Max. Compressive Stress (ksi)	Estimated Ending Blow Count (Blows/ft)	At Stroke (ft)
Delmag/ D100-13	2805	1.375	19.0	66	10.0
		1.5	18.2	64	10.1
		1.75	16.9	61	10.3
IHC/ S-400		1.375	23.9	27	6.6
		1.5	23.0	27	6.6
		1.75	21.3	27	6.6
Menck/ MHU 500T		1.375	24.8	19	6.1
		1.5	24.2	19	6.1
		1.75	23.0	20	6.1

*Steel pipe pile, Fy = 45 ksi

The GRLWEAP™ wave equation program is a one-dimensional analysis and does not consider buckling or bending of the pile due to non-uniform blows or localized stresses at the pile tip, which may occur during pile driving. Also, it has been observed in the field that significantly harder or softer driving could occur than the GRLWEAP™ predictions.

Bent 2 Piles

Analysis 1: Delmag D 100-13; 108-inch diameter CISS pile at 1.375-inch thick

The analysis for the Delmag D 100-13 indicates that this hammer would not be capable of driving 108-inch diameter steel pipe piles at Bent 2 within the acceptable blow count limit of 102 blows/ft (1/8" /blow) to an approximate penetration depth of 134.2 feet. At a driving resistance of about 8492 kips, the maximum blow count would be approximately 841 blows/ft. The acceptable blow count limit would be exceeded at approximately 86 feet penetration.

Analysis 2: Delmag D 100-13; 108-inch diameter CISS pile at 1.500-inch thick

The analysis for the Delmag D 100-13 indicates that this hammer would not be capable of driving 108-inch diameter steel pipe piles at Bent 2 within the acceptable blow count limit of 102 blows/ft (1/8" /blow) to an approximate penetration depth of 134.2 feet. At a driving resistance of about 8492 kips, the maximum blow count would be approximately 682 blows/ft. The acceptable blow count limit would be exceeded at approximately 86 feet penetration.

Analysis 3: Delmag D 100-13; 108-inch diameter CISS pile at 1.750-inch thick

The analysis for the Delmag D 100-13 indicates that this hammer would not be capable of driving 108-inch diameter steel pipe piles at Bent 2 within the acceptable blow count limit of 102 blows/ft (1/8" /blow) to an approximate penetration depth of 134.2 feet. At a driving resistance of about 8492 kips, the maximum blow count would be approximately 533 blows/ft. The acceptable blow count limit would be exceeded at approximately 86 feet penetration.

Analysis 4: IHC S-400; 108-inch diameter CISS pile at 1.375-inch thick

The analysis for the IHC S-400 indicates that this hammer would be capable of driving 108-inch diameter steel pipe piles at Bent 2 within the acceptable blow count limit of 102 blows/ft (1/8" /blow) to an approximate penetration depth of 134.2 feet. At a driving resistance of about 8492 kips, the maximum blow count would be approximately 90 blows/ft with a maximum compressive stress of approximately 24.0 ksi and a hammer stroke of 6.6 ft.

Analysis 5: IHC S-400; 108-inch diameter CISS pile at 1.500-inch thick

The analysis for the IHC S-400 indicates that this hammer would be capable of driving 108-inch diameter steel pipe piles at Bent 2 within the acceptable blow count limit of 102 blows/ft (1/8" /blow) to an approximate penetration depth of 134.2 feet. At a driving resistance of about 8492 kips, the maximum blow count would be approximately 85 blows/ft with a maximum compressive stress of approximately 23.0 ksi and a hammer stroke of 6.6 ft.

Analysis 6: IHC S-400; 108-inch diameter CISS pile at 1.750-inch thick

The analysis for the IHC S-400 indicates that this hammer would be capable of driving 108-inch diameter steel pipe piles at Bent 2 within the acceptable blow count limit of 102 blows/ft (1/8" /blow) to an approximate penetration depth of 134.2 feet. At a driving resistance of about 8492 kips, the maximum blow count would be approximately 80 blows/ft with a maximum compressive stress of approximately 21.3 ksi and a hammer stroke of 6.6 ft.

Analysis 7: Menck 500T; 108-inch diameter CISS pile at 1.375-inch thick

The analysis for the Menck 500T indicates that this hammer would be capable of driving 108-inch diameter steel pipe piles at Bent 2 within the acceptable blow count limit of 102 blows/ft (1/8" /blow) to an approximate penetration depth of 134.2 feet. At a driving resistance of about 8492 kips, the maximum blow count would be approximately 63 blows/ft with a maximum compressive stress of approximately 24.9 ksi and a hammer stroke of 6.1 ft.

Analysis 8: Menck 500T; 108-inch diameter CISS pile at 1.500-inch thick

The analysis for the Menck 500T indicates that this hammer would be capable of driving 108-inch diameter steel pipe piles at Bent 2 within the acceptable blow count limit of 102 blows/ft (1/8" /blow) to an approximate penetration depth of 134.2 feet. At a driving resistance of about 8492 kips, the maximum blow count would be approximately 60 blows/ft with a maximum compressive stress of approximately 24.2 ksi and a hammer stroke of 6.1 ft.

Analysis 9: Menck 500T; 108-inch diameter CISS pile at 1.750-inch thick

The analysis for the Menck 500T indicates that this hammer would be capable of driving 108-inch diameter steel pipe piles at Bent 2 within the acceptable blow count limit of 102 blows/ft (1/8" /blow) to an approximate penetration depth of 134.2 feet. At a driving resistance of about 8492 kips, the maximum blow count would be approximately 56 blows/ft with a maximum compressive stress of approximately 23.0 ksi and a hammer stroke of 6.1 ft.

Bent 3 Piles

Analysis 10: Delmag D 100-13; 108-inch diameter CISS pile at 1.375-inch thick

The analysis for the Delmag D 100-13 indicates that this hammer would not be capable of driving 108-inch diameter steel pipe piles at Bent 3 within the acceptable blow count limit of 102 blows/ft (1/8" /blow) to an approximate penetration depth of 105.0 feet. At a driving resistance of about 5464 kips, the maximum blow count would be approximately 152 blows/ft. The acceptable blow count limit would be exceeded at approximately 91 feet penetration.

Analysis 11: Delmag D 100-13; 108-inch diameter CISS pile at 1.500-inch thick

The analysis for the Delmag D 100-13 indicates that this hammer would not be capable of driving 108-inch diameter steel pipe piles at Bent 3 within the acceptable blow count limit of 102 blows/ft (1/8" /blow) to an approximate penetration depth of 105.0 feet. At a driving resistance of about 5464 kips, the maximum blow count would be approximately 143 blows/ft. The acceptable blow count limit would be exceeded at approximately 93 feet penetration.

Analysis 12: Delmag D 100-13; 108-inch diameter CISS pile at 1.750-inch thick

The analysis for the Delmag D 100-13 indicates that this hammer would not be capable of driving 108-inch diameter steel pipe piles at Bent 3 within the acceptable blow count limit of 102 blows/ft (1/8" /blow) to an approximate penetration depth of 105.0 feet. At a driving resistance of about 5464 kips, the maximum blow count would be approximately 131 blows/ft. The acceptable blow count limit would be exceeded at approximately 95 feet penetration.

Analysis 13: IHC S-400; 108-inch diameter CISS pile at 1.375-inch thick

The analysis for the IHC S-400 indicates that this hammer would be capable of driving 108-inch diameter steel pipe piles at Bent 3 within the acceptable blow count limit of 102 blows/ft (1/8" /blow) to an approximate penetration depth of 105.0 feet. At a driving resistance of about 5464 kips, the maximum blow count would be approximately 47 blows/ft with a maximum compressive stress of approximately 24.0 ksi and a hammer stroke of 6.6 ft.

Analysis 14: IHC S-400; 108-inch diameter CISS pile at 1.500-inch thick

The analysis for the IHC S-400 indicates that this hammer would be capable of driving 108-inch diameter steel pipe piles at Bent 3 within the acceptable blow count limit of 102 blows/ft (1/8" /blow) to an approximate penetration depth of 105.0 feet. At a driving resistance of about 5464 kips, the maximum blow count would be approximately 46 blows/ft with a maximum compressive stress of approximately 23.0 ksi and a hammer stroke of 6.6 ft.

Analysis 15: IHC S-400; 108-inch diameter CISS pile at 1.750-inch thick

The analysis for the IHC S-400 indicates that this hammer would be capable of driving 108-inch diameter steel pipe piles at Bent 3 within the acceptable blow count limit of 102 blows/ft (1/8" /blow) to an approximate penetration depth of 105.0 feet. At a driving resistance of about 5464 kips, the maximum blow count would be approximately 45 blows/ft with a maximum compressive stress of approximately 21.3 ksi and a hammer stroke of 6.6 ft.

Analysis 16: Menck 500T; 108-inch diameter CISS pile at 1.375-inch thick

The analysis for the Menck 500T indicates that this hammer would be capable of driving 108-inch diameter steel pipe piles at Bent 3 within the acceptable blow count limit of 102 blows/ft (1/8" /blow) to an approximate penetration depth of 105.0 feet. At a driving resistance of about 5464 kips, the maximum blow count would be approximately 35 blows/ft with a maximum compressive stress of approximately 25.0 ksi and a hammer stroke of 6.1 ft.

Analysis 17: Menck 500T; 108-inch diameter CISS pile at 1.500-inch thick

The analysis for the Menck 500T indicates that this hammer would be capable of driving 108-inch diameter steel pipe piles at Bent 3 within the acceptable blow count limit of 102 blows/ft (1/8" /blow) to an approximate penetration depth of 105.0 feet. At a driving resistance of about 5464 kips, the maximum blow count would be approximately 35 blows/ft with a maximum compressive stress of approximately 24.4 ksi and a hammer stroke of 6.1 ft.

Analysis 18: Menck 500T; 108-inch diameter CISS pile at 1.750-inch thick

The analysis for the Menck 500T indicates that this hammer would be capable of driving 108-inch diameter steel pipe piles at Bent 3 within the acceptable blow count limit of 102 blows/ft (1/8" /blow) to an approximate penetration depth of 105.0 feet. At a driving resistance of about 5464 kips, the maximum blow count would be approximately 33 blows/ft with a maximum compressive stress of approximately 23.2 ksi and a hammer stroke of 6.1 ft.

Bent 4 Piles

Analysis 19: Delmag D 100-13; 108-inch diameter CISS pile at 1.375-inch thick

The analysis for the Delmag D 100-13 indicates that this hammer would be capable of driving 108-inch diameter steel pipe piles at Bent 4 within the acceptable blow count limit of 102 blows/ft (1/8" /blow) to an approximate penetration depth of 57.0 feet. At a driving resistance of about 2805 kips, the maximum blow count would be approximately 66 blows/ft with a maximum compressive stress of approximately 19.0 ksi and a hammer stroke of 10.0 ft.

Analysis 20: Delmag D 100-13; 108-inch diameter CISS pile at 1.500-inch thick

The analysis for the Delmag D 100-13 indicates that this hammer would be capable of driving 108-inch diameter steel pipe piles at Bent 4 within the acceptable blow count limit of 102 blows/ft (1/8" /blow) to an approximate penetration depth of 57.0 feet. At a driving resistance of about 2805 kips, the maximum blow count would be approximately 64 blows/ft with a maximum compressive stress of approximately 18.2 ksi and a hammer stroke of 10.1 ft.

Analysis 21: Delmag D 100-13; 108-inch diameter CISS pile at 1.750-inch thick

The analysis for the Delmag D 100-13 indicates that this hammer would be capable of driving 108-inch diameter steel pipe piles at Bent 4 within the acceptable blow count limit of 102 blows/ft (1/8" /blow) to an approximate penetration depth of 57.0 feet. At a driving resistance of about 2805 kips, the maximum blow count would be approximately 61 blows/ft with a maximum compressive stress of approximately 16.9 ksi and a hammer stroke of 10.3 ft.

Analysis 22: IHC S-400; 108-inch diameter CISS pile at 1.375-inch thick

The analysis for the IHC S-400 indicates that this hammer would be capable of driving 108-inch diameter steel pipe piles at Bent 4 within the acceptable blow count limit of 102 blows/ft (1/8" /blow) to an approximate penetration depth of 57.0 feet. At a driving resistance of about 2805 kips, the maximum blow count would be approximately 27 blows/ft with a maximum compressive stress of approximately 23.9 ksi and a hammer stroke of 6.6 ft.

Analysis 23: IHC S-400; 108-inch diameter CISS pile at 1.500-inch thick

The analysis for the IHC S-400 indicates that this hammer would be capable of driving 108-inch diameter steel pipe piles at Bent 4 within the acceptable blow count limit of 102 blows/ft (1/8" /blow) to an approximate penetration depth of 57.0 feet. At a driving resistance of about 2805 kips, the maximum blow count would be approximately 27 blows/ft with a maximum compressive stress of approximately 23.0 ksi and a hammer stroke of 6.6 ft.

Analysis 24: IHC S-400; 108-inch diameter CISS pile at 1.750-inch thick

The analysis for the IHC S-400 indicates that this hammer would be capable of driving 108-inch diameter steel pipe piles at Bent 4 within the acceptable blow count limit of 102 blows/ft (1/8" /blow) to an approximate penetration depth of 57.0 feet. At a driving resistance of about 2805 kips, the maximum blow count would be approximately 27 blows/ft with a maximum compressive stress of approximately 21.3 ksi and a hammer stroke of 6.6 ft.

Analysis 25: Menck 500T; 108-inch diameter CISS pile at 1.375-inch thick

The analysis for the Menck 500T indicates that this hammer would be capable of driving 108-inch diameter steel pipe piles at Bent 4 within the acceptable blow count limit of 102 blows/ft (1/8" /blow) to an approximate penetration depth of 57.0 feet. At a driving resistance of about 2805 kips, the maximum blow count would be approximately 19 blows/ft with a maximum compressive stress of approximately 24.8 ksi and a hammer stroke of 6.1 ft.

Analysis 26: Menck 500T; 108-inch diameter CISS pile at 1.500-inch thick

The analysis for the Menck 500T indicates that this hammer would be capable of driving 108-inch diameter steel pipe piles at Bent 4 within the acceptable blow count limit of 102 blows/ft (1/8" /blow) to an approximate penetration depth of 57.0 feet. At a driving resistance of about 2805 kips, the maximum blow count would be approximately 19 blows/ft with a maximum compressive stress of approximately 24.2 ksi and a hammer stroke of 6.1 ft.

Analysis 27: Menck 500T; 108-inch diameter CISS pile at 1.750-inch thick

The analysis for the Menck 500T indicates that this hammer would be capable of driving 108-inch diameter steel pipe piles at Bent 4 within the acceptable blow count limit of 102 blows/ft (1/8" /blow) to an approximate penetration depth of 57.0 feet. At a driving resistance of about 2805 kips, the maximum blow count would be approximately 20 blows/ft with a maximum compressive stress of approximately 23.0 ksi and a hammer stroke of 6.1 ft.

General

It should be noted that all driving output data generated by the GRLWEAP™ Program presumes uniform hammer blows, with leads and hammer perfectly aligned. The analyses do not consider the effects of eccentric blows, malfunctioning hammers, or Contractor-selected reduction in fuel setting for Diesel hammers. Some Diesel hammers may exhibit operating efficiencies significantly lower than the theoretical 80% used in the analyses, subject to condition and maintenance states. The analyses also do not consider higher stresses, which could be induced by bending, non-axial hammer alignment, or high local stress concentrations, and therefore should be considered as minimum values. Local pile damage can occur at the pile tip due to highly localized pile stresses caused by non-uniform resistance from sloping rock, **boulders, cobbles**, or obstructions, even if the calculated average axial stresses are within the allowable limits. These stresses cannot be predicted by wave equation analysis. The analysis results are only valid for the assumptions noted in the above sections and the soil profile input provided.

Conclusions and Recommendations

Based upon the results of the driveability analyses with reference to the submitted information from the Geotechnical Designer, the following has been concluded:

- Delmag D100-13 hammer would be capable of driving the 108-inch diameter steel pipe piles at either 1.375-inch, 1.5-inch or 1.75-inch thick within the allowable compressive stress only at Bent 4, and would **exceed** the maximum allowable blow count limit at Bents 2 and 3.
- ICE S-400 hammer would be capable of driving the 108-inch diameter steel pipe piles at 1.375-inch, 1.5-inch or 1.75-inch thick within the allowable compressive stress at Bents 2, 3 and 4.
- Menck MHU 500T hammer would be capable of driving the 108-inch diameter steel pipe piles at 1.375-inch, 1.5-inch or 1.75-inch thick within the allowable compressive stress at Bents 2, 3 and 4.
- Piles were assumed to be made of ASTM Designation A252 Grade 3 steel (as per section 49-5.01 of the Caltrans' Standard Specifications, May 2006).
- Predicted driving resistances at assigned tip elevations exceed required nominal compressive resistances in each analyzed case.
- A pile driving system submittal for this project is necessary upon hammer(s) selection. The driving system submittal must contain a driveability analysis showing that the proposed driving system will install all the piles to the specified tip elevations at acceptable rates of penetration without overstressing the piles. According to the Geotechnical Designer, lateral design pile tip elevation will need to be addressed if the tip is placed within the formational rock materials.

- Hard driving conditions should be anticipated due to the very dense nature of the decomposed and friable, gravelly, cobbly, and boulder-sized conglomerate materials at the site. Drilling to assist driving provisions might be necessary as stated in the Draft Foundation Report. GRLWEAP software does not have the capability to analyze steel pipe pile being driven in formational rock materials. Based on our study and the presented results, the formational rock materials as described above were modeled as very dense sandy/granular materials.

If you have any questions or comments pertaining to this report, please contact Michael K. Harris, P.E. at (916) 227-1058.

4/30/09

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APPENDIX A

DRIVEABILITY ANALYSIS CHARTS

INDEX TO APPENDIX A

Bent 3 Piles: 108-inch dia., IHC S-400 Hammer
STEEL PIPE PILE

ANALYSIS 13: 1.375-inch thick pile
ANALYSIS 14: 1.500-inch thick pile
ANALYSIS 15: 1.750-inch thick pile

Bent 3 Piles: 108-inch dia., Menck 500T hammer
STEEL PIPE PILE

ANALYSIS 16: 1.375-inch thick pile
ANALYSIS 17: 1.500-inch thick pile
ANALYSIS 18: 1.750-inch thick pile

Bent 4 Piles: 108-inch dia., Delmag D100-13 Hammer
STEEL PIPE PILE

ANALYSIS 19: 1.375-inch thick pile
ANALYSIS 20: 1.500-inch thick pile
ANALYSIS 21: 1.750-inch thick pile

Bent 4 Piles: 108-inch dia., IHC S-400 Hammer
STEEL PIPE PILE

ANALYSIS 22: 1.375-inch thick pile
ANALYSIS 23: 1.500-inch thick pile
ANALYSIS 24: 1.750-inch thick pile

Bent 4 Piles: 108-inch dia., Menck 500T Hammer
STEEL PIPE PILE

ANALYSIS 25: 1.375-inch thick pile
ANALYSIS 26: 1.500-inch thick pile
ANALYSIS 27: 1.750-inch thick pile

ANALYSIS 1
Bent 2
108" Pile, 1.375-inch Thick
Delmag D 100-13 Hammer

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	13.1	1.0	12.0	0.0	0.000	0.000	12.04	0.0
4.0	28.2	4.1	24.0	0.0	0.000	0.000	12.04	0.0
6.0	45.4	9.3	36.1	0.0	0.000	0.000	12.04	0.0
8.0	64.7	16.6	48.1	0.0	0.000	0.000	12.04	0.0
10.0	86.0	25.9	60.1	0.0	0.000	0.000	12.04	0.0
12.0	109.4	37.3	72.1	0.0	0.000	0.000	12.04	0.0
14.0	134.9	50.7	84.2	0.0	0.000	0.000	12.04	0.0
16.0	162.4	66.3	96.2	0.0	0.000	0.000	12.04	0.0
18.0	192.1	83.9	108.2	0.0	0.000	0.000	12.04	0.0
20.0	223.8	103.5	120.2	0.0	0.000	0.000	12.04	0.0
22.0	257.5	125.3	132.3	2.7	16.715	-12.005	8.87	121.2
24.0	293.4	149.1	144.3	3.1	17.005	-12.148	8.98	121.2
26.0	331.3	175.0	156.3	3.4	17.059	-12.089	9.01	118.7
28.0	371.3	202.9	168.3	4.1	17.277	-12.095	9.12	117.5
30.0	709.6	241.3	468.3	12.8	17.781	-10.337	9.38	111.5
32.0	792.9	291.2	501.6	15.1	17.899	-10.059	9.45	110.7
34.0	879.7	344.7	535.0	17.3	17.945	-9.667	9.46	109.8
36.0	970.1	401.7	568.4	19.2	18.013	-9.366	9.51	110.0
38.0	1064.1	462.3	601.8	21.4	18.135	-9.063	9.56	110.6
40.0	1620.2	536.2	1084.0	42.1	18.420	-6.224	9.76	110.0
42.0	1742.9	625.0	1118.0	45.3	18.483	-5.909	9.79	110.3
44.0	1871.2	719.2	1152.0	48.8	18.517	-5.634	9.83	111.0
46.0	2005.0	819.0	1185.9	53.0	18.609	-5.336	9.85	111.0
48.0	2144.2	924.3	1219.9	57.6	18.591	-5.039	9.88	111.3
50.0	1333.6	1006.9	326.7	26.8	18.266	-9.715	9.65	110.8
52.0	1403.0	1064.2	338.7	29.0	18.276	-9.661	9.67	110.5
54.0	1474.4	1123.7	350.8	31.6	18.299	-9.530	9.69	110.2
56.0	1836.8	1218.3	618.5	41.3	18.489	-7.866	9.80	109.6
58.0	1934.0	1315.6	618.5	43.4	18.438	-7.807	9.83	109.7
60.0	2033.9	1415.5	618.5	45.6	18.599	-7.721	9.85	109.7
62.0	2136.5	1518.0	618.5	48.0	18.525	-7.675	9.87	109.7
64.0	2241.6	1623.2	618.5	50.6	18.647	-7.597	9.89	109.8
66.0	2349.5	1731.0	618.5	53.4	18.690	-7.545	9.92	109.9
68.0	2459.9	1841.4	618.5	56.6	18.737	-7.559	9.93	109.8
70.0	2388.2	1936.6	451.6	51.0	18.720	-8.608	9.99	110.6
72.0	2468.6	2015.3	453.4	52.9	18.802	-8.737	10.01	110.9
74.0	2550.0	2094.9	455.1	54.8	18.882	-8.881	10.03	111.2
76.0	2632.3	2175.4	456.9	56.9	18.845	-8.977	10.05	111.3
78.0	2715.5	2256.9	458.6	59.1	18.926	-8.960	10.05	111.4
80.0	2799.7	2339.4	460.4	61.4	18.930	-8.898	10.06	111.3
82.0	2884.9	2422.8	462.1	63.9	18.976	-8.956	10.08	111.5
84.0	2971.0	2507.1	463.9	66.2	18.862	-9.020	10.08	111.5
86.0	3933.6	2696.7	1236.9	115.4	19.092	-5.399	10.16	112.3
88.0	4128.6	2891.7	1236.9	122.0	19.082	-5.283	10.17	112.5
90.0	3666.3	3047.9	618.5	96.1	18.965	-7.741	10.13	111.8

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	3779.4	3160.9	618.5	98.8	18.988	-7.823	10.14	111.8
94.0	3892.5	3274.0	618.5	101.6	19.095	-7.913	10.15	111.8
96.0	4005.6	3387.1	618.5	104.3	19.033	-8.020	10.17	111.9
98.0	4118.7	3500.2	618.5	107.2	19.095	-8.019	10.18	111.8
100.0	4231.8	3613.3	618.5	110.1	19.081	-8.034	10.20	112.0
102.0	4344.9	3726.4	618.5	113.1	19.170	-8.046	10.21	112.1
104.0	4458.0	3839.5	618.5	116.3	19.228	-8.049	10.22	112.3
106.0	5302.7	4065.7	1236.9	169.9	19.372	-5.797	10.31	113.6
108.0	5528.9	4291.9	1236.9	184.1	19.297	-5.651	10.31	113.6
110.0	5755.0	4518.1	1236.9	197.8	19.359	-5.554	10.36	114.3
112.0	5981.2	4744.3	1236.9	213.7	19.359	-5.444	10.39	114.6
114.0	6207.4	4970.5	1236.9	233.4	19.348	-5.976	10.40	114.7
116.0	6433.6	5196.7	1236.9	256.3	19.468	-6.299	10.41	114.8
118.0	6659.8	5422.9	1236.9	282.2	19.516	-6.257	10.42	114.8
120.0	6886.0	5649.1	1236.9	312.1	19.540	-6.040	10.43	114.9
122.0	7112.2	5875.3	1236.9	348.0	19.495	-5.890	10.44	114.9
124.0	7338.4	6101.4	1236.9	392.2	19.541	-5.561	10.45	114.7
126.0	7564.6	6327.6	1236.9	446.9	19.522	-5.695	10.44	114.4
128.0	7790.8	6553.8	1236.9	512.9	19.539	-5.886	10.43	114.2
130.0	8017.0	6780.0	1236.9	597.8	19.415	-6.009	10.41	113.7
132.0	8243.2	7006.2	1236.9	703.0	19.485	-6.150	10.41	113.4
134.0	8469.3	7232.4	1236.9	829.2	19.493	-6.336	10.41	113.2
134.2	8492.0	7255.0	1236.9	841.1	19.486	-6.359	10.41	113.2

Total Continuous Driving Time 416.00 minutes; Total Number of Blows 15343

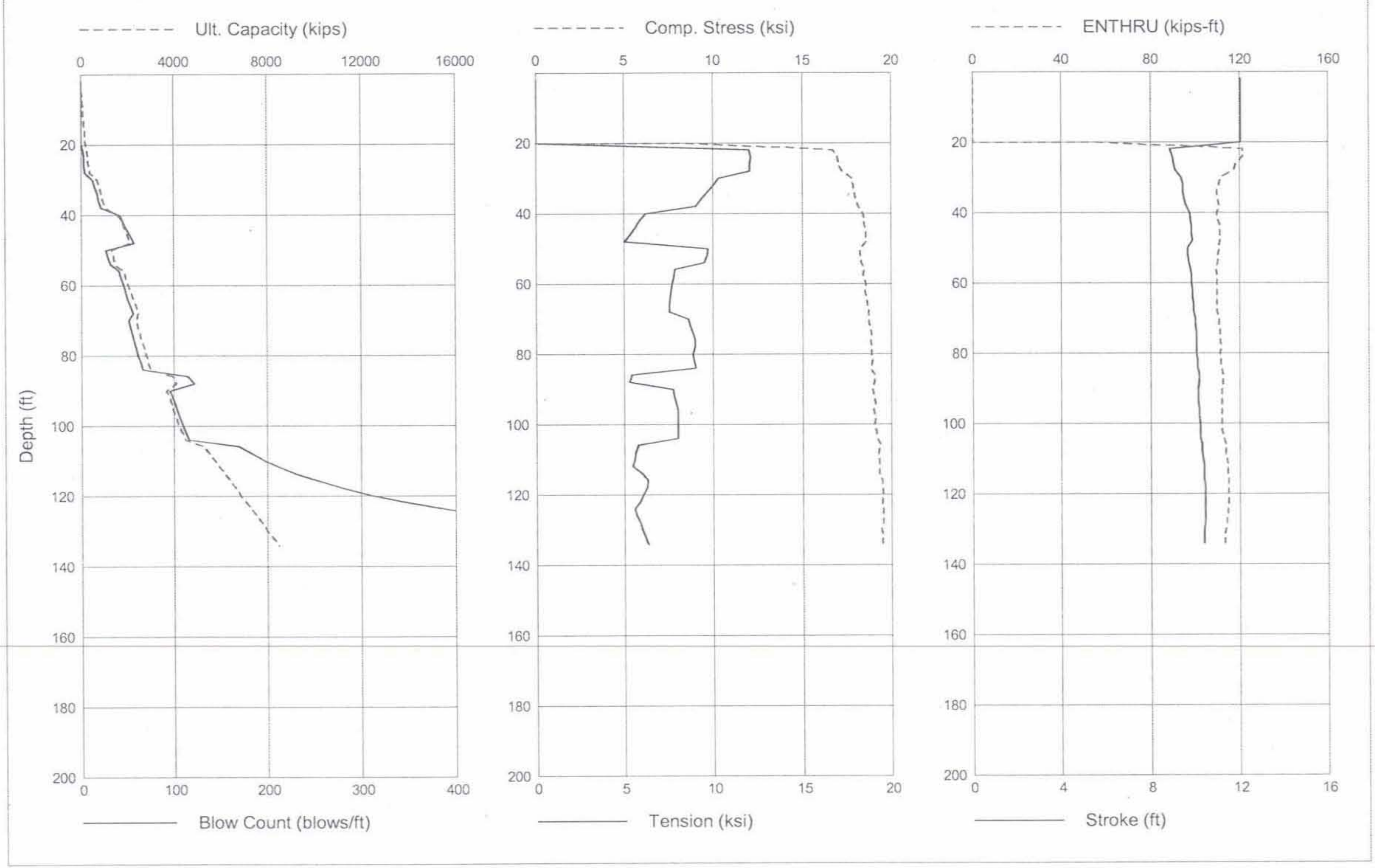
California D.O.T. Geotechnical Services

Apr 29 2009

Colorado B2-Hammer Delmag D100-13,1-375

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



ANALYSIS 2

Bent 2

108" Pile, 1.500-inch Thick

Delmag D100-13 Hammer

California D.O.T. Geotechnical Services
Colorado B2-Hammer Delmag D100-13,1-500

Apr 29 2009
GRLWEAP(TM) Version 2005

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	13.1	1.0	12.0	0.0	0.000	0.000	12.04	0.0
4.0	28.2	4.1	24.0	0.0	0.000	0.000	12.04	0.0
6.0	45.4	9.3	36.1	0.0	0.000	0.000	12.04	0.0
8.0	64.7	16.6	48.1	0.0	0.000	0.000	12.04	0.0
10.0	86.0	25.9	60.1	0.0	0.000	0.000	12.04	0.0
12.0	109.4	37.3	72.1	0.0	0.000	0.000	12.04	0.0
14.0	134.9	50.7	84.2	0.0	0.000	0.000	12.04	0.0
16.0	162.4	66.3	96.2	0.0	0.000	0.000	12.04	0.0
18.0	192.1	83.9	108.2	0.0	0.000	0.000	12.04	0.0
20.0	223.8	103.5	120.2	0.0	0.000	0.000	12.04	0.0
22.0	257.5	125.3	132.3	2.7	15.898	-11.559	9.00	123.8
24.0	293.4	149.1	144.3	3.1	16.410	-11.834	9.12	121.6
26.0	331.3	175.0	156.3	3.3	16.323	-11.721	9.08	118.1
28.0	371.3	202.9	168.3	4.0	16.688	-11.834	9.27	118.0
30.0	709.6	241.3	468.3	12.6	17.041	-10.274	9.51	111.0
32.0	792.9	291.2	501.6	14.5	17.176	-10.003	9.58	111.0
34.0	879.7	344.7	535.0	17.1	17.245	-9.681	9.58	109.2
36.0	970.1	401.7	568.4	19.2	17.366	-9.388	9.64	109.5
38.0	1064.1	462.3	601.8	21.4	17.397	-9.107	9.67	109.8
40.0	1620.2	536.2	1084.0	42.0	17.698	-6.503	9.85	109.4
42.0	1742.9	625.0	1118.0	45.0	17.760	-6.199	9.88	109.5
44.0	1871.2	719.2	1152.0	48.4	17.730	-5.917	9.91	109.8
46.0	2005.0	819.0	1185.9	52.3	17.815	-5.653	9.94	110.2
48.0	2144.2	924.3	1219.9	56.6	17.808	-5.415	9.97	110.5
50.0	1333.6	1006.9	326.7	26.6	17.544	-9.673	9.75	110.1
52.0	1403.0	1064.2	338.7	28.7	17.510	-9.640	9.78	110.4
54.0	1474.4	1123.7	350.8	31.0	17.581	-9.532	9.81	110.1
56.0	1836.8	1218.3	618.5	41.4	17.634	-8.004	9.89	109.2
58.0	1934.0	1315.6	618.5	43.3	17.791	-7.962	9.92	109.0
60.0	2033.9	1415.5	618.5	45.4	17.843	-7.908	9.94	109.0
62.0	2136.5	1518.0	618.5	47.5	17.834	-7.875	9.99	109.4
64.0	2241.6	1623.2	618.5	49.8	17.965	-7.826	10.03	109.8
66.0	2349.5	1731.0	618.5	52.4	18.018	-7.794	10.06	110.0
68.0	2459.9	1841.4	618.5	55.3	17.998	-7.821	10.08	110.2
70.0	2388.2	1936.6	451.6	50.8	17.898	-8.676	10.03	109.4
72.0	2468.6	2015.3	453.4	52.6	17.910	-8.801	10.06	109.7
74.0	2550.0	2094.9	455.1	54.3	18.010	-8.944	10.09	110.2
76.0	2632.3	2175.4	456.9	56.1	18.135	-9.020	10.13	110.5
78.0	2715.5	2256.9	458.6	57.9	18.117	-9.050	10.16	111.0
80.0	2799.7	2339.4	460.4	59.7	18.172	-9.047	10.19	111.5
82.0	2884.9	2422.8	462.1	61.7	18.289	-9.083	10.24	111.9
84.0	2971.0	2507.1	463.9	63.7	18.326	-9.150	10.27	112.2
86.0	3933.6	2696.7	1236.9	116.1	18.313	-5.783	10.24	111.6
88.0	4128.6	2891.7	1236.9	122.6	18.192	-5.693	10.24	111.7
90.0	3666.3	3047.9	618.5	97.9	18.217	-7.933	10.21	111.0

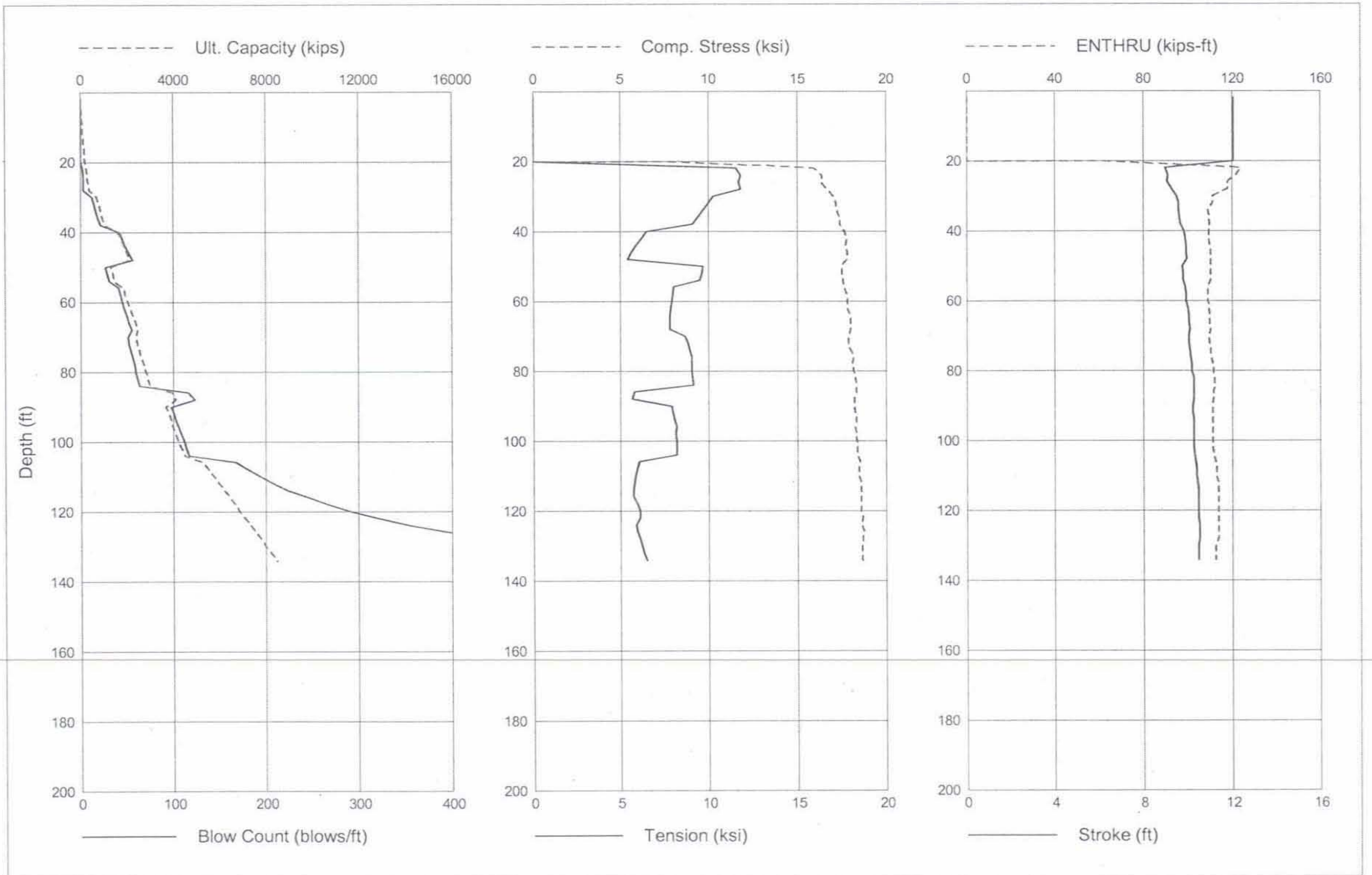
Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	3779.4	3160.9	618.5	100.4	18.285	-7.993	10.23	111.1
94.0	3892.5	3274.0	618.5	103.1	18.324	-8.089	10.24	111.1
96.0	4005.6	3387.1	618.5	105.7	18.281	-8.185	10.24	111.1
98.0	4118.7	3500.2	618.5	108.7	18.329	-8.156	10.25	111.0
100.0	4231.8	3613.3	618.5	111.5	18.349	-8.169	10.27	111.1
102.0	4344.9	3726.4	618.5	114.4	18.391	-8.203	10.28	111.2
104.0	4458.0	3839.5	618.5	117.3	18.374	-8.207	10.29	111.4
106.0	5302.7	4065.7	1236.9	168.0	18.510	-6.034	10.36	112.4
108.0	5528.9	4291.9	1236.9	180.5	18.465	-5.944	10.38	112.7
110.0	5755.0	4518.1	1236.9	194.8	18.493	-5.826	10.39	112.7
112.0	5981.2	4744.3	1236.9	207.9	18.596	-5.785	10.44	113.5
114.0	6207.4	4970.5	1236.9	224.7	18.587	-5.722	10.46	113.7
116.0	6433.6	5196.7	1236.9	245.6	18.608	-5.755	10.46	113.5
118.0	6659.8	5422.9	1236.9	266.7	18.587	-5.937	10.47	113.8
120.0	6886.0	5649.1	1236.9	291.9	18.611	-6.128	10.48	113.7
122.0	7112.2	5875.3	1236.9	320.7	18.679	-6.119	10.49	113.8
124.0	7338.4	6101.4	1236.9	355.0	18.635	-5.888	10.50	113.8
126.0	7564.6	6327.6	1236.9	394.6	18.729	-5.952	10.51	113.7
128.0	7790.8	6553.8	1236.9	443.6	18.703	-6.084	10.51	113.5
130.0	8017.0	6780.0	1236.9	513.8	18.620	-6.223	10.46	112.6
132.0	8243.2	7006.2	1236.9	586.1	18.649	-6.323	10.47	112.5
134.0	8469.3	7232.4	1236.9	673.3	18.662	-6.484	10.47	112.3
134.2	8492.0	7255.0	1236.9	682.1	18.671	-6.499	10.47	112.3

Total Continuous Driving Time 387.00 minutes; Total Number of Blows 14232

California D.O.T. Geotechnical Services Apr 29 2009

Colorado B2-Hammer Delmag D100-13,1-500 Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 GRLWEAP(TM) Version 2005



ANALYSIS 3

Bent 2

108" Pile, 1.750-inch Thick

Delmag D100-13 Hammer

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	13.1	1.0	12.0	0.0	0.000	0.000	12.04	0.0
4.0	28.2	4.1	24.0	0.0	0.000	0.000	12.04	0.0
6.0	45.4	9.3	36.1	0.0	0.000	0.000	12.04	0.0
8.0	64.7	16.6	48.1	0.0	0.000	0.000	12.04	0.0
10.0	86.0	25.9	60.1	0.0	0.000	0.000	12.04	0.0
12.0	109.4	37.3	72.1	0.0	0.000	0.000	12.04	0.0
14.0	134.9	50.7	84.2	0.0	0.000	0.000	12.04	0.0
16.0	162.4	66.3	96.2	0.0	0.000	0.000	12.04	0.0
18.0	192.1	83.9	108.2	0.0	0.000	0.000	12.04	0.0
20.0	223.8	103.5	120.2	0.0	0.000	0.000	12.04	0.0
22.0	257.5	125.3	132.3	0.0	0.000	0.000	12.04	0.0
24.0	293.4	149.1	144.3	3.0	14.933	-11.046	9.23	118.5
26.0	331.3	175.0	156.3	3.1	15.002	-10.887	9.13	114.7
28.0	371.3	202.9	168.3	3.6	15.132	-10.948	9.25	114.2
30.0	709.6	241.3	468.3	12.4	15.900	-10.002	9.76	109.9
32.0	792.9	291.2	501.6	14.2	16.072	-9.792	9.81	109.9
34.0	879.7	344.7	535.0	16.2	16.000	-9.506	9.83	109.9
36.0	970.1	401.7	568.4	18.5	16.164	-9.287	9.87	109.5
38.0	1064.1	462.3	601.8	21.0	16.154	-9.005	9.89	108.2
40.0	1620.2	536.2	1084.0	41.9	16.409	-6.831	10.04	108.9
42.0	1742.9	625.0	1118.0	44.8	16.416	-6.583	10.07	108.7
44.0	1871.2	719.2	1152.0	47.9	16.412	-6.335	10.09	108.4
46.0	2005.0	819.0	1185.9	51.4	16.496	-6.126	10.13	108.6
48.0	2144.2	924.3	1219.9	55.4	16.568	-5.878	10.15	108.6
50.0	1333.6	1006.9	326.7	26.6	16.306	-9.513	9.97	108.7
52.0	1403.0	1064.2	338.7	28.8	16.358	-9.439	10.00	108.9
54.0	1474.4	1123.7	350.8	31.2	16.399	-9.371	10.03	109.1
56.0	1836.8	1218.3	618.5	41.5	16.508	-8.130	10.11	109.2
58.0	1934.0	1315.6	618.5	43.5	16.472	-8.029	10.09	108.5
60.0	2033.9	1415.5	618.5	45.4	16.528	-8.006	10.12	108.4
62.0	2136.5	1518.0	618.5	47.4	16.590	-7.987	10.16	108.3
64.0	2241.6	1623.2	618.5	49.5	16.639	-7.958	10.20	108.3
66.0	2349.5	1731.0	618.5	52.0	16.656	-7.953	10.21	108.1
68.0	2459.9	1841.4	618.5	54.5	16.704	-7.988	10.25	108.5
70.0	2388.2	1936.6	451.6	50.3	16.680	-8.764	10.23	108.4
72.0	2468.6	2015.3	453.4	52.0	16.655	-8.861	10.25	108.5
74.0	2550.0	2094.9	455.1	53.6	16.686	-8.879	10.27	108.8
76.0	2632.3	2175.4	456.9	55.1	16.804	-9.010	10.31	109.3
78.0	2715.5	2256.9	458.6	56.8	16.829	-8.997	10.34	109.6
80.0	2799.7	2339.4	460.4	58.4	16.888	-9.007	10.38	110.1
82.0	2884.9	2422.8	462.1	60.3	16.872	-9.098	10.40	110.3
84.0	2971.0	2507.1	463.9	61.9	16.932	-9.170	10.43	110.6
86.0	3933.6	2696.7	1236.9	119.8	16.844	-6.259	10.40	110.0
88.0	4128.6	2891.7	1236.9	125.8	16.945	-6.159	10.42	110.1
90.0	3666.3	3047.9	618.5	91.8	16.934	-8.132	10.42	110.0

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	3779.4	3160.9	618.5	95.9	16.968	-8.200	10.42	110.1
94.0	3892.5	3274.0	618.5	102.0	16.892	-8.233	10.42	109.8
96.0	4005.6	3387.1	618.5	108.4	16.984	-8.289	10.43	109.9
98.0	4118.7	3500.2	618.5	112.8	16.880	-8.309	10.44	109.7
100.0	4231.8	3613.3	618.5	115.4	17.001	-8.317	10.45	109.8
102.0	4344.9	3726.4	618.5	118.4	16.874	-8.336	10.45	109.7
104.0	4458.0	3839.5	618.5	121.2	17.034	-8.346	10.46	109.9
106.0	5302.7	4065.7	1236.9	167.7	17.109	-6.391	10.51	110.6
108.0	5528.9	4291.9	1236.9	180.8	16.949	-6.234	10.48	110.0
110.0	5755.0	4518.1	1236.9	192.7	16.967	-6.210	10.50	110.3
112.0	5981.2	4744.3	1236.9	205.1	17.098	-6.305	10.53	110.8
114.0	6207.4	4970.5	1236.9	219.7	17.059	-6.243	10.55	111.0
116.0	6433.6	5196.7	1236.9	234.6	17.221	-6.216	10.59	111.4
118.0	6659.8	5422.9	1236.9	251.3	17.254	-6.134	10.62	111.8
120.0	6886.0	5649.1	1236.9	271.2	17.281	-6.068	10.63	111.9
122.0	7112.2	5875.3	1236.9	294.1	17.281	-6.012	10.63	111.8
124.0	7338.4	6101.4	1236.9	319.9	17.230	-6.127	10.64	111.7
126.0	7564.6	6327.6	1236.9	348.0	17.211	-6.264	10.65	111.8
128.0	7790.8	6553.8	1236.9	381.7	17.243	-6.393	10.65	111.7
130.0	8017.0	6780.0	1236.9	423.7	17.216	-6.495	10.63	111.3
132.0	8243.2	7006.2	1236.9	472.0	17.191	-6.570	10.62	110.9
134.0	8469.3	7232.4	1236.9	528.9	17.126	-6.706	10.61	110.5
134.2	8492.0	7255.0	1236.9	532.6	17.248	-6.734	10.61	110.6

Total Continuous Driving Time 360.00 minutes; Total Number of Blows 13190

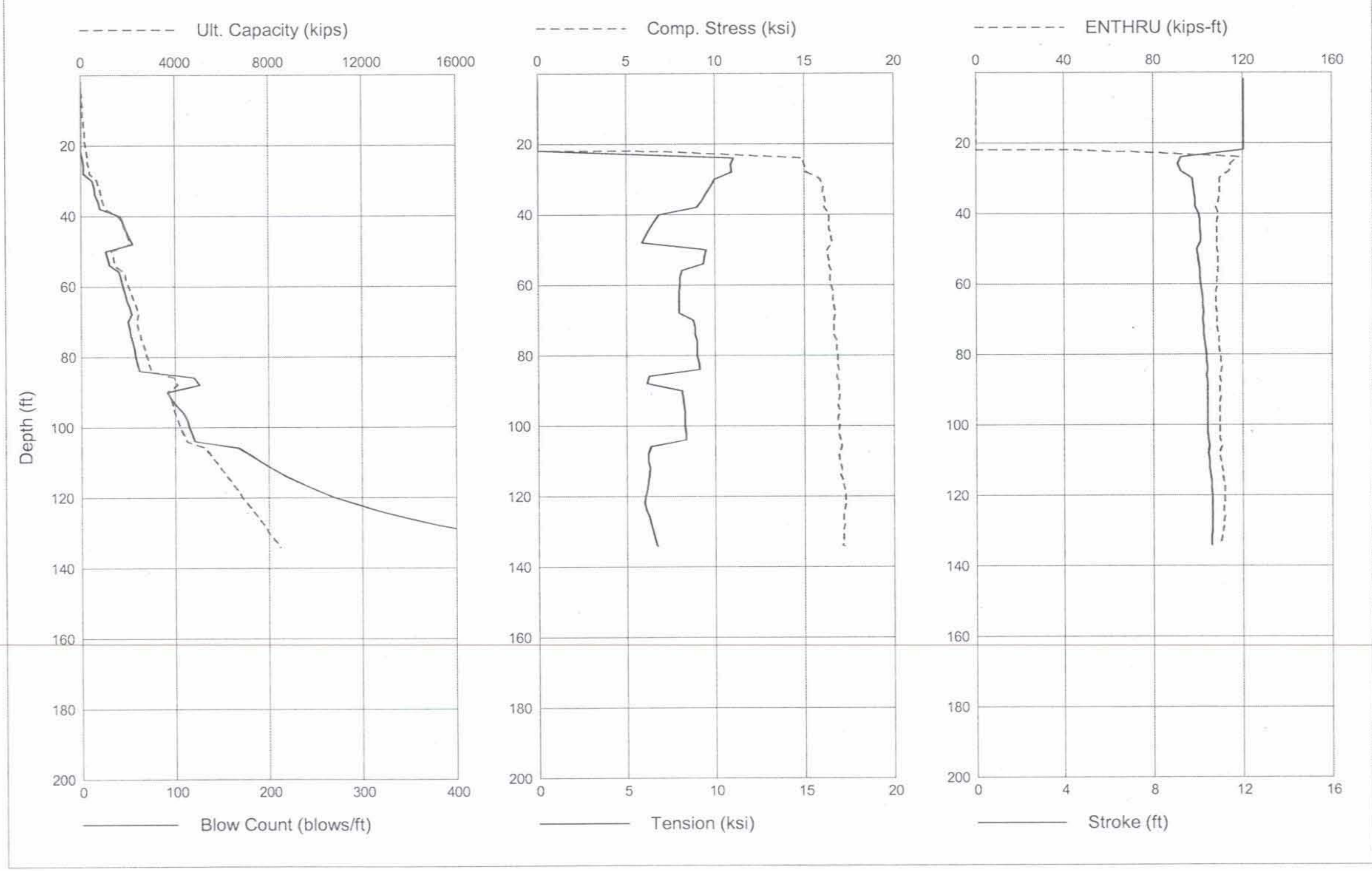
California D.O.T. Geotechnical Services

Apr 29 2009

Colorado B2-Hammer Delmag D100-13,1-750

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



ANALYSIS 4

Bent 2

108" Pile, 1.375-inch Thick

IHC S-400 Hammer

California D.O.T. Geotechnical Services
Colorado B2-Hammer IHC S-400,1-375

Apr 29 2009
GRLWEAP(TM) Version 2005

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	13.1	1.0	12.0	0.0	0.000	0.000	6.62	0.0
4.0	28.2	4.1	24.0	0.0	0.000	0.000	6.62	0.0
6.0	45.4	9.3	36.1	0.0	0.000	0.000	6.62	0.0
8.0	64.7	16.6	48.1	0.0	0.000	0.000	6.62	0.0
10.0	86.0	25.9	60.1	0.0	0.000	0.000	6.62	0.0
12.0	109.4	37.3	72.1	0.0	0.000	0.000	6.62	0.0
14.0	134.9	50.7	84.2	0.0	0.000	0.000	6.62	0.0
16.0	162.4	66.3	96.2	0.0	0.000	0.000	6.62	0.0
18.0	192.1	83.9	108.2	0.0	0.000	0.000	6.62	0.0
20.0	223.8	103.5	120.2	0.0	0.000	0.000	6.62	0.0
22.0	257.5	125.3	132.3	0.0	0.000	0.000	6.62	0.0
24.0	293.4	149.1	144.3	5.8	23.996	-21.174	6.62	265.4
26.0	331.3	175.0	156.3	6.0	23.996	-20.935	6.62	265.4
28.0	371.3	202.9	168.3	6.2	23.996	-20.663	6.62	265.4
30.0	709.6	241.3	468.3	8.2	23.996	-16.687	6.62	265.4
32.0	792.9	291.2	501.6	8.7	23.996	-16.051	6.62	265.4
34.0	879.7	344.7	535.0	9.3	23.996	-15.429	6.62	265.4
36.0	970.1	401.7	568.4	10.0	23.996	-14.722	6.62	265.4
38.0	1064.1	462.3	601.8	10.9	23.996	-14.091	6.62	265.4
40.0	1620.2	536.2	1084.0	18.0	23.996	-8.346	6.62	265.4
42.0	1742.9	625.0	1118.0	18.7	23.996	-7.501	6.62	265.4
44.0	1871.2	719.2	1152.0	19.3	23.996	-6.950	6.62	265.4
46.0	2005.0	819.0	1185.9	20.1	23.996	-6.482	6.62	265.4
48.0	2144.2	924.3	1219.9	20.9	23.996	-6.015	6.62	265.4
50.0	1333.6	1006.9	326.7	11.8	23.996	-14.484	6.62	265.4
52.0	1403.0	1064.2	338.7	12.5	23.996	-14.181	6.62	265.4
54.0	1474.4	1123.7	350.8	13.2	23.996	-13.836	6.62	265.4
56.0	1836.8	1218.3	618.5	17.6	23.996	-10.247	6.62	265.4
58.0	1934.0	1315.6	618.5	18.0	23.996	-9.848	6.62	265.4
60.0	2033.9	1415.5	618.5	18.4	23.996	-9.405	6.62	265.4
62.0	2136.5	1518.0	618.5	18.8	23.996	-9.164	6.62	265.4
64.0	2241.6	1623.2	618.5	19.3	23.996	-9.008	6.62	265.4
66.0	2349.5	1731.0	618.5	19.8	23.996	-8.865	6.62	265.4
68.0	2459.9	1841.4	618.5	20.3	23.996	-8.730	6.62	265.4
70.0	2388.2	1936.6	451.6	19.4	23.996	-9.932	6.62	265.4
72.0	2468.6	2015.3	453.4	19.7	23.996	-9.980	6.62	265.4
74.0	2550.0	2094.9	455.1	20.1	23.996	-10.027	6.62	265.4
76.0	2632.3	2175.4	456.9	20.4	23.996	-10.089	6.62	265.4
78.0	2715.5	2256.9	458.6	20.8	23.996	-10.152	6.62	265.4
80.0	2799.7	2339.4	460.4	21.1	23.996	-10.136	6.62	265.4
82.0	2884.9	2422.8	462.1	21.5	23.996	-10.034	6.62	265.4
84.0	2971.0	2507.1	463.9	21.9	23.996	-9.938	6.62	265.4
86.0	3933.6	2696.7	1236.9	34.7	23.996	-5.730	6.62	265.4
88.0	4128.6	2891.7	1236.9	36.9	23.996	-5.356	6.62	265.4
90.0	3666.3	3047.9	618.5	26.9	23.996	-7.965	6.62	265.4

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	3779.4	3160.9	618.5	27.6	23.996	-7.986	6.62	265.4
94.0	3892.5	3274.0	618.5	28.4	23.996	-8.010	6.62	265.4
96.0	4005.6	3387.1	618.5	29.3	23.996	-8.071	6.62	265.4
98.0	4118.7	3500.2	618.5	30.2	23.996	-8.128	6.62	265.4
100.0	4231.8	3613.3	618.5	31.0	23.996	-8.125	6.62	265.4
102.0	4344.9	3726.4	618.5	31.9	23.996	-8.059	6.62	265.4
104.0	4458.0	3839.5	618.5	32.7	23.996	-7.989	6.62	265.4
106.0	5302.7	4065.7	1236.9	46.6	23.997	-5.828	6.62	265.4
108.0	5528.9	4291.9	1236.9	48.6	23.997	-5.720	6.62	265.4
110.0	5755.0	4518.1	1236.9	50.7	23.999	-5.612	6.62	265.4
112.0	5981.2	4744.3	1236.9	52.8	24.002	-5.687	6.62	265.4
114.0	6207.4	4970.5	1236.9	55.2	24.007	-5.633	6.62	265.4
116.0	6433.6	5196.7	1236.9	57.7	24.016	-5.407	6.62	265.3
118.0	6659.8	5422.9	1236.9	60.3	24.026	-5.186	6.62	265.3
120.0	6886.0	5649.1	1236.9	63.1	24.033	-5.159	6.62	265.3
122.0	7112.2	5875.3	1236.9	66.1	24.036	-5.050	6.62	265.3
124.0	7338.4	6101.4	1236.9	69.4	24.035	-4.763	6.62	265.3
126.0	7564.6	6327.6	1236.9	72.8	24.029	-4.367	6.62	265.2
128.0	7790.8	6553.8	1236.9	76.6	24.020	-4.119	6.62	265.2
130.0	8017.0	6780.0	1236.9	80.6	24.007	-3.979	6.62	265.1
132.0	8243.2	7006.2	1236.9	85.0	23.990	-4.058	6.62	265.1
134.0	8469.3	7232.4	1236.9	89.8	23.969	-3.955	6.62	265.0
134.2	8492.0	7255.0	1236.9	90.3	23.967	-3.941	6.62	265.0

Total Number of Blows: 3492

Driving Time (min):	116	87	69	58	49	43	38	34	31	29
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

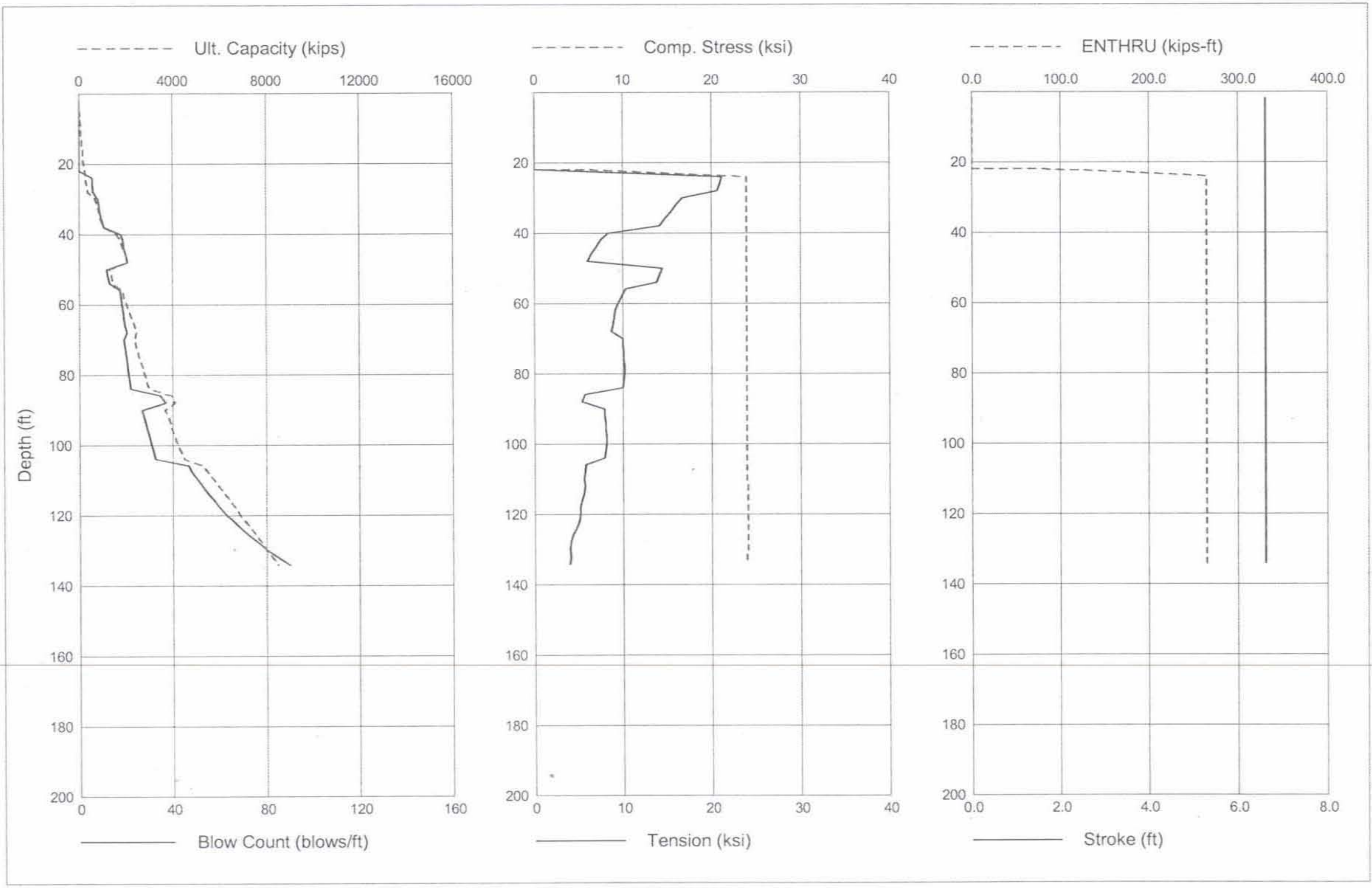
California D.O.T. Geotechnical Services

Apr 29 2009

Colorado B2-Hammer IHC S-400,1-375

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



ANALYSIS 5

Bent 2

108" Pile, 1.500-inch Thick

IHC S-400 Hammer

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	13.1	1.0	12.0	0.0	0.000	0.000	6.62	0.0
4.0	28.2	4.1	24.0	0.0	0.000	0.000	6.62	0.0
6.0	45.4	9.3	36.1	0.0	0.000	0.000	6.62	0.0
8.0	64.7	16.6	48.1	0.0	0.000	0.000	6.62	0.0
10.0	86.0	25.9	60.1	0.0	0.000	0.000	6.62	0.0
12.0	109.4	37.3	72.1	0.0	0.000	0.000	6.62	0.0
14.0	134.9	50.7	84.2	0.0	0.000	0.000	6.62	0.0
16.0	162.4	66.3	96.2	0.0	0.000	0.000	6.62	0.0
18.0	192.1	83.9	108.2	0.0	0.000	0.000	6.62	0.0
20.0	223.8	103.5	120.2	0.0	0.000	0.000	6.62	0.0
22.0	257.5	125.3	132.3	0.0	0.000	0.000	6.62	0.0
24.0	293.4	149.1	144.3	0.0	0.000	0.000	6.62	0.0
26.0	331.3	175.0	156.3	6.1	23.035	-20.294	6.62	263.2
28.0	371.3	202.9	168.3	6.3	23.035	-19.996	6.62	263.2
30.0	709.6	241.3	468.3	8.4	23.035	-16.406	6.62	263.2
32.0	792.9	291.2	501.6	8.9	23.035	-15.816	6.62	263.2
34.0	879.7	344.7	535.0	9.5	23.035	-15.229	6.62	263.2
36.0	970.1	401.7	568.4	10.2	23.035	-14.559	6.62	263.2
38.0	1064.1	462.3	601.8	11.0	23.035	-14.026	6.62	263.2
40.0	1620.2	536.2	1084.0	17.9	23.035	-8.770	6.62	263.2
42.0	1742.9	625.0	1118.0	19.2	23.035	-8.187	6.62	263.2
44.0	1871.2	719.2	1152.0	19.8	23.035	-7.755	6.62	263.2
46.0	2005.0	819.0	1185.9	20.5	23.035	-7.320	6.62	263.2
48.0	2144.2	924.3	1219.9	21.3	23.035	-6.889	6.62	263.2
50.0	1333.6	1006.9	326.7	12.0	23.035	-14.392	6.62	263.2
52.0	1403.0	1064.2	338.7	12.6	23.035	-14.090	6.62	263.2
54.0	1474.4	1123.7	350.8	13.3	23.035	-13.757	6.62	263.2
56.0	1836.8	1218.3	618.5	17.7	23.035	-10.508	6.62	263.2
58.0	1934.0	1315.6	618.5	18.6	23.035	-10.144	6.62	263.2
60.0	2033.9	1415.5	618.5	18.9	23.035	-9.955	6.62	263.2
62.0	2136.5	1518.0	618.5	19.4	23.035	-9.808	6.62	263.2
64.0	2241.6	1623.2	618.5	19.8	23.035	-9.664	6.62	263.2
66.0	2349.5	1731.0	618.5	20.2	23.035	-9.535	6.62	263.2
68.0	2459.9	1841.4	618.5	20.7	23.035	-9.420	6.62	263.2
70.0	2388.2	1936.6	451.6	19.9	23.035	-10.519	6.62	263.2
72.0	2468.6	2015.3	453.4	20.2	23.035	-10.569	6.62	263.2
74.0	2550.0	2094.9	455.1	20.5	23.035	-10.613	6.62	263.2
76.0	2632.3	2175.4	456.9	20.9	23.035	-10.669	6.62	263.2
78.0	2715.5	2256.9	458.6	21.2	23.035	-10.722	6.62	263.2
80.0	2799.7	2339.4	460.4	21.6	23.035	-10.700	6.62	263.2
82.0	2884.9	2422.8	462.1	22.0	23.035	-10.605	6.62	263.2
84.0	2971.0	2507.1	463.9	22.3	23.035	-10.517	6.62	263.2
86.0	3933.6	2696.7	1236.9	34.1	23.035	-5.612	6.62	263.2
88.0	4128.6	2891.7	1236.9	36.1	23.035	-5.515	6.62	263.2
90.0	3666.3	3047.9	618.5	27.0	23.035	-8.707	6.62	263.2

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	3779.4	3160.9	618.5	27.6	23.035	-8.729	6.62	263.2
94.0	3892.5	3274.0	618.5	28.4	23.035	-8.754	6.62	263.2
96.0	4005.6	3387.1	618.5	29.2	23.035	-8.812	6.62	263.2
98.0	4118.7	3500.2	618.5	30.0	23.035	-8.858	6.62	263.2
100.0	4231.8	3613.3	618.5	30.8	23.035	-8.854	6.62	263.2
102.0	4344.9	3726.4	618.5	31.5	23.035	-8.785	6.62	263.2
104.0	4458.0	3839.5	618.5	32.3	23.035	-8.724	6.62	263.2
106.0	5302.7	4065.7	1236.9	46.6	23.035	-5.901	6.62	263.2
108.0	5528.9	4291.9	1236.9	48.4	23.036	-6.061	6.62	263.2
110.0	5755.0	4518.1	1236.9	50.4	23.037	-6.074	6.62	263.2
112.0	5981.2	4744.3	1236.9	52.4	23.039	-6.118	6.62	263.2
114.0	6207.4	4970.5	1236.9	54.5	23.044	-6.041	6.62	263.2
116.0	6433.6	5196.7	1236.9	56.8	23.052	-5.767	6.62	263.2
118.0	6659.8	5422.9	1236.9	59.1	23.061	-5.349	6.62	263.2
120.0	6886.0	5649.1	1236.9	61.7	23.067	-5.190	6.62	263.1
122.0	7112.2	5875.3	1236.9	64.3	23.069	-5.404	6.62	263.1
124.0	7338.4	6101.4	1236.9	67.2	23.068	-5.554	6.62	263.1
126.0	7564.6	6327.6	1236.9	70.2	23.063	-5.589	6.62	263.0
128.0	7790.8	6553.8	1236.9	73.4	23.054	-5.517	6.62	263.0
130.0	8017.0	6780.0	1236.9	76.9	23.042	-5.321	6.62	262.9
132.0	8243.2	7006.2	1236.9	80.6	23.025	-5.007	6.62	262.9
134.0	8469.3	7232.4	1236.9	84.6	23.006	-4.836	6.62	262.8
134.2	8492.0	7255.0	1236.9	85.0	23.004	-4.836	6.62	262.8

Total Number of Blows: 3441

Driving Time (min):	114	86	68	57	49	43	38	34	31	28
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

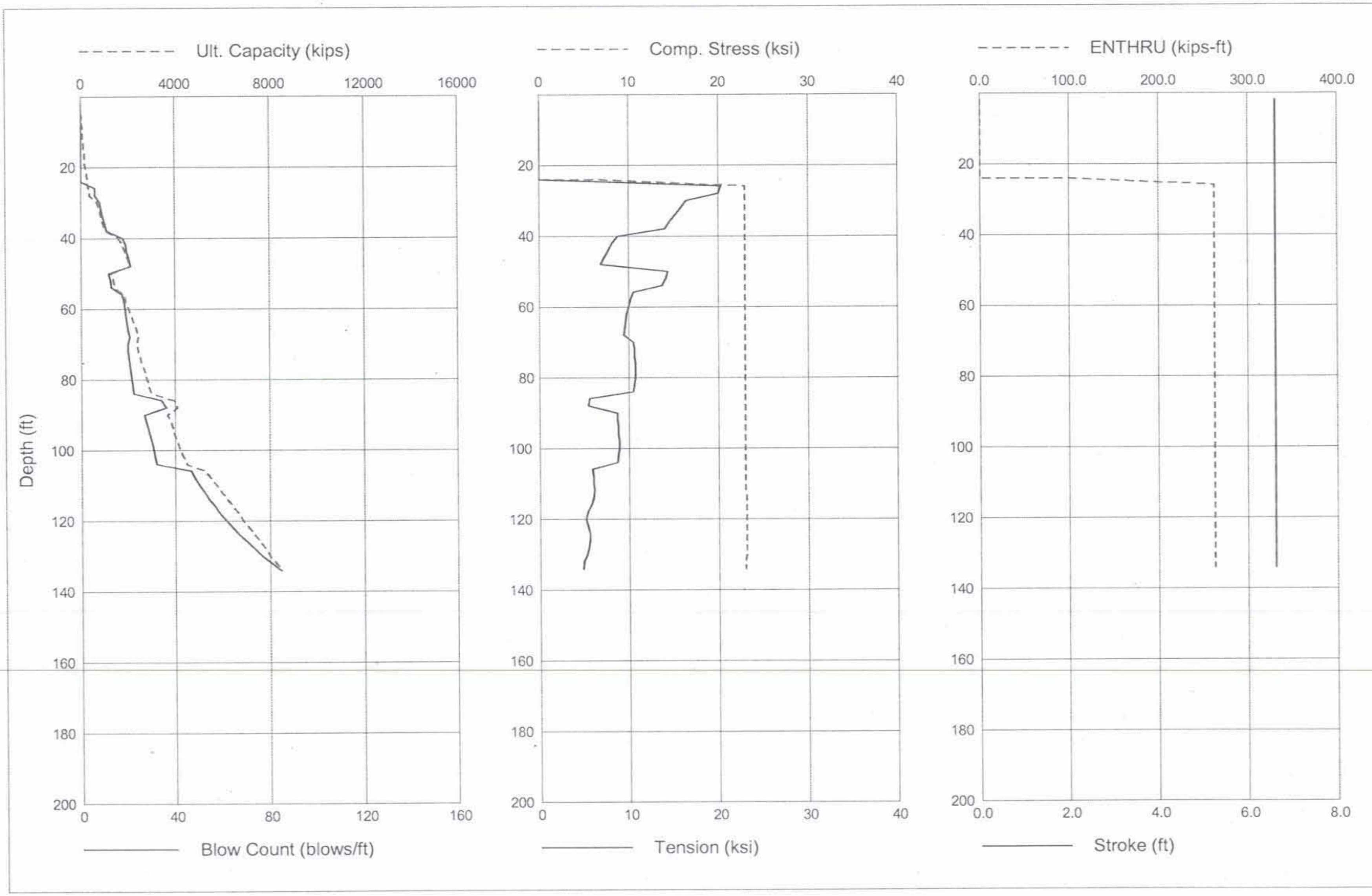
California D.O.T. Geotechnical Services

Apr 29 2009

Colorado B2-Hammer IHC S-400,1-500

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



ANALYSIS 6

Bent 2

108" Pile, 1.750-inch Thick

IHC S-400 Hammer

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	13.1	1.0	12.0	0.0	0.000	0.000	6.62	0.0
4.0	28.2	4.1	24.0	0.0	0.000	0.000	6.62	0.0
6.0	45.4	9.3	36.1	0.0	0.000	0.000	6.62	0.0
8.0	64.7	16.6	48.1	0.0	0.000	0.000	6.62	0.0
10.0	86.0	25.9	60.1	0.0	0.000	0.000	6.62	0.0
12.0	109.4	37.3	72.1	0.0	0.000	0.000	6.62	0.0
14.0	134.9	50.7	84.2	0.0	0.000	0.000	6.62	0.0
16.0	162.4	66.3	96.2	0.0	0.000	0.000	6.62	0.0
18.0	192.1	83.9	108.2	0.0	0.000	0.000	6.62	0.0
20.0	223.8	103.5	120.2	0.0	0.000	0.000	6.62	0.0
22.0	257.5	125.3	132.3	0.0	0.000	0.000	6.62	0.0
24.0	293.4	149.1	144.3	0.0	0.000	0.000	6.62	0.0
26.0	331.3	175.0	156.3	0.0	0.000	0.000	6.62	0.0
28.0	371.3	202.9	168.3	6.3	21.313	-18.664	6.62	258.2
30.0	709.6	241.3	468.3	7.3	21.313	-15.668	6.62	258.2
32.0	792.9	291.2	501.6	8.3	21.313	-15.134	6.62	258.2
34.0	879.7	344.7	535.0	9.7	21.313	-14.636	6.62	258.2
36.0	970.1	401.7	568.4	10.3	21.313	-14.160	6.62	258.2
38.0	1064.1	462.3	601.8	10.9	21.313	-13.594	6.62	258.2
40.0	1620.2	536.2	1084.0	17.9	21.313	-9.472	6.62	258.2
42.0	1742.9	625.0	1118.0	19.3	21.313	-9.101	6.62	258.2
44.0	1871.2	719.2	1152.0	20.7	21.313	-8.727	6.62	258.2
46.0	2005.0	819.0	1185.9	21.4	21.313	-8.354	6.62	258.2
48.0	2144.2	924.3	1219.9	22.1	21.313	-7.985	6.62	258.2
50.0	1333.6	1006.9	326.7	12.2	21.313	-13.905	6.62	258.2
52.0	1403.0	1064.2	338.7	12.8	21.313	-13.597	6.62	258.2
54.0	1474.4	1123.7	350.8	13.4	21.313	-13.342	6.62	258.2
56.0	1836.8	1218.3	618.5	17.9	21.313	-10.929	6.62	258.2
58.0	1934.0	1315.6	618.5	18.9	21.313	-10.771	6.62	258.2
60.0	2033.9	1415.5	618.5	19.9	21.313	-10.631	6.62	258.2
62.0	2136.5	1518.0	618.5	20.4	21.313	-10.504	6.62	258.2
64.0	2241.6	1623.2	618.5	20.8	21.313	-10.380	6.62	258.2
66.0	2349.5	1731.0	618.5	21.2	21.313	-10.274	6.62	258.2
68.0	2459.9	1841.4	618.5	21.7	21.313	-10.175	6.62	258.2
70.0	2388.2	1936.6	451.6	20.9	21.313	-11.119	6.62	258.2
72.0	2468.6	2015.3	453.4	21.2	21.313	-11.164	6.62	258.2
74.0	2550.0	2094.9	455.1	21.5	21.313	-11.207	6.62	258.2
76.0	2632.3	2175.4	456.9	21.8	21.313	-11.257	6.62	258.2
78.0	2715.5	2256.9	458.6	22.2	21.313	-11.300	6.62	258.2
80.0	2799.7	2339.4	460.4	22.5	21.313	-11.283	6.62	258.2
82.0	2884.9	2422.8	462.1	22.9	21.313	-11.204	6.62	258.2
84.0	2971.0	2507.1	463.9	23.2	21.313	-11.125	6.62	258.2
86.0	3933.6	2696.7	1236.9	33.3	21.313	-6.899	6.62	258.2
88.0	4128.6	2891.7	1236.9	35.1	21.313	-6.677	6.62	258.2
90.0	3666.3	3047.9	618.5	27.5	21.313	-9.580	6.62	258.2

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	3779.4	3160.9	618.5	28.0	21.313	-9.601	6.62	258.2
94.0	3892.5	3274.0	618.5	28.7	21.313	-9.632	6.62	258.2
96.0	4005.6	3387.1	618.5	29.4	21.313	-9.691	6.62	258.2
98.0	4118.7	3500.2	618.5	30.1	21.313	-9.736	6.62	258.2
100.0	4231.8	3613.3	618.5	30.8	21.313	-9.733	6.62	258.2
102.0	4344.9	3726.4	618.5	31.5	21.313	-9.684	6.62	258.2
104.0	4458.0	3839.5	618.5	32.2	21.313	-9.623	6.62	258.2
106.0	5302.7	4065.7	1236.9	47.0	21.313	-6.530	6.62	258.2
108.0	5528.9	4291.9	1236.9	49.1	21.313	-6.307	6.62	258.2
110.0	5755.0	4518.1	1236.9	50.8	21.314	-6.103	6.62	258.2
112.0	5981.2	4744.3	1236.9	52.6	21.318	-5.922	6.62	258.2
114.0	6207.4	4970.5	1236.9	54.5	21.326	-5.933	6.62	258.2
116.0	6433.6	5196.7	1236.9	56.5	21.332	-5.983	6.62	258.2
118.0	6659.8	5422.9	1236.9	58.5	21.335	-5.963	6.62	258.2
120.0	6886.0	5649.1	1236.9	60.7	21.337	-5.883	6.62	258.2
122.0	7112.2	5875.3	1236.9	63.0	21.339	-5.787	6.62	258.1
124.0	7338.4	6101.4	1236.9	65.3	21.337	-5.725	6.62	258.1
126.0	7564.6	6327.6	1236.9	67.8	21.332	-5.618	6.62	258.1
128.0	7790.8	6553.8	1236.9	70.5	21.324	-5.518	6.62	258.0
130.0	8017.0	6780.0	1236.9	73.3	21.313	-5.402	6.62	258.0
132.0	8243.2	7006.2	1236.9	76.2	21.299	-5.388	6.62	257.9
134.0	8469.3	7232.4	1236.9	79.4	21.282	-5.501	6.62	257.8
134.2	8492.0	7255.0	1236.9	79.8	21.280	-5.510	6.62	257.8

Total Number of Blows: 3419

Driving Time (min):	113	85	68	56	48	42	37	34	31	28
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

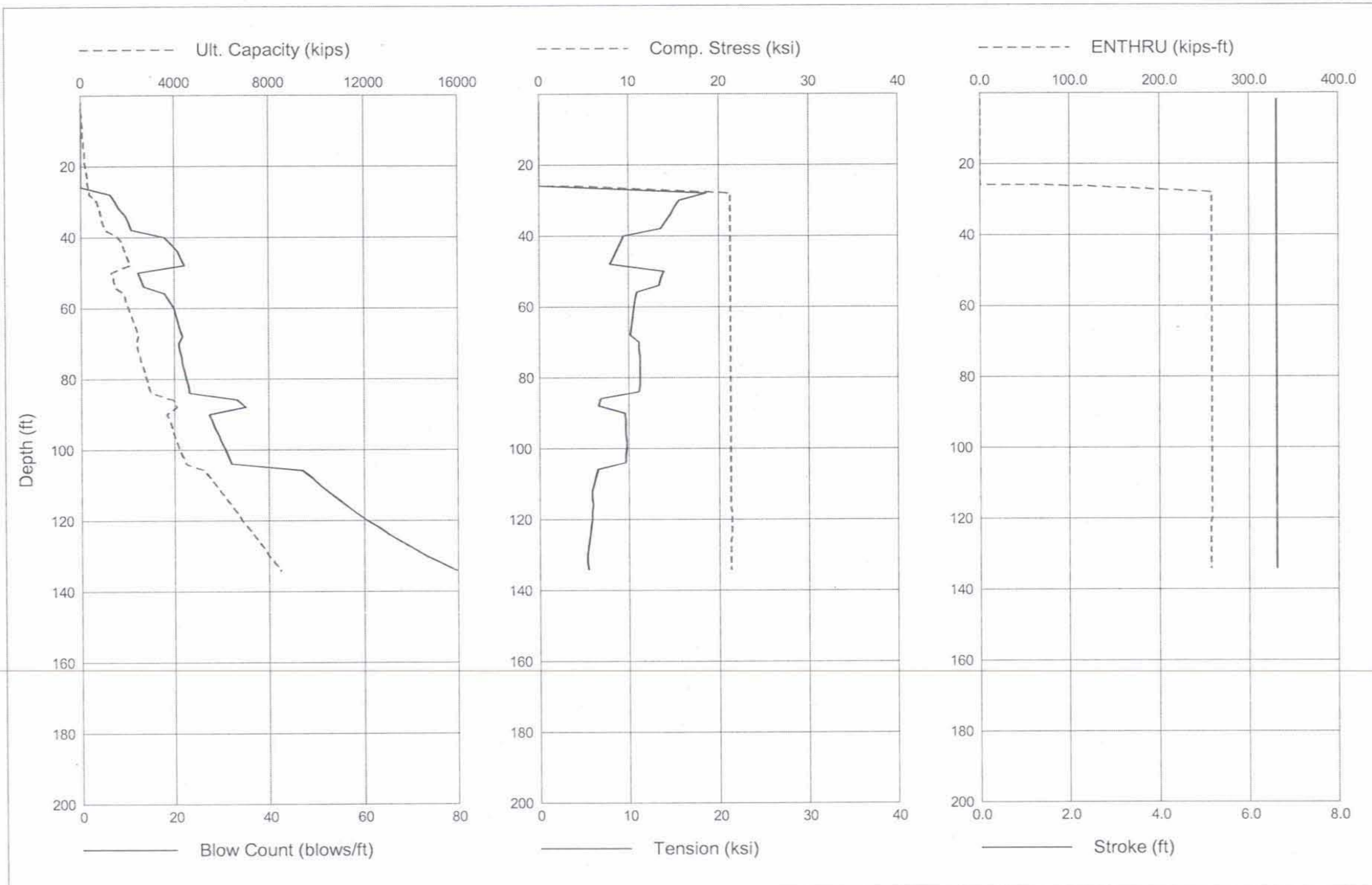
California D.O.T. Geotechnical Services

Apr 29 2009

Colorado B2-Hammer IHC S-400,1-750

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



ANALYSIS 7

Bent 2

108" Pile, 1.375-inch Thick

Menck 500T Hammer

California D.O.T. Geotechnical Services
Colorado B2-Hammer Menck MHU 500T,1-375

Apr 29 2009
GRLWEAP(TM) Version 2005

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	13.1	1.0	12.0	0.0	0.000	0.000	6.15	0.0
4.0	28.2	4.1	24.0	0.0	0.000	0.000	6.15	0.0
6.0	45.4	9.3	36.1	0.0	0.000	0.000	6.15	0.0
8.0	64.7	16.6	48.1	0.0	0.000	0.000	6.15	0.0
10.0	86.0	25.9	60.1	0.0	0.000	0.000	6.15	0.0
12.0	109.4	37.3	72.1	0.0	0.000	0.000	6.15	0.0
14.0	134.9	50.7	84.2	0.0	0.000	0.000	6.15	0.0
16.0	162.4	66.3	96.2	0.0	0.000	0.000	6.15	0.0
18.0	192.1	83.9	108.2	0.0	0.000	0.000	6.15	0.0
20.0	223.8	103.5	120.2	0.0	0.000	0.000	6.15	0.0
22.0	257.5	125.3	132.3	0.0	0.000	0.000	6.15	0.0
24.0	293.4	149.1	144.3	0.0	0.000	0.000	6.15	0.0
26.0	331.3	175.0	156.3	4.7	27.701	-24.234	6.15	375.4
28.0	371.3	202.9	168.3	4.8	27.689	-23.724	6.15	375.4
30.0	709.6	241.3	468.3	6.3	27.682	-18.780	6.15	375.4
32.0	792.9	291.2	501.6	6.7	27.663	-17.795	6.15	375.4
34.0	879.7	344.7	535.0	7.1	27.646	-17.083	6.15	375.4
36.0	970.1	401.7	568.4	7.5	27.623	-16.231	6.15	375.4
38.0	1064.1	462.3	601.8	7.9	27.597	-15.363	6.15	375.4
40.0	1620.2	536.2	1084.0	12.7	27.570	-9.806	6.15	375.4
42.0	1742.9	625.0	1118.0	13.6	27.536	-8.843	6.15	375.4
44.0	1871.2	719.2	1152.0	14.6	27.499	-7.906	6.15	375.4
46.0	2005.0	819.0	1185.9	15.5	27.459	-6.814	6.15	375.4
48.0	2144.2	924.3	1219.9	16.0	27.419	-6.068	6.15	375.4
50.0	1333.6	1006.9	326.7	8.5	27.366	-16.031	6.15	375.4
52.0	1403.0	1064.2	338.7	8.8	27.333	-15.717	6.15	375.4
54.0	1474.4	1123.7	350.8	9.2	27.280	-15.652	6.15	375.4
56.0	1836.8	1218.3	618.5	12.3	27.242	-11.971	6.15	375.4
58.0	1934.0	1315.6	618.5	12.9	27.209	-11.655	6.15	375.4
60.0	2033.9	1415.5	618.5	13.5	27.147	-11.382	6.15	375.4
62.0	2136.5	1518.0	618.5	14.2	27.073	-11.015	6.15	375.4
64.0	2241.6	1623.2	618.5	14.8	27.002	-10.589	6.15	375.4
66.0	2349.5	1731.0	618.5	15.1	26.958	-10.211	6.15	375.4
68.0	2459.9	1841.4	618.5	15.4	26.866	-9.893	6.15	375.4
70.0	2388.2	1936.6	451.6	14.8	26.832	-12.170	6.15	375.4
72.0	2468.6	2015.3	453.4	15.0	26.821	-12.134	6.15	375.4
74.0	2550.0	2094.9	455.1	15.2	26.805	-12.135	6.15	375.4
76.0	2632.3	2175.4	456.9	15.4	26.785	-12.149	6.15	375.3
78.0	2715.5	2256.9	458.6	15.7	26.761	-12.138	6.15	375.3
80.0	2799.7	2339.4	460.4	15.9	26.733	-12.057	6.15	375.3
82.0	2884.9	2422.8	462.1	16.1	26.701	-11.932	6.15	375.3
84.0	2971.0	2507.1	463.9	16.3	26.667	-11.868	6.15	375.3
86.0	3933.6	2696.7	1236.9	23.5	26.632	-5.633	6.15	375.2
88.0	4128.6	2891.7	1236.9	24.6	26.595	-5.490	6.15	375.2
90.0	3666.3	3047.9	618.5	19.2	26.560	-8.335	6.15	375.1

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	3779.4	3160.9	618.5	19.5	26.532	-8.375	6.15	375.0
94.0	3892.5	3274.0	618.5	20.0	26.458	-8.411	6.15	374.9
96.0	4005.6	3387.1	618.5	20.4	26.415	-8.465	6.15	374.8
98.0	4118.7	3500.2	618.5	20.9	26.386	-8.484	6.15	374.7
100.0	4231.8	3613.3	618.5	21.3	26.329	-8.491	6.15	374.6
102.0	4344.9	3726.4	618.5	21.8	26.243	-8.504	6.15	374.5
104.0	4458.0	3839.5	618.5	22.2	26.192	-8.432	6.15	374.5
106.0	5302.7	4065.7	1236.9	32.0	26.154	-6.179	6.15	374.4
108.0	5528.9	4291.9	1236.9	33.9	26.071	-6.067	6.15	374.4
110.0	5755.0	4518.1	1236.9	36.0	25.985	-5.833	6.15	374.4
112.0	5981.2	4744.3	1236.9	38.2	25.896	-5.416	6.15	374.4
114.0	6207.4	4970.5	1236.9	40.0	25.814	-5.262	6.15	374.4
116.0	6433.6	5196.7	1236.9	41.7	25.729	-5.405	6.15	374.4
118.0	6659.8	5422.9	1236.9	43.6	25.641	-5.162	6.15	374.4
120.0	6886.0	5649.1	1236.9	45.6	25.556	-5.020	6.15	374.5
122.0	7112.2	5875.3	1236.9	47.8	25.473	-4.824	6.15	374.5
124.0	7338.4	6101.4	1236.9	50.1	25.339	-4.865	6.15	374.6
126.0	7564.6	6327.6	1236.9	52.5	25.208	-4.755	6.15	374.6
128.0	7790.8	6553.8	1236.9	55.2	25.070	-4.556	6.15	374.7
130.0	8017.0	6780.0	1236.9	57.9	24.949	-4.250	6.15	374.7
132.0	8243.2	7006.2	1236.9	60.5	24.913	-3.930	6.15	374.8
134.0	8469.3	7232.4	1236.9	63.1	24.886	-3.777	6.15	374.9
134.2	8492.0	7255.0	1236.9	63.4	24.884	-3.756	6.15	374.9

Total Number of Blows:	2505									
Driving Time (min):	83	62	50	41	35	31	27	25	22	20
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

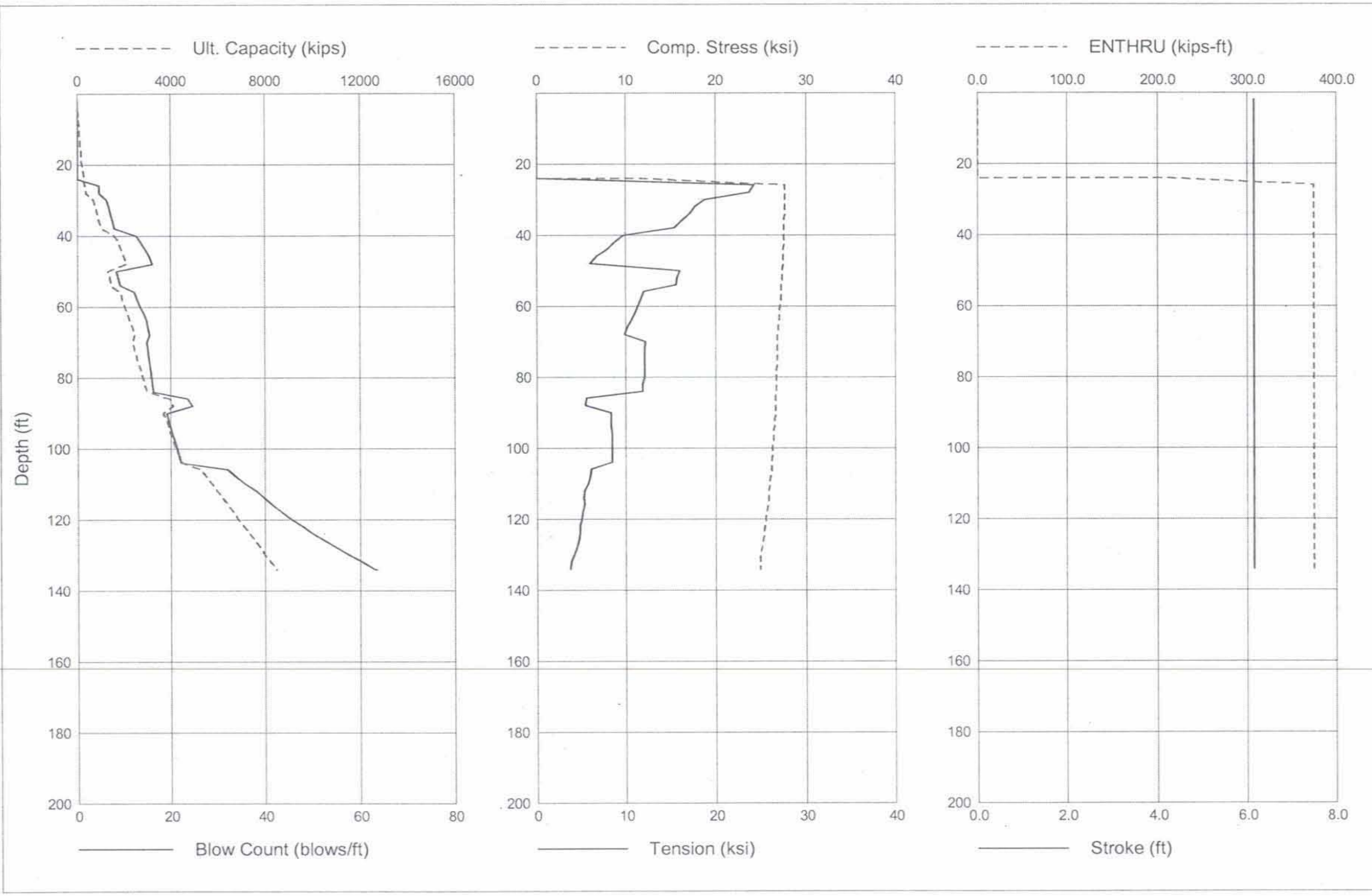
California D.O.T. Geotechnical Services

Apr 29 2009

Colorado B2-Hammer Menck MHU 500T,1-375

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



ANALYSIS 8
Bent 2
108" Pile, 1.500-inch Thick
Menck 500T Hammer

California D.O.T. Geotechnical Services
Colorado B2-Hammer Menck MHU 500T,1-500

Apr 29 2009
GRLWEAP(TM) Version 2005

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	13.1	1.0	12.0	0.0	0.000	0.000	6.15	0.0
4.0	28.2	4.1	24.0	0.0	0.000	0.000	6.15	0.0
6.0	45.4	9.3	36.1	0.0	0.000	0.000	6.15	0.0
8.0	64.7	16.6	48.1	0.0	0.000	0.000	6.15	0.0
10.0	86.0	25.9	60.1	0.0	0.000	0.000	6.15	0.0
12.0	109.4	37.3	72.1	0.0	0.000	0.000	6.15	0.0
14.0	134.9	50.7	84.2	0.0	0.000	0.000	6.15	0.0
16.0	162.4	66.3	96.2	0.0	0.000	0.000	6.15	0.0
18.0	192.1	83.9	108.2	0.0	0.000	0.000	6.15	0.0
20.0	223.8	103.5	120.2	0.0	0.000	0.000	6.15	0.0
22.0	257.5	125.3	132.3	0.0	0.000	0.000	6.15	0.0
24.0	293.4	149.1	144.3	0.0	0.000	0.000	6.15	0.0
26.0	331.3	175.0	156.3	4.9	26.930	-23.839	6.15	374.6
28.0	371.3	202.9	168.3	5.1	26.916	-23.365	6.15	374.6
30.0	709.6	241.3	468.3	6.3	26.913	-18.939	6.15	374.6
32.0	792.9	291.2	501.6	7.0	26.901	-18.134	6.15	374.6
34.0	879.7	344.7	535.0	7.3	26.885	-17.344	6.15	374.6
36.0	970.1	401.7	568.4	7.7	26.864	-16.633	6.15	374.6
38.0	1064.1	462.3	601.8	8.1	26.839	-15.794	6.15	374.6
40.0	1620.2	536.2	1084.0	12.6	26.816	-10.523	6.15	374.6
42.0	1742.9	625.0	1118.0	13.5	26.785	-9.778	6.15	374.6
44.0	1871.2	719.2	1152.0	14.4	26.752	-8.959	6.15	374.6
46.0	2005.0	819.0	1185.9	15.5	26.716	-8.118	6.15	374.6
48.0	2144.2	924.3	1219.9	16.3	26.680	-7.333	6.15	374.6
50.0	1333.6	1006.9	326.7	8.5	26.628	-16.466	6.15	374.6
52.0	1403.0	1064.2	338.7	8.9	26.598	-16.065	6.15	374.6
54.0	1474.4	1123.7	350.8	9.2	26.541	-15.938	6.15	374.6
56.0	1836.8	1218.3	618.5	12.3	26.507	-12.856	6.15	374.6
58.0	1934.0	1315.6	618.5	12.9	26.477	-12.647	6.15	374.6
60.0	2033.9	1415.5	618.5	13.6	26.421	-12.354	6.15	374.6
62.0	2136.5	1518.0	618.5	14.3	26.336	-11.968	6.15	374.6
64.0	2241.6	1623.2	618.5	14.9	26.276	-11.682	6.15	374.6
66.0	2349.5	1731.0	618.5	15.5	26.235	-11.438	6.15	374.6
68.0	2459.9	1841.4	618.5	15.8	26.152	-11.190	6.15	374.6
70.0	2388.2	1936.6	451.6	15.2	26.081	-13.152	6.15	374.6
72.0	2468.6	2015.3	453.4	15.4	26.064	-13.097	6.15	374.6
74.0	2550.0	2094.9	455.1	15.6	26.043	-13.099	6.15	374.6
76.0	2632.3	2175.4	456.9	15.8	26.019	-13.122	6.15	374.5
78.0	2715.5	2256.9	458.6	16.0	25.998	-13.154	6.15	374.5
80.0	2799.7	2339.4	460.4	16.3	25.973	-13.157	6.15	374.5
82.0	2884.9	2422.8	462.1	16.5	25.944	-13.113	6.15	374.5
84.0	2971.0	2507.1	463.9	16.7	25.913	-13.152	6.15	374.5
86.0	3933.6	2696.7	1236.9	23.2	25.883	-5.772	6.15	374.4
88.0	4128.6	2891.7	1236.9	24.2	25.850	-5.515	6.15	374.4
90.0	3666.3	3047.9	618.5	19.4	25.818	-9.418	6.15	374.4

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	3779.4	3160.9	618.5	19.7	25.792	-9.457	6.15	374.4
94.0	3892.5	3274.0	618.5	20.1	25.725	-9.491	6.15	374.4
96.0	4005.6	3387.1	618.5	20.6	25.688	-9.540	6.15	374.4
98.0	4118.7	3500.2	618.5	21.0	25.646	-9.564	6.15	374.4
100.0	4231.8	3613.3	618.5	21.4	25.596	-9.566	6.15	374.4
102.0	4344.9	3726.4	618.5	21.8	25.526	-9.572	6.15	374.4
104.0	4458.0	3839.5	618.5	22.2	25.458	-9.504	6.15	374.4
106.0	5302.7	4065.7	1236.9	31.2	25.424	-5.254	6.15	374.4
108.0	5528.9	4291.9	1236.9	33.0	25.350	-5.108	6.15	374.4
110.0	5755.0	4518.1	1236.9	35.0	25.274	-5.782	6.15	374.4
112.0	5981.2	4744.3	1236.9	37.1	25.194	-6.108	6.15	374.4
114.0	6207.4	4970.5	1236.9	39.4	25.121	-6.049	6.15	374.4
116.0	6433.6	5196.7	1236.9	41.4	25.039	-5.687	6.15	374.4
118.0	6659.8	5422.9	1236.9	43.1	24.947	-5.075	6.15	374.5
120.0	6886.0	5649.1	1236.9	44.9	24.870	-4.970	6.15	374.5
122.0	7112.2	5875.3	1236.9	46.8	24.796	-4.998	6.15	374.5
124.0	7338.4	6101.4	1236.9	48.8	24.677	-4.988	6.15	374.5
126.0	7564.6	6327.6	1236.9	51.0	24.541	-4.984	6.15	374.6
128.0	7790.8	6553.8	1236.9	53.2	24.393	-4.906	6.15	374.6
130.0	8017.0	6780.0	1236.9	55.4	24.265	-4.708	6.15	374.7
132.0	8243.2	7006.2	1236.9	57.6	24.212	-4.485	6.15	374.7
134.0	8469.3	7232.4	1236.9	59.8	24.198	-4.424	6.15	374.7
134.2	8492.0	7255.0	1236.9	60.0	24.197	-4.416	6.15	374.7

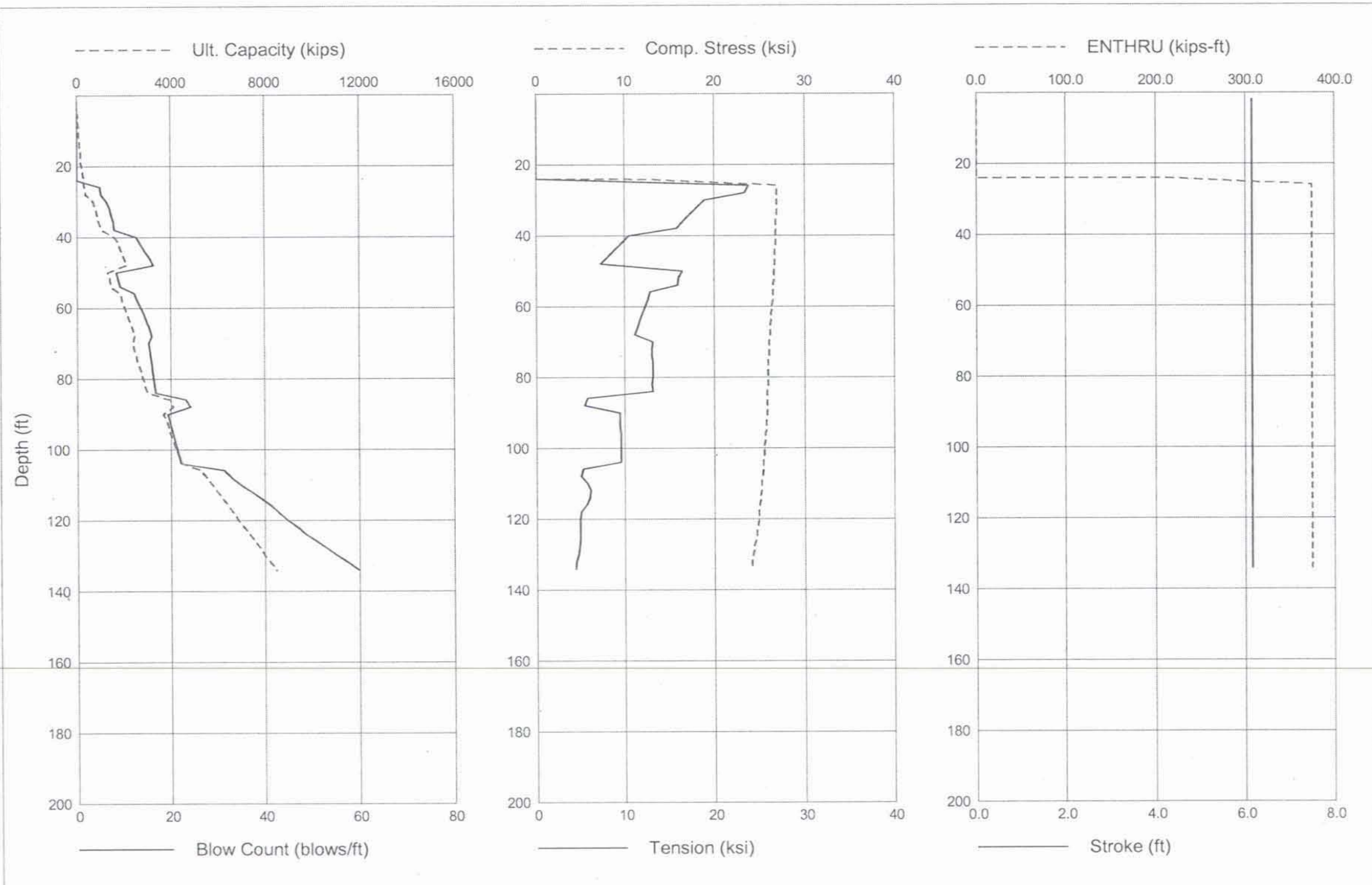
Total Number of Blows: 2478

Driving Time (min):	82	61	49	41	35	30	27	24	22	20
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

California D.O.T. Geotechnical Services — Apr 29 2009

Colorado B2-Hammer Menck MHU 500T,1-500 — Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 — GRLWEAP(TM) Version 2005



ANALYSIS 9

Bent 2

108" Pile, 1.750-inch thick

Menck 500T Hammer

California D.O.T. Geotechnical Services
Colorado B2-Hammer Menck MHU 500T,1-750

Apr 29 2009
GRLWEAP(TM) Version 2005

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	13.1	1.0	12.0	0.0	0.000	0.000	6.15	0.0
4.0	28.2	4.1	24.0	0.0	0.000	0.000	6.15	0.0
6.0	45.4	9.3	36.1	0.0	0.000	0.000	6.15	0.0
8.0	64.7	16.6	48.1	0.0	0.000	0.000	6.15	0.0
10.0	86.0	25.9	60.1	0.0	0.000	0.000	6.15	0.0
12.0	109.4	37.3	72.1	0.0	0.000	0.000	6.15	0.0
14.0	134.9	50.7	84.2	0.0	0.000	0.000	6.15	0.0
16.0	162.4	66.3	96.2	0.0	0.000	0.000	6.15	0.0
18.0	192.1	83.9	108.2	0.0	0.000	0.000	6.15	0.0
20.0	223.8	103.5	120.2	0.0	0.000	0.000	6.15	0.0
22.0	257.5	125.3	132.3	0.0	0.000	0.000	6.15	0.0
24.0	293.4	149.1	144.3	0.0	0.000	0.000	6.15	0.0
26.0	331.3	175.0	156.3	0.0	0.000	0.000	6.15	0.0
28.0	371.3	202.9	168.3	5.5	25.503	-22.461	6.15	373.3
30.0	709.6	241.3	468.3	6.3	25.505	-18.688	6.15	373.3
32.0	792.9	291.2	501.6	6.3	25.488	-18.035	6.15	373.3
34.0	879.7	344.7	535.0	6.7	25.468	-17.261	6.15	373.3
36.0	970.1	401.7	568.4	8.0	25.445	-16.714	6.15	373.3
38.0	1064.1	462.3	601.8	8.4	25.419	-16.055	6.15	373.3
40.0	1620.2	536.2	1084.0	12.6	25.396	-11.439	6.15	373.3
42.0	1742.9	625.0	1118.0	13.5	25.366	-10.771	6.15	373.3
44.0	1871.2	719.2	1152.0	14.3	25.339	-10.168	6.15	373.3
46.0	2005.0	819.0	1185.9	15.3	25.309	-9.577	6.15	373.3
48.0	2144.2	924.3	1219.9	16.5	25.283	-9.157	6.15	373.3
50.0	1333.6	1006.9	326.7	8.8	25.232	-16.552	6.15	373.3
52.0	1403.0	1064.2	338.7	9.1	25.203	-16.241	6.15	373.3
54.0	1474.4	1123.7	350.8	9.4	25.171	-16.122	6.15	373.3
56.0	1836.8	1218.3	618.5	12.5	25.144	-13.640	6.15	373.3
58.0	1934.0	1315.6	618.5	13.1	25.088	-13.525	6.15	373.3
60.0	2033.9	1415.5	618.5	13.8	25.041	-13.329	6.15	373.3
62.0	2136.5	1518.0	618.5	14.4	25.001	-13.078	6.15	373.3
64.0	2241.6	1623.2	618.5	15.1	24.939	-12.814	6.15	373.3
66.0	2349.5	1731.0	618.5	15.7	24.867	-12.581	6.15	373.3
68.0	2459.9	1841.4	618.5	16.3	24.795	-12.376	6.15	373.3
70.0	2388.2	1936.6	451.6	15.4	24.721	-14.015	6.15	373.3
72.0	2468.6	2015.3	453.4	15.8	24.696	-14.022	6.15	373.3
74.0	2550.0	2094.9	455.1	16.3	24.678	-14.048	6.15	373.3
76.0	2632.3	2175.4	456.9	16.7	24.658	-14.077	6.15	373.3
78.0	2715.5	2256.9	458.6	16.9	24.634	-14.103	6.15	373.3
80.0	2799.7	2339.4	460.4	17.1	24.608	-14.112	6.15	373.3
82.0	2884.9	2422.8	462.1	17.3	24.580	-14.093	6.15	373.3
84.0	2971.0	2507.1	463.9	17.5	24.551	-14.116	6.15	373.3
86.0	3933.6	2696.7	1236.9	23.2	24.527	-7.805	6.15	373.3
88.0	4128.6	2891.7	1236.9	24.1	24.506	-7.499	6.15	373.3
90.0	3666.3	3047.9	618.5	20.0	24.461	-11.290	6.15	373.3

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	3779.4	3160.9	618.5	20.3	24.416	-11.272	6.15	373.3
94.0	3892.5	3274.0	618.5	20.7	24.394	-11.129	6.15	373.3
96.0	4005.6	3387.1	618.5	21.1	24.365	-11.179	6.15	373.3
98.0	4118.7	3500.2	618.5	21.5	24.301	-11.224	6.15	373.3
100.0	4231.8	3613.3	618.5	21.8	24.234	-11.283	6.15	373.3
102.0	4344.9	3726.4	618.5	22.2	24.207	-11.240	6.15	373.3
104.0	4458.0	3839.5	618.5	22.6	24.151	-11.197	6.15	373.3
106.0	5302.7	4065.7	1236.9	30.0	24.088	-7.288	6.15	373.3
108.0	5528.9	4291.9	1236.9	31.6	24.022	-6.997	6.15	373.3
110.0	5755.0	4518.1	1236.9	33.3	23.957	-6.728	6.15	373.3
112.0	5981.2	4744.3	1236.9	35.2	23.895	-6.488	6.15	373.3
114.0	6207.4	4970.5	1236.9	37.3	23.816	-6.290	6.15	373.3
116.0	6433.6	5196.7	1236.9	39.5	23.750	-6.118	6.15	373.3
118.0	6659.8	5422.9	1236.9	41.9	23.688	-6.029	6.15	373.3
120.0	6886.0	5649.1	1236.9	44.4	23.604	-6.088	6.15	373.3
122.0	7112.2	5875.3	1236.9	46.2	23.512	-6.141	6.15	373.3
124.0	7338.4	6101.4	1236.9	47.9	23.415	-6.037	6.15	373.3
126.0	7564.6	6327.6	1236.9	49.5	23.305	-5.900	6.15	373.3
128.0	7790.8	6553.8	1236.9	51.1	23.187	-5.755	6.15	373.3
130.0	8017.0	6780.0	1236.9	52.7	23.068	-5.593	6.15	373.3
132.0	8243.2	7006.2	1236.9	54.4	23.007	-5.438	6.15	373.3
134.0	8469.3	7232.4	1236.9	56.1	23.001	-5.319	6.15	373.3
134.2	8492.0	7255.0	1236.9	56.3	23.000	-5.307	6.15	373.3

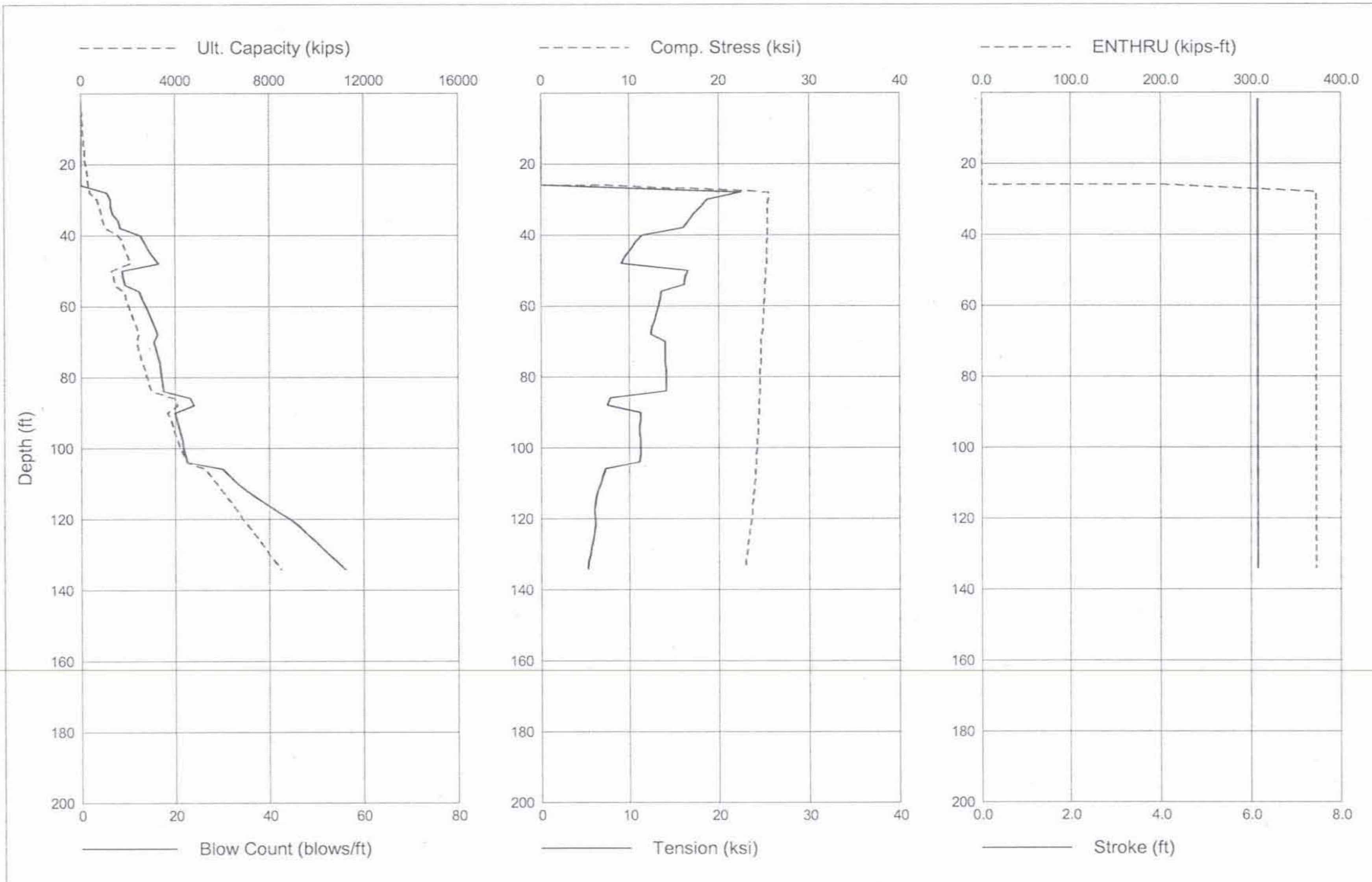
Total Number of Blows:	2446									
Driving Time (min):	81	61	48	40	34	30	27	24	22	20
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

California D.O.T. Geotechnical Services

Apr 29 2009

Colorado B2-Hammer Menck MHU 500T,1-750 Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 GRLWEAP(TM) Version 2005



ANALYSIS 10
Bent 3
108" Pile, 1.375-inch Thick
Delmag D 100-13 Hammer

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	13.5	1.0	12.4	0.0	0.000	0.000	12.04	0.0
4.0	29.0	4.1	24.9	0.0	0.000	0.000	12.04	0.0
6.0	46.6	9.3	37.3	0.0	0.000	0.000	12.04	0.0
8.0	66.3	16.6	49.7	0.0	0.000	0.000	12.04	0.0
10.0	88.1	25.9	62.2	0.0	0.000	0.000	12.04	0.0
12.0	111.9	37.3	74.6	0.0	0.000	0.000	12.04	0.0
14.0	137.8	50.8	87.0	0.0	0.000	0.000	12.04	0.0
16.0	165.8	66.3	99.5	0.0	0.000	0.000	12.04	0.0
18.0	195.9	84.0	111.9	2.1	15.627	-10.062	8.40	127.8
20.0	228.0	103.7	124.4	2.4	16.119	-10.251	8.53	125.9
22.0	262.2	125.4	136.8	2.8	16.454	-10.255	8.65	124.4
24.0	298.5	149.3	149.2	3.2	16.602	-10.128	8.75	123.6
26.0	336.9	175.2	161.7	3.8	16.811	-9.943	8.80	120.4
28.0	377.3	203.2	174.1	4.6	16.892	-9.627	8.85	117.9
30.0	419.8	233.3	186.5	5.6	16.991	-9.370	8.90	116.2
32.0	801.9	283.0	518.9	15.0	17.640	-4.396	9.27	111.7
34.0	890.9	336.3	554.6	17.2	17.802	-4.597	9.33	111.2
36.0	610.1	382.9	227.2	9.9	17.421	-8.379	9.12	112.6
38.0	661.5	421.8	239.7	10.8	17.354	-8.131	9.15	112.6
40.0	714.9	462.8	252.1	11.9	17.577	-7.871	9.20	112.1
42.0	770.4	505.8	264.5	13.3	17.662	-7.645	9.25	112.3
44.0	827.9	551.0	277.0	14.9	17.749	-7.460	9.31	112.2
46.0	887.6	598.2	289.4	16.0	17.703	-7.355	9.34	111.7
48.0	949.3	647.5	301.8	17.2	17.807	-7.268	9.38	111.5
50.0	1013.1	698.8	314.3	18.6	17.912	-7.054	9.41	111.2
52.0	915.7	739.8	175.9	15.7	17.780	-9.113	9.34	111.0
54.0	962.4	781.9	180.5	16.5	17.878	-9.095	9.37	110.9
56.0	1010.1	825.1	185.0	17.4	17.967	-9.111	9.43	111.1
58.0	1059.0	869.4	189.6	18.4	17.915	-9.143	9.47	110.9
60.0	1108.9	914.7	194.2	19.4	18.052	-9.126	9.49	110.6
62.0	1159.9	961.1	198.7	20.6	18.088	-9.141	9.52	110.4
64.0	1211.9	1008.6	203.3	21.8	18.148	-9.124	9.54	110.2
66.0	1447.8	1064.5	383.3	29.9	18.254	-6.461	9.65	109.7
68.0	1525.2	1129.4	395.8	31.1	18.366	-6.130	9.69	109.9
70.0	1604.7	1196.5	408.2	31.7	18.462	-5.818	9.75	110.5
72.0	1686.2	1265.5	420.6	32.4	18.394	-5.472	9.77	110.4
74.0	1769.8	1336.7	433.1	33.1	18.536	-5.056	9.77	109.9
76.0	2726.5	1447.1	1279.4	68.1	18.862	-2.349	9.98	109.6
78.0	2878.7	1599.3	1279.4	72.4	18.849	-2.336	10.01	109.6
80.0	3036.4	1757.0	1279.4	76.9	18.837	-2.340	10.03	109.5
82.0	3199.6	1920.2	1279.4	81.4	18.952	-2.328	10.05	109.7
84.0	3368.3	2088.9	1279.4	86.0	18.941	-2.308	10.08	110.0
86.0	3542.6	2263.1	1279.4	90.8	18.973	-2.296	10.11	110.3
88.0	3722.3	2442.9	1279.4	96.0	19.081	-2.302	10.13	110.6
90.0	3907.5	2628.1	1279.4	100.4	19.142	-2.448	10.17	111.1

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	4098.3	2818.8	1279.4	105.0	19.208	-2.746	10.21	111.6
94.0	4294.5	3015.1	1279.4	109.9	19.219	-3.045	10.25	112.0
96.0	4496.0	3216.5	1279.4	115.7	19.158	-3.264	10.27	112.2
98.0	4702.4	3422.9	1279.4	122.1	19.336	-3.444	10.29	112.3
100.0	4913.7	3634.3	1279.4	129.5	19.276	-3.534	10.30	112.3
102.0	5130.0	3850.6	1279.4	137.6	19.383	-3.404	10.31	112.4
104.0	5351.3	4071.9	1279.4	146.5	19.398	-3.247	10.33	112.4
105.0	5463.7	4184.3	1279.4	151.8	19.412	-3.158	10.33	112.3

Total Continuous Driving Time 107.00 minutes; Total Number of Blows 3994

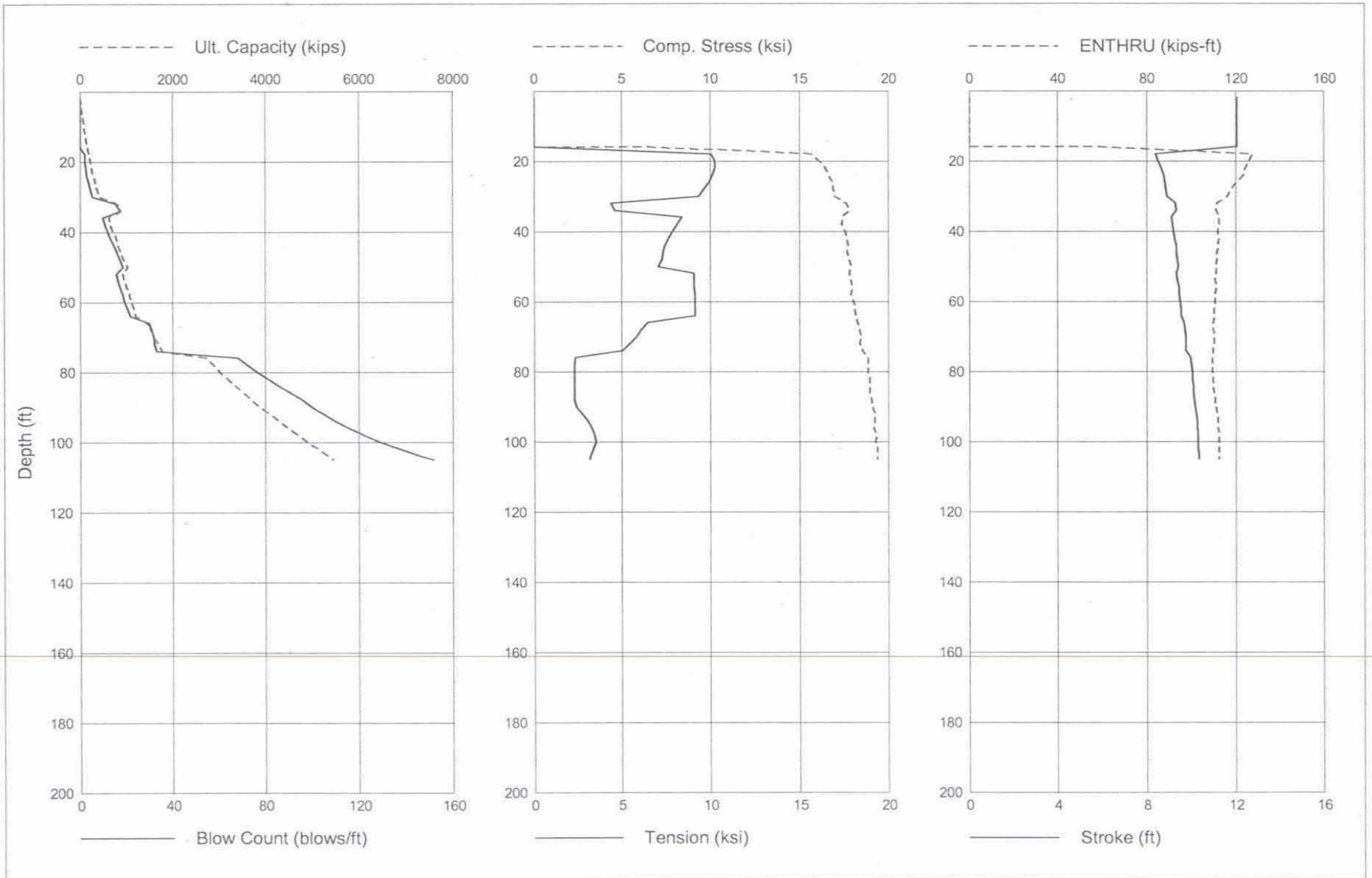
California D.O.T. Geotechnical Services

Apr 29 2009

Colorado B3-Hammer Delmag D100-13, 1-375

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



ANALYSIS 11

Bent 3

108" Pile, 1.500-inch Thick

Delmag D 100-13 Hammer

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	13.5	1.0	12.4	0.0	0.000	0.000	12.04	0.0
4.0	29.0	4.1	24.9	0.0	0.000	0.000	12.04	0.0
6.0	46.6	9.3	37.3	0.0	0.000	0.000	12.04	0.0
8.0	66.3	16.6	49.7	0.0	0.000	0.000	12.04	0.0
10.0	88.1	25.9	62.2	0.0	0.000	0.000	12.04	0.0
12.0	111.9	37.3	74.6	0.0	0.000	0.000	12.04	0.0
14.0	137.8	50.8	87.0	0.0	0.000	0.000	12.04	0.0
16.0	165.8	66.3	99.5	0.0	0.000	0.000	12.04	0.0
18.0	195.9	84.0	111.9	2.1	14.713	-9.565	8.40	127.4
20.0	228.0	103.7	124.4	2.4	15.545	-10.169	8.69	125.9
22.0	262.2	125.4	136.8	2.8	15.828	-10.229	8.82	124.5
24.0	298.5	149.3	149.2	3.2	16.071	-10.156	8.90	122.0
26.0	336.9	175.2	161.7	3.7	16.165	-9.994	8.98	120.1
28.0	377.3	203.2	174.1	4.4	16.251	-9.739	9.02	118.7
30.0	419.8	233.3	186.5	5.3	16.401	-9.482	9.06	116.9
32.0	801.9	283.0	518.9	14.9	16.997	-4.962	9.43	112.1
34.0	890.9	336.3	554.6	17.0	16.999	-4.415	9.46	111.3
36.0	610.1	382.9	227.2	9.6	16.714	-8.381	9.24	111.9
38.0	661.5	421.8	239.7	10.8	16.797	-8.180	9.29	112.1
40.0	714.9	462.8	252.1	11.9	16.850	-7.998	9.35	111.7
42.0	770.4	505.8	264.5	13.1	16.983	-7.767	9.39	112.0
44.0	827.9	551.0	277.0	14.6	16.967	-7.578	9.43	111.6
46.0	887.6	598.2	289.4	16.1	17.107	-7.500	9.47	111.3
48.0	949.3	647.5	301.8	17.3	17.136	-7.437	9.51	111.2
50.0	1013.1	698.8	314.3	18.6	17.222	-7.223	9.53	111.0
52.0	915.7	739.8	175.9	15.6	17.183	-9.081	9.50	111.5
54.0	962.4	781.9	180.5	16.4	17.157	-9.033	9.52	110.8
56.0	1010.1	825.1	185.0	17.2	17.230	-9.021	9.52	110.1
58.0	1059.0	869.4	189.6	18.2	17.232	-9.028	9.55	109.9
60.0	1108.9	914.7	194.2	19.2	17.296	-9.043	9.58	109.9
62.0	1159.9	961.1	198.7	20.2	17.269	-9.099	9.64	110.2
64.0	1211.9	1008.6	203.3	21.4	17.349	-9.088	9.66	110.0
66.0	1447.8	1064.5	383.3	29.7	17.503	-6.715	9.77	109.2
68.0	1525.2	1129.4	395.8	31.6	17.550	-6.411	9.79	109.2
70.0	1604.7	1196.5	408.2	32.3	17.700	-6.137	9.84	109.6
72.0	1686.2	1265.5	420.6	33.0	17.725	-5.808	9.85	109.4
74.0	1769.8	1336.7	433.1	33.7	17.797	-5.475	9.88	109.5
76.0	2726.5	1447.1	1279.4	65.7	18.054	-2.482	10.07	109.4
78.0	2878.7	1599.3	1279.4	70.0	18.095	-2.565	10.09	109.0
80.0	3036.4	1757.0	1279.4	74.4	18.021	-2.564	10.10	108.8
82.0	3199.6	1920.2	1279.4	79.2	18.179	-2.445	10.12	108.8
84.0	3368.3	2088.9	1279.4	83.9	18.219	-2.440	10.15	109.1
86.0	3542.6	2263.1	1279.4	88.6	18.238	-2.416	10.17	109.4
88.0	3722.3	2442.9	1279.4	93.5	18.265	-2.407	10.20	109.7
90.0	3907.5	2628.1	1279.4	97.7	18.220	-2.416	10.23	110.1

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

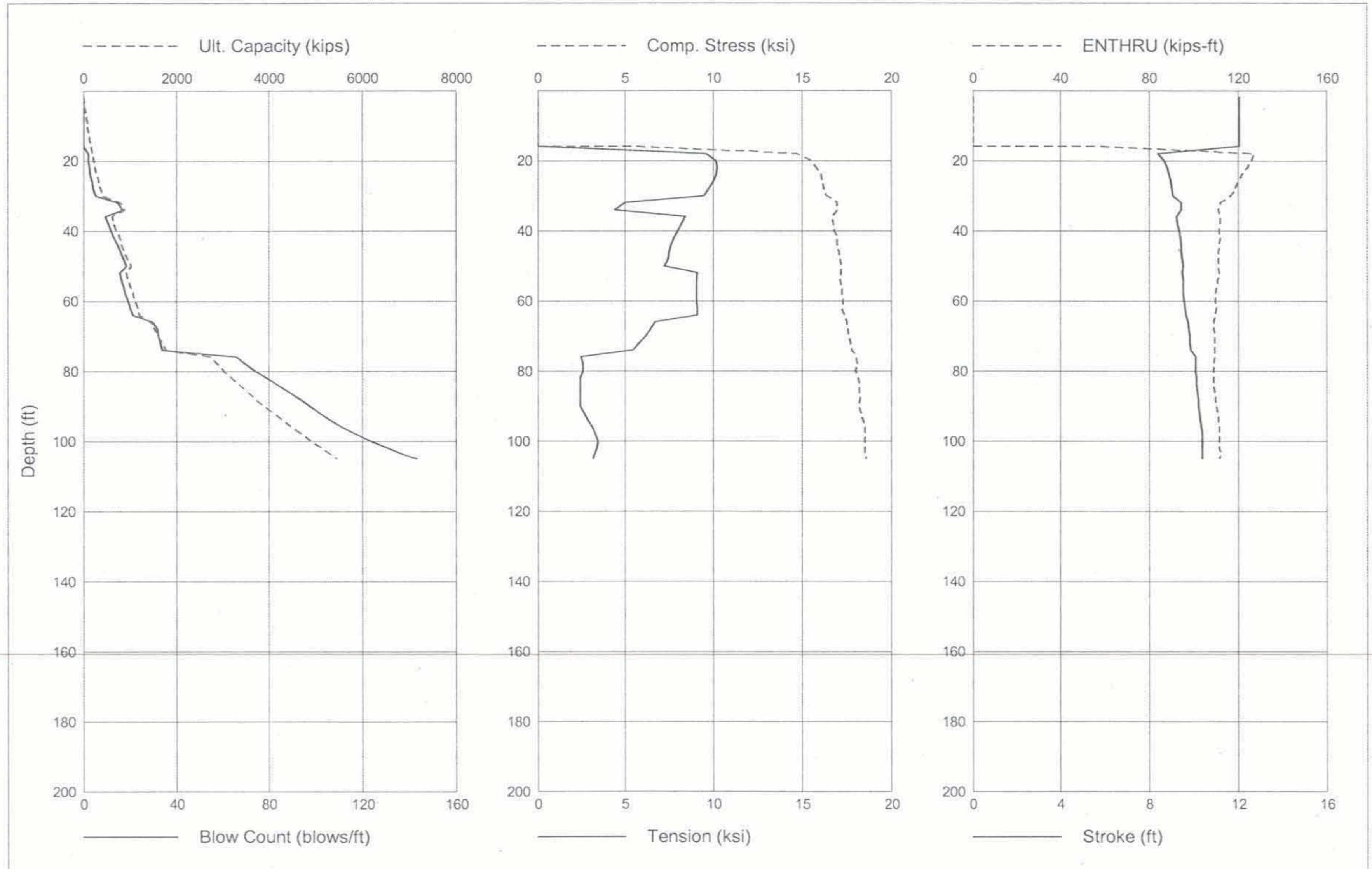
Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	4098.3	2818.8	1279.4	102.0	18.301	-2.635	10.26	110.6
94.0	4294.5	3015.1	1279.4	106.4	18.451	-2.874	10.31	111.1
96.0	4496.0	3216.5	1279.4	111.3	18.508	-3.103	10.35	111.6
98.0	4702.4	3422.9	1279.4	117.1	18.523	-3.290	10.37	111.6
100.0	4913.7	3634.3	1279.4	123.6	18.548	-3.434	10.37	111.7
102.0	5130.0	3850.6	1279.4	130.6	18.546	-3.412	10.39	111.7
104.0	5351.3	4071.9	1279.4	138.4	18.545	-3.242	10.41	111.8
105.0	5463.7	4184.3	1279.4	143.3	18.578	-3.161	10.39	111.4

Total Continuous Driving Time 104.00 minutes; Total Number of Blows 3880

California D.O.T. Geotechnical Services

Apr 29 2009

Colorado B3-Hammer Delmag D100-13, 1-500 — Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 — GRLWEAP(TM) Version 2005



ANALYSIS 12

Bent 3

108" Pile, 1.750-inch Thick

Delmag D 100-13 Hammer

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	13.5	1.0	12.4	0.0	0.000	0.000	12.04	0.0
4.0	29.0	4.1	24.9	0.0	0.000	0.000	12.04	0.0
6.0	46.6	9.3	37.3	0.0	0.000	0.000	12.04	0.0
8.0	66.3	16.6	49.7	0.0	0.000	0.000	12.04	0.0
10.0	88.1	25.9	62.2	0.0	0.000	0.000	12.04	0.0
12.0	111.9	37.3	74.6	0.0	0.000	0.000	12.04	0.0
14.0	137.8	50.8	87.0	0.0	0.000	0.000	12.04	0.0
16.0	165.8	66.3	99.5	0.0	0.000	0.000	12.04	0.0
18.0	195.9	84.0	111.9	0.0	0.000	0.000	12.04	0.0
20.0	228.0	103.7	124.4	2.4	14.095	-9.429	8.78	124.6
22.0	262.2	125.4	136.8	2.8	14.676	-9.801	8.99	122.8
24.0	298.5	149.3	149.2	3.1	14.891	-9.816	9.09	120.8
26.0	336.9	175.2	161.7	3.6	15.160	-9.907	9.29	120.1
28.0	377.3	203.2	174.1	4.1	15.357	-9.753	9.34	117.8
30.0	419.8	233.3	186.5	4.9	15.383	-9.486	9.37	117.3
32.0	801.9	283.0	518.9	14.8	15.830	-5.844	9.70	111.2
34.0	890.9	336.3	554.6	16.9	15.916	-5.157	9.73	110.8
36.0	610.1	382.9	227.2	9.4	15.673	-8.509	9.53	112.1
38.0	661.5	421.8	239.7	10.6	15.734	-8.283	9.57	111.8
40.0	714.9	462.8	252.1	11.8	15.783	-8.069	9.60	110.4
42.0	770.4	505.8	264.5	13.0	15.849	-7.884	9.64	110.7
44.0	827.9	551.0	277.0	14.5	15.812	-7.740	9.68	110.4
46.0	887.6	598.2	289.4	16.4	15.913	-7.592	9.72	110.7
48.0	949.3	647.5	301.8	17.4	16.023	-7.476	9.75	110.3
50.0	1013.1	698.8	314.3	18.7	16.047	-7.307	9.78	110.4
52.0	915.7	739.8	175.9	15.6	15.865	-8.811	9.73	110.2
54.0	962.4	781.9	180.5	16.4	16.011	-8.784	9.75	109.8
56.0	1010.1	825.1	185.0	17.2	15.960	-8.785	9.78	109.6
58.0	1059.0	869.4	189.6	18.1	16.120	-8.785	9.81	109.7
60.0	1108.9	914.7	194.2	19.1	16.133	-8.812	9.84	109.7
62.0	1159.9	961.1	198.7	20.2	16.047	-8.813	9.86	109.5
64.0	1211.9	1008.6	203.3	21.3	16.211	-8.798	9.89	109.3
66.0	1447.8	1064.5	383.3	29.9	16.233	-6.882	9.99	108.8
68.0	1525.2	1129.4	395.8	31.6	16.323	-6.628	10.01	108.2
70.0	1604.7	1196.5	408.2	33.5	16.440	-6.382	10.05	108.3
72.0	1686.2	1265.5	420.6	34.2	16.421	-6.154	10.07	108.3
74.0	1769.8	1336.7	433.1	34.9	16.516	-5.905	10.10	108.3
76.0	2726.5	1447.1	1279.4	62.5	16.717	-2.664	10.25	108.0
78.0	2878.7	1599.3	1279.4	66.4	16.739	-2.826	10.28	107.9
80.0	3036.4	1757.0	1279.4	70.3	16.781	-2.851	10.30	107.8
82.0	3199.6	1920.2	1279.4	74.4	16.865	-2.717	10.33	107.8
84.0	3368.3	2088.9	1279.4	79.2	16.886	-2.545	10.34	107.9
86.0	3542.6	2263.1	1279.4	84.0	16.912	-2.555	10.36	108.3
88.0	3722.3	2442.9	1279.4	89.4	16.894	-2.555	10.38	108.4
90.0	3907.5	2628.1	1279.4	93.5	16.977	-2.569	10.40	108.7

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	4098.3	2818.8	1279.4	97.4	17.003	-2.617	10.43	108.9
94.0	4294.5	3015.1	1279.4	101.5	16.956	-2.649	10.46	109.3
96.0	4496.0	3216.5	1279.4	105.7	17.101	-2.716	10.49	109.8
98.0	4702.4	3422.9	1279.4	110.4	17.063	-2.846	10.53	110.1
100.0	4913.7	3634.3	1279.4	115.5	17.168	-2.939	10.54	110.3
102.0	5130.0	3850.6	1279.4	121.1	17.182	-3.021	10.56	110.4
104.0	5351.3	4071.9	1279.4	127.7	17.176	-3.037	10.56	110.2
105.0	5463.7	4184.3	1279.4	131.1	17.091	-2.981	10.57	110.2

Total Continuous Driving Time 100.00 minutes; Total Number of Blows 3712

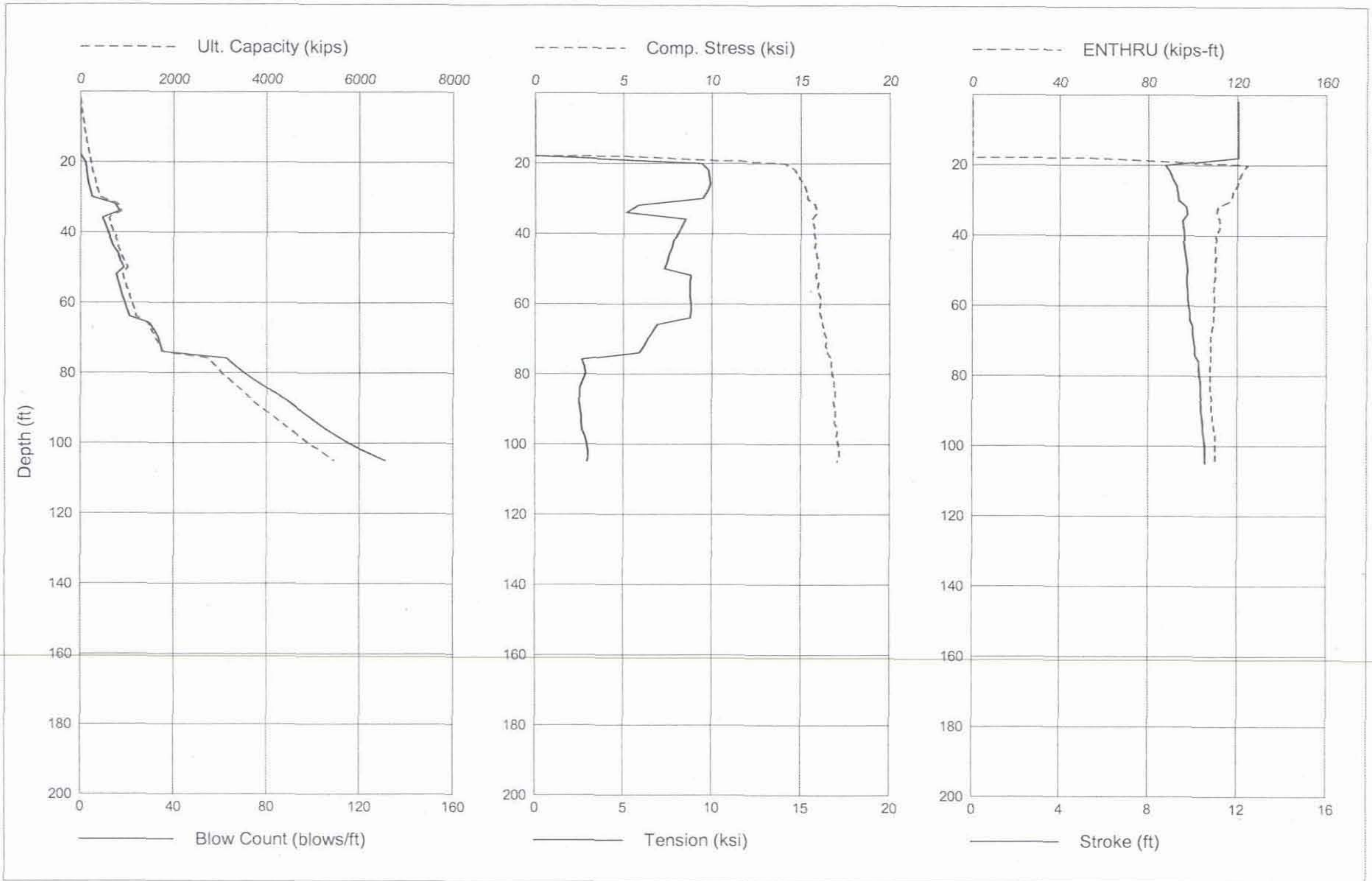
California D.O.T. Geotechnical Services

Apr 29 2009

Colorado B3-Hammer Delmag D100-13, 1-750

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



ANALYSIS 13

Bent 3

108" Pile, 1.375-inch Thick

IHC S-400 Hammer

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	13.5	1.0	12.4	0.0	0.000	0.000	6.62	0.0
4.0	29.0	4.1	24.9	0.0	0.000	0.000	6.62	0.0
6.0	46.6	9.3	37.3	0.0	0.000	0.000	6.62	0.0
8.0	66.3	16.6	49.7	0.0	0.000	0.000	6.62	0.0
10.0	88.1	25.9	62.2	0.0	0.000	0.000	6.62	0.0
12.0	111.9	37.3	74.6	0.0	0.000	0.000	6.62	0.0
14.0	137.8	50.8	87.0	0.0	0.000	0.000	6.62	0.0
16.0	165.8	66.3	99.5	0.0	0.000	0.000	6.62	0.0
18.0	195.9	84.0	111.9	0.0	0.000	0.000	6.62	0.0
20.0	228.0	103.7	124.4	0.0	0.000	0.000	6.62	0.0
22.0	262.2	125.4	136.8	4.4	23.996	-21.652	6.62	265.4
24.0	298.5	149.3	149.2	4.6	23.996	-21.226	6.62	265.4
26.0	336.9	175.2	161.7	4.8	23.996	-20.774	6.62	265.4
28.0	377.3	203.2	174.1	5.0	23.996	-20.246	6.62	265.4
30.0	419.8	233.3	186.5	5.4	23.996	-19.863	6.62	265.4
32.0	801.9	283.0	518.9	9.1	23.996	-13.524	6.62	265.4
34.0	890.9	336.3	554.6	10.1	23.996	-12.843	6.62	265.4
36.0	610.1	382.9	227.2	6.4	23.996	-18.549	6.62	265.4
38.0	661.5	421.8	239.7	6.8	23.996	-18.123	6.62	265.4
40.0	714.9	462.8	252.1	7.3	23.996	-17.639	6.62	265.4
42.0	770.4	505.8	264.5	7.8	23.996	-17.306	6.62	265.4
44.0	827.9	551.0	277.0	8.3	23.996	-16.928	6.62	265.4
46.0	887.6	598.2	289.4	8.9	23.996	-16.517	6.62	265.4
48.0	949.3	647.5	301.8	9.3	23.996	-16.046	6.62	265.4
50.0	1013.1	698.8	314.3	9.7	23.996	-15.618	6.62	265.4
52.0	915.7	739.8	175.9	8.5	23.996	-17.746	6.62	265.4
54.0	962.4	781.9	180.5	8.9	23.996	-17.579	6.62	265.4
56.0	1010.1	825.1	185.0	9.3	23.996	-17.399	6.62	265.4
58.0	1059.0	869.4	189.6	9.8	23.996	-17.206	6.62	265.4
60.0	1108.9	914.7	194.2	10.0	23.996	-16.995	6.62	265.4
62.0	1159.9	961.1	198.7	10.3	23.996	-16.781	6.62	265.4
64.0	1211.9	1008.6	203.3	10.7	23.996	-16.627	6.62	265.4
66.0	1447.8	1064.5	383.3	13.1	23.996	-13.409	6.62	265.4
68.0	1525.2	1129.4	395.8	13.8	23.996	-12.965	6.62	265.4
70.0	1604.7	1196.5	408.2	14.6	23.996	-12.586	6.62	265.4
72.0	1686.2	1265.5	420.6	15.4	23.996	-12.218	6.62	265.4
74.0	1769.8	1336.7	433.1	16.2	23.997	-12.082	6.62	265.4
76.0	2726.5	1447.1	1279.4	27.5	23.997	-8.268	6.62	265.4
78.0	2878.7	1599.3	1279.4	28.6	23.997	-8.038	6.62	265.4
80.0	3036.4	1757.0	1279.4	29.7	23.999	-7.812	6.62	265.4
82.0	3199.6	1920.2	1279.4	30.8	24.002	-7.626	6.62	265.4
84.0	3368.3	2088.9	1279.4	32.0	24.007	-7.467	6.62	265.4
86.0	3542.6	2263.1	1279.4	33.3	24.016	-7.293	6.62	265.3
88.0	3722.3	2442.9	1279.4	34.5	24.026	-7.101	6.62	265.3
90.0	3907.5	2628.1	1279.4	35.7	24.033	-6.928	6.62	265.3

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	4098.3	2818.8	1279.4	36.9	24.036	-6.754	6.62	265.3
94.0	4294.5	3015.1	1279.4	38.2	24.034	-6.586	6.62	265.3
96.0	4496.0	3216.5	1279.4	39.6	24.029	-6.411	6.62	265.2
98.0	4702.4	3422.9	1279.4	41.0	24.020	-6.230	6.62	265.2
100.0	4913.7	3634.3	1279.4	42.6	24.007	-6.055	6.62	265.1
102.0	5130.0	3850.6	1279.4	44.3	23.989	-5.857	6.62	265.1
104.0	5351.3	4071.9	1279.4	46.0	23.968	-5.647	6.62	265.0
105.0	5463.7	4184.3	1279.4	47.0	23.956	-5.539	6.62	264.9

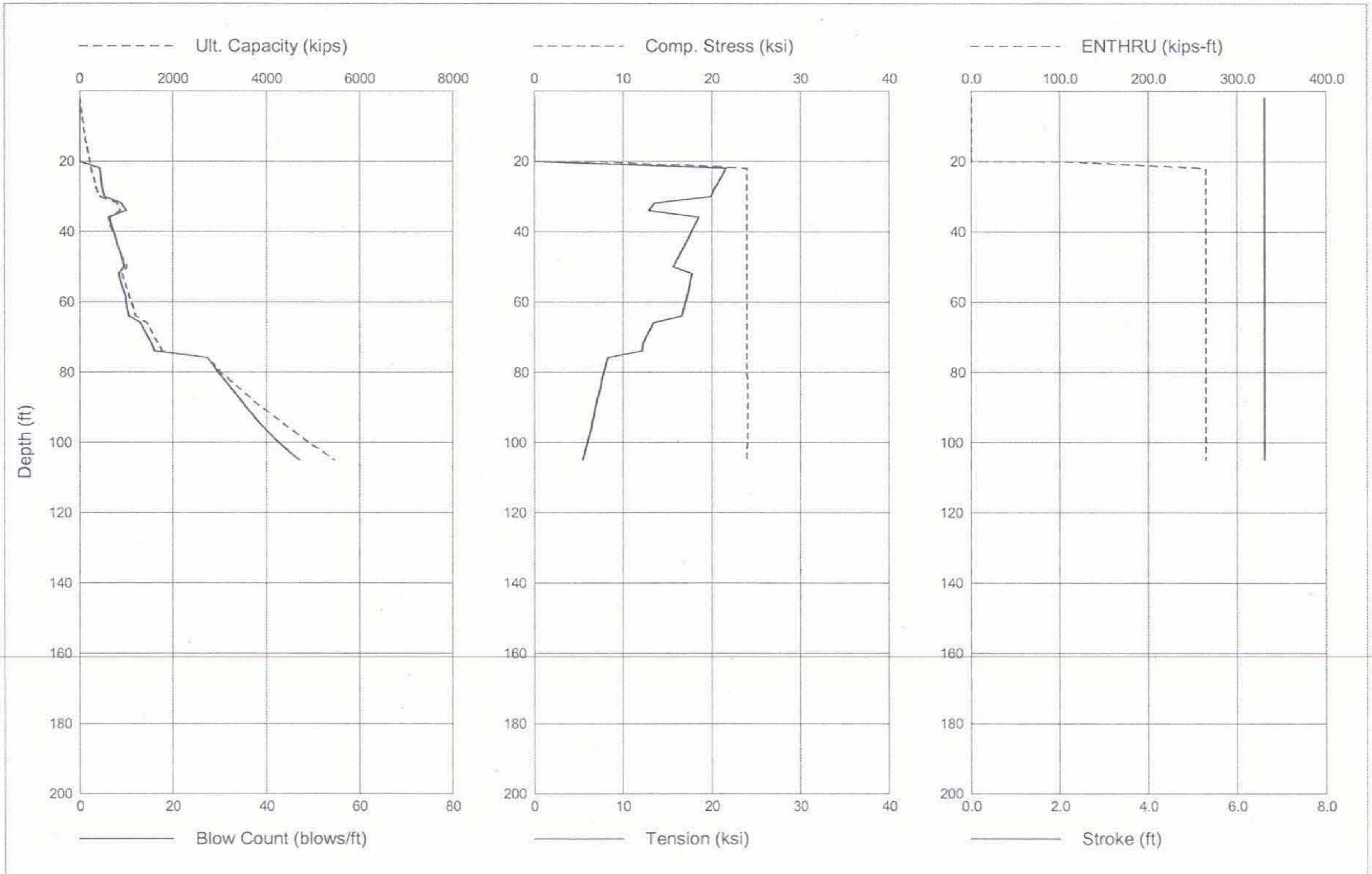
Total Number of Blows: 1577

Driving Time (min):	52	39	31	26	22	19	17	15	14	13
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

California D.O.T. Geotechnical Services — Apr 29 2009

Colorado B3-Hammer IHC S-400, 1-375 — Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 — GRLWEAP(TM) Version 2005



ANALYSIS 14

Bent 3

108" Pile, 1.500-inch Thick

IHC S-400 Hammer

California D.O.T. Geotechnical Services
Colorado B3-Hammer IHC S-400, 1-500

Apr 29 2009
GRLWEAP(TM) Version 2005

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	13.5	1.0	12.4	0.0	0.000	0.000	6.62	0.0
4.0	29.0	4.1	24.9	0.0	0.000	0.000	6.62	0.0
6.0	46.6	9.3	37.3	0.0	0.000	0.000	6.62	0.0
8.0	66.3	16.6	49.7	0.0	0.000	0.000	6.62	0.0
10.0	88.1	25.9	62.2	0.0	0.000	0.000	6.62	0.0
12.0	111.9	37.3	74.6	0.0	0.000	0.000	6.62	0.0
14.0	137.8	50.8	87.0	0.0	0.000	0.000	6.62	0.0
16.0	165.8	66.3	99.5	0.0	0.000	0.000	6.62	0.0
18.0	195.9	84.0	111.9	0.0	0.000	0.000	6.62	0.0
20.0	228.0	103.7	124.4	0.0	0.000	0.000	6.62	0.0
22.0	262.2	125.4	136.8	4.6	23.035	-21.450	6.62	263.2
24.0	298.5	149.3	149.2	4.7	23.035	-21.040	6.62	263.2
26.0	336.9	175.2	161.7	4.9	23.035	-20.588	6.62	263.2
28.0	377.3	203.2	174.1	5.2	23.035	-20.115	6.62	263.2
30.0	419.8	233.3	186.5	5.5	23.035	-19.728	6.62	263.2
32.0	801.9	283.0	518.9	9.1	23.035	-14.383	6.62	263.2
34.0	890.9	336.3	554.6	10.2	23.035	-13.175	6.62	263.2
36.0	610.1	382.9	227.2	6.4	23.035	-17.947	6.62	263.2
38.0	661.5	421.8	239.7	6.8	23.035	-17.662	6.62	263.2
40.0	714.9	462.8	252.1	7.3	23.035	-17.343	6.62	263.2
42.0	770.4	505.8	264.5	7.9	23.035	-16.989	6.62	263.2
44.0	827.9	551.0	277.0	8.4	23.035	-16.598	6.62	263.2
46.0	887.6	598.2	289.4	9.0	23.035	-16.161	6.62	263.2
48.0	949.3	647.5	301.8	9.5	23.035	-15.784	6.62	263.2
50.0	1013.1	698.8	314.3	9.8	23.035	-15.435	6.62	263.2
52.0	915.7	739.8	175.9	8.6	23.035	-17.823	6.62	263.2
54.0	962.4	781.9	180.5	9.0	23.035	-17.617	6.62	263.2
56.0	1010.1	825.1	185.0	9.4	23.035	-17.397	6.62	263.2
58.0	1059.0	869.4	189.6	9.9	23.035	-17.168	6.62	263.2
60.0	1108.9	914.7	194.2	10.3	23.035	-16.960	6.62	263.2
62.0	1159.9	961.1	198.7	10.6	23.035	-16.814	6.62	263.2
64.0	1211.9	1008.6	203.3	10.9	23.035	-16.635	6.62	263.2
66.0	1447.8	1064.5	383.3	13.1	23.035	-13.225	6.62	263.2
68.0	1525.2	1129.4	395.8	13.8	23.035	-12.868	6.62	263.2
70.0	1604.7	1196.5	408.2	14.6	23.035	-12.548	6.62	263.2
72.0	1686.2	1265.5	420.6	15.3	23.035	-12.261	6.62	263.2
74.0	1769.8	1336.7	433.1	16.2	23.035	-11.941	6.62	263.2
76.0	2726.5	1447.1	1279.4	27.2	23.035	-8.414	6.62	263.2
78.0	2878.7	1599.3	1279.4	28.3	23.036	-8.210	6.62	263.2
80.0	3036.4	1757.0	1279.4	29.4	23.037	-8.006	6.62	263.2
82.0	3199.6	1920.2	1279.4	30.5	23.039	-7.843	6.62	263.2
84.0	3368.3	2088.9	1279.4	31.7	23.045	-7.694	6.62	263.2
86.0	3542.6	2263.1	1279.4	33.0	23.052	-7.535	6.62	263.2
88.0	3722.3	2442.9	1279.4	34.3	23.061	-7.363	6.62	263.2
90.0	3907.5	2628.1	1279.4	35.5	23.067	-7.203	6.62	263.1

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	4098.3	2818.8	1279.4	36.6	23.069	-7.047	6.62	263.1
94.0	4294.5	3015.1	1279.4	37.9	23.067	-6.888	6.62	263.1
96.0	4496.0	3216.5	1279.4	39.2	23.062	-6.726	6.62	263.0
98.0	4702.4	3422.9	1279.4	40.6	23.054	-6.558	6.62	263.0
100.0	4913.7	3634.3	1279.4	42.1	23.041	-6.390	6.62	262.9
102.0	5130.0	3850.6	1279.4	43.6	23.025	-6.190	6.62	262.9
104.0	5351.3	4071.9	1279.4	45.3	23.005	-5.986	6.62	262.8
105.0	5463.7	4184.3	1279.4	46.2	22.994	-5.879	6.62	262.7

Total Number of Blows: 1572

Driving Time (min):	52	39	31	26	22	19	17	15	14	13
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

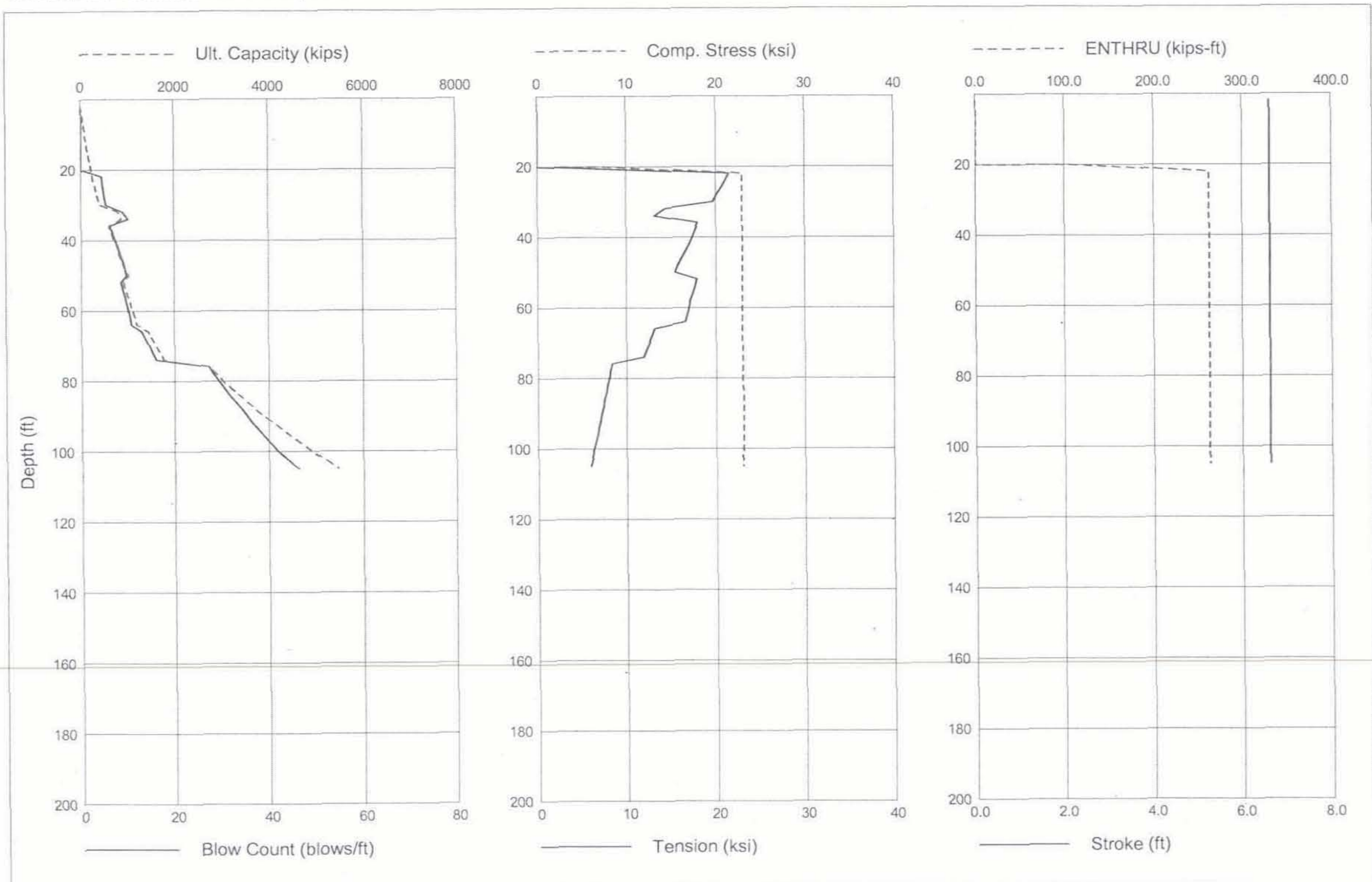
California D.O.T. Geotechnical Services

Apr 29 2009

Colorado B3-Hammer IHC S-400, 1-500

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



ANALYSIS 15

Bent 3

108" Pile, 1.750-inch Thick

IHC S-400 Hammer

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	13.5	1.0	12.4	0.0	0.000	0.000	6.62	0.0
4.0	29.0	4.1	24.9	0.0	0.000	0.000	6.62	0.0
6.0	46.6	9.3	37.3	0.0	0.000	0.000	6.62	0.0
8.0	66.3	16.6	49.7	0.0	0.000	0.000	6.62	0.0
10.0	88.1	25.9	62.2	0.0	0.000	0.000	6.62	0.0
12.0	111.9	37.3	74.6	0.0	0.000	0.000	6.62	0.0
14.0	137.8	50.8	87.0	0.0	0.000	0.000	6.62	0.0
16.0	165.8	66.3	99.5	0.0	0.000	0.000	6.62	0.0
18.0	195.9	84.0	111.9	0.0	0.000	0.000	6.62	0.0
20.0	228.0	103.7	124.4	0.0	0.000	0.000	6.62	0.0
22.0	262.2	125.4	136.8	0.0	0.000	0.000	6.62	0.0
24.0	298.5	149.3	149.2	5.0	21.313	-20.300	6.62	258.2
26.0	336.9	175.2	161.7	5.3	21.313	-19.976	6.62	258.2
28.0	377.3	203.2	174.1	5.5	21.313	-19.614	6.62	258.2
30.0	419.8	233.3	186.5	5.7	21.313	-19.217	6.62	258.2
32.0	801.9	283.0	518.9	8.9	21.313	-14.638	6.62	258.2
34.0	890.9	336.3	554.6	10.0	21.313	-13.975	6.62	258.2
36.0	610.1	382.9	227.2	6.6	21.313	-17.845	6.62	258.2
38.0	661.5	421.8	239.7	7.1	21.313	-17.453	6.62	258.2
40.0	714.9	462.8	252.1	7.4	21.313	-17.033	6.62	258.2
42.0	770.4	505.8	264.5	7.8	21.313	-16.723	6.62	258.2
44.0	827.9	551.0	277.0	8.4	21.313	-16.415	6.62	258.2
46.0	887.6	598.2	289.4	9.0	21.313	-16.141	6.62	258.2
48.0	949.3	647.5	301.8	9.8	21.313	-15.834	6.62	258.2
50.0	1013.1	698.8	314.3	10.2	21.313	-15.422	6.62	258.2
52.0	915.7	739.8	175.9	8.7	21.313	-17.276	6.62	258.2
54.0	962.4	781.9	180.5	9.1	21.313	-17.098	6.62	258.2
56.0	1010.1	825.1	185.0	9.5	21.313	-16.907	6.62	258.2
58.0	1059.0	869.4	189.6	10.0	21.313	-16.708	6.62	258.2
60.0	1108.9	914.7	194.2	10.4	21.313	-16.491	6.62	258.2
62.0	1159.9	961.1	198.7	11.0	21.313	-16.263	6.62	258.2
64.0	1211.9	1008.6	203.3	11.6	21.313	-16.020	6.62	258.2
66.0	1447.8	1064.5	383.3	13.2	21.313	-13.671	6.62	258.2
68.0	1525.2	1129.4	395.8	13.9	21.313	-13.324	6.62	258.2
70.0	1604.7	1196.5	408.2	14.5	21.313	-12.936	6.62	258.2
72.0	1686.2	1265.5	420.6	15.2	21.313	-12.519	6.62	258.2
74.0	1769.8	1336.7	433.1	16.0	21.313	-12.194	6.62	258.2
76.0	2726.5	1447.1	1279.4	26.7	21.313	-8.391	6.62	258.2
78.0	2878.7	1599.3	1279.4	27.8	21.313	-8.227	6.62	258.2
80.0	3036.4	1757.0	1279.4	28.9	21.314	-8.064	6.62	258.2
82.0	3199.6	1920.2	1279.4	30.1	21.318	-7.934	6.62	258.2
84.0	3368.3	2088.9	1279.4	31.3	21.326	-7.820	6.62	258.2
86.0	3542.6	2263.1	1279.4	32.5	21.332	-7.692	6.62	258.2
88.0	3722.3	2442.9	1279.4	33.8	21.335	-7.552	6.62	258.2
90.0	3907.5	2628.1	1279.4	34.9	21.337	-7.417	6.62	258.2

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	4098.3	2818.8	1279.4	36.0	21.339	-7.285	6.62	258.1
94.0	4294.5	3015.1	1279.4	37.1	21.337	-7.142	6.62	258.1
96.0	4496.0	3216.5	1279.4	38.3	21.332	-6.997	6.62	258.1
98.0	4702.4	3422.9	1279.4	39.6	21.324	-6.853	6.62	258.0
100.0	4913.7	3634.3	1279.4	41.0	21.313	-6.718	6.62	258.0
102.0	5130.0	3850.6	1279.4	42.4	21.299	-6.558	6.62	257.9
104.0	5351.3	4071.9	1279.4	43.9	21.281	-6.394	6.62	257.8
105.0	5463.7	4184.3	1279.4	44.7	21.271	-6.309	6.62	257.8

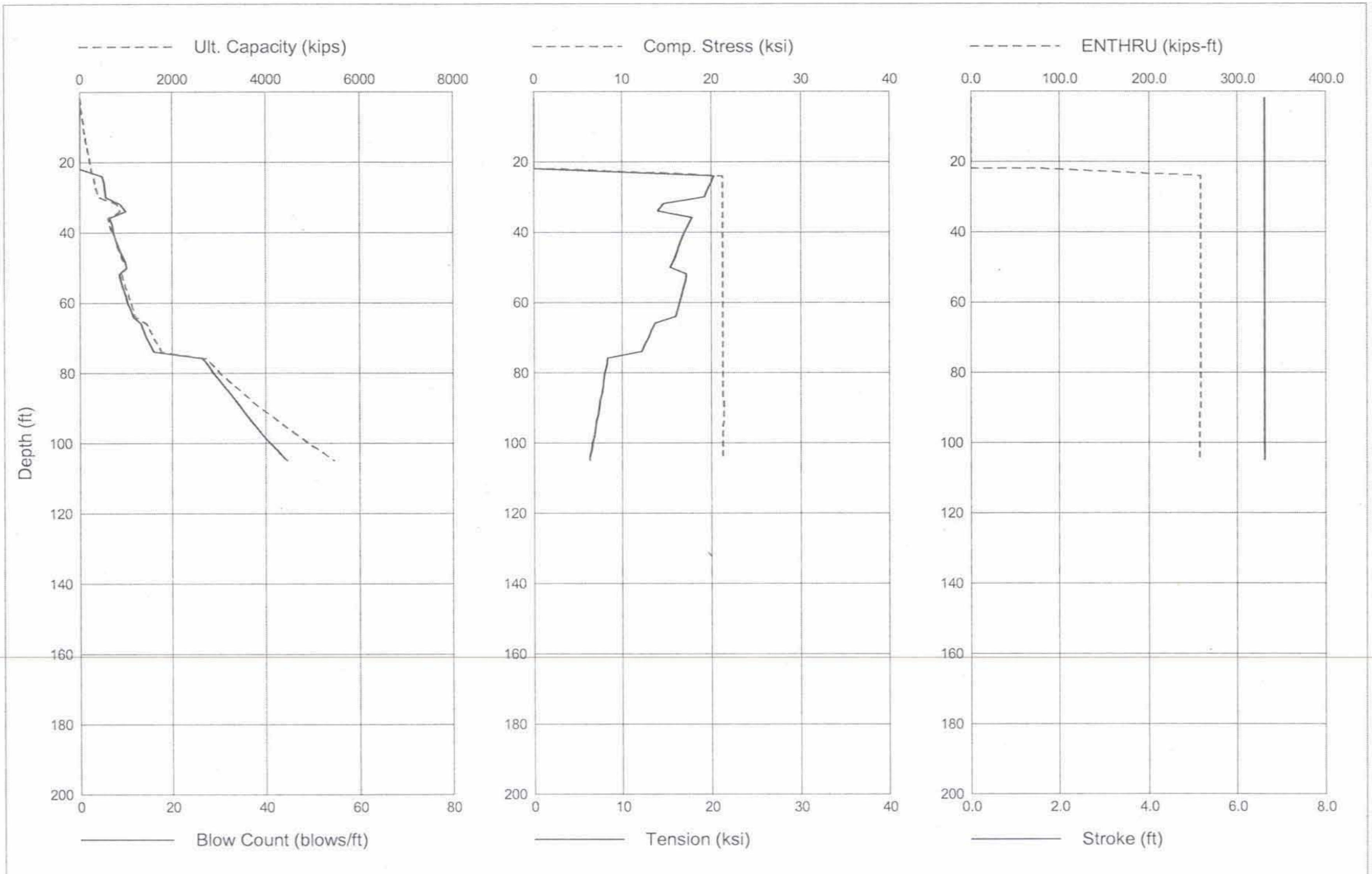
Total Number of Blows: 1548

Driving Time (min):	51	38	30	25	22	19	17	15	14	12
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

California D.O.T. Geotechnical Services — Apr 29 2009

Colorado B3-Hammer IHC S-400, 1-750 — Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 — GRLWEAP(TM) Version 2005



ANALYSIS 16

Bent 3

108" Pile, 1.375-inch Thick

Menck 500T Hammer

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	13.5	1.0	12.4	0.0	0.000	0.000	6.15	0.0
4.0	29.0	4.1	24.9	0.0	0.000	0.000	6.15	0.0
6.0	46.6	9.3	37.3	0.0	0.000	0.000	6.15	0.0
8.0	66.3	16.6	49.7	0.0	0.000	0.000	6.15	0.0
10.0	88.1	25.9	62.2	0.0	0.000	0.000	6.15	0.0
12.0	111.9	37.3	74.6	0.0	0.000	0.000	6.15	0.0
14.0	137.8	50.8	87.0	0.0	0.000	0.000	6.15	0.0
16.0	165.8	66.3	99.5	0.0	0.000	0.000	6.15	0.0
18.0	195.9	84.0	111.9	0.0	0.000	0.000	6.15	0.0
20.0	228.0	103.7	124.4	0.0	0.000	0.000	6.15	0.0
22.0	262.2	125.4	136.8	3.3	26.869	-22.299	6.15	375.4
24.0	298.5	149.3	149.2	3.4	26.850	-21.909	6.15	375.4
26.0	336.9	175.2	161.7	3.6	26.835	-21.517	6.15	375.4
28.0	377.3	203.2	174.1	3.7	26.838	-21.080	6.15	375.4
30.0	419.8	233.3	186.5	3.9	26.843	-20.618	6.15	375.4
32.0	801.9	283.0	518.9	6.3	26.847	-14.472	6.15	375.4
34.0	890.9	336.3	554.6	7.0	26.846	-14.321	6.15	375.4
36.0	610.1	382.9	227.2	4.6	26.844	-18.451	6.15	375.4
38.0	661.5	421.8	239.7	4.8	26.841	-17.901	6.15	375.4
40.0	714.9	462.8	252.1	5.1	26.832	-17.316	6.15	375.4
42.0	770.4	505.8	264.5	5.4	26.820	-16.769	6.15	375.4
44.0	827.9	551.0	277.0	5.7	26.802	-16.429	6.15	375.4
46.0	887.6	598.2	289.4	6.1	26.780	-16.146	6.15	375.3
48.0	949.3	647.5	301.8	6.5	26.753	-15.867	6.15	375.3
50.0	1013.1	698.8	314.3	6.9	26.723	-15.445	6.15	375.3
52.0	915.7	739.8	175.9	6.0	26.685	-18.841	6.15	375.3
54.0	962.4	781.9	180.5	6.3	26.647	-18.720	6.15	375.3
56.0	1010.1	825.1	185.0	6.4	26.605	-18.596	6.15	375.3
58.0	1059.0	869.4	189.6	6.7	26.562	-18.467	6.15	375.2
60.0	1108.9	914.7	194.2	7.0	26.517	-18.342	6.15	375.2
62.0	1159.9	961.1	198.7	7.3	26.483	-18.219	6.15	375.1
64.0	1211.9	1008.6	203.3	7.6	26.424	-18.078	6.15	375.1
66.0	1447.8	1064.5	383.3	9.3	26.385	-13.751	6.15	375.0
68.0	1525.2	1129.4	395.8	9.7	26.349	-13.582	6.15	374.9
70.0	1604.7	1196.5	408.2	10.2	26.312	-13.497	6.15	374.8
72.0	1686.2	1265.5	420.6	10.7	26.213	-13.410	6.15	374.7
74.0	1769.8	1336.7	433.1	11.3	26.164	-13.329	6.15	374.6
76.0	2726.5	1447.1	1279.4	19.7	26.140	-10.273	6.15	374.5
78.0	2878.7	1599.3	1279.4	20.4	26.067	-10.024	6.15	374.4
80.0	3036.4	1757.0	1279.4	21.3	25.959	-9.782	6.15	374.4
82.0	3199.6	1920.2	1279.4	22.3	25.869	-9.581	6.15	374.4
84.0	3368.3	2088.9	1279.4	23.5	25.814	-9.395	6.15	374.4
86.0	3542.6	2263.1	1279.4	24.7	25.723	-9.185	6.15	374.4
88.0	3722.3	2442.9	1279.4	26.1	25.653	-8.958	6.15	374.4
90.0	3907.5	2628.1	1279.4	27.0	25.579	-8.721	6.15	374.5

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	4098.3	2818.8	1279.4	27.9	25.499	-8.474	6.15	374.5
94.0	4294.5	3015.1	1279.4	28.9	25.412	-8.201	6.15	374.6
96.0	4496.0	3216.5	1279.4	29.9	25.318	-7.916	6.15	374.6
98.0	4702.4	3422.9	1279.4	31.0	25.236	-7.619	6.15	374.7
100.0	4913.7	3634.3	1279.4	32.1	25.162	-7.323	6.15	374.7
102.0	5130.0	3850.6	1279.4	33.3	25.095	-7.017	6.15	374.8
104.0	5351.3	4071.9	1279.4	34.6	25.026	-6.704	6.15	374.9
105.0	5463.7	4184.3	1279.4	35.3	24.992	-6.546	6.15	374.9

Total Number of Blows:	1156									
Driving Time (min):	38	28	23	19	16	14	12	11	10	9
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

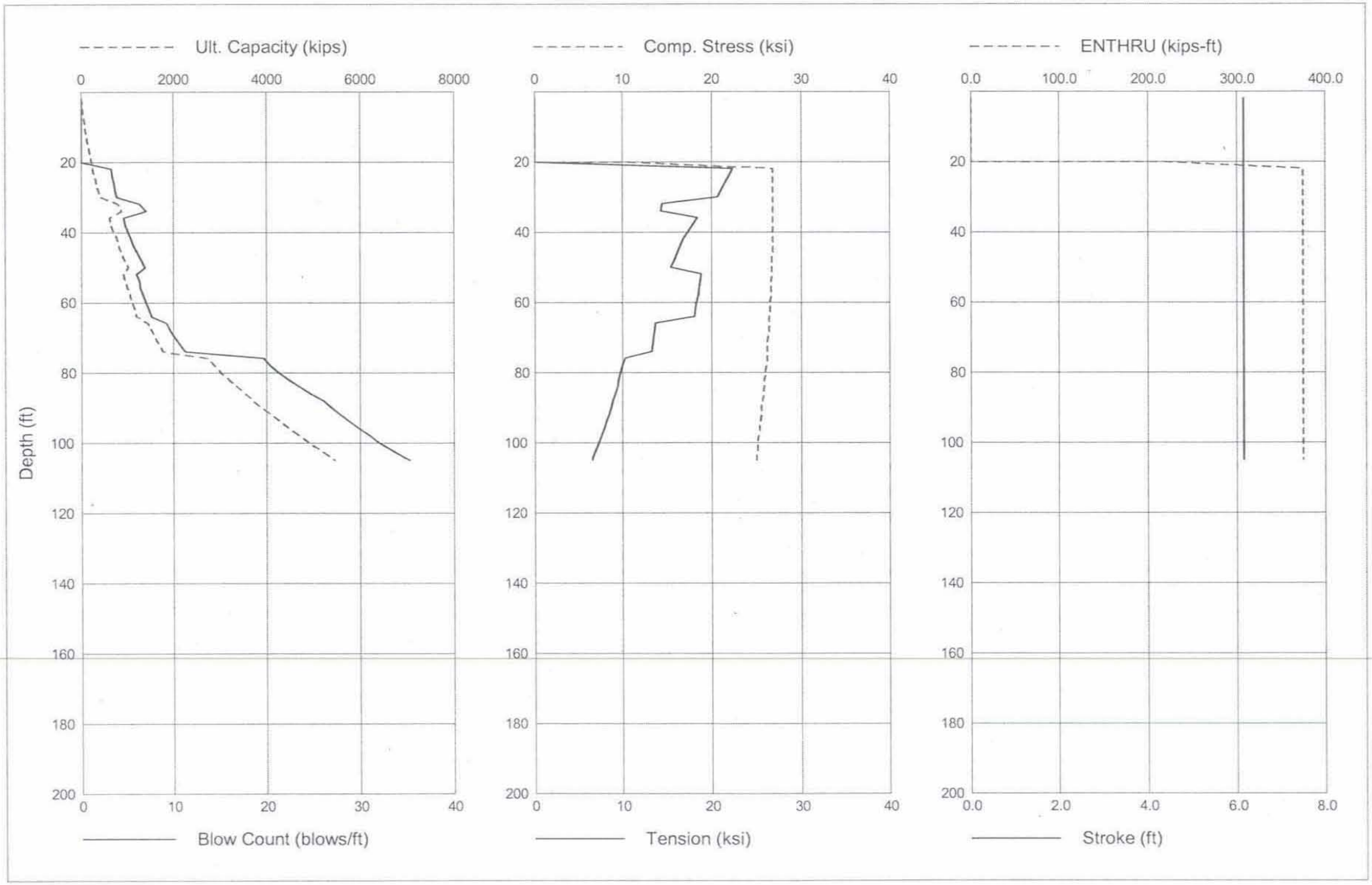
California D.O.T. Geotechnical Services

Apr 29 2009

Colorado B3-Hammer Menck MHU 500T, 1-375

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



ANALYSIS 17

Bent 3

108" Pile, 1.500-inch Thick

Menck 500T Hammer

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	13.5	1.0	12.4	0.0	0.000	0.000	6.15	0.0
4.0	29.0	4.1	24.9	0.0	0.000	0.000	6.15	0.0
6.0	46.6	9.3	37.3	0.0	0.000	0.000	6.15	0.0
8.0	66.3	16.6	49.7	0.0	0.000	0.000	6.15	0.0
10.0	88.1	25.9	62.2	0.0	0.000	0.000	6.15	0.0
12.0	111.9	37.3	74.6	0.0	0.000	0.000	6.15	0.0
14.0	137.8	50.8	87.0	0.0	0.000	0.000	6.15	0.0
16.0	165.8	66.3	99.5	0.0	0.000	0.000	6.15	0.0
18.0	195.9	84.0	111.9	0.0	0.000	0.000	6.15	0.0
20.0	228.0	103.7	124.4	0.0	0.000	0.000	6.15	0.0
22.0	262.2	125.4	136.8	0.0	0.000	0.000	6.15	0.0
24.0	298.5	149.3	149.2	3.6	26.102	-22.474	6.15	374.6
26.0	336.9	175.2	161.7	3.7	26.099	-22.131	6.15	374.6
28.0	377.3	203.2	174.1	3.9	26.102	-21.764	6.15	374.6
30.0	419.8	233.3	186.5	4.1	26.106	-21.364	6.15	374.6
32.0	801.9	283.0	518.9	6.4	26.110	-13.755	6.15	374.6
34.0	890.9	336.3	554.6	7.1	26.109	-13.630	6.15	374.6
36.0	610.1	382.9	227.2	5.0	26.103	-19.360	6.15	374.6
38.0	661.5	421.8	239.7	5.1	26.094	-18.861	6.15	374.6
40.0	714.9	462.8	252.1	5.3	26.079	-18.375	6.15	374.6
42.0	770.4	505.8	264.5	5.6	26.060	-17.829	6.15	374.6
44.0	827.9	551.0	277.0	5.9	26.038	-17.248	6.15	374.6
46.0	887.6	598.2	289.4	6.2	26.013	-16.881	6.15	374.5
48.0	949.3	647.5	301.8	6.6	25.989	-16.558	6.15	374.5
50.0	1013.1	698.8	314.3	7.0	25.962	-16.093	6.15	374.5
52.0	915.7	739.8	175.9	6.3	25.927	-19.188	6.15	374.5
54.0	962.4	781.9	180.5	6.4	25.892	-19.081	6.15	374.5
56.0	1010.1	825.1	185.0	6.7	25.854	-18.979	6.15	374.5
58.0	1059.0	869.4	189.6	6.9	25.815	-18.880	6.15	374.4
60.0	1108.9	914.7	194.2	7.2	25.774	-18.790	6.15	374.4
62.0	1159.9	961.1	198.7	7.5	25.743	-18.701	6.15	374.4
64.0	1211.9	1008.6	203.3	7.8	25.688	-18.597	6.15	374.4
66.0	1447.8	1064.5	383.3	9.5	25.656	-14.673	6.15	374.4
68.0	1525.2	1129.4	395.8	9.9	25.611	-14.337	6.15	374.4
70.0	1604.7	1196.5	408.2	10.4	25.577	-13.932	6.15	374.4
72.0	1686.2	1265.5	420.6	10.9	25.493	-13.460	6.15	374.4
74.0	1769.8	1336.7	433.1	11.5	25.441	-12.959	6.15	374.4
76.0	2726.5	1447.1	1279.4	20.1	25.410	-10.516	6.15	374.4
78.0	2878.7	1599.3	1279.4	21.1	25.345	-10.319	6.15	374.4
80.0	3036.4	1757.0	1279.4	22.0	25.250	-10.121	6.15	374.4
82.0	3199.6	1920.2	1279.4	23.0	25.155	-9.963	6.15	374.4
84.0	3368.3	2088.9	1279.4	24.1	25.100	-9.818	6.15	374.4
86.0	3542.6	2263.1	1279.4	25.1	25.039	-9.654	6.15	374.4
88.0	3722.3	2442.9	1279.4	26.3	24.976	-9.518	6.15	374.5
90.0	3907.5	2628.1	1279.4	27.6	24.911	-9.333	6.15	374.5

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	4098.3	2818.8	1279.4	28.5	24.840	-9.123	6.15	374.5
94.0	4294.5	3015.1	1279.4	29.4	24.762	-8.890	6.15	374.5
96.0	4496.0	3216.5	1279.4	30.3	24.673	-8.656	6.15	374.6
98.0	4702.4	3422.9	1279.4	31.2	24.599	-8.416	6.15	374.6
100.0	4913.7	3634.3	1279.4	32.2	24.538	-8.180	6.15	374.6
102.0	5130.0	3850.6	1279.4	33.2	24.479	-7.912	6.15	374.7
104.0	5351.3	4071.9	1279.4	34.3	24.418	-7.630	6.15	374.7
105.0	5463.7	4184.3	1279.4	34.9	24.387	-7.493	6.15	374.7

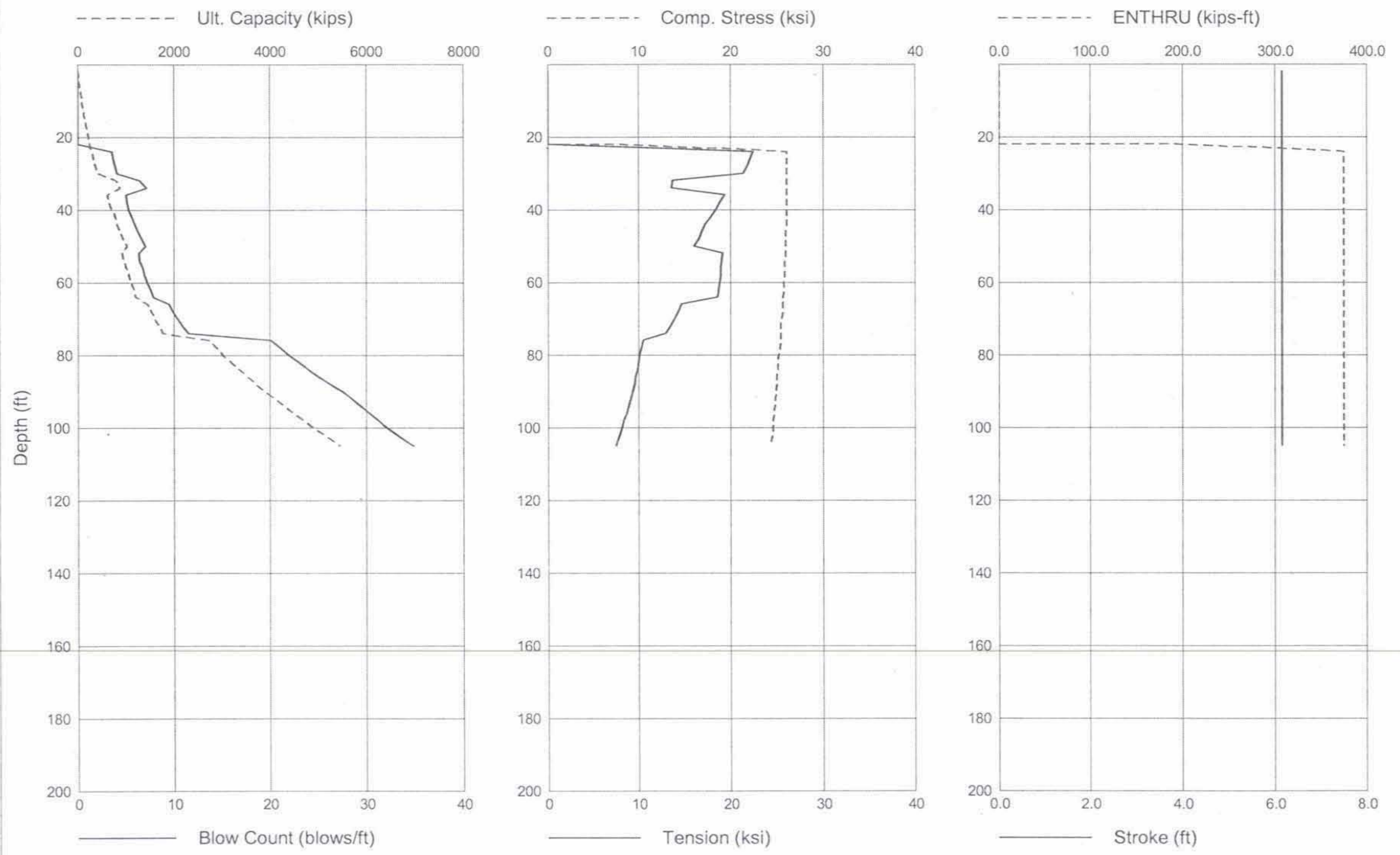
Total Number of Blows: 1169

Driving Time (min):	38	29	23	19	16	14	12	11	10	9
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

California D.O.T. Geotechnical Services Apr 29 2009

Colorado B3-Hammer Menck MHU 500T, 1-500 Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 GRLWEAP(TM) Version 2005



ANALYSIS 18

Bent 3

108" Pile, 1.750-inch Thick

Menck 500T Hammer

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	13.5	1.0	12.4	0.0	0.000	0.000	6.15	0.0
4.0	29.0	4.1	24.9	0.0	0.000	0.000	6.15	0.0
6.0	46.6	9.3	37.3	0.0	0.000	0.000	6.15	0.0
8.0	66.3	16.6	49.7	0.0	0.000	0.000	6.15	0.0
10.0	88.1	25.9	62.2	0.0	0.000	0.000	6.15	0.0
12.0	111.9	37.3	74.6	0.0	0.000	0.000	6.15	0.0
14.0	137.8	50.8	87.0	0.0	0.000	0.000	6.15	0.0
16.0	165.8	66.3	99.5	0.0	0.000	0.000	6.15	0.0
18.0	195.9	84.0	111.9	0.0	0.000	0.000	6.15	0.0
20.0	228.0	103.7	124.4	0.0	0.000	0.000	6.15	0.0
22.0	262.2	125.4	136.8	0.0	0.000	0.000	6.15	0.0
24.0	298.5	149.3	149.2	4.0	24.726	-22.254	6.15	373.3
26.0	336.9	175.2	161.7	4.1	24.727	-21.890	6.15	373.3
28.0	377.3	203.2	174.1	4.3	24.729	-21.600	6.15	373.3
30.0	419.8	233.3	186.5	4.5	24.733	-21.306	6.15	373.3
32.0	801.9	283.0	518.9	6.6	24.736	-15.914	6.15	373.3
34.0	890.9	336.3	554.6	7.3	24.734	-14.800	6.15	373.3
36.0	610.1	382.9	227.2	5.3	24.729	-19.930	6.15	373.3
38.0	661.5	421.8	239.7	5.6	24.720	-19.506	6.15	373.3
40.0	714.9	462.8	252.1	5.8	24.708	-19.042	6.15	373.3
42.0	770.4	505.8	264.5	5.9	24.691	-18.569	6.15	373.3
44.0	827.9	551.0	277.0	6.2	24.672	-18.188	6.15	373.3
46.0	887.6	598.2	289.4	6.5	24.649	-17.771	6.15	373.3
48.0	949.3	647.5	301.8	6.9	24.622	-17.326	6.15	373.3
50.0	1013.1	698.8	314.3	7.3	24.593	-16.974	6.15	373.3
52.0	915.7	739.8	175.9	6.5	24.558	-19.000	6.15	373.3
54.0	962.4	781.9	180.5	6.8	24.524	-18.932	6.15	373.3
56.0	1010.1	825.1	185.0	7.1	24.489	-18.867	6.15	373.3
58.0	1059.0	869.4	189.6	7.4	24.460	-18.802	6.15	373.3
60.0	1108.9	914.7	194.2	7.6	24.429	-18.743	6.15	373.3
62.0	1159.9	961.1	198.7	7.9	24.385	-18.682	6.15	373.3
64.0	1211.9	1008.6	203.3	8.2	24.353	-18.617	6.15	373.3
66.0	1447.8	1064.5	383.3	9.9	24.331	-15.783	6.15	373.3
68.0	1525.2	1129.4	395.8	10.3	24.271	-15.409	6.15	373.3
70.0	1604.7	1196.5	408.2	10.8	24.202	-15.016	6.15	373.3
72.0	1686.2	1265.5	420.6	11.2	24.176	-14.601	6.15	373.3
74.0	1769.8	1336.7	433.1	11.8	24.132	-14.200	6.15	373.3
76.0	2726.5	1447.1	1279.4	20.7	24.069	-10.342	6.15	373.3
78.0	2878.7	1599.3	1279.4	21.5	23.988	-10.224	6.15	373.3
80.0	3036.4	1757.0	1279.4	22.4	23.943	-10.088	6.15	373.3
82.0	3199.6	1920.2	1279.4	23.1	23.876	-9.950	6.15	373.3
84.0	3368.3	2088.9	1279.4	23.9	23.823	-9.849	6.15	373.3
86.0	3542.6	2263.1	1279.4	25.0	23.768	-9.783	6.15	373.3
88.0	3722.3	2442.9	1279.4	26.1	23.709	-9.727	6.15	373.3
90.0	3907.5	2628.1	1279.4	26.9	23.647	-9.607	6.15	373.3

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	4098.3	2818.8	1279.4	27.6	23.579	-9.466	6.15	373.3
94.0	4294.5	3015.1	1279.4	28.4	23.516	-9.307	6.15	373.3
96.0	4496.0	3216.5	1279.4	29.1	23.453	-9.141	6.15	373.3
98.0	4702.4	3422.9	1279.4	29.9	23.397	-8.980	6.15	373.3
100.0	4913.7	3634.3	1279.4	30.8	23.343	-8.795	6.15	373.3
102.0	5130.0	3850.6	1279.4	31.6	23.291	-8.606	6.15	373.3
104.0	5351.3	4071.9	1279.4	32.6	23.245	-8.399	6.15	373.3
105.0	5463.7	4184.3	1279.4	33.1	23.224	-8.289	6.15	373.3

Total Number of Blows: 1170

Driving Time (min):	39	29	23	19	16	14	13	11	10	9
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

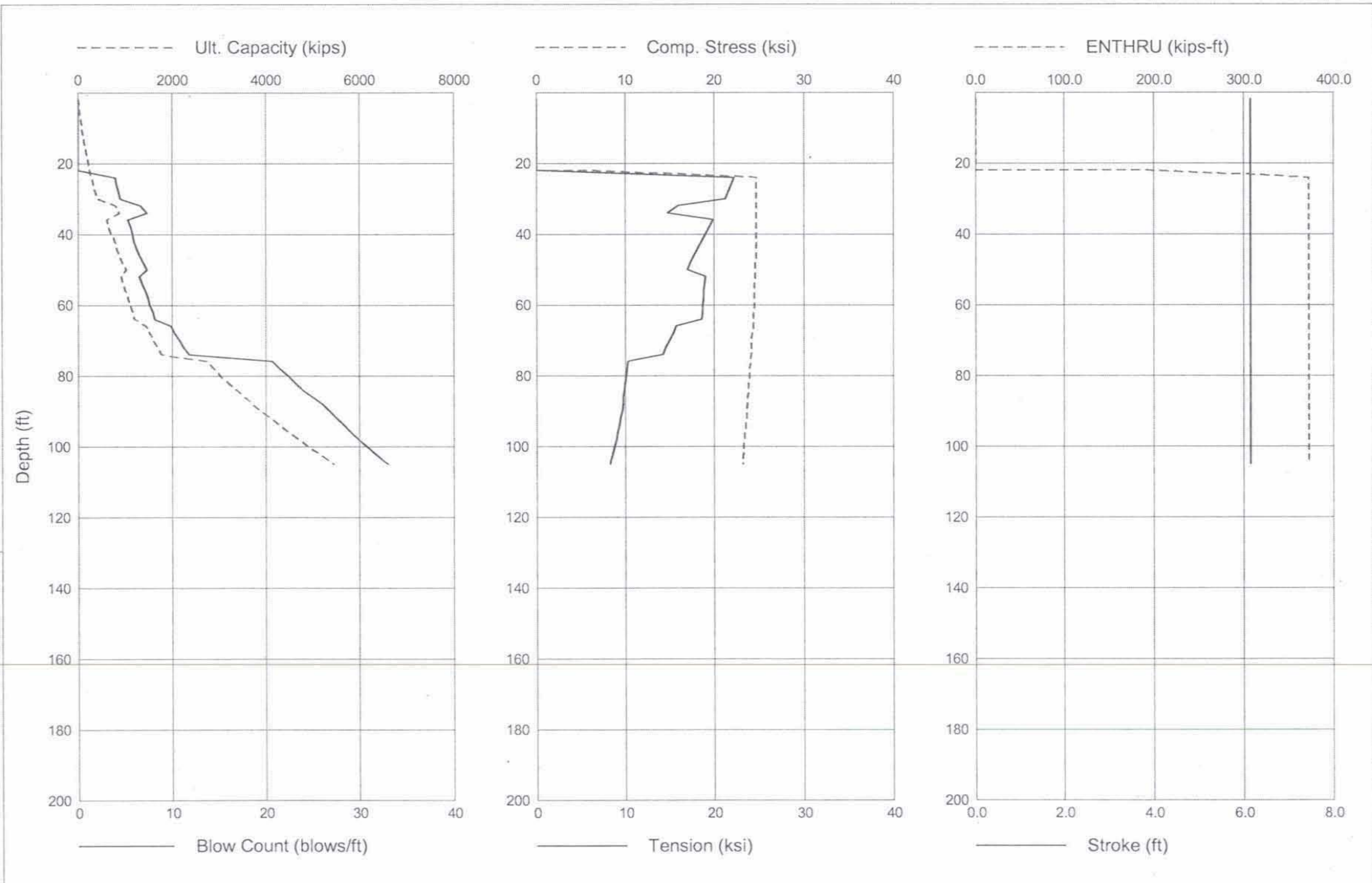
California D.O.T. Geotechnical Services

Apr 29 2009

Colorado B3-Hammer Menck MHU 500T, 1-750

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



ANALYSIS 19

Bent 4

108" Pile, 1.375-inch Thick

Delmag D 100-13 Hammer

California D.O.T. Geotechnical Services
Colorado B4-Hammer Delmag D100-13, 1-375

Apr 29 2009
GRLWEAP(TM) Version 2005

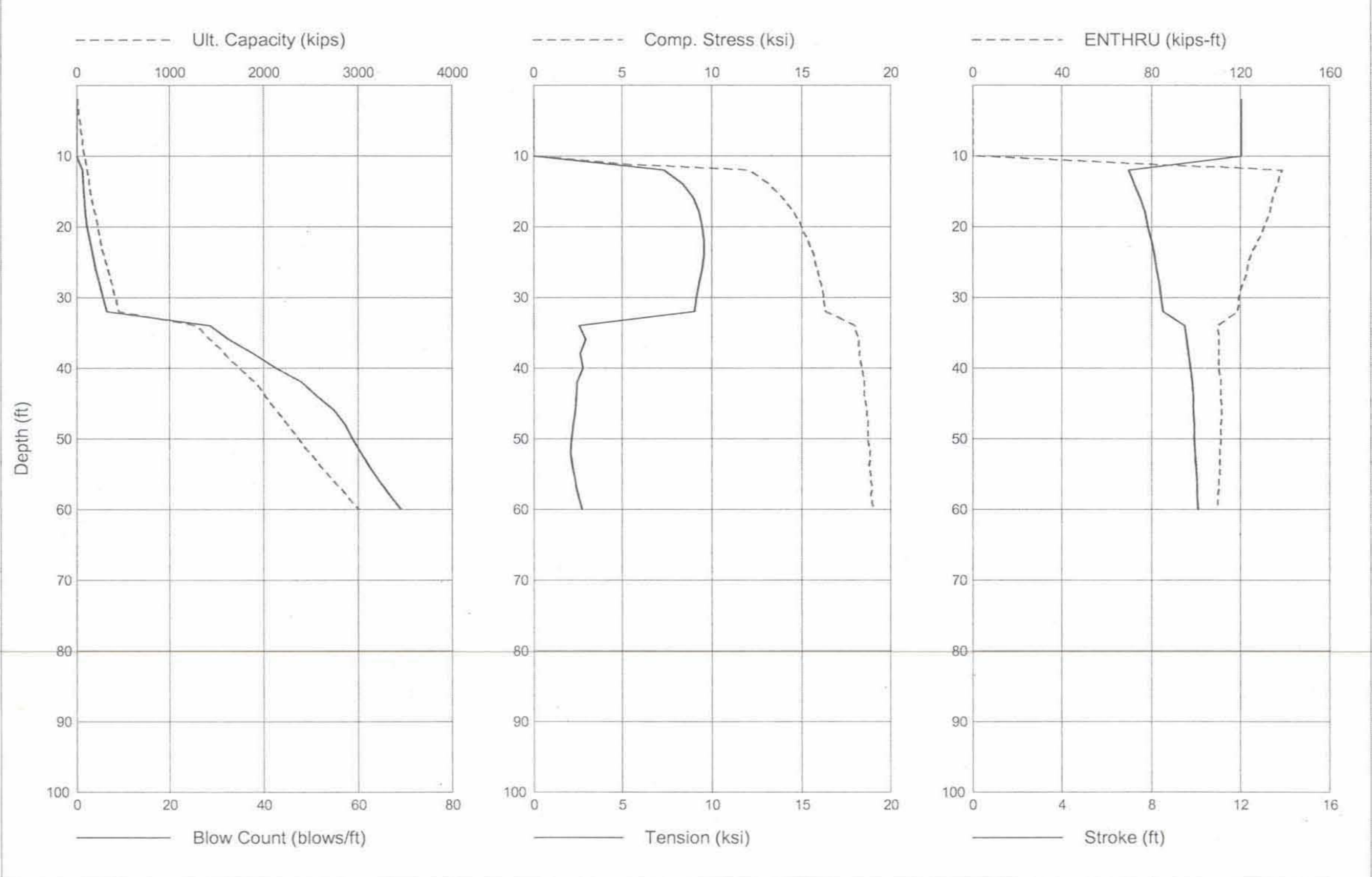
Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	13.5	1.0	12.4	0.0	0.000	0.000	12.04	0.0
4.0	29.0	4.1	24.9	0.0	0.000	0.000	12.04	0.0
6.0	46.6	9.3	37.3	0.0	0.000	0.000	12.04	0.0
8.0	66.3	16.6	49.7	0.0	0.000	0.000	12.04	0.0
10.0	88.1	25.9	62.2	0.0	0.000	0.000	12.04	0.0
12.0	111.9	37.3	74.6	1.3	12.097	-7.315	6.97	138.7
14.0	137.8	50.8	87.0	1.5	13.215	-8.423	7.25	136.7
16.0	165.8	66.3	99.5	1.7	13.959	-8.967	7.50	134.7
18.0	195.8	83.9	111.9	2.0	14.612	-9.285	7.69	133.4
20.0	228.0	103.6	124.4	2.4	15.024	-9.475	7.85	130.9
22.0	262.2	125.4	136.8	2.9	15.386	-9.571	8.02	127.8
24.0	298.4	149.2	149.2	3.5	15.698	-9.547	8.13	124.8
26.0	336.8	175.1	161.7	4.2	15.863	-9.449	8.23	123.1
28.0	377.2	203.1	174.1	5.0	16.070	-9.320	8.32	121.4
30.0	419.6	233.1	186.5	5.8	16.217	-9.164	8.41	119.1
32.0	464.2	265.2	199.0	6.6	16.360	-9.028	8.50	118.7
34.0	1288.4	334.4	954.0	28.6	17.992	-2.603	9.48	109.8
36.0	1436.1	409.1	1027.0	32.8	18.220	-2.950	9.57	110.1
38.0	1589.4	489.3	1100.0	37.8	18.290	-2.619	9.66	110.2
40.0	1748.1	575.0	1173.0	42.7	18.364	-2.795	9.75	110.3
42.0	1912.3	666.3	1246.1	48.0	18.517	-2.474	9.82	111.0
44.0	2020.2	763.0	1257.2	51.3	18.553	-2.420	9.86	111.2
46.0	2133.6	865.2	1268.3	55.0	18.672	-2.375	9.89	111.4
48.0	2252.4	973.0	1279.4	57.2	18.754	-2.277	9.91	111.0
50.0	2365.7	1086.2	1279.4	58.8	18.743	-2.162	9.94	111.0
52.0	2484.4	1205.0	1279.4	60.6	18.865	-2.114	9.97	110.9
54.0	2608.7	1329.3	1279.4	62.5	18.799	-2.229	10.00	110.6
56.0	2738.5	1459.0	1279.4	64.5	18.914	-2.379	10.03	110.5
57.0	2805.4	1526.0	1279.4	65.8	18.967	-2.450	10.04	110.1
58.0	2873.7	1594.3	1279.4	66.8	18.923	-2.557	10.06	110.0
60.0	3014.5	1735.1	1279.4	69.2	19.010	-2.764	10.09	109.7

Total Continuous Driving Time 39.00 minutes; Total Number of Blows 1473

California D.O.T. Geotechnical Services — Apr 29 2009

Colorado B4-Hammer Delmag D100-13, 1-375 — Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 — GRLWEAP(TM) Version 2005



ANALYSIS 20

Bent 4

108" Pile, 1.500-inch Thick

Delmag D 100-13 Hammer

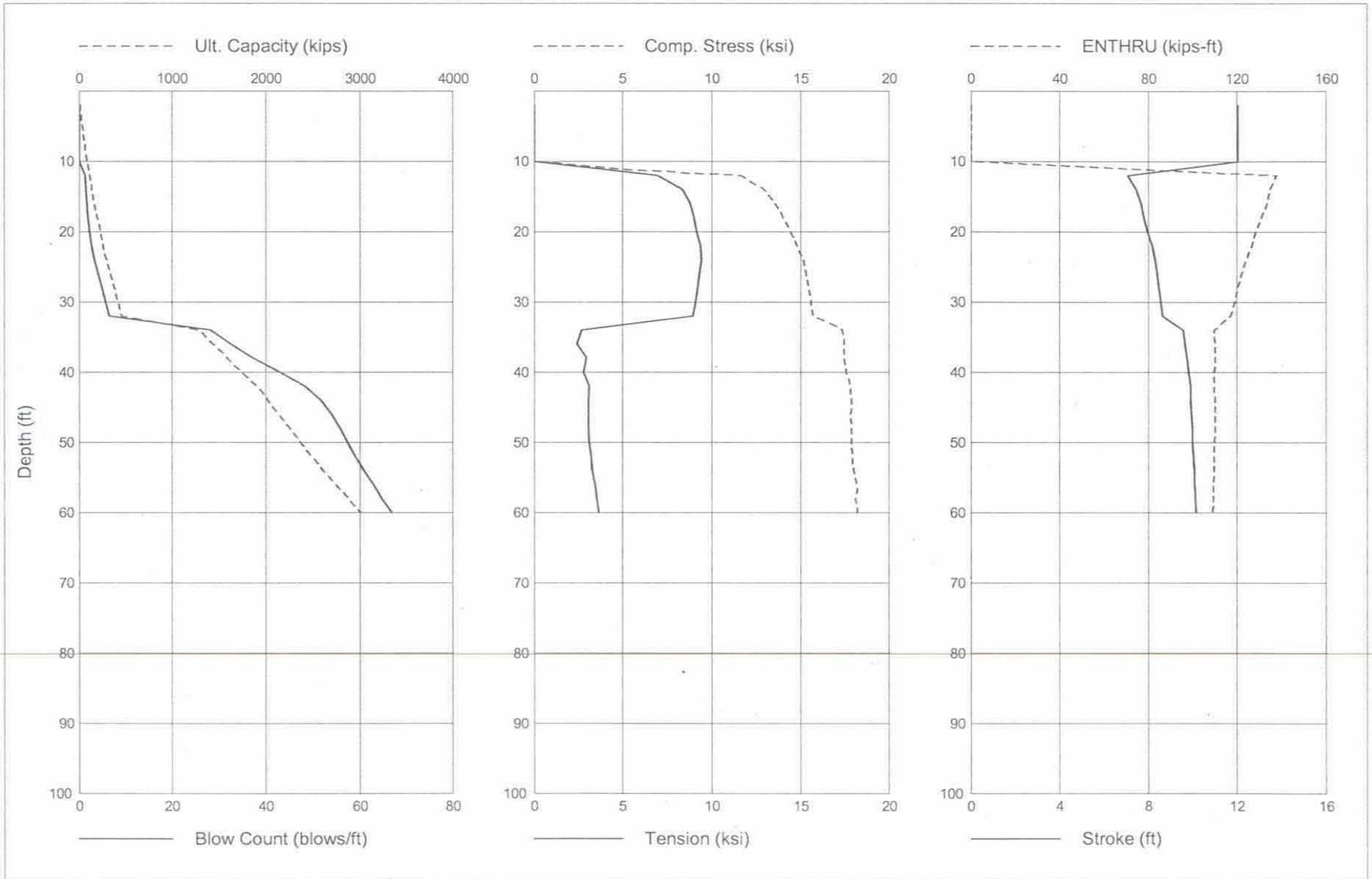
Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	13.5	1.0	12.4	0.0	0.000	0.000	12.04	0.0
4.0	29.0	4.1	24.9	0.0	0.000	0.000	12.04	0.0
6.0	46.6	9.3	37.3	0.0	0.000	0.000	12.04	0.0
8.0	66.3	16.6	49.7	0.0	0.000	0.000	12.04	0.0
10.0	88.1	25.9	62.2	0.0	0.000	0.000	12.04	0.0
12.0	111.9	37.3	74.6	1.3	11.614	-6.961	7.08	137.9
14.0	137.8	50.8	87.0	1.6	12.943	-8.352	7.46	134.9
16.0	165.8	66.3	99.5	1.8	13.573	-8.785	7.65	133.7
18.0	195.8	83.9	111.9	2.0	14.021	-8.993	7.80	131.3
20.0	228.0	103.6	124.4	2.3	14.433	-9.156	7.94	128.7
22.0	262.2	125.4	136.8	2.8	14.822	-9.370	8.16	126.8
24.0	298.4	149.2	149.2	3.4	15.165	-9.392	8.28	124.4
26.0	336.8	175.1	161.7	4.1	15.310	-9.292	8.37	122.2
28.0	377.2	203.1	174.1	4.9	15.495	-9.192	8.46	120.5
30.0	419.6	233.1	186.5	5.7	15.590	-9.077	8.55	119.3
32.0	464.2	265.2	199.0	6.6	15.715	-8.946	8.63	117.2
34.0	1288.4	334.4	954.0	28.3	17.355	-2.678	9.59	109.8
36.0	1436.1	409.1	1027.0	32.6	17.444	-2.418	9.66	110.1
38.0	1589.4	489.3	1100.0	37.2	17.486	-2.951	9.75	110.3
40.0	1748.1	575.0	1173.0	43.0	17.592	-2.782	9.82	109.8
42.0	1912.3	666.3	1246.1	48.4	17.828	-3.144	9.90	110.0
44.0	2020.2	763.0	1257.2	51.8	17.906	-3.071	9.94	110.1
46.0	2133.6	865.2	1268.3	53.9	17.841	-3.083	9.96	110.3
48.0	2252.4	973.0	1279.4	55.8	17.867	-3.077	9.99	110.1
50.0	2365.7	1086.2	1279.4	57.4	17.917	-3.134	10.01	110.0
52.0	2484.4	1205.0	1279.4	59.1	17.967	-3.211	10.04	109.8
54.0	2608.7	1329.3	1279.4	60.9	17.998	-3.305	10.07	109.7
56.0	2738.5	1459.0	1279.4	62.8	18.142	-3.427	10.10	109.4
57.0	2805.4	1526.0	1279.4	63.8	18.198	-3.490	10.12	109.3
58.0	2873.7	1594.3	1279.4	64.7	18.099	-3.543	10.13	109.3
60.0	3014.5	1735.1	1279.4	67.0	18.234	-3.677	10.16	108.9

Total Continuous Driving Time 39.00 minutes; Total Number of Blows 1452

California D.O.T. Geotechnical Services — Apr 29 2009

Colorado B4-Hammer Delmag D100-13, 1-500 — Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 — GRLWEAP(TM) Version 2005



ANALYSIS 21

Bent 4

108" Pile, 1.750-inch Thick

Delmag D 100-13 Hammer

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	13.5	1.0	12.4	0.0	0.000	0.000	12.04	0.0
4.0	29.0	4.1	24.9	0.0	0.000	0.000	12.04	0.0
6.0	46.6	9.3	37.3	0.0	0.000	0.000	12.04	0.0
8.0	66.3	16.6	49.7	0.0	0.000	0.000	12.04	0.0
10.0	88.1	25.9	62.2	0.0	0.000	0.000	12.04	0.0
12.0	111.9	37.3	74.6	0.0	0.000	0.000	12.04	0.0
14.0	137.8	50.8	87.0	1.6	11.900	-7.670	7.67	133.6
16.0	165.8	66.3	99.5	1.8	12.768	-8.330	7.93	129.9
18.0	195.8	83.9	111.9	2.0	13.255	-8.730	8.18	130.0
20.0	228.0	103.6	124.4	2.3	13.594	-8.831	8.29	127.6
22.0	262.2	125.4	136.8	2.7	13.902	-8.878	8.40	125.2
24.0	298.4	149.2	149.2	3.3	14.152	-8.920	8.52	122.6
26.0	336.8	175.1	161.7	4.0	14.331	-8.907	8.62	120.0
28.0	377.2	203.1	174.1	4.8	14.465	-8.814	8.71	118.0
30.0	419.6	233.1	186.5	5.5	14.569	-8.719	8.78	116.5
32.0	464.2	265.2	199.0	6.4	14.719	-8.615	8.87	115.1
34.0	1288.4	334.4	954.0	28.2	16.095	-3.229	9.80	109.3
36.0	1436.1	409.1	1027.0	31.8	16.225	-3.290	9.88	109.3
38.0	1589.4	489.3	1100.0	36.5	16.349	-2.574	9.96	109.5
40.0	1748.1	575.0	1173.0	41.5	16.359	-2.546	10.01	109.8
42.0	1912.3	666.3	1246.1	47.5	16.526	-2.882	10.07	109.7
44.0	2020.2	763.0	1257.2	50.6	16.551	-2.930	10.10	109.5
46.0	2133.6	865.2	1268.3	52.5	16.546	-2.928	10.12	109.0
48.0	2252.4	973.0	1279.4	54.2	16.556	-3.081	10.16	108.6
50.0	2365.7	1086.2	1279.4	55.6	16.592	-3.147	10.18	108.5
52.0	2484.4	1205.0	1279.4	57.1	16.729	-3.205	10.21	108.2
54.0	2608.7	1329.3	1279.4	58.7	16.776	-3.247	10.24	108.0
56.0	2738.5	1459.0	1279.4	60.3	16.721	-3.289	10.27	107.9
57.0	2805.4	1526.0	1279.4	61.1	16.851	-3.291	10.29	107.9
58.0	2873.7	1594.3	1279.4	62.0	16.880	-3.294	10.30	107.8
60.0	3014.5	1735.1	1279.4	63.8	16.929	-3.289	10.34	107.7

Total Continuous Driving Time 38.00 minutes; Total Number of Blows 1407

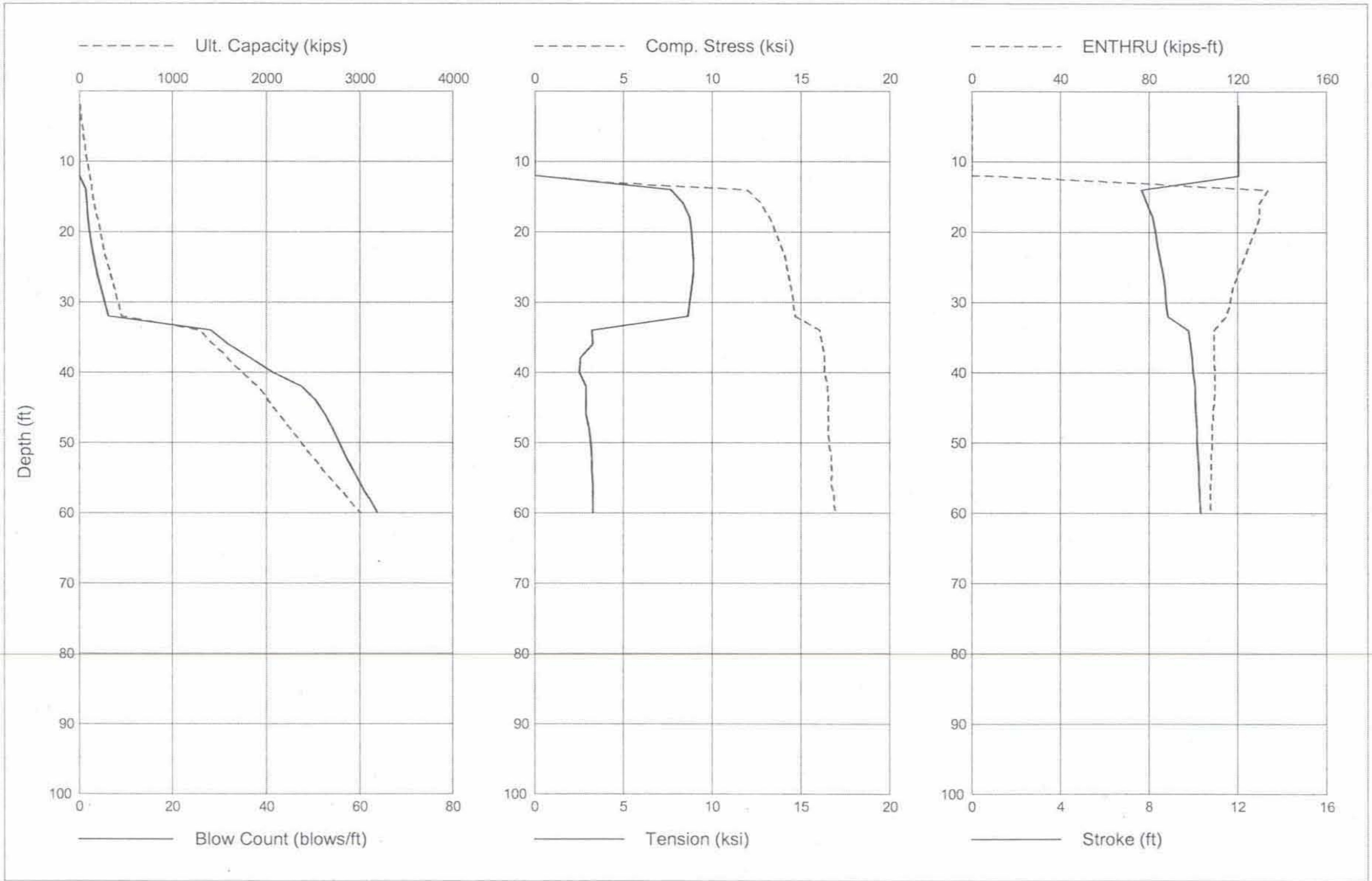
California D.O.T. Geotechnical Services

Apr 29 2009

Colorado B4-Hammer Delmag D100-13, 1-750

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



ANALYSIS 22

Bent 4

108" Pile, 1.375-inch Thick

IHC S-400 Hammer

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	13.5	1.0	12.4	0.0	0.000	0.000	6.62	0.0
4.0	29.0	4.1	24.9	0.0	0.000	0.000	6.62	0.0
6.0	46.6	9.3	37.3	0.0	0.000	0.000	6.62	0.0
8.0	66.3	16.6	49.7	0.0	0.000	0.000	6.62	0.0
10.0	88.1	25.9	62.2	0.0	0.000	0.000	6.62	0.0
12.0	111.9	37.3	74.6	0.0	0.000	0.000	6.62	0.0
14.0	137.8	50.8	87.0	0.0	0.000	0.000	6.62	0.0
16.0	165.8	66.3	99.5	2.6	23.996	-19.396	6.62	265.4
18.0	195.8	83.9	111.9	2.7	23.997	-19.131	6.62	265.4
20.0	228.0	103.6	124.4	2.9	23.997	-18.835	6.62	265.4
22.0	262.2	125.4	136.8	3.1	23.997	-18.559	6.62	265.4
24.0	298.4	149.2	149.2	3.2	23.997	-18.297	6.62	265.4
26.0	336.8	175.1	161.7	3.5	23.997	-18.006	6.62	265.4
28.0	377.2	203.1	174.1	3.7	23.998	-17.683	6.62	265.4
30.0	419.6	233.1	186.5	4.0	24.000	-17.322	6.62	265.4
32.0	464.2	265.2	199.0	4.3	24.003	-16.972	6.62	265.4
34.0	1288.4	334.4	954.0	13.6	24.008	-10.589	6.62	265.4
36.0	1436.1	409.1	1027.0	15.4	24.016	-10.051	6.62	265.3
38.0	1589.4	489.3	1100.0	17.1	24.026	-9.512	6.62	265.3
40.0	1748.1	575.0	1173.0	18.5	24.033	-9.001	6.62	265.3
42.0	1912.3	666.3	1246.1	19.7	24.036	-8.509	6.62	265.3
44.0	2020.2	763.0	1257.2	20.5	24.035	-8.314	6.62	265.3
46.0	2133.6	865.2	1268.3	21.3	24.030	-8.125	6.62	265.2
48.0	2252.4	973.0	1279.4	22.3	24.021	-7.954	6.62	265.2
50.0	2365.7	1086.2	1279.4	23.3	24.007	-7.842	6.62	265.1
52.0	2484.4	1205.0	1279.4	24.3	23.990	-7.735	6.62	265.1
54.0	2608.7	1329.3	1279.4	25.4	23.968	-7.634	6.62	265.0
56.0	2738.5	1459.0	1279.4	26.6	23.951	-7.533	6.62	264.9
57.0	2805.4	1526.0	1279.4	27.2	23.946	-7.485	6.62	264.8
58.0	2873.7	1594.3	1279.4	27.9	23.939	-7.435	6.62	264.8
60.0	3014.5	1735.1	1279.4	28.6	23.923	-7.344	6.62	264.6

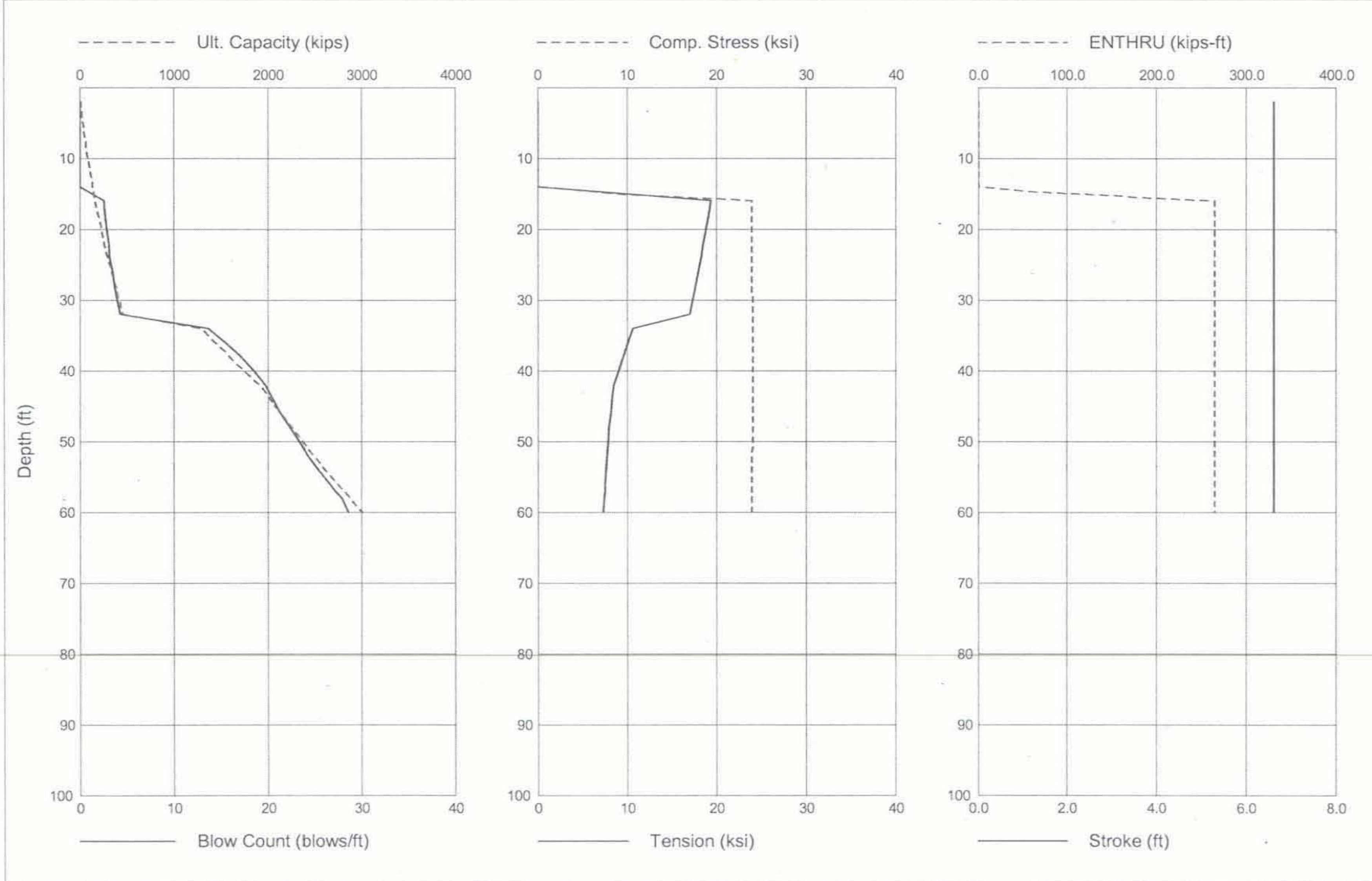
Total Number of Blows: 643

Driving Time (min):	21	16	12	10	9	8	7	6	5	5
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

California D.O.T. Geotechnical Services | Apr 29 2009

Colorado B4-Hammer IHC S-400, 1-375 | Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 | GRLWEAP(TM) Version 2005



ANALYSIS 23

Bent 4

108" Pile, 1.500-inch Thick

IHC S-400 Hammer

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	13.5	1.0	12.4	0.0	0.000	0.000	6.62	0.0
4.0	29.0	4.1	24.9	0.0	0.000	0.000	6.62	0.0
6.0	46.6	9.3	37.3	0.0	0.000	0.000	6.62	0.0
8.0	66.3	16.6	49.7	0.0	0.000	0.000	6.62	0.0
10.0	88.1	25.9	62.2	0.0	0.000	0.000	6.62	0.0
12.0	111.9	37.3	74.6	0.0	0.000	0.000	6.62	0.0
14.0	137.8	50.8	87.0	0.0	0.000	0.000	6.62	0.0
16.0	165.8	66.3	99.5	0.0	0.000	0.000	6.62	0.0
18.0	195.8	83.9	111.9	2.8	23.035	-18.581	6.62	263.2
20.0	228.0	103.6	124.4	3.0	23.035	-18.325	6.62	263.2
22.0	262.2	125.4	136.8	3.2	23.035	-18.066	6.62	263.2
24.0	298.4	149.2	149.2	3.3	23.035	-17.838	6.62	263.2
26.0	336.8	175.1	161.7	3.6	23.036	-17.586	6.62	263.2
28.0	377.2	203.1	174.1	3.8	23.036	-17.316	6.62	263.2
30.0	419.6	233.1	186.5	4.1	23.038	-17.017	6.62	263.2
32.0	464.2	265.2	199.0	4.4	23.041	-16.691	6.62	263.2
34.0	1288.4	334.4	954.0	13.6	23.045	-10.418	6.62	263.2
36.0	1436.1	409.1	1027.0	15.1	23.053	-9.956	6.62	263.2
38.0	1589.4	489.3	1100.0	17.0	23.061	-9.489	6.62	263.2
40.0	1748.1	575.0	1173.0	18.9	23.067	-9.021	6.62	263.1
42.0	1912.3	666.3	1246.1	20.2	23.069	-8.562	6.62	263.1
44.0	2020.2	763.0	1257.2	20.9	23.068	-8.384	6.62	263.1
46.0	2133.6	865.2	1268.3	21.7	23.063	-8.217	6.62	263.0
48.0	2252.4	973.0	1279.4	22.6	23.054	-8.061	6.62	263.0
50.0	2365.7	1086.2	1279.4	23.5	23.042	-7.958	6.62	262.9
52.0	2484.4	1205.0	1279.4	24.4	23.026	-7.859	6.62	262.9
54.0	2608.7	1329.3	1279.4	25.5	23.005	-7.765	6.62	262.8
56.0	2738.5	1459.0	1279.4	26.6	22.985	-7.683	6.62	262.7
57.0	2805.4	1526.0	1279.4	27.2	22.977	-7.642	6.62	262.6
58.0	2873.7	1594.3	1279.4	27.7	22.970	-7.601	6.62	262.6
60.0	3014.5	1735.1	1279.4	28.3	22.954	-7.525	6.62	262.4

Total Number of Blows: 639

Driving Time (min):	21	15	12	10	9	7	7	6	5	5
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

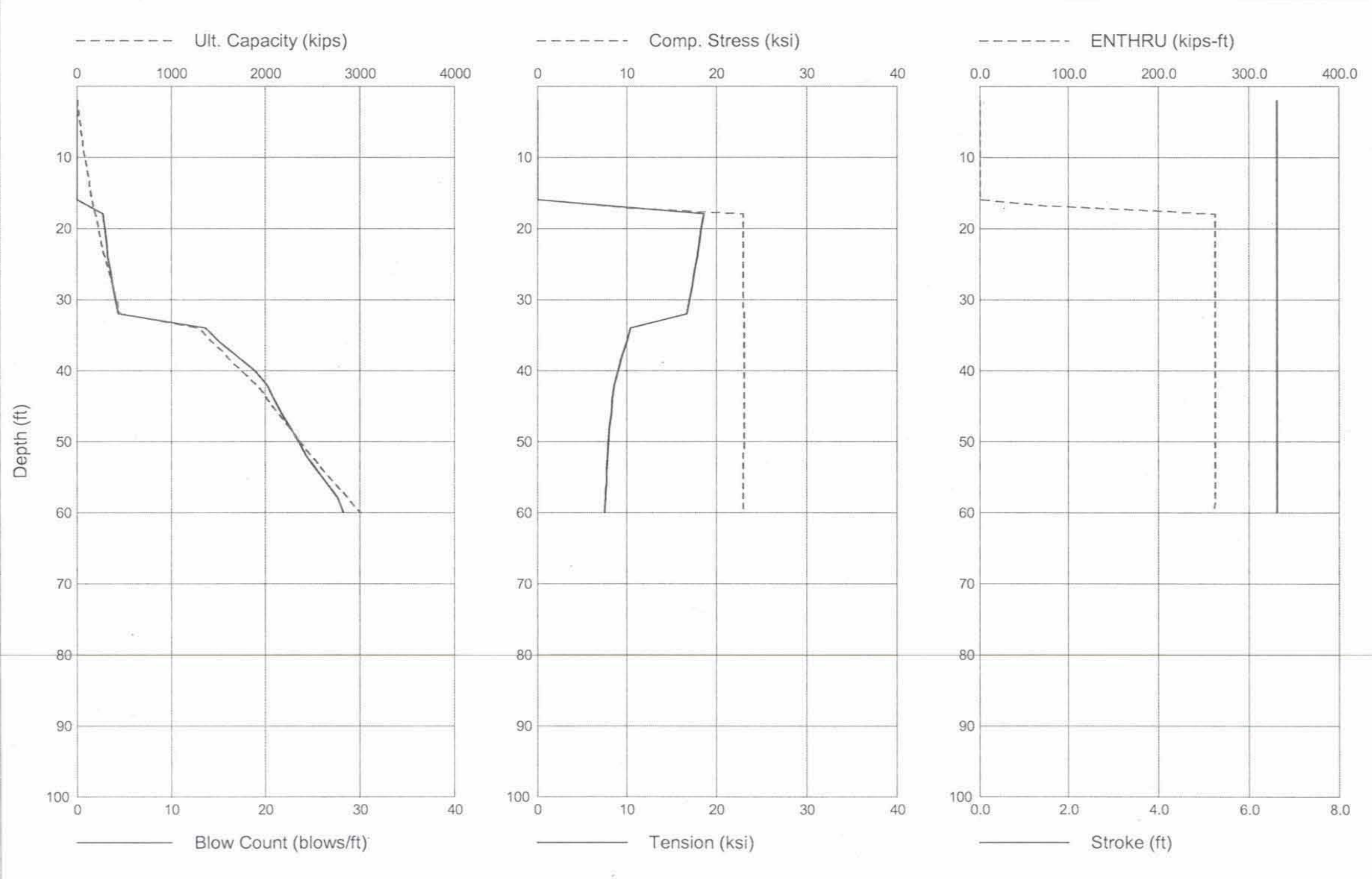
California D.O.T. Geotechnical Services

Apr 29 2009

Colorado B4-Hammer IHC S-400, 1-500

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



ANALYSIS 24

Bent 4

108" Pile, 1.750-inch Thick

IHC S-400 Hammer

California D.O.T. Geotechnical Services
Colorado B4-Hammer IHC S-400, 1-750

Apr 29 2009
GRLWEAP(TM) Version 2005

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	13.5	1.0	12.4	0.0	0.000	0.000	6.62	0.0
4.0	29.0	4.1	24.9	0.0	0.000	0.000	6.62	0.0
6.0	46.6	9.3	37.3	0.0	0.000	0.000	6.62	0.0
8.0	66.3	16.6	49.7	0.0	0.000	0.000	6.62	0.0
10.0	88.1	25.9	62.2	0.0	0.000	0.000	6.62	0.0
12.0	111.9	37.3	74.6	0.0	0.000	0.000	6.62	0.0
14.0	137.8	50.8	87.0	0.0	0.000	0.000	6.62	0.0
16.0	165.8	66.3	99.5	0.0	0.000	0.000	6.62	0.0
18.0	195.8	83.9	111.9	3.1	21.313	-17.639	6.62	258.2
20.0	228.0	103.6	124.4	3.2	21.313	-17.291	6.62	258.2
22.0	262.2	125.4	136.8	3.4	21.313	-17.105	6.62	258.2
24.0	298.4	149.2	149.2	3.5	21.313	-16.919	6.62	258.2
26.0	336.8	175.1	161.7	3.8	21.313	-16.717	6.62	258.2
28.0	377.2	203.1	174.1	4.0	21.314	-16.500	6.62	258.2
30.0	419.6	233.1	186.5	4.3	21.315	-16.263	6.62	258.2
32.0	464.2	265.2	199.0	4.5	21.321	-16.010	6.62	258.2
34.0	1288.4	334.4	954.0	13.9	21.327	-9.940	6.62	258.2
36.0	1436.1	409.1	1027.0	15.2	21.332	-9.581	6.62	258.2
38.0	1589.4	489.3	1100.0	16.7	21.335	-9.215	6.62	258.2
40.0	1748.1	575.0	1173.0	18.5	21.338	-8.858	6.62	258.2
42.0	1912.3	666.3	1246.1	20.7	21.339	-8.496	6.62	258.1
44.0	2020.2	763.0	1257.2	21.9	21.337	-8.354	6.62	258.1
46.0	2133.6	865.2	1268.3	23.1	21.332	-8.212	6.62	258.1
48.0	2252.4	973.0	1279.4	23.9	21.324	-8.079	6.62	258.0
50.0	2365.7	1086.2	1279.4	24.8	21.313	-7.989	6.62	258.0
52.0	2484.4	1205.0	1279.4	25.6	21.299	-7.902	6.62	257.9
54.0	2608.7	1329.3	1279.4	26.2	21.281	-7.819	6.62	257.8
56.0	2738.5	1459.0	1279.4	26.8	21.261	-7.739	6.62	257.7
57.0	2805.4	1526.0	1279.4	27.1	21.251	-7.701	6.62	257.7
58.0	2873.7	1594.3	1279.4	27.4	21.243	-7.663	6.62	257.6
60.0	3014.5	1735.1	1279.4	28.0	21.224	-7.740	6.62	257.4

Total Number of Blows: 656

Driving Time (min):	21	16	13	10	9	8	7	6	5	5
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

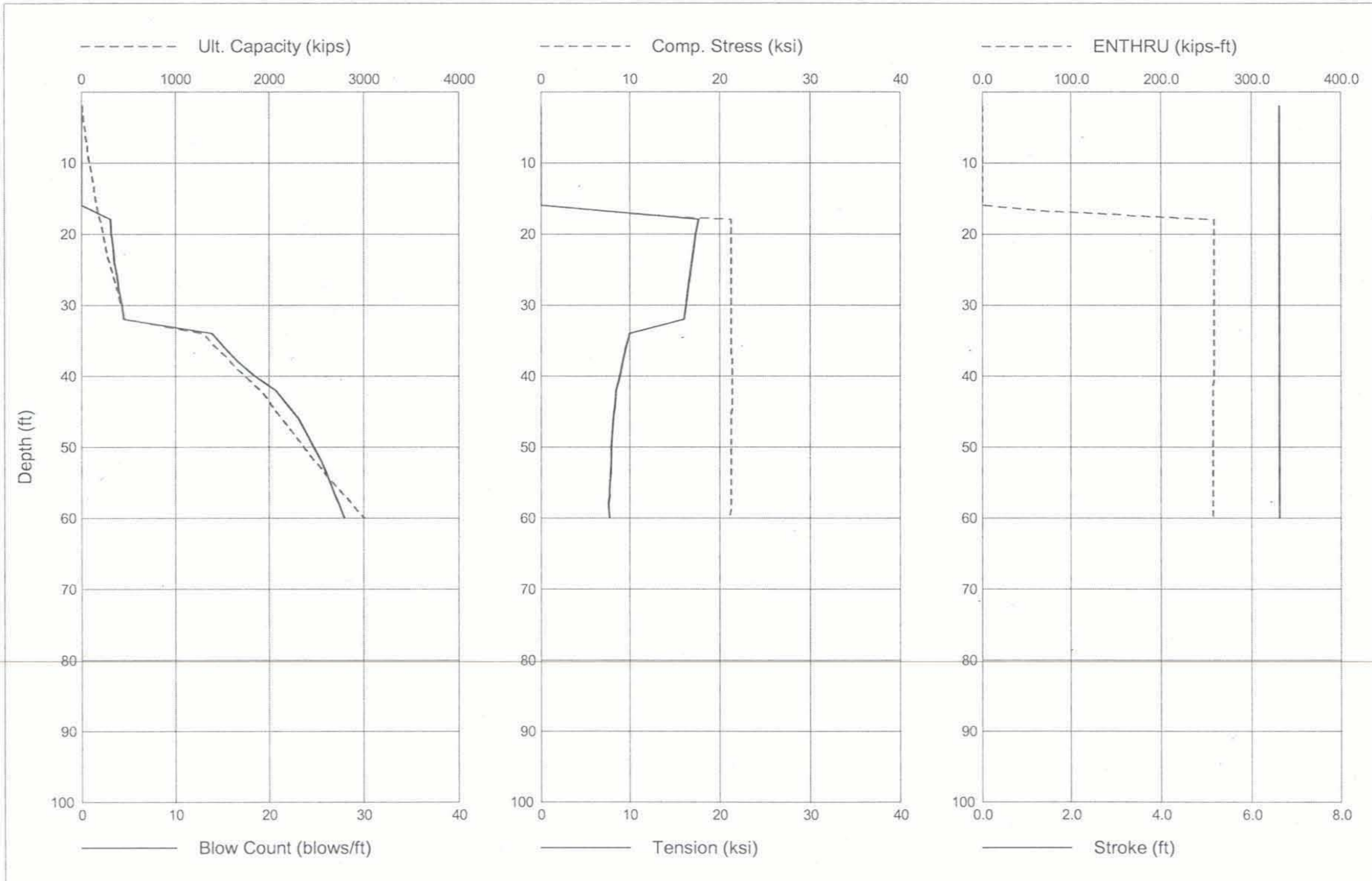
California D.O.T. Geotechnical Services

Apr 29 2009

Colorado B4-Hammer IHC S-400, 1-750

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



ANALYSIS 25

Bent 4

108" Pile, 1.375-inch Thick

Menck 500T Hammer

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	13.5	1.0	12.4	0.0	0.000	0.000	6.15	0.0
4.0	29.0	4.1	24.9	0.0	0.000	0.000	6.15	0.0
6.0	46.6	9.3	37.3	0.0	0.000	0.000	6.15	0.0
8.0	66.3	16.6	49.7	0.0	0.000	0.000	6.15	0.0
10.0	88.1	25.9	62.2	0.0	0.000	0.000	6.15	0.0
12.0	111.9	37.3	74.6	0.0	0.000	0.000	6.15	0.0
14.0	137.8	50.8	87.0	0.0	0.000	0.000	6.15	0.0
16.0	165.8	66.3	99.5	0.0	0.000	0.000	6.15	0.0
18.0	195.8	83.9	111.9	2.1	25.425	-23.064	6.15	374.3
20.0	228.0	103.6	124.4	2.2	25.415	-22.649	6.15	374.3
22.0	262.2	125.4	136.8	2.3	25.398	-22.189	6.15	374.3
24.0	298.4	149.2	149.2	2.5	25.377	-21.709	6.15	374.3
26.0	336.8	175.1	161.7	2.6	25.350	-21.261	6.15	374.3
28.0	377.2	203.1	174.1	2.8	25.318	-20.809	6.15	374.3
30.0	419.6	233.1	186.5	3.0	25.284	-20.312	6.15	374.3
32.0	464.2	265.2	199.0	3.2	25.245	-19.796	6.15	374.4
34.0	1288.4	334.4	954.0	10.1	25.229	-13.153	6.15	374.4
36.0	1436.1	409.1	1027.0	11.2	25.190	-12.629	6.15	374.5
38.0	1589.4	489.3	1100.0	12.1	25.149	-12.072	6.15	374.5
40.0	1748.1	575.0	1173.0	12.9	25.106	-11.494	6.15	374.6
42.0	1912.3	666.3	1246.1	13.9	25.076	-10.941	6.15	374.6
44.0	2020.2	763.0	1257.2	14.4	25.048	-10.727	6.15	374.7
46.0	2133.6	865.2	1268.3	15.1	25.018	-10.494	6.15	374.7
48.0	2252.4	973.0	1279.4	15.7	24.983	-10.240	6.15	374.8
50.0	2365.7	1086.2	1279.4	16.3	24.946	-10.020	6.15	374.9
52.0	2484.4	1205.0	1279.4	17.0	24.911	-9.788	6.15	375.0
54.0	2608.7	1329.3	1279.4	17.7	24.875	-9.544	6.15	375.1
56.0	2738.5	1459.0	1279.4	18.4	24.845	-9.296	6.15	375.2
57.0	2805.4	1526.0	1279.4	18.8	24.841	-9.166	6.15	375.2
58.0	2873.7	1594.3	1279.4	19.2	24.837	-9.035	6.15	375.2
60.0	3014.5	1735.1	1279.4	20.1	24.817	-8.766	6.15	375.2

Total Number of Blows: 449

Driving Time (min):	14	11	8	7	6	5	4	4	4	3
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

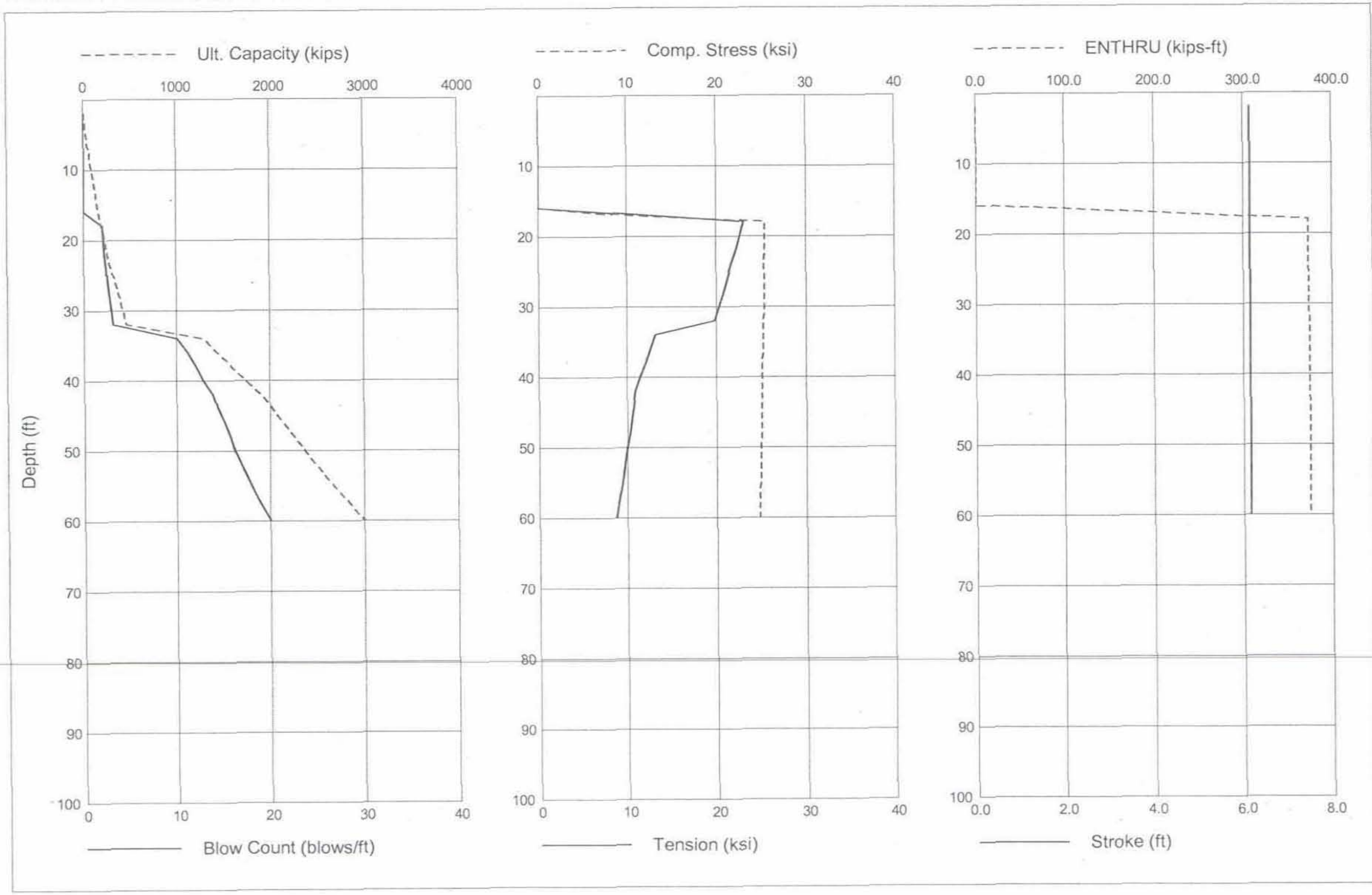
California D.O.T. Geotechnical Services

Apr 29 2009

Colorado B4-Hammer Menck MHU 500T, 1-375

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



ANALYSIS 26

Bent 4

108" Pile, 1.500-inch Thick

Menck 500T Hammer

California D.O.T. Geotechnical Services
Colorado B4-Hammer Menck MHU 500T, 1-500

Apr 29 2009
GRLWEAP(TM) Version 2005

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	13.5	1.0	12.4	0.0	0.000	0.000	6.15	0.0
4.0	29.0	4.1	24.9	0.0	0.000	0.000	6.15	0.0
6.0	46.6	9.3	37.3	0.0	0.000	0.000	6.15	0.0
8.0	66.3	16.6	49.7	0.0	0.000	0.000	6.15	0.0
10.0	88.1	25.9	62.2	0.0	0.000	0.000	6.15	0.0
12.0	111.9	37.3	74.6	0.0	0.000	0.000	6.15	0.0
14.0	137.8	50.8	87.0	0.0	0.000	0.000	6.15	0.0
16.0	165.8	66.3	99.5	0.0	0.000	0.000	6.15	0.0
18.0	195.8	83.9	111.9	2.2	24.707	-22.899	6.15	374.4
20.0	228.0	103.6	124.4	2.3	24.698	-22.593	6.15	374.4
22.0	262.2	125.4	136.8	2.4	24.685	-22.255	6.15	374.4
24.0	298.4	149.2	149.2	2.6	24.666	-21.884	6.15	374.4
26.0	336.8	175.1	161.7	2.7	24.643	-21.485	6.15	374.4
28.0	377.2	203.1	174.1	2.8	24.615	-21.070	6.15	374.4
30.0	419.6	233.1	186.5	3.0	24.583	-20.655	6.15	374.4
32.0	464.2	265.2	199.0	3.3	24.547	-20.280	6.15	374.4
34.0	1288.4	334.4	954.0	10.1	24.529	-13.190	6.15	374.4
36.0	1436.1	409.1	1027.0	11.2	24.492	-12.783	6.15	374.4
38.0	1589.4	489.3	1100.0	12.4	24.452	-12.330	6.15	374.5
40.0	1748.1	575.0	1173.0	13.3	24.412	-11.863	6.15	374.5
42.0	1912.3	666.3	1246.1	14.1	24.369	-11.452	6.15	374.5
44.0	2020.2	763.0	1257.2	14.6	24.344	-11.292	6.15	374.5
46.0	2133.6	865.2	1268.3	15.2	24.306	-11.118	6.15	374.6
48.0	2252.4	973.0	1279.4	15.8	24.275	-10.918	6.15	374.6
50.0	2365.7	1086.2	1279.4	16.4	24.244	-10.746	6.15	374.6
52.0	2484.4	1205.0	1279.4	17.1	24.211	-10.568	6.15	374.7
54.0	2608.7	1329.3	1279.4	17.8	24.198	-10.382	6.15	374.7
56.0	2738.5	1459.0	1279.4	18.6	24.188	-10.190	6.15	374.8
57.0	2805.4	1526.0	1279.4	19.0	24.183	-10.089	6.15	374.8
58.0	2873.7	1594.3	1279.4	19.4	24.179	-9.982	6.15	374.8
60.0	3014.5	1735.1	1279.4	20.3	24.167	-9.757	6.15	374.8

Total Number of Blows: 456

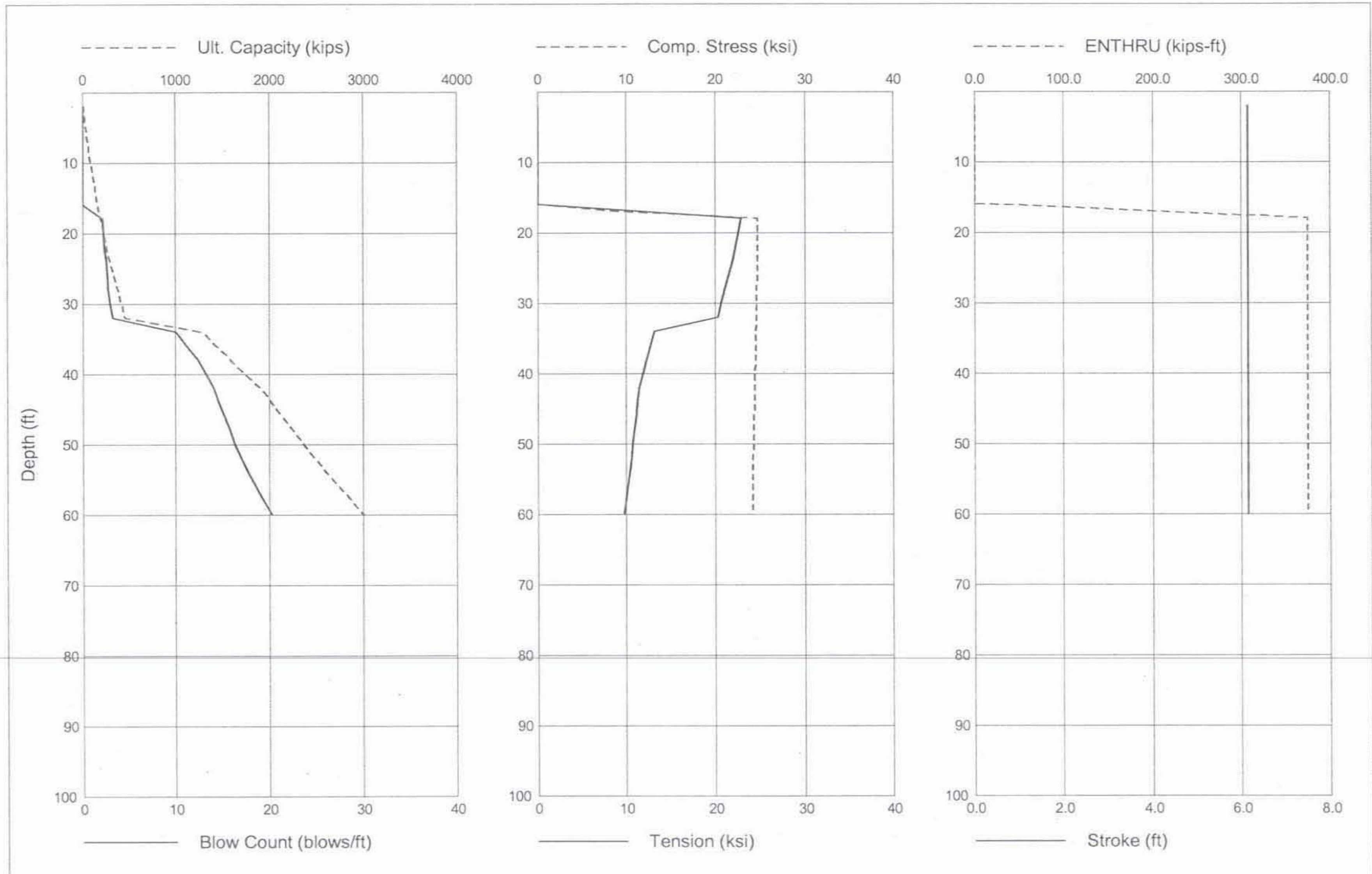
Driving Time (min):	15	11	9	7	6	5	5	4	4	3
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

California D.O.T. Geotechnical Services

Apr 29 2009

Colorado B4-Hammer Menck MHU 500T, 1-500 Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 GRLWEAP(TM) Version 2005



ANALYSIS 27

Bent 4

108" Pile, 1.750-inch Thick

Menck 500T Hammer

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	13.5	1.0	12.4	0.0	0.000	0.000	6.15	0.0
4.0	29.0	4.1	24.9	0.0	0.000	0.000	6.15	0.0
6.0	46.6	9.3	37.3	0.0	0.000	0.000	6.15	0.0
8.0	66.3	16.6	49.7	0.0	0.000	0.000	6.15	0.0
10.0	88.1	25.9	62.2	0.0	0.000	0.000	6.15	0.0
12.0	111.9	37.3	74.6	0.0	0.000	0.000	6.15	0.0
14.0	137.8	50.8	87.0	0.0	0.000	0.000	6.15	0.0
16.0	165.8	66.3	99.5	0.0	0.000	0.000	6.15	0.0
18.0	195.8	83.9	111.9	0.0	0.000	0.000	6.15	0.0
20.0	228.0	103.6	124.4	2.5	23.387	-21.640	6.15	373.3
22.0	262.2	125.4	136.8	2.6	23.376	-21.398	6.15	373.3
24.0	298.4	149.2	149.2	2.7	23.360	-21.163	6.15	373.3
26.0	336.8	175.1	161.7	2.9	23.340	-20.920	6.15	373.3
28.0	377.2	203.1	174.1	3.0	23.316	-20.663	6.15	373.3
30.0	419.6	233.1	186.5	3.2	23.289	-20.386	6.15	373.3
32.0	464.2	265.2	199.0	3.4	23.258	-20.092	6.15	373.3
34.0	1288.4	334.4	954.0	10.2	23.246	-12.513	6.15	373.3
36.0	1436.1	409.1	1027.0	11.2	23.215	-12.256	6.15	373.3
38.0	1589.4	489.3	1100.0	12.1	23.183	-11.987	6.15	373.3
40.0	1748.1	575.0	1173.0	13.3	23.150	-11.716	6.15	373.3
42.0	1912.3	666.3	1246.1	14.7	23.115	-11.431	6.15	373.3
44.0	2020.2	763.0	1257.2	15.4	23.093	-11.331	6.15	373.3
46.0	2133.6	865.2	1268.3	16.2	23.046	-11.221	6.15	373.3
48.0	2252.4	973.0	1279.4	16.9	23.013	-11.102	6.15	373.3
50.0	2365.7	1086.2	1279.4	17.5	23.010	-11.008	6.15	373.3
52.0	2484.4	1205.0	1279.4	18.0	23.007	-10.922	6.15	373.3
54.0	2608.7	1329.3	1279.4	18.6	23.001	-10.837	6.15	373.3
56.0	2738.5	1459.0	1279.4	19.3	22.992	-10.748	6.15	373.3
57.0	2805.4	1526.0	1279.4	19.6	22.986	-10.704	6.15	373.3
58.0	2873.7	1594.3	1279.4	20.0	22.980	-10.660	6.15	373.3
60.0	3014.5	1735.1	1279.4	20.7	22.968	-10.555	6.15	373.2

Total Number of Blows: 467

Driving Time (min):	15	11	9	7	6	5	5	4	4	3
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

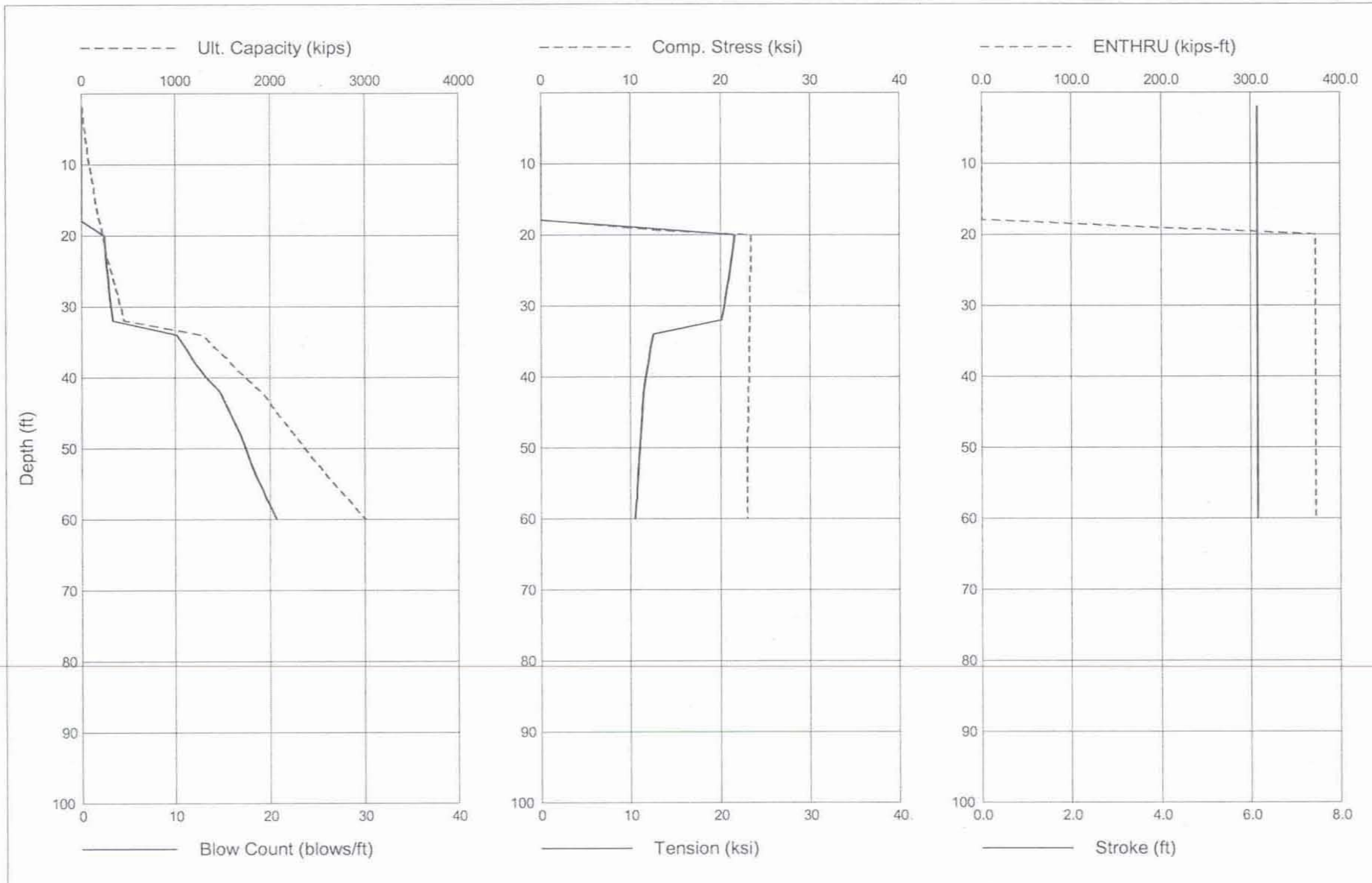
California D.O.T. Geotechnical Services

Apr 29 2009

Colorado B4-Hammer Menck MHU 500T, 1-750

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



Memorandum

Flex your power!
Be energy efficient!

To: MR. DAVID SOON
Senior Bridge Engineer
Bridge Design Branch 7
Office of Bridge Design North
Division of Engineering Services
Structure Design

Date: May 18, 2009

File: 08-SBd-62-PM 142.3
08-378701
Four Retaining Walls for the
Colorado River Bridge Replacement
New Bridge No. 54-1272

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
Geotechnical Services
Office of Geotechnical Design – South 2

Subject: Revised Geotechnical Design Report

This Revised Geotechnical Design Report is to supersede the previous Geotechnical Design Recommendations memorandum prepared by our office dated March 16, 2009.

This Geotechnical Design Report for the four retaining walls (Retaining Walls 7523 A and B, 7524, 7535 A and B, and 7536) presents the geotechnical information for the proposed retaining walls for the proposed replacement of the Colorado River Bridge (Br. No. 54-1272). In preparation of this report the following documents are reviewed:

- Field investigation results of eight exploratory test borings (April, 2007 and January, 2008).
- Preliminary Foundation Report prepared by Geotechnical Design- South 2, dated March 17, 2006
- Seismic Design Recommendations, prepared by Office of Geotechnical Design- South 2, dated June 25, 2008.
- Colorado River Bridge (Repair) Log-of-Test-Borings prepared by Structure Design, dated April 13, 1990
- Revised Preliminary Foundation Report prepared by the Office of Geotechnical Design- South 2, dated February 21, 2003
- Preliminary Geologic Recommendations and Resource Estimate for Advanced Planning Studies prepared by Structures prepared by the Office of Structure Foundations, dated January 24, 2000

The proposed bridge replacement is located just south of the existing bridge. This proposed structure will be a 4-span Cast-In-Place Box Girder type bridge and will require the construction of four retaining walls.

Geotechnical/Geologic Information

The following geotechnical and geologic information for the proposed retaining walls are based on the recent field investigations and the Log of Test Borings from the Colorado River Bridge scour rehabilitation and retrofit project.

The subsurface materials encountered on the California side of the project (Retaining Walls 7523 and 7524) consist of fill material composed of dense to very dense silty SAND, sandy SILT and sandy GRAVEL form elevations 372 ft. to 355 ft. Below the fill, from elevations 355 ft. to 250 ft., the subsurface material is composed of medium dense to dense inter-bedded layers of SAND, SAND with gravel, gravelly SAND, sandy GRAVEL.

The subsurface materials encountered on the Arizona side of the project (Retaining Walls 7535 and 7536) consist inter-bedded layers of medium dense to very dense SILT, silty SAND, GRAVEL and COBBLES form elevation 382 ft. to 344 ft. Below this material, from elevations 344 ft. to 295 ft., the subsurface material is a formational unit composed of intensely weathered, conglomerate formational BEDROCK.

Groundwater

Groundwater elevation at the site generally corresponds to the water level in the Colorado River. Water level variations in the river may vary due to agricultural demands, discharges for up-river dams, and seasonal fluctuations. During the recent foundation investigations, the river surface elevation was at the approximate elevation of 343.0 feet. This is also the assumed to be the groundwater elevation. Groundwater surface elevations are subject to seasonal fluctuations and will be encountered at higher or lower elevations depending on seasonal conditions at time of construction.

Environmental Considerations

During the field investigations (April 2007 and January 2008), possible hydrocarbon contaminated soils were encountered in borings B-5, B-5B, and WB-3. As indicated on the respective boring logs (LOTB) these soils were encountered at the approximate elevations of 355.0 feet to 350.0 feet and were between 5 feet and 8 feet in thickness. It was noted in the field at the respective time of the subsurface investigations that these soils contained a strong petroleum odor. Those suspected materials excavated by the drilling program were drummed and left on a local site for testing to characterize the possible contamination and proper disposal. The laboratory results showed that the drill cuttings and fluids were non-detect for any hazardous substance.

Corrosion

Corrosion test results for soil samples collected from borings B-1, B-5B, WB-3, are shown below in Table 3. The soil samples tested from borings B-1 and B-5B are considered non-corrosive. The soil samples tested from boring WB-3 is considered corrosive by current Caltrans standards.

Table 3 – Corrosion Test Summary

Location	SIC Number	pH	Minimum Resistivity (Ohm-Cm)	Sulfate Content (ppm)	Chloride Content (ppm)
Boring B-1 Depth 5.0-35.0 feet	C638801	8.50	937	270	250
Boring B-5B Depth 0.0-35.0 feet	Tested By Contractor	9.23	1.300	N/A	195
Boring WB-3 Depth 5.0-30.0 feet	Tested By Contractor	6.78	300	240	525

Note: Caltrans currently defines a corrosive environment as an area where the soil has either a chloride concentration of 500 ppm or greater, a sulfate concentration of 2000 ppm or greater, or has a pH of 5.5 or less. With the exception of MSE walls, soil and water are not tested for chlorides and sulfates if the minimum resistivity is greater than 1,000 ohm-cm.

Seismic Data and Liquefaction Potential

The Office of Geotechnical Design, South 2, has provided Seismic Design Recommendations in a memorandum dated June 25, 2008. The site is located about 24 miles south of the Chemehuevi Graben Fault (CGR, Mw=6, normal fault) and 33 miles north of the Blythe Graben Fault (BGN, Mw=6, normal fault). From the 1996 Caltrans California Seismic Hazard Map, the bridge is within peak horizontal bedrock acceleration (PBA) zone of 0.1g. However, PBA = 0.2g, which is the minimum consideration for design, is recommended. The report also concludes that the potential for soil liquefaction is low.

Retaining Wall Recommendations

The following retaining wall recommendations are based on the existing geotechnical data from the references listed above. The retaining walls are identified as noted in the General Plan sheets. The locations of the proposed retaining walls are summarized in Table 1 below.

- **Retaining Wall 7523 A (CA-North)**

  A Caltrans Standard Type 1 Retaining Wall, with design heights of 10 to 16 feet, can be used form Stations 7523+76.4 to 7526+52.3. Due to the existing loose to medium dense surficial soils along the walls layout line, it is recommended that the existing soil/foundation material beneath the wall footings should be sub-excavated and re-compacted. The sub-excavations should extend to a depth of approximately 1.0 feet below the bottom of footing elevations. The sub-excavated areas shall then be backfilled with native material compacted to 95% relative compaction as stated in Section 19.5 of the Standard Specifications. The limits of the sub-excavated and backfilled area shall include the full footing footprints and extend a minimum of 1 foot outside of those footing footprints. After the sub-excavation and re-compaction is complete at the footing elevations, the allowable soil bearing capacity will equal 3.5 kips/ft^2. Proper drainage facilities should be installed to insure no hydrostatic pressure building up behind the wall.

- **Retaining Wall 7523 B (CA-North)**

A tie back wall may be used for the construction of the access roadway adjacent to the New Rte 62 Roadway from Stations 7526+52.3 to 7528+32.5. This wall can be constructed top-down and in limited spaces. Due to existing soil conditions, temporary shoring may be required for cuts exceeding 5 feet in height vertically. Proper drainage facilities should be installed to insure no hydrostatic pressure building up behind the wall. The soil parameters for design purposes for this tie back wall are as follows:

Unit Weight = 125 lb/ft^3
Internal Friction Angle of Soil = 30°
Coefficient of Active Earth Pressure (K_a) = 0.33
Inclination = 15°
Transfer Load = 3.2 tons/ft^2 (ultimate)

- **Retaining Wall 7524 (CA-South)**

Due to the constraints of the Right-of-Way clearances for this retaining wall (7524), a Caltrans special design Type-5 Retaining Wall may be used. This retaining wall will be designed by Structure Design. The retaining wall height varies from 4 to 22 feet and can be used form Stations 7523+67.4 to 7528+32.5. Due to the existing loose to medium dense surficial soils along the walls layout line, it is recommended that the existing soil/foundation material beneath the wall footings should be sub-excavated and re-compacted. The sub-excavations should extend to a depth of approximately 1.0 feet below the bottom of footing elevations. The sub-excavated areas shall then be backfilled with native material compacted to 95% relative compaction as stated in Section 19.5 of the Standard Specifications. The limits of the sub-excavated and backfilled area shall include the full footing footprints and extend a minimum of 1 foot outside of those footing footprints. Once compacted, it can assumed that the foundation material can provide the following soil parameters; allowable bearing capacity of 5.9 kips/ft^2 (17.8 kips/ft^2 ultimate bearing capacity), 35° for the angle of internal friction, zero (0) cohesion and a unit weight of 125 lb/ft^3. Proper drainage facilities should be installed to insure no hydrostatic pressure building up behind the wall.

- **Retaining Wall 7535 A (AZ-North)**

A tie back wall may be used for the construction of the access roadway adjacent to the New Rte 62 Roadway from Stations 7535+67.5 to 7536+67.5. This wall can be constructed top-down and in limited spaces. The wall height varies from 12 to 17 feet. Due to existing soil conditions, temporary shoring may be required for cuts exceeding 5 feet in height vertically. Proper drainage facilities should be installed to insure no hydrostatic pressure building up behind the wall. The soil parameters for design purposes for this tie back wall are as follows:

Unit Weight = 125 lb/ft^3
Internal Friction Angle of Soil = 32°
Coefficient of Active Earth Pressure (K_a) = 0.31
Inclination = 15°
Transfer Load = 6.2 tons/ft^2 (ultimate)

- **Retaining Wall 7535 B (AZ-North)**

A Caltrans Standard Type 1 Retaining Wall, with design heights of 4 to 8 feet, can be used form Stations 7536+69.2 to 7537+50.0. The allowable soil bearing capacity of the soil/foundation material will equal 2.2 kips/ft^2. The footing excavation area shall include the full footing footprints and extend a minimum of 1 foot outside the footing footprints. The wall footings must be placed on undisturbed native material. If the soil/foundation material is disturbed, this material must be scarified and compacted to 95% relative compaction as stated in Section 19.5 of the Standard Specifications. Proper drainage facilities should be installed to insure no hydrostatic pressure building up behind the wall.

- **Retaining Wall 7536 (AZ-South)**

A Caltrans Standard Type 1 Retaining Wall, with design heights of 6 to 12 feet, can be used form Stations 7535+67.5 to 7537+50.0. The allowable soil bearing capacity of the soil/foundation material will equal 2.8 kips/ft^2. The footing excavation area shall include the full footing footprints and extend a minimum of 1 foot outside the footing footprints. The wall footings must be placed on undisturbed native material. If the soil/foundation material is disturbed, this material must be scarified and compacted to 95% relative compaction as stated in Section 19.5 of the Standard Specifications. Proper drainage facilities should be installed to insure no hydrostatic pressure building up behind the wall.

Table 1
Summary of Proposed Retaining Wall Locations

Wall ID	Wall Beginning Station	Wall Ending Station
7523 A	32 ft LT RTE 62 CL, STA 7523+67.40	32 ft LT RTE 62 CL, STA 7526+52.30
7523 B	32 ft LT RTE 62 CL, STA 7526+52.30	32 ft LT RTE 62 CL, STA 7528+32.50
7524	37 ft RT RTE 62 CL, STA 7523+67.40	37 ft RT RTE 62 CL, STA 7528+32.50
7535 A	32 ft LT RTE 62 CL, STA 7535+67.50	32 ft LT RTE 62 CL, STA 7536+67.50
7535 B	32 ft LT RTE 62 CL, STA 7536+67.5	32 ft LT RTE 62 CL, STA 7537+50.00
7536	37 ft RT RTE 62 CL, STA 7535+67.50	37 ft RT RTE 62 CL, STA 7537+50.00

Construction Considerations

Since groundwater elevations at the site generally correspond to the water level in the Colorado River, water levels within the river varies daily. The contractor may need to implement dewatering methods during excavations for the wall footings that are near the river. This may be the case for the eastern most portions for retaining walls 7523 B and 7524 that are closest to the river.

The recommendations provided in this report are based on specific project information regarding structure type and location that have been provided by the Office of Bridge Design-North. If any conceptual changes are made during final project design, the Office of Geotechnical Design-South 2 should review those changes to determine if these preliminary recommendations are still applicable.

If you require further information, please contact Mark Wilson at (916) 227-1257 or Shawn Wei at (916) 227-5252.

Prepared by: Date: 5-18-09

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Engineering Geologist
Branch C
Office of Geotechnical Design- South 2

cc: A. Abghari
S. Wei
Project File
Specs. & Estimates
RE Pending File

Memorandum

Flex your power!
Be energy efficient!

To: SHAWN WEI
Senior Transportation Engineer
Office of Geotechnical Design South-2

Attn: Mark Wilson

Date: April 30, 2009

File: 08-SBd-62-PM142.3
08-378701
Colorado River Bridge
(Replace)
Bridge No. 54-1272

From: **DEPARTMENT OF TRANSPORTATION**
Division of Engineering Services
Geotechnical Services - MS 5

Subject: Driveability Study – Anchor Piles

Attached is a report summarizing the results of driveability analyses performed by this Office for the subject pile load test anchor piles at Bent 2 of the above-referenced project.

If you have any questions or comments regarding this report, please contact Michael K. Harris, P.E. at (916) 227-1058.

BRIAN LIEBICH, P.E.
Senior Transportation Engineer
Foundation Testing Branch

Attachments

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MKH/mkh

FOUNDATION TESTING BRANCH

April 30, 2009

08-SBd-62-PM142.3

08-378701

Colorado River Bridge (Replace)

Bridge No. 54-1272

Driveability Study – Anchor Piles

April 30, 2009

Project Information

08-SBd-62-PM142.3
08-378701
Colorado River Bridge (Replace)
Bridge No. 54-1272

Subject

Driveability Study – Anchor Piles

Introduction

This Office has performed a set of pile driveability analyses for the proposed installation of open-ended, 48-inch diameter steel pipe piles of varying wall thicknesses for use as temporary anchor piles for a pile load test at Bent 2 of the above-referenced project. The analyses were requested by Mr. Shawn Wei of the Office of Geotechnical Design South-2 (OGDS-2) on April 28, 2009 to support the foundation recommendations. According to the submitted preliminary design information, the subject anchor piles at Bent 2 are required to be driven to a penetration depth of approximately 131.2 feet. Personnel from the Foundation Testing Branch (FTB) of the Office of Geotechnical Support performed the analyses utilizing GRLWEAP™ computer program, Version 2005. This study models the performance of the same various pile driving systems as the production pile study to determine the suitability of a possible hammer for achieving satisfactory installation of the subject anchor piles at Bent 2. The submitted pile and soil information were used in the analyses to determine the performance of various driving systems on proposed shell thicknesses as requested by the Geotechnical Designer.

Description of Piling

The driveability study was performed for the proposed installation of the open-ended, 48-inch diameter steel pipe piling to be installed temporarily for a pile load test at Bent 2 of the Colorado River Bridge replacement structure. Based on the submitted information, minimum steel yield strength was not specified; therefore, this study will assume the steel pipe piles to be in conformance with ASTM Designation A 252, Grade 3 steel with minimum yield strength of 45 ksi. This places the maximum allowable compressive stress during driving at 0.95*45 = 42.75 ksi. Pile wall shell thickness is to be determined based on the results of this study.

The pile type, pile cut-off and design tip elevation for the subject piles were provided by Mark Wilson of OGDS-2. Table I presents the submitted pile information that was used in the driving analyses at the location of Bent 2.

Table I. Anchor Pile Information at Bent 2

Support Location	Pile Type*	Soil Surface Elevation* (ft)	Pile Tip Elevation* (ft)	Analyzed Pile Penetration Length (ft)
Bent 2	48-inch dia. steel pipe pile	339.7	208.5	131.2

* Information provided by M. Wilson.

Subsurface Conditions and Soil Resistance Parameters

For Boring B-2 at Bent 2, the foundation material at the site consists of medium dense sand with gravel grading to very dense sand and gravel. Loose sand and silty sand layers were encountered within the soil matrix. Underlain these layers are the very dense decomposed, weathered sand and gravel conglomerate.

For complete description of the subsurface conditions, please refer to the Log of Test Borings (LOTBs) in the Foundation Report. Table II presents the soil resistance parameters that were utilized to model the dynamic soil behavior for the subject piles at the location of Bent 2.

Table II: Soil Resistance Parameters

PARAMETER TYPE	QUAKE	DAMPING
Skin (Shaft)	0.10-inch	0.05 sec/ft
Toe	0.10-inch.	0.15 sec/ft

Pile Driving Resistance

To install a driven pile, the pile must overcome resistance to penetration developed by the soil. The driving resistance will determine the size of the required pile driving hammer and the stress magnitude imparted to the steel pile by the driving system. As such, an estimate of driving resistance is necessary to perform a driveability study when investigating the potential for pile damage due to steel overstressing during driving. Driving resistance can be related to static axial capacity using set-up and relaxation factors applied to various layers of soil that the pile penetrates. Several methods are available to estimate pile static axial capacity and thereby driving resistance. These methods will generally determine a range of axial capacities for a given pile penetration. To be conservative, pile tip elevation may be based on lower estimates of static capacity, but higher capacity estimates are generally used for the driveability analysis.

The maximum initial driving resistance predicted by GRLWEAP, based on the submitted information provided by Mr. Mark Wilson (OGDS-2) at Bent 2 is estimated to be approximately 3600 kips. This estimate relies upon the following assumptions:

- Piles will be driven as open-ended steel pipe piles. Plugging will not occur.
- The anticipated driving resistance includes the resistance contributions of approximately 87% from skin friction (Qs); and 13% from end bearing (Qp). Percentage distributions are based on GRLWEAP output.
- The set-up factor at this site is expected to be minimal due to the presence of the predominately cohesionless soils within the overall embedded length of the pile.

- Formational rock may be encountered in the driving of the anchor piles. Formational rock materials (gravelly/cobble/boulder-sized) were modeled as very dense granular/sandy materials (due to limitation of the GRLWEAP program).

- The anticipated driving resistance includes the additional resistance contribution of the scourable soil layer at the bent locations. This has no effect on permanent structure design, since the anchor piles are temporary non-production piles.

Description of Pile Driving Systems

This study involved modeling the performance of three selected driving systems to reflect the range of rated energies possibly appropriate for the installation of the 48-inch diameter steel pipe piles of five (5) different wall thicknesses to the proposed tip elevations at the Bent 2 location.

The analyses were performed using GRLWEAP™ recommended default parameters. For each hammer, the analysis was performed with the hammer operating at maximum stroke for determining driving-behavior stresses imparted to the steel pile. The analysis performed for each hammer was utilized to demonstrate the predicted blow counts and corresponding maximum compressive stresses expected during pile driving. Standard configurations for the hammer driving systems and related components were based upon information published in GRLWEAP™ literature and database. The hammer characteristics are listed in Table III.

Table III: Summary of Hammer Systems

Hammer Manufacturer	Delmag	IHC	Menck
Hammer Model	D100-13	S-400	MHU 500T
Hammer Type	OED	ECH	ECH
Rated Energy (kip-ft)	265.67	292.60	405.53
Ram Weight (kips)	22.066	44.20	65.958
Maximum Stroke (ft)	13.5	6.62	6.1

Note: OED= Open End Diesel; ECH = External Combustion Hammer (Hydraulic)

Discussion of Results

Analysis printouts and charts depicting predicted relationships between driving resistances (for steel pipe pile portion only) and driving stresses versus blow counts for each of the hammers are included in Appendix A. The analysis results of the three hammers are summarized in Table IV.

Table IV: Summary of Results, Anchor Piles at Bent 2

Hammer Manufacturer/ Model	Estimated Maximum Driving Resistance (kips)	Pile Wall Thickness*(In.)	Estimated Max. Compressive Stress (ksi)	Estimated Ending Blow Count (Blows/ft)	At Stroke (ft)
Delmag D100-13	3584	1.250	28.9	117	10.2
		1.375	28.0	107	10.1
		1.500	26.9	101	10.1
		1.625	26.0	97	10.0
		1.750	25.3	94	10.0
IHC S-400		1.250	32.6	32	6.6
		1.375	31.9	31	6.6
		1.500	31.3	29	6.6
		1.625	30.7	29	6.6
		1.750	30.0	28	6.6
Menck 500T		1.250	31.6	23	6.1
		1.375	31.0	22	6.1
		1.500	30.5	21	6.1
		1.625	30.1	21	6.1
		1.750	29.6	20	6.1

*Steel pipe pile, Fy = 45 ksi

The GRLWEAP™ wave equation program is a one-dimensional analysis and does not consider buckling or bending of the pile due to non-uniform blows or localized stresses at the pile tip, which may occur during pile driving. Also, it has been observed in the field that significantly harder or softer driving could occur than the GRLWEAP™ predictions.

Bent 2 Anchor Piles

Analysis 1: Delmag D 100-13; 48-inch diameter steel pipe pile at 1.250-inch thick

The analysis for the Delmag D 100-13 indicates that this hammer would not be capable of driving 48-inch diameter steel pipe piles at Bent 2 within the acceptable blow count limit of 102 blows/ft (1/8" /ft) to an approximate penetration depth of 131.2 feet. At a driving resistance of about 3584 kips, the maximum blow count would be approximately 117 blows/ft. The acceptable blow count limit would be exceeded at approximately 127 feet penetration.

Analysis 2: Delmag D 100-13; 48-inch diameter steel pipe pile at 1.375-inch thick

The analysis for the Delmag D 100-13 indicates that this hammer would not be capable of driving 48-inch diameter steel pipe piles at Bent 2 within the acceptable blow count limit of 102 blows/ft (1/8" /ft) to an approximate penetration depth of 131.2 feet. At a driving resistance of about 3584 kips, the maximum blow count would be approximately 107 blows/ft. The acceptable blow count limit would be exceeded at approximately 129 feet penetration.

Analysis 3: Delmag D 100-13; 48-inch diameter steel pipe pile at 1.500-inch thick

The analysis for the Delmag D 100-13 indicates that this hammer would be capable of driving 48-inch diameter steel pipe piles at Bent 2 within the acceptable blow count limit of 102 blows/ft (1/8" /ft) to an approximate penetration depth of 131.2 feet. At a driving resistance of about 3584 kips, the maximum blow count would be approximately 101 blows/ft with a maximum compressive stress of approximately 26.9 ksi and a hammer stroke of 10.1 ft.

Analysis 4: Delmag D 100-13; 48-inch diameter steel pipe pile at 1.625-inch thick

The analysis for the Delmag D 100-13 indicates that this hammer would be capable of driving 48-inch diameter steel pipe piles at Bent 2 within the acceptable blow count limit of 102 blows/ft (1/8" /ft) to an approximate penetration depth of 131.2 feet. At a driving resistance of about 3584 kips, the maximum blow count would be approximately 97 blows/ft with a maximum compressive stress of approximately 26.0 ksi and a hammer stroke of 10.0 ft.

Analysis 5: Delmag D 100-13; 48-inch diameter steel pipe pile at 1.750-inch thick

The analysis for the Delmag D 100-13 indicates that this hammer would be capable of driving 48-inch diameter steel pipe piles at Bent 2 within the acceptable blow count limit of 102 blows/ft (1/8" /ft) to an approximate penetration depth of 131.2 feet. At a driving resistance of about 3584 kips, the maximum blow count would be approximately 94 blows/ft with a maximum compressive stress of approximately 25.3 ksi and a hammer stroke of 10.0 ft.

Analysis 6: IHC S-400; 48-inch diameter steel pipe pile at 1.250-inch thick

The analysis for the IHC S-400 indicates that this hammer would be capable of driving 48-inch diameter steel pipe piles at Bent 2 within the acceptable blow count limit of 102 blows/ft (1/8" /ft) to an approximate penetration depth of 131.2 feet. At a driving resistance of about 3584 kips, the maximum blow count would be approximately 32 blows/ft with a maximum compressive stress of approximately 32.6 ksi and a hammer stroke of 6.6 ft.

Analysis 7: IHC S-400; 48-inch diameter steel pipe pile at 1.375-inch thick

The analysis for the IHC S-400 indicates that this hammer would be capable of driving 48-inch diameter steel pipe piles at Bent 2 within the acceptable blow count limit of 102 blows/ft (1/8" /ft) to an approximate penetration depth of 131.2 feet. At a driving resistance of about 3584 kips, the maximum blow count would be approximately 31 blows/ft with a maximum compressive stress of approximately 31.9 ksi and a hammer stroke of 6.6 ft.

Analysis 8: IHC S-400; 48-inch diameter steel pipe pile at 1.500-inch thick

The analysis for the IHC S-400 indicates that this hammer would be capable of driving 48-inch diameter steel pipe piles at Bent 2 within the acceptable blow count limit of 102 blows/ft (1/8" /ft) to an approximate penetration depth of 131.2 feet. At a driving resistance of about 3584 kips, the maximum blow count would be approximately 29 blows/ft with a maximum compressive stress of approximately 31.3 ksi and a hammer stroke of 6.6 ft.

Analysis 9: IHC S-400; 48-inch diameter steel pipe pile at 1.625-inch thick

The analysis for the IHC S-400 indicates that this hammer would be capable of driving 48-inch diameter steel pipe piles at Bent 2 within the acceptable blow count limit of 102 blows/ft (1/8" /ft) to an approximate penetration depth of 131.2 feet. At a driving resistance of about 3584 kips, the maximum blow count would be approximately 29 blows/ft with a maximum compressive stress of approximately 30.7 ksi and a hammer stroke of 6.6 ft.

Analysis 10: IHC S-400; 48-inch diameter steel pipe pile at 1.750-inch thick

The analysis for the IHC S-400 indicates that this hammer would be capable of driving 48-inch diameter steel pipe piles at Bent 2 within the acceptable blow count limit of 102 blows/ft (1/8" /ft) to an approximate penetration depth of 131.2 feet. At a driving resistance of about 3584 kips, the maximum blow count would be approximately 28 blows/ft with a maximum compressive stress of approximately 30.0 ksi and a hammer stroke of 6.6 ft.

Analysis 11: Menck MHU 500T; 48-inch diameter steel pipe pile at 1.250-inch thick

The analysis for the Menck 500T indicates that this hammer would be capable of driving 48-inch diameter steel pipe piles at Bent 2 within the acceptable blow count limit of 102 blows/ft (1/8" /ft) to an approximate penetration depth of 131.2 feet. At a driving resistance of about 3584 kips, the maximum blow count would be approximately 23 blows/ft with a maximum compressive stress of approximately 31.6 ksi and a hammer stroke of 6.1 ft.

Analysis 12: Menck MHU 500T; 48-inch diameter steel pipe pile at 1.375-inch thick

The analysis for the Menck 500T indicates that this hammer would be capable of driving 48-inch diameter steel pipe piles at Bent 2 within the acceptable blow count limit of 102 blows/ft (1/8" /ft) to an approximate penetration depth of 131.2 feet. At a driving resistance of about 3584 kips, the maximum blow count would be approximately 22 blows/ft with a maximum compressive stress of approximately 31.0 ksi and a hammer stroke of 6.1 ft.

Analysis 13: Menck MHU 500T; 48-inch diameter steel pipe pile at 1.500-inch thick

The analysis for the Menck 500T indicates that this hammer would be capable of driving 48-inch diameter steel pipe piles at Bent 2 within the acceptable blow count limit of 102 blows/ft (1/8" /ft) to an approximate penetration depth of 131.2 feet. At a driving resistance of about 3584 kips, the maximum blow count would be approximately 21 blows/ft with a maximum compressive stress of approximately 30.5ksi and a hammer stroke of 6.1 ft.

Analysis 14: Menck MHU 500T; 48-inch diameter steel pipe pile at 1.625-inch thick

The analysis for the Menck 500T indicates that this hammer would be capable of driving 48-inch diameter steel pipe piles at Bent 2 within the acceptable blow count limit of 102 blows/ft (1/8" /ft) to an approximate penetration depth of 131.2 feet. At a driving resistance of about 3584 kips, the maximum blow count would be approximately 21 blows/ft with a maximum compressive stress of approximately 30.1 ksi and a hammer stroke of 6.1 ft.

Analysis 15: Menck MHU 500T; 48-inch diameter steel pipe pile at 1.750-inch thick

The analysis for the Menck 500T indicates that this hammer would be capable of driving 48-inch diameter steel pipe piles at Bent 2 within the acceptable blow count limit of 102 blows/ft (1/8" /ft) to an approximate penetration depth of 131.2 feet. At a driving resistance of about 3584 kips, the maximum blow count would be approximately 20 blows/ft with a maximum compressive stress of approximately 29.6 ksi and a hammer stroke of 6.1 ft.

General

It should be noted that all driving output data generated by the GRLWEAP™ Program presumes uniform hammer blows, with leads and hammer perfectly aligned. The analyses do not consider the effects of eccentric blows, malfunctioning hammers, or Contractor-selected reduction in fuel setting for Diesel hammers. Some Diesel hammers may exhibit operating efficiencies significantly lower than the theoretical 80% used in the analyses, subject to condition and maintenance states. The analyses also do not consider higher stresses, which could be induced by bending, non-axial hammer alignment, or high local stress concentrations, and therefore should be considered as minimum values. Local pile damage can occur at the pile tip due to highly localized pile stresses caused by non-uniform resistance from sloping rock, **boulders, cobbles**, or obstructions, even if the calculated average axial stresses are within the allowable limits. These stresses cannot be predicted by wave equation analysis. The analysis results are only valid for the assumptions noted in the above sections and the soil profile input provided.

Conclusions and Recommendations

Based upon the results of the driveability analyses with reference to the submitted information from the Geotechnical Designer, the following has been concluded:

- Delmag D100-13 hammer would be capable of driving the 48-inch diameter steel pipe anchor piles at either 1.5-inch, 1.625-inch or 1.75-inch wall thickness within the allowable compressive stress, and would **exceed** the maximum allowable blow count limit at wall thicknesses of 1.25-inch and 1.375-inch.

- IHC S-400 hammer would be capable of driving the 48-inch diameter steel pipe anchor piles over the entire range of wall thicknesses modeled, within the allowable compressive stress.

- Menck MHU 500T hammer would be capable of driving the 48-inch diameter steel pipe anchor piles over the entire range of wall thicknesses modeled, within the allowable compressive stress.

- Piles were assumed to be made of ASTM Designation A252 Grade 3 steel (as per section 49-5.01 of the Caltrans' Standard Specifications, May 2006).

- A pile driving system submittal for this project is necessary upon hammer(s) selection. The driving system submittal must contain a driveability analysis showing that the proposed driving system will install all the piles to the specified tip elevations at acceptable rates of penetration without overstressing the piles.

- Hard driving conditions should be anticipated due to the very dense nature of the decomposed and friable, gravelly, cobbly, and boulder-sized conglomerate materials at the site. Drilling to assist driving provisions might be necessary as stated in the Draft Foundation Report. GRLWEAP software does not have the capability to analyze steel pipe pile being driven in formational rock materials. Based on our study and the presented results, the formational rock materials as described above were modeled as very dense sandy/granular materials.

If you have any questions or comments pertaining to this report, please contact Michael K. Harris, P.E. at (916) 227-1058.

4/30/09

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APPENDIX A

DRIVEABILITY ANALYSIS CHARTS

INDEX TO APPENDIX A

ANALYSIS 1

48" Pile, 1.250-inch Thick

Delmag D 100-13 Hammer

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	5.4	0.5	5.0	0.0	0.000	0.000	12.04	0.0
4.0	11.8	1.8	9.9	0.0	0.000	0.000	12.04	0.0
6.0	19.0	4.1	14.9	0.0	0.000	0.000	12.04	0.0
8.0	27.2	7.4	19.8	0.0	0.000	0.000	12.04	0.0
10.0	36.3	11.5	24.8	0.0	0.000	0.000	12.04	0.0
12.0	46.3	16.6	29.7	0.0	0.000	0.000	12.04	0.0
14.0	57.2	22.5	34.7	0.0	0.000	0.000	12.04	0.0
16.0	69.1	29.5	39.7	0.0	0.000	0.000	12.04	0.0
18.0	81.9	37.3	44.6	0.0	0.000	0.000	12.04	0.0
20.0	95.6	46.0	49.6	1.2	17.603	-10.476	6.58	141.5
22.0	110.2	55.7	54.5	1.3	18.997	-11.481	6.79	139.7
24.0	125.7	66.3	59.5	1.4	20.170	-12.272	6.98	137.3
26.0	142.2	77.8	64.4	1.5	20.988	-12.770	7.16	136.7
28.0	159.6	90.2	69.4	1.7	21.490	-12.974	7.27	136.7
30.0	300.3	107.3	193.1	4.0	23.457	-11.811	7.93	126.1
32.0	336.3	129.4	206.8	4.7	23.722	-11.558	8.03	124.4
34.0	373.8	153.2	220.6	5.3	23.906	-11.243	8.11	123.1
36.0	412.9	178.5	234.3	6.0	24.112	-10.903	8.18	121.6
38.0	453.6	205.5	248.1	7.2	24.269	-10.517	8.24	119.7
40.0	685.2	238.3	446.9	12.2	25.337	-7.219	8.67	116.2
42.0	738.7	277.8	460.9	13.2	25.486	-6.766	8.74	116.3
44.0	794.6	319.7	474.9	14.4	25.674	-6.325	8.82	116.6
46.0	852.9	364.0	488.9	15.9	25.900	-5.902	8.90	116.7
48.0	913.7	410.8	503.0	17.4	26.042	-5.446	8.97	116.8
50.0	582.2	447.5	134.7	8.4	24.642	-11.335	8.37	117.7
52.0	612.6	473.0	139.7	9.0	24.734	-11.238	8.42	117.0
54.0	644.0	499.4	144.6	9.6	24.914	-11.116	8.48	116.5
56.0	796.4	541.5	255.0	13.0	25.587	-9.066	8.77	116.1
58.0	839.7	584.7	255.0	13.9	25.722	-8.893	8.83	116.2
60.0	884.1	629.1	255.0	14.9	25.867	-8.766	8.89	116.3
62.0	929.6	674.7	255.0	16.0	26.012	-8.672	8.96	116.3
64.0	976.4	721.4	255.0	17.1	26.162	-8.573	9.02	116.4
66.0	1024.3	769.3	255.0	18.4	26.307	-8.487	9.08	116.4
68.0	1073.4	818.4	255.0	19.6	26.442	-8.371	9.13	116.3
70.0	1046.9	860.7	186.2	18.6	26.341	-9.627	9.09	115.8
72.0	1082.6	895.7	186.9	19.6	26.477	-9.747	9.14	115.8
74.0	1118.7	931.0	187.6	20.6	26.573	-9.876	9.18	115.7
76.0	1155.2	966.8	188.4	21.4	26.683	-9.961	9.21	115.4
78.0	1192.1	1003.1	189.1	22.2	26.764	-10.068	9.25	115.3
80.0	1229.5	1039.7	189.8	22.9	26.813	-10.114	9.28	115.2
82.0	1267.3	1076.8	190.5	23.6	26.907	-10.035	9.31	115.1
84.0	1305.5	1114.3	191.2	24.1	26.980	-9.931	9.33	114.7
86.0	1708.5	1198.5	510.0	39.4	27.385	-4.240	9.51	112.7
88.0	1795.2	1285.2	510.0	42.0	27.464	-3.978	9.55	113.0
90.0	1609.6	1354.6	255.0	31.2	27.234	-7.899	9.43	112.1

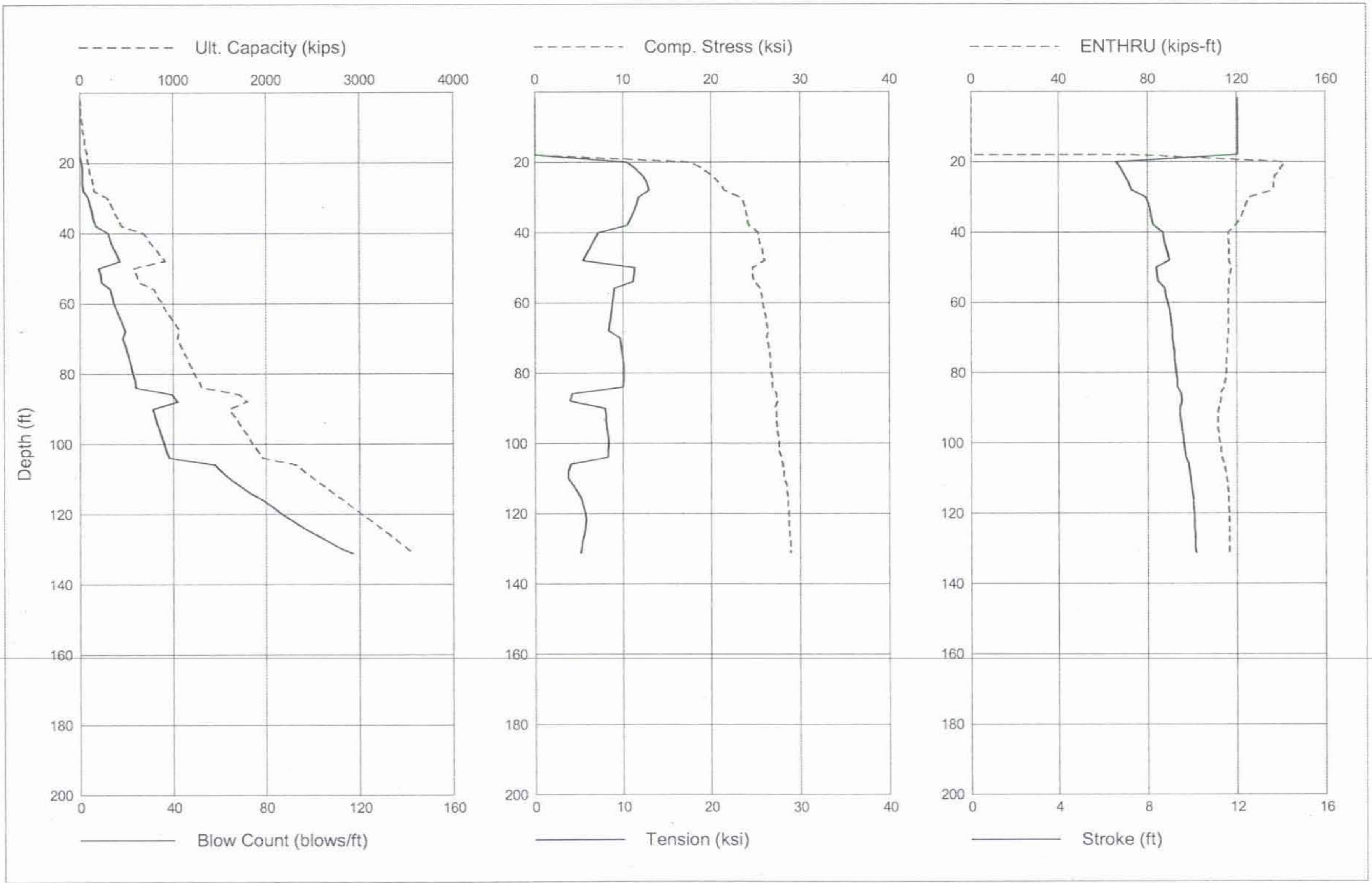
Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	1659.8	1404.8	255.0	32.0	27.316	-8.011	9.46	111.7
94.0	1710.1	1455.1	255.0	33.0	27.362	-8.100	9.50	111.4
96.0	1760.4	1505.4	255.0	34.1	27.437	-8.208	9.53	111.7
98.0	1810.6	1555.6	255.0	35.1	27.586	-8.299	9.58	112.2
100.0	1860.9	1605.9	255.0	36.1	27.681	-8.344	9.62	112.5
102.0	1911.2	1656.2	255.0	37.2	27.683	-8.272	9.66	112.8
104.0	1961.4	1706.4	255.0	38.3	27.877	-8.253	9.70	113.1
106.0	2316.9	1807.0	510.0	57.6	28.090	-4.056	9.82	114.6
108.0	2417.5	1907.5	510.0	61.1	28.238	-3.787	9.87	114.9
110.0	2518.0	2008.0	510.0	64.8	28.252	-3.825	9.92	115.3
112.0	2618.5	2108.5	510.0	68.7	28.507	-4.331	9.97	115.8
114.0	2719.0	2209.1	510.0	73.2	28.542	-4.836	10.01	116.1
116.0	2819.6	2309.6	510.0	78.2	28.633	-5.246	10.03	116.3
118.0	2920.1	2410.1	510.0	82.7	28.622	-5.535	10.05	116.4
120.0	3020.6	2510.6	510.0	86.7	28.783	-5.736	10.08	116.7
122.0	3121.1	2611.2	510.0	91.2	28.766	-5.805	10.10	116.7
124.0	3221.7	2711.7	510.0	96.2	28.772	-5.735	10.11	116.6
126.0	3322.2	2812.2	510.0	101.4	28.903	-5.594	10.13	116.6
128.0	3422.7	2912.8	510.0	107.1	28.918	-5.423	10.14	116.5
130.0	3523.3	3013.3	510.0	113.0	29.002	-5.234	10.15	116.6
131.2	3583.6	3073.6	510.0	117.2	28.912	-5.130	10.16	116.5

Total Continuous Driving Time 99.00 minutes; Total Number of Blows 3745

California D.O.T. Geotechnical Services — Apr 29 2009

Colorado B2-Anchor,Hammer D100-13,1.250 — Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 — GRLWEAP(TM) Version 2005



ANALYSIS 2

48" Pile, 1.375-inch Thick

Delmag D 100-13 Hammer

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	5.4	0.5	5.0	0.0	0.000	0.000	12.04	0.0
4.0	11.8	1.8	9.9	0.0	0.000	0.000	12.04	0.0
6.0	19.0	4.1	14.9	0.0	0.000	0.000	12.04	0.0
8.0	27.2	7.4	19.8	0.0	0.000	0.000	12.04	0.0
10.0	36.3	11.5	24.8	0.0	0.000	0.000	12.04	0.0
12.0	46.3	16.6	29.7	0.0	0.000	0.000	12.04	0.0
14.0	57.2	22.5	34.7	0.0	0.000	0.000	12.04	0.0
16.0	69.1	29.5	39.7	0.0	0.000	0.000	12.04	0.0
18.0	81.9	37.3	44.6	0.0	0.000	0.000	12.04	0.0
20.0	95.6	46.0	49.6	0.0	0.000	0.000	12.04	0.0
22.0	110.2	55.7	54.5	1.3	18.369	-11.502	6.90	139.5
24.0	125.7	66.3	59.5	1.4	19.496	-12.308	7.09	136.9
26.0	142.2	77.8	64.4	1.6	20.407	-12.902	7.26	135.6
28.0	159.6	90.2	69.4	1.7	21.010	-13.179	7.40	135.3
30.0	300.3	107.3	193.1	3.9	22.816	-12.255	8.02	125.4
32.0	336.3	129.4	206.8	4.6	23.128	-12.060	8.12	123.5
34.0	373.8	153.2	220.6	5.3	23.285	-11.768	8.20	122.2
36.0	412.9	178.5	234.3	6.0	23.433	-11.453	8.26	120.9
38.0	453.6	205.5	248.1	7.3	23.614	-11.161	8.33	118.9
40.0	685.2	238.3	446.9	12.3	24.601	-8.138	8.72	115.4
42.0	738.7	277.8	460.9	13.3	24.707	-7.739	8.78	115.7
44.0	794.6	319.7	474.9	14.4	24.850	-7.328	8.85	115.9
46.0	852.9	364.0	488.9	15.8	24.985	-6.890	8.90	115.9
48.0	913.7	410.8	503.0	17.3	25.158	-6.502	8.98	116.1
50.0	582.2	447.5	134.7	8.4	24.006	-11.930	8.45	117.6
52.0	612.6	473.0	139.7	8.9	24.074	-11.789	8.50	117.0
54.0	644.0	499.4	144.6	9.5	24.140	-11.656	8.54	116.4
56.0	796.4	541.5	255.0	13.2	24.825	-9.852	8.81	115.1
58.0	839.7	584.7	255.0	14.1	24.948	-9.692	8.86	115.3
60.0	884.1	629.1	255.0	15.0	25.058	-9.554	8.91	115.4
62.0	929.6	674.7	255.0	16.1	25.164	-9.452	8.96	115.4
64.0	976.4	721.4	255.0	17.3	25.345	-9.375	9.03	115.5
66.0	1024.3	769.3	255.0	18.6	25.372	-9.258	9.08	115.5
68.0	1073.4	818.4	255.0	19.9	25.606	-9.229	9.14	115.5
70.0	1046.9	860.7	186.2	18.7	25.421	-10.325	9.10	115.3
72.0	1082.6	895.7	186.9	19.7	25.595	-10.459	9.14	115.1
74.0	1118.7	931.0	187.6	20.7	25.687	-10.543	9.17	114.8
76.0	1155.2	966.8	188.4	21.7	25.669	-10.637	9.20	114.5
78.0	1192.1	1003.1	189.1	22.6	25.813	-10.771	9.23	114.3
80.0	1229.5	1039.7	189.8	23.2	25.895	-10.741	9.27	113.9
82.0	1267.3	1076.8	190.5	23.6	25.982	-10.711	9.29	113.7
84.0	1305.5	1114.3	191.2	24.1	26.054	-10.633	9.32	113.4
86.0	1708.5	1198.5	510.0	38.4	26.443	-5.403	9.49	112.2
88.0	1795.2	1285.2	510.0	40.9	26.444	-5.163	9.52	112.3
90.0	1609.6	1354.6	255.0	30.6	26.261	-8.818	9.42	112.3

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	1659.8	1404.8	255.0	31.3	26.414	-8.872	9.46	111.9
94.0	1710.1	1455.1	255.0	32.3	26.427	-8.965	9.49	111.5
96.0	1760.4	1505.4	255.0	33.3	26.565	-9.068	9.52	111.4
98.0	1810.6	1555.6	255.0	34.2	26.650	-9.160	9.56	111.7
100.0	1860.9	1605.9	255.0	35.2	26.655	-9.179	9.59	111.8
102.0	1911.2	1656.2	255.0	36.2	26.716	-9.131	9.62	112.1
104.0	1961.4	1706.4	255.0	37.1	26.836	-9.074	9.66	112.3
106.0	2316.9	1807.0	510.0	57.0	27.090	-5.123	9.77	113.7
108.0	2417.5	1907.5	510.0	60.1	27.212	-4.849	9.81	114.1
110.0	2518.0	2008.0	510.0	63.3	27.304	-4.604	9.86	114.4
112.0	2618.5	2108.5	510.0	66.9	27.262	-4.436	9.90	114.7
114.0	2719.0	2209.1	510.0	70.7	27.453	-4.267	9.94	115.1
116.0	2819.6	2309.6	510.0	74.9	27.464	-4.447	9.97	115.5
118.0	2920.1	2410.1	510.0	78.8	27.512	-4.855	10.00	115.7
120.0	3020.6	2510.6	510.0	82.5	27.662	-5.215	10.01	115.7
122.0	3121.1	2611.2	510.0	86.3	27.749	-5.494	10.04	115.9
124.0	3221.7	2711.7	510.0	90.4	27.785	-5.700	10.05	115.9
126.0	3322.2	2812.2	510.0	94.6	27.828	-5.781	10.07	116.0
128.0	3422.7	2912.8	510.0	99.1	27.882	-5.740	10.09	116.0
130.0	3523.3	3013.3	510.0	104.1	27.922	-5.601	10.11	116.1
131.2	3583.6	3073.6	510.0	107.0	27.993	-5.474	10.12	116.2

Total Continuous Driving Time 96.00 minutes; Total Number of Blows 3621

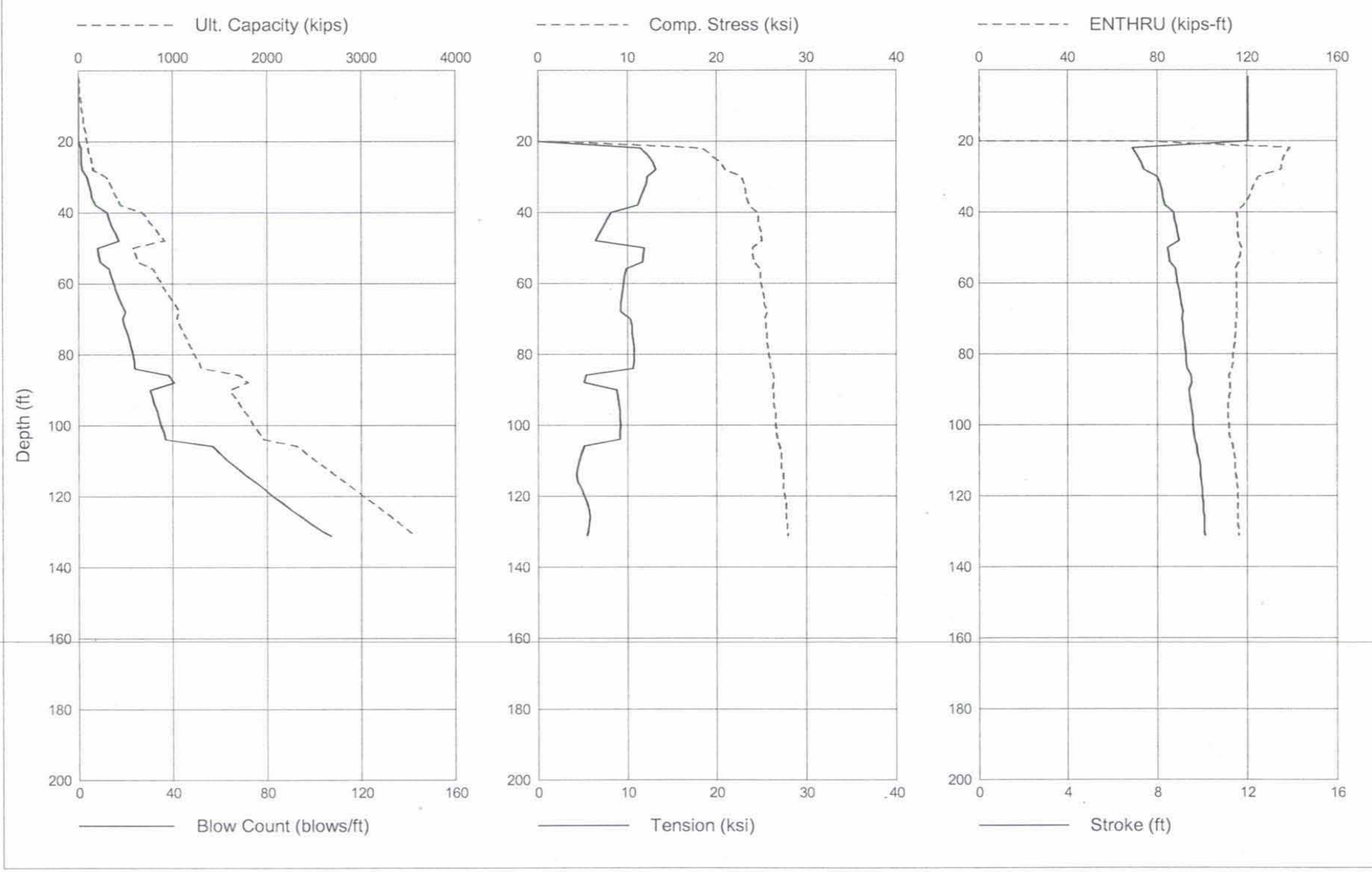
California D.O.T. Geotechnical Services

Apr 29 2009

Colorado B2-Anchor,Hammer D100-13,1.375

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



ANALYSIS 3

48" Pile, 1.500-inch Thick

Delmag D 100-13 Hammer

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	5.4	0.5	5.0	0.0	0.000	0.000	12.04	0.0
4.0	11.8	1.8	9.9	0.0	0.000	0.000	12.04	0.0
6.0	19.0	4.1	14.9	0.0	0.000	0.000	12.04	0.0
8.0	27.2	7.4	19.8	0.0	0.000	0.000	12.04	0.0
10.0	36.3	11.5	24.8	0.0	0.000	0.000	12.04	0.0
12.0	46.3	16.6	29.7	0.0	0.000	0.000	12.04	0.0
14.0	57.2	22.5	34.7	0.0	0.000	0.000	12.04	0.0
16.0	69.1	29.5	39.7	0.0	0.000	0.000	12.04	0.0
18.0	81.9	37.3	44.6	0.0	0.000	0.000	12.04	0.0
20.0	95.6	46.0	49.6	0.0	0.000	0.000	12.04	0.0
22.0	110.2	55.7	54.5	1.3	17.687	-11.311	6.96	139.7
24.0	125.7	66.3	59.5	1.4	18.828	-12.203	7.16	136.9
26.0	142.2	77.8	64.4	1.6	19.854	-12.917	7.37	135.3
28.0	159.6	90.2	69.4	1.7	20.445	-13.265	7.49	133.1
30.0	300.3	107.3	193.1	3.9	22.335	-12.586	8.11	124.6
32.0	336.3	129.4	206.8	4.6	22.566	-12.387	8.20	123.3
34.0	373.8	153.2	220.6	5.3	22.763	-12.144	8.28	121.6
36.0	412.9	178.5	234.3	6.0	22.898	-11.911	8.34	120.1
38.0	453.6	205.5	248.1	6.8	23.032	-11.623	8.41	119.6
40.0	685.2	238.3	446.9	12.4	23.874	-8.808	8.76	115.1
42.0	738.7	277.8	460.9	13.5	23.943	-8.439	8.82	114.7
44.0	794.6	319.7	474.9	14.6	24.114	-8.074	8.88	115.1
46.0	852.9	364.0	488.9	15.8	24.309	-7.686	8.94	115.3
48.0	913.7	410.8	503.0	17.3	24.405	-7.334	9.01	115.5
50.0	582.2	447.5	134.7	8.6	23.386	-12.265	8.52	116.6
52.0	612.6	473.0	139.7	9.1	23.432	-12.176	8.56	116.5
54.0	644.0	499.4	144.6	9.5	23.554	-12.075	8.60	116.2
56.0	796.4	541.5	255.0	13.3	24.070	-10.363	8.83	114.7
58.0	839.7	584.7	255.0	14.2	24.216	-10.256	8.89	114.4
60.0	884.1	629.1	255.0	15.2	24.302	-10.107	8.94	114.4
62.0	929.6	674.7	255.0	16.2	24.448	-10.035	8.99	114.3
64.0	976.4	721.4	255.0	17.3	24.526	-9.954	9.04	114.5
66.0	1024.3	769.3	255.0	18.6	24.700	-9.893	9.09	114.7
68.0	1073.4	818.4	255.0	20.0	24.768	-9.819	9.14	114.6
70.0	1046.9	860.7	186.2	18.7	24.710	-10.849	9.10	114.3
72.0	1082.6	895.7	186.9	19.6	24.828	-10.965	9.14	114.3
74.0	1118.7	931.0	187.6	20.6	24.890	-11.049	9.18	114.1
76.0	1155.2	966.8	188.4	21.5	24.945	-11.137	9.20	113.7
78.0	1192.1	1003.1	189.1	22.4	24.884	-11.195	9.23	113.4
80.0	1229.5	1039.7	189.8	23.3	25.057	-11.235	9.25	113.0
82.0	1267.3	1076.8	190.5	23.7	25.134	-11.187	9.28	112.8
84.0	1305.5	1114.3	191.2	24.0	25.150	-11.116	9.31	112.6
86.0	1708.5	1198.5	510.0	37.7	25.460	-6.314	9.47	112.2
88.0	1795.2	1285.2	510.0	39.9	25.657	-6.105	9.51	111.9
90.0	1609.6	1354.6	255.0	30.0	25.471	-9.540	9.48	112.9

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	1659.8	1404.8	255.0	31.0	25.482	-9.517	9.42	111.2
94.0	1710.1	1455.1	255.0	31.9	25.578	-9.565	9.45	111.0
96.0	1760.4	1505.4	255.0	32.8	25.643	-9.675	9.49	110.6
98.0	1810.6	1555.6	255.0	33.7	25.592	-9.783	9.52	110.9
100.0	1860.9	1605.9	255.0	34.6	25.738	-9.813	9.56	111.2
102.0	1911.2	1656.2	255.0	35.4	25.825	-9.790	9.61	111.6
104.0	1961.4	1706.4	255.0	36.2	25.997	-9.766	9.65	112.0
106.0	2316.9	1807.0	510.0	55.8	26.203	-6.040	9.75	113.3
108.0	2417.5	1907.5	510.0	59.5	26.271	-5.777	9.79	113.4
110.0	2518.0	2008.0	510.0	62.6	26.324	-5.527	9.82	113.6
112.0	2618.5	2108.5	510.0	65.9	26.379	-5.308	9.85	113.8
114.0	2719.0	2209.1	510.0	69.2	26.404	-5.161	9.90	114.4
116.0	2819.6	2309.6	510.0	72.9	26.502	-5.209	9.93	114.8
118.0	2920.1	2410.1	510.0	76.1	26.646	-5.360	9.96	115.2
120.0	3020.6	2510.6	510.0	79.3	26.742	-5.393	9.99	115.4
122.0	3121.1	2611.2	510.0	82.7	26.761	-5.285	10.00	115.4
124.0	3221.7	2711.7	510.0	86.2	26.733	-5.220	10.01	115.4
126.0	3322.2	2812.2	510.0	90.1	26.826	-5.230	10.02	115.3
128.0	3422.7	2912.8	510.0	94.2	26.887	-5.288	10.04	115.3
130.0	3523.3	3013.3	510.0	98.4	26.898	-5.375	10.06	115.3
131.2	3583.6	3073.6	510.0	101.1	26.850	-5.441	10.06	115.4

Total Continuous Driving Time 93.00 minutes; Total Number of Blows 3539

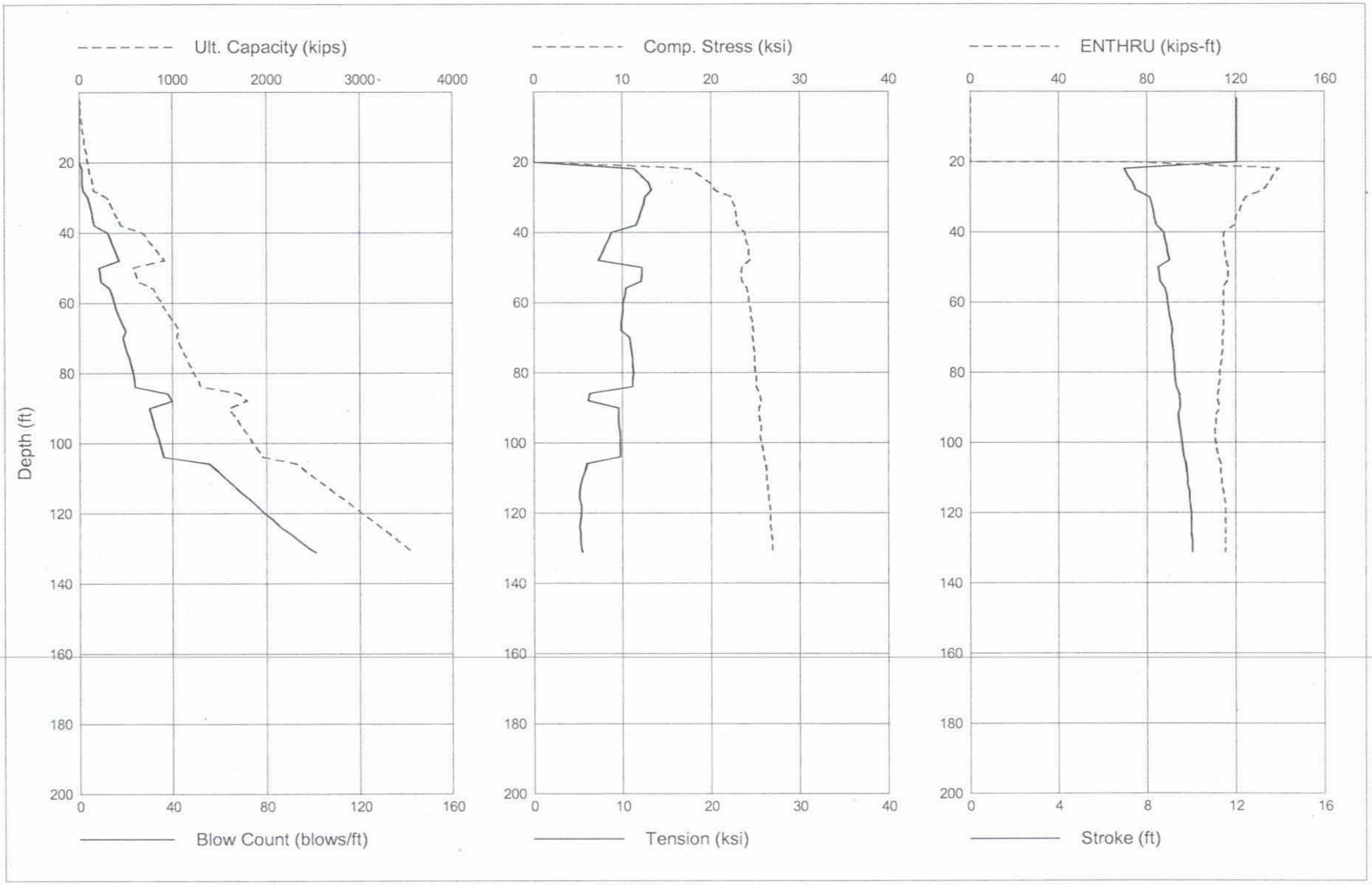
California D.O.T. Geotechnical Services

Apr 29 2009

Colorado B2-Anchor,Hammer D100-13,1.500

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



ANALYSIS 4

48" Pile, 1.625-inch Thick

Delmag D 100-13 Hammer

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	5.4	0.5	5.0	0.0	0.000	0.000	12.04	0.0
4.0	11.8	1.8	9.9	0.0	0.000	0.000	12.04	0.0
6.0	19.0	4.1	14.9	0.0	0.000	0.000	12.04	0.0
8.0	27.2	7.4	19.8	0.0	0.000	0.000	12.04	0.0
10.0	36.3	11.5	24.8	0.0	0.000	0.000	12.04	0.0
12.0	46.3	16.6	29.7	0.0	0.000	0.000	12.04	0.0
14.0	57.2	22.5	34.7	0.0	0.000	0.000	12.04	0.0
16.0	69.1	29.5	39.7	0.0	0.000	0.000	12.04	0.0
18.0	81.9	37.3	44.6	0.0	0.000	0.000	12.04	0.0
20.0	95.6	46.0	49.6	0.0	0.000	0.000	12.04	0.0
22.0	110.2	55.7	54.5	0.0	0.000	0.000	12.04	0.0
24.0	125.7	66.3	59.5	1.4	18.245	-12.065	7.24	136.3
26.0	142.2	77.8	64.4	1.6	19.301	-12.797	7.44	134.8
28.0	159.6	90.2	69.4	1.7	20.003	-13.260	7.59	133.1
30.0	300.3	107.3	193.1	3.8	21.876	-12.798	8.20	125.0
32.0	336.3	129.4	206.8	4.4	21.971	-12.630	8.27	123.3
34.0	373.8	153.2	220.6	5.3	22.164	-12.418	8.35	121.1
36.0	412.9	178.5	234.3	6.1	22.411	-12.193	8.42	119.2
38.0	453.6	205.5	248.1	6.8	22.560	-11.942	8.48	118.6
40.0	685.2	238.3	446.9	12.5	23.271	-9.298	8.78	114.5
42.0	738.7	277.8	460.9	13.6	23.417	-8.973	8.85	114.4
44.0	794.6	319.7	474.9	14.7	23.462	-8.663	8.91	114.3
46.0	852.9	364.0	488.9	15.9	23.688	-8.293	8.97	114.6
48.0	913.7	410.8	503.0	17.4	23.789	-7.917	9.02	114.6
50.0	582.2	447.5	134.7	8.8	22.897	-12.602	8.61	116.0
52.0	612.6	473.0	139.7	9.3	22.869	-12.510	8.65	115.8
54.0	644.0	499.4	144.6	9.7	23.034	-12.361	8.67	115.3
56.0	796.4	541.5	255.0	13.3	23.446	-10.785	8.86	114.7
58.0	839.7	584.7	255.0	14.2	23.481	-10.670	8.92	114.5
60.0	884.1	629.1	255.0	15.2	23.633	-10.532	8.97	114.0
62.0	929.6	674.7	255.0	16.3	23.666	-10.470	9.01	113.8
64.0	976.4	721.4	255.0	17.4	23.849	-10.351	9.05	113.6
66.0	1024.3	769.3	255.0	18.6	23.836	-10.295	9.10	113.6
68.0	1073.4	818.4	255.0	19.9	24.061	-10.247	9.14	113.7
70.0	1046.9	860.7	186.2	18.6	23.999	-11.196	9.11	113.2
72.0	1082.6	895.7	186.9	19.6	23.984	-11.284	9.15	113.1
74.0	1118.7	931.0	187.6	20.5	24.043	-11.366	9.18	113.1
76.0	1155.2	966.8	188.4	21.3	24.094	-11.456	9.21	113.0
78.0	1192.1	1003.1	189.1	22.1	24.275	-11.566	9.23	112.8
80.0	1229.5	1039.7	189.8	23.0	24.321	-11.579	9.26	112.5
82.0	1267.3	1076.8	190.5	23.7	24.360	-11.507	9.28	112.1
84.0	1305.5	1114.3	191.2	24.3	24.211	-11.327	9.22	110.8
86.0	1708.5	1198.5	510.0	37.0	24.819	-7.037	9.49	112.6
88.0	1795.2	1285.2	510.0	39.1	24.752	-6.837	9.51	112.2
90.0	1609.6	1354.6	255.0	30.1	24.636	-9.898	9.39	111.0

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	1659.8	1404.8	255.0	30.7	24.696	-9.972	9.42	110.6
94.0	1710.1	1455.1	255.0	31.6	24.714	-10.045	9.46	110.5
96.0	1760.4	1505.4	255.0	32.4	24.813	-10.164	9.49	110.4
98.0	1810.6	1555.6	255.0	33.3	24.828	-10.252	9.53	110.5
100.0	1860.9	1605.9	255.0	34.0	25.026	-10.281	9.56	110.9
102.0	1911.2	1656.2	255.0	34.7	25.028	-10.277	9.60	111.3
104.0	1961.4	1706.4	255.0	35.6	25.149	-10.232	9.63	111.6
106.0	2316.9	1807.0	510.0	53.6	25.290	-6.789	9.74	112.9
108.0	2417.5	1907.5	510.0	57.7	25.455	-6.541	9.77	113.0
110.0	2518.0	2008.0	510.0	62.2	25.501	-6.296	9.80	113.3
112.0	2618.5	2108.5	510.0	65.4	25.516	-6.089	9.82	113.3
114.0	2719.0	2209.1	510.0	68.6	25.575	-5.898	9.85	113.5
116.0	2819.6	2309.6	510.0	71.8	25.611	-6.007	9.89	114.1
118.0	2920.1	2410.1	510.0	74.7	25.715	-6.122	9.93	114.4
120.0	3020.6	2510.6	510.0	77.5	25.867	-6.131	9.96	114.7
122.0	3121.1	2611.2	510.0	80.4	25.774	-6.064	9.98	114.9
124.0	3221.7	2711.7	510.0	83.6	25.836	-5.954	9.99	114.9
126.0	3322.2	2812.2	510.0	86.9	25.885	-5.835	10.00	114.9
128.0	3422.7	2912.8	510.0	90.5	25.897	-5.773	10.01	114.9
130.0	3523.3	3013.3	510.0	94.3	25.911	-5.901	10.02	114.9
131.2	3583.6	3073.6	510.0	96.6	25.993	-6.012	10.04	115.0

Total Continuous Driving Time 91.00 minutes; Total Number of Blows 3472

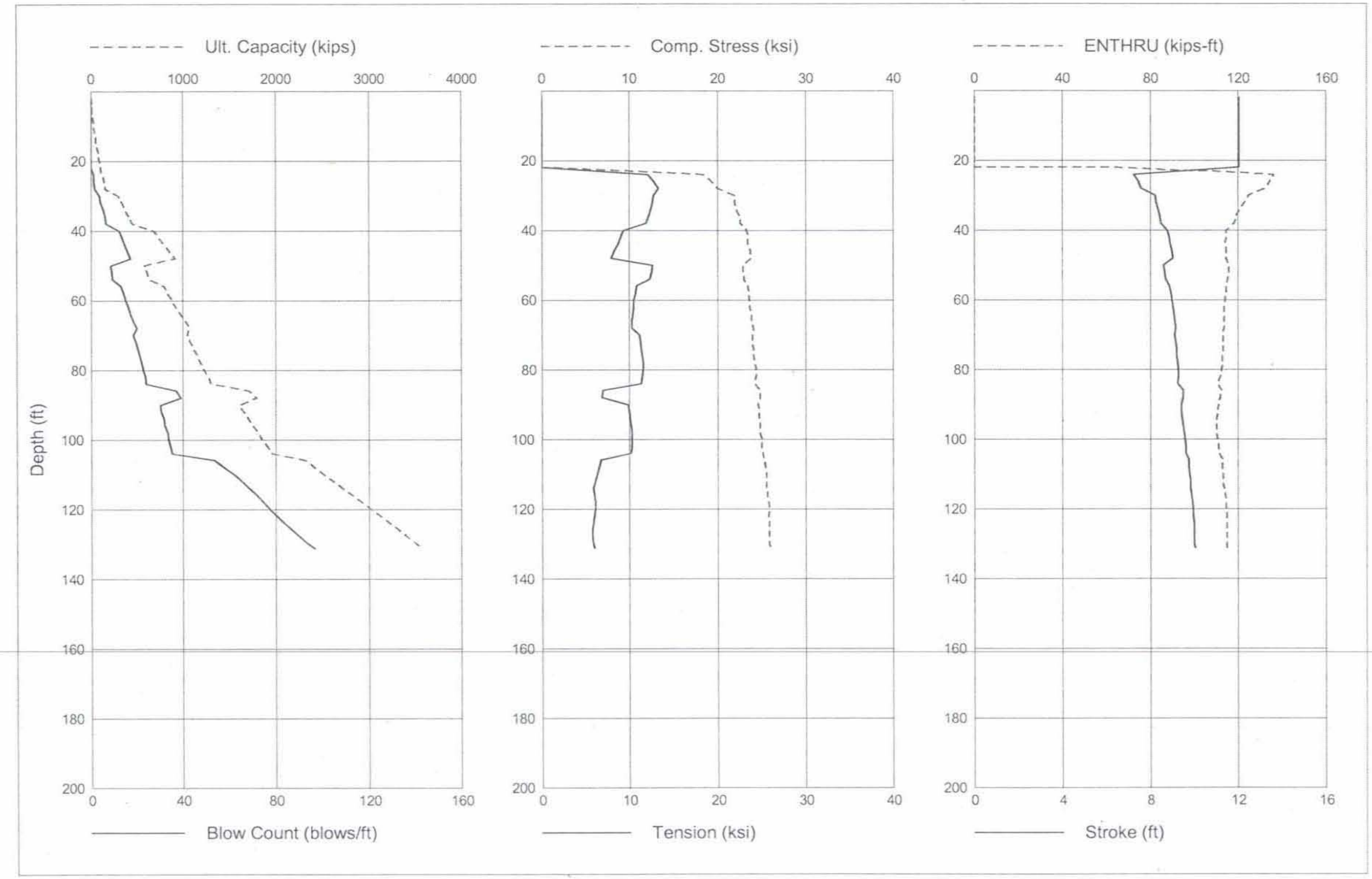
California D.O.T. Geotechnical Services

Apr 29 2009

Colorado B2-Anchor,Hammer D100-13,1.625

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



ANALYSIS 5

48" Pile, 1.750-inch Thick

Delmag D 100-13 Hammer

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	5.4	0.5	5.0	0.0	0.000	0.000	12.04	0.0
4.0	11.8	1.8	9.9	0.0	0.000	0.000	12.04	0.0
6.0	19.0	4.1	14.9	0.0	0.000	0.000	12.04	0.0
8.0	27.2	7.4	19.8	0.0	0.000	0.000	12.04	0.0
10.0	36.3	11.5	24.8	0.0	0.000	0.000	12.04	0.0
12.0	46.3	16.6	29.7	0.0	0.000	0.000	12.04	0.0
14.0	57.2	22.5	34.7	0.0	0.000	0.000	12.04	0.0
16.0	69.1	29.5	39.7	0.0	0.000	0.000	12.04	0.0
18.0	81.9	37.3	44.6	0.0	0.000	0.000	12.04	0.0
20.0	95.6	46.0	49.6	0.0	0.000	0.000	12.04	0.0
22.0	110.2	55.7	54.5	0.0	0.000	0.000	12.04	0.0
24.0	125.7	66.3	59.5	0.0	0.000	0.000	12.04	0.0
26.0	142.2	77.8	64.4	1.6	18.660	-12.580	7.50	134.4
28.0	159.6	90.2	69.4	1.7	19.485	-13.122	7.66	133.2
30.0	300.3	107.3	193.1	3.8	21.332	-12.954	8.28	123.9
32.0	336.3	129.4	206.8	4.4	21.547	-12.763	8.35	122.4
34.0	373.8	153.2	220.6	5.2	21.755	-12.595	8.44	120.6
36.0	412.9	178.5	234.3	6.0	21.839	-12.383	8.49	118.9
38.0	453.6	205.5	248.1	6.8	21.977	-12.172	8.56	118.6
40.0	685.2	238.3	446.9	12.4	22.654	-9.690	8.81	114.4
42.0	738.7	277.8	460.9	13.6	22.770	-9.409	8.88	114.1
44.0	794.6	319.7	474.9	14.8	22.866	-9.096	8.94	113.8
46.0	852.9	364.0	488.9	16.1	23.060	-8.759	9.00	113.8
48.0	913.7	410.8	503.0	17.5	23.123	-8.440	9.05	114.0
50.0	582.2	447.5	134.7	9.0	22.398	-12.754	8.69	115.2
52.0	612.6	473.0	139.7	9.5	22.439	-12.649	8.70	114.8
54.0	644.0	499.4	144.6	9.9	22.504	-12.547	8.73	114.6
56.0	796.4	541.5	255.0	13.2	22.860	-11.059	8.90	115.1
58.0	839.7	584.7	255.0	14.1	22.801	-10.936	8.93	114.4
60.0	884.1	629.1	255.0	15.1	22.945	-10.860	8.99	114.1
62.0	929.6	674.7	255.0	16.2	23.157	-10.774	9.04	113.7
64.0	976.4	721.4	255.0	17.4	23.122	-10.682	9.07	113.1
66.0	1024.3	769.3	255.0	18.6	23.316	-10.611	9.12	113.0
68.0	1073.4	818.4	255.0	19.9	23.401	-10.572	9.16	113.0
70.0	1046.9	860.7	186.2	18.5	23.263	-11.450	9.13	113.1
72.0	1082.6	895.7	186.9	19.4	23.348	-11.534	9.16	112.8
74.0	1118.7	931.0	187.6	20.3	23.477	-11.616	9.19	112.6
76.0	1155.2	966.8	188.4	21.1	23.500	-11.707	9.22	112.5
78.0	1192.1	1003.1	189.1	21.9	23.611	-11.794	9.25	112.4
80.0	1229.5	1039.7	189.8	22.7	23.628	-11.811	9.28	112.2
82.0	1267.3	1076.8	190.5	23.8	23.488	-11.623	9.22	110.7
84.0	1305.5	1114.3	191.2	24.4	23.559	-11.580	9.24	110.7
86.0	1708.5	1198.5	510.0	36.5	24.032	-7.584	9.49	112.4
88.0	1795.2	1285.2	510.0	38.5	24.104	-7.381	9.51	112.0
90.0	1609.6	1354.6	255.0	29.9	23.849	-10.254	9.41	110.5

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	1659.8	1404.8	255.0	30.5	24.010	-10.345	9.44	110.2
94.0	1710.1	1455.1	255.0	31.3	24.033	-10.407	9.47	110.1
96.0	1760.4	1505.4	255.0	32.1	24.033	-10.486	9.50	110.0
98.0	1810.6	1555.6	255.0	32.9	24.210	-10.577	9.53	110.2
100.0	1860.9	1605.9	255.0	33.6	24.279	-10.624	9.56	110.5
102.0	1911.2	1656.2	255.0	34.4	24.295	-10.611	9.59	110.8
104.0	1961.4	1706.4	255.0	35.1	24.318	-10.576	9.62	111.1
106.0	2316.9	1807.0	510.0	51.7	24.662	-7.412	9.74	112.6
108.0	2417.5	1907.5	510.0	55.4	24.675	-7.148	9.78	113.1
110.0	2518.0	2008.0	510.0	59.6	24.758	-6.917	9.80	113.1
112.0	2618.5	2108.5	510.0	64.5	24.818	-6.712	9.81	112.9
114.0	2719.0	2209.1	510.0	68.3	24.863	-6.512	9.83	112.9
116.0	2819.6	2309.6	510.0	71.3	24.939	-6.590	9.86	113.4
118.0	2920.1	2410.1	510.0	73.8	24.912	-6.745	9.90	113.9
120.0	3020.6	2510.6	510.0	76.2	25.019	-6.783	9.94	114.3
122.0	3121.1	2611.2	510.0	78.9	25.056	-6.696	9.96	114.5
124.0	3221.7	2711.7	510.0	81.8	25.156	-6.582	9.98	114.6
126.0	3322.2	2812.2	510.0	84.8	25.213	-6.483	9.99	114.6
128.0	3422.7	2912.8	510.0	88.0	25.231	-6.376	10.00	114.6
130.0	3523.3	3013.3	510.0	91.6	25.258	-6.361	10.00	114.5
131.2	3583.6	3073.6	510.0	93.6	25.278	-6.461	10.02	114.6

Total Continuous Driving Time 90.00 minutes; Total Number of Blows 3416

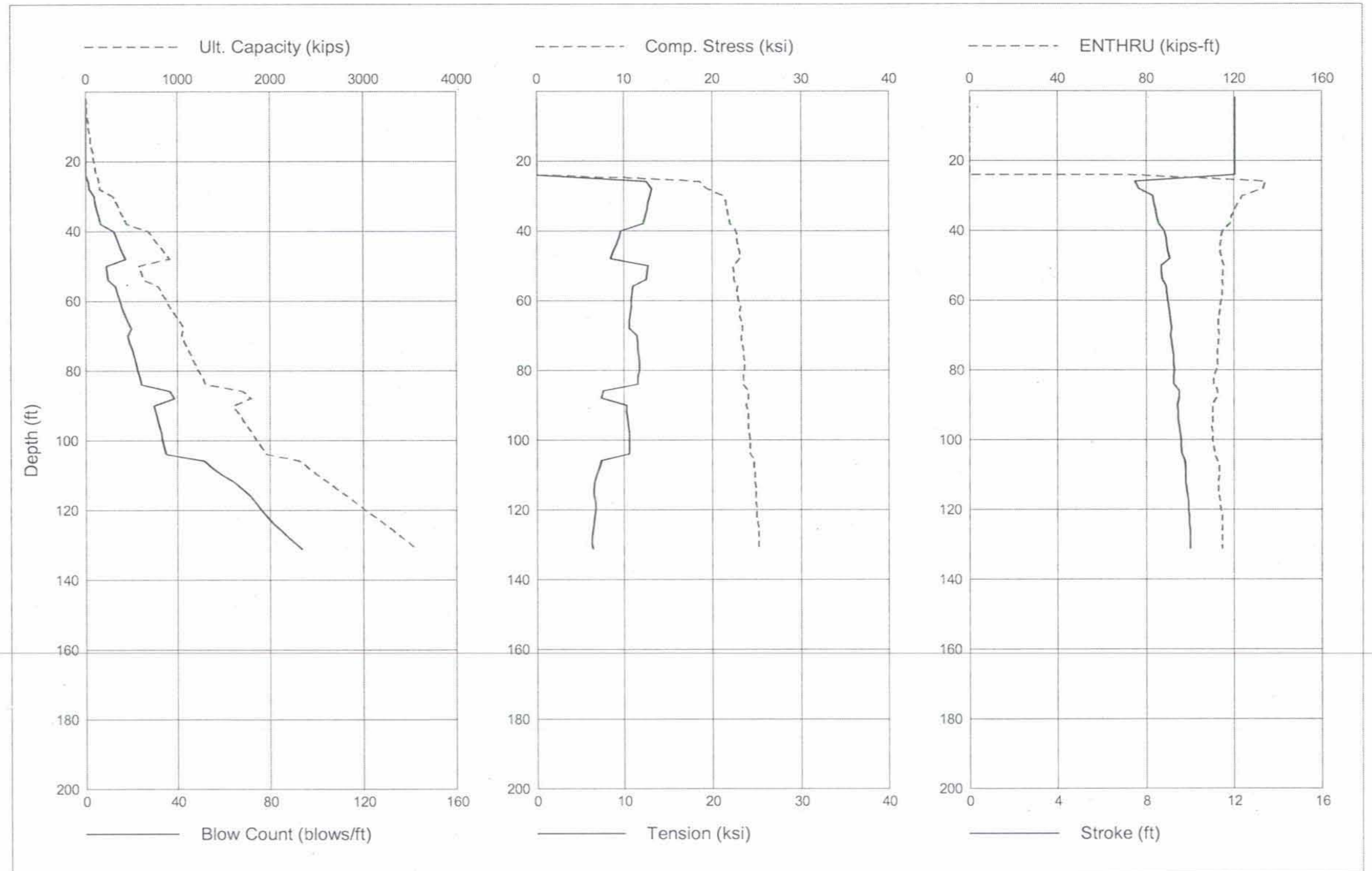
California D.O.T. Geotechnical Services

Apr 29 2009

Colorado B2-Anchor,Hammer D100-13,1.750

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



ANALYSIS 6

48" Pile, 1.250-inch Thick

IHC S-400 Hammer

California D.O.T. Geotechnical Services
Colorado B2-Anchor,Hammer IHC S400,1.250

Apr 29 2009
GRLWEAP(TM) Version 2005

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	5.4	0.5	5.0	0.0	0.000	0.000	6.62	0.0
4.0	11.8	1.8	9.9	0.0	0.000	0.000	6.62	0.0
6.0	19.0	4.1	14.9	0.0	0.000	0.000	6.62	0.0
8.0	27.2	7.4	19.8	0.0	0.000	0.000	6.62	0.0
10.0	36.3	11.5	24.8	0.0	0.000	0.000	6.62	0.0
12.0	46.3	16.6	29.7	0.0	0.000	0.000	6.62	0.0
14.0	57.2	22.5	34.7	0.0	0.000	0.000	6.62	0.0
16.0	69.1	29.5	39.7	0.0	0.000	0.000	6.62	0.0
18.0	81.9	37.3	44.6	0.0	0.000	0.000	6.62	0.0
20.0	95.6	46.0	49.6	0.0	0.000	0.000	6.62	0.0
22.0	110.2	55.7	54.5	0.0	0.000	0.000	6.62	0.0
24.0	125.7	66.3	59.5	0.0	0.000	0.000	6.62	0.0
26.0	142.2	77.8	64.4	0.0	0.000	0.000	6.62	0.0
28.0	159.6	90.2	69.4	2.9	32.604	-30.608	6.62	272.5
30.0	300.3	107.3	193.1	3.8	32.604	-23.858	6.62	272.6
32.0	336.3	129.4	206.8	4.0	32.604	-23.011	6.62	272.6
34.0	373.8	153.2	220.6	4.2	32.604	-21.757	6.62	272.6
36.0	412.9	178.5	234.3	4.4	32.604	-20.641	6.62	272.6
38.0	453.6	205.5	248.1	4.6	32.604	-19.530	6.62	272.6
40.0	685.2	238.3	446.9	6.9	32.604	-10.228	6.62	272.7
42.0	738.7	277.8	460.9	7.3	32.604	-9.131	6.62	272.7
44.0	794.6	319.7	474.9	7.8	32.604	-7.849	6.62	272.7
46.0	852.9	364.0	488.9	8.4	32.604	-7.005	6.62	272.7
48.0	913.7	410.8	503.0	9.0	32.604	-6.972	6.62	272.7
50.0	582.2	447.5	134.7	4.9	32.604	-19.811	6.62	272.6
52.0	612.6	473.0	139.7	5.0	32.604	-19.321	6.62	272.6
54.0	644.0	499.4	144.6	5.2	32.604	-18.479	6.62	272.6
56.0	796.4	541.5	255.0	6.8	32.604	-12.288	6.62	272.6
58.0	839.7	584.7	255.0	7.1	32.604	-11.478	6.62	272.6
60.0	884.1	629.1	255.0	7.4	32.604	-10.812	6.62	272.5
62.0	929.6	674.7	255.0	7.7	32.604	-10.226	6.62	272.5
64.0	976.4	721.4	255.0	8.0	32.604	-9.656	6.62	272.5
66.0	1024.3	769.3	255.0	8.4	32.604	-9.056	6.62	272.5
68.0	1073.4	818.4	255.0	8.7	32.604	-8.389	6.62	272.5
70.0	1046.9	860.7	186.2	8.1	32.604	-10.025	6.62	272.5
72.0	1082.6	895.7	186.9	8.4	32.604	-9.618	6.62	272.5
74.0	1118.7	931.0	187.6	8.7	32.604	-9.199	6.62	272.5
76.0	1155.2	966.8	188.4	8.9	32.604	-8.716	6.62	272.5
78.0	1192.1	1003.1	189.1	9.2	32.604	-8.216	6.62	272.5
80.0	1229.5	1039.7	189.8	9.5	32.604	-7.590	6.62	272.5
82.0	1267.3	1076.8	190.5	9.8	32.604	-7.107	6.62	272.5
84.0	1305.5	1114.3	191.2	10.1	32.604	-6.662	6.62	272.6
86.0	1708.5	1198.5	510.0	14.7	32.604	-4.828	6.62	272.6
88.0	1795.2	1285.2	510.0	15.3	32.604	-4.829	6.62	272.6
90.0	1609.6	1354.6	255.0	12.0	32.604	-4.721	6.62	272.6

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	1659.8	1404.8	255.0	12.2	32.604	-4.621	6.62	272.6
94.0	1710.1	1455.1	255.0	12.5	32.604	-4.403	6.62	272.5
96.0	1760.4	1505.4	255.0	12.7	32.604	-4.299	6.62	272.5
98.0	1810.6	1555.6	255.0	13.0	32.604	-4.841	6.62	272.5
100.0	1860.9	1605.9	255.0	13.3	32.604	-5.449	6.62	272.5
102.0	1911.2	1656.2	255.0	13.5	32.604	-5.403	6.62	272.4
104.0	1961.4	1706.4	255.0	13.8	32.605	-5.133	6.62	272.4
106.0	2316.9	1807.0	510.0	18.8	32.607	-6.120	6.62	272.3
108.0	2417.5	1907.5	510.0	19.7	32.611	-6.433	6.62	272.2
110.0	2518.0	2008.0	510.0	20.5	32.619	-6.445	6.62	272.1
112.0	2618.5	2108.5	510.0	21.3	32.632	-6.290	6.62	272.0
114.0	2719.0	2209.1	510.0	22.2	32.647	-6.171	6.62	271.9
116.0	2819.6	2309.6	510.0	23.2	32.659	-6.042	6.62	271.8
118.0	2920.1	2410.1	510.0	24.2	32.666	-6.120	6.62	271.6
120.0	3020.6	2510.6	510.0	25.2	32.668	-6.323	6.62	271.4
122.0	3121.1	2611.2	510.0	26.3	32.665	-6.391	6.62	271.2
124.0	3221.7	2711.7	510.0	27.5	32.657	-6.276	6.62	271.0
126.0	3322.2	2812.2	510.0	28.7	32.653	-6.017	6.62	270.8
128.0	3422.7	2912.8	510.0	30.1	32.644	-5.674	6.62	270.5
130.0	3523.3	3013.3	510.0	31.5	32.629	-5.502	6.62	270.2
131.2	3583.6	3073.6	510.0	32.3	32.618	-5.359	6.62	270.1

Total Number of Blows: 1322

Driving Time (min):	44	33	26	22	18	16	14	13	12	11
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

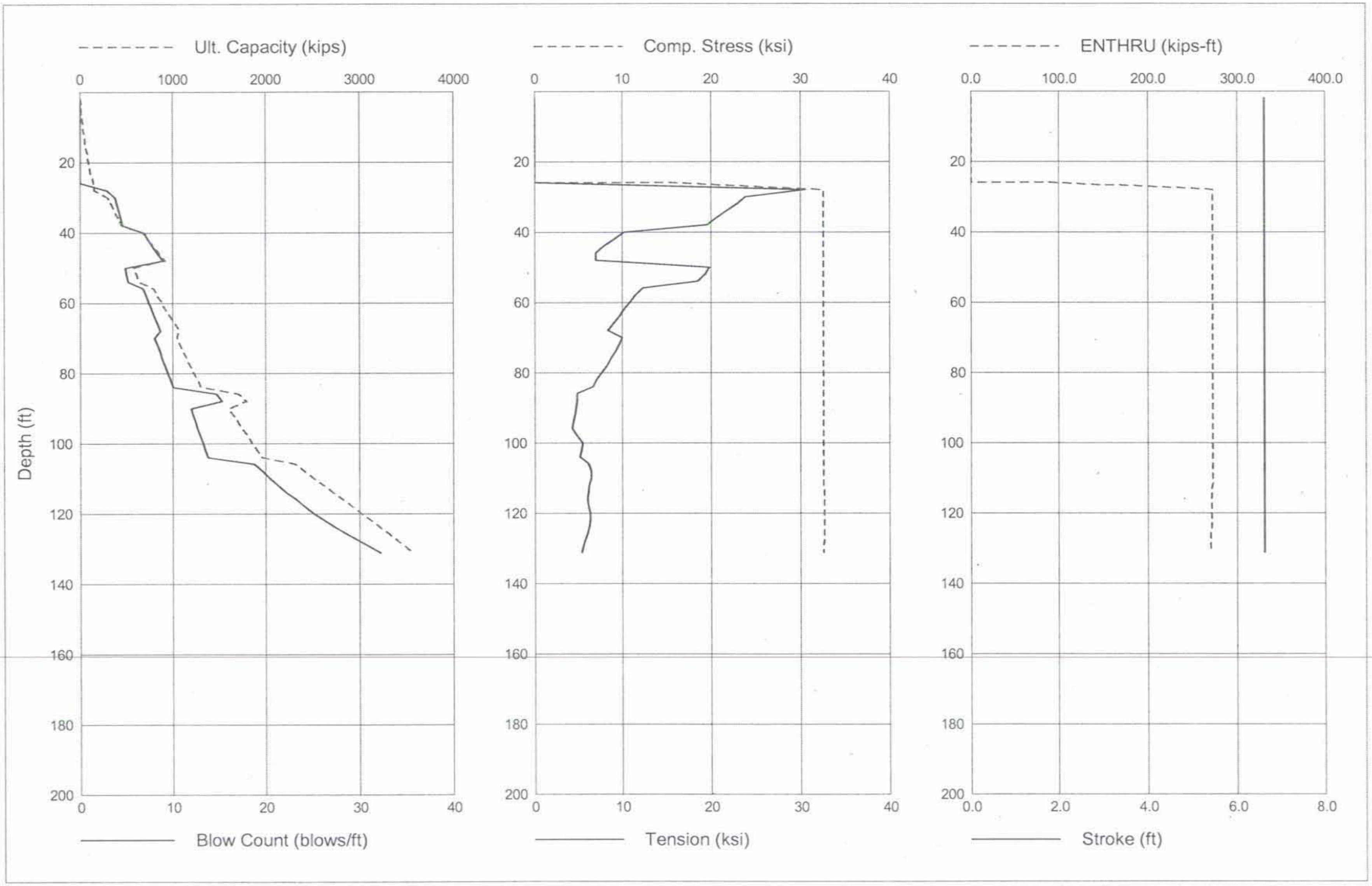
California D.O.T. Geotechnical Services

Apr 29 2009

Colorado B2-Anchor,Hammer IHC S400,1.250

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



ANALYSIS 7
48" Pile, 1.375-inch Thick
IHC S-400 Hammer

California D.O.T. Geotechnical Services
Colorado B2-Anchor,Hammer IHC S400,1.375

Apr 29 2009
GRLWEAP(TM) Version 2005

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	5.4	0.5	5.0	0.0	0.000	0.000	6.62	0.0
4.0	11.8	1.8	9.9	0.0	0.000	0.000	6.62	0.0
6.0	19.0	4.1	14.9	0.0	0.000	0.000	6.62	0.0
8.0	27.2	7.4	19.8	0.0	0.000	0.000	6.62	0.0
10.0	36.3	11.5	24.8	0.0	0.000	0.000	6.62	0.0
12.0	46.3	16.6	29.7	0.0	0.000	0.000	6.62	0.0
14.0	57.2	22.5	34.7	0.0	0.000	0.000	6.62	0.0
16.0	69.1	29.5	39.7	0.0	0.000	0.000	6.62	0.0
18.0	81.9	37.3	44.6	0.0	0.000	0.000	6.62	0.0
20.0	95.6	46.0	49.6	0.0	0.000	0.000	6.62	0.0
22.0	110.2	55.7	54.5	0.0	0.000	0.000	6.62	0.0
24.0	125.7	66.3	59.5	0.0	0.000	0.000	6.62	0.0
26.0	142.2	77.8	64.4	0.0	0.000	0.000	6.62	0.0
28.0	159.6	90.2	69.4	0.0	0.000	0.000	6.62	0.0
30.0	300.3	107.3	193.1	4.0	31.923	-24.233	6.62	272.3
32.0	336.3	129.4	206.8	4.2	31.923	-23.451	6.62	272.3
34.0	373.8	153.2	220.6	4.4	31.923	-22.263	6.62	272.3
36.0	412.9	178.5	234.3	4.6	31.923	-21.391	6.62	272.3
38.0	453.6	205.5	248.1	4.8	31.923	-20.099	6.62	272.3
40.0	685.2	238.3	446.9	6.9	31.923	-11.559	6.62	272.4
42.0	738.7	277.8	460.9	7.4	31.923	-10.517	6.62	272.4
44.0	794.6	319.7	474.9	7.9	31.923	-9.686	6.62	272.4
46.0	852.9	364.0	488.9	8.4	31.923	-8.624	6.62	272.4
48.0	913.7	410.8	503.0	8.9	31.923	-7.562	6.62	272.4
50.0	582.2	447.5	134.7	5.1	31.923	-20.720	6.62	272.3
52.0	612.6	473.0	139.7	5.2	31.923	-19.884	6.62	272.3
54.0	644.0	499.4	144.6	5.4	31.923	-19.589	6.62	272.3
56.0	796.4	541.5	255.0	6.8	31.923	-14.080	6.62	272.3
58.0	839.7	584.7	255.0	7.2	31.923	-13.326	6.62	272.3
60.0	884.1	629.1	255.0	7.5	31.923	-12.589	6.62	272.3
62.0	929.6	674.7	255.0	7.8	31.923	-11.933	6.62	272.3
64.0	976.4	721.4	255.0	8.1	31.923	-11.557	6.62	272.4
66.0	1024.3	769.3	255.0	8.4	31.923	-11.088	6.62	272.4
68.0	1073.4	818.4	255.0	8.8	31.923	-10.585	6.62	272.4
70.0	1046.9	860.7	186.2	8.2	31.923	-12.012	6.62	272.4
72.0	1082.6	895.7	186.9	8.5	31.923	-11.628	6.62	272.4
74.0	1118.7	931.0	187.6	8.7	31.923	-11.395	6.62	272.4
76.0	1155.2	966.8	188.4	9.0	31.923	-11.072	6.62	272.4
78.0	1192.1	1003.1	189.1	9.3	31.923	-10.646	6.62	272.4
80.0	1229.5	1039.7	189.8	9.5	31.923	-10.226	6.62	272.4
82.0	1267.3	1076.8	190.5	9.8	31.923	-9.876	6.62	272.4
84.0	1305.5	1114.3	191.2	10.1	31.923	-9.384	6.62	272.4
86.0	1708.5	1198.5	510.0	14.3	31.923	-5.308	6.62	272.4
88.0	1795.2	1285.2	510.0	14.8	31.923	-5.484	6.62	272.4
90.0	1609.6	1354.6	255.0	12.2	31.923	-6.525	6.62	272.4

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	1659.8	1404.8	255.0	12.4	31.923	-5.483	6.62	272.4
94.0	1710.1	1455.1	255.0	12.6	31.923	-5.836	6.62	272.3
96.0	1760.4	1505.4	255.0	12.8	31.923	-4.917	6.62	272.3
98.0	1810.6	1555.6	255.0	13.0	31.923	-4.464	6.62	272.3
100.0	1860.9	1605.9	255.0	13.2	31.923	-4.389	6.62	272.2
102.0	1911.2	1656.2	255.0	13.4	31.923	-4.333	6.62	272.1
104.0	1961.4	1706.4	255.0	13.6	31.923	-4.252	6.62	272.1
106.0	2316.9	1807.0	510.0	18.1	31.923	-5.962	6.62	272.0
108.0	2417.5	1907.5	510.0	18.9	31.924	-6.104	6.62	271.9
110.0	2518.0	2008.0	510.0	19.8	31.931	-6.139	6.62	271.8
112.0	2618.5	2108.5	510.0	20.7	31.942	-5.987	6.62	271.6
114.0	2719.0	2209.1	510.0	21.6	31.956	-6.041	6.62	271.5
116.0	2819.6	2309.6	510.0	22.5	31.967	-6.319	6.62	271.3
118.0	2920.1	2410.1	510.0	23.4	31.973	-6.319	6.62	271.1
120.0	3020.6	2510.6	510.0	24.3	31.977	-6.110	6.62	271.0
122.0	3121.1	2611.2	510.0	25.3	31.982	-5.809	6.62	270.7
124.0	3221.7	2711.7	510.0	26.4	31.983	-5.731	6.62	270.5
126.0	3322.2	2812.2	510.0	27.5	31.979	-5.676	6.62	270.3
128.0	3422.7	2912.8	510.0	28.6	31.970	-5.624	6.62	270.1
130.0	3523.3	3013.3	510.0	29.8	31.957	-5.474	6.62	270.0
131.2	3583.6	3073.6	510.0	30.6	31.947	-5.342	6.62	270.0

Total Number of Blows: 1294

Driving Time (min):	43	32	25	21	18	16	14	12	11	10
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

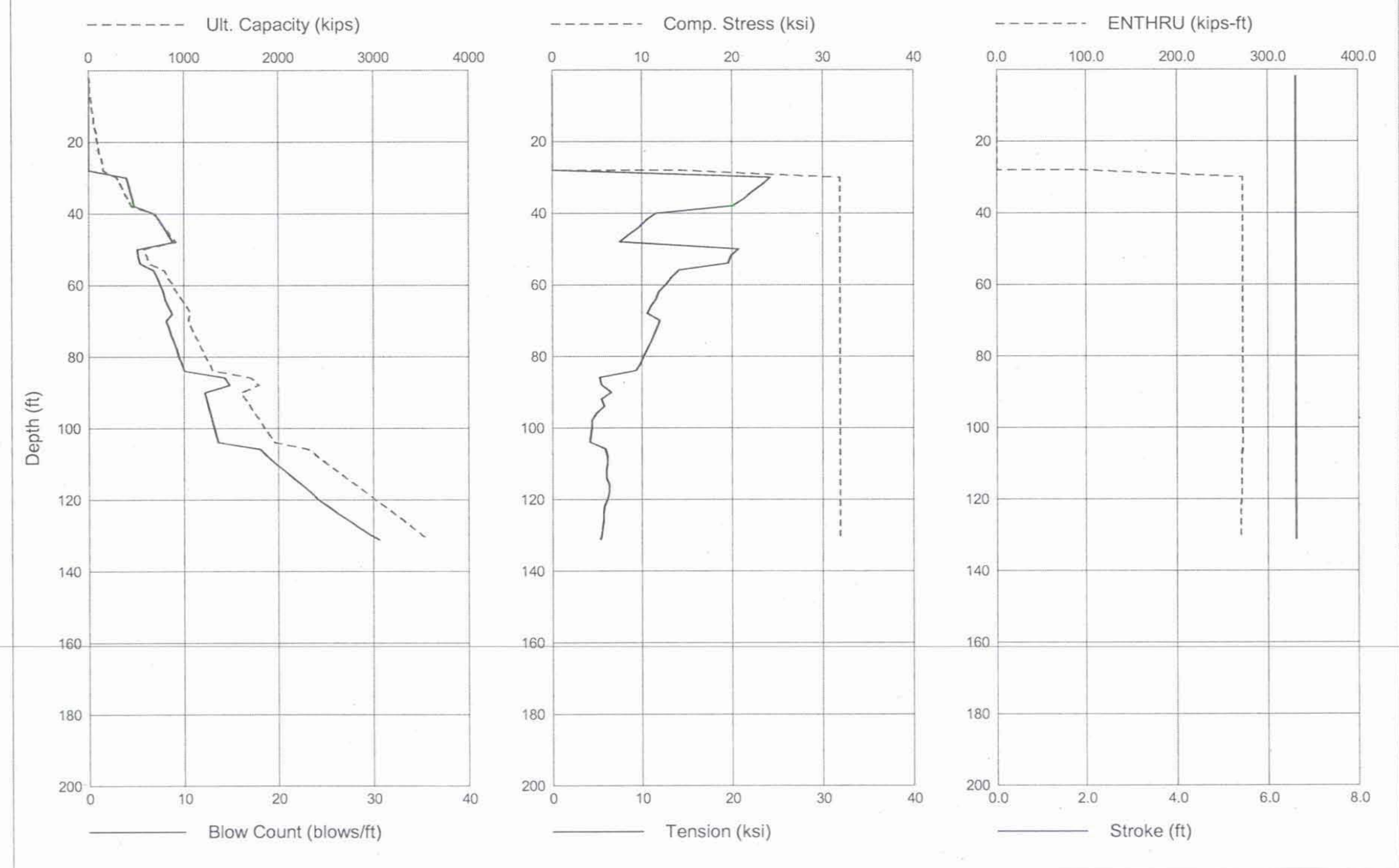
California D.O.T. Geotechnical Services

Apr 29 2009

Colorado B2-Anchor,Hammer IHC S400,1.375

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



ANALYSIS 8

48" Pile, 1.500-inch Thick

IHC S-400 Hammer

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	5.4	0.5	5.0	0.0	0.000	0.000	6.62	0.0
4.0	11.8	1.8	9.9	0.0	0.000	0.000	6.62	0.0
6.0	19.0	4.1	14.9	0.0	0.000	0.000	6.62	0.0
8.0	27.2	7.4	19.8	0.0	0.000	0.000	6.62	0.0
10.0	36.3	11.5	24.8	0.0	0.000	0.000	6.62	0.0
12.0	46.3	16.6	29.7	0.0	0.000	0.000	6.62	0.0
14.0	57.2	22.5	34.7	0.0	0.000	0.000	6.62	0.0
16.0	69.1	29.5	39.7	0.0	0.000	0.000	6.62	0.0
18.0	81.9	37.3	44.6	0.0	0.000	0.000	6.62	0.0
20.0	95.6	46.0	49.6	0.0	0.000	0.000	6.62	0.0
22.0	110.2	55.7	54.5	0.0	0.000	0.000	6.62	0.0
24.0	125.7	66.3	59.5	0.0	0.000	0.000	6.62	0.0
26.0	142.2	77.8	64.4	0.0	0.000	0.000	6.62	0.0
28.0	159.6	90.2	69.4	0.0	0.000	0.000	6.62	0.0
30.0	300.3	107.3	193.1	4.2	31.272	-24.048	6.62	272.1
32.0	336.3	129.4	206.8	4.3	31.272	-23.144	6.62	272.1
34.0	373.8	153.2	220.6	4.6	31.272	-22.294	6.62	272.1
36.0	412.9	178.5	234.3	4.8	31.272	-21.228	6.62	272.1
38.0	453.6	205.5	248.1	5.0	31.272	-20.369	6.62	272.1
40.0	685.2	238.3	446.9	7.0	31.272	-12.690	6.62	272.1
42.0	738.7	277.8	460.9	7.5	31.272	-12.175	6.62	272.1
44.0	794.6	319.7	474.9	8.0	31.272	-11.552	6.62	272.1
46.0	852.9	364.0	488.9	8.5	31.272	-10.797	6.62	272.1
48.0	913.7	410.8	503.0	9.0	31.272	-9.845	6.62	272.1
50.0	582.2	447.5	134.7	5.2	31.272	-20.836	6.62	272.1
52.0	612.6	473.0	139.7	5.4	31.272	-20.186	6.62	272.1
54.0	644.0	499.4	144.6	5.6	31.272	-19.435	6.62	272.1
56.0	796.4	541.5	255.0	6.9	31.272	-14.561	6.62	272.1
58.0	839.7	584.7	255.0	7.2	31.272	-14.090	6.62	272.1
60.0	884.1	629.1	255.0	7.6	31.272	-13.571	6.62	272.1
62.0	929.6	674.7	255.0	7.9	31.272	-13.233	6.62	272.1
64.0	976.4	721.4	255.0	8.3	31.272	-13.044	6.62	272.1
66.0	1024.3	769.3	255.0	8.6	31.272	-12.706	6.62	272.1
68.0	1073.4	818.4	255.0	8.9	31.272	-12.303	6.62	272.1
70.0	1046.9	860.7	186.2	8.4	31.272	-13.479	6.62	272.1
72.0	1082.6	895.7	186.9	8.6	31.272	-13.213	6.62	272.1
74.0	1118.7	931.0	187.6	8.9	31.272	-13.074	6.62	272.1
76.0	1155.2	966.8	188.4	9.1	31.272	-12.839	6.62	272.1
78.0	1192.1	1003.1	189.1	9.4	31.272	-12.547	6.62	272.1
80.0	1229.5	1039.7	189.8	9.6	31.272	-12.186	6.62	272.1
82.0	1267.3	1076.8	190.5	9.9	31.272	-11.837	6.62	272.1
84.0	1305.5	1114.3	191.2	10.2	31.272	-11.570	6.62	272.1
86.0	1708.5	1198.5	510.0	14.0	31.272	-4.445	6.62	272.1
88.0	1795.2	1285.2	510.0	14.5	31.272	-3.868	6.62	272.1
90.0	1609.6	1354.6	255.0	12.4	31.272	-7.794	6.62	272.1

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	1659.8	1404.8	255.0	12.6	31.272	-7.751	6.62	272.0
94.0	1710.1	1455.1	255.0	12.8	31.272	-7.510	6.62	272.0
96.0	1760.4	1505.4	255.0	13.0	31.272	-7.284	6.62	272.0
98.0	1810.6	1555.6	255.0	13.1	31.272	-7.133	6.62	271.9
100.0	1860.9	1605.9	255.0	13.3	31.272	-7.064	6.62	271.8
102.0	1911.2	1656.2	255.0	13.5	31.272	-7.008	6.62	271.8
104.0	1961.4	1706.4	255.0	13.7	31.272	-6.945	6.62	271.7
106.0	2316.9	1807.0	510.0	17.5	31.272	-5.586	6.62	271.6
108.0	2417.5	1907.5	510.0	18.3	31.273	-5.256	6.62	271.5
110.0	2518.0	2008.0	510.0	19.1	31.275	-6.055	6.62	271.3
112.0	2618.5	2108.5	510.0	19.9	31.280	-6.441	6.62	271.2
114.0	2719.0	2209.1	510.0	20.8	31.288	-6.596	6.62	271.0
116.0	2819.6	2309.6	510.0	21.8	31.299	-6.558	6.62	270.9
118.0	2920.1	2410.1	510.0	22.7	31.312	-6.240	6.62	270.7
120.0	3020.6	2510.6	510.0	23.7	31.320	-5.677	6.62	270.5
122.0	3121.1	2611.2	510.0	24.6	31.325	-5.906	6.62	270.3
124.0	3221.7	2711.7	510.0	25.6	31.325	-5.905	6.62	270.2
126.0	3322.2	2812.2	510.0	26.6	31.322	-5.664	6.62	270.1
128.0	3422.7	2912.8	510.0	27.6	31.313	-5.610	6.62	270.0
130.0	3523.3	3013.3	510.0	28.7	31.301	-5.556	6.62	269.9
131.2	3583.6	3073.6	510.0	29.4	31.292	-5.459	6.62	269.8

Total Number of Blows:	1282									
Driving Time (min):	42	32	25	21	18	16	14	12	11	10
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

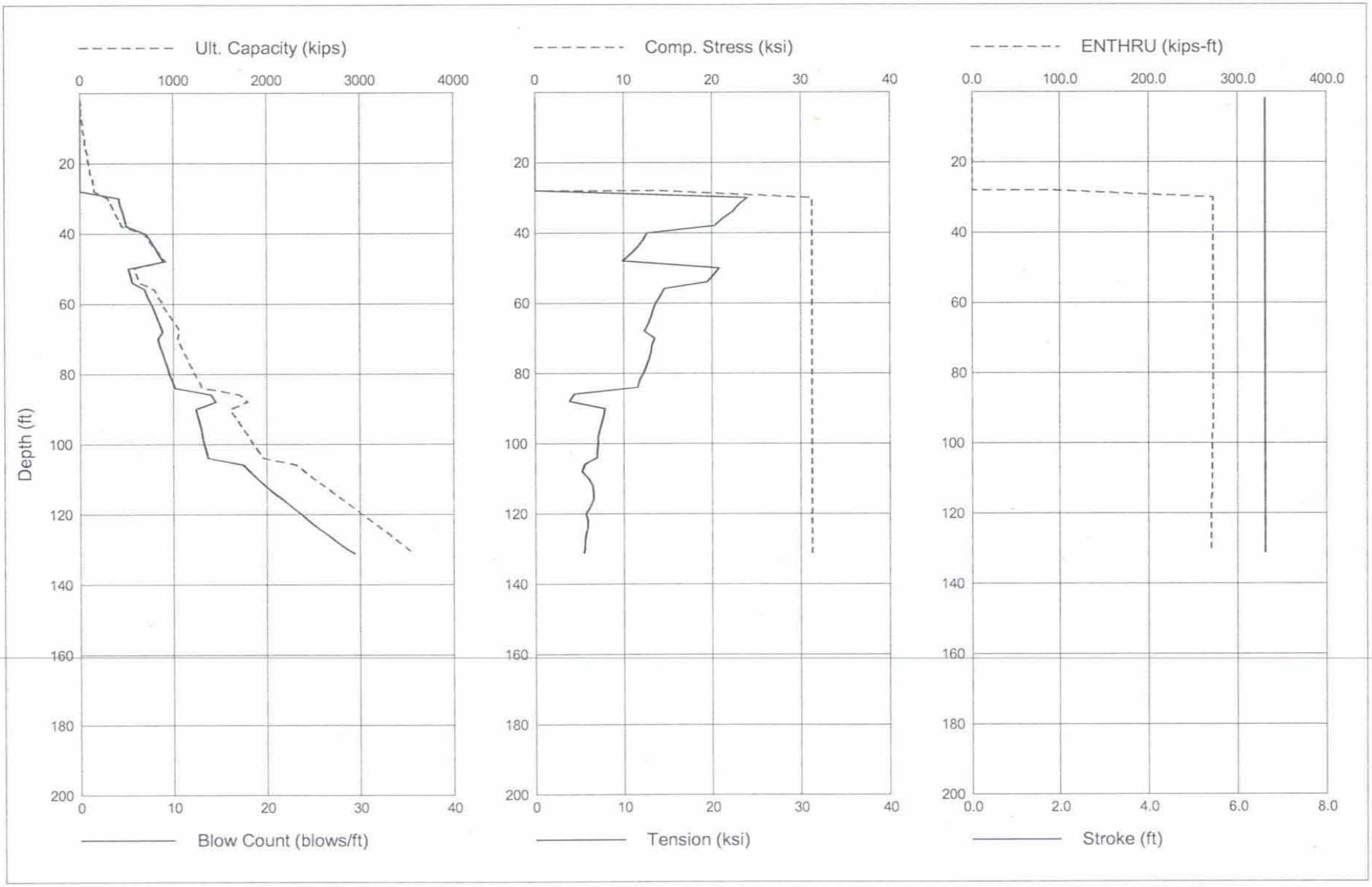
California D.O.T. Geotechnical Services

Apr 29 2009

Colorado B2-Anchor,Hammer IHC S400,1.500

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



ANALYSIS 9

48" Pile, 1.625-inch Thick

IHC S-400 Hammer

California D.O.T. Geotechnical Services
Colorado B2-Anchor,Hammer IHC S400,1.625

Apr 29 2009
GRLWEAP(TM) Version 2005

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	5.4	0.5	5.0	0.0	0.000	0.000	6.62	0.0
4.0	11.8	1.8	9.9	0.0	0.000	0.000	6.62	0.0
6.0	19.0	4.1	14.9	0.0	0.000	0.000	6.62	0.0
8.0	27.2	7.4	19.8	0.0	0.000	0.000	6.62	0.0
10.0	36.3	11.5	24.8	0.0	0.000	0.000	6.62	0.0
12.0	46.3	16.6	29.7	0.0	0.000	0.000	6.62	0.0
14.0	57.2	22.5	34.7	0.0	0.000	0.000	6.62	0.0
16.0	69.1	29.5	39.7	0.0	0.000	0.000	6.62	0.0
18.0	81.9	37.3	44.6	0.0	0.000	0.000	6.62	0.0
20.0	95.6	46.0	49.6	0.0	0.000	0.000	6.62	0.0
22.0	110.2	55.7	54.5	0.0	0.000	0.000	6.62	0.0
24.0	125.7	66.3	59.5	0.0	0.000	0.000	6.62	0.0
26.0	142.2	77.8	64.4	0.0	0.000	0.000	6.62	0.0
28.0	159.6	90.2	69.4	0.0	0.000	0.000	6.62	0.0
30.0	300.3	107.3	193.1	4.3	30.639	-23.606	6.62	271.7
32.0	336.3	129.4	206.8	4.5	30.639	-22.661	6.62	271.7
34.0	373.8	153.2	220.6	4.7	30.639	-21.958	6.62	271.7
36.0	412.9	178.5	234.3	4.9	30.639	-20.795	6.62	271.7
38.0	453.6	205.5	248.1	5.2	30.639	-20.223	6.62	271.7
40.0	685.2	238.3	446.9	7.1	30.639	-13.528	6.62	271.7
42.0	738.7	277.8	460.9	7.5	30.639	-13.155	6.62	271.7
44.0	794.6	319.7	474.9	8.1	30.639	-12.624	6.62	271.7
46.0	852.9	364.0	488.9	8.7	30.639	-11.944	6.62	271.7
48.0	913.7	410.8	503.0	9.2	30.639	-11.105	6.62	271.7
50.0	582.2	447.5	134.7	5.4	30.639	-20.571	6.62	271.7
52.0	612.6	473.0	139.7	5.6	30.639	-20.026	6.62	271.7
54.0	644.0	499.4	144.6	5.7	30.639	-19.400	6.62	271.7
56.0	796.4	541.5	255.0	7.0	30.639	-15.692	6.62	271.7
58.0	839.7	584.7	255.0	7.3	30.639	-15.256	6.62	271.7
60.0	884.1	629.1	255.0	7.6	30.639	-14.767	6.62	271.7
62.0	929.6	674.7	255.0	8.0	30.639	-14.240	6.62	271.7
64.0	976.4	721.4	255.0	8.4	30.639	-13.882	6.62	271.7
66.0	1024.3	769.3	255.0	8.8	30.639	-13.456	6.62	271.7
68.0	1073.4	818.4	255.0	9.1	30.639	-13.188	6.62	271.7
70.0	1046.9	860.7	186.2	8.6	30.639	-14.675	6.62	271.7
72.0	1082.6	895.7	186.9	8.8	30.639	-14.380	6.62	271.7
74.0	1118.7	931.0	187.6	9.0	30.639	-14.161	6.62	271.7
76.0	1155.2	966.8	188.4	9.3	30.639	-14.018	6.62	271.7
78.0	1192.1	1003.1	189.1	9.5	30.639	-13.907	6.62	271.7
80.0	1229.5	1039.7	189.8	9.8	30.639	-13.798	6.62	271.7
82.0	1267.3	1076.8	190.5	10.0	30.639	-13.699	6.62	271.7
84.0	1305.5	1114.3	191.2	10.3	30.639	-13.661	6.62	271.7
86.0	1708.5	1198.5	510.0	14.1	30.639	-5.997	6.62	271.7
88.0	1795.2	1285.2	510.0	14.4	30.639	-5.715	6.62	271.7
90.0	1609.6	1354.6	255.0	12.6	30.639	-9.862	6.62	271.7

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	1659.8	1404.8	255.0	12.8	30.639	-9.809	6.62	271.6
94.0	1710.1	1455.1	255.0	13.0	30.639	-9.457	6.62	271.6
96.0	1760.4	1505.4	255.0	13.2	30.639	-9.193	6.62	271.6
98.0	1810.6	1555.6	255.0	13.3	30.639	-8.983	6.62	271.5
100.0	1860.9	1605.9	255.0	13.5	30.639	-8.900	6.62	271.4
102.0	1911.2	1656.2	255.0	13.7	30.639	-8.828	6.62	271.4
104.0	1961.4	1706.4	255.0	13.9	30.639	-8.754	6.62	271.3
106.0	2316.9	1807.0	510.0	17.0	30.639	-3.969	6.62	271.2
108.0	2417.5	1907.5	510.0	17.8	30.640	-3.896	6.62	271.0
110.0	2518.0	2008.0	510.0	18.5	30.642	-3.868	6.62	270.9
112.0	2618.5	2108.5	510.0	19.3	30.646	-3.867	6.62	270.8
114.0	2719.0	2209.1	510.0	20.1	30.653	-4.542	6.62	270.6
116.0	2819.6	2309.6	510.0	21.0	30.663	-5.471	6.62	270.4
118.0	2920.1	2410.1	510.0	22.0	30.674	-6.328	6.62	270.2
120.0	3020.6	2510.6	510.0	23.0	30.682	-6.616	6.62	270.2
122.0	3121.1	2611.2	510.0	24.0	30.686	-6.484	6.62	270.1
124.0	3221.7	2711.7	510.0	24.9	30.686	-6.080	6.62	270.0
126.0	3322.2	2812.2	510.0	25.9	30.683	-5.552	6.62	269.9
128.0	3422.7	2912.8	510.0	26.9	30.675	-5.101	6.62	269.8
130.0	3523.3	3013.3	510.0	27.9	30.664	-4.712	6.62	269.7
131.2	3583.6	3073.6	510.0	28.6	30.655	-4.476	6.62	269.6

Total Number of Blows: 1277

Driving Time (min):	42	31	25	21	18	15	14	12	11	10
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

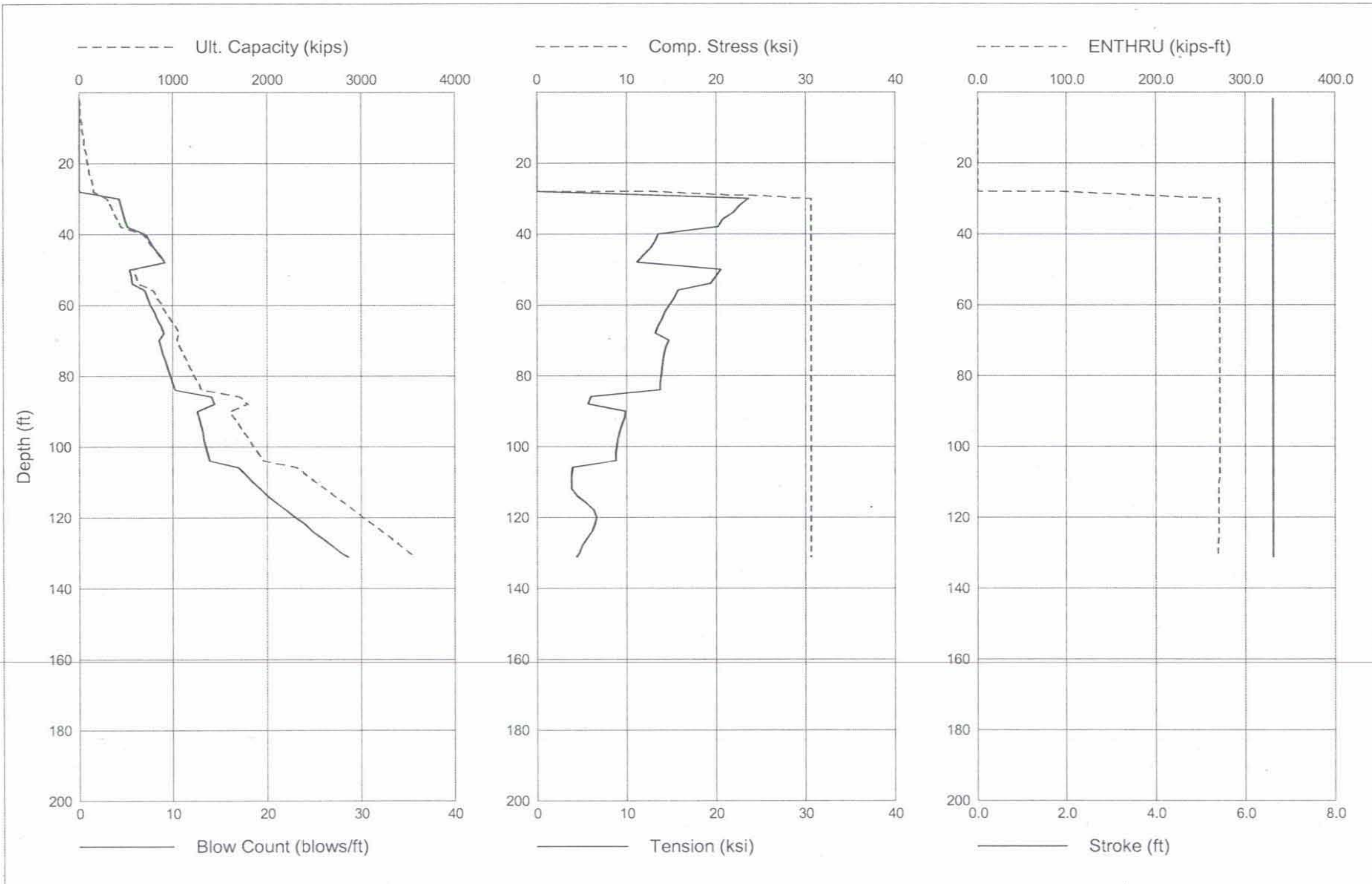
California D.O.T. Geotechnical Services

Apr 29 2009

Colorado B2-Anchor,Hammer IHC S400,1.625

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



ANALYSIS 10
48" Pile, 1.750-inch Thick
IHC S-400 Hammer

California D.O.T. Geotechnical Services
Colorado B2-Anchor,Hammer IHC S400,1.750

Apr 29 2009
GRLWEAP(TM) Version 2005

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	5.4	0.5	5.0	0.0	0.000	0.000	6.62	0.0
4.0	11.8	1.8	9.9	0.0	0.000	0.000	6.62	0.0
6.0	19.0	4.1	14.9	0.0	0.000	0.000	6.62	0.0
8.0	27.2	7.4	19.8	0.0	0.000	0.000	6.62	0.0
10.0	36.3	11.5	24.8	0.0	0.000	0.000	6.62	0.0
12.0	46.3	16.6	29.7	0.0	0.000	0.000	6.62	0.0
14.0	57.2	22.5	34.7	0.0	0.000	0.000	6.62	0.0
16.0	69.1	29.5	39.7	0.0	0.000	0.000	6.62	0.0
18.0	81.9	37.3	44.6	0.0	0.000	0.000	6.62	0.0
20.0	95.6	46.0	49.6	0.0	0.000	0.000	6.62	0.0
22.0	110.2	55.7	54.5	0.0	0.000	0.000	6.62	0.0
24.0	125.7	66.3	59.5	0.0	0.000	0.000	6.62	0.0
26.0	142.2	77.8	64.4	0.0	0.000	0.000	6.62	0.0
28.0	159.6	90.2	69.4	0.0	0.000	0.000	6.62	0.0
30.0	300.3	107.3	193.1	4.5	30.024	-22.998	6.62	271.4
32.0	336.3	129.4	206.8	4.7	30.024	-22.243	6.62	271.4
34.0	373.8	153.2	220.6	4.9	30.024	-21.523	6.62	271.4
36.0	412.9	178.5	234.3	5.1	30.024	-20.835	6.62	271.4
38.0	453.6	205.5	248.1	5.3	30.024	-20.374	6.62	271.4
40.0	685.2	238.3	446.9	7.2	30.024	-14.932	6.62	271.4
42.0	738.7	277.8	460.9	7.6	30.024	-14.260	6.62	271.4
44.0	794.6	319.7	474.9	8.2	30.024	-13.328	6.62	271.4
46.0	852.9	364.0	488.9	8.7	30.024	-12.629	6.62	271.4
48.0	913.7	410.8	503.0	9.3	30.024	-11.840	6.62	271.4
50.0	582.2	447.5	134.7	5.6	30.024	-20.742	6.62	271.4
52.0	612.6	473.0	139.7	5.8	30.024	-20.506	6.62	271.4
54.0	644.0	499.4	144.6	5.9	30.024	-20.217	6.62	271.4
56.0	796.4	541.5	255.0	7.1	30.024	-16.850	6.62	271.4
58.0	839.7	584.7	255.0	7.4	30.024	-16.608	6.62	271.4
60.0	884.1	629.1	255.0	7.7	30.024	-16.300	6.62	271.4
62.0	929.6	674.7	255.0	8.1	30.024	-15.917	6.62	271.4
64.0	976.4	721.4	255.0	8.4	30.024	-15.487	6.62	271.4
66.0	1024.3	769.3	255.0	8.9	30.024	-15.007	6.62	271.4
68.0	1073.4	818.4	255.0	9.3	30.024	-14.656	6.62	271.4
70.0	1046.9	860.7	186.2	8.6	30.024	-16.226	6.62	271.4
72.0	1082.6	895.7	186.9	8.9	30.024	-16.029	6.62	271.4
74.0	1118.7	931.0	187.6	9.2	30.024	-15.886	6.62	271.4
76.0	1155.2	966.8	188.4	9.4	30.024	-15.756	6.62	271.4
78.0	1192.1	1003.1	189.1	9.6	30.024	-15.632	6.62	271.4
80.0	1229.5	1039.7	189.8	9.9	30.024	-15.520	6.62	271.4
82.0	1267.3	1076.8	190.5	10.1	30.024	-15.418	6.62	271.3
84.0	1305.5	1114.3	191.2	10.4	30.024	-15.402	6.62	271.3
86.0	1708.5	1198.5	510.0	14.2	30.024	-6.837	6.62	271.3
88.0	1795.2	1285.2	510.0	14.6	30.024	-6.386	6.62	271.3
90.0	1609.6	1354.6	255.0	12.9	30.024	-12.133	6.62	271.3

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	1659.8	1404.8	255.0	13.0	30.024	-12.055	6.62	271.2
94.0	1710.1	1455.1	255.0	13.2	30.024	-11.822	6.62	271.2
96.0	1760.4	1505.4	255.0	13.4	30.024	-11.577	6.62	271.2
98.0	1810.6	1555.6	255.0	13.5	30.024	-11.392	6.62	271.1
100.0	1860.9	1605.9	255.0	13.7	30.024	-11.318	6.62	271.0
102.0	1911.2	1656.2	255.0	13.9	30.024	-11.249	6.62	271.0
104.0	1961.4	1706.4	255.0	14.1	30.024	-11.179	6.62	270.9
106.0	2316.9	1807.0	510.0	16.9	30.024	-4.960	6.62	270.7
108.0	2417.5	1907.5	510.0	17.5	30.025	-4.325	6.62	270.6
110.0	2518.0	2008.0	510.0	18.2	30.026	-4.318	6.62	270.5
112.0	2618.5	2108.5	510.0	18.8	30.030	-5.087	6.62	270.3
114.0	2719.0	2209.1	510.0	19.6	30.036	-5.132	6.62	270.2
116.0	2819.6	2309.6	510.0	20.4	30.045	-4.989	6.62	270.1
118.0	2920.1	2410.1	510.0	21.3	30.056	-4.764	6.62	270.0
120.0	3020.6	2510.6	510.0	22.2	30.063	-4.474	6.62	269.9
122.0	3121.1	2611.2	510.0	23.2	30.066	-5.152	6.62	269.9
124.0	3221.7	2711.7	510.0	24.2	30.066	-5.662	6.62	269.8
126.0	3322.2	2812.2	510.0	25.2	30.063	-5.749	6.62	269.7
128.0	3422.7	2912.8	510.0	26.2	30.056	-5.548	6.62	269.6
130.0	3523.3	3013.3	510.0	27.2	30.046	-5.184	6.62	269.6
131.2	3583.6	3073.6	510.0	27.8	30.038	-4.932	6.62	269.6

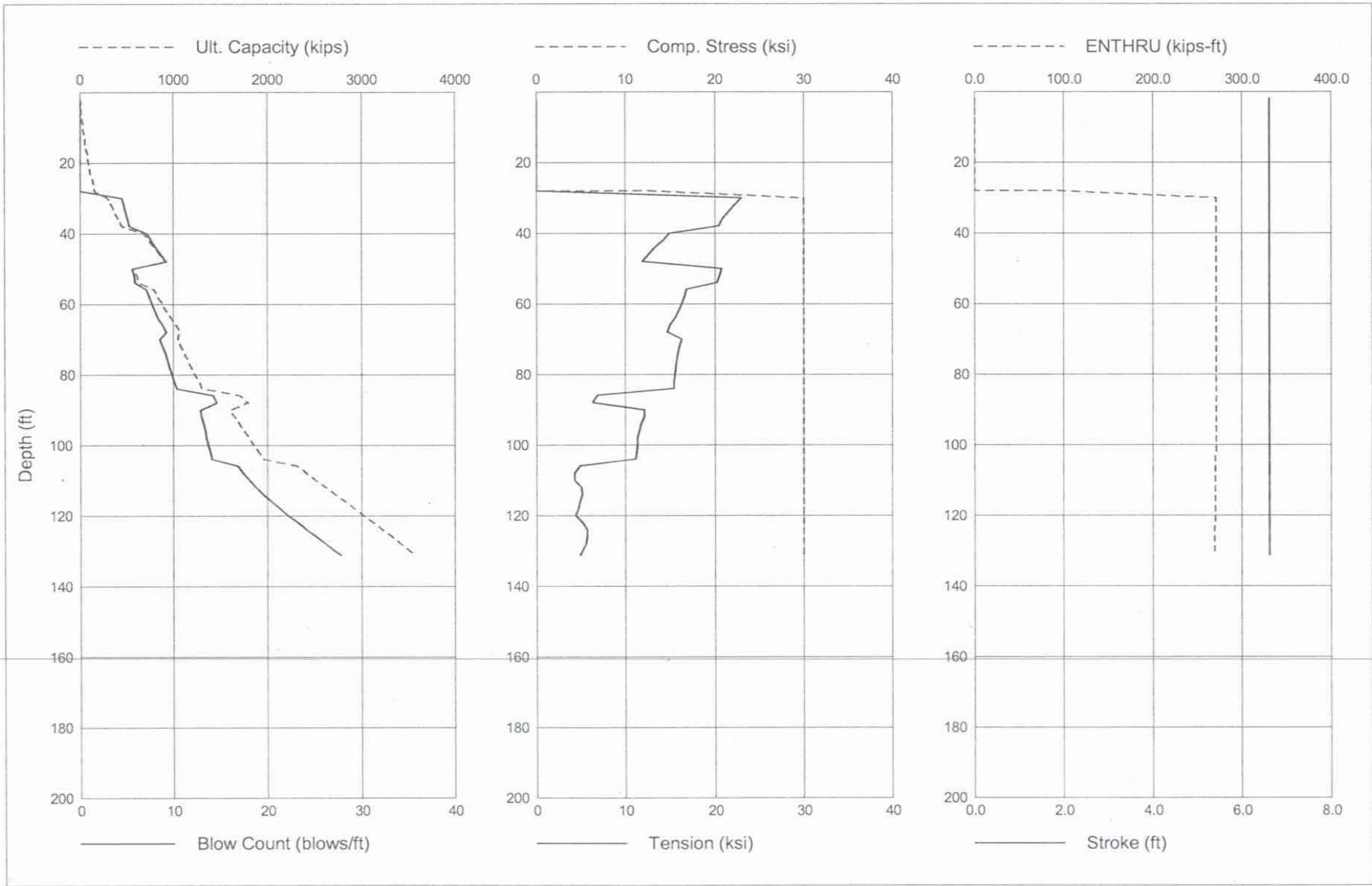
Total Number of Blows: 1272

Driving Time (min):	42	31	25	21	18	15	14	12	11	10
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

California D.O.T. Geotechnical Services | Apr 29 2009

Colorado B2-Anchor,Hammer IHC S400,1.750 | Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 | GRLWEAP(TM) Version 2005



ANALYSIS 11

48" Pile, 1.250-inch Thick

Menck MHU 500T Hammer

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	5.4	0.5	5.0	0.0	0.000	0.000	6.15	0.0
4.0	11.8	1.8	9.9	0.0	0.000	0.000	6.15	0.0
6.0	19.0	4.1	14.9	0.0	0.000	0.000	6.15	0.0
8.0	27.2	7.4	19.8	0.0	0.000	0.000	6.15	0.0
10.0	36.3	11.5	24.8	0.0	0.000	0.000	6.15	0.0
12.0	46.3	16.6	29.7	0.0	0.000	0.000	6.15	0.0
14.0	57.2	22.5	34.7	0.0	0.000	0.000	6.15	0.0
16.0	69.1	29.5	39.7	0.0	0.000	0.000	6.15	0.0
18.0	81.9	37.3	44.6	0.0	0.000	0.000	6.15	0.0
20.0	95.6	46.0	49.6	0.0	0.000	0.000	6.15	0.0
22.0	110.2	55.7	54.5	0.0	0.000	0.000	6.15	0.0
24.0	125.7	66.3	59.5	0.0	0.000	0.000	6.15	0.0
26.0	142.2	77.8	64.4	0.0	0.000	0.000	6.15	0.0
28.0	159.6	90.2	69.4	0.0	0.000	0.000	6.15	0.0
30.0	300.3	107.3	193.1	2.6	34.455	-19.229	6.15	378.3
32.0	336.3	129.4	206.8	2.8	34.431	-18.206	6.15	378.4
34.0	373.8	153.2	220.6	2.9	34.401	-17.143	6.15	378.4
36.0	412.9	178.5	234.3	3.1	34.365	-16.237	6.15	378.5
38.0	453.6	205.5	248.1	3.2	34.323	-15.163	6.15	378.5
40.0	685.2	238.3	446.9	4.7	34.287	-9.698	6.15	378.6
42.0	738.7	277.8	460.9	5.1	34.252	-9.696	6.15	378.6
44.0	794.6	319.7	474.9	5.4	34.212	-9.668	6.15	378.6
46.0	852.9	364.0	488.9	5.7	34.167	-9.600	6.15	378.7
48.0	913.7	410.8	503.0	6.0	34.117	-9.157	6.15	378.7
50.0	582.2	447.5	134.7	3.3	34.053	-15.578	6.15	378.7
52.0	612.6	473.0	139.7	3.5	33.997	-15.039	6.15	378.8
54.0	644.0	499.4	144.6	3.6	33.956	-14.419	6.15	378.9
56.0	796.4	541.5	255.0	4.5	33.909	-9.475	6.15	379.0
58.0	839.7	584.7	255.0	4.7	33.819	-9.372	6.15	379.0
60.0	884.1	629.1	255.0	5.0	33.769	-9.238	6.15	379.1
62.0	929.6	674.7	255.0	5.2	33.727	-9.064	6.15	379.1
64.0	976.4	721.4	255.0	5.4	33.644	-8.838	6.15	379.2
66.0	1024.3	769.3	255.0	5.6	33.637	-8.650	6.15	379.2
68.0	1073.4	818.4	255.0	5.9	33.624	-8.402	6.15	379.3
70.0	1046.9	860.7	186.2	5.5	33.605	-8.271	6.15	379.3
72.0	1082.6	895.7	186.9	5.6	33.581	-8.054	6.15	379.3
74.0	1118.7	931.0	187.6	5.8	33.551	-7.788	6.15	379.3
76.0	1155.2	966.8	188.4	6.0	33.515	-7.372	6.15	379.3
78.0	1192.1	1003.1	189.1	6.2	33.474	-6.875	6.15	379.3
80.0	1229.5	1039.7	189.8	6.4	33.435	-6.205	6.15	379.2
82.0	1267.3	1076.8	190.5	6.6	33.393	-5.518	6.15	379.2
84.0	1305.5	1114.3	191.2	6.8	33.346	-5.868	6.15	379.1
86.0	1708.5	1198.5	510.0	10.1	33.297	-3.271	6.15	378.9
88.0	1795.2	1285.2	510.0	10.6	33.246	-3.685	6.15	378.7
90.0	1609.6	1354.6	255.0	8.7	33.201	-5.740	6.15	378.6

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	1659.8	1404.8	255.0	8.9	33.165	-5.775	6.15	378.4
94.0	1710.1	1455.1	255.0	9.2	33.091	-5.829	6.15	378.2
96.0	1760.4	1505.4	255.0	9.4	33.040	-6.007	6.15	377.9
98.0	1810.6	1555.6	255.0	9.7	33.003	-6.177	6.15	377.6
100.0	1860.9	1605.9	255.0	9.9	32.928	-5.836	6.15	377.2
102.0	1911.2	1656.2	255.0	10.2	32.886	-5.591	6.15	376.9
104.0	1961.4	1706.4	255.0	10.5	32.794	-5.969	6.15	376.8
106.0	2316.9	1807.0	510.0	13.3	32.742	-4.111	6.15	376.8
108.0	2417.5	1907.5	510.0	13.9	32.661	-3.914	6.15	376.7
110.0	2518.0	2008.0	510.0	14.5	32.585	-3.039	6.15	376.6
112.0	2618.5	2108.5	510.0	15.1	32.472	-3.470	6.15	376.6
114.0	2719.0	2209.1	510.0	15.7	32.355	-3.630	6.15	376.9
116.0	2819.6	2309.6	510.0	16.4	32.238	-3.949	6.15	377.1
118.0	2920.1	2410.1	510.0	17.2	32.128	-4.269	6.15	377.3
120.0	3020.6	2510.6	510.0	18.0	32.012	-3.988	6.15	377.5
122.0	3121.1	2611.2	510.0	18.8	31.891	-3.731	6.15	377.7
124.0	3221.7	2711.7	510.0	19.6	31.775	-3.485	6.15	377.8
126.0	3322.2	2812.2	510.0	20.5	31.707	-3.496	6.15	377.9
128.0	3422.7	2912.8	510.0	21.4	31.663	-3.662	6.15	378.1
130.0	3523.3	3013.3	510.0	22.4	31.616	-3.858	6.15	378.1
131.2	3583.6	3073.6	510.0	23.0	31.587	-3.931	6.15	378.1

Total Number of Blows:	927								
Driving Time (min):	30	23	18	15	13	11	10	9	8	7
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

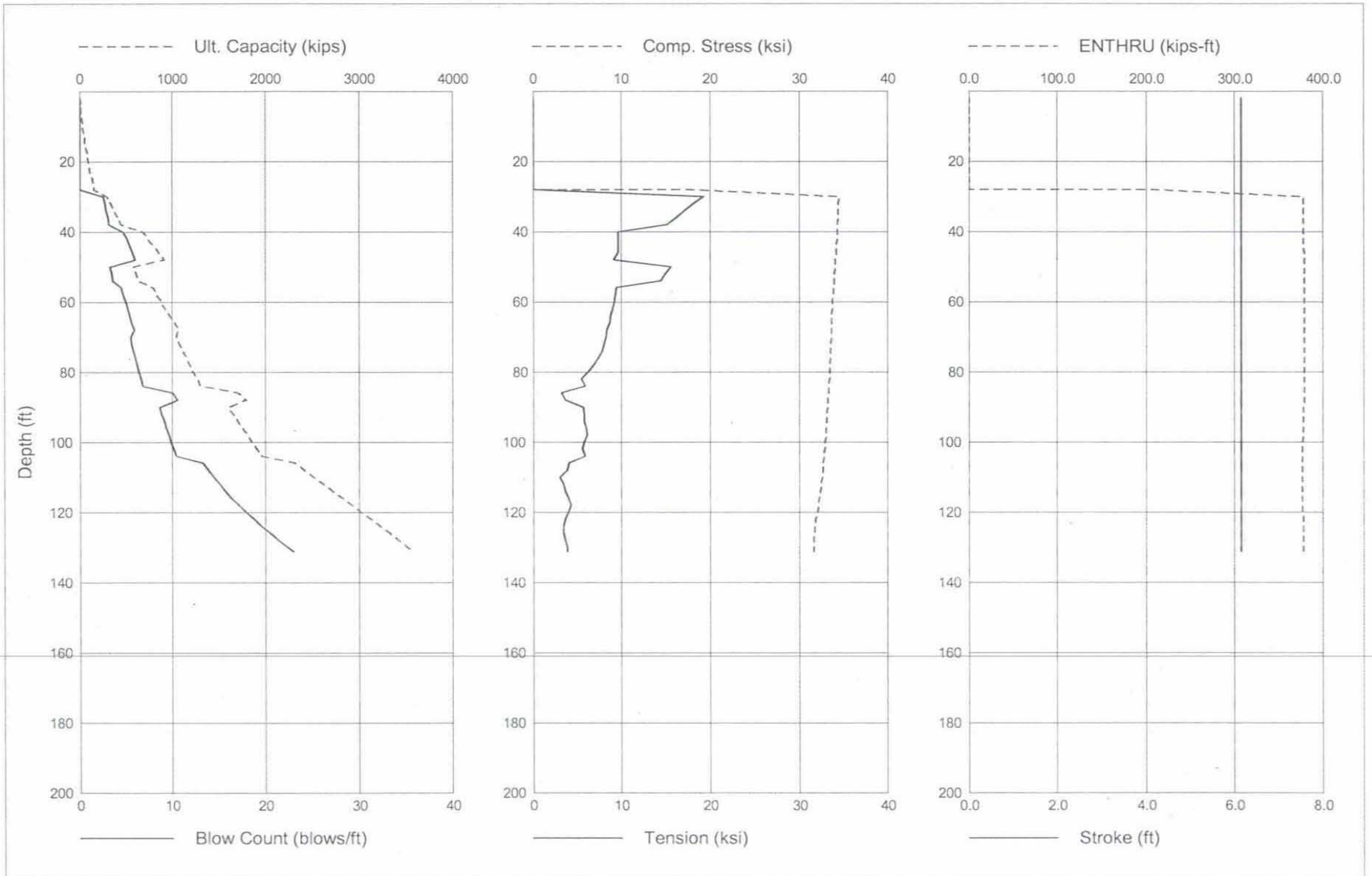
California D.O.T. Geotechnical Services

Apr 29 2009

Colorado B2-Anchor,Hammer MHU 500T,1.250

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



ANALYSIS 12

48" Pile, 1.375-inch Thick

Menck MHU 500T Hammer

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	5.4	0.5	5.0	0.0	0.000	0.000	6.15	0.0
4.0	11.8	1.8	9.9	0.0	0.000	0.000	6.15	0.0
6.0	19.0	4.1	14.9	0.0	0.000	0.000	6.15	0.0
8.0	27.2	7.4	19.8	0.0	0.000	0.000	6.15	0.0
10.0	36.3	11.5	24.8	0.0	0.000	0.000	6.15	0.0
12.0	46.3	16.6	29.7	0.0	0.000	0.000	6.15	0.0
14.0	57.2	22.5	34.7	0.0	0.000	0.000	6.15	0.0
16.0	69.1	29.5	39.7	0.0	0.000	0.000	6.15	0.0
18.0	81.9	37.3	44.6	0.0	0.000	0.000	6.15	0.0
20.0	95.6	46.0	49.6	0.0	0.000	0.000	6.15	0.0
22.0	110.2	55.7	54.5	0.0	0.000	0.000	6.15	0.0
24.0	125.7	66.3	59.5	0.0	0.000	0.000	6.15	0.0
26.0	142.2	77.8	64.4	0.0	0.000	0.000	6.15	0.0
28.0	159.6	90.2	69.4	0.0	0.000	0.000	6.15	0.0
30.0	300.3	107.3	193.1	2.8	33.917	-21.537	6.15	378.7
32.0	336.3	129.4	206.8	2.9	33.895	-20.350	6.15	378.7
34.0	373.8	153.2	220.6	3.0	33.868	-19.238	6.15	378.7
36.0	412.9	178.5	234.3	3.2	33.835	-18.064	6.15	378.8
38.0	453.6	205.5	248.1	3.3	33.797	-16.927	6.15	378.8
40.0	685.2	238.3	446.9	4.7	33.761	-9.305	6.15	379.0
42.0	738.7	277.8	460.9	5.0	33.721	-9.271	6.15	379.0
44.0	794.6	319.7	474.9	5.3	33.685	-9.237	6.15	379.0
46.0	852.9	364.0	488.9	5.7	33.644	-9.184	6.15	379.0
48.0	913.7	410.8	503.0	6.0	33.599	-9.150	6.15	379.0
50.0	582.2	447.5	134.7	3.5	33.539	-17.433	6.15	378.9
52.0	612.6	473.0	139.7	3.6	33.488	-16.774	6.15	379.0
54.0	644.0	499.4	144.6	3.7	33.449	-16.372	6.15	379.0
56.0	796.4	541.5	255.0	4.6	33.407	-11.557	6.15	379.1
58.0	839.7	584.7	255.0	4.8	33.309	-10.787	6.15	379.2
60.0	884.1	629.1	255.0	5.0	33.264	-10.044	6.15	379.2
62.0	929.6	674.7	255.0	5.2	33.225	-9.354	6.15	379.2
64.0	976.4	721.4	255.0	5.4	33.128	-8.769	6.15	379.2
66.0	1024.3	769.3	255.0	5.7	33.055	-8.434	6.15	379.3
68.0	1073.4	818.4	255.0	5.9	33.043	-8.209	6.15	379.3
70.0	1046.9	860.7	186.2	5.5	33.026	-9.165	6.15	379.2
72.0	1082.6	895.7	186.9	5.7	33.011	-8.639	6.15	379.2
74.0	1118.7	931.0	187.6	5.9	32.992	-8.192	6.15	379.2
76.0	1155.2	966.8	188.4	6.1	32.969	-7.733	6.15	379.1
78.0	1192.1	1003.1	189.1	6.3	32.940	-7.235	6.15	379.0
80.0	1229.5	1039.7	189.8	6.5	32.907	-6.636	6.15	379.0
82.0	1267.3	1076.8	190.5	6.7	32.868	-6.412	6.15	378.9
84.0	1305.5	1114.3	191.2	6.9	32.826	-6.296	6.15	378.7
86.0	1708.5	1198.5	510.0	10.1	32.781	-4.349	6.15	378.5
88.0	1795.2	1285.2	510.0	10.5	32.735	-2.960	6.15	378.3
90.0	1609.6	1354.6	255.0	8.8	32.694	-6.114	6.15	378.1

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	1659.8	1404.8	255.0	9.1	32.661	-5.614	6.15	377.9
94.0	1710.1	1455.1	255.0	9.4	32.582	-5.160	6.15	377.6
96.0	1760.4	1505.4	255.0	9.7	32.536	-4.930	6.15	377.3
98.0	1810.6	1555.6	255.0	9.9	32.502	-5.222	6.15	377.0
100.0	1860.9	1605.9	255.0	10.2	32.433	-5.616	6.15	377.0
102.0	1911.2	1656.2	255.0	10.4	32.346	-6.029	6.15	377.1
104.0	1961.4	1706.4	255.0	10.7	32.297	-6.142	6.15	377.2
106.0	2316.9	1807.0	510.0	13.5	32.250	-4.315	6.15	377.4
108.0	2417.5	1907.5	510.0	14.0	32.147	-3.957	6.15	377.5
110.0	2518.0	2008.0	510.0	14.6	32.059	-3.804	6.15	377.7
112.0	2618.5	2108.5	510.0	15.1	31.957	-3.827	6.15	377.8
114.0	2719.0	2209.1	510.0	15.7	31.857	-4.502	6.15	378.0
116.0	2819.6	2309.6	510.0	16.4	31.750	-4.546	6.15	378.1
118.0	2920.1	2410.1	510.0	17.0	31.649	-4.544	6.15	378.2
120.0	3020.6	2510.6	510.0	17.7	31.535	-5.006	6.15	378.3
122.0	3121.1	2611.2	510.0	18.4	31.433	-5.231	6.15	378.4
124.0	3221.7	2711.7	510.0	19.1	31.307	-5.324	6.15	378.5
126.0	3322.2	2812.2	510.0	19.9	31.189	-5.596	6.15	378.5
128.0	3422.7	2912.8	510.0	20.7	31.101	-5.493	6.15	378.6
130.0	3523.3	3013.3	510.0	21.6	31.057	-5.074	6.15	378.6
131.2	3583.6	3073.6	510.0	22.1	31.031	-4.842	6.15	378.6

Total Number of Blows: 927

Driving Time (min):	30	23	18	15	13	11	10	9	8	7
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

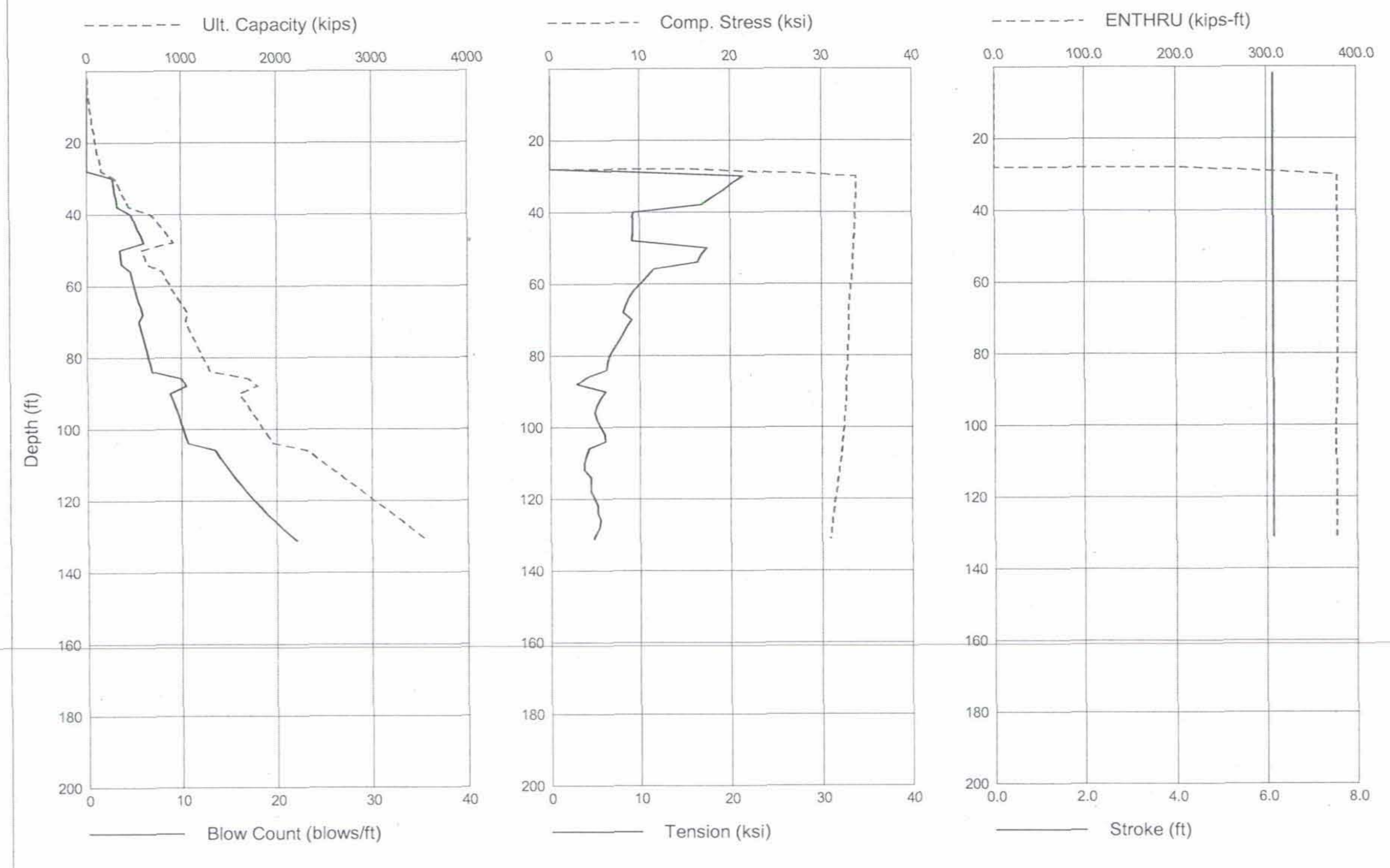
California D.O.T. Geotechnical Services

Apr 29 2009

Colorado B2-Anchor,Hammer MHU 500T,1.375

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



ANALYSIS 13

48” Pile, 1.500-inch Thick

Menck MHU 500T Hammer

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	5.4	0.5	5.0	0.0	0.000	0.000	6.15	0.0
4.0	11.8	1.8	9.9	0.0	0.000	0.000	6.15	0.0
6.0	19.0	4.1	14.9	0.0	0.000	0.000	6.15	0.0
8.0	27.2	7.4	19.8	0.0	0.000	0.000	6.15	0.0
10.0	36.3	11.5	24.8	0.0	0.000	0.000	6.15	0.0
12.0	46.3	16.6	29.7	0.0	0.000	0.000	6.15	0.0
14.0	57.2	22.5	34.7	0.0	0.000	0.000	6.15	0.0
16.0	69.1	29.5	39.7	0.0	0.000	0.000	6.15	0.0
18.0	81.9	37.3	44.6	0.0	0.000	0.000	6.15	0.0
20.0	95.6	46.0	49.6	0.0	0.000	0.000	6.15	0.0
22.0	110.2	55.7	54.5	0.0	0.000	0.000	6.15	0.0
24.0	125.7	66.3	59.5	0.0	0.000	0.000	6.15	0.0
26.0	142.2	77.8	64.4	0.0	0.000	0.000	6.15	0.0
28.0	159.6	90.2	69.4	0.0	0.000	0.000	6.15	0.0
30.0	300.3	107.3	193.1	2.9	33.393	-23.077	6.15	378.8
32.0	336.3	129.4	206.8	3.0	33.373	-22.372	6.15	378.8
34.0	373.8	153.2	220.6	3.2	33.348	-21.118	6.15	378.8
36.0	412.9	178.5	234.3	3.3	33.318	-20.346	6.15	378.8
38.0	453.6	205.5	248.1	3.5	33.282	-19.056	6.15	378.8
40.0	685.2	238.3	446.9	4.8	33.250	-11.531	6.15	379.0
42.0	738.7	277.8	460.9	5.0	33.207	-10.373	6.15	379.0
44.0	794.6	319.7	474.9	5.3	33.169	-9.214	6.15	379.0
46.0	852.9	364.0	488.9	5.7	33.132	-8.685	6.15	379.0
48.0	913.7	410.8	503.0	6.1	33.092	-8.629	6.15	379.1
50.0	582.2	447.5	134.7	3.6	33.034	-19.770	6.15	378.9
52.0	612.6	473.0	139.7	3.7	32.987	-19.005	6.15	378.9
54.0	644.0	499.4	144.6	3.8	32.951	-18.590	6.15	379.0
56.0	796.4	541.5	255.0	4.7	32.912	-13.785	6.15	379.0
58.0	839.7	584.7	255.0	4.8	32.811	-13.211	6.15	379.1
60.0	884.1	629.1	255.0	5.0	32.767	-12.647	6.15	379.1
62.0	929.6	674.7	255.0	5.2	32.731	-12.052	6.15	379.1
64.0	976.4	721.4	255.0	5.4	32.643	-11.380	6.15	379.1
66.0	1024.3	769.3	255.0	5.7	32.539	-10.734	6.15	379.1
68.0	1073.4	818.4	255.0	6.0	32.508	-9.982	6.15	379.0
70.0	1046.9	860.7	186.2	5.5	32.501	-11.886	6.15	379.0
72.0	1082.6	895.7	186.9	5.7	32.488	-11.432	6.15	378.9
74.0	1118.7	931.0	187.6	5.9	32.471	-10.986	6.15	378.9
76.0	1155.2	966.8	188.4	6.1	32.450	-10.451	6.15	378.8
78.0	1192.1	1003.1	189.1	6.3	32.424	-9.933	6.15	378.7
80.0	1229.5	1039.7	189.8	6.5	32.393	-9.332	6.15	378.6
82.0	1267.3	1076.8	190.5	6.7	32.357	-8.729	6.15	378.5
84.0	1305.5	1114.3	191.2	6.9	32.319	-8.168	6.15	378.3
86.0	1708.5	1198.5	510.0	10.2	32.279	-4.667	6.15	378.0
88.0	1795.2	1285.2	510.0	10.6	32.237	-4.096	6.15	377.8
90.0	1609.6	1354.6	255.0	8.9	32.198	-5.618	6.15	377.7

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	1659.8	1404.8	255.0	9.1	32.168	-5.182	6.15	377.5
94.0	1710.1	1455.1	255.0	9.4	32.085	-5.740	6.15	377.5
96.0	1760.4	1505.4	255.0	9.6	32.042	-5.516	6.15	377.6
98.0	1810.6	1555.6	255.0	9.8	32.011	-5.514	6.15	377.7
100.0	1860.9	1605.9	255.0	10.0	31.948	-5.081	6.15	377.9
102.0	1911.2	1656.2	255.0	10.1	31.852	-5.086	6.15	378.0
104.0	1961.4	1706.4	255.0	10.3	31.810	-4.998	6.15	378.1
106.0	2316.9	1807.0	510.0	13.5	31.767	-5.899	6.15	378.2
108.0	2417.5	1907.5	510.0	14.0	31.673	-6.208	6.15	378.2
110.0	2518.0	2008.0	510.0	14.6	31.575	-5.718	6.15	378.3
112.0	2618.5	2108.5	510.0	15.2	31.474	-5.986	6.15	378.4
114.0	2719.0	2209.1	510.0	15.8	31.390	-6.217	6.15	378.5
116.0	2819.6	2309.6	510.0	16.4	31.294	-6.020	6.15	378.6
118.0	2920.1	2410.1	510.0	17.0	31.195	-5.622	6.15	378.6
120.0	3020.6	2510.6	510.0	17.6	31.098	-5.748	6.15	378.7
122.0	3121.1	2611.2	510.0	18.2	31.005	-5.849	6.15	378.7
124.0	3221.7	2711.7	510.0	18.9	30.856	-6.018	6.15	378.7
126.0	3322.2	2812.2	510.0	19.6	30.734	-6.336	6.15	378.7
128.0	3422.7	2912.8	510.0	20.3	30.607	-6.589	6.15	378.7
130.0	3523.3	3013.3	510.0	21.0	30.567	-6.762	6.15	378.6
131.2	3583.6	3073.6	510.0	21.4	30.543	-6.612	6.15	378.6

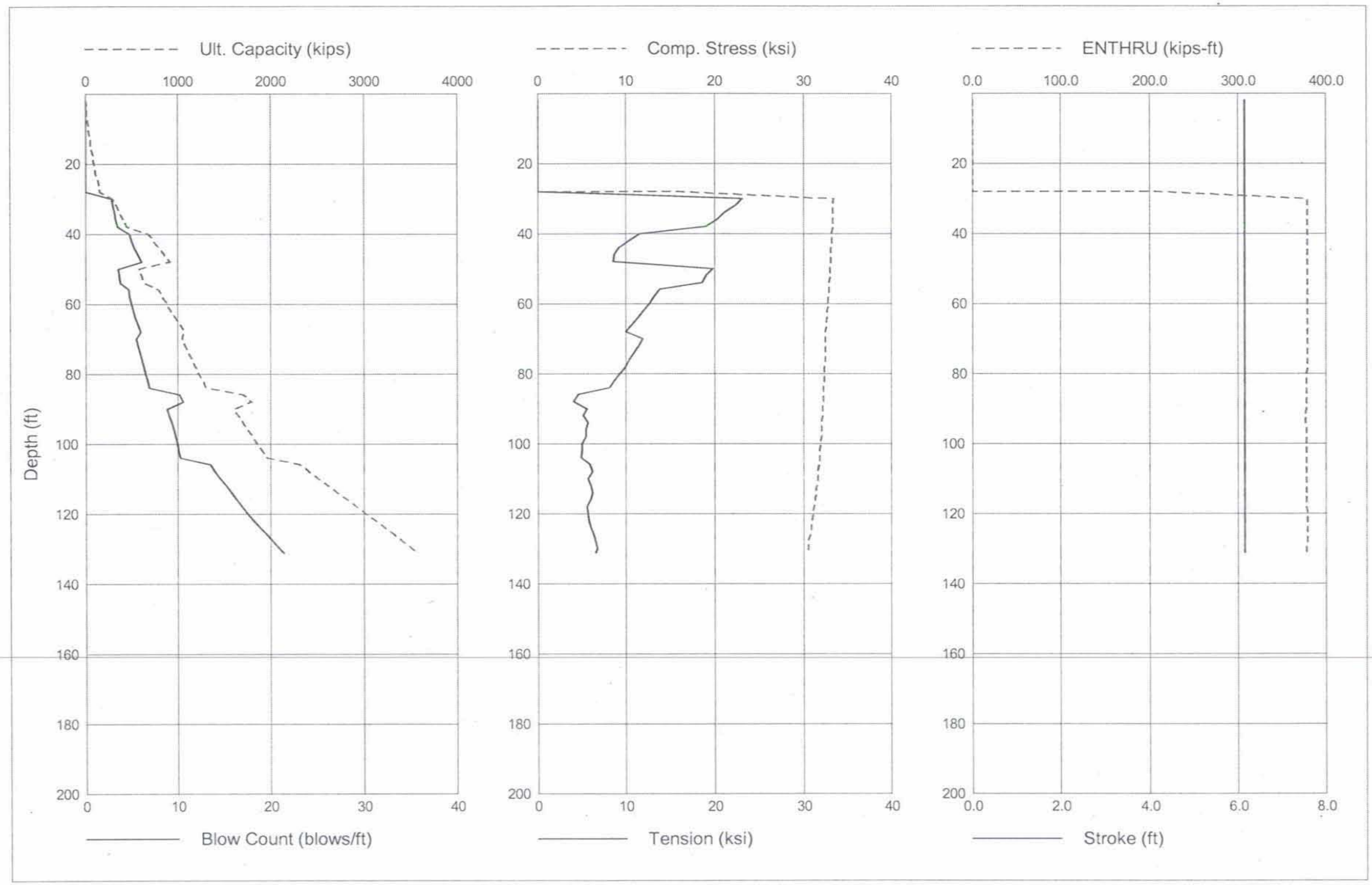
Total Number of Blows: 926

Driving Time (min):	30	23	18	15	13	11	10	9	8	7
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

California D.O.T. Geotechnical Services — Apr 29 2009

Colorado B2-Anchor,Hammer MHU 500T,1.500 — Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 — GRLWEAP(TM) Version 2005



ANALYSIS 14

48" Pile, 1.625-inch Thick

Menck MHU 500T Hammer

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	5.4	0.5	5.0	0.0	0.000	0.000	6.15	0.0
4.0	11.8	1.8	9.9	0.0	0.000	0.000	6.15	0.0
6.0	19.0	4.1	14.9	0.0	0.000	0.000	6.15	0.0
8.0	27.2	7.4	19.8	0.0	0.000	0.000	6.15	0.0
10.0	36.3	11.5	24.8	0.0	0.000	0.000	6.15	0.0
12.0	46.3	16.6	29.7	0.0	0.000	0.000	6.15	0.0
14.0	57.2	22.5	34.7	0.0	0.000	0.000	6.15	0.0
16.0	69.1	29.5	39.7	0.0	0.000	0.000	6.15	0.0
18.0	81.9	37.3	44.6	0.0	0.000	0.000	6.15	0.0
20.0	95.6	46.0	49.6	0.0	0.000	0.000	6.15	0.0
22.0	110.2	55.7	54.5	0.0	0.000	0.000	6.15	0.0
24.0	125.7	66.3	59.5	0.0	0.000	0.000	6.15	0.0
26.0	142.2	77.8	64.4	0.0	0.000	0.000	6.15	0.0
28.0	159.6	90.2	69.4	0.0	0.000	0.000	6.15	0.0
30.0	300.3	107.3	193.1	3.0	32.883	-24.435	6.15	378.7
32.0	336.3	129.4	206.8	3.2	32.864	-23.355	6.15	378.7
34.0	373.8	153.2	220.6	3.3	32.841	-22.767	6.15	378.7
36.0	412.9	178.5	234.3	3.4	32.813	-21.685	6.15	378.8
38.0	453.6	205.5	248.1	3.6	32.780	-20.965	6.15	378.8
40.0	685.2	238.3	446.9	4.9	32.751	-13.221	6.15	378.9
42.0	738.7	277.8	460.9	5.1	32.711	-12.436	6.15	378.9
44.0	794.6	319.7	474.9	5.4	32.672	-11.491	6.15	378.9
46.0	852.9	364.0	488.9	5.7	32.633	-10.427	6.15	378.9
48.0	913.7	410.8	503.0	6.1	32.605	-9.333	6.15	378.9
50.0	582.2	447.5	134.7	3.8	32.540	-21.208	6.15	378.8
52.0	612.6	473.0	139.7	3.9	32.504	-20.914	6.15	378.8
54.0	644.0	499.4	144.6	4.0	32.463	-20.365	6.15	378.8
56.0	796.4	541.5	255.0	4.7	32.426	-15.478	6.15	378.9
58.0	839.7	584.7	255.0	4.9	32.362	-14.859	6.15	378.9
60.0	884.1	629.1	255.0	5.1	32.302	-14.033	6.15	378.8
62.0	929.6	674.7	255.0	5.3	32.247	-13.482	6.15	378.8
64.0	976.4	721.4	255.0	5.5	32.165	-12.926	6.15	378.8
66.0	1024.3	769.3	255.0	5.7	32.080	-12.479	6.15	378.8
68.0	1073.4	818.4	255.0	6.0	32.001	-11.889	6.15	378.8
70.0	1046.9	860.7	186.2	5.6	31.994	-13.333	6.15	378.7
72.0	1082.6	895.7	186.9	5.7	31.983	-12.938	6.15	378.6
74.0	1118.7	931.0	187.6	5.9	31.967	-12.589	6.15	378.5
76.0	1155.2	966.8	188.4	6.1	31.947	-12.255	6.15	378.4
78.0	1192.1	1003.1	189.1	6.3	31.923	-11.842	6.15	378.3
80.0	1229.5	1039.7	189.8	6.5	31.894	-11.388	6.15	378.2
82.0	1267.3	1076.8	190.5	6.7	31.862	-10.979	6.15	378.1
84.0	1305.5	1114.3	191.2	6.9	31.826	-10.413	6.15	377.9
86.0	1708.5	1198.5	510.0	10.5	31.790	-4.515	6.15	377.9
88.0	1795.2	1285.2	510.0	10.9	31.751	-4.574	6.15	377.9
90.0	1609.6	1354.6	255.0	8.8	31.716	-6.507	6.15	378.0

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	1659.8	1404.8	255.0	9.1	31.687	-6.509	6.15	378.1
94.0	1710.1	1455.1	255.0	9.3	31.611	-6.493	6.15	378.1
96.0	1760.4	1505.4	255.0	9.5	31.561	-6.501	6.15	378.2
98.0	1810.6	1555.6	255.0	9.7	31.532	-6.500	6.15	378.3
100.0	1860.9	1605.9	255.0	9.8	31.474	-6.496	6.15	378.3
102.0	1911.2	1656.2	255.0	10.0	31.386	-6.496	6.15	378.4
104.0	1961.4	1706.4	255.0	10.2	31.333	-6.393	6.15	378.5
106.0	2316.9	1807.0	510.0	13.5	31.294	-5.100	6.15	378.5
108.0	2417.5	1907.5	510.0	14.0	31.209	-5.276	6.15	378.6
110.0	2518.0	2008.0	510.0	14.5	31.120	-5.565	6.15	378.6
112.0	2618.5	2108.5	510.0	15.0	31.027	-5.870	6.15	378.7
114.0	2719.0	2209.1	510.0	15.6	30.944	-6.135	6.15	378.7
116.0	2819.6	2309.6	510.0	16.2	30.850	-6.466	6.15	378.7
118.0	2920.1	2410.1	510.0	16.8	30.753	-6.626	6.15	378.7
120.0	3020.6	2510.6	510.0	17.4	30.665	-6.411	6.15	378.7
122.0	3121.1	2611.2	510.0	18.0	30.581	-6.524	6.15	378.7
124.0	3221.7	2711.7	510.0	18.6	30.444	-6.638	6.15	378.7
126.0	3322.2	2812.2	510.0	19.1	30.289	-6.632	6.15	378.6
128.0	3422.7	2912.8	510.0	19.7	30.141	-6.496	6.15	378.6
130.0	3523.3	3013.3	510.0	20.3	30.093	-6.307	6.15	378.5
131.2	3583.6	3073.6	510.0	20.7	30.071	-6.227	6.15	378.4

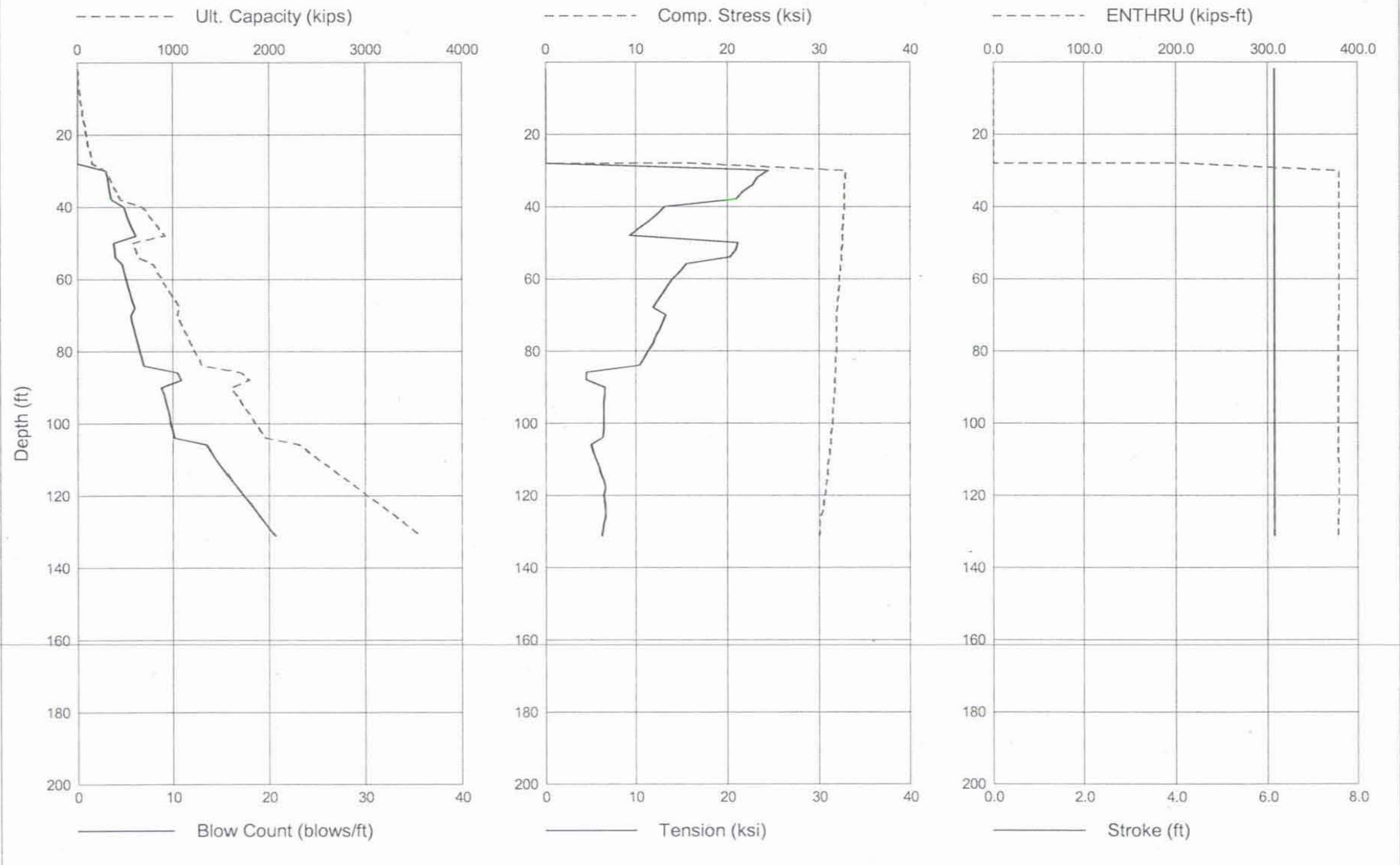
Total Number of Blows: 923

Driving Time (min):	30	23	18	15	13	11	10	9	8	7
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

California D.O.T. Geotechnical Services   Apr 29 2009

Colorado B2-Anchor,Hammer MHU 500T,1.625   Gain/Loss 1 at Shaft and Toe 1.000 / 1.000   GRLWEAP(TM) Version 2005



ANALYSIS 15

48" Pile, 1.750-inch Thick

Menck MHU 500T Hammer

California D.O.T. Geotechnical Services
Colorado B2-Anchor,Hammer MHU 500T,1.750

Apr 29 2009
GRLWEAP(TM) Version 2005

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
2.0	5.4	0.5	5.0	0.0	0.000	0.000	6.15	0.0
4.0	11.8	1.8	9.9	0.0	0.000	0.000	6.15	0.0
6.0	19.0	4.1	14.9	0.0	0.000	0.000	6.15	0.0
8.0	27.2	7.4	19.8	0.0	0.000	0.000	6.15	0.0
10.0	36.3	11.5	24.8	0.0	0.000	0.000	6.15	0.0
12.0	46.3	16.6	29.7	0.0	0.000	0.000	6.15	0.0
14.0	57.2	22.5	34.7	0.0	0.000	0.000	6.15	0.0
16.0	69.1	29.5	39.7	0.0	0.000	0.000	6.15	0.0
18.0	81.9	37.3	44.6	0.0	0.000	0.000	6.15	0.0
20.0	95.6	46.0	49.6	0.0	0.000	0.000	6.15	0.0
22.0	110.2	55.7	54.5	0.0	0.000	0.000	6.15	0.0
24.0	125.7	66.3	59.5	0.0	0.000	0.000	6.15	0.0
26.0	142.2	77.8	64.4	0.0	0.000	0.000	6.15	0.0
28.0	159.6	90.2	69.4	0.0	0.000	0.000	6.15	0.0
30.0	300.3	107.3	193.1	3.2	32.386	-25.160	6.15	378.5
32.0	336.3	129.4	206.8	3.3	32.369	-24.266	6.15	378.6
34.0	373.8	153.2	220.6	3.4	32.347	-23.400	6.15	378.6
36.0	412.9	178.5	234.3	3.6	32.321	-22.809	6.15	378.6
38.0	453.6	205.5	248.1	3.7	32.297	-21.761	6.15	378.6
40.0	685.2	238.3	446.9	5.0	32.275	-14.999	6.15	378.7
42.0	738.7	277.8	460.9	5.2	32.243	-14.007	6.15	378.7
44.0	794.6	319.7	474.9	5.5	32.209	-12.899	6.15	378.7
46.0	852.9	364.0	488.9	5.8	32.172	-11.792	6.15	378.7
48.0	913.7	410.8	503.0	6.1	32.136	-10.962	6.15	378.7
50.0	582.2	447.5	134.7	3.9	32.090	-22.339	6.15	378.6
52.0	612.6	473.0	139.7	4.0	32.062	-21.726	6.15	378.6
54.0	644.0	499.4	144.6	4.1	31.986	-21.326	6.15	378.6
56.0	796.4	541.5	255.0	4.8	31.950	-17.281	6.15	378.6
58.0	839.7	584.7	255.0	5.0	31.922	-16.639	6.15	378.6
60.0	884.1	629.1	255.0	5.2	31.865	-15.931	6.15	378.6
62.0	929.6	674.7	255.0	5.4	31.777	-15.474	6.15	378.6
64.0	976.4	721.4	255.0	5.6	31.696	-14.723	6.15	378.6
66.0	1024.3	769.3	255.0	5.8	31.644	-14.055	6.15	378.5
68.0	1073.4	818.4	255.0	6.0	31.557	-13.381	6.15	378.5
70.0	1046.9	860.7	186.2	5.6	31.528	-15.262	6.15	378.4
72.0	1082.6	895.7	186.9	5.8	31.511	-14.731	6.15	378.3
74.0	1118.7	931.0	187.6	6.0	31.491	-14.108	6.15	378.2
76.0	1155.2	966.8	188.4	6.1	31.466	-13.606	6.15	378.1
78.0	1192.1	1003.1	189.1	6.3	31.438	-13.146	6.15	378.1
80.0	1229.5	1039.7	189.8	6.5	31.411	-12.525	6.15	378.1
82.0	1267.3	1076.8	190.5	6.7	31.381	-12.191	6.15	378.2
84.0	1305.5	1114.3	191.2	6.9	31.348	-11.840	6.15	378.2
86.0	1708.5	1198.5	510.0	10.6	31.315	-4.276	6.15	378.2
88.0	1795.2	1285.2	510.0	11.1	31.281	-4.634	6.15	378.3
90.0	1609.6	1354.6	255.0	8.8	31.246	-7.745	6.15	378.3

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
92.0	1659.8	1404.8	255.0	9.1	31.219	-7.747	6.15	378.3
94.0	1710.1	1455.1	255.0	9.3	31.149	-7.739	6.15	378.4
96.0	1760.4	1505.4	255.0	9.6	31.101	-7.741	6.15	378.4
98.0	1810.6	1555.6	255.0	9.8	31.065	-7.735	6.15	378.5
100.0	1860.9	1605.9	255.0	10.1	31.011	-7.726	6.15	378.5
102.0	1911.2	1656.2	255.0	10.2	30.930	-7.724	6.15	378.6
104.0	1961.4	1706.4	255.0	10.4	30.869	-7.630	6.15	378.6
106.0	2316.9	1807.0	510.0	13.1	30.833	-5.087	6.15	378.6
108.0	2417.5	1907.5	510.0	13.6	30.755	-5.206	6.15	378.6
110.0	2518.0	2008.0	510.0	14.1	30.673	-5.661	6.15	378.6
112.0	2618.5	2108.5	510.0	14.6	30.588	-6.025	6.15	378.7
114.0	2719.0	2209.1	510.0	15.1	30.511	-5.677	6.15	378.7
116.0	2819.6	2309.6	510.0	15.6	30.424	-5.744	6.15	378.6
118.0	2920.1	2410.1	510.0	16.2	30.320	-6.326	6.15	378.6
120.0	3020.6	2510.6	510.0	16.8	30.239	-6.555	6.15	378.6
122.0	3121.1	2611.2	510.0	17.4	30.161	-6.294	6.15	378.5
124.0	3221.7	2711.7	510.0	18.0	30.035	-5.889	6.15	378.4
126.0	3322.2	2812.2	510.0	18.6	29.892	-6.032	6.15	378.4
128.0	3422.7	2912.8	510.0	19.2	29.737	-6.228	6.15	378.3
130.0	3523.3	3013.3	510.0	19.7	29.635	-6.385	6.15	378.1
131.2	3583.6	3073.6	510.0	20.1	29.614	-6.379	6.15	378.1

Total Number of Blows: 917

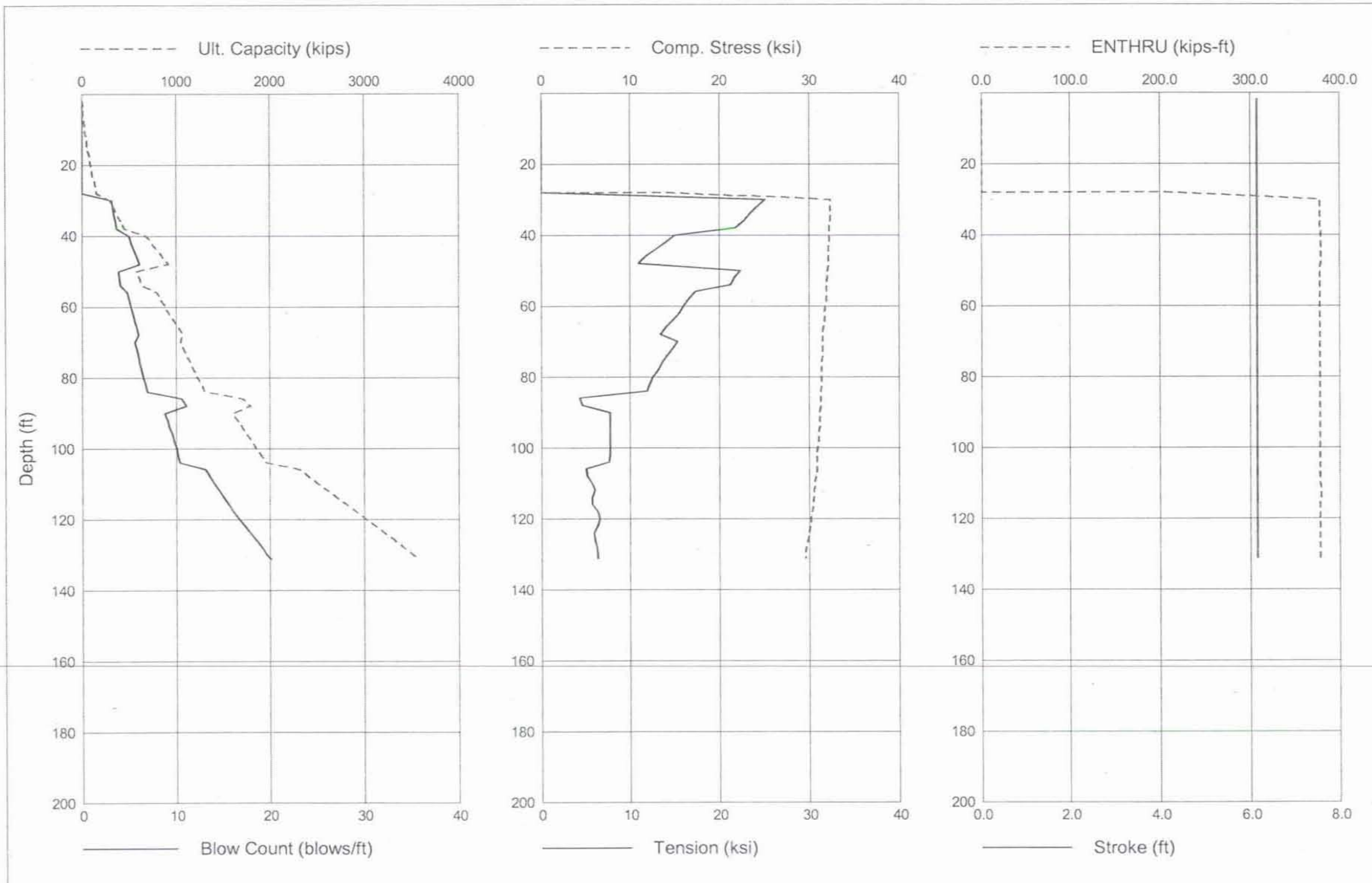
Driving Time (min):	30	22	18	15	13	11	10	9	8	7
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

California D.O.T. Geotechnical Services

Apr 29 2009

Colorado B2-Anchor,Hammer MHU 500T,1.750   Gain/Loss 1 at Shaft and Toe 1.000 / 1.000   GRLWEAP(TM) Version 2005



Memorandum

Flex your power!
Be energy efficient!

To: MR. DAVID SOON
Senior Bridge Engineer
Office of Bridge Design-North
Bridge Design Branch 7
Structure Design

Date: June 22, 2009

File: 08-SBd-62-PM 142.3
08 378701
Colorado River Bridge
(Replace)
Bridge No. 54-1272

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
Geotechnical Services
Office of Geotechnical Design – South 2

Subject: Revised Foundation Report

This Revised Foundation Report is to supersede the previous Foundation Report prepared by our office dated May 7, 2009.

As requested on August 22, 2006 the Office of Geotechnical Design – South 2 (OGDS2) prepared this Foundation Report for the proposed bridge replacement of the existing 10-span Colorado River Bridge (Bridge No. 54-1000).

The following references were used in evaluating the site conditions:

- General Plan No.1, prepared by Structures Design, Design Branch 7, dated September 30, 2008
- Field investigation results of eight exploratory test borings (April 2007 and January 2008).
- Preliminary Foundation Report prepared by Geotechnical Design- South 2, dated March 17, 2006
- Seismic Design Recommendations, prepared by Office of Geotechnical Design- South 2, dated June 25, 2008.
- Colorado River Bridge (Repair) Log-of-Test-Borings prepared by Structure Design, dated April 13, 1990
- Revised Preliminary Foundation Report prepared by the Office of Geotechnical Design- South 2, dated February 21, 2003
- Preliminary Geologic Recommendations and Resource Estimate for Advanced Planning Studies prepared by Structures prepared by the Office of Structure Foundations, dated January 24, 2000

Project Description

The proposed bridge site is located in the eastern most part of San Bernardino County on State Highway 62 at the Colorado River which is also the border between the states of California and Arizona. At the bridge site, the project proposes to construct a new bridge to replace the existing Colorado River Bridge (Bridge No. 54-1000). The new bridge is proposed to accommodate 4-lanes of traffic whereas the existing bridge presently accommodates 2-lanes of traffic. The new Colorado River Bridge (Bridge No. 54-1272) is proposed to be a 4-span, cast-in-place, prestressed, concrete box-girder structure with seat abutments and two-column bents.

Geology/Geotechnical Information

The foundation investigations performed in April 2007 and January 2008 consisted of advancing nine 3.75 inch mud rotary borings throughout the site location. This investigation at the bridge site generally revealed alluvial material overlying a formational conglomerate/sandstone bedrock. The recent river deposited alluvial material is composed of loose to dense, medium to coarse-grained SAND with scattered fine to coarse GRAVEL and occasional lenses of fine sand, silty and clayey type of soils. Scattered cobbles were also noted within this alluvial material. Underlying the alluvium is a conglomerate formational bedrock. This formational material is a weakly cemented and decomposed bedrock containing medium to coarse grained sand and gravels. Cobbles and boulders (~14 inch diameter) were encountered within this conglomerate. The depth of the formational bedrock ranges in elevations from approximately 212.0 feet at boring B-2 to 345.0 feet at boring WB-3. This formational material slopes downward toward the west. For more specific bedrock descriptions, refer to the LOTB sheets. The deepest boring during the foundation investigation was advanced to the approximate elevation of 143.0 feet.

Environmental Considerations

During the field investigations (April 2007 and January 2008), possible hydrocarbon contaminated soils were encountered in borings B-5, B-5B, and WB-3. As indicated on the respective boring logs (LOTB) these soils were encountered at the approximate elevations of 355.0 feet to 350.0 feet and were between 5 feet and 8 feet in thickness. It was noted in the field at the respective time of the subsurface investigations that these soils contained a strong petroleum odor. Those suspected materials excavated by the drilling program were drummed and left on a local site for testing to characterize the possible contamination and proper disposal. The laboratory results showed that the drill cuttings and fluids were non-detect for any hazardous substance.

Groundwater

Groundwater elevation at the site generally corresponds to the water level in the Colorado River. Water level variations in the river may vary due to agricultural demands, discharges for up-river dams, and seasonal fluctuations. During the recent foundation investigations, the river surface elevation was at the approximate elevation of 343.0 feet. This is also the assumed groundwater elevation. Groundwater surface elevations are subject to seasonal fluctuations and will be encountered at higher or lower elevations depending on seasonal conditions at time of construction.

Scour Potential

After the previous and recent subsurface investigations, hydraulic information provided by Hydraulics Branch, and forwarded by Structure Design, states that at bents 2, 3, and 4, the total potential scour is 37.8 feet. Structure Hydraulics states that they have no concerns with the abutment locations.

Corrosion

Corrosion test results for soil samples collected from borings B-1, B-5B, WB-3, are shown below in Table 1. The soil samples tested from borings B-1 and B-5B are considered non-corrosive. The soil samples tested from boring WB-3 is considered corrosive by current Caltrans standards.

Table 1 – Corrosion Test Summary

Location	SIC Number	pH	Minimum Resistivity (Ohm-Cm)	Sulfate Content (ppm)	Chloride Content (ppm)
Boring B-1 Depth 5.0-35.0 feet	C638801	8.50	937	270	250
Boring B-5B Depth 0.0-35.0 feet	Tested By Contractor	9.23	1.300	N/A	195
Boring WB-3 Depth 5.0-30.0 feet	Tested By Contractor	6.78	300	240	525

Note: Caltrans currently defines a corrosive environment as an area where the soil has either a chloride concentration of 500 ppm or greater, a sulfate concentration of 2000 ppm or greater, or has a pH of 5.5 or less. With the exception of MSE walls, soil and water are not tested for chlorides and sulfates if the minimum resistivity is greater than 1,000 ohm-cm.

Seismic Data and Liquefaction Potential

The Office of Geotechnical Design, South 2, has provided Seismic Design Recommendations in a memorandum dated June 25, 2008. The site is located about 24 miles south of the Chemehuevi Graben Fault (CGR, Mw=6, normal fault) and 33 miles north of the Blythe Graben Fault (BGN, Mw=6, normal fault). From the 1996 Caltrans California Seismic Hazard Map, the bridge is within peak horizontal bedrock acceleration (PBA) zone of 0.1g. However, PBA = 0.2g, which is the minimum consideration for design, is recommended. The report also concludes that the potential for soil liquefaction is low.

Foundation Recommendations

The following recommendations are for the proposed Colorado River Bridge replacement (Bridge No. 54-1272), as shown on the General Plan dated September 30, 2008, load and foundation design information provided by Mr. David Soon from the Office of Structure Design, and the subsurface investigations conducted at this site.

The new bridge will be supported on Cast-In-Drilled-Hole (CIDH) piles at the abutment support locations 1 and 5. At bent locations 2, 3 and 4, CIDH piles with driven steel shells may be used for support of the proposed structure.

Abutment Locations

At Abutment 1 and 5 support locations, CIDH pile will be used for supports. Tables 2 and 3 below, presents the abutment design information provided by Structure Design. Below, Table 4 presents abutment foundations CIDH pile data.

Table 2: Abutment 1 and 2 CIDH Design Information Provided by Structure Design

Support Location	Design Method	Pile Type	Finished Grade Elevation (ft)	Bottom of Footing Elevation (ft)	Pile Cap Size (ft)		Permissible Settlement under Service Load (in)(1)	Number of Piles Per Support
					B	L		
Abut 1 (Stage 2)	WSD	2' CIDH	354.0	348.00	18.0	35.25	1"	15
Abut 1 (Stage 3)	WSD	2' CIDH	354.0	344.50	18.0	39.25	1"	21
Abut 5 (Stage 2)	WSD	2' CIDH	373.5	363.00	12.0	35.25	1"	10
Abut 5 (Stage 3)	WSD	2' CIDH	373.5	363.00	12.0	39.25	1"	12

Note: 1) Based on CALTRANS' current practice, the total permissible settlement is one inch for structures with continuous spans or multi-column bents, and two inches for single span structures with seat abutments..

Table 3: Abutment Foundation Design Loads Provided by Structure Design

Support Location	Service 1 Limit State (WSD)			Strength Limit State (Controlling Group)				Extreme Event Limit State (Controlling Group)			
	Total Loads		Permanent Loads	Compression		Tension		Compression		Tension	
	Per Support (kips)	Max Per Pile (kips)	Per Support (kips)	Per Support (kips)	Max Per Pile (kips)	Per Support (kips)	Max Per Pile (kips)	Per Support (kips)	Max Per Pile (kips)	Per Support (kips)	Max Per Pile (kips)
Abut 1 (Stage 2)	6,181	177	5,714	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Abut 1 (Stage 3)	(1)	182	(1)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Abut 5 (Stage 2)	3,996	220	3,555	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Abut 5 (stage3)	(1)	231	(1)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Note: 1) Service-1 Limit State Load Per Support are combined (abutment Stage 2 + Stage 3) at each abutment location

Table 4: Abutment - CIDH Pile Data

Location	Pile Type	Cut-Off Elevation (ft)	Service-I Limit State Load per Support		Service-I Limit State Total Load per Pile in Compression (kips)	Nominal Resistance (kips)	Design Tip Elevation	Specified Tip Elevation	Nominal Driving Resistance Required
			Total (kips)	Permanent (kips)					
Abut 1 (Stage 2)	24 inch CIDH	348.25	6,181	5,714	177	354	276.2 (1)	276.2 (1)	N/A
Abut 1 (Stage 3)	24 inch CIDH	344.75	(2)	(2)	182	364	272.5 (1)	272.5 (1)	N/A
Abut 5 (Stage 2)	24 inch CIDH	363.25	3,996	3,555	220	440	323.0 (1)	323.0 (1)	N/A
Abut 5 (Stage 3)	24 inch CIDH	363.25	(2)	(2)	231	462	323.0 (1)	323.0 (1)	N/A

Note: 1) Design tip elevation is controlled by: (a) Compression
2) Service-I Limit State Load Per Support are combined (abutment a+b) at each abutment location.

Bent Locations

At all bent locations, 8 foot diameter CIDH piles with 9 foot diameter driven steel shells may be used for supports. Tables 5 and 6 below, presents the bent design information provided by Structure Design.

Table 5: Bent Foundation Information Provided by Structure Design

Support Location	Pile Type	Finished Grade Elevation-Thalweg (ft)	Cut-off Elevation (ft)	Scour Elevation (ft) (1)	Permissible Settlement Under Service Load (in)	Number of Piles per Support
Bent 2	96" CIDH w/ 108x1.375" Driven Steel Shell	327.8	340.0	297.7	1	2
Bent 3	96" CIDH w/ 108x1.375" Driven Steel Shell	327.8	341.0	297.7	1	2
Bent 4	96" CIDH w/ 108x1.375" Driven Steel Shell	327.8	343.0	297.7	1	2

Note: 1) Scour Elevation= Thalweg Elevation – [(Degradation Scour (22.5') + ½ Local Scour (7.6')]

Table 6: Bent Foundation Design Loads Provided by Structure Design

Support Location	Service 1 Limit State			Strength Limit State (Controlling Group)				Extreme Event Limit State (Controlling Group)			
	Total Loads		Permanent Loads	Compression		Tension		Compression		Tension	
	Per Support (kips)	Max Per Pile (kips)	Per Support (kips)	Per Support (kips)	Max Per Pile (kips)	Per Support (kips)	Max Per Pile (kips)	Per Support (kips)	Max Per Pile (kips)	Per Support	Max Per Pile (kips)
Bent 2	4,800	4,800	4,050	9,250	6,450	0	0	4,850	4,850	0	0
Bent 3	4,600	4,600	3,900	8,900	6,200	0	0	4,650	4,650	0	0
Bent 4	4,600	4,600	3,900	8,900	6,200	0	0	4,650	4,650	0	0

The specified pile tip elevation for the Bents 2 through 4 CIDH piles with driven steel shells are shown below in Table 7.

Table 7: Bent 2 through 4 Foundation Design Recommendations

Support Location	Pile Type	Cut-Off Elevation (ft)	Required Nominal Resistance for Strength Limit State (kips)				Specified Tip Elevation for Driven Shell (ft)	CIDH Design Tip Elevations (ft)	Specified Tip Elevation for CIDH (ft)	Steel Shell Nominal Driving Resistance Required (kips) (2)
			CIDH Pile w/ Driven Steel Shell		Driven Steel Shell Only					
			Compression (φ=0.7)	Tension (φ=0.7)	Compression (φ=0.7)	Tension (φ=0.7)				
Bent 2 (Load test Pile)	96" CIDH w/ 108x1.375" Driven Steel Shell	340.0	9,215	0	7,125	0	205.5 219.0 (1)	186.5 (a-I) 214.8 (a-II)	186.5	8,492 (2)
Bent 3	96" CIDH w/ 108x1.375" Driven Steel Shell	341.0	8,858	0	3,545	0	228.4	190.4 (a-I) 227.4 (a-II)	190.4	5,464 (2)
Bent 4	96" CIDH w/ 108x1.375" Driven Steel Shell	343.0	8,858	0	0	0	292.0	222.0 (a-I) 259.0 (a-II)	222.0	2,805 (2)
Anchor Piles	48"x1.5" Steel Pipe Piles	340.0	N/A	N/A	N/A	4,000	208.5	N/A	N/A	3,584 (3)

Note: Design tip elevations are controlled by (a-1) Compression (Strength Limit), (a-II) Compression (Extreme Event), (III) Lateral

1) Specified Tip Elevation for Pile Load Test Only
2) Nominal driving Resistance values are based on the Estimated Maximum Driving Resistance values stated in the Revised Driveability Study from the Foundation Testing Branch, dated April 30, 2009.
3) Nominal driving Resistance values for the anchor piles are based on the Estimated Maximum Driving Resistance values stated in the Driveability Study – Anchor Piles memorandum from the Foundation Testing Branch, dated April 30, 2009.

The Pile Data Table for Bents 2 through 4 is presented in Table 8, below.
The ultimate geotechnical pile capacity for the CIDH piles with driven shells will meet or exceed the required nominal resistance in compression.

Table 8: Pile Data Table Bent 2 through 4

Support Location	Pile Type	Total Nominal Resistance of CIDH w/ Driven Steel Shell (kips)		Nominal Resistance (Driven Steel Shell) (kips)		Driven Shell Specified Tip Elevation for (ft)	CIDH Design Tip Elevations (ft)	Specified Tip Elevation for CIDH (ft)	Steel Shell Nominal Driving Resistance Required (kips)
		Compression	Tension	Compression	Tension				
Bent 2	96" CIDH w/ 108x1.375" Driven Steel Shell	9,220	0	7,130	0	205.5	186.5 (a)	186.5	8,492 (3)
Bent 2 (Load test Pile)	108x1.375" Driven Steel Shell	N/A	N/A	5,500	0	219.0 (1)	N/A	N/A	8,492 (3)
Bent 3	96" CIDH w/ 108x1.375" Driven Steel Shell	8,860	0	3,550	0	228.4	190.4 (a)	190.4	5,464 (3)
Bent 4	96" CIDH w/ 108x1.375" Driven Steel Shell	8,860	0	0	0	292.0	222.0 (a)	222.0	2,805 (3)
Anchor Piles	48"x1.5" Steel Pipe Piles	N/A	N/A	N/A	4,000	208.5	N/A	N/A	3,584 (4)

Note: Design tip elevations are controlled by (a) Compression (Strength Limit), (b) Tension, (c) Settlement, (d) Lateral Load

1) Specified Tip Elevation for Pile Load Test Only.
2) The CIDH specified tip elevation shall not be raised.
3) Nominal driving Resistance values are based on the Estimated Maximum Driving Resistance values stated in the Revised Driveability Study from the Foundation Testing Branch, dated April 30, 2009.
4) Nominal driving Resistance values for the anchor piles are based on the Estimated Maximum Driving Resistance values stated in the Driveability Study – Anchor Piles memorandum from the Foundation Testing Branch, dated April 30, 2009.

Pile Load Test

We recommend a pile load test for compression to be performed at the south pile of Bent 2 location. The pile load test will be used to test the external skin friction of the driven shell only and will also control Bent location 3. The load test the nominal load of 5,500 kips at Bent 2. The 9 foot diameter driven steel shell has a designed and specified tip at elevation 205.5. However, we recommend the shell of the test pile be initially driven to elevation 219.0 and tested at that elevation. After the pile load test is complete, the shell should be driven to the specified tip elevation. However, an extra 18 feet length of stick up, to the approximate elevation of 358.0, must be provided to permit pile dynamic analysis. The excess length may then be cut to trim the pile to the elevation needed for the pile load test.

In addition to the extra 18 feet referred to the above for the pile load test, it is advisable to provide another separate 18 feet of shell which may be utilized in case it became necessary to dynamically monitor piles in other locations.

The anchor piles shall be 4.0 feet x 1.5 inch thick steel pipes and shall be driven to elevation 208.5.

The load testing for the driven shell shall be performed after the interior clean out to elevation 228.0 to ensure that only the external skin friction is being tested. A positive water pressure head must be maintained within the driven shell while testing to avoid any quick conditions which may disrupt the skin friction of the production pile. A minimum of 14 days is required for set-up after driving both the driven shell of the test pile and the anchor piles before the load testing is performed. A re-tap should be performed 7 days after the initial installation of the driven shell of the test pile.

After the load testing is complete and the driven shell has been accepted, the shell may be incorporated into the new bridge foundation system, and the anchor piles will be abandoned in accordance with the Special Provisions. The design and specifications of the pile load testing to be included with the contract plans will be developed by the Foundation Testing Branch of the Office of Geotechnical Support. Please contact Brian Liebech for further information on this subject.

Pile acceptance criteria will be developed using the wave equation analysis after the completion of the load testing and dynamic monitoring.

General Notes

1) All support locations are to be plotted in plan view on the Log of Test Borings as stated in "Memo to Designers" 4-2. The plotting of support locations should be made prior to requesting a final foundation review.

2) When applicable, the structure engineer shall show on the plans, in the pile data table, the design pile tip elevation required to meet the lateral load demands. If the design pile tip elevation required to meet the lateral load demands exceeds the specified pile tip elevations given within this report, the Office of Geotechnical Design-South II, Branch B shall be contacted for further recommendations.

3) A drivability study will be performed by the Foundation Testing Branch to determine the drivability and thickness of the permanent steel shells at the bent locations. This information will be forwarded to Structures Design when completed.

Construction Considerations

Abutment Locations (CIDH Piles):

1) Since the groundwater is anticipated to be that of the river water elevation, the contractor may encounter groundwater during CIDH pile construction. Groundwater levels indicated on the LOTB sheets reflect the measured groundwater levels at the time of the Caltrans investigation. At the time of construction, the groundwater surface elevations may be significantly higher or lower than those shown on the LOTB due to seasonal fluctuations.

2) Caving conditions may be anticipated in the alluvium material at the Abutment locations. To mitigate the caving conditions within the alluvium, temporary casings may be used during the construction of the CIDH piles. If temporary casings are used, all casings shall be removed during the concrete placement.

3) Simple de-watering of the drilled shaft excavations by pumping methods may not be feasible at the abutment locations when groundwater is encountered. The contractor should anticipate wet conditions when constructing the CIDH shafts and place concrete using a slurry displacement method.

4) At Abutment 5 locations, the contractor should be aware that difficult drilling may be anticipated due to the presents of cobbles that were encountered during the field exploration.

5) The calculated geotechnical capacity of the CIDH piles is base on skin friction. The calculated geotechnical capacity of all CIDH piles was determined by ignoring one pile diameter at the bottom of the pile.

6) The slurry to be used for placing concrete, using slurry displacement method, shall be mineral or synthetic slurry only. Use of water shall not be allowed as slurry.

7) The contractor will need to use care while drilling the shafts for the CIDH piles using slurry. Due to the decomposed nature of the formational bedrock encountered at the Abutment 5 location, rapid insertion and removal of the drilling tools during the drilling process can cause excessive scouring and caving of the walls of the drilled shaft.

Bent Locations (CIDH Piles with Driven Steel Shells):

Driven Steel Shells:

1) The calculated geotechnical capacity of the piles at the bent locations 2 and 3 is based on skin friction from the driven steel shells. Therefore, vibratory hammers, oscillatory or rotary methods of the steel shell installation shall not be allowed. All shells must be driven to the specified casing tip elevations. The specified casing tip elevations are based on the estimated lowest top-of-rock elevations at the pile locations. Therefore, portions of the permanent steel shells may extend greater than 10 feet into the bedrock. PDA monitoring

for shell integrity may be performed. Please contact Foundation Testing Branch for PDA monitoring prior to shell driving.

2) The recommended driven steel shells, at the bent locations, are intended to minimize construction difficulties due to caving of the loose alluvial material overlying the weathered bedrock. The driven steel shells will not eliminate the potential for caving within the formational bedrock.

3) Internal driving shoes will be necessary to achieve SPTE for the shells in the dense formational material.

4) Hard driving of the anchor piles shall be anticipated to achieve SPTE. A driving shoe is recommended for the installation of the anchor piles at bent location 2. The outer diameter of the selected driving shoes shall be identical to that of the pile shell.

CIDH Piles:

5) Due to the chaotic nature of the bedrock, the contractor should take necessary precautions, when drilling in the bedrock, to prevent the possibility of cobble and boulder sized material caving into or causing the CIDH pile excavation to deflect from vertical during construction.

6) If the contractor decides to utilize a simple auger method to drill the CIDH piles at the Bent 2, 3 and 4 locations, the contractor should be aware that the rotating action of the auger within the fractured rock matrix, will produce material being removed from the excavation that will appear to be cobbles and boulders.

7) The contractor will need to use care while drilling the shafts for the CIDH piles using slurry. Due to the decomposed nature of the formational bedrock, rapid insertion and removal of the drilling tools during the drilling process can cause excessive scouring and caving of the walls of the drilled shaft.

8) The calculated geotechnical capacity of the CIDH piles is based upon skin friction and relies upon a concrete bond to the rock walls of the drilled shaft. It is imperative that the borehole walls are not contaminated with drill cuttings or loose materials. The use of rotator or oscillator methods for drilling of CIDH piles shall not be allowed. The alluvium or rock cuttings trapped between the borehole walls and rotator or oscillator drill rod will result in a capacity reduction of the CIDH piles.

9) It is recommend that the CIDH portion of the bent pile be tested with sonic calipers to test for any voids in the formational bedrock before the placement of the structural cage and concrete is placed. Please contact Foundation Testing Branch for more information.

10) The slurry to be used for placing concrete, using slurry displacement method, shall be mineral or synthetic slurry only. Use of water shall not be allowed as slurry.

The recommendations contained in this report are based on specific project information regarding structure type, location, and design loads that have been provided by the Office of Bridge Design-North, Design Branch 7. If any conceptual changes are made during final project design, the Office of Geotechnical Design-South 2 should review those changes to determine if these foundation recommendations are still applicable. Any questions regarding the above recommendations should be directed to the attention of Mark Wilson, (916) 227-1257, or Shawn Wei, (916) 227-5252, at the Office of Geotechnical Design-South 2, Branch C.

Prepared by: Date: 6-22-09

MARK WILSON
Engineering Geologist
Branch C
Office of Geotechnical Design- South 2

PROFESSIONAL GEOLOGIST • MARK J. WILSON No.8164 • STATE OF CALIFORNIA

Supervised by: Date: 6-22-09

SHAWN WEI, P.E., Chief
Branch C
Office of Geotechnical Design- South 2

REGISTERED PROFESSIONAL ENGINEER YUSHENG WEI No. C056262 Exp.12-31-09 CIVIL STATE OF CALIFORNIA

cc: Abbas Abghari – OGDS-2
S. Wei
R.E. Pending File
John Stayton - Specs & Estimates
Project File

OFFICE OF STRUCTURES
FINAL HYDRAULIC REPORT

Colorado River

Bridge # 54-1272
PM 142.3 on SR 62
Bridge between Earp, California
And Parker, Arizona
At the California – Arizona Border

JOB:
Bridge Replacement for Bridge Number 54-1272

LOCATION:
08-SBD-62-PM 142.3

DATE:
May 2, 2008

WRITTEN BY:
Ronald L McGaugh

REVIEWED BY:
Tony Nedwick

General:

This report supersedes all previous reports. *To avoid confusion previous reports should not be used for comparison.*

It is proposed to construct a new four lane wide bridge to replace the existing scour critical bridge. The scope of the proposed work will be to reduce future traffic delays, relieve congestion and improve safety between California and Arizona. Environmental concerns and Right-of-Way Acquisitions limited the horizontal alignment options and played a critical role in choosing the alignment. Two alternatives, alt. 3A and alt. 3B, are being considered to replace the existing ten span 658.5 feet long bridge.

Alternative 3A proposes a new bridge length of 715.0 feet to span the Colorado River. Structure depth for the new six span precast, prestressed Bulb Tee girder bridge will be 7.0 feet. The new bridge will be supported on 5 bents. Each bent will consist of two 8.0 feet diameter cast-in-drilled-hole columns with permanent steel shells.

Alternative 3B proposes a new bridge length of 720.0 feet to span the Colorado River. Structure depth for the new four span cast-in-place prestressed box girder bridge will be approximately 8.0 feet. The new bridge will be supported on three bents. Each bent will be comprised of two 8 feet diameter cast-in-drilled-hole columns with permanent steel shells.

The proposed structures for Alternatives 3A and 3B should not materially affect the existing waterway conveyance.

This report makes reference to and uses information from the August 1990, Colorado River Floodway Maps Public Law 99-450, between river miles 169 through 182. United States Department of the Interior – Geological survey for the Colorado River below Parker Dam for dates between 1934 and 1989 and chapter 1 of the Biological Assessment.

All calculated elevations are based on NGVD 1929.

Basin:

In the United States, the Colorado River drains about 250,000 square miles from portions of seven States – Wyoming, Colorado, Utah, New Mexico, Nevada, Arizona, and California. Over 170,000 square miles of the watershed are above Hoover Dam. The headwaters of the Colorado River are located in central Colorado, about 1,440 river-miles upstream from its mouth and 1,000 river-miles upstream from Hoover Dam. The bridge site is approximately 17 miles downstream of Parker Dam. The drainage area contributing to the flows at the bridge site are near 180,000 square miles.

The Colorado River basin ranges from 14,000 feet to approximately 30 feet in elevation. Most water discharge occurs during the months of April through July when the winter snow pack melts. Lee Ferry, 15.5 miles downstream of Glen Canyon Dam is the boundary between the upper basin and the lower basin of the Colorado River. The area of the lower Colorado River basin is generally arid, with very little tributary runoff reaching the mainstream of the Colorado River, except during occasional storms. The bridge site elevation is near 375 feet. Precipitation rates near the bridge site are near 6 inches per year.

Discharges:

The Colorado River system water is highly regulated with more than 20 dams. Since there is so much regulation over these flows by various structures and agencies, Structure Hydraulics will use the discharges provided by the Bureau of Reclamation – Parker Dam facility. This facility is located approximately 17 miles upstream of the existing bridge site. Flows controlled through this facility determine the flow at the bridge site. There are no significant discharge changes along this 17 mile reach. The following flow capacities from the dam facility are regulated by Bureau of Reclamation policy. The 100-year Q is approximately 40,000 cubic feet per second. Typical maximum daily releases from the dam site are approximately 19,000 cubic feet per second (power house capacity) during high electrical power demands. Typical water surface elevations for the maximum daily releases are 346.9 feet. The Ordinary High Water shall be taken as 12 ft in depth in the deepest part of the river, yields approximately 11,020 cubic feet per second. Since the flow rates are set by policy, and the BLM policy did not specify a 50- year Q, none will be provided for this report.

Typically FHR reports for structures located within the state of California address the 100-year Q for design purposes. However this bridge replacement project is jointly funded by the states of California and Arizona. The Arizona Department of Transportation (ADOT) is requiring the Check Flood for Bridge Scour be included in the Extreme Event II Limit (500-year Q).

Located near the Parker Dam Facility is USGS Gage 09427520. Using the information from the gage and inputting the data into the WATSTORE program, the 500-year discharge value is extrapolated to approximately 74,000 cubic feet per second.

The Probable Maximum Flood (PMF) for Parker Dam is nearly 400,000 cubic feet per second. This is the maximum flow that the dam can handle without failure. A discharge of this size would inundate large portions of the basin downstream and is beyond the scope of this study.

Water Surface Elevations:

The water surface elevations are calculated using a Consultant Survey, verified by Caltrans Preliminary Investigations North section. The information from the surveys were input into the software programs CAiCE, WMS and Brease to calculate the channel cross sections and flow parameters.

The large channel cross section is on a relatively straight reach for over 3000 feet. This reach adequately conveys the 100 and 500-year discharges. Contraction scour or channel capacity will not be a limiting condition for the indicated recurrence interval.

Existing Conditions

The river at this bridge is mandated by the United States Coast Guard to have navigational clearance of 27 feet above ordinary high-water elevation.

According to Public Notice 11-78 in a November 8, 1990, memo from the United States Coast Guard the ordinary high-water elevation is 12 feet maximum depth for the main navigational channel between existing Piers 3 and 5. The average existing channel bottom elevation (in the navigational waterway area in 1990) is 331.3 feet. Typical water surface elevation for the ordinary high water is 344.0 feet. Therefore, the ordinary high-water elevation is near 344 feet.

Alternatives 3A and 3B are based on approximate general plan models and are subject to minor revisions.

For both Alternative 3A and 3B, the 100-year event flood elevations are approximately 352.4 feet. The minimal soffit elevation to pass the 100-year event is 353.2 feet. The minimal soffit elevation to pass the 500-year event is 359.9 feet. These minimal soffit elevations include 1 foot of freeboard. The Maximum Daily Flow stage elevation is approximately 346.9 feet. The Ordinary High Water stage elevation is approximately 344.0 feet.

To meet the Coast Guard's navigational requirement, the Ordinary High Water elevation plus the additional 27 foot clearance yields a soffit elevation of 371 feet over the navigational portion of the waterway.

For recreational use of the river some system of identification may be needed to indicate the navigational portion of the channel.

Velocity:

The flow parameters used for these Alternatives on this relatively straight reach of channel are a roughness coefficient of 0.035, and gradient of 0.0004.

Alternative 3A
The estimated average channel velocity for the 100-year discharge in the entire channel is 4.9 feet per second. The estimated navigational area channel velocity for the 100-year discharge is approximately 6.4 feet per second. The estimated average channel velocity for the 500-year discharge over the entire channel width is 6.1 feet per second

Alternative 3B
The estimated average channel velocity for the 100-year discharge in the entire channel is 4.9 feet per second. The estimated navigational area channel velocity for the 100-year discharge is approximately 6.4 feet per second. The estimated average channel velocity for the 500-year discharge over the entire channel width is 6.0 feet per second

Streambed:

At the bridge site the streambed is composed of sand, gravel and boulders overlying bedrock approximately 60 feet below. The bridge site is 17 miles downstream of the Parker Dam and 1.5 miles downstream of the Headgate Rock Diversion Dam. The Bridge site lies in the Parker Valley with the Whipple Mountains on the west side of the valley (California side) and the Buckskin mountains on the east side of the valley (Arizona side). Away from the bridge site, in the mountain area, the soils are generally gravelly loam and broken sandy soils. The river flows through a narrow canyon and ends at the Pacific Ocean. At the bridge site, the slope is fairly flat to mild with a gradient of 0.0004. The channel overbanks has light to moderate vegetation. The potential for channel migration and degradation are considered in the recommendations made in this report.

Scour:

Generally over 70 years this channel has been to degraded slowly. In the early 1970's there was a point of rapid aggregation, but since then the channel has returned to its slow rate of degradation. The total potential scour is calculated in accordance with the Federal Highway Administration (FHWA) Hydraulic Engineering Circular Number 18. The estimated total channel degradation is approximately 23 feet for an assumed bridge life span of 75 years (0.30 foot per year). Contraction and abutment scour are negligible due to the bridge length and cross section configuration. Log of Test Borings from the 1990 rehabilitation of the existing structure, indicates the soil that has no armoring capabilities.

Alternative 3A
For the 100-year discharge event the anticipated local pier scour is 13.9 feet. For the 500-year discharge event the anticipated local pier scour is 15.3 feet.

Alternative 3B
For the 100-year discharge event the anticipated local pier scour is 13.9 feet. For the 500-year discharge event the anticipated local pier scour is 15.3 feet.

These local pier scour depths demonstrate the amount of scour that would occur during these respective events only and do not include degradation.

No major channel migration is anticipated with the control structures upstream. It is anticipated that the future channel thalweg will move to the future bent constructed closest to the existing thalweg. Abutments are beyond the banks of he channel and it is recommended that no special hydraulic design need to be incorporated into the abutment design. Structure Foundations and Geology will need to be consulted on the design of the abutment foundations.

Drift:

Historical records do not indicate a major problem with drift. The required navigational clearance is sufficient to pass drift under the structure.

Bank Protection:

The District will be responsible for bank protection. District should maintain the protection to ensure bank stability.

Below is a summary of key design parameters based on the hydrology and hydraulic analysis performed for this structure.

HYDROLOGIC/HYDRAULIC SUMMARY		
Drainage Area: 180,000 mi^2 Control Point –Parker Dam Existing Thalweg Elevation=327.8 ft	**Alternative 3A bridge length 715 ft**	**Alternative 3B bridge length 720 ft**
	6 spans	4 spans
Maximum daily discharge	19000 ft^3/s	19000 ft^3/s
100 year discharge	40000 ft^3/s	40000 ft^3/s
500 year discharge	74000 ft^3/s	74000 ft^3/s
Water surface elevations		
Ordinary High Water discharge(11020)	344.0 ft	344.0 ft
maximum daily discharge (19000)	346.9 ft	346.9 ft
100 year discharge (40000)	352.4 ft	352.4 ft
500 year discharge (74000)	358.9 ft	358.9 ft
Velocities		
100 year discharge (40000)	4.9 ft/s	4.9 ft/s
500 year discharge (74000)	6.1 ft/s	6.0 ft/s
Scour		
Estimated Degradation in 75 years (0.30 foot per year)	22.5 ft	22.5 ft
Long term estimated scour elevation in 75 years	305.3 ft	305.3 ft
Pier scour depth 100 year discharge (40000)	13.9 ft	13.9 ft
Pier scour depth 500 year discharge (74000)	15.3 ft	15.3 ft

Flood plain data are based upon information available when the plans were prepared and are shown to meet federal requirements. **The accuracy of said information is not warranted by the State and interested or affected parties should make their own investigation. Addendums may be necessary as Foundation Reports are completed.**

This report has been prepared under my direction as the professional engineer in responsible charge of the work, in accordance with the provisions of the Professional Engineers Act of the State of California.

REGISTERED PROFESSIONAL ENGINEER
RONALD L. McGAUGH
Lic. # C61217
Exp. 6/2009
CIVIL
STATE OF CALIFORNIA

Ronald L McGaugh

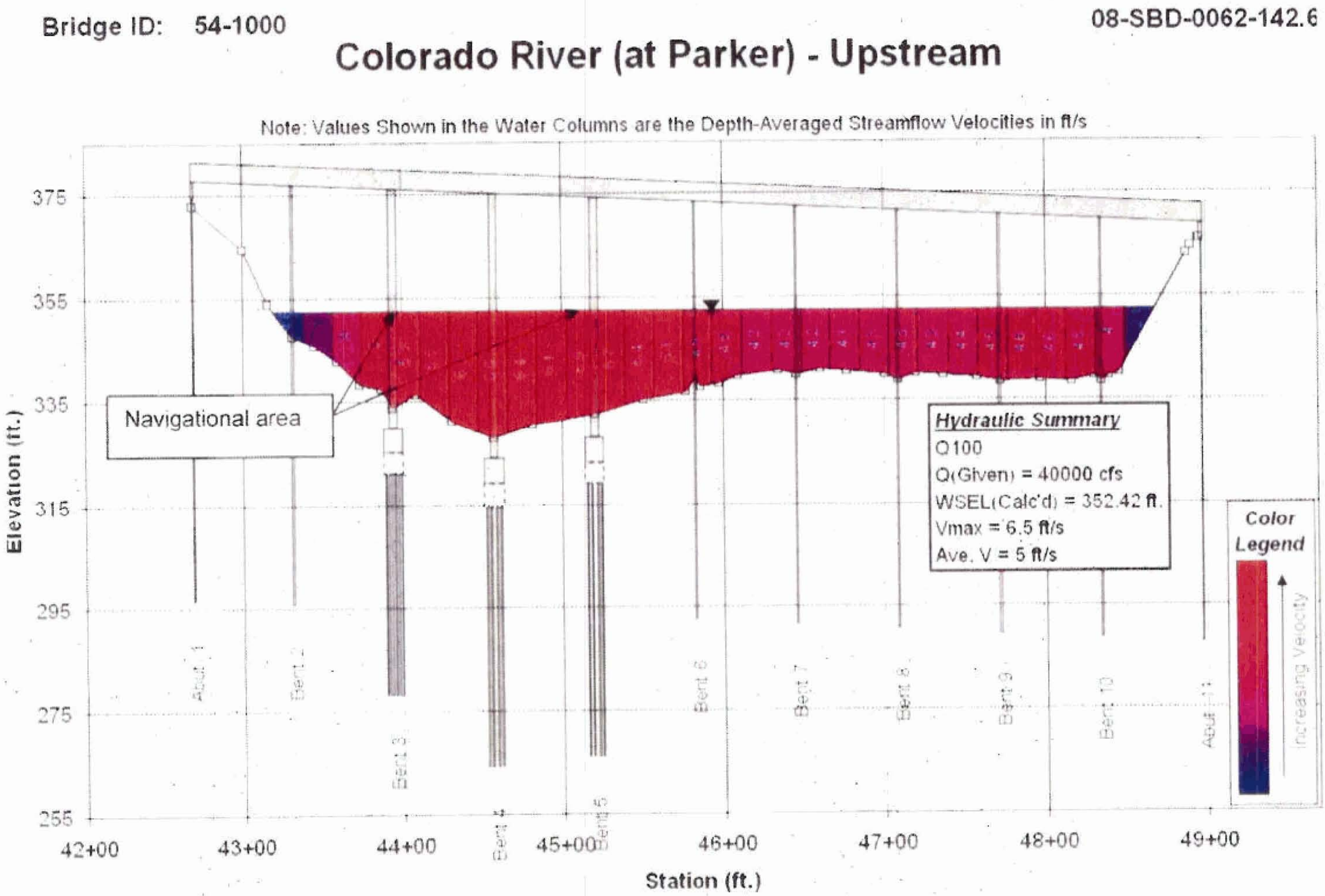
Registered Civil Engineer (Signature)

May 2 2008

Date

Registration Number

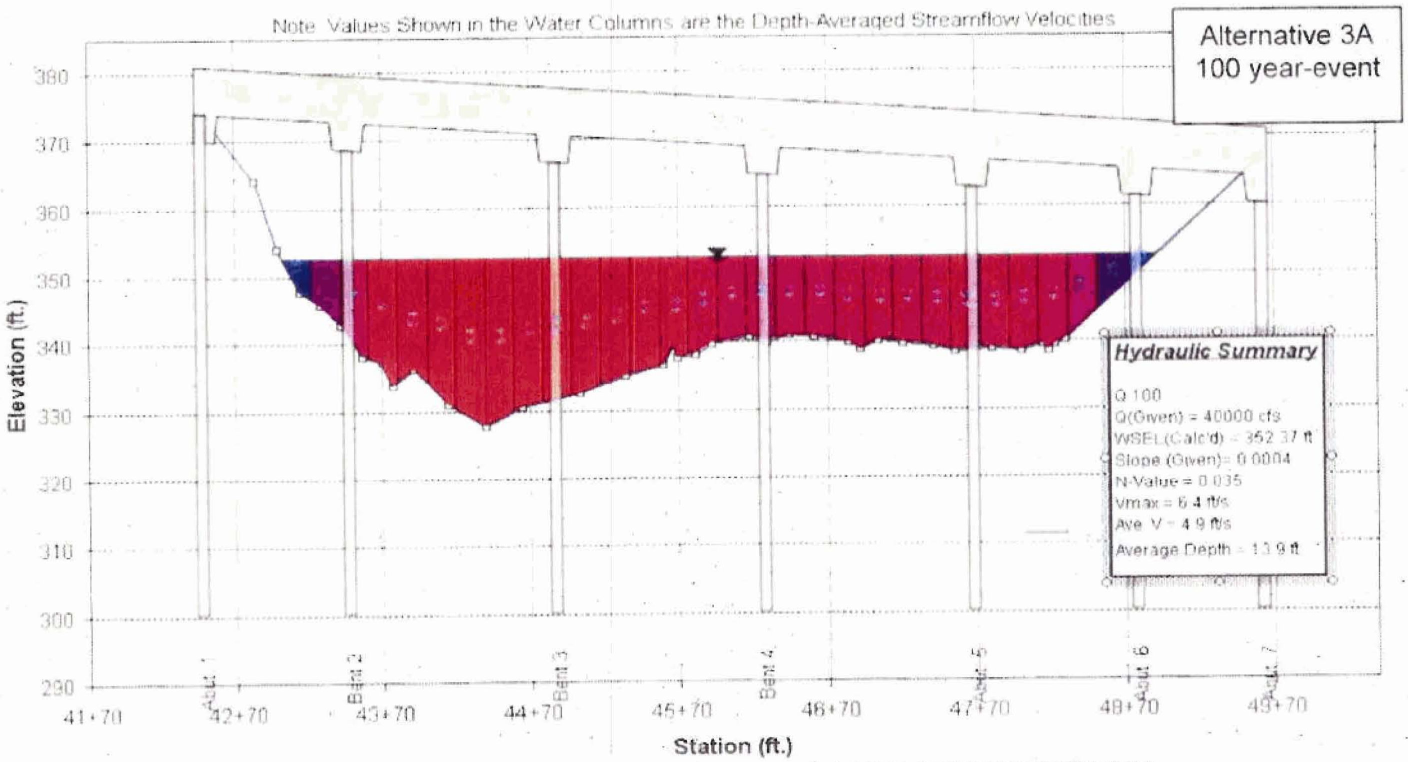
Appendix

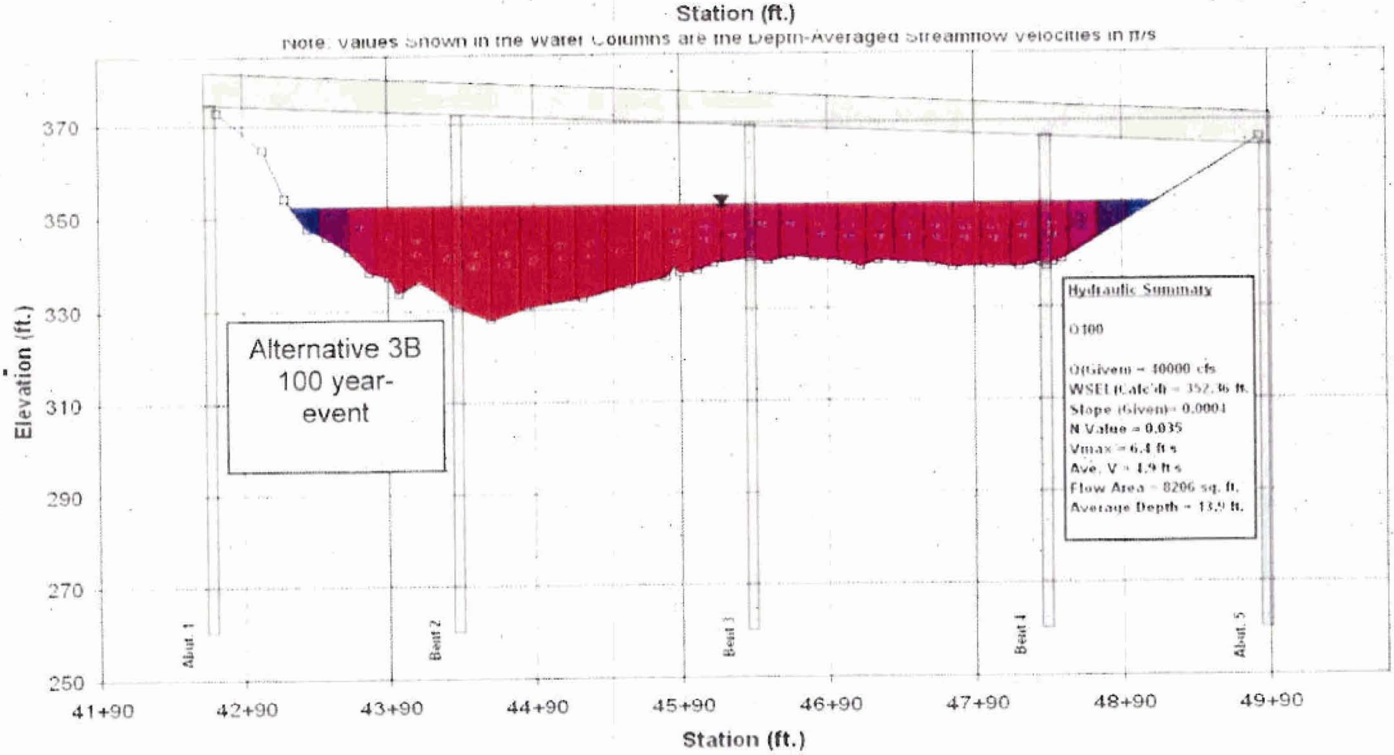


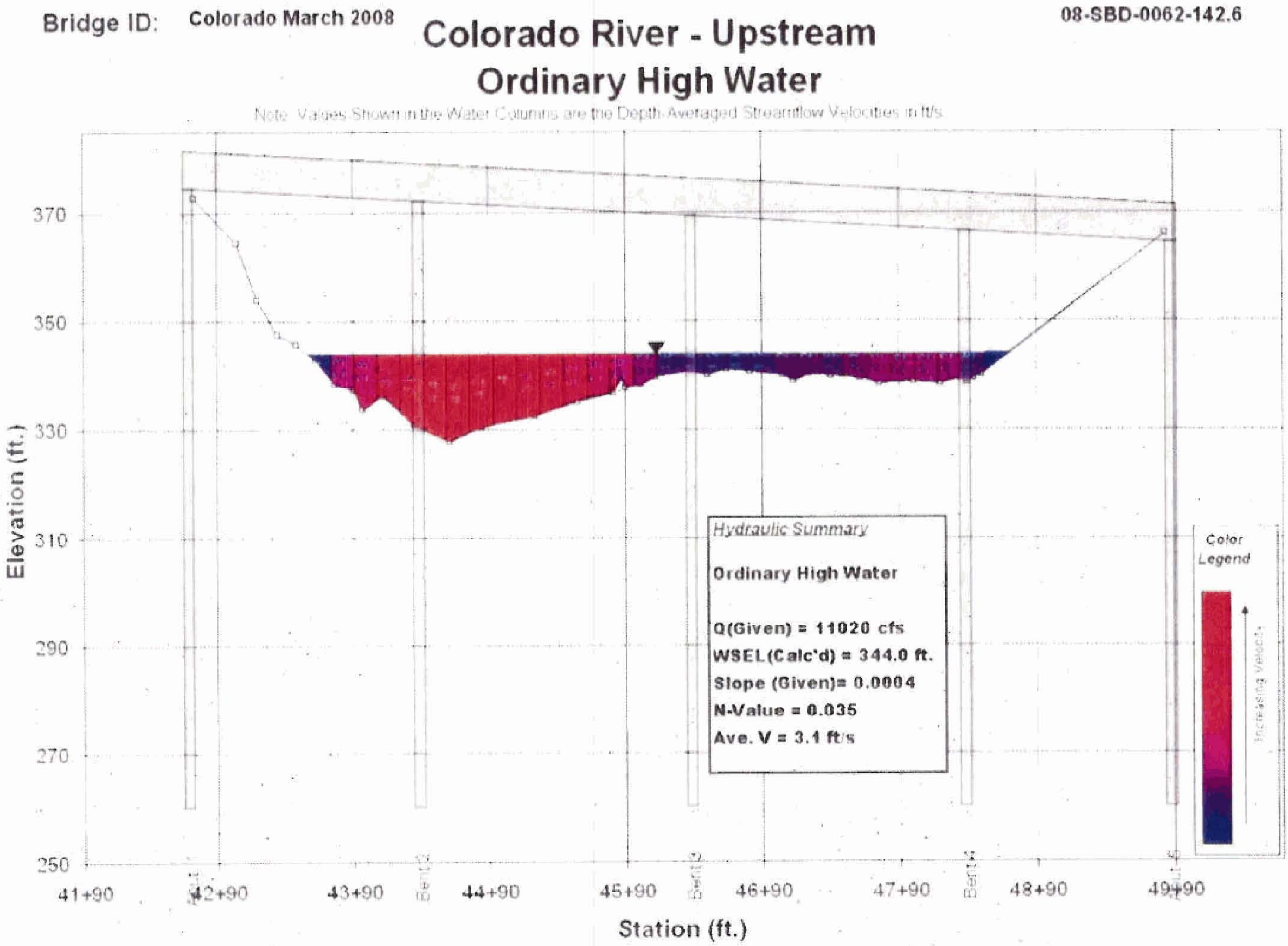
Existing Conditions

Bridge ID: 54-1272-3A **08-SBD-0062-142.6**

Colorado River - Upstream






Bridge ID: Colorado March 2008
08-SBD-0062-142.6
Colorado River - Upstream
Ordinary High Water
Note: Values Shown in the Water Columns are the Depth-Averaged Streamflow Velocities in ft/s
Elevation (ft.)
370
350
330
310
290
270
250
41+90
42+90
43+90
44+90
45+90
46+90
47+90
48+90
49+90
Station (ft.)
Hydraulic Summary
Ordinary High Water
Q(Given) = 11020 cfs
WSEL(Calc'd) = 344.0 ft.
Slope (Given)= 0.0004
N-Value = 0.035
Ave. V = 3.1 ft/s
Color Legend
Increasing Velocity

Colorado River Bridge
08-SBd-SR 62-PM 142.3
BR. No. 54-1272
EA 08-378700

U.S. Department of Transportation
United States Coast Guard

Commander
Eleventh CG District

Building 10, Rm 214
Coast Guard Island
Alameda, CA 94501-5100
Staff Symbol: (oan-br)
(415) 437-3514

8 November 1990 ① JAV
② BSJ
③ APB
Last JER

PUBLIC NOTICE 11-78

PROPOSED MODIFICATION OF THE CALIFORNIA ROUTE 62 HIGHWAY BRIDGE ACROSS THE COLORADO RIVER MILE 176.25 BETWEEN PARKER, ARIZONA AND EARP, CALIFORNIA

PURPOSE: The purpose of this notice is to solicit public comment on a proposal to modify a fixed highway bridge across the Colorado River, mile 176.25, between Parker, AZ and Earp, CA.

PROPOSAL: The California Department of Transportation, Division of Structures, Box 942874, Sacramento, California 94274-0001 (tel. no. 916-324-2683) has applied for a permit to modify the Parker Highway Bridge carrying Rte. 62 across the Colorado River between Parker, Arizona and Earp, California. Work will involve pier repairs and enable the bridge to better withstand earthquakes. Concrete casements will be added to the piers and rock riprap will be placed at the foot of the piers. The work would result in a minor reduction in horizontal clearance through the bridge.

NAVIGATION: Navigation on this reach of the Colorado River consists mainly of small motorboats used by fishermen and other recreational boaters; there is no commercial navigation. The proposed work would reduce horizontal clearance from 63 feet to 56 feet; vertical clearance would be unchanged. The casements would reduce horizontal clearances approximately 7 feet to 56 feet in the main navigation channel between piers 4 and 5, and the channel immediately east of it between piers 3 and 4. The casements would reduce horizontal clearances approximately 3.5 feet to 59.5 feet in the channels between piers 2 and 3, and piers 5 and 6. Vertical clearance is 27 feet above ordinary high water and 29 feet above normal pool elevation (low water) in the main navigation channel, and will not be changed. Maximum depths are 10 feet at normal pool elevation (low water) and 12 feet at ordinary high water in the main navigation channel. Rock riprap would be placed at the foot of each pier, decreasing depths by less than 3 feet at distances within 10 to 12 feet of each pier.

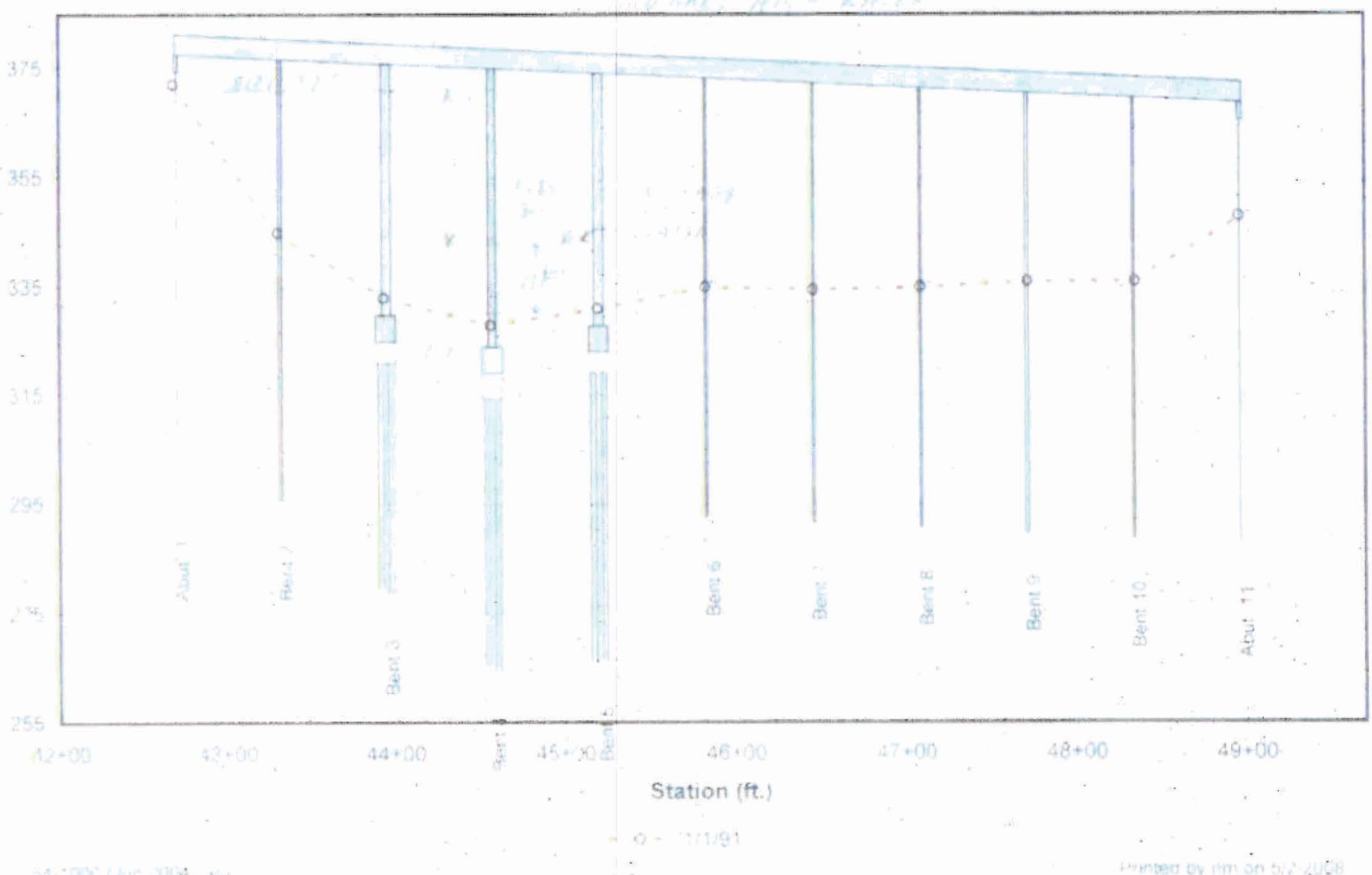
90 NOV 13 AM 11:5
DIVISION OF STRUC...

ENVIRONMENTAL CONSIDERATIONS: The Federal Highway Administration is the lead federal agency for environmental review under the National Environmental Policy Act (NEPA) for the Parker Highway Bridge modification project. They have prepared a Categorical Exemption/Exclusion Determination dated 15 May 1990. The Coast Guard normally exempts minor bridge modification projects such as this from formal environmental review, and also plans to prepare a Categorical Exclusion for this permit action. The project is located in the 100 year flood plain but will have negligible effect on the flood plain. Bridge pier casement modifications will involve adding approximately 60 cubic yards of concrete to the piers and approximately 739 cubic yards of rock protection at the base of the piers. The bridge modification will not result in the loss of wetlands. No parklands, wildlife refuges or historic properties will be affected by the modification.

OTHER APPROVALS: The applicant received water quality certification from the State of Arizona on 10 October 1990, and approval of the California Regional Water Quality Control Board on 9 May 1990. The U.S. Army Corps of Engineers has advised the applicant that this work is covered by their nationwide permit. The project is not in the Coastal Zone.

REQUEST FOR COMMENTS: The Coast Guard would like your comments to help us make our decision on whether or not to issue a bridge permit. Interested persons may help us by submitting comments to Commander (oan), Eleventh Coast Guard District, Building 10, Room 214, Coast Guard Island, Alameda, CA 94501-5100. Commentors should include their name and give reasons for support or opposition to the proposal. All comments received before 10 December 1990 will be made a part of the official record and given careful consideration on this permit application. Final action will be taken by the Commander, Eleventh Coast Guard District, and the information published in the Local Notice to Mariners.

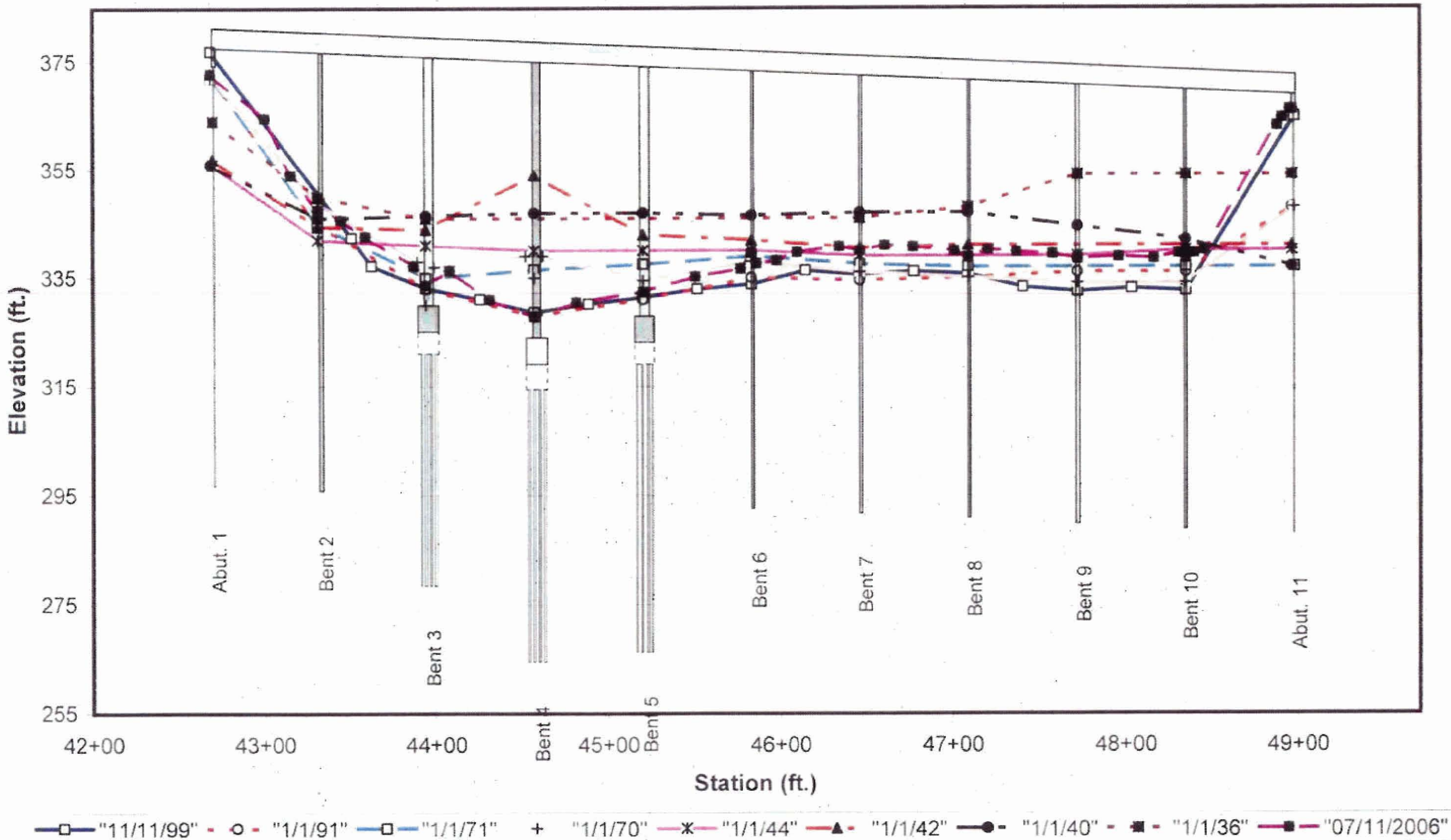
M. E. GILBERT
Rear Admiral, U.S. Coast Guard
Commander, Eleventh Coast Guard District


375
355
335
315
295
275
255
42+00
43+00
44+00
45+00
46+00
47+00
48+00
49+00
Station (ft.)
Abut 1
Bent 2
Bent 3
Bent 6
Bent 8
Bent 9
Bent 10
Abut 11

Bridge ID: 54-1000

08-SBD-0062-142.6

Colorado River (at Parker) - Upstream



54-1000 (Jun 2004) .xlu

Printed by rlm on 4/24/2008

STATE OF CALIFORNIA ARNOLD SCHWARZENEGGER, Governor

DEPARTMENT OF INDUSTRIAL RELATIONS
DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT
464 West Fourth Street, Suite 354
San Bernardino, CA, 92401

Telephone (909) 383-6782
FAX (909) 388-7132

March 4, 2009

Mr. Alex Sanchez
Cal Trans District 8
464 West 4^{th} Street – 11th floor
San Bernardino, CA 92401

Subject: Underground Classification Numbers – C062-071-09T thru C067-071-09T
Highway 62 Colorado River Bridge Bents

Dear Mr. Sanchez:

The information provided to this office relative to the above project has been reviewed. On the basis of this analysis, Underground Classifications of "Potentially-Gassy" have been assigned to the drill shafts identified on your submittal. Please retain copies for your records and deliver true and correct copies of the Classification to the contractor(s) engaged in the work (for posting at the jobsite). In the future, any classification request will require a full size set of drawings.

The piles for the bridge abutments were shown on the plan as 24-inch in diameter. According to California Code of Regulations Title 8 Section 8403 a tunnel bore is 30-inch and larger inch diameter. As such the abutment piles were not given a classification because they fall outside the scope and application of the Tunnel Safety Orders.

A Pre-job Conference with the Division is required prior to commencing any activity associated with construction of tunnels. Also, be advised that, whenever an employee enters any bore or shaft being constructed under 30-inches in diameter, the Mining and Tunneling Unit then has immediate jurisdiction over that job. Please contact us prior to entering such spaces.

If you have any questions, please contact this office.

Sincerely,

Jim Henze
Senior Engineer

cc:

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

San Bernardino Office R5D3

Underground Classification

C062-071-09T

Cal-Trans District 8

(NAME OF TUNNEL OR MINE AND COMPANY NAME)

of 464 West 4th Street 11th Floor San Bernardino, CA 92401

(MAILING ADDRESS)

at **Highway 62 Colorado River Bridge Bent 2**

(LOCATION)

has been classified as *****POTENTIALLY-GASSY*****

(CLASSIFICATION)

as required by the California Labor Code Section 7955.

The Division shall be notified if sufficient quantities of flammable gas or vapors have been encountered underground. Classifications are based on the California Labor Code Part 9, Tunnel Safety Orders and Mine Safety Orders.

A 96-inch diameter estimated 144-feet deep drilled bent shaft for Highway 62 bent 2 downstream pile side located at construction station 7530+10, Earp, San Bernardino County.

This classification shall be conspicuously posted at the place of employment.

Date March 3, 2009

Jim Henze, Senior Engineer

cc: File

91 82348

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

San Bernardino Office R5D3

Underground Classification

C063-071-09T

Cal-Trans District 8

(NAME OF TUNNEL OR MINE AND COMPANY NAME)

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(CLASSIFICATION)

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Date March 3, 2009

Jim Henze, Senior Engineer

cc: File

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

San Bernardino Office R5D3

Underground Classification

C064-071-09T

Cal-Trans District 8

(NAME OF TUNNEL OR MINE AND COMPANY NAME)

of 464 West 4th Street 11th Floor San Bernardino, CA 92401

(MAILING ADDRESS)

at Highway 62 Colorado River Bridge Bent 3

(LOCATION)

has been classified as ***POTENTIALLY-GASSY***

(CLASSIFICATION)

as required by the California Labor Code Section 7955.

The Division shall be notified if sufficient quantities of flammable gas or vapors have been encountered underground. Classifications are based on the California Labor Code Part 9, Tunnel Safety Orders and Mine Safety Orders.

A 96-inch diameter estimated 131-feet deep drilled bent shaft for Highway 62 bent 3 downstream pile side located at construction station 7532+10, Earp, San Bernardino County.

This classification shall be conspicuously posted at the place of employment.

Date March 3, 2009

Jim Henze, Senior Engineer

cc: File

91 82348

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

San Bernardino Office R5D3

Underground Classification

C065-071-09T

Cal-Trans District 8

(NAME OF TUNNEL OR MINE AND COMPANY NAME)

of 464 West 4th Street 11th Floor San Bernardino, CA 92401

(MAILING ADDRESS)

at **Highway 62 Colorado River Bridge Bent 3**

(LOCATION)

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Date March 3, 2009

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91 82346

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

San Bernardino Office R5D3

Underground Classification

C066-071-09T

Cal-Trans District 8

(NAME OF TUNNEL OR MINE AND COMPANY NAME)

of 464 West 4th Street 11th Floor San Bernardino, CA 92401

(MAILING ADDRESS)

at **Highway 62 Colorado River Bridge Bent 4**

(LOCATION)

has been classified as *****POTENTIALLY-GASSY*****

(CLASSIFICATION)

as required by the California Labor Code Section 7955.

The Division shall be notified if sufficient quantities of flammable gas or vapors have been encountered underground. Classifications are based on the California Labor Code Part 9, Tunnel Safety Orders and Mine Safety Orders.

A 96-inch diameter estimated 116-feet deep drilled bent shaft for Highway 62 bent 4 downstream pile side located at construction station 7534+10, Earp, San Bernardino County.

This classification shall be conspicuously posted at the place of employment.

Date March 3, 2009

Jim Henze, Senior Engineer

cc: File

91 82348

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

San Bernardino Office R5D3

Underground Classification

C067-071-09T

Cal-Trans District 8

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Date March 3, 2009

Jim Henze, Senior Engineer

cc: File

91 62346

DEPARTMENT OF INDUSTRIAL RELATIONS
DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT
464 West Fourth Street, Suite 354
San Bernardino, CA, 92401

Telephone (909) 383-6782
FAX (909) 388-7132

August 26, 2009

Mr. Alex Sanchez
Cal Trans District 8
464 West 4th Street – 11th floor
San Bernardino, CA 92401

Subject: Underground Classification Numbers – C011-071-10T thru C014-071-10T
Highway 62 Colorado River Bridge Load Test Anchor Piles

Dear Mr. Sanchez:

The information provided to this office relative to the above project has been reviewed. On the basis of this analysis, Underground Classifications of "Potentially-Gassy" have been assigned to the drill shafts identified on your submittal. Please retain copies for your records and deliver true and correct copies of the Classification to the contractor(s) engaged in the work (for posting at the jobsite). In the future, any classification request will require a full size set of drawings.

A Pre-job Conference with the Division is required prior to commencing any activity associated with construction of tunnels. Also, be advised that, whenever an employee enters any bore or shaft being constructed under 30-inches in diameter, the Mining and Tunneling Unit then has immediate jurisdiction over that job. Please contact us prior to entering such spaces.

If you have any questions, please contact this office.

Sincerely,

Jim Henze
Senior Engineer

cc:

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

San Bernardino Office R5D3

Underground Classification

C011-071-10T

Cal-Trans District 8

(NAME OF TUNNEL OR MINE AND COMPANY NAME)

of 464 West 4th Street 11th Floor San Bernardino, CA 92401

(MAILING ADDRESS)

at Highway 62 Colorado River Bridge Bent 2 Pile Load Test

(LOCATION)

has been classified as ***POTENTIALLY-GASSY***

(CLASSIFICATION)

as required by the California Labor Code Section 7955.

The Division shall be notified if sufficient quantities of flammable gas or vapors have been encountered underground. Classifications are based on the California Labor Code Part 9, Tunnel Safety Orders and Mine Safety Orders.

SPECIAL CONDITIONS

The erection, operation or dismantling of any boom-type lifting equipment or cranes, or any part thereof, closer than the clearances from energized overhead high-voltage lines set forth in §2946. Provisions for Preventing Accidents Due to Proximity to Overhead Lines shall be prohibited.

A 48-inch diameter by estimated 130.5-feet deep drilled bent shaft for Highway 62 Bent 2 test anchor pile downstream side located at approximate construction station 7529+81.25, Earp, San Bernardino County.

This classification shall be conspicuously posted at the place of employment.

Date August 26, 2009

Jim Henze, Senior Engineer

cc: File

91 02348

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

San Bernardino Office R5D3

Underground Classification

C012-071-10T

Cal-Trans District 8

(NAME OF TUNNEL OR MINE AND COMPANY NAME)

of 464 West 4th Street 11th Floor San Bernardino, CA 92401

(MAILING ADDRESS)

at **Highway 62 Colorado River Bridge Bent 2 Pile Load Test**

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Date August 26, 2009

Jim Henze, Senior Engineer

cc: File

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

San Bernardino Office R5D3

Underground Classification

C013-071-10T

Cal-Trans District 8

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This classification shall be conspicuously posted at the place of employment.

Date August 26, 2009

Jim Henze, Senior Engineer

cc: File

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

San Bernardino Office R5D3

Underground Classification

C014-071-10T

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This classification shall be conspicuously posted at the place of employment.

Date August 26, 2009

Jim Henze, Senior Engineer

cc: File

91 82940

State of California | Business, Transportation and Housing Agency

Memorandum

To: MR. DAVID SOON
Bridge Design Branch 7
Office of Bridge Design North
Structure Design
Division of Engineering Services

Date: June 25, 2008

File: 08-378701
08-SBd-62-PM 142.3

Colorado River Bridge (Replace)
Bridge 54-1272

From: MAHMOUD KHOJASTEH
Office of Geotechnical Design South 2
Geotechnical Services - MS 5
Division of Engineering Services

Subject: **Seismic Design Recommendations**

Introduction

This memorandum is an update of our memorandum of June 30, 2006 and presents seismic design recommendations for the design of the above bridge, which replaces Bridge No. 54-1000.

Seismicity

The site is located about 38 km south of Chemehuevi Graben Fault (CGR, Mw = 6, normal fault) and 54 km north of Blythe Graben Fault (BGN, Mw = 6, normal fault). From the 1996 Caltrans California Seismic Hazard Map, the structure is within peak horizontal bedrock acceleration (PBA) zone of 0.1g. However, PBA = 0.2g, which is the minimum considered for design, is recommended. A copy of local seismic map is attached.

Site Condition

From subsurface investigations conducted in 1990 and the field notes of the latest logs of test borings in 2007, the site is classified as soil type D as defined in Table B-1 of Caltrans Seismic Design Criteria (SDC).

Design Response Spectrum

Standard SDC acceleration response spectrum for $M_w = 6$, PBA = 0.2g and soil type D (shown on SDC Figure B-7) is recommended for design. A copy of the acceleration response spectrum is attached for your reference.

Liquefaction

Based on the above subsurface investigations, the site is underlain by layers of medium dense to dense sand and silty sand with varying amount of gravel. River water surface elevation fluctuates and was measured at an elevation 343 ft in April 2007. Loose to medium dense saturated sand and silt have the potential for soil liquefaction under strong ground shaking. However, for the level of expected ground shaking at this site and based on liquefaction analysis, the potential for soil liquefaction is considered low.

Surface Fault Rupture Hazards

The site is not located within Alquist-Priolo Fault Rupture Hazard Zones. The potential for surface rupture hazards is considered negligible.

If you have any question please contact Mahmoud Khojasteh at (916) 227-7211.

MAHMOUD KHOJASTEH
Senior Materials and Research Engineer

REGISTERED PROFESSIONAL ENGINEER
MAHMOUD KHOJASTEH
No. C049266
Exp. 9/30/08
CIVIL
STATE OF CALIFORNIA

c: File
M. Wilson –GDS2
S. Wei –GDS2

Attachments: 2

DEPARTMENT OF TRANSPORTATION

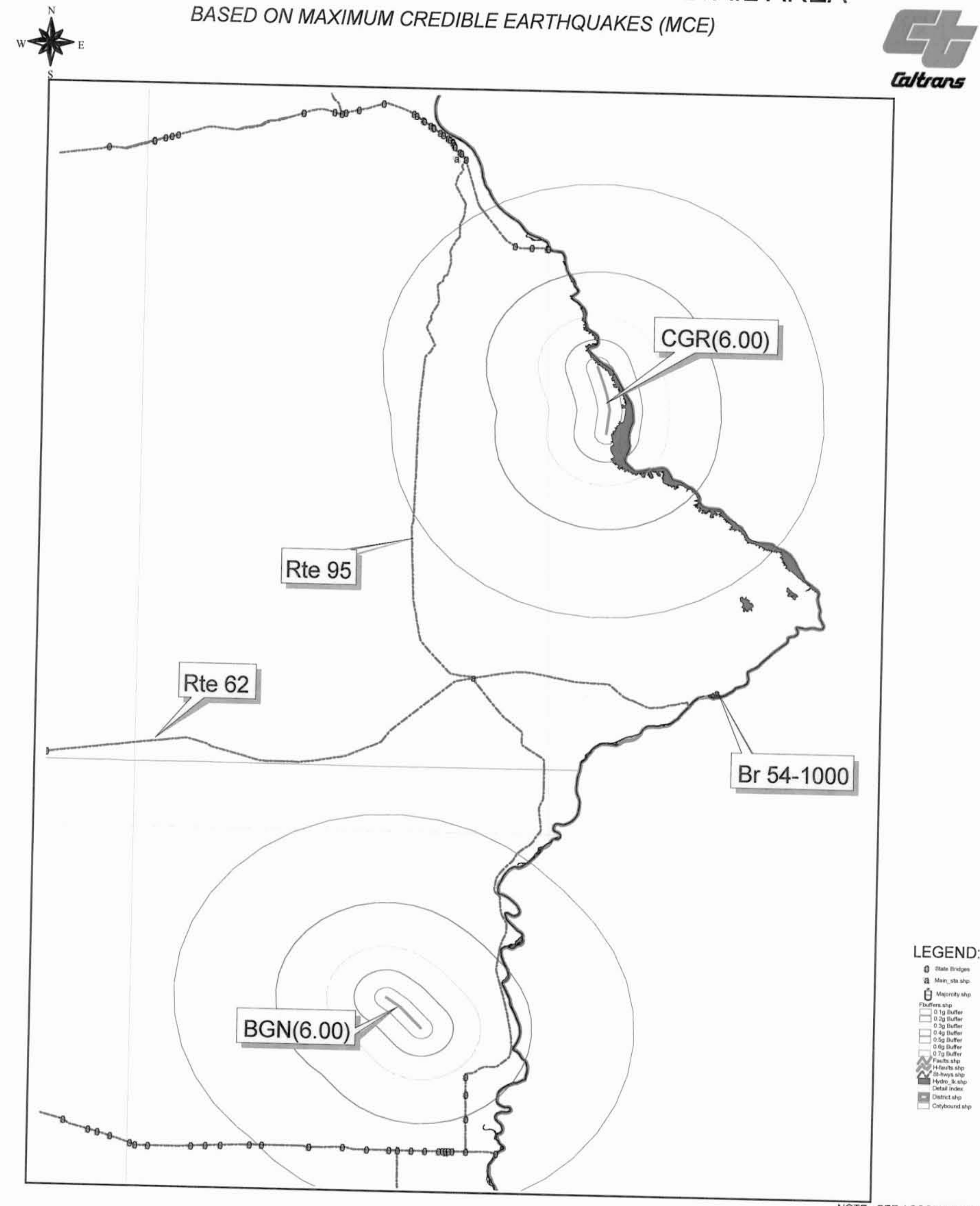
STATE OF CALIFORNIA
BUSINESS, TRANSPORTATION AND HOUSING AGENCY

ENGINEERING SERVICE CENTER

CALIFORNIA SEISMIC HAZARD MAP 1996 - DETAIL AREA

BASED ON MAXIMUM CREDIBLE EARTHQUAKES (MCE)

Caltrans

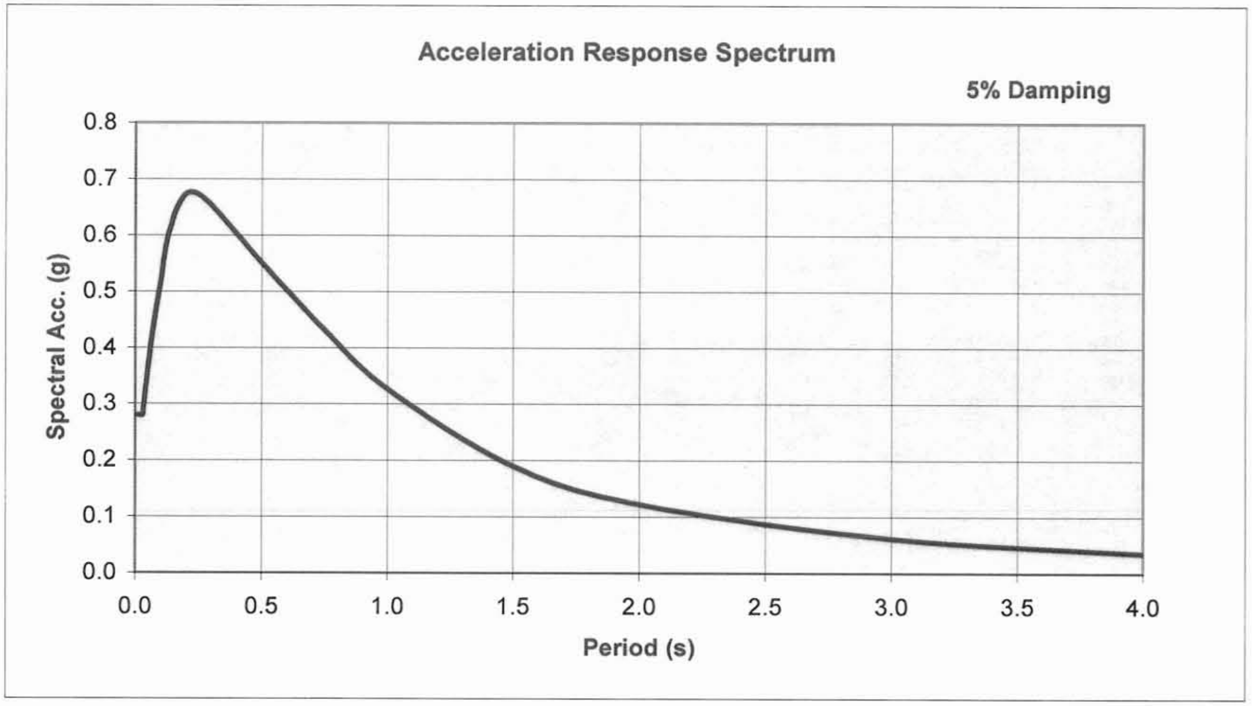


NOTE: SEE ACCOMPANYING TECHNICAL REPORT FOR NAMES OF FAULTS CORRESPONDING TO FAULT CODES

Colorado River Bridge

Bridge No. 54-1272

Period (s)	ARS (g)
0.010	0.280
0.020	0.280
0.030	0.280
0.050	0.364
0.075	0.448
0.100	0.519
0.120	0.579
0.150	0.629
0.170	0.653
0.200	0.673
0.240	0.674
0.300	0.653
0.400	0.602
0.500	0.551
0.750	0.431
1.000	0.327
1.500	0.190
2.000	0.122
3.000	0.061
4.000	0.035



Fault Chemehuevi Graben
Style Normal
Magnitude 6.0
R (km) 38
Soil Type D
SDC Fig. B-7
Note:

State of California | Business, Transportation and Housing Agency

Memorandum

To: MR. DAVID SOON
Bridge Design Branch 7
Office of Bridge Design North
Structure Design
Division of Engineering Services

Date: July 17, 2008

File: 08-378701
08-SBd-62-PM 142.3

Colorado River Bridge (Replace)
Bridge 54-1272

From: MAHMOUD KHOJASTEH
Office of Geotechnical Design South 2
Geotechnical Services - MS 5
Division of Engineering Services

Subject: **Py Curves at Bents 2, 3 and 4**

In response to your e-mail of July 3, attached please find py curves for 8' CISS pile shafts at Bents 2, 3 and 4 for the above bridge. The information from 2007 boring log field notes were used to estimate soil parameters.

If you have any question please contact Mahmoud Khojasteh at (916) 227-7211.

Attachments:

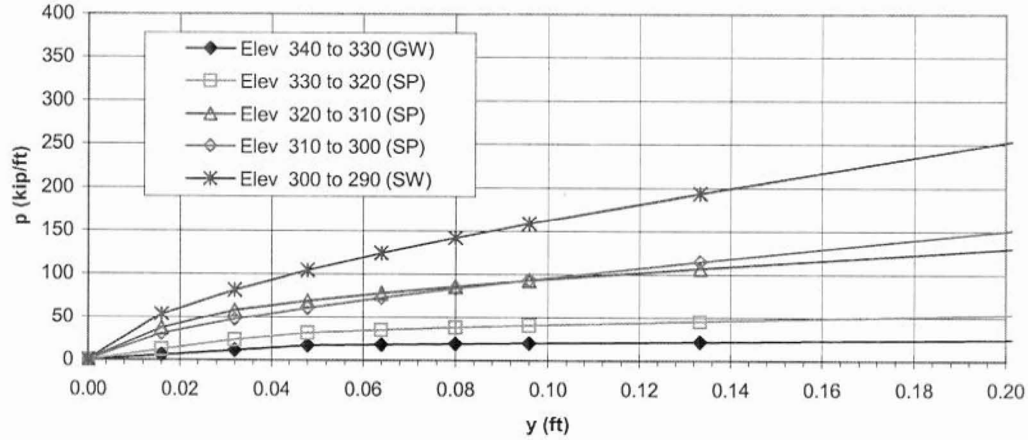
c: M. Wilson –GDS2
S. Wei –GDS2
File

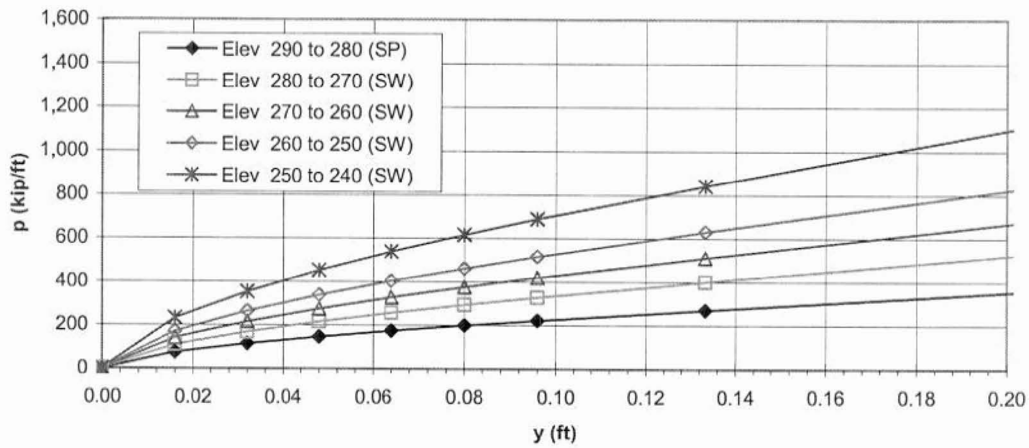
Clorado River Bridge

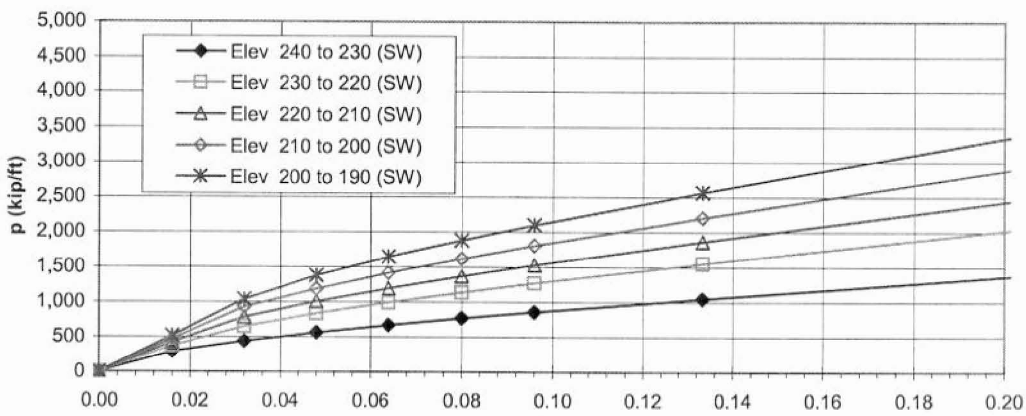
Bridge No. 54-1272

08-378701

Bent 2		**O.G.**	340.0	**Pile**	**96" CISS**
Sta.	0	**Cut-off**	340.0	**GWS**	347.0







Attachments:

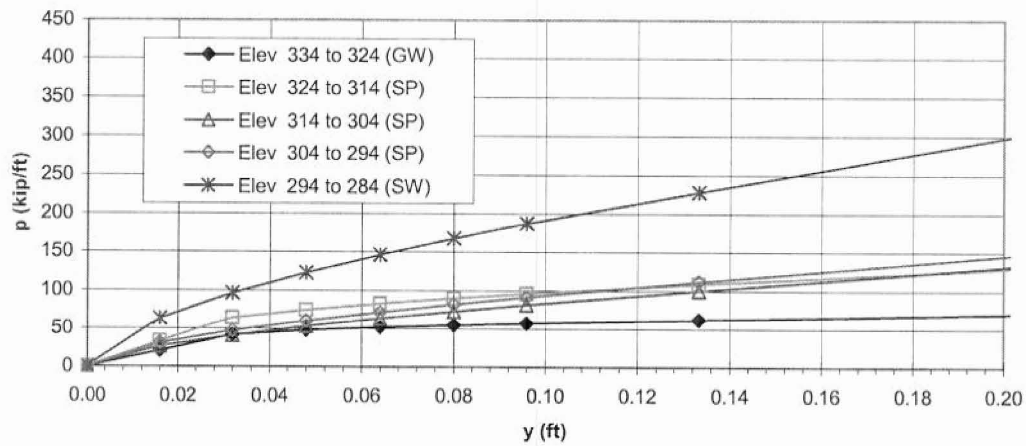
02-07 0 4/3/07

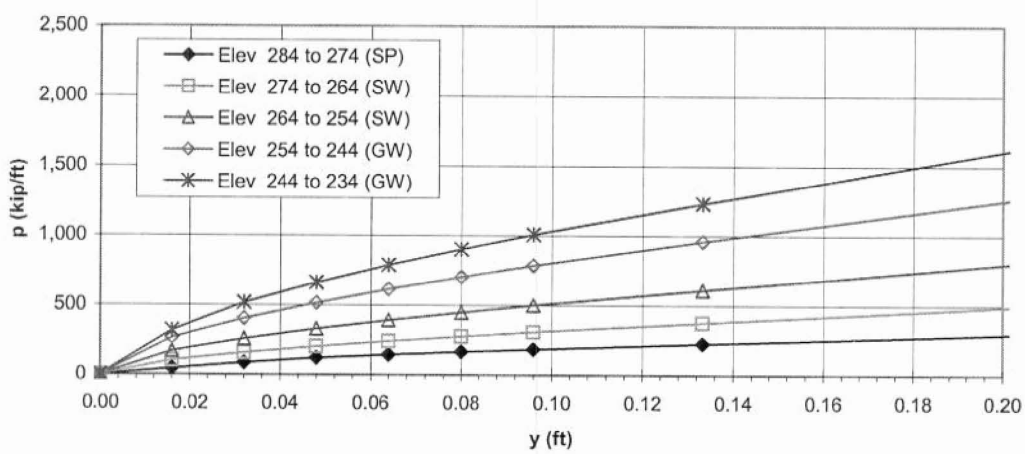
Clorado River Bridge

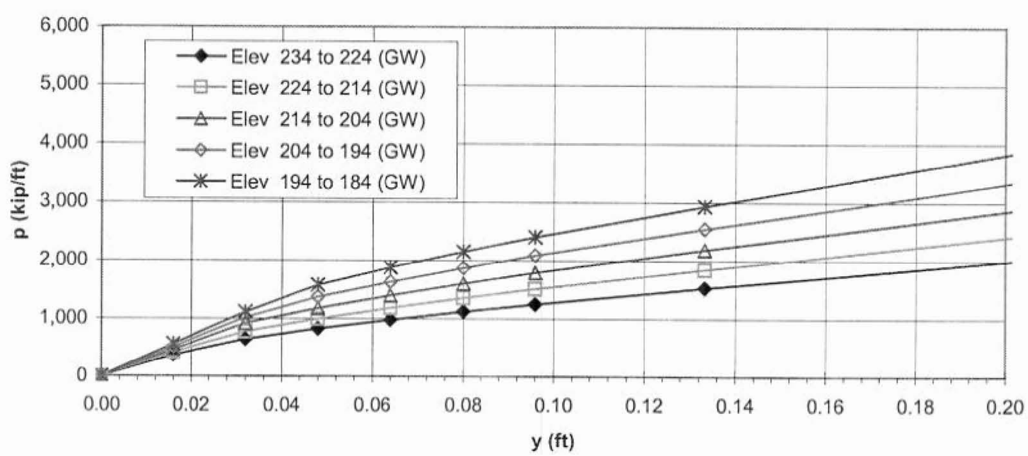
Bridge No. 54-1272

08-378701

Bent 3		**O.G.**	334.0	**Pile**	**96" CISS**
Sta.	0	**Cut-off**	340.0	**GWS**	347.0



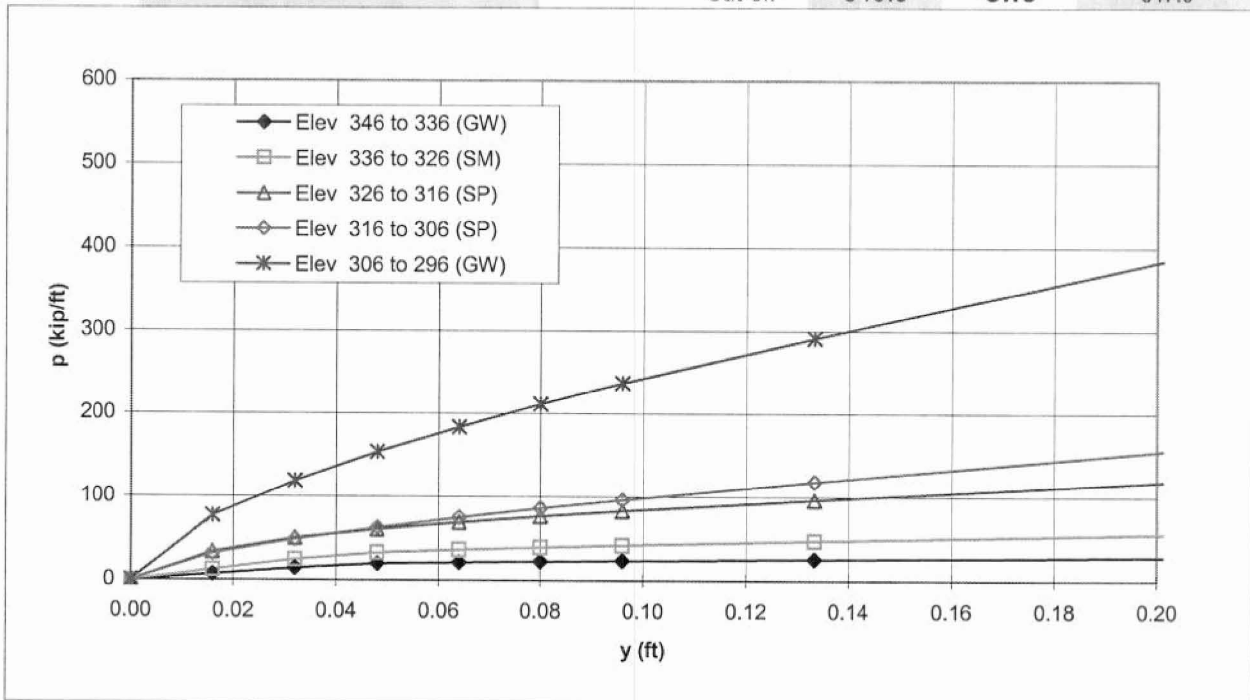


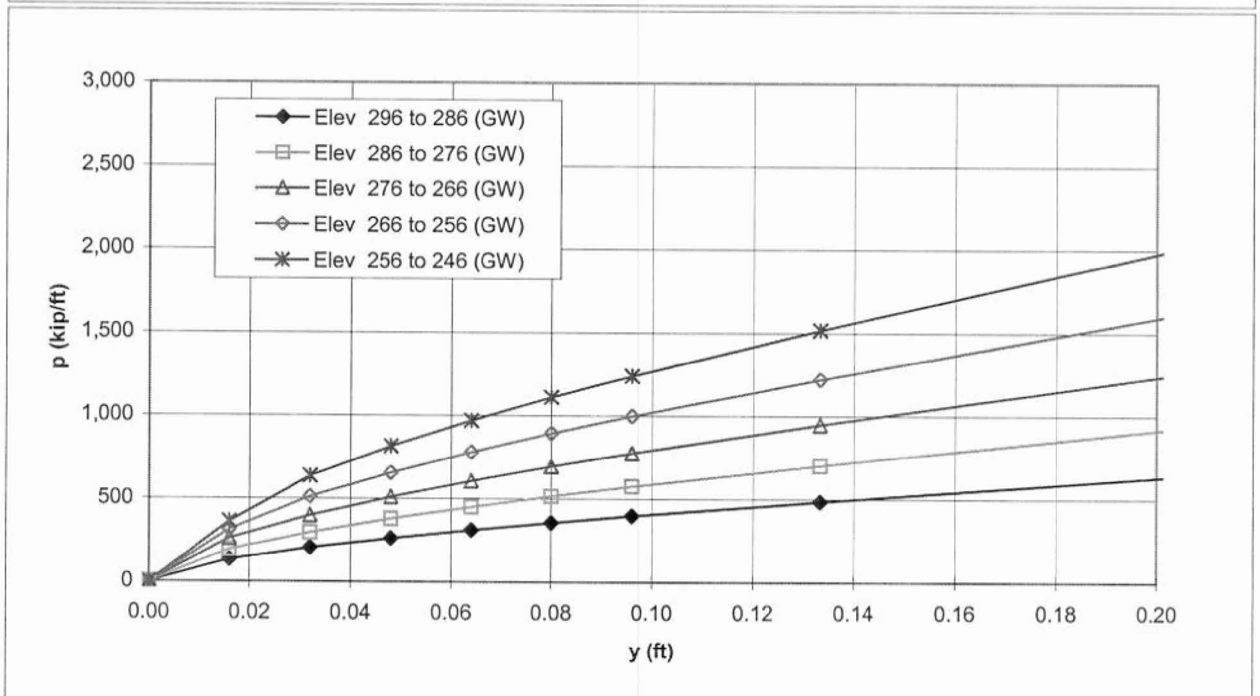


03-07 0 3/20/07

Clorado River Bridge
Bridge No. 54-1272
08-378701

Bent 4		O.G.	346.0	Pile	96" CISS
Sta.	0.0	Cut-off	340.0	GWS	347.0





04-07 3/13/07
Notes

Clorado River Bridge

Bridge No. 54-1272

08-378701

Bent 2

Sta.	0	O.G.	340.0	Pile	96" CISS
		Cut-off	340.0	GWS	347.0

y (ft)	Elev 340 to 330 (GW)	y (ft)	Elev 330 to 320 (SP)	y (ft)	Elev 320 to 310 (SP)	y (ft)	Elev 310 to 300 (SP)	y (ft)	Elev 300 to 290 (SW)
0.00	0.0	0.00	0.0	0.00	0.0	0.00	0	0.00	0
0.02	5.6	0.02	11.8	0.02	36.7	0.02	31	0.02	53
0.03	11.2	0.03	23.5	0.03	58.2	0.03	47	0.03	81
0.05	16.6	0.05	31.8	0.05	69.1	0.05	61	0.05	104
0.06	17.9	0.06	35.2	0.06	78.0	0.06	73	0.06	124
0.08	18.9	0.08	38.1	0.08	85.8	0.08	83	0.08	142
0.10	19.9	0.10	40.6	0.10	92.7	0.10	93	0.10	158
0.13	21.6	0.13	45.5	0.13	106.6	0.13	114	0.13	193
0.24	26.0	0.24	58.3	0.24	142.7	0.24	171	0.24	288
0.30	28.5	0.30	65.5	0.30	163.1	0.30	203	0.30	340
0.48	28.5	0.48	65.5	0.48	163.1	0.48	203	0.48	340
0.80	28.5	0.80	65.5	0.80	163.1	0.80	203	0.80	340

y (ft)	Elev 290 to 280 (SP)	y (ft)	Elev 280 to 270 (SW)	y (ft)	Elev 270 to 260 (SW)	y (ft)	Elev 260 to 250 (SW)	y (ft)	Elev 250 to 240 (SW)
0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
0.02	75	0.02	110	0.02	141	0.02	170	0.02	232
0.03	114	0.03	168	0.03	215	0.03	264	0.03	353
0.05	145	0.05	215	0.05	275	0.05	338	0.05	452
0.06	173	0.06	256	0.06	328	0.06	403	0.06	538
0.08	198	0.08	293	0.08	375	0.08	462	0.08	616
0.10	222	0.10	328	0.10	419	0.10	516	0.10	688
0.13	271	0.13	400	0.13	512	0.13	630	0.13	840
0.24	402	0.24	595	0.24	761	0.24	936	0.24	1,249
0.30	476	0.30	704	0.30	901	0.30	1,108	0.30	1,479
0.48	476	0.48	704	0.48	901	0.48	1,108	0.48	1,479
0.80	476	0.80	704	0.80	901	0.80	1,108	0.80	1,479

Attachn	Elev 240 to 230 (SW)	y (ft)	Elev 230 to 220 (SW)	y (ft)	Elev 220 to 210 (SW)	y (ft)	Elev 210 to 200 (SW)	y (ft)	Elev 200 to 190 (SW)
0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
0.02	288	0.02	374	0.02	422	0.02	469	0.02	516
0.03	439	0.03	650	0.03	783	0.03	925	0.03	1,033
0.05	561	0.05	832	0.05	1,002	0.05	1,184	0.05	1,377
0.06	669	0.06	991	0.06	1,193	0.06	1,410	0.06	1,640
0.08	766	0.08	1,135	0.08	1,367	0.08	1,615	0.08	1,878
0.10	856	0.10	1,268	0.10	1,527	0.10	1,804	0.10	2,099
0.13	1,045	0.13	1,548	0.13	1,864	0.13	2,203	0.13	2,563
0.24	1,553	0.24	2,301	0.24	2,771	0.24	3,274	0.24	3,809
0.30	1,839	0.30	2,725	0.30	3,281	0.30	3,877	0.30	4,510
0.48	1,839	0.48	2,725	0.48	3,281	0.48	3,877	0.48	4,510
0.80	1,839	0.80	2,725	0.80	3,281	0.80	3,877	0.80	4,510

Note: p (kip/ft) 02-07 0 4/3/07

Clorado River Bridge

Bridge No. 54-1272

08-378701

Bent 3						O.G.	334.0	Pile	96" CISS
Sta.	0					Cut-off	340.0	GWS	347.0

y (ft)	Elev 334 to 324 (GW)	y (ft)	Elev 324 to 314 (SP)	y (ft)	Elev 314 to 304 (SP)	y (ft)	Elev 304 to 294 (SP)	y (ft)	Elev 294 to 284 (SW)
0.00	0.0	0.00	0.0	0.00	0.0	0.00	0	0.00	0
0.02	20.7	0.02	33.0	0.02	26.5	0.02	31	0.02	63
0.03	41.5	0.03	63.7	0.03	40.9	0.03	47	0.03	96
0.05	48.0	0.05	74.1	0.05	52.7	0.05	60	0.05	123
0.06	51.6	0.06	82.5	0.06	63.1	0.06	71	0.06	146
0.08	54.6	0.08	89.6	0.08	72.6	0.08	82	0.08	167
0.10	57.2	0.10	95.9	0.10	81.4	0.10	91	0.10	187
0.13	62.2	0.13	108.5	0.13	100.0	0.13	112	0.13	228
0.24	75.0	0.24	140.9	0.24	150.2	0.24	166	0.24	339
0.30	82.1	0.30	159.1	0.30	178.4	0.30	196	0.30	402
0.48	82.1	0.48	159.1	0.48	178.4	0.48	196	0.48	402
0.80	82.1	0.80	159.1	0.80	178.4	0.80	196	0.80	402

y (ft)	Elev 284 to 274 (SP)	y (ft)	Elev 274 to 264 (SW)	y (ft)	Elev 264 to 254 (SW)	y (ft)	Elev 254 to 244 (GW)	y (ft)	Elev 244 to 234 (GW)
0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
0.02	43	0.02	103	0.02	168	0.02	264	0.02	317
0.03	86	0.03	158	0.03	256	0.03	403	0.03	517
0.05	120	0.05	202	0.05	328	0.05	515	0.05	661
0.06	143	0.06	241	0.06	391	0.06	614	0.06	788
0.08	164	0.08	276	0.08	447	0.08	703	0.08	902
0.10	184	0.10	308	0.10	500	0.10	785	0.10	1,008
0.13	224	0.13	376	0.13	610	0.13	959	0.13	1,231
0.24	333	0.24	559	0.24	907	0.24	1,426	0.24	1,829
0.30	395	0.30	662	0.30	1,074	0.30	1,688	0.30	2,166
0.48	395	0.48	662	0.48	1,074	0.48	1,688	0.48	2,166
0.80	395	0.80	662	0.80	1,074	0.80	1,688	0.80	2,166

y (ft)	Elev 234 to 224 (GW)	y (ft)	Elev 224 to 214 (GW)	y (ft)	Elev 214 to 204 (GW)	y (ft)	Elev 204 to 194 (GW)	y (ft)	Elev 194 to 184 (GW)
0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
0.02	364	0.02	412	0.02	460	0.02	507	0.02	555
0.03	641	0.03	775	0.03	918	0.03	1,015	0.03	1,110
0.05	820	0.05	991	0.05	1,174	0.05	1,369	0.05	1,574
0.06	977	0.06	1,181	0.06	1,399	0.06	1,630	0.06	1,875
0.08	1,119	0.08	1,352	0.08	1,602	0.08	1,867	0.08	2,148
0.10	1,250	0.10	1,511	0.10	1,790	0.10	2,086	0.10	2,399
0.13	1,526	0.13	1,845	0.13	2,185	0.13	2,547	0.13	2,930
0.24	2,269	0.24	2,742	0.24	3,248	0.24	3,786	0.24	4,355
0.30	2,686	0.30	3,247	0.30	3,846	0.30	4,483	0.30	5,157
0.48	2,686	0.48	3,247	0.48	3,846	0.48	4,483	0.48	5,157
0.80	2,686	0.80	3,247	0.80	3,846	0.80	4,483	0.80	5,157

Note: p (kip/ft)   03-07   0   3/20/07

Bent 4

Sta.	0.0			O.G.	346.0	Pile	96" CISS
				Cut-off	340.0	GWS	347.0

y (ft)	Elev 346 to 336 (GW)	y (ft)	Elev 336 to 326 (SM)	y (ft)	Elev 326 to 316 (SP)	y (ft)	Elev 316 to 306 (SP)
0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
0.016	7.1	0.016	12.4	0.016	33.6	0.016	31.6
0.032	14.2	0.032	24.7	0.032	50.3	0.032	48.7
0.048	19.6	0.048	32.8	0.048	60.5	0.048	62.6
0.064	21.1	0.064	36.4	0.064	69.0	0.064	74.9
0.080	22.4	0.080	39.5	0.080	76.3	0.080	86.0
0.096	23.4	0.096	42.2	0.096	83.0	0.096	96.4
0.133	25.5	0.133	47.5	0.133	96.4	0.133	118.2
0.240	30.7	0.240	61.2	0.240	131.5	0.240	177.0
0.300	33.6	0.300	68.9	0.300	151.2	0.300	210.0
0.480	33.6	0.480	68.9	0.480	151.2	0.480	210.0
0.800	33.6	0.800	68.9	0.800	151.2	0.800	210.0

y (ft)	Elev 306 to 296 (GW)	y (ft)	Elev 296 to 286 (GW)	y (ft)	Elev 286 to 276 (GW)	y (ft)	Elev 276 to 266 (GW)
0.000	0.0	0.000	0.0	0.000	0	0.000	0
0.016	76.8	0.016	133.7	0.016	194	0.016	261
0.032	118.7	0.032	203.8	0.032	295	0.032	398
0.048	153.2	0.048	260.8	0.048	378	0.048	510
0.064	183.6	0.064	310.6	0.064	450	0.064	607
0.080	211.3	0.080	355.8	0.080	516	0.080	696
0.096	237.0	0.096	397.5	0.096	576	0.096	777
0.133	291.4	0.133	485.3	0.133	703	0.133	949
0.240	438.0	0.240	721.4	0.240	1,045	0.240	1,410
0.300	520.5	0.300	854.2	0.300	1,238	0.300	1,670
0.480	520.5	0.480	854.2	0.480	1,238	0.480	1,670
0.800	520.5	0.800	854.2	0.800	1,238	0.800	1,670

y (ft)	Elev 266 to 256 (GW)	y (ft)	Elev 256 to 246 (GW)	y (ft)	Elev ()	y (ft)	Elev ()
0.000	0	0.000	0				
0.016	314	0.016	362				
0.032	512	0.032	636				
0.048	656	0.048	814				
0.064	781	0.064	970				
0.080	894	0.080	1,111				
0.096	999	0.096	1,241				
0.133	1,220	0.133	1,516				
0.240	1,814	0.240	2,253				
0.300	2,148	0.300	2,667				
0.480	2,148	0.480	2,667				
0.800	2,148	0.800	2,667				

Note: p (kip/ft) 04-07 3/13/07

Notes

State of California Business, Transportation and Housing Agency

Memorandum

To: MR. DAVID SOON
Office of Bridge Design North, Branch 7
Division of Engineering Services

Date: June 12, 2008
File: 08-SBd-62-PM 142.3
08-378701
Colorado River Bridge (Replace)
Bridge No. 54-1272

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
Geotechnical Services
Office of Geotechnical Design – South 2

Subject: Pile Driving Impact on Railroad Bridge.

This memo presents a brief summary and conclusions of existing literature on the effects of man made earthborn vibrations on nearby railroad bridge structures due to construction related vibrations. This is in response to an e-mail request by David Soon (May 29, 2008) to concerns that pile-driving operations at the new Colorado River Bridge may cause subsidence of railroad bridge caissons due to liquefaction and/or densification of the subsurface soils.

Brief Description of the Project

The historic Arizona & California railroad bridge built in early 1900s is about 170-feet north of the proposed new replacement bridge. The 5-span railroad bridge is supported on massive concrete caissons that are 70-feet deep and 27-feet x 44-feet in plan.

The proposed 4-span Colorado River Bridge (Bridge No. 54-1272) with two column bents is to be supported on 8-feet diameter cast-in-steel-shell (CISS) piles. The proposed CISS piles are to be driven about 130-feet from the bottom of the riverbed into the sandstone bedrock. The sandstone bedrock is increasing in elevation from west to east, deepest being at bent 2 location. The subsurface, at bent locations, primarily consists of loose to dense Silty Sand/Sand Gravel mix underlain by weakly cemented conglomerate sandstone bedrock. The maximum average water depth in the river is about 10-feet. Please refer to Attachment #1 for idealized soil profile along with approximate bridge support locations.

Vibration Damage Criteria

During pile driving operation, vibration levels near the source depend mainly on the soil's penetration resistance. In soils such as sand and silt, as is the case, the driving resistance is relatively low. As a result, a large portion of the impact energy is used to advance the pile. Hence less energy is available for generating ground vibrations. Studies have shown that the vertical components of these vibrations are the strongest and that peak particle velocity correlates best with damage and complaints.

A considerable amount of research has been done to correlate vibrations from single events such as dynamite blasts with architectural and structural damage. The U.S. Bureau of Mines (FHWA 1995) has set a "safe blasting limit" of 50 mm/s (2 in/s). Below this level there is virtually no risk of building damage. In addition, the U.S. Bureau of Mines (FHWA 1995) criteria indicates that the particle velocities should be less than 13 mm/s and 19 mm/s for older and more modern construction to prevent cracks in the walls.

Structural Damage

Since pile-driving operation is similar to dynamic compaction, literature from dynamic compaction (FHWA 1995) is adopted in order to estimate the particle velocity at the railroad bridge. Dynamic compaction is a ground improvement technique where a large mass, usually a concrete block, is crane lifted and dropped (free fall) onto the ground for soil densification thereby to improve soil density and strength. Assuming that the 8-feet diameter CISS piles are driven using a 500 kJ (rated energy) hammer, the estimated particle velocity at the rail road bridge would be about 3 mm/s. Since this estimate is much smaller than the criteria set by the U.S. Bureau of Mines for older construction, it is reasonable to conclude that the structural damage to the railroad bridge would be minimal to none.

Liquefaction

Preliminary Seismic Design Recommendations memo for the proposed bridge concluded that the liquefaction potential of the subsurface soils is considered to be low. Since the energy released into the subsurface by pile driving operation is much smaller compared to the energy released by an expected earthquake event, it is reasonable to conclude that liquefaction potential of subsurface soils at the railroad bridge would be low.

Permanent Deformation due to Soil Densification

Based on numerous observations Dowding (pp. 325) concluded that pile driving *"vibrations may cause permanent deformation, to approximately a distance of one pile length, in liquefiable soils, which are generally loose, cohesionless, clean sands and/or uniform silts that lie below the water table and are of geologically recent, fluvial orgin."* Svinkin (2006) concluded that *"Pile driving operations produce major vibration impact on adjacent buildings within distances about one pile length in sand...."* As stated in the "Liquefaction" section, the site soils are not liquefaction susceptible and the distance between the proposed new bridge and the railroad bridge (170-feet) is greater than the length of the pile (130-feet) driven into the subsurface.

Further, the ambient vibrations caused by the passing trains (Caltrans 2002) are expected to be much higher than the vibrations caused by the pile driving operation (Caltrans 1997) at the proposed bridge. Therefore, any loose soils that are present at the railroad bridge and in the nearby surroundings would have been densified long back due to the ambient vibrations caused by the passing trains. Hence it is reasonable to conclude that permanent deformation at the railroad bridge would be minimal to none.

Case Histories

A list of books, peer-reviewed journal articles and information articles containing numerous case histories of vibration monitoring due to pile driving operation is presented in the "References & Bibliography," at the end of this memo.

Preconstruction Survey
In spite of high confidence level that the proposed pile driving operation does not cause harm to the railroad bridge foundations, a preconstruction survey should be conducted before the pile driving operation to ensure the safety and serviceability of the railroad bridge. A line and grade survey should be performed to establish control and grade lines to detect movements of the piers and selected locations of the bridge deck. In addition, the railroad bridge and piers should be thoroughly inspected for existing cracks. The extent and location of the cracks should be documented with photographs as well as with a video recording.

Monitoring
Instrumentation for monitoring and recording of vibration parameters, such as peak particle velocities at the railroad bridge, should be installed before pile driving. During pile driving operation the monitored values should be compared against predetermined threshold values to ensure safety and serviceability of the railroad bridge.

Conclusion
Based on a review of the published case histories, we conclude that the railroad bridge foundations are far enough away to not be impacted by the pile driving operations at the proposed Colorado River Bridge.

Construction Notes
In order to minimize the pile driving impact to the railroad bridge, the pile driving operation should avoid the conjunction of railroad traffic periods.

Any questions regarding this memo should be directed to the attention of Mohan Bonala at (916) 227-8884 or Shawn Wei at (916) 227-5252.

Prepared by: Date: June 12, 2008

REGISTERED PROFESSIONAL ENGINEER
MOHAN V.S. BONALA
No. C63046
Exp. 06/30/2008
CIVIL
STATE OF CALIFORNIA

MOHAN BONALA, P.E. C63046
Transportation Engineer – Civil
Office of Geotechnical Design – South 2
Branch C

Attachment 1: Idealized soil profile with approximate bridge support locations.

cc: Abbas Abghari
Shawn Wei
R.E. Pending File
Project File – North
Project File – South

References & Bibliography

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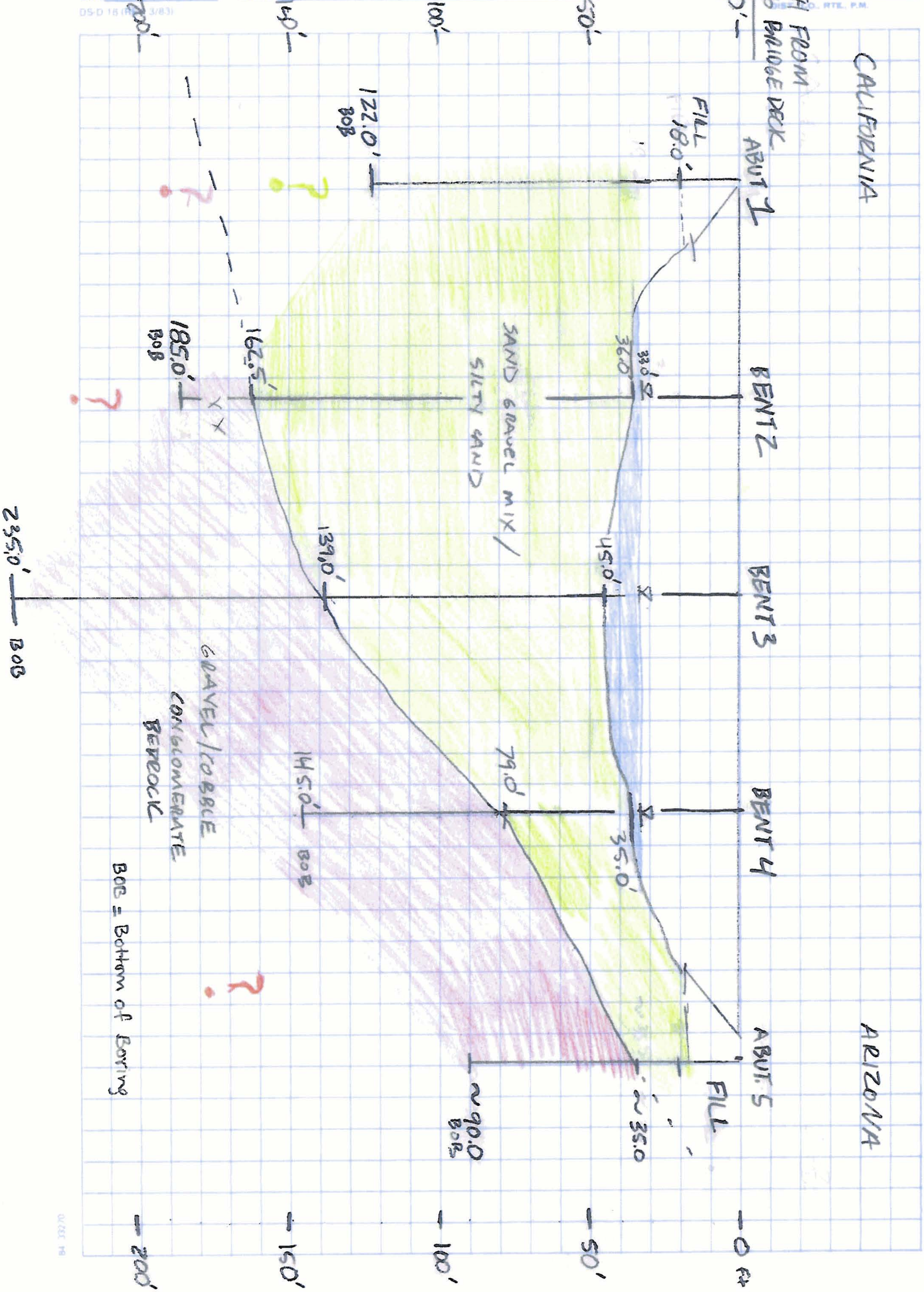
http://www.dot.state.wi.us/library/research/docs/tsrs/tsrconstructionvibration.pdf

By M. WILSON Job ATTACHMENT # 1 Sheet ___ of ___

Date 06/11/08 Subject ___

DS-D 18 (REV. 3/83) Dist. Co. Rte. P.M.



State of California | Business, Transportation and Housing Agency

Memorandum

To: MR. DAVID SOON
Bridge Design Branch 7
Office of Bridge Design North
Structure Design
Division of Engineering Services

Date: August 9, 2010

File: 08-378701
08-SBd-62-PM 142.3

Attention: Eduardo Ortega

Colorado River Bridge (Replace)
Bridge 54-1272

From: MAHMOUD KHOJASTEH M. Khojasteh
Office of Geotechnical Design South 2
Geotechnical Services - MS 5
Division of Engineering Services

REGISTERED PROFESSIONAL ENGINEER
MAHMOUD KHOJASTEH
No. C049266
Exp. 9/30/2010
CIVIL
STATE OF CALIFORNIA

Subject: **Py Curves at Bents 2, 3 and 4 for Ultimate Degradation Case**

In response to Eduardo Ortega e-mail of August 6, 2010, attached please find 3 tables covering the data of py curves for 8' CISS pile shafts at Bents 2, 3 and 4 for the ultimate degradation condition. The information from 2007 field notes of boring logs was used to estimate soil parameters. Channel Elevations after ultimate degradation were provided by Eduardo Ortega in an e-mail dated November 18, 2008. The attached information was originally provided in my e-mail of November 25, 2008.

If you have any question please contact Mahmoud Khojasteh at (916) 227-7211.

Attachments: 3

c: M. Wilson –GDS2
S. Wei –GDS2
File

Bent 2

Sta.	0.0	O.G.	294.2	Pile	96" CISS
		Cut-off	343.0	GWS	347.0

y (ft)	Elev 294.2 to 284.2 (SW)	y (ft)	Elev 284.2 to 274.2 (SP)	y (ft)	Elev 274.2 to 264.2 (SW	y (ft)	Elev 264.2 to 254.2 (SW)
0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
0.016	6.3	0.016	23.6	0.016	53.8	0.016	46.4
0.032	12.7	0.032	47.2	0.032	73.5	0.032	71.5
0.048	18.1	0.048	62.8	0.048	88.3	0.048	92.1
0.064	19.5	0.064	68.9	0.064	100.5	0.064	110.2
0.080	20.6	0.080	74.0	0.080	111.2	0.080	126.6
0.096	21.6	0.096	78.5	0.096	120.7	0.096	141.8
0.133	23.5	0.133	87.3	0.133	139.9	0.133	174.0
0.240	28.3	0.240	109.8	0.240	190.4	0.240	260.8
0.300	31.0	0.300	122.5	0.300	218.8	0.300	309.6
0.480	31.0	0.480	122.5	0.480	218.8	0.480	309.6
0.800	31.0	0.800	122.5	0.800	218.8	0.800	309.6

y (ft)	Elev 254.2 to 244.2 (SW)	y (ft)	Elev 244.2 to 234.2 (SW)	y (ft)	Elev 234.2 to 224.2 (SW	y (ft)	Elev 224.2 to 214.2 (SW)
0.000	0.0	0.000	0.0	0.000	0	0.000	0
0.016	68.4	0.016	105.8	0.016	146	0.016	241
0.032	104.3	0.032	161.2	0.032	223	0.032	368
0.048	133.4	0.048	206.2	0.048	285	0.048	470
0.064	158.9	0.064	245.7	0.064	340	0.064	560
0.080	182.0	0.080	281.4	0.080	389	0.080	642
0.096	203.4	0.096	314.3	0.096	435	0.096	717
0.133	248.3	0.133	383.8	0.133	531	0.133	876
0.240	369.1	0.240	570.5	0.240	790	0.240	1,302
0.300	437.0	0.300	675.5	0.300	935	0.300	1,541
0.480	437.0	0.480	675.5	0.480	935	0.480	1,541
0.800	437.0	0.800	675.5	0.800	935	0.800	1,541

y (ft)	Elev 214.2 to 204.2 (SW)	y (ft)	Elev 204.2 to 194.2 (SW)	y (ft)	Elev 194.2 to 184.2 (SW	y (ft)	Elev 184.2 to 174.2 (SW)
0.000	0	0.000	0	0.00	0	0.00	0
0.016	302	0.016	350	0.02	397	0.02	445
0.032	478	0.032	598	0.03	729	0.03	868
0.048	611	0.048	766	0.05	932	0.05	1,111
0.064	728	0.064	912	0.06	1,110	0.06	1,323
0.080	834	0.080	1,044	0.08	1,272	0.08	1,515
0.096	932	0.096	1,167	0.10	1,421	0.10	1,693
0.133	1,138	0.133	1,425	0.13	1,735	0.13	2,067
0.240	1,692	0.240	2,118	0.24	2,579	0.24	3,073
0.300	2,003	0.300	2,508	0.30	3,054	0.30	3,639
0.480	2,003	0.480	2,508	0.48	3,054	0.48	3,639
0.800	2,003	0.800	2,508	0.80	3,054	0.80	3,639

Note: p (kip/ft) 02-07 case: ultimate degradation and scour 4/3/07

Notes

Bent 3

Sta. 0.0 | **O.G.** 294.2 | **Pile** 96" CISS
Cut-off 340.0 | **GWS** 347.0

y (ft)	Elev 294.2 to 284.2 (SW)	y (ft)	Elev 284.2 to 274.2 (SP)	y (ft)	Elev 274.2 to 264.2 (SW	y (ft)	Elev 264.2 to 254.2 (SW)
0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
0.016	6.3	0.016	10.4	0.016	33.3	0.016	69.5
0.032	12.7	0.032	20.9	0.032	54.4	0.032	99.4
0.048	18.1	0.048	26.1	0.048	64.7	0.048	122.5
0.064	19.5	0.064	29.0	0.064	73.1	0.064	142.1
0.080	20.6	0.080	31.6	0.080	80.4	0.080	159.5
0.096	21.6	0.096	33.8	0.096	86.8	0.096	175.2
0.133	23.5	0.133	38.2	0.133	99.9	0.133	207.6
0.240	28.3	0.240	49.5	0.240	133.8	0.240	293.3
0.300	31.0	0.300	55.9	0.300	153.0	0.300	341.5
0.480	31.0	0.480	55.9	0.480	153.0	0.480	341.5
0.800	31.0	0.800	55.9	0.800	153.0	0.800	341.5

y (ft)	Elev 254.2 to 244.2 (GW)	y (ft)	Elev 244.2 to 234.2 (GW)	y (ft)	Elev 234.2 to 224.2 (GW	y (ft)	Elev 224.2 to 214.2 (GW)
0.000	0.0	0.000	0.0	0.000	0	0.000	0
0.016	96.1	0.016	150.4	0.016	213	0.016	278
0.032	148.8	0.032	229.3	0.032	325	0.032	432
0.048	192.3	0.048	293.4	0.048	416	0.048	553
0.064	230.6	0.064	349.4	0.064	495	0.064	659
0.080	265.5	0.080	400.2	0.080	567	0.080	754
0.096	297.9	0.096	447.1	0.096	634	0.096	843
0.133	366.6	0.133	546.0	0.133	774	0.133	1,029
0.240	551.8	0.240	811.5	0.240	1,151	0.240	1,530
0.300	655.9	0.300	960.9	0.300	1,362	0.300	1,812
0.480	655.9	0.480	960.9	0.480	1,362	0.480	1,812
0.800	655.9	0.800	960.9	0.800	1,362	0.800	1,812

y (ft)	Elev 214.2 to 204.2 (GW)	y (ft)	Elev 204.2 to 194.2 (GW)	y (ft)	Elev 194.2 to 184.2 (GW	y (ft)	Elev 184.2 to 174.2 (GW)
0.000	0	0.000	0	0.00	0	0.00	0
0.016	326	0.016	374	0.02	422	0.02	470
0.032	550	0.032	678	0.03	815	0.03	940
0.048	704	0.048	867	0.05	1,043	0.05	1,230
0.064	838	0.064	1,033	0.06	1,242	0.06	1,465
0.080	960	0.080	1,183	0.08	1,422	0.08	1,678
0.096	1,072	0.096	1,321	0.10	1,589	0.10	1,874
0.133	1,310	0.133	1,614	0.13	1,940	0.13	2,289
0.240	1,947	0.240	2,398	0.24	2,884	0.24	3,402
0.300	2,305	0.300	2,840	0.30	3,415	0.30	4,028
0.480	2,305	0.480	2,840	0.48	3,415	0.48	4,028
0.800	2,305	0.800	2,840	0.80	3,415	0.80	4,028

Note: p (kip/ft) 03-07 case: ultimate degradation and scour 3/20/07

Notes

Bent 4

Sta. 0.0 | **O.G.** 304.0 | **Pile** 96" CISS
Cut-off 340.0 | **GWS** 347.0

y (ft)	Elev 304 to 294 (GW)	y (ft)	Elev 294 to 284 (GW)	y (ft)	Elev 284 to 274 (GW)	y (ft)	Elev 274 to 264 (GW)
0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
0.016	6.3	0.016	48.6	0.016	89.6	0.016	97.7
0.032	12.7	0.032	97.2	0.032	163.8	0.032	151.4
0.048	18.1	0.048	123.1	0.048	193.8	0.048	195.6
0.064	19.5	0.064	134.4	0.064	218.4	0.064	234.6
0.080	20.6	0.080	143.9	0.080	239.5	0.080	270.2
0.096	21.6	0.096	152.1	0.096	258.3	0.096	303.2
0.133	23.5	0.133	168.1	0.133	296.0	0.133	373.2
0.240	28.3	0.240	209.1	0.240	394.2	0.240	561.9
0.300	31.0	0.300	232.1	0.300	449.4	0.300	668.0
0.480	31.0	0.480	232.1	0.480	449.4	0.480	668.0
0.800	31.0	0.800	232.1	0.800	449.4	0.800	668.0

y (ft)	Elev 264 to 254 (GW)	y (ft)	Elev 254 to 244 (GW)	y (ft)	Elev 244 to 234 (GW)	y (ft)	Elev 234 to 224 (GW)
0.000	0.0	0.000	0.0	0.000	0	0.000	0
0.016	153.1	0.016	217.0	0.016	278	0.016	326
0.032	233.3	0.032	330.8	0.032	439	0.032	559
0.048	298.6	0.048	423.2	0.048	562	0.048	715
0.064	355.7	0.064	504.1	0.064	670	0.064	852
0.080	407.3	0.080	577.4	0.080	767	0.080	975
0.096	455.1	0.096	645.1	0.096	857	0.096	1,090
0.133	555.7	0.133	787.7	0.133	1,047	0.133	1,331
0.240	826.0	0.240	1,170.8	0.240	1,556	0.240	1,978
0.300	978.0	0.300	1,386.3	0.300	1,842	0.300	2,342
0.480	978.0	0.480	1,386.3	0.480	1,842	0.480	2,342
0.800	978.0	0.800	1,386.3	0.800	1,842	0.800	2,342

y (ft)	Elev 224 to 214 (GW)	y (ft)	Elev 214 to 204 (GW)	y (ft)	Elev 204 to 194 (GW)	y (ft)	Elev 194 to 184 (GW)
0.000	0	0.000	0	0.00	0	0.00	0
0.016	375	0.016	423	0.02	471	0.02	519
0.032	688	0.032	826	0.03	942	0.03	1,038
0.048	880	0.048	1,058	0.05	1,247	0.05	1,447
0.064	1,048	0.064	1,260	0.06	1,485	0.06	1,724
0.080	1,201	0.080	1,443	0.08	1,701	0.08	1,974
0.096	1,341	0.096	1,612	0.10	1,900	0.10	2,205
0.133	1,638	0.133	1,968	0.13	2,320	0.13	2,693
0.240	2,435	0.240	2,926	0.24	3,449	0.24	4,003
0.300	2,883	0.300	3,464	0.30	4,083	0.30	4,740
0.480	2,883	0.480	3,464	0.48	4,083	0.48	4,740
0.800	2,883	0.800	3,464	0.80	4,083	0.80	4,740

Note: p (kip/ft) 04-07 case: ultimate degradation and scour 3/13/07
Notes