Preserving America's Heritage

July 10, 2019

Ms. Lynne Urquhart
Environmental Engineer
FHWA-Alabama Division
9500 Wynlake Place
Montgomery, AL 36117

Ref: *I-10 Mobile River Bridge and Bayway Project*
*Mobile and Baldwin Counties, Alabama*
*ACHPConnect Log Number: 005065*

Dear Ms. Urquhart:

Enclosed is your copy of the fully executed Section 106 agreement (Agreement) for the referenced undertaking. By carrying out the terms of the Agreement, Federal Highway Administration will fulfill its responsibilities under Section 106 of the National Historic Preservation Act (NHPA) and the regulations of the Advisory Council on Historic Preservation, "Protection of Historic Properties" (36 CFR Part 800). Please ensure that all consulting parties are provided a copy of the executed Agreement in accordance with 36 CFR 800.6(c)(9). The original Agreement will remain on file at our office.

If we may be of further assistance as the Agreement is implemented, please contact Ms. Mandy Ranslow at (202) 517-0218 or by e-mail at mranslow@achp.gov and reference the ACHPConnect Log Number above.

Sincerely,

Jaime Loichinger
Assistant Director
Federal Permitting, Licensing, and Assistance Section
Office of Federal Agency Programs

Enclosure

ADVISORY COUNCIL ON HISTORIC PRESERVATION
401 F Street NW, Suite 308 • Washington, DC 20001-2637
Phone: 202-517-0200 • Fax: 202-517-6381 • achp@achp.gov • www.achp.gov

MEMORANDUM OF AGREEMENT
AMONG THE FEDERAL HIGHWAY ADMINISTRATION
THE ALABAMA STATE HISTORIC PRESERVATION OFFICE
THE ALABAMA DEPARTMENT OF TRANSPORTATION
AND THE ADVISORY COUNCIL ON HISTORIC PRESERVATION
REGARDING THE
I-10 MOBILE RIVER BRIDGE AND BAYWAY
MOBILE AND BALDWIN COUNTIES, ALABAMA
FEDERAL-AID PROJECT DPI-0030 (005)

WHEREAS the Alabama Department of Transportation (ALDOT) has requested funding for Project DPI-0030(005) (undertaking) in Mobile and Baldwin Counties with Federal-Aid funds from the Federal Highway Administration (FHWA) pursuant to 23 USC 101 et seq. Federal-Aid Highways; and

WHEREAS, the undertaking, consists of constructing a new 6-lane bridge on I-10 across the Mobile River and replacing the existing I-10 bridges across Mobile Bay with 8 lanes of new bridges in Mobile and Baldwin Counties; and

WHEREAS, FHWA and ALDOT, in consultation with the Alabama State Historic Preservation Officer (SHPO) and Consulting Parties, have defined the undertaking's Area of Potential Effect (APE) as an area range starting at the I-10 and Broad Street Interchange, moving northward to Virginia Street then west to Ann Street, north to Springhill Avenue, east to Beauregard Street and then crossing the Federal Mobile Harbor Navigation Channel approximately 500' north of US-90 and approximately 500' south of I-10 to the Eastern Shore. An addition to the APE includes a 1,000' corridor to the north centered on US-90 then Bay Bridge Road past I-165 to Velma St. in Prichard. *(See Attachment #1)*; and

WHEREAS, FHWA and ALDOT have determined that the undertaking may have an adverse visual effect on the Church Street East Historic District and the Lower Dauphin Street Historic District *(See Attachment #1 )*, which are listed in the National Register of Historic Places; FHWA and ALDOT have also determined that the undertaking may have an adverse effect on archaeological sites *(See Attachment #2)*; FHWA and ALDOT have consulted with the SHPO pursuant to 36 CFR 800, the regulations implementing Section 106 of the *National Historic Preservation Act* (54 USC 306108) and

WHEREAS, FHWA and ALDOT have documented that consultation in the *Draft Environmental Impact Statement (DEIS) signed July 22, 2014* and the *Supplemental DEIS signed on March 26, 2019;* and

WHEREAS, FHWA and ALDOT have consulted with the Section 106 Consulting Parties and Federally-recognized tribes with historical ties to Alabama listed in *Attachment #3* regarding the effects of the undertaking on historic properties; and

WHEREAS, in accordance with 36 CFR 800.6(a)(1), FHWA has notified the Advisory Council on Historic Preservation (ACHP) of its adverse effect determination with specified documentation, and the ACHP has chosen *to* participate in the consultation pursuant to 36CFR 800.6(a)(1)(iii); and

WHEREAS, the ALDOT is an invited signatory to this Memorandum of Agreement; and

WHEREAS, the public and Consulting Parties have been afforded the opportunity to consult and comment on the Project;

NOW, THEREFORE, FHWA, the SHPO, the ALDOT and the ACHP agree that the undertaking shall be implemented in accordance with the following stipulations in order to take into account the effect of the undertaking on historic properties.

## I. STIPULATIONS

FHWA and ALDOT shall ensure that the following measures are carried out:

**A. Lighting:** Lighting associated with the bridge approaches, bridges, ramps, roadway widening, and other components of the project shall be designed to meet current design criteria, while minimizing light pollution. In order to incorporate the newest technology available at the time of construction, lighting fixtures will not be specified until later in the design process. Measures to minimize light pollution on residential areas along I-10 shall be incorporated into the project through the use of light shielding technology, fixtures, and other means as appropriate. Measures to minimize light pollution on historic resources will be developed with input from the SHPO and Section 106 Consulting Parties through the Aesthetic Steering Committee. ALDOT will consult with FHWA, the Aesthetic Steering Committee, and the selected design team during the design phase to ensure compliance with the Section 106 Memorandum of Agreement. *Attachment #7* describes the Aesthetic Steering Committee in more detail.
To prevent or minimize collision and nesting by migratory fowl, the maximum allowable duration for strobe (beacon) lighting on the bridge tower(s) will be requested in Federal Aviation Administration (FAA) permit application(s) for the project. These lighting requirements will be coordinated with the U.S. Coast Guard (USCG) for compliance with navigational lighting requirements and the FAA for air traffic requirements as part of the permitting process.

**B. Bridge Aesthetics:** Opportunities to incorporate bridge aesthetics and contextual design of the proposed project will be developed as the design progresses with input from the SHPO and Section 106 Consulting Parties through the Aesthetic Steering Committee. ALDOT will consult with FHWA, the Aesthetic Steering Committee, and the selected design team during the design phase to ensure compliance with the Section 106 Memorandum of Agreement.

**C. Visual:** Aesthetic and landscape plans for areas within ALDOT's right-of-way, including areas beneath the bridge, will be developed and implemented. ALDOT will consult with FHWA, the Aesthetic Steering Committee, and the selected design team during the design phase to ensure compliance with the Section 106 Memorandum of Agreement.
ALDOT understands the importance of maintaining and improving the tree canopy within downtown Mobile in areas that are outside of ALDOT's right-of-way. To achieve this, ALDOT has partnered with the City of Mobile in the *Right Tree, Right Place* program. This program places appropriate trees and landscaping throughout the City of Mobile. ALDOT has committed to contribute $50,000 to the *Right Tree, Right Place* program to help maintain and improve the tree canopy in downtown Mobile. The City of Mobile will be responsible for administering this money. The *Right Tree, Right Place* Committee will make sure that trees and landscaping are implemented within the City's right-of-way that are compatible with the setting and comply with municipal regulations.

**D. Archaeology:** Phase I archaeological surveys and limited Phase II testing have been conducted. Due to widespread disturbed historic overburden present in many areas, a program of integrated Phase I and Phase II (Phase I/II) evaluation has been employed. This approach utilizes specialized heavy machinery to remove disturbed overburden to expose, record, and sample undisturbed cultural features and zones in areas where standard Phase I techniques are inadequate. The SHPO and the tribes have been consulted on this approach. The SHPO gave their approval, and the tribes expressed no ***concerns***.

The project's APE has been divided into survey blocks to organize and record fieldwork results. There are 17 Survey Blocks plus 5 other named areas being investigated for this project. Each Survey Block contains smaller parcels delineated by ownership tracts, ranging from 1 to 9 tracts per Survey Block. There are 61 tracts associated with the project. Some of the tracts are not yet accessible for archaeological investigation, but fieldwork will proceed when the properties become available. Survey Blocks are shown in *Attachment #2*.

No ground-disturbing activities will be allowed on any parcels containing identified or potential archaeological sites until Phase I, Phase II, and/or Phase III investigations are complete and the results have been coordinated with the SHPO and tribes.

Impacts from the undertaking will be documented as the design progresses and as additional access to the potentially affected parcels is obtained.

Efforts will be made to avoid and/or minimize impacts on archaeological sites listed on, eligible for, or potentially eligible for listing on the NRHP. For sites where impacts cannot be avoided, mitigation will be performed in the form of Phase III Data Recovery or other approved alternative mitigation plans, as coordinated with the SHPO and tribes. Where required, Phase III Data Recovery investigations will be performed at affected parcels once specific impact locations are known and prior to commencement of ground-disturbing activities.

*Attachment #4 Post-Review Discovery Plan* outlines procedures that shall be followed in the event intact archaeological deposits are uncovered during the course of the undertaking.

*Attachment #5* and *Attachment #6* contain *The Alabama Burial Act* and *The Advisory Council on Historic Preservation's Policy Statement Regarding Treatment of Burial Sites, Human Remains, and Funerary Objects*, respectively.

**E. Historic Battleship Park:** ALDOT and FHWA met with the Battleship USS ALABAMA Memorial Park Commission on April 21, 2017 to discuss the Commission's concerns about access to the Park and potential impacts that could occur as result of this project. ALDOT evaluated several options to provide more direct access to the Park. Concepts providing direct access to the Park via a new ramp or relocating the Park's entrance could not meet design criteria for safe roadway conditions; therefore, they were not advanced for further construction. Existing access to the Battleship USS ALABAMA Memorial Park would not be altered in the final condition of this project.

In order to improve signage directing travelers to the Park, ALDOT has developed a preliminary signage plan for the USS ALABAMA Battleship Memorial Park including proposed locations and types of signs. The plan was developed with input from the SHPO and the USS ALABAMA Battleship Memorial Park Commission. New signs are proposed to supplement the existing signs along the I-10 corridor. The signs will direct travelers from I-10 to the Park. ALDOT met with the USS ALABAMA Battleship Memorial Park Commission on August 10, 2018, to give them an update on the project and the latest signage plan. ALDOT will meet with the USS ALABAMA Battleship Memorial Park Commission to finalize the signage plan prior to approving the final signage plan before construction begins.

Access to the USS ALABAMA Battleship Memorial Park will be maintained before, during, and after construction.

**F. Vibrations:** ALDOT conducted a study to evaluate potential vibration impacts for pile driving and to help identify construction methodologies that would avoid vibration impacts to properties in proximity of the project (*Attachment #8*). Based on the study, ALDOT has committed to:

1. Limit vibration to a maximum level of 0.5 inch per second for modern structures and 0.1 inch per second for historic structures at the location of the structure.
2. Survey and monitor for potential vibration damage for all modern structures within 150 feet of vibration-causing construction operations and all historic structures within 250 feet of vibration-causing construction operations. In addition, due to concerns raised by the Section 106 Consulting Parties, vibrations will also be monitored at Christ Church Cathedral, Old City Hall (History Museum of Mobile), Condé-Charlotte Museum House, Phoenix Fire Museum, Austal, the Wallace Tunnel, and the Bankhead Tunnel. These structures are well beyond the distance where vibration levels of 0.5 and 0.1 inch per second were projected to occur based on the vibration study and, therefore, represent conservative survey distances to ensure adjacent structures are not damaged.
3. Require the Concessionaire to obtain the services of a competent vibration or seismologist consultant to conduct vibration surveys and monitor and record ground vibrations during the entire demolition and construction phase operations. If at any time the maximum vibration level is exceeded, the Concessionaire will be required to make appropriate changes to reduce vibration to acceptable levels prior to continuing operations.
4. Prior to acceptance of the project, the Concessionaire will be required to submit a vibration report covering the life of the project. Photographic, video and other surveys of surrounding structures and utilities (pre-construction and post-construction) will be made as part of the documentation record.
5. Any damage to historic structures due to vibrations resulting from construction activities will be repaired/restored in accordance with ALDOT Specification 107.12, 107.14 and 107.15 *Protection and Restoration of Property, Landscape and Utility Facilities*, 36CFR 800.12 *Emergency Situations* and 36 CFR 68 *The Secretary of Interior's Standards for the Treatment of Historic Properties.*

**G. Public Involvement:** Public Hearings were held on May 7 and May 9, 2019. The public, local agencies, and Section 106 Consulting Parties were given the opportunity to provide input regarding available design information as part of the public involvement process. The Section 106 Consulting Parties will be notified in writing (via letter and/or e-mail) of all future public involvement activities.

## II. DURATION

This MOA will expire if its terms are not carried out within 10 years from the date of its execution. Prior to such time, FHWA and ALDOT may consult with the other signatories to reconsider the terms of the MOA and amend it in accordance with Stipulation VI below.

## III. POST-REVIEW DISCOVERIES

If properties are discovered that may be historically significant or unanticipated effects on historic properties found, the FHWA shall implement the discovery plan included as *Attachment #4*, Post Review Discoveries Plan of this MOA.

## IV. MONITORING AND REPORTING

Each year following the execution of this MOA until it expires or is terminated, ALDOT shall provide all parties to this MOA and the ACHP, a summary report detailing work undertaken pursuant to its terms. Such report shall include any scheduling changes proposed, any problems encountered, and any disputes and objections received in FHWA's efforts to carry out the terms of this MOA.

## V. DISPUTE RESOLUTION

Should any signatory to this MOA object at any time to any actions proposed or the manner in which the terms of this MOA are implemented, FHWA shall consult with such party to resolve the objection. If FHWA determines that such objection cannot be resolved, FHWA will:

**A.** Forward all documentation relevant to the dispute, including the FHWA's proposed resolution, to the ACHP. The ACHP shall provide FHWA with comments on the resolution of the objection within thirty (30) days of receiving adequate documentation. Prior to reaching a final decision on the dispute, FHWA shall prepare a written response that takes into account any timely advice or comments, regarding the dispute from the ACHP, signatories and provide them with a copy of this written response. FHWA will then proceed according to its final decision.

**B.** If the ACHP does not provide its advice regarding the dispute within the thirty (30) day time period, FHWA may make a final decision on the dispute and proceed accordingly. Prior to reaching such a final decision, FHWA shall prepare a written response that takes into account any timely comments regarding the dispute from the signatories to the MOA, and provide them and the ACHP with a copy of such written response.

**C.** FHWA's responsibility to carry out all other actions subject to the terms of this MOA that are not the subject of the dispute remain unchanged.

## VI. AMENDMENTS

This MOA may be amended when such an amendment is agreed to in writing by all signatories. The amendment will be effective on the date a copy signed by all of the signatories is filed with the ACHP.

## VII. TERMINATION

If any signatory or concurring party to this MOA determines that its terms will not or cannot be carried out, that party shall immediately consult with the other signatories to attempt to develop an amendment per Stipulation VI, above. If within thirty (30) days an amendment cannot be reached, any signatory may terminate the MOA upon written notification to the other signatories.

Once the MOA is terminated, and prior to work continuing on the undertaking, FHWA must either (a) execute an MOA pursuant to 36CFR 800.6 or (b) request, take into account, and respond to the comments of the ACHP under 36CFR 800.7. FHWA shall notify the signatories as to the course of action it will pursue.

Execution of this MOA by the FHWA and SHPO and the ACHP, and implementation of its terms evidence that FHWA has taken into account the effects of this undertaking on historic properties.

**SIGNATORIES:**

FEDERAL HIGHWAY ADMINISTRATION

By: Mark D. Bartlett 6/27/19
Mark Bartlett, Division Administrator Date

ADVISORY COUNCIL ON HISTORIC PRESERVATION

By: for 7-11-2019
for John M. Fowler, Executive Director Date

ALABAMA STATE HISTORIC PRESERVATION OFFICE

By: Lee Anne Wofford June 27, 2019
Lee Anne Wofford, Deputy SHPO Date

**INVITED SIGNATORY:**

ALABAMA DEPARTMENT OF TRANSPORTATION

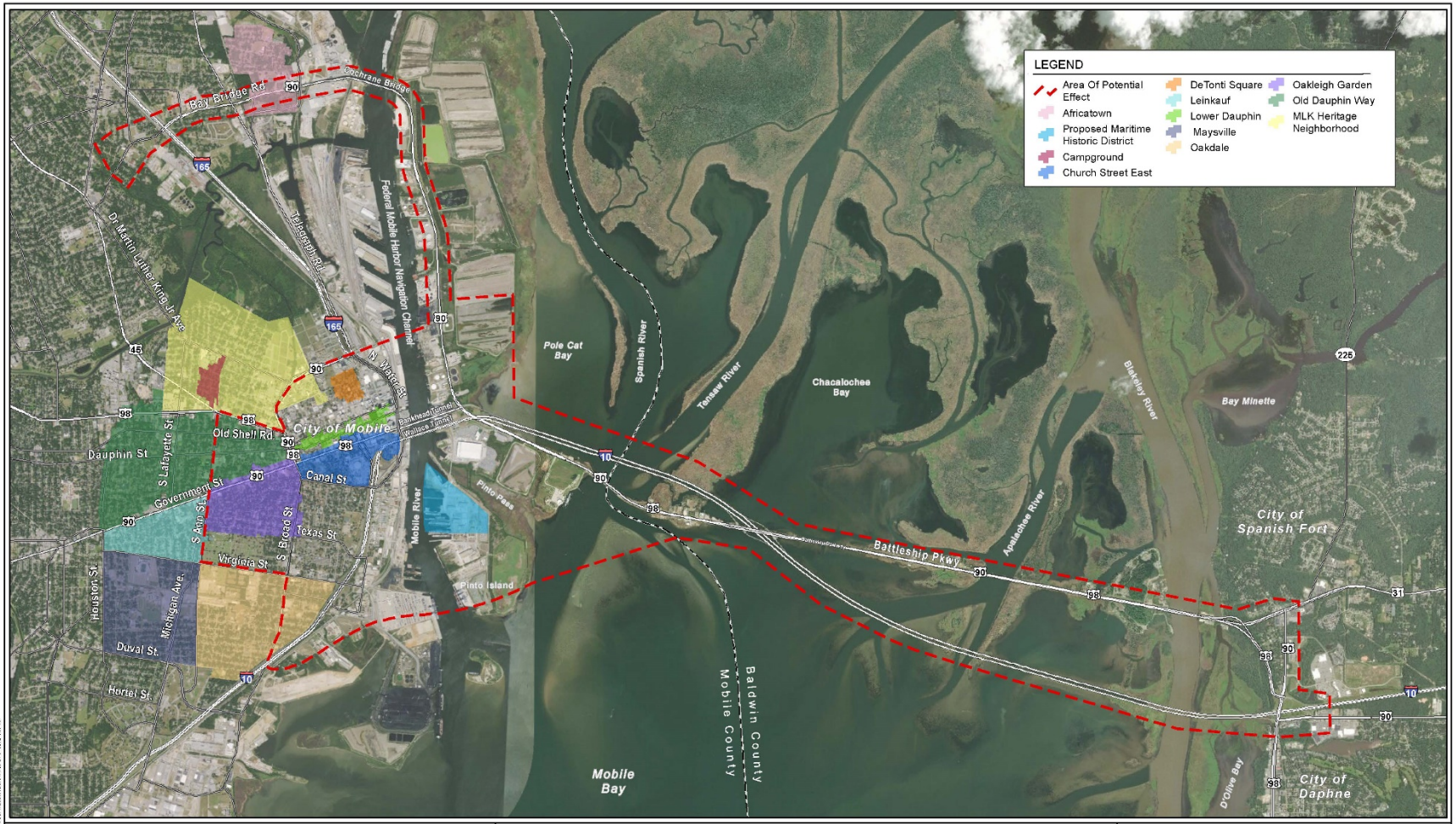
By: John R. Cooper DTH 6-27-19
John R. Cooper, Transportation Director Date

## ***Attachment #1. Area of Potential Effect (APE)***

The Area of Potential Effect (APE), for the I-10 Mobile River Bridge project was established in consultation with the State Historic Preservation Officer (SHPO) and other Section 106 Consulting Parties *(see Attachment #3)*.

The FHWA has defined the undertaking's APE as a range starting at I-10 and Broad Street in the Oakdale Historic District, moving northward to Virginia Street then west to Ann Street. The Ann Street border goes north to Springhill Avenue then east to Beauregard Street. The APE follows Beauregard Street and then crosses the Federal Mobile Harbor Navigation Channel approximately 500' north of US-90 and approximately 500' south of I-10 to the Eastern Shore. An addition to the APE includes a 1,000' corridor to the north, centered on US-90 then Bay Bridge Road past I-165 to Velma Street in Prichard.

*National Register* listed Historic Districts included in the APE are: The Church Street East Historic District, the Oakleigh Garden Historic District, Lower Dauphin Historic District, DeTonti Square Historic District, Oakdale Historic District, Maysville Historic District, and the Africatown Historic District.




ALABAMA DEPARTMENT OF TRANSPORTATION
I-10 MOBILE RIVER BRIDGE
AND BAYWAY PROJECT
PROJECT No. DPI-0030 (005)
MOBILE AND BALDWIN COUNTIES, ALABAMA

DEPARTMENT OF TRANSPORTATION

thompson

MOTT MACDONALD

HDR

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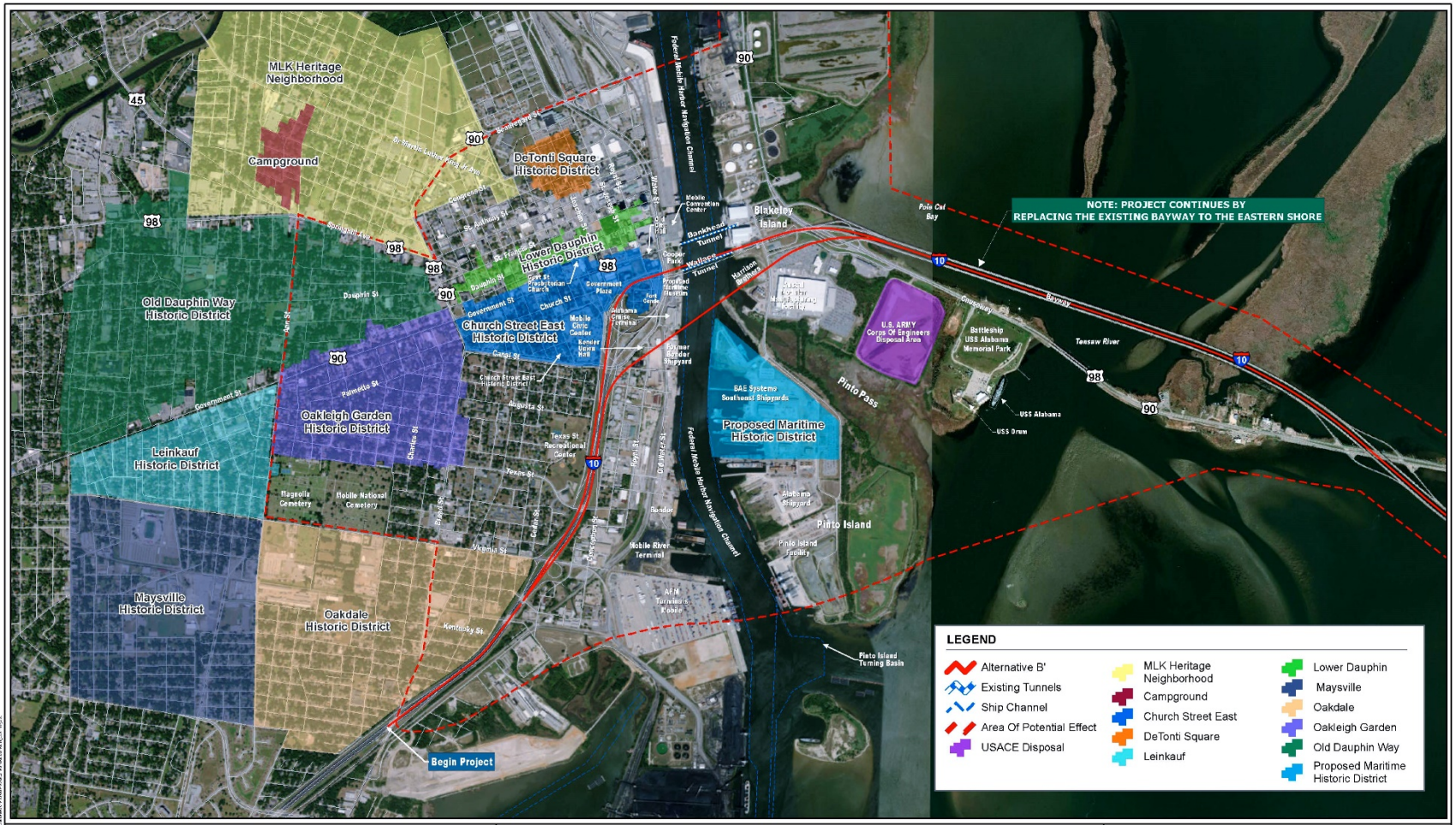
# HISTORIC DISTRICTS AND AREA OF POTENTIAL EFFECT

PROJECT NO.: 15-1101-0300

DATE: DECEMBER 2018




ALABAMA DEPARTMENT OF TRANSPORTATION
I-10 MOBILE RIVER BRIDGE
AND BAYWAY PROJECT
PROJECT No. DPI-0030 (005)
MOBILE AND BALDWIN COUNTIES, ALABAMA

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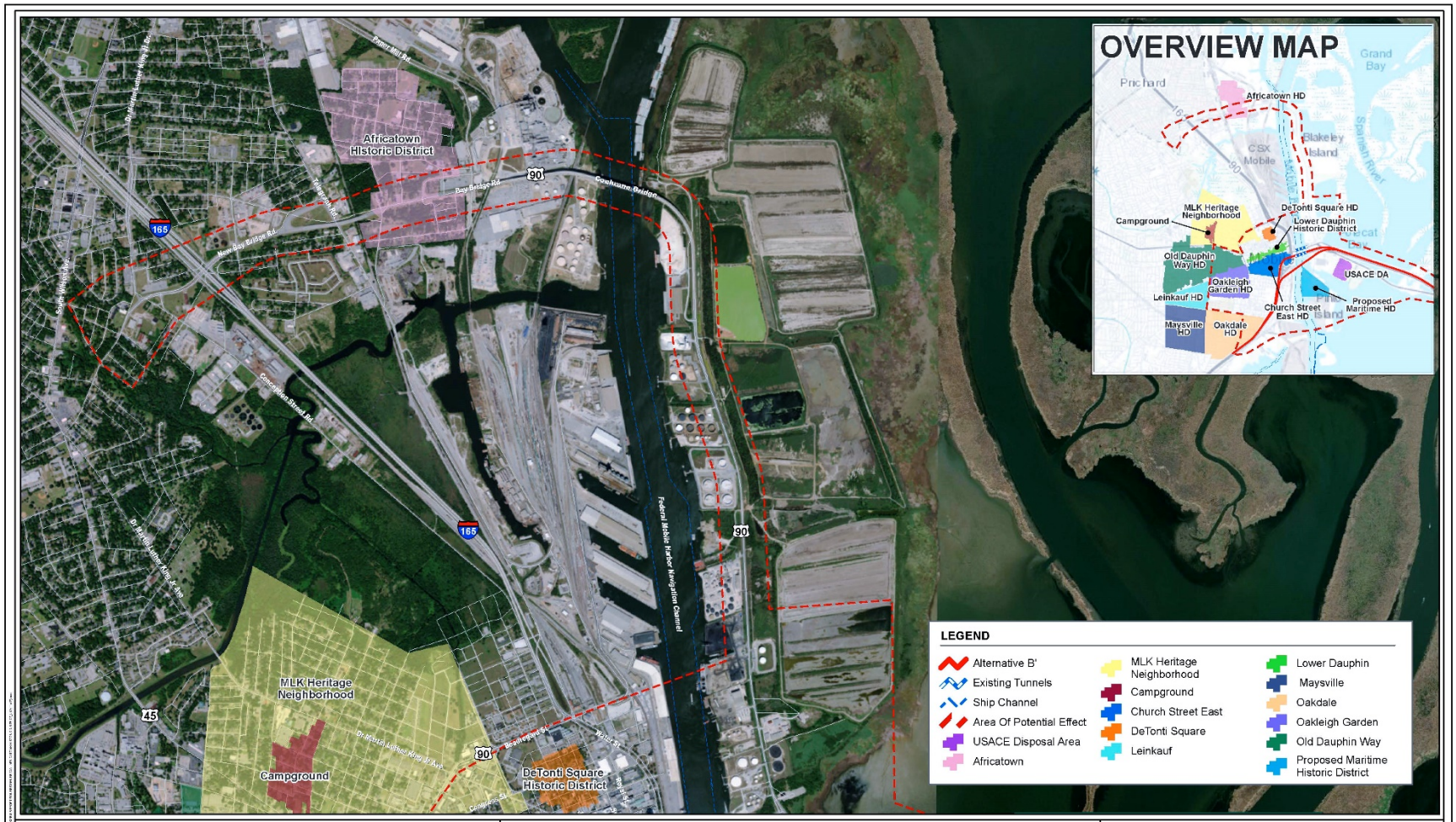
# HISTORIC DISTRICTS AND AREA OF POTENTIAL EFFECT

| PROJECT NO.: | DATE: |
|---|---|
| 15-1101-0300 | DECEMBER 2018 |




ALABAMA DEPARTMENT OF TRANSPORTATION
I-10 MOBILE RIVER BRIDGE
AND BAYWAY PROJECT
PROJECT No. DPI-0030 (005)
MOBILE AND BALDWIN COUNTIES, ALABAMA

1,000 0 1,000 Feet

0 0.5 1 Miles

# HISTORIC DISTRICTS AND AREA OF POTENTIAL EFFECT

| PROJECT NO.: | DATE: |
|---|---|
| 15-1101-0300 | DECEMBER 2018 |

***Attachment #2. Archaeological Investigation Maps {REDACTED}***

***Attachment #3. Section 106 Consulting Parties and Tribal Contact Information***

***Section 106 Consulting Party Contact Information***

Mr. John Sledge
Mobile Historic Development Commission
PO Box 1827
Mobile, AL 36633-1827

Ms. Elizabeth Merritt
National Trust for Historic Preservation
2600 Virginia Ave NW
Suite 1100
Washington, DC 20037

Mr. John Hildreth
National Trust for Historic Preservation
William Aiken House
456 King St - 3rd Floor
Charleston, SC 29403

Ms. Lee Anne Wofford
Alabama Historical Commission
468 S Perry St
Montgomery, AL 36130

The Honorable Sandy Stimpson
Mayor of Mobile
PO Box 1827
Mobile, AL 36633-1827

Commissioner Connie Hudson
President
Mobile County Commission
205 Government St
Mobile, AL 36644-1001

The Honorable Dane Haygood
Mayor of Daphne
PO Box 400
Daphne, AL 36526

The Honorable Michael McMillan
Mayor of Spanish Fort
PO Box 7226
Spanish Fort, AL 36527

Commissioner Chris Elliot
Baldwin County Commission
1100 Fairhope Ave
Fairhope, AL 36532

Ms. Mary Cousar
6 St Joseph St
Mobile, AL 36602

Ms. Elizabeth Stevens
Downtown Mobile Alliance
PO Box 112
Mobile, AL 36601

Ms. Elizabeth Harris
The Conde-Charlotte Museum House
104 Theatre St
Mobile, AL 36602

Mr. Ray Harris
Signal Shipyard/Bender Shipbuilding & Repair Co
601 S Royal St
Mobile, AL 36602

Mr. Douglas Burtu Kearley
Friends of the Museum
10 Wisteria Ave
Mobile, AL 36607

Mr. Herndon Inge
PO Box 40188
Mobile, AL 36640

Ms. Ann Bedsole
6 St Joseph St
Mobile, AL 36602

Ms. Carolyn Jeffers
Christ Church Cathedral
115 S Conception St
Mobile, AL 36602

Historic Mobile Preservation Society
300 Oakleigh Place
Mobile, AL 36604

Major General Janet Cobb
USS ALABAMA Battleship Memorial Park
PO Box 65
Mobile, AL 36601-0065

Mr. Tilmon Brown
Restore Mobile
PO Box 40037
Mobile, AL 36640

Ms. Mandy Ranslow
Advisory Council on Historic Preservation
401 F Street NW
Washington, DC 20001-2637

Mr. Anderson Flen
Mobile County Training School
800 Whitley St
Prichard, AL 36610

Mr. Joe Womack
Africatown C.H.E.S.S.
812 Center St
Mobile, AL 36610

Robert L. Hope Community Center
c/o Mr. James Hope
50507 Stonebridge Ln
Birmingham, AL 35242

Ms. Ossia Edwards
Prichard City Council
216 East Prichard Ave
Prichard, AL 36610

Ms. Cynthia Walton
National Historic Landmarks Program Manager
National Park Service, SE Region
100 Alabama St. SW
Atlanta, GA 30303

Pastor Christopher Williams, Sr.
6717 Spice Pond Rd
Eight Mile, AL 36613

***Tribal Contact Information***

Erin Thompson
THPO Coordinator
Absentee-Shawnee Tribe
2025 S Gordon Cooper Drive
Shawnee, OK 74801

Nita Battiste
Council Vice-Chairperson
Alabama-Coushatta Tribe of Texas
571 State Park Road 56
Livingston, TX 77351

Walter Celestine
Vice-Chairman, Alabama-Coushatta Cultural Committee
Alabama-Coushatta Tribe of Texas
571 State Park Road 56
Livingston, TX 77351

Samantha Robison
Historic Preservation Officer
Alabama-Quassarte Tribe of OK
PO Box 187
Wetumka, OK 74880

Steve Landsberry
Tribal Administrator
Alabama-Quassarte Tribe of OK
PO Box 187
Wetumka, OK 74880

Elizabeth Toombs
THPO
Cherokee Nation
PO Box 948
Tahlequah, OK 74465

Ms. Catherine Gray
History and Preservation Officer
Cherokee Nation
PO Box 948
Tahlequah, OK 74465

Kirk Perry
Executive Officer of Historic Preservation
Chickasaw Nation
PO Box 154
Ada, OK 74821

Karen Brunso
THPO
Chickasaw Nation
PO Box 1548
Ada, OK 74821

Monty Stick
Historic Preservation and Repatriation Technician
Chickasaw Nation
PO Box 1548
Ada, OK 74821

LaDonna Brown
Tribal Anthropologist
Chickasaw Nation
PO Box 1548
Ada, OK 74821

Gingy Nail
Assistance Historic Preservation Officer
Chickasaw Nation
PO Box 1548
Ada, OK 74821

Amber Hood
Preservation and Repatriation Manager
Chickasaw Nation
PO Box 1548
Ada, OK 74821

Margeaux Smith
Historic Preservation and Repatriation Technician
PO Box 1548
Ada, OK 74821

Dr. Ian Thompson
Director, Historic Preservation Department
Choctaw Nation of Oklahoma
PO Drawer 1210
Durant, OK 74701

Lindsey Bilyeu
Senior Section 106 Compliance Review Officer
Choctaw Nation of Oklahoma
PO Drawer 1210
Durant, OK 74701

Deanna Byrd, RPA
NAGPRA Liaison-Coordinator
Choctaw Nation of Oklahoma
PO Drawer 1210
Durant, OK 74701

Dr. Linda Langley
THPO
Coushatta Tribe of Louisiana
PO Box 10
Elton, LA 70532

Raynella Fontenot
Cultural Revitalization Coordinator
Coushatta Tribe of Louisiana
PO Box 10
Elton, LA 70532

Russell Townsend
THPO
Eastern Band of The Cherokee Nation
Qualla Boundary Reservation
PO Box 455
Cherokee, NC 28719

Stephen Yerka
Tribal Historic Preservation Specialist for DOT/FHWA
Eastern Band of The Cherokee Nation
Qualla Boundary Reservation
PO Box 455
Cherokee, NC 28719

Chief Glenda J. Wallace
Eastern Shawnee Tribe of Oklahoma
PO Box 350
127 West Oneida
Seneca, MO 64865

Brett Barnes
TPO
Eastern Shawnee Tribe of Oklahoma
PO Box 350
127 West Oneida
Seneca, MO 64865

David Cook
Preservation
Kialegee Tribal Town
PO Box 332
Wetumka, OK 74883

Ken Carleton
THPO
Mississippi Band of Choctaw Indians
PO Box 6257
Choctaw, MS 39350

RaeLynn Butler
Historical and Cultural Preservation Manager
Muscogee (Creek) Nation
PO Box 580
Okmulgee, OK 74447

Corain-Lowe Zepeda
THPO
Muscogee (Creek) Nation
PO Box 580
Okmulgee, OK 74447

Emman Spain
NAGPRA Officer
Muscogee (Creek) Nation
PO Box 580
Okmulgee, OK 74447

Carolyn White
Acting THPO
Poarch Band of Creek Indians
5811 Jack Springs Road
Atmore, AL 36502

Margaret Baggett
Secretary
Poarch Band of Creek Indians
5811 Jack Springs Road
Atmore, AL 36502

Theodore (Ted) Isham
Historic Preservation Officer
Seminole Nation of OK
PO Box 1498
Seminole, OK 74868

Alan Emarthle
Seminole Nation of OK
PO Box 1498
Seminole, OK 74868

Dr. Paul Backhouse
THPO
Seminole Tribe of FL
Tribal Historic Preservation Office
30290 Josie Billie Highway
PMB 1004
Clewiston, FL 33440

Bradley Mueller
Compliance Supervisor, THPO
Seminole Tribe of FL
Tribal Historic Preservation Office
30290 Josie Billie Highway
PMB 1004
Clewiston, FL 33440

Andrew Weidman
Compliance Specialist for the THPO Office
Tribal Historic Preservation Office
30290 Josie Billie Highway
PMB 1004
Clewiston, FL 33440

Dawn Hutchins
Compliance Office
Tribal Historic Preservation Office
30290 Josie Billie Highway
PMB 1004
Clewiston, FL 33440

Terry Clouthier
THPO/NAGPRA Contact
Thlopthlocco Tribal Town
PO Box 188
Okemah, OK 74859

Earl Barbry, Jr.
THPO
Tunica-Biloxi Tribe of Louisiana
PO Box 1589
Marksville, LA 71351

Sheila Bird
THPO and Director of Natural Resources
United Keetowah Band of the Cherokee Indians in Oklahoma
PO Box 746
Tahlequah, OK 74465

Rachel Perash
NAGPRA Coordinator
United Keetowah Band of the Cherokee Indians in Oklahoma
PO Box 746
Tahlequah, OK 74465

Alina J. Shively
Deputy THPO
Jena Band of Choctaw Indians
PO Box 14
Jena, LA 71342

***Attachment #4. Post-Review Discovery Plan***

A. When notified by the Concessionaire or other outside party, ALDOT shall notify FHWA immediately if it appears that a FHWA funded undertaking has affected a previously unidentified property that may be eligible for the *National Register* or affected a known historic property in an unanticipated manner.

1. ALDOT shall require the Concessionaire to stop construction activities in the vicinity of the discovery and shall require the Concessionaire to take all reasonable measures to avoid or minimize harm to the property until FHWA concludes consultation with SHPO or THPO or Tribes.

2. FHWA shall notify SHPO or THPO and Tribes at the earliest possible time, but no later than 72 hours, and consult to develop actions that will take into account the effects of the undertaking.

B. When notified by a Concessionaire, ALDOT shall notify FHWA at the earliest possible time, but no later than 72 hours, if intact archaeological deposits are uncovered in the course of any undertaking.

1. ALDOT shall require the Concessionaire to stop all work immediately in the vicinity of the discovery and take reasonable measures to avoid or minimize harm to the finds. The site and all archaeological findings shall be secured and access to the APE of the individual project restricted.

2. The Concessionaire shall inform FHWA immediately and FHWA shall consult with SHPO or THPO and Tribes.

3. Work in the APE of the project cannot resume until consultation is completed or until an archeologist who meets the *Professional Qualifications* determines the extent of the archeological deposit. Work may then resume in unaffected areas of the APE outside of the delineated deposit.

C. If an unmarked grave, indications of a burial, or human remains are present, compliance with the Alabama Cemetery and Human Remains Protection Act is required.

1. ALDOT shall require the Concessionaire to stop work immediately in the vicinity of the discovery and secure the area. ALDOT shall immediately notify FHWA and the law enforcement agencies of the discovery.

2. Within twenty-four hours of notification by ALDOT, FHWA shall notify and coordinate with the Tribes. The local law enforcement officials, in concert with a professional bioarchaeologist, shall assess the nature and age of the human skeletal remains. FHWA shall notify the Alabama Historical Commission at the earliest possible time after the discovery. If the coroner, bio-archaeologist, and/or appropriate local official determines that the human skeletal remains are older than 50 years of age, the Alabama Historical Commission has jurisdiction over the remains until final determinations of origin are made.

3. In all cases, FHWA shall follow guidelines set forth by the ACHP in its "Human Remains Policy."

D. In cases where the human remains are determined to be American Indian:

1. FHWA shall take the lead in working with Tribes and the Alabama Historical Commission and consulting parties to ensure compliance with the Alabama Cemetery and Human Remains Protection Act and other applicable laws. In addition, FHWA shall follow guidelines set forth by the ACHP in its "Human Remains Policy."

2. FHWA shall hold a consultation meeting about the remains with Tribes and representatives of the Alabama Historical Commission as necessary. Such a consultation meeting may include a site visit to review the situation.

3. In all cases, the preferred action is to avoid further disturbance of the remains, unless there is no alternative to further disturbance.

E. FHWA shall also notify SHPO or THPO and Tribes of any time constraints, and FHWA and SHPO or THPO and Tribes shall mutually agree upon timeframes for this consultation. ALDOT and the Concessionaire may participate in this consultation. FHWA shall provide SHPO or THPO and/or Tribes with written recommendations that take into account the effect of the undertaking. If SHPO or THPO and Tribes do not object to FHWA's recommendations within the agreed upon timeframe, FHWA shall require the Concessionaire to modify the scope of work as necessary to implement the recommendations.

***Attachment #5. The Alabama Burial Act***

**ALABAMA HISTORICAL COMMISSION**
***The State Historic Preservation Office***

**468 S. Perry Street Montgomery, Alabama 36130-0900**
**Voice: (334)242-3184**
**Fax: (334)262-1083**
**www.preservealа.org**

# Desecration, defacement, etc., of memorial of dead; invasion or mutilation of corpse.

***Code of Alabama* 1975, §13A-7-23.1, as amended**

(a) Any person who willfully or maliciously injures, defaces, removes, or destroys any tomb, monument, gravestone , burial mound, earthen or shell monument containing human skeletal remains or associated burial artifacts, or other structure or thing placed or designed for a memorial of the dead, or any fence, railing, curb, or any enclosure for the protection or ornamentation of any tomb, monument, gravestone, burial mound, earthen or shell monument containing human skeletal remains or associated burial artifacts, or other structure before mentioned, or for any enclosure for the burial of the dead, or any person who willfully and wrongfully or maliciously destroys, removes, cuts, breaks, or injures any tree, shrub, plant, flower, decoration, or other real or personal property within any cemetery or graveyard shall be guilty of a Class A misdemeanor.

(b) Any person who willfully or maliciously desecrates, injures, defaces, removes, or destroys any tomb, monument, structure, or container of human remains, burial mound, earthen or shell monument containing human skeletal remains or associated burial artifacts, and invades or mutilates the human corpse or remains shall be guilty of a Class C felony and upon conviction the person shall be punished as provided by law.

(c) The provisions of subsections (a) and (b) shall not apply to any person holding a permit issued by the Alabama Historical Commission pursuant to subsection (d), to anyone operating a cemetery under standard rules and regulations and maintenance procedures, or to any person otherwise authorized by law to remove or disturb a tomb, monument, grave marker, burial mound, earthen or shell monument, or similar structure, or its contents, as described in subsections (a) and (b), nor shall the provisions of subsections (a) and (b) apply to any person authorized to take any action on municipal property.

(d) The Alabama Historical Commission, to provide for the lawful preservation, investigation, restoration, or relocation of human burial remains, human skeletal remains, or funerary objects, shall promulgate rules and regulations for the issuance of a permit and may issue a permit to persons or companies who seek to restore, preserve, or relocate human burial remains, human skeletal remains, funerary objects, or otherwise disturb, a place of burial."

(Acts 1980, No. 80-706, p. 1424; Acts 1993, No. 93-770, §1; Acts 1993, 1st Ex. Sess., No. 93-905, p. 201, §1;

***Act 2010-723).***

See also Administrative Code, Chapter 460-X-10.01

***Attachment #6. Advisory Council on Historic Preservation- Policy Statement Regarding Treatment of Burial Sites, Human Remains and Funerary Objects***

Preserving America s Heritage

# ADVISORY COUNCIL ON HISTORIC PRESERVATION

## POLICY STATEMENT
## REGARDING
## TREATMENT OF BURIAL SITES, HUMAN REMAINS AND FUNERARY OBJECTS

**Preamble**: This policy offers leadership in resolving how to treat burial sites, human remains, and funerary objects in a respectful and sensitive manner while acknowledging public interest in the past. As such, this policy is designed to guide federal agencies in making decisions about the identification and treatment of burial sites, human remains, and funerary objects encountered in the Section 106 process, in those instances where federal or state law **does not prescribe a course of action**.

This policy applies to all federal agencies with undertakings that are subject to review under Section 106 of the National Historic Preservation Act (NHPA; 16 U.S.C. § 470f), and its implementing regulations (36 CFR Part 800). To be considered under Section 106, the burial site must be or be a part of a historic property, meaning that it is listed, or eligible for listing, in the National Register of Historic Places.

The Advisory Council on Historic Preservation (ACHP) encourages federal agencies to apply this policy throughout the Section 106 process, including during the identification of those historic properties. In order to identify historic properties, federal agencies must assess the historic significance of burial sites and apply the National Register criteria to determine whether a property is eligible. Burial sites may have several possible areas of significance, such as those that relate to religious and cultural significance, as well as those that relate to scientific significance that can provide important information about the past. This policy does not proscribe any area of significance for burial sites and recognizes that the assessment must be completed on a case-by-case basis through consultation.

The policy is not bound by geography, ethnicity, nationality, or religious belief, but applies to the treatment of all burial sites, human remains, and funerary objects encountered in the Section 106 process, as the treatment and disposition of these sites, remains, and objects are a human rights concern shared by all.

This policy also recognizes the unique legal relationship between the federal government and tribal governments as set forth in the Constitution of the United States, treaties, statutes and court decisions, and acknowledges that, frequently, the remains encountered in Section 106 review are of significance to Indian tribes.

Section 106 requires agencies to seek agreement with consulting parties on measures to avoid, minimize, or mitigate adverse effects to historic properties. Accordingly, and consistent with Section 106, this policy does not recommend a specific outcome from the consultation process. Rather, it focuses on issues and perspectives that federal agencies ought to consider when making their Section 106 decisions. In many cases, federal agencies will be bound by other applicable federal, tribal, state, or local laws that do

prescribe a specific outcome, such as the Native American Graves Protection and Repatriation Act (NAGPRA). The federal agency must identify and follow applicable laws and implement any prescribed outcomes.

For undertakings on federal and tribal land that encounter Native American or Native Hawaiian human remains and funerary objects, NAGPRA applies. NHPA and NAGPRA are separate and distinct laws, with separate and distinct implementing regulations and categories of parties that must be consulted.[1] Compliance with one of these laws does not mean or equal compliance with the other. Implementation of this policy and its principles does not, in any way, change, modify, detract or add to NAGPRA or other applicable laws.

**Principles:** When burial sites, human remains, or funerary objects will be or are likely to be encountered in the course of Section 106 review, a federal agency should adhere to the following principles:

**Principle 1:** Participants in the Section 106 process should treat all burial sites, human remains and funerary objects with dignity and respect.

**Principle 2:** Only through consultation, which is the early and meaningful exchange of information, can a federal agency make an informed and defensible decision about the treatment of burial sites, human remains, and funerary objects.

**Principle 3:** Native Americans are descendants of original occupants of this country. Accordingly, in making decisions, federal agencies should be informed by and utilize the special expertise of Indian tribes and Native Hawaiian organizations in the documentation and treatment of their ancestors.

**Principle 4:** Burial sites, human remains and funerary objects should not be knowingly disturbed unless absolutely necessary, and only after the federal agency has consulted and fully considered avoidance of impact and whether it is feasible to preserve them in place.

**Principle 5**: When human remains or funerary objects must be disinterred, they should be removed carefully, respectfully, and in a manner developed in consultation.

**Principle 6:** The federal agency is ultimately responsible for making decisions regarding avoidance of impact to or treatment of burial sites, human remains, and funerary objects. In reaching its decisions, the federal agency must comply with applicable federal, tribal, state, or local laws.

**Principle 7**: Through consultation, federal agencies should develop and implement plans for the treatment of burial sites, human remains, and funerary objects that may be inadvertently discovered.

**Principle 8:** In cases where the disposition of human remains and funerary objects is not legally prescribed, federal agencies should proceed following a hierarchy that begins with the rights of lineal descendants, and if none, then the descendant community, which may include Indian tribes and Native Hawaiian organizations.

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[1] The ACHP's publication *Consulting with Indian Tribes in the Section 106 Process* and the National Association of Tribal Historic Preservation Officers' publication *Tribal Consultation: Best Practices in Historic Preservation* provide additional guidance on this matter.

**DISCUSSION:**

**Principle 1: Participants in the Section 106 process should treat all burial sites, human remains and funerary objects with dignity and respect.**

Because the presence of human remains and funerary objects gives a historic property special importance as a burial site or cemetery, federal agencies need to consider fully the values associated with such sites. When working with human remains, the federal agency should maintain an appropriate deference for the dead and the funerary objects associated with them, and demonstrate respect for the customs and beliefs of those who may be descended from them.

Through consultation with descendants, culturally affiliated groups, descendant communities, and other parties, federal agencies should discuss and reach agreement on what constitutes respectful treatment.

**Principle 2: Only through consultation, which is the early and meaningful exchange of information, can a federal agency make an informed and defensible decision about the treatment of burial sites, human remains, and funerary objects.**

Consultation is the hallmark of the Section 106 process. Federal agencies must make a "reasonable and good faith" effort to identify consulting parties and begin consultation early in project planning, after the federal agency determines it has an undertaking and prior to making decisions about project design, location, or scope.

The NHPA, the ACHP's regulations, and Presidential Executive Orders set out basic steps, standards, and criteria in the consultation process, including:

- Federal agencies have an obligation to seek out all consulting parties [36 CFR § 800.2(a)(4)], including the State Historic Preservation Officer (SHPO)/Tribal Historic Preservation Officer (THPO) [36 CFR § 800.3(c)].

- Federal agencies must acknowledge the sovereign status of Indian tribes [36 CFR § 800.2(c)(2)(ii)]. Federal agencies are required to consult with Indian tribes on a government-to-government basis in recognition of the unique legal relationship between federal and tribal governments, as set forth in the Constitution of the United States, treaties, statutes, court decisions, and executive orders and memoranda.

- Consultation on a government-to-government level with Indian tribes cannot be delegated to non-federal entities, such as applicants and contractors.

- Federal agencies should solicit tribal views in a manner that is sensitive to the governmental structures of the tribes, recognizing their desire to keep certain kinds of information confidential, and that tribal lines of communication may argue for federal agencies to provide extra time for the exchange of information.

- Properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization may be determined eligible for inclusion on the National Register [16 U.S.C. § 470a(d)(6)(A)], and federal agencies must consult with any Indian tribe or Native Hawaiian organization that attaches religious and cultural significance to such historic properties [16 U.S.C. § 470a(d)(6)(B) and 36 CFR § 800.2(c)(2)(ii)(D)].

**Principle 3: Native Americans are descendants of original occupants of this country. Accordingly, in making decisions, federal agencies should be informed by and utilize the special expertise of Indian tribes and Native Hawaiian organizations in the documentation and treatment of their ancestors.**

This principle reiterates existing legal requirements found in federal law, regulation and executive orders, and is consistent with positions that the ACHP has taken over the years to facilitate enfranchisement and promote broad participation in the Section 106 process. Federal agencies must consult with Indian tribes on a government-to-government basis because they are sovereign nations.

Indian tribes and Native Hawaiian organizations bring a special perspective on how a property possesses religious and cultural significance to them. Accordingly, federal agencies should utilize their expertise about, and religious and cultural connection to, burial sites, human remains, and associated funerary objects to inform decision-making in the Section 106 process.

**Principle 4: Burial sites, human remains and funerary objects should not be knowingly disturbed unless absolutely necessary, and only after the federal agency has consulted and fully considered avoidance of impact and whether it is feasible to preserve them in place.**

As a matter of practice, federal agencies should avoid impacting burial sites, human remains, and funerary objects as they carry out their undertakings. If impact to the burial site can be avoided, this policy does not compel federal agencies to remove human remains or funerary objects just so they can be documented.

As this policy advocates, federal agencies should always plan to avoid burial sites, human remains, and funerary objects altogether. When a federal agency determines, based on consultation with Section 106 participants, that avoidance of impact is not appropriate, the agency should minimize disturbance to such sites, remains, and objects. Accordingly, removal of human remains or funerary objects should occur only when other alternatives have been considered and rejected.

When a federal agency determines, based on consultation with Section 106 participants, that avoidance of impact is not appropriate, the agency should then consider any active steps it may take to preserve the burial site in place, perhaps through the intentional covering of the affected area, placement of markers, or granting of restrictive or other legal protections. In many cases, preservation in place may mean that, to the extent allowed by law, the locations of burial sites, human remains, and funerary objects should not be disclosed publicly. Alternatively and consistent with the Section 106 regulations [36 CFR § 800.5(a)(2)(vi)], natural deterioration of the remains may be the acceptable or preferred outcome of the consultation process.

**Principle 5: When human remains or funerary objects must be disinterred, they should be removed carefully, respectfully, and in a manner developed in consultation.**

When the federal agency decides that human remains or funerary objects must be disturbed, they should be removed respectfully and dealt with according to the plan developed by the federal agency in consultation. "Careful" disinterment means that those doing the work should have, or be supervised by people having, appropriate expertise in techniques for recognizing and disinterring human remains.

This policy does not endorse any specific treatment. However, federal agencies must make a reasonable and good faith effort to seek agreement through consultation before making its decision about how human remains and/or funerary objects shall be treated.

The plan for the disinterment and treatment of human remains and/or funerary objects should be negotiated by the federal agency during consultation on a case-by-case basis. However, the plan should provide for an accurate accounting of federal implementation. Depending on agreements reached through the Section 106 consultation process, disinterment may or may not include field recordation. In some instances, such recordation may be so abhorrent to consulting parties that the federal agency may decide it is inappropriate to carry it out. When dealing with Indian tribes, the federal agency must comply with its legal responsibilities regarding tribal consultation, including government-to-government and trust responsibilities, before concluding that human remains or funerary objects must be disinterred.

**Principle 6: The federal agency is ultimately responsible for making decisions regarding avoidance of impact to or treatment of burial sites, human remains, and funerary objects. In reaching its decisions, the federal agency must comply with applicable federal, tribal, state, or local laws.**

Federal agencies are responsible for making final decisions in the Section 106 process [36 CFR § 800.2(a)]. The consultation and documentation that are appropriate and necessary to inform and support federal agency decisions in the Section 106 process are set forth in the ACHP's regulations [36 CFR Part 800].

Other laws, however, may affect federal decision-making regarding the treatment of burial sites human remains, and funerary objects. Undertakings located on federal or tribal lands, for example, are subject to the provisions of NAGPRA and the Archaeological Resources Protection Act (ARPA). When burial sites, human remains, or funerary objects are encountered on state and private lands, federal agencies must identify and follow state law when it applies. Section 106 agreement documents should take into account the requirements of any of these applicable laws.

**Principle 7: Through consultation, federal agencies should develop and implement plans for the treatment of burial sites, human remains, and funerary objects that may be inadvertently discovered.**

Encountering burial sites, human remains, or funerary objects during the initial efforts to identify historic properties is not unheard of. Accordingly, the federal agency must determine the scope of the identification effort in consultation with the SHPO/THPO, Indian tribes and Native Hawaiian

organizations, and others before any archaeological testing has begun [36 CFR § 800.4(a)] to ensure the full consideration of avoidance of impact to burial sites, human remains, and funerary objects.

The ACHP's regulations provide federal agencies with the preferred option of reaching an agreement ahead of time to govern the actions to be taken when historic properties are discovered during the implementation of an undertaking. In the absence of prior planning, when the undertaking has been approved and construction has begun, the ACHP's post-review discovery provision [36 CFR § 800.13] requires the federal agency to carry out several actions:

(1) make reasonable efforts to avoid, minimize, or mitigate adverse effects to such discovered historic properties;
(2) notify consulting parties (including Indian tribes and Native Hawaiian organizations that might attach religious and cultural significance to the affected property) and the ACHP within 48 hours of the agency's proposed course of action;
(3) take into account the recommendations received; and then
(4) carry out appropriate actions.

NAGPRA prescribes a specific course of action when Native American and Native Hawaiian human remains and funerary objects are discovered on federal or tribal lands in the absence of a plan—cessation of the activity, protection of the material, notification of various parties, consultation on a course of action and its implementation, and then continuation of the activity. However, adherence to the plan under Principle 5 would cause new discoveries to be considered "intentional excavations" under NAGPRA because a plan has already been developed, and can be immediately implemented. Agencies then could avoid the otherwise mandated 30 day cessation of work for "inadvertent discoveries."

**Principle 8: In cases where the disposition of human remains and funerary objects is not legally prescribed, federal agencies should proceed following a hierarchy that begins with the rights of lineal descendants, and if none, then the descendant community, which may include Indian tribes and Native Hawaiian organizations.**

Under the ACHP's regulations, "descendants" are not identified as consulting parties by right. However, federal agencies shall consult with Indian tribes and Native Hawaiian organizations that attach religious and cultural significance to burial sites, human remains and associated funerary objects, and be cognizant of their expertise in, and religious and cultural connection to, them. In addition, federal agencies should recognize a biological or cultural relationship and invite that individual or community to be a consulting party [36 CFR § 800.3(f)(3)].

When federal or state law does not direct disposition of human remains or funerary objects, or when there is disagreement among claimants, the process set out in NAGPRA may be instructive. In NAGPRA, the "ownership or control" of human remains and associated funerary objects lies with the following in descending order: specific lineal descendants; then tribe on whose tribal lands the items were discovered; then tribe with the closest cultural affiliation; and then tribe aboriginally occupying the land, or with the closest "cultural relationship" to the material.

**Definitions Used for the Principles**

- **Burial Site**: Any natural or prepared physical location, whether originally below, on, or above the surface of the earth, into which as a part of the death rite or ceremony of a culture, individual human remains are deposited [25 U.S.C. 3001.2(1)].
- **Consultation:** The process of seeking, discussing, and considering the views of other participants, and, where feasible, seeking agreement with them regarding matters arising in the Section 106 review process [36 CFR § 800.16(f)].
- **Consulting parties:** Persons or groups the federal agency consults with during the Section 106 process. They may include the State Historic Preservation Officer; the Tribal Historic Preservation Officer; Indian tribes and Native Hawaiian organizations; representatives of local governments; applicants for federal assistance, permits, licenses, and other approvals; and/or any additional consulting parties [based on 36 CFR § 800.2(c)]. Additional consulting parties may include individuals and organizations with a demonstrated interest in the undertaking due to the nature of their legal or economic relation to the undertaking or affected properties, or their concern with the undertaking's effects on historic properties [36 CFR § 800.2(c)(6)].
- **Disturbance:** Disturbance of burial sites that are listed in or eligible for listing in the National Register of Historic Places will constitute an adverse effect under Section 106. An adverse effect occurs when "an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, setting, materials, workmanship, feeling, or association" [36 CFR § 800.5(a)(1)].
- **Federal land:** Lands under a federal agency's control. Mere federal funding or permitting of a project does not turn an otherwise non-federal land into federal land (see *Abenaki Nation of Mississquoi* v. *Hughes*, 805 F. Supp. 234 (D. Vt. 1992), aff'd, 990 F. 2d 729 (2d Cir. 1993) (where the court found that a Clean Water Act permit issued by the US Army Corps of Engineers did not place the relevant land under federal "control" for NAGPRA purposes).
- **Funerary objects:** "items that, as part of the death rite or ceremony of a culture, are reasonably believed to have been placed intentionally at the time of death or later with or near individual human remains" [25 U.S.C. 3001(3)(B)].
- **Historic property:** "Any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. It includes artifacts, records, and remains that are related to and located within such properties, and it includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register of Historic Places criteria" [36 CFR § 800.16(1)].
- **Human remains:** The physical remains of a human body. The term does not include remains or portions of remains that may reasonably be determined to have been freely given or naturally shed by the individual from whose body they were obtained, such as hair made into ropes or nets [see 43 CFR § 10.2(d)(1)].
- **Indian Tribe**: "An Indian tribe, band, nation, or other organized group or community, including a Native village, Regional Corporation or Village Corporation, as those terms are defined in Section 3 of the Alaska Native Claims Settlement Act [43 U.S.C. 1602], which is recognized as eligible for the special programs and services provided by the United States to Indians because of their status as Indians" [36 CFR § 800.16(m)].
- **Native American:** Of, or relating to, a tribe, people, or culture that is indigenous to the United States [25 U.S.C. 3001 (9)]. Of, or relating to, a tribe, people, or culture indigenous to the Unites States, including Alaska and Hawaii [43 CFR 10.2(d)].

- **Native Hawaiian:** Any individual who is a descendant of the aboriginal people who, prior to 1778, occupied and exercised sovereignty in the area that now constitutes the state of Hawaii [36 CFR § 800.16(s)(2)].
- **Native Hawaiian Organization:** Any organization which serves and represents the interests of Native Hawaiians; has as a primary and stated purpose the provision of services to Native Hawaiians; and has demonstrated expertise in aspects of historic preservation that are significant to Native Hawaiians [36 CFR § 800.16(s)].
- **Policy statement:** A formal statement, endorsed by the full ACHP membership, representing the membership's collective thinking about what to consider in reaching decisions about select issues, in this case, human remains and funerary objects encountered in undertakings on federal, tribal, state, or private lands. Such statements do not have the binding force of law.
- **Preservation in place:** Taking active steps to ensure the preservation of a property.
- **Protection of Historic Properties**: Regulations [36 CFR Part 800] implementing Section 106 of the National Historic Preservation Act.
- **Section 106**: That part of the National Historic Preservation Act which establishes a federal responsibility to take into account the effects of undertakings on historic properties and to provide the Advisory Council on Historic Preservation a reasonable opportunity to comment with regard to such action.
- **State Historic Preservation Officer:** The official appointed or designated pursuant to Section 101(b)(1) of NHPA to administer the state historic preservation program.
- **Tribal Historic Preservation Officer**: The official appointed by the tribe's chief governing authority or designated by a tribal ordinance or preservation program who has assumed the responsibilities of the SHPO for purposes of Section 106 compliance on tribal lands in accordance with Section 101(d)(2) of NHPA.
- **Treatment:** Under Section 106, "treatments" are measures developed and implemented through Section 106 agreement documents to avoid, minimize, or mitigate adverse effects to historic properties.

**Acronyms Used for the Policy Statement**

- **ACHP**: Advisory Council on Historic Preservation.
- **ARPA**: Archaeological Resources Protection Act [16 U.S.C. 470aa-mm].
- **NHPA**: National Historic Preservation Act [16 U.S.C. § 470f].
- **NAGPRA**: The Native American Graves Protection and Repatriation Act [25 U.S.C. 3001 et seq].
- **SHPO**: State Historic Preservation Officer
- **THPO**: Tribal Historic Preservation Officer

*[The members of the Advisory Council on Historic Preservation unanimously adopted this policy on February 23, 2007]*

## *Attachment #7. Aesthetic Steering Committee Framework*

**A. Purpose of Aesthetic Steering Committee**

Major infrastructure projects around the U.S. have increasingly included an Aesthetics Steering Committee to assist in engaging communities with the aesthetic design. For this project, ALDOT will develop an Aesthetic Steering Committee to provide input on preferences regarding the aesthetics of the project. The Aesthetic Steering Committee will serve on behalf of the community and Section 106 Consulting Parties to provide input on likes, dislikes, and preferences related to aesthetics so that ALDOT can communicate those preferences to the proposing teams and ensure that commitments related to aesthetics are upheld as the project is designed and constructed.

To encourage open and honest feedback on aesthetic preferences, the members of the committee will not be released to the proposing teams or the public until after a team is selected to design, build, finance, operate, and maintain the project. During the pre-proposal phase, the proposing teams will receive input from the Committee through ALDOT. After a team is selected, the winning team will work directly with the Aesthetic Steering Committee and ALDOT to finalize the aesthetic components of the project.

**B. Members of Aesthetic Steering Committee**

The Aesthetic Steering Committee will be comprised of members from Mobile and Baldwin Counties. The following organizations will be invited to participate as members of the Aesthetic Steering Committee:

- 

Eight of the nine organizations invited to serve on the Committee are Section 106 Consulting Parties. The invitees consist of individuals and organizations with interests in historic resources, as well as the region as a whole. They have a diverse background in terms of training and education, which will allow them to provide a variety of perspectives as part of this process.

**C. Roles and Responsibilities of Committee**

The involvement of the Aesthetic Steering Committee will be a collaborative process that occurs through in-person meetings. The Aesthetic Steering Committee will meet with ALDOT as needed to develop Aesthetic Guidelines for the project and to provide feedback on the Aesthetic and Landscape Plans submitted by the proposing teams. The Committee will also work with the selected team during the final design and construction phase(s) of the project.

The Aesthetic Steering Committee will be responsible for assisting ALDOT in the development of Aesthetic Guidelines to address commitments and preferences related to the following aesthetic elements:

- Land use compatibility,
- Aesthetics,
- Landscaping,
- Form commonality,
- Materials and finishes,
- Barriers,
- Retaining walls,
- Overhead gantries and sign structures,
- Bridge structures,
- Interchange areas,
- Straddle bents,
- High level approaches to main span of bridge,
- Bicycle/pedestrian amenities and connectivity,
- Treatment of areas beneath the Mobile River Bridge and its approach structures,

- Roadway and bridge lighting, and
- Aesthetic lighting.

The Aesthetic Steering Committee will also provide input on appropriate themes and regional context that should be used by the teams to create a project that reflects the culture and history of the project area and complements its setting.

The following table provides a list of activities in which the Aesthetic Steering Committee will participate:

| ***Activity*** | ***Purpose/Focus*** |
|---|---|
| Initial Meeting | • Learn about the proposed project through available design information, including typical sections, maps, and a visualization/animation.<br>• Discuss various aesthetic components to be included in the project.<br>• Review photographs and drawings of bridges and other project components (such as ramps, interchanges, roadways, lighting, etc.) from projects around the world to identify likes and dislikes.<br>• Discuss what makes the Mobile and Baldwin County region unique and what aspects should be incorporated into themes for the project. |
| Meeting on Precedent Images | • Review precedent images showing different aesthetic components (bridge railings, retaining walls, roadway lighting, bridge lighting, aesthetic lighting, landscaping, colors, materials, etc.) to identify likes and dislikes. |
| Meeting on Draft Aesthetic Guidelines | • Review Draft Aesthetic Guidelines developed based on input received from Committee during previous meetings. |
| Meeting to Review Pre-Proposal Preliminary Aesthetic and Landscape Plans – Submittal #1 | • Review pre-proposal preliminary Aesthetic and Landscape Plans submitted by proposing teams. The primary aesthetic elements contained in this initial submittal from the proposing teams are expected to include the following: overall design approach and theme, main span bridge and structures, retaining walls, aesthetic lighting, landscape and urban design, and pedestrian access.<br>• Provide comments on submittals, focusing on likes, dislikes, and how well the package reflects the preferences set forth in the Aesthetic Guidelines.<br>• ALDOT to share the feedback from the Committee with the proposing teams. |
| Meeting to Review Pre-Proposal Preliminary Aesthetic and Landscape Plans – Submittal #2 | • Review revised preliminary Aesthetic and Landscape Plans submitted by proposing teams. The primary aesthetic elements contained in this initial submittal from the proposing teams are expected to include the following: overall design approach and theme, main span bridge and structures, retaining walls, aesthetic lighting, landscape and urban design, and pedestrian access.<br>• Provide comments on submittals, focusing on likes, dislikes, and how well the package reflects the preferences set forth in the Aesthetic Guidelines.<br>• ALDOT to share the feedback from the Committee with the proposing teams. |
| Meeting to Review Pre-Proposal Preliminary Aesthetic and Landscape Plans – Submittal #3 | • Review revised preliminary Aesthetic and Landscape Plans submitted by proposing teams. The primary aesthetic elements contained in this initial submittal from the proposing teams are expected to include the following: overall design approach and theme, main span bridge and structures, retaining walls, aesthetic lighting, landscape and urban design, and pedestrian access.<br>• Provide comments on submittals, focusing on likes, dislikes, and how well the package reflects the preferences set forth in the Aesthetic Guidelines.<br>• ALDOT to share the feedback from the Committee with the proposing teams. |
| Meeting to Review | • Review Aesthetic and Landscape Plans submitted as part of each team's proposal. |

| *Activity* | *Purpose/Focus* |
|---|---|
| Aesthetic and Landscape Plans Submitted with Proposals | • Provide comments on submittals.<br>• ALDOT to use the feedback from the Committee to evaluate the Aesthetic and Landscape Plans in each team's proposal. |
| Meeting(s) with Selected Team during Design and Construction Phase(s) | • Meet directly with the selected team and ALDOT to finalize the details of Aesthetic and Landscape Plans.<br>• Provide input on more detailed components of the project, such as light fixtures, colors, types of materials, signage, aesthetic lighting, barriers, and other elements.<br>• May require multiple meetings. |

**D. Updates to Section 106 Consulting Parties regarding Aesthetic Steering Committee Activities**
ALDOT will provide summaries of Aesthetic Steering Committee activities to Section 106 Consulting Parties after the meetings occur.

***Attachment #8. Vibrations Study***

# Final Report on Vibrations Due to Pile Driving at the Mobile River Bridge Site

**Research Project 930-839R**

***INVESTIGATION OF PILE SETUP (FREEZE) IN ALABAMA***

***Development of a Setup Prediction Method and Implementation into LRFD Driven Pile Design***

***<u>Addendum:</u> Pile Driving Vibration Monitoring of the Future Mobile River Bridge Project***

**John Cleary, Ph.D., P.E. (P.I. for Vibration Monitoring)**
**Eric Steward, Ph.D. (Co. P.I. for Vibration Monitoring)**
**Andrew Gillis (Graduate Student)**
Department of Civil Engineering
University of South Alabama
Mobile, AL 36688

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## ABSTRACT

All projects have some amount of inherent risk; one such risk associated with construction projects is the potential for ground vibrations that could damage nearby structures. Research has been conducted on the effects of vibrations on structures; however, the expected levels of vibration are dependent on several factors including the soil conditions at the construction site. Therefore, site-specific investigations are often recommended.

After concerns were raised by the Alabama Department of Transportation (ALDOT) about damage potential at a project site in South Alabama, an addendum was added to a research project related to investigating pile setup in Alabama soils. The purpose of the addendum was to investigate ground vibrations from pile driving at a project site near the Mobile River in Mobile, Alabama.

An investigation and vibration monitoring program was developed for four pile sizes that are often used by the Alabama Department of Transportation (ALDOT). The piles included thirty-six inch square and twenty-four inch square concrete piles, as well as, two steel H-Piles. The piles were driven using typical installation techniques and the vibration levels at various distances from the piles were monitored.

The investigation found that the largest vibrations were observed while driving the thirty-six inch concrete pile. The maximum vibrations observed had a magnitude of 0.82 inches per second at fifty feet from the pile. The vibrations at 150 feet from the pile had dissipated to 0.15 inches per second. The results of the monitoring program and a literature review determined that an allowable vibration level of 0.5 inches per second for modern structures and 0.1 inches per second for potentially sensitive structures should be established for construction activity at or near the location of the project site. Additionally, a survey distance of 150 feet for modern structures and 250 feet for potentially sensitive structures is recommended.

# INTRODUCTION

## Background

The following report contains the analysis of ground vibrations generated during a pile driving research study located at the Mobile River Bridge Project Site. The project site, owned by the Alabama Department of Transportation (ALDOT), is located on the Mobile River just south of the Alabama Cruise Terminal, Figure 1. The study consisted of monitoring ground vibrations during the installation of four driven piles; two precast concrete piles and two steel H-piles. The study was conducted in response to concerns raised by ALDOT related to possible damage of nearby structures from ground-borne vibrations. The primary objective of this project was to determine the distance that pile driving operations can be conducted with minimal risk to nearby structures. To accomplish this, the vibration levels at various distances from the driven piles were determined and a prediction equation for other distances was developed. This study was conducted by researchers from the Department of Civil Engineering at the University of South Alabama between August 15, 2013 and August 27, 2013.

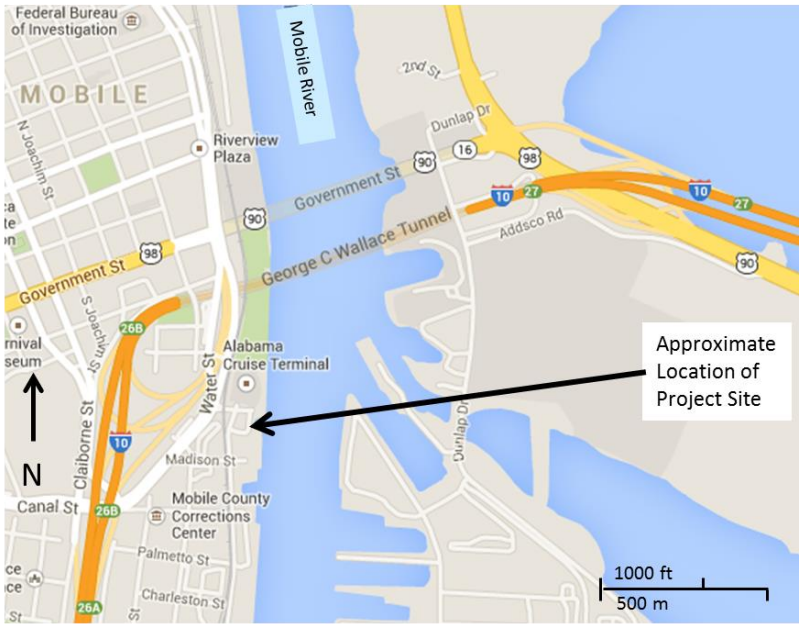



**Figure 1:** Location of project site, Mobile, AL **(Google 2013)**

## Objective

This project consisted of several objectives. The first was to determine the vibration levels from typical piles used by ALDOT. The second objective was to develop a methodology to predict vibrations at any distance from the pile. The third and final objective of the project was to develop guidelines on allowable vibrations for the project site.

## Scope

The scope if this report is limited to the vibrations portion of the larger project: *Investigation of Pile Setup (Freeze) In Alabama: Development of a Setup Prediction Method and Implementation into LRFD Driven Pile Design; Addendum: Pile Driving Vibration Monitoring of the Future Mobile River Bridge Project* (Research Project 930-839R).

The vibrations portion of the project was limited to the aforementioned location near the Mobile River. The project included monitoring vibrations during pile installation and restrikes, analysis of vibration data, development of vibration prediction methodology, and vibration limit recommendations.

## Report Organization

The report is organized into five main sections: Introduction, Literature Review, Experimental Design, Results, and Conclusions. Each section contains sub sections as needed.

## LITERATURE REVIEW

### Construction Vibrations

Ground vibrations are commonly generated from several sources including roadway traffic, railroad traffic, and construction activity. Vibrations can be measured and quantified using several different parameters including: displacement, velocity, and acceleration. Ground vibrations are typically measured by the velocity of the ground surface and reported as Peak Particle Velocity or PPV. Typical units of PPV are inches per second (in/sec) in the US system or millimeters per second (mm/sec) in the SI system of units. Typical construction activity that generates vibrations includes: pile driving, heavy equipment operation, concrete breaking (jackhammers), and truck/equipment traffic. Although the level of vibrations generated from these sources can vary widely, some typical vibration levels have been included in Table 1.

**Table 1:** Typical ground vibrations from construction equipment (Hanson, Towes and Lance 2006)

| **Equipment** | | **PPV (in/sec)** (Distance = 25 ft.) |
|---|---|---|
| Pile Driver (impact) | upper range | 1.518 |
| | typical | 0.644 |
| Pile Driver (vibratory) | upper range | 0.734 |
| | typical | 0.170 |
| Bulldozer | large | 0.089 |
| | small | 0.003 |
| Caisson Drilling | | 0.089 |
| Loaded Trucks | | 0.076 |
| Jackhammer | | 0.035 |

Table 1 shows that under typical conditions, pile driving has the potential to create large vibration levels, relative to other construction activity. The pile installation method, however, can affect the level of vibrations. High displacement piles are typically driven using an impact hammer and low displacement piles are sometimes driven using a vibratory hammer. Research has shown that the vibration magnitudes from vibratory hammers are typically smaller than from impact hammers. Additionally, installation techniques such as pre-boring and jetting can reduce vibration levels from impact pile driving (Woods 1997).

The mechanism of vibration formation is the transfer of energy from the pile driving hammer to the pile and then to the surrounding soil. The transfer of energy comes from two main sources. The first is the skin friction that is developed along the surface of the pile and the second is the displacement of the soil at the pile tip. For high displacement piles, the main source of energy transfer is at the pile tip. Several factors can affect the magnitude of vibrations including pile size, pile type, soil type, and the hammer energy. The most important factor in determining vibration levels is the distance from the pile, since vibrations will mitigate or dampen with distance from the source (Dowding 1996).

## Damage Thresholds

Vibrations generated from construction activity can cause several concerns at adjacent structures that range from annoyance to structural damage. Several studies have been conducted to determine the relationship between vibration levels, human perception, and structural damage. Table 2 contains a summary of a study reported by Hendriks (2002) for continuous vibrations. The study concluded that vibration levels that are large enough to "annoy people" are at threshold levels for architectural damage to structures that contain plaster walls or ceilings. Since these levels are below levels of even minor structural damage, the perception of building occupants can sometimes lead to discrepancies in the effects of vibrations. The values listed in Table 2 are generally conservative when compared to pile driving vibrations since they were developed for continuous vibrations. Pile driving operations develop discontinuous vibrations that can reduce the damage potential (Hendriks 2002).

**Table 2:** Continuous vibration levels and effects (Hendriks 2002)

| **Vibration Level (Peak Particle Velocity)** | **Human Reaction** | **Building Effects** |
|---|---|---|
| 0.006-0.019 in/sec | Threshold of perception; | Vibrations unlikely to cause damage |
| 0.08 in/sec | Vibration readily perceptible | Recommended upper level for ruins and ancient monuments |
| 0.1 in/sec | Continuous vibrations begin to annoy people | Virtually no risk of "architectural" damage to normal buildings |
| 0.2 in/sec | Vibrations annoying to people in buildings | Threshold at which there is a risk of "architectural" damage to normal dwelling- houses with plaster wall and ceilings |
| 0.4-0.6 in/sec | Vibrations considered unpleasant by people subjected to continuous vibrations | Vibrations at a greater level than normally expected from traffic, but would cause "architectural" damage and possible minor structural damage |

In addition to the many studies to determine the effect of vibrations on structures, several State and Federal Agencies, as well as, International Organizations have developed guidelines on permissible vibration levels due to construction activity. Much of the early work related to vibrations was performed by the United States Bureau of Mines (USBM) in the 1970's and 80's (Siskind, et al. 1980). This research focused on vibrations from blasting operations. Figure 2 shows the recommended vibration limits for blasting as a function of frequency. The limits range from 0.2 to 2.0 inches per second (in/sec).

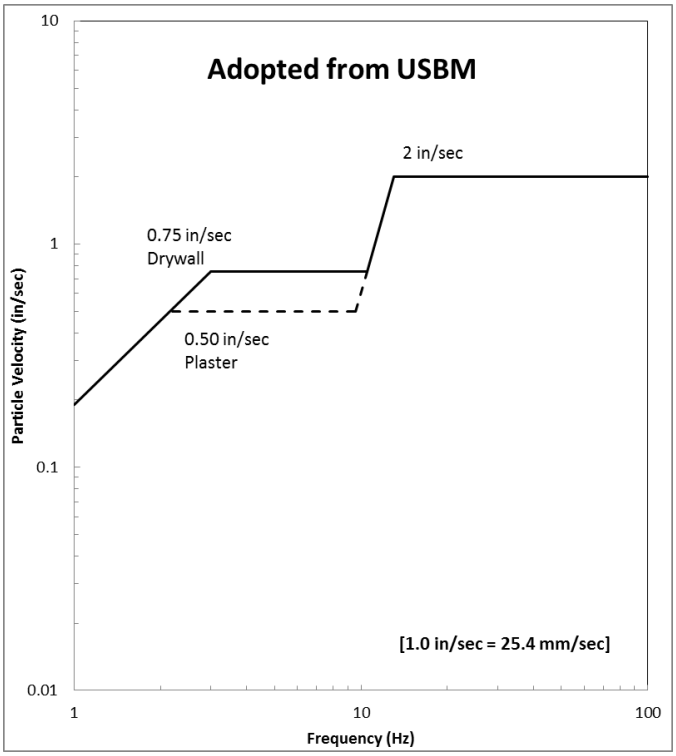



**Figure 2**: Vibration limits from the USBM (Siskind, et al. 1980)

The American Association of State Highway and Transportation Officials (AASHTO) and the Federal Transit Administration (FTA) have developed guidelines for vibration limits that range from 0.1 to 1.5 in/sec depending on the structure type as shown in Table 3.

**Table 3**: AASHTO and FTA criteria for construction vibrations

| Organization/Jurisdiction | Comments | PPV (in/sec) |
|---|---|---|
| American Association of State Highway and Transportation Officials (AASHTO 1990) | Residential buildings, plastered walls | 0.2-0.3 |
| | Residential buildings in good repair with gypsum board walls | 0.4-0.5 |
| | Engineered structures, without plaster | 1.0-1.5 |
| | Historic sites or other critical locations | 0.1 |
| Federal Transit Administration (FTA 2006) | Reinforced-concrete, steel or timber | 0.5 |
| | Engineered concrete and masonry | 0.3 |
| | Non-engineered timber and masonry | 0.2 |
| | Buildings extremely susceptible to vibration damage | 0.12 |

The vibration criteria developed by the various states also have a wide range of values as shown in Table 4. If the table is carefully analyzed, the vibration limits can be divided into several categories including: modern structures, sensitive structures, and miscellaneous structures. The range of vibration limits for modern structures is from 0.4 to 1.0 in/sec and sensitive structures have a range of 0.08 to 0.2 in/sec. These vibration limits correlate well to the AASHTO and FTA limits. A thorough review of construction vibration limits can be found in several reports including: (Tao and Zhang 2012), (Wilson Ihrig & Associates 2012), and (Cleary 2013).

**Table 4**: State criteria for construction vibrations

| **Organization/Jurisdiction** | **Comments** | **PPV (in/sec)** |
|---|---|---|
| California Department of Transportation (Caltrans 2002) | Upper level for possible damage<br>Threshold for damage to plaster<br>Ruins and ancient monuments | 0.4-0.6<br>0.20<br>0.08 |
| Florida DOT (FDOT 2010) | All construction<br>Fresh concrete | 0.5<br>1.5 |
| Iowa DOT (Iowa DOT n.d.) | Project specific specification | 0.2 |
| Louisiana Department of Transportation and Development (Tao and Zhang 2012) | General scenario<br>- New requirements<br>- Old requirements<br>Historic structures or loose sandy soil | <br>0.5<br>0.2<br>0.1 |
| New Hampshire DOT (NHDOT 2010) | Modern Homes<br>Older Homes | 0.75<br>0.50 |
| New York City DOT (New York City DOT 2009) | Piles driven adjacent to subway structures (may be lowered) | 0.5 |
| Rhode Island DOT (RIDOT 2010) | Lower limits may be applied by engineer | 1.0 |

**Dynamic Settlement**

In addition to structural damage and human perception, dynamic settlement can occur due to construction vibrations. Research has shown that if loose cohesionless soils (loose sands) are present, relatively low vibration levels can cause densification (Dowding 1996). This densification can lead to settlement related damage in adjacent structures. Loose sands are typically defined as having a relative density less than 40% (Tao and Zhang 2012). Dynamic settlement has occurred in some soils at vibration levels as low as 0.1 in/sec. If loose sands are located on or near a project site, then special considerations for construction vibrations need to be considered.

**Vibration Prediction**

Since it is typically unrealistic for most construction projects to conduct full scale testing to determine the expected levels of vibrations and since only a discrete number of locations are measured during testing, several methods have been developed to predict vibration levels. The first prediction equations were developed as early as 1912 by Golitsin who developed a simple equation to predict the peak particle displacement of ground vibrations from earthquakes. The equation, as reported by (Bayraktar, et al. 2013) is as follows,

$$A_2 = A_1\sqrt{r_1/r_2}\, e^{-\gamma(r_2-r_1)}, \quad (1)$$

where $A_1$ is the peak particle displacement of ground vibrations at a distance $r_1$ from the source, $A_2$ is the peak particle displacement of ground vibrations at a distance $r_2$ from the source, and $\gamma$ is a vibration attenuation coefficient.

More recently, several methods have been developed to predict the peak particle velocity (PPV) from construction activity, pile driving in particular. Hendriks (2002) reported several equations to predict the propagation of construction vibrations. The first equation presented by Hendriks was first reported by Richart, et.al. (1970), who cited Bornitz (1931),

$$V = V_o(D_o/D)^{0.5} e^{\alpha(D_0-D)} \quad (2)$$

where V is the peak particle velocity at distance D, $V_o$ is the peak particle velocity at reference distance $D_o$, and $\alpha$ is a vibration attenuation parameter that must be determined experimentally.

Hendriks (2002) also reported a simplified equation for pile driving vibrations that is similar to an equation reported by Woods (1997) as follows,

$$V = V_o(D_o/D)^k \quad (3)$$

where V is the peak particle velocity at distance D, $V_o$ is the peak particle velocity at reference distance $D_o$, and k is a vibration attenuation parameter that must be determined experimentally.

Several researchers have found that a better correlation with predicted and measured vibrations could be determined by including the energy of the pile driving hammer in the equation. This approach is often referred to as the "scaled-distance" approach. One commonly used equation was developed by Wiss and reported by Bayrakter, et al. (2013),

$$v = k\left[D/\sqrt{W_t}\right]^{-n} \quad (4)$$

where $W_t$ is the energy of the source, v is the peak particle velocity at distance D, k is the intercept value of the peak particle velocity at a scaled distance of $D/(W_t)^{1/2}$ equal to one, and n is a vibration attenuation parameter that must be determined experimentally.

The previous equations are relatively accurate at predicting ground vibrations when compared to experimental data, however, they all require testing to determine the soil parameters. Jones & Stokes (2004) performed an extensive literature review and determined that the following equation, with the assumed values shown, could be used to predict pile driving vibrations without experimental evaluations:

$$PPV_{Impact\ Pile\ Driver} = PPV_{Ref}(25/D)^{n}\left(E_{equip}/E_{ref}\right)^{0.5} \quad (5)$$

where $PPV_{Impact\ Pile\ Driver}$ is the peak particle velocity at distance D in feet, $PPV_{Ref}$ is equal to 0.65 in/sec for a reference pile driver at 25 feet, $E_{ref}$ is equal to 36,000 ft-lb (rated energy of reference pile driver), $E_{equip}$ is the rated energy of impact pile driver in foot-pounds, and n is a vibration attenuation parameter with a recommended value of 1.1.

Jones and Stokes also provided a table, Table 5, with suggested "n" values based on the soil type.

**Table 5:** Suggested "n" values based on soil class: Adopted from (Jones & Stokes 2004)

| Soil Class | Description of Soil | Suggested Value of "n" |
|---|---|---|
| I | Weak or soft soils: loose soils, dry or partially saturated peat and muck, mud, loose beach sand, and dune sand, recently plowed ground, soft spongy forest or jungle floor, organic soils, top soil. (shovel penetrates easily) | 1.4 |
| II | Competent soils: most sands, sandy clays, silty clays, gravel, silts, weathered rock. (can dig with shovel) | 1.3 |
| III | Hard soils: dense compacted sand, dry consolidated clay, consolidated glacial till, some exposed rock. (cannot dig with shovel, need pick to break up) | 1.1 |
| IV | Hard, competent rock: bedrock, freshly exposed hard rock. (difficult to break with hammer) | 1.0 |

## EXPERIMENTAL DESIGN

### Overview

The main objective of this research was to determine the distance from nearby structures that pile driving operations can be conducted with minimal risk to those structures. It is important to note that these guidelines were developed for typical piles used by ALDOT at the project site. The project was divided into two phases, collecting data during pile driving and analyzing the data. The information related to the project site, the test piles, the pile driving equipment, and the data collection equipment is located below.

### Project Site

The project site is located on the west bank of the Mobile River, just south of the Alabama Cruise Terminal. The soil profile at the site consists primarily of sandy soils to a depth of 90 feet below the ground surface with a clay layer located at an approximate depth of 90 to 110 feet. Table 6 contains a summary of the soil layers that were defined by a standard penetration test (SPT) conducted at the project site. Appendix A contains the details of the soil investigations conducted by an ALDOT drill crew and Southern Earth Sciences.

**Table 6:** Soil profile at site location

| Depth (ft.) | Basic Material | Average Blow Count | Consistency |
|---|---|---|---|
| 0-23.5 | Sand | 12 | Loose to Medium |
| 23.5-89.5 | Sand | 31 | Medium to Dense |
| 89.5-108.5 | Clay | 28 | Stiff to Very Stiff |
| 108.5-115 | Sand | 27 | Medium |

Figure 3 contains a plan view of the project site. The dashed line in the figure represents the approximate property boundary. Note that the pile locations are approximate and the drawing is not to scale. The arc lines shown in the drawing represent the approximate distance from the piles to where the monitoring equipment was located.

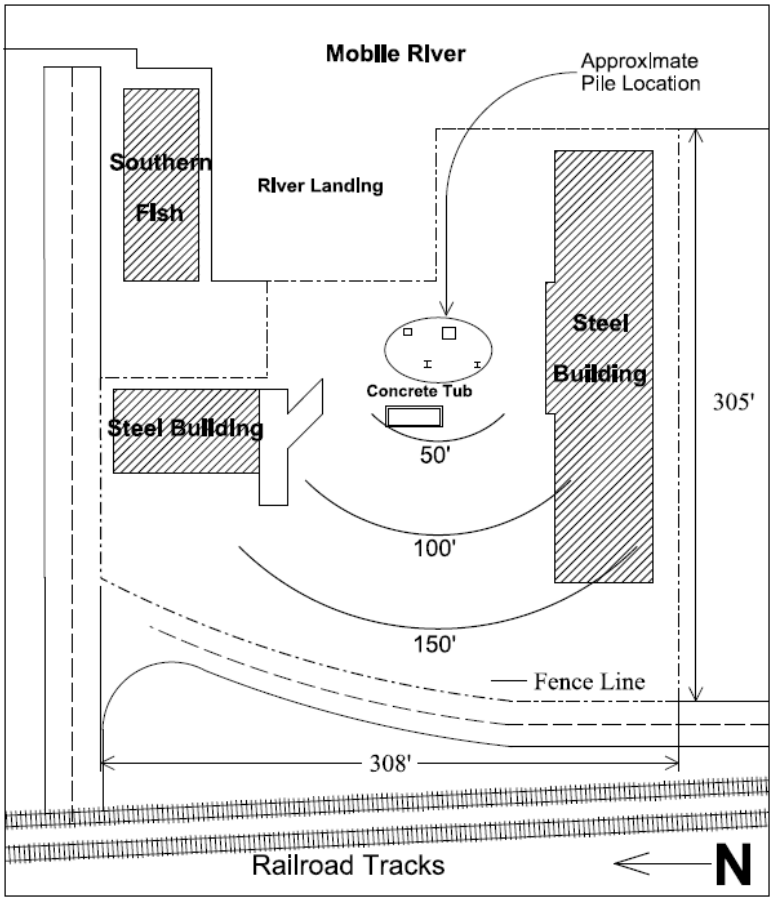



**Figure 3:** Plan view of Mobile River Bridge Project Site

Four test piles were driven for this project, two prestressed precast concrete piles (PPC) and two steel H-Piles. Table 7 contains descriptions of the piles and Appendix B contains the details of the two pile driving hammers utilized on this project. The piles were installed using typical techniques including pile jetting or vibration followed by driving with a diesel hammer. The concrete piles were jetted to a depth of approximately 30 feet and driven to the final elevation using a Delmag Model D-62-22 diesel hammer. A vibratory driver was used to drive the steel HP 14 to 55 feet and the HP 12 to 15 feet. The steel piles were then driven to the final elevation using an APE Model D30-42 diesel hammer.

**Table 7:** Pile descriptions

| Pile | Cross Section | Material | Length |
|---|---|---|---|
| #1 | 24” Square | Precast Concrete | 81 ft |
| #2 | 36” Square | Precast Concrete | 89 ft |
| #3 | HP14x117 | Steel | 106 ft |
| #4 | HP12x53 | Steel | 70 ft |

**Vibration Monitoring**

Data collectors were placed at various locations throughout the pile installation and testing process. The data collectors utilized for this project were Minimate Plus tri-axial geophones manufactured by Instantel. Each tri-axial geophone unit contains three geophones oriented on three mutually perpendicular axes. The units come with software allowing data collection and analysis in several configurations. For this research, the units were configured to collect histogram data during two-second intervals. When configured in this way the data collector measures all vibrations over the interval, but only records the maximum PPV and the frequency that it occurred at for each geophone over the two second interval.

The geophones were placed at predetermined distances from each pile during installation. Three of the data collectors were located at approximately 50, 100, and 150 feet. A fourth data collector, which had two geophone units attached to it, was located at various distances throughout testing to collect additional information. Table 8 contains a detailed account of the location of each data collector during testing.

During the initial driving of the 36-inch PPC pile, geophone number three was located at the edge of the project site near Southern Fish and Oyster, an adjacent property owner. The fourth data collector had one geophone unit placed at 100 feet from the pile and the other geophone unit was attached to the brick façade of a building that was located on the project site. Please note that the 30-day restrike was at 32-days for the 36-inch concrete pile and 31-days for the 24-inch concrete pile.

**Table 8:** Geophone location during testing

| | | Geophone Unit | | | | |
|---|---|---|---|---|---|---|
| **Initial Drive** | **Pile Type** | **#1** | **#2** | **#3** | **#4a** | **#4b** |
| Aug. 19, 2013 | 36” PCP | 50 ft | 150 ft | 69 ft | 100 ft | Building |
| Aug. 20, 2013 | 24” PCP | 99.5 ft | 142 ft | n/a | n/a | n/a |
| Aug. 21, 2013 | HP 12 | 53 ft | 101 ft | 144 ft | n/a | n/a |
| Aug. 21, 2013 | HP 14 | 58 ft | 106 ft | 146 ft | n/a | n/a |
| **24 Hour Restrike** | | | | | | |
| Aug. 22, 2013 | HP 12 | 50 ft | 150 ft | 100 ft | n/a | n/a |
| Aug. 22, 2013 | HP 14 | 50 ft | 150 ft | 100 ft | n/a | n/a |
| **3-Day Restrike** | | | | | | |
| Aug. 22, 2013 | 36” PCP | 50 ft | n/a | 100 ft | n/a | n/a |
| Aug. 23, 2013 | 24” PCP | 50 ft | 150 ft | 100 ft | n/a | n/a |
| **7-Day Restrike** | | | | | | |
| Aug. 26, 2013 | 36” PCP | 50 ft | 150 ft | 100 ft | 75 ft | 125 ft |
| Aug. 27, 2013 | 24” PCP | 50 ft | 150 ft | 100 ft | 75 ft | 125 ft |
| **30-Day Restrike** | | | | | | |
| Sept. 20, 2013 | 36” PCP | 50 ft | 150 ft | 100 ft | n/a | n/a |
| Sept. 20, 2013 | 24” PCP | 55 ft | 155 ft | 105 ft | n/a | n/a |
| Sept. 20, 2013 | HP 12 | 50 ft | 150 ft | 100 ft | n/a | n/a |
| Sept. 20, 2013 | HP 14 | 50 ft | 150 ft | 100 ft | n/a | n/a |

# RESULTS

## Vibration Levels

Vibrations were monitored during installation and restrikes on the 36-inch concrete pile at three, seven, and thirty days. A communication error occurred between the ALDOT personnel, the pile driving contractor, and the research team during the installation of the 24-inch concrete pile which resulted in the start of driving prior to the installation of the vibration monitors. Due to this error, the 24-inch concrete pile only had vibrations monitored during the final stage of driving and at all restrikes. The steel piles were monitored during installation and during the one day and thirty day restrikes.

Baseline vibration data was collected at the project site by monitoring vibration levels due to railroad activity from a pair of railroad tracks located adjacent to the project site, Figure 3. The approximate distance from the tracks to the data collectors was determined and the vibration levels from train activity were evaluated. Due to the relatively low vibration levels recorded during train activity, baseline data was not collected for truck traffic.

The vibration data collected from the project site was analyzed and the peak particle velocity (PPV) from each pile was recorded. Table 9 contains a summary of the results. The largest recorded vibration during this study occurred while driving the 36-inch concrete pile and resulted in a PPV of 0.82 inches per second at a distance of 50 feet.

**Table 9:** Maximum PPV (in/sec) during pile driving operations

| Vibration Source | Horizontal Distance from Pile | | |
|---|---|---|---|
| | **50 feet** | **100 feet** | **150 feet** |
| 36" Concrete Pile | 0.82 | 0.28 | 0.15 |
| HP14x117 | 0.18 | 0.09 | 0.11 |
| HP12x53 | 0.23 | 0.07 | 0.08 |
| Railroad Activity | 0.03[1] | 0.02[1] | 0.02[1] |

[1]The approximate distances were 60, 110, and 160 feet

Figure 4 shows the maximum PPV for the 36-inch concrete pile, the H-Piles, and railroad activity observed during testing. Since the maximum vibrations occurred during the beginning of the driving process, the 24-inch concrete pile was not included in this figure. The figure confirms that the largest vibrations recorded were associated with the installation of the 36-inch concrete pile.

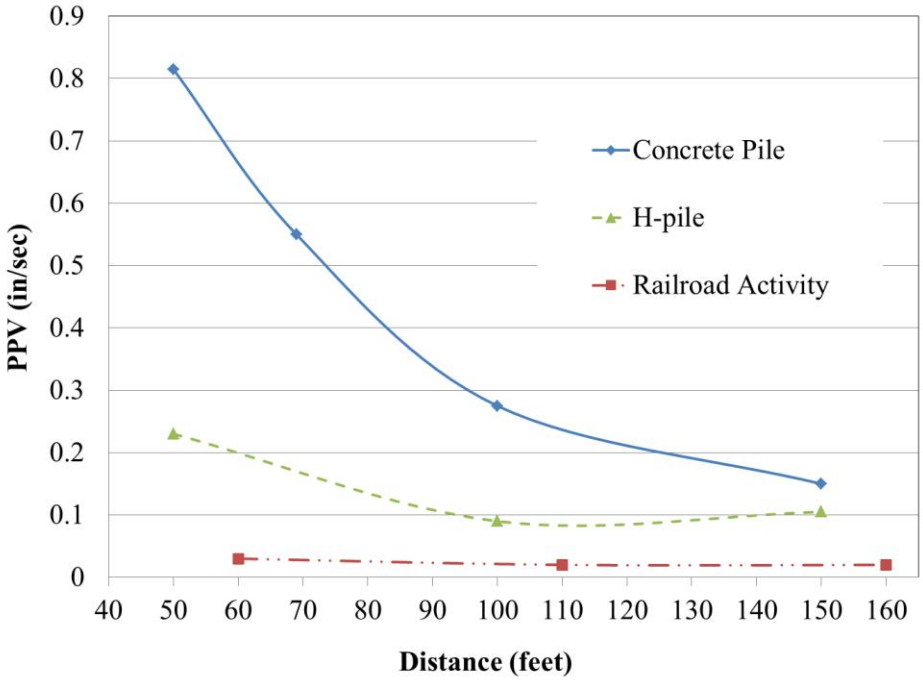



**Figure 4:** Maximum recorded vibration levels during pile installation

During the driving of the 36-inch concrete pile, one of the geophones was attached to the brick façade of a building that was located on the project site. The building was located to the south of the piles, Figure 3, and was approximately 90 feet from the 36-inch concrete pile. The brick façade was located on the west end of the building and was approximately 140 feet from the pile. The data from this geophone was analyzed and it was determined that the vibration levels were below the threshold for detection, 0.005 in/sec. This indicates that the ground vibrations did not have enough energy to cause vibrations in the building. Additionally, crack width monitors were installed on the outside wall of the building. The crack widths and lengths were monitored throughout the project and it was determined that there were no changes in any of the cracks.

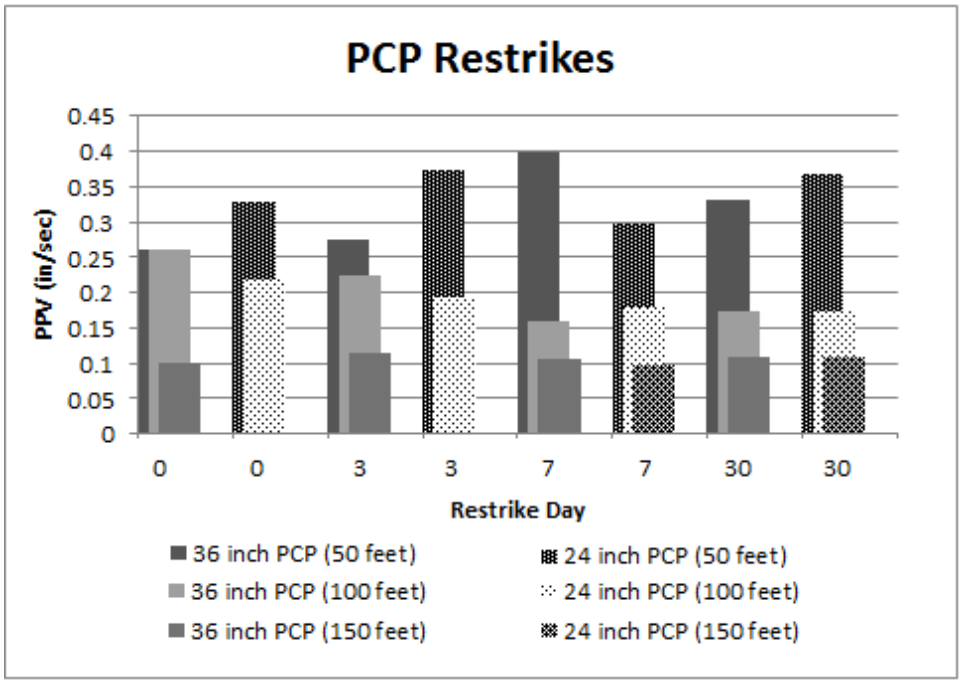



**Figure 5:** Bar chart of restrikes on precast concrete piles (PCP)

An analysis was performed to compare the vibrations between the 24- and 36-inch concrete piles since data was not collected throughout the driving of the 24-inch pile. Figure 5 shows a bar chart of the vibration levels for each of the concrete piles during the restrikes, note that day zero is at the end of drive. Figure 6 shows the same data in the form of a data plot. The data indicates that the vibration levels for the 24- and 36-inch concrete piles are similar and that the maximum vibrations, near the start of driving, would be expected to be approximately equal for each concrete pile.

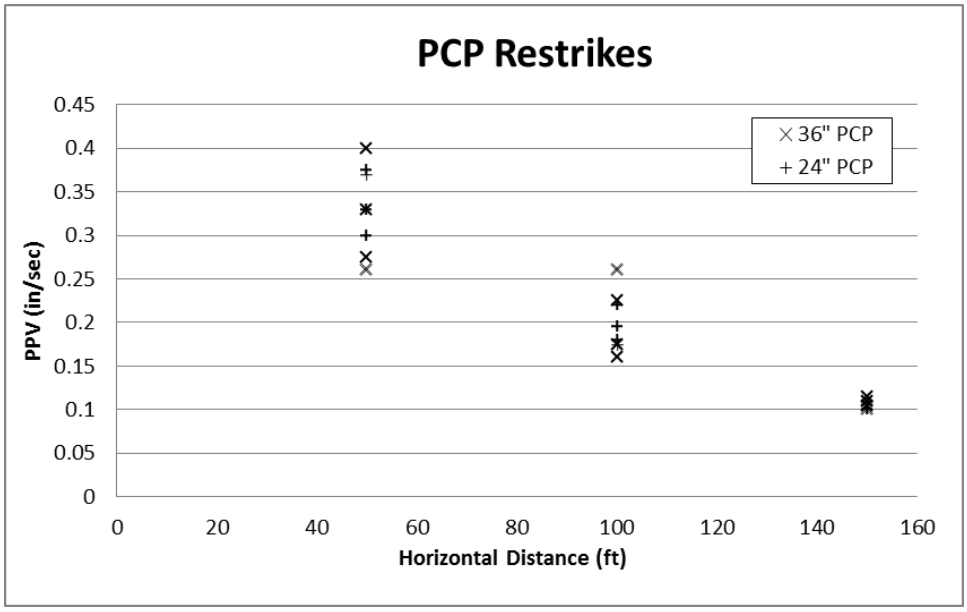



**Figure 6:** Data plot of restrikes on precast concrete piles (PCP)

**Prediction Equation**

The second major objective of this project was to develop a methodology to predict the vibration level at various distances from the pile location. Since the primary use of this research is for determining the vibration levels for piles typically used by ALDOT located at or near the project site, two prediction equations were developed. The equations are based on the maximum peak particle velocities while driving the 36-inch concrete pile and the H-piles. Both equations are based on Equation 3, as presented by Hendriks (2002), where the vibration attenuation parameter (*k*) was determined with the experimental data. Equation 6 was developed to predict vibrations for 36 inch concrete pile,

$$PPV = 0.15\left(\frac{150}{d}\right)^{1.6}, \tag{6}$$

and Equation 7 was developed to predict vibrations for the H-piles,

$$PPV = 0.23\left(\frac{50}{d}\right)^{1.6}, \tag{7}$$

where, in both equations, *PPV* is the peak particle velocity at distance (*d*) in inches per second and *d* is the distance from the pile in feet.

Figure 7 shows a plot of the experimental data and the peak particle velocities based on the prediction equation. The results indicate that the prediction equation model fit the experimental data well. However, due to the unusual increase in vibration magnitude at 150 feet for the H-piles, the prediction equation under-predicts the vibration magnitude at 150 feet. It was also noted that the soil attenuation parameter (*k*) for both equations was determined to be 1.6. This was expected since the parameter is primarily dependent on the soil properties and less dependent on the pile type or hammer energy.

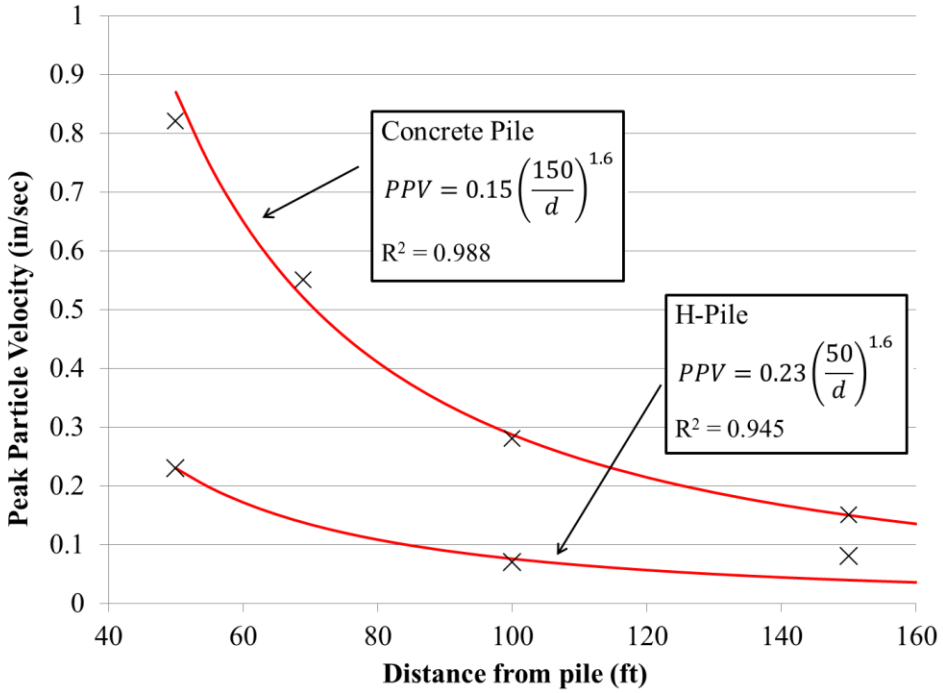



**Figure 7:** Peak particle velocity versus distance

## CONCLUSIONS

The experimental data shows that the largest vibrations occurred during the installation of the 36-inch concrete pile, which was recorded as 0.82 inches per second. According to the research presented in Table 2 (Hendriks 2002), a vibration level of 0.82 inches per second has the potential to cause structural damage to an adjacent structure. However, this vibration was recorded at a distance of 50 feet from the pile; the vibration level at 100 feet from the pile was reduced to 0.275 inches per second. This vibration level could cause potential architectural damage to buildings constructed with plaster, but would not likely cause structural damage. At 150 feet the vibration levels were reduced to 0.15 inches per second, a level that would have little to no risk of damage to adjacent structures.

Based on the experimental data and a thorough review of the literature, it is recommend that a maximum vibration level of 0.5 inches per second for modern structures and 0.1 inches per second for potentially sensitive structures be allowed for construction activity at or near the location of the project site. These vibration levels are the allowable levels at the location of the structure. To determine if any structures should be surveyed and monitored for potential vibration damage, a survey distance of 150 feet for modern structures and 250 feet for potentially sensitive structures should be established. The monitoring distances should be measured from the source of the vibration. The ground vibration prediction equation that was developed would estimate a peak particle velocity of 0.15 inches per second at 150 feet and 0.07 inches per second at 250 feet. The survey distances are well beyond the distance where the prediction equation would estimate vibration levels of 0.5 and 0.1 inches per second and therefore would represent conservative survey distances to ensure adjacent structures are not damaged.

### Recommendations for Future Research

The research presented in this report contains detailed analysis for a particular location in the state of Alabama; however, data has not been collected and analyzed for other regions of the state with differing soil conditions. A state wide research project should be initiated to determine vibration propagation and attenuation criteria for soil conditions located throughout the state. This data could be used to develop prediction equations that could be used in project planning. Additionally, the results of this research could be used to develop model vibration specifications for the state of Alabama.

In addition to the research mentioned above, it is recommended that a vibration monitoring program be developed for any large scale construction projects in urban environments. These programs could be used not only to ensure the construction activity is not damaging nearby structures, but to ensure the public that the DOT is proactive in preventing damage.

## REFERENCES


AASHTO. *Standard recommended practice for evaluation of transportation-related earthborne vibrations.* Washington, DC: Designation R8-81, American Association of State Highway and Transportation Officials, 1990.

Bayraktar, Mehmet Emre, Youngcheol Kang, Mark Svinkin, and Farrukh Arif. *Evalaluation of Vibration Limits and Mitigation Technuques for Urban Construction.* Final Report (FDOT Contract No.: BDK80 977-22), Tallahassee, FL: Florida Department of Transportation, 2013.

Board, Transportation Research. *NCHRP Synthesis of Highway Practice: Dynamic Effects of Pile Installation on Adjacent Structures.* Engineering, Washington, D.C: National Research Council, 1997.

Caltrans. *Transportation Related Earthborne Vibrations.* Technical Advisory, TAV-02-01-R9601, California Department of Transportation, 2002.

Cleary, John. "Synopsis on State Requirements for Vibrations During Pile Driving." *ASCE Texas Section Fall Conderence and ASCE Construction Institute Summit.* Dallas, Texas, 2013.

Dowding, Charles H. *Construction Vibrations.* Upper Saddle River, NJ: Prentice Hall, 1996.

FDOT. *Standard Specifications for Road and Bridge Construction.* Florida Department of Transportation, 2010.

FTA. *Transit Noise and Vibration Impact Assessment.* Washington, DC: Federal Transit Administration, Prepared by C.E. Hanson, D.A. Towers, and L.D. Meister, Prepared for the Office of Planning and Environment, 2006.

Google, Google Maps. *"Mobile, AL." Map.* November 1, 2013.

Hanson, Carl, David Towes, and Meister Lance. *Transit Noise and Vibration Impact Assesment.* Washington D.C.: United States of America Department of Transportation, Federal Transit Administration, 2006.

Hendriks, Rudy. *Transportation Related Earthborne Vibrations.* Engineering, Sacramento: California Department of Transportation, 2002.

Iowa DOT. *Special Provisions for Vibration Monitoring (Multiple).* Iowa Department of Transportation, n.d.

Jones & Stokes. *Transportation- and construction-induced vibration guidance manual.* June. (J&S 02-039.) Sacramento, CA. Prepared for California Department of Transportation, Noise, Vibration, and Hazardous Waste Management Office, 2004.

New York City DOT. *Standard Highway Specifications.* New York City Department of Transportation, 2009.

NHDOT. *Standard Specifications for Road and Bridge Construction.* New Hampshire Department of Transportation, 2010.

Richart, F. E., R. D. Woods, and J. R. Hall. *Vibrations of Soils and Foundations.* Englewood Cliffs, New Jersey: Prentice-Hall, 1970.

RIDOT. *Standard Specifications for Road and Bridge Construction.* Rhode Island Department of Transportation, 2010.

Siskind, D E, M S Stagg, J W Kopp, and C H Dowding. *Structure Response and Damage Produced by Ground Vibration From Surface Mine Blasting.* Washington, D.C.: Report of Investigations 8507, U.S. Bureau of Mines, 1980.

Tao, Mingjiang, and Mo Zhang. *Update LADOTD Policy on Pile Driving Vibration Management.* FHWA/LA.11/483: Louisiana Department of Transportation and Development, 2012.

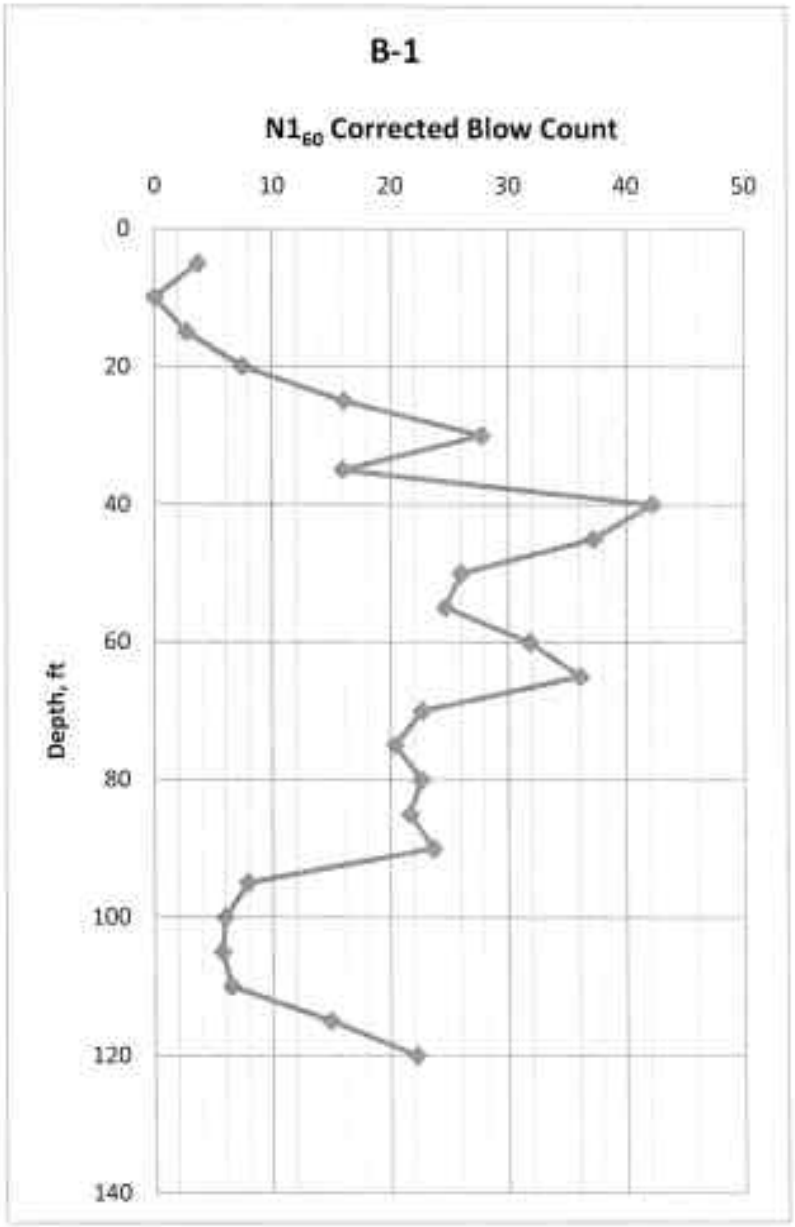
Wilson Ihrig & Associates, ICF International, and Simpson Gumpertz & Heger. *Current Practices to Address Construction Vibration and Potential Effects to Historic Buildings Adjacent to Transportation Projects: NCHRP 25-25/Task 72.* National Cooperative Highway Research Program, 2012.

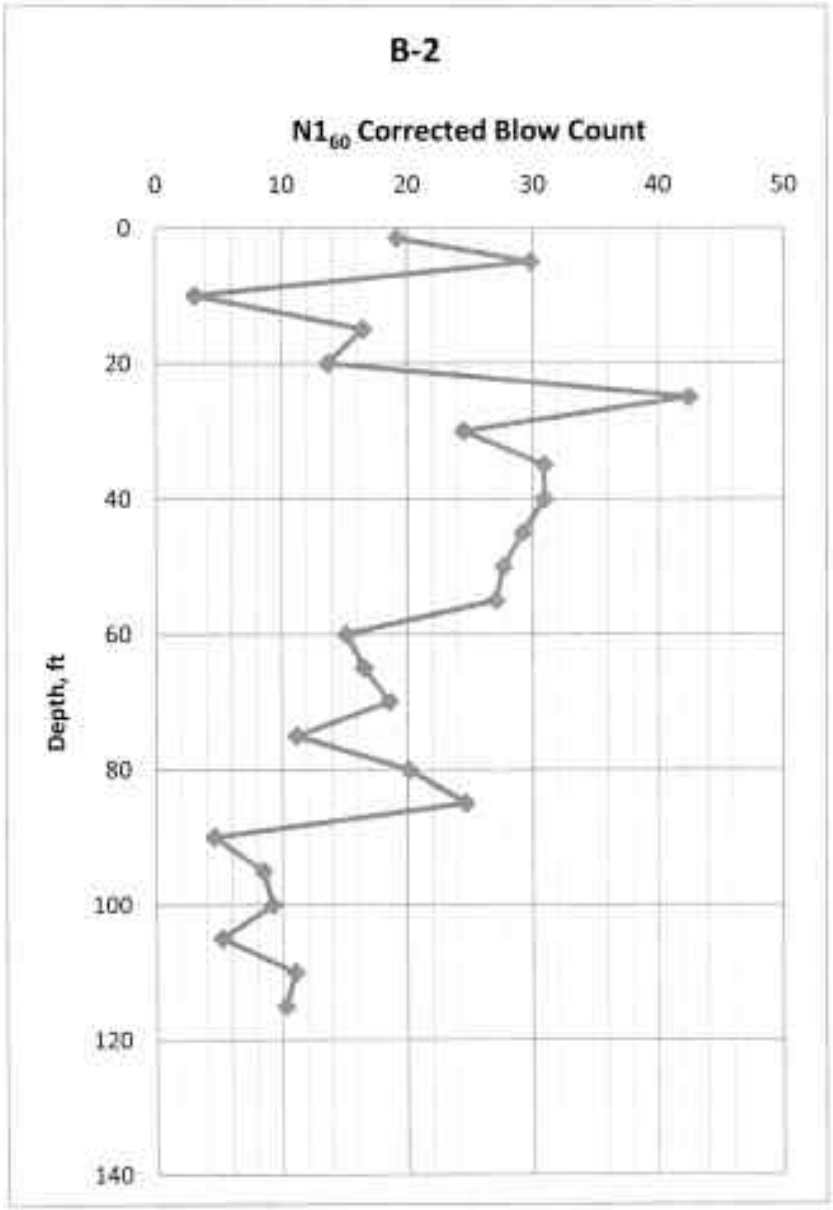
Woods, R D. *Dymanic Effects of Pile Installations on Adjacent Structures, NCHRP Synthesis 253.* Washington, D.C.: Transportation Research Board, National Research Council, 1997.

## Appendix A: Soil Reports

Two soil investigations were performed at the site. The first was a Standard Penetration Test (SPT), which was performed at two locations. The first location, labeled B-1 in the documents that follow, was located at a property owned by ALDOT that is several hundred feet to the west of the project site. This location was an alternate location for testing. The second location, labeled B-2, was at the project site in the vicinity of where the test piles were installed. The SPT test was performed by an ALDOT drill crew.

The second soil investigation performed was a Seismic Cone Penetration Test (SCPT). Two locations were also investigated, both on the project site. The first test was performed at the location of the test piles and the second was located at 100 to 120 feet from the test piles. The results of both investigations are included here. The SCPT was conducted by Southern Earth Sciences.


B-1
N1$_{60}$ Corrected Blow Count
0
10
20
30
40
50
Depth, ft
0
20
40
60
80
100
120
140


B-2
N1$_{60}$ Corrected Blow Count
0
10
20
30
40
50
Depth, ft
0
20
40
60
80
100
120
140

Project# DPI-0030 (005) Division 9th

Station _____ Offset _____ Ft _____

Ground Elev. 0.0 Water Elev. in Hole _____

Depth of Strata BOR# B-1 Visual BOR Loc. _____

| From | To | Consistency or Density | Approx. Moisture | Color | Basic Matl. |
|---|---|---|---|---|---|
| 0.0 | 0.3 | Asphalt | | | |
| 0.3 | 18.5 | V. Loose | Moist | Br | br. Sand |
| 18.5 | 23.5 | Loose | Moist | Br | SAND |
| 23.5 | 38.5 | Med | Moist | TAN | SAND |
| 38.5 | 63.5 | Dense | Moist | TAN | sand |
| 63.5 | 68.5 | Very Dense | Moist | TAN | Sand |
| 68.5 | 93.5 | Dense | Moist | Tan | Sand |
| 93.5 | 108.5 | Stiff | Moist | Gray | Clay |
| 108.5 | 118.5 | HARD | Moist | Gray | Clay |
| 118.5 | 120.0 | Dense | Moist | Gray | SAND |

Remarks by Driller Installed well monitor

GPS Cord. 42' 11"

LAT. Water - 10' 3" 24 Hrs

LONG.

County Mobile Date 8-8-12

C/L Driller Young / Evans

Type Drill Used SE 9050 Total Hole Depth 120.0

Identification CME 550X 2.25 Hollow Stem

| Other Pertinent Components | Sample No. | Penetration or Sample Elev. From | To | "N" Blow .5 | 1.0 | 1.5 | "N" Value |
|---|---|---|---|---|---|---|---|
| * | 1-A | 3.5 | 5.0 | 1 | 1 | 1 | 2 |
| W/ clay * | 1-B | 8.5 | 10.0 | W | O | H | WOH |
| * | 1-C | 13.5 | 15.0 | WH | 1 | 1 | 2 |
| | 1-D | 18.5 | 20.0 | 1 | 2 | 4 | 6 |
| | 1-E | 23.5 | 25.0 | 5 | 5 | 9 | 14 |
| | 1-F | 28.5 | 30.0 | 10 | 12 | 14 | 26 |
| | 1-G | 33.5 | 35.0 | 9 | 7 | 9 | 16 |
| W/ Sand * | 1-H | 38.5 | 40.0 | 26 | 23 | 22 | 45 |
| W/ Sand * | 1-I | 43.5 | 45.5 | 23 | 23 | 19 | 42 |
| More matl | 1-J | 48.5 | 50.0 | 11 | 14 | 17 | 31 |
| | 1-K | 53.5 | 55.0 | 9 | 16 | 15 | 31 |
| | 1-L | 58.5 | 60.0 | 18 | 20 | 22 | 42 |
| * | 1-M | 63.5 | 65.0 | 20 | 23 | 27 | 50 |
| * | 1-N | 68.5 | 70.0 | 14 | 16 | 17 | 33 |
| | 1-O | 73.5 | 75.0 | 7 | 15 | 16 | 31 |

* Samples in Jars

Project# DPT-0030 (005) Division 9th

Station _____ Offset _____ Ft _____

Ground Elev. _____ Water Elev. in Hole _____

Depth of Strata BOR# B-1 Visual BOR Loc. _____

| From | To | Consistency or Density | Approx. Moisture | Color | Basic Matl. |
|---|---|---|---|---|---|
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Remarks by Driller _____

GPS Cord. _____

LAT. _____

LONG. _____

County Mobile Date 8-6-12

_____ C/L Driller Young/Evans

Type Drill Used SE 9050 Total Hole Depth 120.0'

Identification CME 550X 2.25 Hollow Stem

| Other Pertinent Components | Sample No. | Penetration or Sample Elev. From | To | "N" Blow .5 | 1.0 | 1.5 | "N" Value |
|---|---|---|---|---|---|---|---|
| | 1-P | 78.5 | 80.0 | 12 | 17 | 19 | 36 |
| | 1-Q | 83.5 | 85.0 | 12 | 18 | 18 | 36 |
| | 1-R | 88.5 | 90.0 | 17 | 22 | 19 | 41 |
| * | 1-S | 93.5 | 95.0 | 3 | 6 | 8 | 14 |
| | 1-T | 98.5 | 100.0 | 5 | 5 | 6 | 11 |
| | 1-U | 103.5 | 105.0 | 4 | 5 | 6 | 11 |
| * | 1-V | 108.5 | 110.0 | 3 | 6 | 7 | 13 |
| * | 1-W | 113.5 | 115.0 | 6 | 15 | 16 | 31 |
| * | 1-X | 118.5 | 120.0 | 13 | 21 | 27 | 48 |
| | | | | | | | |
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| | | | | | | | |

1-S HAS A JAR Samples of Clay

Project# DP1-0030 (005) Division 9th

Station _____ Offset _____ Ft _____

Ground Elev. 0.0 Water Elev. in Hole _____

Depth of Strata BOR# B-2 Visual BOR Loc. _____

| From | To | Consistency or Density | Approx. Moisture | Color | Basic Matl. |
|---|---|---|---|---|---|
| 0.0 | 0.2 | Topsoil | — | | |
| 0.2 | 3.5 | Loose | Moist | Br | Sand |
| 3.5 | 8.5 | Med | Moist | Br | Sand |
| 8.5 | 13.5 | V Loose | Moist | Br | Sand |
| 13.5 | 23.5 | Med | Moist | Gray | Sand |
| 23.5 | 28.5 | Dense | Moist | Tan | Sand |
| 28.5 | 33.5 | Med | Moist | Tan | Sand |
| 33.5 | 58.5 | Dense | Moist | Tan | Sand |
| 58.5 | 78.5 | Med | Moist | Tan | Sand |
| 78.5 | 89.5 | Dense | Moist | Tan | Sand |
| 89.5 | 93.5 | Stiff | Moist | Gray | Clay |
| 93.5 | 103.5 | V Stiff | Moist | Gray | Clay |
| 103.5 | 108.5 | Stiff | Moist | Gray | Clay |
| 108.5 | 115.0 | Med | Moist | Gray | Sand |
| | | | | | |

Remarks by Driller _____

GPS Cord. _____

LAT. _____

LONG. _____

County Mobile Date 8-9-12

C/L Driller Turner / Evans

Type Drill Used SE 9050 Total Hole Depth 115.0

Identification CME 550X 2.25 Hollow Stems

| Other Pertinent Components | Sample No. | Penetration or Sample Elev. From | To | "N" Blow .5 | 1.0 | 1.5 | "N" Value |
|---|---|---|---|---|---|---|---|
| * | 2-A | 0.0 | 1.5 | 4 | 4 | 4 | 8 |
| w/ Gravel * | 2-B | 3.5 | 5.0 | 5 | 7 | 9 | 16 |
| w/ Org. Matl. * | 2-C | 8.5 | 10.0 | 1 | 1 | 1 | 2 |
| * | 2-D | 13.5 | 15.0 | 2 | 5 | 7 | 12 |
| | 2-E | 18.5 | 20.0 | 5 | 4 | 7 | 11 |
| * | 2-F | 23.5 | 25.0 | 16 | 18 | 19 | 37 |
| | 2-G | 28.5 | 30.0 | 10 | 11 | 12 | 23 |
| * | 2-H | 33.5 | 35.0 | 7 | 15 | 16 | 31 |
| | 2-I | 38.5 | 40.0 | 7 | 13 | 20 | 33 |
| — | 2-J | 43.5 | 45.0 | 9 | 14 | 19 | 33 |
| w/ Sand & Org matl | 2-K | 48.5 | 50.0 | 7 | 15 | 18 | 33 |
| | 2-L | 53.5 | 55.0 | 10 | 16 | 18 | 34 |
| * | 2-M | 58.5 | 60.0 | 10 | 10 | 10 | 20 |
| | 2-N | 63.5 | 65.0 | 6 | 12 | 11 | 23 |
| | 2-O | 68.5 | 70.0 | 12 | 17 | 10 | 27 |

* Jar Sample

Project# _____ Division _____

Station _____ Offset _____ Ft _____

Ground Elev. _____ Water Elev. in Hole _____

Depth of Strata BOR# B-2 Visual BOR Loc. _____

| From | To | Consistency or Density | Approx. Moisture | Color | Basic Matl. |
|---|---|---|---|---|---|
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Remarks by Driller _____

GPS Cord. _____

LAT. _____

LONG. _____

County _____ Date 8-9-12

_____ C/L Driller _____

Type Drill Used _____ Total Hole Depth 115'

Identification

| Other Pertinent Components | Sample No. | Penetration or Sample Elev. From | To | "N" Blow .5 | 1.0 | 1.5 | "N" Value |
|---|---|---|---|---|---|---|---|
| | 2-T | 73.5 | 75 | 6 | 7 | 10 | 17 |
| * | 2-U | 78.5 | 80.0 | 6 | 11 | 21 | 32 |
| | 2-R | 83.5 | 85.0 | 12 | 18 | 23 | 41 |
| * | 2-S | 88.5 | 90.0 | 4 | 4 | 4 | 8 |
| * | 2-T | 93.5 | 95.0 | 6 | 7 | 8 | 15 |
| * | 2-U | 98.5 | 100.0 | 1 | 9 | 8 | 17 |
| * | 2-V | 103.5 | 105.0 | 2 | 4 | 6 | 10 |
| * | 2-W | 108.5 | 110.0 | 5 | 9 | 13 | 22 |
| | 2-X | 113.5 | 115.0 | 6 | 9 | 13 | 22 |
| | | | | | | | |
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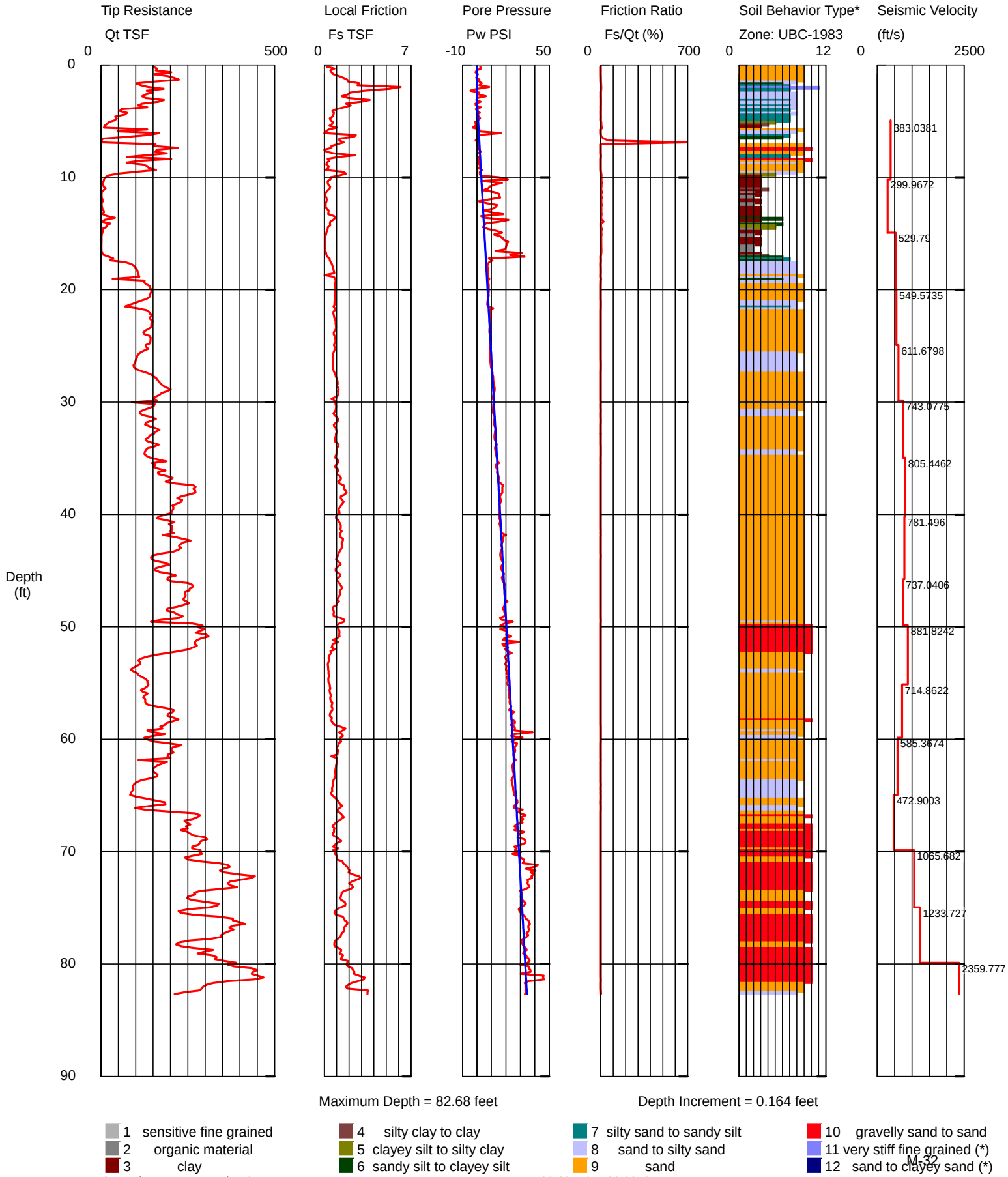
| | | | | | | | |

2-T has 3 Jars
2-U has 2 Jars
2-V has 3 Jars

# Southern Earth Sciences

Operator: Mike Wright
Sounding: SCPT-1
Cone Used: DDG0892

CPT Date/Time: 8/14/2013 9:08:56 AM
Location: Test Pile Evaluation
Job Number: 13-000




Maximum Depth = 82.68 feet

Depth Increment = 0.164 feet

1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

Groundwater measured at 3.1'

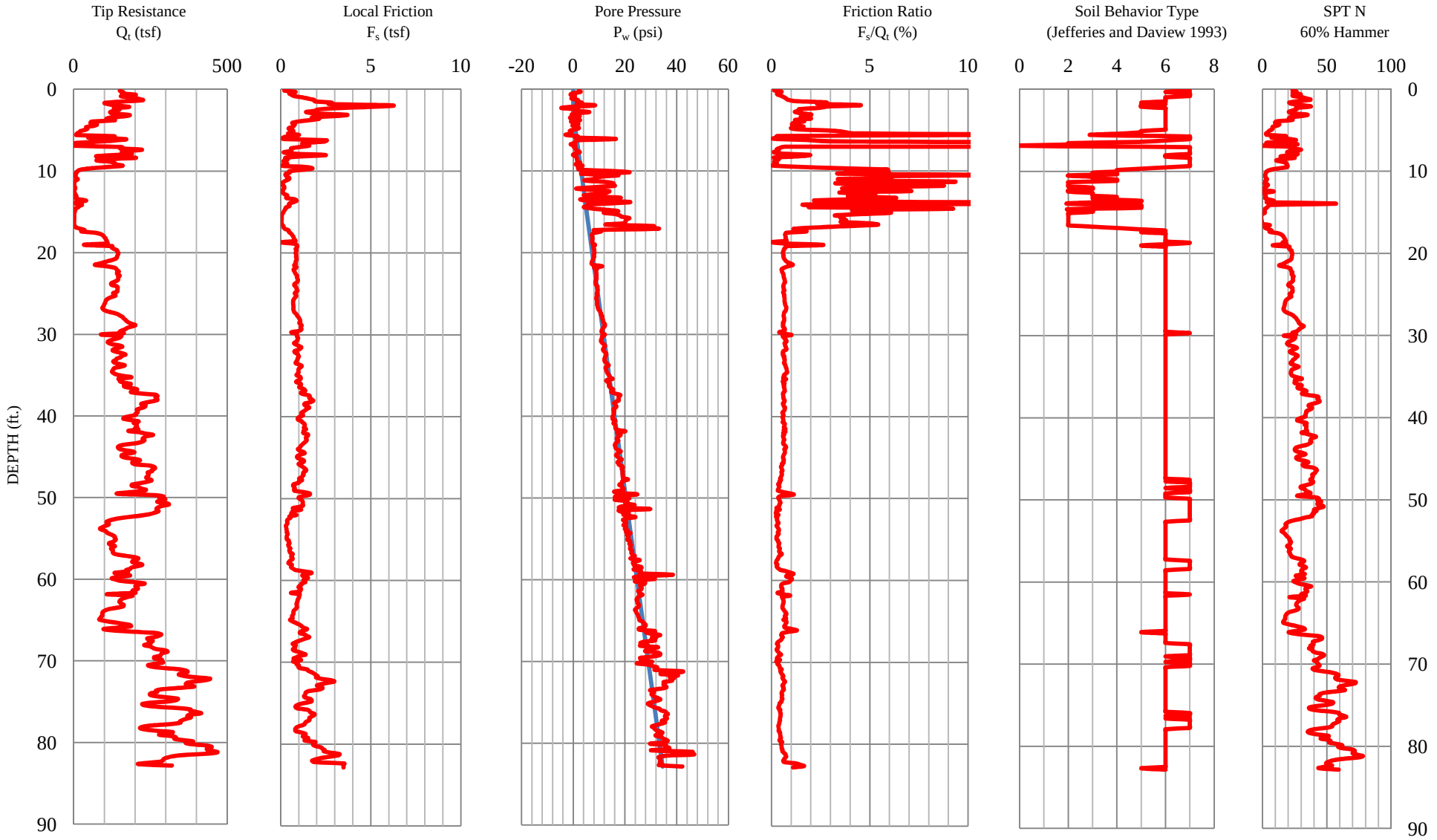
N30.68546 W88.03791

*Soil behavior type and SPT based on data from UBC-1983

# CONE PENETRATION TEST LOG

SOUTHERN EARTH SCIENCES, INC.
Geotechnical, Environmental & Construction Materials Testing

| | | | | | |
|---|---|---|---|---|---|
| **Project Name:** | Test Pile Evaluation | **Cone Used:** | DDG0892 | **Groundwater Level:** | 3.1 feet |
| **Project No.:** | 13-000 | **Operator:** | Mike Wright | **Elevation:** | Unknown |
| **Sounding:** | SCPT-1 | **CPT Date:** | 8/14/2013 | **Lat/Long:** | N30.68546 W88.03791 |




Baseline Data:

| | $Q_t$ (tsf) | $F_s$ (tsf) | $P_w$ (psi) |
|---|---|---|---|
| Initial Baseline: | 0 | 0 | 0 |
| Final Baseline: | -0.602 | 0.002 | -0.172 |

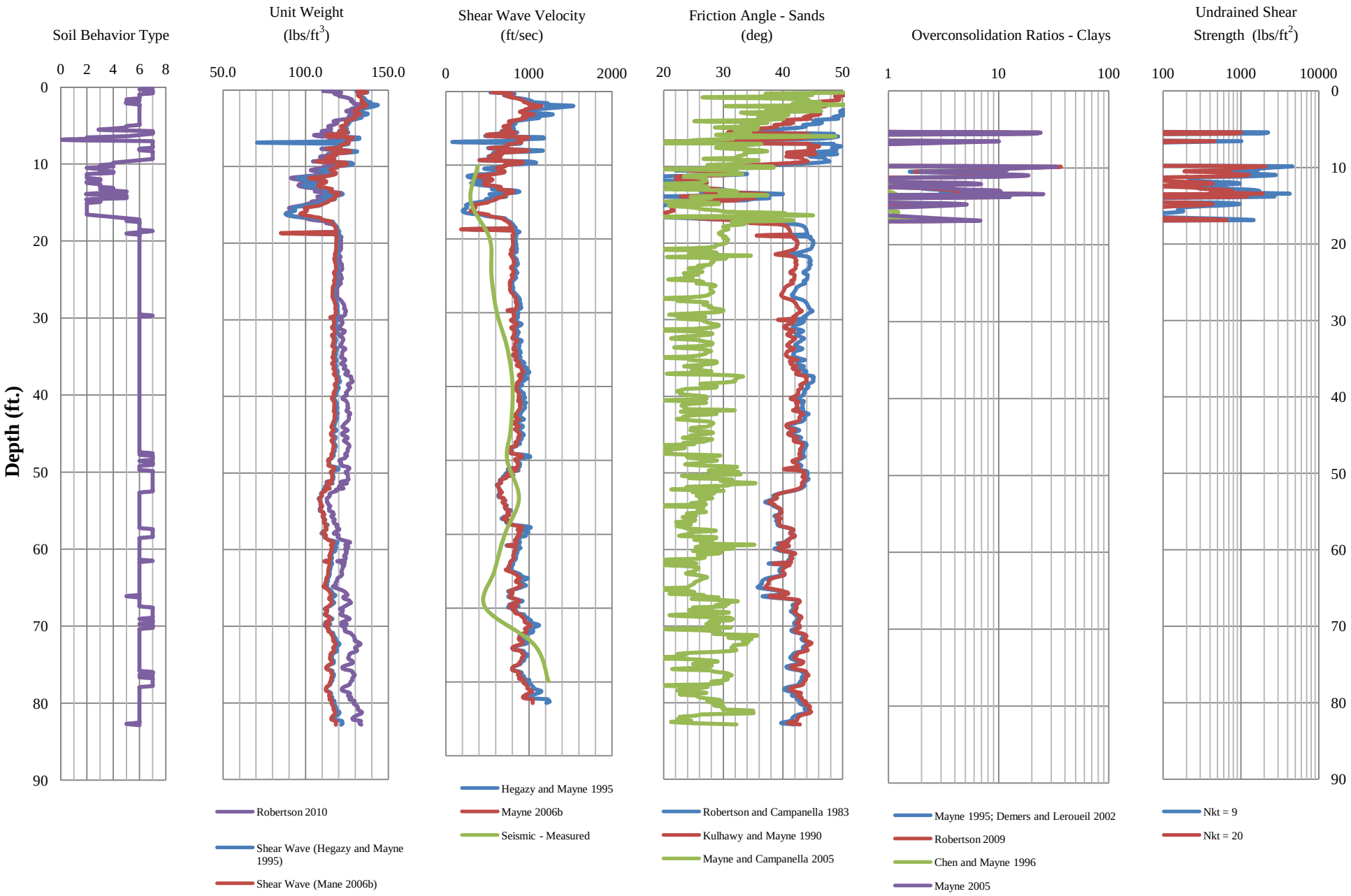
SPT N, SOIL BEHAVIOR TYPE, OR ZONE NUMBER FROM CPT CLASSIFICATION INDEX, Ic

Organic Clay Soils = 2, Clays = 3, Silt Mixtures = 4, Sand Mixtures = 5, Sands = 6, Gravelly Sands = 7

# CONE PENETRATION TEST LOG

SOUTHERN EARTH SCIENCES, INC.
Geotechnical, Environmental & Construction Materials Testing

| | | | | | |
|---|---|---|---|---|---|
| **Project Name:** | Test Pile Evaluation | **Cone Used:** | DDG0892 | **Groundwater Level:** | 3.1 feet |
| **Project No.:** | 13-000 | **Operator:** | Mike Wright | **Elevation:** | Unknown |
| **Sounding:** | SCPT-1 | **CPT Date:** | 8/14/2013 | **Lat/Long:** | N30.68546 W88.03791 |

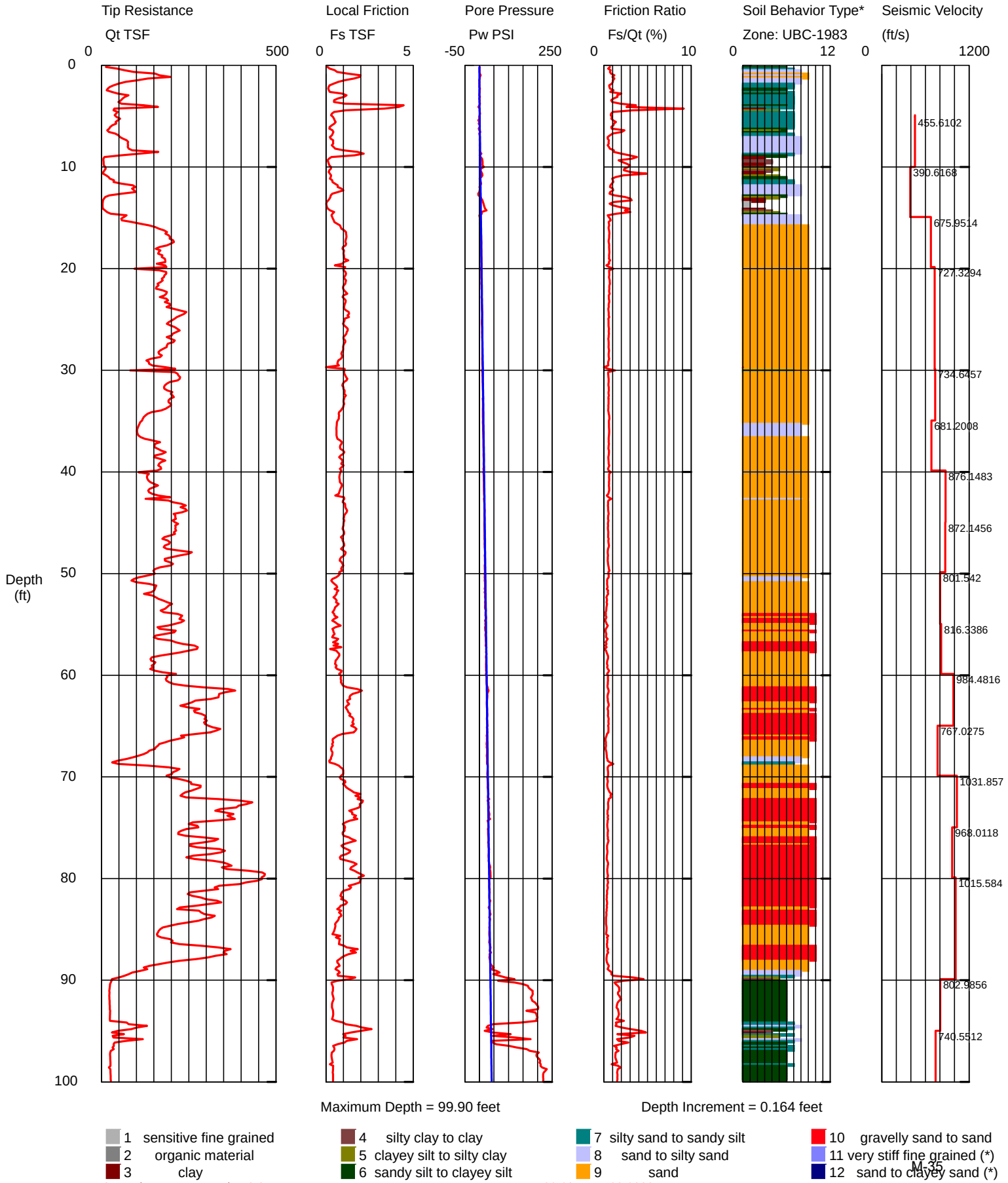



PARAMETERS ABOVE ARE BASED UPON EMPIRICAL CORRELATIONS AND SHOULD BE CONSIDERED APPROXIMATE. IT IS RECOMMENDED THAT CALCULATED PARAMETERS BE CORRELATED BY SPECIFIC LABORATORY DATA AND/OR LOCAL EXERIENCE.

# Southern Earth Sciences

Operator: Mike Wright
Sounding: SCPT-2
Cone Used: DDG0892

CPT Date/Time: 8/14/2013 10:35:15 AM
Location: Test Pile Evaluation
Job Number: 13-000




Maximum Depth = 99.90 feet

Depth Increment = 0.164 feet

1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

Groundwater measured at 3.2'

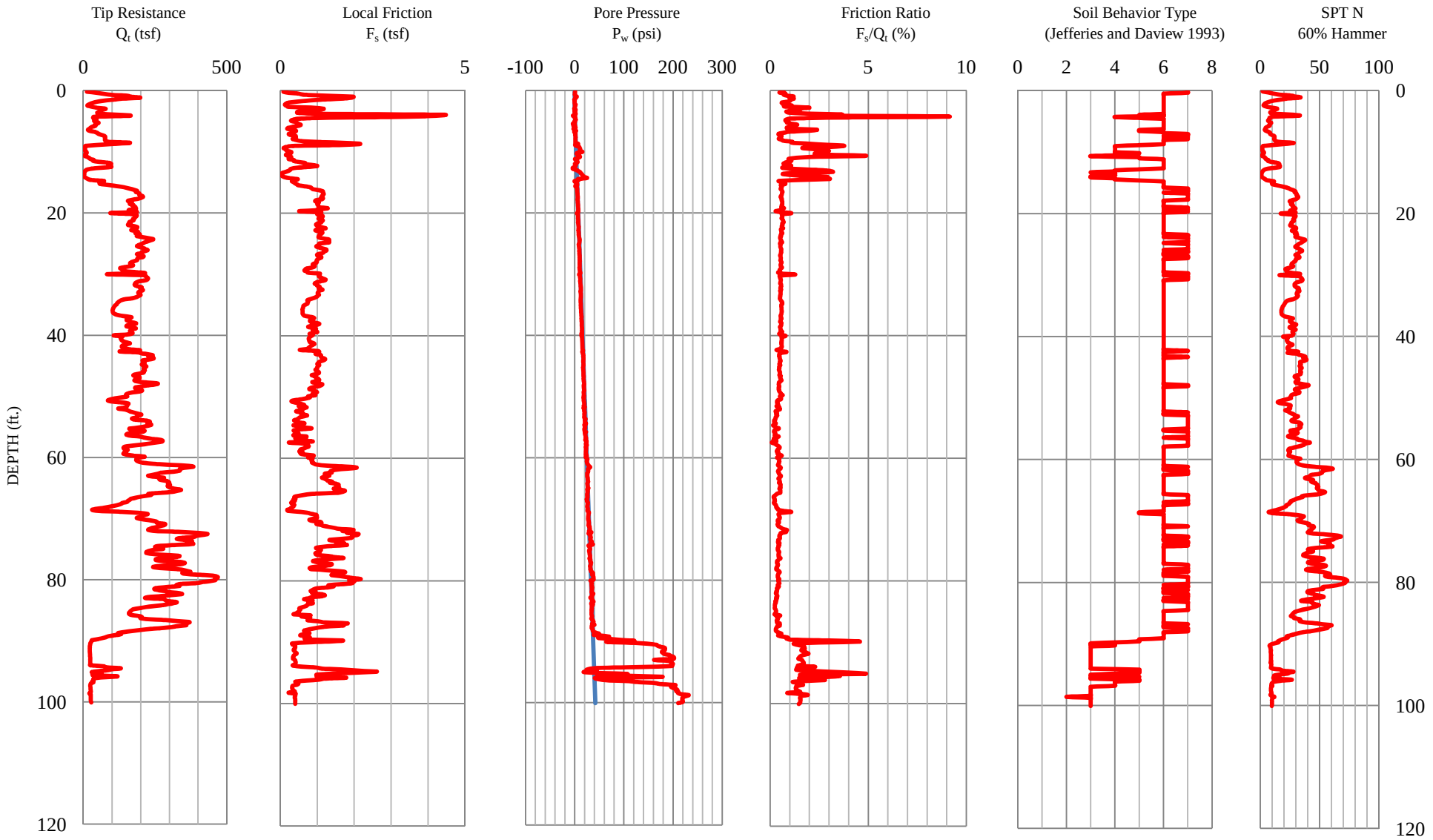
N30.68541 W88.03821

*Soil behavior type and SPT based on data from UBC-1983

# CONE PENETRATION TEST LOG

SOUTHERN EARTH SCIENCES, INC.
Geotechnical, Environmental & Construction Materials Testing

| | | | | | |
|---|---|---|---|---|---|
| **Project Name:** | Test Pile Evaluation | **Cone Used:** | DDG0892 | **Groundwater Level:** | 3.2 feet |
| **Project No.:** | 13-000 | **Operator:** | Mike Wright | **Elevation:** | Unknown |
| **Sounding:** | SCPT-2 | **CPT Date:** | 8/14/2013 | **Lat/Long:** | N30.68541 W88.03821 |




Baseline Data:

| | $Q_t$ (tsf) | $F_s$ (tsf) | $P_w$ (psi) |
|---|---|---|---|
| Initial Baseline: | 0 | 0 | 0 |
| Final Baseline: | 0.357 | 0.012 | 0.210 |

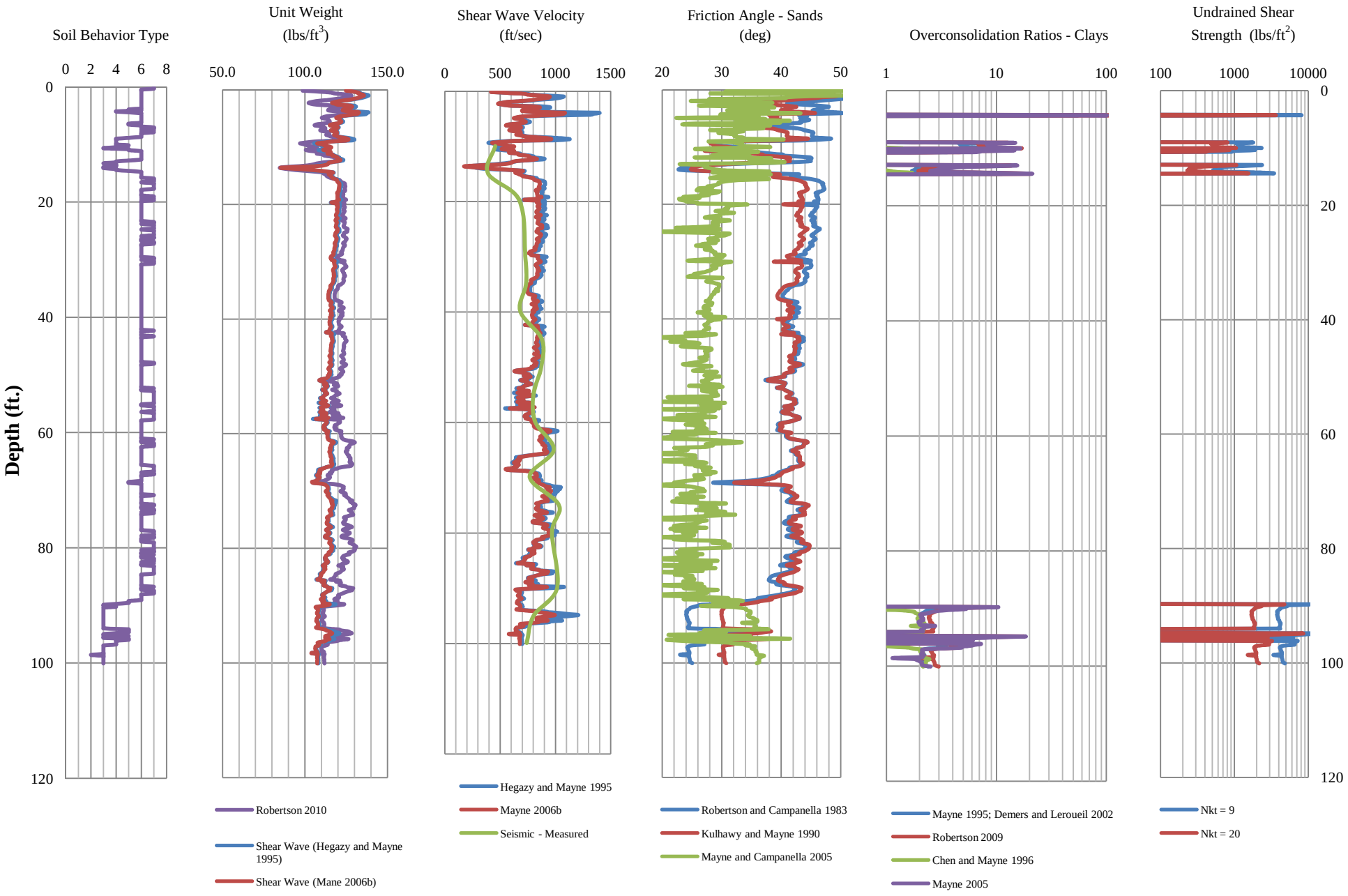
SPT N, SOIL BEHAVIOR TYPE, OR ZONE NUMBER FROM CPT CLASSIFICATION INDEX, Ic

Organic Clay Soils = 2, Clays = 3, Silt Mixtures = 4, Sand Mixtures = 5, Sands = 6, Gravelly Sands = 7

# CONE PENETRATION TEST LOG

SOUTHERN EARTH SCIENCES, INC.
Geotechnical, Environmental & Construction Materials Testing

| | | | | | |
|---|---|---|---|---|---|
| **Project Name:** | Test Pile Evaluation | **Cone Used:** | DDG0892 | **Groundwater Level:** | 3.2 feet |
| **Project No.:** | 13-000 | **Operator:** | Mike Wright | **Elevation:** | Unknown |
| **Sounding:** | SCPT-2 | **CPT Date:** | 8/14/2013 | **Lat/Long:** | N30.68541 W88.03821 |




PARAMETERS ABOVE ARE BASED UPON EMPIRICAL CORRELATIONS AND SHOULD BE CONSIDERED APPROXIMATE. IT IS RECOMMENDED THAT CALCULATED PARAMETERS BE CORRELATED BY SPECIFIC LABORATORY DATA AND/OR LOCAL EXERIENCE.

# Appendix B: Pile Driving Hammer Information

| | Fuel Setting #1 | Fuel Setting #2 | Fuel Setting #3 | Fuel Setting #4 |
|---|---|---|---|---|
| **Concrete Piles used Delmag Model D-62-22 Single Acting Diesel Hammer** | | | | |
| **36 in PCP** | | | | |
| Setting Usage | Down to 43 feet | 43 to 45 feet | 45 to 48 feet | 48 feet to end Restrikes |
| Rated Energy | 78,960 ft. lbs. | 109,725 ft. lbs. | 138,960 ft. lbs. | 165,000 ft. lbs |
| **24 in PCP** | | | | |
| Setting Usage | Down to 61 feet | 61 feet to end Restrikes | N/A | N/A |
| Rated Energy | 78,960 ft. lbs. | 109,725 ft. lbs. | | |
| **Steel Piles used APE Model D30-42 Single Acting Diesel Hammer** | | | | |
| **HP 14** | | | | |
| Setting Usage | N/A | N/A | Entire depth Restrikes | N/A |
| Rated Energy | | | 66,977 ft. lbs. | |
| **HP 12** | | | | |
| Setting Usage | N/A | Entire depth Restrikes | N/A | N/A |
| Rated Energy | | 55,070 ft. lbs | | |

FORM C-14 **ALABAMA DEPARTMENT OF TRANSPORTATION**

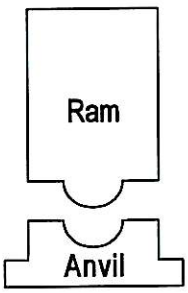
Revised 08-07-95 PILE AND DRIVING EQUIPMENT DATA FORM

| Project Number | County | Division |
|---|---|---|
| USA Test Pile & Vibration | Mobile | 9th |

| Pile Driving Contractor or Subcontractor | Bridge Identification Number |
|---|---|
| Jordan Pile Driving Inc. | N/A |

Details of access method to pile top for dynamic testing are: ☐ Attached ☒ Not Applicable

**Hammer Components**




**Hammer**

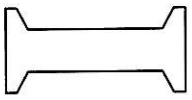
Manufacturer: Delmag Model: D-62-22
Type: S.A. Diesel Serial No.: 238
Rated Energy: 165,000 (ft.-lbs.) at 11.3 (ft.) Length of Stroke

Modifications: Adjustable Fuel Pump

| | |
|---|---|
| Pump Setting 1 | 78,960 ft. lbs. |
| Pump Setting 2 | 109,725 ft. lbs. |
| Pump Setting 3 | 136,950 ft. lbs. |
| Pump Setting 4 | 165,000 ft. lbs. |

**Capblock (Hammer Cushion)**

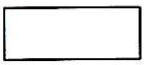
Material: Aluminum & Micarta Alternating
Thickness: 6 (in.) Area: 381 (in.²)
Modulus of Elasticity - E : 450 KSI (P.S.I.)
Coefficient of Restitution - e : 0.8



**Pile Cap**

Helmet ✓
Bonnet
Anvil Block
Drivehead

Weight : 10,000 (lbs.)
Note: Should include weight of striker plate.



**Pile Cushion**

Cushion Material: Plywood
Thickness: 10 (in.) Area: 576 (in.²)
Modulus of Elasticity - E : 45 KSI (P.S.I.)
Coefficient of Restitution - e : 0.5

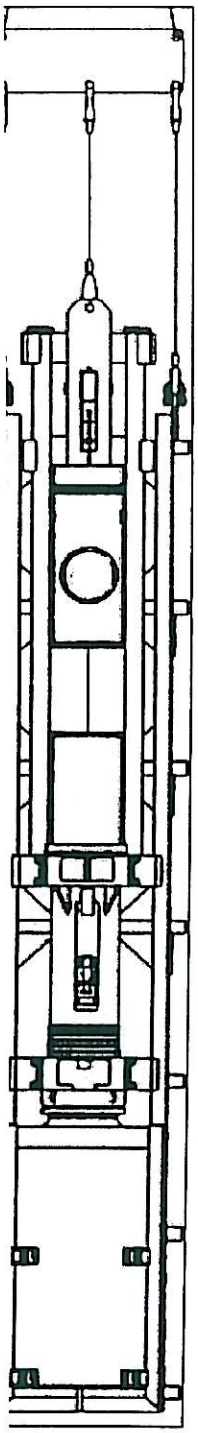
**Pile**

Pile Type: 36" x 36" & 24" x 24" Prestressed Concrete Test Pile
Length (in Leads): 89' & 81' (ft.)
Weight / Ft: 936 & 510 (lbs./ft.)
Wall Thickness: NA (in.) Taper: NA
Cross Sectional Area: 489 & 898 (in²)
Design Pile Capacity: (Tons)
Description of Splice: N/A

Tip Treatment Description: N/A

Note: If mandrel is used to drive this pile, attach separate manufacturer's detail sheet(s) including weight and dimensions.

Submitted By: Davis Daniel Date:



## Model D62-22 Diesel Hammer

| | |
|---|---|
| Maximum obtainable energy | 203,216 ft-lbs |
| Maximum obtainable stroke | 178 inches |
| Pump setting 1: (minimum) | 78,956 ft-lbs |
| Pump setting 2: | 109,749 ft-lbs |
| Pump setting 3: | 137,186 ft-lbs |
| Pump setting 4: (maximum) | 164,250 ft-lbs |
| Stroke at rated energy | 135 inches |
| Energy at rated stroke | 165,000 ft-lbs |
| Speed (blows per minute) | 36-50 |
| Ram | 13,700 lbs |
| Anvil | 2,833 lbs |
| Hammer weight (includes trip device) | 29,491 lbs |
| Typical operating (weight with drive cap) | 32,963 lbs |
| Fuel tank (runs on diesel or bio-diesel) | 25.86 gal |
| Oil tank | 8.32 gal |
| Weight | 1100 lbs |
| Diameter | 25 inches |
| Thickness | 8 inches |
| Type | Monocast MC 901 |
| Diameter | 25 inches |
| Thickness | 2 inches |
| Elastic-modulus | 285 kips per square inch |
| Coeff. of restrituion | 0.8 |
| Weight (fits 8 by 26 inch leads) | 1,350 lbs |
| Diesel or Bio-diesel fuel | 5.28 gal/hr |
| Lubrication oil | 0.84 gal/hr |
| **Grease twice per day | |
| Length overall | 232.6 inches |
| Length over cylinder extension | 272.0 inches |
| Impact block diameter | 27.9 inches |
| Width over bolts | 32.6 inches |
| Hammer width overall | 31.5 inches |
| Width for guiding- face to face | 22.0 inches |
| Hammer center to pump guard | 19.3 inches |
| Hammer center to bolt center | 15.0 inches |
| Hammer depth overall | 38.2 inches |
| Minimum clearance for leads | 19.7 inches |

FORM C-14 **ALABAMA DEPARTMENT OF TRANSPORTATION**

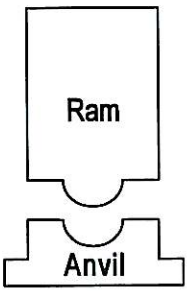
Revised 08-07-95 **PILE AND DRIVING EQUIPMENT DATA FORM**

| Project Number | County | Division |
|---|---|---|
| USA Test Pile & Vibration | Mobile | 9th |

| Pile Driving Contractor or Subcontractor | Bridge Identification Number |
|---|---|
| Jordan Pile Driving Inc. | N/A |

Details of access method to pile top for dynamic testing are: ☐ Attached ☒ Not Applicable

**Hammer Components**

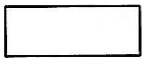



**Hammer**

Manufacturer: APE Model: D30-42
Type: S.A. Diesel Serial No.:
Rated Energy: 74,419 (ft.-lbs.) at 11.25 (ft.) Length of Stroke

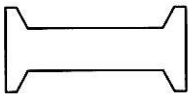
Modifications: Adjustable Fuel Pump

| | |
|---|---|
| Pump Setting 1 | 37,209 ft. lbs. |
| Pump Setting 2 | 55,070 ft. lbs. |
| Pump Setting 3 | 66,977 ft. lbs. |
| Pump Setting 4 | 74,419 ft. lbs. |



**Capblock (Hammer Cushion)**

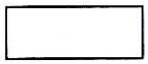
Material: Aluminum & Micarta Alternating
Thickness: 4 (in.) Area: 398 (in.²)
Modulus of Elasticity - E : 285 (P.S.I.)
Coefficient of Restitution - e : 0.8



**Pile Cap**

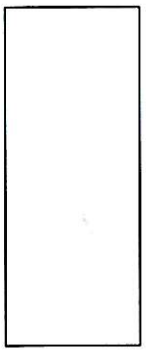
Helmet ✓
Bonnet
Anvil Block
Drivehead

Weight : 1,704 (lbs.)
Note: Should include weight of striker plate.



**Pile Cushion**

Cushion Material: N/A
Thickness: N/A (in.) Area: N/A (in.²)
Modulus of Elasticity - E : N/A (P.S.I.)
Coefficient of Restitution - e : N/A



**Pile**

Pile Type: HP 12 x 53 & HP 14 x117
Length (in Leads): 70' & 106' (ft.)
Weight / Ft: 53 & 117 (lbs./ft.)
Wall Thickness: N/A (in.) Taper: NA
Cross Sectional Area: (in²)
Design Pile Capacity: (Tons)
Description of Splice: Mechanical

Tip Treatment Description:

Note: If mandrel is used to drive this pile, attach separate manufacturer's detail sheet(s) including weight and dimensions.

Submitted By: Davis Daniel Date:

# APE Model D30-42 Single Acting Diesel Impact Hammer

*D30-42 Finishing Dolphin Piles.*

*Optional Variable Throttle Control.*

*Drive Base Assembly.*

## MODEL D30-42 (3.0 metric ton ram)

**SPECIFICATIONS**

| | |
|---|---|
| Stroke at maximum rated energy | 135 in (343 cm) |
| Maximum rated energy (Setting 4) | 74,419 ft-lbs (100.47 kNm) |
| Setting 3 | 66,977 ft-lbs (90.42 kNm) |
| Setting 2 | 55,070 ft-lbs (74.34 kNm) |
| Minimum rated energy (Setting 1) | 37,209 ft-lbs (50.23 kNm) |
| *(Variable throttle allows for infinite fuel settings)* | |
| Maximum obtainable stroke | 157 in (381 cm) |
| Maximum obtainable energy | 86,546 ft-lbs (117 kNm) |
| Speed (blows per minute) | 34-53 |

**WEIGHTS**

| | |
|---|---|
| Ram | 6,615 lbs (3,000 kg) |
| Anvil | 1,358 lbs (616 kg) |
| Anvil cross sectional area | 367.94 in² (2373.80 cm²) |
| Hammer weight (includes trip device) | 13,571 lbs (6,154 kg) |
| Typical operating (weight with DB26 and H-beam insert) | 16,223 lbs (7,357 kg) |

**CAPACITIES**

| | |
|---|---|
| Fuel tank (runs on diesel or bio-diesel) | 17.4 gal (65 liters) |
| Oil tank | 5 gal (19 liters) |

**CONSUMPTION**

| | |
|---|---|
| Diesel or Bio-diesel fuel | 2.6 gal/hr (9.84 liters/hr) |
| Lubrication | 0.26 gal/hr (1 liters/hr) |
| Grease | 8 to 10 pumps every 45 minutes of operation time. |

**STRIKER PLATE FOR DB 26**

| | |
|---|---|
| Weight | 628 lbs (284 kg) |
| Diameter | 22.5 in (57.15 cm) |
| Area | 398 in² (2567.74 cm²) |
| Thickness | 6 in (15.24 cm) |

**CUSHION MATERIAL**

| | |
|---|---|
| Type/Qty | Micarta / 2 each |
| Diameter-DB26 | 22.5 in (57.15 cm) |
| Thickness | 1 in (25.4 mm) |
| Type/Qty | Aluminum / 3 each |
| Thickness | 1/2 in (12.7 mm) |
| Diameter | 22.5 in (57.15 cm) |
| Total Combined Thickness | 3.5 in (8.89 cm) |
| Area | 398 in² (2567.74 cm²) |
| Elastic-modulus | 285 ksi (1,965 mpa) |
| Coeff. of restitution | 0.8 |

**DRIVE CAP**

| | |
|---|---|
| DB 26: | 1,076 lbs (488 kg) |

**INSERT WEIGHT**

| | |
|---|---|
| H-Beam insert for 12" (305 mm) and 14" (355 mm): | 948 lbs (430 kg) |
| Large pipe insert for sizes 12" to 24" diameter: | 1,830 lbs (830 kg) |

**MINIMUM BOX LEAD SIZE/OPERATING LENGTH**

| | |
|---|---|
| Minimum box leader size | 8 in x 26 in (20.32 cm x 66 cm) |
| Operating length as described above | 354 in (900 cm) |


AMERICAN PILEDRIVING EQUIPMENT, INC. APE

**Corporate Offices**
**7032 South 196th**
**Kent, Washington 98032 USA**
**(800) 248-8498 & (253) 872-0141**
**(253) 872-8710 Fax**

**Visit our WEB site:**
**www.apevibro.com**
**e-mail: ape@apevibro.com**


*Note: All specifications are subject to change without notice 08/20/2012*